Willow Run Cold Water Conservation Plan

By Juniata Clean Water Partnership
Along with the Juniata County
Conservation District
Funding for this project was provided by The ColdWater Heritage Program

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INTRODUCTION

In 2009, The Juniata Clean Water Partnership was awarded a Coldwater Heritage Grant to study the Willow Run Watershed in Juniata County and use the gathered and historic data to write a Coldwater Conservation Plan. Willow Run is a coldwater stream that has the potential to be impacted by agricultural practices in it middle section and timbering in its headwaters. Furthermore, there are some tributaries that are listed on the Department of Environmental Protection's 303(d) list of impaired streams. Of particular interest are Dougherty Run and two unnamed tributaries to Dougherty Run that are on the list due to siltation.

The collected data will give an indication of the condition of the watershed. The data will drive the recommendations for the coldwater conservation plan. The plan will list current conditions, will identify potential or real threats and outline a plan to preserve this watershed.

Another goal of this study is to begin to seriously look at the possibility of de-listing Dougherty Run from the impaired stream list. If initial data indicates that water quality may be improving, this plan will begin the process of collecting more concentrated specific data that would meet the Pennsylvania Department of Environmental Protection's standards for de-listing.

The Juniata County Conservation District partnered with us on this project. The District provided valuable data for three sites in the Willow Run watershed that they monitored monthly. They also provided stream assessment data, GIS data, and the use of their colorimeter and other equipment. Perhaps the most valuable relationship was their staff time and energy devoted to this project. Their help was invaluable.

Along with current water quality data, any historic data is listed. There have been some studies done on Willow Run in the past, although they are limited. In 1998 and again in 2000, the Pennsylvania Fish and Boat Commission did a biomass study on Willow Run at three locations. They also conducted chemical/thermal analysis in 1981 and 1986.

The Susquehanna River Basin Commission also did a detailed chemical study in 1985 near Reeds Gap. SRBC also did a detailed chemical/biological/habitat study in 2004. You can find the 2004 report at:
http://www.srbc.net/pubinfo/techdocs/Publication_240/techreport240.htm.

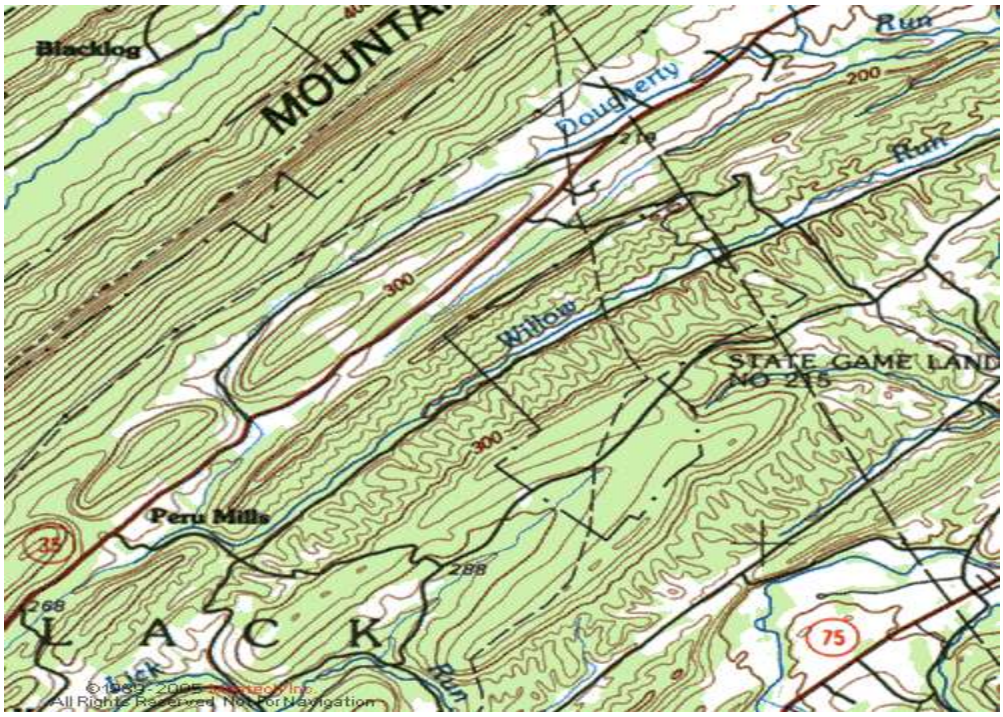
Due to money and time restraints, data from the Department of Environmental Protection could not be obtained. Although more research for data at their regional office in Harrisburg should be done. The section on historic data will go into more details as to what the studies found.

CHAPTER ONE – Background Information

Watershed Description

Willow Run is a 10.64 square mile watershed in Western Juniata County that flows into Tuscarora Creek near the town of McCollochs Mills. The Headwaters of Willow Run begin near Peru Mills. Most of the upper watershed flows through state game lands 215. Willow Run is listed as a class A wild trout stream for much of its length. The entire Willow Run basin is also listed as an HQ-CWF under DEP classification. There is, however, a tributary that flows into Willow within the designated classification stretch that has portions appearing on the 303(d) list of impaired streams. That tributary is Dougherty Run. DEP has three unnamed tributaries of Dougherty Run listed as impaired due to crop related agricultural siltation.

Willow Run is a Limestone influenced stream that has historically held decent numbers of wild trout, especially in the state game lands section. See map below.



Much of the watershed is forested, especially in the headwaters. Although these forested regions are somewhat fragmented. As you go further downstream, agriculture becomes more dominate a land use, especially along State Route 35. Most Willow Run itself is forested but several tributaries, especially Dougherty Run, flow through farmland.

Juniata County is sparsely populated. The 2010 census shows a population of 24,636. Its largest borough and the county seat is Mifflintown. The population of the Willow Run

watershed is approximately 600 persons and the watershed lies in both Lack Township and Tuscarora. Lack Township is forested with little population and the downstream section in Tuscarora Township hold most of the small municipalities. Boroughs within the watershed include McCullochs Mills, Reeds Gap, and Peru Mills.

In 2009, Juniata County along with Mifflin County adopted a joint open space plan entitled Juniata/Mifflin County Greenway, Open Space, and Rural Recreation Plan. In this plan was a chapter on Targeted Conservation Areas that are a high priority for protection. One of these areas was the Willow Run Watershed because its stream corridor and water quality. The recommendations of the plan for conservation of this area are to put the land in conservation easements and for greater municipal regulations. Both Lack and Tuscarora Townships have sub-division and land development ordinances, but neither one has any zoning ordinances in place.

Juniata County Natural Heritage Inventory

In 2007 The Western Pennsylvania Conservancy completed a *Juniata County Natural Heritage Inventory*. This comprehensive inventory of the county lists sites of significance, sites of rare or endangered species, and sites of the highest quality natural areas. This report also details soils, geology and physiography of the county. According to this report the soils and geology of the watershed are the result of long periods of erosion of old bedrock. Because of the diverse geology of the county there is a diverse array of soils. Depending on the parent material (bedrock), slope, and hydrology these soils are amendable to many different land uses.

Most of the soil type within the watershed is of the Berks-Weikert-Bedington association. A soil association is described as a group of soils with a distinctive, proportional pattern of occurrence in the landscape. The Berks- Weikert-Bedington type is described as "moderately deep to shallow, well-drained, nearly level to steep soils on secondary ridges and hills; weathered from gray sandstone and shale. (Excerpt from Juniata County natural Heritage inventory)

The surface geology is described as Irish Valley Member of Catskills in the watershed valley, and Brallier-Harrell and Hamilton Group as you head up the ridges. The Irish Valley Member of Catskills is comprised of nonmarine, grayish-red siltstone and mudstone, and gray and grayish red sandstone interbedded with minor, thin light olive gray siltstone. The Brallier-Harrell is comprised of medium-gray, planar-bedded siltstone interbedded with light olive shale, sparse marine fauna, black shale and dark-gray shale. The Hamilton Group is comprised of Mahantango Formation, and the Marcellus Formation. These formations have marine fossils, marine fauna and local limestone formations.

Another feature of the *Juniata County Natural Heritage Inventory* is its listing of natural heritage sites. In the Willow Run area the State game Lands #215 is listed as such a site. The State game Lands site is a recorded breeding location for the Northern Myotis, which is a mammal species of concern. The Northern Myotis is a species of bat that spends the

winter months hibernating in caverns and the summers frequenting wooded streams and trails.

Forested stream corridor within SGL #215 *photo source: PNHP*

As you can see from the above photo; Willow Run in the state game lands is a pristine stream with a very good riparian buffer and good water quality. The Pennsylvania Fish and Boat Commission has historic data from this section of stream and we will look at that data in Chapter Two.

The Watershed has several small farms that are mostly livestock operations. The watershed also has one Concentrated Animal Operation in operation. Although the number of farms in the county has decreased, the sizes of the farms have increased. This may be due to the incorporation of farms.

Historically, portions of the watershed have been logged. Some logging in the headwaters of Dougherty Run led to severe sedimentation problems in that tributary. There is some logging currently going on in parts of the upstream portions of the watershed. Most of these operations are occurring in the upslope areas. As of this time, little environmental impact seems to be happening. As logging increases in the future, this may need more intensive monitoring of conditions.

CHAPTER TWO – Historic Data

Until recent times, there was little recorded data was found on Willow Run and its tributaries on a consistent basis. In the last few years, the Juniata County Conservation District has collected monthly chemical data at one location on Willow Run and two locations on Dougherty Run. Most of the other data that we found was done at one point in time at various years. The earliest data found was from 1981 when some chemical data was gathered by the Pennsylvania Fish and Boat Commission.

The Willow Run Watershed does have some historic data that we were able to access. The Department of Environmental Protection has data that support their decision to list some tributaries of Willow Run on the impaired stream list. That data was not accessed at this time. A recommendation of this study is to research the archived data to get an historic prospective. The Pennsylvania Fish and Boat Commission did Chemical/thermal analysis in 1981 and 1986. The results are shown in the following table.

Table 1 Chemical-thermal analyses of Willow Run located within Pennsylvania drainage sub-subbasin 12B.

River Mile	SiteLatLon	Section	Site Date	Air Temp	Water Temp	pH	Sp Conductance	Total Alkalinity	Total Hardness
5.08	402338773856	2	7/18/1986	21	16.5	7.6	180	76	94
5.08	402338773856	2	8/6/1981	21	18	8	210	100	134
3.44	402425773726	2	7/16/1986	22	18	7.6	215	98	116
3.44	402425773726	2	8/5/1981	22	20.8	7.8	230	98	130
0.98	402525773514	3	8/1/1986	22	18	7.9	280	104	120
0.98	402525773514	3	8/4/1981	27	22.1	7.4	192	77	100
0	402606773456	4	8/6/1981	21	20	8.1	205	91	116

They also did species surveys in 1992, 1998, and 2000. The results of those surveys are listed below.

Site species collection matrix from Willow Run Sub-SubBasin 12B. Data collected within 1992 survey year. Column Headings Legend:
1- Section 2 River mile 5.08 Site Date 6/4/1992 SiteLatLon 402338773856

Common Name	Scientific Name	1	Code
Brook Trout	Salvelinus fontinalis	X	131
Brown Trout	Salmo trutta	X	122

Site species collection matrix from Willow Run Sub-SubBasin 12B. Data collected within 1998 survey year. Column Headings Legend:
1- Section 2 River mile 3.44 Site Date 8/25/1998 SiteLatLon 402425773726
2- Section 2 River mile 5.08 Site Date 8/26/1998 SiteLatLon 402338773856
3- Section 3 River mile 0.98 Site Date 8/26/1998 SiteLatLon 402525773514

Common Name	Scientific Name	1	2	3	Code
Blacknose Dace	Rhinichthys atratulus	X	X	X	341
Bluntnose Minnow	Pimephales notatus			X	331
Brook Trout	Salvelinus fontinalis		X		131
Brown Trout	Salmo trutta	X	X	X	122
Central Stoneroller	Campostoma anomalum	X	X	X	201
Chain Pickerel	Esox niger	X			195
Common Shiner	Luxilus cornutus	X		X	306
Creek Chub	Semotilus atromaculatus	X	X		351
Cutlip Minnow	Exoglossum maxillingua			X	261
Fallfish	Semotilus corporalis	X	X	X	352
Greenside Darter	Etheostoma blennioides	X	X	X	722
Longnose Dace	Rhinichthys cataractae	X	X	X	342
Margined Madtom	Noturus insignis			X	483
Northern Hog Sucker	Hypentelium nigricans	X			421
Rock Bass	Ambloplites rupestris	X			651
Sculpin species	Cottus	X	X	X	820
Shield Darter	Percina peltata			X	756
Smallmouth Bass	Micropterus dolomieu	X		X	691
White Sucker	Catostomus commersonii	X	X	X	401

Site species collection matrix from Willow Run Sub-SubBasin 12B. Data collected within 2000 survey year. Column Headings Legend:
1- Section 2 River mile 5.27 Site Date 8/11/2000 SiteLatLon 402338773850
2- Section 2 River mile 3.44 Site Date 8/11/2000 SiteLatLon 402425773726
3- Section 2 River mile 6.67 Site Date 8/15/2000 SiteLatLon 402243774007

Common Name	Scientific Name	1	2	3	Code
Blacknose Dace	Rhinichthys atratulus	X	X	X	341
Brook Trout	Salvelinus fontinalis			X	131
Brown Trout	Salmo trutta	X	X	X	122

Common Name	Scientific Name	1	2	3	Code
Central Stoneroller	Campostoma anomalum	X	X		201
Chain Pickerel	Esox niger		X		195
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Greenside Darter	Etheostoma blennioides	X	X		722
Longnose Dace	Rhinichthys cataractae		X		342
Rock Bass	Ambloplites rupestris		X		651
Sculpin species	Cottus	X	X	X	820
Smallmouth Bass	Micropterus dolomieu	X	X		691
Tessellated Darter	Etheostoma olmstedi		X		721
White Sucker	Catostomus commersonii	X	X	X	401

As far as I found no other fish species data has been collected since 2000. The species data was collected at the same sites that the chemical/thermal analysis was done.

Another source of data is from the Susquehanna River Basin Commission. SRBC did a one snapshot collection of data in both 1995 and 2004 at site near mouth at T305 bridge near McCullochs Mills, Juniata Co. (40.418518066 -77.596019333). A recent study of the Juniata River watershed by SRBC was just completed in 2010 and data was not yet available. There was chemical, macroinvertebrates, and habitat data collected in both 1995 and 2004. There was also a chemical study done by the Susquehanna River Basin Commission in 1985 whose data can be found in STORET. A copy of the data can be found in the Appendices. The results for 2004 showed that the water quality was in the high range, biology was nonimpaired, and the habitat was excellent. The historical data showed that poor habitat, middle water quality, and nonimpaired biology; which means that the stream has improved from 1995 to 2004. The results of the chemical data are shown in following table.

Station ID	Sample ID	Date	Time
WILL000.4	6823819	06-09-2004	09:00
WILL000.4	6823820	06-09-2004	09:15

Alkalinity	Aluminum T	Calcium T	Chloride	Hardness	Iron T	Magnesium T	Manganese T
78.2	PBQ	28.5	2.47	95	292	5.68	24
78.2	PBQ	28.1	2.52	93	270	5.62	24

Nitrate-N T	Nitrite-N T	Nitrogen TOT	Phos T Ortho	Phosphorus T	Sodium T	Sulfate T	T Org Carbon
0.67	PBQ	0.85	0.012	0.013	1.93	11.1	1.6

0.7	PBQ	0.8	0.011	0.014	1.91	10.9	1.6	
T Susp Solid	Turbidity	Acidity (field)	Alkalinity (field)	D. O. (field)	Flow	pH (field)	Sp. Cond. (field)	Temp. (field)
PBQ	4.92	6	78	7.07	7.523	7.1	178	17.6
PBQ	5.44	6	78	7.07	7.523	7.1	178	17.6

The methodology for the samples taken during the 2004 sampling round was done using both field and laboratory analysis. The field parameters were Flow, Temperature, PH, and Dissolved Oxygen. The laboratory analysis was done for: Alkalinity, Total Suspended Solids, Total Nitrogen, Nitrates, Turbidity, Total Organic Carbon, Total Hardness, and Total Calcium. All samples for laboratory analysis was iced and shipped to The Department of Environmental Protection bureau of Laboratories.

A comparison of the 1985 data to the 2004 data shows that for the most part the levels of each of the parameters tested were very similar and none of them were exceeding levels of concern. Iron was quite a bit higher in 2004 (292 ug/l) than in 1985 (0.981 ug/l) but still far below the limit for concern.

The methodology for the sampling macroinvertebrates used a modified version of RBP III method. Two kick-screen samples were obtained at the site using a 600 micron mesh screen in a one meter square area. Each sample was preserved and taken to the SRBC lab where it was sorted into a subsample. Organisms were identified to genus, except for midges and aquatic worms which were identified to family (Excerpted from the *Juniata River subbasin Survey 2004* of the SRBC report.).

Macroinvertebrate study 2004

Order	**Family**	***Genus***	WILL 0.4	Dup WILL 0.4
Coleoptera	**Elmidae**	*Optioservus*	4	2
		Stenelmis	1	2
	Psephenidae	*Psephenus*	71	33
Diptera	**Chironomidae**		26	39
	Simulidae	*Simulium*	2	6
	Tipulidae	*Antocha*	6	5
		Hexatoma	1	2
Ephemeroptera	**Baetidae**	*Acentrella*	3	1
		Baetis	10	8
	Heptagenidae	*Epeorus*	2	
		Heptagenia	6	4
		Stenonema	10	8

	Isonychiidae	*Isonychia*	4	19
	Leptophlebiidae	*Paraleptophlebia*		1
Megaloptera	**Corydalidae**	*Nigronia*	6	7

Order	**Family**	***Genus***	Willow 04	Dup Willow 04
Plecoptera	**Leuctridae**	*Leuctra*	12	7
	Nemouridae	*Amphinemura*		1
	Perlidae	*Acroneuria*	1	
		Perlesta	13	17
Trichoptera	**Brachycentridae**	*Brachycentrus*	3	5
	Hydropsychidae	*Ceratopsyche*	35	30
		Cheumatopsyche	1	6
	Philopotamidae	*Chimarra*		6
		Dolophilodes	1	4
	Polycentropodidae	*Polycentropus*	2	1
		TOTAL	220	214

The total numbers in more familiar terms for the fishermen among the readers were:

Beetles – 76 and 37
Midges – 35 and 52
Mayflies – 35 and 41
Alderflies and dobsonflies – 6 and 7
Stoneflies – 26 and 25
Caddis Flies – 42 and 52

Photo taken from insectimages.org

Plecoptera Perlidae perlesta, *one of the species of stoneflies found in Willow Run.*

Habitat conditions were evaluated according to physical stream characteristics relating to substrate, pool and riffle composition, shape of the channel, conditions of the banks, and the riparian zone. These characteristics were rated on a scale of 0-20 with 20 being optimal. The results from 2004 are shown below.

Habitat assessment from 2004

JUNIATA SUBBASIN 2004	Willow Run 0.4
Primary Parameters	
Epifaunal Substrate	15
Instream Cover	16
Embeddedness	16
Velocity/Depth Regimes	14
Secondary Parameters	
Sediment Deposition	15
Channel Flow Status	16
Channel Alteration	16
Frequency of Riffles	15
Tertiary Parameters	
Condition of Banks	13
Left Bank	7
Right Bank	6
Vegetative Protective Cover	16
Left Bank	8
Right Bank	8
Riparian Vegetative Zone Width	16
Left Bank	8
Right Bank	8
Total Habitat Score	
Total Habitat Score	160

This assessment was done at the same site that the water quality and biological samples were taken. The habitat assessment was done within a 100 foot section of stream. The data shows that the substrate and stream channel was very good as was the ratio of riffle/pool. The condition of the banks and the riparian zones was adequate or less than adequate. The condition of the banks was poor. It is recommended that vegetative cover and the riparian zones could use some plantings and maybe some restoration work.

CHAPTER THREE - Preliminary Work

The purpose of the project is to develop a conservation plan for Willow Run in Juniata County. The Juniata County Conservation District began a collecting data on streams in their county in 2009. Willow Run was on the list to be monitored on a monthly basis. The purpose of the monitoring was to establish baseline data and also to be able to identify at an early stage if any threats have been introduced into the watershed to jeopardize its Class A designation. It was noted that there was a major tributary that was listed on the DEP's 303d list of impaired streams due to agriculture related siltation. That stream was Dougherty Run, shown here in at monitoring site 2 on left and site 1 on right.

During initial meetings with the Conservation District, it was decided that we needed to establish more monitoring sites for this project. We added four sites to Willow Run and an additional site on a tributary of Dougherty Run. Sites were chosen by their ease of access and their location in the watershed.

One of the goals that the Conservation District hoped to achieve was to have some data on Dougherty Run that would substantiate beginning the process to remove Dougherty Run from the impaired stream list. If data suggested that water quality was good, then a stricter monitoring process that follows PA DEP protocol for delisting would be justified.

After determining what the objectives were and where we would sample; we took a road trip to visit the selected sites and scouted the watershed. We made some adjustments on site location after deciding that some possible sites were inaccessible. The Juniata Conservation District provided some mapping that included topography, sample points, and some roads. The next step was laying out a timeline and then organizing a public meeting.

The initial public meeting was held in the meeting room at the Juniata County Conservation District Office on April 28, 2010. There were six attendees from the watershed, Chris Snyder from the Conservation District and Deb Nardone from the Coldwater Heritage Program. Juniata Clean Water Partnership opened the meeting with

a brief description of the project, what we hoped to accomplish and how we were going to use the data collected to write a protection plan for the watershed including recommendations. The response to the project was encouraging several attendees remarked that there were trout in Dougherty Run and that Willow Run was not as good a fishing stream as it used to be.

The types of data that was needed for our project was several rounds of water quality testing, macroinvertebrates at one site on Willow Run and one site on Dougherty Run, and a Stream Visual Assessment. One of the rounds of testing was to be collected and then sent to a certified lab to determine quality assurance with the data collected using the equipment from the Conservation District.

Original timelines for data collection involved the Conservation District to continue to test their three sites monthly and for JCWP to test the additional three sites six times during the grant period. Additionally, the macroinvertabrate testing was to be done in the spring after being trained by the Stroud Research Center on proper technique and identification. The training was held in November of 2010. Monthly data collected by the Conservation District used for this report was collected from July 2009 to June 2010. Also, JCWP collected data in August 2010 and January and May of 2011. The May 2011 was sent to a laboratory for quality control. Macroinvertabrates were also collected in May, 2011 and identified to the organism's *order* in the field; specifically Mayfly, Caddis fly, Stonefly, beetles and so forth.

CHAPTER FOUR – Current data

Water Quality

In setting up monitoring schedules and frequency of collection it was decided that the Conservation District would continue to monitor monthly at two sites on Dougherty Run (D01 and D02) and one site on Willow Run (W01) through June, 2010. The additional four sites that were selected for monitoring would be done quarterly with one round of sampling to be taken to Fairway Laboratories in Altoona for quality control. Fairway Labs is a certified lab approved by the Department of Environmental Protection.

The seven sites selected for sampling along with their coordinates were:
Dougherty Run 01…….40.425295 -77.624739
Dougherty Run 02.....40.423658 -77.642983
Dougherty Run 03…….40.406986 -77.596077
Willow Run 01….....40.418479 -77.596077
Willow Run 02……..40.407141 -77.623261
Willow Run 03……..40.374731 -77.693108
Willow Run 04……..40.366696 -77.693108

Water quality data was collected for the following parameters: Stream flow, temperature, Dissolved Oxygen, Conductivity, Specific Conductivity, Salinity, PH, Total Dissolved Solids, Turbidity, Alkalinity, Chlorides, Phosphates, and Nitrates. The types of meters used were:

Global water/ Flow meter-	Serial # 25620
YSI 85 meter-	Serial # 03E0904
Watercheck TDS Pocket meter	Serial# H198115
LaMotte Colorimeters (4)	1) Serial # 29612505
	2) Serial # 10200361
	3) Serial # 35505005
	4) Serial # 36080206

There was an issue with the YSI 85 meter not registering the Dissolved Oxygen correctly during the August 2010 and May 2011 rounds so readings were not accurate and therefore not recorded (see Data Appendix for results).

Additionally, during the January 2010 sampling round, Dougherty sites 01 and 02 along with Willow 01 were frozen and no data was collected. In January 2011, Willow Run 04 was frozen. Dougherty Run 04 had only one round of sampling collected, May 2011. The other times the site was visited, there was no flow recorded.

In reviewing the data, an excess of nitrates in both Dougherty Run and Willow Run seems to be the biggest concern. Every sampling round except the 2011 rounds showed an average of two times the acceptable levels of nitrates. The highest reading was in August 2010 at 5.23. There were also times when the phosphates exceeded allowable limits as well. Having higher than acceptable readings on both of these parameters

indicates agricultural influences on the watershed. Each site on Dougherty Run regularly registered high nitrate levels and Willow Run 01 showed high levels for each month of 2010. Further investigation into the exact causes of the nutrient loading is necessary. The other sites on Willow Run showed good water quality throughout the year. Those sites were consistent with historical data and are located in the stretch of stream that was given the highest designation.

Biological

The macroinvertabrates collection was to be done in April 2010 but due to high water and the availability of staff it was re-scheduled for the fall of 2010. During planning meetings with the Conservation District, it was felt that a training session in the proper collection and in field identification techniques was necessary. A training session with Stroud Research Center was scheduled. Since the best times to collect macros are in the spring and fall, a training session in October was arranged. In the mean time; match money from the WPC/Dominion Small Watershed Grant Program was used to purchase macro sampling equipment. A 500 micron kicknet, 500 micron D-Frame net, a pipette, hand lens, forceps, and trays were purchased along with the partial cost of a Global Flow Meter.

Macroinvertabrate training was done in on November 3, 2010 at the Conservation District office. The training involved how to identify stream reach, collection procedures, and field identification to the common name for the organism's *Order*. Training was given to JCWP and the Conservation District staff.

The round of macro sampling was done at two sites in the watershed in May of 2011. The amount of rain that the watershed received during the spring of 2011 was the main reason that the date was in May. High water made sampling the biology of the stream before that impossible. Willow Run (W03) and Dougherty Run (D01) were the two sites chosen for sampling.

Willow Run W03

Dougherty Run D01

Samples were gathered at two locations at each site using a D-net and kicking two 12 inch x 12 inch square areas. Samples were gathered both in riffle areas and in pool areas.

Samples were then separated on sight into Mayflies, Caddisflies, Stoneflies, Diptera, and Aquatic Worms.

At Willow Run (W03); seventeen 17 mayflies, 4 case building Caddis, 7 net spinning Caddis, 23 aquatic worms, and 3 riffle beetles were captured and identified. Using the Macroinvertabrate Biotic Index sheet (see Appendix) that calculated out to a 19.9 rating which is fair water quality. At Dougherty Run (D01); 4 Mayflies, 5 Case Building Caddis, 2 Free Swimming Caddis, 2 Net Building Caddis, and 40 Aquatic Worms were gathered. Using the same index as above those numbers calculated out to be 14.3 which was poor water quality. It should be noted that the time of year may have contributed to those low numbers as several species of Mayflies and Caddisflies as well as Diptera that may have been present could have already emerged. Also the high waters of early spring may have also contributed to the low numbers. A more representative sampling needs to be conducted before any conclusions can be made.

Habitat

The habitat assessment was done on May 24, 2010 by the Conservation District using a modified **S**tream **V**isual **A**ssessment **P**rotocol (SVAP). This protocol uses a ranking system from 1 to 20 with 1 being worst and 20 being best. The assessment was done using a reach of 100 feet at each site. There are twelve categories of assessment that are done by walking the reach and noting the conditions. The following chart shows the results for Dougherty Run 01 and 02 and Willow Run 01.

	Doug #1	Doug #2	Willow #1
Instream Cover	11	14	19
Epifaunal Substrate	14	11	18
Embeddedness	15	10	17
Velocity/Depth Regimes	18	17	14
Channel Alteration	12	12	11
Sediment Deposition	12	11	16
Frequency of Riffles	14	10	18
Channel Flow Status	16	14	18
Condition of Banks	6	10	13
Bank Vegetative Protection	6	10	14
Grazing of other Disruptive Pressure	17	18	8
Riparian Vegetative Zone Width	8	15	8
Total:	149	152	174

What the data shows for Dougherty Run is that the overall quality of the streambed rated out to an average of 13 which ranks in the sub-optimal category and the conditions of the

bank and riparian zones were even worse at an average of 11.25 which is bordering on the marginal rating.

Willow Run (01) on the other hand rated 16.37 for instream conditions and 10.75 for banks and riparian areas. Instream conditions showed an optimal rating and bank conditions were marginal. This shows that bank restoration and vegetative plantings could greatly improve stream quality and help filter nutrients and sedimentation.

Willow Run in its upper regions is more forested and has much better quality streambed conditions, stream velocity, bank conditions and riparian zones. This is illustrated by the photo below taken at Willow Run site (02). The only exceptions are near bridges and the places were the stream flows near dwellings or camps.

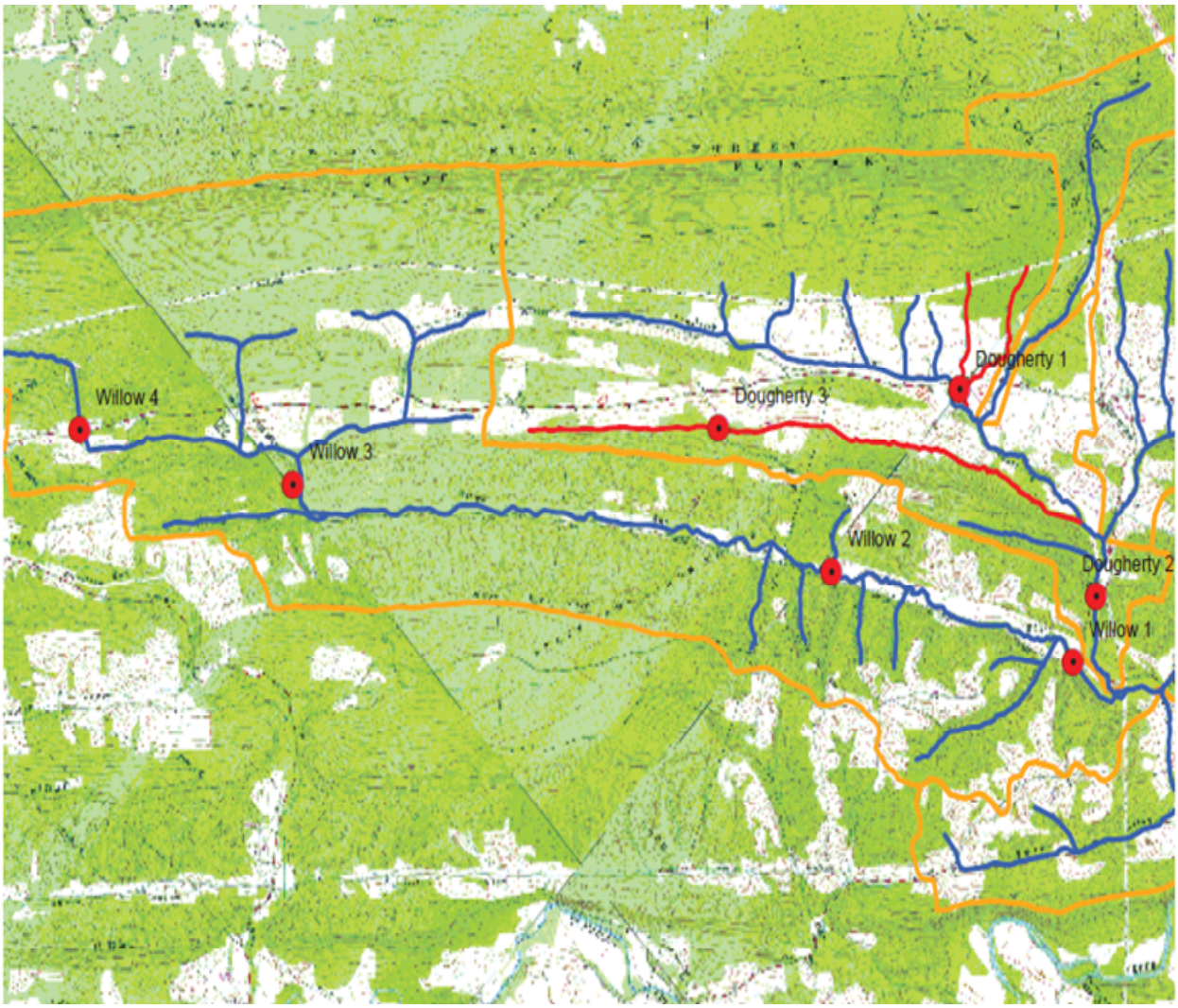
It is recommended that revegetation of the riparian zones, especially trees, and some streambank restoration near bridges would help improve the overall quality of the watershed. The data shows that Dougherty Run has a sedimentation problem that is most likely due to siltation. A more thorough assessment of the watershed to locate sources would be advantageous to developing a restoration plan.

The following map shows the location of the sampling sites. The red stream sections shows impairment on two unnamed tributaries of Dougherty Run.

All seven sites are located next to road crossings. The upper two sampling sites on Willow Run had some postings near the roads. The several mile section of stream

between Willow Run W03 and W02 flowed through the state gamelands and was not monitored. That section historically has the best water quality and the least amount of disturbance.

Sampling Sites



CHAPTER FIVE – Conclusions and Recommendations

Willow Run is listed as a Class A wild trout stream by the Pennsylvania fish and Boat Commission. In its upper reaches, Willow Run flows through a heavily forested area and state game lands #215. The water quality is very good in this stretch and current data seems to this fact. In the Lower section there is more of an influence of people on the watershed. Agriculture and some development dot the landscape. But still the main branch still has good water quality. Some of the Tributaries, especially Dougherty Run are impaired with nutrients, especially Nitrates. This suggests that there is agricultural influences that are affecting water quality. Any restoration efforts in the watershed should first focus on Dougherty Run. Dougherty Run also has a Concentrated Animal Farm Operation CAFO on one of the tributaries and data should be collected downstream of their property. I believe this farm raises chickens. This could impact the stream.

More data needs to be collected in order to better understand what factors are influencing the watershed. Data results collected by the Conservation District in 2010 differed somewhat than the results collected in 2011. Nitrate readings were significantly higher in 2010 for example. Total Dissolved solids, although within allowable limits, was still significantly higher in 2011. This should be noted and further study to keep tabs on the numbers should be done at least four times a year.

The numbers of macroinvertebrates seemed to be low. That may be due to a combination of field identification as opposed to lab identification as well as the time of year the samples were collected. Collection should have occurred in early spring or in the fall when the organisms are still in the nymph stage. Collection of samples in May meant that several species of Mayflies, Caddisflies, and Stoneflies that may be present in the stream may have already emerged and therefore not available for collection. Another fact to consider is the high water volume in the early spring of 2011 may have limited the numbers. Collection of samples at only one site on Willow Run and one site on Dougherty Run did not make for a representative sample. I would suspect that macro numbers would be greatly increased in the more protected upper reaches.

Census data for 2010 shows that population in Juniata County increased by 8 % from 2000 figures. Within the watershed the population increased by 7 % in Tuscarora township and 4.7 % in Lack township (taken from 2010 census data). With this increase comes additional development and its own set of issues. It is recommended that zoning ordinances in both Lack and Tuscarora townships be adopted. Both townships have Subdivision and Land Development Ordinances but lack any zoning. If development increases with population and expansion from the Harrisburg area hits the county, in time these areas may become housing developments. The number of farms in the watershed has decreased which opens up land sales for developers.

There are a few small scale timbering operations in the headwaters and these operations should be required to have timber management plans in place if they do not already. I think at this time all timber extraction is being done responsibly. The Conservation

District should note any new operations as they begin extraction. The footprints needed for timbering can create erosion and sedimentation issues in the watershed.

One of the goals with this project was to hopefully collect data that would suggest that Dougherty Run has the potential to be removed from the Department of Environmental Protection's impaired stream list. In reviewing the data, there is a high concentration of Nitrates in the watershed. Readings in the year 2010 were consistently above the accepted levels of 1.0 ppm. This suggests a strong influence from agriculture which was a concern when the stream was listed. At this time further data is needed along with identifying the stressors on the watershed is necessary. Increased riparian buffers to help filter nutrients and the implementation of agricultural Best Management Practices may help reduce these levels.

Recommendations:

1. ***A forested buffer should be maintained in the headwaters and in State Game Lands #215. There are some areas where this buffer should be widened to 100 feet.*** Currently, a good riparian buffer in state game lands is established and at the present time there appears to be no immediate impacts to the stream. However, as more activity occurs in the headwaters and on state game lands, whether it is from development in the headwaters or resource extraction in the game lands, there may be future threats to the ecosystem. Insuring that a buffer remains is one of the best methods to maintain a healthy stream environment.
2. ***A riparian buffer should be established in the lower sections of Willow Run and also on Dougherty Run. Vegetation should include native trees and shrubs along with native grasses.*** Much of the land use in the Dougherty Run watershed is agriculture. As such, there are many places were the main stem and the tributaries that are dominated by fields and fragmented forest. Many stretches of the stream has little if any riparian buffer strips. I am not sure if any of the farms are enlisted in conservation practices, but CREP (Conservation Resource Enhancement Program) issued through NRCS may be an option. Landowners should be approached to discuss the options that are available to them. The Lower sections of Willow Run also have some stretches with poor riparian buffers. An educational process highlighting the importance of buffers involving the landowners should be done.
3. ***Work with landowners to maintain and improve riparian buffers. Encourage landowners not to mow to stream edges and to leave downed trees in stream channel and along banks alone in order to create habitat.***
4. ***Encourage Lack and Tuscarora Townships to adopt zoning ordinances that incorporate best management practices for development and subdivisions.*** Encouraging township officials to the adopt protective zoning ordinances is a difficult process. At this time, threats from overdevelopment and the overuse of resources is not a significant problem. However, a proactive approach needs to be stressed. There is a foreseeable future where development could occur. As family farms become scarcer and financial difficulties threaten their existence, subdivision of family plots could occur. Also the introduction of large animal

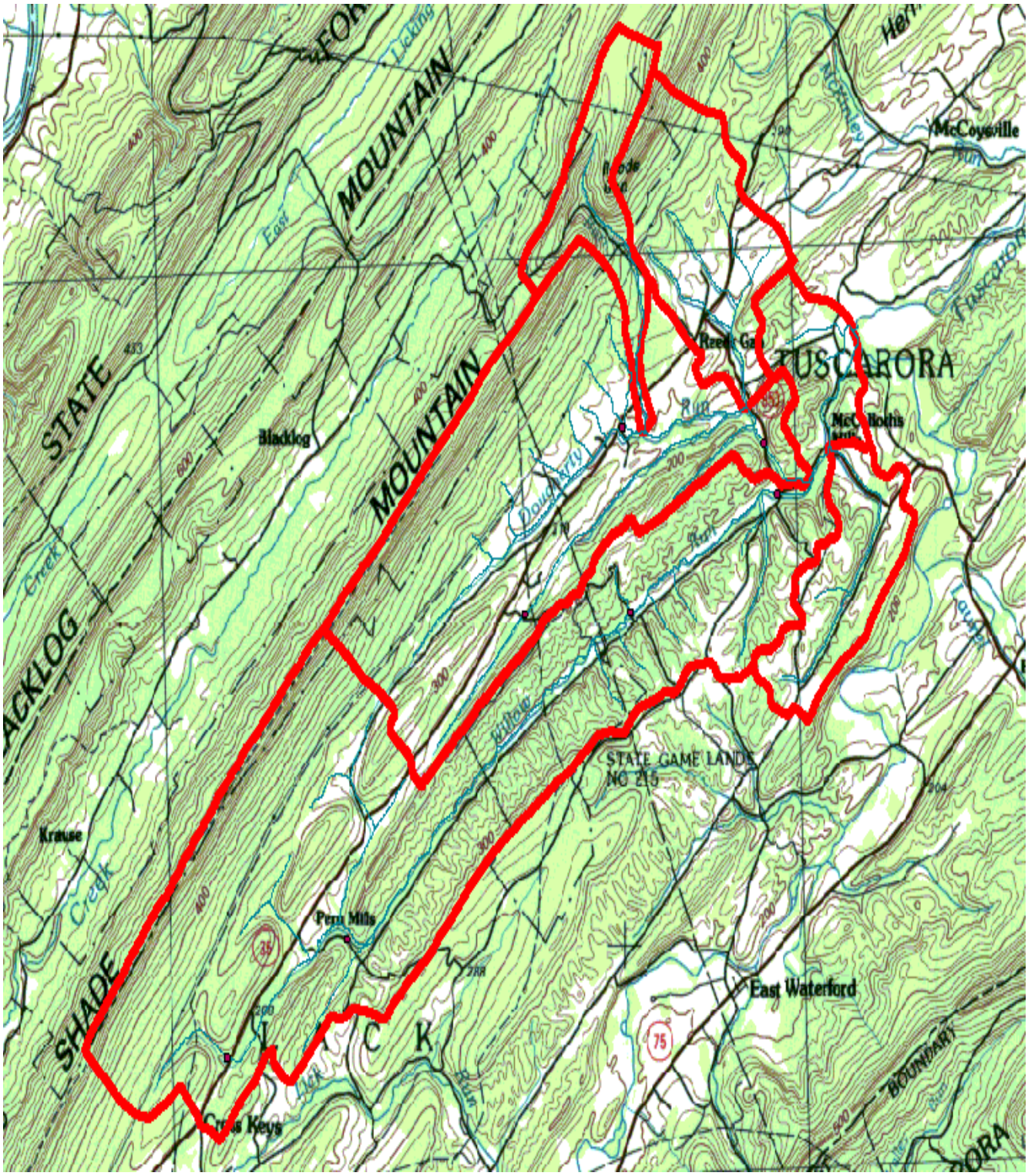
farm operations certainly invites the need for zoning. Volunteer township officials are overwhelmed with work and maintaining the status quo sometimes seems like the best solution. An active educational process that demonstrates how other rural communities addressed this situation may work. It will certainly not happen overnight but the process should be started.

5. ***Encourage all farmers to adopt nutrient management plans in Dougherty Run Watershed.*** The Juniata County Conservation District is actively writing plans and I am not sure how many are currently in place in the watershed. Funding and staff time to continue writing these plans is an issue. Maybe finding private funding sources to help this situation may be a solution.
6. ***Increase monthly monitoring to include additional sites W(02), W(03), W904) on Willow Run and D(03) on Dougherty Run.*** Funding and staff time again is the major roadblock to accomplishing this. Looking to an outside organization to do this should be done. **(See Below)**
7. ***Adopt an EASI (Environmental Alliance for Senior Involvement) volunteer monitoring program in the county.*** This program that was started a decade ago may be an answer to the monitoring needs. Finding volunteer monitors and training them has worked in other counties and may work here as well.
8. ***Work with any Combined Animal Farm Operations to ensure responsible operations.*** These operations need updated nutrient management plans and also again this duty falls on a conservation district that currently has more work than time and resources.
9. ***Do bi-annual monitoring for bacterial analysis.*** Bacteria levels in Willow Run have not been done since 2004 according to any data that I found and that was a one time sample. A bi-annual schedule of monitoring and having the samples analyzed by a certified lab is necessary, especially on Dougherty Run.
10. ***Encourage all timbering activities to have on site approved management plans.***

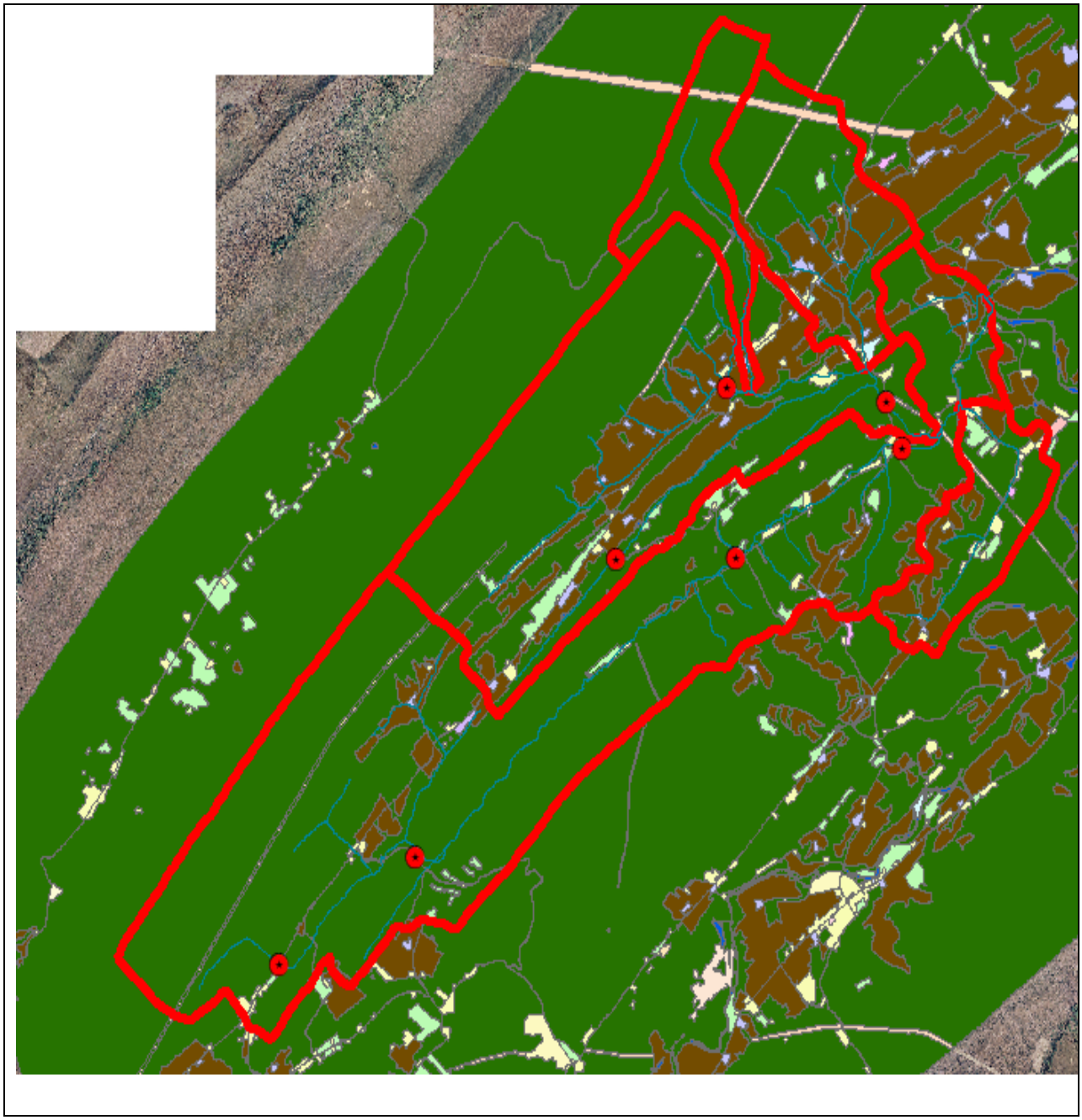
The Willow Run Watershed is a high quality, coldwater fishery (HQ-CWF) that has few major issues at this time. This natural resource should be protected from future encroachments. There are some tributaries that are impaired and restoration efforts should be concentrated on these tributaries in the form of riparian improvements and some stream restoration to provide habitat and reduce sedimentation and erosion. Continued periodic monitoring should be done to ensure that water quality is not compromised. This valuable natural resource and the land surrounding it provides recreational opportunities in the form of fishing and hunting. It also supports a diversified wildlife population and several threatened species of flora and fauna. Taking steps now to insure protection in the future is important to the watershed and to Juniata County.

APPENDIX

Watershed Boundaries

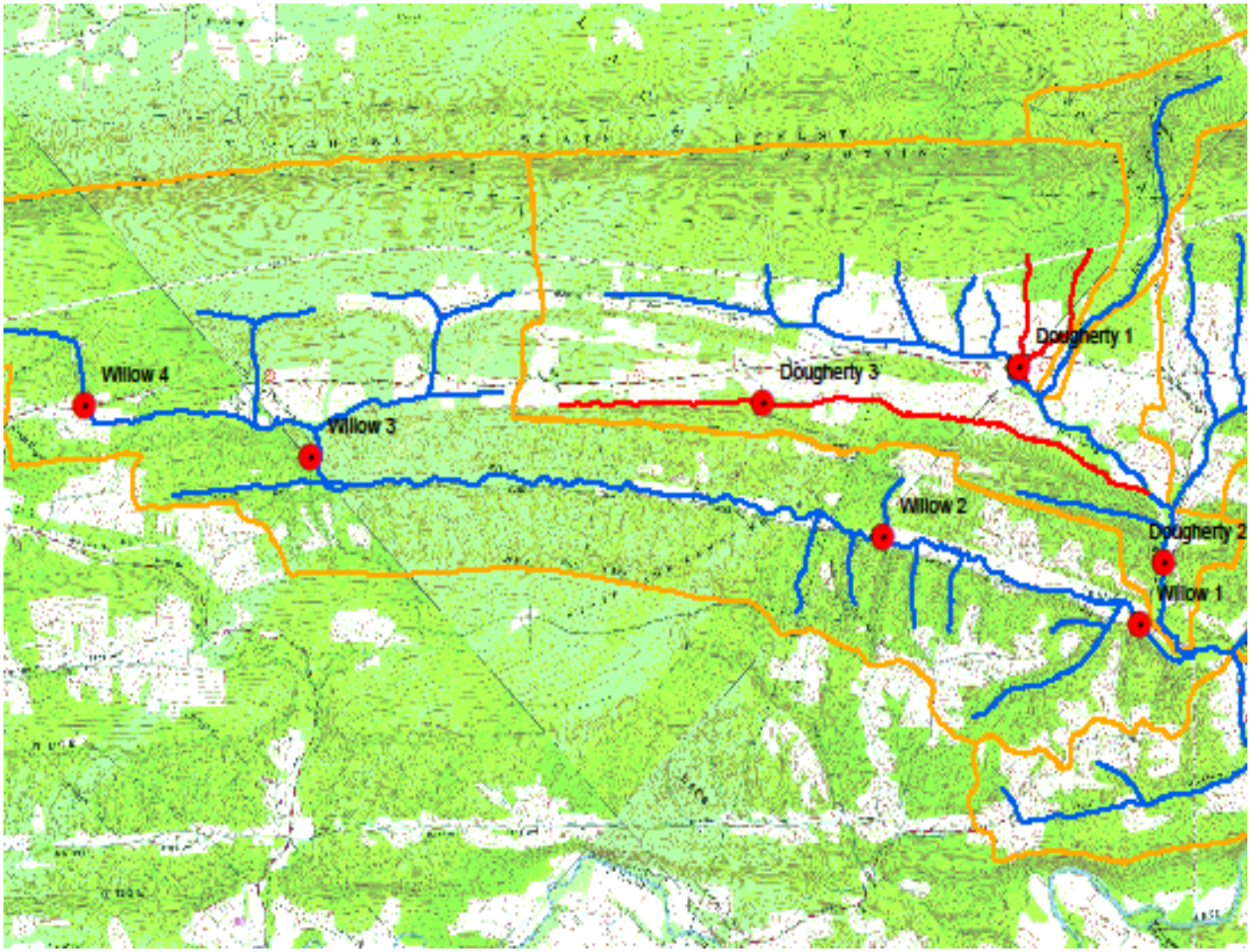


Land Use Map



Green – Forest
Brown – Agriculture
Blue – Water
Other Colors – Miscellaneous land use

Sampling Sites



2010 and 2011 data by site

Dougherty Run sample site 01 (D01)

Sites	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	10-Aug	11-Jan	11-May	High	Low	Average
Dougherty #1	40.425295 - 77.624739																	
Water Temp Celsius	20	21	12.7	7.5	7.2	2	0	2	12	9	12.9	0	23.30	3.30	13.00	23.3	0.00	9.73
Nitrates ppm	4.36	5.23	4.312	2.64	2.04	2.56	Frozen	3.14	3.43	3.39	2.64	5.23	0.83	0.83	0.95	5.23	0.83	2.77
Alkalinity ppm	120	120	80	120	120	120	Frozen	120	120	80	120		150.00	60.00	60.00	150.00	60.00	92.67
Chlorides	21	39	33	31	32	37	0	39	46	27	32	41	36.00	29.00	3.32mg/l			34.36
Conductivity ushom/cm	115.71	110.62	179.8	132.4	124.6	93.2	Frozen	124.6	103.9	131.9	231.9		121.00	120.20		179.80	93.20	122.29
salinity	0.1	0.1	0.09	0	0.09	0.1	Frozen	0.1	0.1	0.1	0.1	0	0.00	0.10		0.00	0.00	0.00
Specific Conductance	188.4	163.7	174.1	181.2	175.4	161.7	140.7	149.5	206.5	168.7	182.3	199.1	N/A	208.00	175.00	208.0	149.5	164.95
TDS	60	60	60	60	60	60	Frozen	40	40	60	80	0	140.00	160.00	118.00	140	40	66.53
Turbitiy FTU	11	12	9	12	15	17	0	16	14	16	11	10	7.00	10.00		12.00	7.00	12.31
Dissolved Oxy PPM	113.6	119.3	123.1	101	109.3	93.4	Frozen	105.3	97.3	88.7	77.1	0	4.04	12.31		123.10	4.04	87.04
Phosphorus ppm	0.07	0.5	0.5	0.18	0.5	0.4	Frozen	0.05	0.06	0.06	0.04	0.05	0.19	0.07	0.20	0.20	0.04	0.21
PH	7.5	7.3	7.1	7.5	6.9	6.5	Frozen	7.1	7.1	7.4	7.2	0	8.50	7.68	7.04	7.68	7.10	7.29
Flow Average ft/sec	1.4	1.2	1.3	4.08	3.6	2.1	Frozen	6.12	6.1	3	2.2		4.98	7.53	2.40	7.53	1.20	3.54
Flow Maximum ft/sec	2.3	2.6	2.7	6.1	3.4	2.5	Frozen	4.6	7.9	5	4.1	0	6.00	8.80	2.70	8.8	2.3	4.52

above limits

check numbers

Sites	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	10-Aug	11-Jan	11-May	High	Low	Average
	40.423658 -																	
Dougherty #2	77598488																	
Water Temp Celsius	21	22	13.2	6.6	6.3	2.2	0	3	10	9.3	14	0	19.20	1.40	13.00	22.00	1.40	10.86
Nitrates ppm	6.64	5.5	5.764	5.41	5.5	4.88	Frozen	5.13	6.64	4.93	6.2	6.2	1.07	0.94	1.60	6.64	0.94	4.74
Alkalinity ppm	120	120	120	120	120	120	Frozen	120	120	80	120		140.00	180.00	74.00	120.00	74.00	119.54
Chlorides	26	36	32	34	32	49	0	35	48	31	39		22.00	28.00	5.91 mg/l			
Conductivity ushom/cm	209.73	224.1	183.7	152.1	179.6	101.7	Frozen	161.9	128.3	169.6	219.6		269.60	133.90		269.00	101.70	177.82
salinity	0.1	0.1	0.1	0.1	0.1	0.1	Frozen	0.1	0.1	0.1	0	0	0.00	0.10				0.08
Specific Conductance	194.1	172	186.7	190.2	168.5	154.3	133	139.4	218.3	142.4	155.7	190.6	203.00	270.00	214.00	270.00	133.00	182.15
TDS	80	80	80	80	80	80	Frozen	60	60	60	90	0	110.00	189.00	152.00	60	189	92.38
Turbitiy FTU	12	13	11	12	13	14	0	14	12	14	10	11	12.00	5.00		14.00	5.00	11.77
Dissolved Oxy. PPM	89.1	97.2	91.1	103.7	101.9	88.8	Frozen	96.3	94.5	91.4	69.5	0	N/A	11.50		103.70	11.50	85.00
Phosphorus ppm	0.08	0.05	0.08	0.77	0.7	0.7	Frozen	0.05	0.05	0.02	0.02	0.02	1.62	0.52	<0.2	1.62	0.20	0.33
PH	8.6	8.3	8.4	7.9	7.5	7.1	Frozen	8.1	7.7	7.9	8.6	0	8.90	8.38	7.16	8.90	7.10	8.04
Flow average ft/sec	4.3	4.1	3.1	0.78	3.9	1.3	Frozen	2.1	2.1	1.75	0.58		1.60	1.35	1.60	4.30	0.58	2.20
Flow Maximum ft/sec	5.9	6.2	5.4	2.4	4.4	5.7	Frozen	3.9	3.9	2	1.1	0	2.60	5.20	2.60	6.2	2	3.66

above limits

check numbers

Sites	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	10-Aug	11-Jan	11-May	High	Low	Aver
Dougherty Run #3	40.406986 -77.642983																	
Water temp. Celsius													no flow	no flow	14.00			
Nitrates													no flow	no flow	4.40			
Alkalinity													no flow	no flow	28.00			
Chlorides													no flow	no flow	11.9 mg/l			
Conductivity													no flow	no flow				
salinity													no flow	no flow				
Specific Conductance													no flow	no flow	179.00			
TDS													no flow	no flow	94.00			
Turbidity																		
													no flow	no flow				
Dissolved Oxygen													no flow	no flow				
Phosphorous													no flow	no flow	0.20			
PH													no flow	no flow	7.25			
Flow Average													no flow	no flow	0.30			
Flow Maximum													no flow	no flow	0.50			

above limits

check numbers

Sites	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apri	May	Jun	10-Aug	11-Jan	11-May	High	Low	Avg
Willow Run #1	40.418479 - 77596077																	
Water temp Celsius	22	19	13.5	5.9	5.7	1.2	0	3	10	7.9	12.9	0	20.90	2.10	15.00	22.00	1.20	10.70
Nitrates ppm	2.55	2.64	2.88	2.45	2.56	2.07	Frozen	3.45	2.59	2.63	2.02	1.34	0.45	0.04	0.69	3.45	0.04	2.03
Alkalinity ppm	180	120	40	120	120	120	Frozen	120	100	120	80	40	120.00	120.00	58.00	180.0	40.0	104.14
Chlorides	31	30	29	30	31	27	0	28	28	23	46	42	53.00	23.00	2.3 mg/l	53.00	23.00	32.38
Conductivity ushom/cm	161.93	171.9	146.3	95.5	136.5	51.8	Frozen	101.6	53.8	173.8	113.8		210.00	91.50		210.0	53.8	125.70
salinity	0	0	0.1	0.1	0.1	0.3	Frozen	0	0.1	0	0.1	0	0.00	0.10				0.08
Specific Conductance	53.1	43.7	45	50.1	53.2	57.9	50.8	48.4	57	61.6	68.9	53.6	no reading	194.20	419.00			83.77
TDS	40	40	40	40	40	40	Frozen	40	40	40	60	0	110.00	32.00	54.00			42.00
Turbidity FTU	12	11	11	12	12	13	0	13	11	13	7	10	6.00	2.00				11.36
Dissolved Oxy PPM	94.3	95.6	92.4	91.7	93.6	87.5	Frozen	95.1	91	87.8	72.5	0	N/A	10.61				90.15
Phosphorus ppm	0	0	0.05	0	0.05	0.07	Frozen	0.05	0.08	0.34	0.05	0.03	0.03	0.41	<0.2			0.07
PH	6.9	7.1	6.8	6.7	6.5	6.9	Frozen	6.6	6.5	6.7	7.1	0	9.10	7.68	7.07			6.78
Flow average ft/sec	2.9	2.9	1.7	1.68	2.7	1.9	Frozen	2.9	2.9	2.39	2.4		1.46	4.34	0.60			2.44
Flow Maximum ft/sec	3.8	4	2.9	3.1	3.3	3.4	Frozen	3.7	4.6	7.8	4.3	0	3.70	9.00	2.20			4.09

above limits

check numbers

Sites	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	10Aug	11-Jan	11-May	High	Low	Avg
Willow Run #2	40.407141 - 77.623261																	
Water temp Celsius													20.40	0.00	16.00			
Nitrates ppm													0.29	0.15	0.72			
Alkalinity ppm													150.00	110.00	60.00			
Chlorides													38.00	14.00	2.26 mg/l			
Conductivity ushom/cm													250.00	99.00				
salinity													0.00	0.10				
Specific Conductance													no reading	no reading	155.00			
TDS													100.00	140.00	128.00			
Turbidity FTU													8.00	11.00				
Dissolved Oxy PPM													N/A	9.07				
Phosphorus ppm													0.06	0.67	<0.2			
PH													8.70	7.31	7.18			
Flow average ft/sec													1.36	1.75	2.50			
Flow Maximum ft/sec													2.60	2.60	2.90			

above limits

check numbers

Sites	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	10-Aug	11-Jan	11-May	High	Low	Avg
Willow Run 03	40.374731 -77.681679																	
Water temp Celsius													20.40	3.60	14.00			
Nitrates ppm													0.58	0.24	0.74			
Alkalinity ppm													130.00	110.00	64.00			
Chlorides													30.00	22.00	2.12 mg/l			
Conductivity ushom/cm													200.00	126.80				
salinity													0.00	0.10				
Specific Conductance													66.00	214.70	168.00			
TDS													130.00	175.00	102.00			
Turbidity FTU													10.00	0.00				
Dissolved Oxy PPM													**N/A**	8.92				
Phosphorus ppm													1.09	0.13	<0.2			
PH													8.40	7.86	7.23			
Flow average ft/sec													4.16	1.77	5.00			
Flow Maximum ft/sec													8.60	4.30	7.00			

above limits

check numbers

Sites	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	10-Aug	11-Jan	11-May	High	Low	Avg
Willow Run 04	40.366696 -77.693108																	
Water temp Celsius													23.00	frozen	13.00			
Nitrates ppm													0.22	frozen	0.65			
Alkalinity ppm													120.00	frozen	60.00			
Chlorides													21.00	frozen	4.18 mg/l			
Conductivity ushom/cm													190.00	frozen				
salinity													0.00	frozen				
Specific Conductance													N/A	frozen	152.00			
TDS													110.00	frozen	84.00			
Turbidity FTU													9.00	frozen				
Dissolved Oxy PPM													3.54	frozen				
Phosphorus ppm													1.03	frozen	<0.2			
PH													9.00	frozen	7.23			
Flow average ft/sec													2.13	frozen	0.40			
Flow Maximum ft/sec													2.20	frozen	0.60			

above limits

check numbers