



# Beneficial Use Support Document Stillwater Creek 2012



Stillwater Creek, RM 9.93

Division of Surface Water  
Water Quality Group  
Southeast District Office

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## Introduction

Ohio EPA sampled 31 streams at 63 locations and three lakes at six lake locations in the Stillwater Creek watersheds from 2011 to 2015 using standard Ohio EPA protocols. Included in this study were assessments of the biological, surface water and recreation (bacterial) condition. A total of 50 biological (2012), 63 water chemistry (2012), 11 sediment (2012), eight fish tissue (2012), and 23 bacterial stations (2012) were sampled in the study area.

Some of the use designations for Stillwater Creek and Little Stillwater Creek are based on 1983, 1988, 1992 or 2003 biological surveys conducted by Ohio EPA while other use designations are from the original 1978 water quality standards (WQS) which were not based on biological surveys. The techniques in use at that time of some of the earlier biological surveys did not include standardized approaches to the collection of in-stream biological or numeric biocriteria. This study represents the first comprehensive survey of the Stillwater Creek and Little Stillwater Creek watersheds which utilized the use of the standardized approach to the collection of in-stream biological and numeric biocriteria to inform the use designation process.

## Recommendations

The streams in the Stillwater Creek study area currently listed in the [Ohio Water Quality Standards](#) (WQS) are assigned one or more of the following aquatic life use designations: Warmwater Habitat (WWH) and Limited Warmwater Habitat (LWH). All other streams still retain their original 1978 WQS designations which were assigned before development of standardized approaches to the collection of instream biological data and numerical biological criteria.

Twenty-four streams were evaluated for aquatic life and recreational use potential in 2012 (Table 1). As a result of the 2012 survey findings, the WWH aquatic life use designation was recommended for all Stillwater Creek basin streams. All segments currently listed as LWH were recommended for re-designation to WWH. Those streams included Stillwater Creek, Boggs Fork, Trail Run, Plum Run, Skull Fork and Miller Fork. All other streams were verified as WWH. Significant findings included the following:

- The **Stillwater Creek** headwaters to Brushy Fork segment is currently listed as LWH due to acid mine drainage with an exemption for TDS due to historical mining. The rest of the mainstem is listed as WWH, and the section from the Uhrichsville dam (RM 5.2) to the mouth was confirmed as WWH in the WQS in a 1985 rule making. The section of Stillwater Creek that is designated LWH met the WWH biological criteria standards with full attainment from the headwaters to Brushy Fork (Clendening dam). Stillwater Creek downstream from Brushy Fork met the WWH biocriteria at all locations except downstream from Brushy Fork (Clendening Lake) and downstream from Little Stillwater Creek (Tappan Lake). Those locations did not meet the WWH criteria due to the poor quality water discharging from both Tappan and Clendening lakes. Mainstem Qualitative Habitat Evaluation Index (QHEI) scores averaged 57.6, which is close to the score of 60 that is considered adequate to support WWH communities. Vast areas of historically mined lands in the basin have been reclaimed and the Ohio Department of Natural Resources Mineral Resources Management (ODNR-DMRM) has been particularly active in gob pile remediation over the last quarter century. For these reasons, the WWH designation is considered appropriate. It is also recommended that the United States Army Corps of Engineers (USACE) modify the discharge from Clendening Lake and Tappan Lake so that water can be released from the middle or the bottom of the lake depending on the quality of the water. This would include monitoring the D.O. levels and not discharging the water from the bottom of the lake when D.O. levels are at their lowest concentration. This will prevent a toxic zone and will improve water quality downstream from the lakes.

- **Little Stillwater Creek** is currently listed as WWH. The section from Plum Run (downstream from Tappan Lake) to Dennison was verified and adopted in the WQS in a 1985 rule making. The upper section of Little Stillwater Creek is the Tappan Lake dam pool. Three sites were sampled downstream from Tappan Lake. The site located below the dam had similar water quality issues as Piedmont Lake on Stillwater Creek and Clendening Lake on Brushy Fork, with low D.O. and a milky white discharge related to high concentrations of sulfates within the lake. The next site downstream on Little Stillwater Creek at RM 5.5 fully met WWH and had a habitat (QHEI) score of 65.0. The lowest downstream site sampled on Little Stillwater Creek was in partial attainment of the WWH aquatic life use due to an impairment of the fish community. The QHEI score at this location was 35.5, which is poor habitat not typically associated with a WWH fish community. The site at RM 5.5 demonstrated that Little Stillwater Creek is capable of supporting a WWH fish community and that with habitat and water quality improvements, it's possible that the other locations would be able to meet WWH. It's recommended that Little Stillwater Creek maintain the current WWH biological use designation. It is also recommended that the discharges from Tappan Lake be modified to prevent the toxic conditions below the dam. This would include monitoring the D.O. levels and not discharging the water from the bottom of the lake when D.O. levels are at their lowest concentration. Another concern about the lower section of the Little Stillwater Creek is the direct habitat alterations and channelization of the creek which are preventing suitable habitat for a WWH community. It's recommended that future habitat alteration projects be minimized or stopped so that the channel can recover and return to a natural state. Additionally, habitat restoration projects could be evaluated and implemented if possible.
- **Clear Fork and Standingstone Fork** are tributaries to Tappan Lake (Little Stillwater Creek). Both streams are currently designated WWH but they have not been verified prior to this survey. There has been a tremendous amount of historic mining in the headwaters of these streams and non-acidic (alkaline) mine drainage flows into both streams. The type of mine drainage found in this area is typically more detrimental to the macroinvertebrate community due to high levels of total dissolved solids (TDS) but doesn't have as much impact on the fish community. Biological performance for macroinvertebrates was fair in both streams. The fish community was exceptional to marginally good in Clear Fork and was marginally good in Standingstone Fork. The physical habitat quality was adequate to support WWH communities with QHEI scores in the 60s at all locations. Mine reclamation activity in the watershed is both recent and on-going. Based on 2012 sampling, the current WWH use should be retained based on existing habitat quality and the prospects for additional recovery.
- The **Crooked Creek** subwatershed includes **Laurel, Watson, and Fallen Timbers reeks** and is located primarily in southeastern Tuscarawas County near the town of Stillwater. Crooked, Laurel, Watson and Fallen Timbers creeks are all designated WWH but have not been verified prior to this survey. This area of the Stillwater Creek watershed does have some historic and active mining, but the impacts have been minimal when compared to other areas mined in the Stillwater Creek watershed. All sites evaluated in the subwatershed met the WWH aquatic life use, with fish and macroinvertebrate narratives ranging from exceptional to marginally good with the exception of Laurel Creek at the mouth, which had a fair fish community. QHEI scores ranged from 44.3 in Watson Creek to 62.5 in Crooked Creek. Even though the habitat in Watson Creek was marginal, the fish performance was exceptional. The WWH use should be retained based on existing biological and habitat quality.
- **Weaver Run** (direct tributary to Stillwater Creek) and **Hitchcock Run** (tributary to Weaver Run) are both listed as unverified WWH in the WQS. Both streams have small drainage areas (less than 10 square miles) and are low gradient wetland streams with aquatic plants and mostly sluggish pool habitat. The large underground Tusky mine complex is located below Hitchcock Run and just north of Weaver Run. Habitat scores were low (QHEI = 35.5 in Weaver Run and 36.8 in Hitchcock Run), reflecting poor stream development and the lack of riffles. Weaver Run was partially meeting WWH (fish were good and macroinvertebrates were fair) and Hitchcock Run was in non-attainment of the WWH biological criteria with fair fish and macroinvertebrate communities. There are no use designations in Ohio for streams that are low gradient and perform like a linear wetland. These conditions do occur naturally, so even though the habitat scores are not supportive of a WWH community, it is recommended that these retain their current WWH use designation.

- **Brushy Fork** is a tributary to the Stillwater Creek near the town of Tippecanoe in Harrison County. Clendening Lake is located on Brushy Fork with its dam located very close to the mouth of Brushy Fork. The headwaters of Brushy Fork drain from the city of Cadiz and have been extensively surfaced mined. Along State Route 22, mine drainage can be seen discharging into the headwaters of Brushy Fork. The fish and macroinvertebrate community were fair upstream from the Clendening Lake dam pool but the habitat scores (QHEI) were both 70. Even though Brushy Fork was not meeting WWH at either location, the fish and macroinvertebrate scores were both close to meeting WWH. The very good habitat scores also indicate that if the water quality were improved through future reclamation or attenuation of mine drainage, Brushy Fork would be able to support a WWH community. It is therefore recommended that Brushy Fork maintain the use designation of WWH.
- **Craborchard Creek** is a tributary to Stillwater Creek near the town of Freeport that flows through Harrison and Guernsey counties. Craborchard Creek is designated WWH but has not been verified in the WQS. There are abandoned underground mines within the watershed, and Rosebud Mining Company has an active underground mining operation called the Vail Mine. Both the fish and the macroinvertebrate communities met the WWH biological criteria with scores ranging from marginally good for the fish and very good for the macroinvertebrates. The habitat score was 65.3 for the QHEI, which is typically associated with a WWH community. With both indicator species meeting the WWH use criteria and the good habitat scores, it is recommended that the WWH use designation should be retained. It is also recommended that discharges from the Vail Mine continue to be monitored to ensure that the water quality is not impacted.
- **Atkinson Creek** is direct tributary to Stillwater Creek located northwest of the town of Freeport. It flows through Guernsey, Tuscarawas and Harrison counties. Atkinson Creek is designated WWH in the WQS. Both the fish and macroinvertebrates met the WWH biological criteria with scores ranging from marginally good for fish and exceptional for macroinvertebrates. The habitat score of Atkinson Creek was 58.5, which is close to the target of 60 for WWH streams. It is recommended that Atkinson Creek maintain the WWH use designation.
- **Tributary to Stillwater Creek (at RM 7.60)** is currently undesignated in the Ohio WQS. It is a small headwater stream draining to Stillwater Creek at RM 7.60. The site sampled had good habitat (QHEI = 55.5) and was fully meeting the WWH biological criteria for both fish and macroinvertebrates. The WWH use designation is recommended for this unnamed tributary to Stillwater Creek.
- **Skull Fork** (tributary to Stillwater Creek) and **Miller Fork** (tributary to Skull Fork) are both currently designated LWH due to acid mine drainage, with an exemption for TDS due to historical mining. Miller Fork had a marginal habitat score (QHEI = 43.5) but the fish and macroinvertebrate communities were both meeting the WWH aquatic life use with scores ranging from marginally good to very good. The habitat scores of Miller Fork were reflective of low gradient wetland stream conditions with poor pool-riffle-run development. Since Miller Fork is currently supporting WWH biological communities, it is recommended that the use designation be changed from LWH to WWH.

Skull Fork was sampled at three locations. The most downstream location had the best habitat score (QHEI=70.3), with marginally good biological communities that met the WWH aquatic life use. The two upstream sites that were sampled at RM 13.0 and RM 6.8 were in non and partial attainment, respectively, due to sedimentation, high TDS and manganese from historic mining impacts. The biological scores ranged from fair to very good, and the habitat scores were below the target of 60 typically associated with WWH communities with QHEIs in the low 50s. Even though the upper sites were not meeting the WWH aquatic life use designation, it is possible that future reclamation projects in the headwaters of Skull Fork and attenuation of historic mine drainage will result in future attainment of the WWH use designation. It is recommended that that the use designation of Skull Fork be changed from LWH to WWH. It is also recommended that this area be evaluated for potential mine reclamation projects to improve the water quality of Skull Fork.

- **Tributary to Skull Fork (at RM 13.8)** is currently undesignated in the Ohio WQS. This is a small headwater stream that had only two fish species (creek chub and johnny darter) but a marginally good macroinvertebrate community with

five coldwater taxa. Since cold water fish were not found in the tributary, a WWH use designation is recommended. One coldwater fish taxa was found below this tributary in Skull Fork, so this stream should be evaluated again in the future to determine if coldwater fish species are using this stream, especially during spring spawning.

- **Boggs Fork** is a direct tributary to Stillwater Creek and is designated LWH with an exemption for TDS due to historical mining from the town of Holloway to the confluence with Stillwater Creek and WWH upstream from Holloway. Two locations were sampled on Boggs Fork at RM 6.7 and RM 0.75. The upstream site had fair biological communities, poor habitat (QHEI = 44.5) and were in non-attainment of the WWH use designation due to TDS and sedimentation from historic coal mining activity. The lower section of Boggs Fork in Holloway met the WWH biocriteria with scores ranging from marginally good to very good. The use designation of the lower site should be changed from LWH to WWH since the biological communities are meeting the WWH biological criteria. Reclamation projects should be targeted for the upper section of Boggs Fork where mine drainage is still entering the watershed from historic coal mining activity. With reclamation and natural attenuation of the mine drainage, it's possible that the biological communities will recover in the headwaters of Boggs Fork and attain the recommended WWH designation.
- **Plum Run and Trail Run** (tributaries to Boggs Fork) are both currently designated LWH due to acid mine drainage with an exemption for TDS due to mining history. Plum Run biological scores ranged from very good to exceptional and met the WWH aquatic life use criteria. Because Plum Run was fully meeting WWH, it is recommended that the use designation be changed from LWH to WWH.

Trail Run was in partial attainment of the WWH aquatic life use criteria with an exceptional fish community and a fair macroinvertebrate community score. The habitat of Trail Run appears to be heavily modified by past mining activity. The QHEI score was very poor (39.5), with instream habitat dominated by a heavy sediment bedload and channelized banks. Many of the streams in the Stillwater Creek watershed are low gradient wetland streams and have limited development of pool-riffle-run complexes. Even though the habitat was marginal, the pools provided enough cover to support an exceptional fish community, but limited the macroinvertebrates. Since Trail Run supports an exceptional fish community, it is recommended that the use designation be changed from LWH to WWH.

- **Sixmile Run** was evaluated for the macroinvertebrate community without a fish or habitat assessment. The macroinvertebrates scored a low fair. Sixmile Run is currently designated as WWH but without a fish assessment, the use designation could not be assessed at this time. It is recommended that a future fish and habitat sample be conducted in Sixmile Run to verify the existing use designation.
- **Spencer Creek** is designated WWH in the WQS. Two locations were sampled in Spencer Creek at RM 6.85 and RM 3.25. The upper site had good habitat (QHEI = 75.5) and was fully meeting the WWH biological criteria for both fish and macroinvertebrates. The lower site had poor habitat (QHEI=39.5) and was in partial attainment of the WWH biological criteria. The macroinvertebrate score and fish IBI score was marginally good to good and was fully meeting the criteria, but the MIwb was only in the fair range. Even though the lower site was in partial attainment, Spencer Creek is capable of supporting a WWH community. It is recommended that Spencer Creek maintain the WWH use designation.

All designated streams in the Stillwater Creek study area are currently assigned as Primary Contact Recreation (PCR), Agricultural Water Supply (AWS) and Industrial Water Supply (IWS). The WQS lists two Public Water Supply (PWS) in the Stillwater Creek watershed. One is an intake on Tappan Lake (Little Stillwater Creek at RM 14.55) for the city of Cadiz and the other was located on the Stillwater Creek mainstem at RM 7.05 for Twin City but is no longer in operation as of 2013.

**Table 1.** Waterbody use designation recommendations for the Stillwater Creek watershed. Designations based on the 1978 and 1985 water quality standards appear as asterisks (\*). *In addition, streams not assessed during the 2012 survey are in small, light blue font.* The following symbol: \*/+ indicates a confirmation of an existing use and a triangle (▲) denotes a new recommended use based on the findings of this report.

Water Body Segment	Use Designations												Comments	
	S R W	Aquatic Life Habitat						Water Supply			Recreation			
		W W H	E W H	M W H	S S H	C W H	L R W	P W S	A W S	I W S	B W	P C R		S C R
Stillwater creek		▲							*/+	*/+		*/+		Formerly PWS Intake for Twin City at RM 7.05
Little Stillwater creek		+						O	+	+		+		PWS Intake for Cadiz at RM 14.55 (Tappan Lake)
Wolf run		*							*	*		*		
Irish run		*							*	*		*		
UT (Little Stillwater Creek RM 7.6)		▲							▲	▲		▲		
Plum run		*/+							*/+	*/+		*/+		
Willis run		*							*	*		*		
Beaverdam run		*							*	*		*		
Edington run		*							*	*		*		
Beaverdam run		*							*	*		*		
Leiper run		*							*	*		*		
Clear fork		*/+							*/+	*/+		*/+		
Standingstone fork		*/+							*/+	*/+		*/+		
Crooked Creek		*/+							*/+	*/+		*/+		
Laurel creek		*/+							*/+	*/+		*/+		
Watson creek		*/+							*/+	*/+		*/+		
Fallen Timber creek		*/+							*/+	*/+		*/+		
Phillips fork		*							*	*		*		
Weaver run		*/+							*/+	*/+		*/+		
Hitchcock run		*/+							*/+	*/+		*/+		
Brushy fork		*/+							*/+	*/+		*/+		
Hefling run		*							*	*		*		
Long Run		*							*	*		*		
Colman run		*							*	*		*		
Huff run		*							*	*		*		
McFadden run		*							*	*		*		
Elk Run		*/+							*/+	*/+		*/+		
South fork		*							*	*		*		
Atkinson creek		*/+							*/+	*/+		*/+		
Craborchard creek		*/+							*/+	*/+		*/+		
Skull Fork		▲							*/+	*/+		*/+		
Millers Fork		▲							*/+	*/+		*/+		
UT (Skull Fork RM 13.87)		▲							▲	▲		▲		
Piedmont reservoir tributaries		*L							*	*		*		

Water Body Segment	Use Designations												Comments	
	S R W	Aquatic Life Habitat						Water Supply			Recreation			
		W W H	E W H	M W H	S S H	C W H	L R W	P W S	A W S	I W S	B W	P C R		S C R
Boggs fork		▲							*/+	*/+		*/+		
Plum Run		▲							*/+	*/+		*/+		
Trail run		▲							*/+	*/+		*/+		
Rush run		*L							*	*		*		
Jockey Hollow run		*							*	*		*		
Indian run		*							*	*		*		
Sixmile run		*							*	*		*		
Lick run		*							*	*		*		
Robinson run		*							*	*		*		
Buttermilk creek		*							*	*		*		
Coal run		*							*	*		*		
Spencer creek		*/+							*/+	*/+		*/+		

SRW = state resource water; WWH = warmwater habitat; EWH = exceptional warmwater habitat; MWH = modified warmwater habitat; SSH = seasonal salmonid habitat; CWH = coldwater habitat; LRW = limited resource water; PWS = public water supply; AWS = agricultural water supply; IWS = industrial water supply; BW = bathing water; PCR = primary contact recreation; SCR = secondary contact recreation

**Table 2.** Aquatic life use attainment status for sampling locations in the Stillwater Creek watershed, 2012. The Index of Biotic Integrity (IBI), Modified Index of Well-being (MIwb), and Invertebrate Community Index (ICI) scores are based on the performance of the biological community. Stream habitat reflects the ability to support a biological community. The Stillwater Creek watershed is located in the Western Allegheny Plateau (WAP) ecoregion. If biological impairment has occurred, the cause(s) and source(s) of the impairment are noted. NA = not applicable. For the aquatic life use designation, R denotes a recommendation that differs from the current use designation.

Stream	River Mile (IBI/ICI)	Drainage Area * (Wade=W/ Boat=B)	Aquatic Life Use Designation	Aquatic Life Attainment Status	IBI	MIwb	ICI <sup>a</sup>	QHEI	Cause/Source of Impairment
Stillwater Creek	56.0/54.0	9.4(W)	LWH/WWH-R	FULL	50	NA	MG <sup>ns</sup>	61.5	
Stillwater Creek	52.8	12.4(W)	LWH/WWH-R	FULL	40 <sup>ns</sup>	NA	MG <sup>ns</sup>	64.0	
Stillwater Creek	50.2/51.0	37.6(W)	LWH/WWH-R	FULL	40 <sup>ns</sup>	8.2 <sup>ns</sup>	34 <sup>ns</sup>	37.5	
Stillwater Creek	38.24	86.0(W)	LWH/WWH-R	FULL	44	9.4	G	65.8	
Stillwater Creek	33/32.9	189.0(W)	LWH/WWH-R	FULL	46	8.1 <sup>ns</sup>	38	54.5	
Stillwater Creek	25.5	282.0(W)	WWH	PARTIAL	43 <sup>ns</sup>	7.4*	30*	63.8	Hydrogen sulfide, D.O. / Dam or impoundment
Stillwater Creek	18.5	345.0(B)	WWH	FULL	52	9.2	42	66.8	
Stillwater Creek	9.9	358.0(B)	WWH	PARTIAL	37 <sup>ns</sup>	8.5	20*	56.8	Direct habitat alterations, Sedimentation/ Channelization
Stillwater Creek	7.0	364.0(B)	WWH	PARTIAL	35*	8.6	LF*	51.5	Direct habitat alterations, Sedimentation, Other flow regime alterations / Channelization, Dam or impoundment
Stillwater Creek	5.1	367.0(W)	WWH	FULL	52	11.0	36	66.8	
Stillwater Creek	3.1	481.0	WWH	FULL	-	-	MG <sup>ns</sup>	-	
Stillwater Creek	2.6	481.0(B)	WWH	PARTIAL	39 <sup>ns</sup>	9.1	14*	50.3	Mine drainage, Direct habitat alterations, Sedimentation / Channelization, Underground mining
Stillwater Creek	1.3	483.0(B)	WWH	PARTIAL	37 <sup>ns</sup>	9.9	16*	52.3	Mine drainage, Direct habitat alterations, Sedimentation / Channelization, Underground mining
Spencer Creek	6.85	6.7(W)	WWH	FULL	46	NA	MG <sup>ns</sup>	75.5	
Spencer Creek	3.25	20.7(W)	WWH	PARTIAL	41 <sup>ns</sup>	7.8*	38	36.5	Direct habitat alterations, Sedimentation / Channelization
Sixmile Run	1.3	4.8	WWH	NA	-	-	LF*	-	Sedimentation, Manganese / Coal mining
Boggs Fork	6.7	13.2(W)	WWH	NON	36*	NA	F*	44.5	Total dissolved solids, Sedimentation / Coal mining
Boggs Fork	0.75	28.5(W)	LWH/ WWH-R	FULL	49	9.1	42	41.5	
Trail Run	0.8/0.75	6.4(W)	LWH/WWH-R	PARTIAL	50	NA	F*	39.5	Sedimentation / Channelization, Coal mining
Plum Run	0.4	6.7(W)	LWH/WWH-R	FULL	46	NA	E	55.8	

Stream	River Mile (IBI/ICI)	Drainage Area * (Wade=W/ Boat=B)	Aquatic Life Use Designation	Aquatic Life Attainment Status	IBI	MIwb	ICI <sup>a</sup>	QHEI	Cause/Source of Impairment
Skull Fork	13/13.8	7.1(W)	LWH/WWH-R	NON	36*	NA	F*	54.5	Sedimentation, Total dissolved solids / Channelization, Coal mining
Skull Fork	6.8	26.9(W)	LWH/WWH-R	PARTIAL	48	7.4*	F*	53.0	Manganese/ Coal mining
Skull Fork	2.2	43.0(W)	LWH/WWH-R	FULL	41 <sup>ns</sup>	8.2 <sup>ns</sup>	34 <sup>ns</sup>	70.3	
Trib. to Skull Fork at RM 13.87	0.6/0.4	2.1(W)	WWH-R	NON	<u>22*</u>	NA	MG <sup>ns</sup>	44.3	Natural conditions (flow or habitat)/Natural sources
Miller Fork	0.9	6.3(W)	LWH/WWH-R	FULL	44	NA	MG <sup>ns</sup>	42.0	
Craborchard Creek	0.8	11.4(W)	WWH	FULL	40 <sup>ns</sup>	NA	VG	65.3	
Atkinson Creek	1.5	11.8(W)	WWH	FULL	40 <sup>ns</sup>	NA	E	52.5	
Brushy Fork	18.85	2.8(W)	WWH	NON	38*	NA	F*	67.3	Total dissolved solids / Coal mining
Brushy Fork	12.5	26.7(W)	WWH	PARTIAL	37*	7.9 <sup>ns</sup>	30*	70.5	Total dissolved solids / Coal mining
Brushy Fork	0.29	69.0	WWH	(NON)	-	-	<u>2*</u>	-	Hydrogen sulfide, D.O. / Dam or impoundment
Elk Run	0.2	5.6(W)	WWH	PARTIAL	32*	NA	VG	62.0	Sulfates, Other flow regime alterations / Dam or Impoundment, Coal Mining
Weaver Run	1.7/1.65	8.5(W)	WWH	PARTIAL	44	NA	F*	35.5	Low Flow, Sedimentation / Channelization, Coal Mining
Hitchcock Run	0.1	3.5(W)	WWH	NON	28*	NA	F*	36.8	Low Flow, Sedimentation/ Channelization, Coal Mining
Crooked Creek	4.0	14.9(W)	WWH	FULL	44	NA	MG <sup>ns</sup>	62.0	
Crooked Creek	0.7	47.3(W)	WWH	FULL	41 <sup>ns</sup>	8.9	38	62.5	
Watson Creek	1.5/1.4	7.9(W)	WWH	FULL	50	NA	MG <sup>ns</sup>	44.3	
Laurel Creek	6.9	10.8(W)	WWH	FULL	48	NA	E	61.5	
Laurel Creek	0.2/0.17	28.0(W)	WWH	PARTIAL	39*	8.0 <sup>ns</sup>	44	54.3	
Fallen Timbers Creek	0.1/0.05	9.5(W)	WWH	FULL	40 <sup>ns</sup>	NA	G	46.0	
Little Stillwater Creek	10.5	71.0(W)	WWH	(NON)	-	-	<u>6*</u>	-	Hydrogen sulfide, D.O. / Dam or impoundment
Little Stillwater Creek	5.5	96.4(W)	WWH	FULL	47	8.2 <sup>ns</sup>	40	65.0	
Little Stillwater Creek	3.8/2.8	105.0(W)	WWH	PARTIAL	33*	7.2*	34 <sup>ns</sup>	35.5	Direct habitat alterations, Sedimentation / Channelization
Clear Fork	8.5	9.9(W)	WWH	PARTIAL	52	NA	F*	65.3	Total dissolved solids, Sedimentation / Coal mining
Clear Fork	3.5/3.8	22.0(W)	WWH	FULL	40 <sup>ns</sup>	8.4	36	62.5	
Standing stone Fork	2.48	7.7(W)	WWH	PARTIAL	42 <sup>ns</sup>	NA	F*	63.5	Total Dissolved Solids, Sedimentation / Coal mining, Channelization
Plum Run (Tappan Lake Trib.)	1.07	4.7(W)	WWH	PARTIAL	40 <sup>ns</sup>	NA	LF*	38.3	Low flow, Sedimentation, Manganese/ Coal mining

Stream	River Mile (IBI/ICI)	Drainage Area * (Wade=W/ Boat=B)	Aquatic Life Use Designation	Aquatic Life Attainment Status	IBI	MIwb	ICI <sup>a</sup>	QHEI	Cause/Source of Impairment
Trib. to Little Stillwater Creek at RM 7.60	0.5	4.3(W)	WWH	FULL	44	NA	G	55.8	

- Refers to the fish site type [wade (W) or boat (B)] and the biocriteria associated with method.

BIOCRITERIA – WAP ECOREGION		
INDEX: Sample Type	WWH	EWB
IBI: Headwater/Wading/Boat	44/ 44/ 40	50/ 50/ 48
MIwb: Wading/ Boat	8.4/ 8.6	9.4/ 9.6
ICI	36	46

<sup>ns</sup> Nonsignificant departure from biocriterion ( $\leq 4$  IBI or ICI units;  $\leq 0.5$  MIwb units).

\* Significant departure from biocriterion ( $>4$  IBI or ICI units;  $>0.5$  MIwb units). Poor and very poor results are underlined.

<sup>a</sup> Narrative evaluation used in lieu of ICI (E=Exceptional; VG=Very Good; G=Good;

MG=Marginally Good; F=Fair; LF =Low Fair; P=Poor; VP=Very Poor).

Table 3: Matrix of macrohabitat features and QHEI scores for the Stillwater Creek watershed, 2012

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes							MWH Attributes										Total MWH Attributes	Q(MWH HL+1)/(MWH+1) Ratio	Q(MWH HL+1)/(MWH+1) Ratio							
			No Channelization or Barriers	Fine Sand/Gravel Substrates	Silt/Fine Substrates	Good Excellent Substrates	Moderate Substrates	Either Shallow or Fast Current/Eddies	Low Normal Overall Embedment	High Influence					Moderate Influence														
										Channelized or No Recovery	Silt/Clay Substrates	No Sinuosity	Shallow No Cover	Max Depth < 40 cm (W/D, HW)	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Bare)	Hardpan Substrate Origin	Fair Poor Development				Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High Mod. Overall Embedment	High Mod. Riffle Embedment	No Riffle
<b>(17-350) Stillwater Creek</b>																													
Year: 2012																													
56.0	61.5	46.51	#	#	#	#	#	#	6											1							4	0.29	0.86
52.8	64.0	9.95	#	#					5											1							4	0.33	1.00
50.2	49.0	2.13	#						4											1							5	0.40	1.40
38.2	65.8	3.35	#	#					4											1							6	0.40	1.60
33.0	54.5	2.34	#						3											2							6	0.75	2.25
25.5	63.8	0.97	#						3											1							6	0.50	2.00
18.5	66.8	0.97	#	#	#	#	#	#	6											0							7	0.14	1.14
9.9	56.8	1.52	#						3											1							6	0.50	2.00
7.0	51.5	1.52	#						3											1							6	0.50	2.00
5.1	66.8	1.52	#	#	#	#	#	#	5											1							4	0.33	1.00
2.6	50.3	1.52	#						3											1							6	0.50	2.00
1.3	52.3	1.52	#						3											1							6	0.50	2.00
<b>(17-351) Laurel Creek</b>																													
Year: 2012																													
6.9	61.5	6.67							3											1							6	0.50	2.00
0.2	54.3	2.42	#	#	#	#	#	#	5											0							5	0.17	1.00
<b>(17-352) Crooked Creek</b>																													
Year: 2012																													
4.0	62.0	7.27	#						4											1							5	0.40	1.40
0.7	62.5	1.63	#	#	#	#	#	#	6											0							5	0.14	0.86
<b>(17-353) Watson Creek</b>																													
Year: 2012																													
1.5	42.5	11.24	#						3											3							5	1.00	2.25
1.5	44.3	5.71	#						3											3							5	1.00	2.25
<b>(17-354) Fallen Timber Creek</b>																													
Year: 2012																													
0.1	51.0	10.31							2											1							6	0.67	2.67
0.1	46.0	10.31							1											2							6	1.50	4.50
<b>(17-356) Weaver Run</b>																													
Year: 2012																													
1.7	35.5	1.39							1											3							6	2.00	5.00

Table 3: Matrix of macrohabitat features and QHEI scores for the Stillwater Creek watershed, 2012

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes							MWH Attributes										Total MWH Attributes	QAMH (M+1)/(MWH+1) Ratio	QAMH (M+1)/(MWH+1) Ratio					
			No Channelization or Recovered Bottom/Gravel Substrates	Silt Free Substrates	Good Excellent Substrates	Moderate Substrates	Elevated/Modest Cover	Fast Current/Eddies	Low Normal Overall Embedment	Max Depth > 40 cm	Low Normal Riffle Embedment	High Influence					Moderate Influence										
												Channelized or No Recovery Silt/Truck Substrates	No Simulosity	Sparsely No Cover	Max Depth < 40 cm (W/O, H/W)	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin				Fair/Good Development	Low Simulosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current
<b>(17-357) Hitchcock Run</b>																											
Year: 2012																											
0.1	36.8	13.24	#							1								3						6	2.00	5.00	
<b>(17-358) Atkinson Creek</b>																											
Year: 2012																											
1.5	58.5	10.99	#	#	#	#	#			4								1							5	0.40	1.40
1.5	52.5	10.99	#	#	#	#	#			3								2							5	0.75	2.00
<b>(17-359) Craborchard Creek</b>																											
Year: 2012																											
0.8	62.5	9.52	#	#	#	#	#			4								2							5	0.60	1.60
0.8	65.3	9.52	#	#	#	#	#			5								1							4	0.33	1.00
<b>(17-360) Little Stillwater Creek</b>																											
Year: 2012																											
5.5	65.0	3.17	#	#	#	#	#			4								0							6	0.20	1.40
2.8	35.5	2.53	#							1								3							7	2.00	5.50
<b>(17-363) Plum Run</b>																											
Year: 2012																											
1.1	38.3	11.24	#							1								2							7	1.50	5.00
<b>(17-369) Clear Fork</b>																											
Year: 2012																											
8.5	65.3	8.66	#	#	#	#	#			5								1							4	0.33	1.00
3.5	62.5	4.13	#	#	#	#	#			5								0							5	0.17	1.00
<b>(17-370) Standingstone Fork</b>																											
Year: 2012																											
2.5	63.5	16.00	#	#	#	#	#	#	#	7								2							3	0.38	0.75
<b>(17-371) Skull Fork</b>																											
Year: 2012																											
13.0	50.5	7.41	#							2								2							6	1.00	3.00
6.8	53.0	3.14	#	#	#	#	#			4								1							6	0.40	1.60
5.2	52.5	3.14	#							2								2							7	1.00	3.33
5.2	59.0	3.14	#	#	#	#	#			4								1							5	0.40	1.40
2.2	70.3	3.16	#	#	#	#	#	#	#	6								0							4	0.14	0.71
0.5	73.3	3.16	#	#	#	#	#	#	#	8								0							3	0.11	0.44
0.5	69.5	3.16	#	#	#	#	#	#	#	5								0							5	0.17	1.00

Table 3: Matrix of macrohabitat features and QHEI scores for the Stillwater Creek watershed, 2012

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes					MWH Attributes					Total MWH Attributes	QHEI HL = 0.2(QMWH+1) Ratio	QHEI ML = 1.0(QMWH+1) Ratio			
			No Channelization or Filled Boulder/Cobble/Gravel Substrates Silt Free Substrates	Good/Better Substrates Moderate/High Stream Bank/In-stream Cover	Fast Current/Eddies Low Normal Overall Max Depth > 40 cm	Low Normal Riffle Embeddedness	Total WWH Attributes	High Influence		Moderate Influence								
								Channelized or No Recovery Silt/Muck Substrates	No Sinuosity Stagnant Cover Max Depth < 40 cm QMO, HWQ	Total MWH Attributes	Recovering Channel Heavy/Moderate Silt Cover Sand Substrates (Bog)	Hardpan Substrate Origin Fair/Poor Development Low Sinuosity				Only 1-2 Cover Types Intermittent and Poor Pools No Fast Current	High/Low Overall Embeddedness High/Low Riffle Embeddedness No Riffle	
<b>(17-372) Millers Fork</b>																		
Year: 2012																		
0.9	42.0	3.86	#	#	#	3	♦	♦	2	•	•	•	•	•	•	5	0.75	2.00
<b>(17-373) Boggs Fork</b>																		
Year: 2012																		
6.7	44.5	5.10	#	#	#	4	♦		1	•	•	•	•	•	•	5	0.40	1.40
6.7	41.5	5.10	#			1	♦	♦	4	•	•	•	•	•	•	5	2.50	5.00
0.7	53.8	3.35		#	#	3	♦	♦	2	•	•	•	•	•	•	5	0.75	2.00
<b>(17-374) Plum Run</b>																		
Year: 2012																		
0.4	55.8	10.42		#	#	2		♦	1	•	•	•	•	•	•	6	0.67	2.67
<b>(17-375) Trail Run</b>																		
Year: 2012																		
0.8	39.5	7.24			#	1	♦	♦	3	•	•	•	•	•	•	5	2.00	4.50
<b>(17-380) Brushy Fork</b>																		
Year: 2012																		
18.9	70.0	26.67	#	#	#	#	#	#	7		♦	1	•	•	•	3	0.25	0.63
18.9	67.3	26.67	#	#	#	#	#	#	6		♦	2	•	•	•	3	0.43	0.86
12.5	70.5	5.41	#	#	#	#	#	#	6			0	•	•	•	5	0.14	0.86
<b>(17-386) Elk Run</b>																		
Year: 2012																		
0.2	51.0	8.20	#	#	#	#	4	♦		1	•	•	•	•	•	5	0.40	1.40
0.2	62.0	8.20	#	#	#	#	#	#	6		♦	1	•	•	•	3	0.29	0.71
<b>(17-392) Spencer Creek</b>																		
Year: 2012																		
6.8	75.5	25.97	#	#	#	#	#	#	7			0	•	•	•	3	0.13	0.50
3.2	36.5	5.62			#	1	♦	♦	3	•	•	•	•	•	•	6	2.00	5.00