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Biological and Water Quality Study of the Captina Creek Watershed

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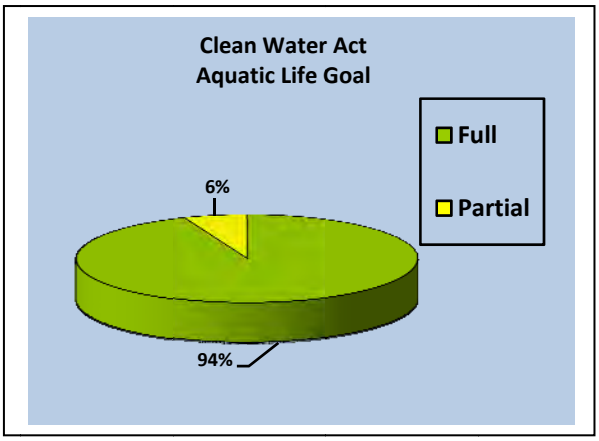
SUMMARY



Rivers and streams in Ohio support a variety of uses such as recreation, water supply, and aquatic life. Ohio EPA evaluates each stream to determine the appropriate use designation and to also determine if the use is meeting the goals of the federal Clean Water Act. Twelve streams in the Captina Creek watershed, located in southern Belmont and northern Monroe counties, were evaluated for aquatic life and recreation use potential in 2008 and 2009 (see Figure 1 and Table 1 for sampling locations).

Of the 32 biological samples collected, 30 sites (94%) were fully meeting the designated or recommended aquatic life use and two (6%) were in partial attainment. The South Fork of Captina Creek was in partial attainment due to sparse habitat predominated by bedrock but the macroinvertebrates were excellent at this location. State endangered Eastern Hellbender salamanders were also caught in the lower and mid section of the South Fork Captina Creek. Cat Run was in partial attainment due to fair fish scores but the macroinvertebrate community was very good. A natural waterfall is located below this location on Cat Run and may be creating a fish passage barrier that resulted in low IBI scores. Seven locations in the Captina Creek watershed were tested for bacteria indicators (*Escherichia coli*) to determine recreation use attainment status. Evaluation of *E. coli* results revealed that all seven locations attained the applicable geometric mean criterion, and thus were in full attainment of the designated recreation use. Six streams within the study area exhibited qualities indicative of the Coldwater Habitat (CWH) aquatic life use. Macroinvertebrate and fish communities from all six streams (Joy Fork, Jakes Run, Peavine Creek, Crabapple Creek, Piney Creek, and Casey Run) were fully meeting expectations of the CWH use.

Water quality throughout the watershed has been consistently good despite historic and active coal mining. The limestone geology of the area has buffered acidic contributions and has kept the pH levels in the range acceptable for supporting aquatic life. Ohio Valley Coal Company (OVCC) and American Energy Corporation (AEC), both owned by Murray Energy, have permitted NPDES discharges located in Perkins Run and Piney Creek which discharge to the upper section of Captina Creek. Elevated levels of total dissolved solids (TDS), metals and conductivity were found during the 2008 and 2009 survey in Captina Creek, Perkins Run and Piney Creek below the two mine discharges. In some cases, levels of TDS and metals exceeded the applicable water quality standards and also exceeded current NPDES permit limits for OVCC and AEC. Coal slurry waste has been released from both the OVCC slurry impoundment as well as from an AEC pipeline which crosses Captina Creek. The slurry is typically a thick, viscous, black material that can potentially smother aquatic life and contains numerous organic and metal contaminants. Contaminated sediments were found in Perkins Run and in Captina Creek downstream from where the slurry spills have occurred. These sediments have not caused biological impairment at the time of sampling but long term chronic exposure could result in future impacts to aquatic life. Elevated nutrients were found in the North Fork Captina Creek downstream from the Barnesville WWTP. The fish and macroinvertebrate communities were meeting WWH but could potentially meet EWH if nutrients were significantly reduced.

The Captina Creek mainstem sites sampled during 2008 and 2009 attained the Exceptional Warmwater Habitat fish and macroinvertebrate biocriterion at all 11 sites evaluated (100%). Fifty four species of fish were found and an impressive 17.5 percent of the fish population in Captina Creek was comprised of fish species intolerant of water pollution. Additionally, some of Ohio's highest values for total macroinvertebrate taxa richness (average of 84.3 taxa per site) and pollution sensitive taxa (average of 42.4 taxa per site) were documented at Captina Creek sites during 2008 and 2009. The exceptional biological integrity of the fish and macroinvertebrate community in Captina Creek is comparable to several of the best streams in Ohio including Big Darby Creek and the Kokosing River. Over the last 26 years of monitoring biological communities in Captina Creek, exceptional fish and macroinvertebrate populations have been maintained.

Table 1. Captina Creek watershed sampling locations from the Ohio EPA 2008-2009 survey.

Site Number	Name	River Mile	Drainage Area	Location Description
1	Captina Creek	23.12	75.4	Downstream Casey Run, @ SR 148 bridge
2	Captina Creek	22.10	87.1	Downstream Perkins Run @ SR 148 bridge
3	Captina Creek	20.90	87.9	Downstream CR 86, adj. SR 148
4	Captina Creek	20.54	96.0	Alledonia @ CR86, Pugh Ridge Road
5	Captina Creek	17.60	125.0	End of TR 114, downstream Bend Fork
6	Captina Creek	16.00	134.0	Armstrongs Mills @ gage
7	Captina Creek	11.70	141.0	SR148 & CR 5
8	Captina Creek	6.71	157.0	SR 148 bridge @ TR 506, Captina
9	Captina Creek	3.33	163.0	SR 148 bridge & CR 56
10	North Fork Captina Creek	6.65	7.0	SR 148 bridge upstream CR 102
11	North Fork Captina Creek	3.94	24.3	SR 26 bridge & SR 148
12	North Fork Captina Creek	0.43	32.6	CR 92 near mouth
13	South Fork Captina Creek	9.48	16.4	TR 35, Skinner Grimes Rd,off SR 800
14	South Fork Captina Creek	2.97	33.7	SR 26 near TR 63
15	South Fork Captina Creek	0.10	36.1	CR 92 near mouth
16	Bend Fork	8.35	9.0	SE Bethesda @ TR 192
17	Bend Fork	3.59	19.6	TR 101 @ ford access
18	Bend Fork	0.26	27.0	At mouth @ ford off TR 101
19	Joy Fork	0.30	6.0	TR 101 stream crossing @ mouth
20	Jakes Run	0.10	5.1	Adj. SR 148 (Hike in along N. Fk.) @ mouth
21	Pea Vine Creek	0.15	9.9	CR 5 near Captina Ck confluence
22	Crabapple Creek	0.46	8.2	Alledonia @ TR 103 1st stream crossing
23	Piney Creek	0.02	9.9	SR 148 at mouth
24	Casey Run	0.75	0.5	North of SR 148, near mouth
25	Long Run	0.04	10.6	SR 148 & CR 26
26	Cat Run	3.30	8.2	TR 203 (Cat Run Rd) Monroe Co.
27	Cat Run	0.25	12.8	CR56, Cat Run Rd, upstr. 1st stream crossing

***The color of the site number corresponds to the narrative biological score (blue is exceptional to very good (meets EWH goals), green is good to marginally good (meets WWH goals), yellow is fair, orange is poor, and red is very poor (fair, poor, very poor do not meet the goals of WWH).**

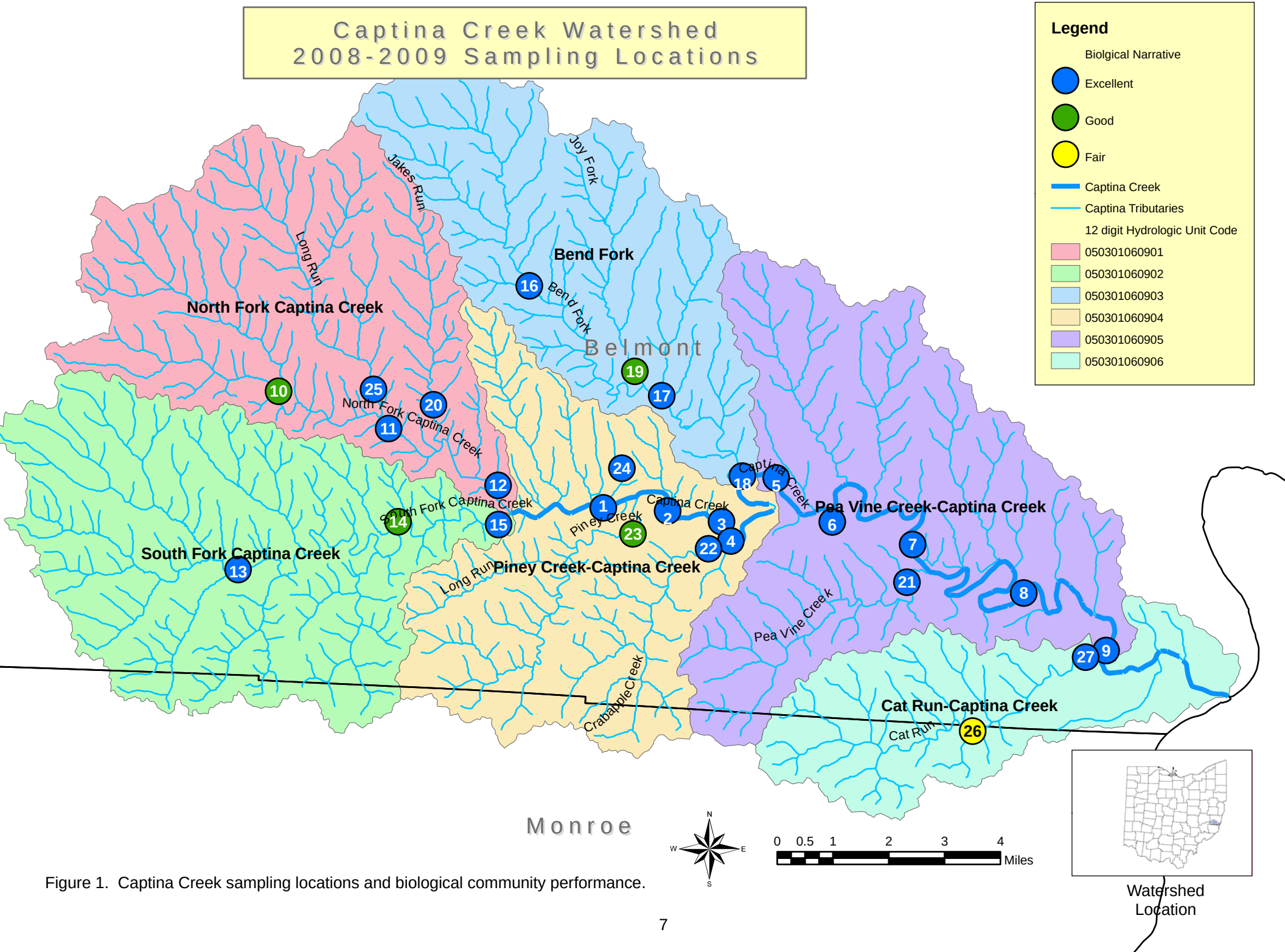


Figure 1. Captina Creek sampling locations and biological community performance.

Table 2. Aquatic life use attainment status for sampling locations in the Captina Creek watershed study area, 2009 and 2008. The Index of Biotic Integrity (IBI), Modified Index of Well-being (Mlwb), 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 Captina 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	Sample Location River Mile	Sampling Type	Eco-region	Aquatic Life Use Designation	Aquatic Life Attainment Status	IBI	Mlwb	ICI[a]	Stream Habitat[b]	Causes/Sources of Impairment
Captina Creek-2008	25.3	Wading	WAP	EWH	FULL	**56**	**9.4**	**56**	84.0	
Captina Creek	23.1	Wading	WAP	EWH	FULL	**56**	**9.8**	**54**	65.5	
Captina Creek-2008	23.1	Wading	WAP	EWH	FULL	**58**	**10.0**	**54**	83.5	
Captina Creek-2008	22.4	Wading	WAP	EWH	FULL	**60**	**9.6**	**52**	85.0	
Captina Creek	22.1	Wading	WAP	EWH	FULL	**52**	**9.6**	**E**	67.0	
Captina Creek	20.9	Wading	WAP	EWH	FULL	**57**	**9.9**	**48**	69.5	
Captina Creek-2008	20.9	Wading	WAP	EWH	FULL	**-**	**-**	**VG**[ns]	-	
Captina Creek	20.5	Wading	WAP	EWH	FULL	**56**	**10.1**	**E**	72.5	
Captina Creek	17.6/17.3	Wading	WAP	EWH	FULL	**52**	**10.3**	**48**	92.0	
Captina Creek	16.0	Wading	WAP	EWH	FULL	**49**[ns]	**10.3**	**52**	70.5	
Captina Creek-2008	16.0	Wading	WAP	EWH	FULL	**56**	**10.1**	**-**	83.5	
Captina Creek	11.7	Wading	WAP	EWH	FULL	**52**	**9.3**[ns]	**42**[ns]	67.5	
Captina Creek	6.7	Wading	WAP	EWH	FULL	**56**	**9.6**	**50**	70.5	
Captina Creek	3.3	Wading	WAP	EWH	FULL	**56**	**9.7**	**52**	75.0	
North Fork Captina Creek	6.6	Headwater	WAP	WWH	FULL	**46**	NA	**G**	71.0	
North Fork Captina Creek	3.9	Wading	WAP	EWH	FULL	**53**	**9.3**[ns]	**52**	66.0	
North Fork Captina Creek	0.4	Wading	WAP	EWH	FULL	**46**[ns]	**9.3**[ns]	**54**	59.0	
South Fork Captina Creek	9.5	Headwater	WAP	EWH-R	FULL	**54**	NA	**VG**	72.5	
South Fork Captina Creek	3.0	Wading	WAP	EWH-R	PARTIAL	**41**[*]	**8.7**[*]	**50**	67.5	Natural/Sparse Habitat
South Fork Captina Creek	0.1	Wading	WAP	EWH-R	FULL	**52**	**9.5**	**52**	60.5	
Bend Fork	8.4	Headwater	WAP	EWH-R	FULL	**50**	NA	**E**	56.5	
Bend Fork	3.6	Headwater	WAP	EWH	FULL	**57**	NA	**50**	86.0	
Bend Fork	0.3	Wading	WAP	EWH	FULL	**52**	**9.5**	**52**	83.0	
Joy Fork	0.1	Headwater	WAP	CWH-R	FULL	**44**	NA	**E**	71.0	

Table 2. Continued.

Stream	Sample Location River Mile	Sampling Type	Eco-region	Aquatic Life Use Designation	Aquatic Life Attainment Status	IBI	MIwb	ICI[a]	Stream Habitat[b]	Causes/Sources of Impairment
Jakes Run	0.1	Headwater	WAP	EWH/CWH-R	FULL	**54**	NA	**VG** [ns]	65.0	
Peavine Creek	0.1	Headwater	WAP	EWH/CWH-R	FULL	**54**	NA	**E**	73.0	
Crabapple Creek	0.5	Headwater	WAP	EWH/CWH-R	FULL	**58**	NA	**E**	75.0	
Piney Creek	0.1	Headwater	WAP	CWH-R	FULL	**56**	NA	**G**	79.5	
Casey Run	0.1	Headwater	WAP	CWH-R	FULL	**44**	NA	**E**	60.0	
Long Run (Trib to N. Fk)	0.1	Headwater	WAP	WWH	FULL	**50**	NA	**VG** [ns]	92.0	
Cat Run	3.3	Headwater	WAP	WWH	PARTIAL	**31***	NA	**VG**	86.0	Natural /waterfall barrier for fish migration
Cat Run	0.3	Headwater	WAP	WWH	FULL	**58**	NA	**VG**	83.0	

BIOCRITERIA – WAP ECOREGION		
INDEX - Site Type	WWH	EWH
IBI: Headwater/Wading	44	50
MIwb: Wading	8.4	9.4
ICI	36	46

[ns] Nonsignificant departure from biocriterion (≤4 IBI or ICI units; ≤0.5 MIwb units).
* Significant departure from biocriterion (>4 IBI or ICI units; >0.5 MIwb units). Poor and very poor results are underlined.
[a] Narrative evaluation used in lieu of ICI (E=Exceptional; VG=Very Good; G=Good; MG=Marginally Good; F=Fair; P=Poor; VP=Very Poor).
[b] Narrative habitat evaluations are based on QHEI scores for wading sites (Excellent ≥75, Good: 60-74, Fair: 45-59, Poor: 30-44, Very Poor <30) and headwater sites (Excellent ≥70, Good: 55-69, Fair: 43-54, Poor: 30-42, Very Poor <30).

RECOMMENDATIONS

The streams in the Captina Creek study area currently listed in the Ohio Water Quality Standards are assigned one or more of the following aquatic life use designations: Exceptional Warmwater Habitat (EWH) or Warmwater Habitat (WWH). Perkins Run is not listed in the Ohio Water Quality Standards. The aquatic life use designation of Captina Creek, Cat Run, Bend Fork, Long Run (trib. To Piney Creek), South Fork Captina Creek, North Fork Captina Creek and Long Run (tributary to North Fork) have been previously verified. All the other Captina Creek tributaries were originally designated for aquatic life uses in the 1978 Ohio WQS. The techniques used then did not include standardized approaches to the collection of instream biological data or numerical biological criteria. This study used biological and habitat data to evaluate and establish aquatic life uses for a number of streams in the Captina Creek study area.

Captina Creek is also listed as an Outstanding State Water based on exceptional ecological values (OAC 3745-1-05). Bend Fork (from Joy Fork to the mouth), North Fork Captina Creek (from Long Run to the mouth), and the South Fork of Captina Creek are listed as Superior High Quality Water in the Ohio Water Quality Standards (OAC 3745-1-05).

Twelve streams in the Captina Creek study area were evaluated for aquatic life and recreation use potential in 2008 and 2009 (Table 3). Significant findings include the following:

- North Fork Captina Creek (from Long Run to the mouth), Bend Fork (from Joy Fork to the mouth), and Captina Creek (from the confluence of the North Fork and South Fork Captina Creek to SR 7 at RM 0.8 where Captina is impounded by the Ohio River backwaters) are currently listed as EWH. Biological monitoring during this study confirmed these streams should maintain the EWH designation.

- Three streams with an existing WWH use designation should be maintained. These streams include North Fork Captina Creek (from headwaters to Long Run), Cat Run and Long Run (trib to North Fork Captina Creek).

- Two streams are currently listed as WWH but are recommended for EWH. These include Bend Fork (Headwaters to Joy Fork), and South Fork Captina Creek.

- The Coldwater Habitat (CWH) aquatic life use designation is recommended for Joy Fork, Piney Creek, and Casey Run based on abundant populations of coldwater fish species and/or coldwater macroinvertebrate taxa. Upstream reaches of Casey Run are also recommended as candidates for the proposed class III primary headwater use designation.

- Peavine Creek, Crabapple Creek, and Jakes Run have a dual aquatic life use designation recommendation of CWH and EWH because of the presence of both cold water taxa and exceptional biological communities.

All streams in this study should retain the Class A (Captina Creek and North Fork Captina Creek) or Class B (all other streams) Primary Contact Recreation (PCR) use, along with the Agricultural Water Supply and Industrial Water Supply uses. It is also recommended that Cat Run be upgraded from Secondary Contact Recreation to PCR due to the presence of multiple access points observed and deep pools.

Captina Creek should retain the Outstanding State Water (OSW) antidegradation classification based on the presence of a state endangered species (Eastern Hellbender), declining fish species and high mean IBI and ICI scores. State endangered Eastern Hellbender salamanders have been found throughout the Captina Creek watershed. Captina Creek is one of the only locations in the state of Ohio where juvenile Eastern Hellbender salamanders have been found indicating that the adults are reproducing. Eastern Hellbender populations found in other watersheds have been older adults with no juveniles found indicating that reproduction is not occurring. Over the last 26 years of monitoring biological communities in Captina Creek, exceptional fish and macroinvertebrate populations have been maintained. The average IBI score in the Captina Creek watershed is comparable to the best streams in Ohio such as Big Darby Creek, the Kokosing River and Wakatomika Creek.

North Fork Captina Creek (from Long Run to the mouth), and the South Fork of Captina Creek should retain the Superior High Quality Water (SHQW) antidegradation classification. Juvenile Eastern Hellbender salamanders have been found in both the North and South Fork of Captina Creek. Bend Fork is currently designated SHQW

from Joy Fork to the mouth but should be expanded to the entire mainstem due to the presence of declining fish species, high IBI and ICI scores and habitat scores greater than 70.

During low flow conditions, the water quality of Captina Creek is dominated by the discharges from the American Energy Mine (AEC) and the Ohio Valley Coal Company (OVCC) mine. Ohio EPA documented that the conductivity of Captina Creek exceeds reference conditions downstream from the point of discharge near RM 22.3 down to RM 3.3. Total dissolved solids (TDS) water quality standard exceedances were also found below the mine discharges. To protect the biological integrity of Captina Creek, which includes state endangered Eastern Hellbender populations, it is recommended that OVCC and AEC provide better treatment of waste mine water to reduce the conductivity, metals, and TDS concentrations and minimize or eliminate discharges during low flow conditions.

Piney Creek is currently designated WWH but is recommended for CWH due to the presence of both coldwater fish and macroinvertebrate taxa. The fish attain the EWH biological criteria; however, the macroinvertebrates are adversely impacted by the high concentration of TDS, conductivity and metals from the American Energy Corporation mine discharge at river mile 2.8. Mayflies are very sensitive to TDS and are almost completely absent from Piney Creek downstream from the mine discharge. It is recommended that AEC provide better treatment of their discharge to remove the high TDS or to avoid discharging during low flow conditions when the TDS concentrations are exacerbated by lack of dilution. If this occurs, Piney Creek could potentially meet EWH. It is also recommended that sampling upstream from AEC on Piney Creek be conducted to determine if Piney is meeting EWH in the upper reaches.

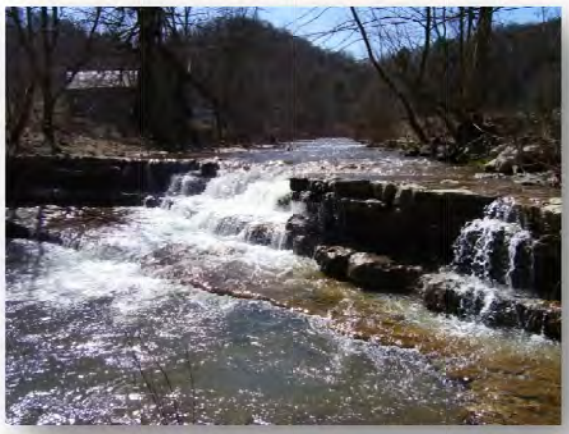
Long Run (tributary to N. Fork) is designated WWH but is currently meeting the EWH biological criteria for both fish and macroinvertebrates at one location near the confluence. Before a recommendation can be made for EWH, additional biological and habitat sampling should be conducted at one or more additional upstream locations in this subwatershed to determine if EWH is warranted.

Joy Fork is meeting EWH for macroinvertebrates but is only meeting WWH for fish. Fish passage is blocked by a culvert. It is recommended that a stream restoration project be conducted to remove this fish barrier. The dual EWH/CWH designation might be warranted if the impediment is removed.

Joy Fork fish barrier

The North Fork of Captina Creek is meeting EWH below Long Run and Eastern Hellbender salamanders have been found in this lower section. Upstream of Long Run, the North Fork of Captina Creek does not meet EWH and is influenced by poorly treated effluent from the Barnesville WWTP. Future upgrades and better maintenance of the treatment plant may result in the North Fork of Captina Creek meeting the EWH biological criteria.

The headwater site in Cat Run was performing at exceptional levels for macroinvertebrates but was not even meeting WWH for fish. A natural waterfall which acts as a fish passage barrier is present at river mile 3.0 that is preventing fish migration. Further investigations need to be conducted to determine if this is the cause of the impairment.


Cat Run fish barrier

Many of the tributaries to Captina Creek were recommended for CWH. Further studies should be conducted to determine if additional streams not evaluated during this survey are meeting CWH. Additionally, streams in the Water Quality Standards that have not been assessed in the Captina Creek watershed should have a biological survey conducted to determine their appropriate use designation.

Table 3. *Waterbody use designation recommendations for Captina Creek and tributaries.* *Designations based on the 1978 and 1985 water quality standards appear as asterisks (*). A plus sign (+) indicates a confirmation of an existing use and a triangle (▲) denotes a new recommended use based on the findings of this report. O - confirmed without a biological assessment.*

Water Body Segment	Use Designations													Comments
		Aquatic Life Habitat						Water Supply			Recreation			
	SRW	WWH	EWH	MWH	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR	
Captina Creek – confluence with North and South Forks to State Route 7 (RM 0.8)			+						+	+		+		
- State Route 7 to the mouth		+							+	+		+		
Cat Run		+							+	+		▲		
Moore Run		*							*	*		*		
Peavine Creek			▲			▲			+	+		+		
Rocky Fork		*							*	*		*		
Anderson Run		*							*	*		*		
Bend Fork			▲						+	+		+		
Millers Run		*							*	*		*		
Joy Fork						▲			+	+		+		
Packsaddle Run		*							*	*		*		
Crabapple Creek			▲			▲			*	*		*		
Piney Creek						▲			*	*		*		
Long Run			▲						+	+		+		
Casey Run						▲			*	*		*		
Berrys Run		*							*	*		*		
Reeves Hollow		*							*	*		*		
Mikes Run		*							*	*		*		
South Fork			+						+	+		+		
Brushy Creek		*							*	*		*		
Flag Run		*							*	*		*		
Cranenest Creek		*							*	*		*		
Millers Run		*							*	*		*		
Slope Creek – RM 1.85		*						o	*	*		*		
- all other segments		*							*	*		*		
North Fork – headwaters to Long Run (RM 4.0)		+							+	+		+		
- Long Run to the mouth			+						+	+		+		
Jakes Run			▲			▲			+	+		+		
Long Run		+							+	+		+		

INTRODUCTION

Thirty stream sampling locations were evaluated in the Captina Creek watershed in Belmont County in 2008 and 2009. Twelve sites on the mainstem of Captina Creek were sampled as well as eighteen locations on tributaries including North Fork Captina Creek, South Fork Captina Creek, Long Run (tributary to North Fork), Jakes Run, Casey Run, Piney Creek, Perkins Run, Bend Fork, Joy Fork, Crabapple Creek, Peavine Creek and Cat Run. A total of seven National Pollutant Discharge Elimination System (NPDES) permitted facilities discharge sanitary wastewater, industrial process water, and/or industrial storm water into the Captina Creek watershed. Samples were collected from three of these facilities including the Barnesville WWTP, American Energy Corporation (Century Mine) and Ohio Valley Coal Company (Powhatan No.6 Mine).

During 2008 and 2009, Ohio EPA conducted a water resource assessment of 12 streams in the Captina Creek watershed using standard Ohio EPA protocols as described in Appendix Table 11. Included in this study were assessments of the biological, surface water and recreation (bacterial) condition. A total of 30 biological, 37 water chemistry, and 7 bacterial stations were sampled in the Captina Creek watershed. All of the biological, chemical and bacteria results can be downloaded from the Ohio EPA GIS interactive maps at the following link: http://www.epa.state.oh.us/dsw/gis/index.aspx.

Specific objectives of the evaluation were to:

- establish the present biological conditions in the Captina Creek watershed by evaluating fish and macroinvertebrate communities,
- identify the relative levels of organic, inorganic, and nutrient parameters in the sediments and surface water,
- evaluate influences from NPDES outfall discharges in the Captina Creek watershed,
- assess physical habitat influences on stream biotic integrity,
- determine recreation water quality,
- compare present results with historical conditions, and
- determine the attainment status and recommend changes if appropriate.

The Captina Creek watershed is in the Western Allegheny Plateau (WAP) ecoregion. The mainstem of Captina Creek (headwaters to RM 0.8), North Fork Captina Creek (from Long Run to the mouth), Bend Fork (from Joy Fork to the mouth), and Long Run (tributary to Piney Creek) are assigned the Exceptional Warmwater Habitat (EWH) aquatic life use in the Ohio Water Quality Standards. Captina Creek is also listed as an Outstanding State Water based on exceptional ecological values (OAC 3745-1-05). Bend Fork (from Joy Fork to the mouth), North Fork Captina Creek (from Long Run to the mouth), and the South Fork of Captina Creek are listed as Superior High Quality Water in the Ohio Water Quality Standards (OAC 3745-1-05).

The other tributary streams listed in the Ohio Water Quality Standards for the study area are assigned the Warmwater Habitat (WWH) aquatic life use designation with the exception of Perkins Run which is undesignated. These streams were originally designated for aquatic life uses in the 1978 Ohio WQS. The techniques used then did not include standardized approaches to the collection of in-stream biological data or numerical biological criteria. This study used biological data to evaluate and establish aquatic life uses for a number of streams in the study area. All designated streams in the Captina Creek watershed are currently assigned as Primary Contact Recreation (PCR) (Cat Run is Secondary Contact Recreation), Agricultural Water Supply (AWS) and Industrial Water Supply (IWS).

The findings of this evaluation may factor into regulatory actions taken by the Ohio EPA (e.g. NPDES permits, Director's Orders, or the Ohio Water Quality Standards (OAC 3745-1), and may eventually be incorporated into State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, Total Maximum Daily Loads (TMDLs) and the biennial Integrated Water Quality Monitoring and Assessment Report (305[b] and 303[d] report).

RESULTS

Water Chemistry

Surface water chemistry samples were collected from the Captina Creek study area (Figure 1, Table 1) from January 2008 through December 2009 from thirty-seven locations. Stations were established in free-flowing sections of the stream and were primarily collected from bridge crossings. Surface water samples were collected directly into appropriate containers, preserved and delivered to Ohio EPA's Environmental Services laboratory. Collected water was preserved using appropriate

methods, as outlined in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2009). Samples were also collected from point source dischargers including Ohio Valley Coal Company, American Energy Corporation and the Barnesville waste water treatment plant. Interactive maps of surface water chemical data, downloadable to excel files, are available at the following link:

http://www.epa.state.oh.us/dsw/gis/index.aspx.

USGS gage data from Captina Creek at Armstongs Mills on SR 148 was used to show flow trends in the Captina Creek watershed during the 2009 survey (Figure 3.) Dates when water samples and bacteria samples were collected in the study area are noted on the graph. Flow conditions during the summer field season were typically lower than the historic median. Low flow conditions were recorded from July through November with some rain events elevating flow above the historic median. Water samples captured a variety of flow conditions in the study area during the field season. Bacteria was collected during the recreation use season (May through October) and was typically collected during low flows.

Surface water samples were analyzed for metals, nutrients, PCBs, semivolatile organic compounds, organochlorinated pesticides, bacteria, pH, temperature, conductivity, dissolved oxygen, percent D.O.saturation, and suspended and dissolved solids (Appendix Tables 1 - 2). Parameters which were in exceedance of the Ohio WQS criteria are reported in

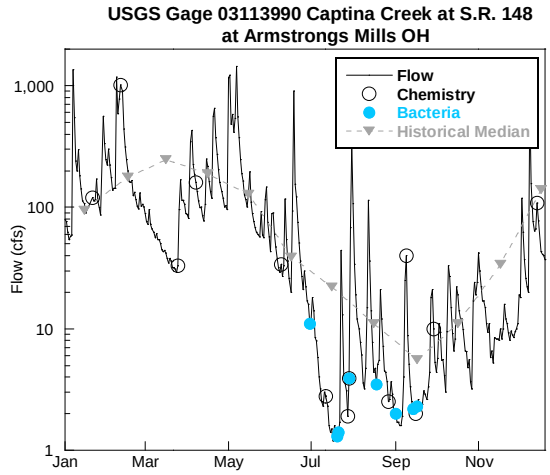


Figure 3. Flow conditions in Captina Creek during the 2009 Ohio EPA survey.

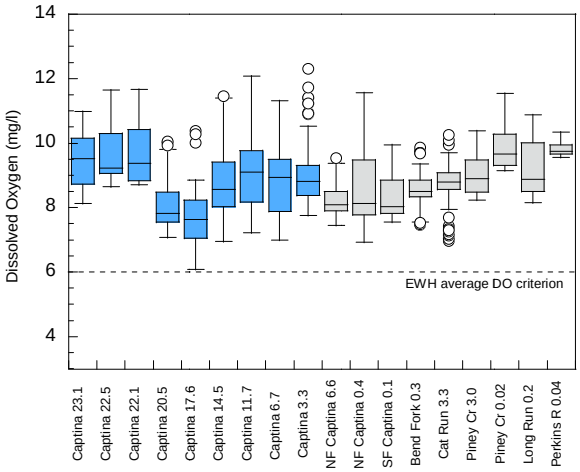


Figure 4. Dissolved oxygen values recorded by Datasonde™ continuous recorders in Captina Creek and select tributaries, summer 2009.

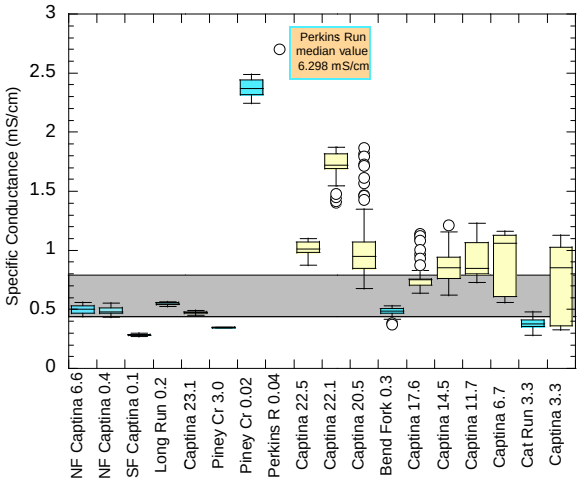


Figure 5. Conductivity values recorded by Datasonde™ continuous recorders in Captina Creek (shaded yellow) and select tributaries (shaded blue), summer 2009. Gray shaded areas represent the range between the median and 90th percentile values for relatively unimpacted reference sites in the WAP ecoregion (Ohio EPA 1992)

Table 4. Bacteriological samples were collected from seven locations, and the results are reported in the Recreation Use section. Datasonde™ water quality recorders were placed at eighteen locations to monitor hourly levels of dissolved oxygen, pH, temperature, and conductivity. (Figures 4 and 5; Appendix Table 3).

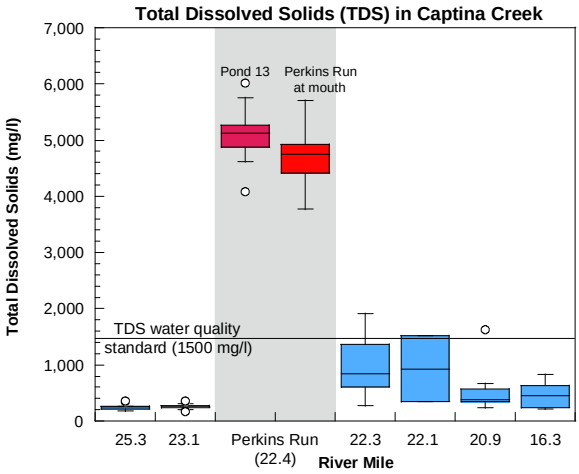


Figure 6. Total Dissolved Solids (TDS) in Captina Creek upstream and downstream from Perkins Run and Ohio Valley Coal outfall 013 discharge.

Metals were measured at 37 locations with 17 parameters tested (Appendix Table 1). Historic mining has occurred in the Captina Creek watershed and currently two mines, Ohio Valley Coal (OVCC) and American Energy Corporation (AEC), are located in the upper section of Captina Creek. Typically mining wastes and discharges can contribute high levels of acidity, metals (i.e. iron, aluminum, manganese, nickel, or zinc), total dissolved solids, high conductivity and low pHs. The limestone geology of the Captina Creek watershed has buffered these acidic contributions and kept the pH levels in the range acceptable for supporting aquatic life. However, elevated levels of total dissolved solids (TDS), metals and conductivity were found in Captina Creek, Perkins Run and Piney Creek below the two mine discharges.

Both mines contribute a significant amount of TDS (Figure 6) and elevate the specific conductance of Captina Creek, Perkins Run and Piney Creek well above reference conditions typically found in the Western Allegany Plateau ecoregion (Figure 5). During low flow conditions in the survey, the conductivity levels in Captina Creek remained elevated from downstream of mine wastewater discharges to the confluence of the Ohio River for nearly 22 river miles. Iron, selenium, copper, nickel and TDS water quality standard violations were found at the mouth of Perkins Run which receives discharges from OVCC outfall 013 as well as the OVCC slurry impoundment (outfall 002). TDS water quality standard violations were also found in Piney Creek downstream from the AEC discharge and in Captina Creek downstream from Perkins Run and Piney Creek (Table 4). Other mining parameters such as sodium, sulfate and aluminum were elevated above reference conditions in Perkins Run, Piney Creek and Captina Creek (Table 5). Since 1999, Ohio EPA has documented at least seven coal slurry releases from the Ohio Valley Coal Company's impoundment to Captina Creek and one slurry spill from American Energy Corporation in 2005. The last slurry release from Ohio Valley Coal Company occurred on February 28, 2008 and discolored Captina Creek for over 22 river miles. More information about Ohio Valley Coal Company and American Energy Corporation can be found in the Effluent Dischargers section.

Nutrients were measured at each water sampling location, and included ammonia-N, nitrate+nitrite-N, total phosphorus, and total Kjeldahl nitrogen (TKN). Summary statistics for nutrients measured in the Captina Creek watershed are detailed in Table 6. Nutrient levels were low at all monitoring locations on the mainstem of Captina Creek and in most of the tributaries. Elevated nutrients were found in the North Fork Captina Creek downstream from the Barnesville WWTP, Perkins Run below OVCC and Long Run upstream from AEC.

DataSonde™ hourly monitoring results for dissolved oxygen, temperature, pH, and conductivity at eighteen locations are listed in Appendix Table 3. Temperature, dissolved oxygen and pH levels were well within acceptable environmental levels but conductivity was elevated above reference conditions in areas below the active mining in Captina Creek, Piney Creek and Perkins Run (Figure 5). Dissolved oxygen measurements were indicative of good water quality, with all values above average EWH (6.0 mg/l) water quality criteria (Figure 4).

Table 4. Exceedances of Ohio Water Quality Standards criteria (OAC3745-1) for chemical/physical parameters measured in the Captina Creek watershed study area, 2008 and 2009. Bacteria exceedances are presented in the Recreation Use Section.

Stream/RM	Location	Parameter (value – ug/l unless noted)
Captina Creek		
25.3	Dst. North Fork and South Fork @ old ford	pH (9.21 SU[b]), Iron (9010[c]), Temp (30.19 C[a])
23.12	Downstream Casey Run @ SR 148	None
22.5	Upstream Perkins Run, dst. Piney Creek	None
22.4	Just downstream Perkins Run	TDS (1910 mg/l[b]), Iron (8070[c])
22.1	Upst. Alledonia, dst. Perkins Run @ SR 148	TDS (1520, 1810, 2320 mg/l[b])
20.9	Downstream Ohio Valley Coal	TDS (1630 mg/l[b])
20.54	Alledonia @ CR 86	None
17.60	@ End of road, 0.4 miles dst. Bend Fork	Temp (30.04 C[a])
16.0	Armstrongs Mills @ USGS gage	None
11.70	Upstream Cravat Coal Co.	Copper (30.7[b])
6.71	Captina @ SR 148	None
3.33	Upstream Steinersville @ SR 148	None
North Fork Captina Creek		
10.52	Upstream Barnesville WWTP	None
10.12	Downstream Barnesville WWTP	Ammonia (12.5 mg/l[b])
6.65	Southeast of Barnesville @ SR 148	None
3.94	Downstream Long Run @ CR 26	None
0.43	Near mouth @ CR 92	None
South Fork Captina Creek		
9.48	South of Somerton @ TR 35	None
2.97	North of New Castle @ SR 26	None
0.10	At mouth, CR 92	None
Bend Fork		
8.35	Southeast of Bethesda @ TR 192	None
3.59	Township Road 101	None
0.26	North of Alledonia @ first ford	None
Cat Run		
3.30	Upstream pipeline @ CR 56	None
0.25	Near mouth @ CR 56	None
Piney Creek		
3.0	Upstream AEC @ TR 87 (upst. Long Run)	None
0.02	Northwest of Alledonia @ SR 148	TDS (2050, 1730, 2470, 1680 mg/l[b])
Long Run (Tributary to the North Fork)		
2.24	Township Road 192	None
0.04	Southeast of Barnesville @ SR 148	None
Perkins Run		
0.3	Downstream OVCC slurry impoundment	TDS (1790, 3250, 3520, 3670, 3840, 3860, 3890, 3480 mg/l[b]), Selenium (6.3, 6.2, 8.2, 9.9, 7.2, 11.4, 6.8[b]), Iron (5960[c])
0.04	At the mouth downstream from OVCC pond 013 discharge.	TDS (4160, 3770, 4460, 4910, 4790, 4410, 4710, 5710, 5010, 4930, 5050, 4910, 4600 mg/l[b]), Selenium (10.2, 9.7, 12.2, 9.5, 10.5, 13.9, 12.2, 8.5, 9.7, 10.9, 9.9, 8.2[b]), Copper (36.4, 30.8, 36.9, 33.4[b]), Nickel (173[b]), Iron (14600, 7060[c])
Casey Run		
0.1	At the mouth	DO (4.36[a])

Table 4. Continued.

Stream/RM	**Location**	**Parameter (value – ug/l unless noted)**
Long Run (Tributary to Piney Creek)		
0.2	Township Road 87	None
Joy Fork		
0.01	At the mouth, Township Road 194	None
Peavine Creek		
0.15	Southeast of Armstrongs Mills @ CR 5	None
Jakes Run		
0.01	South of Hunter at the mouth	None
Crabapple Creek		
0.46	West of Alledonia @ TR 103	None

[a] Exceedance of the aquatic life Outside Mixing Zone Maximum water quality criterion (for D.O., below minimum).

[b] Exceedance of the aquatic life Outside Mixing Zone Average water quality criterion (for D.O., below 24 hour average).

[c] Exceedance of the statewide water quality criteria for the protection of agricultural uses.

Table 5. Summary statistics for select mine drainage inorganic water quality parameters sampled in the Captina Creek watershed study area, 2008 and 2009. The 90th percentile value from reference sites located within the Western Allegheny Plateau ecoregion is shown for comparison. Values above reference conditions or developed values are shaded. n= 4-22.

		Iron	Manganese	Conductivity	Sodium	Sulfate	Aluminum
Units		µg/l	µg/l	umhos/cm	mg/l	mg/l	µg/l
Stream	River Mile	Mean	Mean	Mean	Mean	Mean	Mean
Captina Creek	25.3	1368	158	399	14	49.1	819
Captina Creek	23.12	363	48	406	14	52.2	289
Captina Creek[1]	22.5	129	34	911	109	191	100
Captina Creek	22.4	1485	231	1483	276	379	751
Captina Creek	22.1	595	126	1759	303	560	321
Captina Creek	20.9	862	103	930	123	225	446
Captina Creek	20.54	499	140	1096	154	274	278
Captina Creek	17.60	429	55	873	98	195	211
Captina Creek	16.0	649	52	758	81	172	404
Captina Creek	11.70	203	21	842	97	178	100
Captina Creek	6.71	263	39	785	79	159	100
Captina Creek	3.33	484	47	826	83	175	178
North Fork Captina Creek	10.52	83	42	543	20	40.4	100
North Fork Captina Creek	10.12	413	131	654	52	41.0	229
North Fork Captina Creek	6.65	419	89	563	31	52.1	201
North Fork Captina Creek	3.94	181	67	573	21	87.2	100
North Fork Captina Creek	0.43	163	41	531	22	83.8	116
South Fork Captina Creek	9.48	623	70	253	5.4	20.5	383
South Fork Captina Creek	2.97	208	30	296	7	20.7	100
South Fork Captina Creek	0.10	242	24	307	8	23.3	153
Bend Fork	8.35	220	53	634	19	125	100
Bend Fork	3.59	192	27	542	32	79.6	154
Bend Fork	0.26	240	18	535	30	67.5	166
Cat Run	3.30	157	9	459	40	43.0	130
Cat Run	0.25	544	30	737	72	146	100
Piney Creek[1]	3.0	575	124	358	30	27.4	319
Piney Creek	0.02	115	14	2442	505	674	100
Long Run (NF Captina)[1]	2.24	407	184	617	21	127	201
Long Run (NF Captina)	0.04	265	146	605	13	138	100
Perkins Run	0.3	1196	1513	4650	1051	1578	494
Perkins Run	0.04	2561	1756	6063	1275	2585	831
Casey Run	0.1	290	10	403	4.7	40.7	218
Long Run (Piney Creek)[1]	0.2	1020	137	564	69	65.8	531
Joy Fork	0.01	193	12	549	55	45.1	136
Peavine Creek	0.15	66	11	471	24	41.9	100
Jakes Run	0.01	66	11	407	8	40.8	100
Crabapple Creek	0.46	387	21	691	100	65.5	265
Reference Values: headwater/ wading		1266/ 1820	379/ 610	1019/ 791	86/ 45	259/ 242	750[a]

a – U.S. EPA maximum criteria.
[1] – Only one water sample was collected at this location.

Table 6. Summary statistics for select nutrient water quality parameters sampled in the Captina Creek watershed study area, 2008 and 2009. The 90th percentile value from reference sites located within the Western Allegheny Plateau ecoregion is shown for comparison. Values above reference conditions are shaded yellow. n = 4-21

		Ammonia—N	Nitrate+Nitrite-N	Phosphorus-T
Stream	River Mile	Mean	Mean	Mean
Captina Creek	25.3	0.043	0.33	0.062
Captina Creek	23.12	0.025	0.33	0.024
Captina Creek[1]	22.5	0.025	0.05	0.052
Captina Creek	22.4	0.052	0.23	0.041
Captina Creek	22.1	0.025	0.22	0.029
Captina Creek	20.9	0.028	0.42	0.032
Captina Creek	20.54	0.034	0.07	0.024
Captina Creek	17.60	0.025	0.05	0.02
Captina Creek	16.0	0.025	0.51	0.026
Captina Creek	11.70	0.025	0.06	0.012
Captina Creek	6.71	0.029	0.06	0.017
Captina Creek	3.33	0.025	0.14	0.013
North Fork Captina Creek	10.52	0.025	0.23	0.044
North Fork Captina Creek	10.12	2.661	4.89	1.932
North Fork Captina Creek	6.65	0.131	2.38	0.432
North Fork Captina Creek	3.94	0.032	0.712	0.122
North Fork Captina Creek	0.43	0.025	0.22	0.043
South Fork Captina Creek	9.48	0.032	0.07	0.032
South Fork Captina Creek	2.97	0.025	0.16	0.015
South Fork Captina Creek	0.10	0.025	0.11	0.020
Bend Fork	8.35	0.025	0.27	0.064
Bend Fork	3.59	0.025	0.08	0.071
Bend Fork	0.26	0.025	0.05	0.02
Cat Run	3.30	0.025	0.07	0.014
Cat Run	0.25	0.025	0.06	0.011
Piney Creek[1]	3.0	0.025	0.11	0.022
Piney Creek	0.02	0.025	0.05	0.018
Long Run (NF Captina)[1]	2.24	0.025	0.60	0.011
Long Run (NF Captina)	0.04	0.025	0.22	0.039
Perkins Run	0.3	0.135	0.09	0.034
Perkins Run	0.04	0.329	0.06	0.042
Casey Run	0.1	0.025	0.16	0.109
Long Run (Piney Creek)[1]	0.2	0.063	0.13	0.198
Joy Fork	0.01	0.025	0.10	0.03
Peavine Creek	0.15	0.025	0.06	0.006
Jakes Run	0.01	0.025	0.09	0.013
Crabapple Creek	0.46	0.025	0.05	0.03
Reference Value (headwater/ wading)		0.06/ 0.06	0.606/ 1.054	0.09/ 0.11

[1] – Only one water sample was collected at this location.

Recreation Use

Water quality criteria for determining attainment of recreation uses are established in the Ohio Water Quality Standards (Table 7-13 in OAC 3745-1-07) based upon the presence or absence of bacteria indicators (*Escherichia coli*) in the water column.

Escherichia coli (*E. coli*) bacteria are microscopic organisms that are present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals. *E. coli* typically comprises approximately 97 percent of the organisms found in the fecal coliform bacteria of human feces (Dufour, 1977), but there is currently no simple way to differentiate between human and animal sources of coliform bacteria in surface waters, although methodologies for this type of analysis are becoming more practicable. These microorganisms can enter water bodies where there is a direct discharge of human and animal wastes, or may enter water bodies along with runoff from soils where these wastes have been deposited.

Pathogenic (disease causing) organisms are typically present in the environment in such small amounts that it is impractical to monitor them directly. Fecal indicator bacteria, including *E. coli*, by themselves are usually not pathogenic. However, some strains of *E. coli* can be pathogenic, capable of causing serious illness. Although not necessarily agents of disease, fecal indicator bacteria such as *E. coli* may indicate the potential presence of pathogenic organisms that enter the environment through the same pathways. When *E. coli* are present in high numbers in a water sample, it invariably means that the water has received fecal matter from one source or another. Swimming or other recreation-based contact with water having a high fecal coliform or *E. coli* count may result in ear, nose, and throat infections, as well as stomach upsets, skin rashes, and diarrhea. Young children, the elderly, and those with depressed immune systems are most susceptible to infection.

The Captina Creek watershed streams are designated as a Primary Contact Recreation (PCR) use in OAC Rule 3745-1-24. Water bodies with a designated recreation use of PCR "...are waters that, during the recreation season, are suitable for one or more full-body contact recreation activities such as, but not limited to, wading, swimming, boating, water skiing, canoeing, kayaking and SCUBA diving" [OAC 3745-1-07 (B)(4)(b)]. There are three classes of PCR use to reflect differences in the potential frequency and intensity of use. Streams designated PCR Class B support, or potentially support, occasional primary contact recreation activities. The Captina Creek mainstem and the lower four miles of the North Fork of Captina Creek are designated Class A PCR waters; all other streams assessed during this survey are designated Class B PCR waters. The *E. coli* criteria that apply to PCR Class A and B streams include a geometric mean of 126 and 161 cfu/100 ml, and a maximum value of 298 and 523 cfu/100 ml, respectively. The geometric mean is based on two or more samples and issued as the basis for determining attainment status when more than one sample is collected (Table 7).

Summarized bacteria results are listed in Table 7, and the complete dataset is reported in Appendix Table 4. Downloadable bacteria results are also available from the Ohio EPA GIS interactive maps at the following link: http://www.epa.state.oh.us/dsw/gis/index.aspx. Seven locations in the Captina Creek watershed were tested for *E. coli* levels five to nine times, from June 30th – September 17th, 2009 during low flow conditions. Evaluation of *E. coli* results revealed that all seven locations attained the applicable geometric mean criterion, and thus were in full attainment of the recreation use.

Table 7. A summary of E. coli data for locations sampled in the Captina Creek watershed study area, June 30 – September 17, 2009. Recreation use attainment is based on comparing the geometric mean to the Primary Contact Recreation (PCR) Classes A or B geometric mean water quality criterion of 126 or 161 cfu/100 ml (Ohio Administrative Code 3745-1-07). All values are expressed in colony forming units (cfu) per 100 ml of water. Gray shaded values exceed the applicable PCR Class A or B geometric mean criterion.

Location	River Mile	Recreation Use	# of Samples	Geometric Mean	Maximum Value	Recreation Attainment Status	Source(s) of Bacteria
Captina Creek	23.1	PCR Class A	5	36	90	**FULL**	
Captina Creek	16.0	PCR Class A	9	79	230	**FULL**	
Captina Creek	3.3	PCR Class A	5	37	150	**FULL**	
North Fork Captina Cr.	0.4	PCR Class A	9	99	360	**FULL**	
South Fork Captina Cr.	0.1	PCR Class B	9	44	330	**FULL**	
Bend Fork	0.3	PCR Class B	5	26	80	**FULL**	
Cat Run	0.3	PCR Class B	5	76	1100	**FULL**	

Effluent Dischargers

A total of seven National Pollutant Discharge Elimination System (NPDES) permitted facilities discharge sanitary wastewater, industrial process water, and/or industrial storm water into the Captina Creek watershed. Included in this list are two municipal sanitary wastewater treatment plants for the villages of Barnesville and Bethesda as well as five coal mine processing and preparation plants. The Bellaire Corporation Powhatan Mine No. 3 and Mine No. 5 have ceased mining operations although residual mining impact following reclamation is still present. The other three coal mining facilities consist of the Oklahoma Coal Company - Lynn Tipple facility, the American Energy Corporation – Century Mine and the Ohio Valley Coal Company – Powhatan No. 6 Mine. The coal mines in the area consist of deep shaft coal mining with washing and processing facilities which generate large quantities of coal slurry (sludge). The NPDES permits for the mining operations monitor the industrial process wastewater discharges from these slurry impoundments and industrial storm water discharges from sedimentation ponds down gradient of the processing areas. Each facility is required to monitor their discharges according to sampling and monitoring conditions specified in their NPDES permit and report results to the Ohio EPA on a Monthly Operating Report (MOR). Summarized effluent results are listed in Table 10.

Village of Barnesville WWTP (Ohio EPA Permit # 0PC00001)
The Village of Barnesville's wastewater treatment plant located on Waterworks Road provides sanitary wastewater treatment to approximately 4,225 people within the village. The municipal wastewater treatment plant originally constructed in 1923 and upgraded in 1987 consists of primary sedimentation followed by an oxidation ditch which utilizes the activated sludge process for secondary treatment of the sanitary waste. The wastewater then receives final treatment through final clarification followed by disinfection with ultraviolet light. The wastewater treatment plant has an average daily design flow of 1.3 MGD (Million Gallons per Day) and receives an average daily flow of approximately 0.29 MGD.

Past inspections of the facility have noted poor maintenance on the rotors and paddles in the oxidation ditch which provide essential aeration for secondary treatment of organic wastes. The poor maintenance of the oxidation ditch and inadequate sludge treatment and storage have lead to elevated suspended solids and ammonia concentrations resulting in numerous effluent limit violations over the past several years. In an effort to improve sludge treatment and disposal the village recently was issued a PTI for the installation of two aerobic sludge digester tanks, a sludge belt press and dry storage building. Currently sludge is wasted into a small Imhoff tank which provides no treatment and little storage therefore requiring frequent disposal at another permitted wastewater treatment plant. The proposed upgrades which are to be partially funded through federal stimulus dollars will allow the operator to better manage sludge within the plant and meet Ohio's sludge rules for either land application or disposal in a licensed sanitary solid waste landfill.

With improved maintenance of the facility and the addition of the new sludge treatment components the plant should provide better treatment to minimize effluent violations and reduce pollutant loads to the receiving stream of the North Fork of Captina Creek. Water quality sampling conducted in 2008 and 2009 downstream of the discharge did show elevated ammonia concentrations in the stream above the aquatic life use water quality criteria as well as elevated levels of nitrate+nitrite-N and total phosphorus (Table 6).

Village of Bethesda WWTP (Ohio EPA Permit # 0PB00001)
The Village of Bethesda's wastewater treatment plant located at 63451 Waterworks Road provides sanitary sewer wastewater treatment to approximately 1,400 residents who reside in the village. The wastewater treatment plant constructed in 1990 contains preliminary treatment provided by a bar screen and a grit removal followed by an oxidation ditch which utilizes an activated sludge process for the secondary treatment of organic wastes. The sanitary waste then receives final treatment through final clarification followed by disinfection with chlorination and de-chlorination. In an effort to maintain dissolved oxygen levels in the treated effluent and minimize the oxygen sag impact to the receiving stream, post aeration is provided prior to chlorination. Sludge removed from the facility is digested in an aerobic digester and then either land applied or hauled to another wastewater treatment plant. The sanitary sewer collection system within the village is relatively old and receives significant infiltration and inflow (I&I) which causes occasional plant upsets leading to effluent limit violations. The current NPDES permit contains a compliance schedule to identify and eliminate I&I which should help improve treatment at the plant and reduce any pollutant loads to the receiving stream of Bend Fork following storm events.

Bellaire Corporation Powhatan No. 3 Mine (Ohio EPA Permit # 0IL00042)
The Bellaire Corporation Powhatan Number 3 Mine was a former coal mining and processing facility located near State Route 7 and Big Run creek in Belmont County. During the operation of the mine several years ago the facility was authorized to discharge industrial process wastewater and storm water from the coal cleaning and processing procedure according to conditions of NPDES permit # 0IL00042. The operation at the site ceased several years ago and the site was partially reclaimed although a large gob pile remains on both sides of Big Run just prior to the confluence with the Ohio River. The presence of exposed gob with coal fines continues to contribute a sediment load to Big Run as well as acid mine drainage which contains elevated total dissolved solids (TDS), sulfates, iron, manganese and an acidity load lowering the pH of Big Run. Complete reclamation and restoration of this site would significantly reduce the acid mine drainage impact to Big Run, decrease sedimentation and improve water quality of Big Run. A facility MOR review was not completed for this site since it no longer has an effective NPDES permit and contributes a pollutant load from site wide runoff due to the presence of the large exposed gob pile.

Bellaire Corporation Powhatan No. 5 Mine (Ohio EPA Permit # 0IL00043)
The Bellaire Corporation Powhatan Number 5 Mine was a former coal processing plant located near the intersection of State Route 148 and York Township Road 810 near Powhatan Point, Ohio. The mining and coal processing at this site ceased several years ago and the site was reclaimed according to the Ohio Department of Natural Resources – Division of Mineral Resources Management (DMRM) reclamation criteria. Although the site has been reclaimed the area still contains a sedimentation pond down gradient of the former processing area which discharges to Captina Creek. The discharge is monitored according to conditions of the NPDES permit and sampled for total suspended solids (TSS), iron, manganese, pH, and TDS. The discharge consists of storm water runoff from the reclaimed site in addition to some acid mine drainage seepage from the reclaimed area.

Oklahoma Coal Company – Lynn Tipple Facility (Ohio EPA Permit # 0IL00001)
The Oklahoma Coal Company is a coal mining and processing plant located approximately two miles west of the small town of Captina. The mined coal is cleaned and processed at a local coal preparation plant prior to loading and transportation. Industrial storm water runoff from the preparation plant, clean coal stockpiles, and refuse area is collected into a sedimentation pond which discharges to Captina Creek. The runoff from the processing area goes through a series of storm water retention ponds prior to the final discharge which is monitored as Outfall 001 in the permit. Outfall 001 has a permitted discharge flow of up to 14,000 gpd and is monitored for the mine runoff parameters of iron, manganese, TSS, TDS, and pH. In addition to these parameters mercury monitoring is also being conducted. The other monitored outfall at this mine site is Outfall 005 which consists of a fresh water pond discharge from an undisturbed area up gradient of the primary sedimentation pond providing treatment of the process wastewater. A ten year facility MOR review is shown in Table 10.

American Energy Corporation- Century Mine (Ohio EPA Permit # 0IL00091)
The American Energy Corporation (AEC) – Century Mine located in Wayne Township near Township Road 88 and State Route 145 is a deep shaft coal mine and processing plant which has been in operation since 1969. The Century Mine is one of the leading suppliers of coal in the state of Ohio and a large employer in the region. The mined coal is brought to the surface where it is cleaned and processed prior to being loaded onto rail cars or semi trailers at loading facilities. The processing of the coal involves washing the coal to remove impurities which are then contained within a slurry mixture that is pumped to a large impoundment approximately 1,500 feet away at the Ohio Valley Coal (OVCC) facility. The slurry impoundment provides settling of the solids within the mixture as the wastewater is then discharged and monitored according to the terms and conditions of the NPDES permit for the OVCC facility. The two mines owned and operated by the Murray Energy Corporation share a large coal slurry impoundment for slurry generated from both mine processing areas.

The absence of a slurry impoundment for the AEC mine has required the facility to pump their slurry a long distance to the OVCC impoundment. The pumping of this waste has not been without incident over the last several decades with the most recent slurry spill occurring on August 23, 2005. On this date a portion of the pipeline ruptured creating a leak which led to the release of approximately 30,000 gallons of sludge into Captina Creek near the line break. The slurry spill impacted roughly 3,000 linear feet of the

stream with heavy sludge deposits which coated the stream bed and banks as well as turning the creek black. Upon discovering the break AEC representatives reported the spill to Ohio EPA and an On Scene Coordinator (OSC) was dispatched for investigation and cleanup supervision. The sludge deposits were removed with industrial vacuum trucks and the stream banks cleaned with pressure washers. Although the cleanup was completed within a week a noticeable fish kill was observed at the time of the release. Directors Findings and Orders were issued for the American Energy slurry release which included a fine of $50,000 and development of an emergency response and spill prevention plan. The American Energy Corporation Directors Findings and Orders can be found at the following link:
epa.ohio.gov/portals/35/enforcement/AmericanEnergyCorp.pdf

The AEC mine has nine authorized wastewater discharge points consisting of industrial storm water runoff from coal refuse disposal sites, coal storage areas, mine water discharges and sanitary wastewater discharges from offices and bath houses serving the mine. The original three outfalls at the site were Outfall 008, 011, and 002 with Outfalls 008 and 011 consisting of mainly storm water discharges from the main preparation plant pond discharges. Outfall 011 combines the preparation plant storm water discharge with sanitary wastewater from the main bath house. The preparation plant discharge at Outfall 008 is authorized to discharge 0.190 MGD from a clean coal storage pad as well as storm water runoff from the coal preparation area. The preparation plant areas as well as coal refuse disposal site ponds that are listed as Outfalls 012 through 016 in the NPDES permit are monitored for iron, manganese, TSS, TDS and pH. Outfall 002 consists of mine shaft water which is mostly recycled and used for dust control in the mines.

In 2002 the NPDES permit for AEC was modified to add Outfalls 012 through 016 for expanded mining operations which generated multiple coal refuse disposal sites with sedimentation ponds for storm water runoff controls. The permit modification also allowed for additional sanitary wastewater to be mixed with existing Outfall 011 in addition to a sanitary discharge from a new 10,000 gpd extended aeration package plant to serve the main office and bath house.

Ohio Valley Coal Company Powhatan No. 6 Mine (Ohio EPA Permit # 0IL00046*DD)
The Ohio Valley Coal Company (OVCC) Powhatan Number 6 mine is a large deep shaft coal mine and processing facility located near the intersection of State Route 148 and County Road 86 near the community of Alledonia. The OVCC facility is owned and operated by Robert Murray who also owns the AEC Century Mine which pumps coal slurry to the OVCC facility. The OVCC mine has authorization to discharge from five industrial process wastewater discharges which contain industrial storm water runoff from coal processing areas and a sanitary discharge from the main mine portal bath house.

The main discharge at the facility is from the slurry impoundment pond #2 which is listed as Outfall 001 in the NPDES permit. The slurry impoundment contains coal slurry generated through the washing of coal mined at the OVCC and AEC mines. The impoundment is designed to handle an average daily design flow of 1.5 MGD of coal slurry. The outfall is monitored for the typical coal mining runoff parameters of iron, manganese, TSS, TDS, and pH prior to discharge into Perkins Run. Pond 13 (Outfall 013) is a leachate collection pond located below the slurry impoundment and also discharges to Perkins Run. The discharge from Outfall 013 is treated with potassium permanganate to drop out metals before discharging to Perkins Run. The pond is currently undersized and as a result, permit violations have occurred for iron and manganese as well as exceedances of the water quality standards for TDS.

Figure 7. Discharge from Pond 13 (outfall 013). Note the iron stains on the rocks.

In addition to iron and manganese, other elevated metals that have been found from outfall 013 include aluminum, barium, cadmium, copper, strontium, nickel, selenium, mercury and zinc. A compliance sample collected on March 5, 2008 documented iron levels in Pond 13 at 17,700 µg/l which exceeded the daily maximum permit limit of 7,000 µg/l. Figure 7 shows the iron stained rocks below the discharge from pond 13. Manganese levels were 4,640 µg/l which also exceeded the maximum daily permit limit of 4,000 µg/l. Total dissolved solids were also highly elevated with a value of 4,080 mg/l. Macroinvertebrates were sampled in Perkins Run on May 5, 2008 downstream from the Pond 13 discharge. The macroinvertebrate community was very poor which is indicative of a toxic effect most likely caused from the discharges from outfalls 001 and 013. On July 21 and 22, 2008, a bioassay sample was collected at the mouth of Perkins Run and was found to be acutely toxicity to the *Ceriodaphnia dubia* with a mortality of 85 percent within 48 hours.

The washed and processed coal is stockpiled next to a rail load out facility adjacent to Captina Creek with storm water runoff from the area monitored from the #7 sedimentation pond that discharges to Captina Creek. This pond discharge is listed as Outfall 011 in the NPDES permit and monitored for the same constituents as the slurry impoundment discharge. The beltline which delivers the processed coal from the preparation plant to the loading facility also has a storm water runoff control pond known as pond # 8. This pond discharges to Captina Creek and is listed as Outfall 007 in the NPDES permit and monitored for the same constituents as Outfall 011. The final permitted outfall for the OVCC facility is listed as Outfall 002 in the discharge permit and contains the treated sanitary sewer discharge from a 3,000 gpd extended aeration package plant. The wastewater treatment plant discharges to pond 7 and is monitored for typical sanitary wastewater constituents such as ammonia, biochemical oxygen demand, TSS, and fecal coliform bacteria.

The large discharge from the OVCC facility is the main slurry impoundment (outfall 001) which is designed for the treatment of 1.5 MGD of coal slurry which contains sediment, metals, and dissolved solids. Water quality sampling in Perkins Run showed elevated concentrations of the typical mine drainage constituents as well as ammonia. The sampling results of Perkins Run also showed water chemistry results for specific conductivity to be greater than five times the conductivity level measured on Captina Creek upstream of the confluence with Perkins Run. All three Captina Creek sampling sites downstream of the confluence of Perkins Run showed elevated TDS concentrations above the Ohio Water Quality Standards criteria. A ten year facility MOR review is shown in Table 10.

Figure 8. Captina Creek water samples collected after the Ohio Valley Coal slurry release on Feb. 28, 2008. The container on the left is a water sample from Captina Creek upstream from the slurry release and the container on the right is a water sample from Captina Creek downstream from the slurry release.

Since 1999, Ohio EPA has documented at least seven slurry releases from the Ohio Valley Coal company's impoundment to Captina Creek. The last slurry release from Ohio Valley Coal occurred on February 28, 2008 and discolored Captina Creek for over 22 river miles (Figure 8). Ohio Valley Coal also had a slurry release on July 10, 2007, one slurry release on January 2, 2006, two slurry releases in 2004 (July 31 and August 8), one in 2000 (April 22), and one in 1999 (July 8).

Sediment from the February 2008 slurry release was collected from Perkins Run and was analyzed for organics and metals. The organic and metal parameters that were detected in the slurry sludge deposits collected from Perkins Run are summarized in Table 8 and Table 9. Numerous organics and metals were found above the detection limit. Many of the semi-volatile compounds that were detected exceeded the MacDonald et. al. threshold effect concentrations (TEC). The TEC numbers are intended to determine if sediment may present risks to aquatic organisms. In numerous cases, the levels of contaminants were several orders of magnitude above the screening levels indicating the potential to adversely impact aquatic organisms. Several of the chemicals that were detected at levels well above

the TECs are in the same class of chemicals known as polycyclic aromatic hydrocarbons (PAHs). Most of these chemicals have the same toxic mechanism of action, and thus their effects can be additive, meaning that these exceedences may have an effect beyond that of each chemical taken individually.

Table 8. Organic parameters that were detected in slurry sludge deposits collected from Perkins Run on March 5, 2008 just downstream from the location of the Ohio Valley Coal slurry release. The Ecological Screening Levels for sediment are based on MacDonald et al. 2000 threshold effect concentration (TEC).

parameter	units	Result (OVCC slurry)	Ecological Screening Levels
% Solids	%	65.5	--
2,4-Dimethylphenol	mg/kg	1.27	--
2-Methylnaphthalene	mg/kg	30	--
2-Methylphenol	mg/kg	0.75	--
3&4-Methylphenol	mg/kg	0.83	--
Acenaphthene	mg/kg	0.9	0.00671
Benz[a]anthracene	mg/kg	0.78	0.108
bis(2-Ethylhexyl)phthalate	mg/kg	0.67	--
Chrysene	mg/kg	0.83	0.166
Dibenzofuran	mg/kg	4.26	--
Ethylbenzene	mg/kg	9	--
Fluoranthene	mg/kg	0.7	0.423
Fluorene	mg/kg	2.19	0.0774
Naphthalene	mg/kg	25.1	0.176
Phenanthrene	mg/kg	6.93	0.204
p-Xylene	mg/kg	10	--
Pyrene	mg/kg	1.26	0.195
Toluene	mg/kg	9	--

Table 9. Metal parameters that were detected in slurry sludge deposits collected from Perkins Run on March 5, 2008 just downstream from the location of the Ohio Valley Coal slurry release.

parameter	units	Result	Sediment Reference Values
% Solids	%	65.5	--
Arsenic	mg/kg	18.8	19
Cadmium	mg/kg	0.174	0.8
Chromium	mg/kg	16.3	53
Copper	mg/kg	15.0	33
Lead	mg/kg	9.84	47
Nickel	mg/kg	14.9	61
Selenium	mg/kg	1.10	2.6
Aluminum	mg/kg	8580	53000
Barium	mg/kg	70.1	360
Calcium	mg/kg	15100	27000
Iron	mg/kg	16700	51000
Magnesium	mg/kg	1490	9900
Manganese	mg/kg	117	3000
Potassium	mg/kg	2590	14000
Strontium	mg/kg	115	250
Zinc	mg/kg	48.6	170
Mercury	mg/kg	0.046	0.12

Table 10. Concentrations of monitored chemicals in effluent discharged from 5 facilities in the Captina Creek study area. Results are reported for the time period 1999-2009.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
American Energy Corp - Century Mine (0IL00091)				
Outfall 002 to Piney Creek (RM 2.87)				
pH (SU)	6.9 (5th percentile)	8.62	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	2.7	29.6	35	70
Iron, Total (ug/l)	310	1450	4000	6000
Manganese, Total (ug/l)	60	700	2000	4000
Flow Rate (MGD)	0.001	0.06	Monitor	Monitor
Outfall 008 to Piney Creek (RM 2.5)				
Conductivity (umho/cm)	6520	10000	Monitor	Monitor
pH (SU)	7.5 (5th percentile)	8.6	Monitor	6.5 (min)-9.0 (max)
Residue, Total Dissolved (mg/l)	6200	7320	Monitor	Monitor
Total Suspended Solids (mg/l)	4	40.9	35	70
Iron, Total (ug/l)	120	806	3000	6000
Manganese, Total (ug/l)	170	1930	2000	4000
Flow Rate (MGD)	0.116	0.551	Monitor	Monitor
Outfall 011 to Piney Creek (RM 2.6)				
pH (SU)	7.1 (5th percentile)	8.65	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	7	30	35	70
Iron, Total (ug/l)	150	715	3000	6000
Manganese, Total (ug/l)	61	369	2000	4000
Flow Rate (MGD)	0.078	0.243	Monitor	Monitor
Outfall 013 to Piney Creek (RM 2.7)				
Conductivity (umho/cm)	8400	9080	Monitor	Monitor
pH (SU)	7.5 (5th percentile)	8.44	Monitor	6.5 (min)-9.0 (max)
Residue, Total Dissolved (mg/l)	6420	6990	Monitor	Monitor
Total Suspended Solids (mg/l)	0	10	35	70
Iron, Total (ug/l)	100	525	3000	6000
Manganese, Total (ug/l)	735	1860	2000	4000
Flow Rate (MGD)	0.001	0.0082	Monitor	Monitor
Outfall 015 to Piney Creek (RM 2.7)				
Conductivity (umho/cm)	9760	12500	Monitor	Monitor
pH (SU)	7.5 (5th percentile)	8.7	Monitor	6.5 (min)-9.0 (max)
Residue, Total Dissolved (mg/l)	7600	9400	Monitor	Monitor
Total Suspended Solids (mg/l)	3	30	35	70
Iron, Total (ug/l)	460	1600	3000	6000
Manganese, Total (ug/l)	604	2400	2000	4000
Flow Rate (MGD)	0.006	0.0856	Monitor	Monitor
Outfall 016 to Piney Creek (RM 2.7)				
Conductivity (umho/cm)	6830	8300	Monitor	Monitor
pH (SU)	7.5 (5th percentile)	8.1	Monitor	6.5 (min)-9.0 (max)
Residue, Total Dissolved (mg/l)	6820	7130	Monitor	Monitor
Total Suspended Solids (mg/l)	3	21.9	45	70
Iron, Total (ug/l)	2.5	590	3000	6000
Manganese, Total (ug/l)	0.775	2010	2000	4000
Flow Rate (MGD)	0.15	0.535	Monitor	Monitor

Table 10. Continued.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Outfall 017 to Piney Creek (RM 2.7)				
Flow Rate (GPD)	6000	28000	Monitor	Monitor
Dissolved Oxygen (mg/l)	9	6 (5th percentile)	Monitor	6 (min)
pH (SU)	7.0 (5th percentile)	7.98	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	0	3.6	12	18
Nitrogen, Ammonia (mg/l): summer	0.22	1.03	1.0	1.5
Nitrogen, Ammonia (mg/l): winter	0.29	9.94	3.0	4.0
Fecal Coliform (#/100 ml): summer	0	19100	1000	2000
Chlorine, Total Residual (mg/l): summer	0	0	Monitor	0.019
CBOD 5 day (mg/l)	0.9	7.44	10	15
Barnesville WWTP (0PC00001) – Outfall 001 to North Fork Captina Creek (RM 10.50)				
Dissolved Oxygen (mg/l)	6.9	5.1 (5th percentile)	Monitor	5 (min)
Residue, Total Dissolved (mg/l)	350	515	Monitor	Monitor
Total Suspended Solids (mg/l); winter	5	17.3	30	45 (weekly)
Total Suspended Solids (mg/l): summer	4	12.1	20	30 (weekly)
Oil and grease (mg/l)	0	1.35	Monitor	10
Nitrogen, Ammonia (mg/l): summer	0.18	2.49	1.5	3.0 (weekly)
Nitrite Plus Nitrate, Total - mg/l	7	11.5	Monitor	Monitor
Cyanide, Free - mg/l	0	0	Monitor	Monitor
Nickel, Total Recoverable - ug/l	0	50	Monitor	Monitor
Strontium, Total (Sr) - ug/l	203	256	Monitor	Monitor
Zinc, Total Recoverable - ug/l	30	60	Monitor	Monitor
Cadmium, Total Recoverable - ug/l	0	0	Monitor	Monitor
Lead, Total Recoverable - ug/l	0	6.45	Monitor	Monitor
Chromium, Total Recoverable – ug/l	0	13.5	Monitor	Monitor
Copper, Total Recoverable - ug/l	0	20	Monitor	Monitor
Chromium, Dissolved Hexavalent – ug/l	0	0	Monitor	Monitor
Fecal Coliform (#/100 ml): summer	115	700	1000	2000 (weekly)
Mercury, Total (Low Level) - ng/l	3.01	10.7	12	1700
CBOD 5 day (mg/l): summer	3.55	10	15	22 (weekly)
CBOD 5 day (mg/l): winter	4.4	11.9	25	40 (weekly)
COD (mg/l)	20	40	Monitor	Monitor
pH (SU)	6.5 (5th percentile)	7.5	Monitor	6.5 (min)-9.0 (max)
Flow Rate (MGD)	0.818	1.84	Monitor	Monitor
Bethesda WWTP (0PB00001) – Outfall 001 to Bend Fork (RM 12.2)				
Dissolved Oxygen (mg/l)	8.6	6.1(5th percentile)	Monitor	5 (min)
pH (SU)	7.0 (5th percentile)	7.7	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l); winter	2	6	30	45 (weekly)
Total Suspended Solids (mg/l): summer	2	7	12	18 (weekly)
Oil and grease (mg/l)	5	7.7	Monitor	10
Nitrogen, Ammonia (mg/l): winter	0.08	1.62	2.2	4.4 (weekly)
Nitrogen, Ammonia (mg/l): summer	0.1	0.425	1.5	3.0 (weekly)
Nitrite Plus Nitrate, Total - mg/l	5.46	17.8	Monitor	Monitor
Fecal Coliform (#/100 ml): summer	200	2380	1000	2000 (weekly)
CBOD 5 day (mg/l): summer	2	8	10	15 (weekly)
CBOD 5 day (mg/l): winter	2	6	25	40 (weekly)
Chlorine, Total Residual (mg/l): summer	0	0.02	Monitor	0.019
Flow Rate (MGD)	0.107	0.347	Monitor	Monitor

Table 10. Continued.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Oklahoma Coal Co Lynn Tipple (0IL00001)				
Outfall 001 to Captina Creek (RM 11.6)				
pH (SU)	7.3 (5th percentile)	8.8	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	4	42.8	35	70
Iron, Total (ug/l)	850	2500	3500	7000
Manganese, Total (ug/l)	245	1900	2000	4000
Flow Rate (MGD)	0	0.15	Monitor	Monitor
Outfall 005 to Captina Creek (RM 11.8)				
pH (SU)	7.6 (5th percentile)	8.6	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	2.4	17.5	35	70
Iron, Total (ug/l)	170	1190	3500	7000
Manganese, Total (ug/l)	110	476	2000	4000
Flow Rate (MGD)	0.04	0.288	Monitor	Monitor
Ohio Valley Coal Co Powhatan No 6 Mine (0Il00046)				
Outfall 001 to Perkins Run (Perkins Run discharges to Captina Creek at RM 22.5)				
pH (SU)	7.83 (5th percentile)	8.58	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	9.2	33.7	35	70
Iron, Total (ug/l)	240	1200	3500	7000
Manganese, Total (ug/l)	150	550	2000	4000
Flow Rate (MGD)	2.84	8.53	Monitor	Monitor
Outfall 002 to OVCCC pond 10 (pond 10 discharges to Captina at RM 22.10)				
Dissolved Oxygen (mg/l)	9	4 (5th percentile)	Monitor	Monitor
pH (SU)	7.0 (5th percentile)	7.98	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	0	0	12	18
Nitrogen, Ammonia (mg/l): winter	0.44	6.24	Monitor	Monitor
Nitrogen, Ammonia (mg/l): summer	0.27	1.4	2	3
Fecal Coliform (#/100 ml): summer	0	129	1000	2000
Chlorine, Total Residual (mg/l): summer	0	0	Monitor	0.019
CBOD 5 day (mg/l): summer	0.95	11.5	10	15
Flow Rate (MGD)	0.001	0.02	Monitor	Monitor
Outfall 007 to Captina Creek (RM 22.0)				
pH (SU)	7.5 (5th percentile)	8.8	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	4	25.7	35	70
Iron, Total (ug/l)	160	760	3500	7000
Manganese, Total (ug/l)	167	664	2000	4000
Flow Rate (MGD)	0	0.0426	Monitor	Monitor
Outfall 011 to Captina Creek (RM 22.0)				
pH (SU)	7.4 (5th percentile)	8.9	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	2.8	24	35	70
Iron, Total (ug/l)	380	1400	3500	7000
Manganese, Total (ug/l)	120	625	2000	4000
Flow Rate (MGD)	0	0.005	Monitor	Monitor

Table 10. Continued.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Ohio Valley Coal Co Powhatan No 6 Mine (0Il00046)				
Outfall 013 to Perkins Run (Perkins discharges to Captina Creek at RM 22.5)				
pH (SU)	7.8 (5th percentile)	8.6	Monitor	6.5 (min)-9.0 (max)
Residue, Total Dissolved (mg/l)	4840	5600	Monitor	Monitor
Total Suspended Solids (mg/l)	9.2	32.9	35	70
Sulfate (mg/l)	2500	3280	Monitor	Monitor
Arsenic, Total (ug/l)	0.2	8.2	Monitor	Monitor
Cadmium, Total (ug/l)	2	22.4	Monitor	Monitor
Chromium, Total (ug/l)	0	10.8	Monitor	Monitor
Copper, Total (ug/l)	0	4.9	Monitor	Monitor
Iron, Total (ug/l)	410	1300	3000	6000
Lead, Total (ug/l)	0	1	Monitor	Monitor
Manganese, Total (ug/l)	610	2200	2000	4000
Nickel, Total (ug/l)	60	90.5	Monitor	Monitor
Mercury, Total (ug/l)	0.0015	0.2	Monitor	Monitor
Zinc, Total (ug/l)	30	70.9	Monitor	Monitor
Selenium, Total (ug/l)	1.3	9.76	Monitor	Monitor
Flow Rate (MGD)	0.145	0.877	Monitor	Monitor

Sediment

Sediment samples were collected from ten locations in the Captina Creek watershed study area by the Ohio EPA during August, 2009 (Table 11). Samples were analyzed for metals, semi-volatile organic compounds, volatile organic compounds, nutrients, and particle size. Specific chemical parameters tested and results are listed in Appendix Table 5. Sediment data were evaluated using guidelines established in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald *et.al*. 2000), and *Ohio Specific Sediment Reference Values (SRVs)* for metals (Ohio EPA 2003). The consensus-based sediment guidelines define two levels of ecotoxic effects. A *Threshold Effect Concentration* (TEC) is a level of sediment chemical quality below which harmful effects are unlikely to be observed, and is comparable to background conditions. A *Probable Effect Concentration* (PEC) indicates a level above which harmful effects are likely to be observed.

Sediment samples were conservatively sampled by focusing on depositional areas of fine grain material (silts and clays). These areas typically are represented by higher contaminant levels, compared to sands and gravels. All sediment sampling occurred in areas along the stream bank, which were represented by sparse deposits of fine grained material. These nearbank areas comprised only a small fraction of the bottom substrates of the streams surveyed. Bottom substrates at sediment sites were dominated by gravel, cobble and bedrock material. Organic chemical parameters were tested at all ten sampling locations – sampling locations are noted in Table 1. All but two organic chemicals (naphthalene and 2-methylnaphthalene) were reported as not detected - organic chemical measurements in sediment were within acceptable ecological levels. Naphthalene was found in Captina Creek at RM 20.9 just downstream from Ohio Valley Coal. Napthalene was also detected in slurry sludge which was released from the Ohio Valley Coal slurry impoundment (Table 8).

Select detectable levels of metals are presented in Table 11. Values above ecological screening guidelines are noted with various colors of shading. Arsenic and nickel results were slightly elevated above TEC benchmarks at seven and four sites, respectively. However, all of these values were below Ohio SRV benchmarks. Naphthalene was measured above a probable effect level in Captina Creek at RM 20.9. This elevated sediment naphthalene level did not correlate with co-located biological sampling results. Exceptional biological integrity was documented in Captina Creek at RM 20.9. The sparse deposits of fine grained material in Captina Creek contributed to low exposure levels of potential sediment contaminants to biological communities. Captina Creek watershed sediments were within acceptable ecological levels, and protective of biological integrity.

Table 11. Chemical parameters measured (mg/kg) above screening levels in sediment samples collected in the Captina Creek study area, 2009. Results are reported in mg/kg dry weight. Contamination levels were determined for parameters using consensus-based sediment quality guidelines (MacDonald et.al. 2000). Sediment reference values are listed in the Ohio EPA Ecological Risk Assessment Guidance (2003). Shaded numbers indicate values above the following: Probable Effect Concentration – PEC (red), Threshold Effect Concentration -TEC (yellow), and Sediment Reference Value (orange). Sampling locations are indicated by stream and river mile.

Stream	River Mile	Arsenic	Copper	Nickel	Iron	Naphthalene
Captina Creek	23.12	9.25	21.2	25.1	28,800	<0.92
Captina Creek	20.9	15.1	21.3	24.6	32,000	1.24
Captina Creek	20.54	10.7	19.3	22.7	27,900	<0.81
Captina Creek	14.54	11.1	15.5	17.9	27,600	<0.56
Captina Creek	6.71	11.7	15.4	17.9	39,600	<0.64
Captina Creek	0.5	9.01	23.9	24.3	28,700	<0.90
North Fork Captina Creek	0.43	9.89	17.5	19.7	25,600	<0.78
South Fork Captina Creek	0.1	9.09	15.2	18.9	25,000	<0.73
Bend Fork	0.26	15.3	16.7	20.9	48,300	<0.85
Cat Run	3.3	17.6	41.0	37.5	57,500	<0.63

< - Not detected at or above the method detection limit (MDL value reported with the less than symbol).

Stream Physical Habitat

Stream habitat was evaluated at 28 fish sampling locations in the Captina Creek watershed study area during 2009 (Table 12, Appendix Table 6). Nine of these stations were located on Captina Creek, where habitat quality ranged from good to excellent. The average Qualitative Habitat Evaluation Index (QHEI) score for all Captina Creek sites was 72.2, consistent with very good overall habitat quality. Captina Creek sites were predominated by high quality substrates, including gravel, cobble, and sand; limestone bedrock was the most common substrate at one sampling site (RM 6.7). Moderate embeddedness of the bottom substrates occurred at 5 of the 9 fish sites in Captina Creek. Embeddedness is the degree that cobble, gravel, and boulder substrates are surrounded, impacted in, or covered by fine sand and silt. Extensive amounts are detrimental to bottom spawning fish and can impair macroinvertebrate populations. The high quality substrates, abundant aquatic macrophytes and instream cover, and good channel development within Captina Creek contribute to habitat quality that can support very good to exceptional biological communities.

Captina Creek near Armstrongs Mills

Within the Captina Creek watershed study area, 19 sites on eleven tributary streams were assessed for habitat quality. Excellent stream habitat was recorded at 12 locations (63%), good habitat was noted at six locations (32%), and fair habitat was documented at one location (5%) (Table 13). Nearly all of the tributary stream sites were predominated by high quality cobble and gravel substrates. Limestone bedrock was a predominant substrate at nine of the tributary sites, with abundant amounts at Bend Fork, South Fork Captina Creek, and North Fork Captina Creek sampling sites. One stream site (North Fork Captina Creek – RM 0.4) was rated as fair habitat quality, with a QHEI score below 60. The North Fork Captina site had the following habitat qualities which contributed to the lower score: moderate to extensive substrate embeddedness, fair channel development, shallow pools and riffles, and sparse instream cover. Habitat quality in the 11 tributary streams was sufficient for supporting good to exceptional biological communities.

South Fork Captina Creek near New Castle

Very low stream flow conditions during the 2009 sampling period influenced QHEI scores. Captina Creek flows during the July sampling days were largely at or below the 90th percentile flow duration level of 2.3 cubic feet per second (*i.e.* 90 percent of the historical flows during this seasonal time period were above the 2.3 cfs value). Low stream flows can reduce QHEI metric scores for riffle, run, and pool depth, along with current velocity and channel development.

Table 12. Stream physical habitat (QHEI) summarized results for the Captina Creek watershed study area, 2009.

Stream	River Mile	Location	QHEI	Comments
EXCELLENT				
Captina Creek	17.6	Downstream Bend Fork	92.0	Moderate silt level
Captina Creek	3.3	Upstream Steinersville @ SR 148	75.0	Moderate embeddedness
North Fork Captina Cr.	6.6	SE of Barnesville @ SR 148	71.0	Heavy sediment/silt bedload
South Fork Captina Cr.	9.5	S of Somertown @ TR 35	72.5	Moderate embeddedness/bulldozer adjacent stream
Bend Fork	3.6	TR 101	86.0	
Bend Fork	0.3	At first downstream ford, TR 101	83.0	
Joy Fork	0.3	Hatcher Road	71.0	Limestone bedrock predominant
Peavine Creek	0.1	SE of Armstrong Mills @ CR 5	73.0	Mostly riffle/run habitat
Crabapple Creek	0.5	W of Alledonia @ TR 103	75.0	Mostly riffle/run habitat
Piney Creek	0.1	NW of Alledonia @ SR 148	79.5	Mostly riffle/run habitat/ high conductivity
Long Run	2.2	TR 192	87.0	Heavy silt layer/moderate embeddedness
Long Run	0.1	SE of Barnesville @ SR 148	92.0	Heavy silt layer/ extensive instream cover
Cat Run	3.3	Upst. Pipeline @ CR 56	86.0	Mostly riffle/run habitat
Cat Run	0.4	Near mouth @ CR 56	83.0	Mostly riffle/run habitat
GOOD				
Captina Creek	23.1	Dst. Casey Run @ SR 148	65.5	Fair channel development
Captina Creek	22.1	Dst. Perkins Run @ SR 148	67.0	Extensive embeddedness
Captina Creek	20.9	Dst. Ohio Valley Coal, adj. SR 148	69.5	
Captina Creek	20.5	Adj. SR 148 and Pugh Ridge Road	72.5	Moderate embeddedness
Captina Creek	16.0	Dst. Armstrong Mills @ USGS gage	70.5	Moderate embeddedness
Captina Creek	11.7	Upst. Cravat Coal Co., Adj. SR 148	67.5	
Captina Creek	6.7	SR 148	70.5	Fair channel development/ bedrock predominant
North Fork Captina Cr.	3.9	Dst. Long Run @ CR 26	66.0	Limestone bedrock common
South Fork Captina Cr.	3.0	N of New Castle @ SR 26	67.5	Limestone bedrock predominant
South Fork Captina Cr.	0.1	At mouth, @ CR 92	60.5	Bedrock common/ extensive embedded./ fair development/ shallow pools
Bend Fork	8.4	SE of Bethesda @ TR 192	56.5	Bedrock common/ extensive embedded./ fair develop.
Jakes Run	0.1	At mouth, adjacent SR 148	65.0	Limestone bedrock predominant/ sparse cover
Casey Run	0.2	At mouth, near SR 148	60.0	Mostly riffle-run / fair development/bedrock common
FAIR				
North Fork Captina Cr.	0.4	Near mouth @ CR 92	59.0	Limestone bedrock predominant/ fair development/ shallow pools and riffles

General narrative ranges assigned to QHEI scores.			
Narrative Rating		QHEI Range	
		Headwaters (≤20 sq mi)	Larger Streams
Excellent		≥70	≥75
Good		55 to 69	60 to 74
Fair		43 to 54	45 to 59

Fish Community

A total of 49,006 fish representing 56 species were collected from the Captina Creek watershed study area between June and September, 2009. Relative numbers and species collected per location are presented in Appendix Table 7 and IBI and MIwb scores are presented in Appendix Table 8. Sampling locations were evaluated using Warmwater Habitat or Exceptional Warmwater Habitat biocriteria, along with using Coldwater Habitat narrative benchmarks. A summary of the fish data are presented in Table 15. Captina Creek biological and habitat data are available on Ohio EPA interactive maps at the following link:
http://wwwapp.epa.ohio.gov/dsw/gis/bio/index.php

The Captina Creek mainstem sites sampled during 2008 and 2009 achieved the Exceptional Warmwater Habitat (EWH) fish biocriterion at all 11 sites evaluated (100%). The average IBI (55.1) and MIwb (9.8) scores for Captina Creek were reflective of exceptional biological quality. An impressive 17.5 percent of the fish population in Captina Creek was comprised of fish species intolerant of water pollution. These highly sensitive fish included black redhorse, river chub, bigeye chub, redside dace, silver shiner, rosyface shiner, mimic shiner, stonecat madtom, brindled madtom, banded darter, and variegate darter. The exceptional biological integrity of the fish community in Captina Creek is comparable to several of the best streams in Ohio (Table 13). Historical trends in fish community results, represented by average IBI and MIwb scores, are presented in Table 14. Over the last 26 years of monitoring biological communities in Captina Creek, exceptional fish populations have been maintained.

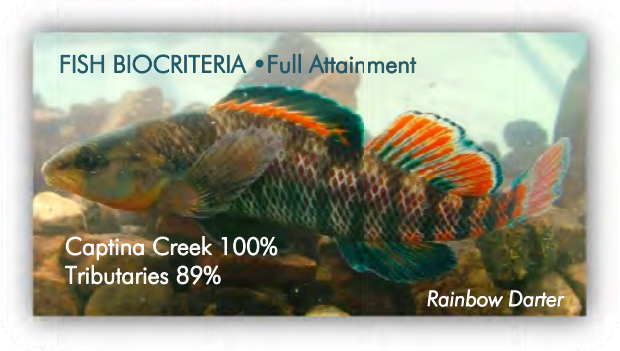


Table 13. Comparison of average IBI and MIwb scores for Captina Creek with other high quality EWH wading streams in Ohio.

Stream	Year	Length	IBI	MIwb
Captina Creek	**2008-09**	**RM 25 – 1**	**55.1**	**9.8**
Twin Creek	2005	RM 46 – 0	53.0	10.1
Salt Creek	2005	RM 43 – 0	52.5	9.9
Wakatomika Cr.	2003	RM 45 - 0	52.1	9.7
Big Darby Cr.	2001-02	RM 76 – 30	50.6	9.1
Kokosing River	2007	RM 55 – 0	49.7	9.4

Table 14. Average IBI and MIwb scores for Captina Creek from 1983 and 2009.

Year	IBI	MIwb
2009	55.1	9.8
1983	53.2	9.8

Captina Creek Tributaries

Eighteen sites on eleven tributary streams in the Captina Creek watershed had fish community assessments completed in 2009. The following streams and sampling locations had fish populations which were fully achieving the EWH fish biocriteria: Bend Fork (RMs 8.4, 3.6, and 0.3), North Fork Captina Creek (RMs 6.6, 3.9, and 0.4), South Fork Captina Creek (RMs 9.5 and 0.1), Long Run, Jakes Run, Peavine Creek, Crabapple Creek, Piney Creek, and Cat Run (RM 0.4). Together, these 14 sites had an average IBI score of 52.8, reflective of exceptional biological integrity. Two tributary sites, Joy Fork and Casey Run, met fish biocriteria conditions for coldwater streams. Both streams had fish communities which achieved the Warmwater Habitat IBI biocriterion, and coldwater species collected included redside dace and southern redbelly dace (Joy Fork), and mottled sculpin (Casey Run). The presence of coldwater fish species, as well as the overall good quality of the fish communities, documented achievement of the CWH aquatic life use designation.

Fish communities from two tributary sampling sites did not meet applicable biological criteria. The South Fork Captina Creek at RM 3.0 had IBI and MIwb scores of 41 and 8.7, respectively. These values were below the EWH biocriteria. The dominance of shallow limestone bedrock within the sampling zone appeared to be a primary factor in the lower fish community index scores at this site. The high percentage of pollution tolerant bluntnose minnow collected in the South Fork Captina Creek negatively influenced the IBI by lowering several scoring metrics (percent tolerant, percent omnivores). Cat Run at RM 3.3 had a fair fish community, with an IBI score of 31. Although a large number of moderately pollution sensitive fantail darters were collected in Cat Run at RM 3.3, pollution tolerant blacknose dace, creek chub, and white sucker comprised 43% of the population. The most likely source of impairment in Cat Run at RM 3.3 is a natural waterfall which acts as a barrier to fish movement and colonization from downstream locations.

Table 15. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in the Captina Creek watershed during 2009 and 2008. Relative numbers and weight are per 0.3 km for wading and headwater sites. NA= not applicable.

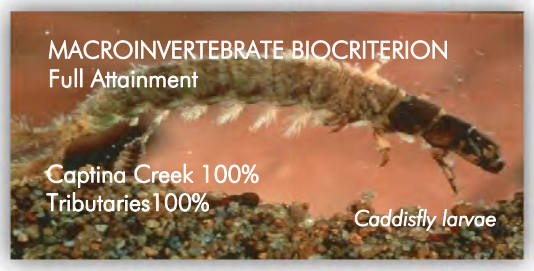
Stream	River Mile	Sampling Method	Fish Species (Total)	Relative Number	Relative Weight (kg)	QHEI (Habitat)	IBI	MIwb	Narrative Evaluation
Captina Creek	23.2	Wading	39	1096	55.45	65.5	**56**	**9.8**	Exceptional
Captina Creek	22.1	Wading	32	2174	39.19	67.0	**52**	**9.6**	Exceptional
Captina Creek	20.9	Wading	33	1112	31.46	69.5	**57**	**9.9**	Exceptional
Captina Creek	20.5	Wading	33	2143	39.77	72.5	**56**	**10.1**	Exceptional
Captina Creek	17.9/17.6	Wading	39	2541	53.39	92.0	**52**	**10.3**	Exceptional
Captina Creek	16.0	Wading	34	3400	86.75	70.5	**49**^{ns}	**10.3**	Very Good/Exceptional
Captina Creek	11.7	Wading	27	913	17.67	67.5	**52**	**9.3**^{ns}	Very Good/Exceptional
Captina Creek	6.7	Wading	34	1072	28.75	70.5	**56**	**9.6**	Exceptional
Captina Creek	3.3	Wading	36	1013	22.42	75.0	**56**	**9.7**	Exceptional
Captina Creek-2008	25.2	Wading	28	693	46.66	84.0	**56**	**9.4**	Exceptional
Captina Creek-2008	23.1	Wading	30	1275	31.46	83.5	**58**	**10.0**	Exceptional
Captina Creek-2008	22.4	Wading	30	1099	29.19	85.0	**60**	**9.6**	Exceptional
Captina Creek-2008	16.0	Wading	28	1449	28.74	83.5	**56**	**10.1**	Exceptional
North Fork Captina Creek	6.6	Headwater	16	616	NA	71.0	**46**	NA	Very Good
North Fork Captina Creek	3.9	Wading	28	1102	35.12	66.0	**53**	**9.3**^{ns}	Very Good/Exceptional
North Fork Captina Creek	0.4	Wading	29	1633	13.50	59.0	**46**^{ns}	**9.3**^{ns}	Very Good
South Fork Captina Creek	9.5	Headwater	24	1587	NA	72.5	**54**	NA	Exceptional
South Fork Captina Creek	3.0	Wading	27	1892	12.35	67.5	**41***	**8.7***	Marginally Good/ Good
South Fork Captina Creek	0.1	Wading	33	1839	7.79	60.5	**52**	**9.5**	Exceptional
Bend Fork	8.4	Headwater	18	4062	NA	56.5	**50**	NA	Exceptional
Bend Fork	3.6	Headwater	22	2338	NA	86.0	**57**	NA	Exceptional
Bend Fork	0.3/ 0.1	Wading	33	1512	14.17	83.0	**52**	**9.5**	Exceptional
Joy Fork	0.3	Headwater	10	1356	NA	71.0	**44**	NA	Good
Jakes Run	0.1	Headwater	12	1300	NA	65.0	**54**	NA	Exceptional
Peavine Creek	0.1	Headwater	13	1080	NA	73.0	**54**	NA	Exceptional
Crabapple Creek	0.5	Headwater	19	1861	NA	75.0	**58**	NA	Exceptional
Piney Creek	0.1	Headwater	19	852	NA	79.5	**56**	NA	Exceptional
Casey Run	0.2	Headwater	5	78	NA	60.0	**44**	NA	Good
Long Run	0.1	Headwater	28	739	NA	92.0	**50**	NA	Exceptional
Cat Run	3.3	Headwater	8	1033	NA	86.0	**31***	NA	Fair
Cat Run	0.4	Headwater	20	925	NA	83.0	**58**	NA	Exceptional

BIOCRITERIA		
INDEX - Site Type	WWH	EWH
IBI: Headwater/Wading	44	50
MIwb: Wading	8.4	9.4

^{ns} Nonsignificant departure from biocriterion (≤4 IBI units; ≤0.5 MIwb units).
* Significant departure from biocriterion (>4 IBI units; >0.5 MIwb units). Poor and very poor results are underlined.

Macroinvertebrate Community

The macroinvertebrate communities from 11 locations in Captina Creek and 18 locations in tributaries in the Captina Creek watershed were sampled in 2009 and 2008. Qualitative samples were collected from all sampling locations. Quantitative Hester/Dendy samples were collected from Captina Creek, North Fork Captina Creek, South Fork Captina Creek, and Bend Fork. A summary of the macroinvertebrate data are presented in Table 16. The macroinvertebrate raw data are presented in Appendix Table 9. Sampling locations were evaluated using Warmwater Habitat or Exceptional Warmwater Habitat biocriteria based on current or recommended aquatic life uses along with Coldwater Habitat narrative benchmarks where applicable.



The Captina Creek mainstem sites sampled during 2008 and 2009 achieved the Exceptional Warmwater Habitat (EWH) macroinvertebrate biocriterion at all 11 sites evaluated (100%). The average ICI score (49.8) for Captina Creek was reflective of exceptional biological quality. Additionally, some of Ohio's highest values for total macroinvertebrate taxa richness (average of 84.3 taxa per site) and pollution sensitive taxa (average of 42.4 taxa per site) were documented at Captina Creek sites during 2008 and 2009. The exceptional biological integrity of the macroinvertebrate community in Captina Creek is comparable to several of the best streams in Ohio (Table 16).

Table 16. Comparison of averages of ICI scores, total macroinvertebrate taxa, and pollution sensitive taxa for Captina Creek with other high quality EWH wading streams in Ohio.

Stream	Year	Length	ICI	Total Taxa	Pollution Sensitive Taxa
Captina Creek	**2008-09**	**RM 25 – 1**	**49.8**	**84.3**	**42.4**
Twin Creek	2005	RM 46 – 0	48.5	71.1	33.3
Salt Creek	2005	RM 43 – 0	47.1	81.8	43.6
Wakatomika Cr.	2003	RM 45 - 0	46.8	76.6	37.8
Big Darby Cr.	2001-02	RM 76 – 30	49.5	79.1	37.9
Kokosing River	2007	RM 55 – 0	47.4	69.9	34.2

Captina Creek Tributaries

Macroinvertebrate communities from all tributary sampling sites in the Captina Creek study area fully achieved biological integrity goals for applicable EWH, WWH, or CWH uses. South Fork Captina Creek, North Fork Captina Creek, and Bend Fork sampling stations were represented by good to exceptional macroinvertebrate communities. Total numbers of macroinvertebrate taxa and pollution sensitive taxa from these three streams were comparable to levels observed in Captina Creek. Where quantitative sampling occurred in these three streams, ICI scores were in the exceptional range, with values between 50 and 54. Sampling results from Joy Fork, Peavine Creek, Crabapple Creek, and Casey Run documented exceptional macroinvertebrate communities. Very good results were noted for Jakes Run, Long Run, and Cat Run.

Six streams within the study area exhibited qualities reflective of the Coldwater Habitat aquatic life use. Macroinvertebrate communities from all six streams (Joy Fork, Jakes Run, Peavine Creek, Crabapple Creek, Piney Creek, and Casey Run) were fully meeting the CWH use. Coldwater taxa numbers from these recommended coldwater streams ranged from two to eight. Coldwater macroinvertebrates collected from these streams included representatives from the following insect orders: true flies (*Daimesa sp., Parametriocnemus sp., Polypedilum (Uresipedilum) aviceps, Pagastia orthogonia, and Paratanytarsus n. sp. 1*); stoneflies *(Leuctra sp., and Sweltsa sp)*; caddisflies *(Diplectrona modesta, Ceratopsyche slossonae, Rhyacophila invaria complex, Goera stylata, and Lepidostoma sp.)*; fishflies *(Nigronia fasciatus)*; mayflies *(Baetis tricaudatus and Maccaffertium ithaca)*; and dragonflies *(Boyeria grafiana).*

Table 17. Summary of macroinvertebrate data collected from natural substrates (qualitative sampling) and quantitative samples in the Captina Creek watershed study area, June – September, 2009.

Stream	River Mile	Data Codes	Total Taxa	Coldwater Taxa	Qual. EPT[a] Taxa	Total Sensitive Taxa	Density Number/ft^2	**ICI**	Narrative Evaluation
Captina Creek	23.1		101	3	30	46	394	54	Exceptional
Captina Creek	22.1	X8,13	86	2	25	38	Low	40[b]	Exceptional
Captina Creek	20.9		90	0	26	46	1052	48	Exceptional
Captina Creek	20.5		62	1	21	30	Moderate	-	Exceptional
Captina Creek	17.3	X15	93	0	23	45	386	48	Exceptional
Captina Creek	16.2		84	1	25	43	1113	52	Exceptional
Captina Creek	11.7		77	0	21	39	426	42[ns]	Very Good
Captina Creek	6.7		84	0	24	48	998	50	Exceptional
Captina Creek	3.3		70	0	20	39	844	52	Exceptional
Captina Creek - 2008	25.3		78	0	17	42	645	56	Exceptional
Captina Creek - 2008	23.1	X8	83	1	23	43	702	54	Exceptional
Captina Creek - 2008	22.4		88	2	17	43	1469	52	Exceptional
Captina Creek - 2008	20.9	X15	78	0	18	37	Low	38[b]	Very Good
North Fork Captina Creek	6.6		49	2	12	16	Moderate	-	Good
North Fork Captina Creek	3.9	X15	91	3	25	45	1052	52	Exceptional
North Fork Captina Creek	0.4		84	1	25	46	1044	54	Exceptional
South Fork Captina Creek	9.5		52	0	17	18	Moderate	-	Very Good
South Fork Captina Creek	3.0		90	1	24	45	1002	50	Exceptional
South Fork Captina Creek	0.1		85	1	23	47	435	52	Exceptional
Bend Fork	8.4		57	1	21	25	Low	-	Exceptional
Bend Fork	3.6		78	3	23	40	1014	50	Exceptional
Bend Fork	0.3		77	3	22	43	634	52	Exceptional
Joy Fork	0.1		48	8	25	30	Moderate	-	Exceptional
Jakes Run	0.1		40	4	19	24	Low	-	Very Good[ns]
Peavine Creek	0.1		55	5	26	30	Moderate	-	Exceptional
Crabapple Creek	0.5		48	2	20	28	Low	-	Exceptional
Piney Creek	0.1		37	4	15	17	Low	-	Good
Casey Run	0.1		41	7	20	20	Moderate	-	Exceptional
Long Run	0.1		63	1	19	21	Moderate	-	Very Good[ns]
Cat Run	3.3		42	5	18	21	Moderate	-	Very Good
Cat Run	0.3		47	4	20	20	Moderate	-	Very Good

Biocriteria		
INDEX – Site Type	WWH	EWH
ICI (narrative)	36 (good)	46 (exceptional)

[a] EPT = total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness.
[b] Narrative evaluation used in lieu of ICI score to assess biological quality. ICI results were influenced by low flow conditions.
[ns] nonsignificant departure from biocriterion or narrative ranges.
Data codes: X8 = non detectable current, X13 = suspected disturbance by vandalism, X15 = current >0.0 feet per second but < 0.3 fps.

WATERSHED ASSESSMENTS UNITS

The Captina Creek watershed study area is comprised of six 12-digit Hydrologic Unit Code (HUC12) watersheds. Data from individual sampling locations in a HUC12 assessment unit are accumulated and analyzed; summary information for each Captina Creek watershed assessment unit (WAU) is presented in this section. The sampling site scores calculated for headwater and wading sites were averaged to determine the intermediate score. The intermediate score was averaged with the principle sites score for an overall measure of aquatic life attainment in the HUC 12 watershed. Data used in this analysis were collected in 2008 and 2009. Four HUC 12 Captina Creek subwatersheds met the Federal CWA goal of 100% attainment (Table 19). Two subwatersheds (South Fork Captina Creek and Cat Run) were below the statewide goal of 80 percent full attainment of Clean Water Act biological integrity. Causes and sources of impairment included the following: shallow bedrock habitat/ natural (South Fork Captina Creek), waterfall fish barrier/ natural (Cat Run).

Table 18. Results for the Captina Creek subwatersheds using the HUC12 aquatic life assessment methodology.

		Headwater Site Assessment (<20mi^2)			Wading Site Assessment (≥20 to <50mi^2)				Principle Site Assessment (≥50 to <500 mi^2)			HUC 12 Assessment Unit Score[b]
HUC 12 WATERSHED	Drainage Area sq. mi.	Total Sites	#Sites Full Attainment	Score	Total Sites	#Sites Full Attainment	Score	Intermediate Score[a]	Total Sites	#Sites Full Attainment	Score	
050301060901 – NF Captina Cr.	32.7	3	3	100.0	2	2	100.0	100.0	0	NA	NA	100.0
050301060902 – SF Captina Cr.	36.0	1	1	100.0	2	1	50.0	75.0	0	NA	NA	75.0
050301060903 – Bend Fork	27.0	3	3	100.0	1	1	100.0	100.0	0	NA	NA	100.0
050301060904 – Piney Creek	29.1	3	3	100.0	0	NA	NA	100.0	8	8	100.0	100.0
050301060905 – Peavine Creek	38.0	1	1	100.0	0	NA	NA	100.0	6	6	100.0	100.0
050301060906 – Cat Run	17.4	2	1	50.0	0	NA	NA	50.0	0	NA	NA	50.0

[a] – Average of headwater and wading scores.
[b] – Average of intermediate and principle sites scores.
NA = Not applicable. No sampling sites in the noted assessment size.

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*Some of the references not in the report can be found in the Appendix Table 11 which includes Methods, Biosurvey Background Information, and Notice to Users.