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Biological and Water Quality Study of the McMahon Creek Watershed and Selected Ohio River Tributaries

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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. Three streams in the McMahon Creek watershed and three selected Ohio River tributaries, located in northern Belmont county, were evaluated for aquatic life and recreation use potential in 2009 (see Figure 1 and Table 1 for sampling locations).

Kings Run entering Little McMahon Creek near Neffs

Of the 10 biological samples collected in the McMahon Creek basin, 9 sites (90%) were fully meeting the designated or recommended aquatic life use and one (10%) was in non-attainment. Little McMahon was in non-attainment of the aquatic life use due to a combination of acid mine drainage (AMD) from historic coal mining and landfill leachate from Buckeye Reclamation landfill. The Buckeye Reclamation landfill is a U.S. EPA Superfund site which is located on top of an area that was previously mined. Extremely elevated levels of iron were found in Kings Run which turns both Kings Run and Little McMahon Creek an orange-red color. One iron concentration from Kings Run was 1,890,000 µg/l and was the highest level of iron detected in a water sample collected by Ohio EPA in the past 10 years. This value of iron is up to four times higher than the highest value of iron found at other streams affected by AMD indicating that the landfill may be exacerbating the AMD situation. Ammonia, barium and total dissolved solids above the water quality criteria were also found in Kings Run below the Buckeye Reclamation landfill.

Four direct Ohio River tributaries were sampled during this survey. Three sites were in non-attainment of the aquatic life use and one was not assessed for fish or habitat. Wegee Creek and Big Run are impacted by acid mine drainage from historic coal mining. Large gob piles adjacent to both Wegee Creek and Big Run cause very poor water quality which prevents fish migration to the upstream locations but the macroinvertebrates were good to exceptional. Pipe Creek was in non-attainment due to poor fish scores but the macroinvertebrate community was exceptional. A natural waterfall is located below this location on Pipe Creek creating a fish passage barrier that resulted in low IBI scores.

Six locations in the McMahon Creek basin and direct tributaries to the Ohio River were tested for bacteria indicators (*Escherichia coli*) to determine recreation use attainment status. Evaluation of *E. coli* results revealed that five of the six locations attained the applicable geometric mean criterion, and thus were in full attainment of the designated recreation use. The one site in non-attainment for recreation use was at RM 17.58 below the village of Warnock which is an unsewered community. The source of the elevated bacteria is most likely from poorly treated or untreated sewage from failing home septic systems. Other large unsewered communities located adjacent to McMahon Creek include Glencoe and Neffs. Even though the 2009 bacteria sampling did not find recreation use impairment below these communities, it is most likely that unsanitary conditions exist which would warrant centralized sewage collection and treatment for both Glencoe and Neffs.

Over the last 26 years of monitoring biological communities in McMahon Creek, fish and macroinvertebrate populations have significantly improved from poor/fair quality in 1983 to very good/ exceptional quality in 2009. A notable 13.9 percent of the fish population in McMahon Creek was comprised of fish species intolerant of water pollution. McMahon Creek from the headwaters to the confluence with Little McMahon Creek exhibited qualities indicative of the exceptional warmwater habitat (EWH) aquatic life use as did Williams Creek. Fish community results from the lower McMahon Creek segment, although attaining WWH biocriteria, were negatively influenced by Kings Run (Tributary to Little McMahon Creek) which has a combination of acid mine drainage and landfill leachate from the Buckeye Reclamation Landfill. A reclamation project on Kings Run should result in improvements to Little McMahon Creek and may also result in the lower McMahon Creek fish population achieving exceptional quality.

Table 1. McMahon Creek watershed and direct Ohio River tributaries sampling locations from the Ohio EPA 2009 survey.

Site Number	Name	Location	River Mile	Drainage Area	Latitude	Longitude
1	McMahon Creek	Upst. Barkcamp Creek, Adj. SR 149	24.10	6.90	40.027997	-81.009608
2	McMahon Creek	Lamira @ CR 78	22.58	15.70	40.021497	-80.989543
3	McMahon Creek	NW of Warnock, Downstream from lane off SR 149	18.60	26.00	40.024200	-80.944400
4	McMahon Creek	Downstream Warnock, Adj Whitney Rd at Ford	17.58	29.30	40.018835	-80.939421
5	McMahon Creek	East of Glencoe @ ST. RT. 149, DST Williams Creek	12.10	51.00	40.002800	-80.877200
6	McMahon Creek	At Neffs, Downstream Little McMahon Creek	7.00	78.50	40.024400	-80.812800
7	McMahon Creek	Adjacent TR 304 Trough Rd	2.30	85.00	40.016700	-80.773100
8	Williams Creek	Adj. Jacobsburg-Glencoe Road	1.40	11.40	39.993060	-80.900933
9	Little McMahon Cr	Downstream Aults Run, Adj. Willow Grove	2.80	9.80	40.046700	-80.855600
10	Little McMahon Cr	Downstream Kings Run @ Wozniak Rd. TR 316	0.85	14.20	40.034555	-80.825443
11*	Kings Run	TR 1248 at mouth	0.05	1.07	40.039196	-80.838002
12	Wegee Creek	SW of Shadyside, Downstream Stone Coal Run	2.21	9.30	39.956900	-80.785600
13	Pipe Creek	Near Vardis, Adj. Pipe Creek Road	1.20	11.20	39.924400	-80.826900
14	Big Run	Upst. AMD impacted area, upst. SR 7	0.45	4.00	39.923920	-80.784036
15*	Big Run	Dwnst. AMD issue, near Ohio River, Pipe Creek Road	0.05	4.50	39.918964	-80.786843

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). Sites with an asterisk (*) are based on chemistry samples only.

McMahon Creek & Ohio River Tributaries

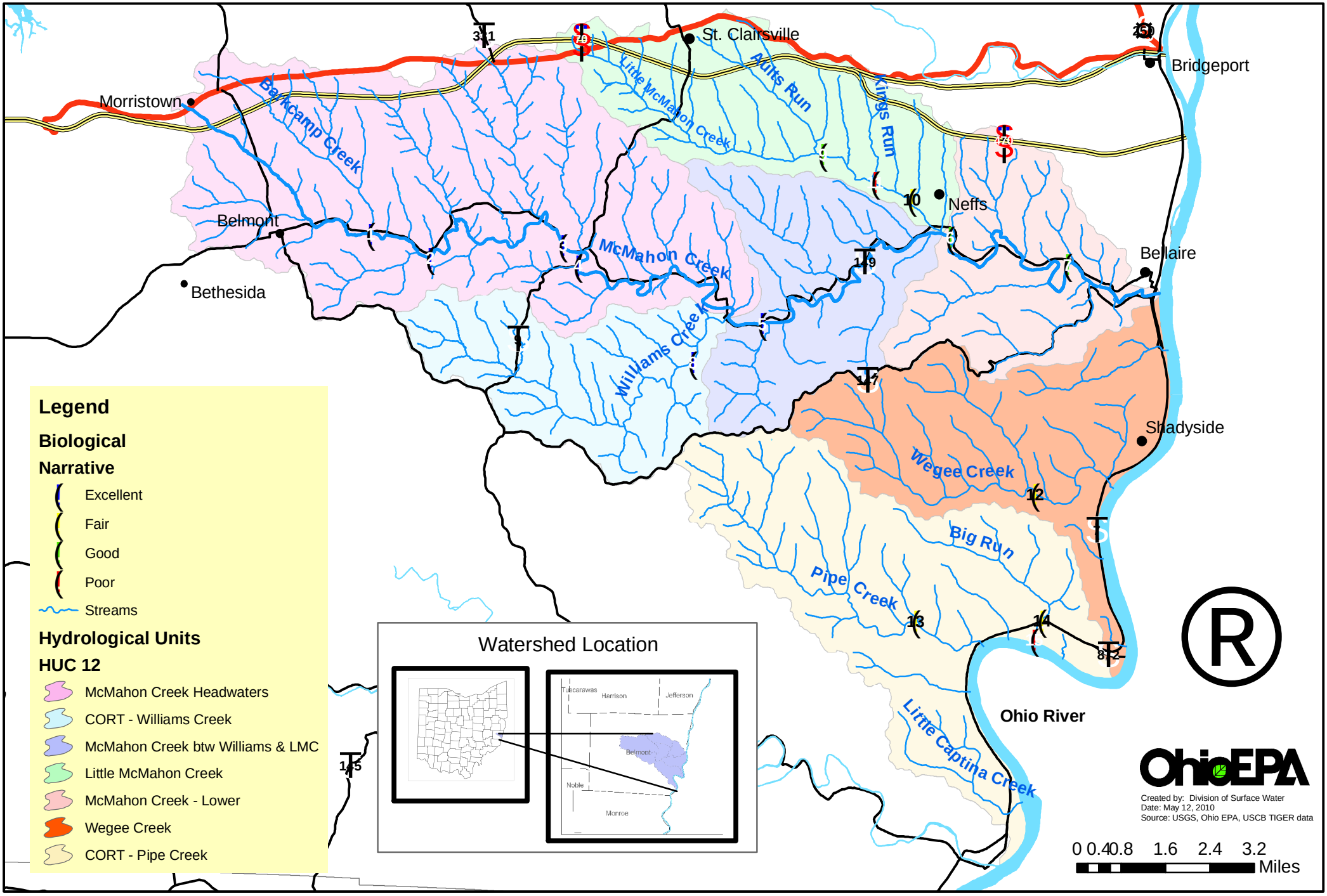


Table 2. *Aquatic life use attainment status for sampling locations in the McMahon Creek watershed study area, 2009. The Index of Biotic Integrity (IBI), Modified Index of Well-being (MIwb), and Invertebrate Community Index (ICI) scores are based on the performance of the biological community. Stream habitat reflects the ability to support a biological community. The McMahon Creek watershed is located in the Western Alleghany 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	Ecoregion	Aquatic Life Use Designation	Aquatic Life Attainment Status	IBI	MIwb	ICI[a]	Stream Habitat[b]	Cause/Source of Impairment
McMahon Creek	24.1	Headwater	WAP	EWH-R	FULL	**48**[ns]	NA	**E**	61.0	
McMahon Creek	22.6	Headwater	WAP	EWH-R	FULL	**50**	NA	**E**	65.5	
McMahon Creek	18.6	Wading	WAP	EWH-R	FULL	**51**	**9.2**[ns]	**44**[ns]	53.0	
McMahon Creek	17.6	Wading	WAP	EWH-R	FULL	**51**	**10.0**	**46**	71.0	
McMahon Creek	12.1	Wading	WAP	EWH-R	FULL	**49**[ns]	**9.4**	**48**	61.5	
McMahon Creek	7.0	Wading	WAP	WWH	FULL	**46**	**8.5**	**44**	63.5	
McMahon Creek	2.3	Wading	WAP	WWH	FULL	**46**	**8.0**[ns]	**50**	74.5	
Little McMahon Creek	2.8	Headwater	WAP	WWH-R	FULL	**44**	NA	**MG**[ns]	55.5	
Little McMahon Creek	0.8	Headwater	WAP	WWH-R	**NON**	**24***	NA	**MG**[ns]	55.5	TDS, barium, iron, sediment, ammonia/ coal mining, acid mine drainage, landfill-CERCLA National Priority List, Superfund Site
Williams Creek	1.4	Headwater	WAP	EWH-R	FULL	**50**	NA	**44**[ns]	83.0	
Wegee Creek	2.2	Headwater	WAP	WWH-R	**NON**	**26***	NA	**E**	69.5	Low pH, aluminum/ coal mining, Acid mine drainage, inappropriate waste disposal (gob piles)
Pipe Creek	1.2	Headwater	WAP	WWH-R	**NON**	**26***	NA	**E**	61.5	Fish passage barrier/ Natural sources- waterfall
Big Run	0.4	Headwater	WAP	WWH-R	**NON**	**24***	NA	**VG**	51.5	low pH, Iron, sediment /coal mining, acid mine drainage inappropriate waste disposal (gob piles)
Big Run	0.1	Headwater	WAP	WWH-R	NA	-	-	**F**	-	low pH, iron, sediment /coal mining, acid mine drainage inappropriate waste disposal (gob piles)

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

RECOMMENDATIONS

The streams in the McMahon Creek and vicinity study area currently listed in the Ohio Water Quality Standards are assigned one or more of the following aquatic life use designations: warmwater habitat (WWH), limited warmwater habitat (LWH) – acid mine drainage, and limited resource water (LRW) – acid mine drainage. The aquatic life use designation of all of the streams in this assessment has been previously verified. This study used current biological data and acid mine drainage restoration goals to evaluate and establish aquatic life uses for McMahon Creek study area streams.

Limited warmwater habitat streams were temporarily designated in the 1978 water quality standards as not meeting specific warmwater habitat criteria. Criteria for the support of the LWH use designation are the same as the criteria for the support of the use designation warmwater habitat. However, individual criteria are varied on a case-by-case basis and supersede the criteria for warmwater habitat where applicable. One stream segment (Big Run – New NACCO mine #3 portal to confluence with the Ohio River) was previously assigned the LWH use in the central Ohio River tributaries study area, with the following WWH criteria exemption: total dissolved solids. No additional stream segments will be designated limited warmwater habitat.

Six streams in the McMahon Creek study area were evaluated for aquatic life and recreation use potential in 2009 (Tables 2 and 6). Significant findings include the following:

- McMahon Creek is currently listed as WWH for its entire length. Biological monitoring during this study confirmed that the lower section of creek from the confluence of Little McMahon Creek to the mouth should remain WWH. Very good to exceptional biological performance in the upper section of McMahon Creek supports an upgrade to EWH. Fish community results from the lower McMahon Creek segment, although attaining WWH biocriteria, were negatively influenced by Kings Run (Tributary to Little McMahon Creek) which has a combination of acid mine drainage and landfill leachate from the Buckeye Reclamation landfill. A reclamation project on Kings Run should result in improvements to Little McMahon Creek and may also result in the lower McMahon Creek fish population achieving exceptional quality. Biological communities in McMahon Creek have improved substantially between 1983 and 2009.

- Three large unsewered communities along McMahon Creek (Glencoe, Neffs and Warnock) would benefit from centralized sanitary collection systems. Recreation use impairment was found below Warnock but unsanitary conditions from failing or no home septic systems probably exist throughout the watershed.

- Little McMahon Creek is currently listed as LRW from Chambers Run (RM 5.8) to the mouth. All other segments are unverified as WWH. The WWH use designation is recommended for the entire length of Little McMahon Creek. Full attainment of the WWH use was documented at RM 2.8; further downstream, a combination of AMD in Kings Run and leachate from Buckeye Reclamation landfill caused impairment in Little McMahon Creek. With proper reclamation, the lower section of Little McMahon Creek would also be likely to attain the WWH use.

- Williams Creek is currently listed as a WWH stream based on biological sampling results from the 1980s. Very good to exceptional biology was documented in 2009, along with excellent physical habitat. Together these attributes support the upgrading of the aquatic life use to EWH.

- Big Run is currently listed as LWH and LRW and Wegee Creek is listed as LRW based on acid mine drainage influences. Both are direct tributaries to the Ohio River. Large gob piles adjacent to Big Run and Wegee Creek cause poor water quality that prevent fish migration to the upstream locations. The poor water quality creates a barrier that results in poor fish communities upstream from the gob piles but the macroinvertebrates were good to excellent in both streams. Currently a reclamation project is planned for Big Run which will remove the gob piles. Ohio DNR-Mineral Resources Management is also planning to evaluate Wegee Creek for potential reclamation projects. With proper reclamation, the water quality will significantly improve and fish communities will be able to colonize upstream. Big Run and Wegee Creek would be likely to attain the WWH use designation with the removal of the gob piles and are therefore recommended for WWH.

- Pipe Creek is currently listed in the Ohio WQS as LRW – acid mine drainage. Habitat conditions are adequate for supporting the WWH use and therefore Pipe Creek is recommended for WWH. Pipe Creek was in non-attainment due to poor fish scores but the macroinvertebrate community was exceptional. A natural waterfall is located below this location on Pipe Creek and may be creating a fish passage barrier that resulted in low IBI scores.

All six streams in this study should retain the Primary Contact Recreation class B use, along with the Agricultural Water Supply and Industrial Water Supply uses.

Table 3. *Waterbody use designation recommendations for the McMahon Creek watershed.* *Designations based on the 1978 water quality standards appear as asterisks (*). A triangle sign (▲) indicates a new recommendation and a plus sign (+) indicates confirmation of an existing use based on the findings of this report.*

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	
Pipe Creek		▲							+	+		+		
Big Run		▲							+	+		+		
Wegee Creek		▲							+	+		+		
McMahon Creek – headwaters to Little McMahon Creek			▲						+	+		+		
– Little McMahon Creek to the mouth		+							+	+		+		
Brooks Run		*							*	*		*		
Trough Run		*							*	*		*		
Rock Run		*							*	*		*		
Little McMahon Creek		▲							+	+		+		
Stillhouse Run		*							*	*		*		
Kings Run							+		+	+			+	Acid mine drainage
Aults run							+		+	+			+	Acid mine drainage
Chambers Run		*							*	*		*		
Williams Creek			▲						+	+		+		

INTRODUCTION

Fifteen stream sampling locations were evaluated in the McMahon Creek watershed in Belmont County in 2009. Seven sites on the mainstem of McMahon Creek were sampled as well as four locations on tributaries to McMahon including Little McMahon Creek, Kings Run and Williams Creek. Four locations were also sampled on direct Ohio River tributaries including Big Run, Wegee Creek and Pipe Creek. A total of two National Pollutant Discharge Elimination System (NPDES) permitted facilities discharge sanitary wastewater, industrial process water, and/or industrial storm water into the McMahon Creek watershed. Additionally the Buckeye Reclamation landfill is a U.S. EPA Superfund site that discharges leachate to Kings Run (tributary to Little McMahon Creek). Kings Run was sampled at the mouth downstream from the Buckeye Reclamation landfill discharge.

Figure 2. McMahon Creek Study Area

During 2009, Ohio EPA conducted a water resource assessment of four streams in the McMahon Creek watershed and three direct Ohio River tributaries using standard Ohio EPA protocols as described in Appendix Table 10. Included in this study were assessments of the biological, habitat, surface water and recreation (bacterial) conditions. A total of 14 biological, 15 water chemistry, and 6 bacterial stations were sampled in the McMahon Creek watershed and direct Ohio River tributaries. 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.ohio.gov/dsw/gis/index.aspx

Specific objectives of the evaluation were to:

- establish the present biological conditions in the McMahon Creek watershed and direct Ohio River tributaries 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, Buckeye Reclamation Superfund site, and historic coal mining,
- 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 McMahon Creek watershed and the direct Ohio River tributaries are in the Western Allegheny Plateau (WAP) ecoregion. The mainstem of McMahon Creek, Little McMahon Creek (headwaters to RM 5.8) and Williams Creek are assigned the warmwater habitat (WWH) aquatic life use in the Ohio Water Quality Standards. Pipe Creek, Wegee Creek, Kings Run and Little McMahon Creek (RM 5.8 to the mouth) are assigned the Limited Resource Water (LRW) aquatic life use in the Ohio Water Quality Standards (WQS). Big Run is assigned limited warmwater habitat (LWH) and the LRW aquatic life use in the Ohio WQS.

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 McMahon Creek watershed are currently assigned as Primary Contact Recreation (PCR) Class B (Kings Run is designated Secondary Contact Recreation), Agricultural Water Supply (AWS) and Industrial Water Supply (IWS). Little McMahon Creek is also designated as a Public Water Supply (PWS) at RM 6.6.

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 McMahon Creek study area (Figure 1, Table 1) from April 2009 through December 2009 from fifteen 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 for analysis. Collected water was preserved using appropriate methods, as outlined in

the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2009). Interactive maps of surface water chemical data, downloadable to excel files, are available at the following link:

http://www.epa.ohio.gov/dsw/gis/index.aspx

USGS gage data from Captina Creek at Armstrongs Mills on SR 148 was used to show flow trends in the McMahon 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 lower 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 - 3). Parameters which were in exceedence of the Ohio WQS criteria are reported in Table 4. Bacteriological samples were collected from six locations, and the results are reported in the Recreation Use section. Datasonde™ water quality recorders were placed at seven locations to monitor

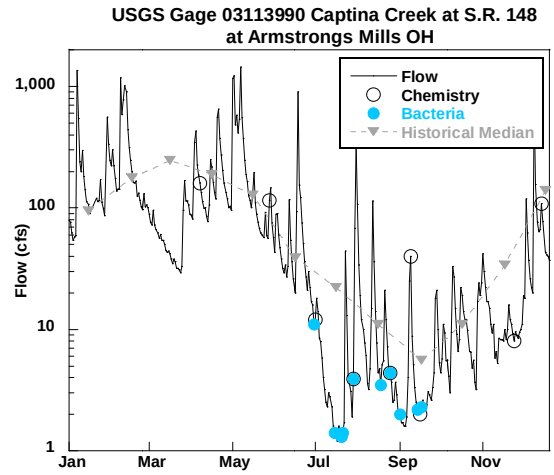


Figure 3. Flow conditions in Captina Creek during the 2009 Ohio EPA survey.

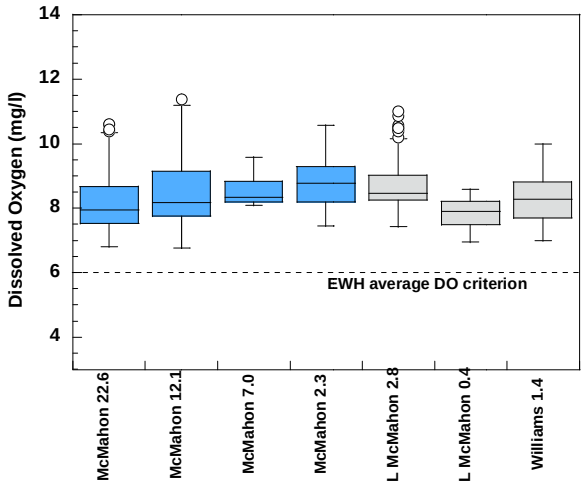


Figure 4. Dissolved oxygen values recorded by Datasonde™ continuous recorders in McMahon Creek and select tributaries, summer 2009.

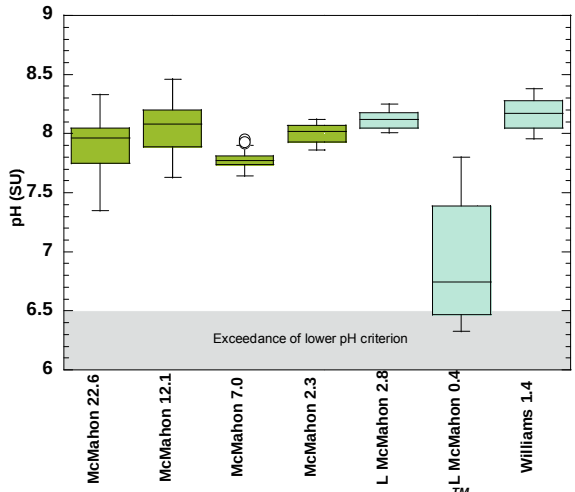


Figure 5. pH values recorded by Datasonde™ continuous recorders in McMahon Creek and select tributaries, summer 2009.

hourly levels of dissolved oxygen, pH, temperature, and conductivity. (Figures 4, 5 and 6; Appendix Table 2).

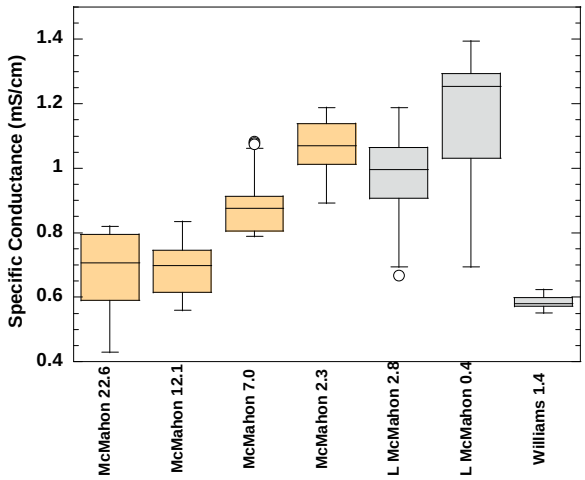


Figure 6. Conductivity values recorded by Datasonde™ continuous recorders in McMahon Creek and select tributaries, summer 2009.

Metals were measured at 15 locations with 17 parameters tested (Appendix Table 1). Coal mining has occurred in the McMahon Creek watershed downstream from Glencoe as well as in the Wegee Creek and Pipe Creek subwatersheds. Mine waste was also placed on top or adjacent to Big Run. Typically coal mine waste and discharges from seeps or gob piles 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 McMahon Creek watershed has buffered these acidic contributions and kept the pH levels in the range acceptable for supporting aquatic life for most of the mined areas on the mainstem of McMahon Creek. Additionally the Ohio Department of Natural Recourses, Mineral Resources Management (ODNR-MRM) has completed numerous reclamation projects in this watershed which has also improved the water quality of McMahon Creek.

Two sites in the McMahon Creek watershed (Kings Run and Little McMahon Creek downstream from Kings Run) exhibited impacts from a combination of historic mining and landfill leachate discharge. The Buckeye Reclamation landfill is a U.S. EPA Superfund site which is located on top of an area that was previously mined. Extremely elevated levels of iron were found in Kings Run which turns both Kings Run and Little McMahon Creek an orange-red color. One value of iron collected in Kings Run was 1,890,000 µg/l and was the highest level of iron detected in a water sample collected by Ohio EPA in the past 10 years. This value of iron is up to four times higher than the highest value of iron found at other streams affected by AMD indicating that the landfill may be exacerbating the AMD situation. Iron, ammonia, barium and total dissolved solids above the water quality standards were found in Kings Run below the Buckeye Reclamation landfill. Iron and pH exceeded the water quality criteria in Kings Run, Little McMahon Creek (below Kings Run) and Big Run.

Typical mining parameters were measured at each water sampling location. Summary statistics for typical mining parameters are detailed in Table 5. Elevated conductivity, sodium and sulfate were found in McMahon Creek downstream from Little McMahon which also corresponds to a drop in the fish community from exceptional upstream from Little McMahon Creek to good. Elevated levels of typical mining parameters were also found in Little McMahon Creek, Kings Run, and Big Run.

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 McMahon Creek watershed are detailed in Table 6. Nutrient levels were low at all monitoring locations on the mainstem of McMahon Creek and in most of the tributaries. Elevated ammonia levels were found in Kings Run, Little McMahon Creek (downstream from Kings Run) and Big Run most likely due to historic mining activities or leachate from the landfill discharge.

DataSonde™ hourly monitoring results for dissolved oxygen, temperature, pH, and conductivity at seven locations are listed in Appendix Table 2. Temperature and dissolved oxygen levels were well within acceptable environmental levels but conductivity was elevated above reference levels in areas below historic coal mining and AMD discharges in McMahon Creek and Little McMahon Creek (Figure 6). Low pH levels were found in Little McMahon Creek below Kings 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 McMahon Creek watershed study area, 2009. Bacteria exceedances are presented in the Recreation Use Section.

Stream/RM	**Location**	**Parameter (value – ug/l unless noted)**
McMahon Creek		
24.1	Upstream Barkcamp Creek along SR 149	None
22.58	Lamira @ CR 78	None
18.6	NW of Warnock, lane off SR 149	None
17.58	Dst. Warnock, adjacent Whitney Road	None
12.1	East of Glencoe @ SR 149	None
7.0	Neffs, downstream Little McMahon Creek	None
2.3	2nd railroad bridge upstream TR 476	None
Little McMahon Creek		
2.8	Downstream Aults Run	None
0.4	Near Neffs @ TR 316	Iron (6920, 12800, 10300, 13400, 11800, 16000, 20300, 22800, 7270[b]), pH – from Datasonde© recorders (6.3-6.4 SU[a])
Williams Creek		
1.4	Adjacent Jacobsburg-Glencoe Road	None
Wegee Creek		
2.21	SW of Shadyside, dst. Stone Coal Run	None
Pipe Creek		
1.2	Near Vadis, adjacent Pipe Creek Road	None
Kings Run[c]		
0.1	Near mouth @ TR 1248	Iron (122000, 249500, 88400,159500, 1890000[b]), Ammonia (2.66, 2.53 mg/l[a]), Barium (303[a]), TDS (1520, 2135 mg/l[a]), pH (5.56 SU[a])
Big Run		
0.32	Dilles Bottom @ SR 7	None
0.05	Railroad trestle at the mouth	Iron (33900, 6120, 12100, 11000[b]), pH (6.12,6.16 SU[a])

[a] Exceedance of the aquatic life Outside Mixing Zone Average water quality criterion .
[b] Exceedance of the statewide water quality criteria for the protection of agricultural uses.
[c] Aquatic life use designation is LRW.

Table 5. Summary statistics for select mine drainage inorganic water quality parameters sampled in the McMahon Creek watershed study area, 2009. The 90th percentile value from reference sites from the Western Allegheny Plateau ecoregion is shown for comparison. Values above reference conditions or developed values are shaded. n= 5-10.

		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
McMahon Creek	24.1	171	65	745	34	129	100
McMahon Creek	22.58	301	101	731	33	132	132
McMahon Creek	18.6	238	27	855	35	205	173
McMahon Creek	17.58	135	25	763	36	146	100
McMahon Creek	12.1	173	15	730	43	131	136
McMahon Creek	7.0	1705	63	1072	77	316	310
McMahon Creek	2.3	157	15	1055	73	306	126
Little McMahon Creek	2.8	41	7	1196	77	287	100
Little McMahon Creek	0.4	12,174	178	1373	98	435	1589
Williams Creek	1.4	72	20	669	72	80.6	100
Wegee Creek	2.21	138	8	565	32	57.5	100
Pipe Creek	1.2	38	5	547	24	75.4	100
Big Run	0.32	635	168	694	42	104	204
Big Run	0.05	13,598	290	501	29	153	4779
Kings Run	0.1	501,880	1121	1815	113	797	2416
Reference Values: headwater/ wading		1266/ 1820	379/ 610	1019/ 791	86/ 45	259/ 242	750[a]

a – U.S. EPA maximum criteria.

Table 6. Summary statistics for select nutrient water quality parameters sampled in the McMahon Creek watershed study area, 2009. The 90th percentile value from reference sites from the Western Allegheny Plateau ecoregion is shown for comparison. Values above reference conditions are shaded yellow.

		Ammonia—N	Nitrate+Nitrite-N	Phosphorus-T
Stream	River Mile	Mean	Mean	Mean
McMahon Creek	24.1	0.05	0.29	0.02
McMahon Creek	22.58	0.04	0.13	0.02
McMahon Creek	18.6	0.03	0.11	0.01
McMahon Creek	17.58	0.04	0.10	0.02
McMahon Creek	12.1	0.025	0.11	0.02
McMahon Creek	7.0	0.025	0.13	0.01
McMahon Creek	2.3	0.025	0.07	0.005
Little McMahon Creek	2.8	0.025	0.09	0.01
Little McMahon Creek	0.4	0.11	0.21	0.01
Williams Creek	1.4	0.025	0.05	0.01
Wegee Creek	2.21	0.025	0.07	0.01
Pipe Creek	1.2	0.025	0.06	0.01
Big Run	0.32	0.04	0.08	0.03
Big Run	0.05	0.10	0.53	0.03
Kings Run	0.1	1.92	0.11	0.02
Reference Value (headwater/ wading)		0.06/ 0.06	0.606/ 1.054	0.09/ 0.11

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 recreational-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 McMahon Creek watershed streams sampled in this survey are designated as a Primary Contact Recreation (PCR) use in OAC Rule 3745-1-13. 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 McMahon Creek mainstem and all other streams assessed during this survey are designated Class B PCR waters. The *E. coli* criteria that apply to PCR Class B streams include a geometric mean of 161 cfu/100 ml, and a maximum value of 523 cfu/100 ml, respectively. The geometric mean is based on two or more samples and is used 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 3. Downloadable bacteria results are also available from the Ohio EPA GIS interactive maps at the following link: http://www.epa.ohio.gov/dsw/gis/index.aspx. Six locations in the McMahon Creek study area were tested for *E. coli* levels six to ten times, from June 30th – September 17th, 2009. Evaluation of *E. coli* results revealed that five of the six locations attained the applicable geometric mean criterion, and thus were in full attainment of the recreation use. One location on McMahon Creek at RM 17.6 exceeded the bacteria criterion, with a geometric mean value of 268 cfu/100 ml. This location on McMahon Creek is located immediately downstream from the small community of Warnock, which does not have centralized sanitary waste treatment, but is served by septic systems. The non-attainment is most likely due to unsanitary conditions from poorly treated sanitary waste. Other large unsewered communities located adjacent to McMahon Creek include Glencoe and Neffs. Even though the 2009 bacteria sampling did not find recreation use impairment below these communities, it is most likely that unsanitary conditions exist which would warrant centralized sewage collection and treatment for both Glencoe and Neffs.

Table 7. A summary of E. coli data for locations sampled in the McMahon 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) Class B geometric mean water quality criterion of 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 PCR Class B geometric mean criterion.

Location	River Mile	Recreation Use	# of Samples	Geometric Mean	Maximum Value	Recreation Attainment Status	Source(s) of Bacteria
McMahon Creek	17.58	PCR Class B	6	268	660	**NON**	Septic systems
McMahon Creek	12.1	PCR Class B	10	64	340	FULL	
Little McMahon Creek	0.4	PCR Class B	10	105	1100	FULL	
Williams Creek	1.4	PCR Class B	6	61	220	FULL	
Wegee Creek	2.21	PCR Class B	6	11	20	FULL	
Pipe Creek	1.2	PCR Class B	6	32	80	FULL	

Effluent Dischargers

A total of two National Pollutant Discharge Elimination System (NPDES) permitted facilities discharge either sanitary wastewater and/or industrial process water mixed with industrial storm water into the McMahon Creek watershed within Belmont County. Included in this list are the Lamira Coal preparation plant and the sanitary wastewater discharge from the St. Clairsville West wastewater treatment plant. The two facilities with individual discharge permits were 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 Discharge Monitoring Report (DMR). Summarized effluent results are listed in Table 8.

In addition to these two permitted facilities a portion of the drainage basin contains either active or reclaimed surface coal mines monitored with current or past general surface coal mining discharge permits. The three coal companies of Marietta Coal Co., Bennoc Inc., and Northshore Coal Co. were issued general surface coal mining permits in the past which required the installation of basic erosion and sediment control best management practices to minimize runoff impacts. These general permitted sites did not collect extensive discharge monitoring data as defined outfalls were not present and minimal runoff monitoring was required. The Buckeye Reclamation Landfill U.S. EPA Superfund Site is also located in the McMahon Creek watershed discharging leachate to Kings Run which is a tributary to Little McMahon Creek.

Lamira Coal Preparation Plant (Ohio EPA Permit # 0IL00109*ED)
The Lamira Coal Preparation Plant owned by Capstone Holding Company is a coal preparation plant for the processing of locally mined coal in Belmont County. The preparation plant complex is located on State Route 149 near Bannock, Ohio and consists of a slurry pond discharge and discharges from surface mine reclamation areas. The facility currently has three permitted outfalls relating to the discharge of mine process wastewater from the slurry pond as well as runoff from reclaimed former processing and mined areas. Outfall 003 is the discharge from the slurry impoundment at the preparation plant which is monitored for pH, suspended solids, iron and manganese. Outfall 001, monitored for the same parameters, is a smaller discharge consisting of storm water runoff from a reclaimed slurry pond and processing area combined with seepage from the former pond. The other mine related discharge from this facility is Outfall 015 which is only storm water runoff from the west side of the reclaimed preparation plant complex. Activity at this facility has recently decreased and the former sanitary discharge from the wastewater treatment plant no longer exists. The former restroom facilities building is now unoccupied and the sanitary discharge, (Outfall 004) no longer discharges. A ten year facility DMR review is shown in Table 8.

St. Clairsville West WWTP (Ohio EPA Permit # 0PA00099*DD)
The St. Clairsville West wastewater treatment plant is an extended aeration package plant with an average daily design flow of .090 MGD for the treatment of sanitary waste from an estimated population of 500 people residing in the western part of St. Clairsville. The treatment plant is located at the end of

Plaza Drive in west St. Clairsville and contains a flow equalization tank, extended aeration basin with clarifier, surface sand filters and disinfection for the complete treatment of sanitary wastewater. The treated effluent is discharged into an unnamed tributary to Little McMahon creek. A ten year facility DMR review is shown in Table 8.

Buckeye Reclamation

The Buckeye Reclamation Landfill (BRL) U.S. EPA Superfund Site is located off County Road 214 approximately 1.2 miles south of Interstate 70 in Belmont County. The site is about 100 acres in size and is located on a tract of land formerly used for deep coal mining until around 1950. During mining operations, the site was a disposal area for mine spoils. BRL was licensed in 1971 and land filling occurred on 50 acres. Municipal waste, industrial sludge and liquids were disposed of in the landfill between 1976 and 1980.

The BRL site was listed on the National Priorities List in 1983 and the Potentially Responsible Parties (PRPs) signed an Administrative Order by Consent (AOC) in 1985 to conduct a remedial investigation (RI) and feasibility study (FS). The RI indentified contamination in soils, surface water and ground water. In August 1991 U.S. EPA issued a record of decision (ROD) that selected a cleanup plan for the site. The selected plan consisted of capping the entire landfill area and installing a ground water collection system to intercept leachate and channel it to a constructed wetland for treatment. Since the ROD was signed, U.S. EPA has made two revisions and the changes are documented in the 1997 Explanation of Significant Differences (ESD) and the 2003 ESD.

In the 1997 ESD, the changes included reducing the solid waste landfill cap from 97 acres to 37 acres, constructing a vegetated soil cap over 24 acres, repairing the existing cap covering 29 acres, modifying the slope of the cap bordering a portion of Kings Run Creek, realigning and lining Kings Run, eliminating the northern impoundment, and delaying construction of the treatment wetland until more data could be collected. The 1997 ESD states that up gradient ground water quality will be based on samples of ground water impacted by coal mine refuse disposal at the site.

Under the 2003 ESD, the flows from Kings Run channel and the landfill leachate collection system are combined for off-site discharge to Little McMahon Creek. The surface water discharge criteria were modified, and a two year monitoring period was established to further evaluate whether or not treatment of surface water discharges will be needed. More information about Buckeye Reclemation can be found on U.S. EPAs web site at the following link: http://www.epa.gov/R5Super/npl/ohio/OHD980509657.htm

Table 8. Concentrations of monitored chemicals in effluent discharged from two facilities within the McMahon Creek watershed study area. Results are reported for the time period 1999-2009.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
St. Clairsville West WWTP (0PA00099) – Outfall 001 to Unnamed Tributary to Little McMahon Creek (RM 6.75)				
Dissolved Oxygen (mg/l)	7.8	6.0 (5th percentile)	Monitor	5.0 (min.)
pH (SU)	7.1 (5th percentile)	7.8	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	2	8	12	18 (weekly)
Ammonia-N (mg/l): winter	0.12	1.6	4.0	6.0
Ammonia-N (mg/l): summer	0.08	1	1.5	2.3
CBOD5 (mg/l)	2.6	6.2	10	15 (weekly)
Flow Rate (MGD)	0.069	0.132	Monitor	Monitor
Chlorine, Total Residual (mg/l)	0.007	0.23	Monitor	0.019
Fecal Coliform (cfu/100ml): Summer	50	1330	1000	2000 (weekly)
Lamira Coal Preparation Plant (0IL00109)				
Outfall 001 to Unnamed Tributary to Brush Run (trib to McMahon Creek at RM 19.3)				
pH (SU)	7.3 (5th percentile)	9	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	2	17.5	35	70
Iron, Total (ug/l)	130	604	3500	7000
Manganese, Total (ug/l)	20	171	2000	4000
Flow Rate (MGD)	0	0.00515	Monitor	Monitor
Outfall 003 to Unnamed Tributary to McMahon Creek at RM 20.1				
pH (SU)	7.5 (5th percentile)	8.4	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	4	23.8	35	70
Iron, Total (ug/l)	100	740	3500	7000
Manganese, Total (ug/l)	100	750	2000	4000
Flow Rate (MGD)	0.324	1.94	Monitor	Monitor
Outfall 009 to Unnamed Tributary to McMahon Creek at RM 20.1				
pH (SU)	7.4 (5th percentile)	8.6	-	-
Total Suspended Solids (mg/l)	5	39.1	-	-
Iron, Total (ug/l)	215	1020	-	-
Manganese, Total (ug/l)	125	665	-	-
Flow Rate (MGD)	0.0431	0.42	-	-
Outfall 015 to Unnamed Tributary to McMahon Creek at RM 20.1				
pH (SU)	7.2 (5th percentile)	9	Monitor	6.5 (min)-9.0 (max)
Total Suspended Solids (mg/l)	13	85.6	35	70
Iron, Total (ug/l)	575	1620	3500	7000
Manganese, Total (ug/l)	270	1510	2000	4000
Flow Rate (MGD)	0.0166	0.367	Monitor	Monitor

Sediment

Sediment samples were collected from five locations in the McMahon Creek watershed study area by the Ohio EPA during August, 2009 (Table 9). Samples were analyzed for metals, semivolatile organic compounds, nutrients, and particle size. Specific chemical parameters tested and results are listed in Appendix Table 4. 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 five sampling locations – sampling locations are noted in Table 1. All but four organic chemicals (naphthalene, 2-methylnaphthalene, phenanthrene, and pentachlorophenol) were reported as not detected - organic chemical measurements in sediment were within acceptable ecological levels. All four organic parameters detected were reported from Little McMahon Creek at RM 0.4.

Detectable levels of select parameters are presented in Table 9. Values above ecological screening guidelines are noted with various colors of shading. Nickel and zinc results were slightly elevated above TEC benchmarks at several sites; however, all of these values were below Ohio SRV benchmarks. Copper measured at two locations was slightly above TEC and Ohio SRV benchmarks. Arsenic was measured at an elevated level in McMahon Creek at RM 12.1, though instream biological results reflected good water resource quality. Naphthalene was measured above a probable effect level in Little McMahon Creek at RM 0.4 with a concentration of 1.09 mg/kg. In Captina Creek, an adjacent stream and watershed, a similar elevated sediment naphthalene level (1.24 mg/kg) did not correlate with co-located biological sampling results. Exceptional biological integrity was documented in Captina Creek although the naphthalene level was above the PEC. The sparse deposits of fine grained material in McMahon Creek contributed to low exposure levels of potential sediment contaminants to biological communities. McMahon Creek watershed sediments were within acceptable ecological levels, and protective of biological integrity.

Table 9. Chemical parameters measured (mg/kg) above screening levels in sediment samples collected in the McMahon 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	Zinc	Naphthalene	Phenanthrene
McMahon Creek	12.1	36.9	27.3	24.5	54,700	123	<0.67	<0.67
McMahon Creek	2.3	16.5	18.9	26.2	44,900	110	<0.59	<0.59
Little McMahon Cr.	0.4	15.5	29.6	30.5	58,500	147	1.09	0.83
Williams Creek	1.4	20.9	35.3	33.3	58,600	101	<0.56	<0.56
Wegee Creek	2.21	20.4	45.5	34.8	79,600	125	<0.53	<0.53

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

Stream Physical Habitat

McMahon Creek near Glencoe

Stream habitat was evaluated at 13 fish sampling locations (Table 10, Appendix Table 5). Seven of these stations were located on McMahon Creek, where habitat quality ranged from fair to good. The average Qualitative Habitat Evaluation Index (QHEI) score for all McMahon Creek sites was 64.3, consistent with good overall habitat quality. McMahon Creek sites were predominated by gravel, with lesser amounts of cobble, sand, boulders and boulders as slabs, limestone bedrock, and silt. Moderate to extensive embeddedness of the bottom substrates occurred at 5 of the 7 fish sites in McMahon 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. Part of the sampling site at RM 18.6 was recently modified by bulldozer activity to attempt to provide bank stability and erosion control along the road. Iron flocculent precipitates, from un-reclaimed mining areas in the Little McMahon Creek subwatershed, were observed along the stream bottom in McMahon Creek at RM 7.0. The iron floc gives the stream a yellow or orange color. The good quality coarse substrates, moderate instream cover, and natural channel development within McMahon Creek contribute to habitat quality that can support good biological communities.

Other Streams/Tributaries

Little McMahon Creek near Neffs

Two streams (Little McMahon Creek and Williams Creek) within the study area are direct tributaries to McMahon Creek. Three other streams (Wegee Creek, Pipe Creek, and Big Run) are near the McMahon Creek watershed, but are direct tributaries to the Ohio River. Little McMahon Creek within the lower 1.5 miles exhibited the effects of acid mine drainage associated with un-reclaimed coal mines along Kings Runs (see photo). Iron flocculent precipitates were covering the stream bottom in the lower 1.5 miles, causing extensive embeddedness of the gravel and cobble substrates. Williams Creek exhibited excellent stream habitat with a QHEI score of 83.0. Wegee Creek, Pipe Creek, and Big Run showed signs of past channel modifications. Channel modifications cause reduced habitat diversity for aquatic life. Wegee Creek and Pipe Creek had QHEI scores indicative of good habitat quality. Both streams had substrates predominated by good quality coarse materials (boulders, cobble, gravel), good channel development, and high quality riffles. Stream habitat quality in Big Run was rated fair, with a QHEI score of 51.5. Conditions contributing to this lower score included channel modification, very shallow riffles and pools, moderate embeddedness and sedimentation, and sparse instream cover. Iron flocculent precipitates were covering the entire stream bottom in Big Run at the biological sampling station.

Table 10. Stream physical habitat (QHEI) summarized results for the McMahon Creek watershed study area, 2009.

Stream	River Mile	Location	QHEI	Comments
EXCELLENT				
Williams Creek	1.4	Adj. Jacobsburg-Glenco Rd.	83.0	Coal fines
GOOD				
McMahon Creek	24.1	Upst. Barkcamp Cr., Adj. SR 149	61.0	Extensive embeddedness/ fair channel development
McMahon Creek	22.6	Lamira @ CR 78	65.5	
McMahon Creek	17.6	Dst. Warnock, Adj. Whitney Rd	71.0	
McMahon Creek	12.1	East of Glencoe @ SR 149	61.5	Extensive embeddedness
McMahon Creek	7.0	At Neffs, Dst. L. McMahon Cr.	63.5	Extensive embeddedness/ AMD
McMahon Creek	2.3	@ 2nd RR Bridge Upst. TR 476	74.5	
Little McMahon Creek	2.8	Downstream Aults Run	55.5	Moderate embeddedness/ fair channel development
Little McMahon Creek	0.8	Dst. Kings Run @ CR 4	55.5	Extensive embeddedness/ AMD/ channel modified
Wegee Creek	2.2	SW Shadyside, Dst. Stone Coal Run	69.5	Recovering channel modification
Pipe Creek	1.2	Near Vadis, Adj. Pipe Creek Rd.	61.5	Channel modified
FAIR				
McMahon Creek	18.6	NW Warnock, Lane Off SR 149	53.0	Recent bulldozing in stream
Big Run	0.4	At Dilles Bottom @ SR 7	51.5	Channel modified/ moderate embeddedness

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 15,352 fish representing 36 species were collected from the McMahon Creek watershed study area between June and September, 2009. Relative numbers and species collected per location are presented in Appendix Table 6 and IBI and MIwb scores are presented in Appendix Table 7. Sampling locations were evaluated using Warmwater Habitat or Exceptional Warmwater Habitat biocriteria. A summary of the fish data are presented in Table 12. McMahon 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 McMahon Creek mainstem sites sampled during 2009 achieved the exceptional warmwater habitat (EWH) fish biocriterion at the upper five stations and warmwater habitat (WWH) biocriterion at the lower two sites. Sampling results during 2009 confirmed that the upper section of McMahon Creek (headwaters to Little McMahon Creek confluence) should be classified as exceptional warmwater habitat. The average IBI (48.7) and MIwb (9.0) scores for McMahon Creek were reflective of very good biological quality. Fish community results from the lower McMahon Creek segment, although attaining WWH biocriteria, were negatively influenced by acid mine drainage conditions from Little McMahon Creek. Improvement in acid mine drainage quality in Little McMahon Creek should result in the lower McMahon Creek fish population achieving exceptional quality. A notable 13.9 percent of the fish population in McMahon Creek was comprised of fish species intolerant of water pollution. These highly sensitive fish included black redhorse, river chub, redside dace, silver shiner, rosyface shiner, mimic shiner, stonecat madtom, and banded darter. Historical trends in fish community results, represented by average IBI and MIwb scores, are presented in Table 11. Over the last 26 years of monitoring biological communities in McMahon Creek, fish populations have improved from fair to very good quality.

Table 11 Average IBI and MIwb scores for McMahon Creek from 1983 and 2009.

Year	IBI	MIwb
2009	48.7	9.0
1983	37.2	7.8

Tributaries

Six sites on five tributary streams in the McMahon Creek watershed (and direct Ohio River streams) had fish community assessments completed in 2009. The following streams and sampling locations had fish populations which were fully achieving the fish biocriteria: Little McMahon Creek (RM 2.8) and Williams Creek.

Fish communities from four tributary sampling sites did not meet applicable biological criteria. Little McMahon Creek at RM 0.8 had an IBI score of 24, reflective of poor water quality. The decline in the fish community of Little McMahon Creek from the upstream site (RM 2.8) to the downstream site (RM 0.8) was associated with a combination of acid mine drainage impacts and leachate from the Buckeye Reclamation landfill from Kings Run which discharges into Little McMahon Creek at RM 1.66. The decline in the Little McMahon Creek fish populations between RM 2.8 and RM 0.8 was highlighted by a substantial reduction in the abundance of pollution sensitive darters – 679 versus 3, respectively. Poor quality fish communities were documented in Wegee Creek, Pipe Creek and Big Run, where IBI scores ranged from 24 to 26. All three streams were predominated by pollution tolerant fish, with values ranging between 52 and 88 percent of the fish community. In addition, low numbers of fish species were recorded (4-5 species) and pollution sensitive darters were sparse or absent. Limitations to fish communities in Wegee Creek and Big Run were caused by historical mining impacts restricting upstream fish migration from downstream uncontaminated areas. Past historical land use changes in combination with a natural waterfall prevents full recovery of the fish community in Pipe Creek.

Table 12. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in the McMahon Creek watershed from June – September, 2009. Relative numbers and weight are per 0.3 km for wading and headwater sites. NA= not applicable.

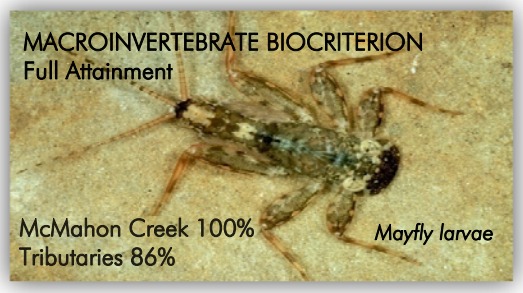
Stream	River Mile	Sampling Method	Fish Species (Total)	Relative Number	Relative Weight (kg)	QHEI (Habitat)	**IBI**	**MIwb**	Narrative Evaluation
McMahon Creek	24.1	Headwater	12	367	NA	61.0	**48**[ns]	NA	Very Good
McMahon Creek	22.6	Headwater	18	1612	NA	65.5	**50**	NA	Exceptional
McMahon Creek	18.6	Wading	24	1900	13.02	53.0	**51**	**9.2**[ns]	Very good/ Exceptional
McMahon Creek	17.6	Wading	26	2512	27.55	71.0	**51**	**10.0**	Exceptional
McMahon Creek	12.1	Wading	19	1852	14.44	61.5	**49**[ns]	**9.4**	Very good/ Exceptional
McMahon Creek	7.0	Wading	26	930	4.76	63.5	**46**	**8.5**	Good/ Very good
McMahon Creek	2.3	Wading	20	510	7.20	74.5	**46**	**8.0**[ns]	Marginally good/ Very good
Little McMahon Creek	2.8	Headwater	13	3692	NA	55.5	**44**	NA	Good
Little McMahon Creek	0.8	Headwater	9	388	NA	55.5	**24***	NA	Poor
Williams Creek	1.4	Headwater	15	1360	NA	83.0	**50**	NA	Exceptional
Wegee Creek	2.2	Headwater	4	1341	NA	69.5	**26***	NA	Poor
Pipe Creek	1.2	Headwater	4	378	NA	61.5	**26***	NA	Poor
Big Run	0.4	Headwater	5	317	NA	51.5	**24***	NA	Poor

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 seven locations in McMahon Creek and seven locations from tributaries in the McMahon Creek watershed or direct Ohio River tributaries were sampled in 2009. Qualitative samples were collected from all sampling locations. Quantitative Hester/Dendy artificial substrate samples were collected from McMahon Creek and Williams Creek. A summary of the macroinvertebrate data are presented in Table 13. The macroinvertebrate raw data are presented in Appendix Table 8. Sampling locations were evaluated using Warmwater Habitat or Exceptional Warmwater Habitat biocriteria based on current or recommended aquatic life use designations.



The McMahon Creek mainstem sites sampled during 2009 achieved the applicable macroinvertebrate biocriterion at all sites evaluated (EWH at 5 sites, WWH at 2 sites). The average ICI score (46.4) for McMahon Creek was reflective of exceptional biological quality. A slight decline in macroinvertebrate quality was noted in McMahon Creek at RM 7.0 downstream from the Little McMahon Creek confluence; however, the EWH biocriterion was still being achieved. Ohio EPA qualitative sampling of the macroinvertebrate community of McMahon Creek occurred during 1983. The five sites sampled in McMahon Creek during 1983 had macroinvertebrate communities ranging in quality from poor to good, with overall stream quality considered fair. Macroinvertebrate sampling results from 2009 reflect a substantial improvement in water quality since 1983.

McMahon Creek and Ohio River Tributaries

Macroinvertebrate communities from 6 of the 7 tributary sampling sites in the McMahon Creek study area fully achieved biological integrity goals for applicable EWH and WWH uses. Two sampling stations on Little McMahon Creek (both locations met the WWH use designation) were represented by marginally good macroinvertebrate communities, where moderately low numbers of pollution sensitive taxa were collected. Very good to exceptional macroinvertebrate populations were documented in Williams Creek, Wegee Creek, and Pipe Creek. Sampling in Big Run, a direct tributary to the Ohio River, revealed impaired conditions associated with acid mine drainage from a large gob pile left from historic mining. The upstream site on Big Run (RM 0.4), located upstream from AMD influences, had a macroinvertebrate community reflective of very good water quality. Downstream from the AMD discharge, the Big Run macroinvertebrate community (RM 0.1) was of fair quality, represented by low total taxa, low pollution sensitive taxa, and an overall scarcity of macroinvertebrates.

Table 13. Summary of macroinvertebrate data collected from natural substrates (qualitative sampling) and quantitative samples in the McMahon Creek study area and other miscellaneous central Ohio River tributaries, June – August, 2009.

Stream	River Mile	Data Codes[#]	Total Taxa[a]	Cold-water Taxa[a]	Qual EPT[b]	Sensitive Taxa[a]	Density (#/ft^2)[c]	**ICI**	Narrative Evaluation[d]
McMahon Creek	24.1	--	64	1	20	22	Moderate	--	Exceptional
McMahon Creek	22.6	--	67	1	20	20	Moderate	--	Exceptional
McMahon Creek	18.6	X13,X15	71	1	18	32	456	44[ns]	Very Good
McMahon Creek	17.6	--	68	0	19	34	1532	46	Exceptional
McMahon Creek	12.1	--	73	2	21	37	349	48	Exceptional
McMahon Creek	7.0	--	69	1	17	33	481	44	Very Good
McMahon Creek	2.3	X13	64	1	22	32	785	50	Exceptional
Little McMahon Creek	2.8	--	43	3	9	12	Moderate	--	Marginally Good [ns]
Little McMahon Creek	0.8	--	30	4	9	11	Low	--	Marginally Good [ns]
Williams Creek	1.4	--	76	4	23	38	105	44 [ns]	Very Good
Wegee Creek	2.2	--	63	3	24	30	Moderate	--	Exceptional
Pipe Creek	1.2	--	56	3	26	27	Moderate	--	Exceptional
Big Run	0.4	--	55	4	19	23	Very low	--	Very Good
Big Run	0.05	--	15	2	5	5	Rare	--	Fair*

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

[a] Includes both qualitative and quantitative taxa.
[b] EPT = qualitative Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness.
[c] Density is represented as the number of organisms per ft^2 on the artificial substrates. For qualitative samples, organism density on the natural substrates is estimated and expressed narratively.
[d] Narrative evaluation used in lieu of ICI score to assess biological quality for qualitative samples.
[ns] nonsignificant departure from biocriterion or narrative ranges.
* Significant departure from biocriterion (>4 ICI units) or narrative ranges. Poor and very poor results are underlined.
# - Data codes: 13 = suspected disturbance by vandalism; 15 = current >0.0 feet per second but < 0.3 fps.

WATERSHED ASSESSMENTS UNITS

The McMahon Creek watershed and selected Ohio River tributaries are comprised of seven 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 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 WAU. Data used in this analysis were collected in 2009. Three McMahon Creek WAUs met the Federal CWA goal of 100% ALU attainment (Table 14). One WAU (Little McMahon Creek) was at 50 percent full attainment. Three subwatersheds which are direct tributaries to the Ohio River (Wegee Creek, Pipe Creek, and Big Run) were at zero percent full attainment. These three subwatersheds were assessed using one location in each WAU. Four of the subwatersheds (Wegee Creek, Pipe Creek, Big Run, and Little McMahon Creek) were below the statewide goal of 80 percent full attainment of Clean Water Act biological integrity. Causes and sources of impairment included the following: low pH, Iron, sediment /coal mining, acid mine drainage inappropriate waste disposal (gob piles) (Wegee Creek, Big Run) TDS, barium, iron, sediment, ammonia/ coal mining, acid mine drainage, landfill-CERCLA National Priority List, Superfund Site (Little McMahon Creek) and fish passage barrier/ natural sources- waterfall (Pipe Creek).

Table 14. Results for the McMahon Creek watershed and selected Ohio River tributaries 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	
050301061206 - Wegee Creek	17.7	1	0	0.0	0	NA	NA	0.0	0	NA	NA	0.0
050301061207 - Pipe Creek	24.3	1	0	0.0	0	NA	NA	0.0	0	NA	NA	0.0
050301061208 - Big Run	7.8	1	0	0.0	0	NA	NA	0.0	0	NA	NA	0.0
050301060701- Williams Cr	12.4	1	1	100	0	NA	NA	100	0	NA	NA	100
050301060702 – Upper McMahon Creek	38.1	2	2	100	2	2	100	100	0	NA	NA	100
050301060703 – Little McMahon Creek	14.9	2	1	50.0	0	NA	NA	50.0	0	NA	NA	50.0
050301060704 – Lower McMahon Creek	25.8	0	NA	NA	0	NA	NA	NA	3	3	100	100

[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 10 which includes Methods, Biosurvey Background Information and Notice to Users.