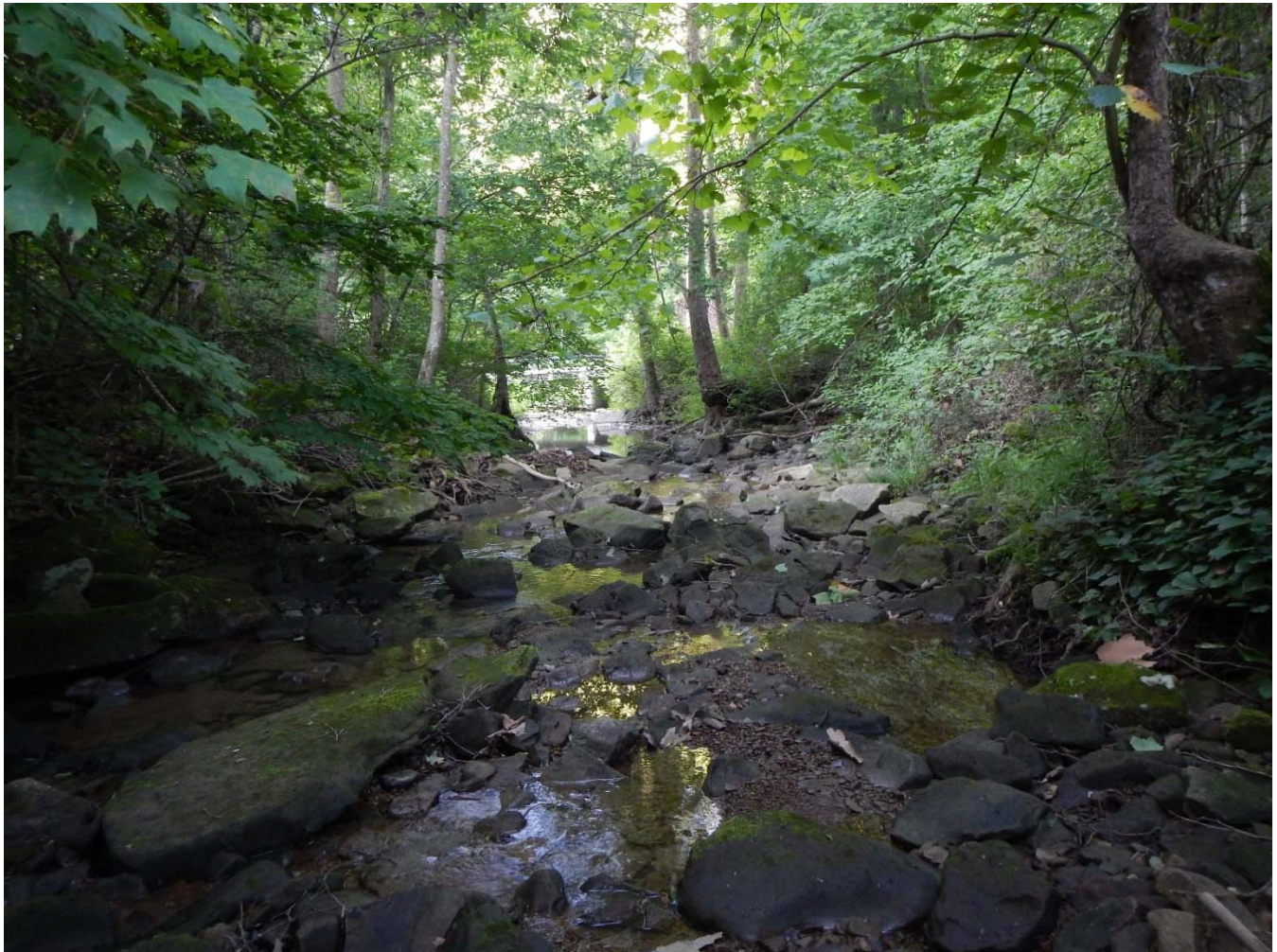




# Loading Analysis Plan and Supporting Data Acquisition Needed for the Southern Ohio River Tributaries Watershed Total Maximum Daily Load Development



*E. Fork Upper Twin Creek, 303597*

Ohio EPA Technical Report AMS/2016- EAGLE-3  
Division of Surface Water  
Assessment and Modeling Section  
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## Introduction

This document provides an overview of the information considered in proposing the strategy to address water quality impairments in the Southern Ohio River Tributaries watershed. These recommendations are based on data collected as part of a biological and water quality study in 2013-2017. A description of the project area, sites, data types, and methods can be found in the Southern Ohio River Tributaries study plan document at ([epa.ohio.gov/static/Portals/35/tmdl/2015\\_SEORT\\_StudyPlan.pdf](http://epa.ohio.gov/static/Portals/35/tmdl/2015_SEORT_StudyPlan.pdf)). A summary of the study results can be found in the biological and water quality report at ([epa.ohio.gov/Portals/35/tmdl/TSD/SORT%202016/SORT\\_Tribs\\_TSD.pdf](http://epa.ohio.gov/Portals/35/tmdl/TSD/SORT%202016/SORT_Tribs_TSD.pdf)).

Sites in the Southern Ohio River Tributaries watershed were assessed for aquatic life use, recreation use and water supply use. The public water supply use was assessed and was in full attainment in the 2020 Integrated Report. The attainment of aquatic life and recreation use is based on specific restoration targets. This document examines those targets and lays out proposals for addressing each impairment. Where appropriate, methods are outlined to develop total maximum daily loads (TMDL) for specific pollutants.

The federal Clean Water Act (CWA) requires that states identify waters not meeting water quality goals and then prioritize them for action to restore their beneficial uses. The resulting list of prioritized impaired waters is known as the 303(d) list. The process of listing involves assigning a condition status (a category) for each of four beneficial uses (aquatic life, human health, recreation, and public water supply) for each assessment unit. For more information on impaired water listings and categories, please Ohio's Integrated Water Quality Monitoring and Assessment Report at: [epa.ohio.gov/wps/portal/gov/epa/divisions-and-offices/surface-water/reports-data/ohio-integrated-water-quality-monitoring-and-assessment-report](http://epa.ohio.gov/wps/portal/gov/epa/divisions-and-offices/surface-water/reports-data/ohio-integrated-water-quality-monitoring-and-assessment-report).

## Aquatic Life Use

### *Evaluation of Biocriteria*

Attainment of Ohio EPA's biocriteria are based on fish and macroinvertebrate scores, as measured by the Index of Biotic Integrity (IBI), Modified Index of well-being (MIwb) and Invertebrate Community Index (ICI). Further explanations of Ohio EPA's biocriteria can be found in Ohio Administrative Code (OAC) Chapter 3745-1-07 and additionally at [epa.ohio.gov/wps/portal/gov/epa/divisions-and-offices/surface-water/reports-data/statewide-biological-and-water-quality-monitoring-and-assessment](http://epa.ohio.gov/wps/portal/gov/epa/divisions-and-offices/surface-water/reports-data/statewide-biological-and-water-quality-monitoring-and-assessment). Goals for those indices in the Southern Ohio River tributaries watershed are shown in Table 1. The attainment status for each site is shown Figure 1 and the scores for impaired sites are shown in Table 2.

Assessments were completed at 90 sites to determine aquatic life use in the Southern Ohio River tributaries in 2013-2017. The study area is composed of all or portions of 23 HUC-12 watershed assessment units. Of the 90 sites sampled, 24 were documented as having partial or non-attainment.

**Table 1 – Biological criteria applicable in the Southern Ohio River Tributaries watershed for aquatic life use designations.**

Ecoregion	Biological Index	Assessment Method <sup>2, 3</sup>	Biological Criteria for the Applicable Aquatic Life Use Designations <sup>1</sup>		
			EWH	WWH	MWH <sup>4</sup>
Interior Plateau (IP)	IBI	Headwater	50	40	24
		Wading	50	40	24
		Boat	48	38	24 / 30
	MIwb	Wading	9.4	8.1	6.2
		Boat	9.6	8.7	5.8 / 6.6
	ICI	All <sup>5</sup>	46	30	22
	Western Allegheny Plateau (WAP)	IBI	Headwater	50	44
Wading			50	44	24 / - / 24
Boat			48	40	24 / 30 / 24
MIwb		Wading	9.4	8.4	6.2 / - / 5.5
		Boat	9.6	8.6	5.8 / 6.6 / 5.4
ICI		All <sup>5</sup>	46	36	22 / - / 30

<sup>1</sup> Aquatic Life Use (ALU) designations: warmwater habitat (WWH); exceptional warmwater habitat (EWH); modified warmwater habitat (MWH); coldwater habitat (CWH), limited resource waters (LRW) and seasonal salmonid habitat (SSH) do not have associated biological criteria.

<sup>2</sup> In general, the assessment method used at a site is determined by its drainage area (DA) according to the following: Headwater: DA ≤ 20 mi<sup>2</sup>; wading: DA >20 mi<sup>2</sup> and ≤ 500 mi<sup>2</sup>; boat: DA > 500 mi<sup>2</sup>.

<sup>3</sup> MIwb not applicable to drainage areas less than 20 mi<sup>2</sup> (headwater sites).

<sup>4</sup> Biocriteria depend on type of MWH. MWH-C (due to channelization) is listed first, MWH-I (due to impoundment) is listed second, and MWH-A (mine affected) is listed third (only applicable in the WAP).

<sup>5</sup> Limited to sites with appropriate conditions for artificial substrate placement.

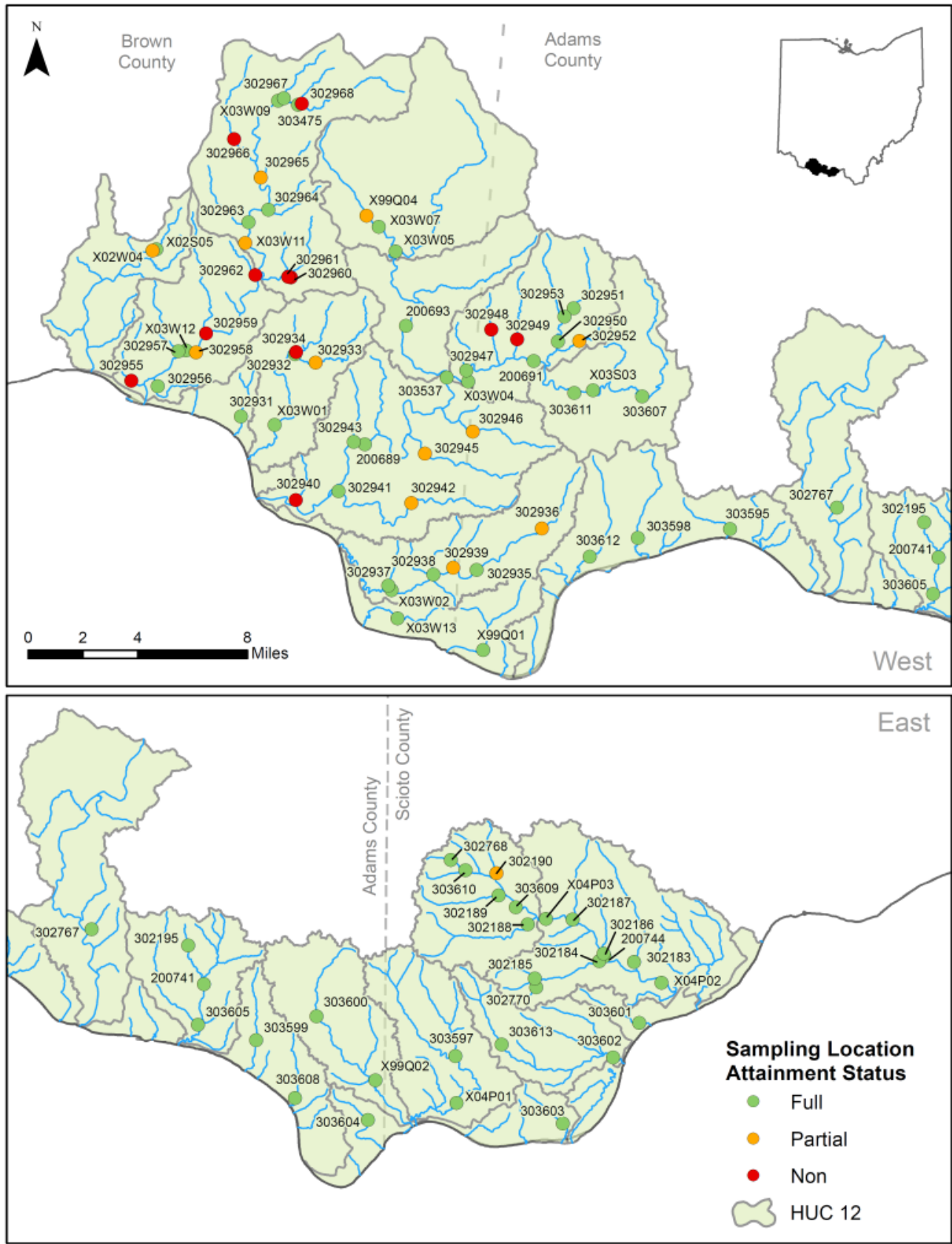


Figure 1 — Map summarizing ALU attainment status in the Southern Ohio River Tributaries watershed in 2013-2017.

**Table 2 – Aquatic life use attainment information for impaired sampling locations in the Southern Ohio River Tributaries watershed, 2013-2017.**

Station	Location	Ecoregion <sup>1</sup> / ALU <sup>2</sup>	(Year) RM <sup>a</sup>	IBI	MIwb <sup>b</sup>	ICI <sup>c</sup>	QHEI	Attain. Status	Causes	Sources
<b>05090201 02 01 – Headwaters Turkey Creek</b>										
302190	Old Lade Run near mouth, adj. Big Run Rd.	WAP/WWH	(2013) 0.20 <sup>H</sup>	36*	-	E	77.3	Partial	Natural (flow or habitat)	Natural sources
<b>05090201 06 04 – Big Threemile Creek</b>										
302936	Big Threemile Creek at Roush Hill Rd. (Rd. 20)	IP/WWH	(2015) 11.12 <sup>H</sup>	34*	-	G	74.8	Partial	unknown	unknown
302939	Meffords Run adj. Meffords Run Rd. (Rd. 248)	IP/WWH	(2015) 0.05 <sup>H</sup>	32*	-	G	80.0	Partial	Natural (flow or habitat)	Natural sources
<b>05090201 07 01 – Headwaters West Fork Eagle Creek</b>										
X99Q04	Honey Creek E of Russellville at Mouth	IP/WWH	(2016) 0.10 <sup>H</sup>	52	-	LF*	70.3	Partial	Ammonia	Russellville WWTP Lagoons
<b>05090201 07 03 – Hills Fork – East Fork Eagle Creek</b>										
302948	Washburn Run dst. St. Rte. 125	IP/WWH	(2015) 1.40 <sup>H</sup>	<u>24</u> *	-	G	66.3	NON	unknown	unknown
302949	Adas Run dst. St. Rte. 125	IP/WWH	(2015) 0.70 <sup>H</sup>	<u>26</u> *	-	G	83.3	NON	unknown	unknown
302952	Lick Run at Old Cincinnati Pike (Rd. 21)	IP/WWH	(2015) 0.95 <sup>H</sup>	32*	-	G	74.3	Partial	Natural (flow or habitat)	Natural sources
<b>05090201 07 05 – Eagle Creek</b>										
302940	Baylor Run at Scoffield Rd.	IP/WWH	(2015) 0.15 <sup>H</sup>	<u>22</u> *	-	G	68.0	NON	Natural (flow or habitat)	Natural sources
302942	Beetle Creek adj. E. Fk. Rd.	IP/WWH	(2015) 4.85 <sup>H</sup>	32*	-	G	75.0	Partial	unknown	unknown
302945	Brushy Fork at Brushy Fork Rd. (Rd. 241)	IP/WWH	(2015) 1.00 <sup>H</sup>	28*	-	G	57.3	Partial	Natural (flow or habitat)	Natural sources
302946	Suck Run at Ebenezer Rd. (Rd. 33)	IP/WWH	(2015) 1.70 <sup>H</sup>	32*	-	E	65.5	Partial	unknown	unknown
<b>05090201 08 01 – Redoak Creek</b>										
302933	Redoak Creek at Rd. 231a	IP/WWH	(2015) 7.20 <sup>H</sup>	30*	-	G	47.5	Partial	unknown	unknown
302934	W. Fk. Redoak Creek at end of Bealer Rd. (Rd. 231)	IP/WWH	(2015) 0.05 <sup>H</sup>	<u>26</u> *	-	MG <sup>ns</sup>	65.8	NON	unknown	unknown
<b>05090201 08 02 – Headwaters Straight Creek</b>										
X03W11	Straight Creek WSW of Russellville at St. Rte. 125	IP/WWH	(2016) 9.45 <sup>W</sup>	34*	7.54*	E	72.3	Partial	unknown	unknown
302960	Washburn Run about 100 yds. dst. Hockman Rd. (Rd. 68)	IP/WWH	(2015) 1.25 <sup>H</sup>	<u>26</u> *	-	MG <sup>ns</sup>	71.0	NON	Natural (flow or habitat)	Natural sources
302961	Bull Run near Mouth	IP/WWH	(2015) 0.05 <sup>H</sup>	<u>26</u> *	-	G	73.5	NON	Natural (flow or habitat)	Natural sources

Station	Location	Ecoregion <sup>1</sup> / ALU <sup>2</sup>	(Year) RM <sup>a</sup>	IBI	MIwb <sup>b</sup>	ICI <sup>c</sup>	QHEI	Attain. Status	Causes	Sources
302962	Scott Run at U.S. Rte. 68	IP/WWH	(2015) 0.20 <sup>H</sup>	<u>12</u> *	-	G	69.5	NON	Natural (flow or habitat)	Natural sources
302965	Honey Run adj. Day Hill-Arnheim Rd.	IP/WWH	(2015) 0.10 <sup>H</sup>	30*	-	MG <sup>ns</sup>	67.8	Partial	Natural (flow or habitat)	Natural sources
302966	West Fork Straight Creek at Westfork Rd. (Rd. 66a)	IP/WWH	(2015) 1.25 <sup>H</sup>	<u>24</u> *	-	G	68.5	NON	unknown	unknown
302968	Sycamore Run near Fite-Hauck Rd. and Ash Ridge Arnheim Rd.	IP/WWH	(2015/2017) 0.05 <sup>H</sup>	30*	-	F*	71.5	NON	Flow regime alterations/Low Flow Copper sulfate	Upstream impoundment - Lake Waynoka drinking water reservoir
									Natural (flow or habitat)	Natural sources
<b>05090201 08 03 – Evans Run – Straight Creek</b>										
302955	Sink Creek adj. Old A and P Rd. (Rd. 67a)	IP/WWH	(2015) 0.15 <sup>H</sup>	<u>24</u> *	-	G	58.8	NON	Natural (flow or habitat)	Natural sources
302958	Campbell Run at Old U.S. Rte. 68 (Rd. 30)	IP/WWH	(2015) 0.20 <sup>H</sup>	32*	-	G	74.5	Partial	Natural (flow or habitat)	Natural sources
302959	Evans Run adj. Straight Creek Rd. (Rd. 255) at confluence	IP/WWH	(2015) 0.05 <sup>H</sup>	<u>22</u> *	-	G	77.3	NON	Natural (flow or habitat)	Natural sources
<b>05090201 10 03 – Big Run – Whiteoak Creek</b>										
X02W04	Town Run dst. Georgetown WWTP	IP/CWH	(2016) 0.63 <sup>H</sup>	20	-	LF*	77.0	Partial	Natural (flow or habitat) Flow regime alternations	Natural sources Municipal point source

1 Level III Ecoregions: Interior Plateau (IP), Western Allegheny Plateau (WAP)

2 Aquatic life use (ALU) designations: exceptional warmwater habitat (EWH), warmwater habitat (WWH), modified warmwater habitat (MWH). ALU designations for listed waters are located in OAC 3745-1 (sections 08 -32)

a River Mile (RM) represents the Point of Record (POR) for the station and may not be the actual sampling RM.

b MIwb is not applicable to headwater streams with drainage areas  $\leq 20$  mi<sup>2</sup>.

c A narrative evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable. VP=Very Poor; P=Poor; LF=Low Fair; F=Fair; MG=Marginally Good; G=Good; VG=Very Good; E=Exceptional.

ns Nonsignificant departure from biocriteria ( $\leq 4$  IBI or ICI units, or  $\leq 0.5$  MIwb units).

\* Indicates significant departure from applicable biocriteria ( $>4$  IBI or ICI units, or  $>0.5$  MIwb units). Underlined scores are in the Poor or Very Poor range.

H Headwater site (draining  $\leq 20$  miles<sup>2</sup>).

W Wading site (non-boat site draining  $>20$  miles<sup>2</sup>).

### Proposed Actions

Ohio EPA considers many factors when deciding how to address impairments. For some projects, no TMDL is required. The watershed may be in attainment or the impairment is being addressed by another program/entity so no further action by the Division of Surface Water is necessary. Additionally, the cause of impairment may be natural (i.e., flow or habitat), in which case no action is required. For those needing a TMDL, the complexity of each impairment—including the primary origin of the pollutant, its delivery mechanisms and the waterbody kinetics involved—will determine the complexity needed in a model. Ohio EPA must also take into consideration ongoing efforts in the watershed, previous TMDL analyses, the questions to be answered by a model and the amount of effort required to complete the model. Depending on the method selected, the Agency may be required to return to the watershed and collect additional data, and it is possible the modeling approach may change. A summary of Ohio EPA's preliminary modeling approaches is presented in Table 3.

**Table 3 – Summary of ALU impairments and potential modeling approaches**

Station	Stream Name	River Mile	HUC 12 (05090201)	Cause(s) of Impairment	Source(s) of Impairment	IR Cat. <sup>1</sup>	Action <sup>2</sup>	Method <sup>3</sup>	Parameter
302190	Old Lade Run	0.20 <sup>H</sup>	02 01	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
302936	Big Threemile Creek	11.12 <sup>H</sup>	06 04	unknown	unknown	5	Other	Follow-up	-
302939	Meffords Run	0.05 <sup>H</sup>	06 04	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
X99Q04	Honey Creek	0.10 <sup>H</sup>	07 01	Ammonia	Russellville WWTP Lagoons	5	Other	Follow-up	-
302948	Washburn Run	1.40 <sup>H</sup>	07 03	unknown	unknown	5	Other	Follow-up	-
302949	Adas Run	0.70 <sup>H</sup>	07 03	unknown	unknown	5	Other	Follow-up	-
302952	Lick Run	0.95 <sup>H</sup>	07 03	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
302940	Baylor Run	0.15 <sup>H</sup>	07 05	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
302942	Beetle Creek	4.85 <sup>H</sup>	07 05	unknown	unknown	5	Other	Follow-up	-
302945	Brushy Fork	1.00 <sup>H</sup>	07 05	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
302946	Suck Run	1.70 <sup>H</sup>	07 05	unknown	unknown	5	Other	Follow-up	-
302933	Redoak Creek	7.20 <sup>H</sup>	08 01	unknown	unknown	5	Other	Follow-up	-
302934	W. Fk. Redoak Creek	0.05 <sup>H</sup>	08 01	unknown	unknown	5	Other	Follow-up	-
X03W11	Straight Creek	9.45 <sup>W</sup>	08 02	unknown	unknown	5	Other	Follow-up	-
302960	Washburn Run	1.25 <sup>H</sup>	08 02	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
302961	Bull Run	0.05 <sup>H</sup>	08 02	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
302962	Scott Run	0.20 <sup>H</sup>	08 02	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
302965	Honey Run	0.10 <sup>H</sup>	08 02	Natural (flow or habitat)	Natural sources	4C	N/A	-	-

Station	Stream Name	River Mile	HUC 12 (05090201)	Cause(s) of Impairment	Source(s) of Impairment	IR Cat. <sup>1</sup>	Action <sup>2</sup>	Method <sup>3</sup>	Parameter
302966	West Fork Straight Creek	1.25 <sup>H</sup>	08 02	unknown	unknown	5	Other	Follow-up	-
302968	Sycamore Run	0.05 <sup>H</sup>	08 02	Flow regime alterations/Low Flow Copper sulfate	Upstream impoundment - Lake Waynoka drinking water reservoir	4C 5	N/A Other	- Follow-up	- -
302955	Sink Creek	0.15 <sup>H</sup>	08 03	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
302958	Campbell Run	0.20 <sup>H</sup>	08 03	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
302959	Evans Run	0.05 <sup>H</sup>	08 03	Natural (flow or habitat)	Natural sources	4C	N/A	-	-
X02W04	Town Run	0.63 <sup>H</sup>	10 03	Natural (flow or habitat) Flow regime alternations	Natural sources Municipal point source	4C 4C	N/A N/A	- -	- -

1. IR Cat. (Integrated Report Category)

Category	Definition/interpretation
4B	Water body is impaired for this parameter, and it has already been addressed by an approved 4B plan
4C	Water body is impaired for this parameter, but the parameter is not considered a pollutant and therefore a TMDL is not required
5	Water body is impaired for this parameter, and it needs to be addressed by additional actions

2. Action

Abbreviation	Definition/interpretation
N/A	Not applicable, no action needed
Other	Action will be taken outside of a new TMDL
TMDL	A Total Maximum Daily Load (TMDL) will be developed

3. Method

Abbreviation	Definition/interpretation
Follow-up	Follow-up sampling is required to determine if the attainment status has changed after ongoing implementation has occurred or to clarify/verify the listed cause of impairment.
QHEI-sed	Sub-metrics of the QHEI (Qualitative habitat evaluation index) will be used to address sedimentation and embeddedness.
NPDES	The impairment will be addressed through Ohio EPA's permitting and compliance programs.

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Assessments of aquatic life use were completed at 90 sites in the Southwest Ohio River tributaries in 2013-2017. The study area is composed of all or portions of 23 HUC-12 watershed assessment units. Of the 90 sites assessed, 24 were documented as having partial or non-attainment.

*No action required due to natural causes of impairment: IR Cat: 4C - Action: N/A*

The cause of impairment at several sites outlined on Table 3 for the Southern Ohio River tributaries watershed is due to natural causes.

Thirteen sites were impaired due to natural conditions relating to physical habitat limitations. Some headwaters had very steep bedrock waterfalls while others became completely desiccated during the summer which made fish passage and establishment very difficult. Natural conditions are not considered a pollutant and therefore were removed from TMDL considerations.

*Follow-up monitoring is recommended prior to TMDL development to address some causes: IR Cat: 5 - Action: Other*

Several causes of impairment outlined on Table 3 for Southern Ohio River watershed were from impacts that may not persist. This is because several actions in the watershed that may have ameliorated these causes have occurred since the 2016 assessment.

Three locations had impairments due to a water treatment plant and wastewater treatment plants (WWTP). One cause of impairment was high copper due to the Lake Waynoka drinking water supply reservoir. Copper sulfate is periodically added to the water supply reservoir to prevent harmful algal blooms, which negatively impact the quality of the community's drinking water supply. In December 2017, staff from Ohio EPA's Division of Surface Water met with the utility superintendent for the Waynoka Regional Water and Sewer District to discuss obtaining authorization to apply pesticides (copper sulfate) to the water supply through the Pesticides Discharge general permit (OHG870002). In addition to obtaining this important authorization, staff discussed the need for the development and implementation of a pesticide application management plan. The plan will address timing, methods, and rates of copper sulfate application to protect the water supply from experiencing harmful algal blooms while ensuring aquatic life water quality criteria in the reservoir and Sycamore Run and Straight Creek downstream will be protected.

In response to conditions observed during the 2016 survey, limits were added to the Russellville WWTP NPDES permit. When it was renewed in 2018, 4.5 mg/L weekly and 3.0 mg/L monthly summer nitrogen-ammonia limits were added to the permit. In addition, Ohio EPA is working with the facility to renovate their land application system to be operational to avoid controlled discharge events during the summer months to lessen the impact to aquatic biology.

Several causes of impairment outlined on Table 3 for Southern Ohio River watershed could not be determined and are listed as causes unknown. There were nine sites with biology impairments where the cause is listed as unknown. The collected data was inconclusive, the decision was made to follow-up on these sites leaving the impairment as unknown.

Because of these factors, follow-up monitoring is recommended prior to TMDL development. When this follow-up monitoring occurs another study plan, water quality results, and Loading Analysis Plan will be published prior to

any new TMDL development. All three of those future documents will include public comment periods before they are considered final.

## Recreation Use

### Evaluation of Criteria

Attainment of recreation use goals is based on numeric criteria for *Escherichia coli* (*E. coli*) as an indicator bacterium. These criteria, shown in Table , are also the targets used for TMDLs. Table lists attainment of recreation use based on criteria at the time of assessment, which were different than the current standards. However, any TMDLs created for those assessment units will use the updated values in Table .

**Table 4 – Water quality criteria for recreation use**

Recreation Use	<i>Escherichia coli</i> (colony forming units per 100 mL)	
	90-day geometric mean	Statistical threshold value <sup>1</sup>
Bathing water	126	410 <sup>a</sup>
Primary contact recreation	126	410
Secondary contact recreation	1030	1030

<sup>1</sup> These criteria shall not be exceeded in more than 10 percent of the samples taken during any ninety-day period.

<sup>a</sup> A beach action value of 235 *E. coli* colony counts per 100 mL shall be used for the purpose of issuing beach and bathing water advisories.

**Table 5 – Recreation use attainment information for impaired sampling locations in the Southern Ohio River Tributaries watershed, 2013-2017.**

Station	Stream Name	HUC-12 (05090201)	RM	# Samples	Geo. Mean	Max. Value	Attain. Status	Possible Sources <sup>1</sup>	Action	Method
303609	Headwaters Turkey Creek	02 01	10.70	5	36.4	4,200	NON	AG, HSTS	TMDL	LDC
303601	Briery Branch – Ohio River	02 04	0.43	5	1,767.6	7,310	NON	AG, HSTS	TMDL	LDC
303603	Rock Run – Ohio River	02 07	0.66	5	400.7	1,200	NON	AG, HSTS	TMDL	LDC
200741	Stout Run	02 09	1.4	5	268.3	1,730	NON	AG, HSTS	TMDL	LDC
303608	Quicks Run – Ohio River	02 10	0.35	5	445.6	20,900	NON	AG, HSTS	TMDL	LDC
303612	Crooked Creek – Ohio River	06 01	1.43	5	335.5	1,200	NON	AG, HSTS	TMDL	LDC
X99Q01	Lawrence Creek – Ohio River	06 05	1.3	5	246.2	816	NON	AG, HSTS	TMDL	LDC
303607	Headwaters East Fork Eagle Creek	07 02	7.9	5	1,320.8	4,030	NON	AG, HSTS	TMDL	LDC
200693	Rattlesnake Creek – West Fork Eagle Creek	07 04	3.3	5	1,245.8	19,600	NON	AG, HSTS	TMDL	LDC
303537	Eagle Creek	07 05	14.43	5	917.5	16,300	NON	AG, HSTS	TMDL	LDC
X03W11	Headwaters Straight Creek	08 02	9.45	5	875.6	7,750	NON	AG, HSTS	TMDL	LDC
X03W12	Evans Run – Straight Creek	08 03	2.78	5	745.9	8,210	NON	AG, HSTS	TMDL	LDC
X02W04	Big Run – Whiteoak Creek	10 03	0.63	5	533.6	1,990	NON	Urban	TMDL	LDC
X02S05	Big Run – Whiteoak Creek	10 03	0.81	5	514.6	2,420	NON	Urban	TMDL	LDC

### Proposed Actions

Concentrations of *E. coli* exceeding the water quality standard are due to both pervasive and direct sources. Two predominant pathways exist for pathogen delivery to water bodies. The first pathway is pathogen-rich discharge, including material such as poorly treated or untreated effluent from wastewater treatment plants, combined sewer overflows, sanitary sewer overflows, household sewage treatment systems and livestock access to streams. This is delivered to the stream by direct discharge. The second pathway is pathogen-rich runoff/drainage from nonpoint sources. The associated delivery mechanism is precipitation-driven wash-off. This type of transport involves the delivery of pathogen-rich material by overland flow during precipitation and runoff events (e.g., summer storms, snowmelt, etc.).

Due to these mechanisms of delivery, the sources of pathogens in surface waters can be determined to a certain extent via the level of stream flow observed. Therefore, Ohio EPA proposes using the load duration curve (LDC) framework for recreation use TMDLs. LDCs are an empirical method of determining TMDL pollutant loading and needed reductions. The main advantage of the use of LDCs is in this method's ability to differentiate loads from various types of sources based on stream flow regime. While this is a basic modeling method, relationships between bacteria source contributions and flow regimes are straight forward. In-stream processes and interactions between pathogen sources are assumed conservative (i.e., not occurring) in this method. *Figure 2* shows an example LDC with corresponding TMDL calculations represented in Table .

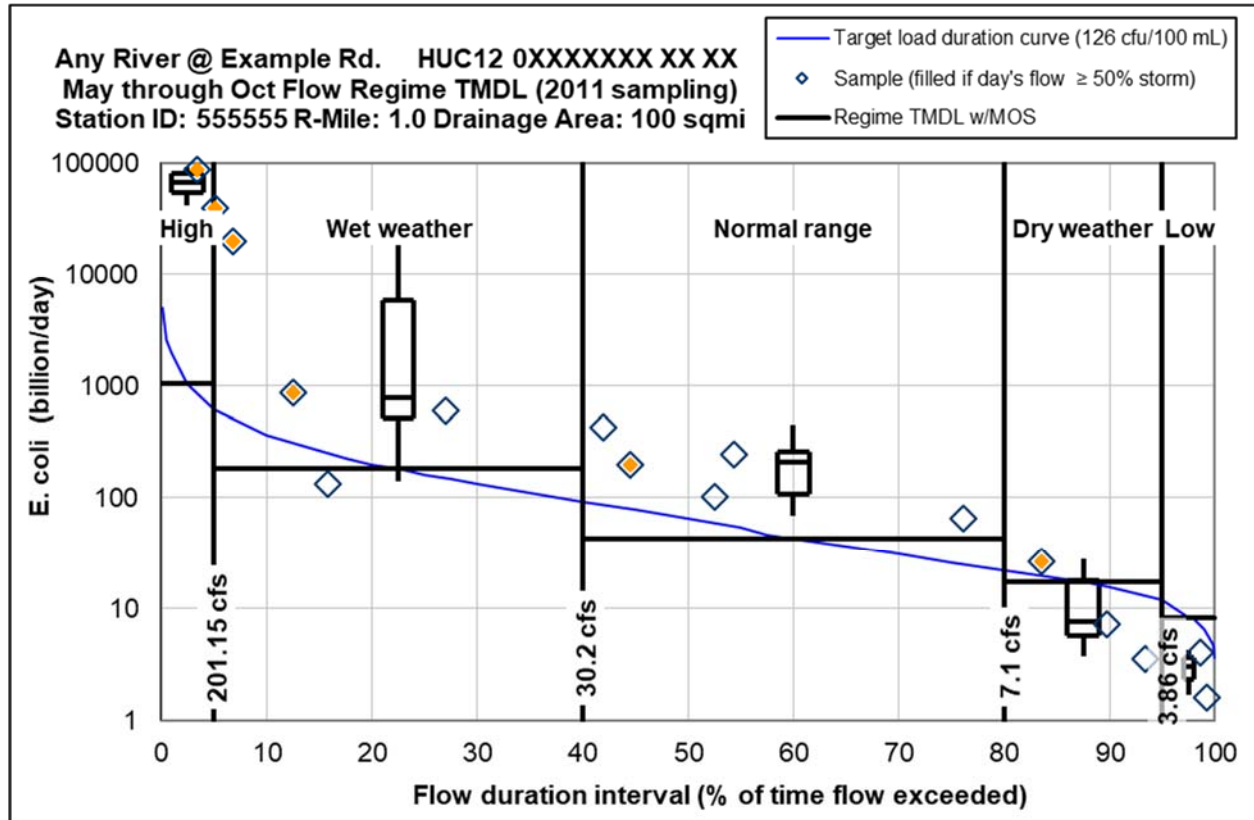


Figure 2 – Example load duration curve.

Table 6 – Example TMDL table calculations (from above load duration curve).

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime	2	4	5	3	2
Median Sample load	66807	781	209.25	7.72	2.99
Total Load Reduction Required	98.9%	82.8%	84.7%	NA	NA
Total Maximum Daily Load	1036.68	182.09	43.25	17.26	8.35
Margin of Safety: 20%	207.34	36.42	8.65	3.45	1.67
Allowance for Future Growth	62.20	10.93	2.60	1.04	0.50
Load Allocation	740.71	127.29	27.63	8.98	2.58
Wasteload Allocation Total	26.43	7.46	4.37	3.80	3.60
MS4	23.01	4.04	0.96	0.38	0.19
Example Town WWTP XPX00XXX	3.41	3.41	3.41	3.41	3.41

## References

- Ohio EPA (Ohio Environmental Protection Agency – Division of Surface Water). 1999. *Association between nutrients, habitat, and the aquatic biota of Ohio's rivers and streams*. Published at: [epa.ohio.gov/wps/portal/gov/epa/divisions-and-offices/surface-water/reports-data/technical-bulletins](http://epa.ohio.gov/wps/portal/gov/epa/divisions-and-offices/surface-water/reports-data/technical-bulletins)
- Ohio EPA (Ohio Environmental Protection Agency – Division of Surface Water). 2015. *Study Plan to the Biological and Water Quality Study of the Southeast Ohio River Tributaries - 2015*. Published at: [epa.ohio.gov/static/Portals/35/tmdl/2015\\_SEORT\\_StudyPlan.pdf](http://epa.ohio.gov/static/Portals/35/tmdl/2015_SEORT_StudyPlan.pdf)
- Ohio EPA (Ohio Environmental Protection Agency – Division of Surface Water). 2019. *Biological and Water Quality Study of Selected Southeastern Ohio River Tributaries, 2015*. Published at: [epa.ohio.gov/Portals/35/tmdl/TSD/SORT%202016/SORT\\_Tribs\\_TSD.pdf](http://epa.ohio.gov/Portals/35/tmdl/TSD/SORT%202016/SORT_Tribs_TSD.pdf)