

Appendix D: Beaver Creek and Grand Lake St. Marys Water Quality Information

Grand Lake St. Marys

The monitoring and assessment of “lakes,” including natural lakes and man-made impounded or upground reservoirs, is an important compliment to the study of stream ecosystems. Lakes act as watershed sinks for the upstream loading of sediment, nutrients, and pesticides. Thus, their assessment may be the best indicator of the combined effects that both point and non point pollution sources have on surface water quality.

Grand Lake St. Marys is the largest inland lake in Ohio at 12,700 acres. It was constructed to store water for the Miami-Erie Canal. The project was completed in 1845 when earthen dams were built on Beaver Creek and the St. Marys River. Grand Lake St. Marys and other canal feeder lakes were the first areas to be dedicated as Ohio State Parks in 1949. The Ohio DNR, Division of Wildlife administers the lake for fish and game propagation and management, including the 1,408 acre Mercer Wildlife Area located in Montezuma Bay. The Ohio DNR, Division of Parks and Recreation administer the campground, three public swimming beaches, and several picnic areas. The lake is designated in the Ohio water quality standards (OAC Chapter 3745-1-29) as exceptional warmwater aquatic life habitat, public water supply, agricultural water supply, industrial water supply, and primary contact recreation. Numerical criteria associated with the public water supply use apply within 500 yards of the City of Celina raw water intake. Recreational criteria established for areas defined as bathing waters apply within the confines of the public beaches located at the state park. Ohio DNR monitors the state park beach waters for *Escherichia coliform* content during the recreation season to ensure that *E. coli* will not be a human health risk.

Grand Lake St. Marys has become increasingly enriched over the years because of cultural activities. A means of predicting algal biomass and classifying lakes is the trophic status index developed by Carlson (1977). The index can be calculated using either Secchi depth, chlorophyll *a*, or phosphorus measurements. Since the index predicts algal biomass, chlorophyll *a* is the best parameter to use. Lakes with values ≤ 37 $\mu\text{g/L}$ are considered oligotrophic, 38-47 mesotrophic, 48-66 eutrophic, and ≥ 67 hypereutrophic. A summary of historical nutrient data and index values is presented in Table 1.

Besides implementing management practices in the watershed, it might be necessary to manage nutrient cycling within the lake. Dredging would be one way of removing nutrient-laden sediment from the system. Sediment is frequently re-suspended in the water column due to the size and shallow depth of the lake, so chemical treatment is not a viable option.

Any new discharges to the lake or its tributaries should be evaluated for appropriate permit requirements and/or discharge restrictions based on the impact to nutrient enrichment or increased algal growth in the lake. An ethanol production plant is proposed to be located on the north side of the lake in Mercer County. They have applied for an NPDES permit to discharge non-process wastewater, primarily non contact cooling water to Grand Lake St. Marys.

Table D-1. Summary of Grand Lake St. Marys nutrient data and Trophic Status Index (Carlson, 1977) based on chlorophyll *a* concentration. A value equal to ½ the lab reporting limit was used in instances where the analytical result was below detection.

Date	Station No.	Chl. <i>a</i> (µg/L)	T-P (µg/L)	T-N (mg/L)	Secchi (m)	TSI (Chl. <i>a</i>)
U.S. EPA National Eutrophication Study (1973)						
08/01/73	01	86.2	186	2.36	0.46	74
	02	84.1	131	2.17	0.41	74
	03	88.4	115	2.30	0.46	75
	04	69.7	128	2.15	0.46	72
10/11/73	01	61.8	480	1.26	0.20	71
	02	63.2	123	1.75	0.41	71
	03	45.3	89	1.45	0.99	68
	04	47.4	83	1.25	0.99	68
Summer Average		68.3	167	1.84	0.55	72
Ohio EPA Clean Lakes Program (1992)						
08/19/92	L-1	119.6	120	1.40	0.3	78
	L-2	126.2	200	1.86	0.25	78
	L-3	115.4	120	1.70	0.25	77
09/11/92	L-1	124.1	110	1.65	0.25	78
	L-2	119.1	60	1.05	0.3	78
	L-3	127.8	150	1.65	0.3	78
Summer Average		122.0	127	1.55	0.28	78
Ohio EPA Clean Lakes Program (1999)						
08/11/99	L-1	238.3	250	4.15	0.2	84
	L-2	277.3	190	2.45	0.2	86
	L-3	246.5	190	2.96	0.2	85
09/09/99	L-1	-	200	2.62	0.2	-
	L-2	241.1	190	2.60	0.15	84
	L-3	266.6	220	2.44	0.15	85
Summer Average		254.0	207	2.87	0.18	85

Excerpt from Wabash River Basin Executive Summary (2002, unpublished). Shaded areas are not within the boundaries of the Beaver Creek and Grand Lake St. Marys watershed.

Table D-2. Attainment of biological criteria for sites sampled in the Wabash River basin, 1999.

RIVER MILE Fish/Invert.	IBI	MIwb	ICI	QHEI	Attainment Status
Wabash River (22-001)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/LRW proposed				
506.4	<u>12*</u> _{flow}	NA	<u>VP*</u>	30.5	NON/NON
504.5	<u>12*</u> _{flow}	NA	<u>VP*</u>	31.5	NON/NON
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
502.2	<u>16*</u>	NA	<u>P*</u>	52.0	NON/NON
494.3/494.4	28*	8.2 ^{ns}	20*	26.5	NON/Partial
489.9	<u>21*</u>	<u>4.5*</u>	14*	25.0	NON/NON
484.8/484.7	<u>26*</u>	7.0*	14*	33.0	NON/Partial
482.2	--	--	<u>4*</u>	--	NON/NON
482.0	<u>14*</u>	<u>2.8*</u>	<u>VP*</u>	42.5	NON/NON
	<i>Eastern Corn Belt Plains</i> WWH (Existing)				
480/480.1	32*	8.8	30*	61.5	Partial
476.2/476.0	29*	7.8 ^{ns}	38	45.0	Partial
469.5	30*	8.2 ^{ns}	MG	49.5	Partial
466.1	<u>25*</u>	7.2*	16*	43.0	NON
Hickory Branch (22-002)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
0.3	32*	NA	F*	32.0	NON/Partial
Crab Branch (22-004)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
0.5/0.4	<u>22*</u>	NA	<u>VP*</u>	37.0	NON/NON
Toti Creek (22-005)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
2.2/2.1	<u>22*</u>	NA	<u>P*</u>	26.0	NON/NON
0.3/0.2	30*	NA	F*	52.5	NON/Full
Stony Creek (22-006)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/Primary Headwater proposed				
0.2/0.1	<u>22*</u>	NA	F*	48.0	NON/deferred
Twomile Creek (22-007)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/Primary Headwater proposed				
1.7	<u>20*</u>	NA	<u>VP*</u>	48.5	NON/deferred
Threemile Creek (22-008)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/LRW proposed				
0.7	<u>20*</u>	NA	<u>VP*</u>	27.0	NON/NON
Ward Ditch (22-010)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/LRW proposed				
0.7	<u>18*</u>	NA	<u>P*</u>	27.0	Non/Full
Bear Creek (22-011)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/LRW proposed				
1.8	<u>12*</u>	NA	<u>VP*</u>	16.0	NON/NON
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
0.1	<u>24*</u>	NA	<u>VP*</u>	12.0	NON/NON

RIVER MILE Fish/Invert.	IBI	MIwb	ICI	QHEI	Attainment Status
<i>Trib to Toti Creek (22-014)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/LRW proposed</i>				
1.2	<u>12</u> *	NA	<u>VP</u> *	18.0	NON/NON
<i>Henry Ditch (22-015)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/Primary Headwater proposed</i>				
1.5	<u>12</u> *	NA	<u>VP</u> *	50.0	NON/deferred
<i>Fort Creek (22-016)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/Primary Headwater proposed</i>				
1.5	--flow	NA	<u>VP</u> *	--	NON/deferred
	<i>Eastern Corn Belt Plains WWH (Existing)/MWH proposed</i>				
0.1	<u>18</u> *	NA	<u>VP</u> *	34.0	NON/NON
<i>Trib to Fort Creek (22-017)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/Primary Headwater proposed</i>				
0.1	<u>16</u> *	NA	<u>VP</u> *	51.5	NON/deferred
<i>Trib to Wabash at 489.32 (22-018)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/LRW proposed</i>				
0.4/0.5	<u>12</u> *	NA	<u>VP</u> *	32.5	NON/NON
<i>Trib to Wabash at 491.06 (22-019)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/LRW proposed</i>				
0.2	<u>16</u> *	NA	<u>VP</u> *	26.0	NON/NON
<i>Trib to Wabash at 492.03 (22-020)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/LRW proposed</i>				
1.1	<u>12</u> * _{flow}	NA	<u>VP</u> *	22.0	NON/NON
<i>Trib to Wabash 492.95 (22-021)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/LRW proposed</i>				
1.2/1.1	<u>12</u> *	NA	<u>VP</u> *	24.0	NON/NON
<i>Beaver Creek (22-100)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/MWH proposed</i>				
10.4	34*	10.0	<u>4</u> *	62.5	NON
9.7	30*	9.0	<u>10</u> *	36.5	NON/Partial
7.6/6.5	<u>22</u> *	6.5*	<u>10</u> *	25.0	NON
2.6/2.5	<u>20</u> *	<u>5.4</u> *	<u>12</u> *	25.0	NON
<i>Big Run (22-101)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/MWH proposed</i>				
0.1	28*	NA	F*	28.0	NON/Full
<i>Little Beaver Creek (22-103)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/MWH proposed</i>				
4.7	<u>24</u> *	NA	F*	41.0	NON/Partial
<i>Little Bear Creek (22-104)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/MWH proposed</i>				
0.1	<u>18</u> *	NA	<u>P</u> *	34.5	NON/NON
<i>Hardin Creek (22-106)</i>					
	<i>Eastern Corn Belt Plains WWH (Existing)/MWH proposed</i>				
3.2	<u>20</u> *	NA	F*	41.0	NON/NON
1.0	<u>26</u> *	NA	F*	26.5	Non/Full

RIVER MILE Fish/Invert.	IBI	MIwb	ICI	QHEI	Attainment Status
Coldwater Creek (22-107)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
8.2	<u>20</u> *	NA	F*	32.5	NON/Partial
7.5	<u>18</u> *	NA	<u>P</u> *	32.0	NON/NON
5.2	<u>18</u> *	NA	<u>P</u> *	32.5	NON/NON
2.4/2.3	28*	NA	F*	42.5	NON/Partial
0.6 ^A /0.3	<u>21</u> *	8.9	<u>VP</u> *	44.0	NON/NON
Burntwood Creek (22-108)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
3/3.1	<u>20</u> *	NA	<u>P</u> *	29.0	NON/NON
Beaver Creek (22-109)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
4.4/4.5	<u>20</u> *	NA	<u>P</u> *	48.5	NON/NON
3.5	<u>22</u> *	NA	<u>VP</u> *	40.5	NON/NON
0.7 ^A /1.5	28*	8.4 ^{ns}	<u>VP</u> *	40.5	NON/NON
Prairie Creek [Beaver] (22-111)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/LRW proposed				
3.1	<u>12</u> * _{flow}	NA	<u>VP</u> *	14.0	NON/NON
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
0.1	<u>16</u> *	NA	F*	28.0	NON/NON
Prairie Creek [Lake] (22-112)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
1.6 ^A	32*	8.9	<u>VP</u> *	46.0	NON/NON
Mississinewa River					
	<i>Eastern Cornbelt Plains</i> MWH (Existing)				
114.9/114.8	28	NA	<u>P</u> *	32.0	Partial
113.8/114.2	36	NA	<u>P</u> *	29.0	Partial
111.5	40	NA	<u>P</u> *	34.0	Partial
108.5	28	5.9	22	31.5	Full
Jordan Ditch (22-201)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/Primary Headwater proposed				
4.2	<u>20</u> *	NA	<u>VP</u> *	43.0	NON/deferred
Grays Branch (22-202)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/Primary Headwater proposed				
3.2	<u>26</u> *	NA	MG	40.5	Partial/deferred
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
0.6	30*	NA	MG	29.0	Partial/Full
Trib to Mississinewa (22-203)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/LRW proposed				
0.3	<u>12</u> * _{flow}	NA	F	25.0	NON/Full
Grand Lake St. Marys (22-999)					
	<i>Eastern Corn Belt Plains</i> EWH (Existing)				
17.7	31	9.2	VP	44.0	No applicable criteria
16.7	32	8.6	VP	46.0	No applicable criteria
15.6	29	6.5	VP	51.5	No applicable criteria
15.1	30	8.5	VP	53.5	No applicable criteria
Barnes Creek (04-535)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
0.5	-- _{flow}	--	<u>P</u> *	--	(NON/NON)

RIVER MILE Fish/Invert.	IBI	MIwb	ICI	QHEI	Attainment Status
Little Chickasaw Creek (04-521)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/LRW proposed				
2.2	-- _{flow}	--	<u>VP*</u>	--	NON/NON
	<i>Eastern Corn Belt Plains</i> MWH (Existing)				
0.2/0.5 ^A	<u>27*</u>	8.1 ^{ns}	<u>VP*</u>	46.5	NON
Chickasaw Creek (04-522)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/MWH proposed				
5.4	<u>20*</u>	NA	F*	28.5	NON/NON
4.2	<u>22*</u>	NA	F*	35.5	NON/Partial
1.3 ^A	<u>29*</u>	7.9 ^{ns}	<u>VP*</u>	24.5	NON/NON
East Fork Chickasaw Creek (04-521)					
	<i>Eastern Corn Belt Plains</i> WWH (Existing)/Primary Headwater proposed				
0.2	<u>24*</u>	NA	F*	34.0	NON/deferred

^A Boat sampling method

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

^{ns} Nonsignificant departure from biocriteria (≤4 IBI or ICI units or ≤0.5 MIwb units)

_{flow} Performance limited by lack of water

Notes:

- The Modified Index of Well-Being (MIwb) is not applicable (NA) to headwater site types
- A qualitative narrative evaluation used when quantitative data were not available or unreliable due to current velocities less than 0.3 fps flowing over the artificial substrates (P = Poor, F = Fair, MG = Marginally Good, G = Good, VG = Very Good, E = Exceptional)
- Use attainment status based on one organism group is parenthetically expressed

Narrative ranges and WWH biocriteria (bold) for Ohio ecoregions. Exception (EWH biocriteria), very good (EWH nonsignificant departure), poor and very poor evaluations are common statewide. For WWH, the ranges of marginally good and nonsignificant departure are the same (except in HELP).

IBI			MIwb		ICI	Narrative Evaluation
Headwater	Wading	Boat	Wading	Boat	All	
50-60	50-60	48-60	≥9.4	≥9.6	46-60	Exceptional
46-49	46-49	44-47	8.9-9.3	9.1-9.5	42-44	Very Good
<i>Eastern Corn Belt Plains</i>						
40-45	40-45	42-43	8.3-8.8	8.5-9.0	36-40	Good
36-39	36-39	38-41	7.8-8.2	8.0-8.4	32-34	Marginally Good
28-35	28-35	26-37	5.9-7.7	6.4-7.9	14-30	Fair
18-27	18-27	16-25	4.5-5.8	5.0-6.3	2-12	Poor
12-17	12-17	12-15	0-4.4	0-4.9	<2	Very Poor

Biocriteria for LRW and MWH (channel modified and impounded) aquatic life uses.

Criteria for EFW and FFW (Channel Modified and Impounded) Aquatic life uses						
IBI			MIwb		ICI	Type
Headwater	Wading	Boat	Wading	Boat	All	
All ecoregions						
18	18	18	4.0	4.0	8	Limited Resource Water
All ecoregions except HELP						
24	24	24	6.2	5.8	22	Channel Modified
--	--	30	--	6.6	--	Impounded

References

Carlson, R.E. 1977. A trophic state index for lakes. *Limnology and Oceanography* 22:361-369.