

4.0 SUBWATERSHED INFORMATION

4.1 Grand Lake St. Marys Subwatersheds

4.1.1 Coldwater Creek

The Coldwater Creek subwatershed drains the western border of the Grand Lake St. Marys drainage basin. The entire subwatershed is located in Mercer County. The acres, square miles and percent of sub-watershed are shown below. The Coldwater Creek Subwatershed, according to percentages, is the third largest of the seven subwatersheds draining to Grand Lake St. Marys. Of the entire Grand/Lake Wabash Watershed, it is the sixth largest of fifteen subwatersheds.

TABLE 12

COLDWATER CREEK	
Acreage	12,366
Square Miles	19.32
% of Grand Lake Watershed Total Land Area	21.0%
% of Grand Lake/Wabash Watershed Total Land Area	6.9%

Water Quality Status

Coldwater Creek, composed of the upper, west fork and lower sections, and including Burntwood Creek has been designated as a warm water habitat (WWH). This aquatic life use designation has been established by the EPA and based on recent data sampling, the water resource is shown as not meeting that use designation, or in a “non-attainment” status. Furthermore, the Coldwater Creek subwatershed has been shown to be NPS impacted. Suspected or proven impacts to these streams include: non-irrigated crop production, animal feeding operations, channelization, removal of riparian vegetation and stream bank destabilization. Definitions and criteria for these descriptives can be found in Appendix C- Aquatic life use designations and assessment terms.

Ohio EPA is currently completing a TMDL report for Beaver Creek and Grand Lake St. Marys, which is in process of being finalized. The draft report calls for phosphorus, nitrate and fecal coliform reduction upwards of 80% to 90% within the Coldwater Creek subwatershed. Detailed information on the sampling results and recommended load reductions can be found in the draft report of the 2007 Ohio EPA TMDL report, which can be obtained by contacting the watershed project office.

Water Supplies and Discharges

There are two community water supplies located in the Coldwater Creek subwatershed. These supplies are the Village of Coldwater and the Village of St. Henry. Also located in the subwatershed is one transient non-community public water supply, which is the VFW Post #5135. Additionally, there is one indirect discharge permit issued to Cooper Farms Processing Facility.

The Village of St Henry Wastewater Treatment Plant (WWTP) discharges to Coldwater Creek as does the stormwater from both the Village of St Henry (draining to three intermittent tributaries) and the eastern and southern portions of the Village of Coldwater.

Based on recent aerial photographs, areas where 10 or more household wastewater treatment and disposal systems were present in close proximity were identified. As with any individual treatment system operating in an area with poorly drained soils, the effects of the effluent on the receiving water body is a concern. These effects grow as the number of systems in a given area increases, thus clusters or groups of 10 or more systems has been used to analyze the potential effects of those systems on the water quality. Regarding Coldwater Creek subwatershed, there were a total of six clusters identified comprised of 75 individual treatment systems.

Highly Erodible Land

Map 27A at the end of this subsection illustrates the highly erodible land locations within the Coldwater Creek subwatershed. Of the seven subwatersheds within the Grand Lake St. Marys watershed, Coldwater Creek ranks third highest in the amount of highly erodible land present within the subwatershed. The highly erodible land information was developed from the 2003 online NRCS Soil Data Mart.

Riparian Corridor Status

The chart on the following page shows the riparian corridor status for the Coldwater Creek subwatershed. The chart indicates the number of miles of each drainage unit that has various widths of tree canopy, or riparian corridor. The numbers account for both sides of the streams; therefore, the number of actual stream miles is half of that shown. The divisions are less than 10 feet in total width, 10 to 40 feet in total width, and greater than 40 feet in total width. The chart is also divided into perennial and intermittent streams under each of the corridor width column headings. MAP 28 illustrates the stream sections under each division.

The chart shows that with a total of 41.08 miles of stream network, the Coldwater Creek subwatershed has 16.18 miles of stream with less than 10 feet of canopy and vegetation, 3.03 miles of stream with 10 to 40 feet canopy and vegetation, and 21.87

miles of stream with greater than 40 feet of canopy and vegetation. The Coldwater Creek subwatershed has the largest number of stream miles within the Grand Lake St. Marys Watershed, which is 29.3%. Of the entire Grand Lake/Wabash Watershed, this subwatershed has the sixth highest number of stream miles, which is 5.8%.

TABLE 13
Riparian Corridor Status

COLDWATER CREEK										
RIPARIAN STATUS	TREE CANOPY <10' IN TOTAL WIDTH			TREE CANOPY 10 to 40' IN WIDTH			TREE CANOPY >40' IN WIDTH			TOTAL STREAM MILES
	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	
	5.80	10.38	16.18	2.46	0.57	3.03	7.54	14.33	21.87	41.08
% of Subwatershed Total	14.1%	25.3%	39.4%	6.0%	1.4%	7.4%	18.4%	34.9%	53.2%	100.0%
% of Grand Lake Watershed Total	4.1%	7.4%	11.5%	1.8%	0.4%	2.2%	5.4%	10.2%	15.6%	29.3%
% of Grand Lake/Wabash Watershed Total	0.8%	1.5%	2.3%	0.3%	0.1%	0.4%	1.1%	2.0%	3.1%	5.8%

Operations and Animal Units

The table on the following page shows the number of operations and the animal units by species for the Coldwater Creek subwatershed. According to the table, there are seven poultry operations, 14 dairy operations, six hog operations, 24 beef operations and four horse operations within the entire subwatershed. The Coldwater Creek subwatershed ranks eighth within the entire Grand Lake/Wabash River Watershed when considering the total number of operations with 55 or 5.6%. Animal units within the subwatershed ranks sixth of 15 with 4.8%.

Totals of animal units for each species are also listed on the table. The inventory for this subwatershed was completed during March of 2007. At the time of the inventory animal units were determined by the number of animals present. Although this is not a 1:1 ratio for all species, it is for beef cattle. The following chart shows the number of each type of animal that makes up 1,000 animal units.

Animal Type	1,000 Animal Unit Equivalent
Beef Cattle	1,000
Dairy Cattle	700
Hogs (over 55 lbs)	2,500
Turkeys	55,000
Layer Chickens	82,000
Pullet Chickens	125,000
Sheep	10,000
Horses	500

TABLE 14
Operations and Animal Units

COLDWATER CREEK														
ANIMAL TYPE	POULTRY		DAIRY		HOG		BEEF		OTHER		TOTAL		Total as % of Grand Lake Watershed	
	# OPER.	# A.U.s	# OPER.	# A.U.s										
# Farms and Animals	4	10,385	14	2,214	6	1,140	24	2,147	(sheep)	0	55	16,478	18.5%	15.7%
	(Trky) 3	545							(hrs) 4	46				
% of subwatershed total	12.7%	66.3%	25.5%	13.4%	10.9%	6.9%	43.6%	13.0%	7.3%	0.3%	100.0%	100.0%		
Total as % of Grand Lake Watershed	2.3%	10.4%	4.7%	2.1%	2.0%	1.1%	8.1%	2.0%	1.3%	0.0%	18.5%	15.7%		
Total as % of Grand Lake/Wabash Watershed	0.71%	3.20%	1.42%	0.65%	0.61%	0.33%	2.43%	0.63%	0.40%	0.01%	5.56%	4.82%		

Manure Production

After considering the number of livestock operations and animal units present in the watershed, it is only fitting to consider the by-products of these animals. The table on the opposite page is used to represent the manure and nutrient production for the Coldwater Creek drainage area. The Coldwater Creek subwatershed ranks sixth overall, of 15, in terms of manure production per annum. Approximately 99,524 tons of manure is produced annually. The remainder of the columns on the table indicates the approximate pounds of nutrients contained in that manure. Nitrogen, potassium, and phosphate, are all important to the agricultural community and are provided to the crops via manure or commercial fertilizer applications.

These nutrients are also important in regards to water quality. According to the table, in the Coldwater Creek subwatershed, the amount of phosphorus that is contained in the manure produced annually would need to be applied at 124 pounds per acre. The table below indicates the average crop removal rates for phosphorus for the major crops produced in the watershed. Values were obtained from the Ohio Agronomy Guide.

CROP	P₂O₅ REMOVAL (lb/ac)
Alfalfa (6T)	80
Corn (150 bu) Grain	55
Corn (25 T) Silage	80
Soybean (50 bu)	40
Wheat (75 bu) Grain	48

Considerations are given to the nutrient phosphorus due to its importance to crop production and the problems associated with the relationship between excessive phosphorus applications and degradation of water quality. Because much of the poultry manure is brokered out of the watershed, it seemed important to reflect the nutrient values assuming that 70% of the poultry manure is moved to locations outside the watershed. Local manure haulers estimated this value to be 90%; however, to be conservative, 70% was assumed for this plan. Under this assumption, the amount of phosphorus that is contained in the manure produced annually in this subwatershed would need to be applied at 63 pounds per acre.

What this seems to indicate throughout the watershed is that according to manure production and crop removal rates for limiting nutrient factors, there are not enough acres for proper manure application methods. The caveat on this statement is that the numbers are best estimates, variations in soil types and tith can vary throughout the fields which may increase, or decrease, crop removal rates, and more importantly, some of the manure produced in each of the subwatershed may be applied to acreages outside of that subwatershed, or even outside of the Grand Lake St Marys watershed. It should be noted that several producers own or rent land both in the Grand Lake St Marys watershed and in neighboring watersheds such as Loramie Creek, Wabash River, or the St Marys River.

TABLE 15
Manure and Nutrient Production

COLDWATER CREEK						
Manure Production	Tons Raw Manure/Year	Lbs. N per Year	Lbs. K ₂ O per Year	Lbs. P ₂ O ₅ per Year	Acres Cropland	Lbs. P ₂ O ₅ per Crop Acre
	99,524	1,686,340	1,059,470	1,268,956	10,271	124
Less 70% Poultry Manure**	72,867	971,303	694,543	652,040	10,271	63
Approximate \$ Value Per Year		\$370,995	\$158,921	\$253,791		
Total Nutrient Value Per Year = \$783,707						

**Based on conversations with poultry manure brokers, it was estimated that at least 70% of the poultry manure is brokered out of the watershed.

The dollar values associated with each nutrient were obtained from OSU Extension Bulletin 604-06, "Ohio Livestock Manure Management Guide." The value for nitrogen is estimated at \$0.22 per pound, the value for P₂O₅ is \$0.20 per pound and the value for K₂O is \$0.15 per pound.

Distance Between Livestock Operations and Streams

The table on the following page shows the distance between various livestock operations located in the Coldwater Creek subwatershed and the waterways that drain to Coldwater Creek and eventually Grand Lake St. Marys. It can be assumed that the greater the distance between a livestock operation and a water system, the potential of pollution from the operation reaching the stream is lessened.

Of notable interest is the number of all livestock operations located less than 1,000 feet from the waterbody. In this particular subwatershed, out of 55 operations, 36 operations, or 65.5%, fall into the category. Also, 19 operations, 34.5%, are in within 2,000 feet and there are no operations less than 3,000 feet from the nearest stream.

TABLE 16
Livestock Operations and Proximity to Streams

COLDWATER CREEK																		
ANIMAL TYPE	POULTRY			DAIRY			HOG			BEEF			OTHER			TOTAL		
	Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream		
	<1000'	<2000'	<3000'															
	5	2	0	10	4	0	3	3	0	15	9	0	3	1	0	36	19	0
% of Subwatershed Total	9.1%	3.6%	0.0%	18.2%	7.3%	0.0%	5.5%	5.5%	0.0%	27.3%	16.4%	0.0%	5.5%	1.8%	0.0%	65.5%	34.5%	0.0%

Non-Point Source Pollution Potential

In order to provide a comparison of the pollution potential of each of the 15 subwatersheds, a ranking system for each of the main potential pollution sources was developed. These potential sources are stream miles with less than 10 feet of vegetation, the number of livestock or poultry operations less than 1,000 feet from a stream, the tons of raw manure produced yearly, the pounds of phosphorus per cropland acre available from the manure, the number of household wastewater disposal systems contained in clusters of ten or more) and the number of homes built pre-1973. Values of 1 (less potential) to 10 (great potential) were given based on ranges shown in the table of the following page. Indicator scores are then summed to obtain a total pollution potential score for the subwatershed.

Subwatershed pollution potential scores can range from a maximum of 60 points to a minimum of six points. The Coldwater Creek subwatershed ranks seventh out of 15, with 55% of the maximum points for pollution potential. Most significantly for the subwatershed is the number of household disposal systems in groups of 10 or more and the number of livestock operations less than 1,000 feet from a stream. Coldwater Creek subwatershed scored eight points out of 10 for both indicators.

NONPOINT SOURCE POLLUTION POTENTIAL SCORING MATRIX

MAXIMUM DRAINAGE UNIT SCORE = 60 (Highest Pollution Potential)

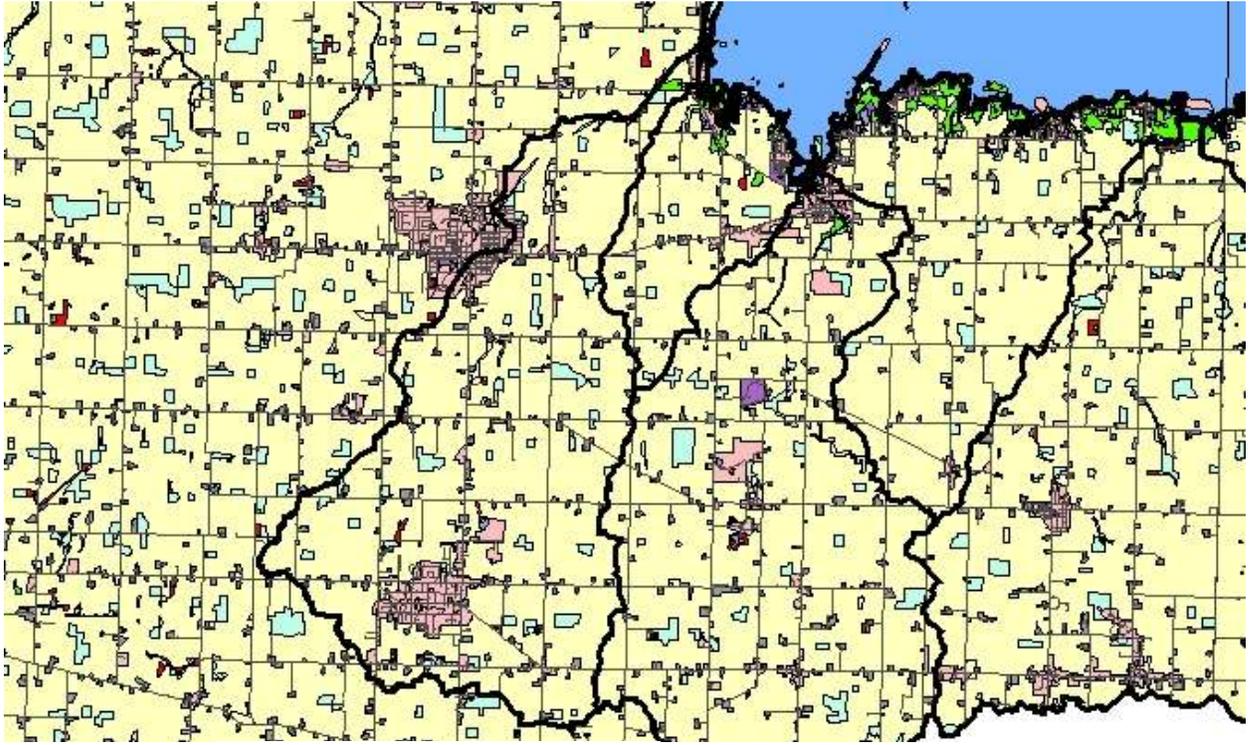
SCORE	Stream Miles with <10' Vegetation	Operations <1,000' to stream	Tons Raw Manure per Year	Lbs. P ₂ O ₅ per Crop Acre	Household Disposal Systems in Groups	No. Homes Built pre-1973
10	72.00+	46+	180,000+	225+	90+	226+
9	64.00 - 71.99	41 - 45	160,000 - 179,999	200 - 224	80 - 89	201 -225
8	56.00 - 63.99	36 - 40	140,000 - 159,999	175 - 199	70 - 79	176 -200
7	48.00 - 55.99	31 - 35	120,000 - 139,999	150 - 174	60 - 69	151 - 175
6	40.00 - 47.99	26 - 30	100,000 - 119,999	125 - 149	50 - 59	126 - 150
5	32.00 - 39.99	21 - 25	80,000 - 99,999	100 - 124	40 - 49	101 - 125
4	24.00 - 31.99	16 - 20	60,000 - 79,999	75- 99	30 - 39	76 - 100
3	16.00 - 23.99	11 - 15	40,000 - 59,999	50 - 74	20 - 29	51 - 75
2	8.00 - 15.99	6 - 10	20,000 - 39,999	25 - 49	10 - 19	26 - 50
1	0.00 - 7.99	0 - 5	0 - 19,999	0 - 24	0 - 10	0 - 25

MINIMUM DRAINAGE UNIT SCORE = 6 (Lowest Pollution Potential)

TABLE 17
NPS Pollution Potential

COLDWATER CREEK							
SUBWATERSHED ATTRIBUTE	Stream Miles with <10' Vegetation SCORE	Operations <1,000' to stream SCORE	Tons Raw Manure per Year SCORE	Lbs. P ₂ O ₅ per Crop Acre SCORE	Household Disposal Systems in Groups SCORE	No. Homes Built pre-1973 SCORE	TOTAL SCORE
	3	8	5	3	8	6	33

MAP 28
Coldwater Creek Land Use



Legend

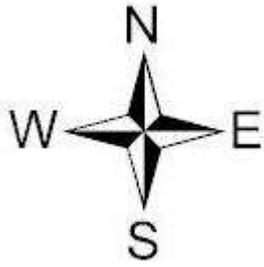
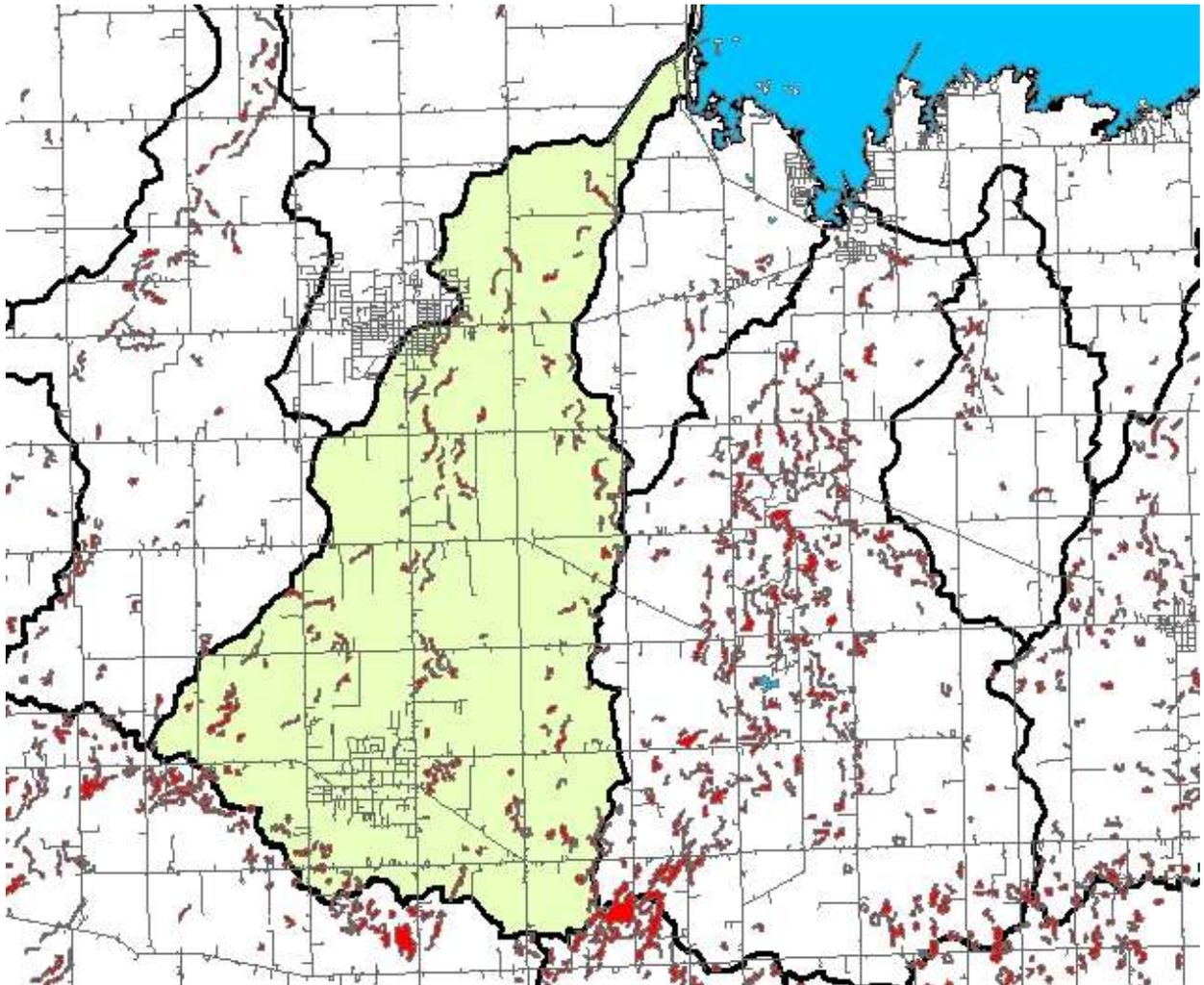
-  Grand Lake/Wabash Watershed
-  Roadways

Land Use

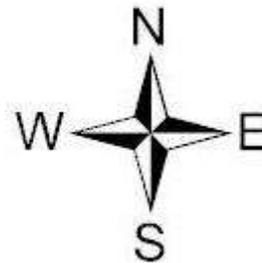
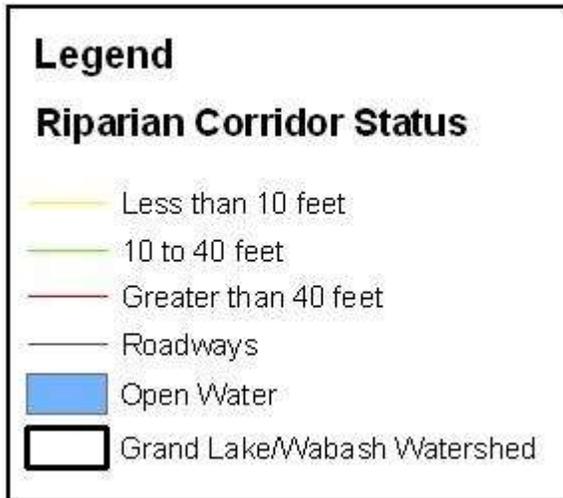
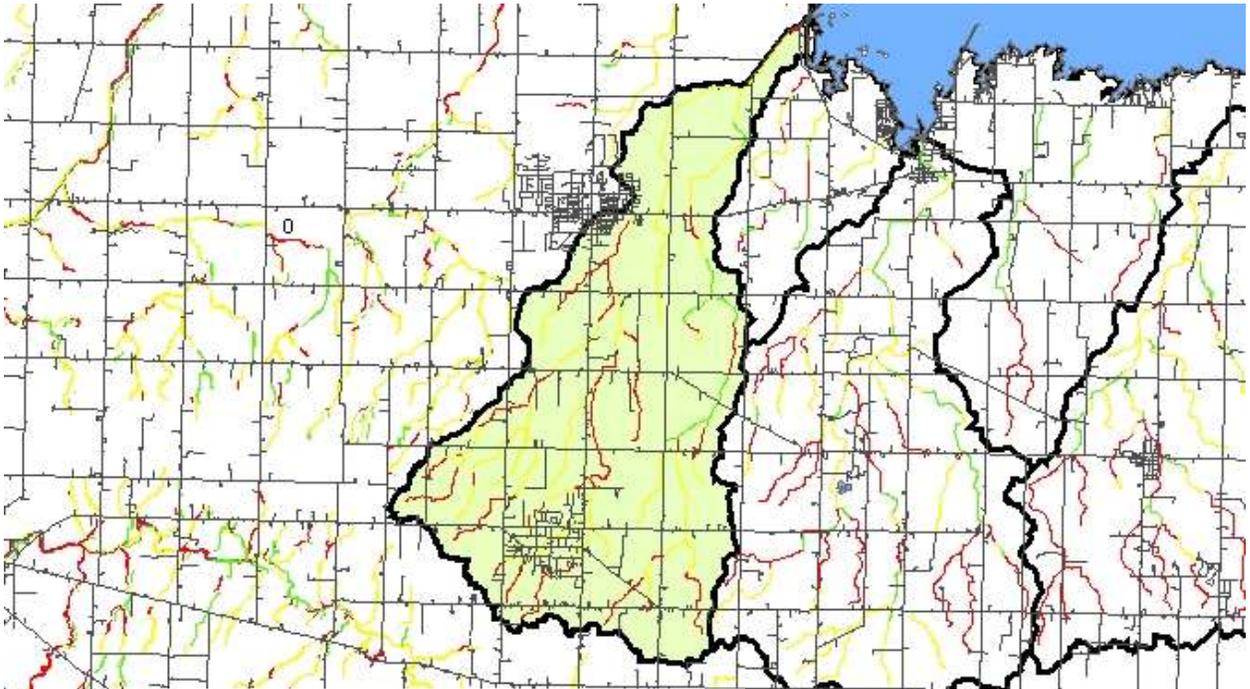
-  Cropland
-  Urban
-  Farmsteads
-  Shrub_Brush
-  Deciduous Forest
-  Open Water
-  Wetlands
-  Barren/Undeveloped



MAP 29
Coldwater Creek Highly Erodible Land



MAP 30
Coldwater Creek Riparian Corridor Status



4.1.2 Grassy/Monroe Creeks

The Grassy and Monroe Creeks drain a small portion of the Grand Lake St. Marys drainage basin along the southwestern edge of the lake. The entire subwatershed is located in Mercer County. The acres, square miles and percent of sub-watershed are shown below. The Grassy/Monroe Creeks subwatershed, according to percentages, is the second smallest of the seven subwatersheds draining to Grand Lake St. Marys. Of the entire Grand/Lake Wabash Watershed, it is the thirteenth largest of fifteen subwatersheds.

TABLE 18

GRASSY/MONROE CREEKS	
Acreage	3,164
Square Miles	4.94
% of Grand Lake Watershed Total Land Area	5.4%
% of Grand Lake/Wabash Watershed Total Land Area	1.8%

Water Quality Status

Grassy and Monroe Creeks have been designated as a warm water habitat (WWH). This aquatic life use designation has been established by the EPA and based on recent data sampling, the water resource is shown as not meeting that use designation, or in a “non-attainment” status. Furthermore, the subwatershed has been shown to be NPS impacted. Suspected or proven impacts to these streams include: non-irrigated crop production, animal feeding operations, channelization, removal of riparian vegetation and stream bank destabilization. Definitions and criteria for these descriptives can be found in Appendix C- Aquatic life use designations and assessment terms.

Ohio EPA is currently completing a TMDL report for Beaver Creek and Grand Lake St. Marys, which is in process of being finalized. The draft report does not call for specific load reductions in the Grassy/Monroe Creeks subwatershed; however, it does call for load reductions of phosphorus, nitrate and fecal coliform in the surrounding subwatersheds. Detailed information on the sampling results and recommended load reductions can be found in the draft report of the 2007 Ohio EPA TMDL report, which can be obtained by contacting the watershed project office.

Water Supplies and Discharges

There are no community water supplies currently located within the boundaries of the Grassy/Monroe subwatershed. There are, however, five transient non-community water supplies, which are TSC Store #240, Its It Landing PWS, Kozy Campground, Kozy Campground Well #2, and the Montezuma Bay Resort. S & K Products is listed as the

only non-transient, non-community public water supplier in this subwatershed, and there are no Ohio EPA NPDES discharge permitted facilities located in this subwatershed.

Based on recent aerial photographs, areas where 10 or more household wastewater treatment and disposal systems were present in close proximity were identified. As with any individual treatment system operating in an area with poorly drained soils, the effects of the effluent on the receiving water body is a concern. These effects grow as the number of systems in a given area increases, thus clusters or groups of 10 or more systems has been used to analyze the potential effects of those systems on the water quality. Regarding Grassy/Monroe Creeks subwatershed, there were no clusters identified.

Highly Erodible Land

Map 30 at the end of this subsection illustrates the highly erodible land locations within the Grassy/Monroe Creeks subwatershed. Of the seven subwatersheds within the Grand Lake St. Marys watershed, Grassy/Monroe Creeks ranks sixth highest in the amount of highly erodible land present within the subwatershed. The highly erodible land information was developed from the 2003 online NRCS Soil Data Mart.

Riparian Corridor Status

The chart on the following page shows the riparian corridor status for the Grassy/Monroe Creeks subwatershed. The chart indicates the number of miles of each drainage unit that has various widths of tree canopy, or riparian corridor. The numbers account for both sides of the streams; therefore, the number of actual stream miles is half of that shown. The divisions are less than 10 feet in total width, 10 to 40 feet in total width, and greater than 40 feet in total width. The chart is also divided into perennial and intermittent streams under each of the corridor width column headings. MAP 31 illustrates the stream sections under each division.

The chart shows that with a total of 4.43 miles of stream network, the Grassy/Monroe Creeks subwatershed has 1.36 miles of stream with less than 10 feet of canopy and vegetation, 1.36 miles of stream with 10 to 40 feet canopy and vegetation, and 1.71 miles of stream with greater than 40 feet of canopy and vegetation. The Grassy/Monroe Creeks subwatershed has the second least number of stream miles within the Grand Lake St. Marys Watershed, which is 3.2%. Of the entire Grand Lake/Wabash Watershed, this subwatershed has the second lowest number of stream miles, which is 0.6%.

TABLE 19
Riparian Corridor Status

GRASSY/MONROE CREEKS										
RIPARIAN STATUS	TREE CANOPY <10' IN TOTAL WIDTH			TREE CANOPY 10 to 40' IN WIDTH			TREE CANOPY >40' IN WIDTH			TOTAL STREAM MILES
	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	
	0.19	1.17	1.36	0.00	1.36	1.36	0.19	1.52	1.71	4.43
% of Subwatershed Total	0.5%	2.8%	3.3%	0.0%	3.3%	3.3%	0.5%	3.7%	4.2%	10.8%
% of Grand Lake Watershed Total	0.1%	0.8%	1.0%	0.0%	1.0%	1.0%	0.1%	1.1%	1.2%	3.2%
% of Grand Lake/Wabash Watershed Total	0.0%	0.2%	0.2%	0.0%	0.2%	0.2%	0.0%	0.2%	0.2%	0.6%

Operations and Animal Units

The table on the following page shows the number of operations and the animal units by species for the Grassy/Monroe Creeks subwatershed. According to the table, there are two poultry operations, four dairy operations, two hog operations, four beef operations and two horse operations within the entire subwatershed. The Grassy/Monroe Creeks subwatershed ranks twelfth within the entire Grand Lake/Wabash River Watershed when considering the total number of operations with 14 or 1.42%. Animal units within the subwatershed ranks thirteenth of 15 with 0.8%.

Totals of animal units for each species are also listed on the table. The inventory for this subwatershed was completed during February and March of 2007. At the time of the inventory animal units were determined by the number of animals present. Although this is not a 1:1 ratio for all species, it is for beef cattle. The following chart shows the number of each type of animal that makes up 1,000 animal units.

Animal Type	1,000 Animal Unit Equivalent
Beef Cattle	1,000
Dairy Cattle	700
Hogs (over 55 lbs)	2,500
Turkeys	55,000
Layer Chickens	82,000
Pullet Chickens	125,000
Sheep	10,000
Horses	500

TABLE 20
Operations and Animal Units

GRASSY/MONROE CREEKS														
ANIMAL TYPE	POULTRY		DAIRY		HOG		BEEF		OTHER		TOTAL		Total as % of Grand Lake Watershed	
	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s						
# Farms and Animals	0 (Trky) 2	0 327	4	543	2	1,360	4	480	(sheep) (hrs) 2	0 10	14	2,720	4.7%	2.6%
% of subwatershed total	14.3%	12.0%	28.6%	20.0%	14.3%	50.0%	28.6%	17.6%	14.3%	0.4%	100.0%	100.0%		
Total as % of Grand Lake Watershed	0.7%	0.3%	1.3%	0.5%	0.7%	1.3%	1.3%	0.5%	0.7%	0.0%	4.7%	2.6%		
Total as % of Grand Lake/Wabash Watershed	0.20%	0.10%	0.40%	0.16%	0.20%	0.40%	0.40%	0.14%	0.20%	0.00%	1.42%	0.80%		

Manure Production

After considering the number of livestock operations and animal units present in the watershed, it is only fitting to consider the by-products of these animals. The table on the opposite page is used to represent the manure and nutrient production for the Grassy/Monroe Creeks drainage area. The Grassy/Monroe Creeks subwatershed ranks twelfth overall, of 15, in terms of manure production per annum. Approximately 22,394 tons of manure is produced annually. The remainder of the columns on the table indicates the approximate pounds of nutrients contained in that manure. Nitrogen, potassium, and phosphate, are all important to the agricultural community and are provided to the crops via manure or commercial fertilizer applications.

These nutrients are also important in regards to water quality. According to the table, in the Grassy/Monroe Creeks subwatershed, the amount of phosphorus that is contained in the manure produced annually would need to be applied at 92 pounds per acre. The table below indicates the average crop removal rates for phosphorus for the major crops produced in the watershed. Values were obtained from the Ohio Agronomy Guide.

CROP	P₂O₅ REMOVAL (lb/ac)
Alfalfa (6T)	80
Corn (150 bu) Grain	55
Corn (25 T) Silage	80
Soybean (50 bu)	40
Wheat (75 bu) Grain	48

Considerations are given to the nutrient phosphorus due to its importance to crop production and the problems associated with the relationship between excessive phosphorus applications and degradation of water quality. Because much of the poultry manure is brokered out of the watershed, it seemed important to reflect the nutrient values assuming that 70% of the poultry manure is moved to locations outside the watershed. Local manure haulers estimated this value to be 90%; however, to be conservative, 70% was assumed for this plan. Under this assumption, the amount of phosphorus that is contained in the manure produced annually in this subwatershed would need to be applied at 73 pounds per acre.

What this seems to indicate throughout the watershed is that according to manure production and crop removal rates for limiting nutrient factors, there are not enough acres for proper manure application methods. The caveat on this statement is that the numbers are best estimates, variations in soil types and tith can vary throughout the fields which may increase, or decrease, crop removal rates, and more importantly, some of the manure produced in each of the subwatershed may be applied to acreages outside of that subwatershed, or even outside of the Grand Lake St Marys watershed. It should be noted that several producers own or rent land both in the Grand Lake St Marys watershed and in neighboring watersheds such as Loramie Creek, Wabash River, or the St Marys River.

TABLE 21
Manure and Nutrient Production

GRASSY/MONROE CREEKS						
Manure Production	Tons Raw Manure/Year	Lbs. N per Year	Lbs. K ₂ O per Year	Lbs. P ₂ O ₅ per Year	Acres Cropland	Lbs. P ₂ O ₅ per Crop Acre
	22,394	295,381	230,222	205,703	2,225	92
Less 70% Poultry Manure**	20,277	245,213	194,448	161,674	2,225	73
Approximate \$ Value Per Year		\$64,984	\$34,533	\$41,141		
Total Nutrient Value Per Year = \$140,658						

**Based on conversations with poultry manure brokers, it was estimated that at least 70% of the poultry manure is brokered out of the watershed.

The dollar values associated with each nutrient were obtained from OSU Extension Bulletin 604-06, "Ohio Livestock Manure Management Guide." The value for nitrogen is estimated at \$0.22 per pound, the value for P₂O₅ is \$0.20 per pound and the value for K₂O is \$0.15 per pound.

Distance Between Livestock Operations and Streams

The table on the following page shows the distance between various livestock operations located in the Grassy/Monroe Creeks subwatershed and the waterways that drain to Grassy and Monroe Creeks and eventually Grand Lake St. Marys. It can be assumed that the greater the distance between a livestock operation and a water system, the potential of pollution from the operation reaching the stream is lessened.

Of notable interest is the number of all livestock operations located less than 1,000 feet from the waterbody. In this particular subwatershed, out of 14 operations, six operations, or 42.9%, fall into the category. Also, four operations, 28.6%, are within 2,000 feet and the remaining 28.6%, four operations, are less than 3,000 feet from the nearest stream.

TABLE 22
Livestock Operations and Proximity to Streams

GRASSY/MONROE CREEKS																		
ANIMAL TYPE	POULTRY			DAIRY			HOG			BEEF			OTHER			TOTAL		
	Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream		
	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'
	1	1	0	1	2	1	1	0	1	3	0	1	0	1	1	6	4	4
% of Subwatershed Total	7.1%	7.1%	0.0%	7.1%	14.3%	7.1%	7.1%	0.0%	7.1%	21.4%	0.0%	7.1%	0.0%	7.1%	7.1%	42.9%	28.6%	28.6%

Non-Point Source Pollution Potential

In order to provide a comparison of the pollution potential of each of the 15 subwatersheds, a ranking system for each of the main potential pollution sources was developed. These potential sources are stream miles with less than 10 feet of vegetation, the number of livestock or poultry operations less than 1,000 feet from a stream, the tons of raw manure produced yearly, the pounds of phosphorus per cropland acre available from the manure, the number of household wastewater disposal systems contained in clusters of ten or more) and the number of homes built pre-1973. Values of 1 (less potential) to 10 (great potential) were given based on ranges shown in the table of the following page. Indicator scores are then summed to obtain a total pollution potential score for the subwatershed.

Subwatershed pollution potential scores can range from a maximum of 60 points to a minimum of six points. The Grassy/Monroe Creeks subwatershed ranks twelfth out of 15, with 20% of the maximum points for pollution potential.

NONPOINT SOURCE POLLUTION POTENTIAL SCORING MATRIX

MAXIMUM DRAINAGE UNIT SCORE = 60 (Highest Pollution Potential)

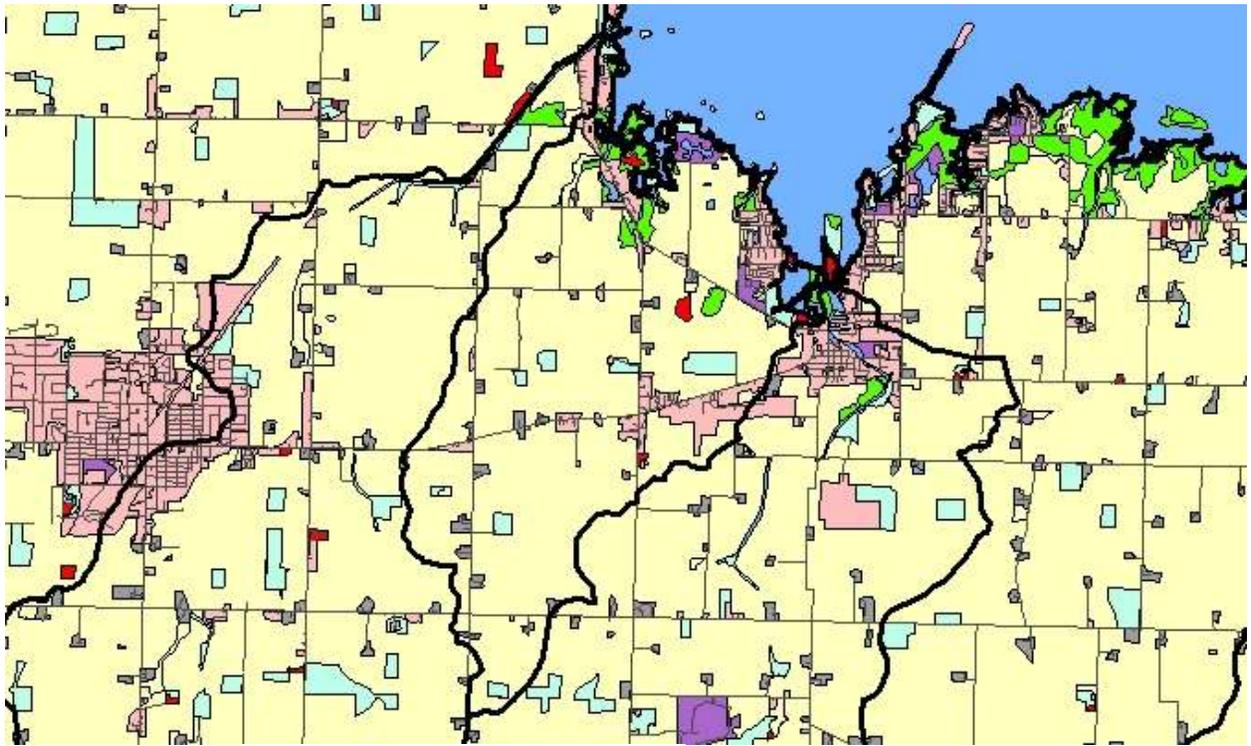
SCORE	Stream Miles with <10' Vegetation	Operations <1,000' to stream	Tons Raw Manure per Year	Lbs. P ₂ O ₅ per Crop Acre	Household Disposal Systems in Groups	No. Homes Built pre-1973
10	72.00+	46+	180,000+	225+	90+	226+
9	64.00 - 71.99	41 - 45	160,000 - 179,999	200 - 224	80 - 89	201 -225
8	56.00 - 63.99	36 - 40	140,000 - 159,999	175 - 199	70 - 79	176 -200
7	48.00 - 55.99	31 - 35	120,000 - 139,999	150 - 174	60 - 69	151 - 175
6	40.00 - 47.99	26 - 30	100,000 - 119,999	125 - 149	50 - 59	126 - 150
5	32.00 - 39.99	21 - 25	80,000 - 99,999	100 - 124	40 - 49	101 - 125
4	24.00 - 31.99	16 - 20	60,000 - 79,999	75- 99	30 - 39	76 - 100
3	16.00 - 23.99	11 - 15	40,000 - 59,999	50 - 74	20 - 29	51 - 75
2	8.00 - 15.99	6 - 10	20,000 - 39,999	25 - 49	10 - 19	26 - 50
1	0.00 - 7.99	0 - 5	0 - 19,999	0 - 24	0 - 10	0 - 25

MINIMUM DRAINAGE UNIT SCORE = 6 (Lowest Pollution Potential)

TABLE 23
NPS Pollution Potential

GRASSY/MONROE CREEKS							
SUBWATERSHED ATTRIBUTE	Stream Miles with <10' Vegetation SCORE	Operations <1,000' to stream SCORE	Tons Raw Manure per Year SCORE	Lbs. P ₂ O ₅ per Crop Acre SCORE	Household Disposal Systems in Groups SCORE	No. Homes Built pre-1973 SCORE	TOTAL SCORE
	1	2	2	3	1	3	12

MAP 31 Grassy/Monroe Land Use

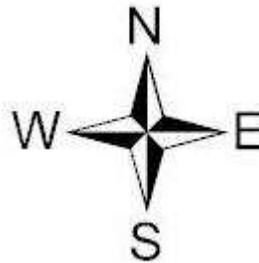


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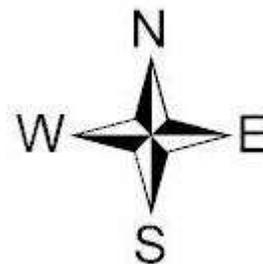
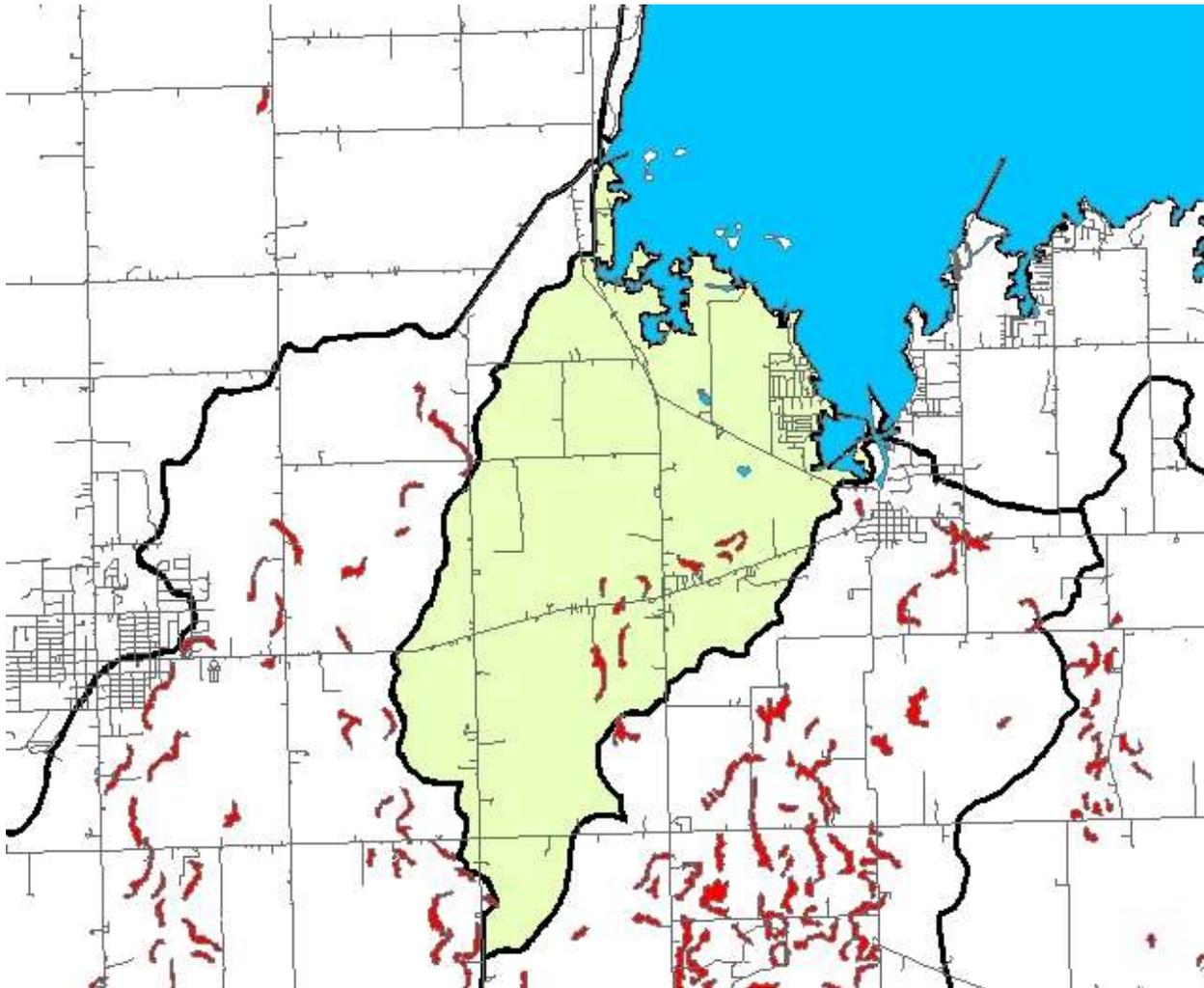
-  Grand Lake/Wabash Watershed
-  Roadways

Land Use

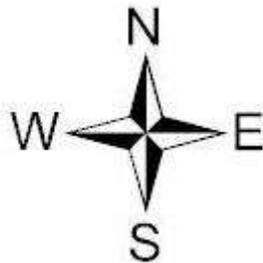
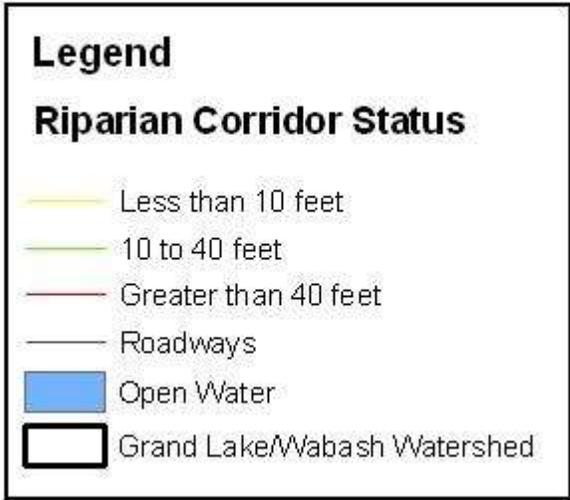
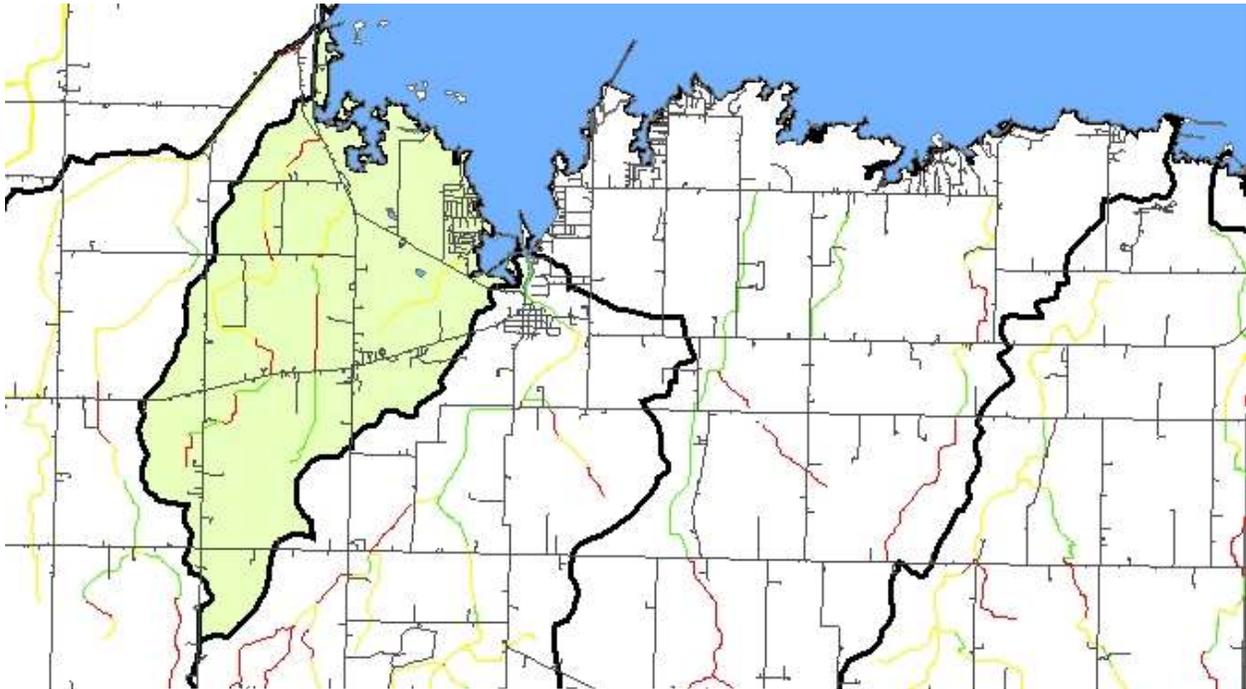
-  Cropland
-  Urban
-  Farmsteads
-  Shrub_Brush
-  Deciduous Forest
-  Open Water
-  Wetlands
-  Barren/Undeveloped



MAP 32
Grassy/Monroe Highly Erodible Land



MAP 33
Grassy/Monroe Riparian Corridor Status



4.1.3 Beaver Creek

The Beaver Creek subwatershed drains a large portion of the Grand Lake St. Marys drainage basin, south of the lake. The subwatershed is located entirely in Mercer County. The acres, square miles and percent of subwatershed are shown below. The Beaver Creek subwatershed, according to percentages, is the second largest of the seven subwatersheds draining to Grand Lake St. Marys. Of the entire Grand Lake/Wabash Watershed, it is the eighth largest of fifteen subwatersheds.

TABLE 24

BEAVER CREEK	
Acreage	13,059
Square Miles	20.40
% of Grand Lake Watershed Total Land Area	21.1%
% of Grand Lake/Wabash Watershed Total Land Area	7.3%

Water Quality Status

Beaver Creek, composed of the Dahlinghaus Ditch, Upper and Lower Beaver and the Montezuma Creeks has been designated as a warm water habitat (WWH). This aquatic life use designation has been established by the EPA and based on recent data sampling, the water resource is shown as not meeting that use designation or in a “non-attainment” status. Furthermore, Beaver Creek has been shown to be NPS impacted. Suspected or proven impacts to these streams include: non-irrigated crop production, animal feeding operations, channelization, removal of riparian vegetation and stream bank destabilization. Definitions and criteria for these descriptives can be found in Appendix C- Aquatic life use designations and assessment terms.

Ohio EPA is currently completing a TMDL report for Beaver Creek and Grand Lake St. Marys, which is in process of being finalized. The draft report calls for phosphorus, nitrate and fecal coliform reduction upwards of 80% to 90% within the Beaver Creek subwatershed. Detailed information on the sampling results and recommended load reductions can be found in the draft report of the 2007 Ohio EPA TMDL report, which can be obtained by contacting the watershed project office.

The Celina municipal waste landfill is located in the Beaver Creek subwatershed. The landfill began operation in 1971. The landfill utilizes leachate collection and monitoring wells for both the old and the new sections. The Old Bunker Hill Landfill site was utilized as a general purpose landfill and used to dispose of septic tank wastewater. The landfill ceased operation in 1969 and there are currently no monitoring of the leachate. Montezuma Creek runs adjacent to this site. This site is also listed on the Ohio EPA’s master sites list.

Water Supplies and Discharges

There is currently one community water supply located at St. Charles Seminary, and servicing approximately 75 people. Also located in the subwatershed are 10 transient non-community water supplies, Park Grand Resort, Arnies Corner & Drive Thru, Elks Club #2170-South, Starlight Drive-In Theater, Doc's Inn PWS, Niekamp Farm & Flea Market PWS, Bucks Inn PWS, Zuma Thru/Sunset Laundry/Car Wash PWS, Lake Shore Resort and Northmoor Landings. Furthermore, a non-transient non-community water supply is also located at the Franklin Elementary School. The Montezuma-Club Island WWTP, the Celina Landfill, Inc. and the Elks Club #2170-South are regulated by the Ohio EPA and are permitted to discharge to Beaver Creek.

Based on recent aerial photographs, areas where 10 or more household wastewater treatment and disposal systems were present in close proximity were identified. As with any individual treatment system operating in an area with poorly drained soils, the effects of the effluent on the receiving water body is a concern. These effects grow as the number of systems in a given area increases, thus clusters or groups of 10 or more systems has been used to analyze the potential effects of those systems on the water quality. Regarding Beaver Creek subwatershed, there were a total of five clusters identified, comprised of 92 individual systems.

Highly Erodible Land

Map 33 at the end of this subsection illustrates the highly erodible land locations within the Beaver Creek subwatershed. Of the seven subwatersheds within the Grand Lake St. Marys watershed, Beaver Creek ranks highest in the amount of highly erodible land present within the subwatershed. The highly erodible land information was developed from the 2003 online NRCS Soil Data Mart.

Riparian Corridor Status

The chart on the following page shows the riparian corridor status for the Beaver Creek subwatershed. The chart indicates the number of miles of each drainage unit that has various widths of tree canopy or riparian corridor. The divisions are less than 10 feet in total width, 10' to 25' in total width, and greater than 25' in total width. The chart is also divided into perennial and intermittent streams under each of the corridor width column headings. MAP 34 illustrates the stream sections under each division.

The chart shows that with a total of 35.61 miles of stream network, the Beaver Creek subwatershed has 12.68 miles of stream with less than 10' of canopy and vegetation, 7.16 miles of stream with 10 to 40 feet of canopy and vegetation, and 15.77 miles of stream with greater than 40 feet of riparian corridor. Overall, the Beaver Creek subwatershed has the third largest number of stream miles at 35.61, 25.4%, of the total stream miles for the Grand Lake St. Marys watershed. Of the entire Grand Lake/Wabash Watershed, this subwatershed has the eight highest number of stream miles at 5.0%.

TABLE 25
Riparian Corridor Status

BEAVER CREEK										
RIPARIAN STATUS	TREE CANOPY <10' IN TOTAL WIDTH			TREE CANOPY 10 to 40' IN WIDTH			TREE CANOPY >40' IN WIDTH			TOTAL STREAM MILES
	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	
	3.33	9.35	12.68	6.10	1.06	7.16	3.61	12.16	15.77	35.61
% of Subwatershed Total	8.1%	22.8%	30.9%	14.8%	2.6%	17.4%	8.8%	29.6%	38.4%	86.7%
% of Grand Lake Watershed Total	2.4%	6.7%	9.0%	4.3%	0.8%	5.1%	2.6%	8.7%	11.2%	25.4%
% of Grand Lake/Wabash Watershed Total	0.5%	1.3%	1.8%	0.9%	0.2%	1.0%	0.5%	1.7%	2.2%	5.0%

Operations and Animal Units

The table on the following page shows the number of operations and the animal units by species for the Beaver Creek subwatershed. According to the table, there are 15 poultry operations, 22 dairy operations, 25 hog operations, 25 beef operations and 4 horse operations within the entire subwatershed. The Beaver Creek subwatershed ranks fourth within the entire Grand Lake/Wabash River Watershed when considering the total number of operations with 91 or 9.2%. Animal units within the subwatershed ranks fourth of 15 with 9.1%.

Totals of animal units for each species are also listed on the table. The inventory for this subwatershed was completed during February and March of 2007. At the time of the inventory animal units were determined by the number of animals present. Although this is not a 1:1 ratio for all species, it is for beef cattle. The following chart shows the number of each type of animal that makes up 1,000 animal units.

Animal Type	1,000 Animal Unit Equivalent
Beef Cattle	1,000
Dairy Cattle	700
Hogs (over 55 lbs)	2,500
Turkeys	55,000
Layer Chickens	82,000
Pullet Chickens	125,000
Sheep	10,000
Horses	500

TABLE 26
Operations and Animal Units

BEAVER CREEK														
ANIMAL TYPE	POULTRY		DAIRY		HOG		BEEF		OTHER		TOTAL		Total as % of Grand Lake Watershed	
	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s
# Farms and Animals	5 (Trky) 10	10,829 1,855	22	3,471	25	11,616	25	3,310	(sheep) (hrs) 4	0 34	91	31,115	30.5%	29.6%
% of subwatershed total	16.5%	40.8%	24.2%	11.2%	27.5%	37.3%	27.5%	10.6%	4.4%	0.1%	100.0%	100.0%		
Total as % of Grand Lake Watershed	5.0%	12.1%	7.4%	3.3%	8.4%	11.0%	8.4%	3.1%	1.3%	0.0%	30.5%	29.6%		
Total as % of Grand Lake/Wabash Watershed	1.52%	3.71%	2.22%	1.02%	2.53%	3.40%	2.53%	0.97%	0.40%	0.01%	9.20%	9.11%		

Manure Production

After considering the number of livestock operations and animal units present in the watershed, it is only fitting to consider the by-products of these animals. The table on the opposite page is used to represent the manure and nutrient production for the Beaver Creek drainage area. The Beaver Creek subwatershed ranks fourth overall, of 15, in terms of manure production per annum. Approximately 191,231 tons of manure is produced annually. The remainder of the columns on the table indicates the approximate pounds of nutrients contained in that manure. Nitrogen, potassium, and phosphate, are all important to the agricultural community and are provided to the crops via manure or commercial fertilizer applications.

These nutrients are also important in regards to water quality. According to the table, in the Beaver Creek subwatershed, the amount of phosphorus that is contained in the manure produced annually would need to be applied at 196 pounds per acre. The table below indicates the average crop removal rates for phosphorus for the major crops produced in the watershed. Values were obtained from the Ohio Agronomy Guide.

CROP	P₂O₅ REMOVAL (lb/ac)
Alfalfa (6T)	80
Corn (150 bu) Grain	55
Corn (25 T) Silage	80
Soybean (50 bu)	40
Wheat (75 bu) Grain	48

Considerations are given to the nutrient phosphorus due to its importance to crop production and the problems associated with the relationship between excessive phosphorus applications and degradation of water quality. Because much of the poultry manure is brokered out of the watershed, it seemed important to reflect the nutrient values assuming that 70% of the poultry manure is moved to locations outside the watershed. Local manure haulers estimated this value to be 90%; however, to be conservative, 70% was assumed for this plan. Under this assumption, the amount of phosphorus that is contained in the manure produced annually in this subwatershed would need to be applied at 126 pounds per acre.

What this seems to indicate throughout the watershed is that according to manure production and crop removal rates for limiting nutrient factors, there are not enough acres for proper manure application methods. The caveat on this statement is that the numbers are best estimates, variations in soil types and tilth can vary throughout the fields which may increase, or decrease, crop removal rates, and more importantly, some of the manure produced in each of the subwatershed may be applied to acreages outside of that subwatershed, or even outside of the Grand Lake St Marys watershed. It should be noted that several producers own or rent land both in the Grand Lake St Marys watershed and in neighboring watersheds such as Loramie Creek, Wabash River, or the St Marys River.

TABLE 27
Manure and Nutrient Production

BEAVER CREEK						
Manure Production	Tons Raw Manure/Year	Lbs. N per Year	Lbs. K ₂ O per Year	Lbs. P ₂ O ₅ per Year	Acres Cropland	Lbs. P ₂ O ₅ per Crop Acre
	191,231	3,040,048	2,051,924	2,192,945	11,181	196
Less 70% Poultry Manure**	154,960	2,059,148	1,532,661	1,410,762	11,181	126
Approximate \$ Value Per Year		\$668,811	\$307,789	\$438,589		
Total Nutrient Value Per Year =	\$1,415,188					

**Based on conversations with poultry manure brokers, it was estimated that at least 70% of the poultry manure is brokered out of the watershed.

The dollar values associated with each nutrient were obtained from OSU Extension Bulletin 604-06, "Ohio Livestock Manure Management Guide." The value for nitrogen is estimated at \$0.22 per pound, the value for P₂O₅ is \$0.20 per pound and the value for K₂O is \$0.15 per pound.

Distance Between Livestock Operations and Streams

The table on the following page shows the distance between various livestock operations located in the Beaver Creek subwatershed and the waterways that drain to Beaver Creek and eventually Grand Lake St. Marys. It can be assumed that the greater the distance between a livestock operation and a water system, the potential of pollution from the operation reaching the stream is lessened.

Of notable interest is the number of all livestock operations located less than 1,000 feet from the waterbody. In this particular subwatershed, out of 89 operations, 45 operations, or 50.6%, fall into the category. Also, 25 operations, 28.1%, are within 2,000 feet and the remaining 21.3%, 19 operations, are less than 3,000 feet from the nearest stream.

TABLE 28
Livestock Operations and Proximity to Streams

BEAVER CREEK																		
ANIMAL TYPE	POULTRY			DAIRY			HOG			BEEF			OTHER			TOTAL		
	Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream		
	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'
	10	4	1	10	6	6	12	6	7	12	9	4	1	0	1	45	25	19
% of Subwatershed Total	11.2%	4.5%	1.1%	11.2%	6.7%	6.7%	13.5%	6.7%	7.9%	13.5%	10.1%	4.5%	1.1%	0.0%	1.1%	50.6%	28.1%	21.3%

Non-Point Source Pollution Potential

In order to provide a comparison of the pollution potential of each of the 15 subwatersheds, a ranking system for each of the main potential pollution sources was developed. These potential sources are stream miles with less than 10 feet of vegetation, the number of livestock or poultry operations less than 1,000 feet from a stream, the tons of raw manure produced yearly, the pounds of phosphorus per cropland acre available from the manure, the number of household wastewater disposal systems contained in clusters of ten or more) and the number of homes built pre-1973. Values of 1 (less potential) to 10 (great potential) were given based on ranges shown in the table of the following page. Indicator scores are then summed to obtain a total pollution potential score for the subwatershed.

Subwatershed pollution potential scores can range from a maximum of 60 points to a minimum of six points. The Beaver Creek subwatershed ranks third (tie) out of 15, with 73.3% of the maximum points for pollution potential. Most significantly for the subwatershed is the number of household disposal systems in groups of 10 or more and the tons of raw manure produced per year. The Beaver Creek subwatershed scored the maximum points for both indicators.

NONPOINT SOURCE POLLUTION POTENTIAL SCORING MATRIX

MAXIMUM DRAINAGE UNIT SCORE = 60 (Highest Pollution Potential)

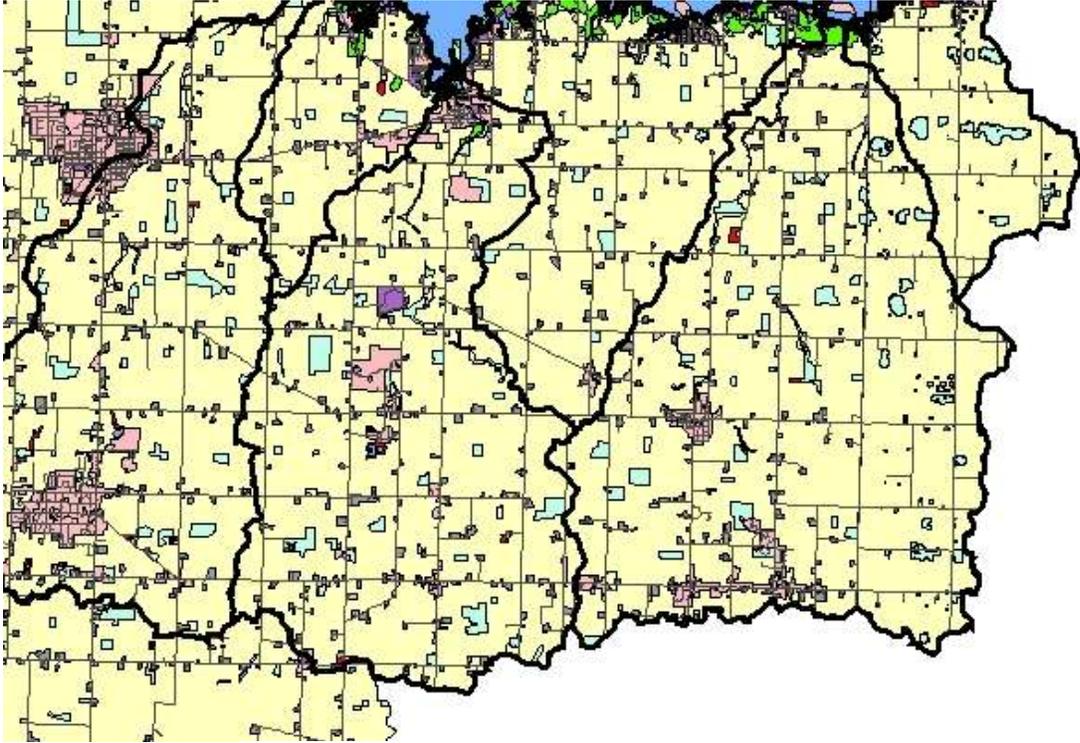
SCORE	Stream Miles with <10' Vegetation	Operations <1,000' to stream	Tons Raw Manure per Year	Lbs. P ₂ O ₅ per Crop Acre	Household Disposal Systems in Groups	No. Homes Built pre-1973
10	72.00+	46+	180,000+	225+	90+	226+
9	64.00 - 71.99	41 - 45	160,000 - 179,999	200 - 224	80 - 89	201 - 225
8	56.00 - 63.99	36 - 40	140,000 - 159,999	175 - 199	70 - 79	176 - 200
7	48.00 - 55.99	31 - 35	120,000 - 139,999	150 - 174	60 - 69	151 - 175
6	40.00 - 47.99	26 - 30	100,000 - 119,999	125 - 149	50 - 59	126 - 150
5	32.00 - 39.99	21 - 25	80,000 - 99,999	100 - 124	40 - 49	101 - 125
4	24.00 - 31.99	16 - 20	60,000 - 79,999	75 - 99	30 - 39	76 - 100
3	16.00 - 23.99	11 - 15	40,000 - 59,999	50 - 74	20 - 29	51 - 75
2	8.00 - 15.99	6 - 10	20,000 - 39,999	25 - 49	10 - 19	26 - 50
1	0.00 - 7.99	0 - 5	0 - 19,999	0 - 24	0 - 10	0 - 25

MINIMUM DRAINAGE UNIT SCORE = 6 (Lowest Pollution Potential)

TABLE 29
NPS Pollution Potential

BEAVER CREEK							
SUBWATERSHED ATTRIBUTE	Stream Miles with <10' Vegetation SCORE	Operations <1,000' to stream SCORE	Tons Raw Manure per Year SCORE	Lbs. P ₂ O ₅ per Crop Acre SCORE	Household Disposal Systems in Groups SCORE	No. Homes Built pre-1973 SCORE	TOTAL SCORE
	2	9	10	6	10	7	44

MAP 34
Beaver Creek Land Use

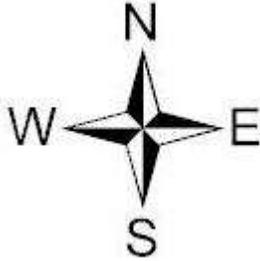


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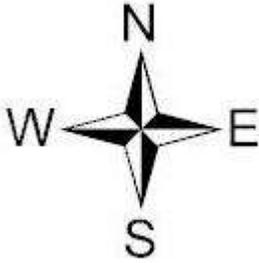
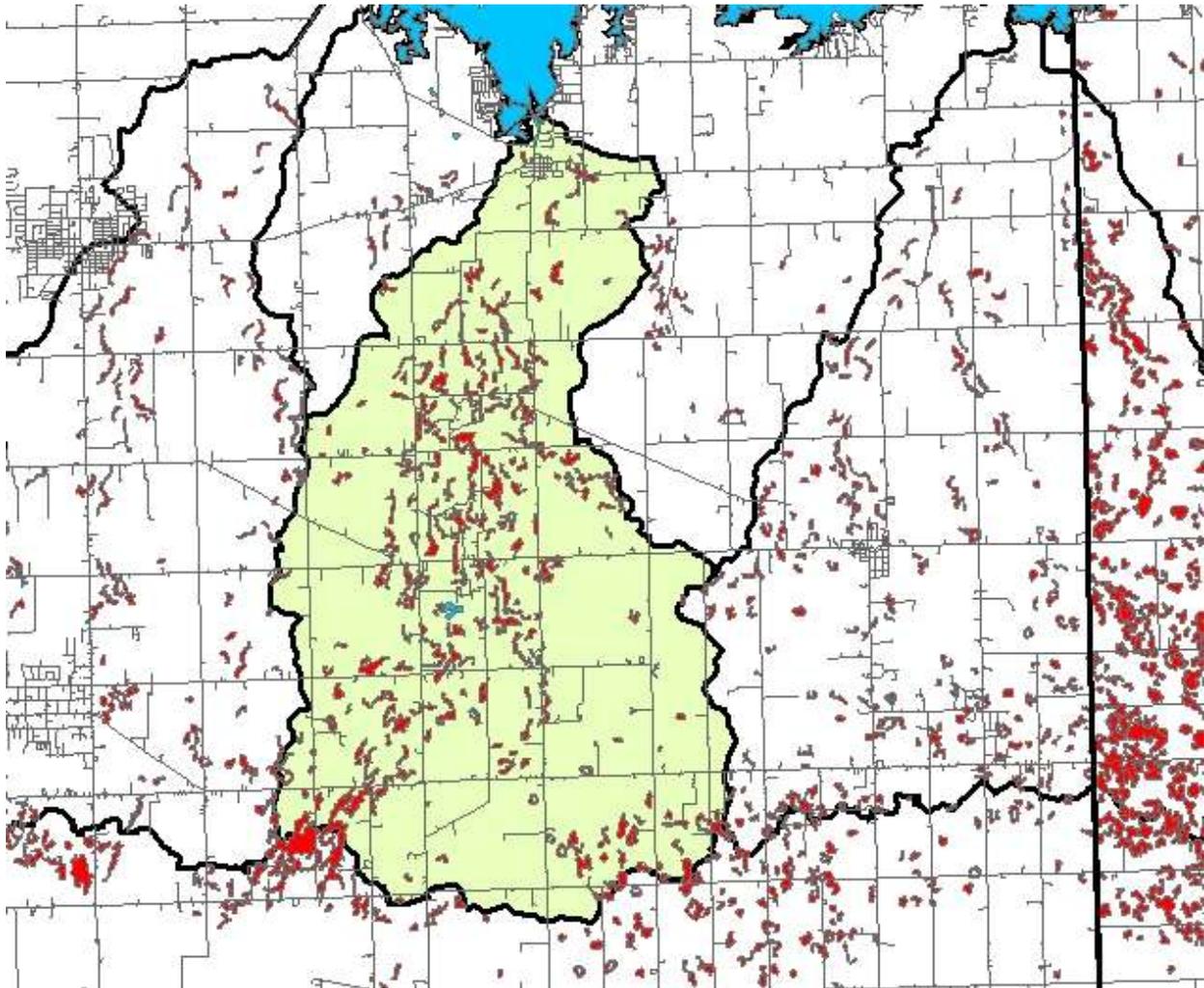
-  Grand Lake/Wabash Watershed
-  Roadways

Land Use

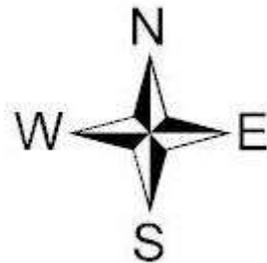
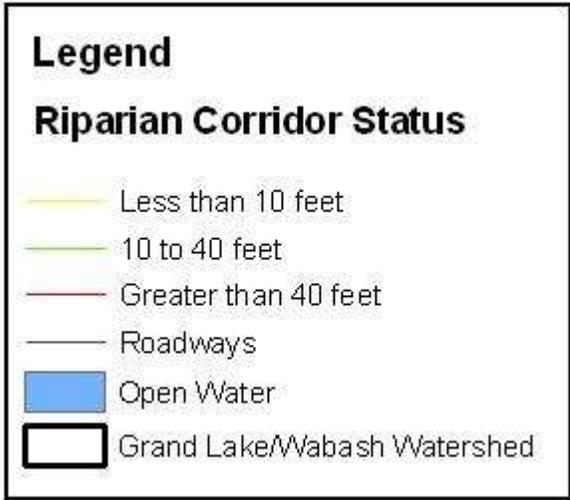
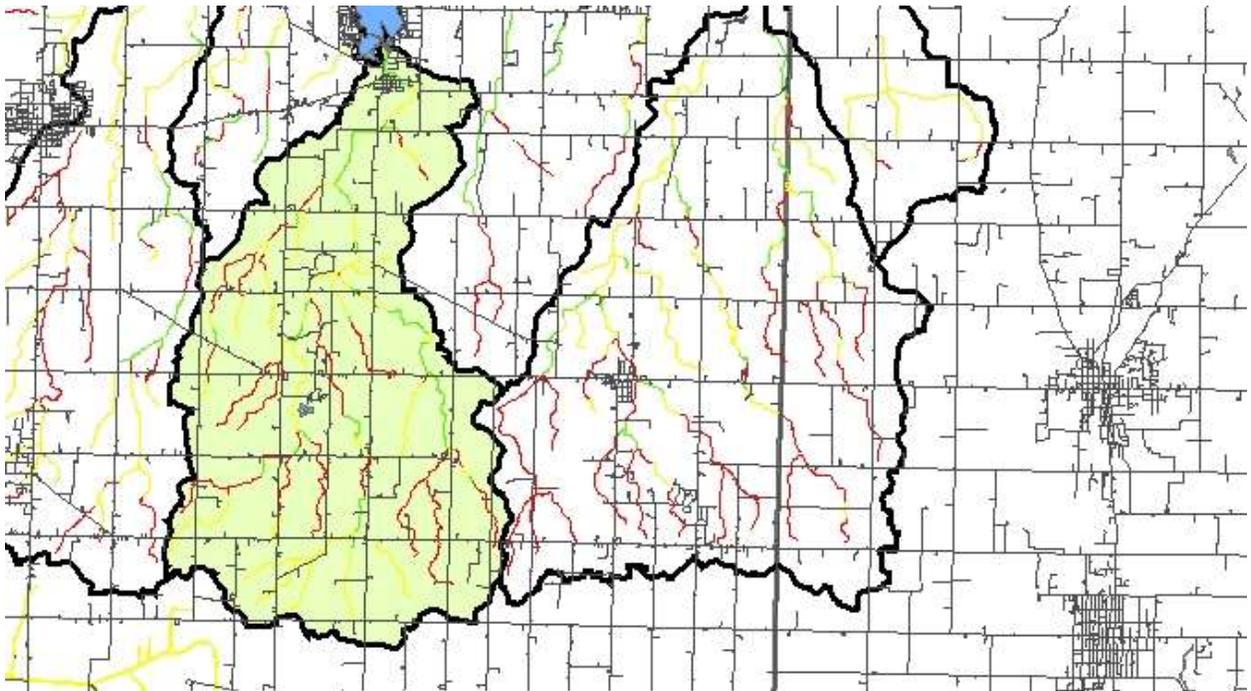
-  Cropland
-  Urban
-  Farmsteads
-  Shrub_Brush
-  Deciduous Forest
-  Open Water
-  Wetlands
-  Barren/Undeveloped



MAP 35
Beaver Creek Highly Erodible Land



MAP 36
Beaver Creek Riparian Corridor Status



4.1.4 Prairie Creek

The Prairie Creek subwatershed drains the central portion of the Grand Lake St. Marys watershed, directly south of the lake. The entire subwatershed is located in Mercer County. The acres, square miles and percent of subwatershed are shown below. The Prairie Creek subwatershed, according to percentages, is the fourth largest of seven subwatersheds draining to Grand Lake St Marys. Of the entire Grand Lake/Wabash Watershed, it is the eleventh largest of 15 subwatersheds.

TABLE 30

PRAIRE CREEK	
Acreage	7,675
Square Miles	11.99
% of Grand Lake Watershed Total Land Area	13.0%
% of Grand Lake/Wabash Watershed Total Land Area	4.3%

Water Quality Status

Prairie Creek, composed of the Upper and Lower Prairie Creeks, has been designated as a warm water habitat (WWH). This aquatic life use designation has been established by the EPA and based on recent data sampling, the water resource is shown as not meeting that use designation, or in a “non-attainment” status. Furthermore, the Prairie Creek subwatershed has been shown to be NPS impacted. Suspected or proven impacts to these streams include: non-irrigated crop production, animal feeding operations, channelization, removal of riparian vegetation and stream bank destabilization. Definitions and criteria for these descriptives can be found in Appendix C- Aquatic life use designations and assessment terms.

Ohio EPA is currently completing a TMDL report for Beaver Creek and Grand Lake St. Marys, which is in process of being finalized. The draft report calls for phosphorus, nitrate and fecal coliform reduction upwards of 80% to 90% within the Prairie Creek subwatershed. Detailed information on the sampling results and recommended load reductions can be found in the draft report of the 2007 Ohio EPA TMDL report, which can be obtained by contacting the watershed project office.

Water Supplies and Discharges

There are currently two community water supplies located within the Prairie Creek subwatershed, Club Island Association and Grand Lake Mobile Home Park. There are 15 transient non-community water supplies, including: Woodhaven MHP PWS, Cottonwood Park, Bayview Water Association, Behm’s Landing A PWS, Sunny Side Inn, Shingle Shack Restaurant, Doss Landing, Duckfoot-Arnold Landing, Bayview Sun & Snow, Beach Point Billiards, Lee’s Landing PWS, D & W Marina, Behms Landing

Restaurant STU1 & STU 2, ODNR Grand Lake St. Marys State Park and Behm's Landing B PWS. No non-transient non-community supplies and no registered discharges are listed with Ohio EPA.

Based on recent aerial photographs, areas where 10 or more household wastewater treatment and disposal systems were present in close proximity were identified. As with any individual treatment system operating in an area with poorly drained soils, the effects of the effluent on the receiving water body is a concern. These effects grow as the number of systems in a given area increases, thus clusters or groups of 10 or more systems has been used to analyze the potential effects of those systems on the water quality. Regarding Prairie Creek subwatershed, there was one cluster identified comprised of 32 individual treatment systems.

Highly Erodible Land

Map 36 at the end of this subsection illustrates the highly erodible land locations within the Prairie Creek subwatershed. Of the seven subwatersheds within the Grand Lake St. Marys watershed, Prairie Creek ranks lowest in the amount of highly erodible land present within the subwatershed. The highly erodible land information was developed from the 2003 online NRCS Soil Data Mart.

Riparian Corridor Status

The chart on the following page shows the riparian corridor status for the Prairie Creek subwatershed. The chart indicates the number of miles of each drainage unit that has various widths of tree canopy, or riparian corridor. The numbers account for both sides of the streams; therefore, the number of actual stream miles is half of that shown. The divisions are less than 10 feet in total width, 10 to 40 feet in total width, and greater than 40 feet in total width. The chart is also divided into perennial and intermittent streams under each of the corridor width column headings. MAP 37 illustrates the stream sections under each division.

The chart shows that with a total of 10.12 miles of stream network, the Prairie Creek subwatershed has 5.16 miles of stream with less than 10 feet of canopy and vegetation, 4.13 miles of stream with 10 to 40 feet canopy and vegetation and 0.83 miles of stream with greater than 40 feet of canopy and vegetation. The Prairie Creek subwatershed has the fourth largest number of stream miles within the Grand Lake St. Marys Watershed, which is 7.2%. Of the entire Grand Lake/Wabash Watershed, this subwatershed has the eleventh highest number of stream miles, which is 1.4%.

TABLE 31
Riparian Corridor Status

PRAIRIE CREEK										
RIPARIAN STATUS	TREE CANOPY <10' IN TOTAL WIDTH			TREE CANOPY 10 to 40' IN WIDTH			TREE CANOPY >40' IN WIDTH			TOTAL STREAM MILES
	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	
	0.00	5.16	5.16	2.58	1.55	4.13	0.00	0.83	0.83	10.12
% of Subwatershed Total	0.0%	12.6%	12.6%	6.3%	3.8%	10.1%	0.0%	2.0%	2.0%	24.6%
% of Grand Lake Watershed Total	0.0%	3.7%	3.7%	1.8%	1.1%	2.9%	0.0%	0.6%	0.6%	7.2%
% of Grand Lake/Wabash Watershed Total	0.0%	0.7%	0.7%	0.4%	0.2%	0.6%	0.0%	0.1%	0.1%	1.4%

Operations and Animal Units

The table on the following page shows the number of operations and the animal units by species for the Prairie Creek subwatershed. According to the table, there are no poultry operations, 10 dairy operations, 16 hog operations 12 beef operations, one horse operation and one sheep operation within the entire subwatershed. The Prairie Creek subwatershed ranks ninth within the entire Grand Lake/Wabash River Watershed when considering the total number of operations with 40 or 4.04%. Animal units within the subwatershed ranks ninth of 15 with 2.75%.

Totals of animal units for each species are also listed on the table. The inventory for this subwatershed was completed during February and March of 2007. At the time of the inventory animal units were determined by the number of animals present. Although this is not a 1:1 ratio for all species, it is for beef cattle. The following chart shows the number of each type of animal that makes up 1,000 animal units.

Animal Type	1,000 Animal Unit Equivalent
Beef Cattle	1,000
Dairy Cattle	700
Hogs (over 55 lbs)	2,500
Turkeys	55,000
Layer Chickens	82,000
Pullet Chickens	125,000
Sheep	10,000
Horses	500

TABLE 32
Operations and Animal Units

PRAIRIE CREEK														
ANIMAL TYPE	POULTRY		DAIRY		HOG		BEEF		OTHER		TOTAL		Total as % of Grand Lake Watershed	
	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s						
# Farms and Animals	0 (Trky)	0 0	10	1,550	16	6,080	12	1,750	(sheep) 1 (hrs) 1	1 4	40	9,385	13.4%	8.9%
% of subwatershed total	0.0%	0.0%	25.0%	16.5%	40.0%	64.8%	30.0%	18.6%	5.0%	0.1%	100.0%	100.0%		
Total as % of Grand Lake Watershed	0.0%	0.0%	3.4%	1.5%	5.4%	5.8%	4.0%	1.7%	0.7%	0.0%	13.4%	8.9%		
Total as % of Grand Lake/Wabash Watershed	0.00%	0.00%	1.01%	0.45%	1.62%	1.78%	1.21%	0.51%	0.20%	0.00%	4.04%	2.75%		

Manure Production

After considering the number of livestock operations and animal units present in the watershed, it is only fitting to consider the by-products of these animals. The table on the opposite page is used to represent the manure and nutrient production for the Prairie Creek drainage area. The Prairie Creek subwatershed ranks ninth overall, of 15, in terms of manure production per annum. Approximately 69,191 tons of manure is produced annually. The remainder of the columns on the table indicates the approximate pounds of nutrients contained in that manure. Nitrogen, potassium, and phosphate, are all important to the agricultural community and are provided to the crops via manure or commercial fertilizer applications.

These nutrients are also important in regards to water quality. According to the table, in the Prairie Creek subwatershed, the amount of phosphorus that is contained in the manure produced annually would need to be applied at 90 pounds per acre. The table below indicates the average crop removal rates for phosphorus for the major crops produced in the watershed. Values were obtained from the Ohio Agronomy Guide.

CROP	P₂O₅ REMOVAL (lb/ac)
Alfalfa (6T)	80
Corn (150 bu) Grain	55
Corn (25 T) Silage	80
Soybean (50 bu)	40
Wheat (75 bu) Grain	48

Considerations are given to the nutrient phosphorus due to its importance to crop production and the problems associated with the relationship between excessive phosphorus applications and degradation of water quality.

What this seems to indicate throughout the watershed is that according to manure production and crop removal rates for limiting nutrient factors, there are not enough acres for proper manure application methods. The caveat on this statement is that the numbers are best estimates, variations in soil types and tith can vary throughout the fields which may increase, or decrease, crop removal rates, and more importantly, some of the manure produced in each of the subwatershed may be applied to acreages outside of that subwatershed, or even outside of the Grand Lake St Marys watershed. It should be noted that several producers own or rent land both in the Grand Lake St Marys watershed and in neighboring watersheds such as Loramie Creek, Wabash River, or the St Marys River.

TABLE 33
Manure and Nutrient Production

PRAIRIE CREEK						
Manure Production	Tons Raw Manure/Year	Lbs. N per Year	Lbs. K ₂ O per Year	Lbs. P ₂ O ₅ per Year	Acres Cropland	Lbs. P ₂ O ₅ per Crop Acre
	69,191	820,159	656,192	548,275	6,095	90
Less 70% Poultry Manure**	69,191	820,159	656,192	548,275	6,095	90
Approximate \$ Value Per Year		\$180,435	\$98,429	\$109,655		
Total Nutrient Value Per Year = \$388,519						

**There is no poultry in the Prairie Creek subwatershed.

The dollar values associated with each nutrient were obtained from OSU Extension Bulletin 604-06, "Ohio Livestock Manure Management Guide." The value for nitrogen is estimated at \$0.22 per pound, the value for P₂O₅ is \$0.20 per pound and the value for K₂O is \$0.15 per pound.

Distance Between Livestock Operations and Streams

The table on the following page shows the distance between various livestock operations located in the Prairie Creek subwatershed and the waterways that drain to Prairie Creek and eventually Grand Lake St. Marys. It can be assumed that the greater the distance between a livestock operation and a water system, the potential of pollution from the operation reaching the stream is lessened.

Of notable interest is the number of all livestock operations located less than 1,000 feet from the waterbody. In this particular subwatershed, out of 40 operations, 21 operations, or 52.5%, fall into the category. Also, 10 operations, 25.0%, are within 2,000 feet and the remaining 22.5%, nine operations, are less than 3,000 feet from the nearest stream.

TABLE 34
Livestock Operations and Proximity to Streams

PRAIRIE CREEK																		
ANIMAL TYPE	POULTRY			DAIRY			HOG			BEEF			OTHER			TOTAL		
	Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream		
	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'
	0	0	0	5	3	2	7	5	4	7	2	3	2	0	0	21	10	9
% of Subwatershed Total	0.0%	0.0%	0.0%	12.5%	7.5%	5.0%	17.5%	12.5%	10.0%	17.5%	5.0%	7.5%	5.0%	0.0%	0.0%	52.5%	25.0%	22.5%

Non-Point Source Pollution Potential

In order to provide a comparison of the pollution potential of each of the 15 subwatersheds, a ranking system for each of the main potential pollution sources was developed. These potential sources are stream miles with less than 10 feet of vegetation, the number of livestock or poultry operations less than 1,000 feet from a stream, the tons of raw manure produced yearly, the pounds of phosphorus per cropland acre available from the manure, the number of household wastewater disposal systems contained in clusters of ten or more) and the number of homes built pre-1973. Values of 1 (less potential) to 10 (great potential) were given based on ranges shown in the table of the following page. Indicator scores are then summed to obtain a total pollution potential score for the subwatershed.

Subwatershed pollution potential scores can range from a maximum of 60 points to a minimum of six points. The Prairie Creek subwatershed ranks tenth out of 15, with 36.7% of the maximum points for pollution potential.

NONPOINT SOURCE POLLUTION POTENTIAL SCORING MATRIX

MAXIMUM DRAINAGE UNIT SCORE = 60 (Highest Pollution Potential)

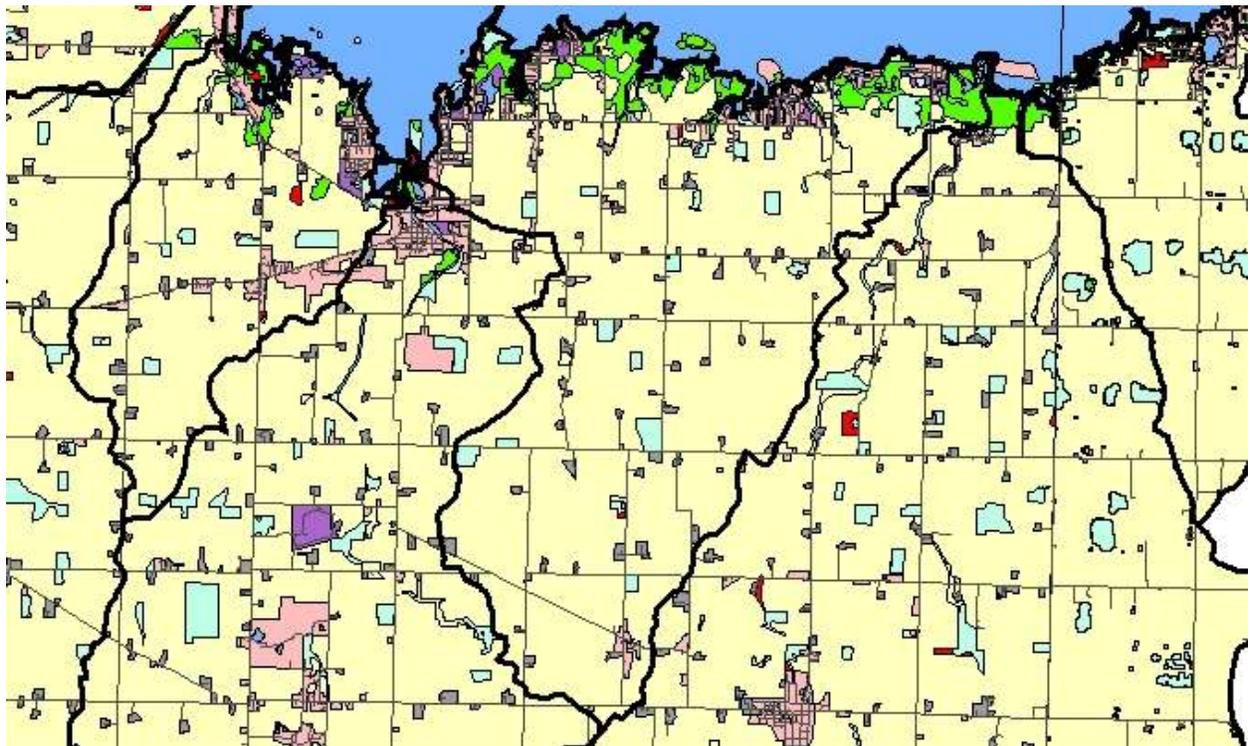
SCORE	Stream Miles with <10' Vegetation	Operations <1,000' to stream	Tons Raw Manure per Year	Lbs. P ₂ O ₅ per Crop Acre	Household Disposal Systems in Groups	No. Homes Built pre-1973
10	72.00+	46+	180,000+	225+	90+	226+
9	64.00 - 71.99	41 - 45	160,000 - 179,999	200 - 224	80 - 89	201 - 225
8	56.00 - 63.99	36 - 40	140,000 - 159,999	175 - 199	70 - 79	176 - 200
7	48.00 - 55.99	31 - 35	120,000 - 139,999	150 - 174	60 - 69	151 - 175
6	40.00 - 47.99	26 - 30	100,000 - 119,999	125 - 149	50 - 59	126 - 150
5	32.00 - 39.99	21 - 25	80,000 - 99,999	100 - 124	40 - 49	101 - 125
4	24.00 - 31.99	16 - 20	60,000 - 79,999	75 - 99	30 - 39	76 - 100
3	16.00 - 23.99	11 - 15	40,000 - 59,999	50 - 74	20 - 29	51 - 75
2	8.00 - 15.99	6 - 10	20,000 - 39,999	25 - 49	10 - 19	26 - 50
1	0.00 - 7.99	0 - 5	0 - 19,999	0 - 24	0 - 10	0 - 25

MINIMUM DRAINAGE UNIT SCORE = 6 (Lowest Pollution Potential)

TABLE 35
NPS Pollution Potential

PRAIRIE CREEK							
SUBWATERSHED ATTRIBUTE	Stream Miles with <10' Vegetation SCORE	Operations <1,000' to stream SCORE	Tons Raw Manure per Year SCORE	Lbs. P ₂ O ₅ per Crop Acre SCORE	Household Disposal Systems in Groups SCORE	No. Homes Built pre-1973 SCORE	TOTAL SCORE
	1	5	4	4	4	4	22

MAP 37 Prairie Creek Land Use

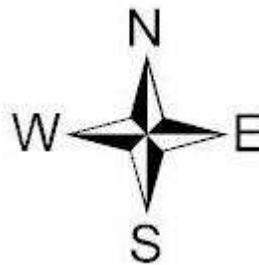


Legend

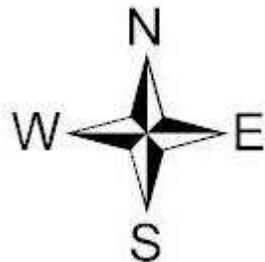
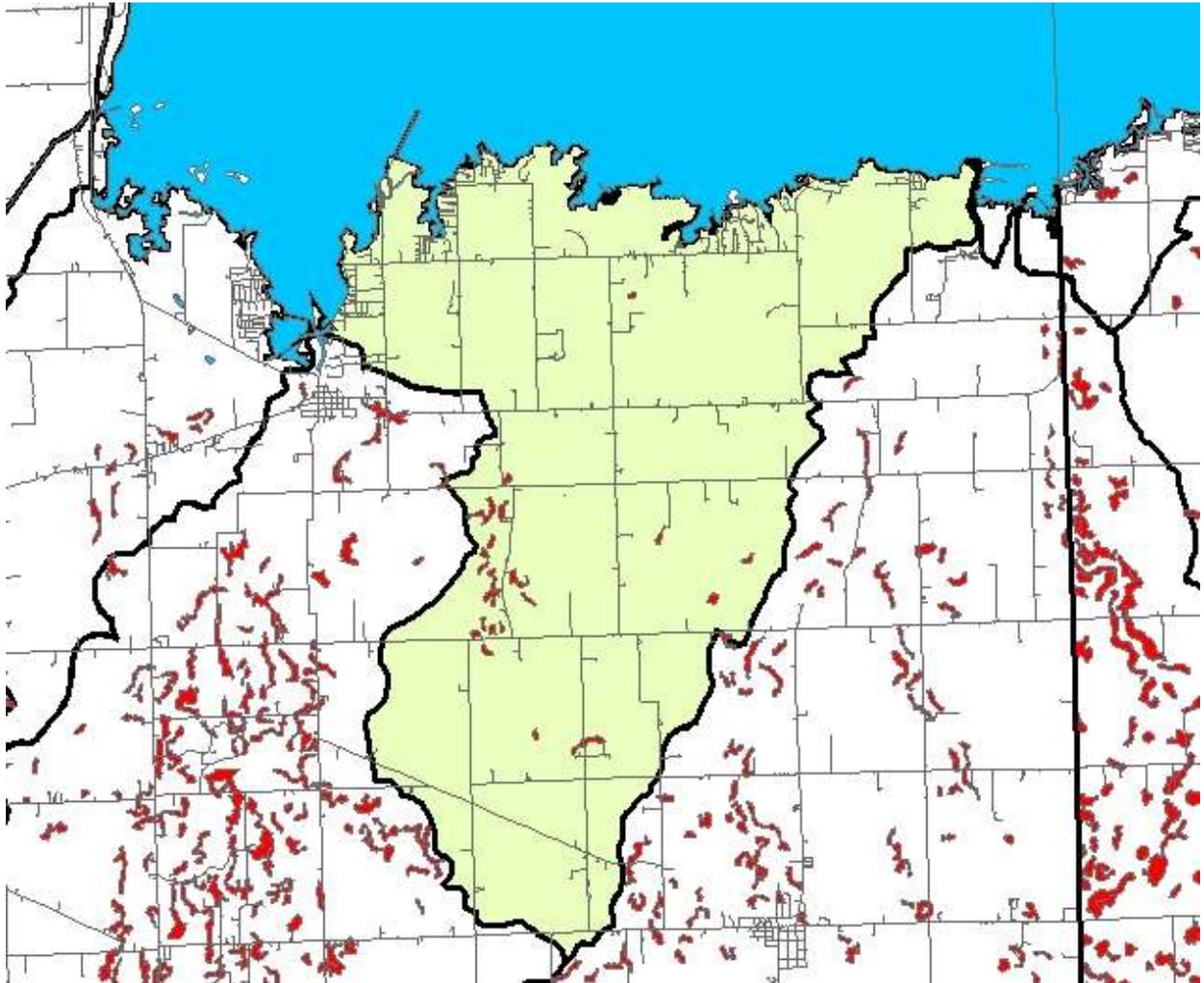
-  Grand Lake/Wabash Watershed
-  Roadways

Land Use

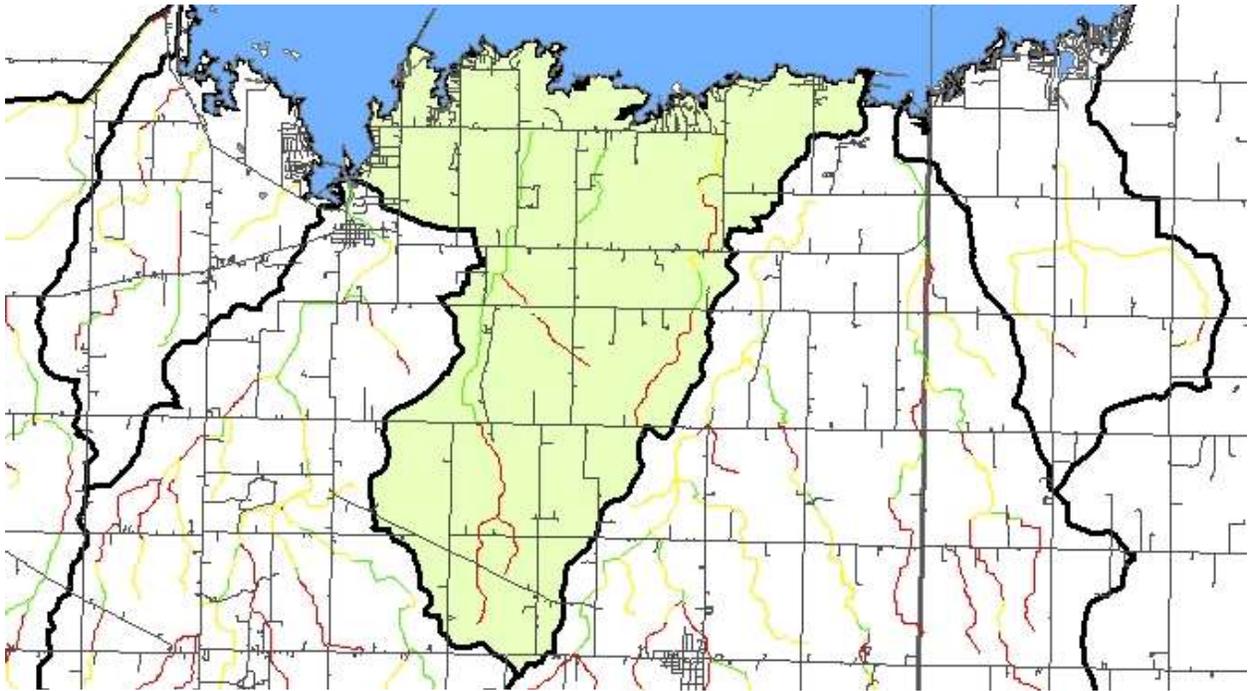
-  Cropland
-  Urban
-  Farmsteads
-  Shrub_Brush
-  Deciduous Forest
-  Open Water
-  Wetlands
-  Barren/Undeveloped



MAP 38
Prairie Creek Highly Erodible Land



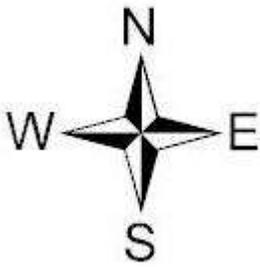
MAP 39
Prairie Creek Riparian Corridor Status



Legend

Riparian Corridor Status

- Less than 10 feet
- 10 to 40 feet
- Greater than 40 feet
- Roadways
- Open Water
- Grand Lake/Wabash Watershed



4.1.5 Chickasaw Creek

The Chickasaw Creek subwatershed drains the lower eastern area of the Grand Lake St Marys drainage basin. The majority of the subwatershed is located in Mercer County and the remainder is located in Auglaize County. The acres, square miles and percent of sub-watershed are shown below. The Chickasaw Creek Subwatershed, according to percentages, is the largest of the seven subwatersheds draining to Grand Lake St. Marys. Of the entire Grand/Lake Wabash Watershed, it is the fourth largest of fifteen subwatersheds.

TABLE 36

CHICKASAW CREEK	
Acreage	16,322
Square Miles	25.50
% of Grand Lake Watershed Total Land Area	27.7%
% of Grand Lake/Wabash Watershed Total Land Area	9.1%

Water Quality Status

Chickasaw Creek, composed of the East Fork and Little Chickasaw Creek drainage units has been designated as a warm water habitat (WWH). This aquatic life use designation has been established by the EPA and based on recent data sampling, the water resource is shown as not meeting that use designation, or in a “non-attainment” status. Furthermore, the Chickasaw Creek subwatershed has been shown to be NPS impacted. Suspected or proven impacts to these streams include: non-irrigated crop production, animal feeding operations, channelization, removal of riparian vegetation and stream bank destabilization. Definitions and criteria for these descriptives can be found in Appendix C- Aquatic life use designations and assessment terms.

Ohio EPA is currently completing a TMDL report for Beaver Creek and Grand Lake St. Marys, which is in process of being finalized. The draft report calls for phosphorus, nitrate and fecal coliform reduction upwards of 50% to 90% within the Chickasaw Creek subwatershed. Detailed information on the sampling results and recommended load reductions can be found in the draft report of the 2007 Ohio EPA TMDL report, which can be obtained by contacting the watershed project office.

Water Supplies and Discharges

Two community water supplies, the Village of Chickasaw, and the Hecht’s Landing Mobile Home Park, are located within the boundaries of the Chickasaw Creek subwatershed. There are also eight transient non-community water supplies, including: Spiritual Center of Maria Stein, American Legion Post #571, Knights of St. Johns PWS,

Hecht's Landing #1 Well PWS, Hecht's Landing #2 Well PWS, Korner Kafe, Schwieterman Family Physicians, Inc. and Maria Stein Center. Two non-transient non-community water supplies, Marion Local Elementary and Marion Local High School are also located in the subwatershed.

There are four Ohio EPA regulated point source discharges; the Chapel Hill Subdivision WWTP, the Chickasaw WTP, the Chickasaw WWTP and the Marion Local School District located in the drainage area. The Wenning Animal Hospital also operates as non-regulated discharger and the stormwater from the Village of Chickasaw also discharges to Chickasaw Creek.

Based on recent aerial photographs, areas where 10 or more household wastewater treatment and disposal systems were present in close proximity were identified. As with any individual treatment system operating in an area with poorly drained soils, the effects of the effluent on the receiving water body is a concern. These effects grow as the number of systems in a given area increases, thus clusters or groups of 10 or more systems has been used to analyze the potential effects of those systems on the water quality. Regarding Chickasaw Creek subwatershed, there is one cluster identified comprised of approximately 35 individual treatment systems.

Highly Erodible Land

Map 39 at the end of this subsection illustrates the highly erodible land locations within the Chickasaw Creek subwatershed. Of the seven subwatersheds within the Grand Lake St. Marys watershed, Chickasaw Creek ranks second highest in the amount of highly erodible land present within the subwatershed. The highly erodible land information was developed from the 2003 online NRCS Soil Data Mart.

Riparian Corridor Status

The chart on the following page shows the riparian corridor status for the Chickasaw Creek subwatershed. The chart indicates the number of miles of each drainage unit that has various widths of tree canopy, or riparian corridor. The numbers account for both sides of the streams; therefore, the number of actual stream miles is half of that shown. The divisions are less than 10 feet in total width, 10 to 40 feet in total width, and greater than 40 feet in total width. The chart is also divided into perennial and intermittent streams under each of the corridor width column headings. MAP 40 illustrates the stream sections under each division.

The chart shows that with a total of 40.39 miles of stream network, the Chickasaw Creek subwatershed has 20.34 miles of stream with less than 10 feet of canopy and vegetation, 5.84 miles of stream with 10 to 40 feet canopy and vegetation, and 14.21 miles of stream with greater than 40 feet of canopy and vegetation. The Chickasaw Creek subwatershed has the second highest number of stream miles within the Grand Lake St. Marys Watershed, which is 28.8%. Of the entire Grand Lake/Wabash Watershed, this subwatershed has the seventh highest number of stream miles, which is 5.7%.

TABLE 37
Riparian Corridor Status

CHICKASAW CREEK										
RIPARIAN STATUS	TREE CANOPY <10' IN TOTAL WIDTH			TREE CANOPY 10 to 40' IN WIDTH			TREE CANOPY >40' IN WIDTH			TOTAL STREAM MILES
	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	
	0.42	19.92	20.34	3.11	2.73	5.84	6.98	7.23	14.21	40.39
% of Subwatershed Total	1.0%	48.5%	49.5%	7.6%	6.6%	14.2%	17.0%	17.6%	34.6%	98.3%
% of Grand Lake Watershed Total	0.3%	14.2%	14.5%	2.2%	1.9%	4.2%	5.0%	5.2%	10.1%	28.8%
% of Grand Lake/Wabash Watershed Total	0.1%	2.8%	2.9%	0.4%	0.4%	0.8%	1.0%	1.0%	2.0%	5.7%

Operations and Animal Units

The table on the following page shows the number of operations and the animal units by species for the Chickasaw Creek subwatershed. According to the table, there are 12 poultry operations, 19 dairy operations, 23 hog operations, 31 beef operations and one sheep operation within the entire subwatershed. The Chickasaw Creek subwatershed ranks fifth within the entire Grand Lake/Wabash River Watershed when considering the total number of operations with 86 or 8.7%. Animal units within the subwatershed ranks third of 15 with 12.9%.

Totals of animal units for each species are also listed on the table. The inventory for this subwatershed was completed during February and March of 2007. At the time of the inventory animal units were determined by the number of animals present. Although this is not a 1:1 ratio for all species, it is for beef cattle. The following chart shows the number of each type of animal that makes up 1,000 animal units.

Animal Type	1,000 Animal Unit Equivalent
Beef Cattle	1,000
Dairy Cattle	700
Hogs (over 55 lbs)	2,500
Turkeys	55,000
Layer Chickens	82,000
Pullet Chickens	125,000
Sheep	10,000
Horses	500

TABLE 38
Operations and Animal Units

CHICKASAW CREEK														
ANIMAL TYPE	POULTRY		DAIRY		HOG		BEEF		OTHER		TOTAL		Total as % of Grand Lake Watershed	
# Farms and Animals	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s						
	10 (Trky) 2	24,678 327	19	3,750	23	11,280	31	3,925	(sheep) 1 (hrs)	0 0	86	43,961	28.9%	41.8%
% of subwatershed total	14.0%	56.9%	22.1%	8.5%	26.7%	25.7%	36.0%	8.9%	1.2%	0.0%	100.0%	100.0%		
Total as % of Grand Lake Watershed	4.0%	23.8%	6.4%	3.6%	7.7%	10.7%	10.4%	3.7%	0.3%	0.0%	28.9%	41.8%		
Total as % of Grand Lake/Wabash Watershed	1.21%	7.32%	1.92%	1.10%	2.33%	3.30%	3.13%	1.15%	0.10%	0.00%	8.70%	12.87%		

Manure Production

After considering the number of livestock operations and animal units present in the watershed, it is only fitting to consider the by-products of these animals. The table on the opposite page is used to represent the manure and nutrient production for the Chickasaw Creek drainage area. The Chickasaw Creek subwatershed ranks third overall, of 15, in terms of manure production per annum. Approximately 230,268 tons of manure is produced annually. The remainder of the columns on the table indicates the approximate pounds of nutrients contained in that manure. Nitrogen, potassium, and phosphate, are all important to the agricultural community and are provided to the crops via manure or commercial fertilizer applications.

These nutrients are also important in regards to water quality. According to the table, in the Chickasaw Creek subwatershed, the amount of phosphorus that is contained in the manure produced annually would need to be applied at 211 pounds per acre. The table below indicates the average crop removal rates for phosphorus for the major crops produced in the watershed. Values were obtained from the Ohio Agronomy Guide.

CROP	P₂O₅ REMOVAL (lb/ac)
Alfalfa (6T)	80
Corn (150 bu) Grain	55
Corn (25 T) Silage	80
Soybean (50 bu)	40
Wheat (75 bu) Grain	48

Considerations are given to the nutrient phosphorus due to its importance to crop production and the problems associated with the relationship between excessive phosphorus applications and degradation of water quality. Because much of the poultry manure is brokered out of the watershed, it seemed important to reflect the nutrient values assuming that 70% of the poultry manure is moved to locations outside the watershed. Local manure haulers estimated this value to be 90%; however, to be conservative, 70% was assumed for this plan. Under this assumption, the amount of phosphorus that is contained in the manure produced annually in this subwatershed would need to be applied at 119 pounds per acre.

What this seems to indicate throughout the watershed is that according to manure production and crop removal rates for limiting nutrient factors, there are not enough acres for proper manure application methods. The caveat on this statement is that the numbers are best estimates, variations in soil types and tith can vary throughout the fields which may increase, or decrease, crop removal rates, and more importantly, some of the manure produced in each of the subwatershed may be applied to acreages outside of that subwatershed, or even outside of the Grand Lake St Marys watershed. It should be noted that several producers own or rent land both in the Grand Lake St Marys watershed and in neighboring watersheds such as Loramie Creek, Wabash River, or the St Marys River.

TABLE 39
Manure and Nutrient Production

CHICKASAW CREEK						
Manure Production	Tons Raw Manure/Year	Lbs. N per Year	Lbs. K ₂ O per Year	Lbs. P ₂ O ₅ per Year	Acres Cropland	Lbs. P ₂ O ₅ per Crop Acre
	230,268	3,970,601	2,475,822	3,021,093	14,290	211
Less 70% Poultry Manure**	173,127	2,404,848	1,715,269	1,698,961	14,290	119
Approximate \$ Value Per Year		\$873,532	\$371,373	\$604,219		
Total Nutrient Value Per Year = \$1,849,124						

**Based on conversations with poultry manure brokers, it was estimated that at least 70% of the poultry manure is brokered out of the watershed.

The dollar values associated with each nutrient were obtained from OSU Extension Bulletin 604-06, "Ohio Livestock Manure Management Guide." The value for nitrogen is estimated at \$0.22 per pound, the value for P₂O₅ is \$0.20 per pound and the value for K₂O is \$0.15 per pound.

Distance Between Livestock Operations and Streams

The table on the following page shows the distance between various livestock operations located in the Chickasaw Creek subwatershed and the waterways that drain to Chickasaw Creek and eventually Grand Lake St. Marys. It can be assumed that the greater the distance between a livestock operation and a water system, the potential of pollution from the operation reaching the stream is lessened.

Of notable interest is the number of all livestock operations located less than 1,000 feet from the waterbody. In this particular subwatershed, out of 86 operations, 41 operations, or 47.7%, fall into the category. Also, 22 operations, 25.6%, are in within 2,000 feet and the remaining 26.7%, 23 operations, are less than 3,000 feet from the nearest stream.

TABLE 40
Livestock Operations and Proximity to Streams

CHICKASAW CREEK																		
ANIMAL TYPE	POULTRY			DAIRY			HOG			BEEF			OTHER			TOTAL		
	Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream		
	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'
	5	5	2	11	4	4	11	3	9	14	10	7	0	0	1	41	22	23
% of Subwatershed Total	5.8%	5.8%	2.3%	12.8%	4.7%	4.7%	12.8%	3.5%	10.5%	16.3%	11.6%	8.1%	0.0%	0.0%	1.2%	47.7%	25.6%	26.7%

Non-Point Source Pollution Potential

In order to provide a comparison of the pollution potential of each of the 15 subwatersheds, a ranking system for each of the main potential pollution sources was developed. These potential sources are stream miles with less than 10 feet of vegetation, the number of livestock or poultry operations less than 1,000 feet from a stream, the tons of raw manure produced yearly, the pounds of phosphorus per cropland acre available from the manure, the number of household wastewater disposal systems contained in clusters of ten or more) and the number of homes built pre-1973. Values of 1 (less potential) to 10 (great potential) were given based on ranges shown in the table of the following page. Indicator scores are then summed to obtain a total pollution potential score for the subwatershed.

Subwatershed pollution potential scores can range from a maximum of 60 points to a minimum of six points. The Chickasaw Creek subwatershed ranks fifth out of 15, with 68.3% of the maximum points for pollution potential. Most significantly for the subwatershed is the tons of raw manure generated per year and the number of homes built prior to 1973. The Chickasaw Creek subwatershed scored the maximum amount of points for both indicators.

NONPOINT SOURCE POLLUTION POTENTIAL SCORING MATRIX

MAXIMUM DRAINAGE UNIT SCORE = 60 (Highest Pollution Potential)

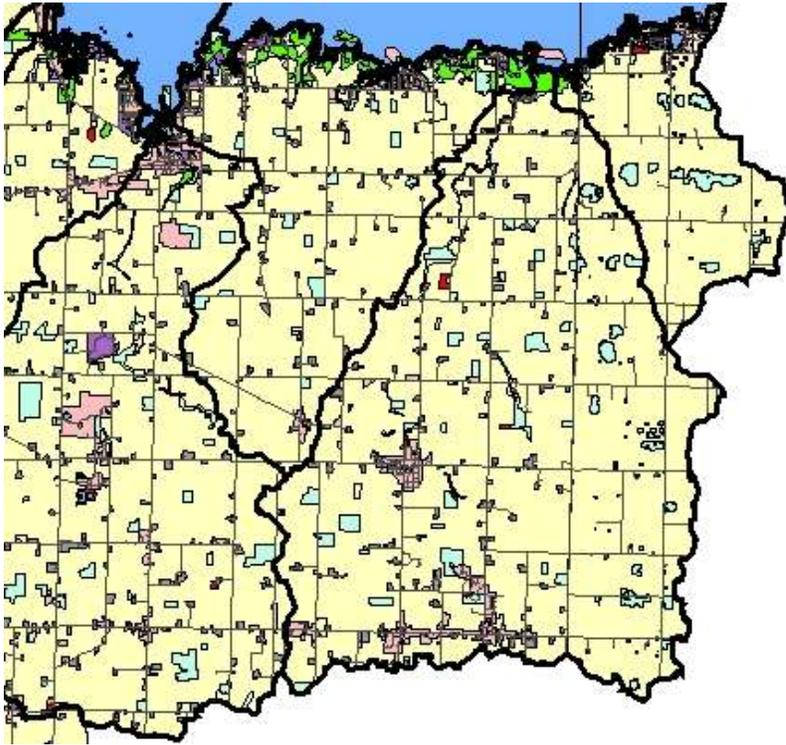
SCORE	Stream Miles with <10' Vegetation	Operations <1,000' to stream	Tons Raw Manure per Year	Lbs. P ₂ O ₅ per Crop Acre	Household Disposal Systems in Groups	No. Homes Built pre-1973
10	72.00+	46+	180,000+	225+	90+	226+
9	64.00 - 71.99	41 - 45	160,000 - 179,999	200 - 224	80 - 89	201 -225
8	56.00 - 63.99	36 - 40	140,000 - 159,999	175 - 199	70 - 79	176 -200
7	48.00 - 55.99	31 - 35	120,000 - 139,999	150 - 174	60 - 69	151 - 175
6	40.00 - 47.99	26 - 30	100,000 - 119,999	125 - 149	50 - 59	126 - 150
5	32.00 - 39.99	21 - 25	80,000 - 99,999	100 - 124	40 - 49	101 - 125
4	24.00 - 31.99	16 - 20	60,000 - 79,999	75- 99	30 - 39	76 - 100
3	16.00 - 23.99	11 - 15	40,000 - 59,999	50 - 74	20 - 29	51 - 75
2	8.00 - 15.99	6 - 10	20,000 - 39,999	25 - 49	10 - 19	26 - 50
1	0.00 - 7.99	0 - 5	0 - 19,999	0 - 24	0 - 10	0 - 25

MINIMUM DRAINAGE UNIT SCORE = 6 (Lowest Pollution Potential)

TABLE 41
NPS Pollution Potential

CHICKASAW CREEK							
SUBWATERSHED ATTRIBUTE	Stream Miles with <10' Vegetation SCORE	Operations <1,000' to stream SCORE	Tons Raw Manure per Year SCORE	Lbs. P ₂ O ₅ per Crop Acre SCORE	Household Disposal Systems in Groups SCORE	No. Homes Built pre-1973 SCORE	TOTAL SCORE
	3	9	10	5	4	10	41

MAP 40
Chickasaw Creek Land Use

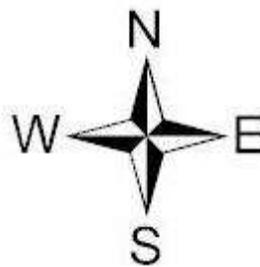


Legend

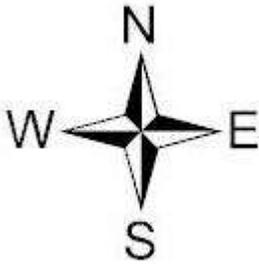
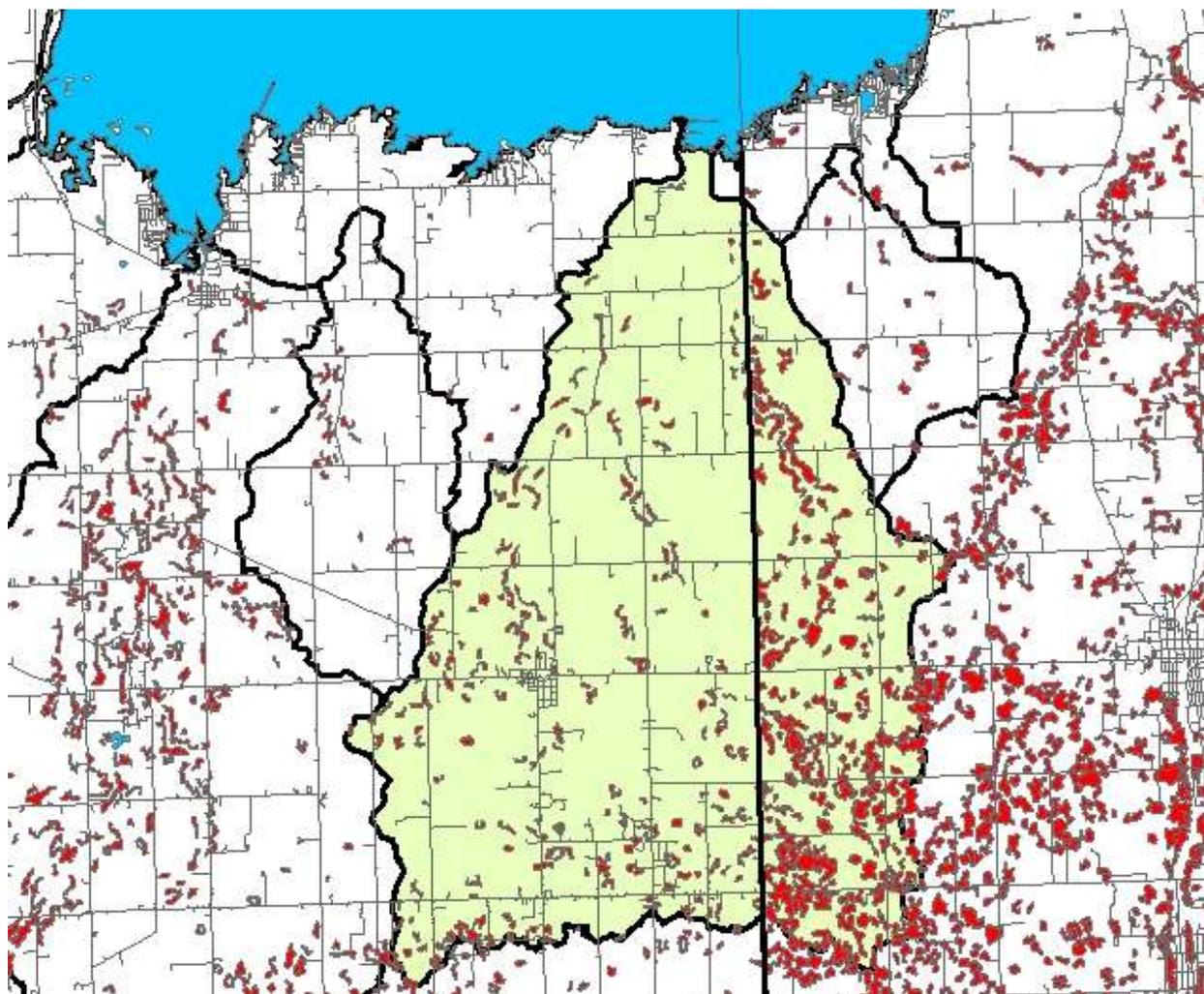
-  Grand Lake/Wabash Watershed
-  Roadways

Land Use

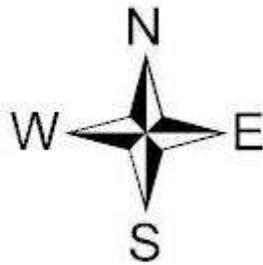
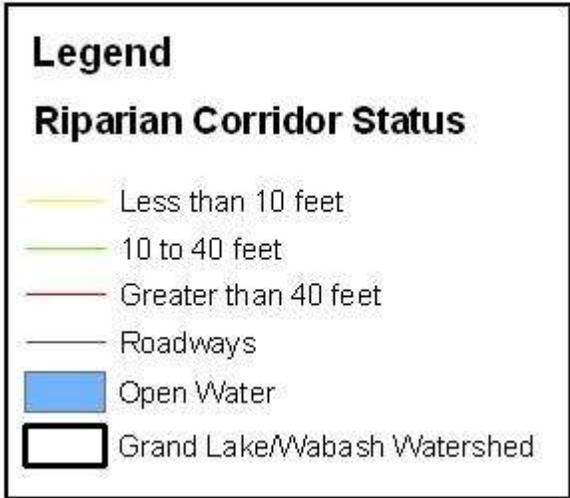
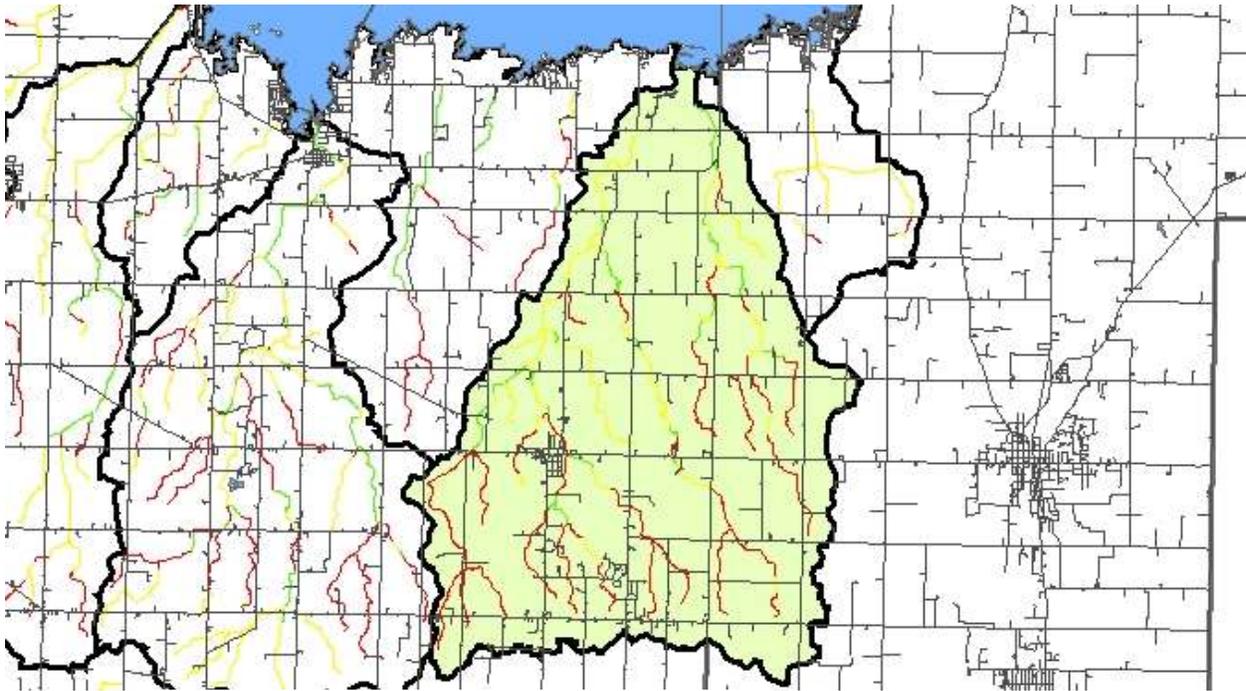
-  Cropland
-  Urban
-  Farmsteads
-  Shrub_Brush
-  Deciduous Forest
-  Open Water
-  Wetlands
-  Barren/Undeveloped



MAP 42
Chickasaw Creek Highly Erodible Land



MAP 42
Chickasaw Creek Riparian Corridor Status



4.1.6 Barnes Creek

The Barnes Creek subwatershed drains the north eastern portion of the Grand Lake St. Marys drainage basin. The majority of the subwatershed is located in Auglaize County and the remainder is located in Mercer County. The acres, square miles and percent of sub-watershed are shown below. The Barnes Creek Subwatershed, according to percentages, is the fifth largest of the seven subwatersheds draining to Grand Lake St. Marys. Of the entire Grand/Lake Wabash Watershed, it is the twelfth largest of fifteen subwatersheds.

TABLE 42

BARNES CREEK	
Acreage	3,486
Square Miles	5.45
% of Grand Lake Watershed Total Land Area	5.9%
% of Grand Lake/Wabash Watershed Total Land Area	1.9%

Water Quality Status

Barnes Creek, composed of lower and upper Barnes Creeks has been designated as a warm water habitat (WWH). This aquatic life use designation has been established by the EPA and based on recent data sampling, the water resource is shown as not meeting that use designation, or in a “non-attainment” status. Furthermore, the Barnes Creek subwatershed has been shown to be NPS impacted. Suspected or proven impacts to these streams include: non-irrigated crop production, animal feeding operations, channelization, removal of riparian vegetation and stream bank destabilization. Definitions and criteria for these descriptives can be found in Appendix C- Aquatic life use designations and assessment terms.

Ohio EPA is currently completing a TMDL report for Beaver Creek and Grand Lake St. Marys, which is in process of being finalized. The draft report calls for phosphorus, nitrate and fecal coliform reductions ranging from 17 to 90% within the Barnes Creek subwatershed. Detailed information on the sampling results and recommended load reductions can be found in the draft report of the 2007 Ohio EPA TMDL report, which can be obtained by contacting the watershed project office.

Water Supplies and Discharges

There is one transient non-community water supply located in the Barnes Creek area and that is the Rustic Haven Camp Ground. There are currently no community or non-transient non-community water supplies in this particular subwatershed, and there are no Ohio EPA regulated point source discharges.

Based on recent aerial photographs, areas where 10 or more household wastewater treatment and disposal systems were present in close proximity were identified. As with any individual treatment system operating in an area with poorly drained soils, the effects of the effluent on the receiving water body is a concern. These effects grow as the number of systems in a given area increases, thus clusters or groups of 10 or more systems has been used to analyze the potential effects of those systems on the water quality. Regarding Barnes Creek subwatershed, there were no clusters identified.

Highly Erodible Land

Map 42 at the end of this subsection illustrates the highly erodible land locations within the Barnes Creek subwatershed. Of the seven subwatersheds within the Grand Lake St. Marys watershed, Barnes Creek ranks fifth highest in the amount of highly erodible land present within the subwatershed. The highly erodible land information was developed from the 2003 online NRCS Soil Data Mart.

Riparian Corridor Status

The chart on the following page shows the riparian corridor status for the Barnes Creek subwatershed. The chart indicates the number of miles of each drainage unit that has various widths of tree canopy, or riparian corridor. The numbers account for both sides of the streams; therefore, the number of actual stream miles is half of that shown. The divisions are less than 10 feet in total width, 10 to 40 feet in total width, and greater than 40 feet in total width. The chart is also divided into perennial and intermittent streams under each of the corridor width column headings. MAP 43 illustrates the stream sections under each division.

The chart shows that with a total of 7.27 miles of stream network, the Barnes Creek subwatershed has 0.42 miles of stream with less than 10 feet of canopy and vegetation, zero miles of stream with 10 to 40 feet canopy and vegetation, and 6.85 miles of stream with greater than 40 feet of canopy and vegetation. The Barnes Creek subwatershed has the fifth highest number of stream miles within the Grand Lake St. Marys Watershed, which is 5.2%. Of the entire Grand Lake/Wabash Watershed, this subwatershed has the twelfth highest number of stream miles, which is 1.0%.

TABLE 43
Riparian Corridor Status

BARNES CREEK										
RIPARIAN STATUS	TREE CANOPY <10' IN TOTAL WIDTH			TREE CANOPY 10 to 40' IN WIDTH			TREE CANOPY >40' IN WIDTH			TOTAL STREAM MILES
	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	
	0.00	0.42	0.42	0.00	0.00	0.00	3.25	3.6	6.85	7.27
% of Subwatershed Total	0.0%	1.0%	1.0%	0.0%	0.0%	0.0%	7.9%	8.8%	16.7%	17.7%
% of Grand Lake Watershed Total	0.0%	0.3%	0.3%	0.0%	0.0%	0.0%	2.3%	2.6%	4.9%	5.2%
% of Grand Lake/Wabash Watershed Total	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.5%	0.5%	1.0%	1.0%

Operations and Animal Units

The table on the following page shows the number of operations and the animal units by species for the Barnes Creek subwatershed. According to the table, there are no poultry operations, four dairy operations, one hog operation, four beef operations and one horse operation within the entire subwatershed. The Barnes Creek subwatershed ranks thirteenth within the entire Grand Lake/Wabash River Watershed when considering the total number of operations with 10 or 1.0%. Animal units within the subwatershed ranks fourteenth of 15 with 0.41%.

Totals of animal units for each species are also listed on the table. The inventory for this subwatershed was completed during March of 2007. At the time of the inventory animal units were determined by the number of animals present. Although this is not a 1:1 ratio for all species, it is for beef cattle. The following chart shows the number of each type of animal that makes up 1,000 animal units.

Animal Type	1,000 Animal Unit Equivalent
Beef Cattle	1,000
Dairy Cattle	700
Hogs (over 55 lbs)	2,500
Turkeys	55,000
Layer Chickens	82,000
Pullet Chickens	125,000
Sheep	10,000
Horses	500

TABLE 44
Operations and Animal Units

BARNES CREEK														
ANIMAL TYPE	POULTRY		DAIRY		HOG		BEEF		OTHER		TOTAL		Total as % of Grand Lake Watershed	
# Farms and Animals	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s						
	0 (Trky)	0 0	4	643	1	400	4	355	(sheep) (hrs) 1	0 0	10	1,398	3.4%	1.3%
% of subwatershed total	0.0%	0.0%	40.0%	0.0%	10.0%	28.6%	40.0%	25.4%	10.0%	0.0%	100.0%	0.0%		
Total as % of Grand Lake Watershed	0.0%	0.0%	1.3%	0.6%	0.3%	0.4%	1.3%	0.3%	0.3%	0.0%	3.4%	1.3%		
Total as % of Grand Lake/Wabash Watershed	0.00%	0.00%	0.40%	0.19%	0.10%	0.12%	0.40%	0.10%	0.10%	0.00%	1.01%	0.41%		

Manure Production

After considering the number of livestock operations and animal units present in the watershed, it is only fitting to consider the by-products of these animals. The table on the opposite page is used to represent the manure and nutrient production for the Barnes Creek drainage area. The Barnes Creek subwatershed ranks fourteenth overall, of 15, in terms of manure production per annum. Approximately 15,146 tons of manure is produced annually. The remainder of the columns on the table indicates the approximate pounds of nutrients contained in that manure. Nitrogen, potassium, and phosphate, are all important to the agricultural community and are provided to the crops via manure or commercial fertilizer applications.

These nutrients are also important in regards to water quality. According to the table, in the Barnes Creek subwatershed, the amount of phosphorus that is contained in the manure produced annually would need to be applied at 32 pounds per acre. The table below indicates the average crop removal rates for phosphorus for the major crops produced in the watershed. Values were obtained from the Ohio Agronomy Guide.

CROP	P₂O₅ REMOVAL (lb/ac)
Alfalfa (6T)	80
Corn (150 bu) Grain	55
Corn (25 T) Silage	80
Soybean (50 bu)	40
Wheat (75 bu) Grain	48

Considerations are given to the nutrient phosphorus due to its importance to crop production and the problems associated with the relationship between excessive phosphorus applications and degradation of water quality.

TABLE 45
Manure and Nutrient Production

BARNES CREEK						
Manure Production	Tons Raw Manure/Year	Lbs. N per Year	Lbs. K ₂ O per Year	Lbs. P ₂ O ₅ per Year	Acres Cropland	Lbs. P ₂ O ₅ per Crop Acre
	15,156	163,458	131,178	90,900	2,875	32
Less 70% Poultry Manure**	15,156	163,458	131,178	90,900	2,875	32
Approximate \$ Value Per Year		\$35,961	\$19,677	\$18,180		
Total Nutrient Value Per Year = \$73,818						

**There is no poultry in the Barnes Creek subwatershed.

The dollar values associated with each nutrient were obtained from OSU Extension Bulletin 604-06, "Ohio Livestock Manure Management Guide." The value for nitrogen is estimated at \$0.22 per pound, the value for P₂O₅ is \$0.20 per pound and the value for K₂O is \$0.15 per pound.

Distance Between Livestock Operations and Streams

The table on the following page shows the distance between various livestock operations located in the Barnes Creek subwatershed and the waterways that drain to Barnes Creek and eventually Grand Lake St. Marys. It can be assumed that the greater the distance between a livestock operation and a water system, the potential of pollution from the operation reaching the stream is lessened.

Of notable interest is the number of all livestock operations located less than 1,000 feet from the waterbody. In this particular subwatershed, out of 10 operations, one operation, or 10.0%, fall into the category. Also, three operations, 30.0%, are in within 2,000 feet and the remaining 60.0%, six operations, are less than 3,000 feet from the nearest stream.

TABLE 46
Livestock Operations and Proximity to Streams

BARNES CREEK																		
ANIMAL TYPE	POULTRY			DAIRY			HOG			BEEF			OTHER			TOTAL		
	Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream		
	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'
	0	0	0	0	1	3	0	1	0	1	0	3	0	1	0	1	3	6
% of Subwatershed Total	0.0%	0.0%	0.0%	0.0%	10.0%	30.0%	0.0%	10.0%	0.0%	10.0%	0.0%	30.0%	0.0%	10.0%	0.0%	10.0%	30.0%	60.0%

Non-Point Source Pollution Potential

In order to provide a comparison of the pollution potential of each of the 15 subwatersheds, a ranking system for each of the main potential pollution sources was developed. These potential sources are stream miles with less than 10 feet of vegetation, the number of livestock or poultry operations less than 1,000 feet from a stream, the tons of raw manure produced yearly, the pounds of phosphorus per cropland acre available from the manure, the number of household wastewater disposal systems contained in clusters of ten or more) and the number of homes built pre-1973. Values of 1 (less potential) to 10 (great potential) were given based on ranges shown in the table of the following page. Indicator scores are then summed to obtain a total pollution potential score for the subwatershed.

Subwatershed pollution potential scores can range from a maximum of 60 points to a minimum of six points. The Barnes Creek subwatershed ranks fourteenth out of 15, with 13.3% of the maximum points for pollution potential.

NONPOINT SOURCE POLLUTION POTENTIAL SCORING MATRIX

MAXIMUM DRAINAGE UNIT SCORE = 60 (Highest Pollution Potential)

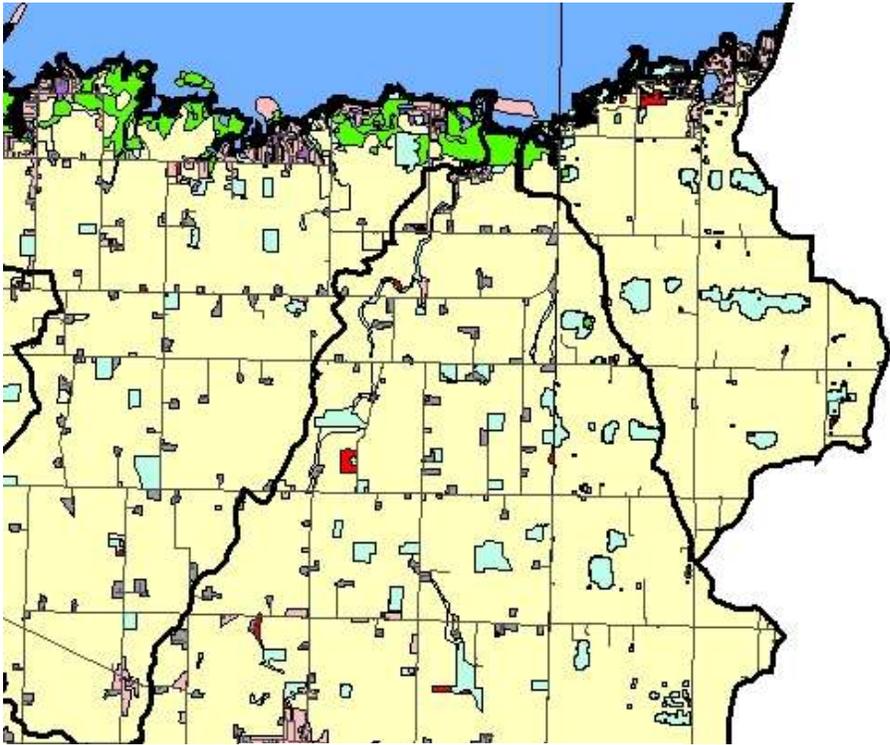
SCORE	Stream Miles with <10' Vegetation	Operations <1,000' to stream	Tons Raw Manure per Year	Lbs. P ₂ O ₅ per Crop Acre	Household Disposal Systems in Groups	No. Homes Built pre-1973
10	72.00+	46+	180,000+	225+	90+	226+
9	64.00 - 71.99	41 - 45	160,000 - 179,999	200 - 224	80 - 89	201 -225
8	56.00 - 63.99	36 - 40	140,000 - 159,999	175 - 199	70 - 79	176 -200
7	48.00 - 55.99	31 - 35	120,000 - 139,999	150 - 174	60 - 69	151 - 175
6	40.00 - 47.99	26 - 30	100,000 - 119,999	125 - 149	50 - 59	126 - 150
5	32.00 - 39.99	21 - 25	80,000 - 99,999	100 - 124	40 - 49	101 - 125
4	24.00 - 31.99	16 - 20	60,000 - 79,999	75- 99	30 - 39	76 - 100
3	16.00 - 23.99	11 - 15	40,000 - 59,999	50 - 74	20 - 29	51 - 75
2	8.00 - 15.99	6 - 10	20,000 - 39,999	25 - 49	10 - 19	26 - 50
1	0.00 - 7.99	0 - 5	0 - 19,999	0 - 24	0 - 10	0 - 25

MINIMUM DRAINAGE UNIT SCORE = 6 (Lowest Pollution Potential)

TABLE 47
NPS Pollution Potential

BARNES CREEK							
SUBWATERSHED ATTRIBUTE	Stream Miles with <10' Vegetation SCORE	Operations <1,000' to stream SCORE	Tons Raw Manure per Year SCORE	Lbs. P ₂ O ₅ per Crop Acre SCORE	Household Disposal Systems in Groups SCORE	No. Homes Built pre-1973 SCORE	TOTAL SCORE
	1	1	1	2	1	2	8

MAP 43
Barnes Creek Land Use

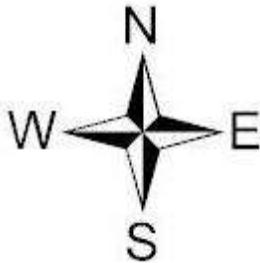


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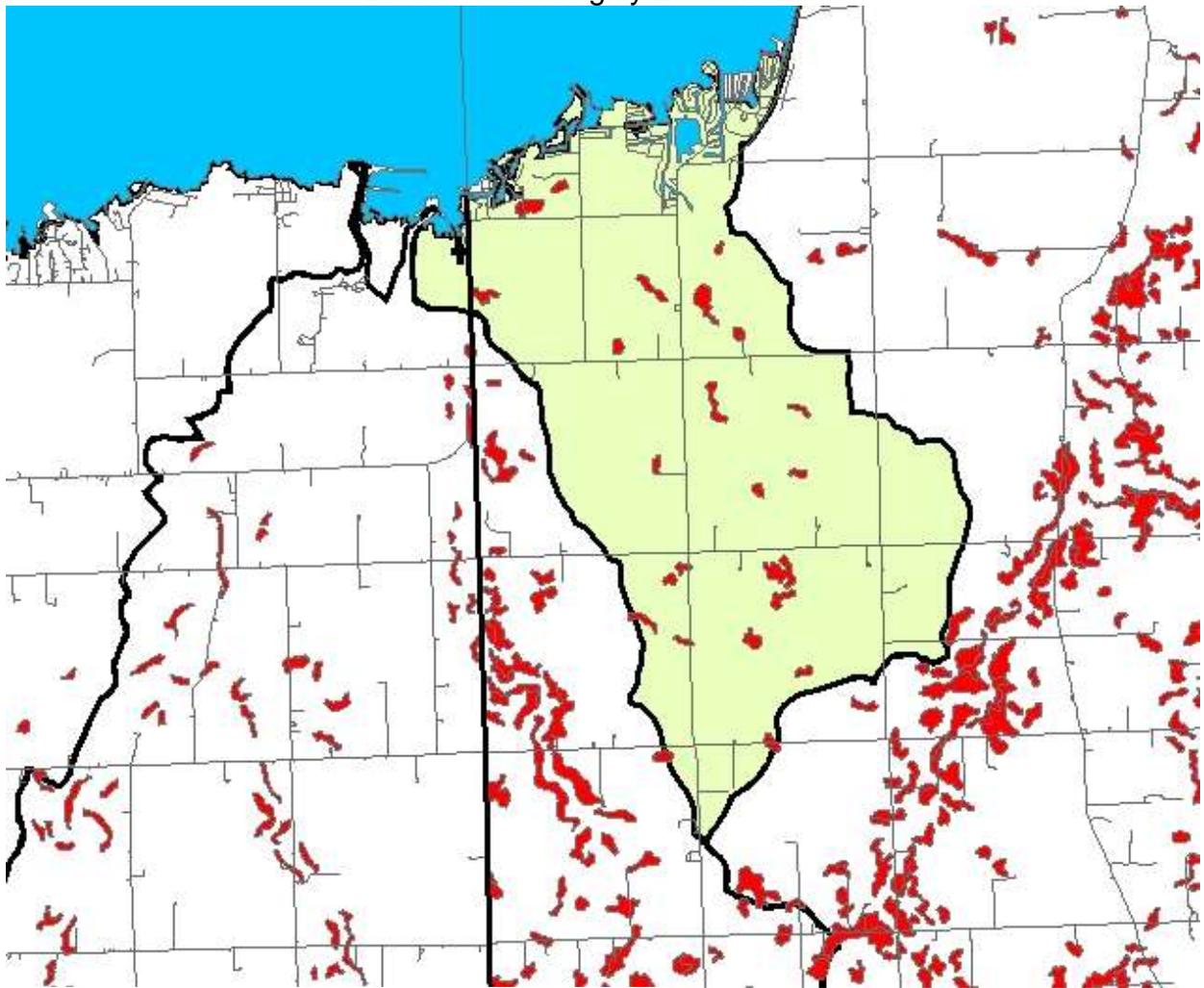
- Grand Lake/Wabash Watershed
- Roadways

Land Use

- Cropland
- Urban
- Farmsteads
- Shrub_Brush
- Deciduous Forest
- Open Water
- Wetlands
- Barren/Undeveloped

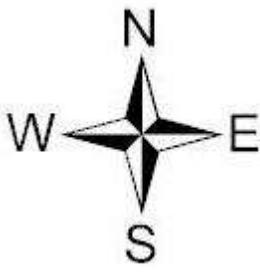


MAP 44
Barnes Creek Highly Erodible Land

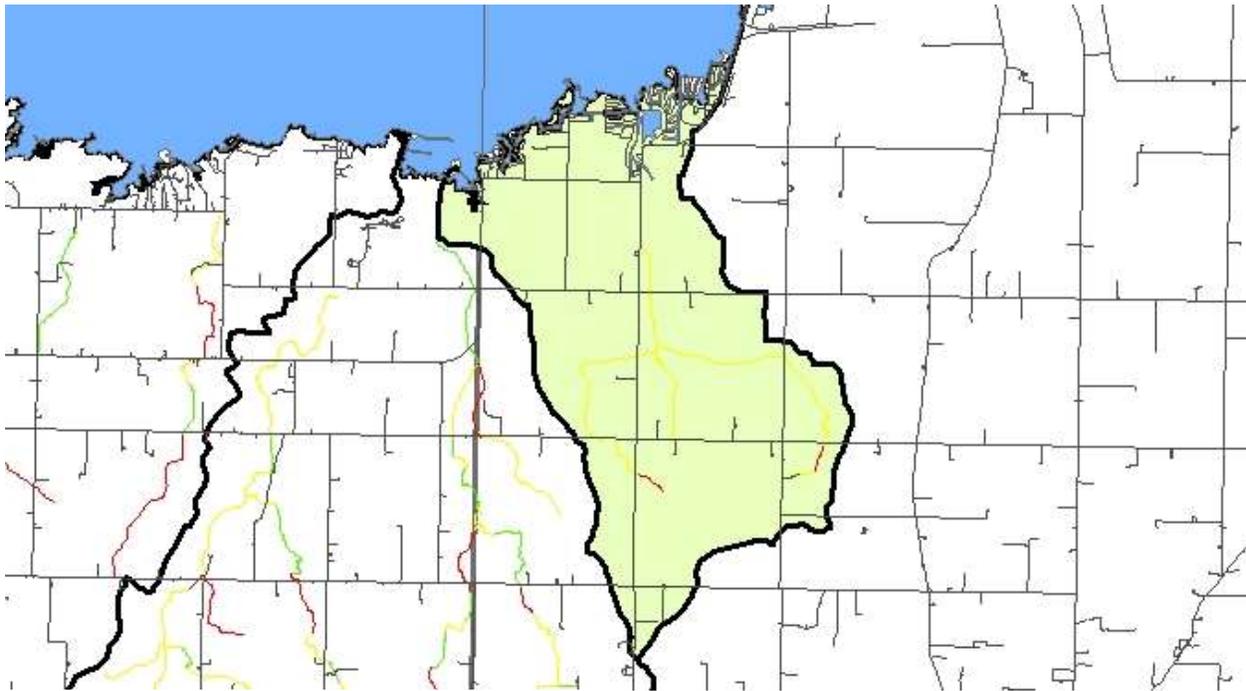


Legend

-  Highly erodible land
-  Roadways
-  Open Water
-  Subwatershed



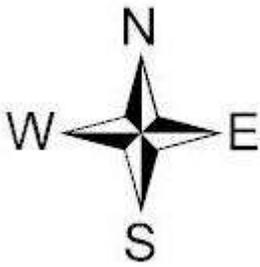
MAP 45
Barnes Creek Riparian Corridor Status



Legend

Riparian Corridor Status

- Less than 10 feet
- 10 to 40 feet
- Greater than 40 feet
- Roadways
- Open Water
- Grand Lake/Wabash Watershed



4.1.7 North Lake Shore

The North Shore subwatershed drains the entire northern portion of the Grand Lake St. Marys drainage basin. The majority of the subwatershed is located in Mercer County, and the remainder is located in Auglaize County. The acres, square miles, and percent of subwatershed are shown below. The North Shore subwatershed, according to percentages, is the smallest subwatershed draining to Grand Lake St. Marys. Of the entire Grand/Lake Wabash Watershed, it is the fourteenth largest of fifteen subwatersheds.

TABLE 48

NORTH LAKE SHORE	
Acreage	3,486
Square Miles	5.45
% of Grand Lake Watershed Total Land Area	5.9%
% of Grand Lake/Wabash Watershed Total Land Area	1.9%

Water Quality Status

The North Shore subwatershed has been identified as a warm water habitat (WWH). Specific sampling in the North Shore subwatershed has not been completed, but this aquatic life use designation has been inferred from information established by Ohio EPA stating that the entire watershed does not meet its use designation, or is in a “non-attainment” status. It is further assumed that the North Shore subwatershed is NPS impacted. Suspected or proven impacts to these streams include: non-irrigated crop production, animal feeding operations, channelization, removal of riparian vegetation and stream bank destabilization. Definitions and criteria for these descriptives can be found in Appendix C- Aquatic life use designations and assessment terms.

Ohio EPA is currently completing a TMDL report for Beaver Creek and Grand Lake St. Marys, which is in process of being finalized. The draft report does not call for specific load reductions in the North Shore subwatershed; however, it does call for load reductions of phosphorus, nitrate and fecal coliform in the surrounding subwatersheds. Detailed information on the sampling results and recommended load reductions can be found in the draft report of the 2007 Ohio EPA TMDL report, which can be obtained by contacting the watershed project office.

Water Supplies and Discharges

There are two community water supplies are located in the North Shore area; the City of St Marys and Northwood Homeowners Association. Regarding the transient non-

community water supplies, five are present; Northmoor Landings, Carter Lumber Co., Grand Slam, Lake Drive In, and the Northmoor Golf LLC.

There is one regulated discharger is located on the North Shore, the Northwood Sanitary Sewer Subdistrict WWTP and three non-regulated dischargers; the Idlewild Subdivision, Kozy Marina-Northmoor Mobile Home Park, and the Chakeres Lake Drive In Theatre. Ohio EPA has also issued an indirect discharge permit to Celina Aluminum Precision Technology, Inc and Qualitec Metal Finishers.

Based on recent aerial photographs, areas where 10 or more household wastewater treatment and disposal systems were present in close proximity were identified. As with any individual treatment system operating in an area with poorly drained soils, the effects of the effluent on the receiving water body is a concern. These effects grow as the number of systems in a given area increases, thus clusters or groups of 10 or more systems has been used to analyze the potential effects of those systems on the water quality. Regarding the North Shore subwatershed, no clusters were identified.

Highly Erodible Land

Map 45 at the end of this subsection illustrates the highly erodible land locations within the North Lake Shore subwatershed. Of the seven subwatersheds within the Grand Lake St. Marys watershed, North Lake Shore ranks fourth highest in the amount of highly erodible land present within the subwatershed. The highly erodible land information was developed from the 2003 online NRCS Soil Data Mart.

Riparian Corridor Status

The chart on the following page shows the riparian corridor status for the North Shore subwatershed. The chart indicates the number of miles of each drainage unit that has various widths of tree canopy, or riparian corridor. The numbers account for both sides of the streams; therefore, the number of actual stream miles is half of that shown. The divisions are less than 10 feet in total width, 10 to 40 feet in total width, and greater than 40 feet in total width. The chart is also divided into perennial and intermittent streams under each of the corridor width column headings. MAP 46 illustrates the stream sections under each division.

The chart shows that with a total of 1.48 miles of stream network, the North Shore subwatershed has 0.91 miles of stream with less than 10 feet of canopy and vegetation, zero miles of stream with 10 to 40 feet canopy and vegetation, and 0.57 miles of stream with greater than 40 feet of canopy and vegetation. The North Shore subwatershed has the lowest number of stream miles within the Grand Lake St. Marys Watershed, which is 1.1%. Of the entire Grand Lake/Wabash Watershed, this subwatershed has the lowest number of stream miles, which is 0.2%.

TABLE 49
Riparian Corridor Status

NORTH LAKE SHORE										
RIPARIAN STATUS	TREE CANOPY <10' IN TOTAL WIDTH			TREE CANOPY 10 to 40' IN WIDTH			TREE CANOPY >40' IN WIDTH			TOTAL STREAM MILES
	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	PEREN- NIAL	INTER- MITTENT	SUB- TOTAL	
	0.00	0.91	0.91	0.00	0.00	0.00	0.00	0.57	0.57	1.48
% of Subwatershed Total	0.0%	2.2%	2.2%	0.0%	0.0%	0.0%	0.0%	1.4%	1.4%	3.6%
% of Grand Lake Watershed Total	0.0%	0.6%	0.6%	0.0%	0.0%	0.0%	0.0%	0.4%	0.4%	1.1%
% of Grand Lake/Wabash Watershed Total	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.2%

Operations and Animal Units

The table on the following page shows the number of operations and the animal units by species for the North Shore subwatershed. According to the table, there are no poultry operations, one dairy operation, no hog operations and one beef operation within the entire subwatershed. The North Shore subwatershed ranks last within the entire Grand Lake/Wabash River Watershed when considering the total number of operations with two or 0.2%. Animal units within the subwatershed ranks last of 15 with 0.04%.

Totals of animal units for each species are also listed on the table. The inventory for this subwatershed was completed during March of 2007. At the time of the inventory animal units were determined by the number of animals present. Although this is not a 1:1 ratio for all species, it is for beef cattle. The following chart shows the number of each type of animal that makes up 1,000 animal units.

Animal Type	1,000 Animal Unit Equivalent
Beef Cattle	1,000
Dairy Cattle	700
Hogs (over 55 lbs)	2,500
Turkeys	55,000
Layer Chickens	82,000
Pullet Chickens	125,000
Sheep	10,000
Horses	500

TABLE 50
Operations and Animal Units

NORTH LAKE SHORE														
ANIMAL TYPE	POULTRY		DAIRY		HOG		BEEF		OTHER		TOTAL		Total as % of Grand Lake Watershed	
	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s	# OPER.	# A.U.s						
# Farms and Animals	0 (Trky)	0 0	1	93	0	0	1	35	(sheep) (hrs)	0 0	2	128	0.7%	0.1%
% of subwatershed total	0.0%	0.0%	50.0%	72.6%	0.0%	0.0%	50.0%	27.4%	0.0%	0.0%	100.0%	100.0%		
Total as % of Grand Lake Watershed	0.0%	0.0%	0.3%	0.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.7%	0.1%		
Total as % of Grand Lake/Wabash Watershed	0.00%	0.00%	0.10%	0.03%	0.00%	0.00%	0.10%	0.01%	0.00%	0.00%	0.20%	0.04%		

Manure Production

After considering the number of livestock operations and animal units present in the watershed, it is only fitting to consider the by-products of these animals. The table on the opposite page is used to represent the manure and nutrient production for the North Shore drainage area. The North Shore subwatershed ranks last overall, of 15, in terms of manure production per annum. Approximately 1,750 tons of manure is produced annually. The remainder of the columns on the table indicates the approximate pounds of nutrients contained in that manure. Nitrogen, potassium, and phosphate, are all important to the agricultural community and are provided to the crops via manure or commercial fertilizer applications.

These nutrients are also important in regards to water quality. According to the table, in the North Shore subwatershed, the amount of phosphorus that is contained in the manure produced annually would need to be applied at eight pounds per acre. The table below indicates the average crop removal rates for phosphorus for the major crops produced in the watershed. Values were obtained from the Ohio Agronomy Guide.

CROP	P₂O₅ REMOVAL (lb/ac)
Alfalfa (6T)	80
Corn (150 bu) Grain	55
Corn (25 T) Silage	80
Soybean (50 bu)	40
Wheat (75 bu) Grain	48

Considerations are given to the nutrient phosphorus due to its importance to crop production and the problems associated with the relationship between excessive phosphorus applications and degradation of water quality.

TABLE 51
Manure and Nutrient Production

NORTH LAKE SHORE						
Manure Production	Tons Raw Manure/Year	Lbs. N per Year	Lbs. K ₂ O per Year	Lbs. P ₂ O ₅ per Year	Acres Cropland	Lbs. P ₂ O ₅ per Crop Acre
	1,750	18,001	14,441	8,831	1,176	8
Less 70% Poultry Manure**	1,750	18,001	14,441	8,831	1,176	8
Approximate \$ Value Per Year		\$3,960	\$2,166	\$1,766		
Total Nutrient Value Per Year =	\$7,892					

**There is no poultry in the North Lake Shore subwatershed.

The dollar values associated with each nutrient were obtained from OSU Extension Bulletin 604-06, "Ohio Livestock Manure Management Guide." The value for nitrogen is estimated at \$0.22 per pound, the value for P₂O₅ is \$0.20 per pound and the value for K₂O is \$0.15 per pound.

Distance Between Livestock Operations and Streams

The table on the following page shows the distance between various livestock operations located in the North Shore subwatershed. It can be assumed that the greater the distance between a livestock operation and a water system, the potential of pollution from the operation reaching the stream is lessened.

Of notable interest is the number of all livestock operations located less than 1,000 feet from the waterbody. In this particular subwatershed, out of two operations, both are less than 3,000 feet from the nearest stream.

TABLE 52

Livestock Operations and Proximity to Streams

NORTH LAKE SHORE																		
ANIMAL TYPE	POULTRY			DAIRY			HOG			BEEF			OTHER			TOTAL		
	Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream			Distance to Stream		
	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'	<1000'	<2000'	<3000'
	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	2
% of Subwatershed Total	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

Non-Point Source Pollution Potential

In order to provide a comparison of the pollution potential of each of the 15 subwatersheds, a ranking system for each of the main potential pollution sources was developed. These potential sources are stream miles with less than 10 feet of vegetation, the number of livestock or poultry operations less than 1,000 feet from a stream, the tons of raw manure produced yearly, the pounds of phosphorus per cropland acre available from the manure, the number of household wastewater disposal systems contained in clusters of ten or more) and the number of homes built pre-1973. Values of 1 (less potential) to 10 (great potential) were given based on ranges shown in the table of the following page. Indicator scores are then summed to obtain a total pollution potential score for the subwatershed.

Subwatershed pollution potential scores can range from a maximum of 60 points to a minimum of six points. The North Shore subwatershed ranks last out of 15, with 11.7% of the maximum points for pollution potential.

NONPOINT SOURCE POLLUTION POTENTIAL SCORING MATRIX

MAXIMUM DRAINAGE UNIT SCORE = 60 (Highest Pollution Potential)

SCORE	Stream Miles with <10' Vegetation	Operations <1,000' to stream	Tons Raw Manure per Year	Lbs. P ₂ O ₅ per Crop Acre	Household Disposal Systems in Groups	No. Homes Built pre-1973
10	72.00+	46+	180,000+	225+	90+	226+
9	64.00 - 71.99	41 - 45	160,000 - 179,999	200 - 224	80 - 89	201 -225
8	56.00 - 63.99	36 - 40	140,000 - 159,999	175 - 199	70 - 79	176 -200
7	48.00 - 55.99	31 - 35	120,000 - 139,999	150 - 174	60 - 69	151 - 175
6	40.00 - 47.99	26 - 30	100,000 - 119,999	125 - 149	50 - 59	126 - 150
5	32.00 - 39.99	21 - 25	80,000 - 99,999	100 - 124	40 - 49	101 - 125
4	24.00 - 31.99	16 - 20	60,000 - 79,999	75- 99	30 - 39	76 - 100
3	16.00 - 23.99	11 - 15	40,000 - 59,999	50 - 74	20 - 29	51 - 75
2	8.00 - 15.99	6 - 10	20,000 - 39,999	25 - 49	10 - 19	26 - 50
1	0.00 - 7.99	0 - 5	0 - 19,999	0 - 24	0 - 10	0 - 25

MINIMUM DRAINAGE UNIT SCORE = 6 (Lowest Pollution Potential)

TABLE 53
NPS Pollution Potential

NORTH LAKE SHORE							
SUBWATERSHED ATTRIBUTE	Stream Miles with <10' Vegetation SCORE	Operations <1,000' to stream SCORE	Tons Raw Manure per Year SCORE	Lbs. P ₂ O ₅ per Crop Acre SCORE	Household Disposal Systems in Groups SCORE	No. Homes Built pre-1973 SCORE	TOTAL SCORE
	1	1	1	1	1	2	7

MAP 46
North Shore Land Use

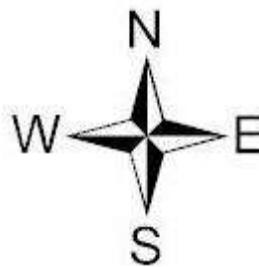


Legend

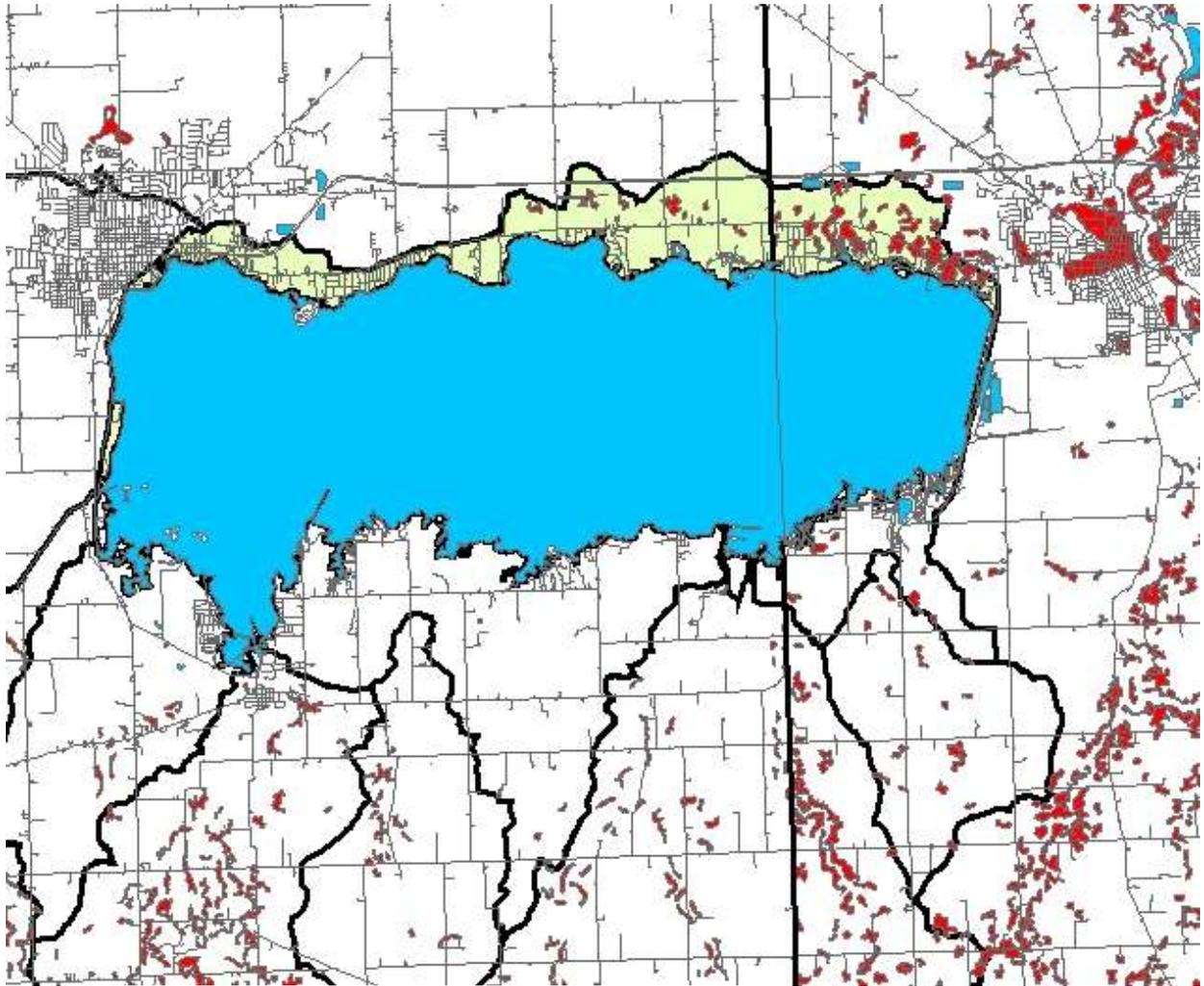
-  Grand Lake/Wabash Watershed
-  Roadways

Land Use

-  Cropland
-  Urban
-  Farmsteads
-  Shrub_Brush
-  Deciduous Forest
-  Open Water
-  Wetlands
-  Barren/Undeveloped

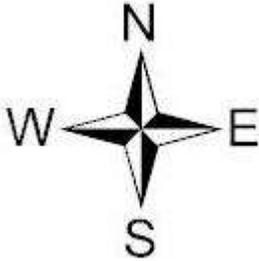


MAP 47
North Shore Highly Erodible Land



Legend

-  Highly erodible land
-  Roadways
-  Open Water
-  Subwatershed



MAP 48
North Shore Riparian Corridor Status

