Michigan Department of Environmental Quality
Surface Water Quality Division
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Total Maximum Daily Load for *Escherichia coli* for Lenawee County Drain No. 70, Lenawee County

INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of *Escherichia coli* (*E. coli*) that will result in the attainment of the applicable WQS in Lenawee County Drain No. 70, a small waterbody in the River Raisin Watershed.

PROBLEM STATEMENT

Lenawee County Drain No. 70 was first placed on the Section 303(d) list in 1998. This TMDL addresses approximately one mile of stream. The TMDL reach is on the Section 303(d) list as:

Waterbody: **Lenawee County Drain No. 70** WBID#: **061103H**
County: Lenawee RF3RchID: 4100002 575 Size: 1 M
Location: Tributary to Big Meadow Creek, Palmyra Twp from Manor Farms and Humphrey Hwy downstream to west of Palmyra
Status: **2** Problem: **Untreated sewage discharge, pathogens (Rule 100).**
TMDL YEAR(s): 2000

Lenawee County Drain No. 70 (Figure 1) was placed on the Section 303(d) list (Creal and Wuycheck, 2000) due to impairment of recreational uses as indicated by the presence of elevated levels of *E. coli*. Historical data collected by Lenawee County officials has documented raw sewage discharges into Lenawee County Drain No. 70 from the Manor Farms Subdivision since the mid 1960s. Fecal coliform data, a historical test used to detect general sewage contamination, routinely found fecal coliform levels greater than 5,000 organisms per 100 milliliter (ml) (Kight, 1998). Recent monitoring data (Appendix 1) collected by the Michigan Department of Environmental Quality (MDEQ) in 2001 documented continued exceedances of the WQS for *E. coli* (the current pathogen indicator in the Michigan WQS) at all five stations sampled (Table 1), with exception of the May sampling at East Carleton Road. Monthly geometric mean *E. coli* concentrations in 2001 ranged from 59 *E. coli* per 100 ml in May at Carleton Road to 54,500 *E. coli* per 100 ml in May at Humphrey Highway (Table 1). The particularly high levels of *E. coli* at Humphrey Highway (Figure 2) are consistent with the Lenawee County Health Department findings of seven to eight houses sharing a community drain field that discharges to Lenawee County Drain at Humphrey Highway (Kight, 1998).

NUMERIC TARGET

The impaired designated use for Lenawee County Drain No. 70 at this location is total body contact recreation. Rule 100 of the Michigan WQS requires that this waterbody be protected for total body contact recreation from May 1 to October 31. The target levels for this designated use are the ambient *E. coli* standards established in Rule 62 of the WQS as follows:

> R 323.1062 Microorganisms.
> Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 *Escherichia coli (E. coli)* per 100 milliliters, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of 3 or more samples taken at representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of 300 *E. coli* per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sampling area.

For this TMDL, the WQS of 130 per 100 ml as a 30-day geometric mean is the target level for the TMDL reach from May 1 to October 31. As previously stated, 2001 monitoring data indicated consistent exceedances of WQS in the TMDL reach with particularly high levels of *E. coli* at Humphrey Highway.

SOURCE ASSESSMENT

Lenawee County Drain No. 70 is located entirely in Palmyra Township of Lenawee County. The TMDL reach is from Humphrey Highway, downstream one mile to East Carleton Road (Figure 1).

Potential pathogen sources for this waterbody are primarily due to illicit sewer connections in the drain. Records and data show that Lenawee County Drain No. 70 has been receiving untreated, raw sewage from homes in the Manor Farms Subdivision since the mid 1960s. As far back as April 1969, the Michigan Department of Natural Resources responded to complaints of sewage in Lenawee County Drain No. 70, noting physical evidence of human waste at that time (Kight, 1998). Based on the information and data available, the Manor Farms Subdivision appears to be the primary source of *E. coli*.

LINKAGE ANALYSIS

The link between the *E. coli* concentration in Lenawee County Drain No. 70 and the potential sources is the basis for the development of the TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and the sources. This provides the basis for estimating the total assimilative capacity of the drain and any needed load reductions. For this TMDL, the primary loading of pathogens likely enters Lenawee County Drain No. 70 by illicit connections and raw sewage inputs from local homes just upstream of Humphrey Highway.

The guiding water quality management principle used to develop the TMDL was that compliance with the numeric pathogen target in Lenawee Country Drain No. 70 depends on the control of *E. coli* from illicit connections. If the *E. coli* inputs can be controlled, then total body contact recreation in Lenawee County Drain No. 70 will be protected.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by the waterbody while still achieving WQS. As indicated in the Numeric Target section, the target for this pathogen TMDL is the WQS of 130 *E. coli* per 100 ml. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the environmental conditions that will be used when defining allowable levels. Many TMDLs are designed around the concept of a "critical condition." The "critical condition" is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical conditions for the control of point sources in Michigan are given in R 323.1090. In general, the lowest monthly 95% exceedance flow for streams is used as a design condition for point source discharges. *E. coli* sources to the Lenawee County Drain No. 70 arise from a mixture of wet and dry weather-driven nonpoint sources, and there is no single critical condition that is protective for all other conditions. For these sources, there are a number of different allowable loads that will ensure compliance, as long as they are distributed properly throughout the watershed.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For *E. coli*, however, mass is not an appropriate measure, and the USEPA allows pathogen TMDLs to be expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). Therefore, this pathogen TMDL is concentration-based consistent with R 323.1062, and the TMDL at East Carleton Road is equal to the target concentration of 130 *E. coli* per 100 ml for each month of the recreational season (May through October) (Table 2).

ALLOCATIONS

TMDLs are comprised of the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for nonpoint sources, and the MOS. As previously indicated, this pathogen TMDL will not be expressed on a mass loading basis and is concentration-based consistent with USEPA regulations in 40 CFR, Section 130.2(i).

WLAs

At this time, there are no known permitted point source discharges to Lenawee County Drain No. 70; therefore, the WLA is equal to zero.

LAs

Because this TMDL is concentration-based, the LA is equal to 130 *E. coli* per 100 ml. As indicated in the Source Assessment Section, the primary source of *E. coli* is Manor Farms Subdivision in Palmyra Township.

MOS

This section addresses the incorporation of an MOS in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be either implicit (i.e., incorporated into the TMDL analysis thorough conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS because no rate of decay was used.

SEASONALITY

Seasonality in the TMDL is addressed by expressing the TMDL in terms of a total body contact recreation season that is defined as May 1 through October 31 by R 323.1100 of the WQS. There is no total body contact during the remainder of the year primarily due to cold weather. In addition, because this is a concentration-based TMDL, WQS will be met regardless of flow conditions in the applicable season.

MONITORING

In 2001, pathogens were monitored at five stations from May through September (Figure 1). Future monitoring will take place after the regional wastewater treatment plant (WWTP) is built and connected to the Manor Farms Subdivision. A regional WWTP is planned and will provide service to Manor Farms Subdivision. The earliest monitoring will likely be performed is 2004, but may be later depending on progress of the regional WWTP. When these results indicate that the waterbody may be meeting WQS, sampling will be conducted at the appropriate frequency to determine if the
30-day geometric mean value of 130 *E. coli* per 100 ml is being met.

REASONABLE ASSURANCE ACTIVITIES

The Lenawee Country Drain Commissioner has applied for a State Revolving Fund low interest loan to build a regional WWTP. In addition, Palmyra Township has passed a resolution, dated January 23, 2002, to design and construct a regional treatment plant with neighboring Madison Township. This proposed WWTP will encompass the Manor Farms Subdivision, as well as other areas in surrounding townships requiring sewer systems. This facility has a National Pollutant Discharge Elimination System permit on public notice and sewer connections are expected in 2004. The discharge location for this new WWTP will be the River Raisin, eliminating the primary source of *E. coli* problems in Lenawee County Drain No. 70.

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REFERENCES

Creal, W. and J. Wuycheck. 2000. Federal Clean Water Act Section 303(d) List – Michigan's Submittal for Year 2000. Michigan Department of Environmental Quality, Surface Water Quality Division, Report Number MI/DEQ/SWQ-00/018.

Kight, Michael. 1998. Correspondence to Richard Jackson, Palmyra Township Clerk.

USEPA. 2001. Protocol for Developing Pathogen TMDLs. United States Environmental Protection Agency, 841-R-00-002.

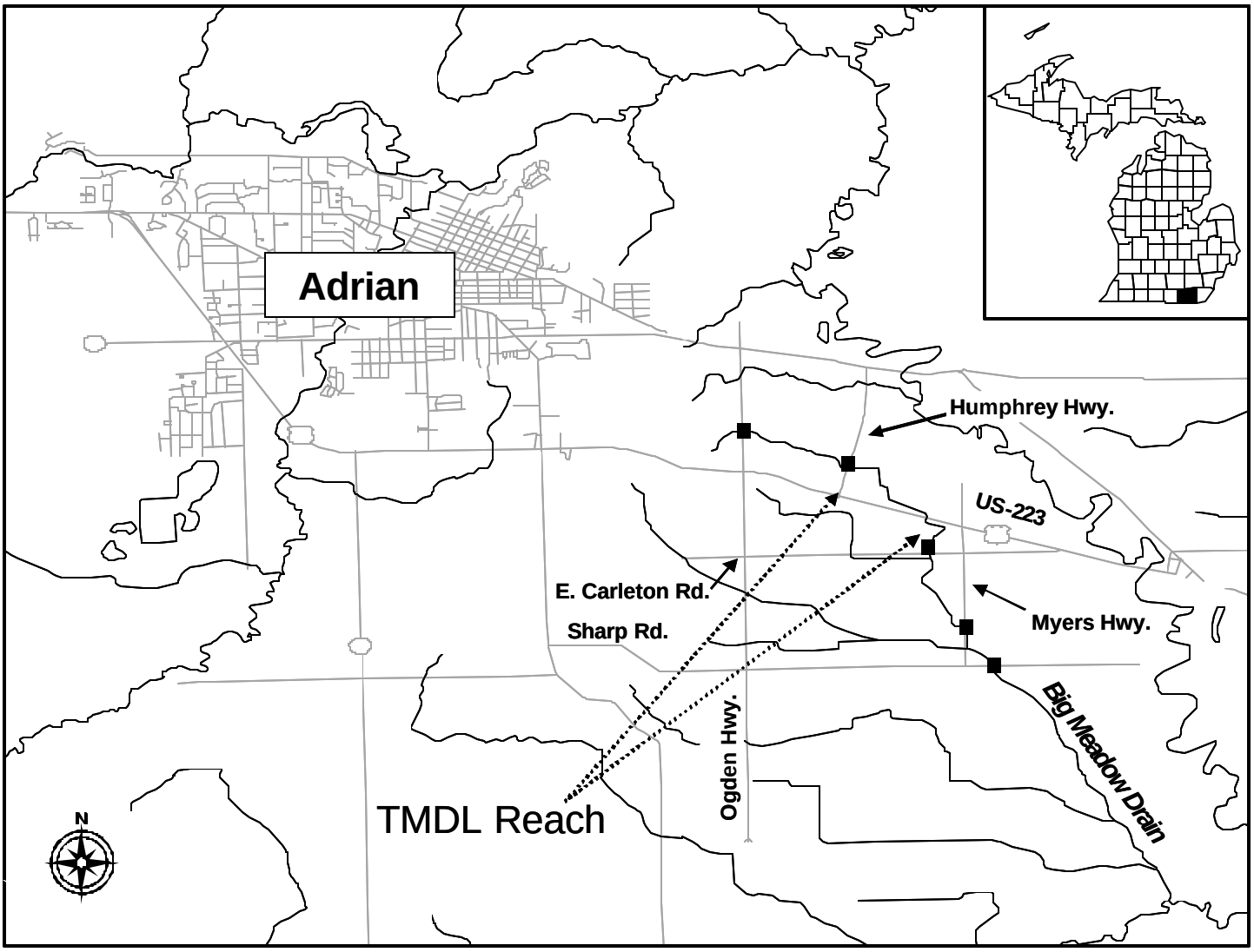

Figure 1. Lenawee County Drain No. 70 *E. coli* sampling locations, Palmyra Township, Michigan, 2001.

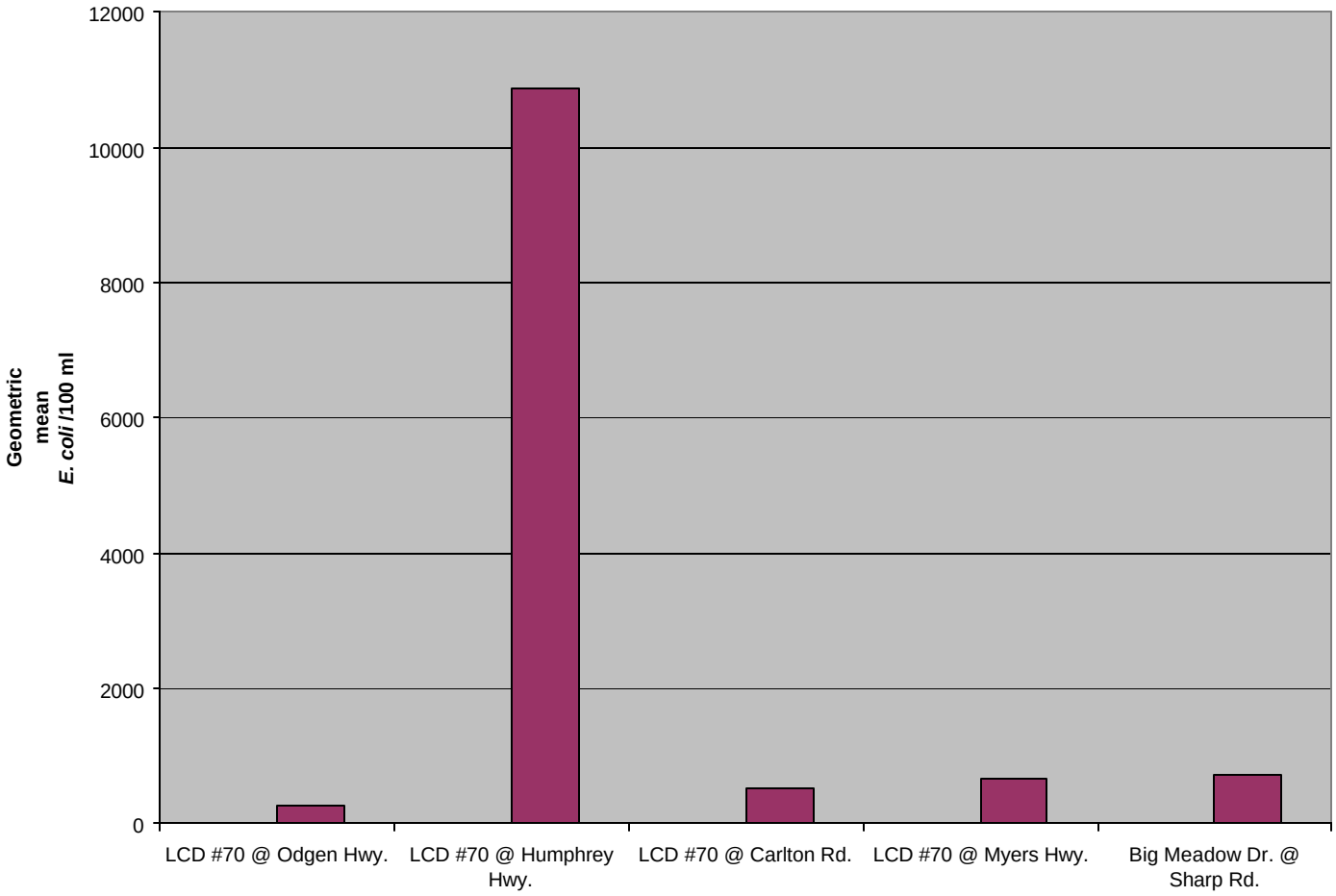

Figure 2. Geometric mean *E. coli* results from Lenawee County Drain No. 70, Palmyra Township, Michigan, 2001.

Table 1. MDEQ *E. coli* data for Lenawee County Drain No. 70, Palmyra Township, Michigan, 2001.

		E. coli concentration (#/100 ml)			
Sample Location	**Month**	**minimum**	**Geometric mean**	**maximum**	**# of results**
Lenawee County Dr. #70 @ Ogden Highway	May	200	269	360	3
	June	90	282	1,900	9
	July	*	*	*	*
	August	*	*	*	*
	September	*	*	*	*
Lenawee County Dr. #70 @ Humphrey Hwy.	May	46,000	54,500	69,000	3
	June	2,700	11,330	36,000	12
	July	3,200	17,130	112,000	15
	August	1,720	4,296	6,200	12
	September	7,500	7,830	8,000	3
Lenawee County Dr. #70 @ Carleton Rd.	May	50	59	70	3
	June	60	366	1,020	12
	July	360	602	1,210	15
	August	360	796	1,900	12
	September	1,200	1,673	2,600	3
Lenawee County Dr. #70 @ Myers Hwy.	May	260	270	280	3
	June	130	615	2,400	12
	July	460	925	2,500	15
	August	380	525	760	12
	September	1,000	1,335	1,700	3
Big Meadow Dr. @ Sharp Rd.	May	*	*	*	*
	June	700	706	710	3
	July	520	1,047	2,700	15
	August	270	488	790	12
	September	500	592	740	3

***** no data collected during this month at this location.

Table 2. Allowable *E. coli* concentrations by month in the Lenawee County Drain No. 70 Watershed.

	May	June	July	August	September	October
Lenawee County Drain No. 70	130	130	130	130	130	130

Appendix 1. MDEQ 2001 *E. coli* monitoring data for Lenawee County Drain No. 70. Data are presented upstream to downstream followed by Big Meadow Drain.

Lenawee Co. Drain No. 70 at Ogden Highway LD-2A	Lenawee Co. Drain No. 70 at Humphrey Highway LD-3A	Lenawee Co. Drain No. 70 at Carlton Road LD-1A
5/30/2001	**5/30/2001**	**5/30/2001**
360	69000	50
200	51000	60
270	46000	70
6/4/2001	**6/4/2001**	**6/4/2001**
180	4600	130
120	3800	60
190	2700	140
6/11/2001	**6/11/2001**	**6/11/2001**
110	29000	510
90	29000	700
110	29000	660
6/18/2001	**6/18/2001**	**6/18/2001**
880	36000	970
1900	23000	900
1500	8000	1020
	6/25/2001	**6/25/2001**
	10100	200
	8300	380
	7000	330
	7/2/2001	**7/2/2001**
	9400	360
	11700	380
	11200	440
	7/10/2001	**7/10/2001**
	110000	500
	101000	770
	104000	500
	7/17/2001	**7/17/2001**
	73000	900
	68000	990
	112000	1210
	7/24/2001	**7/24/2001**
	3700	680
	3200	720
	3600	710
	7/31/2001	**7/31/2001**
	4600	450
	4700	520
	4400	490
	8/6/2001	**8/6/2001**
	3900	900
	5200	780
	5200	680
	8/14/2001	**8/14/2001**
	6000	1090
	5800	1900
	6200	1070
	8/21/2001	**8/21/2001**
	2160	450
	2240	360
	1720	480
	8/27/2001	**8/27/2001**
	6000	900
	5700	900
	6100	970
	9/5/2001	**9/5/2001**
	8000	1200
	8000	1500
	7500	2600

Appendix 1 continued.

Lenawee Co. Drain No. 70 at Myers Highway LD-4A	Big Meadow Drain at Sharp Road LD-2B
5/30/2001	**6/25/2001**
270	710
260	710
280	700
6/4/2001	**7/2/2001**
130	910
870	880
940	860
6/11/2001	**7/10/2001**
310	2700
280	2400
470	2100
6/18/2001	**7/17/2001**
2400	2000
2300	1200
530	1510
6/25/2001	**7/24/2001**
530	790
620	690
700	700
7/2/2001	**7/31/2001**
800	520
780	570
810	520
7/10/2001	**8/6/2001**
1200	760
2000	790
2500	690
7/17/2001	**8/14/2001**
1500	540
1300	470
1200	430
7/24/2001	**8/21/2001**
630	430
640	420
770	390
7/31/2001	**8/27/2001**
460	270
590	500
520	420
8/6/2001	**9/5/2001**
670	740
680	500
690	560
8/14/2001	
540	
550	
760	
8/21/2001	
420	
380	
440	
8/27/2001	
500	
460	
380	
9/5/2001	
1000	
1400	
1700	