

Michigan Department of Environmental Quality
Water Division
September 2004

Total Maximum Daily Load for *Escherichia coli* for Potters Lake and Burdick Drain
Lapeer 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, Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide a basis for determining the pollutant reductions necessary from both point and nonpoint sources (NPS) to restore and maintain the quality of the 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 Potters Lake and Burdick Drain, located in Lapeer and Genesee Counties. These water bodies are tributaries of Black Creek, a tributary of Kearsley Creek, which flows into the Flint River in the vicinity of Flint, Michigan. Potters Lake and Burdick Drain are in the Southern Michigan Northern Indiana Till Plain Ecoregion (Omernik and Gallant, 1988).

PROBLEM STATEMENT

This TMDL addresses two listings: Potters Lake and 0.5 miles of Burdick Drain in Elba Township, both located in Lapeer County. The TMDL reach for Potters Lake and Burdick Drain appears on the Section 303(d) list as:

POTTERS LAKE

County: LAPEER

Location: Vicinity of Elba Twp.

HUC: 4080204 RF3RchID: 4080204 675.00

Problem: Untreated sewage discharge, pathogens (Rule 100).

TMDL YEAR(s): 2004

WBID#: 210413F

Size: 160 A

BURDICK DRAIN

County: LAPEER

Location: Enters NE part of Potters Lake after crossing Davison Rd., and Olgelthorp Rd., Elba Twp., SE ¼ of the SW ¼ of Sec 6. (T7N, R9E).

HUC: 4080204 RF3RchID: 4080204 0

Problem: Untreated sewage discharge, pathogens (Rule 100).

TMDL YEAR(s): 2004

WBID#: 210414D

Size: 0.5 M

Potters Lake and Burdick Drain (Figure 1) were placed on the Section 303(d) list due to impairment of recreational uses as indicated by the presence of elevated levels of *E. coli* (Wolf and Wuycheck, 2004). Sampling conducted in Potters Lake by the Michigan Department of

Environmental Quality (MDEQ) in 2002, indicated exceedance of the WQS at all but one location (Table 1). Thirty-day geometric mean *E. coli* concentrations ranged from 20 *E. coli* per 100 milliliters (ml) at multiple locations to 1,157 *E. coli* per 100 ml at the east shore location (PL-4A). The east shore location consistently exceeded WQS from mid-June through mid-July. Daily geometric mean concentrations ranged from 20 *E. coli* per 100 ml at multiple locations to 13,165 *E. coli* per 100 ml at the north sample location (PL-1A) on June 21, 2002 (Table 1, Figure 2). (Note that the June 21, 2002 data were omitted from Figure 2 in order to clearly represent lesser exceedances found during the remainder of the sample season). Multiple exceedances were noted at the east shore location with four events greater than 2,000 *E. coli* per 100 ml. In addition, four out of five locations had their greatest daily geometric mean exceedance on June 21, 2002, with two stations greater than 10,000 *E. coli* per 100 ml.

Sampling at the Potters Lake inlet and outlet indicate exceedances at both locations (Table 2). Limited data was collected due to dry and/or stagnant conditions; however, daily geometric mean inlet concentrations ranged from 25 *E. coli* per 100 ml to 7,670 *E. coli* per 100 ml, while concentrations in the outlet ranged from 20 *E. coli* per 100 ml to 5,823 *E. coli* per 100 ml (Figure 3).

Burdick Drain was sampled at two locations in 2002 and 2003. Data collected in 2002, indicate WQS exceedances at both locations (Table 3). Daily geometric mean concentrations ranged from 20 *E. coli* per 100 ml at both locations to 19,128 *E. coli* per 100 ml at the upstream station (BD-1) (Figure 4). (Note that the May 31, 2002 data were omitted from Figure 4 in order to clearly represent lesser exceedances found during the remainder of the sample season). Burdick Drain was also sampled from May through mid-August 2003. *E. coli* concentrations decreased considerably relative to 2002 (Table 4). Thirty-day geometric mean concentrations were calculated through the end of July and indicated no exceedance of the WQS (Table 4). Only one exceedance of the daily geometric mean was observed at the upstream location (BD-1) on May 6, 2003 (Figure 5).

NUMERIC TARGET

The impaired designated use addressed by this TMDL is total body contact recreation. Rule 100 of the Michigan WQS requires that this water body 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 *E. coli* per 100 ml, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during five or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of three 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 ml. Compliance shall be based on the geometric mean of three or more samples taken during the same sampling event at representative locations within a defined sampling area.

The WQS of 130 *E. coli* per 100 ml as a 30-day geometric mean and 300 *E. coli* per 100 ml as a daily maximum are the target levels for the TMDL reach from May 1 to October 31. The 2002 monitoring data indicated exceedances of WQS at all locations except the west shore station on

Potters Lake (PL-5). The 2003 data for Burdick Drain, with the exception of the May 6, 2003 daily geometric exceedance, indicate WQS were met.

SOURCE ASSESSMENT

The Potters Lake and Burdick Drain watershed covered by this TMDL are located in Genesee and Lapeer Counties. The largest percentage of the watershed (64%), is located in Davison Township, Genesee County, with the remaining 36% falling in Elba Township in Lapeer County. These TMDL listings were primarily due to failing and/or leaking septic systems in Burdick Drain in the vicinity of Potters Lake. Evidence of multiple septic failures was noted in a sanitary wastewater survey performed in the 1980s (Reznick and Hamilton, 1981). Follow-up sampling conducted by the Department of Natural Resources in 1989, found the same conditions as the earlier survey with residents constructing trenches to drain away leaking septic fields during rain events and periods of saturated soils (Goble and Oemke, 1989). In order to address the septic failures, a sanitary sewer collection system was extended to the eastern portion of Potters Lake (located in Lapeer County) in 1997.

Other possible sources of *E. coli* could be from storm water runoff, animals (i.e., domestic and non-domestic), and to a lesser degree agriculture. Daily geometric mean exceedance, greater than 2,000 *E. coli* per 100 ml, were found on multiple occasions at the east Potters Lake sample location (PL-4A), despite homes on the eastern portion of the lake being connected to a sanitary sewer system. It is possible that waterfowl utilizing lake and riparian habitat (i.e., lake resident's yards) could be contributing to *E. coli* exceedances in this portion of the lake. Avian species (ducks, geese, crows, sea gulls, pigeons, and starlings) have been shown to be a major source (50%) of *E. coli* contamination at a beach in southeastern Michigan (Samadpour, 2001). Wind and wave action on Potters Lake may be influencing *E. coli* exceedances on the eastern portion of the lake. If avian species are utilizing one part of the lake, internal wave action may disperse *E. coli* to another part of the lake as horizontal transport of pathogens is a recognized phenomenon (Brooks et al., 2004). At least half of the exceedances at this station coincide with rain events recorded in nearby Flint, Michigan. It should be noted that four out of five sample locations on Potters Lake had their greatest exceedances on June 21, 2002, during dry conditions, with two stations greater than 10,000 *E. coli* per 100 ml. While agriculture makes up approximately 40% of the land use in the watershed, only one exceedance at the inlet (PL-6A) on May 31, 2002, coincided with a rain event (Purdue, 2003).

LINKAGE ANALYSIS

Determining the link between the *E. coli* concentrations in Potters Lake and Burdick Drain and the potential sources is necessary to develop the TMDL. This link provides the basis for estimating the total assimilative capacity of the stream and any needed load reductions. For this TMDL, the major loadings of pathogens likely enter Potters Lake and Burdick Drain by wet and dry weather sources, such as unregulated storm water runoff and water fowl utilizing the lake and riparian habitat.

The guiding water quality management principle used to develop the TMDL was that compliance with the numeric pathogen target in Potters Lake and Burdick Drain depends on the control of *E. coli* from storm water runoff, animal influences, and to a lesser extent agricultural inputs via land uses upstream of Potters Lake and Burdick Drain. If the *E. coli* inputs can be controlled to meet the numeric standards, then total body contact recreation in Potters Lake and Burdick Drain will be protected.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by the water body while still achieving WQS. As indicated in the numeric target section, the targets for this pathogen TMDL are the WQS of 130 *E. coli* per 100 ml as a 30-day geometric mean and 300 *E. coli* per 100 ml as a daily maximum. 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. The critical conditions for the control of point sources in Michigan, defined by stream flows, are given in R 323.1082 and R 323.1090 of the WQS.

In general, the lowest monthly 95% exceedance flow for streams is used as a design condition for point source discharges. However, for pathogens in point source discharges of treated or untreated human sewage, levels are restricted to a monthly average limit of 200 fecal coliform per 100 ml regardless of stream flow. Therefore, the design stream flow is not a critical condition for determining the allowable loading of pathogens for Wastewater Treatment Plants (WWTPs). In addition, sources of pathogens to Potters Lake and Burdick Drain arise from a mixture of wet and dry weather-driven NPS. 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 is equal to the target concentration of 130 *E. coli* per 100 ml as a 30-day geometric mean and daily geometric mean of 300 *E. coli* per 100 ml in all portions of the TMDL reach for each month of the recreational season (May through October). Expressing the TMDL as a concentration equal to the WQS ensures that the WQS will be met under all flow and loading conditions; therefore, a critical condition is not applicable for this TMDL.

ALLOCATIONS

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

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

WLAs

There are no permitted point source discharges to the listed reach of Potters Lake and Burdick Drain; therefore, the WLA is equal to zero.

LAs

The LA incorporates the pathogen sources for this water body, which include storm water runoff and animal influences. This TMDL is concentration-based. Therefore, the LA is equal to 130 *E. coli* per 100 ml. The determination of individual LAs will be based on the assumption of equal bacteria concentration per unit area for all lands in the watershed. Therefore, the relative responsibility for achieving the necessary reductions of bacteria and maintaining acceptable conditions will be determined by the amount of land under the jurisdiction of the various units of local government in the watershed. This gives a clear indication of the relative amount of effort that will be required by each entity to restore and maintain the total body contact designated uses in Potters Lake and Burdick Drain. This TMDL reach is located in Davison and Elba Townships, Genesee and Lapeer Counties.

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, including the pollutant decay rate if applicable. The MOS can be either implicit (i.e., incorporated into the TMDL analysis through 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 is used. The MDEQ has determined that the use of the WQS of 130 *E. coli* per 100 ml is a more conservative approach because pathogen organisms have a limited capability of surviving outside of their hosts and a rate of decay would normally be used. Applying a rate of decay could result in a discharge limit that would be greater than the WQS, thus no rate of decay is applied in order to provide for greater protection of water quality. Applying the WQS to be met under all flow conditions also adds to the assurance of the MOS.

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. WQS will be met regardless of flow conditions in the applicable season because this is a concentration-based TMDL.

MONITORING

Pathogens were monitored at a total of nine stations from May through September 2002. Seven stations were on Potters Lake (including an inlet and outlet sample), and the remaining two locations were on Burdick Drain. Additional monitoring was conducted in 2003, at two Burdick Drain stations. Future monitoring will take place during the rotating, five-year basin monitoring. When these results indicate that the water body may be meeting WQS, sampling will be conducted at the appropriate frequency (as defined in the numeric target section) to determine if the 30-day geometric mean value of 130 *E. coli* per 100 ml and 300 *E. coli* per 100 ml as a daily maximum are being met.

REASONABLE ASSURANCE ACTIVITIES

The residences on the east portion of Potters Lake were connected to the Genesee #2 WWTP in 1997. In addition, Elba Township is undertaking a sewer extension project that will provide service to residents located on the headwaters of Burdick Drain. The project completion date is

scheduled for July 2005, with residential hook-ups expected by September 2005. The existing sewer and the extension project will eliminate the major human sources of *E. coli* to Potters Lake and Burdick Drain. To date, neither the Genesee nor Lapeer County Health Departments have any reported issues from residents on Potters Lake or Burdick Drain.

The Genesee County Drain Commissioner was awarded a Section 319 Grant for the Kearsley Creek Water Quality Improvement Plan. Black Creek, for which Potters Lake and Burdick Drain are headwaters, is a tributary of Kearsley Creek. The grant proposes to gather additional information in order to make accurate decisions regarding land management, floodplain management, efficient use of soil erosion control efforts, and structural and nonstructural improvements on Kearsley Creek. The grant also seeks to identify and correct key areas of concerns in the tributaries (i.e., Black Creek), which will ultimately benefit the headwaters by reducing potential runoff. The Section 319 Grant will last two years; from February 2003 to February 2005.

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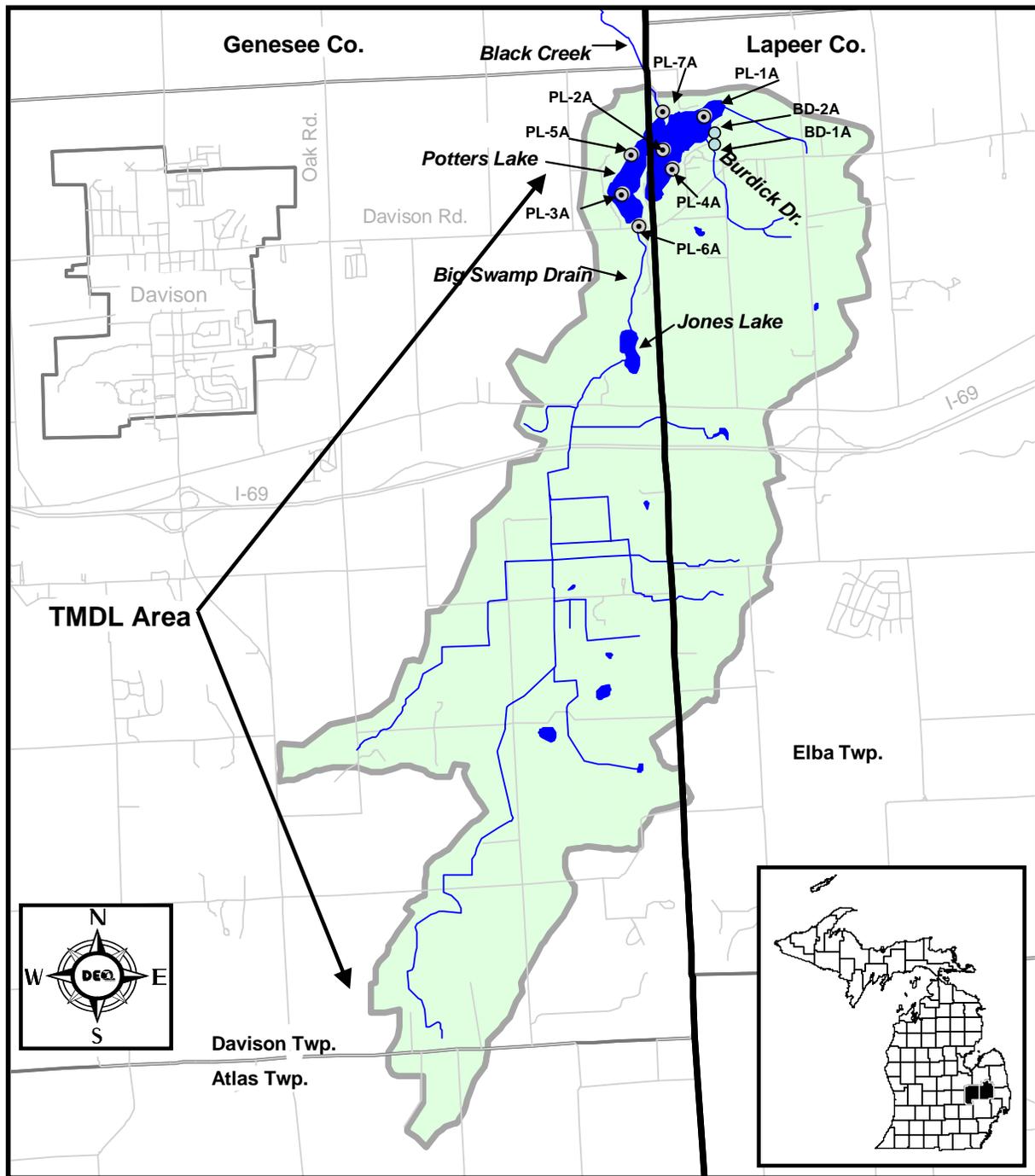


Figure 1. Potters Lake and Burdick Drain *E. coli* sampling locations, Lapeer and Genesee Counties, Michigan, 2002 and 2003.

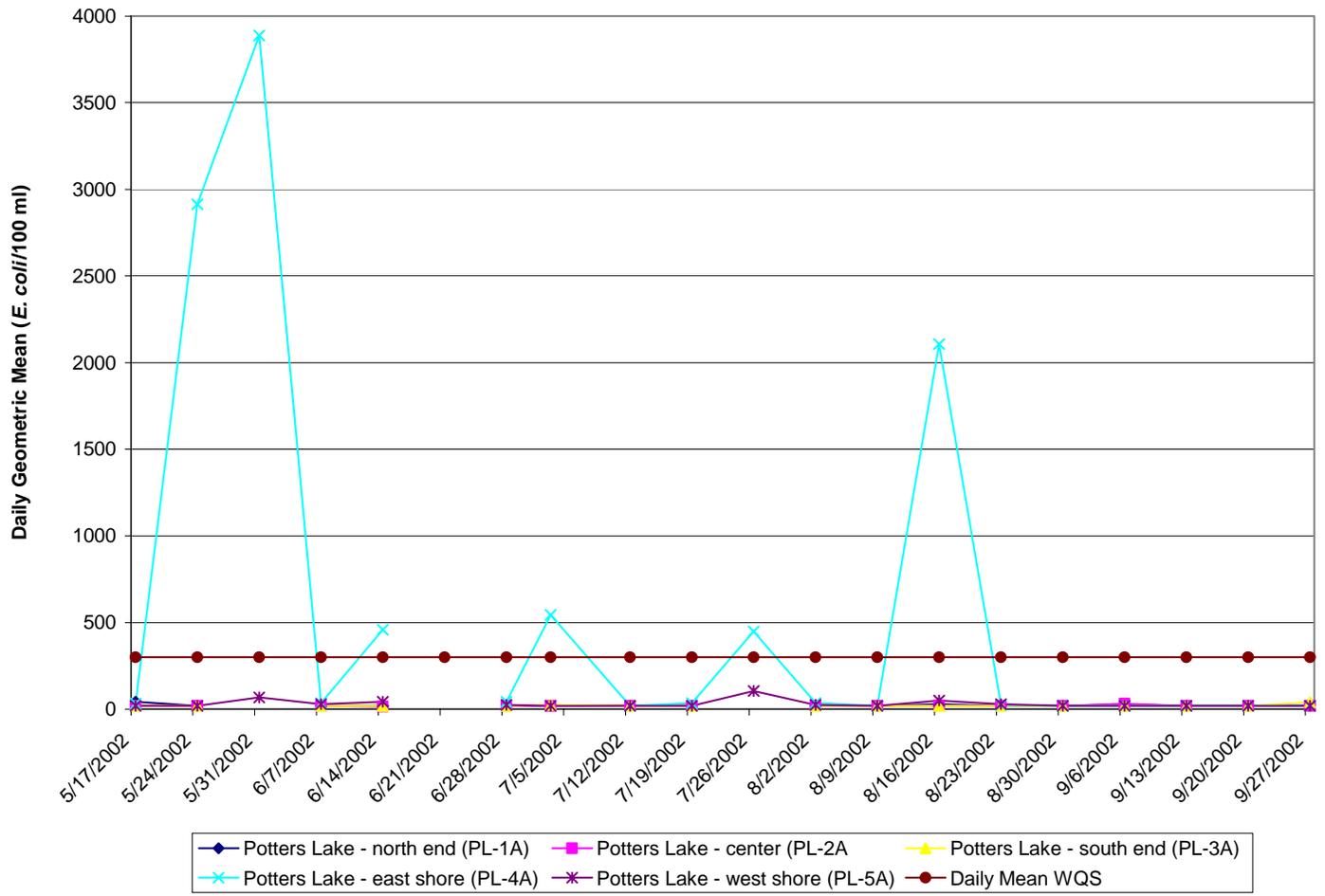


Figure 2. Potters Lake *E. coli* monitoring, Lapeer and Genesee Counties, Michigan, 2002.
NOTE: July 21, 2002 data omitted.

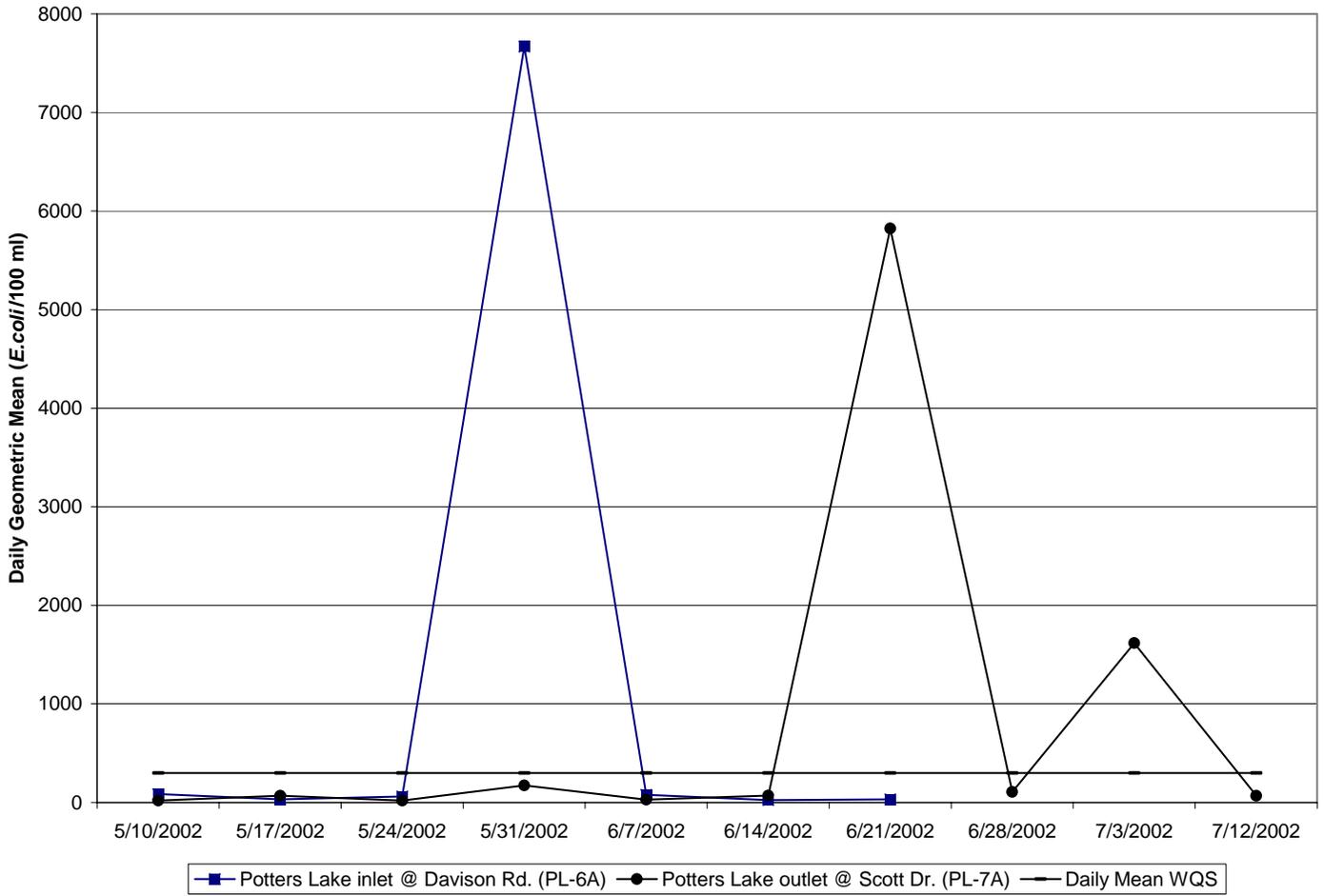


Figure 3. Potters Lake inlet and outlet *E. coli* monitoring, Lapeer and Genesee Counties, Michigan, 2002.

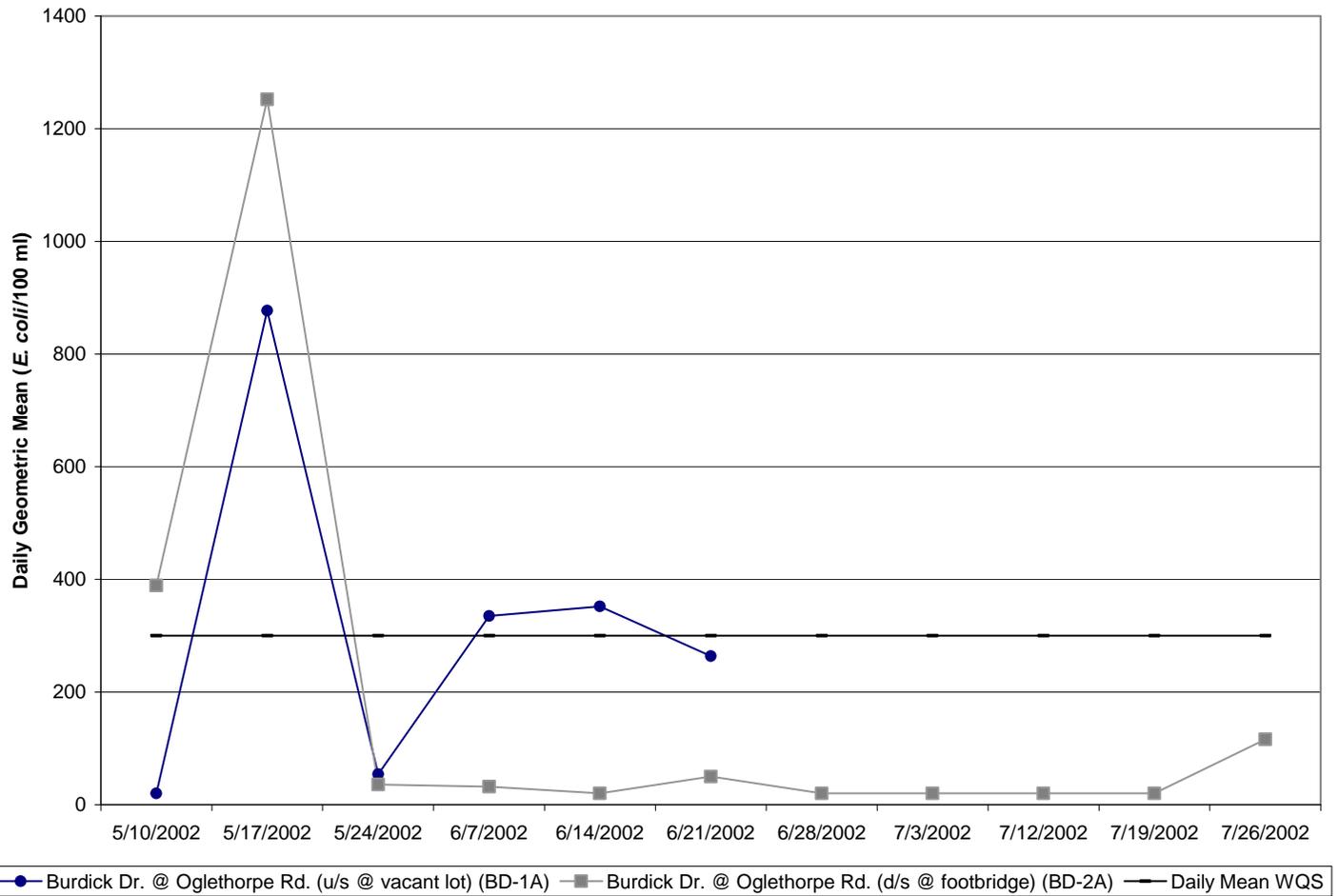


Figure 4. Burdick Drain *E. coli* monitoring, Lapeer County, Michigan, 2002.
NOTE: May 31, 2002 data omitted.

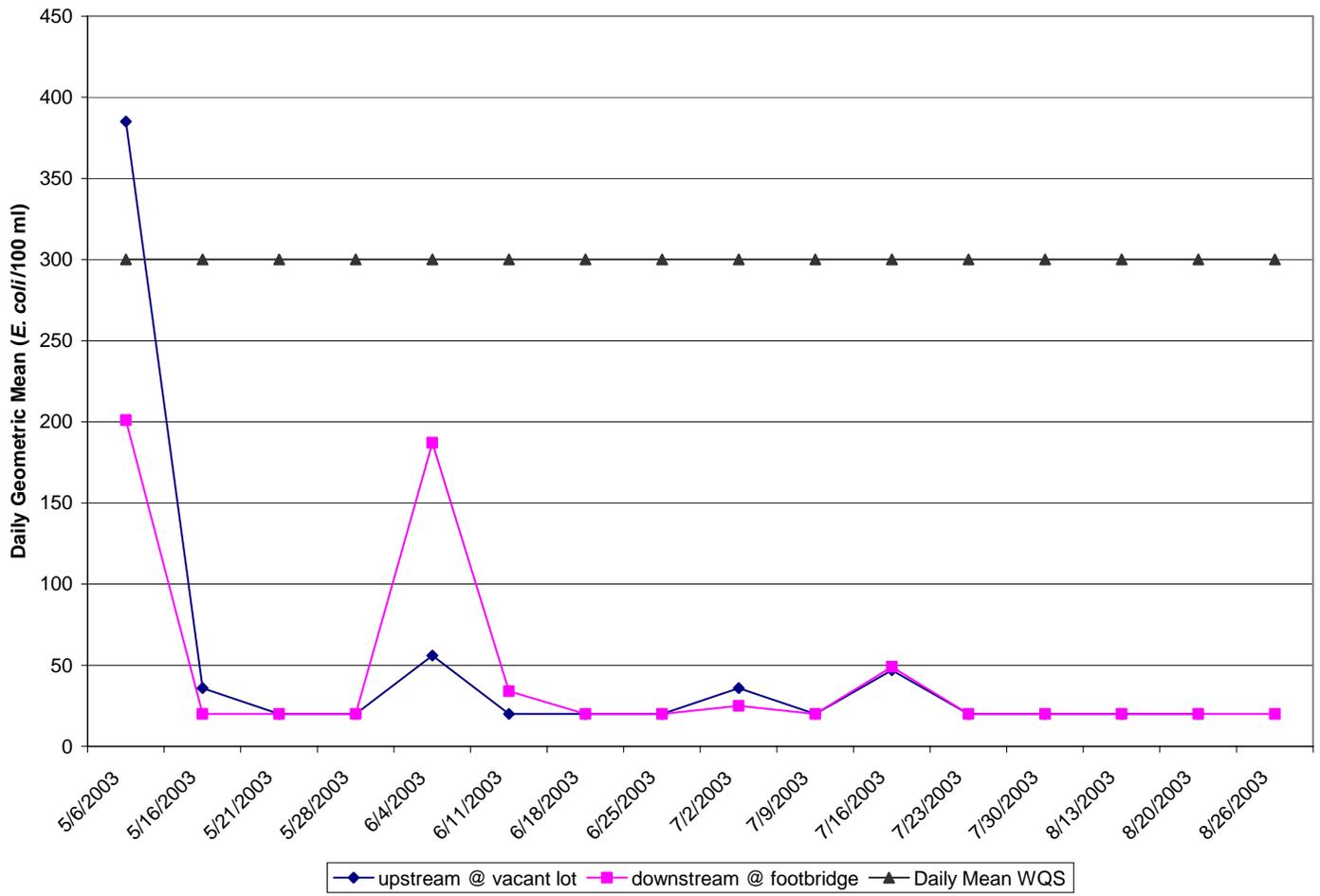


Figure 5. Burdick Drain *E. coli* monitoring, Lapeer and Genesee Counties, Michigan, 2003.

Table 1. MDEQ 2002 *E. coli* monitoring data for Potters Lake, Lapeer and Genesee Counties (*E. coli*/100 ml). Shaded areas indicate exceedances of the WQS.

DATE	Potters Lake - north end PL-1A			Potters Lake - center PL - 2A			Potters Lake - south end PL - 3A			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
5/10/2002	*	---	---	*	---	---	*	---	---	sunny, 50°
	*			*			*			
	*			*			*			
5/17/2002	20	43	---	20	20	---	20	20	---	sunny, 50°
	20			20			20			
	200			20			20			
5/24/2002	20	20	---	20	20	---	20	20	---	overcast, 65°
	20			20			20			
	20			20			20			
5/31/2002	@	---	---	@	---	---	@	---	---	sunny, 75°
	@			@			@			
	@			@			@			
6/7/2002	20	20	---	20	20	---	20	20	---	sunny 75°
	20			20			20			
	20			20			20			
6/14/2002	20	20	---	20	15	---	20	20	---	heavy rain 65°
	20			20			20			
	20			8			20			
6/21/2002	10600	13165	---	1600	579	---	10200	1543	---	humid, 80°
	13800			760			360			
	15600			160			1000			
6/28/2002	20	20	---	20	20	---	20	20	---	sunny, 80°
	20			20			20			
	20			20			20			

Table 1. continued (*E. coli*/100 ml).

DATE	Potters Lake - north end PL-1A			Potters Lake - center PL - 2A			Potters Lake - south end PL - 3A			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
7/3/2002	20 20 20	20	73	20 20 20	20	37	20 40 20	25	50	sunny, 85°
7/12/2002	20 20 20	20	73	20 20 20	20	37	20 20 20	20	50	sunny, 75°
7/19/2002	20 20 20	20	73	20 20 20	20	39	20 20 20	20	50	overcast, 80°
7/26/2002	@ @ @	---	---	@ @ @	---	---	@ @ @	---	---	thunderstorms, 90°
8/2/2002	20 20 20	20	---	20 20 20	20	---	20 20 20	20	---	cloudy, 80°
8/9/2002	20 20 20	20	---	20 20 20	20	---	20 20 20	20	---	sunny, 75°
8/16/2002	20 20 60	29	---	20 20 20	20	---	20 20 20	20	---	thunderstorms, 75°
8/23/2002	20 20 20	20	---	20 20 20	20	---	20 20 20	20	---	light rain, 65°

Table 1. continued (*E. coli*/100 ml).

DATE	Potters Lake - north end PL-1A			Potters Lake - center PL - 2A			Potters Lake - south end PL - 3A			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
8/30/2002	20	20	22	20	20	20	20	20	20	sunny, 75°
	20			20			20			
	20			20			20			
9/6/2002	20	29	23	20	32	22	20	20	20	sunny, 70°
	60			40			20			
	20			40			20			
9/13/2002	20	20	23	20	20	22	20	20	20	sunny, 75°
	20			20			20			
	20			20			20			
9/20/2002	20	20	22	20	20	22	20	20	20	overcast, 70°
	20			20			20			
	20			20			20			
9/27/2002	20	20	22	20	20	22	20	40	23	overcast, 70°
	20			20			160			
	20			20			20			

Table 1. continued (*E. coli*/100 ml).

DATE	Potters Lake - east shore PL-4A			Potters Lake - west shore PL-5A			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
5/10/2002	20	32	---	*	---	---	sunny, 50°
	40			*			
	40			*			
5/17/2002	20	32	---	20	20	---	sunny, 50°
	20			20			
	80			20			
5/24/2002	3400	2914	---	20	20	---	overcast, 65°
	2600			20			
	2800			20			
5/31/2002	6800	3888	---	200	68	---	sunny, 75°
	2400			20			
	3600			80			
6/7/2002	20	34	208	60	29	---	sunny 75°
	20		20				
	100		20				
6/14/2002	160	458	355	20	43	32	heavy rain 65°
	3000		20				
	200		200				
6/21/2002	11600	11675	1157	20	58	40	humid, 80°
	14000			120			
	9800			80			
6/28/2002	40	43	498	40	25	42	sunny, 80°
	100		20				
	20		20				

Table 1. continued (*E. coli*/100 ml).

	Potters Lake - east shore PL-4A			Potters Lake - west shore PL-5A			
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	Weather data
7/3/2002	260	543	336	20	20	32	sunny, 85°
	1400			20			
	440			20			
7/12/2002	20	20	302	20	20	30	sunny, 75°
	20			20			
	20			20			
7/19/2002	100	34	180	20	20	26	overcast, 80°
	20			20			
	20			20			
7/26/2002	440	448	94	80	105	29	thunderstorms, 90°
	320			120			
	640			120			
8/2/2002	40	36	90	40	25	29	cloudy, 80°
	60			20			
	20			20			
8/9/2002	20	20	47	20	20	29	sunny, 75°
	20			20			
	20			20			
8/16/2002	3600	2107	119	20	50	35	thunderstorms, 75°
	1000			80			
	2600			80			
8/23/2002	40	25	112	60	29	38	light rain, 65°
	20			20			
	20			20			

Table 1. continued (*E. coli*/100 ml).

DATE	Potters Lake - east shore PL-4A			Potters Lake - west shore PL-5A			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
8/30/2002	20	20	60	20	20	27	sunny, 75°
	20			20			
	20			20			
9/6/2002	20	20	53	20	20	26	sunny, 70°
	20			20			
	20			20			
9/13/2002	20	20	53	20	20	26	sunny, 75°
	20			20			
	20			20			
9/20/2002	20	20	21	20	20	22	overcast, 70°
	20			20			
	20			20			
9/27/2002	20	20	20	20	20	20	overcast, 70°
	20			20			
	20			20			

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@ Sample not collected due to unsafe conditions

* Sample site stagnant

Sample site dry

**Table 2. MDEQ 2002 *E. coli* monitoring data for Potters Lake inlet and outlet, Lapeer and Genesee Counties (*E. coli*/100 ml).
Shaded areas indicate exceedances of the WQS.**

DATE	Potters Lake inlet @ Davison Rd. PL-6A			Potters Lake outlet @ Scott Dr. PL-7A			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
5/10/2002	80	86	---	20	20	---	sunny, 50°
	80			20			
	100			20			
5/17/2002	40	32	---	20	68	---	sunny, 50°
	40			40			
	20			400			
5/24/2002	100	62	---	20	20	---	overcast, 65°
	120			20			
	20			20			
5/31/2002	5600	7670	---	160	172	---	sunny, 75°
	7600			160			
	10600			200			
6/7/2002	140	77	158	20	29	42	sunny 75°
	160			20			
	20			60			
6/14/2002	20	25	124	60	70	54	heavy rain 65°
	20			40			
	40			140			
6/21/2002	20	32	124	8200	5823	132	humid, 80°
	20			8600			
	80			2800			
6/28/2002	#	---	---	20	107	185	sunny, 80°
	#			140			
	#			440			

Table 2. continued (*E. coli*/100 ml).

Potters Lake inlet @ Davison Rd. PL-6A				Potters Lake outlet @ Scott Dr. PL-7A			Weather data
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
7/3/2002	*	---	---	1200	1616	289	sunny, 85°
	*			1600			
	*			2200			
7/12/2002	*	---	---	100	68	344	sunny, 75°
	*			160			
	*			20			
7/19/2002	*	---	---	#	---	---	overcast, 80°
	*			#			
	*			#			
7/26/2002	40	46	---	#	---	---	thunderstorms, 90°
	60			#			
	40			#			
8/2/2002	*	---	---	#	---	---	cloudy, 80°
	*			#			
	*			#			
8/9/2002	*	---	---	#	---	---	sunny, 75°
	*			#			
	*			#			
8/16/2002	*	---	---	#	---	---	thunderstorms, 75°
	*			#			
	*			#			
8/23/2002	*	---	---	#	---	---	light rain, 65°
	*			#			
	*			#			

Table 2. continued (*E. coli*/100 ml).

Potters Lake inlet @ Davison Rd. PL-6A				Potters Lake outlet @ Scott Dr. PL-7A			Weather data
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
8/30/2002	#	---	---	#	---	---	sunny, 75°
	#			#			
	#			#			
9/6/2002	#	---	---	#	---	---	sunny, 70°
	#			#			
	#			#			
9/13/2002	#	---	---	#	---	---	sunny, 75°
	#			#			
	#			#			
9/20/2002	#	---	---	#	---	---	overcast, 70°
	#			#			
	#			#			
9/27/2002	#	---	---	#	---	---	overcast, 70°
	#			#			
	#			#			

Sample site dry

Table 3. MDEQ 2002 *E. coli* monitoring data for Burdick Drain, Lapeer County (*E. coli*/100 ml). Shaded areas indicate exceedances of the WQS.

DATE	Burdick Dr. @ Oglethorpe Rd. (upstream @ vacant lot BD-1A)			Burdick Dr. @ Oglethorpe Rd. (downstream @ footbridge BD-2A)			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
5/10/2002	20	20	---	420	389	---	sunny, 50°
	20			260			
	20			540			
5/17/2002	900	877	---	1320	1252	---	sunny, 50°
	1040			1240			
	720			1200			
5/24/2002	80	54	---	20	36	---	overcast, 65°
	20			20			
	100			120			
5/31/2002	14600	19128	---	24400	8037	---	sunny, 75°
	21400			2800			
	22400			7600			
6/7/2002	280	335	361	40	32	340	sunny 75°
	480			20			
	280			40			
6/14/2002	400	352	640	20	20	188	heavy rain 65°
	340			20			
	320			20			
6/21/2002	360	264	503	80	50	99	humid, 80°
	160			80			
	320			20			
6/28/2002	*	---	---	20	20	88	sunny, 80°
	*			20			
	*			20			

Table 3. continued (*E. coli*/100 ml).

DATE	Burdick Dr. @ Oglethorpe Rd. (upstream @ vacant lot BD-1A)			Burdick Dr. @ Oglethorpe Rd. (downstream @ footbridge BD-2A)			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
7/3/2002	*	---	---	20	20	26	sunny, 85°
	*			20			
	*			20			
7/12/2002	*	---	---	20	20	24	sunny, 75°
	*			20			
	*			20			
7/19/2002	*	---	---	20	20	24	overcast, 80°
	*			20			
	*			20			
7/26/2002	*	---	---	80	116	28	thunderstorms, 90°
	*			140			
	*			140			
8/2/2002	#	---	---	*	---	---	cloudy, 80°
	#			*			
	#			*			
8/9/2002	#	---	---	*	---	---	sunny, 75°
	#			*			
	#			*			
8/16/2002	#	---	---	*	---	---	thunderstorms, 75°
	#			*			
	#			*			
8/23/2002	#	---	---	*	---	---	light rain, 65°
	#			*			
	#			*			

Table 3. continued (*E. coli*/100 ml).

DATE	Burdick Dr. @ Oglethorpe Rd. (upstream @ vacant lot BD-1A)			Burdick Dr. @ Oglethorpe Rd. (downstream @ footbridge BD-2A)			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
8/30/2002	#	---	---	*	---	---	sunny, 75°
	#			*			
	#			*			
9/6/2002	#	---	---	*	---	---	sunny, 70°
	#			*			
	#			*			
9/13/2002	#	---	---	*	---	---	sunny, 75°
	#			*			
	#			*			
9/20/2002	#	---	---	*	---	---	overcast, 70°
	#			*			
	#			*			
9/27/2002	#	---	---	*	---	---	overcast, 70°
	#			*			
	#			*			

* sample site stagnant

sample site dry

Table 4. MDEQ 2003 *E. coli* monitoring data for Burdick Drain, Lapeer County (*E. coli*/100 ml). Shaded areas indicate exceedances of the WQS.

DATE	Burdick Dr. @ Oglethorpe Rd. (upstream @ vacant lot BD-1A)			Burdick Dr. @ Oglethorpe Rd. (downstream @ footbridge BD-2A)			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
5/6/2003	340	385	---	140	201	---	overcast, 65°
	600			180			
	280			320			
5/16/2003	20	36	---	20	20	---	overcast, 70°
	120			20			
	20			20			
5/21/2003	20	20	---	20	20	---	sunny, 50°
	20			20			
	20			20			
5/28/2003	20	20	---	20	20	---	partly sunny, 60°
	20			20			
	20			20			
6/4/2003	20	56	50	340	187	50	rain, 50°
	20			160			
	440			120			
6/11/2003	20	20	28	100	34	35	cloudy, 50°
	20			20			
	20			20			
6/18/2003	20	20	25	20	20	35	partly sunny, 75°
	20			20			
	20			20			
6/25/2003	20	20	25	20	20	35	sunny, 95°
	20			20			
	20			20			

Table 4. continued (*E. coli*/100 ml).

DATE	Burdick Dr. @ Oglethorpe Rd. (upstream @ vacant lot BD-1A)			Burdick Dr. @ Oglethorpe Rd. (downstream @ footbridge BD-2A)			Weather Data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
7/2/2003	40 20 60	36	28	20 20 40	25	36	sunny, 90°
7/9/2003	20 20 20	20	23	20 20 20	20	23	overcast, 75°
7/16/2003	260 20 20	47	27	20 300 20	49	25	sunny, 65°
7/23/2003	20 20 20	20	27	20 20 20	20	25	sunny, 70°
7/30/2003	20 20 20	20	27	20 20 20	20	25	sunny, 85°
8/6/2003	* * *	---	---	* * *	---	---	cloudy, 75°
8/13/2003	20 20 20	20	---	20 20 20	20	---	sunny, 85°
8/20/2003	20 20 20	20	---	20 20 20	20	---	sunny, 90°

Table 4. continued (*E. coli*/100 ml).

DATE	Burdick Dr. @ Oglethorpe Rd. (upstream @ vacant lot BD-1A)			Burdick Dr. @ Oglethorpe Rd. (downstream @ footbridge BD-2A)			Weather Data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
8/26/2003	#	---	---	20	20	---	rain, 75°
	#			20			
	#			20			
9/3/2003	#	---	---	#	---	---	sunny, 70°
	#			#			
	#			#			
9/12/2003	#	---	---	#	---	---	sunny, 68°
	#			#			
	#			#			
9/17/2003	#	---	---	#	---	---	sunny, 78°
	#			#			
	#			#			
9/24/2003	#	---	---	20	20	---	cloudy, 60°
	#			20			
	#			20			

* sample site stagnant

sample site dry

