

**Michigan Department of Environmental Quality
Surface Water Quality Division
June 2002**

**Total Maximum Daily Load for *Escherichia Coli* in Plaster Creek,
Kent County, Michigan**

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 levels 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 then 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 Plaster Creek, a tributary to the Grand River, located in Kent County.

PROBLEM STATEMENT

This TMDL addresses approximately 12 miles of Plaster Creek in the greater Grand Rapids area where recreational uses are impaired by elevated levels of pathogens. Michigan's Section 303(d) list (Creal and Wuycheck, 2000) cites the Grand River confluence upstream to Dutton Park (Hanna Lake Avenue and 76th Street) as the affected reach. The TMDL reach (Figure 1) is on the Section 303(d) list as:

Waterbody: **Plaster Creek** WBID#: **082806H**
County: Kent RF3RchID: 4050006 10 Size: 12 M
Location: Grand River confluence upstream to Dutton Park (Hanna Lake Avenue and 76th Street).
Status: **2** Problem: **Fish and macroinvertebrate communities rated poor; Pathogens (Rule 100).**

TMDL YEAR(s): 2001

Plaster Creek was placed on the Section 303(d) list due to impairment of recreational uses by the presence of elevated levels of *E. coli*. Historical data collected by the Kent County Health Department documented elevated levels of *E. coli* in 1997. Monitoring data (Appendix 1) collected in 2001 by the Michigan Department of Environmental Quality (MDEQ) documented exceedances of the WQS, in both Plaster Creek and the two tributaries sampled (Table 1). In addition, seasonal geometric means for the 2001 sampling season exhibited elevated levels throughout the 12-mile reach of the creek. Monthly geometric mean *E. coli* concentrations in Plaster Creek for 2001 ranged from 216 *E. coli* per 100 milliliters (ml) in June at 28th Street to 4,340 *E. coli* per 100 ml in August at 60th Street (Table 1). Sampling associated with rain events (Appendix 1) yielded substantially higher *E. coli* concentrations in Plaster Creek and the tributaries.

Monthly geometric mean *E. coli* concentrations for the Plaster Creek tributaries ranged from 481 *E. coli* per 100 ml in June at 28th Street to 6,903 *E. coli* per 100 ml in September at 60th Street (Table 1). Overall, the highest *E. coli* data collected for Plaster Creek came from the

tributary at 60th Street (Figure 2). The lowest monthly geometric mean at this station was 2,043 *E. coli* per 100 ml in July and the highest was 6,903 *E. coli* per 100 ml in September (Table 1). The 2001 data collected indicate that the upper end of the Plaster Creek Watershed, specifically in the area of 60th Street, may be a substantial source of *E. coli* to Plaster Creek.

In addition, the Kent County Health Department has sampled Plaster Creek at three locations in both the cities of Grand Rapids and Kentwood. In general, these data agree with the MDEQ 2001 data indicating consistent exceedances of WQS for *E. coli* in Plaster Creek. These data can be found at <http://www.accesskent.com/living/environhealth>.

NUMERIC TARGETS

The impaired designated use for Plaster Creek at this location is total body contact. 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.

In addition, sanitary wastewater from point sources have an additional target as follows:

Rule 62. (3) Discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform bacteria per 100 milliliters, based on the geometric mean of all of 5 or more samples taken over a 30-day period, nor more than 400 fecal coliform bacteria per 100 milliliters, based on the on the geometric mean of all of 3 or more samples taken during any period of discharge not to exceed 7 days. Other indicators of adequate disinfection may be utilized where approved by the department.

Sanitary wastewater discharges are considered in compliance with the WQS of 130 *E. coli* per 100 ml if their National Pollutant Discharge Elimination System (NPDES) permit limit of 200 fecal coliform per 100 ml as a monthly average is met. This is assumed because *E. coli* are a subset of fecal coliform (American Public Health Association, 1995). When the wastewater of concern is sewage, fecal coliform is substantially higher than *E. coli* (Whitman, 2001). When the point source discharge is meeting their limit of 200 fecal coliform per 100 ml, it can reasonably be assumed that there are less than 130 *E. coli* per 100 ml in the effluent.

For this TMDL, the WQS of 130 *E. coli* 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 at all ten stations sampled. Storm water runoff

appears to be a major contributor of *E. coli* to Plaster Creek, as indicated by two high sampling events on August 10, 2001 and September 7, 2001. Despite the runoff inputs to Plaster Creek, the consistent *E. coli* exceedances throughout the sampling season seem to indicate a constant source of *E. coli* to Plaster Creek and the tributaries.

SOURCE ASSESSMENT

The Plaster Creek Watershed is located in Kent County. The listed TMDL reach is the Grand River confluence upstream to Dutton Park (Hanna Lake Avenue and 76th Street) (Figure 1). Municipalities in the watershed include the cities of Grand Rapids, Wyoming, Kentwood, and East Grand Rapids, and the townships of Gaines, Caledonia, Cascade, Ada, and Grand Rapids (Figure 3). Table 2 shows the distribution of land in the Plaster Creek Watershed for each municipality.

Potential pathogen sources for this waterbody include those typically associated with urban and suburban runoff, as well as illicit connections. As previously discussed, sampling that coincided with rain events showed substantial increases in *E. coli* concentrations in both Plaster Creek and the tributaries. There are 106 storm water permits in the Plaster Creek Watershed (Table 3). Another possible source could be agricultural inputs, as the headwaters of Plaster Creek are heavily influenced by this type of land use.

There are 16 permitted discharges to the Plaster Creek Watershed (Table 3, Figure 4). Eleven are covered by general permits, of which seven are wastewaters associated with gasoline and/or related petroleum products and the remaining four are noncontact cooling water discharges. In addition, there are five individual NPDES permits in the Plaster Creek Watershed for the following facilities: R & K Enterprises LLC (MI0002861), Steelcase Inc. – Kentwood (MI0043061), GM-NAO-Grand Rapids (MI0043877), Delphi Automotive Systems LLC (MI0001236), and the Grand Rapids Waste Water Treatment Plant (WWTP) (MI0026069). With exception to the Grand Rapids WWTP, these other four discharges generally consist of mine dewatering, noncontact cooling water, and coal pile runoff. These four discharges are not considered to contain treated or untreated human sewage; therefore, these discharges are not a source of *E. coli* to Plaster Creek and the requirements of Rule 62(3) do not apply.

The city of Grand Rapids has five outfalls, four combined sewer overflows (CSOs) and one WWTP emergency bypass, to the Plaster Creek Watershed. The city of Grand Rapids has a combined sewer overflow system and is authorized to discharge combined sewer overflows at four locations on Silver Creek Drain, a highly modified tributary of Plaster Creek (Table 3, Figure 4). Section A.6.a. of the Grand Rapids WWTP NPDES permit (MI0026069) authorizes combined sewer overflows in response to rainfall or snowmelt conditions when total available transportation and treatment capabilities are exceeded. Following the approved Phase III plan outlined in the Grand Rapids WWTP NPDES permit, two outfalls are scheduled for complete elimination by December 31, 2006, with the remaining two eliminated by December 31, 2019. The Grand Rapids WWTP also maintains an emergency bypass, outfall 002, to Plaster Creek at the downstream end, between Godfrey and Market Street. This bypass has occurred once in the last ten years, in June 1996, and discharges only in cases of extreme circumstances. Due to the infrequent discharge from this outfall and the future elimination of the combined sewage system overflows, these outfalls are not considered a source of *E. coli* for this TMDL.

LINKAGE ANALYSIS

The link between the *E. coli* concentration in Plaster Creek 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 creek and any needed load reductions. For this TMDL, the primary loading of pathogens appears to enter Plaster Creek by both wet and dry weather conditions.

Based on 2001 monitoring data, every location sampled on Plaster Creek and the tributaries were exceeding WQS. Compliance with the numeric pathogen target in Plaster Creek depends on the removal of illicit connections, eliminations of combined sewer overflows, control of *E. coli* in storm water, and control of agricultural inputs. This concept was the guiding water quality management principle used to develop the TMDL. If the *E. coli* inputs can be controlled, then total body contact recreation in Plaster Creek 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 Targets 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. However, *E. coli* sources to Plaster Creek arise from a mixture of dry and wet weather-driven 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* indicators, 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 for each month of the recreational season (May through October).

In addition, an allocation strategy for nonpoint sources has been selected that assumes equal bacteria loads per unit area for all lands within the watershed. Consistent with the allocation strategy, Table 4 shows the TMDL or allowable concentrations for *E. coli* by applicable month in the Plaster Creek Watershed.

ALLOCATIONS

TMDLs are comprised of the sum of individual wasteload 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 waterbody. Conceptually, this definition is denoted by the equation:

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

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 at 40 CFR, Section 130.2(i).

WLAs

As mentioned previously, there are 16 permitted point source discharges to Plaster Creek or its tributaries. Eleven discharges are covered by general permits and are not known to contain treated or untreated human sewage. Four discharges are covered by individual NPDES permits and due to the nature of the discharges -- mine dewatering, noncontact cooling water, and coal pile runoff, Rule 62(3) does not apply. These discharges are not considered sources of *E. coli* to Plaster Creek so the WLA is equal to zero.

The remaining outfall is the Grand Rapids WWTP emergency bypass to Plaster Creek. This bypass has occurred once in the last ten years and only functions under extreme circumstances. Due to the infrequent discharge from this outfall, it is not given a WLA. In addition, the city of Grand Rapids has a permitted combined sewer overflow system. Four outfalls discharge to Silver Creek Drain, a modified tributary of Plaster Creek. This combined sewer overflow system is scheduled for complete elimination, with two outfalls eliminated by the end of 2006 and the other two by December 31, 2019. Due to the future elimination of the combined system overflows, the WLA remains equal to zero.

LAs

This TMDL is concentration-based; therefore, the LA is equal to 130 *E. coli* per 100 ml. The assumption used in the allocation strategy is that there are equal bacteria loads per unit area for all lands within 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 local units of government within the watershed. Table 2 gives the relative land in the watershed for each of the local units of governments. 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 to Plaster Creek.

The government entities with the largest percent land area in the Plaster Creek Watershed are the city of Grand Rapids (26%), Gaines Township (26%), and the city of Kentwood (23%). These three entities make up 75% of the Plaster Creek Watershed. The remaining 25% of the watershed is made up by the city of Wyoming (7%), Grand Rapids Township (7%), Cascade Township (6%), the city of East Grand Rapids (3%), Ada Township (1%), and Caledonia Township (1%).

The LA incorporates the pathogen sources for this waterbody, including those typically associated with urban and suburban runoff, as well as illicit connections. This includes the 106 storm water permits in the Plaster Creek Watershed (Table 3), as well as agricultural inputs.

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 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 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 Rule 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 ten stations from May to September (Figure 1). Subsequent weekly sampling will begin at appropriate stations in May 2002, and conclude in September 2002. If sampling in 2002 indicates WQS are exceeded, sampling will be oriented toward source identification. If 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.

In future years, assuming WQS are not met immediately, additional sampling will be conducted from May to September at appropriate stations. Sampling will be adjusted as needed to assist in continued source identification and elimination. 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

Storm water inputs, agricultural inputs, and illicit discharges are likely the dominant source of *E. coli* to Plaster Creek, given the wide variety of land uses in the watershed. Implementation activities to meet the TMDL require measures to reduce *E. coli* sources. Efforts to reduce *E. coli* sources are currently in place. The city of Grand Rapids has implemented their Phase I storm water permit (MI0053872). This permit includes the preparation and implementation of a storm water management plan (approved September 8, 1998), public education and outreach, and an illicit discharge elimination program. To further reduce the input of *E. coli* in Plaster Creek, the city of Grand Rapids has begun locating and eliminating illicit discharges within the city since the plan was approved. In addition, all known outfalls in the city of Grand Rapids drainage system have been cataloged.

The city of Grand Rapids has also been awarded a Clean Michigan Initiative (CMI) grant of about \$75,000 to aid in the investigation of approximately 270 outfalls of various origin within the city limits that discharge to Plaster Creek and tributaries (CMI, 2001). Overall, the city has a proactive approach to monitoring water quality. The city began water quality monitoring in 1969 and created an Environmental Protection Services Department in 1995. This department is responsible for wastewater collection and treatment, storm water management, and addresses other environmental issues that face urban areas.

The remaining municipalities of Wyoming, Kentwood, East Grand Rapids, Gaines Township, Caledonia Township, Ada Township, Grand Rapids Township, and Cascade Township will likely be subject to the Phase II storm water permits. These permits will require activities that reduce *E. coli* inputs through the public education, storm water management plan, and illicit connection identification and elimination requirements.

Plaster Creek has an MDEQ approved (November 23, 1999) watershed management plan in accordance with the requirements of the CMI Nonpoint Source Pollution Control Grants Program (KCDC, 1999). A CMI grant (tracking code number 1999-0039) was approved by the

MDEQ for two storm water detention basin retrofit construction projects located in the Plaster Creek Watershed: the Wyoming Department of Public Works and the Laraway-Brooklyn detention basins. The contract end date for the retrofitting projects is July 2002. The CMI grant amount was for \$386,100 with a local match of \$128,700 for a project total of \$514,800.

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REFERENCES

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- KCDC – Kent County Drain Commissioners Office. July 1999. Amendment to the “Plaster Creek Nonpoint Watershed Project” – December 1987, as amended in 1989. Project No. F99037. Prepared by: Kent County Drain Commissioner and Fishbeck, Thompson, Carr and Huber, Inc.
- Personal communication, Richard L. Whitman. United States Geological Survey, October 2001.
- USEPA. 2001. Protocol for Developing Pathogen TMDLs. United States Environmental Protection Agency, 841-R-00-002.

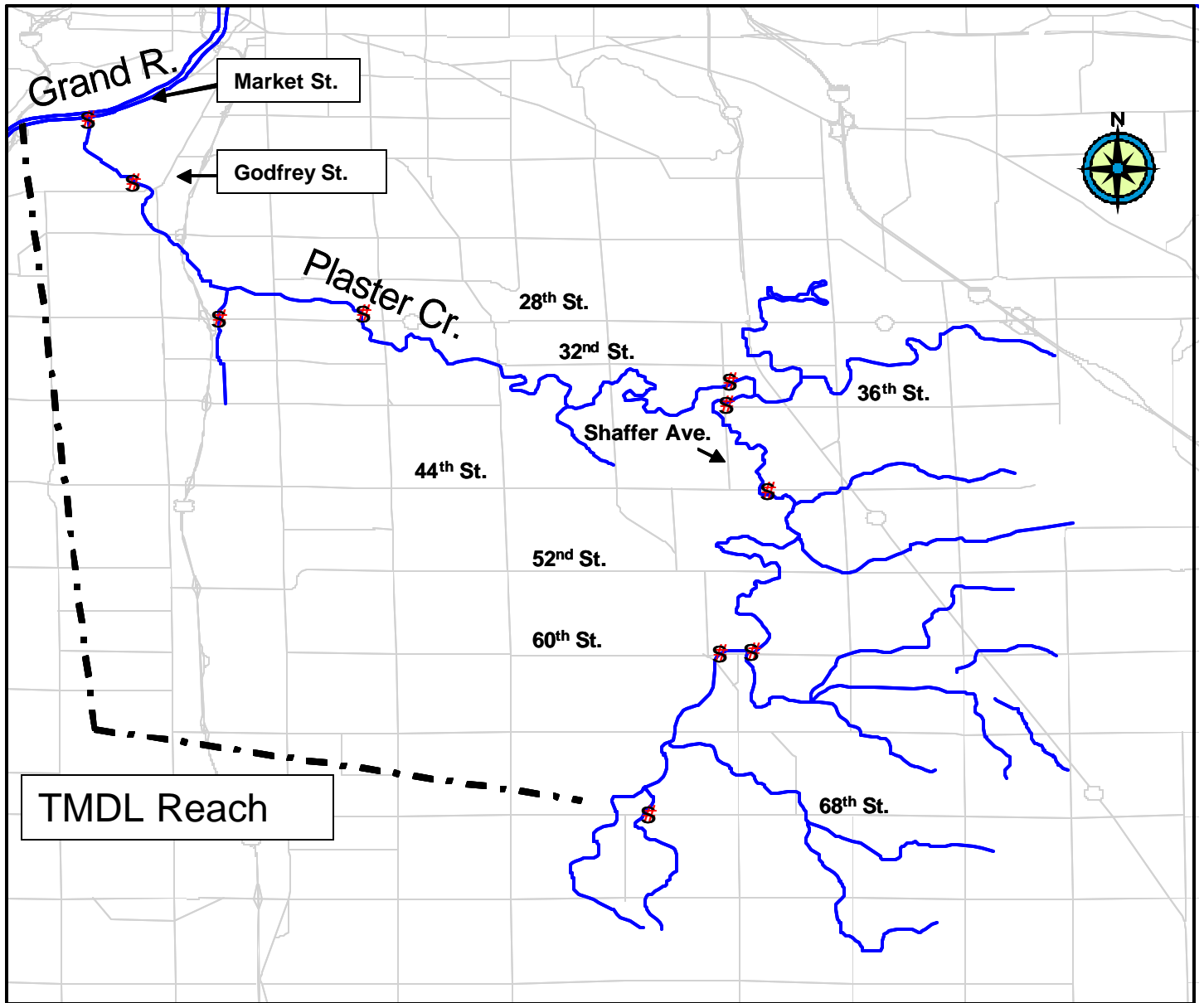


Figure 1. Sampling locations for Plaster Creek and selected tributaries, May through September 2001, Kent County, Michigan.

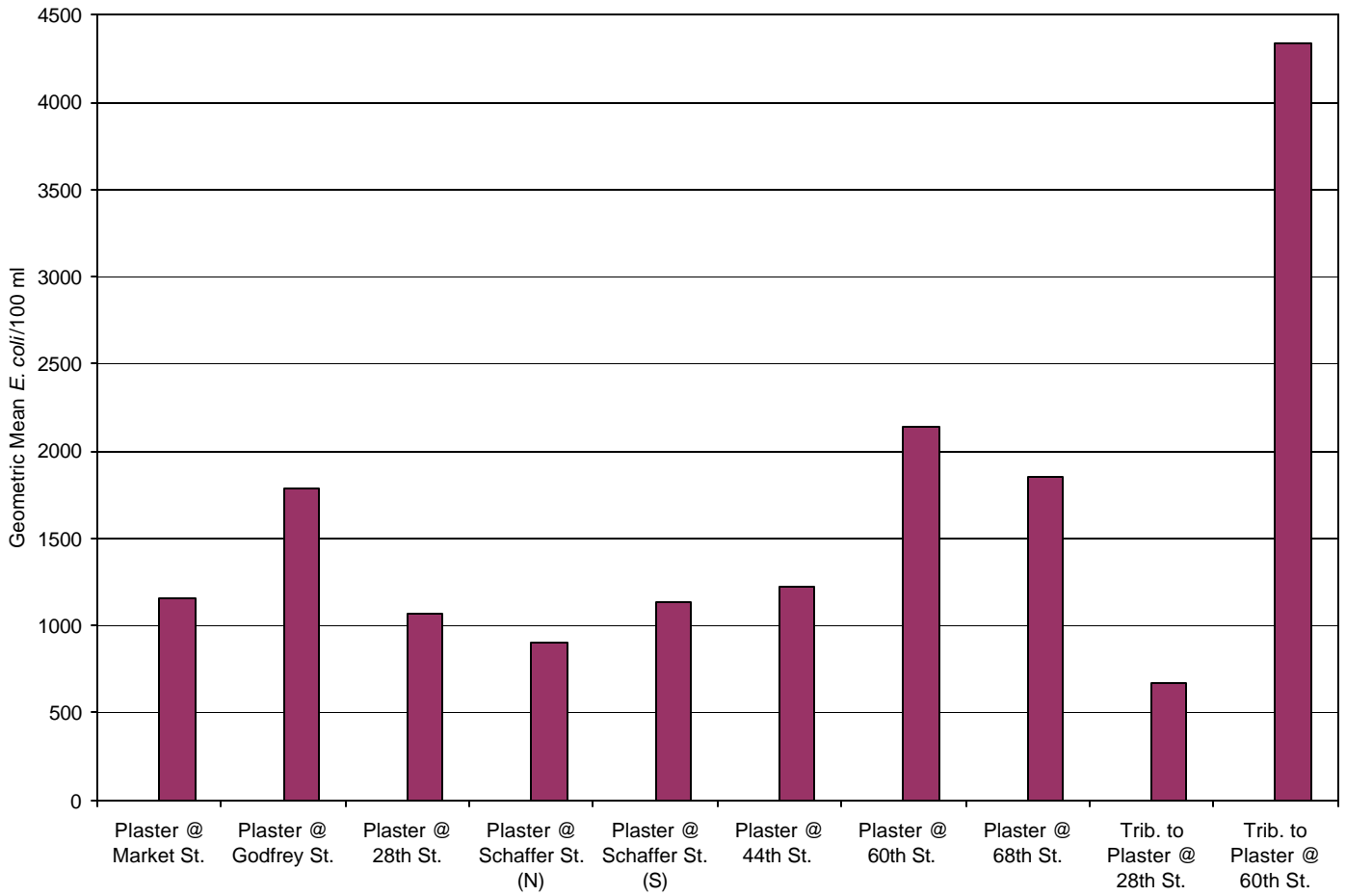


Figure 2. Seasonal geometric mean *E. coli* results for Plaster Creek and selected tributaries, Kent County, Michigan, May through September 2001. Data are presented downstream to upstream, followed by tributaries.

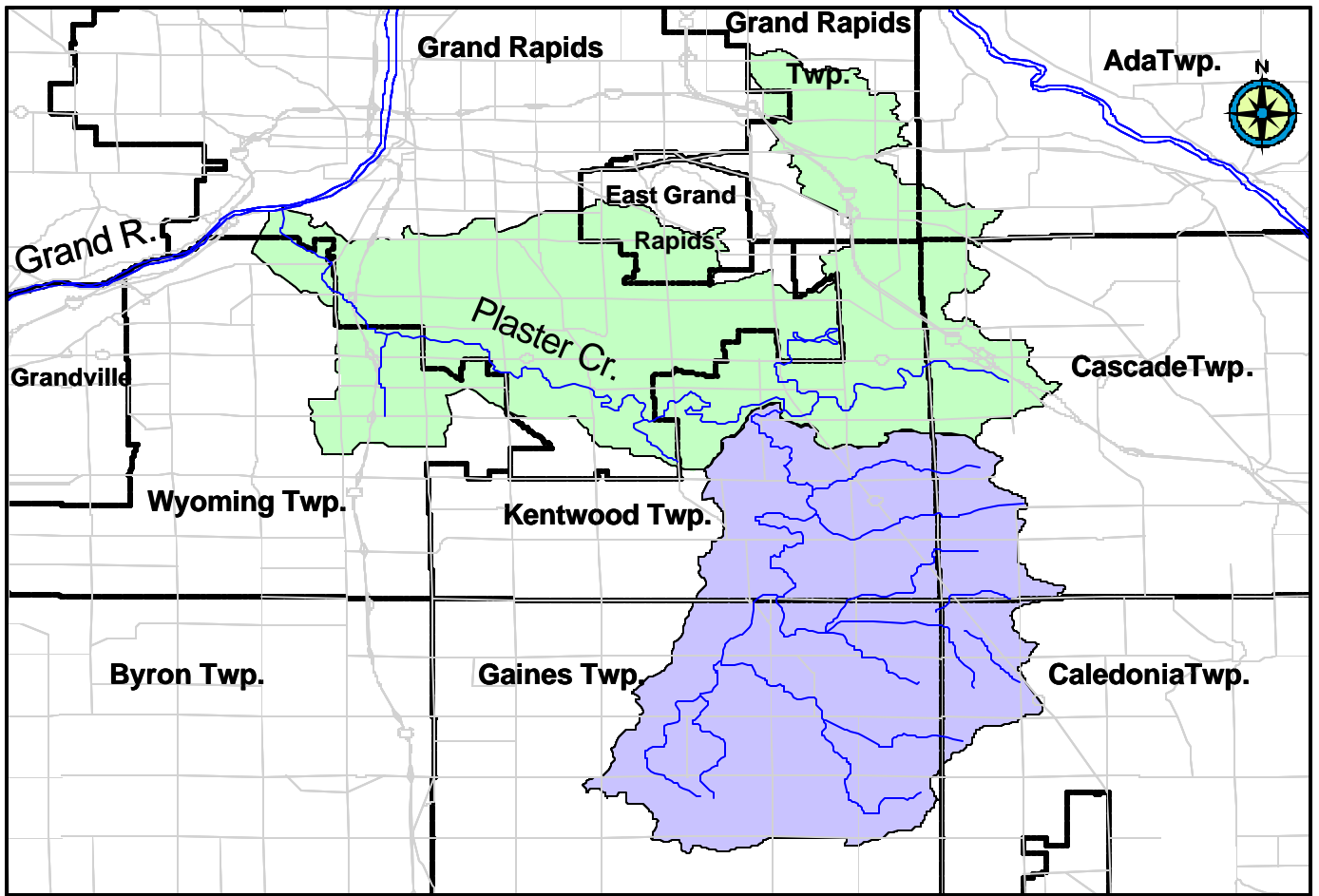


Figure 3. Municipalities in the Plaster Creek Watershed.

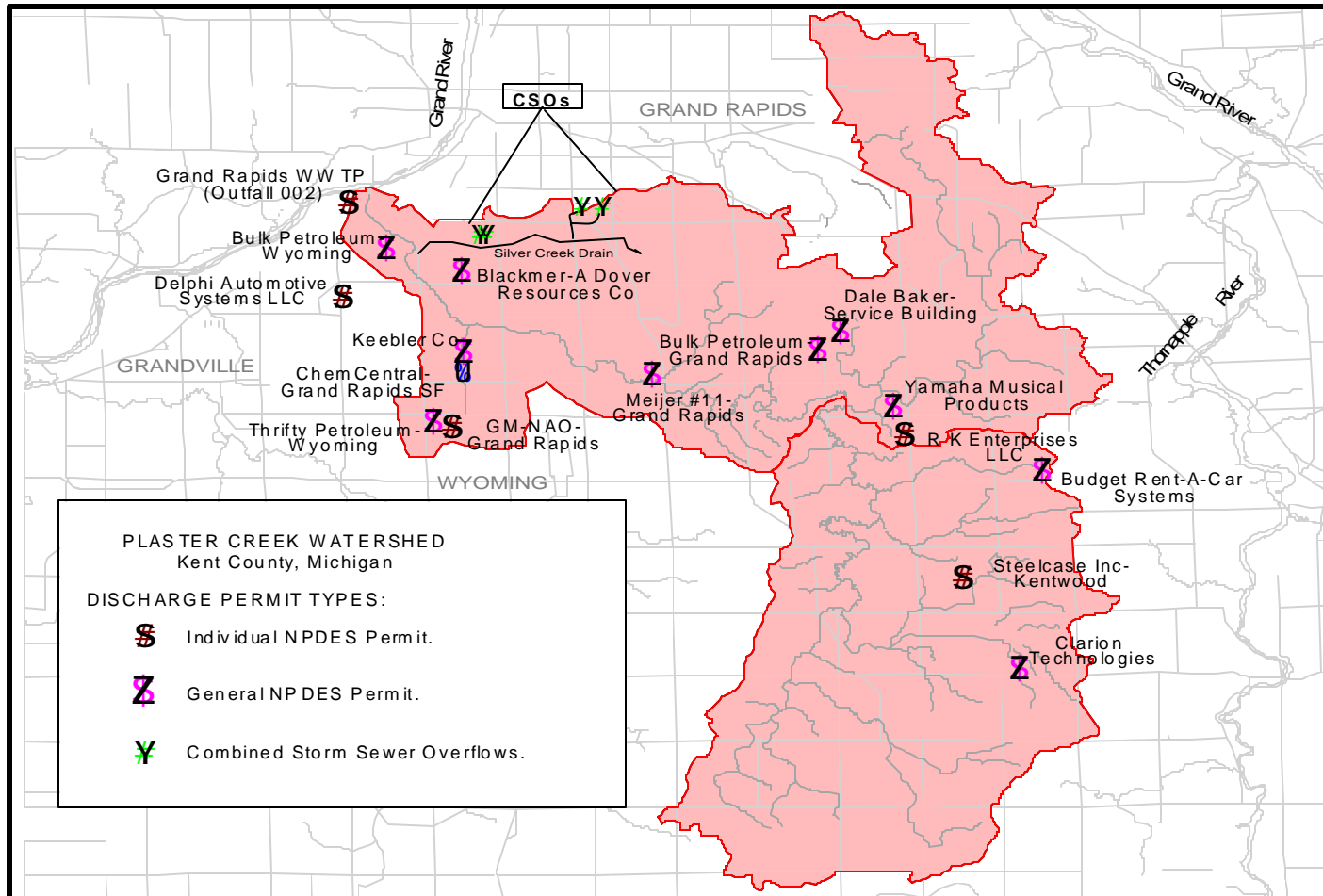


Figure 4. NPDES permitted outfalls in the Plaster Creek Watershed, excluding storm water permits.

Table 1. MDEQ *E. coli* data for Plaster Creek in the greater Grand Rapids area, Kent County Michigan, 2001.

Sample Location	Month	Minimum	Geometric Mean	Maximum	# of results
Plaster Creek @ Market St.	May	360	433	580	3
	June	370	663	1,800	12
	July	290	580	860	12
	August	400	3,197	560,000	18
	September	230	1,149	9,000	24
Plaster Creek @ Godfrey St.	May	3,500	4,138	4,500	3
	June	300	500	870	12
	July	360	629	940	12
	August	590	3,561	37,000	18
	September	600	3,058	86,000	24
Plaster Creek @ 28 th St.	May	340	465	590	3
	June	10	216	860	12
	July	160	707	3,270	12
	August	390	2,243	23,300	18
	September	510	1,853	58,000	24
Plaster Creek @ Schaffer Ave. (N)	May	550	769	1,400	3
	June	380	542	810	12
	July	190	359	580	12
	August	290	1,650	19,900	18
	September	380	1,189	6,200	24
Plaster Creek @ Schaffer Ave. (S)	May	650	798	900	3
	June	420	738	1,500	12
	July	150	465	1,000	12
	August	420	1,871	32,100	18
	September	460	1,583	8,100	24
Plaster Creek @ 44 th St.	May	610	807	980	3
	June	510	680	1,000	12
	July	240	661	4,700	12
	August	350	1,953	22,600	18
	September	440	1,656	5,660	24
Plaster Creek @ 60 th St.	May	580	706	810	3
	June	280	938	1,800	12
	July	620	1,788	6,200	12
	August	490	4,340	600,000	18
	September	500	2,378	720,000	24
Plaster Creek @ 68 th St.	May	400	467	580	3
	June	620	1,454	3,100	12
	July	540	1,758	6,910	12
	August	460	2,515	30,000	18
	September	480	2,016	72,000	24

Table 1 continued.

Sample Location	Month				# of results
		minimum	geometric mean	maximum	
Tributary to Plaster Creek @ 28 th St.	May	430	499	590	3
	June	310	481	710	12
	July	390	872	2,600	12
	August	300	1,048	29,200	18
	September	30	513	15,000	24
Tributary to Plaster Creek @ 60 th St.	May	5,700	5,995	6,300	3
	June	1,760	2,945	4,700	12
	July	890	2,043	4,700	12
	August	1,000	4,713	26,900	18
	September	880	6,903	4,700,000	24

Table 2. Distribution of land for each municipality in the Plaster Creek Watershed.

<u>Municipality</u>	<u>Square Miles</u>	<u>Percent</u>
City of Grand Rapids	17.6	26
Gaines Township	18.0	26
Kentwood	16.0	23
Wyoming	4.9	7
Grand Rapids Township	4.8	7
Cascade Township	4.4	6
East Grand Rapids	1.8	3
Ada Township	0.6	1
Caledonia Township	0.6	1
TOTAL	68.7	100

Table 3. Permitted outfalls in the Plaster Creek Watershed.

PERMIT NO.	FACILITY NAME	RECEIVING WATERS
Individual NPDES Permits:		
MI0001236	Delphi Automotive Systems LLC	Plaster Creek
MI0002861	R K Enterprises LLC	Plaster Creek
MI0043061	Steelcase Inc-Kentwood	Plaster Creek
MI0043877	GM-NAO-Grand Rapids	Cole Drain
MI0026069	Grand Rapids WWTP	Plaster Creek
	CSO - Ionia Avenue and Stevens Street	Silver Creek Drain
	CSO - Alexander Street and Cooper Avenue	Silver Creek Drain
	CSO - Alexander Street and Kalamazoo Avenue	Silver Creek Drain
	CSO - Stevens Street at Railroad Crossing	Silver Creek Drain
General Permits:		
MIG080036	Thrifty Petroleum-Wyoming	Plaster Creek
MIG080083	Meijer #11-Grand Rapids	Ken-O-Sha Creek
MIG080115	Bulk Petroleum-Wyoming	Plaster Creek
MIG080172	J & H Oil Co-Wyoming	Plaster Creek
MIG080422	Budget Rent-A-Car Systems	unnamed trib to Plaster Creek
MIG080985	Bulk Petroleum-Grand Rapids	Whiskey Creek
MIG081003	Dale Baker-Service Building	Whiskey Creek
MIG250151	Keebler Co	Plaster Creek
MIG250152	Blackmer-A Dover Resources Co	Plaster Creek
MIG250156	Clarion Technologies	Plaster Creek
MIG250271	Yamaha Musical Products	Little Plaster Creek
Substantive Requirements Document:		
MIU990004	ChemCentral-Grand Rapids SF	Cole Drain
Storm Water Permits:		
MIR20G102	River City Metal Products	Plaster Creek
MI0053937	MDOT - Grand Rapids - MS4	Plaster Creek
MI0053872	Grand Rapids - MS4	Plaster Creek
MIS110038	Burton St Recycling-Supply Co	Plaster Creek
MIS110041	Midwest Bumper Co	Silver Creek
MIS110042	Grand Rapids Plastics-4220 RBC	Plaster Creek
MIS110052	Thompson-McCully Co-Market Co	Plaster Creek
MIS110057	Kentwood Packaging-Powder	Plaster Creek
MIS110118	Mitco Inc	Plaster Creek
MIS110129	P & K Steel Service Inc	Plaster Creek
MIS110137	Grand Rapids Carvers Inc	Plaster Creek
MIS110283	Wamar Products Inc	Plaster Creek
MIS110294	Tabletting Inc	Plaster Creek
MIS110296	Starcade Inc	Plaster Creek
MIS110297	State Heat Treat-Grand Rapids	Plaster Creek
MIS110299	Stagood-Metal Components Inc	Plaster Creek
MIS110347	USPS-Wyoming	Plaster Creek
MIS110352	Stephenson & Lawyer-GR	Plaster Creek
MIS110365	Schupan & Sons Inc-Recycling	Plaster Creek
MIS110366	Conway Central Express-Kentwood	Plaster Creek
MIS110486	Riviera Tool Company	Plaster Creek

Table 3 continued.

PERMIT NO.	FACILITY NAME	RECEIVING WATERS
MIS110487	Reliance Finishing Co	Plaster Creek
MIS110488	Rapid Die & Engineering	Plaster Creek
MIS110491	Price Industries Inc	Plaster Creek
MIS110497	Lacks-Brockton Mold	Plaster Creek
MIS110504	Michigan Packaging Co	Little Plaster Creek
MIS110505	Michigan Colprovia	Plaster Creek
MIS110506	Mich Cert Con-Grand Rapids	Plaster Creek
MIS110508	Consolidated Rail Corporation	Plaster Creek
MIS110515	Lake Mich Packaging Products	Plaster Creek
MIS110526	Lily Products of Mich	Plaster Creek
MIS110527	Knoll Inc-Grand Rapids	Plaster Creek
MIS110529	Kentwood Manufacturing Co	Plaster Creek
MIS110530	Key Plastics Inc-GR	Plaster Creek
MIS110538	Hill Machinery Co Inc	Plaster Creek
MIS110553	BF Goodrich Avionics Sys Inc	Plaster Creek
MIS110563	Christopher Metal Fabricating	Plaster Creek
MIS110568	Die Dimensions Corp	Plaster Creek
MIS110569	Blackmer-A Dover Resources Co	Plaster Creek
MIS110570	Cascade Engineering 5141-36	Little Plaster Creek
MIS110572	Helen Inc-Envir Coatings	Plaster Creek
MIS110573	Country Fresh Inc	Plaster Creek
MIS110574	Dyna Plate Inc	Plaster Creek
MIS110577	Hi Tec Laser Die-J-Tec Prod	Plaster Creek
MIS110578	Imperial Sheet Metal	Plaster Creek
MIS110581	Keebler Co	Plaster Creek
MIS110583	Consolidated Metal Prdts Inc	Silver Creek Drain
MIS110585	Consumers Concrete-15	Plaster Creek
MIS110586	CSX Transport-Wyoming Yard	Plaster Creek
MIS110591	Lacks Ent-Plastic Plate 2	Plaster Creek
MIS110592	Lacks Ent-52nd-Paint East	Plaster Creek
MIS110593	Lacks Ent-52nd-Paint West	Plaster Creek
MIS110594	Lacks Ent-Barden Assembly	Plaster Creek
MIS110595	Lacks Ent-52nd Mold	Plaster Creek
MIS110596	Lacks Ent-Airplane Plant	Plaster Creek
MIS110597	Lacks Ent-Distribution Center	Plaster Creek
MIS110599	Interface AR-32nd Street	Whiskey Creek
MIS110601	Meridian Auto-GR-Plt 1	Plaster Creek
MIS110602	Meridian Auto-GR-Plt 4 & 5	Plaster Creek
MIS110603	Meridian Auto-GR-Plt 7	Plaster Creek
MIS110607	Allied Finishing Inc	Plaster Creek
MIS110613	American Litho-Inc	Plaster Creek
MIS110616	Adac Plastics Inc-GR	Plaster Creek
MIS110618	Autocam Corporation	Plaster Creek
MIS110621	Advance Packaging Corp	Plaster Creek
MIS110626	Amerikam	Plaster Creek
MIS110630	A & K Finishing-Danvers	Plaster Creek
MIS110631	A & K Finishing-Donker	Plaster Creek
MIS110658	Electro Chem Finish Co-44th	Plaster Creek
MIS110660	Detroit Diesel Remanufacturing	Plaster Creek
MIS110673	Smith Industries Inc-Patterson	Plaster Creek

Table 3 continued.

PERMIT NO.	FACILITY NAME	RECEIVING WATERS
MIS110703	MC Van Kampen Trucking	Plaster Creek
MIS110707	Modular Transportation-Mart	Plaster Creek
MIS110709	Lacks Ent-Airwest Mold	Plaster Creek
MIS110751	Venture Grand Rapids	Plaster Creek
MIS110778	Reliance Plastisol Coating Co	Plaster Creek
MIS110802	Diecraft-GR	Plaster Creek
MIS110818	Paladin Ind Inc	Plaster Creek
MIS110820	Parker Motor Freight Inc	Plaster Creek
MIS110823	Team Industries	Plaster Creek
MIS110825	Fki Indust-Keeler Die Cast	Silver Creek Drain
MIS110827	Plastic Mold Technology Inc	Plaster Creek
MIS110829	Yamaha Musical Products	Little Plaster Creek
MIS110840	M & E Manufacturing	Plaster Creek
MIS110848	Grand Rapids Plastics-4050 RBC	Plaster Creek
MIS110850	MacDonalds Ind-44th St	Plaster Creek
MIS110894	American Metal & Plastics	Plaster Creek
MIS110945	Master Finish Company	Plaster Creek
MIS111015	Development-GR	Plaster Creek
MIS111017	Dieline-GR	Plaster Creek
MIS111028	Magic Finishing Company	Plaster Creek
MIS111048	Bishop Distributing Co	Plaster Creek
MIS111058	Eerdmans Printing Co	Plaster Creek
MIS111078	Steeltech Ltd	Silver Creek Drain
MIS111080	Davidson Plyforms Inc	Plaster Creek
MIS111104	Towne Air Freight Inc	Plaster Creek
MIS111105	Beverlin Manufacturing Corp	Plaster Creek
MIS111106	Cascade Engineering 4950-37	Little Plaster Creek
MIS111110	Magna-Lakeland	Plaster Creek
MIS111111	CSX Transport-BIDS GR	Plaster Creek
MIS111119	Federal Express-GRRRA	Plaster Creek
MIS111137	Michigan Wheel Corp	Plaster Creek
MIS111190	Lacks Airline Campus	Plaster Creek
MIS111191	Lacks Brockton Campus	Plaster Creek
MIS111192	Lacks 52nd Campus	Plaster Creek
MIS111193	Lacks Barden Campus	Plaster Creek

Table 4. Allowable *E. coli* concentrations by month in the Plaster Creek Watershed.

May	June	July	August	September	October
130	130	130	130	130	130

Table 5. Plaster Creek average flows (cfs) at the confluence with the Grand River.

May	June	July	August	September	October
39	27	21	18	18	22

Appendix 1. MDEQ *E. coli* monitoring data for Plaster Creek, greater Grand Rapids area, 2001. Data are presented downstream to upstream, followed by tributaries.

Plaster Creek @ Market St. PC-1A	Plaster Creek @ Godfrey St. PC-2A	Plaster Creek @ 28th St. PC-4A	Plaster Creek @ Schaffer Ave. (N) PC-5A	Plaster Creek @ Schaffer Ave. (S) PC-6A	Weather data
5/31/2001 390	5/31/2001 4500	5/31/2001 590	5/31/2001 1400	5/31/2001 650	Sunny, cool
580	3500	340	550	900	
360	4500	500	590	870	
6/7/2001 530	6/7/2001 550	6/7/2001 380	6/7/2001 380	6/7/2001 420	Partly sunny, mild
720	480	50	460	530	
960	520	270	380	720	
6/14/2001 430	6/14/2001 300	6/14/2001 490	6/14/2001 570	6/14/2001 690	Partly cloudy, hot, humid
370	450	390	810	620	
600	430	330	590	580	
6/21/2001 460	6/21/2001 410	6/21/2001 10	6/21/2001 590	6/21/2001 730	Partly cloudy, cool, mild
410	310	510	450	560	
390	510	560	700	690	
6/27/2001 1800	6/27/2001 780	6/27/2001 <10	6/27/2001 530	6/27/2001 1300	Partly cloudy, mild
1300	700	1300	560	1200	
1200	870	860	640	1500	
7/6/2001 710	7/6/2001 600	7/6/2001 2400	7/6/2001 350	7/6/2001 470	Clear and cool
860	600	2600	400	460	
790	380	160	450	470	
7/13/2001 290	7/13/2001 380	7/13/2001 440	7/13/2001 260	7/13/2001 1000	Clear, mild
310	360	880	330	990	
430	410	110	440	980	
7/20/2001 720	7/20/2001 880	7/20/2001 3270	7/20/2001 190	7/20/2001 170	Partly cloudy, warm and humid
590	820	380	250	150	
680	940	2660	230	240	
7/27/2001 660	7/27/2001 880	7/27/2001 290	7/27/2001 580	7/27/2001 670	Sunny, 65° F
630	920	530	540	450	
650	910	720	560	560	
8/3/2001 400	8/3/2001 4000	8/3/2001 1100	8/3/2001 450	8/3/2001 420	sunny, clear, 80° F
500	4500	700	470	450	
580	4500	500	290	440	
8/10/2001 500000	8/10/2001 15100	8/10/2001 23300	8/10/2001 18900	8/10/2001 32100	Partly cloudy, mild heavy rain last night
560000	37000	19600	19900	22700	
31900	36400	16000	19700	24800	
8/17/2001 700	8/17/2001 650	8/17/2001 810	8/17/2001 530	8/17/2001 490	Mostly cloudy, mild
630	590	800	510	590	
600	620	780	500	520	
8/24/2001 5100	8/24/2001 4700	8/24/2001 3800	8/24/2001 3500	8/24/2001 3600	Overcast, mild
4600	4600	4200	3400	3500	
4200	4300	3700	2800	3800	
8/29/2001 600	8/29/2001 910	8/29/2001 400	8/29/2001 350	8/29/2001 500	Clear, mild
490	900	390	440	550	
470	880	410	390	520	
8/31/2001 6500	8/31/2001 6500	8/31/2001 7400	8/31/2001 4200	8/31/2001 4100	Partly cloudy, mild
7500	7400	7400	3900	3900	
6700	6700	7000	4100	3200	

Appendix 1 continued.

Plaster Creek @ Market St. PC-1A	Plaster Creek @ Godfrey St. PC-2A	Plaster Creek @ 28th St. PC-4A	Plaster Creek @ Schaffer Ave. (N) PC-5A	Plaster Creek @ Schaffer Ave. (S) PC-6A	Weather data
9/5/2001 420 600 480	9/5/2001 1000 980 810	9/5/2001 1500 770 780	9/5/2001 1100 900 1100	9/5/2001 900 900 900	Clear, mild
9/7/2001 8700 2880 9000	9/7/2001 86000 59000 60000	9/7/2001 58000 26000 32000	9/7/2001 6200 5590 5060	9/7/2001 8100 6380 5160	Overcast, warm, rain
9/11/2001 7900 7300 7400	9/11/2001 7500 7100 8000	9/11/2001 4000 3900 6200	9/11/2001 3400 2300 4200	9/11/2001 7600 3300 3200	Clear, 62° F
9/14/2001 440 400 390	9/14/2001 790 820 840	9/14/2001 560 510 550	9/14/2001 400 420 410	9/14/2001 550 500 460	Clear, cool
9/18/2001 280 290 230	9/18/2001 4400 4400 3300	9/18/2001 810 560 800	9/18/2001 400 380 410	9/18/2001 920 920 910	Clear, mild
9/20/2001 880 900 920	9/20/2001 1300 1450 1400	9/20/2001 990 970 960	9/20/2001 910 920 910	9/20/2001 900 890 930	Overcast, cool
9/26/2001 2700 3000 2300	9/26/2001 5000 5000 6000	9/26/2001 2300 2400 2300	9/26/2001 1900 1000 700	9/26/2001 2400 2200 2200	Overcast, rainy, mild
9/28/2001 430 570 570	9/28/2001 600 650 810	9/28/2001 900 1070 1000	9/28/2001 1600 1400 1040	9/28/2001 1700 2300 1200	Overcast, cool

Appendix 1 continued.

Plaster Creek @ 44th St. PC-7A	Plaster Creek @ 60th St. PC-9A	Plaster Creek @ 68th St. PC-10A	Trib. to Plaster Creek @ 28th St. PC-3A	Trib. to Plaster Creek @ 60th St. PC-8A	Weather data
5/31/2001 980 610 880	5/31/2001 810 750 580	5/31/2001 580 440 400	5/31/2001 430 590 490	5/31/2001 5700 6000 6300	Sunny, cool
6/7/2001 510 600 580	6/7/2001 460 640 610	6/7/2001 730 970 620	6/7/2001 530 600 540	6/7/2001 3600 4500 4300	Partly sunny, mild
6/14/2001 680 640 590	6/14/2001 1250 1330 1020	6/14/2001 2220 2550 2400	6/14/2001 570 460 310	6/14/2001 2150 2210 2250	Partly cloudy, hot, humid
6/21/2001 810 670 680	6/21/2001 1170 280 1110	6/21/2001 1140 1470 800	6/21/2001 320 330 340	6/21/2001 1800 1900 1760	Partly cloudy, cool, mild
6/27/2001 770 750 1000	6/27/2001 1300 1800 1800	6/27/2001 3100 2000 1800	6/27/2001 650 670 710	6/27/2001 4700 4700 4300	Partly cloudy, mild
7/6/2001 2610 1130 4700	7/6/2001 3000 3000 3520	7/6/2001 3700 3700 3500	7/6/2001 2600 1500 2400	7/6/2001 4500 4570 4700	Clear and cool
7/13/2001 320 280 240	7/13/2001 810 790 880	7/13/2001 680 700 650	7/13/2001 400 390 420	7/13/2001 900 890 900	Clear, mild
7/20/2001 610 470 450	7/20/2001 6200 4930 5840	7/20/2001 6910 6840 6860	7/20/2001 1560 1490 1520	7/20/2001 2800 3240 2930	Partly cloudy, warm and humid
7/27/2001 530 610 560	7/27/2001 620 710 760	7/27/2001 590 540 570	7/27/2001 430 450 460	7/27/2001 1280 1360 1640	Sunny, 65° F
8/3/2001 680 1000 1200	8/3/2001 1200 800 900	8/3/2001 1300 1300 2400	8/3/2001 450 500 300	8/3/2001 1700 1700 1500	Sunny, clear, 80° F
8/10/2001 17000 20700 22600	8/10/2001 400000 430000 600000	8/10/2001 13600 19200 12100	8/10/2001 29200 11600 11800	8/10/2001 26900 21800 25700	Partly cloudy, mild heavy rain last night
8/17/2001 600 560 700	8/17/2001 900 960 990	8/17/2001 880 920 900	8/17/2001 500 450 350	8/17/2001 1200 1100 1000	Mostly cloudy, mild
8/24/2001 3400 3700 3500	8/24/2001 1240 1270 1160	8/24/2001 1030 990 970	8/24/2001 510 460 490	8/24/2001 4400 4700 4500	Overcast, mild
8/29/2001 470 520 350	8/29/2001 490 620 590	8/29/2001 460 530 600	8/29/2001 380 420 370	8/29/2001 2300 2420 2400	Clear, mild
8/31/2001 3100 3100 3100	8/31/2001 19000 30000 21000	8/31/2001 21000 30000 19000	8/31/2001 2500 2600 2500	8/31/2001 19000 25000 25800	Partly cloudy, mild

Appendix 1 continued.

Plaster Creek @ 44th St. PC-7A	Plaster Creek @ 60th St. PC-9A	Plaster Creek @ 68th St. PC-10A	Trib. to Plaster Creek @ 28th St. PC-3A	Trib. to Plaster Creek @ 60th St. PC-8A	Weather data
9/5/2001 830 900 930	9/5/2001 1730 1100 1100	9/5/2001 3300 3000 3800	9/5/2001 310 300 260	9/5/2001 2900 2500 2100	Clear, mild
9/7/2001 5270 3990 5660	9/7/2001 51000 720000 530000	9/7/2001 23000 65000 72000	9/7/2001 10600 15000 1900	9/7/2001 4300000 3800000 4700000	Overcast, warm, rain
9/11/2001 3300 4200 4300	9/11/2001 3400 2300 4100	9/11/2001 610 600 590	9/11/2001 360 280 220	9/11/2001 6300 6500 6600	Clear, 62° F
9/14/2001 440 500 520	9/14/2001 520 500 510	9/14/2001 510 480 490	9/14/2001 230 250 330	9/14/2001 880 900 920	Clear, cool
9/18/2001 1010 1010 910	9/18/2001 660 640 620	9/18/2001 560 500 450	9/18/2001 180 210 30	9/18/2001 4500 4400 4500	Clear, mild
9/20/2001 2410 2350 3110	9/20/2001 2220 1980 2110	9/20/2001 1010 990 1000	9/20/2001 950 910 890	9/20/2001 2600 2300 990	Overcast, cool
9/26/2001 2400 1800 1800	9/26/2001 1600 2400 2100	9/26/2001 3500 3500 7200	9/26/2001 1900 1600 2300	9/26/2001 1600 2100 2300	Overcast, rainy, mild
9/28/2001 1400 1000 1800	9/28/2001 690 680 670	9/28/2001 2600 2300 2900	9/28/2001 280 130 160	9/28/2001 5400 5000 5400	Overcast, cool