

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

**Total Maximum Daily Load for *Escherichia Coli* in the Galien River,
Berrien 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 levels of pollutants for a water body 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 the Galien River, located in Berrien County.

PROBLEM STATEMENT

This TMDL addresses approximately two miles of the Galien River near New Troy where recreational uses are impaired by elevated levels of pathogens. Michigan's Section 303(d) list (Creal and Wuycheck, 2000) cites the upstream terminus as the confluence of the east branch of the Galien River and the downstream terminus as the confluence of Kirktown Creek. The TMDL reach is on the Section 303(d) list as:

Waterbody: **Galien River** WBID#: **083301A**
County: Berrien RF3RchID: 4040001 23 Size: 2 M
Location: Galien River in the vicinity of New Troy – 1.0 mile d/s of Avery Road to 1.0 mile u/s of Avery Road (Kirktown Creek confluence u/s to the E. Br. Galien River confluence).
Status: **2** Problem: **WQS exceedances for *E. coli*; CSO, pathogens (Rule 100).**
TMDL YEAR(s): 2000

The Galien River 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 Berrien County Health Department documented elevated levels of *E. coli* in 1996. Monitoring data (Appendix 1) collected in 2001 by the MDEQ documented exceedances of the WQS, in both the Galien River and tributaries, at all eight stations (Table 1). Seasonal geometric means for the 2001 sampling season exhibited elevated levels at stations above and below the listed reach (Figure 3). Monthly geometric mean *E. coli* concentrations in the Galien River for 2001 ranged from 266 *E. coli* per 100 milliliters (ml) in September at Elm Valley Road to 1,546 *E. coli* per 100 ml in May at Minnich Road (Table 1). Overall, the highest *E. coli* data collected in the Galien River were at Avery/Mill Road and Minnich Road. Both of these stations routinely exceeded 1,000 *E. coli* per 100 ml, with maximum results of 2,900 *E. coli* per 100 ml and 4,300 *E. coli* per 100 ml, respectively (Table 1).

Monthly geometric mean *E. coli* data in the tributaries sampled ranged from 411 *E. coli* per 100 ml in September in Kirktown Creek at Weechick Road to 5,066 *E. coli* per 100 ml in September in the east branch of the Galien River. The 2001 data collected indicate that the east branch of the Galien River may be a substantial source of *E. coli* to the main branch (Table 1).

Based on the 2001 monitoring data collected by the MDEQ, the upstream boundary has been extended to Elm Valley Road and the downstream boundary extended to Flynn Road (Figure 1). This modified reach includes both Kirktown Creek and the east branch of the Galien River since monitoring data indicates exceedances on these tributaries as well. The source area for the TMDL includes all the tributaries and land upstream of Flynn Rd (Figure 2).

Besides *E. coli*, the official 303(d) listing erroneously states a combined sewer overflow (CSO) problem in the Galien River. There are no permitted CSOs in the listed reach; therefore, this TMDL does not address the issue of CSOs. The listing was corrected to delete the reference to CSOs.

NUMERIC TARGETS

The impaired designated use for the Galien River 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, there is one permitted wastewater sewage lagoon (WWSL) discharge to the Galien River, which has an additional target:

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.

The WWSL is permitted to discharge during the months of March through May and October through December. The discharge period overlaps the recreational season in May and October only and will be 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 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 eight stations sampled. One heavy rain event coincided with sampling on August 16, 2001. The consistent *E. coli* exceedances from May to September indicate a constant source of *E. coli* to both the Galien River and the tributaries sampled, regardless of wet weather events.

SOURCE ASSESSMENT

The modified listed TMDL reach for the Galien River is Elm Valley Road (upstream boundary) to Flynn Road (downstream boundary) (Figure 1). In addition, the source area for this TMDL includes the area upstream of Flynn Road and all tributaries. This is based on the 2001 monitoring data documenting exceedances at all sampling locations. The townships in the source area include Weesaw Township, Galien Township, Buchanan Township, Baroda Township, Bertrand Township, Chikaming Township, Oronoko Township, and Three Oaks Township, (Figure 2). Table 2 shows the distribution of land in the source area for each township.

Potential pathogen sources for this waterbody include agricultural inputs, since a majority of the surrounding land is used for agricultural production and to a lesser degree, urban land uses. Much of the watershed has been ditched and tilled to more efficiently drain water from the land. MDEQ staff have reported agricultural impacts, such as unlimited cattle access, to the east branch of the Galien River, which may explain the consistent exceedances from May to September. Other potential sources may be illicit connections to storm drains in the villages of New Troy and Galien, as well as storm water runoff. There are no known continuous point source discharges of *E. coli* in this reach; however, there is one permitted seasonal lagoon discharge - the Galien WWSL (MIG580299). As previously discussed, this facility's discharge overlaps with the recreational season in May and October only and is not considered a significant source of *E. coli* as indicated by discharge monitoring results reported to MDEQ staff.

LINKAGE ANALYSIS

The link between the *E. coli* concentration in the Galien River 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 river and any needed load reductions. For this TMDL, the primary loading of pathogens appears to enter the Galien River by both wet and dry weather conditions and storm water related nonpoint sources.

Based on 2001 monitoring data, the background concentration of *E. coli* was found to be exceeding the WQS. This conclusion was the basis for redefining the TMDL reach with an extended source area. Additional data will be collected during the 2002 sampling season to document existing conditions. The guiding water quality management principle used to develop the TMDL was that compliance with the numeric pathogen target in the Galien River depends on the continued control of point source *E. coli*, and the control of *E. coli* in storm water, illicit connections, and agricultural inputs. If the *E. coli* inputs can be controlled, then total body contact recreation in the Galien River 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, for pathogens in point source discharges of treated or untreated human sewage, levels are restricted to a monthly average limit of 200 per 100 ml for fecal coliforms regardless of stream flow. Therefore, the design stream flow is not a critical condition for determining the allowable loadings for the WWTP. In addition, other *E. coli* sources to the Galien River 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 all 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 this TMDL, an allocation strategy for nonpoint sources has been selected that assumes equal bacteria loads per unit area for all lands within the watershed. The point sources are handled consistent with Rule 62(3). The allocation process for each month of the recreational season (May through October) is outlined below.

1. This TMDL is concentration-based, so the TMDL is equal to the pathogen WQS of 130 *E. coli* per 100 ml.
2. There are no known continuous point source discharges of *E. coli* in the watershed; however, there is one permitted lagoon discharge. The Galien WWSL (MIG580299) has a seasonal discharge during the months of March through May and October through December. The facility has a fecal coliform limit of 200 per 100 ml as a monthly average. The WWTP will be considered in compliance with the WQS of 130 *E. coli* per 100 ml if their NPDES permit limit of 200 fecal coliform per 100 ml as a monthly average is met. As previously discussed, 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.
3. Monitoring data collected in 2001 indicated exceedances of the WQS at all locations sampled. Due to this, the TMDL reach was extended downstream to Flynn Road and upstream to Elm Valley Road (Figure 1) and the entire watershed upstream of Flynn Road is now included as a source area (Figure 2).

Consistent with the allocation strategy, Table 3 shows the TMDL or allowable concentrations for *E. coli* by applicable month in the Galien River 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 an 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:

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

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(1).

WLAs

The Galien WWSL (MIG580299) is the only permitted point source discharge that contains treated or untreated human sewage to the listed reach of the Galien River. This facility has a seasonal discharge during the months of March through May and October through December and has a fecal coliform limit of 200 per 100 ml as a monthly average. As previously stated, when the WWTP is meeting their permit limit, it is assumed the WQS will be met in the discharge. Therefore, the WLA will be equal to 130 *E. coli* per 100 ml for the months of May and October.

LAs

Due to WQS exceedances at all locations sampled, the source area has been extended to include the entire reach of the watershed. This TMDL is concentration-based; therefore, the LA is equal to 130 *E. coli* per 100 ml, and the determination of individual LAs will be based on the assumption of 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 LAs 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 the Galien River.

The government entities with the largest percent land area in the Galien River watershed are Weesaw Township --which includes the village of New Troy-- (43%) and Galien Township (27%), making up 70% of the watershed. The remaining 30% of the watershed is made of Buchanan Township (17%), Baroda Township (7%), Bertrand Township (3%), Three Oaks Township (1%), Chikaming Township (1%), and Oronoko Township (1%).

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.

Example Loading Assessment

Although this TMDL is concentration-based, an example calculation using counts per day was used to simulate a loading assessment. The TMDL, on a loading basis, can be calculated as a function of stream flow using the following equation:

$$\text{TMDL} = Q_{\text{riv},x} \times C_{\text{WQS}}$$

Where:

TMDL = Loading capacity in the river (counts per time).

$Q_{\text{riv},x}$ = River flow (volume of water per time).

C_{WQS} = WQS concentration (counts per volume of water).

The loading capacity defined in the above equation applies to all river flows for which WQS apply. The monthly average flows for the Galien River at Flynn Road are given in Tables 4 and 5 and were used to calculate the total allowable load to the Galien River.

Using the previously stated conditions from the allocation strategy, the allocations based on average flow conditions were determined using the following process:

1. For the Galien River, the allowable concentrations were converted to allowable loads.
2. LAs were determined for each local entity based on the relative areas of jurisdiction within each subwatershed. These results are given in Table 6.
3. The WLA was determined for the village of Galien based on their annual permitted discharge of 50.55 million gallons. A design flow was calculated using a six month discharge period and assuming a regular lagoon discharge scenario of ten days on, seven days off for a flow of 0.42 million gallons per day, respectively. This flow was used to calculate the WLA for May and October only, the months the discharge overlaps with the recreational season. These results are given in Table 7.
4. The Galien River flows used in calculations for the LAs were taken at Flynn Road. The flow data was provided by the Hydrology Unit, Land and Water Management Division, MDEQ.
5. The TMDL total load was calculated using the flow of the Galien River, which includes the design flow of the WWSL for May and October, and uses the formula in Table 7.

The results of the loading assessment for the listed reach of the Galien River under average flow conditions are given in Table 7. The assessment shows primarily that if the LAs are met, the TMDL will not be exceeded in the Galien River at Flynn Road for each month of the recreational season.

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, water quality was monitored at eight 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

Agricultural runoff and illicit discharges are likely the dominant source of *E. coli* to the Galien River, given the rural nature of the watershed. To a small degree, storm water runoff could potentially be another source as well. Implementation activities to meet the TMDL require measures to reduce *E. coli* sources and loads. Under the Phase 2 storm water regulations, municipalities in the watershed will be evaluated against applicable criteria and may be required to obtain Phase 2 storm water permits. These permits will likely require activities that reduce pathogen inputs.

In addition, the Berrien County Drain Commission has been awarded a Section 319 Watershed Management Grant that will include developing a comprehensive watershed management plan, implementing an Information and Education strategy that identifies target audiences and delivers messages based on the sources and causes of nonpoint solution, and conducting other activities aimed at restoring the Galien River watershed.

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

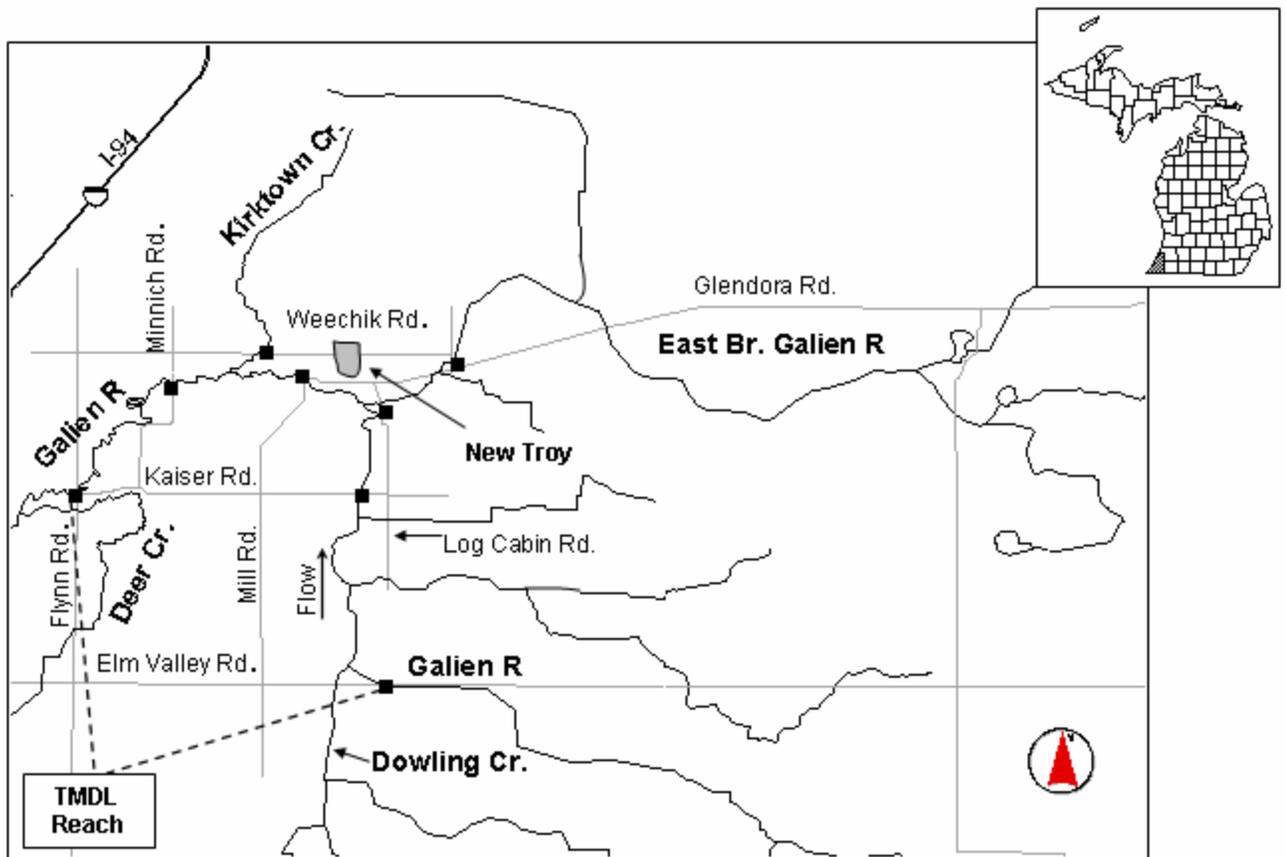


Figure 1. Sampling locations for the Galien River and selected tributaries, May through September 2001, Berrien County, Michigan.

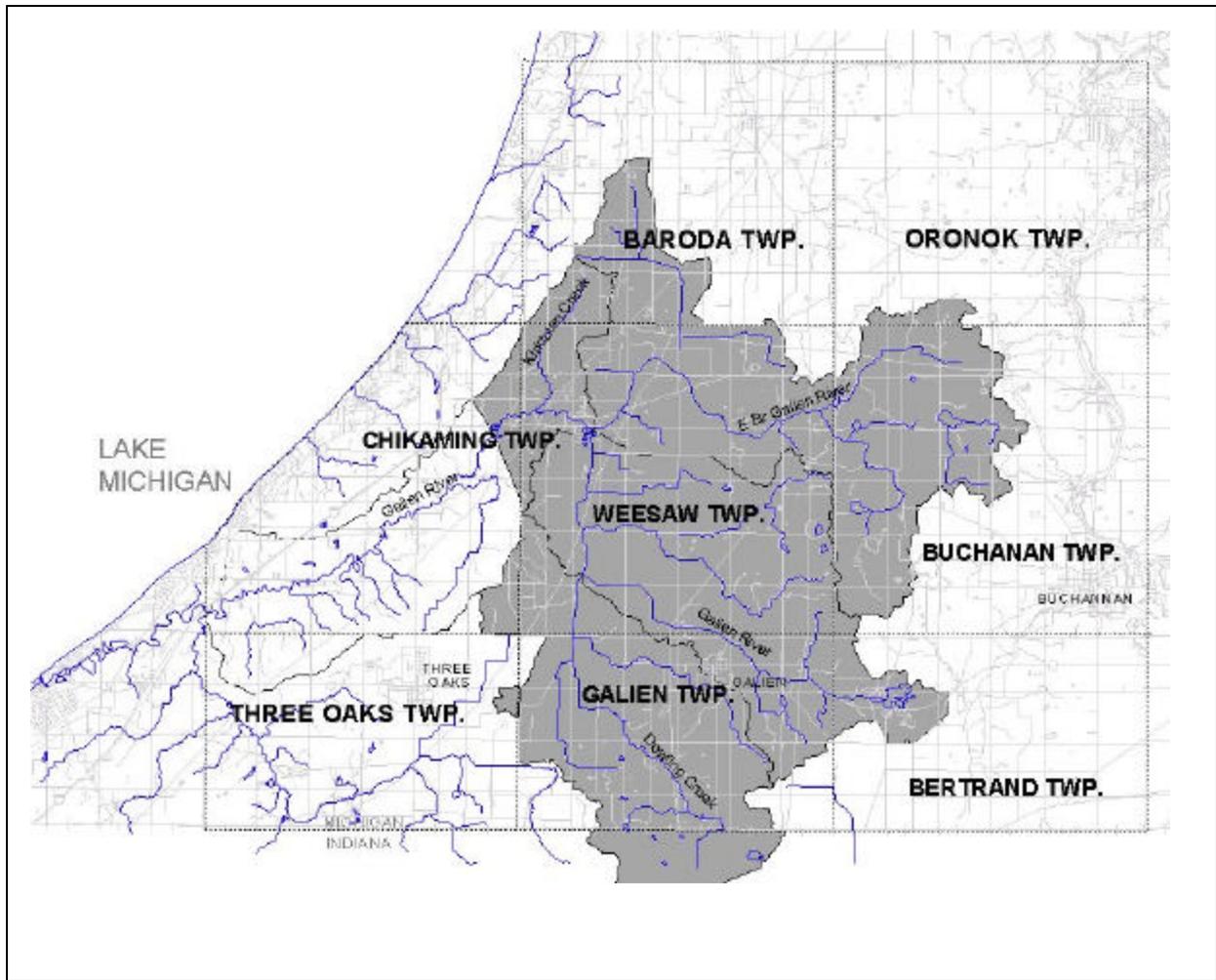


Figure 2. The shaded area indicates the townships included in the source area for the Galien River *E. coli* TMDL. The downstream end of the source area is at Flynn Road on the Galien River.

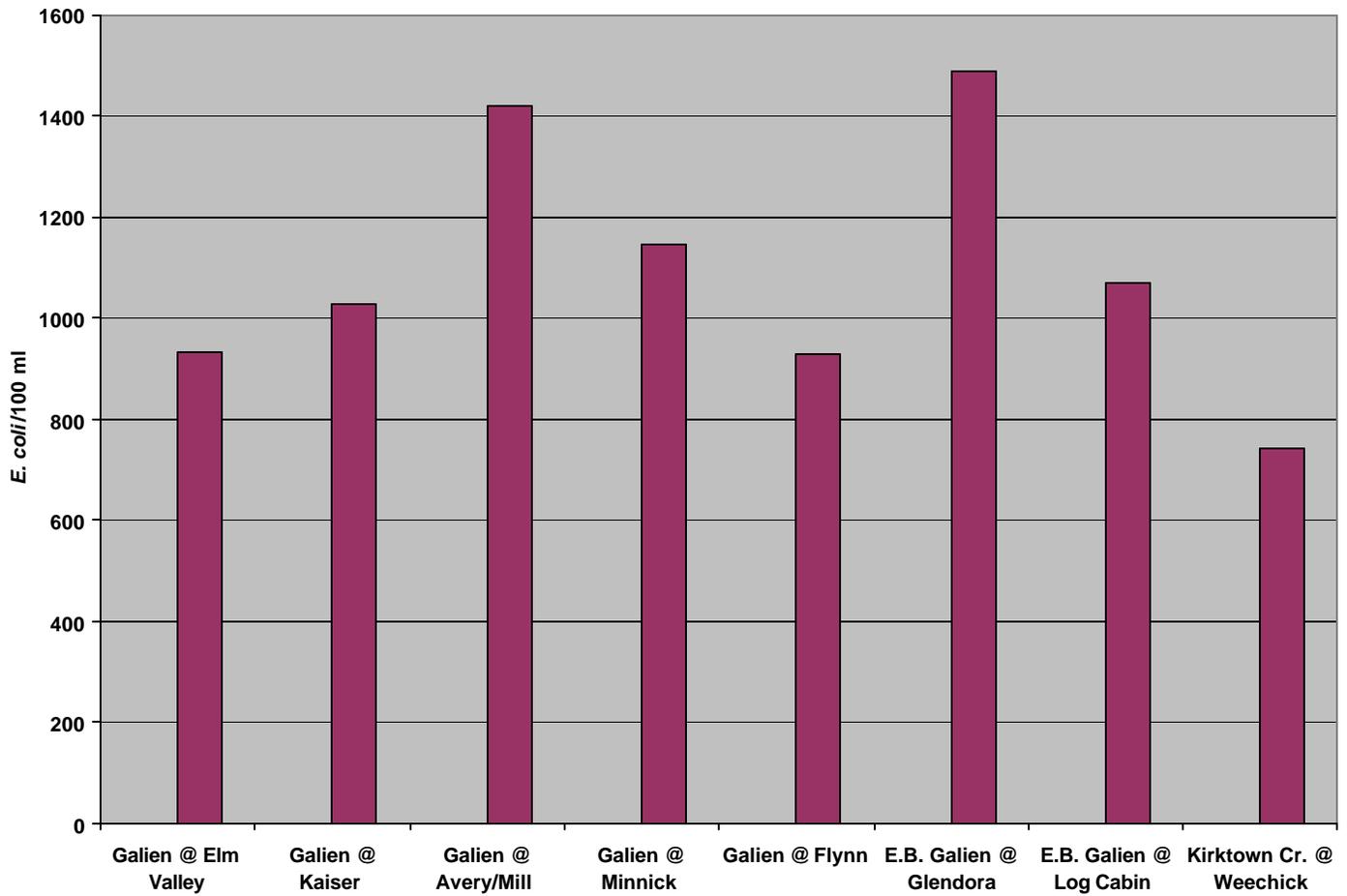


Figure 3. Seasonal geometric mean *E. coli* results for the Galien River and selected tributaries, Berrien County, Michigan, May through September, 2001. Data are presented upstream to downstream, followed by tributaries.

Table 1. MDEQ *E. coli* data for the Galien River in the vicinity of New Troy, Michigan, 2001.

Sample Location	Month	<i>E. coli</i> Concentration (#/100 ml)			# of Results
		Minimum	Geometric Mean	Maximum	
Galien @ Elm Valley Rd.	May	*	*	*	*
	June	420	682	1,170	6
	July	520	1,072	1,900	12
	August	330	1,213	5,500	15
	September	180	266	350	3
Galien @ Kaiser Rd.	May	880	952	1,000	3
	June	490	1,236	2,700	12
	July	580	924	1,400	12
	August	390	1,104	5,000	15
	September	520	565	630	3
Galien @ Avery/Mill Rd.	May	1,200	1,285	1,360	3
	June	1,120	1,495	2,900	6
	July	*	*	*	*
	August	*	*	*	*
	September	*	*	*	*
Galien @ Minnich Rd.	May	1,450	1,546	1,700	3
	June	590	1,018	2,200	12
	July	790	1,255	3,000	12
	August	480	1,180	4,300	15
	September	800	832	890	3
Galien @ Flynn Rd.	May	*	*	*	*
	June	480	991	2,000	6
	July	610	939	1,400	12
	August	400	932	2,900	15
	September	730	779	810	3
E.B. Galien @ Glendora Rd.	May	1,100	1,327	1,700	3
	June	560	1,033	2,800	12
	July	690	1,471	4,000	11
	August	840	1,608	3,500	15
	September	5,000	5,066	5,100	3
E.B. Galien @ Log Cabin Rd.	May	1,300	1,417	1,500	3
	June	600	931	1,160	6
	July	*	*	*	*
	August	*	*	*	*
	September	*	*	*	*
Kirktown Cr. @ Weechick Rd.	May	1,100	1,301	1,600	3
	June	440	807	1,800	12
	July	340	696	1,830	12
	August	250	729	1,300	15
	September	380	411	470	3

*no data collected during this month at this location.

Table 2. Distribution of land for each municipality in the source area.

Municipality	Square Miles	Percent
Weesaw Township	34.9	43
Galien Township	22.0	27
Buchanan Township	13.6	17
Baroda Township	5.6	7
Bertrand Township	2.5	3
Chikaming Township	1.2	1
Oronoko Township	1.0	1
Three Oaks Township	0.4	1
TOTAL	81.2	100

Table 3. Allowable *E. coli* concentrations by month in the Galien River watershed.

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

Table 4. Galien River average flows (cfs) at Flynn Road.

May	June	July	August	September	October
86	62	43	38	36	41

Table 5. Galien River average flows (cfs), including the Galien WWSL flows.

May	June	July	August	September	October
86.7	62	43	38	36	41.7

Table 6. LAs for the Galien River watershed upstream of Flynn Road for average flow (relative loading units*).

	Percent land in watershed	May	June	July	August	September	October
Weesaw Twp.	43	117	85	59	52	49	56
Galien Twp.	27	74	53	37	33	31	35
Buchanan Twp.	17	46	33	23	21	19	22
Baroda Twp.	7	19	14	10	8	8	9
Bertrand Twp.	3	8	6	4	4	4	4
Chikaming Twp.	1	3	2	1	1	1	1
Three Oaks Twp.	1	3	2	1	1	1	1
Oronoko Twp.	1	3	2	1	1	1	1
TOTAL	100	273	197	136	121	114	129

*Relative Loading Units = *E. coli* concentration (130 counts/100 ml) x River flow (cfs) x (10 x .646 x 3.785) / 10³

Table 7. TMDL for the Galien River, May 1 to October 31 (relative loading units).*

	May	June	July	August	September	October
WLA	2.1	0	0	0	0	2.1
LA	273	197	136	121	114	129
TOTAL LOAD (TMDL)	275.1	197	136	121	114	131.1

*Relative Loading Units = *E. coli* concentration (130 counts/100 ml) x River flow or effluent flow (cfs) x (10 x .646 x 3.785) / 10³

Appendix 1. MDEQ *E. coli* monitoring data for the Galien River, vicinity of New Troy, 2001. Data are presented upstream to downstream, followed by tributaries.

Galien River @ Elm Valley Rd. GR-3B	Galien River @ Kaiser Rd. GR-4A	Galien River @ Avery/Mill Rd. GR-3A	Galien River @ Minnick Rd. GR-1A
6/20/2001	5/25/2001	5/25/2001	5/25/2001
420	1000	1300	1700
540	980	1200	1500
520	880	1360	1450
6/28/2001	6/6/2001	6/6/2001	6/6/2001
1170	2200	1500	2200
1120	2700	1300	2000
650	2200	2900	800
7/5/2001	6/13/2001	6/13/2001	6/13/2001
580	1320	1420	790
560	1220	1240	840
520	1140	1120	950
7/12/2001	6/20/2001		6/20/2001
1100	560		660
600	540		600
1900	490		590
7/26/2001	6/28/2001		6/28/2001
1570	1800		1120
1600	1100		1530
1480	1800		1390
7/19/2001	7/5/2001		7/5/2001
1400	600		900
1400	580		790
1500	620		810
8/2/2001	7/12/2001		7/17/2001
1020	980		1600
1070	1400		1300
1400	1000		1500
8/9/2001	7/26/2001		7/26/2001
1200	1020		850
1300	890		910
990	1020		830
8/16/2001	7/19/2001		7/19/2001
1100	1300		3000
1140	1000		2100
1070	1080		2100
8/23/2001	8/2/2001		8/2/2001
5500	860		1440
5500	800		2400
4700	900		1400
8/29/2001	8/9/2001		8/9/2001
330	910		480
340	920		550
360	920		510
9/4/2001	8/16/2001		8/16/2001
350	1000		1400
180	1400		1700
300	1600		1800
	8/23/2001		8/23/2001
	3500		4300
	3500		2200
	5000		2300
	8/29/2001		8/29/2001
	410		560
	420		580
	390		610
	9/4/2001		9/4/2001
	630		890
	550		810
	520		800

Appendix 1 continued.

Galien River @ Flynn Rd. GR-5B	E. Branch Galien River @ Glendora Rd. GR-6A	E. Branch Galien River @ Log Cabin Rd. GR-5A	Kirktown Creek @ Weechick Rd. GR-2A
6/20/2001	5/25/2001	5/25/2001	5/25/2001
550	1700	1300	1600
480	1100	1460	1100
510	1250	1500	1250
6/28/2001	6/6/2001	6/6/2001	6/6/2001
1900	1000	800	1800
1850	1030	910	800
2000	1000	600	1800
7/5/2001	6/13/2001	6/13/2001	6/13/2001
610	770	1160	1140
660	730	1120	1320
700	560	1150	1370
7/12/2001	6/20/2001		6/20/2001
1200	600		520
790	620		470
1400	650		440
7/26/2001	6/28/2001		6/28/2001
800	2600		530
880	2800		500
820	2600		500
7/19/2001	7/5/2001		7/5/2001
1300	710		340
1400	690		420
1200	720		400
8/2/2001	7/12/2001		7/12/2001
800	3500		540
540	4000		470
700	2400		520
8/9/2001	7/26/2001		7/26/2001
630	1050		1830
840	1020		1810
450	1090		1770
8/16/2001	7/19/2001		7/19/2001
1200	2100		700
1400	2400		700
1800	8/2/2001		600
8/23/2001	2200		8/2/2001
2700	2300		1050
2900	2700		1200
2700	8/9/2001		1700
8/29/2001	3500		8/9/2001
400	1700		480
410	2100		530
460	8/16/2001		520
9/4/2001	1600		8/16/2001
730	1800		1300
800	2800		1300
810	8/23/2001		1300
	970		8/23/2001
	1150		800
	1220		950
	8/29/2001		950
	880		8/29/2001
	840		250
	900		270
	9/4/2001		290
	5100		9/4/2001
	5100		380
	5000		470
			390