

**Michigan Department of Natural Resources and Environment
Water Resources Division
June 2010**

**Total Maximum Daily Load for *E. coli* for
Planter Creek
Gogebic 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 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 states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of *Escherichia coli* (*E. coli*) that will result in the attainment of the applicable WQS in Planter Creek, located in Gogebic County, Michigan (Figure 1).

PROBLEM STATEMENT

This TMDL addresses the listing that appears on Michigan's 2010 Section 303(d) list (LeSage and Smith, 2010) as:

PLANTER CREEK

County: GOGEBIC

Location: From Jackson Creek confluence upstream, including tributaries.

Use impairments: Total and partial body contact recreation.

Cause: *E. coli*

Source: Combined Sewer Overflows

TMDL Year(s): 2010

AUID: 040201010204-01

SIZE: 9.12 M

Planter Creek was first placed on the Section 303(d) list in 2000 due to impairment of recreational uses by *E. coli* (Creal and Wuycheck, 2000). Combined Sewer Overflows (CSOs) were listed as the source of *E. coli*. Monitoring data collected by the Michigan Department of Natural Resources and Environment (DNRE) in 2008 documented several exceedances of the daily maximum and 30-day geometric mean WQS for *E. coli* during the total body contact (TBC) recreational season of May 1 through October 31, and periodic exceedances of the partial body contact (PBC) WQS (Table 1; Figures 2-3).

The TMDL reach is located in the Planter Creek watershed, which flows into Jackson Creek, a tributary to the Black River and finally Lake Superior (Hydrologic Unit Code [HUC] 04020101) (Figure 1). The Planter Creek watershed covers 2,848 acres (about 4.5 square miles) of Gogebic County (United States Geological Survey [USGS], 1999). Glacial topology of this region is bedrock-controlled ground moraine consisting of thin till deposits overlying bedrock (Jerome, 2006). The iron formation of the Gogebic Iron Range extends almost 80 miles between Atkins Lake in Wisconsin and Lake Gogebic in Michigan (Reed, 1957). There are no major urban areas within the Planter Creek watershed. The population is approximately 180 people (United States Census Bureau, 2000).

NUMERIC TARGET

The impaired designated uses addressed by this TMDL are TBC and PBC recreation. The designated use rule (Rule 100 [R 323.1100] of the Part 4 rules, WQS, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended) states that this water body be protected for TBC recreation from May 1 through October 31 and PBC recreation year-round. The target levels for these designated uses 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 milliliters (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.

(2) All surface waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 *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.

The target for sanitary wastewater discharges is:

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

For this TMDL, 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 to protect the TBC use are the target levels for the TMDL reach from May 1 through October 31, and 1000 *E. coli* per 100 mL as a daily maximum year-round to protect the PBC use. The 2008 monitoring data indicated daily maximum and monthly average TBC WQS exceedances at Stations 1-5, and periodic exceedances of the PBC WQS.

DATA DISCUSSION

E. coli data were collected by the DNRE from five sites in Gogebic County from June 4 through September 18, 2008 (Figure 1). Precipitation data for the two days prior to each DNRE sampling event were obtained from a weather station in Ironwood, Michigan, approximately 15 miles west of Planter Creek (Table 1; NOAA, 2009). *E. coli* daily maximum and 30-day geometric mean data for 2008 are shown in Table 1 and Figures 2-3. All stations are located within the TMDL reach. The highest daily maximum *E. coli* concentration of 9,855 *E. coli* per 100 mL was recorded at Station 2 on July 30, 2008. The daily maximum TBC standard (300 *E. coli* per 100 mL) was exceeded at Station 1 on 3 sampling dates, at Station 2 on 6 sampling dates, at Station 3 on 6 sampling dates, at Station 4 on 5 sampling dates, and at Station 5 on 2 sampling dates. The PBC recreation daily maximum standard (1000 *E. coli* per

100 mL) was exceeded on one occasion at Stations 2 and 4, and exceeded on two occasions at Station 3. The TBC 30-day geometric mean standard (130 *E. coli* per 100 mL) was exceeded on the majority of sampling dates at Stations 2-4, and on at least half of the sampling dates at Station 1.

SOURCE ASSESSMENT

Land cover data from 2000 show that the Planter Creek watershed is dominated by deciduous, mixed, and evergreen forest (78 percent) (USGS, 2000). Additional land cover includes developed land (7 percent), woody wetlands (7 percent), and cultivated crops (4 percent). Possible sources of *E. coli* include CSOs and illicit connections to storm sewers, and to a lesser degree, agriculture and wildlife waste.

As previously mentioned, there are no urban areas within the TMDL watershed; however, the city of Wakefield has been included as a source of *E. coli*. Man-made modifications have altered the natural drainage area in the TMDL watershed. Approximately 100 years ago, the city of Wakefield constructed a dam and rock tunnel to connect Sunday Lake to the Planter Creek watershed. This nonoperational dam located on the northeast side of Sunday Lake acts as a spillway into Planter Creek (Western U.P. Planning & Development Region, 2008). The rock tunnel was constructed to route CSOs away from Sunday Lake thereby impacting Planter Creek (personal communication, Steve Casey, Upper Peninsula District Supervisor, November 9, 2010).

There are two National Pollutant Discharge Elimination System (NPDES) permits in or affecting the TMDL watershed; a Certificate of Coverage under the general permit for wastewater stabilization lagoons (WWSLs) and the statewide Michigan Department of Transportation (MDOT) Municipal Separate Storm Sewer System permit (MS4) (MI0057364). The Wakefield WWSL (MI0021440) is authorized to discharge treated municipal wastewater from outfall 001 to Planter Creek from March 1 through May 31 and October 1 through December 31. Wakefield is also authorized to discharge diluted sewage during periods of high flow and snow melt from outfall 002 to Planter Creek. The city's sanitary sewer collection system experiences increased flows (i.e., infiltration and inflow) as a result of groundwater entering broken pipes and from footing drain connections to the collection system. Periods of snow melt cause additional flows to enter, and overwhelm, the collection system causing sewage overflows to Planter Creek via diversion manholes. The diversion manholes allow diluted sewage to be routed into the storm sewer system in order to protect against basement flooding of homes in the city. Untreated sewage discharges from Outfall 002 are a source of *E. coli* to Planter Creek. According to the DNRE's CSO and Sanitary Sewer Overflow (SSO) System Database, no CSO or SSO discharge events were reported during the monitoring period (June through September 2008) (DNRE, 2009). Outfalls 001 and 002 are shown in Figure 1.

Other potential sources of *E. coli* include illicit connections to the city of Wakefield's storm sewer system and houses with failing or nonexistent on-site systems. As described above, the city of Wakefield is served by a combined sanitary sewer system. The city has taken numerous steps to upgrade their system, including the elimination of excess infiltration and inflow; however, there is a potential for *E. coli* to enter Planter's Creek via illicit connections to the storm sewer system. The Western Upper Peninsula Health Department conducted a tour of homes along Planter Creek in the summer of 2010. One home had a direct discharge to Planter Creek, but the home was vacant. No other properties are believed to be adversely impacting Planter Creek (personal communication, L. Madison, Western Upper Peninsula Health Department, October 29, 2010).

Based on the land cover data and field observations, application of animal manure and direct cattle access are not likely nonpoint sources of *E. coli* to Planter Creek. However, an

abandoned animal barn is located approximately 600 meters upstream of Station 2 where occasional WQS exceedances were observed – one such exceedance was greater than 9,000 *E. coli* per 100 ml. This exceedance does not appear to be wet weather related. Land cover data also indicates (i.e., 78 percent forest) that wildlife contributions may be an additional source of *E. coli* to Planter Creek. There are no permitted Concentrated Animal Feeding Operations in the Planter Creek watershed.

To assist in determining potential sources of *E. coli* to Planter Creek, a load duration curve analysis was developed for each sampling station as outlined by Cleland (2002). A load duration curve considers how flow conditions relate to a variety of pollutant sources (point and nonpoint sources). The load duration curves for each station sampled on Planter Creek are included in Figures 4-8. The USGS gage used to determine the load duration curves is located on the Black River (Ontonagon River Basin, HUC 04020102) in Bessemer, Michigan (Gage #4031000). A ratio of the drainage area of the Black River to the drainage area of the ungaged watersheds (defined as the drainage area ratio), was calculated for each of the five sample locations for this TMDL. The curves were generated by applying these drainage area ratios to gaged flows for the period of record.

The load duration curves indicate that no sampling occurred in mid to high flow conditions; therefore, *E. coli* concentrations relative to such events cannot be determined. Exceedances of the TBC daily maximum WQS were observed under mid to dry flow conditions (i.e., low flows) (Figures 4-8). Note that data points above the curve to the right side of the figure indicate *E. coli* WQS exceedances during dry weather conditions (lower flows). The dry weather exceedances observed indicate that sources of *E. coli* on the sampling dates during this study were not related to precipitation events (i.e., runoff). A possible source of *E. coli* during mid to low flows is a constant source, such as illicit connections of sewage sources to the city of Wakefield's storm sewers and/or direct discharges of untreated sewage to Planter Creek.

LOADING CAPACITY (LC) DEVELOPMENT

The LC 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 TBC 30-day geometric mean WQS of 130 *E. coli* per 100 mL, daily maximum of 300 *E. coli* per 100 mL, and the PBC daily maximum WQS of 1000 *E. coli* per 100 ml. Concurrent with the selection of a numeric concentration endpoint, development of the LC requires identification of the critical condition. The "critical condition" is defined as the set of environmental conditions (e.g., flow) used in development of the TMDL that result in attaining WQS and has an acceptably low frequency of occurrence.

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). Therefore, this pathogen TMDL is concentration-based, consistent with R 323.1062, and the TMDL is equal to the TBC target concentrations of 130 *E. coli* per 100 mL as a 30-day geometric mean and daily maximum of 300 *E. coli* per 100 mL in all portions of the TMDL reach for each month of the recreational season (May through October) and PBC target concentration of 1000 *E. coli* per 100 mL as a daily maximum year-round. 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.

LC

The LC is the sum of individual waste load allocations (WLAs) for point sources and load

allocations (LAs) for nonpoint sources and natural background levels. In addition, the LC must include a margin of safety (MOS), either implicitly within the WLA or LA, 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:

$$LC = \sum WLA_s + \sum LA_s + MOS$$

The LC represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. Because this TMDL is concentration-based, the total loading for this TMDL is equal to the TBC 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 during the recreation season and PBC WQS of 1000 *E. coli* per 100 mL as a daily maximum year-round.

WLAs

The WLA for the Wakefield WWSL (MI0021440) and the MDOT MS4 (M10057364) is equal to 130 *E. coli* per 100 mL as a 30-day average and 300 *E. coli* per 100 mL as a daily maximum during the recreational season between May 1 and October 31, and 1000 *E. coli* per 100 mL as a daily maximum the remainder of the year.

LAs

Because this TMDL is concentration-based, the LA is also equal to 130 *E. coli* per 100 mL as a 30-day geometric mean and 300 *E. coli* per 100 mL as a daily maximum during the recreational season and 1000 *E. coli* per 100 mL as a daily maximum year-round. This LA is based on the assumption that all land, regardless of use, will be required to meet the WQS. 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 local unit of government in the watershed. The entire Planter Creek watershed is located within Wakefield Township.

MOS

This section addresses the incorporation of an MOS in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality, including the pollutant decay rate, if applicable. The MOS can be either implicit (i.e., incorporated into the WLA or LA 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. Pathogen organisms ordinarily have a limited capability of surviving outside of their hosts and a rate of decay could be developed. However, applying a rate of decay could result in an allocation that would be greater than the WQS, thus no rate of decay is applied to provide for greater protection of water quality. The DNRE has determined that the use of the TBC 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 during the recreational season, and the PBC WQS of 1000 *E. coli* per 100 mL as a daily maximum year-round for the WLA and LA is a more conservative approach than developing an explicit MOS. This accounts for the uncertainty in the relationship between pollutant loading and water quality, based on available data and the assumption to not use a rate of decay. Applying the WQS to be met under all flow conditions also adds to the assurance that an explicit MOS is unnecessary.

SEASONALITY

The WQS for *E. coli* are expressed in terms of seasons, e.g., TBC from May 1 through October 31 and PBC year-round. Allocations and controls developed for the more protective

TBC season are also expected to assure attainment of the daily maximum PBC WQS of 1000 *E. coli* per 100 mL, year-round. Because this is a concentration-based TMDL, WQS must be met regardless of flow conditions.

REASONABLE ASSURANCE ACTIVITIES

Permits for the NPDES permitted facilities that may be a source of fecal contamination contain measures to reduce or eliminate the potential for fecal contamination of Planters Creek. Michigan regulates discharges containing treated or untreated human waste (i.e., sanitary wastewater) using fecal coliform. Sanitary wastewater discharges are required to meet 200 fecal coliform per 100 mL as a monthly average and 400 fecal coliform per 100 mL as a maximum. The sanitary discharges are expected to be in compliance with the ambient WQS of 130 *E. coli* per 100 mL and 300 *E. coli* per 100 mL if their NPDES permit limits for fecal coliform are met. Discharge monitoring reports for the Wakefield WWSL indicate the facility has been meeting their NPDES permit limits for fecal coliform.

Untreated CSOs from the city of Wakefield are under long-term correction. Since 1996, approximately \$16 million in federal, state, and local funds were used to improve the sewer system. These improvements included sewer construction in locations served by failing septic systems in 1996, storm and sanitary sewer separation in the south and east part of the city in 1999-2000, storm and sanitary sewer separation in the west side of the city in 2004-2005, and replacement of failing sanitary sewers in 2007. A project is currently underway, slated for construction in the 2011 construction season, for which approximately \$5 million in federal Rural Development funds will be used for separation of remaining combined sewers, eliminating the two remaining combined sewer diversions (untreated CSO outfalls), sanitary lift station upgrades, sanitary sewer line replacement, and storm water infiltration elimination. At the conclusion of the projects, collection sewer flows will be evaluated to determine if the system has adequately met the goals of the Final CSO Control Program, which is contained in the city's NPDES discharge permit. Successful completion of the Final CSO Control Program will contribute towards eliminating a source of *E. coli* from entering Planter Creek.

The MDOT has a statewide Individual NPDES Storm Water Permit (MI0057364) to cover storm water discharges from their MS4. This statewide permit requires the permittee to reduce the discharge of pollutants to the maximum extent practicable and employ Best Management Practices to comply with TMDL requirements.

MONITORING

Future monitoring will take place as part of the five-year rotating basin monitoring, as resources allow, once actions have occurred to address sources of *E. coli*. When these results indicate that the water body 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 and daily maximum values of 300 *E. coli* per 100 ml and 1000 *E. coli* per 100 ml are being met.

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REFERENCES

- Cleland, B. 2002. TMDL Development from the “Bottom Up” – Part II. Using Duration Curves to Connect the Pieces. America’s Clean Water Foundation.
- Creal, W. and J. Wuycheck. 2000. Clean Water Act Section 303(d) List, Michigan Submittal for Year 2000. DNRE Report No. MI/DEQ/SWQ-00/018.
- Jerome, D.S. 2006. Landforms of the Upper Peninsula, Michigan. United States Department of Agriculture, Natural Resources Conservation Service. 56 pp.
- LeSage, S and J. Smith. 2010. Draft Water Quality and Pollution Control in Michigan: 2010 Sections 303(d) and 305(b) Integrated Report. DNRE Report No. MI/DEQ/WB-10/001.
- DNRE. 2009. Department of Environmental Quality, Combined Sewer Overflow and Sanitary Sewer Overflow System, CSO/SSO Events for Planter Creek from February 2000 through April 2008, downloaded December 18, 2009. <http://www.deq.state.mi.us/csosso>.
- NOAA. 2009. National Climatic Data Center. <http://www.ncdc.noaa.gov/oa/ncdc.html>.
- Reed, R.C. 1957. Michigan Iron Mines. State of Michigan, Department of Conservation, Geological Survey Division. 12 pp.
- United States Census Bureau. 2000. American Factfinder. <http://factfinder.census.gov>.
- USGS. 1999. National Hydrography Dataset (NHD). Catchment Shapefile. Vector Digital Data.
- USGS. 2000. National Land Cover Dataset (NLCD). 30m. Raster Digital Data. August 8, 2000.
- Western U.P. Planning & Development Region. 2008. City of Wakefield Flood Mitigation Plan. August 28, 2008.



Figure 1. Location of Planter Creek monitoring sites (1-5) and the Wakefield WWSL within the TMDL watershed.

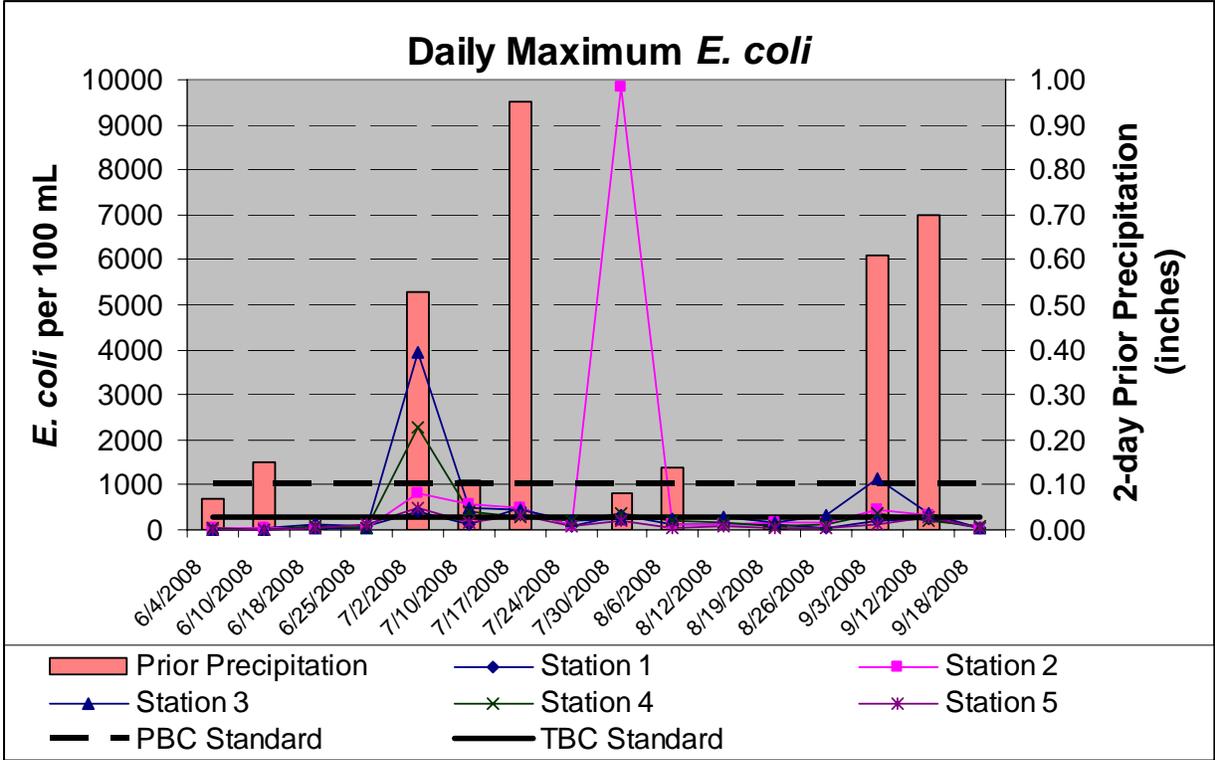


Figure 2. Daily Maximum *E. coli* sampling results from Planter Creek (Stations 1-5).

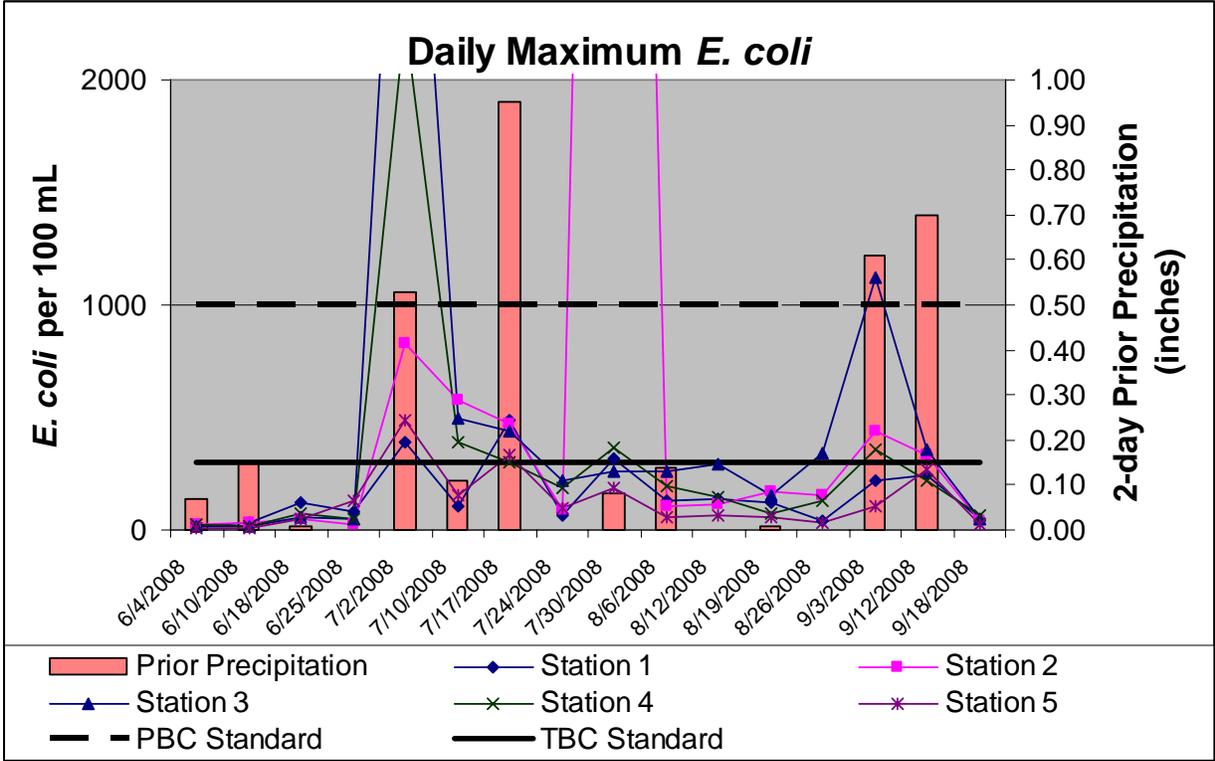


Figure 3. Detail of daily Maximum *E. coli* sampling results from Planter Creek (Stations 1-5).

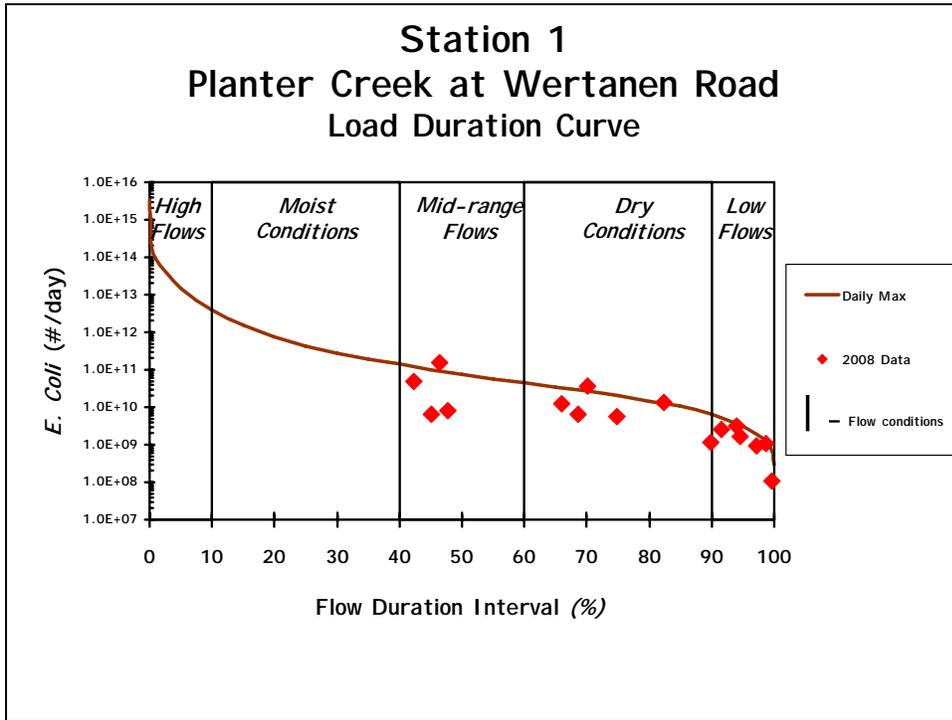


Figure 4. Flow duration curve for Planter Creek at Wertanen Road (Station 1). *E. coli* data and USGS Gage Duration Interval 4031000, 0.18 square miles.

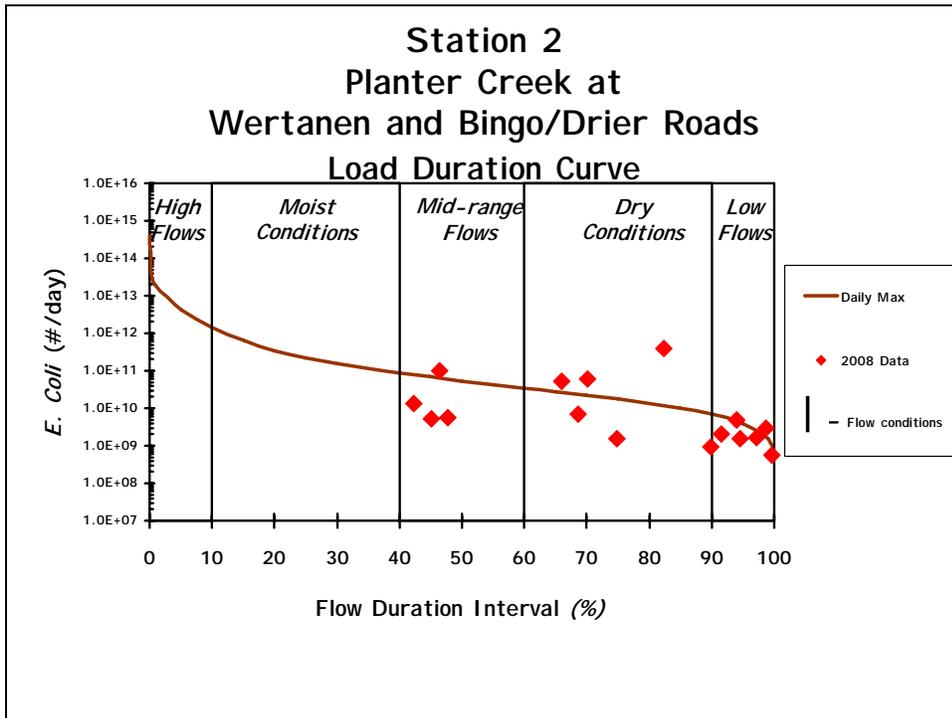


Figure 5. Flow duration curve for Planter Creek at Wertanen and Bingo/Drier Roads (Station 2). *E. coli* data and USGS Gage Duration Interval 4031000, 0.63 square miles.

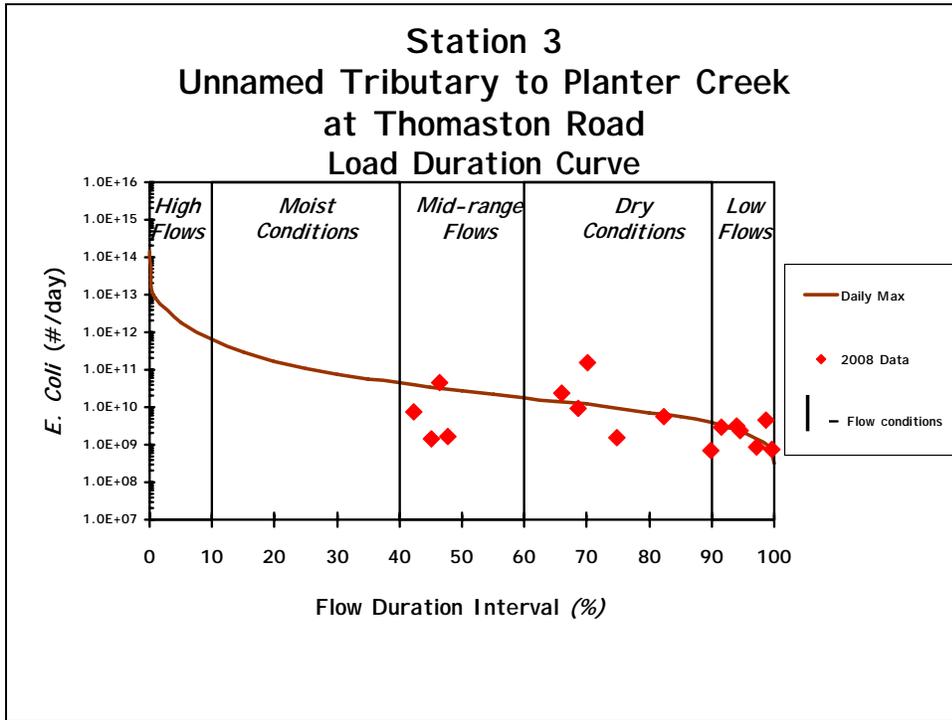


Figure 6. Flow duration curve for the Unnamed Tributary to Planter Creek at Thomaston Road (Station 3). *E. coli* data and USGS Gage Duration Interval 4031000, 1.40 square miles.

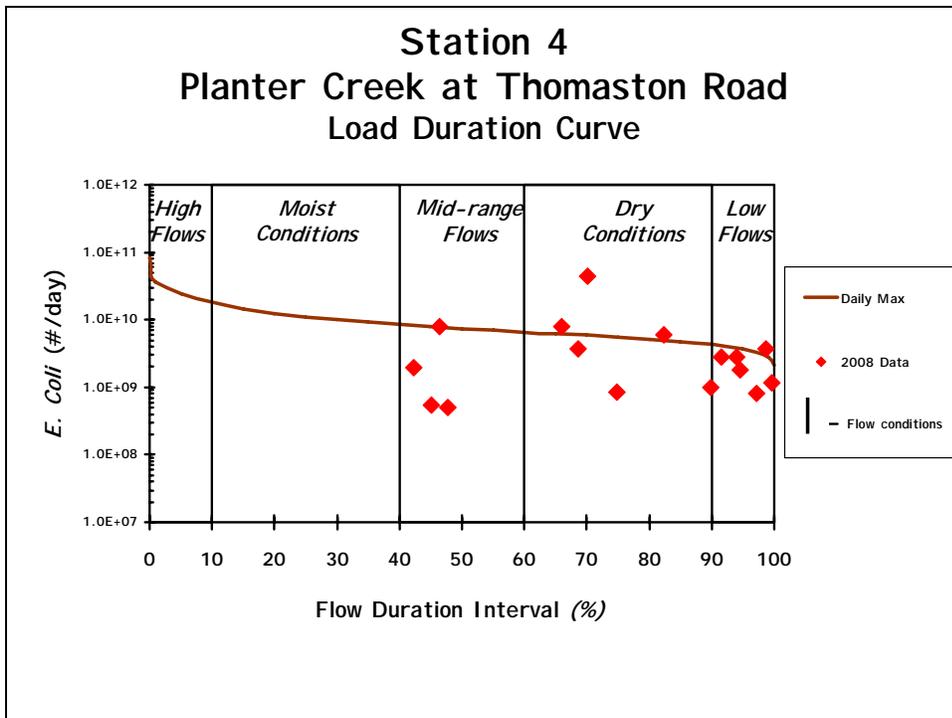


Figure 7. Flow duration curve for Planter Creek at Thomaston Road (Station 4). *E. coli* data and USGS Gage Duration Interval 4031000, 0.30 square miles.

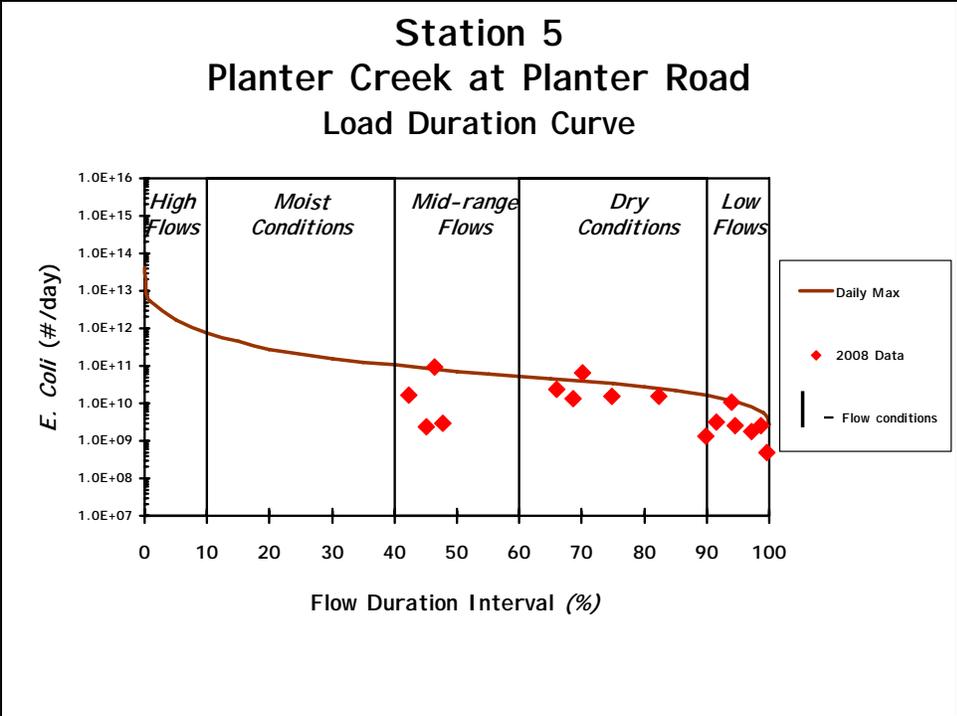


Figure 8. Flow duration curve for Planter Creek at Planter Road (Station 5). *E. coli* data and USGS Gage Duration Interval 4031000, 4.20 square miles.

Table 1. Weekly *E. coli* sampling results (counts per 100 mL) from Planter Creek (Stations 1-5). June 4 through September 18, 2008. Exceedances of the TBC WQS are shaded gray and PBC exceedances are outlined in bold.

Date	Station 1 Planter Creek at Wertanen Road			Station 2 Planter Creek at Wertanen and Bingo/Drier Roads			Station 3 Unnamed Tributary to Planter Creek at Thomaston Road			Station 4 Planter Creek at Thomaston Road, downstream of Wakefield WWSL			Station 5 Planter Creek at Planter Road			Prior 2-Day Precipitation (inches)
	Sample Results	Daily Max.	30-day Geomean	Sample Results	Daily Max.	30-day Geomean	Sample Results	Daily Max.	30-day Geomean	Sample Results	Daily Max.	30-day Geomean	Sample Results	Daily Max.	30-day Geomean	
6/4/2008	24 16 18	19		21 22 25	23		13 16 11	13		16 26 23	21		9 8 6	8		0.07
6/10/2008	33 26 28	29		27 30 32	30		20 28 8	16		21 24 17	20		10 10 14	11		0.15
6/18/2008	160 105 113	124		40 50 66	51		72 45 58	57		73 68 68	70		47 57 51	52		0.01
6/25/2008	80 93 74	82		30 23 24	25		36 56 56	48		39 60 42	46		157 138 112	134		0.00
7/2/2008	461 361 365	393	74	866 770 866	833	59	3,610 3,650 4,610	3,931	75	2,420 2,420 1,990	2,267	79	816 579 248	489	49	0.53
7/10/2008	105 91 133	108	105	866 435 517	580	113	435 649 435	497	155	345 387 435	387	142	196 143 129	153	90	0.11
7/17/2008	387 488 613	487	184	488 548 387	470	197	435 365 517	435	298	326 276 308	303	243	326 291 387	332	177	0.95
7/24/2008	84 59 58	66	162	91 84 86	87	219	194 219 236	216	388	178 167 222	188	297	86 123 86	97	201	0.00
7/30/2008	387 345 248	321	213	8,660 9,210 12,000	9,855	721	248 276 261	261	545	272 411 435	365	449	192 160 214	187	214	0.08
8/6/2008	124 166 116	134	172	173 63 96	102	473	313 214 276	264	317	248 172 186	199	276	73 65 43	59	140	0.14
8/12/2008	139 130 143	137	180	93 119 126	112	340	210 387 308	293	285	102 194 150	144	226	48 145 37	64	118	0.00
8/19/2008	233 93 88	124	137	147 206 172	173	279	148 192 125	153	232	58 73 91	73	170	56 51 76	60	84	0.01
8/26/2008	37 45 48	43	126	162 150 144	152	312	548 344 210	341	254	125 138 135	133	159	30 33 33	32	67	0.00
9/3/2008	194 228 228	216	116	435 365 548	443	168	980 1,200 1,200	1,122	340	308 387 387	359	158	102 111 107	107	60	0.61
9/12/2008	248 272 206	240	131	261 365 387	333	213	365 276 461	359	361	166 276 228	219	161	276 261 260	266	81	0.70
9/18/2008	51 41 56	49	106	60 50 18	38	171	25 73 77	52	256	72 57 78	68	139	30 16 21	22	65	0.00