Michigan Department of Environmental Quality
Surface Water Quality Division
August 2001

Total Maximum Daily Load for *Escherichia Coli* in Geddes Pond, Huron River, Washtenaw 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 (40 Code of Federal Regulations Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a 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. This TMDL follows the phased approach due to inherent uncertainties in estimating loading from nonpoint sources. Under the phased approach, load allocations and wasteload allocations are calculated using the best available data and information, recognizing the need for additional monitoring data to determine if the load reductions required by the TMDL lead to attainment of WQS. The phased approach provides for the implementation of the TMDL while additional data are collected to reduce uncertainty.

As part of the TMDL development, a support document was developed (Limno-Tech, Inc., 2000). This document contains background information about the listed waterbody, known water quality data, and source assessment. The TMDL was developed based on this support document and additional information, including a site visit by the Michigan Department of Environmental Quality (MDEQ) in December 2000 (Thelen, 2001).

PROBLEM STATEMENT

This TMDL addresses approximately five miles of the Huron River near Ann Arbor 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 Geddes Avenue and the downstream terminus as the Geddes Dam at Dixboro Road. However, based on a December 19, 2000 site visit by the MDEQ (Thelen, 2001), the upstream boundary was extended to Argo Dam (Figure 1) for TMDL development to include an important recreational area at the confluence of Allen Creek with the Huron River. The TMDL reach is on the Section 303(d) list as:

Waterbody: **Huron River (Geddes Pond)** WBID#: **061203B**
County: Washtenaw RF3RchID: 4090005 9 Size: 2 M
Location: Geddes Pond Dam u/s to Geddes Avenue.
Status: **2** Problem: **Pathogens (Rule 100).**
TMDL YEAR(s): 2000

The Huron River (Geddes Pond) was placed on the Section 303(d) list due to impairment of recreational uses by the presence of elevated levels of pathogens. Most of the data collection efforts in the listed reach were made in the early to middle 1980s. More than 500 samples were collected in Lower Geddes Pond for fecal coliform analysis in the1980s, but less than 100 samples were collected in the 1990s. Samples for *Escherichia coli (E. coli)*, the pathogen of concern, were collected in the 1980s, but not in the 1990s. Despite the sparse data available,

some general trends in bacterial concentration can be made over time. Lower Geddes Pond has consistently exhibited the highest bacteria concentrations among all Huron River reaches in the Ann Arbor area. Historical exceedances of state standards and high bacteria counts were common in the 1970s, 1980s, and 1990s, although improvements have been made since the peaks of the 1980s (Limno-Tech, Inc., 2000).

NUMERIC TARGETS

The impaired designated use for the Huron 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.

For this TMDL, the WQS of 130 per 100 milliliters (ml) as a 30-day geometric mean is the target level for the TMDL reach from May 1 to October 31. Wet and dry weather geometric mean concentrations from the 1980s show *E. coli* concentrations higher for Geddes Pond than for any part of the Huron River immediately upstream. Wet weather fecal coliform data for three decades of sampling in Geddes Pond showed the geometric mean concentration at 436 per 100 ml in the 1980s, with an observed maximum of 110,000 per 100 ml. For dry weather, the fecal coliform geometric mean peaked at 104 per 100 ml, with an observed maximum of 120,000 per 100 ml. Geddes Pond is also the receiving water for three direct tributaries (Millers Creek, Malletts Creek and Swift Run Creek), plus Traver Creek and Allen Drain immediately upstream. Observed fecal coliform counts in these tributaries in the 1980s ranged from 1,515 per 100 ml to 19,840 per 100 ml as a wet weather geometric mean. Maximum wet weather counts in the 1980s for Malletts Creek were 740,000 per 100 ml (Limno-Tech, Inc., 2000).

SOURCE ASSESSMENT

Potential pathogen sources for this waterbody include sources typically associated with urban and suburban runoff because the immediate watershed is primarily comprised of these land types.

Municipalities in the Huron River watershed include the city of Ann Arbor, the University of Michigan (U-M), Ann Arbor Township, Northfield Township, Pittsfield Township, Lodi Township, Scio Township, Ypsilanti Township, and Superior Township. Table 1 shows the distribution of land for each subwatershed in the listed reach of the Huron River.

Table 1. Distribution of land for each subwatershed in the listed reach of the Huron River.

	Subwatershed Area (sq. mi)	Percentage of Land Area in Subwatershed	Percentage of Immediate Watershed
Allen Creek			
City of Ann Arbor	4.0	90	
University of Michigan	0.43	10	
Total area	4.43	100	13
Traver Creek			
City of Ann Arbor	3.3	45	
University of Michigan	0.072	1	
Ann Arbor Township	3.8	52	
Northfield Township	0.17	2	
Total area	7.342	100	22
Millers Creek			
City of Ann Arbor	2.4	67	
University of Michigan	1.2	33	
Ann Arbor Township	0.0028	0.0007	
Total area	3.6028	100	11
Mallets Creek			
City of Ann Arbor	7.6	68	
University of Michigan	0.42	3.7	
Pittsfield Township	2.5	23	
Ann Arbor Township	0.017	0.2	
Lodi Township	0.43	3.8	
Scio Township	0.1403	1.3	
Total area	11.1073	100	32
Swift Run			
City of Ann Arbor	1.9	35	
Pittsfield Township	2.7	50	
Ann Arbor Township	0.69	13	
Superior Township	0.09	1.6	
Ypsilanti Township	0.021	0.4	
Total area	5.401	100	16
Direct Drainage			
City of Ann Arbor	1.8	82	
University of Michigan	0.39	18	
Total area	2.19	100	6
TOTAL	**34.0731**		**100**

Further source evaluation indicates that bacteria loads from a large part of Ann Arbor enter Geddes Pond via the storm water system. Bacteria loads are also delivered to Geddes Pond by tributaries that drain a large portion of Ann Arbor. Other potential pathogen sources for Geddes Pond include upstream inputs, illicit sewer connections, pet and wildlife feces, and a small number of on-site wastewater treatment systems (septic systems) (Limno-Tech, Inc., 2000).

LINKAGE ANALYSIS

The link between the *E. coli* concentration in the Huron River and the identified sources on the tributaries 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 identified 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 enters the Huron River directly through the tributaries and storm sewers within the listed reach. Given the low level of *E. coli* in the Huron River upstream of the listed reach, the guiding water quality management principle used to develop the TMDL was that compliance with the numeric pathogen target in the Huron River depended on pathogen control in the tributaries and storm sewers. If the pathogen inputs to the tributaries and storm sewers could be controlled, then total body contact recreation in the Huron River would 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 is used to address aquatic life concerns. However, bacteria sources to the Huron River in the listed reach 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. In addition, 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). 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.

The majority of the land (67%) in the Geddes Pond watershed falls under the jurisdictions of the city of Ann Arbor and the University of Michigan (U-M) (Table 2). These entities now have National Pollutant Discharge Elimination System (NPDES) required storm water permits. Other municipalities in the watershed will soon be considered to have permits in Phase 2 of the storm water permitting program. These storm water permits provide a mechanism for controlling bacterial loads to Geddes Pond and a structure for source characterization efforts. Therefore, this TMDL categorizes allowable loads by subwatershed and storm water permit holders, where applicable.

Table 2. Distribution of land in immediate Geddes Pond Watershed by Government Entity.

Government Entity	Number of Sq. Miles	Percent of Total Watershed
Ann Arbor	21	62.0
Pittsfield Township	5.2	15.3
Ann Arbor Township	4.5	13.3
University of Michigan	2.5	7.4
Lodi Township	0.43	1.3
Scio Township	0.14	0.4
Superior Township	0.09	0.2
Ypsilanti Township	0.021	0.1
TOTAL	**33.881**	**100.0**

Because bacteria loads originate from a number of different locations, there is not a single unique loading capacity that will ensure compliance with WQS. Rather, there are a large number of different allowable levels that will all ensure compliance, as long as they are distributed properly throughout space.

For this TMDL, an allocation strategy has been selected that assumes equal bacteria loads per unit area for all lands within the watershed. 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. All surface tributaries (not enclosed) are required to comply with the WQS of 130 *E. coli* per 100 milliliter (ml) as a monthly average. This requirement applies to Traver Creek, Millers Creek, Malletts Creek, and Swift Run Creek.

3. For the enclosed tributaries, the daily maximum WQS of 300 *E. coli* per 100 ml shall apply as a monthly average. The enclosed tributaries of the watershed are Allen Creek and the direct drainage area. Based on a December 19, 2000 MDEQ site visit (Thelen, 2001), it was determined that the confluence of Allen Creek with the Huron River represents an important recreational area. By maintaining the concentration of 300 *E. coli* per 100 ml in Allen Creek, any area of WQS exceedance in the Huron River will be minimized.

4. The average *E. coli* concentration in Barton Pond was determined to be 10 *E. coli* per 100 ml and was used as background. To confirm the background concentration, a sampling station was added upstream of Argo Dam. This station is downstream of Barton Pond, but upstream of the listed reach of the Huron River.

5. If surface tributaries meet the monthly average of 130 *E. coli* per 100 ml, the enclosed tributaries meet a monthly average of 300 *E. coli* per 100 ml and background levels do not significantly increase, then total body contact recreation for the Huron River will be met.

Consistent with the allocation strategy, Table 3 shows the allowable concentrations for each of the subwatersheds of the listed reach of the Huron River.

Table 3. Allowable *E. coli* Concentrations for the Subwatersheds of the Huron River.

	May	June	July	August	September	October
	Monthly Average *E. coli* Concentration (per 100 ml)					
Allen Creek	300	300	300	300	300	300
Traver Creek	130	130	130	130	130	130
Millers Creek	130	130	130	130	130	130
Malletts Creek	130	130	130	130	130	130
Swift Run Creek	130	130	130	130	130	130
Direct drainage	300	300	300	300	300	300

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 water body. Conceptually, this definition is denoted by the equation:

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

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for nonpoint sources, and the MOS. As previously indicated, this pathogen TMDL will not be expressed on a mass loading basis and is concentration-based consistent with EPA regulations at 40 CFR 130.2(1).

WLAs

There are about 10 permitted non-storm water point source discharges within the listed reach. However, none of these have applied for or reported discharges of *E. coli.* Therefore, the WLA for this TMDL is equal to zero.

LAs

The primary sources of bacteria in the watershed consist of urban runoff from lands under the jurisdiction of two entities that have municipal storm water permits, the city of Ann Arbor and the U-M (see Figure 1 and Table 2). Runoff from lands in Pittsfield Township is also included and the township will soon be required to have a permit in Phase 2 of the storm water permitting program. While runoff from these entities is or will be covered by NPDES permits, it was still considered under the LA category because of the diffuse nature of the sources.

A small portion of land in the watershed does not fall under the jurisdiction of existing (or soon to be developed) storm water permits. This includes lands in Ann Arbor, Northfield, Lodi, Scio, Superior, and Ypsilanti Townships. Runoff from these lands is also included in the LA category.

Because this TMDL is concentration-based, 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 in the subwatersheds will be determined by the amount of land under the jurisdiction of the various local units of governments within each of the subwatersheds. Table 1 gives the relative LAs by subwatershed for each of the local entities. The percentage of land within the subwatersheds for each of the local units of government 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 use to this reach of the Huron River.

The government entity with the largest percent land area in the Geddes Pond watershed is Ann Arbor. The City of Ann Arbor makes up a majority of the Allen Creek, Millers Creek, Malletts Creek and Direct Drainage subwatersheds and is the second largest government entity in the Traver Creek subwatershed next to Ann Arbor Township. Pittsfield Township contains the largest percentage of land area in the Swift Run Creek subwatershed (see Tables 1 and 2).

The upstream sources of *E. coli* entering the listed reach must also be included in the LA category. Measurements of *E. coli* have been made in Barton Pond. The average concentration determined from these measurements was 10 *E. coli* per 100 ml. The TMDL assumes that the upstream boundary concentration will remain consistent at all river flows.

MOS

This section addresses the incorporation of a MOS in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading, water quality and knowledge of continuous point sources of *E. coli*. The MOS can be either implicit (i.e., incorporated into the TMDL analysis thorough conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS through the establishment of a substantial reserved allocation in the Huron River. Conservative assumptions in the development of the TMDL included the surface tributaries meeting the monthly average WQS of 130 *E. coli* per 100 ml; the enclosed tributaries meeting a monthly average of 300 *E. coli* per 100 ml; and the background conditions equaling 10 *E. coli* per 100 ml. Given these assumptions and the much larger flow in the Huron River compared to the tributaries, the pathogen WQS will be met in the listed reach with a substantial MOS or reserved allocation. The example loading assessment, given below, demonstrates that the magnitude of the MOS can also be estimated under any chosen flow scenario.

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:

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

Where:

TMDL = Loading capacity in the river (counts per time).
$Q_{riv,x}$ = 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. It must be noted that the loading capacity in the TMDL reach is directly dependent upon the upstream loads (because they directly affect C_x).

The monthly average flows for the Huron River and tributaries from May through October are given in Table 4 and were used to demonstrate the relative magnitude of allowable loads from the various units of government for one flow scenario.

Table 4. Huron River and Tributary Average Flows (cfs) Used to Calculate Loading.

Waterbody	May	June	July	August	September	October
Huron River	606	403	243	183	216	268
Allen Creek	4.45	3.49	1.78	1.34	1.58	1.97
Traver Creek	1.87	1.25	0.75	0.57	0.67	0.83
Millers Creek	2.92	1.94	1.17	0.88	1.04	1.29
Mallets Creek	6.55	4.35	2.62	1.98	2.33	2.89
Swift Run Creek	1.01	0.67	0.4	0.31	0.36	0.45
direct drainage	1.31	1.15	0.53	0.4	0.47	0.58

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 Huron River and each tributary, 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 5.

3. The background levels of *E. coli* for the Huron River were converted to loads and are given in Table 6.

4. The Huron River flows used in the calculations were based on United States Geological Survey gage data of statistical monthly means for the years 1915-1997. The gage is located 4.2 miles upstream of Geddes Dam on the Huron River at Wall Street in Ann Arbor, Michigan.

The results of the loading assessment for the listed reach of the Huron River under average flow conditions are given in Table 7. The assessment shows that if the LAs are met, the TMDL will not be exceeded in the Huron River for each month of the recreational season. It also demonstrates the relative magnitude of the reserved allocation or MOS for each month.

Table 5. Load Allocations for Huron River Tributaries for Average Flow (relative loading units*)

	Watershed Area (sq. mi)	May	June	July	August	September	October
****Allen Creek**							
City of Ann Arbor	4.0	29.7	23.4	11.7	8.9	10.4	13.0
University of Michigan	0.43	3.3	2.6	1.3	1.0	1.2	1.4
Total LA	4.43	33.0	26.0	13.0	9.8	11.6	14.4
Traver Creek							
City of Ann Arbor	3.3	2.65	1.80	1.08	0.81	0.94	1.17
University of Michigan	0.072	0.06	0.04	0.02	0.02	0.02	0.03
Ann Arbor Township	3.8	3.05	2.07	1.24	0.93	1.09	1.35
Northfield Township	0.17	0.14	0.09	0.06	0.04	0.05	0.06
Total LA	7.342	5.9	4.0	2.4	1.8	2.1	2.6
Millers Creek							
City of Ann Arbor	2.4	6.20	4.13	2.46	1.86	2.19	2.73
University of Michigan	1.2	3.10	2.06	1.23	0.93	1.10	1.36
Ann Arbor Township	0.0028	0.01	0.01	0.01	0.01	0.01	0.01
Total LA	3.6028	9.3	6.2	3.7	2.8	3.3	4.1
Mallets Creek							
City of Ann Arbor	7.6	14.23	9.44	5.68	4.31	5.06	6.29
University of Michigan	0.42	0.79	0.52	0.31	0.24	0.28	0.35
Pittsfield Township	2.5	4.68	3.11	1.87	1.42	1.67	2.07
Ann Arbor Township	0.017	0.03	0.02	0.01	0.01	0.01	0.01
Lodi Township	0.43	0.81	0.53	0.32	0.24	0.29	0.36
Scio Township	0.1403	0.26	0.17	0.10	0.08	0.09	0.12
Total LA	11.1073	20.8	13.8	8.3	6.3	7.4	9.2
Swift Run							
City of Ann Arbor	1.9	1.13	0.74	0.46	0.35	0.39	0.49
Pittsfield Township	2.7	1.60	1.05	0.65	0.50	0.54	0.70
Ann Arbor Township	0.69	0.41	0.27	0.17	0.13	0.14	0.18
Superior Township	0.09	0.05	0.03	0.02	0.01	0.02	0.02
Ypsilanti Township	0.021	0.01	0.01	0.01	0.01	0.01	0.01
Total LA	5.401	3.2	2.1	1.3	1.0	1.1	1.4
****Direct Drainage**							
City of Ann Arbor	1.8	7.89	6.90	3.21	2.38	2.79	3.53
University of Michigan	0.39	1.71	1.50	0.69	0.52	0.61	0.77
Total LA	2.19	9.6	8.4	3.9	2.9	3.4	4.3
TOTAL LA		**81.8**	**60.5**	**32.6**	**24.6**	**28.9**	**36.0**

* Relative Loading Units = *E. coli* concentration (130 counts/100 ml) x River flow (cfs) x (10 x .646 x 3.785) / 10^3
** Allen creek and Direct Drainage use *E. coli* concentration of 300 counts/100 ml

Table 6. Background Loads of *E. coli* for the Huron River (relative loading units)*.

May	June	July	August	September	October
150	99	59	45	53	66

*relative loading unit = *E. coli* concentration (10 cts/100ml) x River flow (cfs) x (10 x .646 x 3.785)/10^3

Table 7. TMDL including LAs, WLAs, and MOS for the Huron River, May to October 31 (relative loading units).*

	May	June	July	August	September	October
WLA	0	0	0	0	0	0
LA	231.8	159.5	91.6	69.6	81.9	102
MOS (reserved allocation)	1694.2	1121.5	680.4	512.4	605.1	750
TOTAL LOAD	1926	1281	772	582	687	852

*relative loading unit = *E. coli* concentration (130 cts/100ml) x River flow (cfs) x (10 x .646 x 3.785)/10^3

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 100 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

As previously discussed, this TMDL was developed following a phased approach. First, needed reductions of pollutant loads were estimated. Next, water quality will be monitored to determine the effectiveness of reductions. Recommended monitoring includes sample collection from all five tributaries (Swift Run Creek, Mallets Creek, Millers Creek, Traver Creek, and Allen Creek) at stations 1, 2, 3, 5, and 6 (Figure 1). One upstream location (station 7, Figure 1), as well as one location in Geddes Pond (station 4, Figure 1) will be sampled. Sampling will also include one wet and dry weather event. Initially, in May 2001 each station will be sampled five times. Subsequent sampling from June through September will be based on data collected in May. If sampling in May 2001 indicates WQS are exceeded, sampling will be oriented toward source identification. If sampling indicates WQS are met, sampling frequency will be increased to determine if WQS are met.

In future years, assuming WQS are not met immediately, sampling frequency will be once per month from May through September at all seven locations. 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

Urban storm water runoff is likely the dominant source of *E. coli* to Geddes Pond. Implementation activities to meet the TMDL require measures to reduce *E. coli* sources and loads. These measures will include activities that are already required of the NPDES municipal storm water permitees within the watershed. These permits have been in place since 1996, allowing the permittees several years to initiate quality programs. Currently, the city of Ann Arbor, Michigan Department of Transportation, and the U-M hold NPDES municipal storm water permits.

The city of Ann Arbor's NPDES municipal storm water permit contains several general requirements that, when implemented, could help reduce the delivery of pathogens to Geddes Pond. The permit requires a plan for effective elimination of illicit discharges and prohibition of illicit discharges. The permit requires that all catch basins be mapped and regularly cleaned. Effective storm water management in areas of redevelopment and new development is required. A public education program on storm water management and impacts of storm water pollution is also required.

The city of Ann Arbor is actively pursuing all of the above requirements and has an ongoing storm drain examination program that includes cross-connection searches. Some ordinances have been changed to require more storm water management in new developments. They have an active public education program that has been developed in cooperation with the Huron River Watershed Council.

The Ann Arbor campus of U-M also has an NPDES storm water permit. The U-M has developed the required storm water management program that contains several elements that could help reduce the delivery of pathogens to local waters and eventually to Geddes Pond on the Huron River. The U-M's permit essentially requires the same management activities as the city of Ann Arbor's NPDES permit, including illicit discharge elimination, pollution prevention, and public education.he U-M is actively meeting the permit requirements. For example, for illicit connections, the U-M campus is divided into a grid system and each grid is routinely tested for illicit connections.

When the Phase 2 storm water requirements are applicable, other municipalities in the watershed will also be considered for an NPDES municipal storm water permit. These permits will likely require activities that reduce pathogen inputs, similar to those in the city of Ann Arbor and U-M storm water permits.

Prepared by: Christine Thelen, Aquatic Biologist
Great Lakes and Environmental Assessment Section
Surface Water Quality Division
Michigan Department of Environmental Quality
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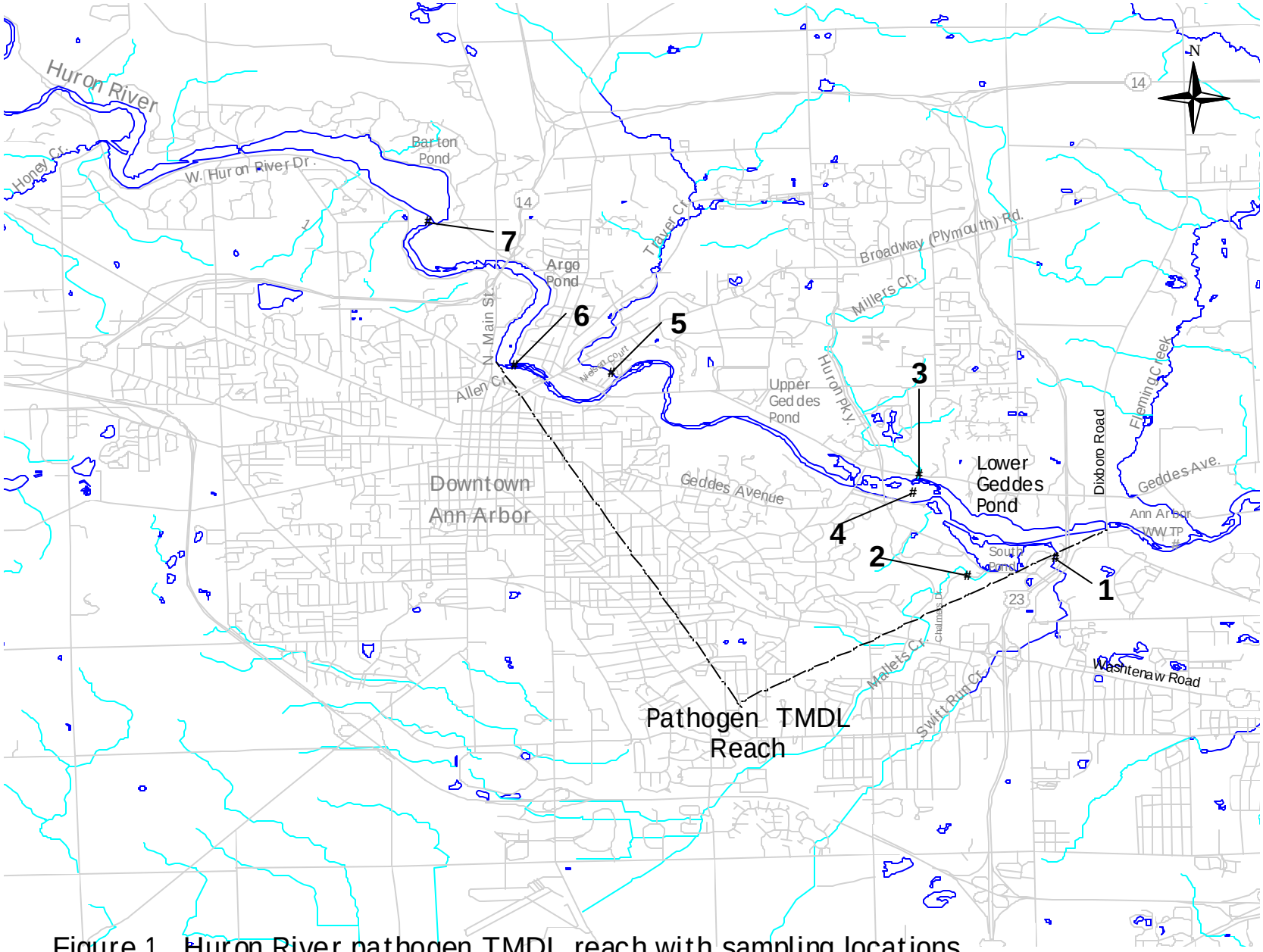

Figure 1. Huron River pathogen TMDL reach with sampling locations.

Figure 2. Subwatersheds in the Huron River TMDL listed reach.