PHOSPHORUS REDUCTION IMPLEMENTATION PLAN FOR THE MIDDLE HURON RIVER WATERSHED

October 2011 — September 2016

For the purpose of achieving the Total Maximum Daily Load (TMDL) and removing the nutrient impairments of Ford and Belleville Lakes

Developed by and for the Middle Huron Initiative.

The Middle Huron Initiative is a watershed-based partnership of businesses, academic institutions, and local, county and state governments working since 1996 to prevent pollution in the middle Huron River Watershed, Michigan and meet federal water quality standards for Ford and Belleville lakes.

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1. BACKGROUND

Within the Huron River Watershed is the region known as the middle Huron River Watershed (middle Huron), which encompasses 292 square miles in parts of three counties – Jackson, Washtenaw, and Wayne, with the majority of the region located within north and central Washtenaw County. The middle Huron contains a mix of land uses ranging from agricultural operations in the Mill Creek area to the urbanized population center of the Ann Arbor-Ypsilanti metropolitan area.

The middle Huron portion contains the highest gradient waters in the Huron River, falling 195 feet in elevation as it flows through the region. Subsequently, these waters were largely dammed in the past for power generation, resulting in a series of eight impoundments. Today the primary purpose for most of the impoundments is recreation. Eleven creeksheds comprise the middle Huron: Allens Creek; Belleville Lake; Boyden Creek; Fleming Creek; Ford Lake; Honey Creek; Malletts Creek; Mill Creek; Miller Creek; Swift Run; and Traver Creek. The delineation of the middle Huron resulted from the phosphorus TMDL for Ford and Belleville lakes. Monitoring and modeling by the State of Michigan Department of Environmental Quality (MDEQ) in the 1990s delineated that the drainage area impacts the conditions in these two reservoirs.

Problem Definition

Ford Lake and Belleville Lake, two reservoirs on the Huron River in Washtenaw County and Wayne County, respectively, were listed as impaired waterbodies on Michigan's Section 303(d) list (Impaired Waterbodies List) due to disruption of recreational uses by the presence of nuisance algal blooms. In response to their appearance on the list, MDEQ developed a Total Maximum Daily Load (TMDL) for phosphorus in 1996 in order to attain recreational uses of both lakes. The U.S. EPA approved the State's TMDL for the lakes in 2004.

Nuisance algal blooms that occur in the summer months in Ford and Belleville lakes impair total body contact recreation activities, such as swimming, and also impair the aesthetic pleasures the lakes provide. The blooms are associated with high phosphorus levels in the river and lake waters, which originate from both *point sources* -- discharges out the end of a pipe from industry and municipal wastewater treatment -- and from *nonpoint sources* -- polluted runoff from turfgrass, pavement, agricultural fields, streambank erosion, and many other sources more difficult to pinpoint.

The Nature and Sources of Phosphorus[1]

Phosphorus (P) is an essential nutrient for all life forms, and is the eleventh-most abundant

[1] *Text adapted from the website of the Michigan Department of Environmental Quality, Water Bureau, Surface Water, NPDES Permits. May 2006.*

mineral in the earth's crust. In surface waters, phosphorus is usually present as phosphate (PO_4-P). Phosphorus is needed for plant growth and is required for many metabolic reactions in plants and animals. Organic phosphorus is a part of living plants and animals, their by-products, and their remains.

Generally, phosphorus is the limiting nutrient in freshwater aquatic systems. That is, if all phosphorus is used, plant growth will cease, no matter how much nitrogen is available. Phosphorus typically functions as the "growth-limiting" factor because it is usually present in very low concentrations. The natural scarcity of phosphorus can be explained by its attraction to organic matter and soil particles. Any unattached or "free" phosphorus is quickly removed from the aquatic system by algae and larger aquatic plants.

Excessive concentrations of phosphorus can quickly cause extensive growth of aquatic plants and algal blooms. Several detrimental consequences may result. Surfeit algae and plant growth can lead to depletion of the oxygen that is dissolved in the water. Water can hold only a limited supply of dissolved oxygen (DO), and it comes from only two sources — diffusion from the atmosphere and as a byproduct of photosynthesis. Excessive growth leads to depletion of DO because of nighttime respiration by living algae and plants and because of the bacterial decomposition of dead algae/plant material. Extensive bacterial decomposition of detritus can create “dead-zones”, or areas of anaerobic conditions, especially near the bottom of the water column. Depletion of DO adversely affects many animal populations and can cause fish kills due to a dearth of this metabolic necessity.

In addition to low DO problems, excessive plant growth can increase the pH of the water because plants and algae remove dissolved carbon dioxide from the water during photosynthesis, thus altering the carbonic acid-carbonate balance. Because plants and algae provide food and habitat to animals, the relative abundance shifts of the different species affects the composition of the animal community. Drinking water supplies may experience taste and odor problems, and the costs of treating drinking water can increase.

Finally, high nutrient concentrations interfere with recreation and aesthetic enjoyment of water resources by causing reduced water clarity, unpleasant swimming conditions, pungent odors, blooms of toxic and nontoxic organisms, interference with boating, and "polluted appearances." The economic implications are significant for many communities. Phosphorus may accumulate in sediment, both in deposited clays and silts and deposited organic matter. In such cases, phosphorus and other nutrients may be released from the sediment in the future. This feedback loop results in an internal phosphorus loading. Subsequently, a reduction in phosphorus input from the nearby streams and larger watershed may not be effective in reducing algal blooms for a number of years.

Phosphorus enters surface waters from both point and nonpoint sources. The primary point source of phosphorus is sewage treatment plants. A normal adult excretes 1.3 - 1.5 g of phosphorus per day. Additional phosphorus originates from the use of industrial products, such as toothpaste, detergents, pharmaceuticals, and food-treating compounds. Primary treatment of waste removes only 10% of the phosphorus in the waste stream; secondary treatment removes only 30%. Tertiary treatment is required to remove additional phosphorus

from the water. The amount of additional phosphorus that can be removed varies with the success of the treatment technologies used. Available technologies include biological removal and chemical precipitation.

Nonpoint sources of phosphorus include both natural and human sources. Natural sources include 1) phosphate deposits and phosphate-rich rocks which release phosphorus during weathering, erosion, and leaching, and 2) sediments in lakes and reservoirs which release phosphorus during seasonal overturns. The primary human nonpoint sources of phosphorus include runoff from agricultural areas, and urban/residential areas. Because phosphorus has a strong affinity for soil, little dissolved phosphorus will be transported in runoff, except where poor fertilizer management practices are used. Instead, the eroded sediments carry the adsorbed phosphorus to the water body.

TMDL Mandate and Applicable Water Quality Goals and Regulation

Section 303(d) of the federal Clean Water Act and the U. S. Environmental Protection Agency's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop TMDLs for waterbodies that do not meet Water Quality Standards (WQS). Michigan law (R323.1100 of Part 4, Part 31 of PA 451, 1994, revised 4/2/99) mandates that all surface waters be protected for the full range of designated uses. The uses are:

- Agriculture
- Industrial water supply
- Public water supply at the point of intake
- Navigation
- Warm water fishery (or cold water fishery, where applicable)
- Other indigenous aquatic life and wildlife
- Partial body contact recreation
- Total body contact recreation between May 1 and October 31

The impaired designated uses for Ford and Belleville lakes are total body contact recreation and partial body contact recreation. Rule 100 of the Michigan WQS requires that these waterbodies be protected for total body contact recreation between May 1 and October 31.

The Clean Water Act requires that these water bodies be returned to meeting all designated uses through the TMDL development process. A TMDL quantifies the maximum amount of a pollutant a water body can accept without violating water quality standards. TMDLs are tools for achieving water quality safeguards and assessing the impact of improvements. The MDEQ is required, under Section 303(d) of the federal Clean Water Act, to determine the health of the waters of the state. Those waters not meeting water quality standards are placed on a list referred to as the Impaired Water bodies List. This list comprises the waters that require a TMDL and sets forth a schedule for establishment. TMDL development methodology varies based on the type of pollutant causing impairment.

Rule 60 of the Michigan WQS (Part 4 of Act 451) limits phosphorus concentrations in point source discharges to 1 mg/l of total phosphorus as a monthly average. The rule states that other limits may be placed in permits when deemed necessary. The rule also requires that

nutrients be limited as necessary to prevent excessive growth of aquatic plants, fungi or bacteria, which could impair designated uses of the surface water.

According to the MDEQ, phosphorus limits are placed in NPDES permits for all discharges which have the potential to contain significant quantities of phosphorus. The limit of 1 mg/l is contained in permits for discharges to surface waters which do not have substantial problems with high levels of nutrients. More stringent limits are required for discharges to surface waters which are very sensitive to nutrient inputs. Many of these surface waters are in developed areas with substantial point source and nonpoint source phosphorus inputs. In such areas, a waste load allocation may be necessary. The DEQ must determine the total amount of phosphorus (in pounds per day) which can be assimilated into the particular surface water. The DEQ then works with the dischargers to decide on appropriate phosphorus limits for each permit, without exceeding the total assimilative capacity of the surface water.

Phosphorus TMDL for Ford Lake and Belleville Lake

In December of 1993, a 12-month phosphorus loading analysis was initiated by the MDEQ to investigate the water quality of the Middle Huron. The analysis showed that Ford and Belleville lakes were impaired as they failed to meet water quality standards due to phosphorus enrichment, which contributed to nuisance algae blooms. Based on water quality sampling and accepted mathematical models, a phosphorus TMDL of 50 µg/L at Michigan Avenue and 30 µg/L in Belleville Lake was established for the months of April to September. This TMDL was originally approved by the U.S. EPA in 2000 and the most recent version was published by MDEQ in September 2004.

According to MDEQ, the TMDL should assure the attainment of water quality standards for Belleville Lake, and significantly reduce problems in Ford Lake, in addition to meeting the requirements of Water Quality Standard R 323.1060(2) which states "nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi, or bacteria which are or may become injurious to the designated uses of the waters of the state."

Based on three years of scheduled monitoring and the employment of the Walker methodology of lake trophic assessment, the TMDL estimated that the annual total phosphorus load was 80,000 lbs/year. Approximately half of this load was derived from point sources, and half was from nonpoint sources. The Mill Creek Subwatershed was estimated from water quality monitoring to be contributing nearly one-fourth of the total phosphorus. The Mill Creek Subwatershed Management Plan[1] estimates the phosphorus loading from Mill Creek to be 12,000 to 15,000 lbs/year, and 15,000 lbs/yr enter the system from sources upstream of Mill Creek. The remaining 50,000 to 53,000 lbs/year are contributed by the Middle Huron Watershed as defined in this plan (downstream of the Mill Creek outflow). To reach the TMDL goal will require a reduction in current phosphorus loads by 50 percent, which is approximately 25,000-26,500 lbs/year.

Recent and current phosphorus contributions from the major point sources in the Middle Huron Watershed (including Mill Creek) are determined from self-reporting to the MDEQ,

and shown in Table 1. Altogether, the four major point source facilities contribute approximately 24,355 pounds per year of total phosphorus to the Middle Huron system. The loading from these facilities is up 45% from 16,800 in 2007, up 2% from 23,800 pounds per year in 2003 (the last times a full estimate was made), and down 22% from the original loading calculations in 1996. The Ann Arbor Waste Water Treatment Plant is by far the largest contributor to the system, making up 96% of the total point source load.

Table 1. Current Total Phosphorus Loads from Major NPDES Facilities in the Middle Huron Watershed (source: Reports from the facilities)

*Based on most recent annual reporting**	**Avg Daily Flow (mgd)**	**Avg Concentration (mg/L)**	**Avg Daily Loading (lb/day)**	**Annual Load (lb/yr)**
Chelsea WWTP	1.13	0.09	0.84	308
Dexter WWTP	0.39	0.19	0.59	214
Loch Alpine SA	0.21	0.26	0.43	158
Thornton Farms WWTP	0.04	0.22	0.07	25
Ann Arbor WWTP	18.29	0.43	64.75	23,650
Total	**20.06**		**66.68**	**24,355**

* June 2010 through May 2011.

The total allocated pounds per day for the major point sources in the Middle Huron Watershed ranges from 166 lb/day in April to 55 lb/day in July and August. The larger permitted allocation in April is to account for the higher spring discharge. As shown in Table 2, the majority of the waste load allocation is assigned to the Ann Arbor WWTP. The original allocation included the contributions from the DaimlerChysler proving grounds in Chelsea. As of 2004, that facility no longer contributed effluent containing phosphorus to the watershed. The company opted to connect to Sylvan Township's new pipeline that removes the effluent from the Proving Grounds and transports it to a treatment facility west of the Washtenaw County line in Jackson County's Leoni Township, and out of the Huron River Watershed. Therefore, the Chelsea Proving Grounds no longer holds a NPDES permit from MDEQ to send effluent to Letts Creek. The 210 lbs/yr of total phosphorus that the company previously contributed has been removed (whether temporarily or permanently is not clear) from the watershed as a result.

Table 2. Total Phosphorus Wasteload Allocation (WLA) (lb/day) for Middle Huron TMDL
(source: Kosek,1996)

	Apr	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Ann Arbor WWTP	150	60	60	50	50	60
Chelsea WWTP	9.5	2.2	2.2	1.8	1.8	2.2
*DaimlerChrysler-Chelsea**	*0.5*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*
Dexter WWTP	3.0	0.9	0.9	0.8	0.8	0.9
Loch Alpine SA	1.5	0.6	0.6	0.5	0.5	0.6
Other Point Sources	1.5	1.7	1.7	1.7	1.7	1.7
Total Point Source WLA	166	66	66	55	55	66

* DaimlerChrysler-Chelsea is no longer a point source to the Huron River.

The major point sources are all operating under permits that were revised in December 2006 following a negotiated settlement between the point sources and the State of Michigan. Under this agreement, the permit limits were adjusted slightly from 1993 levels, but not as far as TMDL limits. It is further stated that the permit levels will be set to TMDL levels in 2012. If the facilities increase the concentration level of phosphorus in their effluent to the current permit limits, then their annual load would jump to over 59,000 pounds per year of total phosphorus (see Table 3).

Table 3. Potential Total Phosphorus Loads from Major NPDES Facilities Operating at Current Permit Limits (source: MDEQ)

	Avg Daily Flow (mgd)	Max. Avg. Concentration (mg/L)	Avg Daily Load (lb/day)	Annual Load (lb/yr)
Chelsea WWTP	1.3	0.8	9.8	3577.0
Dexter WWTP	0.58	0.6	2.9	1058.5
Loch Alpine SA	0.31	0.8	2.1	766.5
Ann Arbor WWTP	29.5	1.0	147.6	53,880.6
Total	**31.7**		**162.4**	**59,282.6**

The total load allocation among the nonpoint and point sources are shown in Table 4. In all months except May the load allocated to the point sources exceeds that of the nonpoint sources. If the reductions are met, then the load allocation for April through July provides a buffer of 4 to 48 pounds of total phosphorus, and the allocation would just suffice the TMDL in August and September.

Table 4. Total Phosphorus Load Allocation (LA) (lb/day) and TMDL for Middle Huron (Source: Kosek, 1996)

	Apr	May	Jun	Jul	Aug	Sep
Nonpoint Source LA	91	100	61	29	19	37
Point Source WLA	166	66	66	55	55	66
LA + WLA	257	166	127	84	74	103
TMDL	304	214	139	88	74	103
Remaining	**47**	**48**	**12**	**4**	**0**	**0**

Water Sampling Data Summary

In September 1991, a hazardous material response team was summoned to investigate a reported "green paint spill" in Ford Lake. The "paint" was really a severe algae bloom. This incident brought MDEQ field scientists to the lakes to conduct intensive monitoring of the Huron River and its tributaries from 1992-1994; this monitoring formed the basis for the development of the phosphorus TMDL. The primary water quality parameter measured by MDEQ was Total Phosphorus (TP).

MDEQ has continued to conduct water quality monitoring in the Huron River and in Ford and Belleville Lakes since the development of the TMDL through 2006, and then again in 2009. Each monitoring season, from April to October, state field scientists visited the watershed one time per month to measure nutrients and ambient water quality parameters at two river sites — the Huron River at Bandemer Park, and the Huron River at Michigan Avenue, just upstream of where the Huron enters Ford Lake. In addition, they measured water clarity, chlorophyll a, various nutrients, and other water quality parameters at various depths at four locations within each of the two lakes. Every five years, MDEQ conducts more intensive and extensive monitoring in the middle Huron through its basin monitoring program. The Huron River Watershed has been monitored through this program in 1997, 2002, and 2007; 2012 is the next year in which MDEQ will monitor the Huron.

In addition to monitoring conducted by the State, in 2002 HRWC developed a companion monitoring program for nine of the tributaries flowing into the middle Huron. HRWC staff and trained volunteers measure stream discharge, collect grab samples for lab analysis of TP, Nitrate + Nitrite, and Total Suspended Solids, and monitor other water quality parameters. Each site was originally visited one time per month. In 2006, analysis for *E. coli* was added. In 2008, storm sampling was added and monitoring frequency was increased to twice per month. Finally, in 2010, monitoring at stormwater investigative sites was added. A river site upstream of the confluence of Mill Creek is monitored for upstream conditions, and 9 tributary sites from Dexter to Ypsilanti are included in the program[2].

The data collected by the State is used to measure the progress towards meeting the phosphorus TMDL. Now, HRWC's tributary monitoring program is the only program collecting data on nutrients in the tributaries flowing into the middle Huron, while the University of Michigan, in partnership with the City of Ann Arbor, monitors river sites. One shortcoming of the program is that it does not monitor Total Nitrogen, which would enable estimating the ratio of TP:TN, an indicator of conditions favorable to the formation of nuisance algal blooms. Dr. John Lehman at the University of Michigan conducted a study of this ratio from 2003-06 and concluded that TP is the limiting nutrient for blooms under most conditions.

A few general comments can be made about the data. TP concentrations entering and within Ford Lake have generally decreased over time. Analysis of 2009 data by MDEQ showed that concentrations entering Ford Lake were below the TMDL target of 50 μg/l every month except August (see Fig. 1). Concentrations within the lake were below the target except for in April and August. However, concentrations in Belleville Lake have been consistently above its lower target of 30 μg/l. In 2009, the Belleville Lake concentration target was met only once.

[2] For more information including site maps and data reports, visit the program website: http://www.hrwc.org/our-work/programs/water-quality-monitoring/

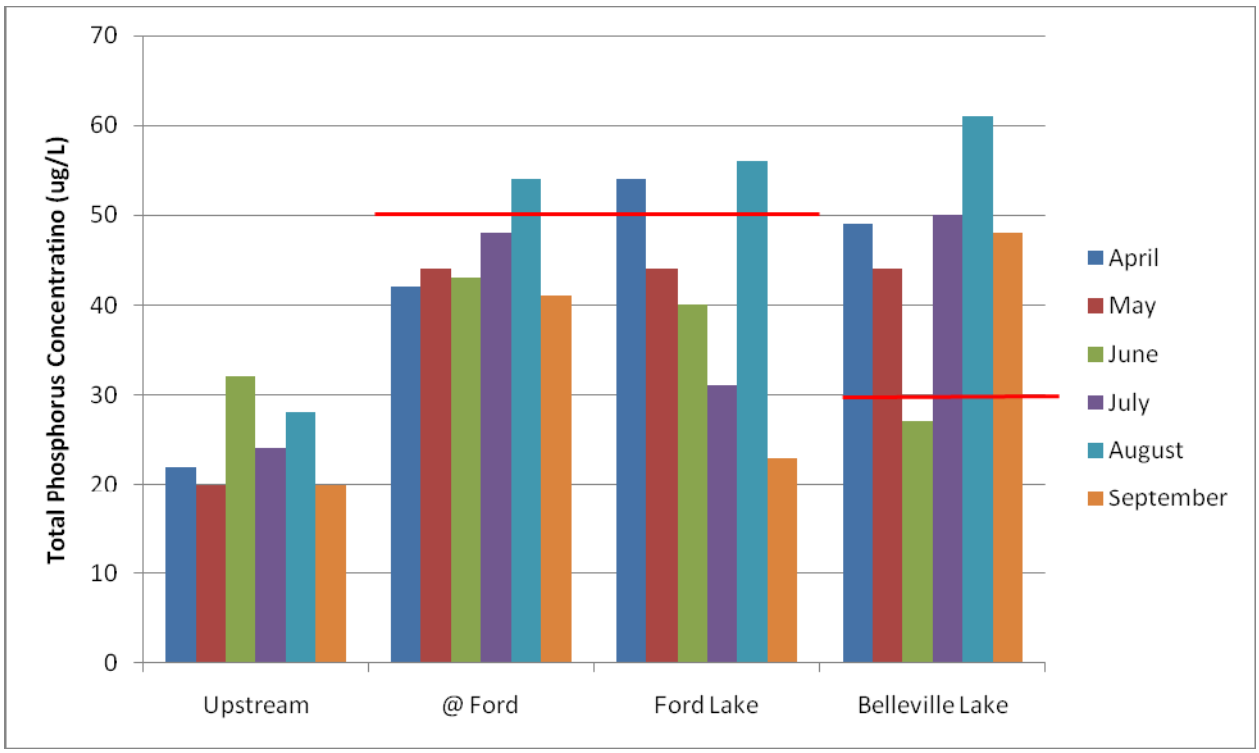

Figure 1. Total phosphorus concentrations at stream and lake stations sampled by MDEQ from April through September, 2009. There were only three instances for Ford Lake where results showed greater phosphorus concentrations than the goal of the TMDL. Belleville Lake was often well over its threshold for phosphorus loading.

Tributary monitoring indicates similar trends. Generally, total phosphorus concentrations have decreased in tributaries, especially those in urban areas, though 2010 results were highly variable. Concentrations outside of the urban area averaged 37 µg/l between 2008-10, while those inside the urban area around Ann Arbor averaged 52 µg/l. However, tributaries in urban areas declined by 28% from 2003-06 levels, while less-urban creeks only declined 17%. Finally, data from the station at the entry to Ford Lake showed an average concentration between 2008-10 of 53 µg/l, just above the target level of 50 µg/l (Fig. 2).

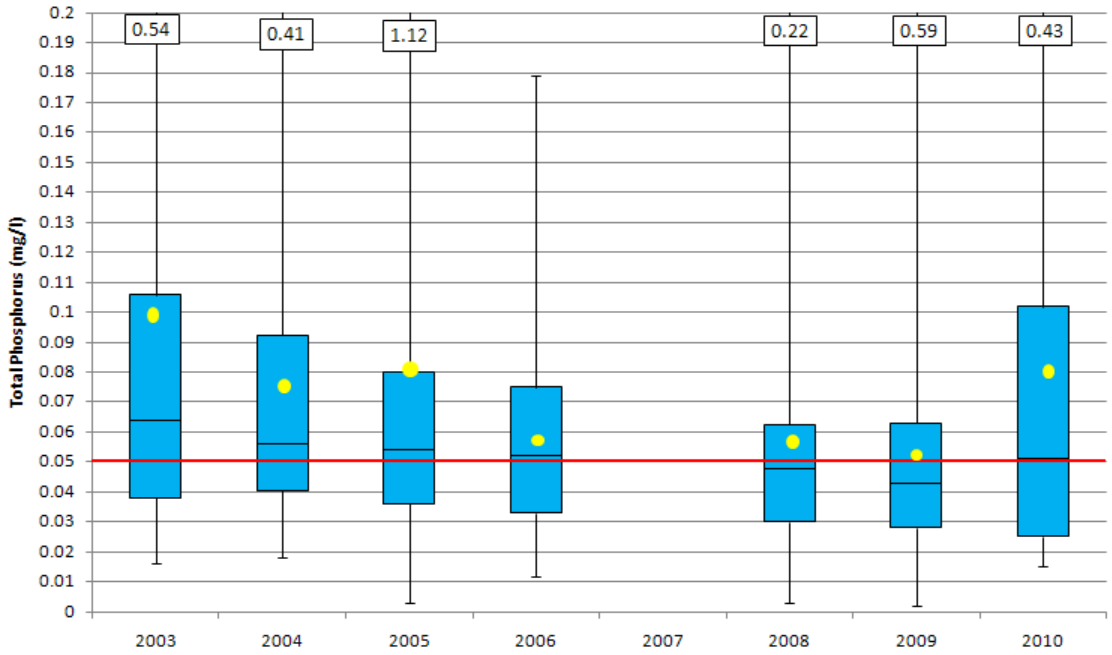

Figure 2. Total phosphorus concentrations for sampling across 10 tributary sites up to twice per month from May to September 2003 to 2010. Annual quartile and medians are shown in boxes, with maxima and minima in whiskers and annual means illustrated with points. Note the general decrease in total phosphorus concentrations from earlier years, especially 2003.

Phosphorus loading has also been assessed using a number of approaches. Extrapolating into seasonal loads suggests that the maximum load should reach 28,036 lbs April through September to be compliant with the TMDL. The TMDL assumes that about half (39,574 lbs) of the total modeled load comes during this growing season. This requires a total load reduction of 11,538 lbs. Of the total load, 24,293 lbs (61%) were estimated to be coming from nonpoint sources, with the remainder (15,561 lbs) from point sources. Again extrapolating from load allocations, the load reduction required of nonpoint sources is 14,035 lbs over the April to September growing season, while point sources are required to reduce by 1,165 lbs.

Based on past reporting, point sources have reduced loading to 9,438 lbs/yr or 34% below waste load allocations, though some monthly violations still occur. This represents a load reduction of 6,123 lbs from 1996 levels. The point source reduction represents a solid buffer for any load reduction shortfalls. Monthly point source load limit violations will need to be eliminated, and nonpoint source load reductions also must be accounted for to reach the TMDL for phosphorus in the watershed.

Current annual loading estimates vary from the original TMDL model. For 2003, the point source phosphorus load was reported as 23,800 lbs/yr. As indicated previously, the most recent reporting indicates an annual load of 24,355 lbs/yr by point sources – a significant reduction from 1996 levels. Loading from tributaries estimated by the 1996 model used for TMDL development indicates 22,000 lbs/yr was being contributed by nonpoint sources (see Table 5).

Table 5. Total Phosphorus Loading from Tributary Sources (Source: Kosek, 1996)

Significant Sources	Load from '96 Sampling	Load from '96 Model	Percent of Total	Percent Difference
Upstream Sources	30,000	30,000	37.5%	
Boyden Creek		961	1.2%	
Honey Creek		1,039	1.3%	
Other sources (upper section)	2,000		0.0%	
HBP Subtotal	32,000	32,000	40.0%	
Allens Creek	1,000	1,813	2.3%	81%
Traver Creek		1,855	2.3%	
Malletts Creek	700	3,945	4.9%	464%
Miller Creek		1,957	2.4%	
Swift Run	300	1,210	1.5%	303%
Other sources (middle section)	9,700	920	1.2%	-91%
Dixboro Road Subtotal	43,700	43,700	54.6%	
Ann Arbor WWTP	28,000	28,000	35.0%	0%
Fleming Creek	1,300	1,300	1.6%	0%
Superior Drain			0.0%	
Other sources (lower section)	7,000	7,000	8.8%	0%
Michigan Avenue Total	80,000	80,000	100.0%	

However, due to the large set of data obtained through monitoring, there is a much richer set of data available for loading analysis. Instead of using land use models or extreme extrapolation from a few data points, HRWC was able to apply statistical techniques based on flow-concentration relationships that provide much more accurate and current loading estimates (Table 6). Load estimates were computed using all monitoring data for tributary sites from 2003-10. The statistical model also accounts for the sampling months. See Appendix A for statistical modeling details. Data from 1995 was also modeled for comparison.

Table 6. Total phosphorus loading estimates (lbs/day) for select river and tributary locations.

Site	TP Mean Daily Load Est. (2003-10)	TP Mean Daily Load Est. (1995)	% Difference
Huron @ N. Territorial (upstream)	50.99	41.07	+24.2%
Mill Creek	39.51	30.25	+30.6%
Honey Creek	4.62	2.22	+108.1%

Allens Creek	3.27	2.74	+19.3%
Traver Creek	1.06	5.08	-79.1%
Fleming Creek	6.55	3.52	+86.1%
Millers Creek	0.38	5.36	-92.9%
Malletts Creek	11.72	14.76	-20.6%
Swift Run	1.60	0.82	+95.1%
Superior Drain	0.76	NA	NA
Huron @ Ford Lake (US-12)	151.43	200.59	-24.5

Overall, this analysis indicates that loading to Ford Lake has decreased by an estimated 25%. Total phosphorus loading to Ford Lake over the April to September TMDL period is estimated to be 27,655 lbs, which is 381 pounds below the TMDL target.

In 2003, the U.S. EPA awarded a 3-year STAR grant to the University of Michigan for a new study of the middle reach of the Huron River and Ford Lake and Belleville Lake that provides a more comprehensive assessment of nutrients and the factors that influence nuisance algal blooms. Dr. John Lehman was the Principal Investigator. His team found the following results:

1. From June 2003 to December 2004, 33427 kilograms (kg) of total phosphorus (TP) entered Ford Lake. During the same time period, AAWWTP reports discharging 12,427 kg TP to the Huron River (37%).
2. Of the 12,427 kg P that AAWWTP discharged to the Huron River, only 8,854 kg (71%) emerged from Superior Pond. This represents 26% of the load to Ford Lake.
3. More TP entered Ford Lake during May 2004 as a result of the 22 May flood than had been discharged by AAWWTP in the previous year.
4. From June 2003 to March 2005, 4,279 kg of dissolved phosphorus (DP) was discharged from Barton Pond into the Huron River above Ann Arbor. During the same time, 12,205 kg DP was present below Geddes Pond and upstream of the AAWWTP outfall. This represents an increase of 7926 KG added within Ann Arbor above its WWTP.
5. Also from June 2003 to March 2005, 22,804 kg DP exited Superior Dam, an increase of 10,599 kg from upstream of the WWTP (N.B. This is less than the reported discharge by AAWWTP owing to retention within Superior Pond).
6. 23,002 kg DP entered Ford Lake, an increase of 198 kg from Superior Rd. to Spring St.
7. For Particulate P (PP; DP + PP = TP), 16,771 kg discharged from Barton Pond; 12,043 kg discharged from Geddes Pond. This is a net loss of 4,728 kg PP removed by Argo and Geddes Ponds. The balance between PP retention and DP release resulted in the net addition of 3,198 kg P to the River within Ann Arbor.
8. From June 2003 to March 2005, 16,190 kg discharged from Superior Dam. This is an increase of 4,147 kg compared to upstream of the AAWWTP. The N/P ratio of this

added particulate matter is too low for it to be biological matter. It is almost surely eroded soil. 18,349 kg PP entered Ford Lake. This is an increase of 2,159 kg. The N/P ratio of this particulate matter is too low for it to be biological matter. It is soil, too.

9. 41,351 kg TP entered Ford Lake and 32,445 kg exited. This was a removal of 8,906 kg or a retention of 21.5%. The proportioning between dissolved and particulates was such that 19.3% of DP and 24.3% of PP were retained. [2]

The STAR project contributed much needed information on the role resuspension of phosphorus particles in Ford Lake plays in the production of nuisance algal blooms.

- Phosphorus release rates of sediment core samples in Ford Lake were up to 3X greater than release rates from multiple other eutrophic lakes located in western Michigan. Internal loading was found to play a key role in seasonal bloom development in Ford Lake.
- Internal loading of phosphorus is complicated, and interwoven with concentrations of other nutrients like nitrogenous compounds. Phosphorus release was found to be more prevalent with oxygen depletion of the lower water column, a common problem in the summer; an iron trap forms that causes phosphorus and iron to leach from the bottom sediments and into the open water, exacerbating the algal bloom.[3]

Stakeholders: Point Source Contributors and Nonpoint Source Contributors

Governmental units in the middle Huron River Watershed include the City of Ann Arbor, Ann Arbor Charter Township, Barton Hills Village, City of Belleville, City of Chelsea, Dexter Township, Dexter Village, Freedom Township, Lima Township, Lodi Township, Lyndon Township, Northfield Township, Pittsfield Charter Township, Salem Township, Scio Township, Sharon Township, Superior Charter Township, Sylvan Township, Van Buren Charter Township, Webster Township, Ypsilanti Charter Township and City of Ypsilanti. In addition, the Washtenaw County Water Resources Commissioner has jurisdiction over those tributaries (or portions thereof) designated as county drains. Other jurisdictions that may impact nonpoint and point source contributions of phosphorus and other pollutants are Ann Arbor Public Schools, University of Michigan, Van Buren Township Public Schools, Washtenaw Intermediate School District, Washtenaw Community College, Washtenaw County Road Commission, and Wayne County.

The point sources that have been identified as “major” in the middle Huron are the Ann Arbor Wastewater Treatment Plant, Chelsea Wastewater Treatment Plant, Dexter Wastewater Treatment Plant, and Loch Alpine Wastewater Treatment Plant. Additional point sources contribute relatively small amounts of phosphorus in their effluents.

The stakeholders made the conscious decision to gain active involvement from the entities with more significant land ownership in the TMDL areas. This decision reflects the understanding that stakeholders with jurisdiction over small portions of the TMDL area have little motivation to be engaged in the planning process. However, all stakeholders have been invited to participate in meetings and other events pertaining to the TMDL, particularly during the formation of the Middle Huron Initiative Partnership.

Middle Huron Initiative Goals and Objectives

In the fall of 1994, MDEQ staff convened a meeting of representatives from 17 middle Huron communities, requesting they develop a voluntary strategy to meet the phosphorus reduction goals. These communities and MDEQ, along with the Washtenaw County Water Resources Commissioner and the Huron River Watershed Council formed the Middle Huron River Watershed Initiative.

The overall goal of the Initiative is to improve the ecological quality and, thus, the recreational and economical resources in the middle Huron River Watershed by rallying communities around reducing non-point and point sources of pollution. The objectives that the Initiative seeks to fulfill are:

1. Return Ford and Belleville lakes to their designated uses, and improve the water quality of the middle Huron and its tributaries;
2. Work with communities of the middle Huron to develop a partnership to achieve these ends in the most cost-effective manner possible;
3. Reduce summer loading of phosphorus to the river system to meet the TMDL set by the Michigan Department of Environmental Quality; and
4. Improve the overall water, fisheries and recreational qualities of the middle Huron River Watershed.

The 1999 Agreement for Voluntary Reduction of Phosphorus Loading to the Middle Huron states that this cooperative approach to meeting the TMDL will be pursued by the partner communities and agencies, and then reevaluated in 2004 to determine whether the goals have been attained. With the expiration of the 1999 Agreement in April 2004, the partners formed a sub-committee to create a replacement agreement since the phosphorus reduction goal of the TMDL had not yet been attained.

The 2004-2009 Agreement was completed in early fall 2004 after review by the partners. All current partners were presented with the opportunity to sign the current agreement, but not all of the partners did. Several of the larger businesses that had NPDES permits to discharge to the middle Huron River Watershed also were approached during the drafting of the Agreement to gain their support as signatories. The Agreement was effective January 1, 2006 and expired at the end of September, 2009.

Within the 2004 Agreement and point source permits, MDEQ committed to review the TMDL and reevaluate the limits and subsequent permit requirements. As of the expiration of the Cooperative Agreement in 2009, MDEQ had not completed their evaluation, so a new agreement was not drafted. Following several stakeholder meetings and after receiving numerous comments from Middle Huron Partners, on February 9, 2011, MDEQ issued a letter indicating that, while they decided that their evaluation indicated that no TMDL revision was necessary, they clarified that "…any new or expanding permitted source would not be allowed unless there is a commensurate decrease in phosphorus loading from other permitted sources within the watershed."[4]

Specific TMDL Implementation Objectives for Point and Nonpoint Source Contributions[3]

MDEQ believes that phosphorus concentration is the critical variable in this system, since it is the limiting nutrient for algae growth in these short retention-time lakes. If the total phosphorus concentration going into Ford Lake can be limited at or below 50 µg/L in April-September, then the lakes should respond by decreasing the algae growth to non-nuisance levels and Belleville Lake should meet its 30 µg/L goal. Therefore, the loading capacity is expressed as a phosphorus concentration of 50 µg/L at the Michigan Avenue bridge on the Huron River (just upstream of Ford Lake) for the months of April through September. Phosphorus load, though related to the concentration, will vary with riverine flow. In order to decrease 1995 loadings to the desired loading capacity levels, it will be necessary to reduce phosphorus loads from both point and nonpoint sources. The wasteload allocations (WLAs), AKA point sources, and load allocations (LAs), AKA nonpoint sources, were calculated for each month (Table 7). TMDL implementation consists of reducing point and nonpoint source loads to the levels presented in Table 7.

Table 7. WLAs and LAs for the Ford and Belleville Lakes TMDL for Phosphorus.

	WLA/LA by Month (lb/d)					
	APR	MAY	JUN	JUL	AUG	SEP
TMDL	304	214	139	88	74	103
Ann Arbor WWTP	150	60	60	50	50	60
Chelsea WWTP	9.5	2.2	2.2	1.8	1.8	2.2
Dexter WWTP	3.0	0.9	0.9	0.8	0.8	0.9
Loch Alpine WWTP	1.5	0.6	0.6	0.5	0.5	0.6
Chrysler-Chelsea	0.5	0.3	0.3	0.3	0.3	0.3
Other Point Sources[a]	1.5	1.7	1.7	1.7	1.7	1.7
Total Point Source WLA	166	66	66	55	55	66
Nonpoint Source LA	91	100	61	29	19	37
Remaining	47	48	12	4	0	0

[a]There are 12 minor point source dischargers in the watershed area of interest. For more details, see Brenner and Rentschler, 1996.

The nonpoint source load allocations are equal to a 57% reduction from current "expected" nonpoint source loads in April and a 58% reduction from current "expected" nonpoint source loads in May-September. Point Sources were required to reduce their loading by 7% from 1995 levels.

[3] *text adapted from TMDL for Phosphorus in Ford and Belleville Lakes, MDEQ, Water Division, September 2004*

II. Significant Progress Since TMDL Development

Fifteen years have passed since original TMDLs for Ford and Belleville Lakes were developed and the technical committee of the Middle Huron Initiative developed a list of best management practices for reducing the major sources of phosphorus, known as the "Phosphorus Reduction Strategy." The strategy focused on the sources of (1) urban stormwater runoff, (2) rural runoff, and (3) point sources. This was followed by a revision that was originally intended to result in two phosphorus reduction implementation plans (RIPs). The Non-Point Source RIP was developed in 2006 and revised in 2008. The Point Source RIP was never completed.

Middle Huron Initiative

Meanwhile, the partners to the Middle Huron Initiative continue to meet and discuss opportunities for phosphorus reduction projects. The partners meet twice per year to discuss issues of shared concern and report to each other on the projects and initiatives that each partner is engaging towards the goal of improving ecological quality. These projects and initiatives are presented and the positive and negative lessons learned are shared. At these semiannual meetings, the partners also discuss broad initiatives such as monitoring and educational campaigns that are best implemented collectively.

This structure serves to establish the Initiative as an incubator of policy and project ideas. Those that work can be implemented by other partners and those that do not can be improved or dropped. This framework allows each partner to be more effective by not duplicating ineffective projects, engaging in those with proven results, and pooling resources to collectively engage in large scale efforts.

Prior to the implementation of the NPDES stormwater permit program, several of the Middle Huron Initiative Partners took remarkable voluntary measures to reduce phosphorus pollution and increase public education and involvement on the topic. To this end, several federal and state grants worth more than $2.0 million were awarded to the Initiative Partners where one of the stated goals of the projects has been to reduce phosphorus contributions as mandated in the TMDL.

Stormwater Programs

In 1995, implementation of the federal stormwater program began with Phase I being applied to large metropolitan areas. In the middle Huron, this included the City of Ann Arbor and the University of Michigan. In 2003, many other municipalities and two Washtenaw County agencies were added to the program in Phase II. All agencies with municipal stormwater discharges were provided with discharge permits and required to engage in six minimum measures to reduce stormwater pollution. Many of these required activities were designed to reduce nutrient runoff and therefore helped to reduce phosphorus loading into the middle Huron River.

In 2008, most of the entities with stormwater permits joined to form the Middle Huron Stormwater Advisory Group (SAG). The SAG was formed to coordinate many stormwater activities on a watershed basis. The SAG partners include:

- Washtenaw County Water Resources Commissioner
- Washtenaw County Road Commission
- Village of Dexter
- City of Ann Arbor
- Pittsfield Township
- City of Ypsilanti
- Ypsilanti Township
- Eastern Michigan University
- Ann Arbor Public Schools

Municipalities and agencies within the middle Huron River Watershed that hold stormwater permits, but do not participate in the SAG include:

- Barton Hills Village
- Northfield Township
- University of Michigan
- Veterans Affairs Hospital
- Washtenaw Community College
- Willow Run Community Schools
- Ypsilanti Public Schools

Program and Project Summary

Point Source Upgrades and Investments

Village of Dexter Water Utilities

From 1999-2004 the Dexter Waste Water Treatment Plant (WWTP) obtained a loan of $2 million from Rural Development to repair and upgrade the plant capacity. The original plant was built in 1977, and many components of the system had reached the end of their life. The WWTP ability to remove pollutants was degrading due to old equipment, and the rehabilitation was needed to bring the plant back to maximum effectiveness. The design flow for the plant of 0.58 millions of gallons per day (mgd) was not changed. The rotating biological reactors were removed and replaced with activated sludge tanks. The overhaul included the centrifical pumps, grinder pump, primary and secondary clarifiers, sand filters, electrical systems and control systems. The gas chemical feed system was replaced with a safer liquid feed system for bleach and bisulfite. The ferric chloride system was replaced to achieve better phosphorous removal in the system. The previous plant design was for 1.0 mg/L phosphorous effluent, and the new design is for 0.4mg/l in the effluent. The new system was flow controlled, to put the chemicals in the water when it was needed most.

In 2005, the Village of Dexter conducted a flow capacity study for the WWTP. The conclusions of the study were for an equalization basin for the WWTP to maximize present use of equipment through equalizing flows, evening out chemical use, and taking care of storm surges. Design was carried out in 2006 and 2007, and Dexter began applying for funding for the project. In 2009 Dexter received $1.5 million in funding through TARP for the project, and work was started that fall. The equalization basin project was finished in the spring of 2011, and is currently under start up.

The Village of Dexter has also been doing work in the collection system that is just as important to the operations of the WWTP as the plant itself. As funds came available, Dexter has replaced and lined aging sewer main and conducted manhole rehabilitation in the Village. Both have reduced the influent flow from storm and ground water.

City of Ann Arbor Waste Water Utility

In addition to its equipment maintenance program, the City of Ann Arbor WWTP has a Capital Improvements Program that identifies major capital investments for equipment and infrastructure to address short- and long-term needs. The WWTP's Facilities Master Plan (FMP) identifies recommended improvements at the plant to meet process, equipment and infrastructure requirements for the next 25 years. These improvements include complete demolition and replacement of the older West Plant portion of the WWTP. The engineering firm hired by the WWTP to design the improvements identified in the FMP is preparing 90% complete design documents for this project, which is called the Facilities Renovations Project (FRP). A construction contract was started in 2009, and construction of the FRP will take about five years to complete.

The FRP addresses all aspects of wastewater treatment at the WWTP with the exception of solids processing and handling. The WWTP has completed its Sewage Residuals Management Plan (SRMP) to achieve the same objectives as the FMP for management of sewage sludge and other solids for the next 25 years. These improvements include replacement of the biosolids management systems and equipment at the WWTP. The engineering firm hired by the WWTP to design the improvements identified in the SRMP completed final design documents for this project, which is called the Residuals Handling Improvements Project (RHIP). Construction of the RHIP is underway and will be completed during 2011.

City of Chelsea Waste Water Utility

The City of Chelsea Waste Water Utility did not provide a summary of their past or future investments in treatment upgrades or other improvements.

Loch Alpine Sanitary Authority

The Loch Alpine Sanitary Authority WWTP uses multiple feed points for ferric chloride to control effluent phosphorus concentrations. In addition, a polyelectrolyte is introduced at the final clarifier to reduce effluent suspended solids, and thus phosphorus that has been chemically precipitated.

Public education regarding the use of phosphorus containing products at residents' homes continues to be distributed through Association newsletters and the Loch Alpine web site.

Other Point Sources

There are a number of other much smaller point sources that are permited to discharge phosphorus into the middle Huron River. Many of these were invited to participate in the Middle Huron Partnership Initiative, but they have declined. It is not known what level of past or future investment has been made at these facilities.

Stormwater and Non-point Source Programs and Projects

Stormwater Programs

Public Education
The Phase II stormwater permittees fund a Public Education Plan (PEP) that includes numerous activities to educate and inform residents and other target groups about their involvement with stormwater and how to minimize their impact on water resources. Messaging specifically targets phosphorus reduction. Partners conduct some activities individually, but also contribute to several large joint efforts that include a biannual calendar, news media ads and involvement in events.

Illicit Discharge Elimination Programs
All stormwater permittees have developed IDEP programs to inspect their stormwater system to find suspected sources of contamination, determine the ultimate sources, and eliminate any illicit connections or dumping. These programs require significant investment of time and resources, and have resulted in few discoveries.

Construction Runoff Control
All permittees have established programs for soil erosion and sediment control from new or redevelopment construction. Such developments require permits and inspections for practices to keep exposed soils on site or controlled from runoff. This has reduced a significant potential source of phosphorus.

Post-Construction Stormwater Ordinances
All Phase I and II municipalities in the watershed passed post-construction stormwater ordinances that require that all new and re-development projects capture and treat the first flush of stormwater runoff and protect stream channels from erosion due to peak flow runoff. The Washtenaw County Water Resources Commissioner has established stormwater standards for construction that municipalities within the county reference. These standards are currently being revised to encourage greater infiltration and low impact development practices. While the ordinances do not address pre-existing developments, they will help prevent additional loading when new development occurs.

Pollution Prevention and Good Housekeeping
MS4s have all engaged in activities to educate internal staff on the state-of-the-art in pollution prevention practices and develop good housekeeping practices to reduce or eliminate pollution sources on their own properties and operations. Practices like spill prevention and clean-up, fertilizer reduction or elimination, vehicle maintenance and washing, have all improved since permits were originally issued, resulting in reduction in phosphorus sources.

Partner-Specific Projects
The projects identified below have been completed by Middle Huron partners that go beyond stormwater required commitments. A number of these projects have contributed significantly to the decrease in observed phosphorus concentrations and loading.

Ann Arbor Township

Post-Construction Stormwater Ordinance: The Township's new ordinance (revised in 2010) deserves special mention due to its unique approach. The ordinance requires first-flush treatment and additionally requires any development with over 20% impervious surface to infiltrate or treat additional volume. Need to summarize why it is unique and what the likely impact is. P-reduction Benefit: minimizes runoff and erosion from all new developments.

Eastern Michigan University

Tree Nursery: A new nursery was installed in 2010. The nursery will be utilized to supply trees for planting across the university and elsewhere in the watershed as part of an annual Arbor Day event.

Underground Detention: Underground detention was installed to treat runoff from a large parking lot.

Hydrodynamic Separator: A separator was installed to treat runoff from the student center loading dock to reduce oil and grease runoff.

Ypsilanti Township

Aeration of Ford Lake: The Ford Lake Dam was operated to bypass turbines and release from the bottom during low mixing periods to keep the lake bottom from reaching anoxic conditions. During such operation, no phosphorus spikes or algae blooms were observed. The management technique eliminates a large source of phosphorus import from lake bottom sediment. Cost: $30,000 in lost energy generation revenue.

University of Michigan

Botanical Gardens Stream Restoration: Several projects were completed to dredge and enhance a detention pond receiving runoff from the dirt/gravel parking areas and to stabilize portions of Fleming Creek streambanks.

Detention Pond Retrofits: Ponds were retrofit at two locations to detain first-flush runoff and increase sediment removal. In addition, sediment forebays were created or enhanced at two other locations on campus to aid in sediment removal.

Hydrodynamic Separators: Devices were installed at nineteen locations throughout campus to aid in sediment and phosphorus removal.

Millers Creek Streambank Stabilization: The University stabilized a segment of eroding streambank at the North Campus Administration Complex, reducing sedimentation and phosphorus inputs.

Soil Erosion & Sedimentation Control Program: The University is an Authorizaed Public Agency which administers the SESC program for construction & renovation projects on campus involving earth disturbance. The program includes site plan review, BMP use, and weekly inspections (at a minimum). These efforts aid in reducing sediment and phosphorus inputs to the storm water system.

Huron River Streambank Stabilization: A streambank stabilization project was completed at Nichols Arboretum through a joint effort between the University and the City of Ann Arbor. The project utilized soft-armoring techniques and rock vanes to stabilize the bank and protect an emergency access road. The project should aid in the reduction of sediment and phosphorus discharge to the Huron River by reducing erosion of the streambank at this location.

Washtenaw County Water Resources Commissioner

County Stormwater Rules Revisions: Stormwater management rules that detain first flush for 24-hour period and the bankfull storm are in place, and updates to require infiltration of first flush are in final draft to be completed in 2012. The amount of TP reduction and stormwater flow reduction varies per site.

Mary Beth Doyle Park (formerly Brown Park): Involved the redesign of the flood control structure to improve water quality treatment and improve habitat. Design completed in 2005

and construction completed in 2007. Phosphorus reduction: 980 lbs/yr ; TSS and flow reduction were not calculated. Cost: $250,000 (design) + $2.244 million (construction).

Rain Barrel Sale*:* Washtenaw County promotes regional rain barrel sales via email and social media (i.e. Facebook). Washtenaw County Land Conservancy, Alliance of Rouge Communities and other events are promoted as they arise.

Continuous Stream Flow Measurement: USGS stream flow gages have been installed at Chalmers Rd and, more recently, at Mary Beth Doyle Park. Cost: $13,000 annually for O&M.

Good Housekeeping, Pollution Prevention: The Washtenaw County Facilities and Parks and Recreation Commission are current partners in the WCWRC's Community Partners for Clean Streams Program (CPCS). The CPCS program works with partners to find ways to protect water quality through pollution prevention and good housekeeping practices. Each facility submits to an evaluation and walk-through inspection which specifically focuses on maintaining engineered stormwater controls, equipment and vehicle maintenance, landscape and building maintenance, as well as waste management.

Washtenaw County Road Commission

Hydrodynamic Separators: Devices were installed at four locations to test their effectiveness at sediment and phosphorus removal.

Ann Arbor Public Schools

Skyline High School: Built in 2006-07, the school features a green roof and extensive stormwater infiltration and treatment. The property exceeds county standards for runoff capture and treatment, achieving complete capture and treatment for storms up to the 100-year event.

City of Ann Arbor

Phosphorus Fertilizer Ordinance*:* A city-wide ordinance banning the use of phosphorus containing fertilizers for turf-grass application was enacted in 2007. An education program preceded implementation.

Library Green Roofs: Green roofs have been established on three city libraries to reduce and treat runoff from otherwise impervious rooftops.

West Park Improvements: Portions of runoff that otherwise would have been sent directly to storm drains was diverted into a newly established stormwater treatment system in West Park. Features include swirl concentrators, vegetated swales, rain gardens and stormwater wetlands.

Millers Creek Streambank Stabilization: A segment of highly eroding streambank were stabilized, reducing sedimentation and phosphorus inputs.

Huron River Watershed Council

Millers Creek Rainwater Project: Completed in 2011, HRWC focused resources on a single residential neighborhood that seemed to contribute to erratic stormwater flows. A series of stormwater basin retrofits were completed, along with the installation of several large neighborhood rain gardens and numerous small, household rain gardens. Rain barrels were also provided to residents at reduced cost. The result was improved flow patterns.

Rain Barrel Sales: In partnership with the City of Ann Arbor, HRWC has hosted two rain barrel sales to watershed residents. The City subsidized the cost to city residents.

Mill Creek Streambank Stabilizations: With a grant from the Michigan DEQ, HRWC coordinated two streambank stabilization projects along severely eroding sections of Mill Creek in an area dominated by agriculture. The stabilizations utilized natural restoration techniques and now serve as demonstration sites.

Educational Campaigns*:* In addition to the work contributing to stormwater Public Education Plans, HRWC has developed educational materials, news articles, workshops, and other campaigns to educate watershed residents about their contribution of nutrients and how to reduce their impact.

Summary of Phosphorus Loading Reduction and Current Status

HRWC and volunteers have collected data since 2003 at nine tributary monitoring stations within the TMDL drainage area. The University of Michigan and DEQ have collected samples at Ford Lake, Belleville Lake and several sites in the Huron River. Seasonal (April – September) and annual loads were calculated based on original 1995 data collected by DEQ[5] and 2003-10 data collected by HRWC[6] and Dr. John Lehman at the University of Michigan[7].

- Sampling in pre-ordinance years (before local ordinances to reduce phosphorus use in lawn fertilizers were mandated), 2003-2007, at Ford Lake showed an average total phosphorus concentration of **0.0526 mg/L**, which translates into an estimated **TP load of 48,527 lbs/yr**.
- Since 2008, the **mean TP concentration entering Ford Lake was 0.0528 mg/L**, which is approximately the same as the concentration from 2003-2006. Through 2009, the mean concentration was much lower than when results from 2010 are taken into account. Mean concentration was much higher in 2010 than in previous years pulling the mean concentration upward.
- The total TP concentration from 2003-10 was 0.0527 mg/L, which translated into an estimated **TP load of 54,382 lbs/yr, or 27,191 lbs over the growing season (TMDL limit period).** This total figure is below the total load limit calculated from the TMDL.

- Sampling from tributaries indicated a strong decrease in phosphorus concentrations through 2009, with greater variability in 2010.
- Reporting from point sources showed that, collectively, they discharged well below their cumulative waste load allocation, though a small number of exceedences of monthly limits occurred. Thornton Farms was not included in the analysis.

III. Current and New Programs for Phosphorus Reduction in the Middle Huron River Watershed

Measures to reduce phosphorus will include many activities that are already underway, and others that are planned and included in other management plans. In some cases, entire creekshed projects have been funded by public and private monies to restore the creeks; Malletts Creek and Millers Creek are two such examples. Some programs and projects are required of the National Pollutant Discharge Elimination System (NPDES) municipal stormwater permittees within the watershed through the Phase I and Phase II of that program.

Moreover, implementation of activities to meet other TMDLs in the middle Huron River Watershed has had the reciprocal effect of helping to reduce phosphorus. Most notably, the activities planned for meeting the TMDL for *E. coli* in the Huron River often will address phosphorus since many sources of *E. coli* also are sources of phosphorus. All of the stakeholders affected by the *E. coli* TMDL are also Partners of the Middle Huron Initiative. Implementation of activities to meet that TMDL is underway and will continue until the TMDL is achieved. Similarly, plans have been developed to address biota impairments in Malletts Creek and Swift Run by reducing sedimentation. Activities to reduce erosion and sediment transport also have the effect of reducing phosphorus loading.

In order to meet the phosphorus reduction target of 50% for the region, the participating community partners to the Middle Huron Cooperative Agreement developed a number of different approaches, as discussed above and in previous sections. Many activities originally outlined in those plans have been accomplished (see Section II) and resulted in significant reductions in loading to Ford Lake as well as lower phosphorus concentrations within both Ford and Belleville Lakes, based on analysis of monitoring data (see Section II).

The earlier draft strategies have been updated and combined into a single phosphorus reduction strategy here. As discussed in Section II, the phosphorus load reduction target as of the beginning of 2011 had been achieved. However, the partners still believe that loading reduction is necessary to help achieve a long-term, unimpaired state. Most of this load reduction will come from stormwater and non-point source reductions. Point sources identified in the TMDL have already achieved their reduction targets and are below loading targets by 6,123 lbs.

Table 8 is a summary of the major reduction activities targeted to be implemented over the next five years to reduce phosphorus loading below the TMDL targets. Loading reduction estimates are based on published estimates when available or analysis using the Watershed Treatment Model. See Appendix X for the model and additional load reduction calculations. Specific details for activities listed in the table follow.

Table 8. Summary of the 2012-16 Phosphorus Reduction Strategy

Activity Category	P Load Reduction Estimate (lbs/yr)	Implementation Timeframe	Cost Estimate over Five Years
Priority agricultural BMPs from the Mill Creek Subwatershed Management Plan	6,782	Originally scheduled 2004-2008. Opportunistic implementation over 5 years.	$4.7 M
Uncompleted Malletts Creek Restoration Plan Activities	1,075	Original schedule through 2009. 15% complete. New plan through 2016.	$12.0 M
Uncompleted items from the Millers Creek Watershed Improvement Plan	345	Original schedule through 2014. 10% complete. Opportunistic implementation through 2016.	$8.1 M
Phosphorus Fertilizer Reduction	1,039	Ordinances implemented 2007-10. State law implemented 2012. Ongoing education needed.	$5,000
Point Source Improvements	Unknown	Ongoing improvement projects through 2016.	Unknown
Construction Site Runoff Control	1,641	Ongoing program. Regular inspection, O&M.	$3.13 M
Public Education Program	992	Current. Annual campaigns ongoing.	$200,000
Septic Inspection and Repair	1,440	Ongoing program	$32.0 M
Illicit Discharge Elimination	533	Program implementation underway; investigations ongoing	$278,000
Street sweeping	359	Annual sweeping in sections of Ann Arbor, Ypsilanti and University of Michigan	$967,500
Priority partner projects	Variable	Targeted for implementation 2012-16	Being determined
Totals	**14,206**		**$61.4 M**

Thus, these activities will account for more than the needed load reduction in order to meet the reduction target for the watershed. The targeted loading reductions from these activities exceed the point and non-point source targets for a number of reasons, all related to uncertainty. The contributors to this plan generally want to use the precautionary principle to account for uncertainty and err on the side of being overprotective. While the TMDL included excess loading up to the daily maximum that was not directly allocated (essentially a margin of safety), that margin was small. As should be clear from the loading analysis discussed in section II, loading estimates are not exact and computational methods can vary. Also, there is extensive uncertainty within the load reduction estimates, though the modelers were conservative in estimates. Further, the exact relationship between the phosphorus load entering the Ford Lake impoundment and the phosphorus concentrations in Ford and Belleville Lakes (the ultimate targets) is not clearly defined and confounded by numerous other variables. Finally, waste water treatment plants in the watershed are all currently operating below design capacity. Current point source loading is not expected to continue as housing eventually expands and waste water treatment demands increase. It is likely that, as capacity is approached, point sources will approach or exceed their permitted loading limits, though they are making investments in capital improvements.

Activity Details

Agricultural BMPs in Mill Creek Subwatershed
A suite of agricultural BMPs (as well as non-agricultural BMPs) were recommended in the *Mill Creek Subwatershed Management Plan.* Since the dominant land use in the Mill Creek drainage is agriculture, it was projected to be the primary source of phosphorus. Significant practices for phosphorus reduction, as recommended by local National Resource Conservation Service (NRCS) agents, along with target scope in the Mill Creek subwatershed include:

- Grassed Waterways – receiving runoff from 98 acres
- Grade Stabilization Structures – 66
- Conservation cover – 665 acres
- Conservation crop rotation with tillage – 1,965 acres
- Waste storage facilities – 15-20
- Livestock use exclusions – 8,000 feet
- Vegetated filter strips – treating 170.5 acres
- Nutrient management – 6,551 acres

Responsible entities: Agricultural BMPs, by their nature, are voluntary and targeted at private landowners. HRWC and other partners will coordinate with NRCS to evaluate implementation of current practices and identify opportunities for BMP implementation through US Department of Agriculture programs. In the recent past, HRWC has successfully engaged two large agricultural land owners in riparian setbacks and streambank stabilizations.

Malletts Creek Restoration Plan Activities
A suite of urban BMPs were prescribed for Malletts Creek restoration and treatment. A number of these have been implemented and described previously in this plan. Significant

activities planned for 2012-15 include the following projects along with the area or length of treatment:

- Esch Ave Hydrodynamic Separator – 1,496 acres
- Esch Ave Roadside Bioinfiltration – 4 acres
- Platt Rd Hydrodynamic Separation – 380 acres
- Malletts Ellsworth Basin Improvements – 1,582 acres
- Stone School Rd Retrofits: Offline first flush sewer, bioswale, hydrodynamic separation – 12 acres
- South State Rd MDOT Pollutant Removal – 880 acres
- Burns Park Porous Alley – 1.5 acres
- Malletts @ Chalmers Dr/Huron Pkwy Storm Sewer (SS) – 340 ft
- Malletts @ S Huron Pkwy SS – 2,200 ft.
- Malletts @ Platt/Manchester SS – 2,800 ft.
- Malletts @ Packard Outfall SS – 600 ft.
- Malletts @ Research Park SS – 1,000 ft.
- Malletts @ Boardwalk/S State SS – 1,200 ft
- Malletts @ Eisenhower/Oakbrook SS – 1,800 ft
- Lans Basin – 500 acres

Responsible entities: Activities were planned through the State Revolving Fund Loan Program by Washtenaw County Water Resources Commission, and includes participation from the City of Ann Arbor and Pittsfield Township.

Millers Creek Watershed Improvement Plan
The Millers Creek plan includes 112 improvement opportunities and 45 recommended activities. Most activities included specific geographic targets. BMP types include reforestation, roof drain modification, detention basin retrofits, floodplain storage, new storm detention, detention basin retrofits, and stream bank stabilization. Project locations, effort can be obtained from the plan.

Responsible entities: the plan includes projects for WCWRC, HRWC, Ann Arbor Township, Ann Arbor, Ann Arbor Public Schools and the University of Michigan.

Phosphorus Fertilizer Reduction
The City of Ann Arbor, City of Ypsilanti, Pittsfield Township, and Ypsilanti Township all have passed ordinances prohibiting the use of fertilizers containing phosphorus. The State of Michigan recently passed a statewide law which will take effect in January 2012. Education and evaluation will be needed to determine the effectiveness of this law's implementation.

Responsible entities: All Middle Huron Partners.

Point Source Improvements
Each of the listed point sources in the Middle Huron has developed a schedule of capital improvements to improve the quality of treated water entering the Huron River system. These improvements are included in section II beginning on page 20.

Responsible entities: Ann Arbor, Chelsea, Dexter and Loch Alpine Waste Water Treatment Plants

Construction Site Runoff Control
Each entity with a stormwater permit has established construction site runoff controls and inspections. These programs require ongoing operation.

Responsible entities: All permitted entities in the Middle Huron River watershed.

Public Education Program
Each permitted entity also must engage in a Public Education Program. Much of this is accomplished jointly through the SAG.

Responsible entities: All permitted entities, led by HRWC.

Septic Inspection and Repair
A program to inspect septic tanks and systems at time of home sale is being implemented throughout Washtenaw County. Inspectors evaluate systems on site and recommend maintenance or remediation to home buyers to improve the effective treatment and reduce failures from septic systems. Washtenaw County's "Time of Sale" Ordinance requires that prior to any residential property transfer: 1) the septic system must be inspected by certified inspectors, 2) a report must be submitted to the Environmental Health Regulation Department and 3) the seller must receive an authorization letter from the Department. Over 4,300 systems have been evaluated annually, countywide, with over 540 septic system corrections documented to date. Most of the municipalities in Washtenaw County are now participating in this program.

Responsible entity: Washtenaw County Department of Public Health on behalf of county municipalities

Illicit Discharge Elimination
Each entity with a stormwater permit has established a program to discover, investigate and eliminate illicit sanitary connections to stormwater systems. These programs require ongoing operation and are regularly evaluated.

Responsible entities: All permitted entities.

Street sweeping
Several municipalities engage in regular sweeping of streets and parking lots. This practice has been shown to be effective at removing soil and other phosphorus-containing material. Effort by entity varies depending on roadway or parking surfaces under jurisdiction.

Responsible entities: City of Ann Arbor, Washtenaw County (parking lots only), Ypsilanti Township (by WCRC), City of Ypsilanti (parking lots), Village of Dexter, MDOT, and the University of Michigan.

A detailed summary of additional priority partner projects is included below.

Priority Partner Projects

City of Ann Arbor in partnership with WCWRC

Implement State Revolving Fund Loan Plan Projects*:* Projects identified throughout the city in Allens, Traver, Malletts, Millers and Swift Run Creeksheds. Obtain the complete plan at from the WC WRC. Implement 2012-14.

Implement Stormwater Activities in Capital Improvements Plan: The city's 5-year Capital Improvement Plan includes numerous activities to repair, upgrade or otherwise improve stormwater infrastructure. These activities are prioritized upon their impact on reducing phosphorus in stormwater out flows. Current plan is at http://www.a2gov.org/government/publicservices/systems_planning/capitalimprovements/Pages/CapitalImprovementsPlan.aspx
Cost:$28,700,607. Implement 2012-16.

Comprehensive Tree Planting*:* Inventory target areas with high phosphorus removal potential and establish trees as part of a Green Infrastructure initiative. Implement 2012-14.

Adopt-a-Drain Pilot Project: Partnering with HRWC and WC WRC, volunteers will be recruited to adopt local catch basins to clear them of debris and reduce sediment and nutrient inputs. If successful, the project will be extended to other county jurisdictions. Cost:$15,000 for initial start-up. Implement 2012-16.

Ann Arbor Township

Fleming Creek Streambank Erosion Remediation: Address significant erosion issue on a tributary to Fleming Creek. Tons of sediment have likely been lost to date and it is continuing to head-cut. The project would stabilize the streambank and halt head-cutting. Implement 2012-14.

Washtenaw Community College Stormwater Improvements: New infiltration and storage to capture and treat runoff to Swift Run and direct to Huron River. Implement 2012-13.

Village of Dexter

Tree Planting: Increase infiltration and nutrient uptake by prioritizing and planting trees in public spaces across the village. Young to mature trees will be newly established. Implement 2012-14.

Riparian Wetland Restoration*:* Enhance wetlands riparian to Mill Creek that are part of new floodplain established by dam removal. Implement 2013-14.

Regional Stormwater Detention: Add detention to capture and treat stormwater prior to entering wetlands riparian to Mill Creek. Implement 2013-14.

Greening Central Street: When the street is scheduled for resurfacing, add porous pavement in parking lanes, and add rain gardens and bioswales for drainage where appropriate. Implement 2016.

Restore Mill Creek Banks*:* Repair the Baker Road outfall and stabilize banks to reduce impact from stormwater flows and reduce erosion and downstream sedimentation. Implement 2013-14.

Eastern Michigan University

Mark Jefferson Science Building LEED Certification*:* The application for LEED certification includes a significant stormwater capture system. Implement 2012-14.

Westview Rain Garden Pilot: Small site includes infiltration swales. A new rain garden will be added to increase infiltration Implement 2013.

New Construction Standards*:* Building standards are being revised to match those developed by the Washtenaw County Water Resource Commissioner. The new standards will increase treatment and infiltration of runoff from new construction. Implement 2012.

Ypsilanti Township

Feasibility Study for Permanent Aeration of Ford Lake: A study would determine the feasibility of reconfiguring the Ford Lake Dam or installing aerators to keep the lake bottom from reaching anoxic conditions. Such an effort would eliminate a large source of phosphorus import from lake bottom sediment. Implement 2012.

LID Demonstration: A series of Low Impact Development practices will be installed on Township-owned properties in visible locations. Targets are in the Superior Drain creeksheds. Cost:$50,000 Implement 2012.

Van Buren Township

Belleville Lake Erosion Remediation*:* Inventory Belleville Lake shoreline, which has steep slopes, for areas of significant erosion and identify candidates for remediation. Two areas have already been identified and will be remediated using bioengineering techniques. Cost:$150,000 Implement 2012.

Pittsfield Township

Porous Pavement Demonstration: At the township hall and fire department location, install porous pavement in less-trafficked parking areas. Implement 2012-14.

Washtenaw County Water Resources Commissioner

Implement State Revolving Fund Loan Plan Projects: Pin coordination with the City of Ann Arbor, projects are identified throughout the city in Allens, Traver, Malletts, Millers and Swift Run Creeksheds. Obtain complete plan from WCWRC Implement 2012-14.

Detention Basin Retrofits: Three basins in the city of Ann Arbor were identified for retrofit designs to treat the first-flush of runoff and remove phosphorus. Concept designs have been completed for each, and a complete engineering design has been developed for one site in the Malletts Creek drainage. Implement 2012-14.

Riparian Buffers and Bank Stabilization: Projects are planned at areas along Traver and Malletts Creeks and County Farm Park Drain. The Malletts Creek and County Farm Park Drain projects are currently underway. They address 7,400 and 3,400 feet of unstable streambank respectively. Implement 2012-14.

Rain Garden Installation and Demonstration: Rain gardens, and bioswales are being installed at a number of locations in Ann Arbor, including road projects along Miller Rd., Dexter Rd., Stadium Blvd., and Stone School Rd. Hydrodynamic separators will be installed where appropriate. Implement annually 2012-16.

Porous Alley Demonstration*:* An Alley in a residential neighborhood in Ann Arbor will be resurfaced with porous pavement. Implement 2012.

Revised Stormwater Standards and Soil Erosion Rules*:* The standards and rules are currently being revised to improve first-flush treatment and encourage greater infiltration and treatment of runoff during and after construction. These standards and rules apply to most of the county. Implement 2012.

Washtenaw County Road Commission

Gravel Road Improvements*:* Several gravel roads in low-lying areas are targeted for improvements to slow down runoff rates and infiltrate it prior to discharging to creeks and the Huron River. Implement 2013-14.

Porous Pavement Installation: Sections of the Commission's parking lot and non-motorized paths along targeted roadways will be replaced with porous pavement. Implement 2013-14.

Streambank Stabilization: Several sections along roads or right-of-ways that drain directly to the river and tributary streams will be stabilized to reduce erosion. Projects occur on a continual basis. Implement 2012-16.

Scio Township

Marshall Road Farm Preservation and Stream Buffering: A set of farms along Marshall Road, which drain directly to the main branch of Mill Creek are targeted for preservation protections such as conservation easements. Buffers along Mill Creek will be encouraged as part of the negotiation process. Implement 2012-14.

Ann Arbor Public Schools

New Stormwater Detention, Treatment: New stormwater treatment practices including detention, porous pavement and rain gardens are being considered for school properties as

they are planned for improvement projects. 1 elementary school in Allens Creek is targeted for 2012. Implement 2012-16

University of Michigan

Porous Pavement Installation: Increase use of porous pavement and porous pavers at construction and renovation projects throughout campus, as appropriate, based on site-conditions and project constraints. Projects including porous pavers/pavement already scheduled for construction include Varsity Drive and Crisler. Implement 2012-16.

Stormwater Detention & Treatment Using Vegetation: Continue to identify and increase utilization of vegetative best management practices, including green roofs, bioswales, vegetative buffers, etc. on construction and renovation project sites, as appropriate based on site conditions and project constraints. Implement 2012-16.

Hydrodynamic Separators: Continue to target parking lot renovation and construction projects for use of hydrodynamic separators to aid in sediment removal. Implement 2012-16.

Stormwater Detetnion Basin Improvements: Stormwater basin maintenance and retrofit projects will continue to be identified and completed, as appropriate and feasible. Projects will review opportunities to aid in first flush detention and controlled discharge, to aid in sediment removal. Projects currently under review include potential retrofits at NC-51 and the Tennis Center basin. Implement 2012-2016.

Invasive Species Removal & Native Planting: Increase infiltration and nutrient uptake by continuing invasive species removal projects to encourage native species to re-establish. Implement 2012-16.

IV. Overcoming Barriers, Gaps and Other Forces

As framed by the terms of the TMDL, the ultimate measure of implementation success will be documented changes in water quality, showing improvement over time. The success in achieving such reductions has been documented in previous sections and provides testament to the investment and effort of the Middle Huron Partners up to this point. However, potential barriers to the complete achievement of TMDL limits and lake concentration targets exist and must be considered in implementation planning.

Time Delays

Positive feedback from even the most diligent efforts may be several years in the future due to the lead time needed to implement best management practices throughout the watershed. Participants must set realistic expectations about the amount of time needed to continue identified programs while awaiting positive results. Otherwise, impatience, discouragement, or competition for limited local funding could lead to discontinuation of effective programs. Prompt communication of small successes through news releases, web sites, and community newsletters will be important to encourage the continued efforts of TMDL partner communities.

Technical Challenges

The tracking of quantitative results over time carries a set of technical and logistical challenges. Variation in weather patterns over the years of a study adds to the complexity of trend analysis of the data. Collecting correctly timed wet weather samples is particularly daunting, as personnel may not be available during a particular major summer storm occurring outside of business hours. Using trained and dedicated volunteers may become necessary in order to overcome budget constraints and to increase the number of samples and data points used in calculations.

Knowledge Gaps

Gaps exist in our knowledge of the importance of particle resuspension from the impoundments themselves under anoxic conditions. The systematic study by John Lehman detailed the inputs of nutrients to Ford and Belleville lakes and the middle Huron River and concluded that current incidents of algae blooms are more responsive to resuspension from lake bottom sediments than to changes in loading to the lakes from upstream. He further showed that such resuspension can be controlled by avoiding anoxic conditions during periods of thermal separation[8]. Monitoring lake conditions over time will be important for better understanding the relationship between upstream and in-lake sources of phosphorus.

Economics

Another challenge is the changing economic environment. With the current economic downturn, usage of current waste water treatment plants has been reduced and no new plants have been proposed. Likewise, little construction activity is occurring, so a potential source of phosphorus runoff is being minimized through earth moving and the resultant sediment erosion. As the economy recovers and the middle Huron River Watershed returns as a focal point of growth and expansion, further stress will be placed on waste water treatment capacity and the demand may increase for additional treatment plants. The DEQ has helped this situation by clarifying that no additional point source permits will be issued unless the additional loading is balanced with loading reductions. Future development and its likely impacts need to be better understood, however.

For many partners in this TMDL implementation, activities have been in place for several years and have reaped benefits, as has been demonstrated, and the lakes appear to be on a course toward achieving an unimpaired state. Still, the limits have not yet been achieved and many of the current programs only recently have been put into place. However, with the current economic downturn restricting government and institutional resources, the challenge will be to identify the most cost-effective measures and to continue funding them. Managers and programs will both need to be adaptive, while continuing to appeal to the public's expectation that the waters of our state will attain the standards set forth by Congress through the passage of the Clean Water Act in 1972.

V. Accountability Structure for Implementation[4]

Participants, Reporting, Timeline, Monitoring, Contingency Plans

Stakeholder Structure

The stakeholders for this implementation plan are committed to continued water quality improvement in the middle Huron River watershed. Those who took on this responsibility by signing The Middle Huron Cooperative Agreement for Reduction of Phosphorus Loading to the Middle Huron River Watershed (September 16, 2004) were:

- Charter Township of Ann Arbor
- City of Ann Arbor
- Village of Barton Hills
- City of Chelsea
- Village of Dexter
- Loch Alpine Sanitary Authority
- Lodi Township
- Charter Township of Pittsfield
- Scio Township
- Charter Township of Superior
- City of Ypsilanti
- Charter Township of Ypsilanti
- University of Michigan
- Charter Township of Van Buren
- Washtenaw County Water Resources Commissioner's Office
- Huron River Watershed Council
- Michigan Department of Environmental Quality

The following units of government also are subject to the TMDL and were encouraged to sign the Cooperative Agreement:

- Washtenaw County Road Commission
- Lima Township
- City of Belleville
- Freedom Township
- Sylvan Township
- Dexter Township
- Webster Township

[4] *adapted from Implementation Plan for the TMDL for* E. coli *for the Huron River, Geddes Pond (2006).*

- Lyndon Township
- Charter Township of Salem

The Cooperative Agreement is expired and needs to be revised to account for changes since 2004, the activities prescribed under this plan, and lessons learned from years of work in the middle Huron and elsewhere. The 17 stakeholders listed above are committed to continued water quality improvement in the middle Huron contributing area. Toward this end, local governments, the Huron River Watershed Council and the University of Michigan have been conducting a variety of actions to improve water quality and promote stewardship. The variety and number of these programs can be seen in detail in Table 9.

Reporting and Timeline

Although many ongoing actions to restore water quality and habitat in the middle Huron are voluntary, each stakeholder has assumed responsibility to continue their efforts, as resources allow and needs dictate. Through initiating and continuing these voluntary actions, each stakeholder has assumed responsibility for a share of water quality restoration in the Huron River Basin. These discretionary programs are dependent on funding, perceived needs, sound and reliable technical assistance, clear regulatory authority, constituent support, and demonstrated effectiveness. Some actions are required under the permit regulations of the Clean Water Act.

Under their stormwater permits, these communities and organizations are obligated to develop, implement, and enforce a stormwater management program designed to reduce the discharge of pollutants from the drainage system to the "maximum extent practicable," to protect the designated uses of the waters of the state, to protect water quality, and to satisfy the appropriate water quality requirements of state and federal law. Stormwater controls designed to attain the goals of the TMDL must be incorporated into the stormwater management plan, and each permittee must implement appropriate best management practices to comply with the TMDL implementation plan. Both separately and jointly, through a coordinated public education and involvement strategy, stakeholders will also engage in communication with the public that addresses phosphorus TMDL problems, solutions, and successes.

As stated in the Cooperative Agreement, TMDL stakeholders review the status of TMDL implementation at least twice every year for continuous improvement opportunities. The TMDL stakeholders, per the Cooperative Agreement, also submit annual reports to MDEQ.

Additionally, the permittees are required to submit annual progress reports to the Michigan DEQ that contain the following: a description of the status of compliance with general permit conditions; an updated assessment of the water quality conditions within their jurisdiction; a description of identified water quality stresses; and a summary of all information collected and analyzed—including monitoring data. The report must include a summary of upcoming stormwater activities and a description of planned changes in BMPs or measurement of goals. The City of Ann Arbor and the University of Michigan must also provide an assessment of

the pollution reduction and probable receiving water quality effects associated with the program's implementation.

Monitoring and Adaptive Management

In 2007, and at subsequent five-year intervals, the MDEQ completed basin-wide monitoring of the Huron River watershed. In 2009, MDEQ conducted monitoring for the purposes of directly evaluating progress toward achieving the TMDL. Since 2003, HRWC has conducted tributary monitoring on behalf of Middle Huron Partners, and this is expected to continue. Future projects under this implementation plan may incorporate additional monitoring if resources allow. Stakeholders' stormwater permit reporting will include an updated assessment of the water quality conditions within their jurisdiction in either narrative or numeric form. The purpose of this update is to show any obvious changes in phosphorus levels since the previous progress report. Change may be demonstrated by use of data collected by other sources or a group monitoring program.

Through adaptive management—a process that assesses conditions and trends throughout plan implementation, and provides feedback to stakeholders so that adjustments can be made—this Implementation Plan is intended ultimately to achieve TMDL compliance. Through the semi-annual meetings of the Middle Huron Initiative Partnership, the TMDL Implementation Plan working group will meet to review progress with this Implementation Plan. The MDEQ will track permit compliance through stormwater permit oversight, including monitoring activities that address the TMDL implementation goals. Unless the EPA determines that it is necessary to separate TMDL enforcement from the stormwater permit process, enforcement authority will reside in the MDEQ's authority under the provisions of the stormwater rules.

The Middle Huron Partners take seriously the impairments that negatively impact local freshwater resources. This commitment started with the impairments of Ford and Belleville Lakes. This plan is a testament to their focused, coordinated efforts over past years, as well as their will to see the nutrient impairment removed and full use of the water resources restored. Past efforts in the watershed have yielded tremendous public awareness of the threats, and their sources and causes, as well as actions to mitigate the threats. It will require a continued combination of supportive citizens and well-placed on-the-ground projects to finally achieve the ultimate goal. This 5-year Implementation Plan provides the blueprint for reaching the goal of sustainable nutrient limits for Ford and Belleville Lakes and the Huron River from which they emanate.

VI. REFERENCES

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