Middle Huron Stormwater Plan for Addressing Total Maximum Daily Loads (TMDLs)

Appendices

Appendix A:

Quality Assurance Project Plan (QAPP) for the Middle Huron Monitoring Program

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

JENNIFER M. GRANHOLM
GOVERNOR

STEVEN E. CHESTER
DIRECTOR

September 2, 2008

Ms. Laura Rubin – Executive Director
Huron River Watershed Council
1100 North Main, Suite 210
Ann Arbor, Michigan 48105

Dear Ms. Rubin:

SUBJECT: Huron River Quality Assurance Project Plan (QAPP) – Project #481085-08

Staff have reviewed the August 29, 2008, QAPP for the Local Monitoring Clean Michigan Initiative grant project entitled, "**Measuring Nutrient Reduction in the Huron River Watershed.**" The QAPP objectives are consistent with the contract work plan. The framework and procedures for how the environmental data will be collected, processed, analyzed and reported are adequate to achieve the project objectives. Therefore, the QAPP is approved.

If you have any questions or comments, please contact Mr. John Wuycheck, Surface Water Assessment Section, Water Bureau, at 517-335-4195, or you may contact me.

Sincerely,

Eric L. Alexander, Chief
Lakes Huron and Erie Unit
Surface Water Assessment Section
Water Bureau
517-241-7733

ela:jw:rm
cc: Mr. Ric Lawson, HRWC
Mr. Tom Hettinger, DEQ
Mr. Gary Kohlhepp/Grants File, DEQ
Mr. John Wuycheck, DEQ

Quality Assurance Project Plan for the Work Plan Entitled: "Measuring Nutrient Reduction in the Huron River Watershed"

Version 2
Date: September 2, 2008

Grantee: Huron River Watershed Council
MDEQ Tracking Code: #481085-08
Funding Source: Clean Michigan Initiative

Project Administrator: John Wuycheck

MDEQ Use Only:

☐ Approved

☐ Returned for Modifications

_____

Signature of MDEQ Reviewer Date

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1. Project Description

1.1 Project Organization and Distribution List

Table 1. Personnel, Affiliation and Role/Responsibilities of each in the monitoring project

Personnel	Affiliation	Role/Responsibilities
John Wuycheck	MDEQ	Project Officer
Laura Rubin	HRWC	Program oversight and review
Ric Lawson	HRWC	Program management, data management and reporting, and quality assurance
Debi Weiker	HRWC	Field data collection management, volunteer coordination, and quality control
Donna McNeff	Ann Arbor WTP	Laboratory management
Middle Huron Partners	Local government	Supplemental funding, program review and guidance
Volunteers	HRWC	Assist with field data collection

Project Administrator
John (Jack) Wuycheck
Michigan Department of Environmental Quality
517/335-4195
WuycheckJ@Michigan.gov

Grantee
Huron River Watershed Council
1100 N. Main, Suite 210
Ann Arbor, MI 48105

Executive Director
Laura Rubin
(734) 769-5123 ext. 12
lrubin@hrwc.org

Program and Quality Assurance Manager
Ric Lawson
(734) 769-5123 ext. 13
rlawson@hrwc.org

Field Manager
Debi Weiker
(734) 426-5762
dweiker@hrwc.org

Technical Advisor
Dr. Paul Steen
(734) 769-5123 ext. 14

Laboratory Project Manager
Donna McNeff
City of Ann Arbor Water Treatment Plant
919 Sunset Rd
Ann Arbor, MI 48103
(734) 994-2840

Review and Advisory Team
Middle Huron Partners
(current contact list included in Appendix)

Volunteer Data Collectors
Program volunteers change annually and will assist in data collection under the supervision of Debi Weiker and Ric Lawson. Standard Operating Procedures (SOPs) will be distributed at training, and the QAPP will be made available to them upon request.

All others involved with monitoring will receive a copy of this Quality Assurance Program Plan (QAPP) and any revisions.

1.2 Project Description

The Huron River Watershed was a priority geographic area for 2006 for the Water Bureau, and was selected to receive a grant in 2007 before the program was cut. This monitoring project aims to evaluate collective progress of NPS best management practices toward improving water quality in two TMDL areas, and to provide data useful to MDEQ in its reevaluation and development of the state's original total phosphorus Total Maximum Daily Load (TMDL) for the middle Huron River including Ford and Belleville lakes.

1.2.1. Statement of Water Quality Concerns

Eutrophication of two impoundments, Ford Lake and Belleville Lake, are the end result of excess phosphorus entering the middle reach of the Huron River. The resulting nuisance algal blooms in Ford Lake have been documented almost annually since the 1970s. A TMDL for the lakes was accepted by US EPA in 2000 that calls for 50% reduction of 1996 phosphorus levels entering Ford Lake. MDEQ aquatic biologists determined that half of the phosphorus contributions can be attributed to nonpoint sources. The Middle Huron Stream Nutrient Monitoring Program was developed in response to community interest in increasing the data available on nutrient contributions to the middle Huron River. The data is intended to lead to a better understanding of pollution contributions from non-point sources in this portion of the watershed. An improved understanding of sources and water quality trends will help the Partners of the Middle Huron Initiative to focus and track pollution reduction efforts as they strive to meet the phosphorus TMDL for Ford and Belleville lakes.

Upstream of this section, in a river reach known as the Huron Chain of Lakes, is Strawberry Lake. This lake is a natural lake along the Huron River that is downstream of four lakes for which phosphorus TMDLs have either been established or considered. A TMDL was established for phosphorus in

Strawberry Lake in 2000. This project will expand the monitoring program already established for the middle Huron to begin monitoring sites upstream of Strawberry Lake to help community partners in that area track current status and trends in water quality variables.

1.2.2 Project Goal

Collect, synthesize and disseminate data that complements past data and is useful to:

1. Partners of the Middle Huron Initiative and Huron Chain of Lakes to evaluate the collective progress of NPS best management practices (BMPs) in improving water quality in the TMDL areas; and
2. MDEQ for re-evaluation of Michigan's first phosphorus TMDL, for Ford and Belleville lakes.

1.3 Project Tasks and Schedule

Task	**Staff Responsible**	**% of Time**	**Deliverables & Results (deliverables in italics)**
1) Measure stream discharge at 12 sites		35%	
Subtasks			
1.1 Develop and submit QAPP for DEQ approval	Lawson; Weiker; Steen		*Approved QAPP*
1.2 Solicit and train volunteer corps to provide additional field support during extreme wet weather events	Weiker; Steen		Trained field support of 5-8 volunteers
1.3 Conduct field work at each site twice monthly during May - Sept	Lawson; Weiker		Stream discharge data for 12 sites
1.4 Respond to wet weather events as needed. Details will be worked out with DEQ in QAPP development.	Lawson; Weiker		Stream discharge data for 12 sites
1.5 Record data and conduct analyses; download data from pressure sensors and gauge stations	Lawson; Weiker; Steen		*Database files and analytical results*
1.6 Share data with project partners and develop annual data reports	Lawson; Weiker		*Reports for 2008, 2009 field seasons; press releases; presentations*
1.7 Solicit evaluation of data and draft products from Middle Huron Partners, HRWC staff	Lawson		
2) Collect water quality samples and field data at 12 sites		50%	
Subtasks			
2.1 Develop and submit QAPP for DEQ approval	Lawson; Weiker; Steen		*Approved QAPP*
2.2 Calibrate equipment prior to field visits	Weiker		Equipment prepared to manufacturers' specs
2.3 Solicit and train volunteer corps to provide additional field support	Weiker; Steen		Trained field support of 5-8 volunteers

during extreme wet weather events			
2.4 Collect grab samples and record ambient conditions. Specific sampling details will be worked out with DEQ in QAPP development.	Lawson; Weiker		Minimum 24 sample sets per month plus storm samples; field data for DO, pH, conductivity, temp.
2.5 Deliver samples to WTP lab for analysis	Lawson; Weiker		*Water sample analysis data*
2.6 Record data and conduct analyses	Lawson; Weiker; Steen		Nutrient and TSS load calculations for 12 sites; trend analyses of all parameters for 10 sites
2.7 Share data with project partners and develop annual reports	Lawson; Weiker		*Reports for 2008, 2009 field seasons; press releases; presentations*
2.8 Solicit evaluation of data and draft products from Middle Huron Partners, HRWC staff	Lawson		
3) Administer and Close Out Grant		15%	All required documents and deliverables
Subtasks			
3.1 Track budget, invoicing, payroll, meet with Project Administrator	Fike		
3.2 Develop and submit status reports following WB guidance	Lawson		Quarterly status reports
3.3 Provide products and deliverables, including all data collected in hard copy and electronic formats that allow data manipulation	Lawson		*Minimum of 5 copies in paper and digital format*
3.4 Develop and submit final report following WB guidance at end of project	Lawson		*Draft Report; Final Report* (1 copy to PA and 4 copies to Admin. Unit)
3.5 Provide release of claims statement	Lawson		Release claims statement
3.6 Provide project fact sheet	Lawson		*Project fact sheet in paper and digital formats*

Timetable
This project will begin in June 1, 2008 and conclude in May 31, 2010.

Work Plan Activity	Project Quarters								
	2008			2009				2010	
	QTR 2 June	QTR 3 Jul/Aug/Sep	QTR 4 Oct/Nov/Dec	QTR 1 Jan/Feb/Mar	QTR 2 Apr/May/Jun	QTR 3 Jul/Aug/Sep	QTR 4 Oct/Nov/Dec	QTR 1 Jan/Feb/Mar	QTR 2 Apr/May
Task 1) Measure stream discharge at 12 sites									
1.1 Develop and submit QAPP for DEQ approval									
1.2 Solicit and train volunteer corps to provide additional field support during extreme wet weather events									
1.3 Conduct field work at each site twice monthly from May - Sept									
1.4 Respond to wet weather events as needed									
1.5 Record data and conduct analyses; download data from level sensors and gauge stations									
1.6 Share data with project partners and report results									
1.7 Solicit evaluation of data and draft products from Middle Huron Partners, HRWC staff									
Task 2) Collect water quality samples and field data at 12 sites									
2.1 Develop and submit QAPP for DEQ approval									
2.2 Calibrate equipment prior to									

field visits									
2.3 Solicit and train volunteer corps to provide additional field support during extreme wet weather events									
2.4 Collect grab samples and record ambient conditions									
2.5 Deliver samples to WTP lab for analysis									
2.6 Record data and conduct analyses									
2.7 Share data with project partners and report results									
2.8 Solicit evaluation of data and draft products from Middle Huron Partners, HRWC staff									
Task 3) Administer and Close Out Grant									
3.1 Track budget, invoicing, payroll, meet with Project Administrator									
3.2 Develop and submit status reports following WB guidance									
3.3 Provide products and deliverables, including all data collected in hard copy and electronic formats									
3.4 Develop and submit final report following WB guidance at end of project									
3.5 Provide release of claims statement									
3.6 Provide project fact sheet									

1.4 Training Requirements

The program manager and field manager have been trained in all collection techniques as part of professional education programs. The Technical Advisor is consulted for questions on details and analyses. All volunteer collectors receive training at the beginning of the sampling season and are accompanied by the program or field manager on their first sampling experience. Training includes instruction and demonstration of all field techniques, SOPs and data handling procedures.

2. Measurement and Data Acquisition

2.1. Project Objectives

Objective 1: Collect data during dry and wet weather at tributary sites that are comparable to existing data in order to compute loading changes for Total Phosphorus (TP), Total Suspended Solids (TSS), and Nitrate-Nitrite (N-N).

Objective 2: Measure stream discharge (Q) at ten sites in the Middle Huron and two sites in the Chain of Lakes during dry and wet weather conditions for use in calculating seasonal load estimates and flow profiles.

Objective 3: Analyze key water quality indicators at tributary sites (TP, TSS, N-N, Dissolved Oxygen (DO), *E. coli,* conductivity, pH, and temperature) across dry and wet weather conditions to detect trends.

Objective 4: Report data analysis results to the Middle Huron Partners, Huron Chain of Lakes community partners and the MDEQ and assist partners with assessment of current BMP implementation and plan future BMPs.

2.2 Project Design

HRWC will conduct stream monitoring from May through September at one main river site and nine tributary sites in the Middle Huron, and one river site and one tributary site in the Huron Chain of Lakes following currently accepted MDEQ field procedures for wadeable streams. HRWC is committed to working with MDEQ to develop QA/QC procedures for sample collection and analysis that meet MDEQ's approval, as it has successfully done with current and past projects. The monitoring program will be based on the existing program that was designed to complement MDEQ's monitoring program at Ford and Belleville lakes, such that monitoring occurs during the months that the TMDL is in effect and the identical parameters are measured.

Stream discharge and water quality indicators will be measured at each site during dry and wet weather conditions in order to measure ambient conditions and any impacts from stormwater runoff on the sites. Fixed water level sensors will be placed at sites on an annual rotating basis to allow for flow profiling across an entire season. Grab samples will be taken at each of the study sites twice monthly, as staff, volunteers and resources allow. Additional samples will be taken during wet weather events. Water samples will be collected and analyzed in a lab according to US EPA accepted procedures (City of Ann Arbor WTP).

The proposed monitoring sites (Table 1) are located on major tributaries to the middle reach of the Huron River and directly upstream of the Huron Chain of Lakes and represent a mix of land uses. The locations were selected based on their use by MDEQ, HRWC's Adopt-A-Stream program (macroinvertebrate and habitat data), significant subwatershed phosphorus loading modeling estimates, and a desire to capture the range of subwatershed and upstream conditions. Data will be collected from locations that facilitate the extraction of relationships between land cover and ecological stream health. Huron Chain of Lakes sites will complement four sites being monitored by Green Oak Township.

Table 2. Proposed monitoring sites, and surrounding environments

Site #	Water Body	Cross-street	Environment
MH01	Huron River	N. Territorial Rd	Natural River District
MH02	Allens Creek	outfall to Huron River	High-density urban
MH03	Fleming Creek	Geddes Rd	Woodland; wetland
MH04	Honey Creek	Wagner Rd	Low-density residential
MH05	Malletts Creek	Chalmers Rd	Low-density residential; commercial
MH06	Mill Creek	Parker Rd	Agricultural; drain confluence
MH07	Millers Creek	Geddes Rd	Woodland; medium-density residential
MH08	Superior Drain	Clark Rd	Agricultural; low-density residential
MH09	Swift Run	Shetland Rd	Medium-density residential
MH10	Traver Creek	Nielsen Ct	High-density residential; commercial
COL01	Huron River	Hamburg Rd.	Medium-density residential
COL02	Davis Creek	Silver Lake Rd.	Woodland, wetland, low-density residential

In the event of wet weather, grab samples will be taken at sites with fixed water level sensors. Stream discharge measurements will be taken using data from equipment existing in the following streams: Malletts (USGS), Mill (USGS), Huron @ Hamburg (USGS), and Allens (City of Ann Arbor). Water level sensors maintained by HRWC generate continuous data and were placed at Traver and Swift in 2007. Honey Creek is targeted for a sensor in 2008, with Fleming and Davis targeted in 2009. Stream discharge will be measured directly by project and volunteer staff with flow meters at the remaining sites on a bi-monthly basis.

2.3 Sample Collection Methods

Stream monitoring will be conducted twice monthly from May through September at the designated monitoring sites described in section 2.2. The monitoring teams, consisting of at least two individuals, after picking up equipment at the HRWC offices, will travel to a pre-designated site and first complete a field data sheet (see Appendix) that documents the location, date, time, team members and weather conditions for the current and previous days. The field data sheet is also used to record information about the water samples and the water quality measurement results using the Horiba multiprobe. Upon completion of the fieldwork, the monitoring team will deliver grab samples to the AAWTP laboratory for analysis and return equipment to the HRWC office. A 'chain-of-custody' form (see Appendix) will be completed and submitted to the lab to follow the water samples.

2.3.1 Parameters to be Measured

The following parameters will be measured at each site:

- Water level and discharge (in cubic feet per second)
- Total Phosphorus (TP in mg/l)
- Total Suspended Solids (TSS in mg/l)

- Nitrate and Nitrite (NN in mg/l)
- *Escherichia coli* (in count per 100 ml)
- Dissolved oxygen (in mg/l)
- Water temperature (in degrees Celsius)
- Conductivity (in micro Siemens)
- pH

All parameters will be collected during each sampling event, with the exception of water discharge. See the discussion in section 2.3.4 for water discharge procedures. Also, only water level (later downloaded discharge), TP, TSS, NN and *E. coli* will be collected during storm events. Table 3 below includes specific statistics for each parameter.

Table 3. Analytical specifics for measured parameters

Parameter	Method	Detection Limit/Range	Sample Volume (ml)	Bottle Type	Preserva-tive	Hold Time
Total phosphorus	SM20 4500-P B.5 and E	0.01 ppm	100 or 250	plastic	none	48 hrs
Total Suspended solids	SM 20 2540 D	0.1 ppm	750	plastic	none	none
Nitrate/nitrite	SM20 4500 – NO3 B / SM20 4500 – NO2 B	NO_2 - 0.1 ppb NO_3 - 0.2 ppm	750	plastic	none	48 hrs
E. Coli	SM20 9213 D	0 per 100 ml	100	Sterile Whirl-pak	none	24 hrs
Dissolved Oxygen	Horiba U-10 water quality probe	0.0 - 19.9 mg/l	NA; measured with field instrument			
Conductivity	Horiba U-10	0 - 100 mS/cm	NA; measured with field instrument			
pH	Horiba U-10	0 - 14 pH	NA; measured with field instrument			
Temperature	Horiba U-10	0 - 50 °C	NA; measured with field instrument			
Flow	Marsh-McBirney Flomate 2000	-0.5 to +19.99 ft/sec	NA; measured with field instrument			

2.3.2 Equipment

A Horiba U-10 Water Quality Checker multiparameter monitoring instrument will be used to collect additional paramteres inculding pH, DO, conductivity and temperature.

Water flow measurements will be made using a top-setting rod, that allows all adjustments to be made from above water, with a Marsh McBirney Flo-Mate (Model 2000) portable flow meter.

"WaterMark" Style C stream gauges, graduated to hundredths and marked at every foot and every tenth, will be used.

HOBO pressure sensors (model U20-001-01) will be purchased from Onset Computer Corporation (www.onsetcomp.com), and installed by the project manager.

2.3.3 Grab Sampling

Collectors will obtain a sufficient supply of sample bottles, labels, a cooler (with freezer pack), and field data sheets. They will follow sampling protocols (see Appendix) to collect grab samples and deliver to the laboratory for analysis.

2.3.4 Flow Monitoring

Water level and discharge will be recorded in two ways. Three sites (Huron @ Hamburg Rd., Mill, and Malletts) have USGS stations associated with them, and one (Allens) has a auto-recorded managed by the City of Ann Arbor. At these sites, water levels will be recorded along with time during each sampling event. Water level and discharge information will later be downloaded and recorded on field sheets and entered into the database. No further flow information will be collected.

Two additional sites will have HOBO water level sensors installed. These will be set to record pressure and temperature every 10 minutes. Pressure is converted to water level by adjusting for barometric pressure following procedures included in the HOBO data logger user guide, which is kept on file at the HRWC offices. Water level will be converted to discharge by developing rating curves for each site by collecting at least seven flow measurements spanning the range of water levels, following flow procedures included in the Appendix.

For the remaining sites, staff gauges have been installed. Rating curves will be established for each of these gauges to translate a staff gauge level reading into a discharge estimate as indicated in the flow procedures in the Appendix.

2.3.5 Wet-Weather Monitoring

In addition to the twice monthly monitoring at each location, a minimum of one wet weather event will be sampled at each site over the course of the grant project. Following analysis, subsequent events will be monitored for sites based on data need and availability of resources. The actual number of events sampled will depend on the frequency of suitable wet weather events, thus, the distribution of events sampled is difficult to predict.

Wet weather events will be in response to precipitation events predicted to yield a minimum of 0.5 inches within 24 hours. Mobilization will occur when storms of the desired magnitude are predicted, based on available hourly forecast predictions.

Samples will be collected at the onset of a storm event (one to two samples), at peak flow (one sample), and at the end of the event (one sample). Peak flow for a given event will be determined by monitoring the change in staff gauge measurements and regularly collecting grab samples through the water level crest.

In addition, one replicate will be collected during each sampling event for quality assurance, and a field blank will be utilized at the beginning of each sampling period to ensure contamination of samples is not occurring. Specific guidance for storm event sampling is included in the sampling SOP included in the Appendix.

2.4 Data Quality Objectives

Accuracy and precision statistics for each of the measured parameters are included in Table 4 below.

Table 4. Accuracy and precision of measured parameters

Parameter	Accuracy	Repeatability/ Precision
Total Phosphorus	2.8% (from spikes)	3.5%
Total Suspended Solids	.0001 mg/l (from blanks)	19.6%
Nitrate/nitrite	NO_2: 6.0% (spikes) NO_3: 4.3% (spikes)	3.0% 7.2%
E. Coli	NA	
Dissolved Oxygen	0.1 mg/l	±0.1 mg/l
Conductivity	0-1 mS/cm: 0.01 mS/cm 1-10 mS/cm: 0.1 mS/cm 10-100 mS/cm: 1 mS/cm	1%/F.S.
pH	0.1 pH	±0.05 pH
Temperature	1°C	±0.3°C
Flow	± 2% of reading ± 0.05 ft/sec	± 0.05 ft/sec

For lab-analyzed chemical parameters, accuracy objectives are to stay within 10% using blanks and spikes. Precision objectives are to stay within 10% for all but TSS, and within 20% for TSS using field duplicates. For field parameters, the following objectives will apply.

2.4.1 Precision

Different teams will measure discharge at the same water levels to calculate precision of teams.

2.4.2 Accuracy

New volunteers and student interns will receive training that includes practice in the stream. They will then take water samples, measure water quality parameters and flow in teams of two or three members, accompanied by trainers on their first outing for stream monitoring. Periodically trainers will accompany them as an additional check on proper technique and sampling protocol.

2.4.3 Representativeness

Monitoring sites have been selected to be representative of the chemical concentrations and loads entering the Huron River from tributaries. As such the measures should be the cumulative impact from each tributary. By taking baseflow samples at regular intervals, the dataset should be representative of the conditions at the output of these tributaries. Including storm samples should allow for calculation of a representative set of loadings for each tributary.

2.4.4 Comparability

Standard procedures are being followed for all measures, which have been and are being utilized in other watersheds. This should allow for comparable results.

2.4.5 Completeness

Our objective is to complete multiple measurements of discharge at sufficient water levels to develop a rating curve for each staff gauge or level sensor installed at each monitoring site. We expect to collect samples twice per month at all monitoring sites for base flow and a storm event for each. Following validation by the project and field managers, the objective is to maintain 95% valid results and at least 90% completeness according to the above outcome objectives.

2.5 Quality Control Procedures

All field equipment and lab equipment will be calibrated with a frequency consistent with procedures in each instrument's manual. Dates on all calibration chemicals will be inspected and chemicals replaced as needed. As indicated previously, field duplicates and blanks will be collected and analyzed for laboratory parameters for use in calculated accuracy and precision. Each will be collected and analyzed at a frequency of one for every ten samples. Relative % differences will be reported for each along with the monitoring data.

2.6 External Data Acquisition

Data has been collected regularly under this monitoring program since 2003. This data will be included in the final report. That data will be distinguished from data collected under the grant project.

In order to compute water level using the HOBO pressure sensors, a barometric pressure record covering the period of monitoring is necessary. Barometric pressure data is available from a wide network of weather stations via the Weather Underground at www.weatherunderground.com. The nearest station to the location of each sensor will be selected as the barometric pressure source. The data will be regularly downloaded from the website and processed for import into the software that accompanies the pressure sensor. The software uses an algorithm to use the barometric pressure data to compensate for the atmospheric portion of the pressure measurement recorded by the sensor and compute a water level from the remaining pressure. Since the compensation is a relative computation tied to an initial water level measurement at the time of installation, either raw or elevation-corrected barometric pressure can be used.

3. Data Validation and Reporting

3.1 Data Review, Validation and Verification

Upon completion of field sampling, collectors will deliver samples to the lab, where labels will be matched to the chain-of-custody form before the lab signs off on the transfer. The data forms will be delivered to HRWC offices where they will be reviewed by the program or field manager for completeness. All equipment will be signed back in and check for completeness. The program manager will download any water level and discharge measures and record those on the data forms prior to initialing the data forms. If any data or equipment is discovered missing, the project manager will make an effort to recover at the time of turn-in. If this is not possible, the data gap will be noted on the data form. Collectors will be instructed on any procedures that were not properly followed. A determination will then be made on the validity of the data collection. If necessary, the collection will be rescheduled.

3.2 Reconciliation with DQOs

Upon receipt of data from laboratory analysis, the results of field blanks and duplicates will be evaluated to confirm that accuracy and precision objectives are being met. Any exceedences will be reported to the laboratory corrective actions will be requested. Further, individual samples will be evaluated with lab staff to determine if any should be deemed invalid. A completeness

statistic will also be computed as a percentage of samples validated against the total of samples collected. Any violations of DQOs will be included as caveats in data analysis reports.

3.3 Data Management

Once data are collected from the field, they are entered into the program database. The database is an Access database that is integrated with other monitoring data collected by the HRWC. The database helps to reduce data entry error by including field limitations. The database is housed on the HRWC server, which is backed up nightly on-site and twice per month off-site. The data are compiled and analyzed in Excel to calculate statistics and trends for each site for the measured parameters.

3.4 Reporting

Monitoring, quality control evaluation and data analysis progress will be reported quarterly to the DEQ Project Officer. Following a comprehensive analysis of the full 2003-2009 dataset, the results will be synthesized into a final report for hard-copy and electronic distribution to MDEQ, Water Bureau (WB), community partners of the Middle Huron Initiative and Huron Chain of Lakes at semiannual meetings, and on the HRWC website. Data collected as part of this grant project will be segregated and reported separately to the DEQ Project Officer. All data will be submitted to the DEQ Project Officer at the close of the grant.

3.5 Audits

The necessity of field audits is limited as the field manager accompanies volunteer collectors on a regular basis. In addition, sampling teams will be reset each year to provide for comparison of results from different collectors. The program manager will also conduct field samples on occasion as an additional level of program evaluation.

Any systemic problems discovered through this process by either manager will be discussed and retraining will be scheduled for collectors as needed to address problems. Other programmatic corrective actions will be taken as necessary and communicated to volunteer collectors. If necessary, this program QAPP will be updated with revised procedures. All problems will be reported via quarterly reports to the DEQ project officer.

4. Appendices

Included with this document are the following appended documents:

1. Middle Huron Partners Contact List (as of July 2008)
2. Field sampling procedures
3. Flow monitoring procedures
4. 2008 Field Data Form
5. Flow Monitoring Form
6. Chain of Custody Form

Appendix B:

DRAFT Non-Point Source Pollution (Phosphorus) Reduction Implementation Plan for Middle Huron River Watershed

DRAFT 7/24/07

NONPOINT SOURCE POLLUTION (PHOSPHORUS) REDUCTION IMPLEMENTATION PLAN FOR THE MIDDLE HURON RIVER WATERSHED

September 2004 — October 2009

For the purpose of fulfilling the obligations stated in the document
"The Middle Huron Cooperative Agreement for Reduction for Phosphorus
Loading to the Middle Huron River Watershed" (September 16, 2004)



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.

MIDDLE HURON INITIATIVE

Acknowledgements

The authors wish to recognize the commitment of the many individuals, organizations, and communities whose resources, research, and talents have contributed to this Middle Huron Watershed Initiative.

The Boards of Trustees of Ann Arbor Charter Township, Barton Hills Village, Dexter Village, Lodi Township, Pittsfield Charter Township, Scio Township, Superior Charter Township, Van Buren Charter Township, and Ypsilanti Charter Township
The City Councils of Ann Arbor, Chelsea Ypsilanti
The Regents of the University of Michigan
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Andrea Dorney, Village of Dexter
Brad Roberts, City of Chelsea
Charles Nielsen, Scio Township
Dan Geyer, TTMPS for Loch Alpine
Dan Swallow, Van Buren Charter Township
Dave Rusnell, DaimlerChrysler, Chelsea Proving Grounds
Dawn Roush, Michigan Department of Environmental Quality
Deborah Kuehn, Superior Charter Township
Donna Dettling, Village of Dexter
Earl Kenzie, City of Ann Arbor
Gerry Kangas, Scio Township
Jan Godek, Lodi Township
Jason Bibby, Ypsilanti Charter Township
Jim Wilkes, Village of Barton Hills
Michael Moran, Ann Arbor Charter Township

By Elizabeth Riggs, Huron River Watershed Council

Cover Photos (left to right): John Lillie; John Cramer; HRWC

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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 falling 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 this area. These waters were largely dammed in the past for power generation, resulting in a series of eight reservoirs. Today the primary purpose for most of the reservoirs 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 estimated that this drainage area impacts the conditions in the two reservoirs.

Problem Definition

Ford Lake and Belleville Lake, reservoirs on the Huron River in Washtenaw County and Wayne County, respectively, previously were listed as impaired waterbodies on Michigan's Section 303(d) list (Impaired Waterbodies List) due to impairment of recreational uses by the presence of nuisance algal blooms. In response to their appearance on the list, MDEQ developed a TMDL for phosphorus in 1996 to be met in the lakes in order to attain recreational uses of the 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. 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.

The Nature and Sources of Phosphorus[1]

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

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

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. Excessive 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. Depletion of DO adversely affects many animal populations and can cause fish kills.

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 of 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, objectionable 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 bottom 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 dynamic results in an internal phosphorus loading. Because of this phenomenon, a reduction in phosphorus inputs 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 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 1) land areas being mined for phosphate deposits, 2) agricultural areas, and 3) urban/residential areas. Because phosphorus has a strong affinity for soil, little dissolved phosphorus will be transported in runoff. Instead, the eroded sediments from mining and agricultural areas carry the adsorbed phosphorus to the water body. An additional source is the overboard discharge of phosphorus-containing sewage by boats.

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 Total Maximum Daily Loads (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 Total Maximum Daily Load (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

The MDEQ determined the Total Maximum Daily Load for phosphorus in the lakes, and in 1996, completed the first TMDL for phosphorus in Michigan. State scientists estimate that to reduce the problems associated with nuisance algal blooms in the reservoirs, it is necessary to reduce summer concentrations of phosphorus in the river at Ford Lake to 50 μg/L. This concentration likely would reduce phosphorus concentration in Belleville Lake to 30 μg/L, which is the goal set by the Michigan Water Resources Commission in 1987. To reach this goal requires reducing 1995 phosphorus loads by approximately 50 percent. MDEQ set forth these goals in the TMDL allocation for the middle Huron. The TMDL was updated in 2004 and approved by the U.S. EPA in November, 2004.

Sampling and modeling of in-lake phosphorus concentrations, conducted by the MDEQ, demonstrated that continued regulatory reductions of phosphorus from the middle Huron wastewater treatment plants and other major dischargers alone would be insufficient to meet water quality targets set for the reservoirs. The concentrations of 50 μg/L in Ford and 30 μg/L in Belleville were derived, in part, from the loading calculations in the reservoirs. Load allocations were based on eight decades of flow data from the USGS. The TMDL set target phosphorus loads by month, which indicated that necessary reductions range from a cushion in April of being 55 pounds below the allocation to 75 pounds above the monthly allocation in May.

Table x. Phosphorus Load Allocation by Month (lbs/day)

	April	May	June	July	August	September
Target Load of TMDL	304	214	139	88	74	103
Estimated Point Source Load*	92	97	77	77	77	77
Estimated NPS Load*	157	192	123	70	50	67
Estimated Total Load	249	289	200	147	127	144
Target Load Reduction	(55)	75	61	59	53	41

* 1996, Brenner and Rentschler

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 that 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 Lake and Belleville Lake since the development of the TMDL. Each monitoring season, from April to October, state field scientists visit the sites 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 measure water clarity, chlorophyll a, 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 and 2002; 2007 is the next year in which MDEQ will monitor the Huron.

In addition to monitoring conducted by the State, HRWC developed in 2002 a companion monitoring program for nine of the tributaries flowing to 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 is visited one time per month. A river site upstream of the confluence of Mill Creek is monitored for upstream conditions, and 9 sites from Dexter to Ypsilanti are monitored as well.

The data collected by the State is the primary monitoring program for the middle Huron River Watershed to measure the progress towards meeting the phosphorus TMDL. Similarly, HRWC's tributary monitoring program is the only program collecting data on nutrients in the tributaries flowing into the middle Huron. However, the sampling efforts conducted by MDEQ and HRWC have had limited usefulness in that they cannot, due to limited resources, provide more robust data on the temporal variation that comes from precipitation events and other environmental factors. Another shortcoming of the two programs is that they do 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.

Given the limitations of the lake and tributary sampling programs, a few general comments can be made about their findings. Except for decreases of TP in 1997, the lakes generally have not met the TMDL of 50 μg/l in Ford Lake and 30 μg/l in Belleville Lake. Increased water clarity was reported from the 2001 and 2002 field seasons; field scientists attribute that increase to the presence of zebra mussels that had recently establish populations in the lakes. Total Phosphorus concentrations in all of the tributaries have exceeded 30 μg/l during the

field seasons of 2003, 2004 and 2005. Even Fleming Creek, the least developed of the creeksheds in the middle Huron, measures TP values closer to 40 μg/l.

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 that factors that influence nuisance algal blooms. Dr. John Lehman is the Principal Investigator. According to the project's website[2], project objectives include compartmentalizing the river system to pinpoint watershed segments responsible for inputs and internal processes that reduce stoichiometric ratios of nitrogen to phosphorus. Evaluating the role of redox transformations and assessing magnitudes of anaerobic nitrate respiration are key elements of the research plan. The project evaluates interactions of river discharge volumes, internal transformations, and weather events as components of adaptive management theory. It identifies the places and conditions that account for significant amounts of denitrification, as well as reservoir management responses that can counteract the conditions that promote nuisance blooms.

Field studies for the project commenced in June 2003. Twelve sites along the Huron River have been sampled on a regular basis: once or twice weekly during summer, weekly during spring and fall, and biweekly during the winter. Lake sampling, including vertical profiles of temperature, oxygen, and water chemistry has been conducted at Barton Pond, Ford Lake, and Belleville Lake. In addition, automated recording instruments have been installed in these lakes to measure temperature, oxygen, pH, and total dissolved salts (as conductivity) around the clock.

In an October 2005 presentation about the project's findings to date, Dr. Lehman provided the following highlights about data collected from June to August, 2003 to 2005. Each day:

- Huron River delivered 562 moles of phosphate
- 964 moles of phosphorus in all dissolved and colloidal forms
- Only about 40% of this phosphorus comes from the Ann Arbor Wastewater Treatment Facility (point source)
- Ford Lake mud released no less than 1228 moles of phosphate each day on average.
- In Ford Lake, non-point sources dominate.

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

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

[2] *Text adapted from University of Michigan U.S. EPA STAR grant-funded project Adaptive Management for Improved Water Quality in Multi-Use Watersheds*

addition, the Washtenaw County Drain Commissioner has jurisdiction over those tributaries (or portions thereof) designated as county drains. Nested 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 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 reflect the group's understanding that stakeholders with jurisdiction over minute portions of he TMDL are 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 these phosphorus reduction goals. These communities and MDEQ, along with the Washtenaw County Drain 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 has 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; as of completion of this annual report not all of the partners that intend to sign the document have done so. Several of the larger businesses that have 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 is effective January 1, 2006. However, it is possible that additional signatories may be added after that date.

Specific TMDL Implementation Objectives for Nonpoint Source Contributions[3]

The 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 kept 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 flow. In order to decrease 1995 loadings to the 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 x). TMDL implementation consists of reducing point and nonpoint source loads to the levels presented in Table x.

Table x. 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.

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

The TMDL for Phosphorus for Ford and Belleville Lakes has this to say about the Load Allocation expectations, which speak to nonpoint sources of phosphorus: 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.

II. Reassessment of Priorities of the 1996 Phosphorus Reduction Strategy for the Middle Huron River Watershed

Ten years have passed since the technical committee of the Middle Huron Initiative developed a list of best management practices for reducing the major sources of phosphorus. They focused on the sources of (1) urban stormwater runoff, (2) rural runoff, and (3) point sources. For the purposes of this document, the reassessment of priority actions will focus on nonpoint sources of pollution both urban and rural. Reassessing practices that reduce point source contributions of phosphorus occurs in the companion to this document, the Point Source Pollution Reduction Implementation Plan (2006).

Brenner and Rentschler (1996) recommended these Best Management Practices for Stormwater Runoff from Residential, Commercial and Industrial Land Uses:

Practice 1:	**Enact Policies to Reduce Imperviousness**
Suggested actions:	Site plan review standards to minimize stormwater and phosphorus runoff
	Natural features protection for woodlands, wetlands and riparian zones
	Limit phosphorus export from new development, evaluated on basis of imperviousness and design and building site soils
	Reduce parking lot size
	Use permeable parking surfaces
	Cluster new residential development
	Enact private road ordinances
Target audience(s):	County and local governments; developers and institutions

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 2:	**Educate and Develop Policies Addressing Use of Fertilizers**
Suggested actions:	Reduce use of fertilizers
	Use low phosphorus fertilizers
	Reduce area of turf grass
	Regulate use of phosphorus fertilizers on sensitive areas
	Change mowing habits; leave lawn clippings for mulch
Target audience(s):	Homeowners; lawn care companies; landscaping companies; parks departments; point of purchase; and institutions

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 3:	**Improve Stormwater Management and Conveyance Systems**
Suggested actions:	Improve design standards for stormwater conveyance systems for new systems (Rules of the Washtenaw Co. Drain Commissioner)
	Clarify responsibility for funding and improve maintenance of stormwater systems and retrofitting old designs, and treatment wetlands
	Promote grass swales and ditches along roads
Target audience(s):	Developers; local governments; homeowners' associations

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 4:	**Provide Incentives to Keep Stormwater On-site for Treatment and Infiltration**
Suggested actions:	Provide incentives and remove obstacles in ordinances and site plan review standards
	Increase incentives via stormwater utility fee
	Encourage infiltration on-site, roof runoff onto lawns, relocate downspouts to permeable areas
	Promote wetland creation on-site
	On-site wet ponds/extended detention ponds
Target audience(s):	Homeowners; developers

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 5:	**Enact Policies to Reduce Soil Erosion from Disturbed Sites**
Suggested actions:	Institute per acre charge for area disturbed
	Improve enforcement of soil erosion control rules
	Increase fees to cover costs of enhance enforcement
	Educate developers and contractors in techniques available for erosion control
	Enact ordinances to protect steep slopes, erodable soils, riparian zones

	Strengthen clearing and grading ordinances to be more proactive than erosion control during and post-development
Target audience(s):	Developers; local governments

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 6:	**Educate for Water Conservation and Recycling of Cooling Water**
Suggested actions:	Reduce domestic water supply inputs to storm sewers/drains via footing drains and other sources
	Provide information to facilitate industry reuse of cooling water
Target audience(s):	Homeowners; developers; industry; institutions

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 7:	**Educate for Changes in Leaf Management**
Suggested actions:	Promote bagging of leaves for pick-up
	Promote composting at home sites
Target audience(s):	Homeowners; local governments

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 8:	**Change Design of Road Construction**
Suggested actions:	Build narrower roads
	Use grass swales
	Change gravel/dirt road design to prevent erosion
Target audience(s):	Developers; road commissions

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 9:	**Educate for Proper Private Car Washing**
Suggested actions:	Promote use of low or no phosphorus soap
	Promote washing cars on grass
Target audience(s):	Vehicle owners

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 10:	**Reduce Illegal or Leaking Connections to Storm Drains**
Suggested actions:	Enact dye testing at time of title transfer or sale
Target audience(s):	Property owners; local governments

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Brenner and Rentschler (1996) recommended these Best Management Practices for Stormwater Runoff from Agricultural Land Uses:

Practice 1:	**Reduce Soil Erosion from Agricultural Fields**
Suggested actions:	Employ conservation tillage
	Install vegetative filter strips
Target audience(s):	Farmers; landowners

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 2:	**Reduce Soil Erosion from Stream Banks**
Suggested actions:	Conduct hydrologic study of Mill Creek
	Restore wetlands to increase storage
	Restore stream banks with soft engineering practices
Target audience(s):	Farmers; landowners; local governments

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

Practice 3:	**Improve Livestock and Nutrient Management**
Suggested actions:	Enforce existing rules such as Right to Farm guidelines
	Provide economic incentives to improve outdated feedlot facilities
	Conduct soil testing and follow test recommendations for fertilizer
	Promote new technologies that reduce costs of nutrient management
Target audience(s):	Farmers

To what extent have these activities been enacted?
Have these activities had a measurable impact on the reduction of phosphorus entering the middle Huron?

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

Measures to reduce phosphorus will include activities that, to a large extent, are required already of the National Pollutant Discharge Elimination System (NPDES) municipal stormwater permittees within the watershed through the Phase I and Phase II of that program. Permit holders located in the middle Huron River Watershed are City of Ann Arbor, University of Michigan, Michigan Department of Transportation, Ann Arbor Charter Township, City of Belleville, Dexter Township, Dexter Village, Northfield Township, Pittsfield Charter Township, Lodi Township, Salem Township, Scio Township, Ypsilanti Charter Township, City of Ypsilanti, Superior Charter Township, Van Buren Charter Township, Washtenaw County, Wayne County, and Webster Township.

Prior to the implementation of the NPDES stormwater permit program, several of the 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 (?) have been awarded to Middle Huron Initiative Partners where one of the stated goals of the projects has been to reduce phosphorus contributions as mandated in the TMDL. 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.

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 also are Partners of the Middle Huron Initiative. Implementation of activities to meet that TMDL is underway and will continue at least until 2011 when the TMDL is slated to be achieved.

Activities to reduce nonpoint sources of phosphorus pollution as planned or currently underway by the Partners are presented in Table x. This table will provide a basis for Partners to review progress towards meeting the TMDL for phosphorus in Ford and Belleville lakes at its semi-annual meetings.

Table X. Middle Huron Non-point Source Pollution (Phosphorus) Reduction Activities

Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Repair Illegal Connections or Failed Septic Systems								
Illicit Discharge Elimination Plan (IDEP)	Remove non-storm discharges to the storm water drainage system by investigating illicit connections in sanitary and storm pipes; help meet Huron TMDL; fulfill storm water permit obligations; and improve water quality.	All local units of govt.; UM	Any program should include: • strategy to perform routine dry weather screening of storm water point sources • plan to re-inspect storm water point sources every 5 years • program to limit infiltration of seepage from sanitary sewers and on-site sewage disposal systems into drainage system, if applicable • legal authority to prohibit discharges into drainage system Inspection by Washtenaw County Drain Commissioner's Field Inspection Division of 10% of County Drains for each program year. Ongoing County Drain inspection following initial program inspections per permit. Estimated 150 locations to be dry weather sampled annually; Drain inspection to follow findings of Environmental Health Department. City of Ann Arbor inspects storm sewers by closed circuit T.V., about 35,000 l.f. annually, removing debris from 125,000 l.f. of storm sewer annually. City works with county for IDEP screening. UM screens one area of campus each year so that entire campus is covered in 4 years. U-M will perform dry weather screening on the entire campus over the 5-year permit cycle; typically done during four to five rounds of screening. Any issues identified for further investigation or correction will be tracked for subsequent reporting Village of Dexter will inspect approximately 6 outfalls per year. City of Ypsilanti will inspect 25% of outfalls in second permit year. Will complete all evaluations by fifth year.	Should substantially reduce sanitary cross connections to storm water drainage system, reducing the illicit discharge of sanitary waste to the Huron River and its tributaries. Assuming 1% of watershed population is illicitly connected, and all connections are discovered and removed within 5 years, this would result in the discounted removal of **533 lbs of P per year**.	Sampling, video and dye-test database (geo-referenced) Number of illicit connections identified and number of corrections implemented (Washtenaw County)	Annually for five years, with repeat investigations	City of Ann Arbor: Craig Hupy at chupy@ci.ann-arbor.mi.us University of Michigan: Malama Chock at chock@umich.edu	$25,000/yr spent by City/County UM annual screening ~$10,000, the cost of correcting cross connections can range from $1000 to $500,000 depending on site specifics.
Pump Station Contingency Plan	Reduce illicit discharges from pump station flooding	Ann Arbor Charter Township	Plan to reduce pump station flooding to prevent illicit discharges entering Huron River past Geddes Dam. Ann Arbor Township operates two lift stations in the urbanized area.	Should reduce illicit discharge of phosphorous from pump station flooding. Loading reduction included in above.	Number of overflows prevented by plan	Ongoing.		

Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Septic Inspection	Identification and correction of failing septic systems that discharge human waste into the ground and groundwater, potentially impacting surface waters.	Washtenaw County, Pittsfield Charter Township, Ann Arbor Township, Van Buren Township, Webster Township, Lodi Township, Scio Township, Salem Township, Village of Dexter, UM	In Washtenaw County the program will involve certified inspectors and occur when there is a transfer of ownership. Pittsfield Charter Township plans to contract from Washtenaw County. Each of their 2200 septic systems will be inspected once every five years. This number will grow as there are more rural home developments now in the site planning process. Ann Arbor Township is currently updating its maps to identify all parcels served by septic systems and is considering developing a septic system/drainfield inspection program to supplement Washtenaw County's permitting and inspection program; AAT does have several residential developments within township boundaries that use septic systems and drainfields for sanitary waste. Possible inspection every 4 years.	Monitoring drainfields and septic systems will help identify and prevent illicit discharges. There are very few septic systems in urban areas. Assuming a 20% failure rate, and 25% inspection and correction rate over five years, loading reduction would be **1,440 lbs/year**.	Percent and acres inspected. Failure rates and percent corrected.	Ongoing; no end date	Leon Moore at morel@washtenaw.org Jan BenDor at 734-822-3122 or clerk@pittsfieldtwp.org Ann Arbor Township Utilities Department – 734-663-3418 or rjudkins@aatwp.org	Up to $300 per inspection $10,000-30,000 for tank or field drain replacement
Operations and Maintenance Programs								
Structural Control Maintenance	Maximize effectiveness of structural controls in removing pollutants from stormwater	All local units of govt; UM	Routine inspection and maintenance for any structural controls intended to remove pollutants from stormwater. Includes specified disposal procedures for any materials removed from the drainage system.	Reduces sediment discharge which is laden with phosphorus Maintenance ensures loading reductions are maximized.	UM – data provided in annual reports available on its website	UM – stormwater management basins inspected annually; maintenance cleaning of catch basins and storm sewer piping conducted semi-annually.		NEED COST DATA
Pesticides and Fertilizers / Lawn Maintenance Program	Minimize discharge of pollutants related to storage, handling and use of pesticides, herbicides, and fertilizers.	All local units of govt.; UM	Employee training and soil testing on all fertilized land; fertilizers applied in accordance with soil test results. U of M employs Integrated Pest Management methodology.	Reduces phosphorous runoff from these applications. Load reduction calculated as part of "Residential Yard Waste Management"	Number of facilities implementing proper practices	Ongoing.	NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	NEED COST DATA
Pollution Prevention Program	Identification and elimination of discharge problems.	Washtenaw County, cooperation from local units of govt.	This program is responsible for inspecting facilities that store, manufacture, or use hazardous, toxic, or polluting materials. Inspectors make sure facilities use and dispose of materials properly to avoid environmental contamination.	Should reduce discharge of pollutants through regular maintenance and proper management. Minor phosphorus reduction.	Inspection reports and improvements made.	Ongoing.	NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	NEED COST DATA

Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Residential Yard Waste Management	Encourage proper disposal of yard trimmings	Washtenaw County, City of Ann Arbor, City of Ypsilanti, Village of Dexter, UM	City of Ann Arbor conducts residential yard waste / compost collection weekly from April 1 to October 31. Also conducts 2 scheduled leaf pick ups in the fall. U of M cleans leaves from curbs and storm drains October through November. City of Ypsilanti conducts leaf pick ups the last week of October, all of November, and the first two weeks of December.	Proper yard waste management should prevent nutrient loading in surface waters – including phosphorous Assuming mixed media, multiple-run educational message reaches 50% of population and 70% change in behavior, combined program could result in discounted load reduction of **992 lbs/yr** from lawn and yard waste.	Tons of yard waste collected	NEED TIME FRAME DATA FOR ALL PARTICIPATING PARTNERS	NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	NEED COST DATA
Street Sweeping	To prevent sediment and debris in street from entering storm sewer system	City of Ann Arbor, City of Ypsilanti, UM, Village of Dexter, Lodi Township, Ann Arbor Township	City of Ann Arbor – downtown area swept 2 times a week; weekly during warm weather conditions. City streets swept 2 times a year (spring and fall after leaf pickup). U of M – occurs monthly throughout the year. Ann Arbor Township – freeway and road maintenance by MDOT, Washtenaw County, and City of Ann Arbor Lodi Township – road maintenance by Washtenaw County City of Ypsilanti – parking lots swept 8 times a year Dexter currently sweeps streets more than once a month on average.	Prevent phosphorous laden sediment from entering storm water system. Assuming mixed implementation of street sweeping in Ann Arbor, U of M and Ypsilanti, results in discounted load reduction of **359 lbs/yr**.	Acres of streets/parking lots swept per year. U of M data available in annual reports available on web site.	Ongoing.	U of M: Malama Chock at chock@umich.edu Ann Arbor: Molly Wade mlwade@a2gov.org NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	Ann Arbor: $129,000 annually
Update Storm Water Management Standards (Pond Landscaping Section)	Reduce nuisance geese habitat at storm water ponds; require buffer or other means.	Local units of govt., UM	Each time storm water system is reviewed or equivalent.	Controls source of likely avian contributor.	Will follow up	No end date.	Harry Sheehan at sheehanh@ewashtenaw.org Jerry Hancock for City of Ann Arbor at 734-994-2711 or jhancock@ci.ann-arbor.mi.us NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	Not tracked.

Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Information and Education								
Public Education Program (PEP)	Awareness and education on storm drain pollution prevention, and impacts on water quality. Encourage the public to reduce discharge of pollutants to storm water.	HRWC, all local units of govt.; UM	Seasonally for approximately 6 years for HRWC. Ongoing for local units of govt. Distribute water quality information, and information on the hazards associated with illicit discharges, as well as proper waste disposal techniques: • Posters, tip cards, and flyers • Articles in the HRWC newsletter and other local newletters • Calendars • PSAs on radio and TV • Web site information • Workshops • Newspaper advertisements • Mailings Promote soil testing.	Difficult to measure beyond the number of homeowners who have received the materials throughout the watershed, including Ypsilanti Township, city of Ann Arbor, Van Buren Township, YCUA service area, Sumpter Township, Village of Milford, customers of Edward Surovell Realtors, and HRWC members. See "Residential Yard Waste Management" for loading reduction.	NEED DATA FOR ALL PARTICIPATING PARTNERS	Seasonally for approximately 6 years for HRWC. Limited quantities available upon request; reprints can be made if several communities wish to reissue the materials (contact HRWC). NEED TIME FRAME DATA FOR ALL PARTICIPATING PARTNERS	Jennifer Wolf at HRWC; jwolf@hrwc.org Jen BenDor at 734-822-3122 or clerk@pittsfieldtwp.org NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	Tip cards (per piece): $0.12-0.30 Pittsfield Township has budgeted $10,350 for Public Education within its 2003 Phase II Compliance Budget. Is this up to date?
Storm Water Drain Marking Project	Reduce discharges to storm water drainage system by marking each storm drain with a warning that it drains to the river.	HRWC, Van Buren Township, City of Ann Arbor, City of Ypsilanti, Ypsilanti Charter Township, Washtenaw County, Pittsfield Township, UM, Scio Township, Village of Dexter, Salem Township	Markers are continuously being placed on drains; markers are replaced every few years when old markers begin to fade or fall off. All new curb storm drains have the message "Dump No Waste – Drains to Waterways" engraved on it.	Raise awareness of connection of storm drains to surface waters. See "Residential Yard Waste Management" for loading reduction.	Number of drains marked. U of M data available in annual reports available on website.	Ongoing.	Elizabeth Riggs at HRWC; eriggs@hrwc.org Craig Hupy at chupy@ci.ann-arbor.mi.us Michelle Bononi at bononim@ewashtenaw.org Jan BenDor at 734-822-3122 or clerk@pittsfieldtwp.org Malama Chock at chock@umich.edu	City of Ann Arbor spends between $1.50 (new lexan markers) and $3.05 ("crystal" coated markers) Washtenaw County budgets $5,000/yr Pittsfield Township budgeted $1,500 for label production (volunteer labor) The University of Michigan has spent $7,000 thus far on curb markers

Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Information and Public Education Through the Internet	Raise awareness and provide education on water quality, septic system maintenance, and guidelines for activities that may result in the pollution of the storm water system.	Pittsfield Charter Township; City of Ann Arbor; Washtenaw County; HRWC; UM, Ann Arbor Charter Township, Lodi Township, Van Buren Township	Provides information regarding local water quality issues to residents visiting these web pages. Special web information at the following organizations' web pages: • Pittsfield Township - http://pittsfieldtwp.org • City of Ann Arbor – http://www.ci.ann-arbor.mi.us • Washtenaw County - http://www.ewashtenaw.org • Huron River Watershed Council - http://www.hrwc.org • UM OSEH - http://www.umich.edu/~oseh/stormwater • Ann Arbor Township - http://www.aatwp.org • Lodi Township- http://twp-lodi.org/ • Van Buren Township - http://www.vanburen-mi.org/Department/Environmental.html	Raise awareness of general water quality issues. See "Residential Yard Waste Management" for loading reduction.	Feedback received from visitors to UM OSEH web page. Number of hits will be counted.	Ongoing.	Jan BenDor at 734-822-3122 or clerk@pittsfieldtwp.org Patrick Irish at pirish@aatwp.org Harry Sheehan; sheehanh@ewashtenaw.org Elizabeth Riggs at HRWC; eriggs@hrwc.org Kay Airton at kjordan1@aatwp.org NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	Minimal.
Environmental Excellence Awards Program	Encourage environmentally sound behavior.	Washtenaw County, cooperation from local units of govt.	Program recognizes businesses and non-profit organizations demonstrating good business practices in the areas of water quality protection and pollution prevention.	Should give businesses incentive to practice environmentally sound behaviors.	NEED DATA	Annually.	NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	NEED COST DATA
RV Waste Disposal Education	Prevent the illicit discharge of black water from RVs.	UM	Handout flyers on sanitary waste to RV owners to educate them on the impact human waste from RVs can have on water quality; Prohibit RV overnight parking in UM lots except for posted Hospital RV parking.	Educate RV owners about proper waste disposal to prevent illicit discharges. No loading from RV Waste has been computed.	No RV illicit discharges have been reported since the program was implemented. This program was implemented after a couple of RV illicit discharges were reported. (UP TO DATE?) A survey of RV owners at the Pioneer High School parking lot was conducted, including educational flyers.	Ongoing.	Malama Chock at chock@umich.edu University Hospital Entrance Program 963-6641	$2,000 IS THIS INFO UP TO DATE?
Community Partners for Clean Streams	Education and Outreach via public/private partnership; promote protection of watersheds/waterways through presentations, print material and signed agreements to manage practices and abide by good housekeeping measures.	Washtenaw County, cooperation from local units of govt.	Ongoing – offered by Washtenaw County. Partners must reapply every 2 years. Offers businesses, institutions and multi-complexes a self assessment to determine how daily site activities impact storm water quality. Program handbooks and display updated to provide enhanced water quality education tools. Specific recruitment programs target relevant businesses.	Inspections ensure partners are meeting program expectations.	Number of new partnerships and partnership renewals – (76 partners in 2003). Behavior changes quantified via partner surveys. Approved site evaluations / surveys and summaries	Ongoing; no end date.	Michelle Bononi at bononim@ewashtenaw.org NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	$160,000/year Up to date?

Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Soil Erosion and Sediment Management								
Construction Site Runoff Control (SESC)	Minimize the impact on water quality through enforcement of Soil Erosion and Sedimentation Control Act, Part 91 and setback ordinances.	All local units of govt.; UM	Monitor and correct sediment discharges, changes of drainage patterns from construction activities. Site Plan Review and Best Management Practices developed. Ann Arbor Township in process of revising storm water management ordinance to require first-flush infiltration and provide incentives for increasing on-site infiltration beyond first flush; should provide significant removals of total phosphorous. Remainder of runoff would be treated with BMPs designed to control 60-80% of solids and phosphorous runoff load.	Minimize impact on water quality of phosphorous inputs from sediment discharges and drainage pattern changes from construction activities. Assuming 50% reduction of construction site runoff, phosphorus load reduction of **1,641 lbs/yr.**		Ongoing.	NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	
Post-Construction Site Runoff Control	Prevent discharges from storm water runoff from new development.	All local units of govt.; UM	Implement and enforce a program to address storm water runoff from new development and redevelopment projects. Site Plan Review and Best Management Practices developed.	Protect receiving water quality from the impacts of development and redevelopment projects.	NEED DATA	NEED TIME FRAME INFO	NEED CONTACT INFO	NEED COST DATA
Prevent Spills and Illegal Dumping								
Spill Clean-ups	Prevent discharge of pollutants from accidental spills.	UM	U of M OSEH routinely responds to minor chemical spills that do not result in release to the environment. Where the spill results in an actual or potential release to the storm water system, the data will be examined for improvements to the response system or educational efforts.	Prevent phosphorous from chemical spills entering the storm water system.	# spills available in annual reports available OSEH website.	Ongoing.	Malama Chock at chock@umich.edu	NEED COST DATA
Illegal Dumping and Pollution Incidence Response Enhanced Program	Prevent illicit discharges from illegal dumping.	Washtenaw County	This program encourages report of illegal dumping in Washtenaw communities and established communication and reporting with local governments via cooperation between Drain Commissioner and Washtenaw County Environmental Health Department. Local government liaisons for this program will be appointed.	NEED IMPACT DATA	Number of reports, number of spill responses contained or mitigated in accordance with county policy where operations level response 12 warranted.	NEED TIME FRAME	NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	NEED COST INFO
Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Reduce Animal Sources - Domestic								

Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Phase II Public Education and Public Involvement (Agriculture)/ Farmland Education	Educate local farmers on livestock management practices and their potential impacts to surface water.	Ann Arbor Township; HRWC, Washtenaw County	Education Materials upon request.	Decrease nutrient loading of phosphorous in surface water from animal waste. Raise awareness.	No data.	Future	Ann Arbor Township Utilities Department Ann Arbor Township NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	Ann Arbor Township: $4,000 - $6,000 IS THIS UP TO DATE? NEED OTHER COST INFO
Education on Pet Waste	Raise awareness on the impact of pet waste on surface water quality.	HRWC, local units of govt. UM	HRWC, City of Ann Arbor and Ypsilanti Township distributes educational flyers and newspaper advertisements on the impact of pet waste on water quality. They also distribute storm water calendars that include this information. The information will also be distributed with dog licenses in the future. Pet waste education on UM website.	Decrease nutrient loading of phosphorous in Huron River due to pet waste. Assuming mixed media, multiple-run educational message reaches 50% of population and 60% change behavior, combined program could result in discounted load reduction of **1,951 lbs/yr** from lawn and yard waste.	Number of mailings and media runs. Results from social surveys.	Spring 2003 and onward.	Jennifer Wolf at HRWC; jwolf@hrwc.org NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	Doggie flyers: $0.03 Storm water calendars: $0.80
Doggie bags in Parks	Provide materials for pet waste clean up.	City of Ann Arbor (Parks)	Provide bags for pet waste clean up. Ongoing.	Reduce pet waste in parks. Load reduction calculated as part of "Education on Pet Waste"	NEED DATA	Ongoing.	City of Ann Arbor Parks: Amy Kuras at 734-994-1827 or akuras@ci.ann-arbor.mi.us Jeff Dehring at 734-994-1913 of jdehring@ci.ann-arbor.mi.us	NEED COST DATA
Pooper Scooper Ordinance	Educate general public, reduce pet waste entering storm sewer.	Local units of govt.	Enact once, publicize.	Control source. Load reduction calculated as part of "Education on Pet Waste"	NEED DATA	No end date.	Harry Sheehan at sheehanh@ewashtenaw.org NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	NEED COST DATA
Reduce Animal Sources - Wildlife								
Native Landscaping Ordinance Development	Canadian geese enjoy foraging on green grass and appreciate the unobstructed view. This plan will diminish green grass cover and encourage the growth of tall prairie species.	Ann Arbor Charter Township, City of Ann Arbor, Pittsfield Charter Township, Scio Township, Village of Dexter	Diminishing green grass cover and encouraging the growth of tall prairie species.	Reduce geese habitat.	Areas converted to native landscaping – no data	NEED TIME FRAME	Ann Arbor Township Natural Features Committee NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	$5,000 IS THIS UP TO DATE?
Operation Goose Down	Decrease goose population in order to reduce the amount of goose droppings. This animal waste contains phosphorous that can enter waterways.	Pittsfield Township	Ongoing application of BMPs to reduce areas of nutrient loading from goose droppings.	Potentially strong impact if these measures achieve elimination of year-round goose habitation. Unknown load reduction.	Research on goose control BMPs show availability of numerous successful and cost-effective methods.	Ongoing, beginning in Spring 2003.	Jan BenDor at 734-822-3122 or clerk@pittsfieldtwp.org	Cost is site specific.

Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Reduce Phosphorous by Land Use Planning & Protection								
Farmland Protection Program	Preserve farmland to minimize surface and storm water pollution since loss of farmland correlates with surface and storm water pollution; preservation of farmland helps protect Huron River tributaries.	Ann Arbor Charter Township	Ongoing implementation of township Purchase of Development Rights Ordinance; landowner applications awarded points for environmentally sound behaviors under PDR programs; grant-seeking for funding of PDR purchases; program will permanently dedicate open space in Ann Arbor Township and help mitigate development pressures.	By preventing further urbanization and by promoting BMPs among farmers raising crops and animals, the program will preclude future illicit discharges.	NEED DATA	Ongoing.	NEED CONTACT INFO	NEED COST INFO
Greenbelt Program		City of Ann Arbor						
Land Development Standards	By preserving more open space under certain development standards to reduce earth disturbance and increased sedimentation by more concentrated development.	All local units of govt?	Enact land development standards in order preserve open space. Pittsfield Township Land Use Comprehensive Plan: Ongoing implementation of new agricultural preservation zoning in all rezoning and site plan applications to prevent further urbanization to preserve agriculture; The old township comprehensive plan allowed dense residential development on sewer and water infrastructure, which degrades the tributary watersheds. Village of Dexter and Scio Township - Baker Road Corridor Joint Planning Initiative to study area adjacent to Baker Road and develop preservation goals. (UP TO DATE?)	Reduce sediment discharges from development activities.	NEED DATA	NEED TIME FRAME	Jan BenDor at 734-822-3122 or clerk@pittsfieldtwp.org NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	Pittsfield - The Township paid $100,000 to consultants and engineers, and staff invested over 200 hours in the plan update in 2002. The cost of continuing to maintain and update the plan is estimated at $5,000 per year. (UP TO DATE?) NEED COST DATA
Impervious Surface Reduction/ Infiltration Enhancement Ordinance	Guide developers and individuals doing site plan review to find opportunities for reducing impervious surfaces and increasing water infiltration.	Scio Township, Ann Arbor Township	Scio Township is in the process of developing this ordinance. Intends to encourage reduction in impervious surfaces by allowing flexibility in the application of other ordinance requirements (parking, roadways, sidewalks, buildings). Ann Arbor Township has included these concerns in updates to the Parking Ordinance and Private Road Ordinance.	Should reduce impact to water quality from pollutants such as pesticides and fertilizers that are commonly carried in storm water runoff from impervious surfaces.	NEED DATA	NEED TIME FRAME	NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	NEED COST DATA
Rules and Ordinances for Storm Water Management	Prevent flooding, control flow, treat storm water, discourage geese by using native landscape buffers by waterways and ponds. Revise existing storm water management ordinance.	Washtenaw County, local units of govt., UM	Ongoing, rules revised roughly every 2 years. Revise ordinance to require designs to meet standards of the Washtenaw County Drain Commissioner.	Detain first flush for 24-hour period; Future rules will likely require infiltration of first flush. Up to date?	None	Rules of the Drain Commissioner will be completed late 2003. Ordinance development will be on-going through summer 2003. Up to date?	Harry Sheehan at sheehanh@ewashtenaw.org Ann Arbor Township Natural Features Committee NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	not tracked

Project Name	*Purpose*	*Involvement*	*Activity and Frequency*	*Loading Reduction Impact*	*Data*	*Schedule / Time Frame*	*Contact*	*Estimated Cost*
Wetlands Protection Program	Damaged and destroyed small wetlands cannot provide the services of filtering and cleaning pollutants in storm water. This program is intended to protect wetlands on one-fifth of an acre or larger. It will also be used to update existing ordinances and create new ordinances to address/meet recommendations of 1999 Washtenaw County Drain Commissioner study IS THIS UP TO DATE?	Pittsfield Township; City of Ann Arbor, HRWC, Ann Arbor Township Other partners?	All existing and new development properties must protect wetlands one-fifth of an acre and larger. Stewardship incentives will be announced on an annual basis, with the eventual goal of enrolling all wetlands owners and restoring and improving the health of township wetlands. Rapid wetland assessment study Development of the following ordinances is ongoing: Open Space Ordinance Wetlands Ordinance Parking Ordinance Model wetland ordinance	The program will protect numerous wetlands in the Mallett's and Swift Run sub watersheds, thus helping to defend the Huron. It will also protect existing open spaces and buffer areas and reduce the required size of parking areas and roads.	Pittsfield Township has applied to the EPA for a grant for Wetland Assessment and Remediation; this would provide scientific data on the condition of specific wetlands.	Spring, 2003 and forward. Ordinance development will be on-going until summer 2003.	Jan BenDor at 734-822-3122 or clerk@pittsfieldtwp.org Ann Arbor Township Natural Features Committee NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	Ordinance development cost was approximately $15,000 in staff and legal time. Citizens donated over 250 hours to the project. The Township has budgeted $1200 to start up the program in 2003, and has applied for an EPA grant for $79,500. IS THIS UP TO DATE?
Site Design for Malletts Creek Regional Detention	Redesign flood control structure to improve water quality treatment; improve habitat	Washtenaw County, City of Ann Arbor, Pittsfield Township, HRWC, MDEQ	Once	A redesigned flood control structure at Mary Beth Doyle park would reduce phosphorus loading by roughly half of the overall target of 50% in Malletts Creek. Resulting load reduction of **1,000 lbs/yr**	Pre and post construction water quality sampling (future)	2003-2004, construction in 2006-07.	Harry Sheehan; sheehanh@ewashtenaw.org	$250,000 for design $2.5 million for construction IS THIS UP TO DATE?
Malletts Creek Plan Activities	Targeted projects to meet the TMDL goal of 50% reduction of phosphorus inputs	Washtenaw County, City of Ann Arbor, Pittsfield Township, HRWC, MDEQ	See Malletts Creek Restoration Project (Appendix F)	Full implementation of plan will result in a further phosphorus load reduction of **1,000 lbs/yr**	See plan	2002-2008	Harry Sheehan; sheehanh@ewashtenaw.org	$16,375,000
Miller's Creek Reconstruction	Improve the health of the creek and creek shed which is degrading due to excessive upland and in-stream erosion.	Altarum; Stantec; Pfizer; City of Ann Arbor; HRWC; MDEQ; UM, Washtenaw County NEEDS UPDATING	The Miller's Creek Watershed Improvement Plan includes numerous activities to reduce phosphorus inputs.	Assume 50% reduction of TP based on implementation plan estimates. Plan estimates average loading of 0.5 lbs/ac/yr or 766 lbs/yr, resulting in load reduction of **383 lbs/yr**.	A monitoring plan is included in the WIP.	Study complete implementing recommendations	Elizabeth Riggs at HRWC; eriggs@hrwc.org NEED CONTACT INFO FOR ALL PARTICIPATING PARTNERS	$330,000 NEEDS UPDATING
Phosphorous Fertilizer Reduction Ordinance	Reduce phosphorous in runoff to help meet TMDL for Huron River, and to limit excessive growth of algae.	Lodi Township, City of Ann Arbor; Pittsfield Township; Ypsilanti Township	Regulate application of manufactured fertilizers on turf areas only; require registration of commercial and institutional applicators; distribute consumer information on the use and effect of manufactured fertilizers. Pittsfield Township adopted an ordinance in 2006	Should reduce the amount of phosphorous-laden runoff entering the Huron River from City of Ann Arbor, and Pittsfield and Lodi Townships Assuming the ordinance achieves 100% compliance, the result is an additional load reduction of **2,077 lbs/yr**.	Awareness survey results; fertilizer sales; compliance survey results.	Implement ordinance in 2006. Ongoing maintenance and enforcement.	Molly Wade, City of Ann Arbor; mlwade@a2gov.org	Ann Arbor Ordinance $16,000 first year; $20,000 after

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. However, potential barriers to this accomplishment exist and must be considered in implementation planning.

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.

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.

Gaps exist in our knowledge of the role of particle resuspension from the impoundments themselves under anoxic conditions. The systematic study underway by PI John Lehman, Ph.D. of the University of Michigan to detail the inputs of nutrients to Ford and Belleville lakes and the middle Huron River and the forms they take should further our confidence in, and understanding of, appropriate control measures. Exploring opportunities to establish similar partnerships with the scientific community will become increasingly important as additional knowledge gaps are identified.

For many partners in this TMDL implementation, activities have been in place for several years and have reaped benefits. Yet, many of the current programs only recently have been put into place through the requirements of the Phase II of the NPDES stormwater permit program. The next few years will be an unprecedented opportunity to demonstrate reductions in phosphorus pollution of the middle Huron River. 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 become 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

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

- 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 Drain Commissioner's Office
- Huron River Watershed Council
- Michigan Department of Environmental Quality

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

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

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

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. Activities included bio-monitoring, septic inspection at time of sale, illicit discharge elimination, mass media educational campaigns, development standards, water resources protection ordinances, wetlands protection and wetlands restoration. Many of these actions have involved stakeholder collaboration; others are unique to individual stakeholders and their constituencies. The variety and number of these programs can be seen in detail in Table x.

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. Two units within the TMDL area are Municipal Separate Storm Sewer System (MS4) Phase I permit holders—the City of Ann Arbor and the University of Michigan; the other governmental stakeholders are all regulated under Phase II with the exception of Chelsea.

Phase I communities have been under permit since December, 1995. Their permits specify best management practices to achieve water quality improvement, including phosphorus reduction. Permit renewal applications will continue to include provisions consistent with the TMDL for Phosphorus for Ford Lake and Belleville Lake, such as illicit discharge elimination, and public information and education.

Phase II communities and entities must submit detailed compliance language that must also include provisions consistent with the TMDL for phosphorus. Phase II communities with Certificates of Coverage are required to submit an approvable plan to comply with all six minimum measures, including provisions consistent with any TMDL affecting the jurisdiction or watershed. The Washtenaw County Drain Commissioner's Office and public school systems received separate Certificates of Coverage and must meet the same requirements as local governments.

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 will review the status of TMDL implementation twice every year from September 2004 to October 2009 for continuous improvement opportunities. The TMDL stakeholders, per the Cooperative Agreement, will submit an annual report to MDEQ on or before May 1 each year that the Cooperative Agreement is in effect.

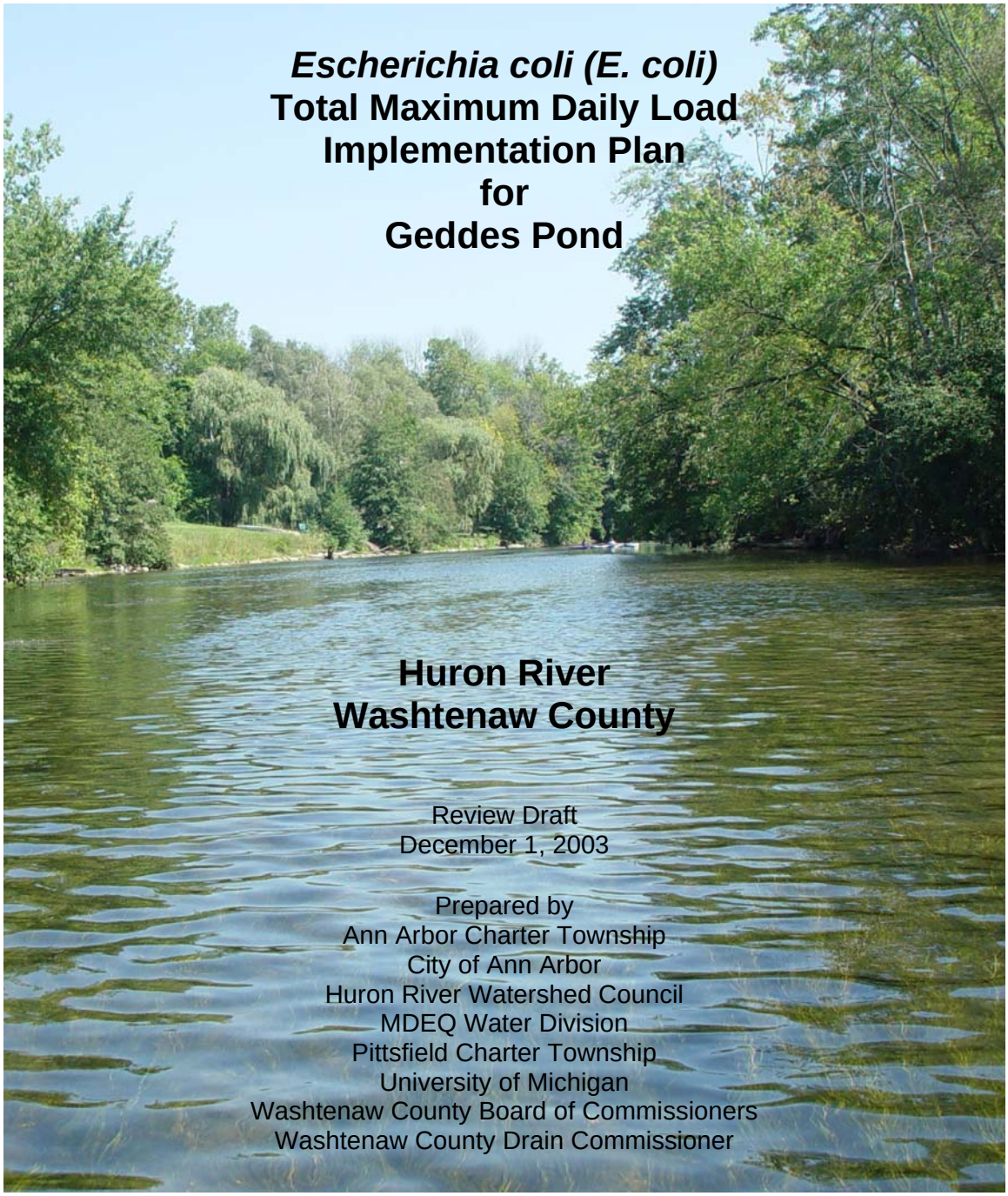
Additionally, the permittees are required to submit annual progress reports to the Michigan DEQ which shall contain the following: a description of the status of compliance with general permit conditions; an updated assessment of the water quality conditions within their jurisdiction; a description of 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.

In 2007, and at subsequent five-year intervals, the MDEQ is scheduled to complete basin-wide monitoring of the Huron River watershed. 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. The semi-annual meeting of the TMDL stakeholders following the 2007 Huron River Basin monitoring and the receipt of the report, stakeholders will convene, with _____ as the convener, to evaluate progress, and submit to the MDEQ any necessary update or adaptation of this implementation plan, with the intention of meeting the existing objectives and timeline.

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.

Appendix C:

E. coli TMDL Implementation Plan for Geddes Pond, Huron River



Escherichia coli (E. coli) Total Maximum Daily Load Implementation Plan for Geddes Pond

Huron River
Washtenaw County

Review Draft
December 1, 2003

Prepared by
Ann Arbor Charter Township
City of Ann Arbor
Huron River Watershed Council
MDEQ Water Division
Pittsfield Charter Township
University of Michigan
Washtenaw County Board of Commissioners
Washtenaw County Drain Commissioner

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Christine Alexander, Michigan Department of Environmental Quality
Rich Badics, Washtenaw County Environmental Health
Jennifer Black, Assistant Planner, Pittsfield Charter Township
Janis Bobrin, Washtenaw County Drain Commissioner
Malama Chock, Coordinator, Environmental Management, Occupational Safety and Health, University of Michigan
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Scott Wade, Limno-Tech, Inc.

Photo credits: John Cramer, Huron River Watershed Council volunteer; Chris Riggs, Huron River Watershed Council

To be submitted for DEQ Approval on March __, 2006

By the *E. coli* TMDL Plan Writing Group:

Jan BenDor, Deputy Clerk/Storm Water Program Coordinator, Pittsfield Charter Township
Elizabeth Riggs, Watershed Planner and Middle Huron Initiative Coordinator, Huron River Watershed Council
Harry Sheehan, Environmental Manager, Washtenaw County Office of the Drain Commissioner
Deb Snell, Environmental Quality Analyst, Water Bureau, Michigan Department of Environmental Quality

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Appendices

A: Map of the Huron River pathogen TMDL region with sample locations.

B: Michigan Department of Environmental Quality (DEQ). August 2001. Geddes Pond/Huron River *E. coli* TMDL.

C: Limno-Tech, Inc. 2000. Supporting Document for the Geddes Pond/ Huron River *E. coli* TMDL.

D. Michigan Department of Environmental Quality (DEQ). 2001. Monitoring data for the Geddes Pond/Huron River *E. coli* TMDL.

E: Earth Tech. 2002*. E. coli* and weather data for all monitoring sites in the Geddes Pond/Huron River *E. coli* TMDL area.

F: City of Ann Arbor, 2002. Precipitation data and *E. coli* data for Geddes Pond/ Huron River *E. coli* TMDL area.

G. Biological Consulting Services of North Florida, Inc. September 2002. Ribotyping analysis of *E. coli* samples.

H. Goose Control Best Management Practices.

I. Matrix of Current *E. coli* Reduction Efforts in the Watershed.

Not referenced in the plan document but utilized in the plan development:

J. City of Ann Arbor Water Treatment Plant. 2002. Water quality monitoring data of Barton Pond.

K. Standard methods for *E. coli* sampling, as promulgated by the EPA, may be seen at http://www.epa.gov/nerlcwww/.

L: Earth Tech. 2002. Summary of *E. coli* monitoring data for Geddes Pond: daily and monthly geometric mean.

Gallup Park attracts large numbers of waterfowl that may contribute to the problem of excessive *E. coli* levels in Geddes Pond and the Huron River.

Problem Definition

Geddes Pond, located on the Huron River in Washtenaw County, Michigan, is listed as an impaired waterbody on Michigan's Section 303(d) list (Impaired Waterbodies List) due to impairment of recreational uses by the presence of elevated levels of pathogens. The listed segment addresses approximately five miles of the Huron River located in the Ann Arbor area, from Geddes Dam at Dixboro Road upstream to Argo Dam (see the map in Appendix A). This segment is also the receiving water for Allens Creek (a tributary that has become enclosed over time) Traver Creek, Millers Creek, Malletts Creek, and Swift Run Creek. Water sampling in this area has shown that Michigan Water Quality Standards (WQS) for *Escherichia coli (E. coli)* are not consistently being met in this waterbody or its tributaries.

According to the Washtenaw County Environmental Health Department, a permanent sign is posted at the perimeter of Geddes Pond instructing people to stay out of the water after rain events due to potentially dangerous pathogen levels. As general policy, the Department advises citizens to stay out of all surface waters for 24 hours after a major rain event to allow pathogen levels to decrease.

A two-mile segment of Allens Creek is listed as an impaired waterbody on the Section 303(d) list due to impairment of recreational uses by the presence of elevated *E. coli* pathogens, and was scheduled for TMDL creation in 2004. Rather than embark on a separate TMDL process for this segment, the Allens Creek listing is being addressed through the Geddes Pond/Huron River *E. coli* TMDL. The water quality monitoring incorporated sampling sites on this segment.

The Nature of Escherichia coli[1]

Bacteria are among the simplest, smallest, and most abundant organisms on earth. Bacteria are "procaryotic" organisms—a term which indicates a cellular structure lacking an organized nucleus and nuclear membrane. Instead of containing genetic information stored on several chromosomes, bacteria contain a single strand of DNA. These organisms reproduce by binary fission, which occurs when a single cell divides to form two new cells called daughter cells. Each daughter cell contains an exact copy of the genetic information contained in the parent cell. The process continues with each daughter cell giving rise to a generation of two new cells. The generation time is the time required for a given population to double in size. This time can be as short as 20 minutes for some bacteria species (e.g., *Escherichia coli*).

While the vast majority of bacteria are not harmful, certain types of bacteria cause disease in humans and animals. Examples of waterborne diseases caused by bacteria are: cholera, dysentery, shigellosis and typhoid fever. During the London cholera epidemics of 1853-1854, Dr. John Snow observed that nearly everyone who became ill obtained their drinking water from a specific well into which a cesspool was leaking. Those who became ill either drank water from the well or came into contact with fecally

[1] Text adapted from MDEQ, Surface Water Quality, NPDES Permits website. February 2003.

contaminated material while tending those already sick. Concerns about bacterial contamination of surface waters led to the development of analytical methods to measure the presence of waterborne bacteria. Since 1880, coliform bacteria have been used to assess the quality of water and the likelihood of pathogens being present. Although several of the coliform bacteria are not usually pathogenic themselves, they serve as an indicator of potential bacterial pathogen contamination. It is generally much simpler, quicker, and safer to analyze for these organisms than for the individual pathogens that may be present. Fecal coliforms are the coliform bacteria that originate specifically from the intestinal tract of warm-blooded animals (e.g., humans, beavers, raccoons, etc.). They are cultured in a special growth medium and incubated at 44.5^{o} C.

The first U.S. standards for drinking water, established by the Public Health Service in 1914, were based on coliform evaluations. It was reasoned that the greatest source of human pathogens in water was from human waste. Each day, the average human excretes billions of coliform bacteria. These bacteria are present whether people are ill or healthy. Monitoring for coliform bacteria was designed to prevent outbreaks of enteric diseases, rather than to detect the presence of specific pathogens. Today, coliform bacteria concentrations are determined using methods specified by the Environmental Protection Agency (EPA) and *Standard Methods for the Examination of Water and Wastewater* (AWWA, APHA, and WEF, 20th ed., 1998).

Sources of Bacteria[2]

Human sources of bacteria can enter water via either point or nonpoint sources of contamination. Point sources are those that are readily identifiable and typically discharge water through a system of pipes. Communities with sewer systems may not have enough capacity to treat the extremely large volume of water sometimes experienced after heavy rainfalls. At such times, treatment facilities may need to bypass some of the wastewater. During bypass or other overflow events, bacteria-laden water is discharged directly into the surface water as either sanitary sewer overflow (SSO) or as combined sewer overflow (CSO). Power outages and flooding can also contribute to the discharge of untreated wastewater.

Illicit connections to storm sewers are a source of bacteria in surface waters, even during dry periods. A connection to a storm sewer is "illicit" when the wastewater requires treatment prior to discharge and should be routed to the sanitary sewer. Only storm water and certain permitted discharges (e.g. clear, non-contact cooling water) should be discharged to a storm sewer.

Nonpoint sources are those that originate over a more widespread area and can be more difficult to trace back to a definite starting point. Failed on-site wastewater disposal systems (septic systems) in residential or rural areas can contribute large numbers of coliforms and other bacteria to surface water and groundwater.

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[2] Text adapted from MDEQ, Surface Water Quality, NPDES Permits website. February 2003

Animal sources of bacteria are often from nonpoint sources of contamination. Concentrated animal feeding operations, however, may become point source dischargers. Agricultural sources of bacteria include livestock excrement from barnyards, pastures, rangelands, feedlots, and uncontrolled manure storage areas. Land application of manure and sewage sludge can also result in water contamination, which is why states require permits, waste utilization plans, or other forms of regulatory compliance.

Storm water runoff from residential, rural, and urban areas can transport waste material from domestic pets and wildlife into surface waters. Landscaping practices may create ideal habitat for geese and other migratory waterfowl, concentrating populations during the nesting season or creating year-round flocks, and creating hazardous quantities of fecal litter, leaving E. coli and other disease-causing organisms ready to be washed into ponds and waterways.

Bacteria from both human and animal sources can cause disease in humans. Bacteria-laden water can either leach into groundwater and seep, via subsurface flow, into surface waters or rise to the surface and be transported by overland flow. Bacteria in overland flow can be transported freely or within organic particles. Overland flow is the most direct route for bacteria transport to surface waters. Underground transport is less direct, because the movement of water and bacteria is impeded by soil porosity and permeability constraints.

TMDL Mandate and Applicable Regulations

Section 303(d) of the Federal Clean Water Act and the United States Environmental Protection Agency's (U.S. EPA) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). The impaired designated use for Geddes Pond/Huron River at this location is total body contact recreation. 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 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.

The Michigan Department of Environmental Quality (DEQ) finalized the Geddes Pond/Huron River *E. coli* TMDL in August, 2001 (Appendix B). The TMDL was developed based in part on a support document written by Limno-Tech, Inc. (Appendix C). The support document contains background information about the listed waterbody, known water quality data, and source assessment. The TMDL was approved by the U. S. EPA on September 17, 2001. The MDEQ recommends that the targets of the TMDL be achieved within 10 years of the approval date.

All surface tributaries (not enclosed) are required to comply with the WQS of 130 *E. coli* per 100 ml as a 30-day geometric mean. This requirement applies to Traver Creek, Millers Creek, Malletts Creek, and Swift Run Creek. Because enclosed tributaries are not considered waters of the state, the daily maximum WQS of 300 *E. coli* per 100 ml will apply as a monthly average to Allens Creek and the direct drainage area (i.e. storm sewers which discharge directly to the Huron River). By maintaining the concentration of 300 *E. coli* per 100 ml in the enclosed tributaries, any area of WQS exceedance in the Huron River will be minimized. If the pathogen inputs can be controlled so that surface tributaries meet a 30-day geometric mean 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 in this reach of the Huron River will be protected.

Sampling Effort and Data Summary

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. 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. The Huron River Pollution Abatement program of the late 1980s and early 1990s identified numerous sources of pathogens in the TMDL area and pursued their elimination. A compilation of this historical data is contained in Appendix C (Limno-Tech, Inc., 2000). These data indicate that Lower Geddes Pond has consistently exhibited the highest bacteria concentrations among all Huron River reaches in the Ann Arbor area. Geddes Pond is also the receiving water for three direct tributaries (Millers Creek, Malletts Creek and Swift Run Creek), plus Traver Creek and Allens Creek that enter immediately upstream. Historic data indicate that each of these tributaries exceed the WQS for pathogens as well. Background (upstream) levels of *E. coli* in Barton Pond were determined to be 10 *E. coli* per 100 ml.

Additional sampling conducted in 2001 by the DEQ corresponds with the findings of the historical data and indicates that the listed reach and its tributaries continue to exceed the WQS for *E. coli*. These sampling results are included in Appendix D.

In 2002, sampling efforts were focused on source identification. With the input of stakeholders, appropriate sampling locations were selected throughout each tributary and sampled on a rotating basis from May to October, 2002. In addition, routine monitoring was conducted at the mouth of each tributary and on Geddes Pond. These

sampling results are included in Appendix D. Precipitation data collected by the City of Ann Arbor is included in Appendix F as well.

The results of the 2002 data indicate that Geddes Pond exceeded the 30-day geometric mean for full body activities during the second half of July and all of August. There was one additional sampling event that exceeded the full body activity daily maximum standard (300 *E. coli* per 100 ml) in September. Each tributary sampled had elevated *E. coli*, and seemed to be influenced by wet weather events.

Allens Creek typically had high *E. coli* concentrations and had visual evidence of illicit connections. Millers Creek, at the east and west branches at Plymouth Road, were typically higher than other locations. Sampling on Malletts Creek was started in July and showed high *E. coli* concentrations for the period sampled, including the Eisenhower Commerce Park site (GPMC-4) which had high spikes in three of six samples collected. Early season sampling on Swift Run Creek indicated elevated concentrations at various locations. However, the last four weeks of sampling were dry or stagnant. Traver Creek *E. coli* concentrations decreased later in the sampling season, but some of the highest concentrations were found at the mouth site (GPT-1).

DNA sampling was also conducted during one sampling event on August 27, 2002, in the hopes of determining whether sources of *E. coli* were human or non-human (included in Appendix G). Unfortunately, the results were inconclusive. Should additional DNA sampling be conducted, it might be best performed earlier in the season (mid-summer perhaps) when *E. coli* numbers are typically highest, and even better, when the DNA analysis methodology increases in sophistication.

Several stakeholders actively participated in the data collection phase and implementation planning phase of the TMDL process. In 2002, stakeholders worked with the DEQ and its contractor to identify possible monitoring locations throughout the TMDL area, including field reconnaissance and meetings to verify the chosen locations. Representatives from the University of Michigan, Pittsfield Charter Township, the City of Ann Arbor, Washtenaw County, and the Huron River Watershed Council contributed to the project in this way.

Sources of the Problem and Stakeholders Involved

For this waterbody, 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.

Potential pathogen sources for this waterbody include sources typically associated with urban and suburban runoff because the immediate watershed is primarily composed of these land types. Source evaluation indicates that bacteria loads from a large part of

Ann Arbor enter Geddes Pond/Huron River via the storm water system. Bacteria loads are also delivered to Geddes Pond/Huron River by tributaries that drain a large portion of the Ann Arbor area. Other pathogen sources for Geddes Pond/Huron River likely include upstream inputs, illicit sewer connections, pet and wildlife feces, and a small number of malfunctioning on-site wastewater treatment systems (septic systems). Agricultural land uses located in the upstream reaches of the Traver Creek watershed make livestock and horse feces other likely sources.

Governmental units in the Geddes Pond/Huron River watershed include the City of Ann Arbor, the University of Michigan (U-M), Ann Arbor Charter Township, Northfield Township, Pittsfield Charter Township, Lodi Township, Scio Township, Ypsilanti Charter Township, and Superior Charter Township. In addition, the Washtenaw County Drain Commissioner has jurisdiction over those tributaries (or portions thereof) designated as county drains. Table 1 shows the distribution of land in each subwatershed in the listed reach by government entity. The stakeholders made the conscious decision to gain active involvement from the entities with more significant landownership in the TMDL area. This decision reflects the group's understanding that stakeholders with jurisdiction over minute portions of the TMDL area have little motivation to be engaged extensively in the planning process. However, all stakeholders have equal opportunity to comment on drafts of the implementation plan.

The Huron River at Gallup Park provides recreation for young and old alike.

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

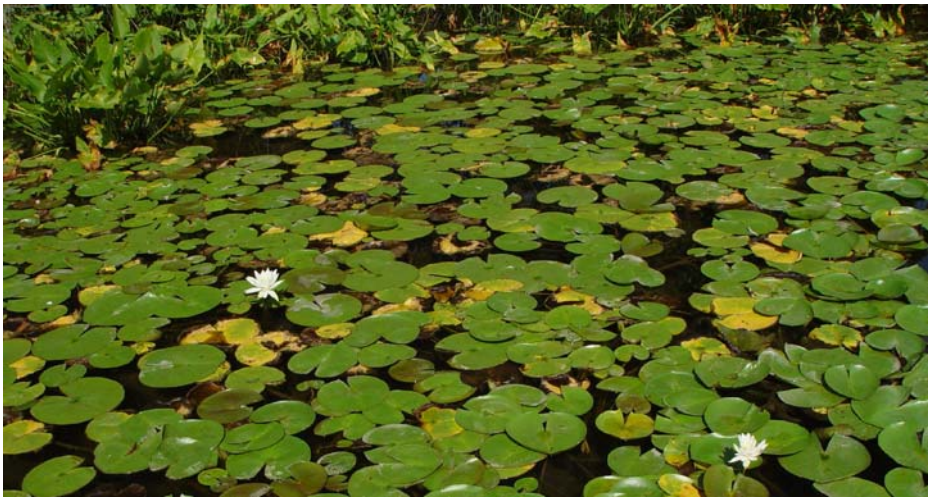
	Subwatershed Area (sq. mi)	Percentage of Land Area in Subwatershed	Percentage of Immediate Watershed
Allens Creek			
City of Ann Arbor	4.0	90	
University of Michigan	0.43	10	
Total area	4.43	100	13
Traver Creek			
City of Ann Arbor	3.3	45	
University of Michigan	0.072	1	
Ann Arbor Township	3.8	52	
Northfield 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
Malletts 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**

Specific Goals and Objectives

The goal of the Geddes Pond/Huron River *E. coli* TMDL is to achieve the WQS of 130 *E. coli* per 100 ml as a 30-day geometric mean in Geddes Pond and its tributaries from Geddes Dam at Dixboro Road upstream to Argo Dam, except in Allens Creek where the goal is to achieve 300 *E. coli* per 100 ml as a 30-day geometric mean (see Appendix B). Data show that urban storm water runoff is the dominant source of *E. coli* in this area. Implementation activities to meet the TMDL require measures to reduce *E. coli* sources and loads.

Measures to reduce *E. coli* will include activities that, to a large extent, are already required of the National Pollutant Discharge Elimination System (NPDES) municipal storm water permittees within the watershed and will soon be required of other municipalities within the watershed under Phase II of the municipal storm water permitting program. Currently, the City of Ann Arbor, U-M and the Michigan Department of Transportation hold NPDES Phase I municipal storm water permits. In 2003, Ann Arbor Charter Township, Pittsfield Charter Township, Lodi Township, Scio Township, Ypsilanti Charter Township, and Superior Charter Township were required to obtain NPDES Phase II permits.

Both Phase I and Phase II municipal storm water permits provide mechanisms for controlling bacterial loads to Geddes Pond and its tributaries and a structure for source characterization efforts. Storm water permits require that a plan for effective elimination of illicit discharges and prohibition of illicit discharges be developed, that all catch basins be mapped and regularly cleaned, that effective storm water management in areas of redevelopment and new development occur, and that a public education program regarding storm water management and impacts of storm water pollution be implemented.



Pickerel weed and lily pads bloom in the shallow reaches of Geddes Pond.

Current and New Programs for *E. coli* Reduction in the Watershed

The stakeholders in this TMDL are familiar with watershed-based cooperation, having partnered on point source and non-point source phosphorus reductions with the goal of meeting a nutrient TMDL for Ford and Belleville lakes. The Middle Huron River Watershed Initiative, the partnership working to meet the nutrient TMDL, has pursued pollutant reductions for nine years. Most of the stakeholders in the *E. coli* TMDL were signatories to a five-year agreement to voluntarily reduce phosphorus contributions to the middle Huron River, an agreement which was re-evaluated in 2004 to determine whether significant progress had been made toward reducing phosphorus by 50 percent of 1996 levels. The signatories revised the agreement to replace it with another five-year cooperative agreement in effect from 2004 to 2009.

Through the coordinated efforts of all stakeholders, coupled with the implementation of municipal storm water permit requirements and the current and ongoing efforts of the Middle Huron River Watershed Initiative, pathogen inputs to the tributaries and storm sewers can be controlled, thereby protecting the designated uses of this TMDL area.

Programs currently in effect in the watershed, or planned for the near future, include efforts to reduce illicit discharges, remove illicit connections, reduce domestic animal sources, reduce wildlife sources, remove *E. coli* by treatment, and prevent pollution through land use planning, regulations and protection. A complete matrix of current *E. coli reduction* efforts in the watershed is provided in Appendix I.

Efforts to Reduce Illicit Discharges

Septic System Inspection Programs

Septic System Inspection Programs are meant to identify and correct failing septic systems that discharge human waste into groundwater or on the surface, and directly or indirectly into surface water. These programs help identify illicit connections and prevent or eliminate illicit discharge. Washtenaw County, Ann Arbor Township, and Pittsfield Township are implementing septic inspection programs.

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 900 systems have been evaluated annually, countywide, with over 450 septic system corrections documented during the first 4 years.

Pittsfield Charter Township plans to contract with the County, to inspect each system (2200 systems total) in the township once every five years. Data show that 20% of township systems inspected under the time of sale program needed repair, and there has been close to 100% correction. The township must establish the funding and authorize the inspection and repair program through a new Surface Water Quality

Ordinance before the program can begin. Depending on the status of the state's Clean Water Bond fund, the program may be enacted in 2007.

Ann Arbor Charter Township is currently updating its maps to identify all parcels served by septic systems, and is considering the development of a similar program to supplement Washtenaw County's septic inspection program. The township has several residential developments within its boundaries that use septic systems and drain fields for sanitary waste. If implemented, inspections would take place every 4 years.

Illicit Discharge Elimination Program (IDEP)

The purpose of the IDEP is to remove non-storm discharges to storm sewers to improve water quality. This program locates and eliminates any illicit connections in sanitary and storm pipes, thus preventing untreated sewage flow to the Huron River. The program is also meant to help meet the Geddes TMDL, and fulfill storm water permit obligations.

Project data include sampling records, video and a dye-test database. The following entities are involved in the IDEP: Washtenaw County, the City of Ann Arbor, Michigan Department of Environmental Quality (MDEQ), and the University of Michigan (U-M). Future areas of investigation, pending funding, are Allens, Swift Run, Traver and Millers Creeks.

The City of Ann Arbor inspects the storm sewer annually by closed circuit T.V., inspecting about 35,000 linear feet and removing debris from about 125,000 linear feet of line. The City sub-contracts to Washtenaw County, approximately four days per month, to do illicit connection screening within Malletts Creek. This program was in effect until December 2003. The estimated cost of the program is $225,000 per year for the City of Ann Arbor and Washtenaw County combined. The HRWC provided information and education (tip cards) on illicit discharges for the City in FY 2003-2004.

The University of Michigan conducts dry weather screening by checking manholes for flow during dry weather. If flow is observed, a sample is collected to determine chemical parameters of the water, including *E. coli* content. This process is meant to track down cross-connections between sanitary and storm sewer lines, and eliminate them. One area of campus is screened each year, so that the entire campus is covered in four years. Data are then compiled into annual dry weather screening reports. The cost of annual screening is approximately $10,000. Illicit connection correction costs range from $1,000 to $500,000 depending on site specifics.

Disallow Occupancy Permits pending inspection for illicit connections

This program mandates the dye testing of storm sewers associated with new development or redevelopment areas. The inspection is done to confirm that these storm sewers have no illicit connections, and are subsequently free of non-storm discharges. The program reduces the chance of illicit discharge to the Huron River. Local units of government are involved in this program. The details of implementation

of this plan have not been completed. This testing process shall take place whenever a certificate of occupancy (or equivalent) is issued and has no end date. Costs are as yet unknown.

Recreational Vehicle (RV) Waste Disposal Education

The University of Michigan Health System and Occupational Safety and Environmental Health (OSEH) implemented this program to prevent the illicit discharge of black water from RVs, after a small number of RV illicit discharges were reported. The plan educates RV owners about proper waste disposal to prevent illicit discharges through signs and fliers. The plan also prohibits RVs from parking overnight in U-M lots, except in U-M hospital lots posted for RV parking. There have been no RV illicit discharges reported since the program began. The estimated cost of the program is $2,000, and it is ongoing with no end date.

The HRWC also provides RV waste disposal education, under contract for the City of Ann Arbor. The Council conducted a survey of RV owners gathered in the Pioneer High School parking lot for a football game, and distributed educational fliers.

Storm Drain/Catch Basin Marking

The purpose of storm water drain marking is to eliminate waste entering the Huron River through storm drains, by means of creating public awareness of the danger of dumping into these drains. Storm drains are marked with a warning stating that any waste entering the drain goes straight to the Huron River. Along with the marking, the project places educational fliers on the doors of residences in the vicinity of newly marked drains.

Markers are continuously placed on drains and replaced every few years, when old markers begin to fade or fall off. New storm drains have a warning engraved on them, stating "Dump No Waste - Drains to Waterways." To date, approximately 6,500 drain markers have been placed, with 4,000 placed in the City of Ann Arbor, 1,500 placed on the U-M campus, and about 1,000 in the Ypsilanti and Ypsilanti Township area. This is an ongoing project with no end date.

Participants include the Huron River Watershed Council, City of Ann Arbor, Ypsilanti Charter Township, Pittsfield Charter Township, Washtenaw County, and University of Michigan facilities and student groups—EnAct, North Campus Service Day, and Residential Student Housing. Pittsfield Township spent $1,500 for label production and Washtenaw County spends approximately $5,000 per year for their markers. The University of Michigan has spent a total of $7,000 for markers. Additionally, the City of Ann Arbor spends approximately $1.50 for each new lexan marker, while $3.05 is spent on each "crystal" coated marker. Volunteers provide the labor to apply markers and hang educational fliers on doors.

Information and Education Mass Media Campaign/Public Education Program (PEP)

The purpose of this program is to provide awareness and education about septic system maintenance and its effect on water quality. Information is distributed through "Keep your septic system safe" tip cards, “Smart Home Maintenance” flyers, articles in the HRWC newsletter, public service announcements on the radio, and calendars.

The program raises awareness of septic system maintenance requirements and storm drain pollution prevention, which should reduce *E. coli* entering the Huron River through illicit discharges. However, the impact is difficult to measure beyond the number of homeowners who have received the materials throughout the watershed, including Ypsilanti Township, the City of Ann Arbor, Van Buren Township, YCUA service area, Sumpter Township, Village of Milford, customers of Edward Surovell Realtors, and HRWC members.

Those involved are: HRWC, local governments, businesses, local media, homeowner's associations, school districts, the USDA Home*A*Syst staff, and three watershed organizations. HRWC will continue to run its program to meet the obligations of the City of Ann Arbor’s Phase I permit. Limited quantities of the materials are available upon request, with mass reprints produced when several communities join in placing an order from HRWC.

Information and Public Education Through the Internet

The purpose of this program is to provide awareness and education about local water quality issues. Information is available at the web pages of local units of government, including Pittsfield Charter Township at http://pittsfieldtwp.org, the City of Ann Arbor at http://www.ci.ann-arbor.mi.us, Washtenaw County at http://www.ewashtenaw.org, the Huron River Watershed Council at http://www.hrwc.org, and U-M Occupational Safety and Environmental Health Department at http://www.umich.edu/~oseh/stormwater. The University of Michigan receives feedback from visitors to its Storm Water Education page. Information and public education through the internet is an ongoing program with minimal cost.

Pump Station Overflow Plan

This plan is meant to reduce pump station flooding, which can cause illicit discharge to enter the Huron River past Geddes dam. The plan was implemented by Ann Arbor Charter Township. Estimated costs are unknown.

Efforts to Reduce Animal Sources – Domestic

Farmer Education

This program is meant to educate farmers on the potential impacts of current livestock management practices on surface water quality. Providing awareness and technical

information to farmers, using various educational materials, should reduce the amount of *E. coli* in surface water from animal waste. Those involved are: Ann Arbor Charter Township, HRWC, the Natural Resources Conservation Service (NRCS), the Washtenaw County Drain Commissioner, and the USDA Farm*A*Syst staff. The time frame for the plan is currently unknown. Estimated costs are $4,000 - $6,000 for Ann Arbor Township.

Education about Pet Waste

This program provides awareness and education to the public concerning the impact of pet waste on surface water quality. The purpose of this education is to decrease the amount of *E. coli* entering the Huron River due to pet waste. HRWC coordinates the production, printing, and distribution of educational flyers regarding the impact of pet waste on water quality. They also distribute storm water calendars that include this information. Pet waste education information is also located on the U-M OSEH website. The impact of the plan will be measured by surveying the population after one year to see if recommendations are being followed. Those involved include HRWC, U-M, the City of Ann Arbor and Ypsilanti Charter Township. The program runs from Spring 2003 forward. The cost of the fliers is $0.03 per piece, while the cost of the calendars is about $0.80 each.

Doggie Bags in Parks

This program provides bags for pet waste clean up. This should reduce pet waste in parks, subsequently reducing the amount of *E. coli* entering the Huron River from pet waste. This project is ongoing in the City of Ann Arbor. Estimated costs are unknown.

Pooper Scooper Ordinance

The purpose of this program is to educate the general public on the impact of pet waste on surface water quality, and to reduce pet waste entering the storm sewer. The plan should decrease illicit discharge into the Huron River by controlling a source of pollution. Local units of government, including Washtenaw County and the City of Ann Arbor, are involved with this project. The ordinance will be drafted and enacted, and then publicized continuously. The estimated cost is unknown.

Efforts to Reduce Animal Sources – Wildlife

Operation Goose Down

This program is meant to decrease *Giant Canada* goose populations, eliminate year-round goose habitation, and in turn, reduce the amount of goose droppings containing *E. coli* that have potential to contaminate waterways. Ongoing application of best management practices such as pond buffer plantings, replacing turf with shrubs and trees, and interfering with feeding and nesting will potentially reduce areas of contamination. See Appendix H for more details regarding the BMPs. The program is

being developed in Pittsfield Charter Township, with homeowners and institutional partners invited to become involved. The timeline for this project is 2003 and forward. Costs are site specific, but research on goose control BMPs shows availability of numerous successful and cost-effective methods. It should be noted that DNR wildlife specialists report that there are no data showing harm to human health from the type of *E. coli* present in goose waste.

Community Partners for Clean Streams

This program provides education through public and private partnership, promoting the protection of watersheds and waterways through presentations, print material, and signed agreements to use BMPs and abide by good housekeeping measures. The intent is to address water fowl habitat and discourage geese through landscaping, storm water pond maintenance, and riparian elements. Those involved include Washtenaw County, businesses, institutions, and multi-family residences, totaling 76 partners. This project is ongoing with no end date. Estimated costs are $160,000 per year.

Native Landscaping Ordinance Development

This program diminishes green grass cover, on which geese enjoy foraging with an unobstructed view, and encourages the growth of tall prairie species. The purpose of this plan is to displace foraging geese by creating an environment unfavorable to geese, subsequently reducing the *E. coli* count in the Huron River from goose droppings. This program, involving Ann Arbor Charter Township, the City of Ann Arbor and Pittsfield Charter Township, is ongoing. Estimated Costs are $5,000.

Update Storm Water Management Standards (Pond Landscaping Section)

This plan is meant to reduce nuisance geese habitat at storm water ponds by the installation of shoreline buffer planting or other means. The plan is utilized each time the storm water system is reviewed or equivalent, with no end date. Those involved include local units of government and U-M. In the future, parks departments may become involved to employ the same strategy near public water features. Estimated costs are unknown.

Efforts to Reduce *E. coli* by Land Use Planning & Protection

Farmland Protection Program

This program prevents surface and storm water pollution through permanently retaining large areas of permeable ground and the natural areas associated with farmland, such as windrows, swales, meadows, small wetlands, and woodlots. Preservation of farmland helps protect the headwaters of Geddes Pond tributaries. Implementation of this plan is expected to eliminate future illicit discharges by precluding further urbanization and by promoting BMPs among farmers raising crops and animals. Under Purchase of Development Rights (PDR) programs, landowner applications are awarded

points competitively, based on such factors as a history of good conservation and storm water management practices.

This program will be carried out by Ann Arbor City and Pittsfield and Ann Arbor Charter Townships through ongoing implementation of PDR Ordinances, the Ann Arbor Parks Department Green Belt Program, with funding of PDR through local tax millage, the USDA 2002 Farm Bill, the Michigan Farmland Preservation Board, and land conservancies. Others involved are: the Washtenaw Farmland Conservation Group, Washtenaw County, Farm Bureau, farmers, farmland owners, the USDA Natural Resources Conservation Service, and the Ecology Center. This project began in 1998 with the passage of the County's PDR Ordinance. Pittsfield enacted a local PDR Ordinance in 2002, and Ann Arbor Township in 2003. Estimated costs are unknown.

The Comprehensive Plan

This tool can help to preserve open land and protect the tributary watersheds, by discouraging residential development outside of sewer, water, and road infrastructure, preventing sprawl development. Through new agricultural preservation zoning, open space in planned unit developments, and recreation-conservation zoning, future illicit discharges can be decreased. The project is ongoing, running from August 2002 forward. Pittsfield Charter Township is currently the only organization involved. The cost to update the plan was $100,000 and over 200 hours of work invested by staff. The cost of maintaining the update is estimated at $5,000 per year.

Wetlands Protection Program

This program, consisting of local regulations and incentives, is meant to protect wetlands on one-fifth of an acre or larger, since damaged and destroyed small wetlands cannot provide the services of filtering and cleaning pollutants in storm water. The program will protect numerous wetlands in the Malletts and Swift Run sub-watersheds, thus helping to buffer the Huron River. A model local wetland ordinance is available from HRWC; the Michigan Coastal Zone Management Program requested the ordinance's development.

Those involved are: Pittsfield Charter Township (with specific involvement by ordinance enforcement officers, Pittsfield Natural Resources Commission, property owners who register for stewardship benefits, and volunteer stewards) the City of Ann Arbor, and Ann Arbor Charter Township. Under the Pittsfield program, stewardship incentives will be announced on an annual basis, with the eventual goal of enrolling all wetlands owners and restoring and improving the health of township wetlands. This program began in the spring of 2003 and continues. Cost of ordinance development was approximately $15,000 in staff and legal time. Pittsfield Township budgeted $1,200 for program start up.

Other Ordinance Development

Ann Arbor Charter Township is addressing wetlands protection along with open space, reducing parking and road requirements, and natural features buffer areas. Implementing the recommendations of the 1999 Washtenaw County Drain Commissioner Study is estimated to cost $5,000.

Pittsfield Charter Township is developing a Natural Features Ordinance to protect trees, native landscapes, and significant wildlife habitat, and a Storm Water Management/Surface Water Quality Ordinance to prevent nonpoint sources of pollution and reduce impervious surface.

Efforts to Reduce *E. coli* by Treatment

Site Design for Malletts Creek Regional Detention

This program will redesign the flood control structure to improve water quality treatment at Malletts Creek and to improve habitat. The new design is expected to significantly reduce bacteria (see http://fpub.epa.gov/npdes/stormwater/menuofbmps/post_27.cfm for more information). The construction will take place between 2006 and 2007, based on available funds. Those involved are: Washtenaw County, the City of Ann Arbor, Pittsfield Charter Township, Huron River Watershed Council, and MDEQ. This activity is a one-time occurrence. Pre and post construction water quality sampling will occur. Estimated cost of design is $250,000 and the estimated cost of construction is $3.4 million.

Millers Creek Study

This study will lead to a plan to improve the health of the creek and creekshed, now being threatened by excessive upland and in-stream erosion. The study sampled 6 locations (dry and wet) taking approximately 15 samples at each site, with *E. coli* being one of the parameters studied. Scott Dierks at Ayres, Lewis, Norris and May (ALNM) conducted the study over 1 1/2 years. The time frame for the study was from April 2002 to August 2003. Based on 80-90 samples, ALNM will make recommendations for installation of BMPs at the end of the study. Those involved are Altarum, ALNM, the City of Ann Arbor, HRWC, citizens, MDEQ, Pfizer, Pollack Design, Tilton & Associates, U-M, and the Washtenaw County Drain Commissioner. Estimated cost for this project is $330,000.

Rules and Ordinances for Storm Water Management

This program helps reduce the *E. coli* count of surface water by preventing flooding, controlling flow, treating storm water, and discouraging geese by using native landscape buffers near waterways and ponds. Additionally, this program is meant to revise existing storm water management ordinances to meet required design standards of the Washtenaw County Drain Commissioner. This program will be implemented by

detaining the first flush for a 24-hour period, thus reducing bacteria count. Future rules will likely require infiltration of first flush. The Rules of the Drain Commissioner are revised roughly every 2 years. The next revision of the Rules will be completed by the end of 2003. Also, ordinance development will be ongoing through 2004. Those involved are: Washtenaw County, local units of government, and developers. Estimated costs for revising the rules will not be tracked. The cost for ordinance development for Ann Arbor Charter Township is $5,000.

Overcoming Barriers and Closing Gaps

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. However, potential barriers to this accomplishment exist and must be considered in implementation planning.

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.

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.

Source identification for *E. coli* pollution is still more an art than an exact science. Current DNA testing can only present probabilities for whether a particular bacterial sample source is animal or human. The strength of the source cannot be known, nor can the specific animal species. Useful conclusions must be made based on local knowledge of the area, visual examination of suspected upstream sources, observations over time, and logic.

There are also gaps in our knowledge of bacterial survival and reproduction under conditions found in yards, parks, ditches, and ponds. For example, requiring a certain number of hours of onsite retention for storm water runoff is thought to guarantee that live *E. coli* bacteria will not escape and reproduce elsewhere. A systematic study of real world conditions to detail the effectiveness of retention, infiltration, and other strategies for control of bacteria, would further our confidence in, and understanding of, these control measures. Exploring opportunities to establish partnerships with the scientific

community will become increasingly important as additional knowledge gaps are identified.

With so many of the current programs only recently put into place, or not yet begun, partners in this TMDL Implementation view the next few years as a creative opportunity to demonstrate reductions in *E. coli* pollution of the Huron River. 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 become 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.

Submergent and emergent aquatic vegetation, including invasive purple loosestrife, proliferates by mid-summer in Geddes Pond, limiting the usability of the waters.

Accountability Structure for Implementation: Participants, Reporting, Timeline, Monitoring, Contingency Plans

The stakeholders for this implementation plan are committed to continued water quality improvement in the Geddes Pond watershed. Those who have taken on this responsibility are:

- Ann Arbor Charter Township
- City of Ann Arbor
- Huron River Watershed Council
- Michigan Department of Environmental Quality
- Pittsfield Charter Township
- University of Michigan, Ann Arbor Campus
- Washtenaw County Drain Commissioner's Office
- Washtenaw County Board of Commissioners and Environmental Health Department
- Washtenaw County Environmental Health Department

The following units of government will also be subject to the TMDL:

- Michigan Department of Transportation
- Washtenaw County Road Commission

Lodi, Northfield, Scio, Superior and Ypsilanti townships have negligible land within the contributing basin and are not expected to be involved in plan implementation unless new information indicates potential sources within these areas.

The eight stakeholders listed above are committed to continued water quality improvement in the Geddes Pond contributing area. Toward this end, local governments, the Huron River Watershed Council and the University of Michigan have been conducting a variety of actions, prior to TMDL development, to improve water quality and promote stewardship. Pre-TMDL activities included bio-monitoring, habitat assessment, septic inspection at time of sale, illicit discharge elimination, mass media educational campaigns, development standards, water resources protection ordinances, wetlands protection and wetlands restoration. Many of these actions have involved stakeholder collaboration; others are unique to individual stakeholders and their constituencies. The variety and number of these programs can be seen in detail in Appendix I.

Although a great many ongoing actions to restore water quality and habitat in Geddes Pond 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 have been required or will soon be required under the permit regulations of the Clean Water Act. Two units within the TMDL area are Municipal Separate Storm Sewer System (MS4) Phase I permit holders—the City of Ann Arbor and the University of Michigan; the other governmental stakeholders are all regulated under Phase II. Of the communities with negligible land area under the TMDL, all but Northfield Township are designated for Phase II regulation.

Phase I communities have been under permit since December, 1995. Their permits specify best management practices to achieve water quality improvement, including *E. coli* reduction. Permit renewal applications will continue to include provisions consistent with the Geddes Pond TMDL, such as illicit discharge elimination, and public information and education.

Phase II communities and entities must submit detailed compliance language that must also include provisions consistent with the Geddes Pond *E. coli* TMDL. Phase II communities with Certificates of Coverage are required to submit an approvable plan to comply with all six minimum measures, including provisions consistent with any TMDL affecting the jurisdiction or watershed. The Michigan Department of Transportation, the Washenaw County Drain Commissioner's Office, and public school systems received separate Certificates of Coverage and must meet the same requirements as local governments.

Taken together, these stakeholders have primary land use authority over 97% of the contributing area for the *E. coli* TMDL. Under their storm water permits, these communities and organizations are obligated to develop, implement, and enforce a storm water 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. Storm water controls designed to attain the goals of the TMDL must be incorporated into the storm water 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 *E. coli* TMDL problems, solutions, and successes.

Additionally, the permittees are required to submit annual progress reports to the Michigan DEQ which shall 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 storm water 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.

Since each storm water permit requires annual reporting, and TMDL goals and activities must be incorporated into the measures prescribed by the permit, separate TMDL reporting is unnecessary. In 2007, and at subsequent five-year intervals, the MDEQ is scheduled to complete basin-wide monitoring of the Huron River watershed. Future projects under this implementation plan may incorporate additional monitoring if resources allow. Stakeholders' storm water 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 *E. coli* levels since the previous progress report. Change may be demonstrated by use of data collected by other sources or a group monitoring program.

Following the 2007 Huron River Basin monitoring and the receipt of the report, stakeholders will convene, with the Washtenaw County Drain Commissioner as the convener, to evaluate progress, and submit to the MDEQ any necessary update or adaptation of this implementation plan, with the intention of meeting the existing objectives and timeline. TMDL stakeholders will review the status of TMDL implementation every five years for continuous improvement opportunities.

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 to ultimately achieve TMDL compliance. Through the annual meetings of the County Intergovernmental Phase II Coordination Committee, the TMDL Implementation Plan working group will meet to review Phase II compliance plans. The MDEQ will track permit compliance through storm water 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 storm water permit process, enforcement authority will reside in the MDEQ's authority under the provisions of the storm water rules.

Evocative of Monet's painting of Giverny in Normandy, this scene of the Huron River and Geddes Pond illustrates how the river's water quality is a key aesthetic asset for the greater Ann Arbor community.

Appendix D:

Malletts Creek Restoration Project: A TMDL Implementation Plan to Improve Biota

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A partnership between The Washtenaw County Drain Commissioner, The City of Ann Arbor, and Pittsfield Township.

EXECUTIVE SUMMARY

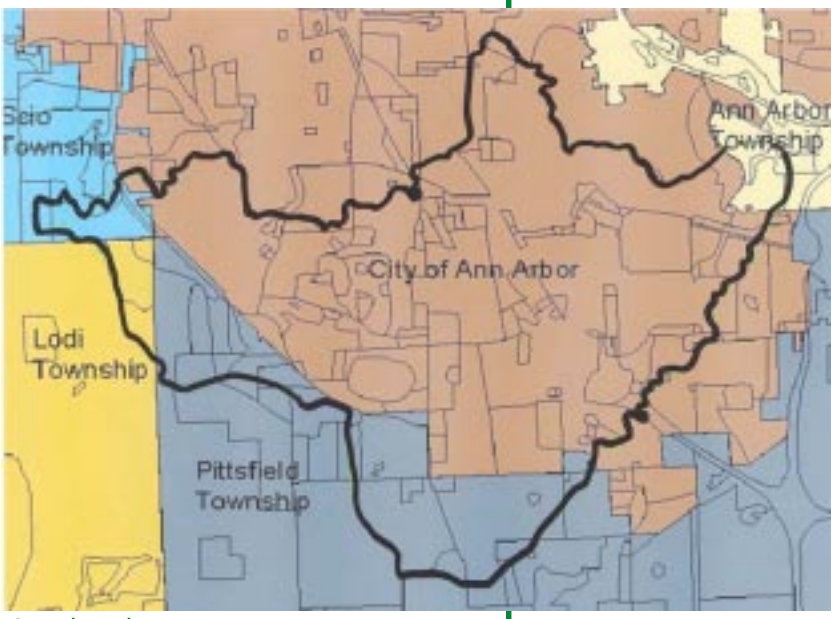
Introduction to Malletts Creek

Malletts Creek is located in eastern Washtenaw County, primarily in the City of Ann Arbor and Pittsfield Township. The Malletts Creek watershed is 11-square miles in area and flows into the Huron River. Most of the creek is a Washtenaw County drain, which means the Drain Commissioner is responsible for maintaining these portions of the drainage course. In the last 40 years, the watershed has seen extensive development, including shopping malls, new subdivisions, apartment complexes, homes, parking lots, businesses, stores, churches, and industrial buildings.

Because much of the land is heavily developed (37% of the land is covered with impervious surfaces), Malletts Creek is considered an urban watershed.

Background of Malletts Creek Restoration Project

Malletts Creek is a Chapter 20 County Drain and natural stream that is in need of maintenance and improvement. The Washtenaw County Drain Commissioner, City of Ann Arbor, and Pittsfield Township, have recognized structural, water quality and flow capacity problems, and wish to restore Malletts Creek. In addition, the Michigan Department of Environmental Quality (MDEQ) has mandated a 50% phosphorus reduction to protect the Huron River and downstream impoundments and has specified the need to improve the creek's habitat (fisheries) value.



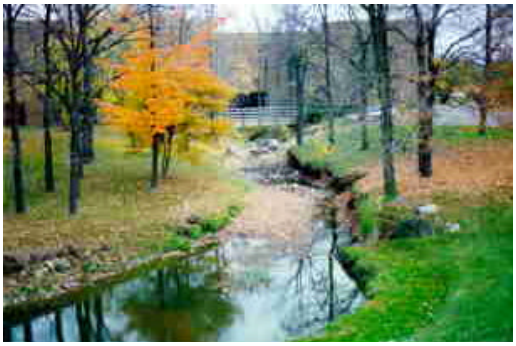
Area location

In order to begin the process of restoration and repair of Malletts Creek, the project sponsors contracted with a consultant team to undertake a comprehensive assessment of the Creek and to develop an overall plan to guide the restoration work.

The consultant team worked closely with staff from the office of the Washtenaw County Drain Commissioner, the City of Ann Arbor and Pittsfield Township, to study Malletts Creek, identify the underlying problems and provide an innovative, long-range, staged, practical, cost-effective approach to solving these problems. The final plan was required to reflect community input, have significant public support, and the approval of the City of Ann Arbor and Pittsfield Township.

Restoration Team

In January of 1999, the consultant team of Environmental Consulting & Technology, Inc. (ECT), Applied Science, Inc. (ASI) and Tilton & Associates, Inc. (TAI) was chosen to study the problems in Malletts Creek and prepare a restoration plan.



Research Park

Severe bank erosion at Chalmers Road

Key Problems

Several key problems were identified in previous work performed by the Office of the Drain Commissioner, the City of Ann Arbor, Pittsfield Township, the Michigan Department of Environmental Quality, the Huron River Watershed Council and the Malletts Creek Association. These included:

Water quantity problems:

- Increased peak quantity and peak velocity in the creek
- Channel and bank erosion resulting from high velocities
- Isolated flooding associated with increased flow and culvert restrictions

Major water quality problems:

- High phosphorus
- Erosion and sedimentation
- Increased water temperature

Structural Problems

- Repairs to headwalls/endwalls
- Repairs to bridge abutments

Diminished habitat:

- Lack of bank vegetation
- Degraded stream beds
- Frequent and severe peak flows

Consequences of the Problems

As a consequence of the urbanization and the resulting flashy flow characteristic of the creek, the view of the creek as a community amenity was diminished. The resulting sediment and associated phosphorus loads from Malletts Creek degrading the downstream impoundments, leading the Michigan Department of Environmental Quality (MDEQ) to require a 50% reduction in the phosphorus loading. In addition, the MDEQ recognized that the Malletts Creek fish and wildlife habitat had been severely impacted. This, coupled with isolated flooding issues, caused the local units of government to initiate this comprehensive restoration project.

Goals of the Restoration Project

The project team analyzed the creek and its watershed, with the goal of developing plans and implementation activities to achieve the following:

- Address structural repairs as needed
- Reduce phosphorus pollution by 50%
- Increase habitat for fish and wildlife
- Control stream velocities and flow rates
- Establish an educated and involved public

Throughout the project, the team aggressively sought and obtained input, advice and preferences of the public, to learn about its perception of problems and acceptable strategies for restoration.

Use a safe lawn fertilizer

Detention Pond by I-94

Data Collection Activities

The team began to study the watershed by collecting existing data on water quality, quantity, and benthic populations. To supplement the existing data, new water quality testing, and a benthic study were conducted. The team performed a limited detention pond inventory, surveyed cross sections, and performed a physical survey by walking the stream and reporting on the vegetation and habitat as well as needed structural repairs.

Best Management Practices (BMPs)

Previous studies of the watershed indicated that sources of its problems are largely "non-point" sources of pollution. Best Management Practices (BMPs) are methods to prevent or mitigate such pollution. Categories of BMPs that were reviewed included management methods, treatment methods, and source controls. BMPs were evaluated by the project team and at public meetings.

Three categories of BMP's were identified and evaluated:

Source controls, such as changing lawn fertilization and landscape practices, are proactive, keeping water runoff clean and using it as a resource. These measures can save money and are particularly useful in residential areas but they need to happen throughout the watershed and require public education and buy-in by the public.

Treatment methods, such as detention ponds, are reactive, cleaning up and slowing down polluted storm water runoff from developed lands. Since they require initial capital investment and long term maintenance, treatment methods can be implemented by government alone, or in partnership with private land owners. Existing ponds can be retrofitted to improve quantity and quality performance

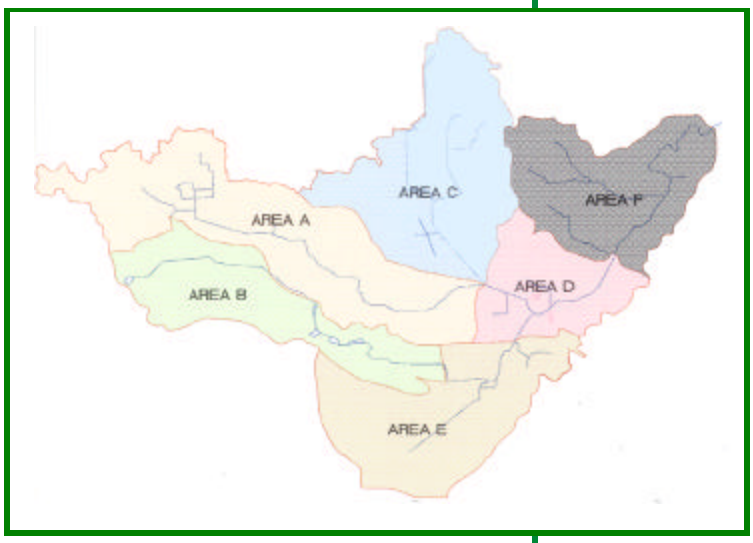
Management methods include revising local ordinances to reduce runoff and improve storm water management and protecting key flood-prone land.

Modeling Study

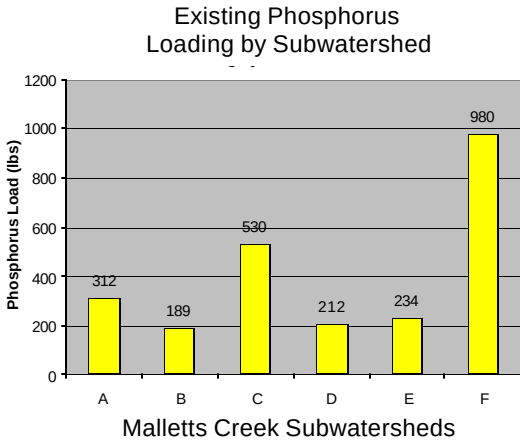
A detailed computer modeling study was performed. This study enabled the team to predict flow rates and flood elevations as well as phosphorus levels in the creek. Simulation of future land use assumed full development of the watershed. Because future development projects will be required to adhere to modern ordinances, the differences are minimal between the existing conditions and the model predictions for future land use. The modeling study components are described below:

Hydraulic Study

- Installed and collected data from a USGS flow gage at Chalmers Road and a rain gage at the U.S. Army Reserve Base on Industrial Highway
- Input data into the EPA Storm Water Management (SWMM) model
- Identified areas of potential flooding and suggested solutions



Malletts Creek Subwatersheds



Phosphorus Study

- Reviewed existing water quality data
- Collected water samples at six locations across the watershed during the year
    - Input this data into a phosphorus loading model
    - Predicted likely sources of high phosphorus loading by subwatershed, and identified anomalies suggesting unknown sources of phosphorus, such as illicit discharges

Hydraulic and Hydrologic Analysis Results

This portion of the modeling study showed that Malletts Creek is experiencing extreme peak flows, most likely attributable to the fact that 22% of the land area in the watershed is impervious surface directly connected to the storm water system and creek. Half of the flow of Malletts Creek is from the Burns Park residential neighborhood (shown as area "C" on the map displayed to the left), which represents 20% of the watershed.

Analysis of the 10-year storm and the 100-year storm showed 5 specific points of concern along Malletts Creek resulting from changes in hydrology, or improperly sited, designed or constructed buildings or private storm water management facilities:

- Eisenhower Office Park (100-year storm)
- Eisenhower Parkway west of State St. (100-year storm)
- Oakbrook Drive east of Main St. (10-year storm)
- Lansdowne residential area (10-year storm)
- Cranbrook Tower area upstream of Briarwood ponds (100-year storm)

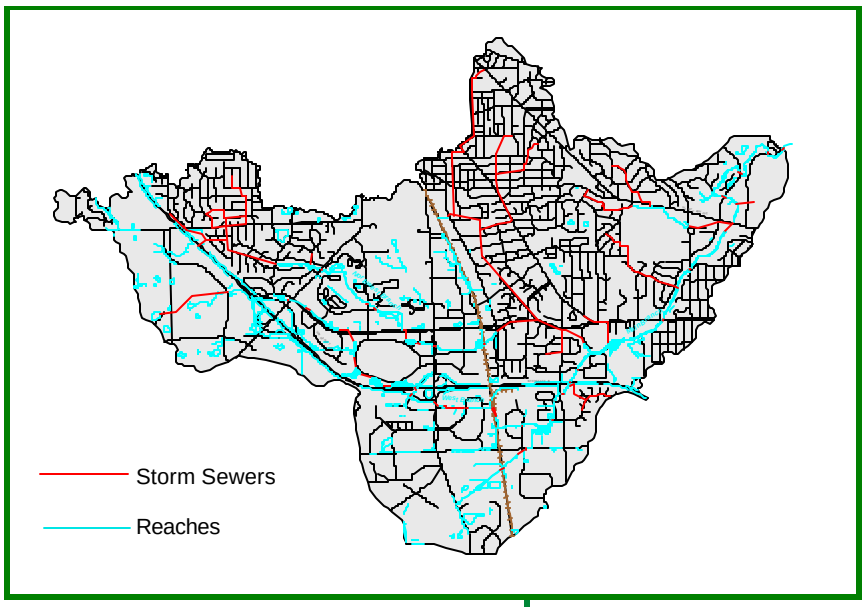
Phosphorus Analysis Results

From the water quality data, it was determined that the majority of the phosphorus pollution washes off of the land, entering the Creek in rainstorms.

The team divided the watershed into 6 subwatersheds for a detailed analysis, and the phosphorus model enabled the team to distribute the contribution of phosphorus among the 6 different subwatersheds.

The phosphorus contribution varied between the subwatersheds which is a significant finding and means that different management activities are appropriate in the subwatersheds. Creative source controls need to be implemented, and treatment methods or detention areas need to be constructed where possible.

To reduce the total phosphorus in the creek by 50% the following activities are recommended:



Malletts Creek hydrology

- Modify existing detention basins to detain and treat smaller storms
- Add 5 in-system storage structures to 3 storm drains (County Farm, Lansdowne and Burns Park areas)
- Promote landowner participation in creek-safe lawn maintenance (target 25% participation)
- Increase street sweeping in residential and commercial areas
- Renovate Brown Park pond, which is owned by the Malletts Creek Drainage District
- Create a new wetland pond at County Farm Park

If these recommendations are implemented, the MDEQ requirements will be fulfilled for the Malletts Creek Watershed.

Habitat Analysis Results

Malletts Creek is under an MDEQ mandate to improve habitat quality. Excessive water velocities are undermining fisheries and species habitat. The following are recommendations from the habitat analysis.

- Increase detention in the watershed to reduce peak velocities
- Remove logjams and sediment islands
- Create meandering low flow channels between pools
- Stabilize stream bank with plantings to provide food and cover for wildlife
- Protect and create riparian wetland areas

The team completed a thorough reconnaissance of Malletts Creek and identified locations where structures and streambanks were in need of repair. Structures such as culverts and headwalls were in some cases found to be deteriorated and will need to be repaired or replaced. Structural streambank stabilization approaches such as rip rap may be needed where vegetative methods are not feasible.

Malletts Creek at Highland Drive

Public Involvement

To be effective, the restoration planning and implementation process must continue to include all the groups that live and work in the watershed. One of the project goals was to establish an educated and involved public. To accomplish this, the team identified a list of stakeholder groups, including elected and appointed officials, environmental groups, public and private schools, business associations, homeowners associations, commercial, residential and riparian landowners and lawn care companies.

Several mechanisms were used to reach and involve these stakeholders. These included a web page, four community-wide meetings, interacting with the Malletts Creek Association (a citizen based creek protection group), conducting focus groups and telephone surveys.

The restoration activities included in this report come from the community as well as the staff of the Washtenaw County Drain Commissioner's Office, City

of Ann Arbor, Pittsfield Township, and the consultant team. The full range of problems in Malletts Creek can only be addressed by including actions that involve the people who live, work and visit the watershed; government alone cannot achieve full success.

Key Findings that Direct Restoration Activities

The study's findings, consisting of direct observation, sampling and analysis, modeling and community involvement, have directed the team to recommend a restoration strategy. The key findings are as follows:

- Peak discharge and velocity exceed acceptable levels
- 97% of the phosphorus pollution occurs from storm water runoff, not dry weather flow
- The urbanized areas, such as most of subwatersheds C and F that are built without detention ponds, contribute more to the Creek's high peak flows velocity and phosphorus problems than others
- With control of discharge and velocity, habitat can be improved

Recommended Restoration Activities

Based on the key findings, the team and stakeholders formulated activities and strategies to accomplish the reduction in peak flows and velocities, reduction in phosphorus concentration and improvement in fish and wildlife habitat.

Treatment Controls

- Institute both public and private solutions for flood concerns
- Retrofit detention basins
- Add in-system storage structures on large storm drains
- Renovate Brown Park pond
- Create wetland pond at County Farm Park
- Create new wetland ponds and extended detention basins
- Install catch basin restrictors

Structural Repairs

- Repair failed endwalls and outlet structures
- Repair broken culverts
- Repair cracked headwalls
- Remove large sediment islands
- Stabilize sections of the streambank

Source Control Activities

- Reduce lawn fertilizer use, increase native landscaping
- Implement related public education and technical assistance program
- Conduct illicit discharge elimination program
- Provide extra resources to strengthen soil erosion and sedimentation control enforcement
- Increase street sweeping
- Revise local government ordinances to reduce runoff and improve storm water management
- Modify residents yard waste and leaf handling practices

Habitat Restoration

- Remove logjams
- Remove sediment islands
- Restore streambank corridor and stabilize erosion
- Make in-stream improvements, the addition of low flow channels, ponds and riffle pools.

The Malletts Creek Restoration Plan also recommends ongoing periodic monitoring to measure program success.

Restoration Plan Activities and Costs

The recommended restoration activities are presented on Table 1. The activities are described and have been given project numbers for tracking of costs and scheduling during a restoration plan period of 6 years. It is further recommended that some activities continue to occur after the 6 year restoration period. These activities are given on Table 2 as on-going activities. The estimated cost of the on-going activities also is given on Table 2.

On Table 3, the costs of the restoration are summarized by year, for the 6 year restoration plan is about $19 million, with about $11.5 million in capital costs for: the construction of a new wetland pond in County Farm Park; improvements of the wetland in Brown Park; streambank stabilization; structural repairs to headwalls, endwalls, bridge abutments, detention pond modifications and construction of in-system storage structures in large storm drains. The remainder of the costs are for finance costs, operation and maintenance (O&M) costs, and public involvement programs.

The current apportionment for drain improvement projects requested by petition to the Drain Commissioner is given on Table 4.

Beneficial Impacts of Restoration Activities

The recommendations of this restoration plan will:

- Reduce peak discharge
- Reduce flow velocity
- Reduce total phosphorus to the Huron River by 50%
- Provide habitat improvement along 7 miles of the Creek
- Increase aesthetic enjoyment of the Creek
- Control flooding for the ten-year storm along the main channel.

Table 1: Restoration Activity Schedule and Estimated Costs

Project #	Restoration Activities	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total Estimated Costs
		SCHEDULE						
1	Illicit Discharge Elimination Program							$212,700
2	Sampling for Bacteria & Phosphorus							$27,720
2a	Sampling for Benthics							$9,900
3	USGS Stream Gage - Continue Operation							$54,000
4	Enforce Existing Ordinances							$450,000
5	Ordinance & Code Revisions for Stormwater Quality & Management							$360,000
6	Stream Maintenance (routine)							$195,000
7	Public Education Program							$720,000
8	Design In-System Storage Structures for Large Storm Drain Outlets							$75,000
9	Remedy 10-yr. Storm Flooding Problem - Design Solution for Oakbrook Drive Crossing							$10,000
10	Investigate 100-yr. Storm Flooding Problems - Determine Responsibilities							$20,000
8a	Construction of In-System Storage Structures							$1,198,214
9a	Remedy 10-yr. Storm Flooding Problems - Start Construction							$42,600
11	Start Detention Pond Study Throughout The Watershed (Survey & Design 40 ponds/year)							$696,360
12	Design Structural Repairs to Stream -To be done by petition.							$150,000
11a	Start Detention Ponds Retrofit - Outlet Structures, Wetlands and Sediment Forebay							$2,218,250
12a	Structural Repairs to Stream -Start Construction							$4,837,815
13	Residential Street Sweeping - Phase 1 - Area F							$10,100
14	Brown Park Pond Improvements - Design							$250,000
15	County Farm Park Wetlands - Design							$50,000
13a	Residential Street Sweeping - Phase 2 - Area F & C							$27,000
14a	Brown Park Pond Improvements - Start Construction							$2,244,163
15a	County Farm Park - Start Construction							$263,600
13b	Residential Street Sweeping - Phase 3 - All Areas							$134,800
14b	Brown Park Pond - Monitoring							$35,000
15b	County Farm Park Wetland Pond - Monitoring							$35,000
16	Sweep Commercial Streets on a Monthly Basis							$68,800
17	Stream Bank Stabilization - Design							$208,000
18	Habitat Improvements - Design							$22,000
19	Pilot Project - Catch Basin Restriction							$1,169,329
20	Catch Basin Cleaning - Clean 2x/year							$944,300
17a	Stream Bank Stabilization - Implement							$2,211,311
18a	Habitat Improvements - Implement							$174,000
								$19,124,962

Table 2: On-going Restoration Activities and Estimated Costs

Project #	Restoration Activities	Estimated Costs/Year
2	Sampling for Bacteria & Phosphorus	$9,360
2a	Sampling for Benthics	$3,300
3	USGS Stream Gage - Continue Operation	$9,000
4	Enforce Existing Ordinances	$75,000
5	Ordinance & Code Revisions for Stormwater Quality & Management	$60,000
6	Stream Maintenance (routine)	$32,500
7	Public Education Program	$120,000
13b	Residential Street Sweeping - Phase 3 - All Area	$67,400
14b	Brown Park Pond - Monitoring	$17,500
15b	County Farm Park Wetland Pond - Monitoring	$17,500
16	Sweep Commercial Streets on a Monthly Basis	$34,400
20	Catch Basin Cleaning - Clean 2x/year	$472,150
	TOTAL	$918,110

Table 3: Malletts Creek Restoration Plan Estimated Costs Summary

	Capital Costs	Finance Costs	O&M Costs	Public Involvement Costs	Total Estimated Costs
Year 1	$ 105,000	$0	$ 323,760	$ 53,000	$ 481,760
Year 2	$ 1,117,600	$294,814	$ 324,900	$ 66,000	$ 1,803,314
Year 3	$ 2,206,500	$698,522	$ 337,060	$ 103,000	$ 3,345,082
Year 4	$ 3,597,500	$1,315,285	$ 269,800	$ 178,000	$ 5,360,585
Year 5	$ 2,729,580	$963,651	$ 965,930	$ 181,000	$ 4,840,161
Year 6	$ 1,807,160	$613,151	$ 758,750	$ 115,000	$ 3,294,061
Totals	$ 11,563,340	$3,885,422	$ 2,980,200	$ 696,000	**$ 19,124,962**

Note: Finance costs are assumed to be 6.5% over 10 years

Finance costs were calculated on capital projects over $500,000

Table 4: Malletts Creek Drainage District Apportionment %

Ann Arbor City	**74.54**
Pittsfield Twp.	**18.85**
State	**5.62**
Washtenaw County	**0.99**

INTRODUCTION

Malletts Creek is a Chapter 20 county drain and natural stream located in an area that has experienced substantial development over the past 40 years. Urbanization has caused the water quality of the creek to become degraded. Fast moving water destroys habitat, damages stream banks and causes erosion. Much of the floodplain is no longer available for capturing sediment, slowing flows and providing habitat. Many areas are bare of trees and other vegetation that are needed to provide food, moderate stream temperatures and stabilize the soil. In its current state, Malletts Creek carries a large amount of phosphorus to South Pond and the Huron River. Water quality sampling conducted by the Michigan Department of Environmental Quality (MDEQ) identified Malletts Creek watershed as among the most significant contributor of phosphorus to the Huron River System.

The control of flow, phosphorus and sediment are key to the success of the restoration effort.

The success of the restoration of Malletts Creek depends on the ability to overcome two major challenges: 1) excessive flows and the resulting erosion and habitat degradation, and 2) pollutants associated with urbanization. A third issue that is also addressed is isolated areas of flooding. These challenges are a direct result of urbanization and the impact of increased impervious surfaces on the hydrology.

The first challenge is to slow the rate of flow during wet weather events. Increases in the amount of impervious area act to deliver runoff very rapidly to the nearest drainage course. There are some ways to decrease the rate and volume of these discharges on a site-by-site basis, but most often these considerations must be instituted at the time of development. This rapid rate of storm water discharge causes channel instability and habitat degradation in several reaches.

Restoration Challenges

- *Decrease wet weather flow rates*
- *Reduce phosphorus contributions in storm water*
- *Reduce flooding potential*

The second challenge is to reduce the amount of pollutants carried by the storm water into the river system. In Malletts Creek, the primary pollutant of concern is phosphorus. MDEQ has mandated a 50% phosphorus load reduction to protect the Huron River and downstream impoundments and has specified the need to improve the creek's habitat and fisheries as well. Urban storm water is the major source of phosphorus as well as a number of other pollutants. A secondary source of phosphorus is the streambank erosion resulting from the high discharge velocities. Because phosphorus leads to frequent algal blooms in the downstream Ford and Belleville Lakes, it is the target parameter on which all control programs were evaluated. It should be noted that many of the proposed control measures are based on the capture of suspended solids, therefore , these methods will also capture other pollutants (other nutrients and heavy metals) associated with the solids.

A third issue is to reduce the flooding potential of the Creek during extreme high flow events. This must be done in a way that does not shift the flooding problem further downstream. Some of the flooding problems are caused by the increased flow that resulted from the upstream urbanization. Others are the result of structures being improperly placed in the floodplain, or improperly designed and constructed. The study identifies areas of potential flooding and recommends a means to address the sites.

These major concerns also lead to secondary concerns, such as diminishing groundwater reserves and increased water temperature, factors that also affect habitat and the potential for a healthy fishery.

In addition to the regulatory mandates, the public has demanded that the creek be restored and that the existing impairments be removed. The desire for a clean and healthy Malletts Creek is well documented in earlier studies completed by the Huron River Watershed Council (HRWC) [1] and the Malletts Creek Association (MCA) [2].

What is the Malletts Creek Restoration Project?

The Washtenaw County Drain Commissioner (WCDC), the City of Ann Arbor and Pittsfield Township have chosen to work together to implement a pragmatic approach to address the many problems facing Malletts Creek. These agencies focused on the Malletts Creek watershed because the public is keenly interested in the resource and because the size of the watershed (11 square miles) allows detailed planning and implementation with a high likelihood of success. As a guide for the implementation process, the Malletts Creek Restoration Plan was commissioned to build upon the earlier work performed by these public agencies as well as the work performed by the HRWC and MCA. The resulting plan addresses water quality issues as well as flooding, habitat, drain maintenance and infrastructure needs. The plan provides the level of detail required for elected officials to evaluate the costs of implementation and the associated benefits and make informed decisions regarding implementation.

Significantly, the recommended actions presented in this plan will fulfill the requirements of the MDEQ and provide the results desired by the general public as verified through a series of public meetings and focus groups.

Clean Michigan Initiative (CMI)

- $50 Million for nonpoint source pollution control
- $90 Million for water quality improvement
- $50 Million for local parks and recreation

Potential Funding Opportunities and the Clean Michigan Initiative

The cost of implementation will be borne by a number of public agencies as well as private landowners, developers and businesses. Fortunately, there are sources of grant funding that can ease the financial burden on the community. A summary of the applicable grant or loan programs is provided in Appendix A. The summary for each funding source includes the due date, match requirement, maximum grant amount, duration, type of project, as well as identifying who can apply and appropriate contact information. Many of the most applicable grant programs are administered through the MDEQ Surface Water Quality Division, Nonpoint Source Program. Some of these programs require a "State-approved Watershed Plan." The WCDC and the HRWC have developed a comprehensive management plan for the Middle Huron River Watershed. [3] The Malletts Creek Restoration Plan is an extension of this earlier work.

The authorization of the Clean Michigan Initiative (CMI) provides substantial funding for the implementation of the recommended restoration activities. One of the objectives to be met in completing this report is to assist the communities in obtaining CMI funding. Following the guidance presented in "Developing a Watershed Management Plan for Water Quality, an Introductory Guide."[4] Table 1 lists the CMI requirements with the corresponding page numbers of the required information in this report.

Table 1
Requirements for a State-approved Watershed Plan

CMI Requirements	*Page Reference*
Define the process including watershed steering committee, lead organization and technical committee	4
Define the geographic scope of the watershed including: a map showing the watershed boundaries, location of surface waters, and a description of the watershed	6, figure 2
List the designated uses that are not being met, designated uses that are threatened and a list of desired uses for the watershed	9
List the known and suspected pollutants for the watershed	14
Identify the causes for each known and suspected source of pollution	14
List the water quality improvements or protection goals for the watershed based on designated uses	10
Define a critical area that geographically narrows the scope of your project by focusing attention on the parts of the watershed that contribute the greatest pollution to the water body	6
Summarize the methods used to conduct the inventory	12
Prioritize the designated uses, pollutants, sources and causes for the watershed and describe the method used to prioritize them	23, Appendix N
Provide a table showing objectives for each of your watershed goals	39
Provide a table showing the system of BMPs needed for each source or cause of pollution and estimated cost	Appendix N
List the tasks needed to implement the system of BMPs for each source in your watershed and their estimated costs	42, Appendix O
Summarize the local projects, programs and ordinances within the watershed and have tasks, responsible parties, milestones and a timeline for improving or adding to those projects, programs and ordinances	42
Provide an implementation/education strategy and a summary of the public participation process that was used, showing the opportunity for public comment and partners involved in developing the plan	Appendix C
Provide an evaluation process that will be used to evaluate the effectiveness of implementing the plan and achieving its goals	44
Identify tasks needed to institutionalize watershed protection	45

Goals of the Restoration Project

The charge to the team was to analyze the creek and its watershed and to develop plans and implementation activities to achieve the following goals:

- Reduce stream flows and velocities.
- Reduce the phosphorus load from Malletts Creek to the Middle Huron River and improve water quality in the creek to an acceptable level.
- Improve habitat for fish and wildlife.
- Identify needed structural improvements along the creek to limit flooding and reduce phosphorus loads as well as improve the aesthetics of, and habitat in, the creek.
- Establish and educate an involved public.
- Ensure the sustainability of the restoration effort by making any long-term commitments (e.g., maintenance) reasonable and workable; and
- Ensure that the restoration project is affordable for the communities.

In 1996 the HRWC, in partnership with 21 communities in the middle Huron River watershed and the MDEQ, completed the first community-driven total maximum daily load (TMDL) calculation for the middle Huron River in Washtenaw and Wayne counties.[5] This effort identified the Malletts Creek watershed as a significant source of phosphorus contributing to the degradation of Ford and Belleville Lakes. The project identified a "5-year phased strategy to meet the TMDL targets for the Huron River" with the objective of reducing the current phosphorus loadings by 50% over the next five years. These reductions could come from either point sources or nonpoint sources. Because the cost of further reducing the phosphorus load from point sources alone was extremely high and unlikely to achieve the required loading levels, the WCDC, the City of Ann Arbor and Pittsfield Township chose to initially target the control of nonpoint sources of phosphorus in Malletts Creek.

In addition to excess phosphorus loadings, the habitat of Malletts Creek is substantially degraded as a result of high velocities, excess sediment loadings and streambank erosion. While a TMDL for the habitat concerns has not been completed for Malletts Creek, the creek is currently a listed non-attainment area and was submitted by MDEQ to the USEPA on the 303d list. Submission on this list will require the completion of a TMDL calculation in the future; TMDL development for Malletts was scheduled to begin in 1999.

Besides these environmental concerns, the project team was charged with prioritizing flooding concerns and infrastructure needs.

Decision Making Process

A Technical Advisory Committee (TAC) was formed that included decision-makers who can bring about change in the watershed. The Malletts Creek TAC included the WCDC, City of Ann Arbor personnel from Engineering, Planning, Parks, Building Inspection and Water Utilities, Pittsfield Township representatives, the HRWC and the MCA. The City of Ann Arbor accepted this restoration plan and the management plan submitted by MCA as the basic planning documents for the restoration of Malletts Creek. The Ann Arbor City Council approved resolution R-105-3-00 on March 6, 2000 (found in Appendix B) that requires an action plan for the City and the formation of a watershed

coordination committee. The purpose of this committee will be to assure that implementation efforts are coordinated and provide assessments of on-going data about conditions in the watershed.

Public Involvement

The Malletts Creek watershed has a highly educated and committed group of citizens. Their involvement in watershed planning preceded the restoration project and is expected to continue through the implementation process. The restoration project team augmented the list of stakeholders for the watershed to included the diverse groups required for successful implementation including:

- elected and appointed officials;
- environmental groups;
- public and private schools;
- business associations;
- homeowners associations, and
- lawn care companies.

The team then identified several mechanisms that would be used to involve and reach out to these stakeholders. These mechanisms included:

- an informative web page;
- four community-wide meetings;
- collaboration with the MCA, and
- focus groups with lawn care companies, homeowners, other large land owners and the science curriculum directors of Ann Arbor Public Schools.

In order to gain the understanding and support of some of the larger commercial landowners and real estate management companies, several telephone interviews were also conducted as part of the public involvement process. Summaries of these meetings are provided in Appendix C.

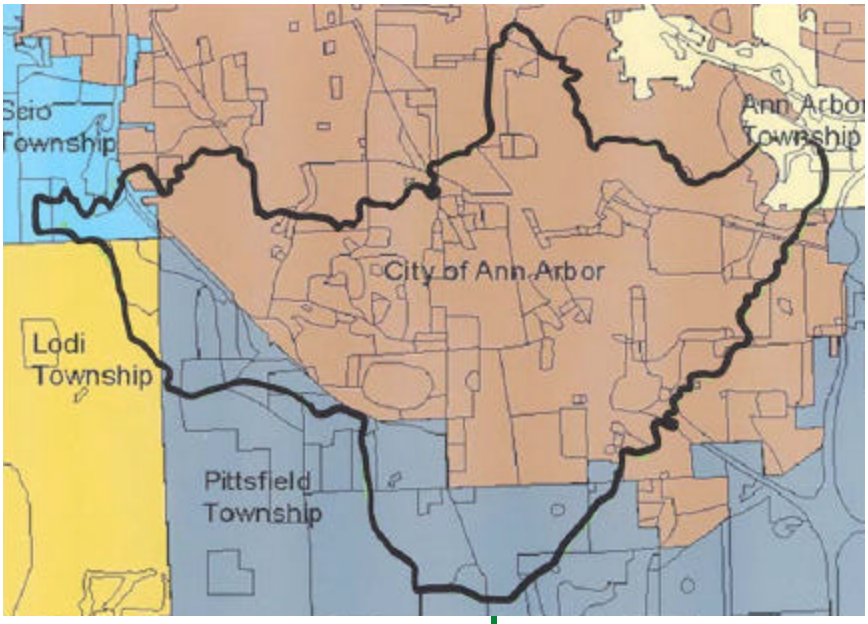


Figure 1: Malletts Creek Watershed

BACKGROUND AND CURRENT CONDITIONS

Location

Malletts Creek (see Figure 1) is located in eastern Washtenaw County and drains to the Huron River. The watershed covers 11 square miles and lies almost entirely within the southern portion of the City of Ann Arbor but also includes portions of Pittsfield Township, Lodi Township, Ann Arbor Township and Scio Township. Malletts Creek is also a publicly-owned county drain and is maintained by the WCDC.

The Main Branch of Malletts Creek is the most easterly branch draining areas south of I-94 including the Ann Arbor Airport (see Figure 2). The West Branch drains the westerly portion of the watershed and extends east of I-94 past Ann Arbor-Saline Road. The West Branch includes the Briarwood commercial area as well as residential and commercial development in Pittsfield Township. The Northwest Branch drains the Dicken, Lansdowne and Briarwood neighborhoods. Several other tributaries to the Northwest Branch have been enclosed and serve the Ann Arbor Hills, Burns Park, Georgetowne and the Allen School neighborhoods. These storm sewer systems are depicted as red on Figure 2.

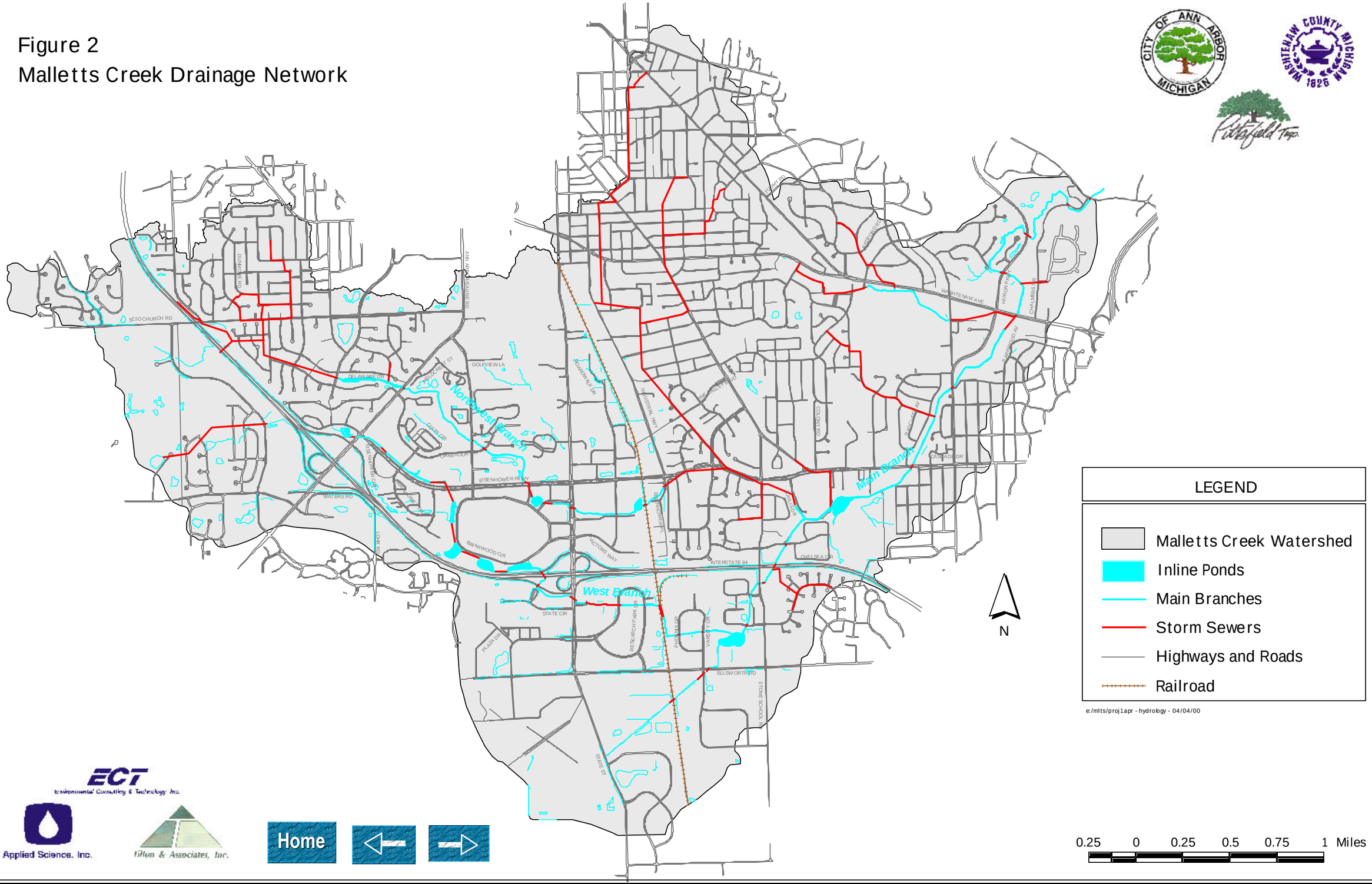
Land Use

The current land use in the watershed is shown on Figure 3 and given on Table 2. The land use map indicates that there is little open space left in the watershed to be developed. The watershed is nearly completely developed with the largest land use category being residential. The open space category on table 2 includes the Ann Arbor Municipal Airport in Pittsfield Township.

Table 2: Land Use Conditions

Land	Existing Conditions Area (acres)	Future Conditions Area (acres)
Residential	3,183	3,483
Commercial	820	1,442
Industrial	888	799
Open Space (airport)	2,016	1,183
TOTAL	6,907	6,907

Figure 2
Malletts Creek Drainage Network



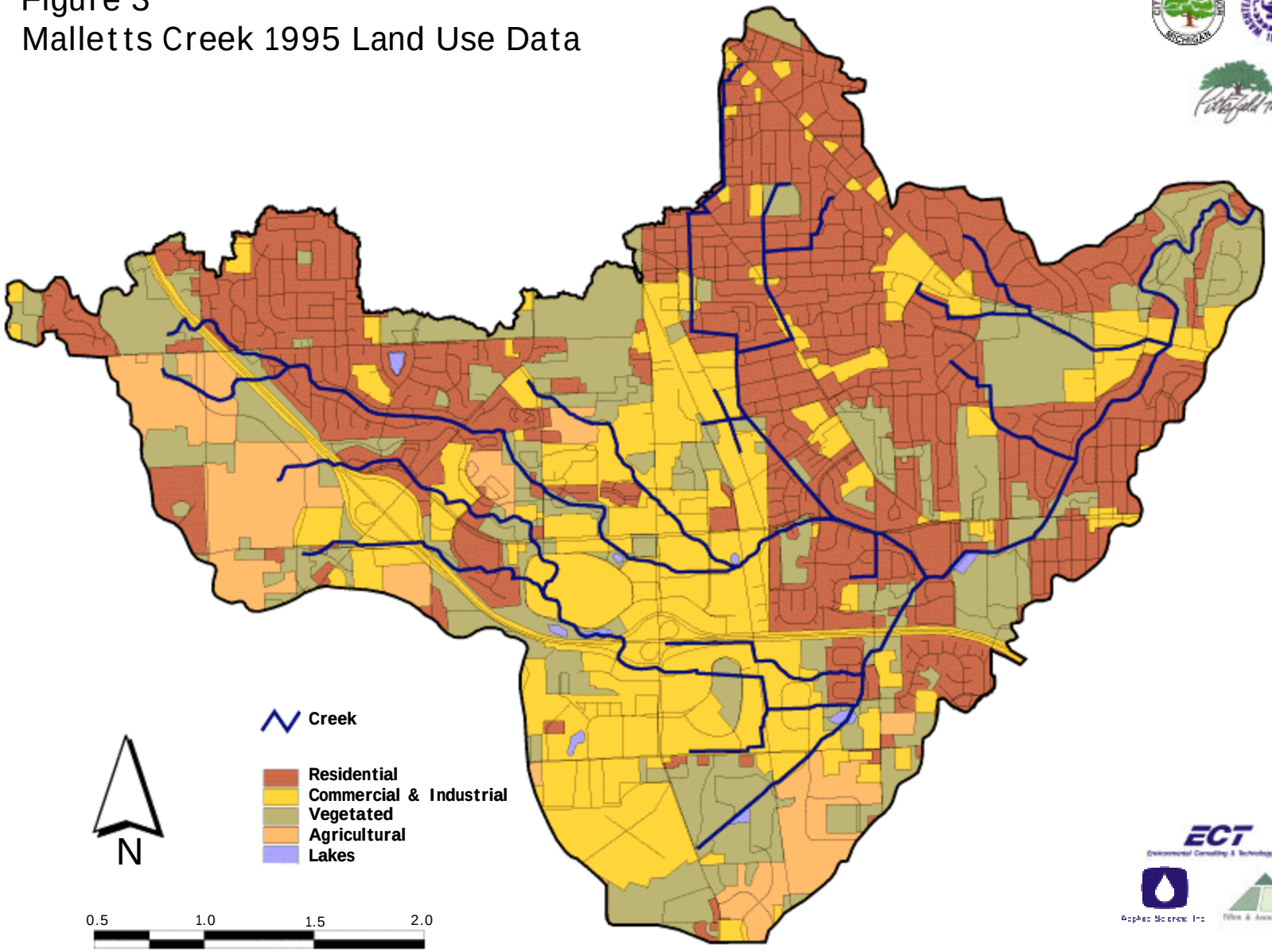
ECT
Environmental Consulting & Technology, Inc.

Applied Science, Inc.

Tilton & Associates, Inc.

Home

Figure 3
Malletts Creek 1995 Land Use Data



Home

In the last 40 years, the Malletts Creek watershed has seen extensive development, including shopping malls, new subdivisions, apartment complexes, homes, parking lots, businesses, stores, churches and industrial buildings. The majority of the watershed is occupied by residential, commercial, and industrial land uses with some pockets of vegetated open space and few remaining areas of agricultural activity.

Hydrology

The hydrology of the creek has been modified by development . When people speak of Malletts Creek they are usually referring to the open channel system depicted as blue on Figure 2. This open waterway is fed by a network of storm drains which have been installed in the developed areas. Most of this drainage system was put in place using design standards that were not sensitive to habitat and other environmental concerns. These drains were designed to rapidly and efficiently carry storm water from developed areas.

Other areas of the watershed have been developed more recently and have been developed with more modern design standards. In these areas detention ponds collect the storm water runoff from roads, rooftops, and parking lots (impervious surfaces), and discharge runoff to the creek at a slower rate, minimizing downstream flooding and protecting the creek environment. Detention ponds are common in some upper portions of the watershed.

Malletts Creek also serves as an important aesthetic resource for citizens as well as a potentially important ecological resource for macroinvertebrates, fish, and wildlife. However, its role as a storm water conduit has impaired the ability of Malletts Creek to serve these other important roles.

Fish Survey

A fish survey was conducted by MDEQ[6] during summer low flow in August 1997 to assess the fish population during the time of greatest stress for most fish. The MDEQ metrics rate the fish community of Malletts Creek as 'Acceptable' at the Eisenhower Road site and 'Poor' at the Chalmers Road site. The difference in rating between the sites is due different expectation based on the size of the stream as well as a higher percentage of the largemouth bass at the Eisenhower Road site.

Designated Uses

The key water quality concern for the MDEQ is whether the creek meets its designated uses. These designated uses are established by the State of Michigan and Federal water quality programs. The impaired uses of Malletts Creek are aquatic life and warmwater fishery. Table 3 lists the watershed concerns noted by stakeholders, and the associated impaired uses that result.

Water quality sampling conducted by MDEQ in 1995 identified the Malletts Creek watershed as among the most significant contributors of phosphorus to the river system.

Table 3
Malletts Creek Watershed Concerns and Impaired Uses

Watershed Concerns	Impaired Designated Uses
Excessive phosphorus	Warm water fishery/aquatic life
Eroding streambanks	Aquatic life
Flashy stream flow	Warm water fishery/aquatic life
Flooding in various areas in watershed	Warm water fishery/aquatic life
Trash and debris in creek	Warm water fishery/aquatic life

Recreational uses of the Huron River, particularly Ford and Belleville Lakes (located in the Middle Huron River system) have been affected by frequent algae blooms. In 1987, The Michigan Water Resources Commission established a target concentration for phosphorus in Belleville Lake of 30 micrograms per liter (Fg/l). In 1994, MDEQ personnel determined that this would be an appropriate target to eliminate the growth of this nuisance aquatic vegetation.

The water quality goals for Malletts Creek as defined by the MDEQ, the HRWC and the MCA are shown in Table 4.

Table 4
Malletts Creek Water Quality Goals

Impaired Uses	Goal
Aquatic life	Increase amount of aquatic life by reducing phosphorus, sediment and peak flows
Warm water fishery	Improve habitat for fish and wildlife by controlling stream velocities and reducing phosphorus

1995 MDEQ Phosphorus Data

MDEQ sampled 11 wet weather events near the mouth of Malletts Creek at Chalmers Road. Approximately three samples were collected during each wet weather event and analyzed for total Kjeldahl nitrogen (TKN), total phosphorus, orthophosphate and total suspended solids (TSS). In addition to the wet weather samples, periodic grab samples were collected between December 1994 and November 1995; thirteen of the grab samples were considered dry weather samples. This data was used to establish the total phosphorus load from Malletts Creek to the Huron River and the Total Maximum Daily Load (TMDL).

Next, the MDEQ identified current sources of phosphorus to Ford and Belleville Lakes and calculated the "allowable" load - the total amount of phosphorus that could enter the Huron River but still meet the target concentration of 30 μg/l.[7] MDEQ divided the TMDL among the many tributaries of the Huron River, including Malletts Creek.

In its current state, Malletts Creek carries a large amount of phosphorus to South Pond and the Huron River. Water quality sampling conducted by MDEQ in 1995 identified the Malletts Creek watershed as among the most significant contributors of phosphorus to the river system. MDEQ also determined that the total phosphorus load in Malletts Creek would need to decrease by 50 percent to meet the target concentration in the Middle Huron River.

Malletts Creek has scored the lowest in terms of biodiversity in the Huron River system.

Aesthetics and Ecological Habitat

Residents of the Malletts Creek watershed involved in the HRWC's Adopt-A-Stream Program have been characterizing the physical state of the stream as well as the benthic populations since 1992. One monitoring site on the West Branch is just downstream of I-94, the next site is downstream of Scheffler Park on the Main Branch, and the third site is on the Main Branch at Chalmers Road. Populations at each site were sampled twice a year and compared to other sites in the Huron River system. When a stream is healthy, a great diversity of creatures can be found in the stream. The two downstream sites have the lowest scores in diversity and all sites in Malletts Creek scored the lowest in the Huron River system.

Warm summer temperatures limit the biota in many headwater reaches. While some downstream reaches of Malletts Creek are buffered by an undeveloped riparian edge and provide the greatest diversity of habitat structure, the flashy nature of the stream flow and poor water quality from urban runoff degrade the habitat structure and aquatic community of the creek. The fish and macroinvertebrate fauna found in Malletts are typical of a small warmwater stream and the tolerant nature of most of the taxa confirms the biological impairment of Malletts Creek.

As a result of the data collection effort it was determined that the key problems in Malletts Creek are as follows:

1. Excessive velocities and flows in the creek
2. Channel and bank erosion as a result of the high velocities
3. Flooding associated with increased flow, undersized hydraulic structures and improper building siting
4. High phosphorus levels in the creek contributing to the impairment of South Pond, and downstream impoundments
5. Diminished habitat due to lack of bank vegetation, degraded stream beds and increased water temperature
6. Needed structural repairs and improvement to existing pipes, culverts and bridges

RESTORATION ACTIVITIES

The restoration activities can be broadly categorized into three types of BMPs: source controls, treatment controls and other management techniques. Following are the recommended activities to meet the water quality goals:

Goal: Reduce Total Phosphorus in the Creek by 50%

A number of activities are required to achieve the ambitious goal of reducing the phosphorus load from Malletts Creek by 50%. These include:

- Retrofit existing detention basins;
- Add five in-system storage structures to three storm drains (County Farm, Lansdowne area and Burns Park/Georgetown area);
- Promote landowner participation in creek-safe lawn maintenance with a target of 25% participation (the phosphorus reduction resulting from 50% participation that was modeled is believed to be offset by the large amount of sediment capture expected in the in-system storage structures);
- Implement related public education and technical assistance programs;
- Conduct an illicit discharge elimination program;
- Increase frequency of street sweeping in residential and commercial areas;
- Increase frequency of catch basin cleaning;
- Renovate and expand Brown Park Pond; and
- Create a new wetland pond at County Farm Park.

Goal: Improve Habitat for Fisheries

The Malletts Creek watershed is listed as a non-attainment area for habitat. This listing will lead to the establishment of a TMDL under which the MDEQ will mandate an improvement in habitat quality. Excessive water velocities are undermining fisheries and species habitat. The following activities or objectives, if implemented, will fulfill the MDEQ requirements for the Malletts Creek watershed:

- Increase detention in the watershed to reduce peak velocities;
- Remove logjams and sediment islands;
- Enforce soil erosion and sedimentation control ordinances;
- Revise local government ordinances to reduce runoff and improve storm water management;
- Create meandering low flow channels between pools;
- Increase stream bank plantings to stabilize banks and provide food and cover for wildlife; and
- Protect and create riparian wetland areas.

Goal: Structural/Engineering Improvements

In addition to addressing the environmental concerns, the team was charged with addressing the structural concerns of the publicly-owned structures along the watercourse. These included:

- Identifying the restrictive culverts and enclosures which cause local flooding
- Identifying structures, including culverts and headwalls and endwalls, where deterioration was found

- Identifying reaches where structural bank stream stabilization solutions are recommended when vegetative approaches alone are likely to fail

Local flooding can be addressed through structural improvements at five locations as described below.

Eisenhower Office Park Area
It is recommended that floodwalls and/or berms be constructed to floodproof the buildings in the 100-year floodplain. It is unclear whether the designing and constructing the floodwalls/berms should be publicly or privately funded since the buildings were constructed prior to adoption of the FEMA FIS and it is not known whether the building were constructed in accordance with permits from the WCDC. The responsibility for the floodproofing will be determined by future investigations.

Eisenhower Parkway West of State
It is recommended that Plaza Drive and Market Place be regraded to provide flow over the parkway to a downstream section of Malletts at a lower elevation, which will not flood the Concord Center buildings. Plaza Drive and Market Place are private roads, which are assumed to be private roads, but the actual ownership is unclear at this time. For several reasons, it is unclear how the recommended solution will be implemented and funded. Further investigations and coordination meetings with Concord Center, Briarwood Mall the City of Ann Arbor and WCDC are required.

Oakbrook Drive Area
It is recommended that the Streambank at Oakbrook Drive be stabilized to prevent bank erosion during floods that overtop the roadway. Since Oakbrook Drive is a public roadway, the stabilization will be designed and constructed as part of the Restoration Plan and funded by the drainage district.

Lansdowne Pond Area
It is recommended that floodwalls be constructed to flood proof the homes not currently flood proofed in this area. Since the homes are private property, the design and construction of floodwalls would be private initiatives. Floodplain elevations will be provided from the SWMM modeling work and FEMA study.

Cranbrook Tower Area
It is recommended that the Brookhaven pond outlet be modified to lower flooding levels in the Cranbrook Tower area. The existing pond outlet is restrictive and has significantly less capacity than the downstream culverts under Eisenhower Parkway.

It is unclear whether modifying the Brookhaven Pond outlet should be a publicly or privately funded project. The Brookhaven Pond outlet carries the flow for the entire branch of Malletts Creek and is in a public ROW. However, the pond was privately constructed and no permit from the WCDC can be found. If a permit was not issued, responsibility for modifying the Brookhaven pond outlet will be private.

If the flooding problem in the Cranbrook Tower area cannot be solved entirely through modifying the Brookhaven Pond outlet (due to the downstream culvert capacity restriction), then floodproofing of the Cranbrook Tower building is recommended. This floodproofing would be private funded as it is not a result of Malletts Creek operations.

A project restoration schedule was prepared and approved by the TAC. This multi-year strategy will allow for technically, financially and environmentally sound sequencing of restoration activities. Tables 9, 10 and 11 show the recommended prioritized restoration activities sequenced over the next 6 years with their associated costs. Further detail for the project schedule and supporting costing information is included in Appendix O.

Table 9: Restoration Activity Schedule and Estimated Costs

Project #	Restoration Activities	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total Estimated Costs
		SCHEDULE						
1	Illicit Discharge Elimination Program							$212,700
2	Sampling for Bacteria & Phosphorus							$27,720
2a	Sampling for Benthics							$9,900
3	USGS Stream Gage - Continue Operation							$54,000
4	Enforce Existing Ordinances							$450,000
5	Ordinance & Code Revisions for Stormwater Quality & Management							$360,000
6	Stream Maintenance (routine)							$195,000
7	Public Education Program							$720,000
8	Design In-System Storage Structures for Large Storm Drain Outlets							$75,000
9	Remedy 10-yr. Storm Flooding Problem - Design Solution for Oakbrook Drive Crossing							$10,000
10	Investigate 100-yr. Storm Flooding Problems - Determine Responsibilities							$20,000
8a	Construction of In-System Storage Structures							$1,198,214
9a	Remedy 10-yr. Storm Flooding Problems - Start Construction							$42,600
11	Start Detention Pond Study Throughout The Watershed (Survey & Design 40 ponds/year)							$696,360
12	Design Structural Repairs to Stream -To be done by petition.							$150,000
11a	Start Detention Ponds Retrofit - Outlet Structures, Wetlands and Sediment Forebay							$2,218,250
12a	Structural Repairs to Stream -Start Construction							$4,837,815
13	Residential Street Sweeping - Phase 1 - Area F							$10,100
14	Brown Park Pond Improvements - Design							$250,000
15	County Farm Park Wetlands - Design							$50,000
13a	Residential Street Sweeping - Phase 2 - Area F & C							$27,000
14a	Brown Park Pond Improvements - Start Construction							$2,244,163
15a	County Farm Park - Start Construction							$263,600
13b	Residential Street Sweeping - Phase 3 - All Areas							$134,800
14b	Brown Park Pond - Monitoring							$35,000
15b	County Farm Park Wetland Pond - Monitoring							$35,000
16	Sweep Commercial Streets on a Monthly Basis							$68,800
17	Stream Bank Stabilization - Design							$208,000
18	Habitat Improvements - Design							$22,000
19	Pilot Project - Catch Basin Restriction							$1,169,329
20	Catch Basin Cleaning - Clean 2x/year							$944,300
17a	Stream Bank Stabilization - Implement							$2,211,311
18a	Habitat Improvements - Implement							$174,000
								$19,124,962

Table 10: Malletts Creek Restoration Plan Estimated Costs Summary

	Capital Costs	Finance Costs	O&M Costs	Public Involvement Costs	Total Estimated Costs
Year 1	$ 105,000	$0	$ 323,760	$ 53,000	$ 481,760
Year 2	$ 1,117,600	$294,814	$ 324,900	$ 66,000	$ 1,803,314
Year 3	$ 2,206,500	$698,522	$ 337,060	$ 103,000	$ 3,345,082
Year 4	$ 3,597,500	$1,315,285	$ 269,800	$ 178,000	$ 5,360,585
Year 5	$ 2,729,580	$963,651	$ 965,930	$ 181,000	$ 4,840,161
Year 6	$ 1,807,160	$613,151	$ 758,750	$ 115,000	$ 3,294,061
Totals	$ 11,563,340	$3,885,422	$ 2,980,200	$ 696,000	**$ 19,124,962**

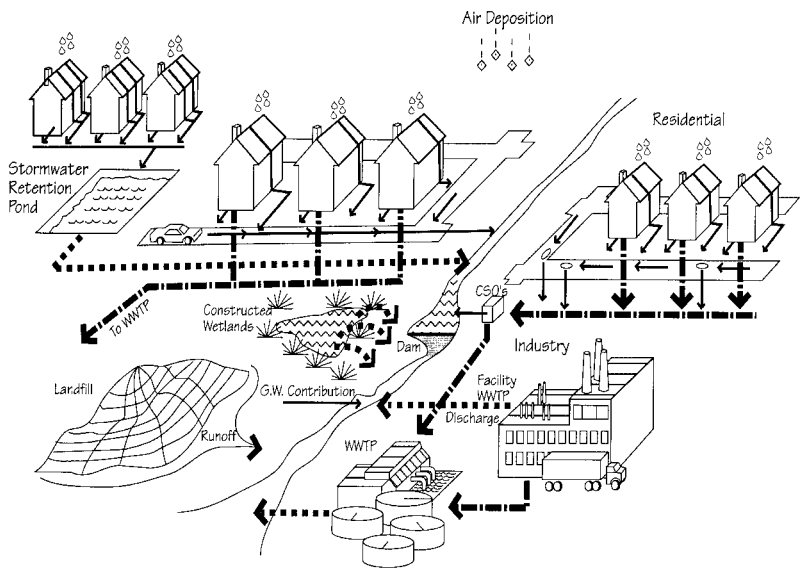
Note: Finance costs are assumed to be 6.5% over 10 years

Finance costs were calculated on capital projects over $500,000

Table 11: Malletts Creek Drainage District Apportionment %

Ann Arbor City	**74.54**
Pittsfield Twp.	**18.85**
State	**5.62**
Washtenaw County	**0.99**

The twenty priority projects identified by the TAC are summarized below. Further detail is provided on each project in the referenced appendix.



Sources of Water Pollution

Project #1: Illicit Discharge Elimination Program

Illicit discharges occur when sanitary sewers are inadvertently connected to the storm drainage system. This type of connection is common in areas that were constructed before modern standards for plan review and inspection were instituted. Illicit connections are sources of both phosphorus and E-Coli. In Area F, where unusually high loadings of phosphorus were measured in dry weather flow, illicit connections are suspected. Thus an illicit discharge elimination program is recommended.

The illicit discharge elimination program will take place over three years at an estimated cost of $212,700. The first phase will provide for county and/or city employees to "walk" the drains, sample the low flow discharge at appropriate areas, identify "hot" outlets and prioritize the areas of concern. The second phase requires a similar sampling program within the enclosed drains that exhibit signs of sewage or other pollutants. The final phase requires site visits at privately owned facilities suspected to have illicit connections. Often dye testing is required.

Details of the cost estimate are provided in Appendix O.

Project #2: Sampling Program for Bacteria, Phosphorus and Benthics

In an effort to evaluate the effectiveness of the restoration project as it proceeds, three monitoring programs are recommended. These programs will document the changes in key chemical parameters, the biological characteristics and the discharge from the creek. Monitoring water quality parameters, during wet weather, such as total phosphorus and E. Coli is recommended at six sampling sites throughout the watershed. The sampling schedule is twice a year, every other year at an estimated cost of $27,720. This cost estimate is based on similar work done on the restoration project in 1999.

Biological monitoring for insects and habitat is recommended at six sites throughout the watershed. The recommended frequency of the sampling is once a year, every other year alternating with the phosphorus and bacteria sampling. The estimated cost of this program is $9,900. This cost estimate of $9,900 was derived from the Adopt-A-Stream program sponsored by the HRWC and assumes they will continue to perform this monitoring.

Project #3: USGS Stream Gage

To gather an accurate picture of the hydrologic conditions of the creek, the USGS installed a stream gage at Chalmers Road. Continuing to operate the USGS stream gage at this site will allow stream flow to be monitored during the restoration process and determine if the recommended flow control pro-

grams are effective in reducing peak discharge rates. This method of evaluation is scheduled for all six years at a total cost of $54,000. This cost estimate is based on the annual cost of the gage as of 1999.

Project #4 Enforce Existing Ordinances

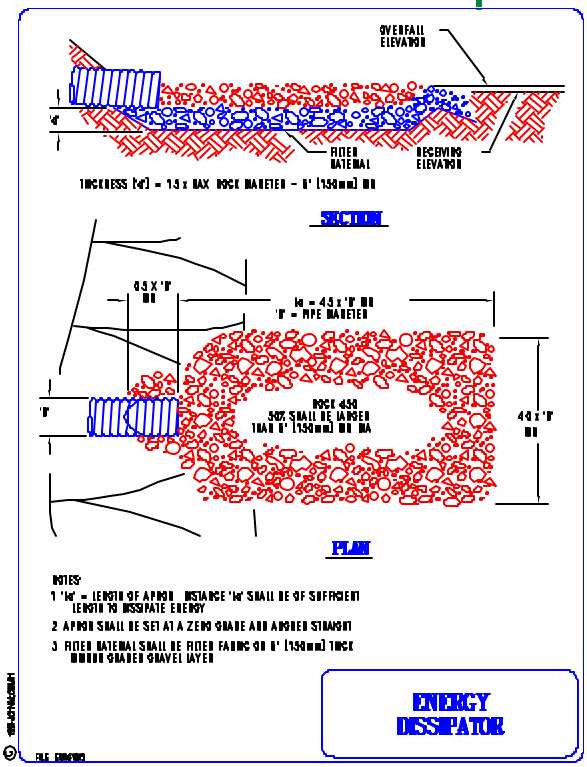
Several of the sources of sediment and phosphorus are currently regulated under existing ordinances. Lack of available staff has prevented adequate enforcement of these regulations. The recommendation is to hire one additional staff person to enforce the existing ordinances concerning construction soil erosion and control, including methods of slope stabilization, sediment-trapping devices, and construction entrance and roadway stabilization. This staff person could be jointly funded by the City of Ann Arbor and Washtenaw County, thereby covering the entire watershed.

Failing culvert

This staff person would also be available to enforce ordinances regarding pond maintenance. Proper maintenance of detention/retention ponds is also required under existing ordinances. Because there is no inspection, there has been no enforcement. The estimated annual cost is $75,000 and is based on the addition of one additional staff person.

Project #5: Ordinance and Code Revisions for Storm Water Quality and Management

In addition to enforcing existing ordinances, revisions are recommended in several local codes and ordinances. The recommended revisions are documented in "Review of Ordinances Affecting Storm Water Quantity and Quality for the Malletts Creek Watershed" included in Appendix L.



Suggested culvert stabilization with energy dissipation

As part of the restoration study, all ordinances that affect storm water quality and quantity were reviewed and recommendations made on aspects that would affect levels of impervious cover, management of storm water flows, sediment and phosphorus. Revisions of existing ordinances and codes would be prorated across the community of origin. The estimated cost is $360,000 over six years and includes legal fees, public meetings and hearings, and assumes no legal challenges to the ordinance revisions. This cost estimate was taken from the literature and is based on a national average.

Project #6: Stream Maintenance (routine)

Annual maintenance on the open channel of Malletts Creek is required to minimize streambank erosion and maintain a healthy stream. For purposes of estimation, it has been assumed that three log jams and/or tree removals as well as repairs of five minor outlet structures will be accomplished each year. This cost is estimated at $195,000 over the 6 year period

Project # 7: Public Education Program

Several urban watershed studies have reported that residential lawns contribute up to 67% of the phosphorus load. Additional sources of phosphorus, such as autumn leaf pick up practices, also contribute to the phosphorus problem. These major sources of phosphorus

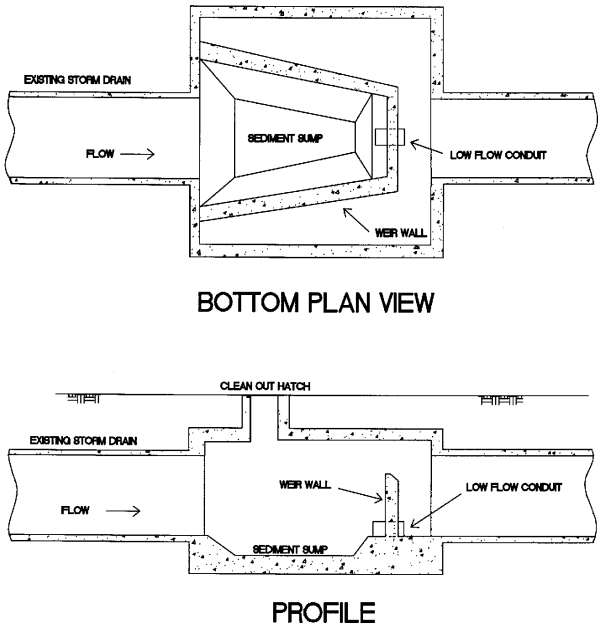


Figure 14: Conceptual Design of In-system Storage Device

can only be reduced by individual homeowners. A public education program aimed at modifying current lawn care practices, promoting low or no phosphorus fertilizer, and proper leaf storage, is recommended to reduce the phosphorus loading to Malletts Creek. It is also recommended that signs be placed at road crossings to increase the publics' awareness of the creek. The estimated cost for a public education program is $720,000 and includes $67,000 a year for materials and the addition of one staff person ($53,000/year) for the length of the restoration project. These estimates are based on costs of a similar effort recently performed by the City of Ann Arbor.

Project #8: In-system Storage Structures for Large Storm Drains

Five (5) in-system storage structures are recommended to be constructed. Three (3) along the storm drain leaving the Burns Park area; 1 along the drain entering the Lansdowne Ponds; and 1 along the County Farm Park drain.

In-system storage structures will substantially reduce downstream peak flow and delay the peaks for most storms. The in-system storage structures will reduce peak flow rates for small storms by up to 50%.

The in-system storage structures currently envisioned are technology taken from combined sewer overflow control programs. The enlarged pipe section serves as a sediment trap and is proposed to be constructed in the middle of the street with easy access for routine cleaning. Figure 14 depicts the conceptual design of the recommended structure. The estimated cost is $1,273,214 and includes design and construction.

The construction cost estimate was taken from similar projects in southeast Michigan, while the maintenance cost was based on the current cost of operating a vactor (high-volume vacuum truck) by the City of Ann Arbor.

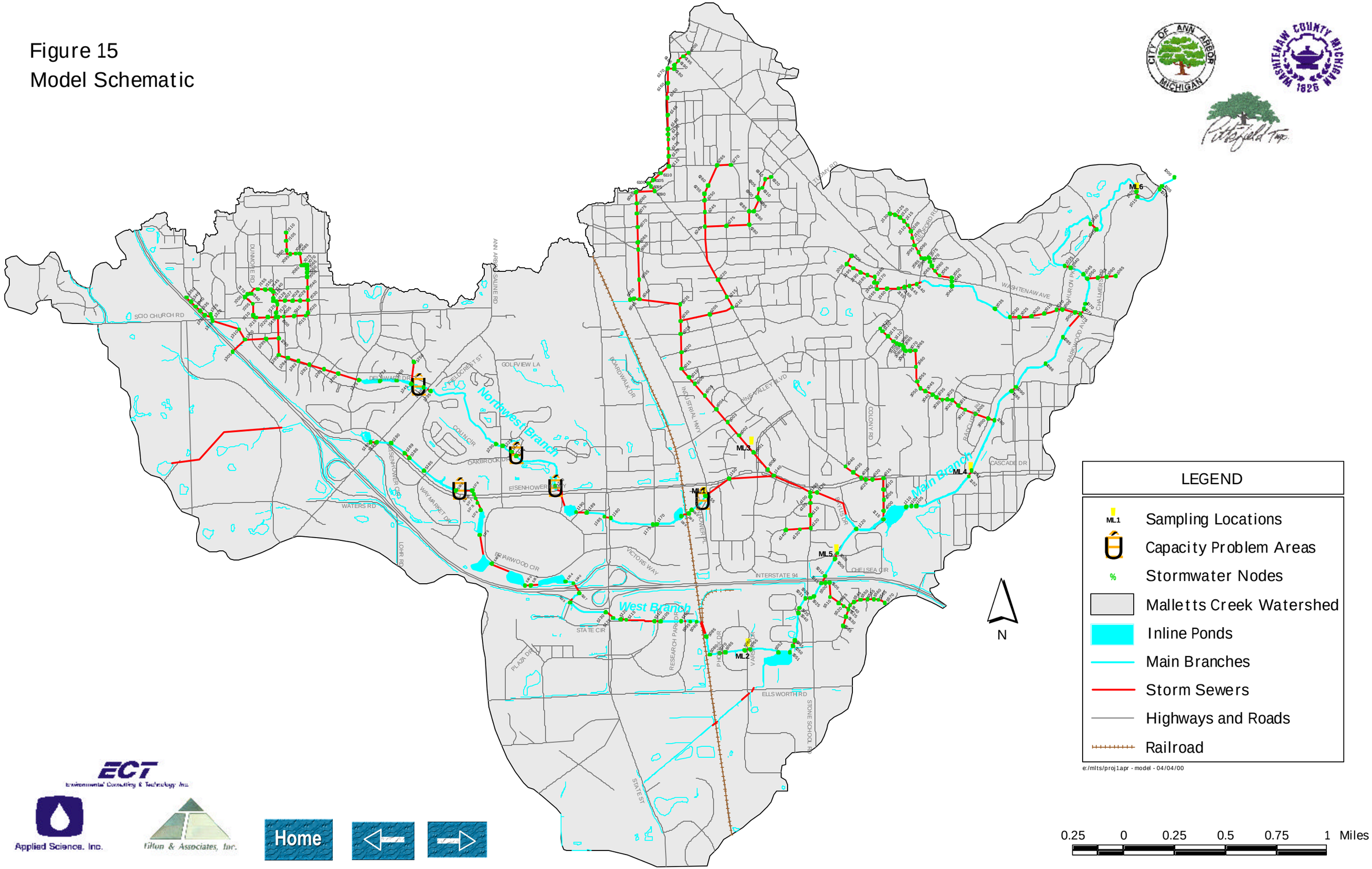
Project #9: Remedy 10-Year Storm Flooding Problems

This project involves the study design and construction of a streambank stabilization project at the Oakbrook Drive crossing of the Northwest Branch of Malletts Creek. These areas are indicated on Figure 15, the model schematic. The cost is estimated to be $52,600.

Project #10: Investigate 100-Year Storm Flooding Problems and Determine Responsibilities

This project involves investigating the flooding problems at the Eisenhower Office Park and in the area of Eisenhower Parkway west of State Street. The estimated cost is $20,000 and includes, further study and analysis, including a survey of grades and building elevations. Research into the permits issued, and compliance with permit conditions will be done. Meetings between affected parties will occur to attempt to develop alternative solutions responsibilities for funding, and an implementation schedule. These areas are indicated on Figure 15, the model schematic.

Figure 15
Model Schematic



Project #11: Retrofit Detention Ponds

It is estimated that there are about 120 detention ponds in the watershed. All of these ponds have a beneficial impact on both flood control and water quality. This beneficial impact could be improved if all of the ponds met modern design standards. To that end, 40 ponds will be surveyed each year for 3 years.

This effort builds upon the detention pond survey performed as part of the restoration project. Seventy ponds were identified of which 31 were surveyed. All twelve of the in-line ponds in Malletts Creek were surveyed. The remaining eighteen ponds were selected because they had the most significant effect on the hydrology/hydraulics of Malletts Creek.

It was assumed that each year 30 of the 40 surveyed ponds will require maintenance and/or modification of the outlet structure. Additionally, some of the ponds will be retrofitted with wetlands and/or sediment forebays. To coordinate this effort, it is assumed that staff time will be required with a level of effort of approximately half-time.

The estimated cost for this phase is $522,000 over three years.

Starting in year 3, construction of the retrofits will begin. This will include:

- Removing existing outlet structures (100-year ponds) and replacement with low flow openings;
- Retrofit ponds (100-year or first flush) with wetlands; and
- Retrofit ponds (100-year or first flush) with a sediment forebay.

Not every pond will require retrofitting. For purposes of the cost estimate, we have assumed that 90 ponds will have the outlet structures modified, 15 ponds will have wetlands and 30 ponds will have a sediment forebay. The total estimated cost is $1,477,500 over three years.

Old Stone School Road bridge in need of repair

Close up of Old Stone School Road bridge damage

Project #12: Structural Repairs

Five locations were identified as potentially requiring major structural repairs. None are in danger of immediate failure but each shows signs of on-going degradation and is in need of attention. All of the projects fall under the jurisdiction of the Drain Commissioner and will likely require that the local units of government petition the Drain Commissioner to finance and construct the required work. The estimated cost is $4,987,815 and includes the design and repairs described in the following paragraphs.

The conduits passing under Old Stone School Road are eroding badly. The eroded sediment, of course, contributes to the sediment load. More importantly the road continues to be undermined. As a result the restoration plan recommends a detailed engineering analysis be performed and the required repairs be completed.

There are two conduits which pass under Eisenhower Road near State and enter into the Briarwood North Pond. Ann Arbor officials report that in the past a series of sink holes have formed, apparently above the lower of the two conduits. These sink holes occurred at regular intervals and in a straight line. This observation suggests that the joints of this pipe were not properly sealed, allowing soil to enter the pipe during wet conditions. The void caused by this process will ultimately lead to a failure. Therefore it is recommended that an

engineering analysis be initiated to identify the severity of this condition, prepare plans and specs for the recommended measures and oversee the construction of the project.

The West Branch of Malletts Creek at Research Park Drive at the east crossing includes a pipe that has been placed apparently to help pass the peak flow. Currently, the entire low flow passes through the conduit leaving the sediment-laden stream channel dry. Discussions with Drain Commissioner staff could not identify the origins or the purpose of the conduit. Thus, the pipe could be removed if it does not adversely impact local drainage and/or flooding. A study is recommended to verify that the conduit can be removed from service without affecting the hydraulic regime. If the project is shown to be feasible, funds have been requested to construct the chosen alternative.

The concrete headwall of the conduit that drains both Area A and Area C shows signs of degradation. Substantial spalling suggests that a study be initiated to assure that the structural integrity has not been compromised. If the headwall and end section are structurally sound, the concrete should be refinished to halt further degradation and extend the life of the structure.

Downstream of Washtenaw Avenue (adjacent to Boston Market), a rock gabion retaining wall is being used to stabilize the west bank. There are no known drawings of this structure. In the past, remedial efforts have been required to mitigate subsidence in the adjacent parking lot and concern remains as to the structural integrity of the gabion retaining wall. It is, therefore, recommended that a geotechnical study be commissioned to evaluate the structural integrity and to precisely monitor the movement of the gabions. If stabilization is required, it should be designed and installed. The current cost estimate does not provide for removal and replacement of the existing structure.

Project #13: Residential Street Sweeping

The first line of defense in reducing pollutants in the creek is to remove them from storm water. Directly connected paved surfaces such as streets and parking lots in residential areas are second only to residential lawns for contribution of phosphorus. Cleaning pavement monthly in residential areas can reduce pollutant discharges to storm water. An increase in street sweeping frequency would be phased in over three years based on evaluation of the first or pilot year. The first year would start with Area F, with subsequent years adding Areas C, D, A and B.

The estimated cost is $10, 100/year and includes labor, equipment, materials, and disposal. Starting in year four additional staff and a sweeper would be needed; the capital costs are estimated to be $50,000/year to lease a sweeper, and $40,000/year for a staff person.

Project #14: Brown Park Pond Improvements

Brown Park provides an opportunity to moderate the downstream impact of flood flows as well as substantially improve its ability to capture phosphorus. All areas tributary to the Brown Park pond will benefit from this improvement.

The redesign of the pond will start in year three for an estimated cost of $250,000. Construction will begin in year four to be completed in year five.

Enlarging Brown Park pond involves the excavation of about 40,000 cubic yards of soil above elevation 801 feet, the excavation of 25,000 cubic yards of soil below elevation 801 feet, and the creation of 8 acres of wetland area.

Construction costs are estimated at $1,627,400. After construction of the wetlands is completed, monitoring of the wetland function will start at an estimated cost of $17,500 a year.

Project #15: County Farm Park Wetland Pond

Construction of an additional wetland pond at County Farm Park will substantially reduce the amount of phosphorus entering Malletts Creek. The creation of a pond in County Farm Park involves the excavation of 7,000 cubic yards of material above elevation 809 feet, the excavation of 3,000 cubic yards of material below elevation 809 feet, as well as the creation of one (1) acre of wetland.

The cost estimate to design the pond is $50,000.

Construction costs are estimated at $263,600. After construction of the wetlands is completed, monitoring of the wetland function will start at an estimated cost of $17,500 a year.

Project #16: Commercial Street and Parking Lot Sweeping

Studies have shown that in some watersheds, commercial areas, streets and parking lots contribute 80%-90% of the phosphorus to surface water. Due to the heavy phosphorus loading caused by sediment washed off streets into storm drains, an enhanced commercial street sweeping and parking lot program is recommended. This program is scheduled to start in year five based upon pilot area evaluation. The cost is estimated at $34,400 and assumes 20% of commercial areas in Malletts Creek are parking lots.

Project #17: Streambank Stabilization – Design and Implement

The stream survey indicated that stream bank erosion was evident in approximately 5 miles of Malletts Creek (measured on one side of the stream). Soil bioengineering methods are proposed for many stretches of Malletts Creek where soil type, bank slope and flooding frequency have contributed to streambank erosion. It is recommended that streambanks be stabilized on all reaches with flow over 3 ft./sec.

Several reaches of Malletts Creek have severe erosion. These coincide with the reaches that experience the highest velocities during wet weather. In these reaches, the modelling effort predicts velocities in excess of 5 ft./sec. which is the velocity at which high rates of erosion are expected. At these high velocities the drag (or tractive forces) cause the soil particles to erode from the streambank. Soil bioengineering is effective at lower velocities but once the velocities exceed 5 ft./sec. these techniques must be augmented with rip rap, gabions or similar structural methods.

Rip rap is the most commonly used structural material for stabilizing streambanks. Gabions are rectangular, rock-filled wire baskets that are pervious, semi-flexible building blocks or mats. Both applications can be improved with the addition of vegetative material. The advantages include:

- Improving the performance of armor layer by preventing washout of fine particles and by reinforcing the underlying native soil.
- A more natural appearance.
- Providing riparian cover and wildlife habitat.
- Slow water velocities near the bank and trap sediment. (Source: Gray & Sotir) [8]

The cost for installing soil bioengineering methods varies with the particular technique chosen. The costs provided in Table 12 were provided by the USDA Natural Resources Conservation Service (NRCS) and were compiled by Robbin B. Sotir & Associates. These costs must be expanded to include the cost of earth moving, toe protection and structural components.

Table 12: Unit Costs
Soil Bioengineering Methods (in 1997 dollars)

Method	Installed Unit Cost
Live stakes	$1.50 - 3.50 per stake
Joint planting	$2.00 - 9.00 per stake
Live fascine	$5.00 - 12.00 per lineal foot
Live cribwall	$14.00 - 25.00 per square foot of front face
Brushlayer - cut	$8.00 - 15.00 per lineal foot
Brushlayer - fill	$12.00 - 25.00 per lineal foot
Vegetated geogrid	$12.00 - 30.00 per lineal foot
Live siltation construction	$12.00 - 16.00 per lineal foot
Brushmattress	$10.00 - 20.00 per square yard
Installation includes: harvesting, transportation, storage, and placement	

It is therefore recommended that plans and specifications be prepared for the high velocity reaches. The design engineer will be required to collect additional soils information to be used with the velocities predicted in the modeling effort to select an appropriate mix of stabilization techniques. The estimated cost for the design is $208,000 and $2,211,311 to implement stabilization. The implementation of the streambank stabilization efforts is scheduled for the sixth year and is projected to continue beyond the project life.

Project #18: Habitat Improvements – Design and Implement

After structural improvements are made to moderate flow and velocity, the following habitat improvements are suggested:

- Revegetation of channel banks with tree plantings along top of the banks to provide shade to the channel and to shade out some of the heavy brush currently growing on the banks.
- Maintain trees and woody vegetation near the tops of banks protected by gabions or rip rap in order to provide shade
- Plant fruit and nut trees at select locations to provide food and nesting cavities for wood ducks, raccoons and squirrels. These plantings should be located in an area that will not require their removal if future maintenance is required.
- Creation of habitat structures in stream such as a hand constructed low flow channel between pools by rock removal to banks.
- Placement of rock cobble in the stream channel and creation of gravel riffles.
- Scattered boulder cluster placement could be implemented where adequate stream bank protection is in place.

Before these are implemented a detailed design must be done at an estimated cost of $22,000. The implementation costs are estimated at $174,000.

Project #19: Catch Basin Restriction Pilot Project

A pilot project is proposed that involves installing catch basin restrictors in the residential areas of the drainage network tributary to the Lansdowne Ponds. This area was chosen since there is less on-street parking in this area than in some other Ann Arbor neighborhoods which will make maintenance easier. Also, the drainage system is newer, and the existing catch basins should include sumps with an outlet pipe which can be more easily retrofit with different types of restrictors.

The restrictors may include: 1) grates with smaller and/or few holes; 2) orifice plates installed on the outlet pipe in the sump; or 3) vortex valves on the outlet pipe.

The pilot project will involve more intensive street sweeping, catch basin cleaning, and leaf pick-up to avoid street flooding complaints. Also, flow monitoring both pre- and post-project is required to determine the effectiveness of the pilot projects in reducing peak flows and velocities. The project estimate ($1,169,329) includes the cost to:

- Place Catch Basin Restrictors in Area A (tributary to Lansdowne Ponds)
- Clean Catch Basins on a monthly basis
- Remove restrictors at end of pilot program (if desired)

Project #20: Catch Basin Cleaning

The preferred place to capture solids associated with road runoff is through street sweeping. The second line of defense is at the catch basin. Once the catch basin becomes full of sediment, it no longer catches sediment. Solids

that make it past the catch basin are delivered directly to the river (unless a retention basin is placed between the catch basin and the river outlet). To assure that the catch basins continue to capture solids, regularly scheduled maintenance is needed. The literature recommends that catch basins be cleaned twice annually (Schueler, 1997).

A cost estimate was made to compare the cost of having catch basins cleaned using a private contractor ($1.5 million) and expanding the existing public (Ann Arbor) staff. The public sector was substantially less costly ($944,300). To cover the entire Malletts Creek drainage area would require adding three new two-person crews and leasing three new vactors. Further detail on the cost estimate is provided in Appendix O.

PUBLIC INVOLVEMENT

The Public Involvement Process

The goal of this component of the project was to establish an educated and involved public and to get feedback on what was possible. The project team first identified a comprehensive list of stakeholders for the watershed that included groups such as elected and appointed officials, environmental groups, public and private schools, business associations, homeowners associations and lawn care companies.

Several mechanisms were used to reach out to and involve these stakeholders. These included a Malletts Creek web page, four community-wide meetings, working with the Malletts Creek Association, focus groups and conducting telephone surveys.

Four Community-wide Meetings

Meeting #1 – Goal: Educate and inform

The goal of this meeting was to inform and educate the public as well as engage them in the planning process. The first meeting introduced the project and identified the major problems of the creek (high phosphorus loading and flooding in certain areas). It was explained that the restoration process must look at the watershed as a whole and not focus on just the creek itself. Any restoration solution must have the commitment and willingness of the stakeholders in the watershed.

Meeting #2 – Goal: Introduce public to BMPs

At this meeting, the public involvement (PI) team emphasized the concept that the Malletts Creek watershed problems would need to be addressed with changes and actions that involved all the people who live in, work in, and visit the watershed. Categories of BMPs were described: management methods, i.e. ordinance review and planning; treatment methods, i.e. detention ponds and storm water wetlands; and source controls, i.e. alternative landscaping and installation of rain barrels. Helpful input from the public was gained and used in designing plan recommendations.

Example of an alternative lawn

Meeting #3 – Goal: Present draft restoration alternatives

The goal of this meeting was three fold: 1) to educate participants about the results of the phosphorus and flow studies, 2) help participants gain an understanding of which types of BMPs (source control, treatment, or management) could be applied in certain areas and 3) gain input and ideas from the public.

Meeting #4 – Goal: Present final restoration plan

This final public meeting was held to: 1) review the project; 2) summarize findings and restoration goals; 3) show restoration activities, implementation time line and projected costs and; 4) gain input from public

Focus Groups

The main goals of focus groups, interviews or surveys were as follows:

- Educate and create awareness among certain essential groups/stakeholders about the problems in the creek and watershed

- Establish a baseline of knowledge with which to help make decisions about recommendations
- Foster a better understanding of preferences, needs, barriers, and motivations
- Assess the potential success of any future recommendations for the restoration plan

Focus Group /Interview Summaries:

- *Elected/Appointed Officials*
  These officials were identified in the stakeholder list and invited to all public meetings. The team had introductory meetings with Ann Arbor City Council, Pittsfield Township Board of Directors and the Ann Arbor Planning Commission to explain the project. Special meetings were held with the planning commissions on 6/23/99 and 1/20/00 to discuss potential ordinance revisions.
- *Schools*
  Both private and public schools were identified in the stakeholder list and invited to public meetings. In addition, conversations were held with staff from the Ann Arbor public schools science curriculum office and a subsequent meeting was held to introduce the project to the science coordinators.
- *Large Businesses*
  Large businesses in the watershed were identified as stakeholders and invited to all public meetings. After a corporate representative attended community meeting #1, a creek clean-up day was held by Dayton Hudson employees. It was found that many of the 100-year detention ponds are owned and managed by private property owners and management companies. A telephone survey was conducted to determine if they would be open to management/structural alternatives regarding their detention ponds. All were amenable to working with the Drain Commissioner in the future on improving the creek by modifying their ponds.
- *Homeowners*
  Riparian homeowners were identified as stakeholders and invited to the public meetings. In addition, a homeowner focus group was conducted during which discussion focused on three main topics: lawn care alternatives, roof runoff alternatives, and detention basin design. This sub-set of homeowners suggested aggressive public education and involvement strategies for lawn and garden maintenance.
- *Lawn Care Companies*
  Lawn Care providers were identified as stakeholders and invited to public meetings. In addition, a focus group was held with lawn care providers. A discussion was held concerning alternative lawn care options, “creek-friendly” lawn care and education for “do-it-your-selfers”. It was interesting to learn that changing the programs and practices of lawn care providers in the watershed is not the key. Only about 15% of the watershed residents use a commercial lawn care service. Additionally, fertilizers that are distributed to retail chains have high phosphorus contents, so a low or no phosphorus alternative is not readily available to the public. Thus, it is the market that supplies lawn and garden fertilizers that should be targeted for change.

REFERENCES

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3. Workplan for the Huron River in the Ann Arbor, Ypsilanti metro area. Washtenaw County Drain Commissioner, Huron River Watershed Council, 1994.
4. Developing a Watershed Management Plan for Water Quality, An Introductory Guide. Michigan Department of Environmental Quality, Surface Water Quality Division; Institute of Water Research, Michigan State University, February 2000.
5. Middle Huron Initiative, Implementation of the Middle Huron Watershed Initiative Phosphorus Reduction Strategy; The Second Year, Huron River Watershed Council, Oct 1998.
6. Assessment of Malletts Creek, Habitat Evaluation and Qualitative Fish Sampling Results. Michigan Department of Environmental Quality, 1997.
7. Staff Report: A Phosphorus loading analysis and proposed TMDL for Ford & Belleville Lakes, Washtenaw and Wayne Counties, December 1994-November 1995. Michigan Department of Environmental Quality, Surface Water Quality Division, January 1996.
8. Biotechnical and Soil Bioengineering Slope Stabilization: A Practical Guide for Erosion Control, D. Gray and R. Sotir, 1996.

Appendix E:

Work Plan and Schedule for the Grant Project Titled: "TMDL Monitoring and Planning in the Middle Huron River Watershed"

TMDL Monitoring and Planning in the Middle Huron River Watershed
Tacking Code 8635-0010
Work Plan

Task/SubTask	Responsible Agency	Budget Category	Products
1. Obtain, Finalize & Sign Contract (0% of WCWRC time)	WCWRC		- Signed Project Contract
2. Consolidate storm system map (35%)			**Products**
a. Partners collect and submit GIS information to contractor. Partners will meet to discuss standards for GIS storm system map information.	Partners	**<u>Grant</u>** Contract $19,000	- Set of discharge points and storm system maps
b. Consolidate existing map information into a complete GIS map for the TMDL areas and the Middle Huron watershed. Available information will be consolidated including, complete storm system, jurisdictional ownership, discharge points, and size. Each watershed partner will be responsible for the quality and completeness of its own data. The TMDL catchment areas, which collectively include most of the Middle Huron watershed, will be the main focus. However, if there is enough funding, the rest of the watershed will be mapped as well. All discharge points will have latitude/longitude coordinates. A good faith effort will be made to encourage watershed partners to improve storm system information where necessary, and, if resources permit, assistance will be provided. Field verification will be conducted if resources permit. Complete discharge mapping is ultimately the responsibility of watershed partner agencies. Other available GIS information will be collected and geo-referenced to the storm system map. Coverages such as land use/land cover, parcel maps, septic vs. sewered, and aerial photography are some examples of additional data that will be collected. If needed, aerial photo interpretation may be conducted in TMDL critical areas. All data collection will be focused on TMDL drainage area. All data will be consistently	Contractor and WCWRC, with partners Contractor with WCWRC and partners	**<u>Match</u>** Salary $1,962	- Storm system map, with discharge points, for the watershed

TMDL Monitoring and Planning in the Middle Huron River Watershed
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Work Plan

Task/SubTask	Responsible Agency	Budget Category	Products
geo-referenced. The storm system map will be finalized and made available via the HRWC website. Identify, through GIS analysis, potential source catchments. A statistical analysis of catchment attributes, such as percentages of septic systems, imperviousness, road density, lawn, etc. will be generated to provide information for selecting monitoring sites (in Task 3) and developing implementation projects (in Task 5).			- TMDL catchment analysis
3. Develop TMDL monitoring plan (10%)	**Responsible Agency**	**Budget Category**	**Products**
a. Consolidate all recent monitoring information for TMDL areas. All available information from available original TMDL development, TMDL implementation plans, and other existing monitoring programs will be collected and organized. Known, recent data sets to be included consist of results from Washtenaw County IDEP, recent DEQ-contracted monitoring, Ford Lake Study, and a number of site-specific monitoring projects.	Contractor with WCWRC and partners Contractor	**<u>Grant</u>** Contract $10,600 **<u>Match</u>** Salary $560	- Compilation of site and monitoring information
b. Develop draft monitoring framework to cover phosphorus and *E. coli* TMDL drainages. In consultation with MDEQ, evaluate existing monitoring information to develop a monitoring framework for further discussion. Analysis will include a statistical power analysis to determine the necessary monitoring frequency. Potential new monitoring sites (to be added to existing sites) will be evaluated using information from task 2 and 3a to determine high-priority sampling sites. Outside of this grant project, an "alternative approach" plan for TMDL monitoring has been drafted and will be submitted as part of stormwater regulation compliance.	Contractor, with WCWRC and partners		- Draft monitoring framework for Middle Huron TMDL areas
c. Develop complete draft monitoring plan. Meetings will be established to consult with partners, DEQ, City of Ann Arbor	Contractor		

TMDL Monitoring and Planning in the Middle Huron River Watershed
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Task/SubTask	Responsible Agency	Budget Category	Products
Water Treatment Plant laboratory staff, and others to discuss details of the monitoring plan. Among items discussed will include initial and follow-up monitoring sites and strategies; baseline and storm sampling strategies; parameters to be analyzed (nutrients, sediments, and *E. coli*, at minimum); data storage, analysis, and reporting; and integration with existing monitoring programs. TSS will be collected to help distinguish particulate from dissolved phosphorus sources. An "alternative approach" for TMDL monitoring is being developed that will combine ambient monitoring with follow-up monitoring into MS4 systems. This plan will be included with the grant work plan when finalized. The dual goal of this approach is to evaluate the effectiveness of existing programs and to identify sources. Identifying sources will be accomplished in the following manner: 1) Analyze data already collected to narrow focus to tributaries high in pollutants contributing to water quality impairment (Phosphorous, TSS , *E. coli*), 2) Conduct follow up sampling within those tributaries to identify reaches and catchments likely to be contributing those pollutants disproportionately, and 3) Establishing implementation strategies, prioritizing BMPs and, to the extent possible, identify locations for BMP implementation. Any evidence of illicit discharges or soil erosion violations will be disseminated immediately to the local jurisdiction for follow up and enforcement action. Follow up and enforcement is not a component of this grant.	Contractor, with WCWRC		- Draft monitoring plan for Middle Huron TMDL areas
d. Develop and submit a QAPP to the DEQ for review and approval at least nine (9) weeks prior to monitoring. Monitoring will not begin (under task 4) without DEQ approval. Any work completed prior to approval will not be reimbursed or counted as match.			- QAPP for monitoring program

TMDL Monitoring and Planning in the Middle Huron River Watershed
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Task/SubTask	Responsible Agency	Budget Category	Products
e. Finalize monitoring plan. Following revision of initial plan, development of a QAPP and initial hot spot monitoring (task 4), the monitoring plan will be finalized.			- Final monitoring plan
4. Conduct hot spot monitoring (10%)	**Responsible agency**	**Budget**	**Products**
a. Select target hot spots for monitoring. Based on the draft monitoring plan, select hot spot sites for initial monitoring. Develop a schedule for baseline and wet weather monitoring for hot spot sites. At minimum, the ten current monitoring sites will be sampled twice monthly and at least 4 additional sites upstream of these sites will be sampled. All nine current tributary sites are near tributary mouths. One site is in the Huron River just beyond the upstream extent of the phosphorus TMDL drainage. Sampling will progress upstream in the tributaries with the highest mean concentrations (or mean loads) of TMDL pollutants to sample between major discharge points where possible. The intent is to isolate different potential source drainages to determine if there are hot spot areas that are contributing more pollutants than others. Such hot spot areas would then be further sampled to narrow down potential sources. Multiple samples from at least 4 upstream sites (more if time and resources allow) will be collected. The contractor has one auto-sampler, which they will use to sample at least 4 events where such information is likely to provide the greatest use in determining the stormwater contribution of pollutants. If another auto-sampler can be obtained, more storm samples will be collected.	Contractor, with WCWRC and partners	**Grant** Contract $35,500 **Match** Salary $560 **Match** Contract $26,300	- Hot spot locations and monitoring schedule
b. Conduct initial monitoring. This monitoring will consist of twice monthly baseline sampling and storm event sampling at hot spot sites.			
c. Analyze initial results and conduct follow-up monitoring. Follow-up to confirm and characterize “hot spot” outfalls,	Contractor, with WCWRC		- Monitoring data

TMDL Monitoring and Planning in the Middle Huron River Watershed
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Task/SubTask	Responsible Agency	Budget Category	Products
discharge points or other contributing areas. Analysis will be directed to characterize loading or contribution of relevant impairments from different sources or areas in TMDL drainages.	Contractor		
d. Create monitoring report. At the completion of the project, a report will be developed to include the monitoring analysis and update conclusions from previous monitoring. In-stream water quality data will be submitted to the DEQ on the STORET template.	Contractor, with WCWRC and partners		- Monitoring report
5. Update TMDL and Watershed Plans (20%)			
a. Update TMDL and WMP action plans. Following development of the monitoring plan and initial hot spot monitoring, existing TMDL implementation plans will be reviewed and evaluated. A desktop evaluation will be conducted to identify potential target sites in hot spot areas for implementation projects. Field investigation will be conducted, where warranted, to verify project feasibility and collect additional information from target sites. A report on suggested revisions will be developed and discussed with Middle Huron partners. The report will recommend actions that are specific in location and content to facilitate development of future BMP projects. Following review of the report, a TMDL action plans will be drafted for Swift Run, and updated for the other three TMDLs. Draft plans will be submitted to DEQ for review. Following sufficient time for DEQ review and comment, the plans will be finalized. Plans will include specific actions and commitments by partners, complete with timeframe and load reductions. Commitments will begin prior to the end of the permit cycle. The intent of this task is to develop information and plans for priority implementation projects to the point that they are ready for implementation. A summary of the ongoing, and past, local efforts to reduce the TMDL pollutant from point and nonpoint sources will be included. Point and nonpoint contributing	Contractor Contractor, with WCWRC and partners Contractor, with WCWRC and Ann Arbor	**<u>Grant</u>** Contract $61,656 **<u>Match</u>** Salary $1,120 **<u>Match</u>** Contract $5,400	- Updated TMDL implementation plans for Ford and Belleville Lakes, Huron River (Argo to Geddes), and Malletts Creek. - New TMDL Implementation Plan for the Swift Run TMDL - Updated WMP

TMDL Monitoring and Planning in the Middle Huron River Watershed
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Task/SubTask	Responsible Agency	Budget Category	Products
sources and their locations (if known) will be identified. Milestones and timelines, to reduce discharges of the pollutant consistent with the TMDL, will be included. TMDL plans will be integrated into the Middle Huron Watershed Management Plan. b. Conduct an assessment of municipal stormwater ponds (based on earlier inventory) to determine best opportunities for retrofitting to achieve water quality benefits (i.e. phosphorus and E. coli reductions). A 1 page summary, regarding the assessment, will be developed. Conceptual design plans for 3 best project candidates will be developed (1-page, plan view), with a detailed design for one project to be bid. . The detailed design will be bid for construction within the first two years of the TMDL plan. c. A completed Contractor Qualification Form will be submitted for any contractor not yet determined.			- 1-page summary of assessment - Prioritized set of retrofit opportunities for municipal stormwater ponds - 3 site designs - 1 complete project design - Contractor Qualification Form
6. Project Administration (25%)			**Products**
a. Submit Quarterly Status Reports *per the Status Report and Project Documentation Requirements.* b. All GIS data will be submitted according to the MDEQ *Electronic Geospatial Data and Format Guidance.* c. Submit Quarterly American Recovery and Reinvestment Act (ARRA) reports. Acknowledgement of ARRA funding on products will be done in accordance with the American Recovery and Reinvestment Act General Guidelines for Emblem and Logo Applications and Michigan Economic Recovery Office Logo Terms of Use. d. Submit all draft and final products and deliverables in both hard copy and electronic format (as specified in the final contract), which include the appropriate logos, consistent with the *Nonpoint Source (NPS) Grants Administration Summary*	WCWRC	**<u>Grant</u>** Contract $8,000 **<u>Match</u>** Salary $1,402	- Quarterly Status Reports - Quarterly ARRA reports - All draft and final products with logos - Final Project Close-out Report - TMDL Implementation Plans - Updated WMP - Fact Sheet - Data - Release of Claims Form - Submittal of all products will be 3 hard copies and 1 electronic version, at a minimum

TMDL Monitoring and Planning in the Middle Huron River Watershed
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Work Plan

Task/SubTask	Responsible Agency	Budget Category	Products
Sheet on the NPS web page. e. Submit draft Project Report, and new/updated TMDL Implementation Plans, 45 days prior to the end of project; incorporate MDEQ comments. f. Submit final Project Report, and TMDL Implementation Plans, 30 days prior to the end of the contract. g. Submit a Project Fact Sheet using the DEQ-NPS template. Draft is due 45 days prior to the end of the contract and the final is due with the Final Project Report.			

WCWRC – Washtenaw County Water Resources Commissioner's office.
Partners – Middle Huron Stormwater Advisory Committee members, which includes: WCWRC, WC Road Commission (potentially), City of Ann Arbor, City of Ypsilanti, Village of Dexter, Pittsfield Township, and Ypsilanti Township. Other non-MS4 municipalities will be invited to participate and review products through the Middle Huron Partnership Initiative – a voluntary partnership created to address the Ford and Belleville Lakes TMDL.

TMDL Monitoring and Planning in the Middle Huron River Watershed
Tacking Code 8635-0010

Project Timetable

Project Tasks	2010												2011								
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1. Obtain, Finalize & Sign Contract																					
2. Consolidate discharge points map																					
A Partners meet and submit mapping information																					
B Consolidate maps into single GIS																					
F Review and finalize discharge points/storm system map																					
3. Develop TMDL monitoring plan																					
A Consolidate existing monitoring information																					
B Develop draft monitoring framework																					
C Complete draft monitoring plan																					
D Develop and submit QAPP																					
E Finalize monitoring plan																					
4. Conduct Hot Spot Monitoring																					
A Select target hot spots																					
B Conduct initial monitoring																					
C Analyze results and follow-up monitoring																					
D Develop monitoring report																					
5. Update TMDL and Watershed Plans																					
A Integrate monitoring plan into the WMP																					
B Update and develop TMDL plans																					
C Assess and design stormwater pond retrofits																					
6. Project Administration																					
A Submit quarterly progress reports																					
B Submit final deliverables																					
C Submit draft and final reports																					
D Submit final data																					
E Submit a release of claims statement																					