Appendix B.

Quality Assurance Project Plan for the Work Plan Entitled: "TMDL Implementation Planning in the Middle Huron River TMDL Watersheds"

Version 1.2
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_____
Signature of MDNRE 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
Rachel Matthews	MDNRE	Project Officer
Harry Sheehan	WCWRC	Grant Administrator
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
Middle Huron Stormwater Advisory Committee	Phase II Watershed Group	Supplemental funding, program review and guidance
Volunteers	HRWC	Assist with field data collection

Project Administrator
Rachel Matthews
Michigan Department of Natural Resources and the Environment
(517) 780-7917
matthewsr@michigan.gov

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

Executive Director
Laura Rubin
(734) 769-5123 ext. 606
lrubin@hrwc.org

Program and Quality Assurance Manager
Ric Lawson
(734) 769-5123 ext. 609
rlawson@hrwc.org

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

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 Teams
Middle Huron Partners
Middle Huron Stormwater Advisory Committee
(current contact list included in Appendix 1)

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

This monitoring project aims to evaluate collective progress of NPS best management practices towards minimizing stormwater-related impairments and improving overall water quality within the middle Huron River system, including the two TMDL areas at Ford and Belleville Lakes. An updated project description and current information about the program can be found at www.hrwc.org/our-work/water-quality-monitoring/.

1.2.1. Statement of Water Quality Concerns

The Middle Huron River watershed drains 217 square miles and lies primarily within Washtenaw County. The watershed culminates in two impoundments: Ford and Belleville Lakes. Both of these have Total Maximum Daily Loads (TMDLs) for phosphorus enrichment, the first TMDLs to be established in the State of Michigan. The watershed is characterized by a mix of urban, agricultural, and natural areas. As of 2000, the watershed was 48% urban, 21% rural, and 27% forest or wetland. Altered watershed hydrology, poor riparian management, and fecal contamination are impacting many of the streams and lakes in the watershed, as indicated by several reaches that appear on the state's list of impaired waters.

The Huron River Watershed is home to one-half million people, numerous threatened and endangered plant and animal species, abundant bogs, wet meadows, and remnant prairies of statewide significance. The Huron is the only state designated scenic river in southeast Michigan. It supplies drinking water to 140,000 people, and its watershed contains two-thirds of the public recreational land in southeast Michigan. Protection of the Huron River system is vital to both the physical health of residents and to the economic health of local communities. However, portions of the system fail to meet minimum water quality standards. Michigan's 303(d) list of impaired waters identifies five

waterbodies in the middle Huron that require the development and implementation of TMDLs for either nonpoint source or municipal separate storm sewer system (MS4) related impairments. They are listed below.

Table 2. Non-Point Source and stormwater impairments in the middle Huron River watershed.

HUC	Waterbody	Designated Use	Cause
040900050403 040900050404	Ford & Belleville Lakes	Aquatic life and wildlife	Phosphorus (total) Excessive algae
040900050402	Huron River (Allen Creek to Geddes Pond)	Total body contact	Escherichia coli
040900050402	Malletts Creek	Warm water fishery Aquatic life and wildlife	Flow alteration
040900050402	Swift Run	Aquatic life and wildlife	Flow alteration Sedimentation/siltation
040900050309	Honey Creek	Total body contact	Escherichia coli

One TMDL has been established in the watershed for phosphorus enrichment. The defined drainage area for this TMDL covers the entire Middle Huron River watershed. TMDLs for *E. coli* are more limited to river and creek sections in Ann Arbor. Watershed management plans (WMPs) have been developed for the middle Huron (see map) as a whole and for Allen Creek, Fleming Creek, Geddes drainage (TMDL plan), Malletts Creek (TMDL plan), Millers Creek, and Mill Creek within the larger middle Huron. Additionally, a Nonpoint Source Reduction Implementation Plan has been developed for the Ford and Belleville Lakes TMDL and a point source plan is under development. The Huron also is listed on the state's Unified Watershed Assessment (UWA) as a Category 1 watershed, indicating its high restoration priority. The top impairments listed in the WMPs in the middle Huron are high sediment and nutrient loadings, altered hydrology, and pathogens, mirroring the TMDL impairments. The main causes of these impairments are related to urban development without proper stormwater impact planning.

The Washtenaw County Water Resources Commissioner (WCWRC), with assistance from the Huron River Watershed Council (HRWC), has regularly convened a number of watershed advisory groups for the middle Huron since the first TMDL was developed, beginning in 1994. The communities and agencies within this watershed have engaged in substantial voluntary effort to develop projects and programs to address TMDLs and other potential impairments through the Middle Huron Initiative. The agencies permitted under stormwater regulations now meet regularly as the Middle Huron Stormwater Advisory Group (SAG). This group has developed a budget and work plan to address regulatory requirements and coordinate ongoing activities within that framework. Planning and implementation of monitoring are both parts of this work plan. Funding for those activities, followed by TMDL activity planning and prioritization, will help fulfill the overall goal of meeting TMDL goals.

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. In 2006, data collection for E.coli was added to the list of water quality concerns for certain stretches of tributaries within the middle Huron system. An improved understanding of pollution sources and water quality trends will help the Partners of the Middle Huron Initiative and the Middle Huron Stormwater Advisory Committee to focus and track pollution reduction efforts as they strive to meet the phosphorus TMDL for Ford and Belleville Lakes and the E.coli TMDL for specific tributaries of the middle Huron River.

1.2.2 Project Goals

Goal 1: Collect, synthesize and disseminate data that complements past data and is useful to the Partners of the Middle Huron Initiative and the SAG to evaluate the collective progress of NPS best management practices (BMPs) in improving water quality in the TMDL areas.

GOAL 2: Identify hot spots and characterize phosphorus loading and *E. coli* dynamics
Objectives under this goal include:

- refine the implementation priorities for locations, commitments, timeline, and costs; and
- establish a baseline for evaluating the success of implementation projects.

Targeted monitoring of potential hot spots will help confirm and better define critical areas that have previously been measured or modeled to be pollutant sources. The associated loadings of phosphorus and *E. coli* will be quantified with initial monitoring. The data also will help to obtain better projections for the likely impact (i.e. loading reductions) of potential projects. The monitoring plan and the monitoring itself also will address the need to establish a better baseline for evaluating the success of future implementation projects, as well as progress toward NPS load reduction targets. Once we have obtained measures of phosphorus concentrations and loading and *E. coli* counts, both during various dry weather flow and during storm events, a baseline will be established that can be used to determine the nature and degree of reductions (or increases) from future projects. This approach has been utilized with great success broadly in the Middle Huron River, where specific phosphorus reductions were measured following the implementation of a phosphorus fertilizer ordinance.

1.3 Project Tasks and Schedule

Following is an annual work plan and schedule for the monitoring program. It is anticipated that this program will be sustained following the completion of the grant period.

Task	Staff Responsible	% of Time	Deliverables & Results (deliverables in italics)
1) Measure stream discharge at 10 sites		35%	
Subtasks			
1.1 Develop and submit QAPP for DNRE approval	Lawson; Weiker		*Approved QAPP*
1.2 Solicit and train volunteer corps to provide field support for discharge measurement	Weiker		Trained field support of 5-8 volunteers
1.3 Collect discharge measures as needed at a range of water levels at each site to complete rating curves	Lawson; Weiker		Stream discharge data for 10 sites
1.4 Respond to wet weather events as needed. High discharge levels will be targeted for measurement following events.	Lawson; Weiker		High discharge data for 10 sites
1.5 Download data from pressure sensors and gauge stations; record data and conduct analyses including completion of stream rating curves;	Lawson; Weiker		*Database files and analytical results*

1.6 Share data with project partners and develop annual data reports	Lawson; Weiker		*Reports for 2010, 2011 field seasons; press releases; presentations*
1.7 Solicit evaluation of data and draft products from Middle Huron Partners, SAG and HRWC staff	Lawson		
2) Collect water quality samples and field data at 10 sites		50%	
Subtasks			
2.1 Develop and submit QAPP for DNRE approval	Lawson; Weiker		*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 field support during baseline monitoring and wet weather events	Weiker		Trained field support of 8 volunteers, at minimum
2.4 Collect baseline grab samples, autosample wet weather events, and record ambient conditions.	Lawson; Weiker		Minimum 20 sample sets per month plus storm samples; field data for DO, pH, conductivity, temp.
2.5 Collect grab samples at 4-5 investigative sites upstream from long-term monitoring sites	Lawson; Weiker		Minimum 8 sample sets per month for total phosphorus, E. coli and TSS
2.6 Deliver samples to WTP lab for analysis	Lawson; Weiker		*Water sample analysis data*
2.7 Record data and conduct analyses	Lawson; Weiker		Nutrient and TSS load calculations for 10 sites; trend analyses of all parameters for 10 sites; paired sample analysis of investigative sites
2.8 Share data with project partners and develop annual reports	Lawson; Weiker		*Annual reports for field seasons; press releases; presentations*
2.9 Solicit evaluation of data and draft products from Middle Huron Partners, SAG, and HRWC staff	Lawson		
3) Administer and Report		15%	All required documents and deliverables
Subtasks			
3.1 Develop and submit status reports following WRD guidance to WCWRC	Lawson		*Quarterly status reports*
3.2 Develop and submit annual report to WCWRC and partners.	Lawson		*Draft Report; Final Report*

Timetable

The grant project will began in February, 2010 and conclude in September 2011. The timeline below is established on an annual timeframe, however, to represent a long term strategy for continuous monitoring activities beyond the scope of this specific project.

Work Plan Activity	Project Months											
	January	February	March	April	May	June	July	August	September	October	November	December
Task 1) Measure stream discharge at 10 sites												
1.1 Develop and submit QAPP for DNRE approval (update in subsequent years)												
1.2 Solicit and train volunteer corps to provide discharge measurement support												
1.3 Measure discharge across a range of water levels at all sites												
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 10 sites + designated investigative sites												
2.1 Develop and submit QAPP for DNRE approval (update in subsequent years)												
2.2 Calibrate equipment prior to field visits												
2.3 Solicit and train volunteer corps to provide field support during baseline monitoring and wet weather events												
2.4 Collect baseline and investigative grab samples, autosample wet weather events,												

Work Plan Activity	Project Months											
	January	February	March	April	May	June	July	August	September	October	November	December
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 Report												
3.1 Develop and submit status reports following WRD guidance												
3.2 Develop and submit annual report to WCWRC and partners.												

1.4 Training Requirements

The program manager and field manager have been trained in all collection techniques as part of professional education programs. Technical advisors from the DNRE and University resources will be sought as necessary to consult 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: Identify phosphorus loading hot spots and E. coli sources to improve targeting of watershed management strategies.

Objective 3: Measure stream discharge (Q) at tributary sites in the Middle Huron dry and wet weather conditions for use in calculating seasonal load estimates and flow profiles.

Objective 4: 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 and discover anomalies.

Objective 5: Report data analysis results to the Middle Huron Partners, SAG and the MDNRE 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 (moving to an April start in 2011) at one main river site and nine tributary sites in the middle Huron following standard field procedures (see Appendices 2 and 3). Additionally, a set of rotating "investigative sites" will be selected upstream of long-term monitoring sites to allow for pairwise evaluation. The monitoring program will be based on the existing program that was designed to complement MDNRE'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 loggers will be placed at sites that do not already have gages, 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. 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 long-term and investigative monitoring sites (Table 3) are located on major tributaries to the middle reach of the Huron River and represent a mix of land uses. The long-term locations were selected based on historical sampling by HRWC, MDNRE, 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. Land use and land cover data have been collected for drainage areas to the monitoring points. These data will be used to help select investigative sampling locations and inform an understanding of relationships between land cover and ecological stream health. A current map of monitoring sites can be found as Figure 1. A live, updated map of long-term and investigative monitoring sites is maintained as a public Google map at www.hrwc.org/our-work/water-quality-monitoring/.

Table 3. Location and information on monitoring sites in the Middle Huron Monitoring Program

Long-Term Sites				
Site #	**Water Body**	**Cross-street**	**Drainage Area (km^2)**	**Land Use**
MH01	Huron River	N. Territorial Rd	1,394	Woodland, wetland; Natural River District
MH02	Mill Creek	Parker Rd	336	Agricultural; drain confluence
MH03	Honey Creek	Wagner Rd	60	Low-density residential
MH04	Allens Creek	outfall to Huron River	13	High-density urban
MH05	Traver Creek	Broadway St.	18	High-density residential; commercial
MH06	Fleming Creek	Geddes Rd	79	Woodland; wetland
MH07	Malletts Creek	Chalmers Rd	28	Low-density residential; commercial
MH08	Millers Creek	Huron Parkway	5	Woodland; medium-density residential
MH09	Swift Run	Shetland Rd	12	Medium-density residential
MH10	Superior Drain	Clark Rd	6	Agricultural; low-density residential
Investigative Sites (as of publication)				
Site ID	**Water Body**	**Cross-street**	**Rationale for selection**	
SR01	Swift Run	Ellsworth Rd.	Impacted creek. Isolates land fill and agriculture from residential.	
Mal01	Malletts Creek	Oakbrook Dr.	High TP loading, e. coli counts. Isolates medium-density residential branch.	
Miller01	Millers Creek	Hubbard Rd.	High TP concentrations. Isolates residential from public land	
AC01	Allens Creek	U of M Golf Course	Only surface access. Downstream of golf course.	
HC01	Honey Creek	Jackson Rd.	E. coli TMDL. Upstream of highway. Separates creek branches.	

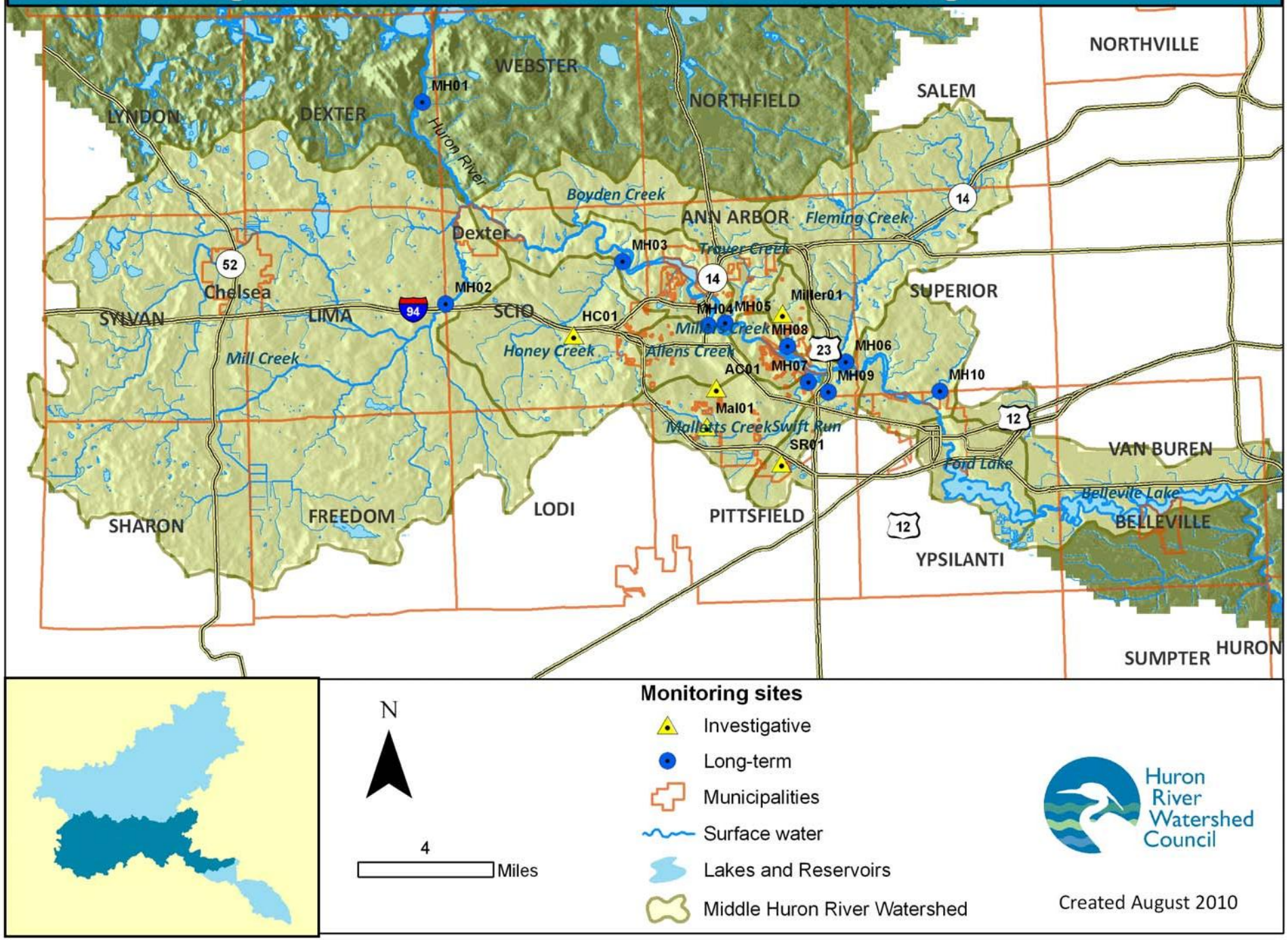
In the event of wet weather, automated samples will be taken at sites with fixed water level loggers or investigative sites upstream. Stream discharge measurements will be taken using data from equipment existing in the following streams: Malletts (USGS), Mill (USGS), and Allens (City of Ann Arbor). Water level sensors maintained by HRWC generate continuous data and were placed at the other long-term sites on an annual rotational basis. Stream discharge will be measured directly by project and volunteer staff with flow meters at all sites to develop stage-discharge rating curves.

In addition to samples taken at the long-term monitoring sites, grab samples will also be taken at 4-5 additional upstream locations each year. These paired samples will be taken in an attempt to isolate hot spots for phosphorus loading or E. coli sources. These investigative sites will be selected with the following criteria in mind:

- critical potential source area drainages and tributary drainages with historically high concentrations, counts or loadings;
- subdivision of stormwater discharge points;
- subdrainages that have a predominance of a land use likely.to be pollutant source;
- proximity to a potential source;
- hydrologic position relative to past monitoring; and
- access and logistical constraints.

Overall, the goal of site selection for investigative sites will be to subdivide critical tributary drainages to isolate probable hot spots or sources and determine their relative contribution of phosphorus, TSS and E. coli compared to paired samples from the downstream end of the tributary. Samples from investigative sites will be collected within an hour of downstream samples so that direct comparisons will be valid.

Figure 1. 2010 Middle Huron River Monitoring Sites



2.3 Sample Collection Methods

Stream monitoring will be conducted twice monthly from May (April, starting in 2011) through September at the designated long-term and investigative 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 4) 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. The team will then travel to any investigative sites on the same tributary stream and collect grab samples from that site. 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 4) will be completed and submitted to the lab to follow the water samples. Copies of the chain of custody form are returned to HRWC with the lab results. Following subsections describe in detail the parameters to be measured, analytical protocols, equipment to be used, and specific protocols for grab sampling and wet weather sampling. See the Appendices for detailed sample collection protocols.

2.3.1 Parameters to be Measured

Under the support of the TMDL grant, 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)
- *Escherichia coli* (in count per 100 ml)

With supplemental support from the Middle Huron Partners and SAG, the following parameters will also be measured at each site:

- Nitrate and Nitrite (N-N in mg/l)
- 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 stream discharge. See the discussion in section 2.3.4 for stream discharge procedures. Also, only water level (later downloaded discharge), TP and *E. coli* will be collected during storm events. TSS will be analyzed for these events as laboratory staff are available and able to do so. However, the lab staff is sometimes limited in their capacity to take on extra samples. For the same reason, E. coli may not be analyzed for some storms, depending on timing, if the holding period would be exceeded. Pre and post monitoring around any new management practice will include all three parameters. Table 4 below includes analytical specifics for each parameter.

Table 4. 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[1]	None[2]	24 hrs[3]
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			

[1] Sterilized 100 ml (or larger) bottles will be used if they can be obtained at a reasonable cost.

[2] Thiosulfate tablets will be included in sample containers at sites where chlorine degradation is a concern.

[3] Samples will be kept on ice immediately following collection and will be stored under refrigeration until analysis can be conducted.

2.3.2 Equipment

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

Stream 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 staff gauges, graduated to hundredths and marked at every foot and every tenth, will be used to measure relative stream water level.

HOBO pressure loggers (model U20-001-01) from Onset Computer Corporation (www.onsetcomp.com), will be installed at long-term sites on a rotating basis at sites without other water level recording equipment. They will be used to measure water pressure, which will be converted to water level using a barometric pressure compensation program.

Samples will be collected in 1000 ml plastic bottles and plastic sterile packs (*E. coli* only).

2.3.3 Grab Sampling

Collectors will obtain a sufficient supply of sample bottles, pre-marked labels, a cooler (with freezer pack), and field data sheets. They will follow sampling protocols (see Appendices 2 and 3) to collect grab samples and deliver to the laboratory for analysis. One duplicate sample will be collected for approximately every ten sampling sets. Most *E. coli* samples will consist of a single grab sample. Several times a year across all sites, a complete set of 3 representative samples will be collected to be consistent with the water quality standard. This sampling protocol will also be conducted for pre and post BMP monitoring.

2.3.4 Flow Monitoring

Water level and discharge will be recorded in two ways. Two sites (Mill and Malletts) have USGS stations associated with them, and one (Allens) has an automated depth-velocity logger 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 at these sites.

Two to three additional sites will have HOBO pressure loggers 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. Barometric pressure data will be obtained from weather stations reported through www.weatherunderground.com. A station will be selected based on closest proximity to the in stream HOBO loggers. Logger pressure data are converted to water level using the compensation tool (algorithm) in the HOBO software. Water level data points 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 3.

For the remaining sites, staff gauges have been installed. Rating curves similar to those for pressure loggers 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 3.

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 with continuous water level monitoring. 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.

Some investigative sites may also be sampled for wet weather discharge. Targeting of investigative sites for wet weather sampling will be based on previous baseline results and the availability of water level loggers at downstream sites. Discharge data will be estimated from downstream site discharge data using drainage area ratios.

In general, wet weather events will be identified as precipitation events predicted to yield a minimum of 0.2 inches within 24 hours. Mobilization will occur when storms of the desired magnitude are predicted, based on available hourly forecast predictions. However, a “dry” period of <0.1 inches of rainfall over 48 hours should precede the potential wet weather event before a site qualifies for event sampling. This general criterion is being used to ensure that the samples collected are representative of runoff events. Tributaries respond differently to storms, however, and the true measure will be to determine if the flow in the target tributary has returned to levels near those that preceded the previous wet weather event. This may require less or more than 48 hours.

Samples will be collected using a programmable autosampler, starting at the onset of a storm and spanning a period not to exceed 24 hours. Four to six samples for analysis will be selected based on the discharge profile of the storm event hydrograph. Samples will be selected to represent the diversity of flow conditions during the wet weather event. At least two samples will be obtained on the rising side of the hydrograph or near the peak. Wet weather samples will

be analyzed for TP, *E. coli*, and, if the lab has sufficient capacity, TSS. There is some concern about the accuracy of E. coli samples collected using the autosampler. When discussing those results in reporting or publications, a caveat will be included until such time that such samples are proven to be valid.

In addition to the six sample sets, one duplicate will be collected for each wet weather sampling event for quality assurance and analysis of sample variance. Specific guidance for storm event sampling is included in the sampling SOP included in the Appendix 2.

2.4 Data Quality Objectives

Accuracy and precision statistics for each of the measured parameters are included in Table 5 below.

Table 5. 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. These objectives will be monitored at the lab across all samples analyzed at the lab – both those run for the HRWC, as well as those for other programs. Running control plots are monitored to stay within accuracy and precision boundaries. The lab maintains a separate QAPP for their lab procedures. This can be reviewed or obtained upon request. The lab is a certified drinking water lab and has thus had their lab procedures reviewed and approved by MDNRE for compliance. The lab is also certified by U.S. EPA as to meet national waste water testing standards, and thus undergoes review and assessment by EPA. Details on these certifications can also be obtained from the lab.

Additionally, a relative percent difference (RPD) will be calculated for each field and duplicate sample pair as a measure of sample site variance for each parameter. Running program mean RPDs will be kept and reported. Any individual RPDs more than 1 standard deviation above the mean will be flagged and reported as potentially unreliable. Samples more than 2 sd away from the mean will result in nullification of that sample set.

For field parameters, the following objectives will apply.

2.4.1 Precision

Volunteers attend both classroom-style and field training to learn the procedures and protocol for collecting water quality data and measuring flow/discharge. Volunteer teams are then observed in the field periodically to audit monitoring activities. Rechecks of flow measurements selected randomly along the channel transect are used to determine precision of monitoring teams' technique.

2.4.2 Accuracy

No standards exist for field estimation of stream discharge, so efforts are made to reduce measurement error. 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 results that are comparable to measurements of the same parameters elsewhere.

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 wet weather event for each. Following validation by the project and field managers, the objective is to maintain results that are 95% valid 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 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 annual reports, and will be distinguished from data collected under the grant project. Additional water quality datasets from outside sources will be reviewed for comparison, but no

meta-analyses will be conducted unless the analysis is discussed with MDNRE and program partners.

USGS Real-time Water Data is used to obtain discharge data from stations located in Malletts and Mill Creeks. The initial data posted is provisional and subject to adjustment throughout the May – September field season. Final posting of discharge data for the season is generally completed by November and the provisional data recorded on field datasheets are checked and updated if necessary.

Discharge data for Allens Creek outfall is obtained from the flow gage maintained by the City of Ann Arbor.

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 samples and duplicates will be evaluated to confirm that accuracy and precision objectives are being met. Any exceedences will be reported to the laboratory, and 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 allowing for rapid comparison of new data with historical data to determine if any entries are missing or outside the normal range. Such entries will be rechecked for data entry error or sampling or analytical anomalies. 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 DNRE Project Officer. Following a comprehensive analysis of the full dataset each year, the results will be synthesized into a final report for electronic distribution to the MDNRE, Water Resources Division (WRD), community partners of the Middle Huron Initiative and SAG at semiannual meetings, and on the HRWC website. Data collected as part of this grant project will be reported separately to the DNRE Project Officer. All data will be submitted to the DNRE 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 DNRE project officer.

4. Appendices

Included with this document are the following appended documents:

1. Middle Huron Partners and Middle Huron Stormwater Advisory Committee Contact Lists (as of June, 2010.)
2. Field sampling and wet weather procedures
3. Flow monitoring procedures
4. 2010 Data Forms:
    a. Field Data Form
    b. Wet Weather Field Data Form
    c. Flow Monitoring Form
    d. Chain of Custody Form