8. Chapter 8 - Methods for Measuring and Evaluating Progress

It is important to have a meter for success for any plan or project and be able to assess the milestones that are reached or evaluate and analyze the achievements. Being able to temporally determine improvements in water quality and, ultimately, in quality of life that results from the implementation of this plan and its various BMPs or treatment trains. The overall success of the project in meeting plan goals and objectives in restoring the designated uses of the Kawkawlin Watershed is dependent upon many variables. Many water quality parameters have been and will continue to be monitored in this watershed by a variety of groups and agencies. Many of these parameters will be continuously monitored from the volunteer and professional talents that are available in this region. These monitoring efforts will be conducted at the local, county, state and, at times, federal levels. The stakeholders and subcommittees will be establishing monitoring targets to which the measured results will be compared and analyzed to determine levels of progress toward targets and watershed goals. It is important to remember these target metrics are not enforceable, but are to be used by the committees to determine the success or failure of implementation efforts. Also, tracking management practices and monitoring water quality changes provide a means to redefine goals and objectives for the watershed.

The evaluations will be performed by local counties, municipalities and organizations within the Kawkawlin Watershed. The MDEQ has the historical studies for comparative analysis and will need to conduct specific environmental measurements to assure that some of the recent Great Lakes Restoration Initiatives are met that will ultimately result in the delisting of the Saginaw Bay AOC.

8.1 *Specific Monitoring Components for Recommended Objectives and BMPs*

The specific monitoring components for measuring the success, efficiency and economic impact of each BMP that is recommended are listed in Table 8.1. Monitoring also has a host of other benefits for the watershed by:

- Establishing water quality managers to further identify existing or emerging water quality issues and concerns, keeping this plan dynamic

- Facilitating responses to watershed emergencies such as spills or flooding and helping water quality managers target specific pollution prevention and remediation programs to address these issues
- Determining whether goals of implementation of pollution control activities are being met

Several methods of evaluation will be discussed and entertained by the planning committees. The following topics will need to be covered and decisions made on the monitoring. It may be necessary to engage the assistance of experts in study design, such as Saginaw Valley State University's Science and Engineering College, to obtain a better overview of the water quality and corridor concerns.

BMP Implementation

The number of BMPs installed in the watershed will be compared to the goals presented in the plan to determine a percentage of project completion. The number of property owners participating in buffer strips or agricultural BMPs is another meter for successful implementation. Another will be the amount of stream restoration performed and subsequent improvement in water quality in defined areas of interest in the river.

Site Inspections and Landowner Interviews or surveys to determine performance of a BMP

Installed BMPs will be inspected and monitored at a determined time interval during the implementation phase of the plan. This will provide information on meeting performance standards and determine if landowners are implementing maintenance agreements.

Image Files and GIS

A map view database project will be set up to monitor specific locations in the watershed and couple the information for that specific site to the point on the map. Information collected and displayed will be the written BMP report and chronological photos to assess progress over time. This will be completed by Bay County GIS or a similar agency. Hard report data will be catalogued at a designated location so as to be available to all those agencies involved in the project now and in the future.

Pollutant Reduction Calculations for BMPs

Upon BMP implementation, the project manager in charge of the project needs to be given the tools or training to determine pollutant reduction calculation. The amounts or percentages of reduction of pathogen counts, phosphorus, nitrogen and sediment prevented from entering the riverine system need to be calculated. The reductions will need to be monitored and recorded throughout the life of the project to be available for comparative analysis by interested parties. Any reductions need to be reported to the Bay County Drain Commissioner; this office will assure that long-term records are maintained on the project for reporting purposes for the acquisition of additional grant funding when success can be shown.

Cost Comparative Analysis

The total cost of each BMP will need to be divided by the amount of pollutants reduced and calculated for each site and quantified. Once completed the pollutant reduction will be compared to the cost of the BMP to determine a cost/benefit comparison. This analysis will be started after year one of implementation and presented to evaluation committees to evaluate the effectiveness of the BMP.

8.1.1 *Measurable Targets*

The process of evaluation of this project is shown in Table 8.1 and each best management practice has a monitoring component, measurement standard, criteria, milestones, evaluation period and partners for progress measurement. For the last component, it will be crucial to have a centralized long-term record keeping system to track progress on the WMP. This progress can then be compared to the goals of the plan to determine if the overall project is on track. This table needs to be periodically reviewed by a technical committee made up of the BCDC, Saginaw Bay RC&D, NRCS, MDEQ, Little Forks Conservancy, SB Land Conservancy, KRWPOA and others for measurement suitability to assure practicality.
This committee can provide input, expertise and assistance with many of the evaluation techniques. The technical staffs of the Saginaw Bay RC&D and NRCS have experience with installing and inspecting BMPs and should be used as much as possible. It may also be necessary to bring in the local agricultural industry to realistically evaluate effectiveness of BMPs for applicability to their industry for more "buy-in." The MDEQ resources for calculating pollutant

reduction should be used for consistency over the life of this long-term project. The "*Pollutants Controlled Calculation and Documentation for Section 319 Watershed Training Manual*" or similar agreed-upon method may be used. It may be necessary over the long term to analyze the evaluation calculations to determine if better methods have been forwarded from ongoing research. Training in doing the calculations should be done at the initiation of each project to assure continuity and elimination of misinterpretation or other errors. UofM, SVSU or MSUE can provide guidance in developing and administering the community surveys.

8.1.2 *Evaluation Criteria for the WMP*

Revisions to the WMP can be driven or established by the criteria proposed in Table 8.1. If reductions in pollutants are not being achieved and the water quality goals are not being met, then the WMP and Table 8.1 may need revisions to the goals. Additionally, the BMPs will need to be evaluated over the long term to determine if the treatment trains proposed are effective over the long term towards meeting the proposed water quality standards. During surveys, if more public input begins to support a change in direction or a change in priorities or if new concerns are proposed or discovered, then actions, commitments and milestones may need to be re-evaluated and directions changed. The monitoring components are also described in the table and are proposed to evaluate the effectiveness of the implementation portion of the plan over time in relation to the criteria proposed.

Some of the criteria for specific sub-watersheds, drains or reaches of the river are appropriate for pollutant reduction calculations or volunteer monitoring results. However, the watershed-wide criteria for measuring progress may be better suited to wider activities such as awareness surveys and fishery surveys in broad areas of the watershed. With this evaluation process, local government, community and watershed residents and agencies will be better informed about the public response, perceived project success, what improvements are necessary and which BMPs to continue to utilize.

Table 8.1 - Monitoring Components for BMP Implementation

Actions and Best Management Practices	Monitoring Components	Units of Measurement	Criteria	Milestone - early 12/31/2013	Milestone-Intermediate 12/31/2017	Evaluation Schedule	Responsible Partners
On-Site Treatment system identification & repairs	Health department annual report	Number of failing septic systems reported or discovered during infra-red surveys	Eliminate or control septic system failures	Obtain funding to construct new systems. Or, increase or maintain ability to enforce the correction of failures	Obtain funding and matches. Eliminate all failing septic systems	Annually	Conduct Monitoring: BCHD Implementation Evaluation: BCD, Stakeholders Committee
On-Site Treatment system education & surveys	Health department annual report	Number of public meetings concerning septic system maintenance that are held, number of mailings	Education of the public concerning septic system maintenance	Hold public education meetings at 30% of communities annually	Hold annual public education meetings at 90% of communities	Annually	BCHD, Stakeholder Committee
On-Site Treatment system regulatory mechanism or time of sale inspections	Health department annual report	Number of failing systems identified through county regulatory mechanism or time of sale inspections, or through IR photography	Enforcement of county Regulatory mechanism or time of sale requirement	Increased identification of failing systems through county regulatory mechanism or time of sale requirement	Replace 100% of failing systems identified through county regulatory mechanism or time of sale requirement	Annually	Conduct Monitoring: BCHD Implement Evaluation: County enforcement agency
Livestock exclusion, alternative water source, watercourse crossings as needed for situation	USDA NRCS yearly status reviews, before and after photos	Number and locations of BMPs installed	Reduce pathogens entering the streams, reduce sediment contribution Reduce bank erosion	Install BMPs at 50% of critical sub-watershed sites	Install BMPs at 90% of critical sub-watershed sites	Annually	Conduct Monitoring: NRCS Implement Evaluation: SB RC&D, Stakeholder Committee, Landowners
Soil and manure testing, nutrient management, CNMP, agricultural waste storage facility, GAAMPS	USDA NRCS yearly status reviews, before and after photos	Number and location of waste storage facilities, soil and manure test results, CNMPs developed, and number of new nutrient management practices	Increased participation in Farm Bill programs, MDA programs, NRCS programs	Identify funding sources. Identify agricultural operations in need of manure and nutrient management BMPs, and CNMPs	75% of operations have manure and nutrient management BMPs, and CNMPs	Annually	Conduct Monitoring: NRCS, SB RC&D Implement Evaluation: SB RC&D, Stakeholder Committee, Landowners
Ag BMPs developed by Agriculture Committee addressing V-ditches, Sumps, Buffers, vegetated outlets and channels, check dams, Vegetated buffers and their use and adaptability to site	SB RC&D, Farm Bureau yearly status reviews, before and after photos	Number and location of BMPs installed	reduce sediment contribution, reduced nutrient contribution	Identify funding sources Install BMPs at 50% of critical sub-watershed sites	Install BMPs at 90% of critical sub-watershed sites	Annually	Conduct Monitoring: NRCS, SB RC&D Implement Evaluation: SB RC&D, Stakeholder Committee, Landowners
Continue to improve system (municipal wastewater operations), operation and maintenance	Wastewater treatment Plant's quarterly and annual reports	Improvements made to municipal wastewater operations, number of illicit discharges and sanitary sewer overflows, maintenance & system expansion strategies	Improved municipal wastewater operations, reduced illicit discharges and overflows, good maintenance strategy	Repair or replace 50% of old or failing wastewater operations, implement system expansion strategy to areas with no sanitary	Repair or replace 100% of old or failing wastewater operations, continue maintenance strategy, implement system expansion strategy to areas with no sanitary	Quarterly, Annually	Implement Evaluation: WWTP, BCHD
Water fowl, wildlife and deer management, improve county pick-up programs, I&E-hazards of road kill, green space protection regulatory mechanism	County road commission reports, volunteer and agency programs, amount of green space protected through regulatory mechanism	Size of deer populations, water fowl and wildlife management programs, success of county pick-up programs, adoption of regulatory mechanism	Successful management of deer, water fowl, and wildlife populations, increased participation in programs, enforcement of green space protection regulatory mechanism	Address 30% of problem areas, develop green space protection strategy	Address 75% of problem areas, adopt green space protection regulatory mechanism	Annually	Implement Evaluation: Road Commission, Board of Commissioners, MDEQ, Saginaw Basin Land Conservancy, Stakeholder Committee
Vegetated buffer or filter strip, conservation tillage, cover crops, crop residue management, green streambank stabilization, stabilized outlets, grassed waterways, windbreaks	Pollutant reduction calculations, quarterly reports, USDA NRCS yearly status reviews, before and after photos	Tons of sediment, pounds of nutrients and pesticides, number and locations of practices installed and implemented, tons of sediment reduced	Reduce sediment, nutrients, and pesticides by 25%, increased participation in programs	Install practices at 50% of identified sub-watershed sites (**Est. Removal: 1,000 tons/yr sed.; 1,100 lb/yr P; 2,200 lb/yr N**)	Install practices at 90% of identified sub-watershed sites (**Est. Removal: 1,800 tons/yr sed.; 2,000 lb/yr P; 4,000 lb/yr N**)	Annually	Conduct monitoring: NRCS, SB RC&D, Ducks Unlimited, US Fish and Wildlife Service Implement Evaluation: SB RC&D, Landowners, Stakeholder Committee, Ducks Unlimited, U.S. Fish and Wildlife Service

Table 8.1 - Monitoring Components for BMP Implementation (cont.)

Actions and Best Management Practices	Monitoring Components	Units of Measurement	Criteria	Milestone - early 12/31/2013	Milestone-Intermediate 12/31/2017	Evaluation Schedule	Responsible Partners
Wetland restoration and protection, conservation easements, green space expansion, wetland or green space regulatory mechanism, match state statute, increase awareness	Wetland restoration sub-watershed sites and inspections, MDEQ wetland status reports, before and after photos	Net gain of wetland acreage, adoption of regulatory mechanism	Stabilize hydrology, increased wetland acres and protection measures, enforcement of regulatory mechanism, increase in participation	Restore 5 critical wetland areas, draft regulatory mechanism, hold 3 public meetings to increase awareness	Restore 20 critical wetland areas, adopt and implement wetland regulatory mechanism, hold 6 public meetings	Annually	Conduct monitoring: NRCS, SB RC&D, Ducks Unlimited, US Fish and Wildlife Service Implement Evaluation: SB RC&D, Landowners, Stakeholder Committee, Ducks Unlimited, U.S. Fish and Wildlife Service, MDEQ
Conservation easement, floodplain management, storm water regulatory mechanism	Development of easements, floodplain management practices, regulatory mechanism adoptions	Number of conservation easements, floodplain management practices, regulatory mechanism adoptions	Stabilized stream flows to reduce suspended solids and maintain the floodplain	Increase management practices and number of conservation easements to include every sub-watershed, implement post construction controls	Increase management practices and number of conservation easements to include every community, adopt a post construction control regulatory mechanism	Bi-annually	Implement Evaluation: NRCS, SB RC&D, BCDC
SESC plans, Low Flow channel design, critical area treatment	Building and zoning reports	Tons of sediment	30% TSS reduction	30% of sub-watershed sites addressed **(Est. Removal: 370 tons/yr)**	90% of sub-watershed sites addressed **(Est. Removal: 1,100 tons/yr)**	Annually	Implement Planning and Evaluation: Huron County Building and Zoning, SB RC&D
Hydrologic study, irrigation management, Low Flow channel design, grade stabilization	Hydrologic analysis, BMP inspections, Drain Commissioner reports, before and after photos	Hydrographs, results of inspections, number and locations of irrigation management practices, two-stage channel designs, and grade stabilizations	Hydrology Number of sub-watershed sites meeting recommendations	Conduct preliminary hydrologic analysis, conduct management at 30%of sub-watershed sites	Final hydrographs, conduct management at 90% of sub-watershed sites	Annually	Conduct Monitoring: Consultant - hydrology, Drain Commission inspection Implement Evaluation: Stakeholder Committee, SB RC&D
Sediment & Nutrient removal strategies	Evaluation and determination of nutrient "hot spots"	Sediment & nutrient test results Locations of sediment bars, channel blockages and nutrient hot spots	Reduction of sediment bars, Reduction of P & N metrics,	Obtain funding and matches. Conduct sediment study, remove 30% of sediment and nutrient hot spots **(Est. Remove: 1,200 ton/yr)**	Obtain funding and matches Remove 70% of sediment and nutrient hot spots **(Est. Removal: 2,900 tons/yr)**	Annually	BCDC, SB RC&D, Engineering Consultant
Address DO in N. Branch, stream restoration of multi channel areas	Evaluation of hydraulics in multi channel areas, assessment of sediments in those areas, assessment of flows in various conditions in those areas	DO levels in multi channel areas, Amount of channels changed to wetlands	Number of flow channels reduced, Area of wetland increased, Maintain high flow channels	Improvement of DO levels to no impairment for 2 yrs to avg 3 mg/L in specified area	Improvement of DO levels to no impairment for 4 yrs to avg. 5 mg/L in specified area	Monthly, weekly in summer (J, J, A, S)	MDEQ, SBCT, Engineering Consultant or BCDC
Green Streambank stabilization	USDA yearly status reviews, before and after photos	Number and locations of BMPs installed	Increase number of installation sub-watershed sites	30% of sub-watershed sites addressed	90% of sub-watershed sites addressed	Annually	Conduct Monitoring: NRCS, TCD, SB RC&D, landowners
LID practices	LID inspections, before and after photos	Sediment reduction, storm water reduction	Increase infiltration or filtering ability, adapt for heavy soils	Increase overall infiltration by 15%	Increase overall infiltration by 30%	Annually	Conduct Monitoring: NRCS, SB RC&D Implement Evaluation: Stakeholder Committee, SB RC&D, MDEQ
Crop residue management, PSNT	USDA yearly status reports, before and after photos	Tons of nutrients, number and locations of crop residue management practices, PSNT	Nutrient reduction of 25%	Manage 30% of Sub-watershed sites **(Est. Removal: 340 lb/yr P; 680 lb/yr N)**	Manage 50% of sub-watershed sites **(Est. Removal: 560 lb/yr P; 1,100 lb/yr N)**	Annually	Conduct Monitoring: NRCS Implement Evaluation: Stakeholder Committee, SB RC&D, Landowners
Integrated pest management	USDA yearly status reports	Number/ location of farms using integrated pest management, reduction in pesticides	Increase in landowner participation	10 sub-watershed sites addressed	40 sub-watershed sites addressed	Annually	Conduct Monitoring: NRCS Implement Evaluation: SB RC&D, Stakeholder Committee, Landowners
Phosphate-free fertilizer regulatory mechanism, lawn pest management, Home*A*Syst, public education program	USDA yearly status reports	Status of phosphorus-free fertilizer regulatory mechanism, number of homeowners using lawn pest management techniques, Home*A*Syst program participation	Adoption of regulatory mechanism, increased participation in programs and practices	I&E materials developed for phosphorus, increase Home*A*Syst program participation	I&E materials distributed, 100% participation in programs	Annually	Implement Evaluation: NRCS, SB RC&D, Stakeholder Committee, Landowners
Watercourse buffer regulatory mechanism	Development of regulatory mechanism, County enforcement	Number and location of stream buffers created as a result of regulatory mechanism	Reduce loss of canopy cover, adoption of regulatory mechanism	Draft regulatory mechanism	Adopt regulatory mechanism	Annually	Implement Evaluation: County Commission, Little Forks Conservancy, SB Land Conservancy, Stakeholder Committee, SB RC&D

Table 8.1 - Monitoring Components for BMP Implementation (cont.)

Actions and Best Management Practices	Monitoring Components	Units of Measurement	Criteria	Milestone - early 12/31/2013	Milestone-Intermediate 12/31/2017	Evaluation Schedule	Responsible Partners
Invasive Aquatic Plant Management	Develop annual watershed monitoring times.	Develop an aerial inventory of areas with invasive plants and determine the acreage eradicated annually in a % or a specified acreage	Annual reduction of area by 20% each year	Obtain Grant Funding 40% reduction of the area of invasive plant species	Obtain Grant Funding Final 60% reduction of area of invasive plant species	Annually	KRWPOA
Establishing Green Water Trail system	Develop a plan and community support. Establish more access points for the public	Number of access sites developed. # of people using the river, exit surveys	Placement in township recreation plans, utilization surveys	South Branch Trail Float Trail	North Branch Float Trail	Annually	KRWPOA, BCDC or County Parks
Establish macroinvertebrate monitoring in specified sub-watersheds	Development of specific monitoring sites	Number and Location of study sites established in specific sub-watershed	Sites will use established MDEQ procedures and document studies	Obtain funding for project, Est. monitoring sites. Begin monitoring 4 times a year	Obtain funding to continue program, Write 5 year report on findings, monitor sites annually at same rate as before	Annually, a summary, Two main reports	MDEQ
Establish water quality monitoring in critical sub-watersheds	Development of specific monitoring sites	Number and Location of study sites established in specific sub-watershed	Sites will use established MDEQ procedures and document studies	Obtain funding for project, Est. monitoring sites. Begin monitoring 4 times a year	Obtain funding to continue program, Write 5 year report on findings, monitor sites annually at same rate as before	Annually	MDEQ
Invasive species management, I&E	MDEQ yearly status reports	Number and locations where invasive species management has been implemented	Reduce spread of invasive species	Establish mandatory boat checks prior to launching, I&E signage at lakes/marinas/boat launches	Support to pass invasive species regulatory mechanism/bill	Annually	Conduct Monitoring: County enforcement agency, MDEQ, Volunteers Implement Evaluation: County enforcement agency, Stakeholder Committee, SB RC&D
Woody debris management, obstruction removal, main channel flow enhancement	Volunteer and agency programs, County inspections	Amount of woody debris, number and location of obstructions, Establish main channel	Manage woody debris through increased number of programs, reduce obstructions to navigation, improve main channel flow, hold workshop on woody debris management	Establish management plan for woody debris, Continues to organize stream clean-ups annually	Manage wood debris, reduce obstructions to navigation by 75%	Spring/Fall	Conduct Monitoring: NRCS, SB RC&D, KRWPOA, local volunteer organizations Implement Evaluation: Stakeholder Committee, NRCS
Volunteer clean-up-public education, dumping regulatory mechanism	Volunteer and agency programs, dumping regulatory mechanism	Number of clean-up programs, adoption of regulatory mechanism	Increase number of programs, adopt dumping regulatory mechanism	Identify areas in need of cleanup efforts and clean-up 30% of sub-watershed sites, draft dumping regulatory mechanism	Conduct cleanup efforts and clean-up 90% of sub-watershed sites, adopt dumping regulatory mechanism	Annually	Conduct Monitoring: KRWPOA, Local volunteer groups and organizations, Road Commissions, Adopt-a-Road programs Implement Evaluation: Stakeholder Committee
Development of Road Trail bike system for Touring Bikes	Development of a Kawkawlin Watershed Bike Tour Road System, interpretive bike stops at BMP sites	# miles of trails developed, Have bike trail travel requests come from web site	Increase different types of recreational opportunities in the Watershed. Utilization surveys	Establish funding, brochures, advertisement and 12 miles of trails	Completion of 20 miles of trails and 5 interpretive sites in watershed	Annually	KRWPOA, Area Biking Club
Public access regulatory mechanism	County Road Commission reports, before and after photos	Number and locations of access sub-watershed sites and improvements	Increase access to sub-watershed sites	Increase access by 30%	Increase access by 90%	Annually	Conduct Monitoring: County Road Commissions Implement Evaluation: SB RC&D, Stakeholder Committee

8.2 *Indicators of Overall Water Quality*

Quantitative measurements will be used in the evaluation to determine the rate and level of water quality improvements which will be focused on aspects of biological, chemical and physical improvements. Categories of indirect and direct indicators will be used. Indirect are those that are measurements of practices and actions that could indicate improvements to water quality but do not provide an actual measurement of water quality. Examples would be miles of buffer strip established or acres of wetland restored to historical function.

Direct environmental indicators would measure water quality by established scientific methodology, for example measurement of TSS or phosphorus levels in the water column and macroinvertebrate surveys (which indicate water quality based on the type of macroinvertebrates discovered, identified and counted).

The following table provides the Water Quality Standards (WQS) and other minimum criteria that should be used for comparative analysis during the recovery of the Kawkawlin Watershed.

Table 8.2 Water Quality Standards

Parameter	Water Quality Standard
pH	6.5 – 9.0
Dissolved Oxygen (DO)	>5 mg/L for surface waters designated for warmwater fishery and aquatic life
Temperature	• The Great Lakes and connecting waters and inland lakes shall not receive a heat load which increases the temperature of the receiving water more than 3 degrees F above the existing natural water temperature (after mixing with the receiving waters). • Rivers, streams, and impoundments shall not receive a heat load which increases the temperature of the receiving water more than 5 degrees F. for warmwater fisheries
Nutrients	• Total Phosphorus: point source discharges limited to 1.0 mg/L of total phosphorus as a monthly average. - In general, nutrients are to be limited as necessary to prevent excessive growth of aquatic plants, fungi, or bacteria, which could impair designated uses of the surface water. The EPA criteria for stream aesthetics is 0.1 mg/L of total phosphorus. Levels of <0.05 mg/L of total phosphorus is considered normal level adequate for aquatic plant and algal growth.

Table 8.2 Water Quality Standards (cont.)

Parameter	Water Quality Standard
E.coli / fecal coliform microbes	• Surface Waters and Surface Water Discharges - Partial Body Contact: 1,000 *E.coli* per 100 mL of water at any time - Total Body Contact: 130 *E.coli* per 100 mL of water as a 30 day average and 300 *E.coli* per 100 mL of water at any time • Bacteria Effluent Limitations in NPDES Permits - WWTPs must conform to the following standard for point source discharges of water: - 200 fecal coliform bacteria per 100 mL of water as a monthly average - 400 fecal coliform bacteria per 100 mL of water as a 7 day average
Total Suspended Solids (TSS) Sediment	• Municipal WWTP must provide a treatment to meet TSS limits of 30 mg/L as a monthly average and 45 mg/L as a 7 day average. • Waters of the State shall not have any of the following unnatural physical properties in quantities which are or may become injurious to any designated use: turbidity, color, oil films, floating solids, foam, settleable solids, suspended solids, and deposits. This kind of rule, which does not establish a numeric level, is known as a "narrative." • Typically, water with a TSS concentration less than 20 mg/L is considered to be clear. Water with TSS levels between 40 and 80 mg/L tend to appear cloudy, while water with concentrations over 150 mg/L usually appears dirty. The nature of the particles that comprise the suspended solids may cause these numbers to vary (for example, clay particles).
Total Dissolved Solids	• In no instance shall total dissolved solids in the waters of the state exceed a concentration of 500 mg/L as a monthly average, nor more than 750 mg/L at any time, as a result of controllable point source discharges. • The waters of the state designated as a public water supply source shall not exceed 125 mg/L of chlorides as a monthly average, except for the Great Lakes and connecting waters, where chlorides shall not exceed 50 mg/L as a monthly average.
Conductivity	• Measurement of the amount of dissolved ions in water (e.g. salt, metals, toxins, etc.) - ≤ 800 µS is considered natural for stream water - ≥ 800 µS is considered excessive and may indicate the presence of toxins in the water

Altered Hydrology

The criteria for assessing flow will be to use an agreed upon hydrologic model and subsequent flows from the model to determine build out effects in urban areas and what might have happened if the existing storm water management plan in effect at the county level was not followed. It may also be time to revisit the Bay County Drain Commissioner's design standards and modify them to meet current NPDES permit requirements of minimum water quality standards and have these standards adopted at the township level where they can be enforced on the local level.

Biological

The MDEQ has developed metrics for estimating the aquatic habitat and health of the fish and benthic communities in a river. The freshwater macroinvertebrates are animals with internal skeletal structures that are larger than 0.5 mm in size. The benthic animals live on rocks, woody debris, sediment in debris or on aquatic plants at some point in their development toward adulthood or period in their life cycle.

Examples of these macroinvertebrates include crayfish, clams, snails, aquatic worms and immature forms of aquatic insects and other insects such as stone flies and May flies. These life forms are important to the food chain of the watershed and they feed upon algae and bacteria on the lower end of that food chain. Some of these aquatic organisms are beneficial because they consume and shred leaves, grass, organic matter and aquatic vegetation in the water. This helps lower the biological oxygen demand of decaying plant organics. Because of their abundance and position in the food chain, these macroinvertebrates play a key role in the energy and nutrient budget of the watershed. If these macroinvertebrates are found in large numbers and are the right types of indicator organisms, they help to classify the overall health of the aquatic environment in the river reach being analyzed or sampled. For example, larval forms of stone flies and May flies indicate a healthy environment and habitat, whereas some worms and midges indicate a lower quality of habitat.

Other quantitative measurements have, as described earlier, a more narrative approach. For example:

Trash and Debris

It is well known that the deposition or dumping of trash and debris can add chemical, nutrients and otherwise degrade the riparian corridor and aquatic habitat. Additionally, if left in place, it ruins the aesthetics of the watershed. Stream and drain cleanup efforts can reduce the amount of trash and debris in the watershed. A measure that can be used for this parameter is the number of volunteers on an annual basis over a period of years that participate in the cleanup effort. If there is a rolloff dumpster used to haul away the trash, a volume can be derived from how full the dumpster is. It may also be prudent to recycle what trash is removed. For example, scrap metal prices currently are high and, by taking the recyclables to a scrap yard and not just land-filling the trash and debris, a volunteer group can obtain some funds to help defray the cost of the project.

8.3 *Watershed Monitoring Efforts*

The assessment and monitoring efforts for water quality will be completed with field measurements of temperature, turbidity, dissolved oxygen, TDS and pH by volunteer groups, the Saginaw Chippewa Tribe environmental group or volunteer groups such as KRWPOA, local schools or community colleges. The more involved analytical chemistry for nutrients (primarily phosphorus and nitrogen), chlorophyll *a* (if requested), and sediment testing (to meet dredging criteria and determination of nutrient "hot spots", these monitoring efforts should include use of professional labs such as: SVSU labs, qualified sediment testing labs, Bay County Health Department, or other designees.

It is essential that workshops and demonstrations of physical measurements can be held to develop a consistent monitoring program. Programs such as Stream Leaders or similar can be used to address the biological and macroinvertebrate inventorying or collections. Scheduled monitoring sessions should be held to establish a baseline and then the monitoring efforts can be held at routine intervals agreed upon by the technical committees overseeing this effort. All data gathered will be entered in a database at an agreed upon central location and shared with all

interested parties to further restoration efforts in the Kawkawlin Watershed. The following table provides Monitoring and Evaluation aspects for the plan.

Table 8.3 – Monitoring and Evaluation

Monitoring Site Location	Parameter	Type of Analysis	Protocol	Frequency	Responsible Party
Station 1: Hoppler Creek @ Auburn Road	S, N, DO, T[1]	Stream Habitat Assess	EPA rapid bio-assessment or approved equivalent	3 – 5 years	MDEQ, university, or contracted consultant
		Suspended sediment conc.	MDEQ Approved method	1x/yr – rain event	Conservation District or agreed upon agency
		Total Phosphorus		1x/yr – rain event	Conservation District or agreed upon agency
		Dissolved Oxygen	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
		Temperature	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
Station 2: SB Kawkawlin @ Garfield Road	S, N, DO, T	Stream Habitat Assess	EPA rapid bio-assessment or approved equivalent	3 – 5 years	MDEQ, university, or contracted consultant
		Suspended sediment conc.	MDEQ Approved method	1x/yr – rain event	Conservation District or agreed upon agency
		Total Phosphorus		1x/yr – rain event	Conservation District or agreed upon agency
		Dissolved Oxygen	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
		Temperature	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
Station 3: Herner Drain @ Jefferson Road	S, N, DO, T	Stream Habitat Assess	EPA rapid bio-assessment or approved equivalent	3 – 5 years	MDEQ, university, or contracted consultant
		Suspended sediment conc.	MDEQ Approved method	1x/yr – rain event	Conservation District or agreed upon agency
		Total Phosphorus		1x/yr – rain event	Conservation District or agreed upon agency
		Dissolved Oxygen	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
		Temperature	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
Station 1: Hoppler Creek @ Auburn Road	S, N, DO, T[1]	Stream Habitat Assess	EPA rapid bio-assessment or approved equivalent	3 – 5 years	MDEQ, university, or contracted consultant
Station 4: Watson Drain @ Rhodes Road	S, N, DO, T	Stream Habitat Assess	EPA rapid bio-assessment or approved equivalent	3 – 5 years	MDEQ, university, or contracted consultant
		Suspended sediment conc.	MDEQ Approved method	1x/yr – rain event	Conservation District or agreed upon agency
		Total Phosphorus		1x/yr – rain event	Conservation District or agreed upon agency
		Dissolved Oxygen	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
		Temperature	Quanta Unit or similar	1x/yr – summer	MDEQ approved party

Table 8.3 – Monitoring and Evaluation (cont.)

Monitoring Site Location	Parameter	Type of Analysis	Protocol	Frequency	Responsible Party
Station 5: SB Kawkawlin River @ Chip Road	S, N, DO, T	Stream Habitat Assess	EPA rapid bio-assessment or approved equivalent	3 – 5 years	MDEQ, university, or contracted consultant
		Suspended sediment conc.	MDEQ Approved method	1x/yr – rain event	Conservation District or agreed upon agency
		Total Phosphorus		1x/yr – rain event	Conservation District or agreed upon agency
		Dissolved Oxygen	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
		Temperature	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
Station 6: NB Kawkawlin River @ Jefferson Road	S, N, DO, T	Stream Habitat Assess	EPA rapid bio-assessment or approved equivalent	3 – 5 years	MDEQ, university, or contracted consultant
		Suspended sediment conc.	MDEQ Approved method	1x/yr – rain event	Conservation District or agreed upon agency
		Total Phosphorus		1x/yr – rain event	Conservation District or agreed upon agency
		Dissolved Oxygen	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
		Temperature	Quanta Unit or similar	1x/yr – summer	MDEQ approved party
Station 7: NB Kawkawlin River @ Fraser Road WQ monitoring site	DO, T, pH, Tb	Dissolved Oxygen	Quanta Unit or similar	3x/yr -spring, summer, fall	Spicer Group[3]
		Temperature	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		pH	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		Tb (NTU)	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
Station 8: NB Kawkawlin River @ Mackinaw Road WQ monitoring site	DO, T, pH, Tb	Dissolved Oxygen	Quanta Unit or similar	3x/yr -spring, summer, fall	Spicer Group
		Temperature	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		pH	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		Tb (NTU)	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
Station 9: NB Kawkawlin River @ Cottage Grove Road, WQ monitoring site	DO, T, pH, Tb	Dissolved Oxygen	Quanta Unit or similar	3x/yr -spring, summer, fall	Spicer Group
		Temperature	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		pH	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		Tb (NTU)	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
Station 10: Culver Creek along N. Union Road, WQ Monitoring site	DO, T, pH, Tb	Dissolved Oxygen	Quanta Unit or similar	3x/yr -spring, summer, fall	Spicer Group
		Temperature	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		pH	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		Tb (NTU)	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group

Table 8.3 – Monitoring and Evaluation (cont.)

Monitoring Site Location	Parameter	Type of Analysis	Protocol	Frequency	Responsible Party
Station 11: Culver Creek, 7 Mile Road crossing WQ Monitoring site	DO, T, pH, Tb	Dissolved Oxygen	Quanta Unit or similar	3x/yr -spring, summer, fall	Spicer Group
		Temperature	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		pH	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		Tb (NTU)	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
Station 12: SB Kawkawlin River @ Mackinaw Road after confluence with Culver Creek WQ Monitoring site	DO, T, pH, Tb	Dissolved Oxygen	Quanta Unit or similar	3x/yr -spring, summer, fall	Spicer Group
		Temperature	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		pH	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
		Tb (NTU)	Quanta Unit or similar	3x/yr - spring, summer, fall	Spicer Group
MB Kawkawlin River & mouth	B	E.coli MPN/100m/L	EPA Method 1103.1	3x/Yr- May, Jul, Sep	Bay County HD or KRWPOA

1) S=sediment, N=nutrients; DO=dissolved oxygen; T=temperature; pH=pH; Tb=Turbidity (NTU); B=bacteria(*E.coli*); P=phosphorus

2) Saginaw Bay RC&D or delegated agency

3) Spicer Group maintains equipment for this type of testing, another agency may be used if necessary

Pathogens (*E.coli*)

The Bay County Health Department will use monitoring data collected and make final determinations if the implementation of BMPs designed to lower pathogen levels is trending towards meeting WQS and the designated uses of the watershed or improving the BUIs of the Saginaw Bay AOC. A decrease in WQS violations for bacteria will meet that standard of measurement and attainment of the standard. A decrease in the amount of seasonal beach closures could also be used as a measure of success in the implementation of the WMP.

The quantitative measurements will include the direct measurement for *E.coli* and the number of point sources or nonpoint sources identified and eliminated will serve as the indirect measurement. A final indirect measurement will be the number of failing on-site treatment systems replaced or brought up to new standards or the amount of point-of-sale inspections done annually during home sales in the watershed boundaries.

Sediment

Photos of sites before and after BMP implementation will be used in the quantitative measurements of sediment reduction. If sediment traps are in use in a treatment train, the size of the trap should be known and the depth of sediment can be determined and a calculation for volume can be completed to develop a direct measurement. Other direct indicators in the environment can be use of biological data gathering such as macroinvertebrate and bio surveys and their comparison over time. Stream sediment loading can be measured through the GLEAS protocol habitat. Measurement of the amount of sediment removed during drain maintenance can also be quantified and reported as a reduction.

Indirect indicators for sediment will include pollutant reduction calculations, tracking of the BMP implementation and installation and MDEQ creel surveys to document the number and species of fish in a reach.

Nutrients

Quantitative testing for total phosphorus and nitrogen will be completed during at least ten years of WMP implementation. It will need to be determined if there is an NDPES discharger that must complete routine testing and if this data can be acquired for analysis or use by monitors of the WMP.

Stream Crossing Surveys

The Saginaw Bay RC&D has completed a stream crossing survey in the past, approximately 10 years ago. It will be beneficial for this agency to complete another survey for comparative analysis and determination of the condition of the crossings. This MDEQ quick screening tool is designed to be an observational assessment and the results are only qualitative in nature. However, with the information from the past survey there can be a comparative analysis that may be used for quantitative aspects. However, this will need to be looked at objectively for application in this watershed.

Altered Hydrology

Table 8.2 lists the measurements for the monitoring plan as it relates to hydrology and the agency or organization responsible for the monitoring. The hydrology of the river system needs to have a model prepared that can be used as a baseline to assess the hydrology on a temporal basis. The interval should be approximately every five years to determine if there is an effect on baseflow, flashy hydrology, or increase in urban or agricultural runoff that cannot be attributed to changes in annual weather patterns.

Biology

Use of Procedure 51 (P51) sampling techniques every 3 to 5 years in the Kawkawlin Watershed to assess macroinvertebrate populations and diversity and comparing these results to past studies will be very helpful. For example, the last assessment was completed in 2006, and there was a P51 assessment done the by a sub-consultant on this plan. It is recommended that after at least 3 years of BMP implementation that the surveys be completed for a comparative analysis. A technical committee should make the decision as to the timeframe, whether 3 years is enough time and whether enough BMPs have been implemented to have an impact in the watershed.