Appendix L

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER BUREAU
January 8, 2010

UPDATE OF PHOSPHORUS LOAD DATA FOR SAGINAW BAY

Summary

In 1983 a phosphorus loading target of 440 metric tons per year was established for Saginaw Bay to help minimize algae-related odor problems in the Saginaw drinking water supply system and lower total phosphorus concentrations in the inner bay. Subsequent updates on progress towards achieving this target load, the last prepared in 1991, indicated that annual phosphorus loads exceeded this target, sometimes substantially. This report examined the results of four monitoring studies that spanned from 1974 to 2005 to assess trends in phosphorus loads to the Bay, and results of two models (L-THIA and SPARROW) that predicted the sources of the phosphorus loads. The monitoring studies demonstrated a strong relationship between river discharge and phosphorus load (wet years = higher loads), and indicated that the phosphorus loading target is only met during drier years. A trend analysis of time vs. discharge-normalized phosphorus loads found a 43 percent decline in annual loads between the time periods of 1974-1980 and 2001-2005. This reduction is presumably largely due primarily to waste water treatment plant upgrades and legislation that limited the phosphorus content of laundry detergent in the 1970s. The models both indicate that agriculture is the major source of phosphorus to Saginaw Bay. L-THIA predicted that 90 percent of the annual phosphorus load due to surface runoff to the Bay is from agricultural lands. SPARROW predicted that the major sources of phosphorus to the Bay are fertilizer (50 percent) and livestock manure (17 percent), while point sources account for 25 percent. Both models indicate that, of the nine subwatersheds draining to Saginaw Bay, the Pigeon-Wiscoggin, Flint, Shiawassee, and Cass River watersheds contribute the most phosphorus to the Bay.

Introduction

In the 1978 Great Lakes Water Quality Agreement, the United States and Canada affirmed their intentions to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin ecosystem. As part of this agreement, in 1983 the two parties finalized phosphorus load targets for each of the Great Lakes. The target total phosphorus load for the Saginaw Bay portion of Lake Huron is 440 metric tons per year. This target was established to minimize odor problems in the Saginaw drinking water supply system and lower total phosphorus concentrations in the inner bay to a target of 15 µg/L.

Periodic reports updating Michigan's progress towards achieving this loading target were published in 1985, 1987, 1988, and 1991. The last of these reports (MDNR et al., 1991) estimated the average annual load of total phosphorus to Saginaw Bay at that time to be 665 metric tons.

The intentions of this report are to:

- Update the status of phosphorus loads to Saginaw Bay.
- Present information on the sources of phosphorus to the Bay

Methods

Phosphorus loading data were obtained from the reports listed in Table 1. All data are presented in Appendix A. Phosphorus load estimates in all four of these reports are based on water sampling programs, not land use-based models. The monitored location representing phosphorus loads to the Bay in each of the four studies was the mouth of the Saginaw River. Consequently, the phosphorus loads in these data sets represent the summed loads of the tributaries making up the Saginaw River watershed (the Tittabawassee, Pine, Chippewa, Shiawassee, Flint, Cass, and Saginaw Rivers) and do not include the tributaries along the eastern and western portions of Saginaw Bay (the Au Gres, Rifle, Kawkawlin, Pigeon, and Pinnebog Rivers, and smaller streams).

Two phosphorus loading models were also used to identify phosphorus sources to the Bay; the Long-Term Hydrologic Impact Assessment (L-THIA) model (Engle et. al., 2005) and the Spatially Referenced Regressions On Watershed attributes (SPARROW) model (Smith et. al., 1997). L-THIA estimates long-term average annual runoff loads from multiple land use categories, and its application to Saginaw Bay phosphorus loads has been previously reported (Vincent, 2009). Phosphorus loads were calculated for seven land use categories:

- Agriculture
- Commercial
- Forest
- Grass/Pasture
- High density residential
- Low density residential
- Water/Wetland

Land use data from 2001 was used as input to L-THIA. Note that since L-THIA is a land-use based model it does not include point source loads. L-THIA was applied to the nine 8-digit hydrologic unit codes (HUCs), or watersheds, that make up the Saginaw Bay drainage area (Figure 1).

SPARROW correlates stream nutrient (phosphorus and nitrogen) concentrations at previously monitored locations with known upstream sources and land surface characteristics, and predicts loadings for locations at unmonitored locations. SPARROW considers four nutrient sources:

- Point source discharges
- Fertilizer sales
- Manure production
- Runoff from "nonagriculture" lands (urban, forest, and range lands)

Note that, unlike L-THIA, SPARROW includes point source loadings.

Most of the input data for SPARROW is from the mid-1980s. Results were calculated for 8-digit HUCs nationwide, including the nine 8-digit HUCs making up the Saginaw Bay drainage.

Results and Conclusions

Trends in Phosphorus Loads

Taken together, the four available data sets listed in Table 1 provide good temporal coverage over the last three-plus decades (Figure 2), including two important periods in the Bay's recent history:

- The mid to late 1970s, when Michigan's waste water treatment plants upgraded from primary treatment to secondary treatment, and the law limiting the phosphorus content of laundry detergents was passed (1977).
- The early 1990s, when zebra mussels first colonized the Bay.

Phosphorus loads have varied substantially during the period of record, by up to a factor six. Phosphorus loads appear to have declined in recent years (2001 to 2005) compared to the 1970s and 1980s, although this pattern is partly obscured by the annual variability in phosphorus load and river discharge, and the strong relationship between discharge and phosphorus load (Figure 3). This issue is addressed further, below.
As noted in the Methods section, comparing recent phosphorus loads to the 1983 target of 440 metric tons per year is complicated by the fact that monitoring data are only available for the Saginaw River watershed, and not for the smaller tributaries along the east and west sides of the Bay. Approximately three-quarters of the overall Saginaw Bay phosphorus load is attributable to the Saginaw River watershed (Table 2), so a 'correction factor' of 25 percent should be added to the Saginaw River load data in Figure 2 to account for the loads from the other tributaries to the Bay. After this correction factor is applied, the overall phosphorus loads to Saginaw Bay in the most recent monitoring period (2001 to 2005) were below the 1983 target in the two drier years, 2003 and 2005, and exceeded the target in the other three, wetter, years (Table 3).

Assessing phosphorus loading trends is also complicated by more-or-less simultaneous occurrence of the law limiting phosphorus in laundry detergents (1977) and a series of consecutive dry years between 1977 and 1980 (Figure 2). Given the strong correlation between discharge and phosphorus load in the Saginaw River, for trend assessment it is appropriate to normalize each year's mean load to its corresponding mean discharge. The results are illustrated in Figure 4; note that the fixed station data (MDNR, 1993) included in Figure 2 were omitted from this analysis because the sampling frequency is unclear from the available documentation. Linear regression of time vs. discharge-normalized phosphorus load indicates a significant decline in loads over the period of record ($p = 0.007$); phosphorus loads declined by 43 percent between the 1974-1980 and 2001-2005 time periods. This decline is presumably due to a combination of waste water treatment plant upgrades and the lower phosphorus content of laundry detergents dating to the 1970s, although changing agricultural practices may have also played a role. Despite this decline in phosphorus loads since the 1970s, however, the 1983 phosphorus load target has only been met recently in dry years (Figure 2).

Phosphorus Sources

The loading data discussed above does not identify the source(s) of the phosphorus loads to Saginaw Bay. Sources of phosphorus were assessed using two models, L-THIA and SPARROW, and point source discharge data for NPDES-permitted facilities.

The L-THIA model, which calculates phosphorus export from different land use types, estimated that runoff from agricultural lands, which constitute about 45 percent of the overall Saginaw Bay drainage area, accounts for 90 percent of the surface runoff phosphorus load (Table 4). Results were similar for each of the nine 8-digit HUCs making up the Saginaw Bay drainage area, with agriculture accounting for greater than 70 percent of the phosphorus loads even in watersheds where it was not the dominant land use (Table 5). It should also be noted that commercial and high density residential land uses, though small in total area, are predicted to have the highest phosphorus loads pre acre (Table 5).

Results of the SPARROW model, which estimates phosphorus loads from known potential sources and landscape characteristics rather than land uses, were generally similar to those of the L-THIA model, in that agricultural sources account for most of the phosphorus loads to Saginaw Bay. The SPARROW model estimated that fertilizer accounts for about 51 percent of the phosphorus load to Saginaw Bay (Figure 5), the large majority of which is presumably agricultural fertilizer. Livestock manure (based on livestock numbers) accounted for an additional 17 percent, so agricultural sources combined accounted for a total of about two-thirds of the total load to the Bay. As of the mid-1980s, when the SPARROW calculations were performed, point sources accounted for about 24 percent of the total annual loadings, while runoff from nonagricultural lands (urban, forest, and range lands) was less than 10 percent of the total. The relative contributions of point and nonpoint source phosphorus loads to the Bay have apparently changed over time. Nonpoint source loads increased from 60 percent of the total load to the Bay in the early 1970s to 77 percent by 1980 (MDNR, 1994) – identical to the results of the SPARROW model reported here, which represent conditions in the mid-1980s. This change is presumably due to the decline of point source phosphorus loadings resulting from wastewater treatment plant upgrades and the laundry detergent phosphorus ban during the 1970s.

Results of the SPARROW and L-THIA models also generally identified the same subwatersheds as major and minor sources of phosphorus to Saginaw Bay (Table 6). For example, both models found that the Flint River and Shiawassee River together account for over one-third of the phosphorus loadings to the Bay, while the Au Gres-Rifle, Kawkawlin-Pine, and Saginaw subwatersheds each account for five to seven percent of the total phosphorus load. This information should be useful for prioritizing subwatersheds for remedial actions.

Phosphorus Load Estimates: Measured vs. Modeled

Although the four sampling-based loading studies (listed in Table 1) and the two modeling studies (L-THIA and SPARROW) all compute phosphorus loads to Saginaw Bay, comparisons between them are problematic for several reasons:

- The sampling-based studies are 1-year 'snap shots' of phosphorus loadings and the L-THIA model's predictions are based on land uses from a single year (2001), while the SPARROW model uses input data from more than one year (mid-1980s, mostly, though the output is assigned to 1987 [Smith et. al., 1997]).
- The sampling-based studies and the SPARROW model include both point sources and nonpoint sources, while the L-THIA model does not include point sources.
- The two models calculate loads for all nine of the 8-digit HUCs that drain into Saginaw Bay, while the sampling-based studies include only the six HUCs that combine to form the Saginaw River drainage (although it is possible to adjust the sampling-based study data sets to account for the other tributaries; see Table 3).

With those caveats, Table 7 compares the two modeled phosphorus loads and the sampling-based loads (extrapolated to the entire Saginaw Bay watershed) for the appropriate year. The SPARROW model load estimate greatly exceeded the measured load in 1987, while the L-THIA model load estimate was slightly lower than the measured load in 2001.

The SPARROW model point source load predictions can also be compared to National Pollutant Discharge Elimination System (NPDES) data for permitted point source dischargers, although this comparison is problematic for several reasons:

- Point source data inputs to the SPARROW model are from the period 1977-1981, while the most readily available NPDES data are from 2008.

- The input data to the SPARROW model includes waste water treatment plants (WWTPs), industrial dischargers, small sanitary waste dischargers and other point sources, while the most readily available NPDES data are for WWTPs and retention treatment basins (RTBs; i.e., treatment facilities for combined sewerage) only. (Note that there are no untreated combined sewerage overflows [CSOs] in the basin.)
- 1977 to 1981 was a period of transition for point sources in Michigan; many WWTPs were being upgraded and installing phosphorus controls, the laundry detergent phosphorus limit came into effect in 1977, there were many more CSOs than RTBs, and the CSOs were not monitored.
- It is unknown whether any RTBs were permitted in 1977-1981, and so it is not known if they were included in the SPARROW input data set.

With those caveats, Table 8 compares the older but presumably more complete SPARROW model point source load predictions from approximately thirty years ago with the sum of the reported WWTP and RTB discharges from 2008. The historic model point source loads are over three times higher than the recently reported WWTP and RTB loads. Assuming the model load estimates are correct, this 72 percent decline over 3 decades may be partly due to the waste water treatment plant upgrades and laundry detergent phosphorus ban that occurred in the 1970s. It should also be noted that phosphorus loads from the RTBs are only a small fraction (approximately 2 percent) of the loads from WWTPs.

Finally, the sum of the phosphorus loads from commercial and high density land uses calculated by the L-THIA model (Table 4) can be considered roughly equivalent to the point source loads from the MS4 storm water communities (although the calculated figure may be biased high by an undetermined amount by inclusion of certain urban nonpoint source loads). Consequently, it is possible to roughly compare the modeled point source loads for MS4 communities with the measured phosphorus loads from WWTPs and RTBs for the entire Saginaw Bay watershed. These data indicate that, among these three point source categories, loads from the 39 waste water treatment plants in the watershed are approximately four times larger than loads from the 44 MS4 communities, and approximately 50 times larger than loads from RTBs (Figure 6). It should be noted that Figure 6 does not include other, presumably small point source phosphorus loads, such as industrial storm water dischargers, waste water sewage lagoons, drinking water treatment plants, and noncontact cooling water.

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Appendix

Total phosphorus loads and average annual discharge from the Saginaw River, 1974-2005

Year	P Load Bierman et. al., 1984 (metric tons/year)	P Load MDNR, 1993 (metric tons/year)	P Load WCMP* (metric tons/year)	P Load Snell, 1986 (metric tons/year)	Mean Annual Discharge (m^3/sec)
1974	1,044	1692			165
1975	1,267	1171			191
1976	937	1459			191
1977	511	492			81
1978	595	588			94
1979	409	621			97
1980	472	562			104
1981		596			135
1982		1772			165
1983		620		561	150
1984		517		664	135
1985		1365			203
1986		1211			222
1987		516			128
1988		420			112
1989		743			127
1990		304			112
1991		1390			207
1992-2000	Phosphorus load data not available for these years				
2001			642		126
2002			513		128
2003			227		74
2004			724		162
2005			288		98

(* MDEQ Water Chemistry Monitoring Program annual reports)

Tables

Table 1. Sources of phosphorus loading data cited in this report.

Citation	Years with Data
Bierman et. al, 1984	1974-1980
Snell Environmental Group, 1986	1983 and 1984
Michigan Department of Natural Resources, 1993	1974-1990
MDEQ Water Chemistry Monitoring Program annual reports (Aiello 2003, 2004, 2005, 2006, & 2008)	2001-2005

Table 2. Contribution of the Saginaw River watershed to the total phosphorus load to Saginaw Bay.

Information Source	Percent of the Total Load to Saginaw Bay
Chapra, 1979	86
MDNR, 1994	66
SPARROW model	78
Average	77

Table 3. Measured Saginaw River and estimated Saginaw Bay phosphorus loads.

Year	Measured Saginaw River Load (metric tons/year)	Estimated Saginaw Bay Load, including unmonitored tributaries (metric tons/year)
	1983 load target = 440 metric tons/year	
2001	642	803
2002	513	641
2003	227	284
2004	724	905
2005	288	360

Table 4. Phosphorus loads from different land uses in the Saginaw Bay drainage area, according to the L-THIA model.

Land Use Type	Land Use (% of drainage area)	Phosphorus Load (metric tons/year)	Phosphorus Load (% of total)	Phosphorus Load per Unit Area (pounds/acre)
Agriculture	45.0	619	90.2	0.55
Commercial	0.4	8	1.1	0.79
Forest	21.7	0.6	0.1	< 0.01
Grass/Pasture	5.9	0.3	0.04	< 0.01
High density residential	1.1	18	2.7	0.69
Low density residential	10.2	41	5.9	0.16
Water/Wetland	15.8	0	0	0
Total		686.9		

Table 5. Phosphorus loads from the agricultural portions of the subwatersheds of the Saginaw Bay drainage area, according to the L-THIA model.

HUC/Watershed	Percent of Drainage Area in Agriculture	Phosphorus Load from Agricultural Lands (% of total for HUC)
Pigeon-Wiscoggin	80.4	96.9
Flint	46.3	81.1
Shiawassee	57.4	93.3
Cass	57.1	96.1
Chippewa-Pine	43.7	93.0
Tittabawassee	21.6	88.5
Kawkawlin-Pine	46.2	90.1
Au Gres-Rifle	15.7	88.7
Saginaw	61.0	70.6

Table 6. Percent of annual phosphorus load to Saginaw Bay from each HUC/subwatershed in the drainage area.

HUC/Watershed	HUC Land Area – Percent of Overall Saginaw Bay Drainage Area	Phosphorus Load – SPARROW (% of total to the Bay)	Phosphorus Load – L-THIA (% of total to the Bay)
Pigeon-Wiscoggin	10.4	12.6	18.7
Flint	15.4	21.1	17.4
Shiawassee	14.6	16.4	17.1
Cass	10.5	14.4	10.8
Chippewa-Pine	11.9	10.6	9.7
Tittabawassee	16.8	7.3	9.6
Kawkawlin-Pine	5.6	6.4	6.4
Au Gres-Rifle	11.9	4.1	5.7
Saginaw	2.9	7.0	4.6

Table 7. Comparison of modeled and sampling-based phosphorus loads for Saginaw Bay.

Year	Sampling-Based Load (metric tons/year)*	Modeled Load (metric tons/year)
1987	645	1,690 (SPARROW)
2001	803	687 (L-THIA**)

(* Adjusted to include tributaries outside the Saginaw River drainage basin.)
(** L-THIA does not include point source loads.)

Table 8. Comparison of point source loads predicted by the SPARROW model (for 1977-1981) and reported by NPDES-permitted dischargers (for 2008) in the Saginaw River subwatersheds.

River	SPARROW Predicted Load (Kg/yr)	WWTP Reported Load (Kg/yr)*	RTB Reported Load (Kg/yr)**
Pine	29,940	6,535	
Flint	176,229	42,659	
Cass	11,776	3,074	
Saginaw	75,302	24,981	1,697
Tittabawassee	41,771	13,424	363
Shiawassee	31,153	8,397	
Total Point Source Loads	366,171	101,130	

(* WWTP = Waste Water Treatment Plant)
(** RTB = Retention Treatment Basin [a.k.a. treatment facility for Combined Sewerage])

Figures

Figure 1. The 8-digit hydrologic unit codes (HUCs) making up the Sagniaw Bay drainage area.

Figure 2. Total phosphorus loads from the Saginaw River, 1974-2005.

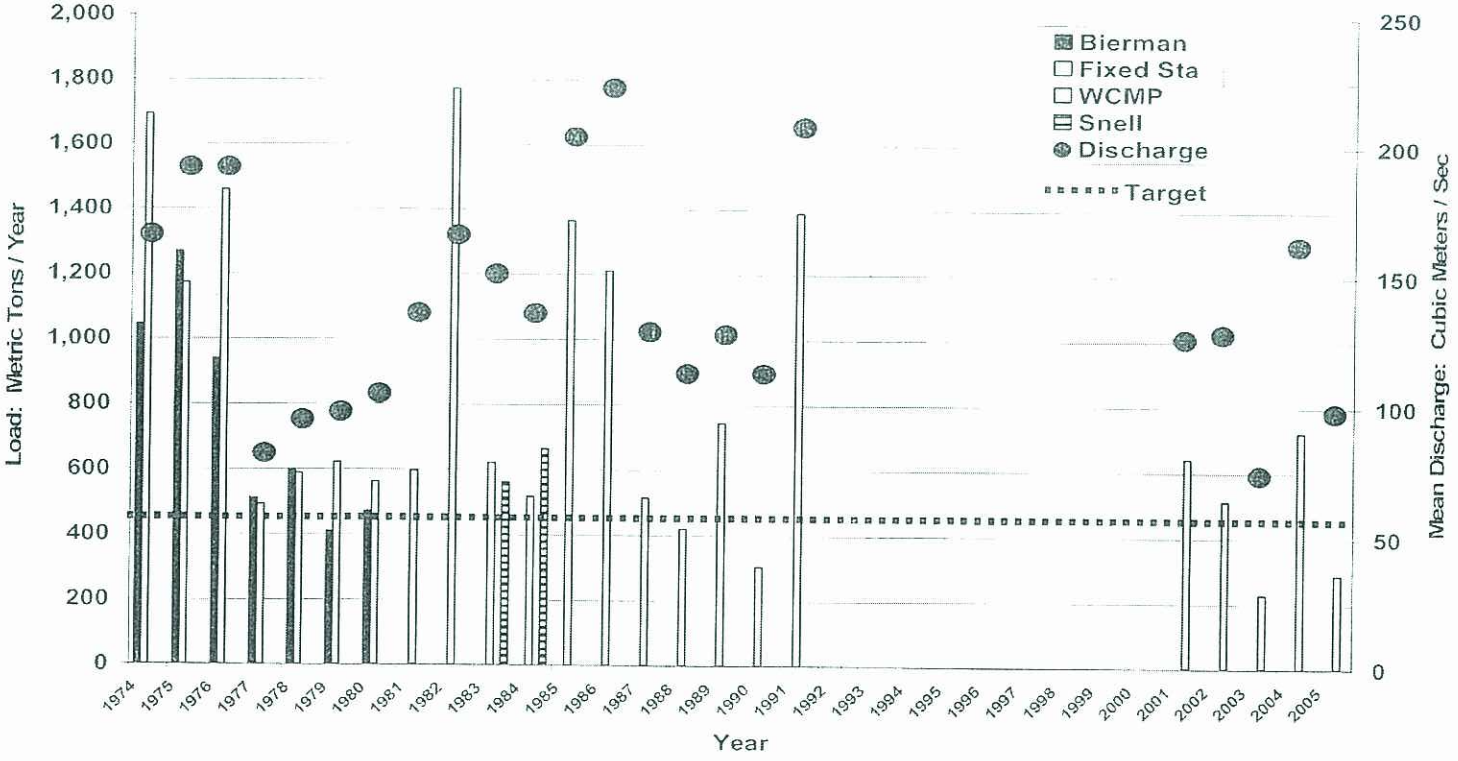


Figure 3. Correlation between Saginaw River discharge and total phosphorus load.

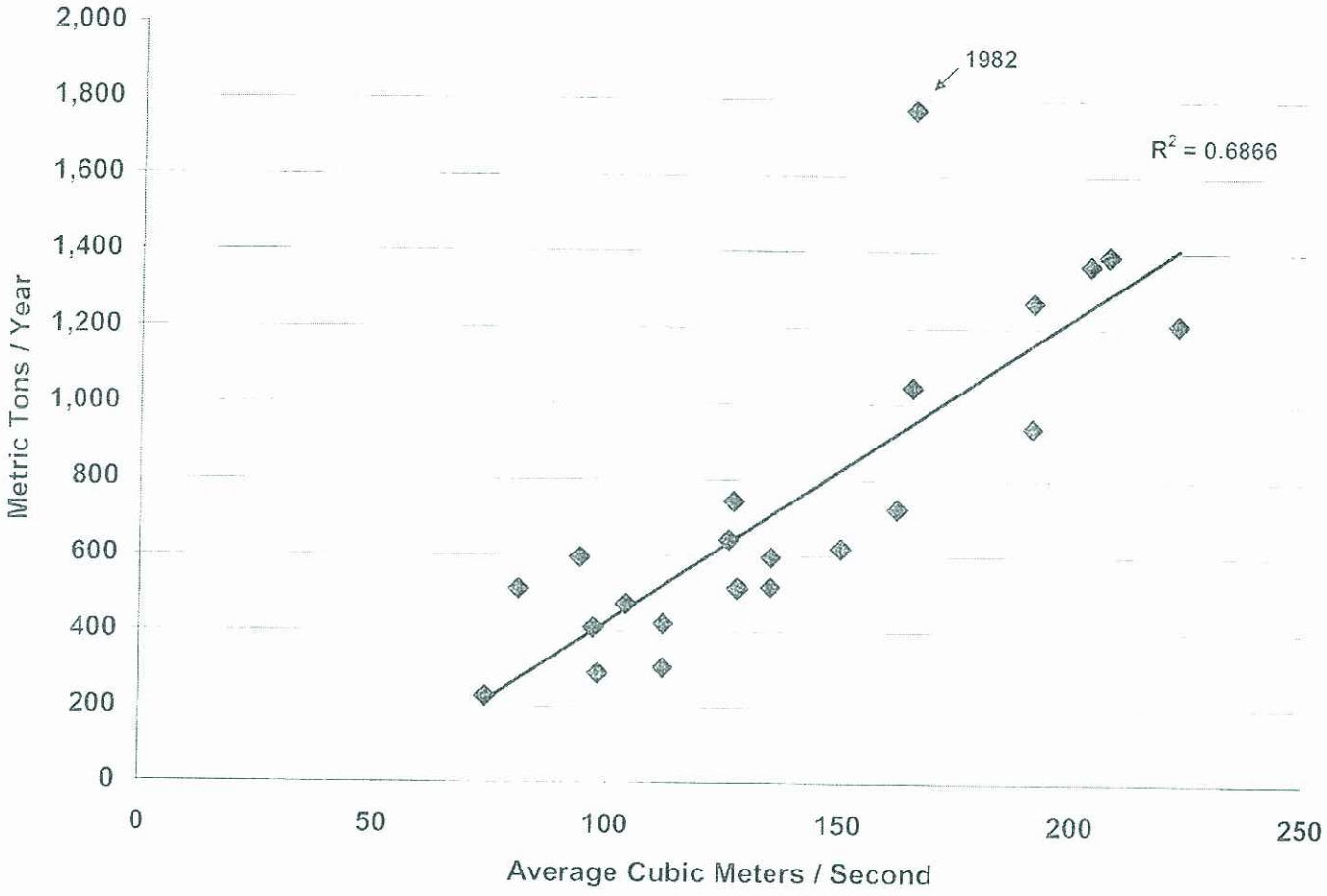


Figure 4. Trend in discharge-normalized phosphorus loads from the Saginaw River.

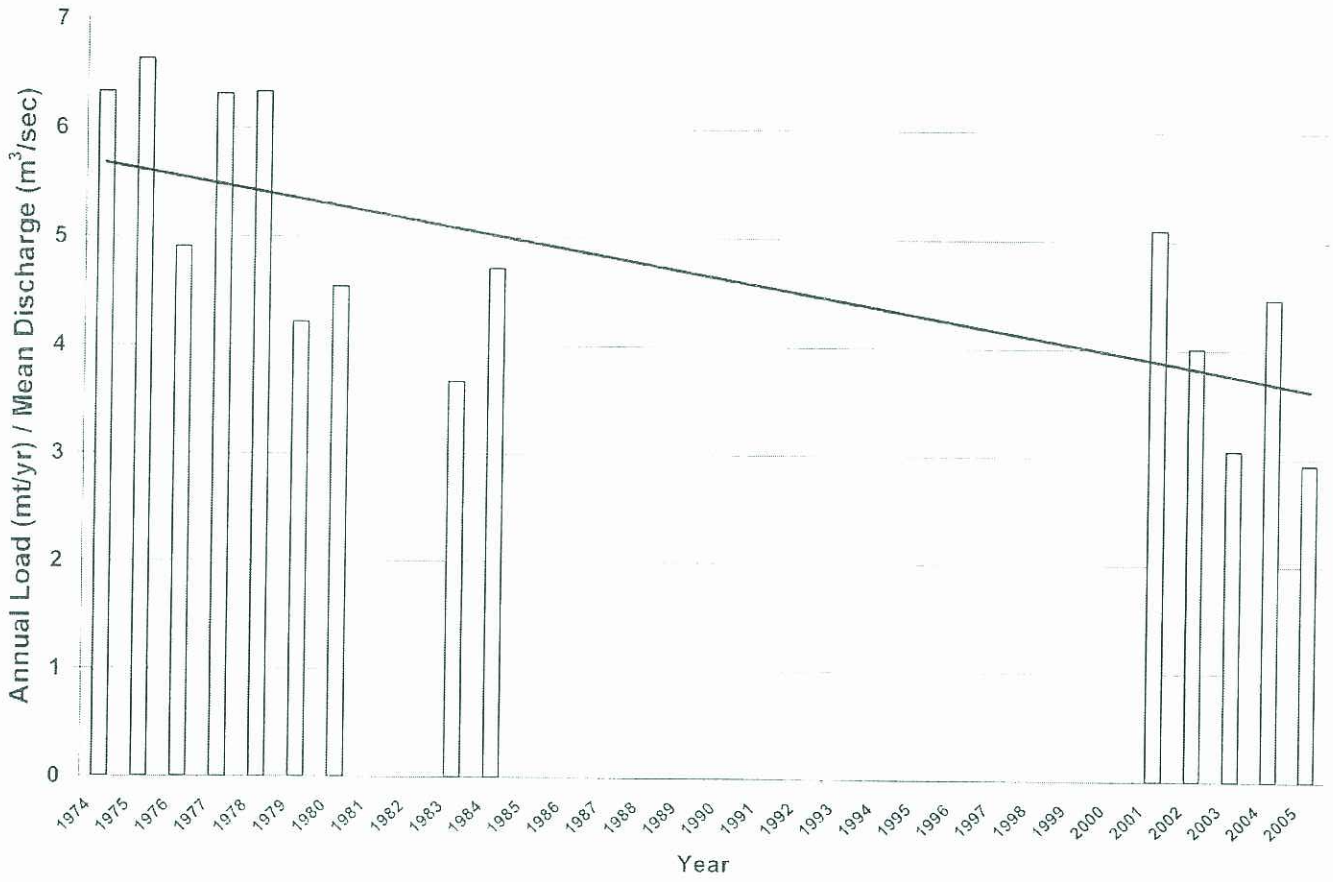


Figure 5. Phosphorus Loads (percent of total load) from different potential sources in the Saginaw Bay watershed, according to the SPARROW model.

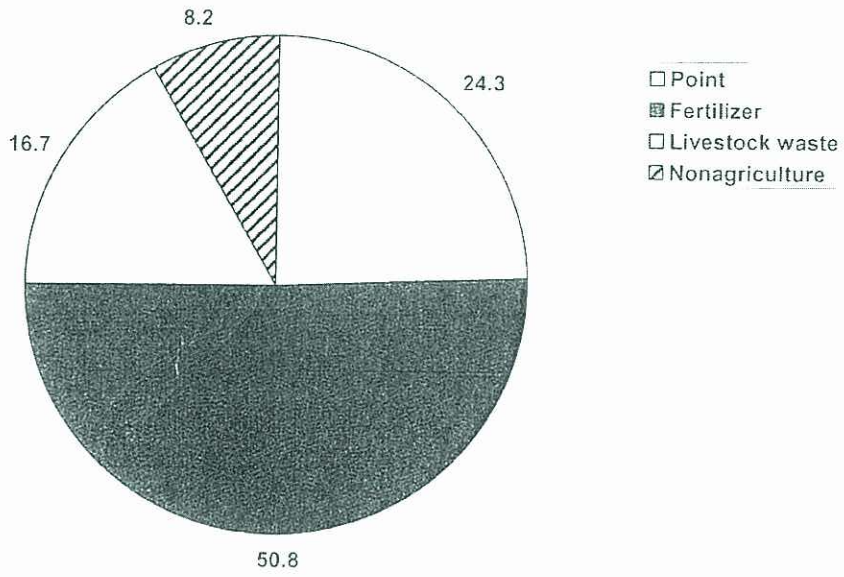
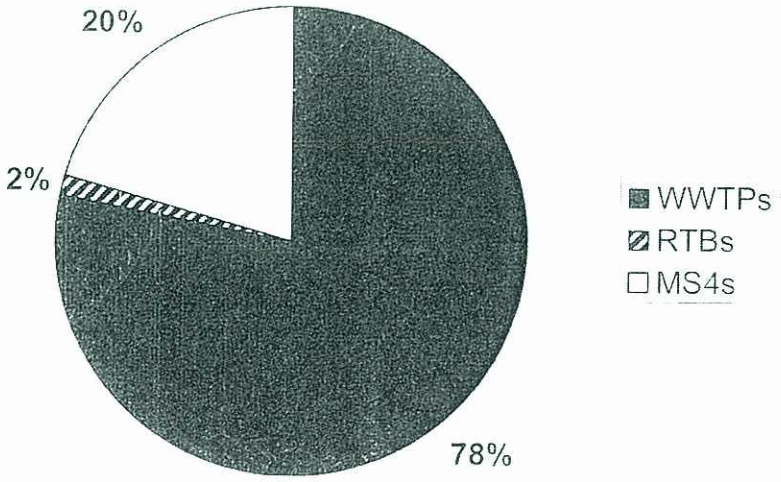


Figure 6. Relative contributions of phosphorus from waste water treatment plants (WWTPs), retention and treatment basins (RTBs), and MS4 storm water communities (MS4s) across the Saginaw Bay watershed to the total point source loads to the Bay. WWTP and RTB data are from the 2008 NPDES permit records; MS4 data are from the loads for commercial and high density land uses calculated by the L-THIA model, based on 2001 land use data.



Saginaw Bay Coastal Initiative
Phosphorus Committee Report

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Background

Phosphorus concentrations in Saginaw Bay water remain higher than anywhere else in Lake Huron. Generally, the Great Lakes are *phosphorus limited*, meaning that the amount of phosphorus determines the basic productivity of the lake. Higher levels of phosphorus support increased plant growth and greater productivity. This increased productivity due to phosphorus loadings from the Saginaw River and tributaries to Saginaw Bay, along with the introduction of zebra mussels, has led to development of substantial 'muck' along the Saginaw Bay shoreline that creates both an aesthetic and economic problem for area businesses and residents.

As part of the Saginaw Bay Coastal Initiative (SBCI), local opinion leaders identified the reduction of phosphorus entering Saginaw Bay as a high priority for them. Because the issue of phosphorus is extremely important to the water quality of Saginaw Bay, MDA Director Don Koivisto and MDEQ Director Steven Chester organized a committee to determine how local, state and federal interests can work together to identify voluntary measures that will reduce phosphorus in the Bay.

In March 2007, a statewide Phosphorus Policy Advisory Committee identified a number of findings and recommendations to control phosphorus on a statewide basis. In March 2008, the Saginaw Bay Phosphorus Committee was formed and asked to review those findings and recommendations, and determine how to translate those recommendations and other recommendations into actions in the Saginaw Bay coastal area. The Saginaw Bay Phosphorus Committee was charged to:

- Identify and evaluate key sources of phosphorus contributing to impacts on the Saginaw Bay.
- Develop recommended 'next steps' to address these sources of phosphorus.
- Identify next steps that can be taken with existing resources and identify potential funding sources for other potential efforts.
- Summarize the findings and recommendations of the Committee for local action.

History[1,2,3]

During the 1970s and 1980s, the Saginaw River added nearly two metric tons of total phosphorus per day to the bay, the largest contribution of phosphorus to the Great Lakes by any river in Michigan. The added phosphorus increased the growth of nuisance blue-green algae that was likely responsible for the foul odor and poor taste of drinking water withdrawn from the bay.

Control of phosphorus inputs was the principal pollution control strategy adopted under the 1972 Great Lakes Water Quality Agreement (GLWQA) between the United States and Canada. The Supplement to Annex 3 of the 1978 Great Lakes Water Quality Agreement specified a total phosphorus target load for Saginaw Bay of 440 tonnes per year. Three phosphorus loading objectives were developed for Inner Saginaw Bay. The primary criterion was taste and odor at the Whitestone Point Water Filtration Plant. Secondary criteria were filter-clogging and taste and odor problems at the Pinconning and Bay City Water Filtration Plants in the inner portion of the bay and the degree of degradation of the inner bay ecosystem.

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[1] State of Michigan Phosphorus Reduction Strategy for the Michigan portion of Lake Erie and Saginaw Bay, 1985.
[2] State of Michigan Phosphorus Reduction Strategy for the Michigan portion of Lake Erie and Saginaw Bay, 1991.
[3] "Phosphorus in Saginaw Bay have we met the target?" Fact Sheet. The Lake Huron Binational Partnership, 2006.

In 1976, the corrected base year load was determined to be 870 metric tonnes per year. The target load of 440 metric tonnes per year was established both because of the desired reduction in water supply taste and odor problems and because the level was realistically achievable. The recommended criterion of 0.015 mg/L as a spring areawide mean total phosphorus concentration represents the estimated 'in Bay" concentration when the 440 tonnes per year target has been met.

Saginaw Bay and the Saginaw River system were listed by the International Joint Commission, Great Lakes Water Quality Board (IJC 1981) as a Class A Area of Concern because of high levels of nutrient inputs and occurrence of toxic compounds in sediments, fish and gull eggs. The Great Lakes Water Quality Board stated that water quality had been degraded due to excessive nutrient inputs.

In October 1983, a supplement to Annex 3 of the GLWQA called for the development of phosphorus reduction plans for Lake Erie, Lake Ontario and Saginaw Bay. Because of this, in March, 1984, US-EPA and the states agreed that each state would prepare a phosphorus reduction strategy for its jurisdictional boundaries.

The State of Michigan strategy for attainment of the phosphorus reduction goals established in the supplement to Annex 3 consisted of two elements: 1) a point source reduction strategy; and 2) a non-point source reduction strategy. As a result of significant point source phosphorus reduction prior to 1982 and costs of further point source reduction, the emphasis of Michigan's strategy was on developing effective nonpoint programs. In 1991 it was concluded that Michigan had exceeded its phosphorus reduction goals for Saginaw Bay. The following recommendations were made to determine the impact of the phosphorus reductions on the basin: 1) Determine a nutrient budget for Saginaw Bay; and 2) Determine new phosphorus reduction goals for Saginaw Bay.

Soon after 1991, zebra mussels appeared in Saginaw Bay. Their presence is believed to have influenced the cycling of phosphorus in the Bay, and may be a cause for recent increases in algae wash-up on area beaches which has renewed concern regarding phosphorus loadings to the Bay.

Source Identification[4]

As part of the SBCI Phosphorus Committee effort, it was requested that MDEQ develop an evaluation of potential sources and related loadings of phosphorus to the Bay. Since, the loading of nonpoint source (NPS) phosphorus is believed to be one of the key contributing factors degrading the water quality of Saginaw Bay this was the focus of the evaluation.

NPS phosphorus loading

The relationship between land use and NPS pollution is well established and a number of simple models have been developed to provide rough estimates of the NPS loads associated with particular land uses. This analysis applies the Geographic Information System (GIS) version of the Long Term Hydrologic Impact Assessment and Nonpoint Source Pollution (L-

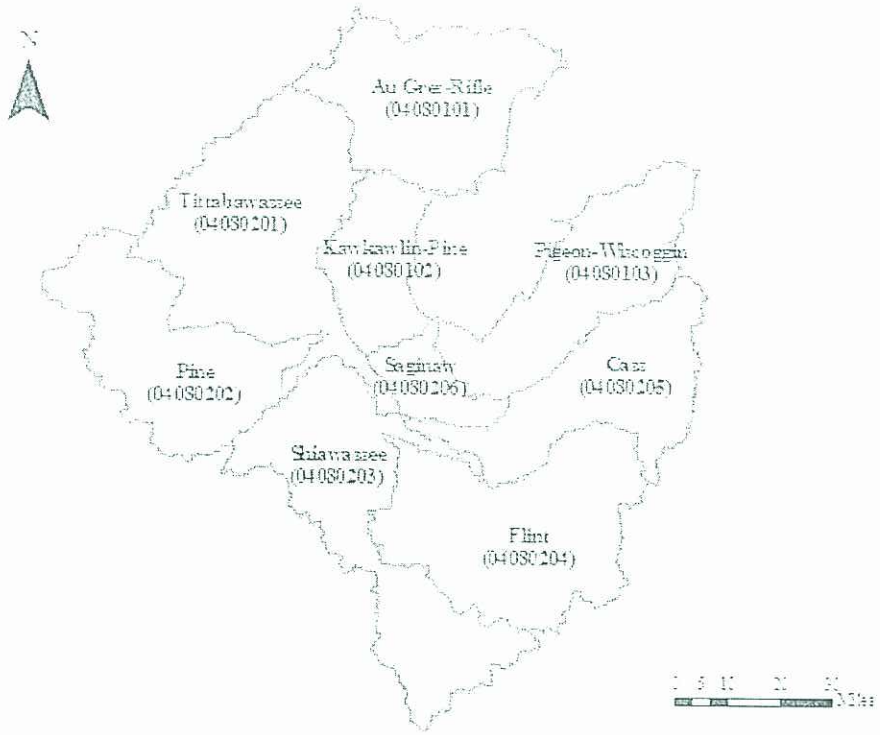
[4] "Using the LTHIA Model to Evaluate Nonpoint Source Loads of Phosphorus to Saginaw Bay", Peter Vincent – DEQ Water Bureau, 2009.

THIA NPS) model to the Saginaw Bay Watershed.[5] Approximation of the total phosphorus loads associated with six land use category is presented by each of the nine sub-basins (8 digit hydrologic unit codes, HUC) that constitute the Saginaw Bay Watershed.

Study Area

This analysis examined total phosphorus loads associated with the following nine sub-basin (8 digit HUC) within the Saginaw Bay Watershed: Au Gres-Rifle (04080101), Kawkawlin-Pine (04080102), Pigeon-Wiscoggin (04080103), Birch-Willow 04080104), Tittabawassee (04080201), Pine (04080202), Shiawassee (04080203), Flint (04080204), Cass (04080205), Saginaw (04080206), figure 1.

Figure 1.



Comparison of Phosphorus Loads by Sub-Basin within the Saginaw Bay Watershed

The L-THIA NPS model's estimate of total phosphorus derived from all sub-basins within the Saginaw Bay Watershed was approximately 1,514,100 pound a year. Table 1 shows the total phosphorus estimated from each sub-basin. The Pigeon-Wiscoggin, Flint and Shiawassee sub-basins are the largest producers of NPS total phosphorus respectively, these three sub-basins account for approximately 53 percent estimated by the model. When normalized by area the Pigeon-Wiscoggin and the Saginaw total phosphorus load per acre is larger than the other sub-basins. The normalized loads from the Shiawassee, Flint, Kawkawlin-Pine, and the Cass Watersheds are comparable.

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[5] Engel, B. A. and Harbor, J. (revised 2005). Long-Term Hydrologic Impact Assessment and Non Point Source Pollutant Model User Manual Version 2.3. Purdue University.

Table 1: Total Phosphorus Load by Sub Basin

Sub-Basin Name	Sub-Basin HUC Number	TP Lbs/Year	Percent of Total Load	Acres	TP Normalized by Area (LBS/Acres)
Pigeon-Wiscoggin	4080103	283,017	18.7%	576,505	0.49
Flint	4080204	263,430	17.4%	850,997	0.31
Shiawassee	4080203	259,653	17.1\	809,445	0.32
Cass	4080205	164,129	10.8%	580,807	0.28
Chippewa-Pine	4080202	146,590	9.7%	655,868	0.22
Tittabawassee	4080201	145,345	9.6%	925,689	0.16
Kawkawlin-Pine	4080102	96,261	6.4%	310,565	0.31
Au Gres	4080101	86,466	5.7%	655,594	0.13
Saginaw	4080206	69,208	4.6\	160,696	0.43
Total		**1,514,102**			

Modeling Results by Land Use Category for the Saginaw Bay Watershed

The total phosphorus load for the Saginaw Bay Watershed is presented by the six land uses categories used in this analysis, table 2. This modeling exercise found agricultural land to account for approximately 90 percent of the total phosphorus load. Low density residential lands, high density residential lands, and commercial lands account for the majority of remaining 10 percent. When normalized by area commercial and high density residential lands have a higher load per acre.

Table 2: Total Phosphorus Load by Land Use Category

Land Use	TP Lbs/Year	Percent of Load	Acres	Percent of Area	Normalized by Area (lbs/acres)
Agricultural	1,365,222	90.2%	2,486,820	45.0%	0.55
Commercial	16,586	1.1%	20,915	0.4%	0.79
Forest	1,400	0.1%	1,196,617	21.7%	0.00
Grass/Pasture	613	0.04%	327,201	5.9%	0.00
HD Residential	40,667	2.7%	58,670	1.1%	0.69
LD Residential	89,612	5.9%	561,603	10.2%	0.16
Water/Wetland			874,149	15.8%	
Total	1,514,102		5,525,978.79		

Point Source Phosphorus loading

The 1991 Michigan Phosphorus Reduction Strategy Update estimated that approximately 50 percent of the phosphorus loading to Saginaw Bay was from point sources. A 2002 Update of the Saginaw River Bay Remedial Action Plan notes that municipalities in the Saginaw Bay

Watershed have invested over $700 million since 1972 to improve wastewater treatment facilities resulting in an estimated reduction in municipal phosphorus loads of approximately 80-90 percent. A recent estimate derived from using the SPARROW model approximates the total phosphorus load from point sources to the Saginaw Bay at about 29 percent.

DEQ Water Bureau is currently evaluating phosphorus loading to Saginaw Bay from point sources. The National Oceanic and Atmospheric Administration also is evaluating phosphorus loading to Saginaw Bay from various sources. These current studies will provide a much more accurate picture of phosphorus sources in the Saginaw Bay Watershed.

Recommendations

In order to gain a better understanding of phosphorus impacts on Saginaw Bay, the SBCI Phosphorus Committee held several meetings to hear from technical experts including: NOAA, DEQ, MDA, Michigan United Conservation Club (MUCC), Farm Bureau, United States Department of Agriculture (USDA), Conservation Districts, Michigan Sugar Company, Bay City Wastewater Treatment Plant, and South East Michigan Council of Governments (SEMCOG). In addition to these presentations, the committee representation included technical experts covering agricultural, urban, and point sources of phosphorus.

To comprehensively address the phosphorus source control issues, the Committee formed three workgroups focused on source reduction: an Agriculture Phosphorus Pollution Prevention (P3) Workgroup; a Stormwater Phosphorus Workgroup; and a Point Source Phosphorus Workgroup. These subcommittees were charged with developing reduction strategies for each of these source areas.

The recommendations below are divided by: SBCI Phosphorus Committee and Source Reduction Workgroups. The Committee recommendations address over-arching needs regarding further evaluation of phosphorus impacts on Saginaw Bay, the Workgroup recommendations outline specific next steps to implement phosphorus reduction strategies for the various source areas.

SBCI Phosphorus Committee

After review of existing information regarding phosphorus sources and loadings to Saginaw Bay, the Committee recommends the following actions to further evaluate phosphorus impacts in Saginaw Bay:

1. MDEQ in cooperation with local interests, develop specific and attainable phosphorus goals for the Saginaw River and for Saginaw Bay.
2. MDEQ in cooperation with local interests develop a Saginaw River and Bay Phosphorus Strategy to meet the newly defined goals. While the recommendations in the attached report are a starting point for action, it is anticipated that additional measures may be necessary to achieve the new phosphorus goals.
3. MDEQ should determine phosphorus loadings from direct tributaries to Saginaw Bay and this information should be incorporated into the Phosphorus Reduction Strategy for Saginaw Bay.
4. MDEQ should coordinate with the Saginaw Bay multi-year study being conducted by the National Oceanic and Atmospheric Administration (NOAA) as well as other on-going monitoring efforts to facilitate the development of the above goals. However, this does not mean that development of the above goals and implementation of the Phosphorus Reduction Strategy for Saginaw Bay should be delayed until completion of the NOAA study.

Source Reduction Workgroups

Agricultural Phosphorus Pollution Prevention(Ag P3) Workgroup

As part of the larger effort, an agriculture phosphorus pollution prevention workgroup was formed to identify actions that could be taken to reduce phosphorus from agricultural sources. The workgroup evaluated both livestock and cropping potential concerns. The recommendations which follow are a combined effort from Michigan State University Extension (MSUE); MDEQ; Michigan Agriculture Environmental Assurance Program (MAEAP); Conservation Districts; agribusiness and individuals.

All operations, regardless of size, should be good stewards of the environment. All operations need to comply with current regulations (ex. no discharges into waters of the state). This heightened awareness of the phosphorus impact in Michigan's surface waters and the need for practical and economic recommendations in the agricultural sector is addressed by local, state, and federal partners. The overall goal of the subcommittee is cost-efficient management. Recommendations to evaluate and implement programs may reduce phosphorus loading into our state's surface waters.

The subcommittee did not feel it is appropriate to prioritize between cropping and livestock because they are both of great importance and differ. Below are recommendations divided into cropping and livestock systems. Recommendations are listed **within cropping** and **within livestock** systems in priority order.

Definitions:
BMP – Best Management Practice
CAFO – Concentrated Animal Feeding Operation: as defined by EPA (see Appendix A)
CNMP – Comprehensive Nutrient Management Plan
GAAMP – Generally Accepted Agricultural Management Practice
Hobby Farm – non-commercial operations (ex. not for profit or those operations not filing Schedule F Federal tax return)
MAEAP – Michigan Agriculture Environmental Assurance Program
MDA – Michigan Department of Agriculture
MFB – Michigan Farm Bureau
MSUE – Michigan State University Extension
NPDES – National Pollutant Discharge Elimination System
NRCS – Natural Resource Conservation Service
Small and medium size farm – commercial operation less than CAFO size
USDA – United States Department of Agriculture

Cropping Systems

1. Develop consistent nutrient recommendations, specific to the Saginaw Bay area, supported and promoted by all groups providing direction for farmers.

Discussion: Currently, groups providing support for farmers on nutrient recommendations are not presenting a consistent message. Nutrient recommendations need to be updated specific to crops grown in the Saginaw Bay area, providing a consistent message to farmers regarding fertilizer application.

2. **Provide incentives to promote on-farm conservation demonstrations in cooperation with producers and agribusinesses.**

Discussion: Funding this recommendation encourages agribusinesses to develop a conservation partnership and jointly support a program to conduct on-farm demonstrations. Conducting on-farm comparisons of management practices is one of the most effective ways to convince producers to adopt management changes. It is important that conservation messages come to producers from a partnership of key business community stakeholders, for example implement dealers, agronomy consultants, lenders, commodity groups, etc.

3. **Promote cover crops for control of wind erosion; allow more flexibility to adapt other wind erosion control practices to match specific site conditions.**

Discussion: Wind erosion is a significant source of sediment containing phosphorus to the Saginaw Bay. A MDNR 1988 study estimated wind erosion resulted in greater than five million metric tons of the soil erosion, accounting for 63% of the total soil erosion in the Saginaw Bay Basin. Cover crops provide the best protection against wind erosion and should be promoted. Other options to address wind erosion (such as wind breaks and filter strips) should be evaluated. The funding agencies, such as USDA, NRCS, conservation districts, etc., should have practices with more flexibility for site specific conditions leading to wider adoption.

4. **Purchase and maintain research farms in the Saginaw Bay area to demonstrate various management practices and evaluate their effectiveness under different cropping systems.**

Discussion: Since the early 1990's, MSU Extension, Huron Conservation District, and Tuscola Conservation District in cooperation with area farmers have successfully conducted demonstration research plots to evaluate the benefits of various conservation practices and cropping management systems. This research has been funded through grants and has had a positive impact encouraging conservation tillage in the Saginaw Bay area. The funding sources for demonstration plots are not permanent. This recommendation is to provide funding for the purchase and maintenance of Saginaw Bay area research farms to establish permanent demonstration sites. Research priorities should have local input and oversight.

5. **Develop and promote a range of options to achieve a minimum vegetative setback from all drains, creeks, rivers, and lakes.**

Discussion: Farming to the edge of drainage ways occurs in the Saginaw Bay area. Providing a vegetative setback between the drainage way and the agricultural production area would reduce the likelihood of erosion and overspray from fertilizer and pesticide applications. Current programs promoting these types of practices have requirements that limit the widespread adoption of vegetative setbacks. The funding agencies, such as USDA, NRCS, conservation districts, etc., should have practices with more flexibility for site specific conditions leading to wider adoption.

6. **Establish the Saginaw Bay area as Michigan's agricultural subsurface tile drainage research area for water quality.**

Discussion: The Saginaw Bay area provides a unique research area to study the effect of agricultural tile and drainage on water quality. It is recommended that resources be provided to MSU to establish an agricultural drainage research and education program similar to the

University of Minnesota's (http://d-outlet.coafes.umn.edu/education.html#educationlinks) or The Ohio State University's (http://www.ag.ohio-state.edu/%7Eagwatmgt/).
Special note: Insure there are no unlawful septic drain connections to agricultural tile drainage prior to any research.

7. Promote GPS and/or zone soil sampling and testing along with fertilizer application to develop accurate baseline for nutrient levels and apply fertilizers based on this information.

Discussion: This recommendation will reduce input costs for fertilizer by accurately identifying and applying nutrients only where needed. It will reduce P levels by only applying to crops what is necessary to achieve realistic yield goals.

While there can be cost savings to accurately applying fertilizers through means of GPS technology, currently many farmers are concerned about costs associated with GPS soil testing and fertilizer application. Demonstrations and grant funding are needed to offset costs to overcome this barrier for adoption of GPS technology.

8. Demonstrate erosion control best management practices (BMPs) to stabilize temporary v-ditches cut for field drainage.

Discussion: A majority of the Saginaw Bay area soils are poorly drained. Farmers cut v-ditches to drain water from low areas in their fields to the nearest ditch or drain to reduce crop damage. V-ditches are not stabilized and can contribute sediment containing phosphorus directly to nearby waterways. Since v-ditches are temporary measures for storm water relief, the problems encountered are very similar to construction storm water. This recommendation is to demonstrate how construction storm water control practices may reduce the risk of sediment discharges from these temporary v-ditches.

9. Promote innovative, environmentally sound drainage ditch design, construction and maintenance in the Saginaw Bay area. This should be coordinated with the North East District of Michigan County Drain Commissioners (includes: Arenac, Bay, Genesee, Gladwin, Huron, Lapeer, Midland, Saginaw, Sanilac, Shiawassee, St. Clair, and Tuscola counties).

Discussion: Many of the waterways in the Saginaw Bay area are designated county drains established to manage water flow. Design, construction and management of these drains in an environmentally sound way could substantially reduce sediment containing phosphorus into the Saginaw Bay. Current drain law and code do not provide many opportunities to work on water quality projects; however coordination of environmental programs and grants with drain projects can provide a process to accomplish both water quantity and quality management. Coordination with the North East District of Michigan County Drain Commissioners will provide greater opportunity to develop a strong working partnership between drain commissioners and environmental programs.

Livestock Systems

Small/Medium Size Farms

1. **Provide funding for Conservation District livestock specialist positions in the Saginaw Bay area to focus on technical assistance to small and medium size livestock operations.**

Discussion: Conservation Districts provide much of the on-farm technical assistance to producers regarding management practices in the Saginaw Bay area. One-on-one assistance with farmers is necessary for implementing best management practices. Conservation District technicians are knowledgeable about the USDA cost share programs and assist farmers with the administrative and technical issues. Additional local technical assistance would result in environmental improvement through greater participation in programs such as the Michigan Agriculture Environmental Assurance Program (MAEAP).

2. **Develop "common sense" standards and solutions that provide low cost, flexible alternatives to address operational problems.**

Discussion: Often federal and state cost-share programs require more comprehensive and expensive solutions than are necessary to resolve simple problems. While cost-share programs exist to address some of the management issues on the farm, these programs often require a long-term commitment and substantial capital outlay. To receive funding, additional issues beyond the immediate practice must be addressed in conjunction with the desired practice. Many of these programs have substantial administrative and process oversight (i.e. application, engineering review, etc.) creating a reluctance, including financial obstacles, for many farmers to participate. Comprehensive farm management planning is an excellent concept; however, in order to achieve an immediate environmental improvement, the process must be streamlined to allow for implementation of practical, low-cost practices. Building flexibility into these cost share programs and offering more options would lead to a greater acceptance and implementation by producers.

3. **Promote the simple message "No runoff – No discharge" through an outreach program targeted to non-permitted (NPDES) small and medium size livestock operations.**

Discussion: Small and medium size livestock farms have diverse operations and management practices. Some of the challenges identified are as follows: age of farmer (pending retirement and not willing to adopt best management practices); storage (expensive for small/medium operations); and short-term timeframe to recapture costs associated with improvements. A simple message, "No runoff – No discharge," should be universally and consistently promoted by all agencies and organizations. The intent is to establish a minimum implementation level for every livestock farm operation in the Saginaw Bay area.

4. **Identify non-traditional approaches to conduct educational outreach to small and medium size livestock operations.**

Discussion: Because of the diversity in management approaches on small and medium size operations, it is difficult to develop a standard educational outreach program with wide appeal. Traditional approaches have had limited effectiveness. To attain broader acceptance and implementation of best management practices, it will be necessary to identify, implement, and evaluate non-traditional approaches.

Hobby Farms

5. Develop a summary report of local ordinances related to livestock within the Saginaw Bay area to provide information and education on existing local ordinances and the Right to Farm Act.

Discussion: Local ordinances exist to regulate the number of livestock a landowner can have per the area owned. Many residents are not familiar with these ordinances. Ordinances and their enforcement vary between governmental units. The Right to Farm Act preempts any local ordinance, regulation or resolution that purports to extend or revise in any manner the provisions of this act or generally accepted agricultural and management practices developed under this act. A grant should be utilized to support an education/outreach program on nutrient management, targeting hobby/small livestock facilities in the Saginaw Bay area.

6. Develop an outreach and education program targeting hobby farms regarding appropriate manure management practices and utilization.

Discussion: In field surveys of area watersheds, hobby farms, particularly farms with only a few animals, have discharges as a result of poor manure management practices. Hobby farms have very different operational needs than production livestock operations. Recognizing hobby farms as a specific target group and promoting sound manure management practices to them should effectively address a majority of these discharges. MDA and MSU Extension are implementing outreach and education programs to these types of farms, and coordination with their efforts will provide a good initiation point for a more intensive regional effort.

Concentrated Animal Feeding Operations

7. Farms accepting manifested manure should have a nutrient management plan with appropriate setbacks; identification of environmentally sensitive areas; and application timing.

Discussion: CAFOs generally manifest a majority of their manure to land owners for application to nearby fields. A NPDES CAFO permit requires a Comprehensive Nutrient Management Plan (CNMP) to outline how and where they will apply manure. Proper land application of manifested manure, including appropriate setbacks; identification of environmentally sensitive areas; and application timing, etc., is not required to be documented. To provide reasonable assurance to the surrounding community, farms accepting manifested manure should develop and implement nutrient management plans that minimize discharge and runoff.

8. Develop an education and certification program for manure applicators, specifically targeting the individuals directly applying manure to the fields.

Discussion: Many custom applicators receive training and continuing education; however, employees directly applying manure to fields do not receive sufficient training to ensure that manure application aligns with the recommendations in a CNMP or NMP. Training employees is essential to provide environmentally sound manure application. A training program should be developed for the manure applicators and their employees providing a basic awareness of discharge and runoff issues.

9. **Promote farms that have implemented sound environmental practices which positively contribute to the surrounding community.**

Discussion: Many farm operations properly manage their manure and have invested in their facilities to achieve sound environmental standards. These positive efforts should be recognized and promoted within the agricultural and local community. It is important to acknowledge that, like other businesses, farms provide jobs and contribute to the local economy.

Manure Utilization

10. **Promote the value and alternative uses of manure.**

Discussion: Manure is becoming much more valuable. Due to the increase in cost of commercial fertilizer, the value of manure has become similar to a commodity. Ensuring that this message is promoted and alternative use options are made readily accessible will provide for better management of manure. Utilization of manure value calculators are available at: http://animalagteam.msu.edu/LandApplication/ManureValueCalculators/tabid/250/Default.aspx.

11. **Update regulations regarding waste management to incorporate "green" technologies.**

Discussion: Waste management regulations were originally developed primarily to address industrial waste streams. Regulations should be re-evaluated to determine how to actively support green technologies, such as anaerobic digesters and composting facilities using co-mingled waste. A workgroup should be formed to draft recommended changes to waste management laws that will encourage green technologies.

12. **Support the Huron Economic Development Council's efforts at developing regional anaerobic digesters for manure and other wastes.**

Discussion: Several years ago, the Huron County Economic Development Corporation (EDC) began to evaluate how they could assist our agricultural industry in economic development projects. One key area that they began to explore was the development of alternative energy related to farms and agriculture. The EDC focused on anaerobic digesters for several reasons. First the basic technology is well understood. Second, there is a significant amount of feedstock, (i.e. manure) for the digesters. Third, digesters could address several issues related to manure and nutrient management on our local farms. The EDC conducted a base line study of several farms in the area, the Lusk Study, to determine implementation issues. The report indicated that digesters could have an impact on farms but the payback was not quick and the farms were not interested in owning and managing what is basically an alternative energy company. The EDC has continued to pursue this track but focused on a large scale, "community" digester that could include several farms and other feedstocks. This has been a long term effort for the EDC.

Currently the EDC is reviewing the qualifications of and interviewing several companies that could be interested in developing a state of the art, community digester in Huron County. The successful company will then begin the process of developing an anaerobic digester, (community scale), meeting with local farms, determining DEQ permitting requirements and utilization of final products. It is anticipated that this process will take 6-8 months ending with the site selection of the digester, all of the required permits, contracts with farms for feedstock, up take contracts for electricity and natural gas and off take solutions for the digested manure.

13. Develop a commercial composting facility for bodies of dead animals and manure in the Saginaw Bay area.

Discussion: Currently there are extremely limited ways to dispose of bodies of dead animals. In the Saginaw Bay area, no landfills accept bodies of dead animals, no rendering options are available, and burial during winter months is not practical. Current legislation does not allow for the co-mingling of bodies of dead animals or manure. Composting is a beneficial way of utilizing various waste streams. Dead animals, both livestock and road kill, pose a hazard when improperly disposed. A commercial composting facility would allow livestock owners to properly dispose of dead animals and manure.

14. Support a link for a Saginaw Bay area manure brokering website. Potentially expand the existing MSU Extension website: http://web2.canr.msu.edu/manure/

Discussion: Provide farmers access to information about where they can buy and/or sell manure. MSU Extension has established a manure brokering website that could be tailored for expanded use in the Saginaw Bay area.

15. Evaluate the Genesee Power model for horse and other manures and explore expanding local collection points.

Discussion: Genesee Power is currently taking horse manure from area farms to convert to energy. Investigating this model may provide another option to address manure utilization in the Saginaw Bay area.

Livestock Exclusion

16. Promote a consistent, simple message "Keep livestock out of waterways."

Discussion: Keeping livestock out of the water is the best way to ensure there is minimal sediment, nutrient, or fecal discharges from these animals into the nearby streams, creeks, drains, rivers, and lakes. A brochure *Acceptable Practices for Managing Livestock Along Lakes, Streams, and Wetlands*, compiled by MDEQ; MDA; MSU Extension; and the United States Department of Agriculture (USDA), NRCS is a resource for information. MSUE Bulletin No. E-3066.

Phosphorus Feed Management

17. Promote the use of a mass balance approach for including phosphorus in livestock diets.

Discussion: Phosphorus is one of the most expensive supplemented mineral in livestock feeds. Most grains used in animal diets (corn, wheat, soybeans) store as much as 80-90% of the total P in the form which is unavailable for uptake by swine (monogastric digestive systems). Use of phytase, a commercially available enzyme, in monogastric diets increases the availability of phytate-bound P, reducing the need for supplemental inorganic P, and resulting in a reduced total P load in manure. We encourage the use of phytase in swine diets and support continued research that allows for the improvement of P utilization among livestock. Additionally, with drastic increases in input costs for livestock producers, many require utilizing co-products, such as distiller's grain, in livestock feeds. Some of these co-products contain concentrated amounts

of P. Livestock producers need to eliminate additional sources of P in the diet to minimize the amount of P being excreted in manure. We support educational and research efforts that help producers and nutritionists include the minimum amount of P necessary into livestock diets.

Ag P3 Workgroup Summary:

The recommendations outlined above must be implemented to reduce phosphorus discharges into surface waters of the Saginaw Bay area. Many resources have to join forces in order to implement these recommendations utilizing science-based information and emphasizing cost-effective management practices. Table 3 provides an initial implementation strategy for the Ag P3 workgroup recommendations.

The recommendations below require immediate and substantial commitment and financial support from MDA, MDEQ, MSUE, NRCS, Conservation Districts, agribusiness, individuals, and other groups to put into action.

- Develop consistent nutrient recommendations, specific to the Saginaw Bay area, supported and promoted by all groups providing direction for farmers.
- Provide funding for Conservation District livestock specialist positions in the Saginaw Bay area to focus on technical assistance to small and medium size livestock operations.
- Develop "common sense" standards and solutions that provide low cost, flexible alternatives to address operational problems.
- Update regulations regarding waste management to incorporate "green" technologies.
- Purchase and maintain research farms in the Saginaw Bay area to demonstrate various management practices and evaluate their effectiveness under different cropping systems.
- Establish the Saginaw Bay area as Michigan's agricultural subsurface tile drainage research area for water quality.

All operations, regardless of size, should be good stewards of the environment. Verification of operations through MAEAP (in any and all of the three systems – Cropping, Livestock, and Farmstead) encompasses several components of the recommendations in this document. We strongly encourage increased participation in MAEAP in the Saginaw Bay area.

Stormwater Phosphorus Workgroup

As part of the larger effort, a Stormwater Phosphorus Workgroup was formed to identify actions that could be taken to reduce phosphorus from urban pollution sources. This workgroup identified three key areas where actions may result in significant reductions in phosphorus loads to Saginaw Bay: 1) Septic systems; 2) Low impact development (LID); and 3) Improvements in stormwater regulations.

Septic Systems

If properly designed and maintained septic systems provide an excellent way to treat wastewater. However, where septic systems are inadequately designed or maintained discharges from these systems can contribute phosphorus and bacteria to nearby streams and lakes. In order to ensure appropriate oversight and functioning of these systems, the following actions are proposed:

1) **Education –**
   Many people view septic systems as wastewater disposal instead of wastewater treatment. It is important to educate homeowners on how septic systems work and how to properly maintain them.

- Establish outreach program utilizing readily available resources targeted to homeowners.

2) **Data Management**:
Septic systems have been used for wastewater treatment in the United States since the 1880s. The permitting system in Michigan for septic systems was standardized in the 1970s. There are many septic systems that were installed prior to this permitting process and therefore are not effectively tracked. Additionally, as the permitting process and sanitary codes developed, information collected for the design and construction of these systems changed leading to variation in available information.

It is critical that information collection and retrieval be standardized, comprehensive, and easily accessible. The recommendations below will help to establish this process:

- Resolution recommending a specific data management system to standardize on statewide basis.
- Demonstrate value of selected data management system to other counties in the Saginaw Bay Watershed through the Kawkawlin River Watershed project.

3) **Develop model local ordinance**:
A model local ordinance should be developed to achieve standard level of septic system inspections and maintenance and create resolution to encourage counties in the Saginaw Bay Watershed to adopt it. Sanitary codes in other surrounding counties will be reviewed to evaluated existing provisions. A matrix of this information will be developed to assist in developing the model code. The following issues will be evaluated for possible inclusion in the ordinance:

- Point-of-Sale Inspections - Inspections mandated by LHDs or the local governing body at the time of home sale have been established in a number of counties statewide. In general, a point of sale approach is opposed by realtors, but would have general support of LHDs if promulgated with flexibility.

- Change In Use Inspections - As a condition of issuance of a building permit for modifications to an existing home, some LHD jurisdictions require a review of the existing on-site wastewater system by the LHD. The overall average frequency of inspection resulting from this approach is unknown.

- Mandatory Inspection/Reporting at the Time of Maintenance Event - Statute requiring the inspection /reporting at the time of pumping of the septic tank or other maintenance event would result in inspection of a significant number of systems. This general approach has been implemented as part of the state of Wisconsin administrative code along with a requirement that all systems be inspected for evidence of surface ponding every 3 years and that newly permitted systems include a management plan.

- Alternative System Guidance – identify a central site(s) for common guidance on alternative systems.

- System age – Systems over a certain age (25 years) should be required to have a regular inspection.

- Dwellings without approved permit – Existing dwellings without an approved septic system permit should be required to have an inspection.

- Onsite sewage treatment language – need to change onsite disposal to onsite treatment in ordinance to reflect the need for ongoing maintenance.

- Annual Septic System Community Report – An annual report should be required to report on the effectiveness of onsite sewage treatment throughout the community.

4) Financing –
One or the critical challenges to effectively addressing septic system problems is providing access to funding for homeowners and municipalities. While funding sources are available for much of this work currently, the actions below are recommended to make this funding more easily accessible:
   - Low interest loans – Outline local program that would provide zero to low interest loans to homeowners. Need to establish clear technical and financial criteria.
   - Evaluate State and/or local funding (loan/grant) for addressing septic system issues.
   - Resolution to support local programs and/or modifications to State funding programs to address septic system issues.

5) Partnerships –
While the County Health Departments provide the principal oversight of septic systems, other local agencies and organizations play a critical role in assisting the Health Departments in identifying and correcting failing systems.

   It is recommended that partnerships be established between local Health Departments and other local agencies and organizations, and that a model inter-agency process to identify and address septic system failures be developed. Partners would include:
   - Drain Commission
   - Road Commission
   - Local Townships and Municipalities (including planning commissions, building departments, and local elected officials)
   - Realtors
   - Homeowners Associations
   - Home builders Associations

Low Impact Development (LID)

Low Impact Development (LID) is an innovative stormwater management approach with a basic principle that is modeled after nature: manage rainfall at the source using uniformly distributed decentralized micro-scale controls. LID's goal is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Techniques are based on the premise that stormwater management should not be seen as stormwater disposal. Instead of conveying and managing/treating stormwater in large, costly end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small, cost-effective landscape features located at the lot level. These landscape features,

known as Best Management Practices (BMPs), are the building blocks of LID. Almost all components of the urban environment have the potential to serve as a BMP. This includes not only open space, but also rooftops, streetscapes, parking lots, sidewalks, and medians. LID is a versatile approach that can be applied equally well to new development, urban retrofits, and redevelopment/revitalization projects.

The following recommendations outline actions in the Saginaw Bay Coastal Area to promote the implementation of LID:

1. **Promote LID Best Management Practices (BMPs) Manual and the Filling the Gaps manual developed for Michigan.**
    - Provide a conduit of communication to professional designers, planners, municipalities, counties and other agencies in a position to implement this manual in the region.

2. **Combined Sewer Overflow (CSO) / Low Impact Design (LID) Drainage district grant project.**
    - Completion of grant project and release of results.
    - Support the public education portion of this project.

3. **Provide a model LID ordinance with a resolution to adopt the ordinance.**
    - Remove obstacles for Low Impact Design in the region.
    - Review existing ordinances in the country and state to develop a model ordinance.
    - Meet with regional, county and municipal planners to determine implementation strategy for Saginaw Bay Region.
    - Provide educational opportunities for planning commissions to introduce the LID concept in order to facilitate change.

6. **Develop LID Outreach Strategy**
    - Develop strategic partnerships with professional regional, state and national organizations to promote LID (Landscape contractors, Michigan Nursery Landscape Association, Turfgrass Association, Professional Associations, MSU Cooperative Extension)
    - Focus Groups for Landscape Architects, Design Engineers, Construction Contractors, Landscape Contractors and lawn / landscape maintenance professionals.
    - Education for review agencies, planners, planning commissions, and engineers to help them understand LID concepts and how to review site plans that are implementing LID in their communities. How not to be a roadblock to change but to be a change agent to implement this type of development.
    - Facilitate education sessions for focus groups.
    - Interaction with local watershed groups, stormwater authorities and municipalities to promote LID.
    - Promote tours to show examples of local LID projects and their impact on water quality
    - Promote use of signage on LID projects in the Saginaw Bay Regions.
    - Provide education for review process of commercial development, plats, condominium projects and industrial sites.

5. Incentives for LID – Promotional piece
    - Develop a list of grants that are available for use as incentives.
    - Research and make available information on grants for use in LID projects.

Stormwater Regulations

Stormwater regulations in Michigan provide a framework for how municipalities, commercial entities, and construction sites can reduce stormwater pollution. While these regulations provide a starting point for pollution reductions, the following recommendations outline actions that will enhance and improve implementation of these regulations:

1. Funding
    - Street Sweeping – provide guidance and resources for improved street sweeping equipment.
    - Catch Basin Cleaning – provide additional resources to clean catch basins on a more frequent basis.
    - Sustainable Funding – Evaluate various sustainable funding options to implement stormwater regulatory requirements.

2. Education
    - Litter Removal – provide local education program on appropriate disposal of grass and leaf litter.
    - Public Outreach – Increase public education on stormwater issues related to phosphorus control targeting television and radio.
    - Catch Basin Signage – Implement programs designed to mark catch basins with environmental message (e.g. Don't Dump Here … Flows to Saginaw Bay).

3. Authority
    - Spills - Expand local authority and resources to address spills.
    - Stormwater Ordinance – Evaluate the legal authority to pass stormwater ordinances at the County level.
    - Drain Code - Modify Chapter 21 & 22 of the Drain Code to allow assessment for Water Quality improvements.
    - Non-MS4 Communities – Evaluate the authority to allow non-MS4 communities to regulate and fund a stormwater program under the MS4 regulations.
    - Phosphorus Ordinances – Encourage the development and passage of zero-P phosphorus ordinances in the Saginaw Bay Watershed Counties and municipalities.

4. Effectiveness
    - MS4 Regulations - Evaluate the effectiveness and challenges of implementing the MS4 regulations in the Saginaw Bay Area as it relates to phosphorus.
    - Common Sense Approach - Establish a stormwater regulatory review committee including regulated communities to develop a "common sense" approach to implementing MS4 requirements.

Stormwater Phosphorus Workgroup Summary

The recommendations above highlight issues that need to be addressed in order to further reduce phosphorus discharges to Saginaw Bay from urban stormwater. These recommendations should be used as a guide in seeking additional technical and financial assistance, and in developing policies related to the implementation of stormwater management

practices. Table 4 provides an initial implementation strategy for the Stormwater Phosphorus Workgroup recommendations.

Point Source Phosphorus Workgroup

The Point Source Phosphorus Workgroup was formed to identify actions that could be taken to reduce phosphorus from industrial and municipal wastewater treatment processes. This workgroup identified three key areas where actions may result in additional reductions in phosphorus loads to Saginaw Bay: 1) Research; 2) Collaboration; and 3) Education.

Research

The wastewater treatment facilities in the Saginaw River are currently meeting or doing better than their allowed phosphorus concentration and loading discharge limits. Further reductions in phosphorus from these facilities would need to be done in a cost effective manner in order for them to justify the expense to their customers. Research is critical in this effort and the following areas of research have been identified that may result in cost effective phosphorus reduction at wastewater treatment facilities in the Saginaw Bay area:

- Develop a Best Management Practices (BMP) manual outlining sustainable practices (chemical, biological, physical) for P reduction that evaluates various municipal and industrial processes and recommends cost effective means to reduce phosphorus.
- Conduct a CSO pilot study to evaluate P removal from chemical additions to a CSO retention basin.
- Conduct a review of P removal technology through a grant to a local university. What's going on in Europe and elsewhere with P removal technology?
- Seek funding to hire a consultant to review point source treatment systems in the Saginaw Bay Watershed and recommend cost effective means to further reduce phosphorus in the discharges.
- Evaluate localized impacts of municipal wastewater treatment lagoons on waterways in the Saginaw Bay Watershed.

Collaboration

Working together can often create cost savings, as well as generate new ideas and approaches. The areas identified below could create a forum for discussion of phosphorus reduction strategies in the Saginaw Bay area:

- Establish a Saginaw Bay IPP partnership among wastewater treatment facilities in the area to evaluate an Industrial Pretreatment Program approach to phosphorus reduction.
- Support the Saginaw Bay Sustainable Business Forum, one component of which could be how industries could reduce phosphorus discharges to the Saginaw Bay.

Education

Ensuring that the general public has accurate information on wastewater treatment facilities in the Saginaw Bay area; and how they can help improve treatment at these facilities is important. The following recommendations address this need:

- Provide education outreach to wastewater treatment system users on phosphorus products that go to the WWTP.
- Develop an information piece comparing actual P discharged versus P loadings allowed in permit.

Point Source Phosphorus Workgroup Summary
Point source dischargers of phosphorus in the Saginaw Bay area are generally meeting or discharging less than they are currently permitted to discharge. There is common interest among the dischargers participating in this effort, however, to look at cost effective ways to further reduce their phosphorus loads. Table 5 provides an initial implementation strategy for the Point Source Phosphorus Workgroup recommendations.

Conclusion

In review of all recommendations for phosphorus reduction to Saginaw Bay, four key concepts standout:

1. **Problem Definition** – While phosphorus is clearly a contributor to algae problems in Saginaw Bay, it is unclear at this point how much it contributes to the overall problem. Ecosystem variables such as zebra mussel impacts, impacts of water levels, and impact of sediment re-suspension need to be incorporated into the evaluation. A better understanding of how much phosphorus is in the system already and ongoing contributions from various sources also needs to be summarized in a nutrient budget for the Saginaw Bay, and translated into a more comprehensive Phosphorus Reduction Strategy.

2. **Education** – Education is identified as a key recommendation throughout all the source reduction strategies. This area can not be over emphasized. Awareness of phosphorus issues is the basis for building partnerships and supporting actions to correct problems. This should be considered as a top priority for any effort to reduce phosphorus in the Saginaw Bay.

3. **Building Partnerships** – The diversity of participation on the SBCI Phosphorus Committee and its workgroups clearly demonstrates the importance of partnerships in the effort to control and reduce phosphorus. Partnerships not only provide a forum for a broader discussion of issues, but also an opportunity to leverage resources. Moving forward with these initiatives will require strong partnerships to ensure greater local buy-in and sustain efforts over the long term.

4. **Sustainability** – Economical solutions was a key component of all discussions within the source reduction workgroups. It was continually emphasized by participants that sustainability is based on a "common sense" approach to problem solution. If a solution to phosphorus reduction is also economical, it will sell itself and be sustainable.

Source Reduction Workgroup

Implementation Strategies

Table 3: Agricultural Pollution Prevention Workgroup Source Reduction Strategy

Livestock Recommendation	Initial Action Items	Lead	Partners	When	Estimated Initial Cost (Mar 2009)
1-Local Ordinance Review	Develop Coastal Zone Mgmt. Grant proposal	Saginaw Bay RC&D		2009	$40,000
2- Hobby Farm/Small Operations Outreach Program	a) Coordination w/ ongoing Pinnebog and Pigeon R. watershed grants; b) Develop grant proposal to circulate to various funding sources	a) Huron CD; b) MSUE	MDEQ, CD, NRCS, DRAIN/ROAD COMMISSIONS, MDA MAEAP, Huron CD	a) Ongoing projects; b) On going (grant request being developed)	a) TBD; b) $15000
3-"No Runoff / No Discharge" Outreach Program	Coordinate with Pigeon/Pinnebog R. Watershed Projects	Huron CD	MDEQ,NRCS,MDA MAEAP, MSUE, Huron Co. DRAIN/ROAD COMMISSIONS	On going	TBD
4-Common Sense Standards and Solutions	a) Request to USDA State Conservationist to participate with the Ag P3 Committee to develop detailed recommendations; b) Request to MDEQ and MDA Directors for letters of support for this recommendation; c) Request to Federal Rep. and Senators in the SBCI area to support this recommendation	Ag P3 Committee	USDA, MDA, MDEQ	February 2009	TBD
5-Fund CD livestock specialist poitions	a) Recommendation to MDEQ & MDA directors to fund 1/2 time position for two years in Huron (will coordinate with Sanilac and Tuscola CD); b) Recommendation to MDEQ &MDA directors to seek funding to provide livestock specialist positions in Tuscola, and Sanilac Counties as well	Huron CD	MDEQ, MDA, Tuscola & Sanilac CDs	On going (grant request for Huron County position being developed)	$60,000
6-Identify Non-traditional outreach approaches	Establish a SBCI Innovative Ag Outreach Committee to develop and implement a non-traditional Educational Outreach Strategy	MSUE	MDEQ, MDA, CD, NRCS, DRAIN/ROAD COMMISSIONS	2010	$10,000
7-Promote Nutrient Mgmt. Plans for Farms Accepting Manifested Waste	Coordinate with CNMP providers to promote NMPs on farms accepting manifested waste and develop an outreach program	MDA MAEAP	MSUE, CNMP Providers, CDs, Commodity Grps., NRCS, Livestock Orgs.	Spring 2009 - Introduce @ CNMP Providers Annual Mtg.	TBD
8-Manure Applicator Education/Certification Program	Expand manure applicator education and certification program to custom manure applicators & farm employees	MSUE	MDEQ, MDA	On going	TBD
9-Promote Good Mgmt. Practices on Farms	Develop and implement a promotional program that highlights environmentally sound management practices on farms to the agricultural and local community	MDA MAEAP	MSUE, CNMP Providers, CDs, Commodity Grps., NRCS, Livestock Orgs.	On going	TBD
10-"Keep Livestock Out of Water" Outreach Program	Develop a grant proposal to implement an education and outreach program on livestock exclusion in coordination with the Drain/Road Commissions	MSUE	CD, NRCS, MDEQ, MDA, DRAIN/ROAD COMMISSIONS, local govt.	Summer 2009	$15,000
11-P Feed Mgmt. "total" balance approach	Expand outreach matls. & program to S	MSUE	nutritionists	2010	TBD
12-Promote Value & Alt. Use of Manure	Develop grant proposal for WIN regarding value and alt. use of manure	MSUE	Huron EDC	Summer 2009	$30,000
13-Genesee Power model for horse manure	Evaluate this model and determine cost effectiveness for Huron County - incorporate into Pinnebog R. project	Huron CD	Huron EDC	On-going	TBD
14-Regional Anaerobic Digester	Recommendation to MDEQ & MDA directors to coordinate with Huron EDC to implement this project	Huron Econ. Devel. Council	MDEQ, MDA, Huron CD	On-going	TBD
15-Saginaw Bay Manure Brokering Website	Establish a Saginaw Bay manure brokering website	MSUE		Summer 2009	TBD
16-Commercial Composting Facility for Dead Animals	Recommendation to MDEQ and MDA Directors to update regulations to allow for commercial composting of manure and dead animals	MDA(Matt Fletcher) MDEQ(Duane Roskowski)		On-going	TBD
17-Update Waste Mgmt. Regulations for Green Technologies	Recommendation to MDEQ and MDA Directors to update waste mgmt. laws on co-mingled wastes	MDA, MDEQ		On-going	$0

Cropping Recommendation	Initial Action Items	Lead	Partners	When	Estimated Initial Cost (Mar 2009)
1-Promote GPS soil testing and fertilizer application	a) Satellite Imagery Project; b) Incorporate into the Pinnebog R. watershed project	a) MSUE; b) Huron CD	Cooperators, Agri-business	a) Summer 2009; b) On-going	a) $11,000; b) TBD
2-Develop Saginaw Bay specific nutrient recommendations and rates	Draft letter to request that the MDEQ and MDA Directors establish a task force to focus on developing Saginaw Bay area specific nutrient recommendations	Ag P3 Committee		March 2009	TBD
3-Purchase and maintain research farm in the Thumb	a) Purchase new research farm; b) Develop proposal to circulate to various funding sources targeting P research @ current research farm	MSU	CDs, MDA, MDEQ	Summer 2009	a) TBD; b) $200,000
4-Promote on-farm conservation demonstrations	Develop a "Sustainable Agriculture Demonstration Project" proposal to submit to Saginaw Bay WIN	CD	MDA, MDEQ, MSUE, Cooperators	Summer 2009	$60,000
5-Erosion control BMPs for temporary v-ditches	Develop a research proposal to evaluate the effectiveness of various temporary erosion control measures to address v-ditches	MSU	CD, MDA, MDEQ, Cooperators, NRCS	Summer 2009	$30,000
6-Promote cover crops and alternative practices for wind erosion control	Incorporate into "Common Sense Standards and Solutions" effort	Ag P3 Committee		February 2009	TBD
7-Develop a range of options to get vegetative setbacks from water	Incorporate into "Common Sense Standards and Solutions" effort	Ag P3 Committee		February 2009	TBD
8-Establish Saginaw Bay as MI agricultural drainage research area	Develop a proposal to present to MSU	MSU, MDA, MDEQ	Local Govts., USDA, Drain Commissions	Summer 2009	TBD
9-Promote innovative, environmentally sound drainage ditch design, construction and maintenance in the Saginaw Bay	Coordinate with the North East District of Michigan County Drain Commissioners (includes: Arenac, Bay, Genesee, Gladwin, Huron, Lapeer, Midland, Saginaw, Sanilac, Shiawassee, St. Clair, and Tuscola counties).	MDEQ	Drain Commissions, MDA	Initiate discussions March 2009	TBD

Total Estimated Initial Cost as of March 2009 $471,000

Acronyms:

CD	Conservation District
CNMP	Comprehensive Nutrient Management Plan
EDC	Economic Development Council
MAEAP	MI Agriculture Environmental Assurance Program
MDA	MI Dept. of Agriculture
MDEQ	MI Dept. of Environmental Quality
MSU	MI State University
MSUE	MI State University Extension
NRCS	Natural Resource Conservation Service
RC&D	Resource Conservation and Development Council
USDA	US Dept. of Agriculture
WIN	Watershed Initiative Network

Table 4: Stormwater Phosphorus Workgroup Source Reduction Strategy

Septic System Recommendations	Initial Action Items	Lead	Partners	When	Estimated Initial Cost (Mar 2009)
1) Education	Establish outreach program utilizing readily available resources targeted to homeowners	DEQ-WB	County Health Departments, SASWA, BASWA, Drain Commissions, Road Commissions, Townships and Municipalities, Homeowner Assoc., Realtors, and Home Builder Assoc., School Districts	June 2009	TBD
2) Data Mgmt	a) Recommendation to DEQ director to develop a specific data management system to standardize on statewide; b) Demonstration of Data Management System for Septic Systems	a) SBCI P Committee; b) Bay County HD	County Health Departments; DEQ Water Bureau On-site Wastewater Unit	a) April 2009; b) On-going thru Kawkawlin R Watershed project	a) TBD; b) $15,000
3) Local Ordinances/Code	Seek grant to develop model local septic system ordinance	Bay County HD	County Health Departments; DEQ Water Bureau On-site Wastewater Unit	April 2009	$10,000
4) Financing	a) Outline criteria for a local low interest loan program for septic system replacement; b) Evaluate State and/or local funding (loan/grant) for addressing septic system issues; c) Resolution to support local HD programs and/or modification to State funding programs to address septic system issues	a) Bay County HD; b) DEQ-WB; c) SBCI P Committee	County Health Departments; DEQ Water Bureau On-site Wastewater Unit and NPS Program	a) Sept. 2009; b) On-going; c) June 2009	a) TBD; b) TBD; c) TBD
5) Partnerships	Develop an inter-agency coordination process to identify and correct failing septic systems	DEQ-WB	Bay and Huron County: Health Depts., Drain Commissions, Road Commissions, Townships and Municipalities, Homeowner Assoc., Realtors, and Home Builder Assoc.	Dec. 2009	TBD

Low Impact Development Recommendations	Initial Action Items	Lead	Partners	When	Estimated Initial Cost (Mar 2009)
1) Promote Michigan's LID BMP Manual and "Filling the Gaps" document in Saginaw Bay Watershed	Provide a conduit for communication to professional designers, planners, municipalities, counties, and other agencies in LID application	SASWA,Spicer Engineering and Designscapes	DEQ-WB	April 2010	TBD
2) CSO-LID demo	Support the public education portion of this on-going project	SASWA & Spicer Engineering	DEQ-WB, City of Saginaw	On-going	TBD
3) Model LID ordinance	Seek grant funding to develop model LID ordinance language	SASWA & Spicer Engineering	DEQ-WB	April 2010	$20,000
4) Develop LID Outreach Strategy	Seek grant funding to develop a strategic educational outreach program to landscape architects, design engineers, construction contractors, landscape contractors, and landscape maintenance professionals.	SASWA,Spicer Engineering, and Designscapes	DEQ-WB	April 2010	$30,000
5) Develop Incentives for LID	Research and make available information on grants for use in LID projects	DEQ-WB NPS		Oct. 2009	TBD

Stormwater Regulations Recommendations	Initial Action Items	Lead	Partners	When	Estimated Initial Cost (Mar 2009)
1) Funding	Evaluate sustainable funding options to implement stormwater regulatory requirement	SASWA & Spicer Engineering	DEQ-WB	April 2010	TBD
2) Stormwater Education	Develop a targeted public outreach strategy related to phosphorus in stormwater	BASWA	DEQ-WB	On-going (205j grant)	$25,000
3) Authority	a) Evaluate legal authority to pass County level stormwater ordinance; b) Evaluate authority to allow non-MS4 communities to regulate and fund a stormwater program under the MS4 regulations; c) Recommend to DEQ and MDA Directors that they support development of statewide phosphorus lawn fertilizer legislation.	a) SASWA; b) Frankenmuth; c) SBCI P Committee	DEQ-WB	a) Summer 2010; b) Summer 2010; c) June 2009	a) TBD; b) TBD; c) TBD
4) Effectiveness	a) evaluate effectiveness and challenges of implementing the MS4 regulations; b) Establish a stormwater regulatory review committee to develop a common sense approach to implementing MS4 requirements	DEQ-WB	MS4 communities	On-going - establishing a MS4 implementation committee	TBD

Total Estimated Initial Cost as of March 2009	$100,000

Acronyms:

BASWA	Bay Area Stormwater Authority
CSO	Combined Sewer Overflow
DEQ	Department of Environmental Quality
HD	Health Department
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer System permit
NPS	Nonpoint Source
SASWA	Saginaw Area Stormwater Authority
SBCI P Committee	Saginaw Bay Coastal Initiative Phosphorus Committee
TBD	To Be Determined
WB	Water Bureau

Table 5: Point Source Phosphorus Workgroup Source Reduction Strategy

Research Recommendations	Initial Action Items	Lead	Partners	When	Estimated Initial Cost (Mar 2009)
1) Sustainable Practices	Seek funding to develop a BMP Manual on sustainable practices for Phosphorus reduction methods (chemical, biological, physical)	SVSU	Dow Chemical, Bay City WWTP, Saginaw WWTP	Summer 2010	TBD
2) CSO Pilot Project	Seek funding to conduct a pilot project looking at chemical additions to a CSO retention basin to reduce P	Bay City WWTP	DEQ-WB	Summer 2010	TBD
3) Phosphorus Removal Technology Review	Seek grant funding to evaluate innovations in phosphorus removal technology.	SVSU	Dow Chemical, Bay City WWTP, Saginaw WWTP	Summer 2010	TBD
4) P3 Consultant	Seek funding to hire a phosphorus pollution prevention consultant to review point source treatment systems in the Saginaw Bay Watershed and recommend cost effective means to further reduce phosphorus in the discharges.	TBD	Bay City WWTP, Saginaw WWTP, Michigan Sugar, Dow Chemical, DEQ-WB	Summer 2010	TBD
5) Municipal Lagoons	Evaluate localized impacts of municipal lagoons in the Saginaw Bay Watershed.	DEQ-WB		Summer 2010	TBD

Collaboration Recommendations	Initial Action Items	Lead	Partners	When	Estimated Initial Cost (Mar 2009)
1) Establish Saginaw Bay IPP Partnership	Develop a partnership of municipal WWTP with IPP programs to discuss how to address phosphorus and other pollutants within their collection systems	Bay City WWTP	Saginaw WWTP, DEQ-WB	Summer 2009	TBD
2) Support the Saginaw Bay Sustainable Business Forum	Work closely with SVSU to incorporate phosphorus reduction issues into this forum and expand membership to include all significant point source dischargers in the Saginaw Bay Watershed	DEQ-Office of P2	Michigan Sugar, Hemlock Semi-conductor, Dow Chemical, DEQ-WB	Summer 2009	TBD

Education Recommendations	Initial Action Items	Lead	Partners	When	Estimated Initial Cost (Mar 2009)
1) Educate users of wastewater treatment systems on P reduction	Provide educational materials to homeowners on phosphorus products that go the the WWTPs	IPP facilities	DEQ-WB, Bay City WWTP, Saginaw WWTP	Summer 2009	TBD
2) Develop information on actual P discharge versus permitted P	Develop a fact sheet comparing phosphorus that point source dischargers in the Saginaw Bay Watershed actually discharge compared to what they are permitted to discharge	DEQ-WB	Bay City WWTP, Saginaw WWTP	Summer 2010	TBD

Acronyms:

CSO	Combined Sewer Overflow
DEQ	Department of Environmental Quality
IPP	Industrial Pretreatment Program
P	Phosphorus
P3	Phosphorus Pollution Prevention
SVSU	Saginaw Valley State University
WB	Water Bureau
WWTP	Wastewater Treatment Plant

Kawkawlin River Volunteer Monitoring Report
1997-2001

Background

In 1997 the Kawkawlin River Property Owners Association initiated a 5 year monitoring program to evaluate water quality on the Kawkawlin River. Four primary monitoring locations were established at State Park Drive Bridge, Chip Road Bridge, Wheeler Road Bridge, and 7-mile Road Bridge. Drains to the Kawkawlin were monitored one of the years to gather some information on various inputs to the main channel. Of the parameters monitored, four are evaluated in this report: Fecal Coliform, Phosphorus, Suspended Solids, and Dissolved Oxygen.

Fecal Coliform

Results indicate that there are sporadic occurrences of fecal coliform levels that may exceed Michigan Water Quality Standards. Fecal coliform counts seem to be higher and occur more frequently at elevated levels at the Chip Road and Wheeler Road stations. During the 2001 monitoring season, Fecal Coliform counts at these stations were elevated in 31% and 42% of the samples respectively.

Phosphorus

Average phosphorus levels over the five years of monitoring at the State Park Drive station were around the EPA water quality criteria protective for rivers (0.1 mg/l). Wheeler Road and 7-mile Road stations were slightly elevated for phosphorus at 0.11 mg/l as a five year average. Chip Road was almost one and a half times the EPA water quality criteria at 0.14 mg/l as a five year average.

Because the Kawkawlin River system has relatively low flow, the watershed may act more like a lake system than a flowing river system in some sections. If this assumption is used, the EPA water quality criteria that would be applied to this system would be the 0.05 mg/l that is protective for lakes and reservoirs. All stations monitored would exceed this lower limit.

Suspended Solids

Based on the stations monitored, suspended solids levels are relatively low and do not seem to be a significant water quality problem in the Kawkawlin River. In the 1994 Saginaw Bay Watershed Prioritization Process, the Kawkawlin River was ranked as a moderate priority for suspended solids based on an average level of 29 mg/l. Volunteer monitoring data, reflects a range of annual averages from 3.4 mg/l (7-mile Road station, 2001) to 33.8 mg/l (Wheeler Road station, 1999). This data seems to confirm the moderate priority identified in the 1994 evaluation.

Dissolved Oxygen

Several violations of Water Quality Standards were noted for Dissolved Oxygen, most at the Seven Mile Road station. The Michigan Water Quality Standard for Dissolved Oxygen is 4 mg/l. Dissolved Oxygen at the Seven Mile Road site was as low as 0.68 mg/l in one sample and there were seven violations noted from 1998-2001.

Next Steps

Based on the five years of monitoring data there seem to be potential impairments to water quality from bacterial contamination, phosphorus, and oxygen depletion in sections of the Kawkawlin River. The following steps should be taken to address these concerns:

1. Watershed Plan – It would be worthwhile to work with Bay County Environmental Affairs Department to develop a comprehensive watershed plan for the Kawkawlin River. This plan would specifically identify potential sources of these problems and outline a strategy to correct them.

2. Bacterial Contamination – Work with the Department of Environmental Quality and Bay County Health Department to identify potential sources of bacterial contamination particularly around the Chip Road and Wheeler Road stations.

3. Phosphorus - Sources of phosphorus should be identified and addressed throughout the watershed, but some priority should be placed on identifying sources around the Chip Road station.

4. Dissolve Oxygen – The Seven Mile Road station should be evaluated to determine the cause of the oxygen sags in this section of the river.

Peer Outreach

- Strategy for disseminating results and lessons learned
- Promotion of technology transfer
- Assist state and local decision makers

The Kawkawlin River project provides the framework for a *public outreach* plan. It will focus on three goals from its *public outreach* section:

- Reduce of E. coli, sediment and nutrient input into to the Kawkawlin River,
- Promote Best Management Practices (BMPs) including low impact development (LID) in the watershed, and
- Protection/restoration the natural river channel habitat and riparian greenway floodplain corridor.

We will use five communication tools to meet our *outreach* goals:

1. featured newspaper articles;
2. local workshops for adults and children;
3. a revolving display (at the Bay City State Park);
4. the Kawkawlin River project website; and
5. Presentations to regional colleagues, conservation groups and other interested parties.

The **newspaper articles**, in the Booth Newspapers (Bay City Times, Saginaw News and Flint Journal) which is a regional paper whose daily readership is 381,000 read by residents in and around the Kawkawlin River and the Saginaw Bay Watershed. The articles will integrate project results with other related WQ activities in the Saginaw Bay Watershed. **Open public workshops**, including site visits, will be held on the following topics: an *E. coli reduction seminar* and *On-site disposal system (OSDS) care and maintenance seminar,* these programs are designed for interested watershed residents to 1). Provide information on E. coli reduction in the watershed, and 2). OSDS care and home-maintenance options, including how to determine if your OSDS is failing will be provided along with a pamphlet. Also, seminars will be developed and presented on the following topics during project life:

- *Innovative BMPs* for rural riparian landowners;
- the state of WQ in the Watershed; and
- *Results* of the BMP effectiveness monitoring program.

The talks will be sponsored by the Bay County Drain Commissioner in cooperation with project partners. The Bay Area Storm Water Authority (BASWA) will organize one BMP-related science activity per year for school children in Bay County for use in the physical science portion of local curriculum. In addition, there will be interpretive signage planned for the BMP demonstration sites; a **permanent revolving display** at the Bay City State Park's Saginaw Bay Visitors Center – Jennison Exhibit Hall will showcase the *innovative* projects and *environmental results* as they occur. This will reach the 50,000 annual visitors to this center, of which 30,000 are area school children who visit the Park. Project

results will also be described in a special section of the **project website** maintained by the stakeholders. **Presentations** on project status/outcomes will include two talks or papers per year by one or more partners at regional natural resource or WQ forums. This will help to *transfer knowledge* (gained from project *results*) to professional colleagues in the Saginaw Bay watershed and other similar watersheds in the state of Michigan. The project will also focus on technical presentations related to BMPs for the Michigan Association of County Drain Commissioners (MACDC) at their annual conferences and the Michigan Water Environment Association's (MWEA) annual conference for watershed professionals.