Bay Area Storm Water Authority

Kawkawlin River Watershed Management Plan

& COASTAL SAGINAW BAY

Introduction

The Saginaw Bay is the single most important natural resource to the Bay County Community. The natural, economic and recreational resources provided by the Saginaw Bay make it critical to the future viability of the area and the State of Michigan. The Saginaw Bay Watershed has been the focus of environmental concern for many years. In 1973 the Saginaw Bay Watershed was recognized and designated one of the areas most affected by human impacts in the Great Lake Basin.

The Saginaw Bay Watershed is Michigan's largest and encompasses all or part of 22 counties and the largest contiguous freshwater coastal wetland in America (RAP Update 2002). Although the land area is relatively homogenous, its use and population is very diverse. Heavy industry, agriculture, tourism and other economic activities take place in the watershed. The 8,700 square mile area is home to 1.4 million people. The watershed features more than 175 inland lakes, about 7,000 miles of rivers and streams, and drains 15 percent of Michigan's land area. The watershed is home to 138 endangered species (MDNR SWQD 1994).

When the Saginaw River and Bay were designated in 1973 as one of the major polluted areas in the Great Lake Basin, the International Joint Commission (IJC) targeted the area for further action. In 1987, it was designated as an "Area of Concern" (AOC) by the Great Lakes Water Quality Agreement. This designation was the result of degraded water quality impairing certain beneficial uses as defined by the agreement. In each of AOCs listed by IJC's Water Quality Board, specific impairments were identified by the states and provinces. Impairments are environmental conditions that are the result of human impact that prevent the resource to be utilized for designated uses as recognized by state and federal programs. A remedial action plan (RAP) for the Saginaw River and Bay was submitted to the IJC in September of 1988. It cited 12 impairments and 101 action activities, including 37 that were considered a priority.

Bay County Urbanized Area

The Bay County Urbanized Area (BCUA), which is the area of land that falls under the Phase II requirements, represents a fraction of the Saginaw Bay Watershed. Although only a small land area, over 75% of the tributary hydraulic flow entering the Saginaw Bay flows through the BCUA. Any watershed management plan for the BCUA needs to recognize the current factors influencing the current condition of the entire watershed.

The BCUA is made up of all or part of 9 municipalities within Bay County. The municipalities include the cities of Bay City and Essexville, and the Townships of Bangor, Hampton, Fraser, Kawkawlin, Monitor, Portsmouth and Frankenlust. The population of the area is approximately 82,500.

The BCUA has an approximate land area of 131.6 square mile (84,239 acres). It is a fraction of the much larger Saginaw Bay Watershed (nearly 8,700 square miles) making up 1.5% of the land area. The geographic area is only a small portion of the Kawkawlin River and Saginaw River sub-watersheds.

Achieving the Bay Area Storm Water Authority's (BASWA) goal of improving the quality of storm water in the BCUA must be measured by our effort, increased public awareness and the measurable success of our long and short term goals developed in this Watershed Management Plan. The focus of BASWA's efforts in the urbanized area will be to:

- Deploy the Public Education Plan
- Remove identifiable illicit discharges
- Implement pollution control techniques utilizing Best Management Practice (BMP)
- Incorporate low impact development and BMP in the public and private sectors of the BASWA communities

The basis of our initial efforts will be to make improvements to storm water quality as outlined in our Public Education Plan and Illicit Discharge Elimination Plans (included in appendix) and the accomplishment of measurable goals included in the Watershed Management Plan.

The Kawkawlin River Watershed

The Kawkawlin River is actually formed by the combination of two tributaries with entirely different characteristics. The North Branch, which begins at the Kawkawlin Creek flooding in Gladwin and Midland Counties, drains an area that is heavily forested. The North Branch contains a rocky bottom that supports the spawning a variety of fish species, most notably walleye. The meandering North Branch has a steep gradient and flows fairly swiftly during most months of the year.

The South Branch, which tends to flow more slowly and has very little fall, drains the agricultural and more urbanized areas of Bay and Saginaw Counties. These two tributaries come together near the village of Kawkawlin to form the main branch of the Kawkawlin River which then flows approximately 4.5 miles to Saginaw Bay (Kawkawlin River Conservation Partnership).

That part of Kawkawlin River Watershed that lies in the BASWA is located in Monitor, Bangor and Kawkawlin Townships. The Tobico Marsh and adjacent wetlands (located in the Bay City Recreation Area) is also part of this important portion of the Kawkawlin River Watershed. Map #1 shows the area of the watershed included in this Kawkawlin River Watershed Plan.

The Kawkawlin River is the third largest sub-watershed in the West Saginaw Bay Coastal Watershed:

Drainage Unit	***Drainage Unit Area (sq km)***
Rifle River	1,002
Augres River	728
Kawkawlin River	580
Direct drainage	492
Tawas River	414
East Branch Augres	362
Pine River	254
Saganing Creek	77
Pinconning River	73

Table 1
Saginaw Bay/River RAP 1994

Geology and Topography

The topography of the Saginaw Bay drainage basin is a product of glacial and post-glacial processes. A geologic region classified by the United States Geological Survey (USGS) as the Saginaw Bay Lake Plain consists primarily of Pennsylvanian sandstone, shale, coal and limestone. Clay sediments generally underlay the topsoil. Sand plains of 5– 10 feet in depth and up to several miles wide were deposited by glacial streams and still serve as stream beds by the existing rivers in the watershed (Saginaw Bay/River RAP 1988). The track of the latest glacial incursion in east central Michigan is evident in the shape of Saginaw Bay and in the nearly continuous band of glacial moraine that now exists and marks the point from where the ice began to melt and retreated northward. These moraines are usually the highest point of vertical relief in the basin and represent the headland of many of the tributaries that flow towards the Bay. Maximum local relief ranges from approximately 20-30 meters along the eastern and southwestern fringe of the basin to over 100 meters in Ogemaw County (Saginaw Bay/River Rap 1994).

The depression created by the glacial lobe that occupied east central Michigan filled with melt water as it withdrew. The height and extent of the lake levels during that period are reflected in the soil strata of the lacustrine plain extending well inland from the eastern,

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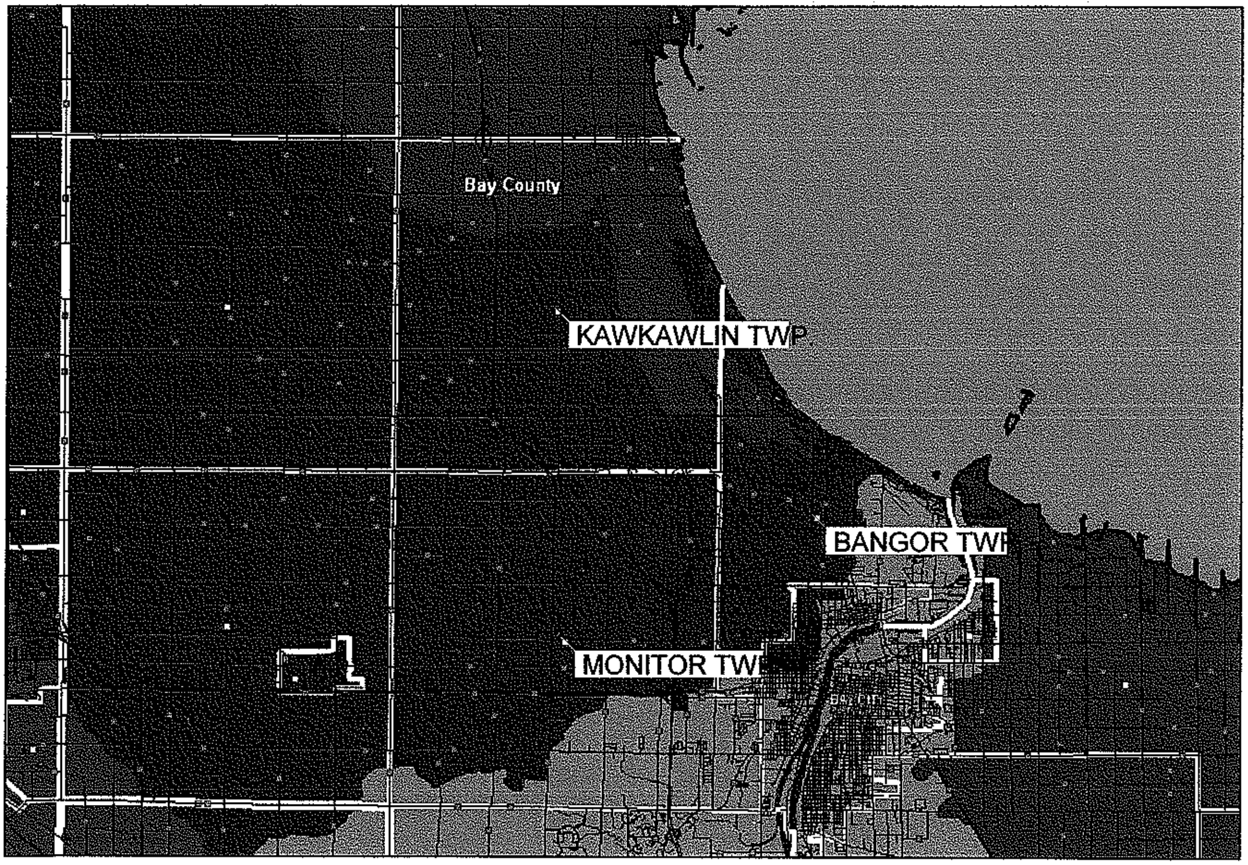
SAGWIN AREA Maps

#1 Kawkawlin River Watershed Boundary

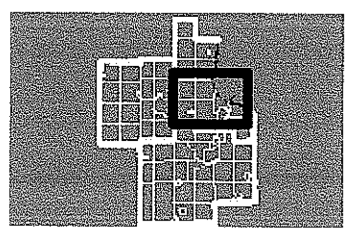
Map Width: 117447 ft (22.24 miles)



MAP LEGEND

- Cass
- Chippewa
- Direct to Lake
- Flint
- Kawkawlin
- Saginaw
- Shiawassee
- Tittabawassee
- Unlabeled/Unknown
- Rivers-Lakes
- County Border
- Municipal Name Municipal Border
- Public Roads

MAP AREA (black box)



southern, and western shores of the bay. Coarse sediment lake plains, indicative of beach or near shore environments occupy substantial areas near the moraine deposits. Clay-rich deposits, which were originally formed well offshore, now occupy large portions of the basin immediately adjacent to the bay (Saginaw Bay/River Rap 1994). The Kawkawlin River Watershed surface geology in the management area is shown on Map #2.

Soils

The varied soils of the Saginaw Bay drainage basin largely reflect the influences that glacial and post-glacial processes have exerted on the parent materials, drainage and topography. The soils that formed on lake plains rich in clay are relatively impermeable and, in their natural state, poorly drained and erodible. These soils occur over large areas to the east, south and southwest of Saginaw Bay and have been extensively drained to permit agriculture (Saginaw Bay/River RAP 1994).

Soils derived from outwash deposits, or from the wave sorted sand of what were once near shore or beach environments, also occupy a large portion of the basin. Usually flat or gently sloping, these coarser soils are often well drained and droughty; however, poorly drained variants are common in some areas due to high water tables of underlying clay pans (Saginaw Bay/River RAP 1994).

The soils that developed on the varied parent materials and slopes of the marginal and terminal moraines are themselves quite varied. Loamy soils are common among the less extreme slopes in the eastern and southern hills; whereas sandy, well drained soils on the relatively extreme slopes are generally limited to the northern part of the basin.

The available water capacity of a soil has water quality as well as hydrologic implications. Low water capacity soils, such as those common in the eastern part of the basin, reach saturation quickly and therefore generate runoff faster and in greater volumes than coarse soils. Surface water runoff problems are generally greatest in the spring, when the lack of vegetative cover and an increasing likelihood of heavy rainfall are likely to cause erosion and delivery of clay particles and adsorbed agricultural chemicals to area waterways (Saginaw Bay/River 1994).

Soil in the Kawkawlin River Watershed

The soils types specific to the Kawkawlin River in the Bay City Urban Area are primarily Tappan-Londo-Poseyville association, Londo-Tappan association, Wixom-Pipestone-Tappan association and Pipestone-Tobico-Rosseau association. Tappan-Londo-Poseyville association are nearly level, somewhat poorly drained soils that formed in loamy and sandy material; on till plains modified by lake water. Londo-Tappan association soils are nearly level, somewhat poorly drained soils that formed in loamy and sandy material on till plains modified by lake water. Wixom-Pipestone-Tappan association are nearly level, somewhat poorly drained and poorly drained soils that formed in sandy and loamy material; on outwash plains and till plains modified by lake water. Pipestone-Tobico-Rosseau association soils are nearly level and gently sloping, well drained to poorly drained soils that formed in sandy material on outwash plains, and beaches. (Soil Survey of Bay County Michigan USDASCS 1980).

Tappan-Londo-Poseyville Association-The soils in this association are used mainly for cultivated crops. In some areas they are used as woodland or for pasture and hay. Wetness is the main limitation to use of these soils for farming and for most nonfarm uses. If adequately drained, these soils have good potential for farming. The potential for building site development is good on Poseyville soils, fair on Londo soils, and poor on Tappan soils.

Londo-Tappan Association- The soils in this association are used mainly for cultivated crops. Wetness is the main limitation to the use of these soils for farming and for most nonfarm uses. The potential for building site development is poor on Tappan soils and fair on Londo soils. The potential for woodland is good.

Wixom-Pipestone-Tappan Association- The soils in this association are used mainly for cultivated crops or are idle farmland. In some areas they are used as woodland and wildlife habitat and for pasture and hay. Wetness is the main limitation to the use of these soils for farming and for most nonfarm uses. Wixom and Pipestone soils have good potential for building site development and for pasture and hay crops and fair potential for woodland and cultivated crops.

Pipestone-Tobico-Rousseau Association- The soils in this association are used mainly for woodland or are idle farmland. In some areas they are used for corn pasture and hay. Wetness is the main limitation to the use of Pipestone and Tobico soils for farming and for most nonfarm uses. Droughtiness is the main limitation to the use of Rousseau soils for farming. Rousseau soils have slight limitations for building site development. (USDA 1980)

Hydrology and Sediments

Precipitation

Precipitation within the basin averages about 30 inches annually. Most of the precipitation, which falls as snow, is potentially available for release during the spring meltoff. The floods of September 1985 (Flint River) and September 1986 (Saginaw, Tittabawassee and Cass Rivers) illustrate the magnitude of variation possible from the norms established over a single century of record keeping (Saginaw Bay/River RAP 1994).

Flow

Saginaw Bay receives an average total tributary of 153.7 cubic meters per second. Of this, 114.5 cms (74.4%) is contributed by the total adjusted average discharge (correlation between runoff per square mile and the drainage area known to exist below a given gage) of the four major tributaries at their confluence to form the Saginaw River. Rivers within the Saginaw Bay drainage basin can generally be described as low slope and event responsive. Both characteristics reflect the long-term inundation of the area by post-glacial lakes, which deposited thick layers of relatively impermeable lacustrine sediments before retreating. Because soils that are developed from these materials are generally very fertile, agricultural development flourished after the demise of the logging era in the Saginaw Basin. This agricultural development was accompanied by the construction of drains, ditches and field tile systems, which encroached upon many of the wetlands along the bay. Besides the known water quality implications, these changes increase the speed in which water is delivered downstream (Saginaw Bay/River RAP).

Similar consequences are associated with the large areas of impermeable surfaces and the extensively channelized river courses found in the urban areas. In addition, large volumes of water are added to the drainage network by townships and municipalities that import drinking water from Lake Huron, Saginaw Bay, or groundwater supplies.

River flows are also affected by the 346 dams in the Saginaw Bay watershed. These include lake level control structures and dams that do not meet Act 300 size criteria. Many of the dams are maintained for recreational purposes. All of them, however, have potential impacts on the aquatic ecosystem including effects on the hydrologic regime, fish and wildlife passage, evapotranspiration rates, sedimentation rates, nutrient loading rates, and fragmentation and loss of habitat (Saginaw Bay/River RAP 1994).

Hydrologic Flow Data for the Kawkawlin River- Hydrologic characteristics relating to drainage area, base flow and flow stability were estimated for the 69 watersheds that have been identified in the Saginaw Bay Watershed Prioritization Process. Flow data for the Kawkawlin River is detailed in Table 2:

Watershed Name	***Drainage Area (sqmi)***	***Flow Stability (cfs/cfs)***	***Flow Stability Rating***	***Base Flow (cfs/sqmi)***	***Base Flow Rating***
North Branch Kawkawlin River	103	36.15	3	0.00	4
South Branch Kawkawlin River	122	37.36	3	0.00	4

Table 2
Saginaw Bay Watershed prioritization Process DNR 1994

Base Flow-Base flow is an estimate of the degree to which a stream may dry up in the summer and the degree to which it is supported by groundwater. Base flows were ranked as:

1. High Base Flow
2. Medium Base Flow
3. Low Base Flow
4. Very Low Base Flow

Base flow is predominantly affected by drainage area and geology. The lowest base flow yields occur in those watersheds that contain a lot of lake bed clay. Other factors that affect base flow include tile drainage, storm drains, and the amount of impervious surfaces present in the watershed (Saginaw Bay/River RAP 1994).

Flow Stability- Flow stability is an estimate of the flashiness of a stream. The wider the fluctuations in flow, the more flashy or unstable the stream is assumed to be. To estimate flow stability, a comparison between the highest average monthly mean flow to the lowest average monthly mean flow is made. The following ranking categories were used to rank the flow stability :

1- Stable Stream
2- Variable Stream
3- Flashy Stream

As shown in the data in table 2, the base flow rating for the Kawkawlin River is rated as a four (4) meaning that the river has a very low base flow. The flow stability for the Kawkawlin River is a three (3). Although an estimate of flood potential was not completed as part of the Saginaw Bay/River RAP in 1994, the data indicates a potential for flooding in a heavy rainfall event. Mitigating the impacts of constructed drainage, storm drains and impervious surface would be an important consideration when planning development within the Kawkawlin Watershed.

Groundwater

The glaciers that left Michigan some 10,000 years ago deposited a complex series of unconsolidated materials including clay, silt, sand, gravel, boulders, and mixtures which are collectively called drift. Water that occupies the pore spaces in this unconsolidated material and in the underlying rock is groundwater.

Base flow within the Saginaw Bay watershed is low, with 0.39 cfs per square mile the largest value found in the entire watershed. Flashiness can be the result of natural features (geology, slope, soil types) or man-made (land use, urbanization and altered cover) (SASWA 2005).

Flooding and Erosion

Virtually the entire shoreline of inner Saginaw Bay is flood prone and the potential for environmental and property damage is a major concern. Prudent use and judicious development of flood prone areas are a major goal of state and local zoning and regulatory programs.

While virtually the entire inner bay is flood prone, much of the outer bay is highly erodible. Numerous stretches have been designated as high-risk erosion areas under Michigan's Shorelands Protection Act (Saginaw Bay/River RAP 1994).

Natural Resources

Wetlands

The most outstanding habitat feature of the Saginaw Bay area is the expansive coastal wetlands of the bay itself, which is the largest remaining freshwater coastal wetland system in the nation. Historic documents indicate that there were approximately 37,400 acres of emergent marsh along the perimeter of the bay prior to western settlement. There were also large expanses of submerged aquatic vegetation in the shallow water zone from the shoreline to a depth of approximately six feet.

This shallow water protected habitat, open to the entire Great Lakes system through Lake Huron, is critical to the sustainment of Great Lakes fish and waterfowl populations. By 1973, emergent coastal marsh vegetation had decreased to approximately 17,800 acres as the result of conversion to agricultural uses, fill for industrial or urban development, and erosion. Even today, many parcels of the remaining privately owned wetlands along Saginaw Bay are under increasing developmental pressure as demand for recreation access/use and shoreline living space intensifies with improving water quality conditions (Saginaw Bay/River RAP 1994). The important wetland areas that remain in the Kawkawlin River Watershed area managed by the BASWA are portrayed in Map #3. All together, wetlands compromise a small percentage of the land mass of the Kawkawlin River Watershed. Additionally, much of the agricultural land in the watershed is converted wetlands. Wetlands filter sediment and pollutants from storm water runoff, recharge groundwater aquifers, support natural water and nutrient cycles and provide habitat for a wide range of biota (SASWA, 2005).

Wildlife Habitat and Recreation

The coastal areas are important for both fish and wildlife habitat. In addition, because of their unique nature, Great Lakes coastal areas have a relatively large number of threatened and endangered species and communities associated with them (Saginaw Bay/River RAP 1994). The North Branch of the Kawkawlin River is vital to the reproduction of many fish species including walleye.

Facilities for non contact recreation activities, such as camping, bicycling, walking and hiking, picnicking, nature study, and bird watching are readily available along the shoreline of Saginaw Bay.

Michigan State Park Use- Saginaw Bay Area (1992-1993)

Table 3

STATE PARK	SIZE (ACRES)	VISITORS – DAY USE	VISITORS - CAMPERS
Tawas Point	185	194,460	83,931
Bay City	224	337,507	70,676
Sleeper	1,795	73,960	75,424
Port Crescent	569	67,059	79,059
Total		672,086	309,083
Saginaw Bay/River RAP 1994			

Recreation in the Kawkawlin River Watershed

In addition, to state parks, there are 10 sites identified as county, township, or municipal parks and /or campgrounds, with frontage on Saginaw Bay. No use data are available for the sites, but their location suggests that water-related non-contact recreation activities take place.

Bay City has a well developed park system on the river including Bigelow Park, Veterans Memorial Park, and Wenonah Park. These parks offer a variety of recreational activities including team sports, picnicking and skating. Smith Park in Essexville offers many activities including a boat launching facility.

Bird watching is a very popular recreational activity in and around the Saginaw Bay. Popular spots for watching include the Fish Point Wildlife Ares near Unionville and the Tobico Marsh in the Bay City State Recreation Area. Other popular recreational activities are hunting, fishing and general wildlife viewing. Surveys conducted by the U.S. Fish and Wildlife Service show that for 1980 over one million Michiganders enjoyed hunting and over 6.6 million users participated in the non-consumptive use of wildlife (Saginaw Bay/River RAP 1994).

Fishing and Water-based Recreation in the Saginaw Bay

Recreation in Michigan centers on the countless waster-related opportunities offered by being surrounded by the Great Lakes. Opportunities for boating, fishing, swimming and hunting are unparalleled. Nationally, Michigan ranks first in the number of registered pleasure boats. The bay, sheltered by land on three sides has numerous access sites, marinas, harbors, and is a nationally significant resource. The Saginaw Bay is a world class walleye fishery. Walleye fishing annually attracts thousands of anglers for both warm season and ice fishing. The walleye spawning runs attract thousands of anglers to the Saginaw River and its tributaries each spring for the annual spring run. The Saginaw Bay walleye population is growing faster than any other major walleye population in the Midwest. Other popular species for anglers include yellow perch, largemouth bass, smallmouth bass, northern pike, brown trout, lake trout, chinook salmon, and steelhead.

In addition to the public access sites, there are 17 state, county and local parks or campgrounds along the shoreline providing opportunities for contact recreation activities with two being in Bay County. Activities at these sites include swimming, sunbathing, camping and other day use activities. The Kawkawlin River serves as both an attractive vacation home site but also as an important harbor for recreational watercraft.

Land Uses

Land use is very diverse in the Saginaw Bay basin spanning a spectrum from relatively undisturbed natural areas, to intensive agricultural lands, to heavily industrialized urban settings. Agriculture is the most extensive single category of land use in the Saginaw Bay drainage basin accounting for just over 60% of the land area. The most concentrated areas of agriculture activity occur in lake plain soils along the eastern and southern shore of Saginaw Bay. In terms of total cropland acreage, Sanilac, Huron, Tuscola, Saginaw and Gratiot counties have the most acreage among the basin counties.

Land Use in Bay County

LAND USE	*ACRES*
Agriculture	194,382
Forest	39,216
Urban	19,461
Open	16,618
Other	10,775
Wetlands	6,918
Total Saginaw Bay/River RAP 1994	287,370

Table 4
Saginaw Bay/River RAP 1994

Land use in the Kawkawlin River Watershed is generally consistent with land use patterns in Bay County. Primary land uses in the management area are primarily agriculture, forest and urban development. Maps #4 shows land use in both the BASWA Urban Area and more specifically the Townships of Kawkawlin, Monitor and Bangor.

Land use in the Kawkawlin River Watershed

Land use	***North Branch Kawkawlin River***	***South Branch Kawkawlin River***
Urban	2.6%	12.6%
Agriculture	43.1%	73.3%
Forested	40.2%	7.5%
Water	0.1%	0.3%
Nonformal	6.1%	4.7%
Wetland	7.9%	1.6%

Table 5
Saginaw Bay/River RAP 1994

Community Profile

Bay County

Bay County is located in Mid-Michigan on the south east side of Saginaw Bay. The county encompasses a land area of 200 square miles. Average county population is 248.0 persons per square mile. This compares to a Michigan average of 175.0 persons per square mile.

Bay County Facts (US Census 2000)

STATISTIC	*BAY COUNTY*	*MICHIGAN*
Population, 2005 estimate	109,029	10,120,860
Population, per cent change 2000-2005	-1.0%	1.8%
Population 2000	110,157	9,938,444
Population, percent change 1990-2000	-1.4%	6.9%
Persons under 5 yrs old, percent, 2000	5.9%	6.4%
Persons under 18 yrs old, percent, 2000	23.2%	25.1%
Persons 65 years old and over, percent, 2004	15.0%	12.3%
High school graduates, percent of persons age 25+, 2000	82.4%	83.4%
Bachelor's degree or higher, pct of persons age 25+, 2000	14.2%	21.8%
Housing units, 2004	47,617	4,433,482
Homeownership rate, 2000	79.3%	73.8%
Per capita money income, 1999	$19,698	$22,168
Median household income	$39,151	$46,291
Private nonfarm establishments, 2003	2,492	237,122
Private nonfarm employment, 2003	33,024	3,885,221
Private nonfarm employment, percent change 200-2003	-6.5%	-4.6%
Housing Unit Bldg Permits	405	54,721

Table 6

Bay County has experienced a one-percent population decline over the last five years. This decline can be attributed to the general decline in manufacturing (Private nonfarm employment) in the State of Michigan and Bay County. While some suburban townships have shown growth the general population of Bay County is in decline. As shown by the US Census the population of Bay County has been in decline since 1990.

Population Density in the Kawkawlin River Watershed Management Area

Population in the Kawkawlin River Watershed management area is concentrated in Bangor Township, the south of Kawkawlin Township and the east of Monitor Township. The north and west parts of Kawkawlin and Monitor Townships remain mostly rural and less populated. Map #5 shows the general population density (per sq. mile).

Bay County Economic Characteristics (US Census 2000)

Occupation Statistics

OCCUPATION	*NUMBER*	*PERCENT*
Management, professional, and related occupations	13,648	26.9%
Service Occupations	8,516	16.8%
Sales and Office Occupations	13,769	27.1%
Farming, fishing and forestry	203	0.4%
Construction, extraction, and maintenance	5,514	10.9%
Production, transportation, and material moving	9,154	18.0%
Public administration	1,672	3.3%

Table 7

As shown by the Census 2000 most employment centered on management, retail service and manufacturing industries.

Industry Statistics

INDUSTRY	*NUMBER*	*PERCENT*
Agriculture, forestry, fishing, hunting and mining	549	1.1%
Construction	3,454	6.8%
Manufacturing	9,502	18.7%
Wholesale trade	1,727	3.4%
Retail trade	7,434	14.6%
Transportation and warehousing, and utilities information	2,318	4.6%
Finance, insurance, real estate and rental and leasing	2,466	4.9%
Professional, scientific, management, administrative and waste management services	2,865	5.6%
Educational, health and social services	10,872	21.4%
Arts, entertainment, recreation, accommodation and food services	4,261	8.4%
Other services (except public administration)	2,539	5.0%
Public administration	1,672	3.3%

Table 8

The primary employers in Bay County continue to be manufacturing with the addition of the growing service sector. The primary growth in the service sector is in the area of health, education and social services. Along with the growth in white collar employment came the migration of housing to the suburbs and waterfront development on the Saginaw Bay shoreline and the Saginaw and Kawkawlin Rivers.

Water Quality Impairments and Designated Uses

The primary criterion for water quality is whether the water body meets designated uses. Designated uses are recognized uses of water established by state and federal water quality programs. In Michigan, the goal is to have all waters of the state meet designated uses.

All surface waters of the state of Michigan are designated for and shall be protected for all the following uses:

- Agriculture
- Industrial water supply
- Public water supply
- Navigation
- Warm water fishery
- Other indigenous aquatic life and wildlife
- Partial body contact recreation
- Total body contact recreation between May 1 and October 31

Developing a Watershed Management Plan for Water Quality 2000

Identifying the designated uses that are not being met and those uses that are threatened by activities on the land is a critical part of all watershed management plans (Developing a WMP 2000).

The RAP (Remedial Action Plan) Report (1988) details a description of the existing condition of the Saginaw Bay Area of Concern. An update report prepared for The Partnership for the Saginaw Bay Watershed titled *Measures of Success: Addressing Environmental Impairments in the Saginaw River and Saginaw Bay* provides a brief account of the historical practices responsible for impairments and celebrates progress to date in addressing problems and proposed measurable goals for the future.

Designated Uses and Listed Impairments

Designated Uses	Listed Impairments
• Agriculture • Industrial water Supply • Public water supply at point of intake • Navigation • Warm water fishery • Other indigenous aquatic life and wildlife • Partial body contact recreation • Total body contact recreation between May 1 and October 31 (Developing a WMP 2000)	• Restrictions on fish or wildlife consumption • Tainting of fish or wildlife flavor • Degradation of fish and wildlife populations • Degradation of fish and wildlife habitat • Bird or animal deformities or reproductive problems • Degradation of benthos (bottom-dwelling organisms) • Restrictions on dredging • Eutrophication • Restriction on drinking water • Beach Closings • Degradation of aesthetics • Degradation of phytoplankton and zooplankton (Measures of Success, 2000)

Table 9

Pollutants in the Watershed

There are a variety of sources of pollutants that contribute to the impairment of watershed resources. These sources include industrial and municipal discharges, combined sewer overflows and contaminated sediments in the river. The non-point sources include urban lawn fertilizers, construction sites, basement footing tiles, downspouts that connect to sanitary sewers and improper cross connections of sanitary sewers. The majority of the industrial discharges come from the four major urbanized areas in the watershed (Midland, Flint, Saginaw and Bay City).

With sixty percent of the land in watershed in agricultural production the nutrient and sediment loads created by agriculture are a major contributor to the degradation of water quality in the watershed. The continued development of agricultural drains continues to contribute to the problem. However, best management practices now being deployed in the watershed by the agricultural are beginning to mitigate the impacts.

Bathing Beach/Surface Water Quality Monitoring Program

During the summer of 2005, the staff of the Bay County Health/Environmental Health Division conducted the Bathing Beach/Surface water Quality Monitoring Program. Funded by a grant from the Michigan Department of Environmental Quality, the program was conducted during peak recreational water use times in areas throughout Bay County. The program started the week of May 30 and ended the week of August 29.

Eight sampling stations were used throughout the county. Five locations were sampled on Saginaw Bay, two on the Saginaw River and one on the Kawkawlin River. Each station was chosen in regards to its use as a public beach and/or its location in the watershed as a key monitoring site. Three samples were taken at each site at least one time per week throughout the thirteen week monitoring period. Water samples were tested for the number of *Escherichia coli, (E Coli)* organisms per 100 ml of water using the *Colilert* bacteriological testing method. Results were published as a daily geometric mean each week and as monthly geometric mean every thirty days.

2005 Bacteriological Water Sample Results- Geometric Mean (Bay Co Health Dept. 2005)

NO	SAMPLING STATION	5/30	6/06	6/13	6/20	6/27	7/04	7/10	7/18	7/25	8/08	8/22	8/29	TOT SUMMER MEANS 5/30-8/22
1	Veteran's Park South	9	71	235	69	20	11	3	6	4	5	2	6	10.39
2	Veteran's Park North	10	131	327	48	14	100	36	100	40	56	84	21	56.20
3	Wenona Beach	22	408	19	9	8	3	1	1	5	5	7	13	6.38
4	Kawkawlin River	41	365	547	117	146	1151	53	29	158	43	127	31	115.48
5	Bay City State Rec Area	30	59	5	3	8	437	3	3	7	1	59	2	8.65
6	Brissette Beach	83	11	1	1	1	429	9	2	1	1	20	2	5.13
7	South Linwwood Beach	2	23	1	2	3	27	4	1	2	3	9	1	3.00
8	Pinconning Park	2	20	11	2	2	20	1	1	3	2	2	1	3.28

Test results of 0 are reported as <1 following the recommended *Colilert* test reporting protocol

Table 10

The data shows that the single event standard of 300 *E. Coli* organisms per 100 ml was exceeded seven times over the regular weekly testing. The Bay County Health Department issued total body contact advisories on the Kawkawlin River three times and one each at Wenona Beach, Veteran's Memorial Park in Bay City, Bay City Recreation Area and Brissette Beach. The data also shows that the 30 day standard of 130 *e. coli* organisms per 100ml was exceeded two times over the course of the year (Bay Co Health Dept 2005). The Bay County Health Department issued a total body contact advisory at the end of June and it continued through the beginning of August, lasting approximately thirty-four days.

Although point and non-point sources of these contamination events cannot be identified directly, there are many different explanations as to what may have caused contamination to the rivers and Bay. First and foremost, combined and raw sewage overflow have been the main source of *E. coli* contamination. Both of these are caused from excess storm water runoff into combined and sanitary sewers (Bay County Health Dept. 2005).

The data shows a significant elevation in the count on the Kawkawlin River at the test site in Bangor Township. The elevated count indicates the importance of controlling raw sewage runoff from overflow and malfunctioning OSDSs in a watershed with low base flow.

High Flow and Nutrient Loading

Urbanization and development in the watershed has resulted in increased hydrological flow throughout the watershed. Man-made agricultural drains and storm-water conveyance systems have increased storm-water runoff. Both of these have increased both the volume and quantity of nutrients that are deposited into the Kawkawlin River and the Saginaw Bay. Elevated plant growth and algal blooms are a direct result of elevated levels of nitrogen and phosphorus in the water. The increased frequency of algal blooms in and around the beaches at the Bay City Recreation Area are a predictable result of the increased nutrient loading of the Saginaw Bay from the Kawkawlin River and other Bay tributaries.

Phosphorus

Wind and water erosion of agricultural land is also the major source of nutrients in the Kawkawlin River and Saginaw Bay. One of the primary reasons is the use of phosphorous and nitrogen fertilizers to increase overall soil fertility and productivity. Fertilizer use has become an integral part of agriculture over the past several decades and the amounts used continue to increase. Fertilizer sales in Michigan increased from over $131 million in 1974 to $242 million by 1982 (Saginaw Bay/River RAP 1994).

Not all of the fertilizer applied is utilized by the crops. Many agricultural soils have high residual phosphorus test values and are reaching saturation point, indicating that this increased application may not be necessary (Saginaw Bay/River RAP 1994). The Michigan Department of Agriculture has estimated that the average phosphorus application in the Saginaw Bay watershed is more than twice what is needed for crops, with applications of 21,015 metric tons (23,116 tons) versus crop phosphorus needs of 9,214 metric tons (10,135 tons) (Saginaw Bay/River RAP 1994).

Priority river basins for fertilizer use were designated in the coastal and Cass River watersheds of the Saginaw Bay drainage basin by Yocum et al (1987). Priority basins were defined as those that were partially or totally included in a county ranked among the top five Michigan counties for fertilizer sales per cropland acre, and contain cropland on either low infiltration rate or high clay soils. Bay, Huron, Saginaw and Tuscola counties are also considered priority management counties for phosphorus reduction efforts under Michigan's phosphorus reduction strategy and will receive greater consideration for the development of accelerated fertilizer and residue management programs (Saginaw Bay/River RAP 1994).

Non-point phosphorus loads to Saginaw Bay are influenced by many of the same factors that affect sediment delivery rates since much of the phosphorus moved off-site is bound to soil particles. However, extensive use of drainage tiles in the Saginaw Bay watershed makes phosphorus transport more complex. Though subsurface drainage tiles increase water percolation through the soil, and thereby generally reduce soil transport, they can contain higher concentrations of soluble phosphorus than surface water run-off (Saginaw Bay/River RAP 1994).

Animal wastes are another significant source of phosphorus to Saginaw Bay. More than 1.7 million metric tons of animal waste is produced annually in the Saginaw Bay basin with almost a million metric tons potentially available to area waters (Saginaw Bay/River RAP 1994).

Urban areas also contribute to the nutrient load of the watershed. Residential fertilizer use has increased along with an increasing interest by landowners in a more cultured landscape. Fertilizers are often applied incorrectly with some of the most fertilized areas being high- income housing surrounding the watershed's lakes and streams.

Nitrogen

Nitrogen is found naturally in surface waters and may enter the water through several natural processes. Nitrogen may also enter surface water through discharges, including household wastewater, municipal waste, industrial waste and agricultural run-off. Excessive nitrogen loads in the water encourage the growth of some toxic types of algal growth. High levels of nitrate in drinking water can also cause serious health effects in infants.

Kawkawlin River Watershed Ecological Indicators

As part of the Saginaw Bay Watershed Prioritization Process (DNR 1994), the ecological indicators for suspended solids, total phosphorous and total NO2 + NO3 in the Kawkawlin River were ranked relative to other pollutants and impairments. All three (suspended solids, total phosphorous and total NO2 + NO3) were found to be a medium priority. The data on source delineation came from watershed agency or basin committee surveys. The table below summarizes the data relative to the Kawkawlin River from that study:

Indicator or Source Reviewed	***Priority Ranking***
Suspended Solids	Medium
Total Phosphorous	Medium
Total NO2 + NO3	Medium
Livestock Access	Low
Tillage Practices	Medium to High
Septic Contamination	Low
Urban	Low to Medium
Water Erosion	Medium
Wind Erosion	Medium to High
Stream Bank Erosion	Medium to High
Sediment Delivery	Medium to High

Table 11

Sedimentation

Erosion

Wind and water erosion of agricultural land is the major source of sediment in the Kawkawlin River and Saginaw Bay. Erosion rates are influenced by a variety of factors such as soil type, water infiltration rates, vegetative cover, management techniques and climate. Agricultural crop lands generally have higher erosion rates than permanently vegetated lands and subsequently deliver a greater amount of eroded material. Subsurface drainage tiles are used extensively in many areas of the Saginaw Bay drainage basin with heavy soils, which can reduce surface erosion. Water discharged from a subsurface drainage tile carries less suspended sediments than surface water runoff (Saginaw Bay/River RAP 1994).

Sedimentation effects both biota and hydrology of rivers and the Saginaw Bay. Deposition of sediments can cover critical spawning habitat for fish, amphibians and macro-invertebrates. Many industrial pollutants also attach to particles and are transported throughout the watershed.

Impaired Designated Uses

The impaired designated uses in the Kawkawlin River Watershed are summarized in the Table 12:

IMPAIRED DESIGNATED USE	*POLLUTANTS & CONSEQUENCES*	*WATER QUALITY IMPAIRMENT*
Agriculture	Flooding & toxic sediments	Flood damage to crops and toxic contamination of soils
Aquatic Life and Wildlife	Sediments, pesticides, chemicals and heavy metals	Toxic to animals, macro-invertebrates and other beneficial organisms
Partial and full body contact	*E. coli* bacteria and nutrients	Public health threat and aesthetic threat to water use

Table 12

The designated use for agriculture is impaired by the high flow impact of flooding and the resulting damage to crops. Soils susceptible to flooding and poor drainage compound the problem. The designated use of supporting aquatic life and wildlife was found to be impaired by sediments, pesticides, chemicals and heavy metals. These substances are a direct threat to aquatic and life and wildlife and a threat to bio-accumulate. Sediments increase turbidity which results in negative impacts on biota. Sediments carry nutrients (phosphorus and nitrogen) that promote algal growth and other water-based plants. Blue-green algae is a health hazard capable of causing skin irritation, swollen lips, eye soreness, earache and asthma for those who come in contact with the water. Pesticides, chemicals and heavy metals are directly toxic to some life forms and are passed up the food chain through others and can be a direct threat to humans. *E. Coli bacteria* in the water is a direct threat to humans when found the water at concentrations above a certain level. Increased nutrients in the water can also be a direct threat to humans causing skin irritations and other health complications.

Threatened Designated Uses

The Threatened designated uses found in the Kawkawlin River Watershed are summarized in table 13:

THREATENED DESIGNATED USE	*POLLUTANTS*	*WATER QUALITY THREAT*
Public Water Supply	*E. coli* Bacteria	E. coli is a direct threat to public health
	Nutrients	High levels of nutrients results increased algal growth that can be a direct threat to human health and affect water quality
Warm Water Fishery	Sediment	Degrades habitat through increased turbidity and deposits covering gravel spawn habitat& also reduces insect and invertebrate populations
	Nutrients	Reduces dissolved oxygen
	Hydrology	Flooding and high water storm water volume
	Pesticides	Toxic to fish
	Oils, Chemicals, Heavy Metals	Toxic to fish and other animals on the food chain through bioaccumulation

Table 13

The Bay City Urban Area draws drinking water from the Saginaw Bay. High levels of *e. coli* requires additional treatment of drinking water which adds significant cost to providing quality drinking water. High levels of nutrients in the Bay can promote the uncontrolled growth of algae and other water-base plant life that can affect the taste and odor of drinking water. In addition, algae also produces toxins which requires additional expensive water treatment.

Degradation of the warm water fishery is a result of the impacts of sediments, excessive nutrients, hydrology, pesticides and the toxicity caused by oils, chemicals, and heavy metals. Sediment covers critical spawning habitat and destroys the invertebrates that are a major food source for a majority of the fish species. Turbidity also lowers the ability to intake oxygen through their gills. Nutrients increase algae and plant growth which causes oxygen depletion when plants die and decompose. Pesticides, oils, chemicals, and heavy metals are a direct toxic threat to fish and wildlife. Significant changes in water volume and stream flow can cause rapid changes in water temperature and leave fish trapped in holes when the water flow rapidly decreases.

Designated Uses Meeting Requirements

The waters of the Kawkawlin River meet the designated uses of industrial water supply and navigation as defined by the State of Michigan.

Sources and Causes of Pollutants

The sources and causes of pollutants (known (k) and suspected (s)) are detailed in Table 14:

POLLUTANT	*SOURCE OF POLLUTANT*	*CAUSE OF POLLUTANT*
Sediment (k)	Stream banks (k)	Human access and use (vehicles, foot and livestock)
		Wildlife Access
		Historic human use (logging)
		Bank erosion from high water flows
	Road-stream crossings (k)	Lack of vegetation replacement at road cuts
		Unpaved Crossings
		Improperly maintained crossings
	Road and drain ditches (k)	Lack of vegetation established or maintained
	Construction sites (k)	Improperly designed erosion control measures
		Improperly maintained erosion control measures
	Urban runoff (s)	Sand/sediment from snow removal
		Impervious service runoff
	Agriculture runoff (k)	Lack of erosion control for sheet runoff
		Rill and gully erosion on field perimeters
	Agricultural drain systems (k)	Poorly designed tile drain systems
		Failing drain structures
Hydrology (k)	Storm water runoff (k)	Increased impervious area due to development
		Malfunctioning and improperly designed storm water retention systems
	Dam discharges (s)	Lack of dam discharge supervision and regulation

	Historic Uses (k)	Extensive drainage system functions too well
Pesticides & Herbicides (k)	Agricultural runoff (k)	Lack of buffer strips around agricultural fields
	Urban runoff (k)	Lack of buffer strips around water bodies
		Improper application of fertilizers
Oils, chemicals & heavy metals (k)	Storm drains (k)	Improper disposal of waste through storm drains
	Impervious surfaces (k)	Oils & other soluble waste substances transported through run off
	Washing (s)	Wash water from vehicles
		Wash water from street or driveway cleaning
		Personal/Industrial wash facilities improperly connected
	Industrial waste (s)	Illicit connection to storm conveyance system
		Improper disposal of waste through storm drainage system
Nutrients	Septic Systems (s)	Limited depth to groundwater table
		Illicit connection to storm water conveyance system
		Lack of proper maintenance
	Animal waste (s)	Household pet waste
		Farm animal waste
	Household Chemicals (s)	Dish detergents discharged through illicit connections
		Detergents from washing vehicles, house etc.
	Agricultural runoff (k)	Run off from agricultural lands
		Improper application of fertilizers
	Urban runoff (k)	Runoff into storm water system
		Improper application of fertilizers
E. Coli Bacteria & Pathogens (k)	Septic systems (k)	Illicit connection to storm conveyance system
		Over-use of existing systems
		Improper installation and operation (older systems)
	Animal waste (k)	Household pet waste
		Farm animal waste

Table 14

Prioritization of Pollutants

The BASWA prioritized the importance of pollutants in the Kawkawlin River Watershed by ranking them by their anticipated impact on public health. Those pollutants that most impact human health will be addressed first in the Watershed Management Plan. Next addressed will be pollutants that degrade water quality for recreation and tourism; those pollutants that degrade fish and wildlife habitat and those pollutants that affect agriculture and industry. This ranking is portrayed in table 15:

DESIGNATED USE	***POLLUTANT***	***PRIORITY RANKING***
Public water supply	*E. Coli* & nutrients	1
Full and partial body contact	*E Coli* & nutrients	2
Warm water fishery & wildlife habitat	Sediments, oils chemicals & heavy metals, pesticides & herbicides	3
Agriculture	hydrology	4

Table 15

Restoration Goals and Objectives

Below are tables and other information relative to the goals and objectives concerning the restoration of desired uses within the Kawkawlin River Watershed management area. So far the WMP has discussed the desired uses and physical characteristics of the watershed; the pollutants that are impairing and threatening designated uses have been identified and prioritized; and the sources and causes of the pollutants have been specified.

A summary of the goals and objectives of the Watershed Management Plan relative to each of the impaired, threatened and designated uses are summarized in Table 16:

THREATENED DESIGNATED USE	***GOAL***	***OBJECTIVE***
Public Water Supply	Protect drinking water supply	Reduce *E. Coli* bacteria, nutrients, and pathogens entering water courses
Warm Water Fishery	Restore and protect habitat	Reduce storm water peak flows
		Reduce sediment, nutrients and chemicals entering water courses

IMPAIRED DESIGNATED USE	*GOAL*	*OBJECTIVE*
Aquatic Life and Wildlife	Enhance and protect habitat for native wildlife	Reduce sediments, nutrients and chemicals entering water courses
Agriculture	Preserve and protect the fertility and production capability of existing agricultural land	Reduce flood damage and remove excess nutrients and toxic chemical runoff into water courses
Partial & Full Body Contact	Restore safe recreational use of involving partial & full body contact to all surface waters	Reduce nutrients, *E. Coli* bacteria, and pathogens entering water courses

Table 16

Illicit Discharge Elimination Program

The first step toward restoration of desired uses began with the development of the Illicit Discharge Elimination Program. In November of 2005 the BASWA deployed it's IDEP with one, two and three year goals as summarized in the activities outlined Table 17:

ACTIVITIES TO BE COMPLETED IN 12 MONTHS	***ACTIVITIES TO BE COMPLETED IN 24 MONTHS***	***ACTIVITIES TO BE COMPLETED IN 36 MONTHS***
Train staff on how to recognize and find illicit connections and discharges, including OSDS discharges	Perform verification and screening on at least 33% of the known PSDs	Perform verification and screening on at least 33% of the known PSDs
Evaluate existing legal authority to prohibit and remove illicit connections and discharges an identify changes of improvements needed for permit compliance	Complete a utility map of the urbanized area.	Continue follow-up investigation and rededication on identified illicit connections
Develop a work plan and schedule prioritizing field verification and screening activities with in the urbanized area	Implement a strategy to identify and repair potential sanitary sewer seepage issues based on utility map	
Perform initial verification and screening on at least 33% of the known PSDs	Continue follow-up investigation and remediation on identified illicit connections	
Begin investigation and rededication of potential illicit connections	Prepare annual report	

IDEP (2005) Continued

ACTIVITIES TO BE COMPLETED IN 12 MONTHS	***ACTIVITIES TO BE COMPLETED IN 24 MONTHS***	***ACTIVITIES TO BE COMPLETED IN 36 MONTHS***
Complete a utility map of the urbanized area		Prepare Annual Report
Develop and establish a public complaint and reporting system		
Implement a construction contract program for reporting of illicit connections		
Prepare annual report		

Table 17

The IDEP (2005) began to deploy activities that would assist in the restoration of BASWA's first priority of protecting designated uses relative to human health. The WMP will follow with supporting important action plan objectives:

Public Water Supply

POLLUTANT	***SOURCE***	***ACTION PLAN OBJECTIVES***
E. Coli Bacteria & other human coliform pathogens	On-site Septic Disposal Systems	Train appropriate staff to recognize and find OSDS discharges
		Screen for OSDS failure
		Educate the public about proper septic system installation and indicators of failure
		Educate owners on proper maintenance of OSDS
		Educate the public on treated discharge
Nutrients	Septic Systems	Determine if septic discharge is contaminating the groundwater
	Animal Waste	Educate the public on the proper disposal of pet waste
		Educate farmers and commercial operators on the proper disposal of animal waste
	Household Chemicals	Educate public on the importance of disposing of various household cleaning chemicals and washing detergents properly
	Agricultural Runoff	Address areas of heavy runoff from farm fields into the storm water collection system
		Educate farmers on the proper fertilization of agricultural lands
	Urban Runoff	Address areas of heavy runoff into the storm water collection system
		Educate residents of the proper way to apply fertilizer to lawns and gardens
		Educate about soil testing

Table 18

Full and Partial Body Contact

POLLUTANT	*SOURCE*	*ACTION PLAN OBJECTIVE*
E. Coli Bacteria & other human coliform pathogens	On-Site Septic Disposal Systems (OSDS)	Screen for point sources of illicit connections to storm water collection system per IDEP
Nutrients	Septic Systems	Determine if septic discharge is contaminating the ground water
		Identify areas where septic systems are illicitly connected to stormwater conveyance system per IDEP
		Educate the public on the proper maintenance of septic systems
	Animal Waste	Educate the public on the proper disposal of pet waste
		Educate farmers and commercial operators on the proper disposal of animal waste
	Household Chemicals	Educate public on the importance of disposing of various household chemicals and washing detergents properly
	Agricultural Runoff	Address areas of heavy runoff from farm fields into the storm water collection system
		Educate farmers of the proper fertilization of agricultural land
	Urban Runoff	Address areas of heavy runoff into the storm water collection system
		Educate residents of the proper fertilization of lawns and gardens
		Educate on proper soil testing

Table 18

Aquatic Life And Wildlife

POLLUTANT	***SOURCE***	***ACTION PLAN OBJECTIVE***
Sediment	Stream Banks	Review of drain maintenance reports when applicable
		Provide a report on stream banks during dry weather screening
		Provide reports to applicable agency for follow-up
		Reduce the amount of erosion and sedimentation by limiting human access & vehicle access when possible
		Implement bank stabilization measures when budgets permit
		Provide documentation to proper agency for action
	Road & Drain Ditches	Train appropriate staff to identify erosion in these drainage systems
		Establish vegetation to prevent erosion in areas reported
	Construction Sites	Develop procedures to report sites of improperly designed and maintained soil erosion measures
		Enforce County ordinances relative to soil erosion on construction sites
	Urban Runoff	Educate public on proper disposal of wash waters containing suspended solids
		Direct runoff flow to grassy areas
		Create vegetated buffer strips
		Promote use of swales, rain gardens and vegetated waterways
	Agriculture Runoff	Document areas of poor drainage designs, failing drain structures, and poor erosion control practices
		CREP strip education
		Buffer Strips by drains
		Educate farmers on Best Management Practice
Pesticides	Agriculture Runoff	Encourage the importance of planting buffer strips around agricultural fields
		Educate farmers on the proper application of fertilizers
		Educate public on the value of buffer strips
		Educate the public on the

		consequences of mowing to close to lakes and streams and other water bodies
Oils, Chemicals and Heavy Metals	Storm Drains	Educate on illicit discharges and all improper disposal of wastes through the storm drain system
		Encourage the use of BMP
		Identify any areas of concern
		Implement proper BMPs for toxic substances
		Educate the public on proper clean up of toxic substances and the proper use of spill kits
		Make sure there are no outlets or drains to stormwater drains

Table 18

Warm Water Fishery

POLLUTANT	*SOURCE*	*ACTION PLAN OBJECTIVE*
Sediment	Stream Banks	Identify areas where bank erosion is occurring due to human or animal traffic or poor bank stabilization
	Road Stream Crossings	Identify and locate river and stream crossings that are improperly graded, lack vegetation or lack of maintenance is causing erosion
	Road and Drain Ditches	Make sure that vegetation or rip-rap is preventing erosion
	Construction Sites	Make sure all construction sites are in compliance with all Soil Erosion and Sediment Control methods
		Make sure all soil erosion and control permits are properly enforced
	Urban Runoff	Educate public on how to reduce sediment in runoff water
	Agricultural Runoff	Identify areas of poor erosion control
		Educate farmers on planting buffer strips of native vegetation adjacent to rivers, streams and other water bodies
Nutrients	Same As Public Water Supply	Same As Public Water Supply

Hydrology	Storm Water Runoff	Identify areas in storm water retention systems and that are not functioning properly
		Educate residents on the importance of reducing impervious surfaces in home design and landscaping
		Educate local government and commercial developers in the reduction of impervious surface in future development
		Comply with discharge guidelines
		Implement BMP to detain runoff as long as possible
	Dam Discharges	Ensure all dams within the watershed are being inspected and meet all standards for proper operation
Pesticides	Agricultural Runoff	Educate farmers and commercial operators on the proper application of pesticides
		Develop and promote the planting of buffer strips around agricultural fields
	Urban Runoff	Educate residents on the proper use and application of pesticides on urban property
		Educate residents on the proper use of buffer strips along urban waterways and ditches
Oils, Chemicals & Heavy Metals	Storm Drains	Educate the public on the negative impacts to human health of toxics infiltrating storm drains
		Promote the labeling of all storm drains informing the public of their direct connection to area waterways
	Impervious Surface	Educate public on the dangers of leaking toxic substances from vehicles entering the storm water conveyance systems
	Washing	Educate the public on the impacts of toxics from the washing of vehicles and other cleaning processes
	Industrial Wastes	Locate areas of Illicit connections and the source of improper waste disposal into stormwater systems

Table 18

Agriculture

POLLUTANT	***SOURCE***	***ACTION PLAN OBJECTIVE***
Hydrology	Storm Water Runoff	Educate land owners of the importance of proper operation and maintenance of storm water retention systems
		Make sure that retention basins are function properly
		Educate landowners on BMPs relative runoff from agricultural and commercial landholdings
	Dam Discharges	Make sure dams and other water retentions systems are operating properly

Table 18

The primary benefit of deployment of the Watershed Management Plan is to restore the desired uses and restore full public and safe use of the watershed's water bodies. Other benefits from deployment:

1. Increased public awareness and participation.
2. Increase water-based recreation and tourism.
3. Improve the ~~Saginaw~~ Kawkawlin River and Bay Fishery
4. Improve wildlife habitat and the protection and propagation of endangered species.
5. Decrease erosion, the sedimentation and resulting degradation of the Saginaw River and Bay for navigation, agriculture and outdoor recreation.

Connecting Action Pan Objectives and Best Management Practices

Accomplishment of full compliance of designated uses and improved water quality results from accomplishment of the Action Plan Objectives utilizing recognized Best Management Practices.

Implementation of Best Management Practices

A Best Management Practice (BMP) is a land management technique that is implemented to help control pollution at the source. Three common types of BMPs are recognized and used generally to control source-point pollution:

1. Structural – These practices involve the construction of storm water basins and erosion stabilization structures like riprap etc.
2. Vegetative – These practices involve the propagation of plants, grasses and trees to prevent erosion.
3. Prevention Management – These practices involve changing management processes and procedures to prevent pollution.

Potential BMPs

Structural, vegetative and Management BMPs were evaluated to determine which would be of value, if deployed, in the Kawkawlin River Watershed. The critical factors in deploying BMPs is the impact and affordability of the practice.

Agricultural BMPs

The USDA (United States Department of Agriculture) has developed four conservation principals that serve as BMPs four the agriculture industry:

1. Conservation Tillage – The practices under conservation tillage include no-till, strip-till, mulch-till and ridge-till. These practices prevent erosion and the runoff of sediments, pesticides and other chemicals and excess fertilizer.
2. Nutrient Management- These practices focus on the nutrient cycle as it applies to agriculture. Practice provides for the proper application of fertilizer and other nutrients to minimize the runoff of excess nutrients.
3. Pest Management – Pest management practices emphasize the proper use and application of pesticides used to treat crop damaging pests. Through integrated pest management techniques the over use of pesticides and chemicals is reduced and the runoff of excess product is minimized.
4. Conservation Buffers – Also known as vegetated strips, bio-filtration strips or buffer zones. The practice of leaving a natural vegetated strip along a watercourse can reduce sediment loading, nutrient, pesticide and chemical infiltration and provide natural cover for wildlife.

(SASWA 2005)

The EPA has developed the following additional BMPs to complement the four BMPs developed by USDA:

5. Irrigation Water Management – This practice aims to reduce non point source pollution caused by or increased by irrigation systems.
6. Grazing Management – Grazing and browsing animals can cause pollution by deposition of animal waste and their proximity to watercourses. Proper management of grazing land can reduce their impact.
7. Animal Feeding Operation Management – Proper operations of animal feed lots will minimize the impact of waste discharges through runoff control, waste storage, waste utilization and nutrient management.
8. Erosion and Sediment Control – SESC measures conserves soils for farming operations while minimizing the sediment loading of watercourses.

(SASWA 2005)

Construction BMPs

Utilizing BMPs on construction sites reduces environmental impacts and in many instances is required by law. Construction BMP standards exist through several sources and are industry recognized:

1. Runoff Control – Controlling the volume and velocity of water that leaves a construction site is accomplished through correct land development practices that include minimal land clearing and stabilization of natural drain areas.
2. Erosion Control – The exposure of soil during construction has a potential for erosion. Proper protection and stabilization is essential.
3. Sediment Control – Protecting the environment from sedimentation of eroded soil is accomplished through perimeter control, sediment traps, and inlet protection of storm water conveyance systems.
4. Managerial Practices – The management of a construction site includes monitoring all aspects of the project. These BMPs may include everything from equipment storage, workers training, inspection and maintenance practices, waste control and assortment of other practices. Ordinances requiring BMPs may also exist under this category.

General Urban, Suburban and Rural BMPs

Through public input the BASWA considered many suggested general BMPs that could have the potential to impact the reduction of pollutants in the Watershed. Listed below are those that were both affordable and would render immediate impact:

1. Proper Maintenance of Storm Water Retention Systems – Proper maintenance of all public and commercial storm water conveyance and retention systems is crucial to prevent sediment and nutrient loading of water courses. BMPs relative to standards of construction and maintenance are crucial.
2. Downspout Disconnection – The disconnection of residential and commercial downspouts would prevent the volume of runoff entering into storm water

conveyance systems. Storm water should be retained onsite utilizing BMPs to do so.

3. Public Education on BMPs relative to Household Hazardous Waste and Household Hazardous Waste Management – Urban and suburban residents need to be educated on the impact of waste and waste generation practices on the watershed. The lack of knowledge of BMPs and their impact on reducing pollutants generated by improper waste disposal, cleaning practices and the benefits of pollutant prevention need to be reinforced through continual public education.
4. Drainage System Identification – Staff and volunteer efforts to label and educate the public on the location of directly connected storm water drains and the impact of pollutants directly conveyed to storm water drains is essential.
5. Reducing Impervious Surface and Promoting Green Space – Public education on the impact of impervious surface and the benefits of including green space in construction and land development. Included should be the benefits of minimizing impervious surface in all development both residential and commercial.
6. Stream and Habitat Restoration – Both public and private land owners should be educated on the requirements to retain natural stream and habitat environments and educated on the benefits of restoration and their beneficial impact on reducing sediment and nutrient loading.

Fragmentation

Fragmentation is a conservation issue because increasing fragmentation can have a negative effect on the diversity of species and communities in an area. Fragmentation can also affect a species ability to persist in an area as a population. A species ability to migrate in response to habitat, such as conversion from a forested land type to agriculture, or a forest fire, is reduced in highly fragmented ecosystem.

BMP Evaluation and Action Plan Objectives

An evaluation of BMPs relative to cost estimates and impact on the retention or restoration of desired uses was completed and the following five-year action plan was developed for deploying BMPs and accomplishing Action Plan Objectives:

BMP & ACTION PLAN OBJECTIVE	*ESTIMATED COST*	*IMPLEMENTATION INFORMATION*	*YEAR*	*FUNDING SOURCE*
Staff training on recognizing OSDS discharges	**$50 – 75/hr**	**Estimate covers full cost of training including replacement staff**	**2007-08**	**BASWA local budgets & grants**
Screen BASWA watershed parcels for OSDS failure	**$50-75/hr**	**To be completed over a two year period**	**2007-09**	**BASWA local budgets & grants**
Educate public on OSDS failure & proper maintenance of septic systems & household waste management	**$150/hr – staff time & .25/piece**	**Cost estimate based on cost of consultant for development and cost per piece of educational material**	**2007-12**	**grants**
Educate farmers and commercial operators on proper animal waste management	**$150/hr – staff time &.25/pc**	**Cost estimate based on cost of consultant for development and cost per piece of educational material**	**2007-12**	**grants**
Promote the installation of sedimentation strips, filter strips, and vegetated strips to control agricultural & urban runoff **Estimates from SASWA (2005)**	**Swales:** **Seeded-$4.50-8.50/li.ft.** **Sodded-$8.50/li.ft.** **Filter strips:** **Seeded-$200-1000/acre** **Seeded & mulched-$800-3500/acre** **Sodded-$4500-48,000/ac** **Construction-$350/ac** **Maintenance-$10/ac** **Sedimentation Basin:** **Construction-$0.60/cft storage** **Maintenance-7% capital cost annually** **Infiltration Basin & Trench:** **Construction-$8/cft storage** **Maintenance-9%& of capital cost annually** **Vegetated Swales:** **Construct-$0.30/sqft** **Maint.-$0.02/sqft/yr**	**To be deployed through local government permits, economic incentives and education**	**2007-12**	**BASWA local budgets & grants**

Table 19

BMP AND ACTION PLAN OBJECTIVE	*ESTIMATED COST*	*IMPLEMENTATION INFORMATION*	*YEAR*	*FUNDING SOURCE*
Educate farmers on the proper fertilization of agricultural lands	**Undetermined**	**BASWA will collaborate with MSU Ext. and SWCS to educate on proper fertilization techniques**	**2007-12**	**To be determined**
Educate Residents of the proper way to apply fertilizer to lawns and gardens & soil testing	**Undetermined**	**BASWA will collaborate with MSU Ext. and SWCS to educate on proper fertilization techniques**	**2007-12**	**To be determined**
Survey stream banks for erosion problems & erosion potential	**$50-75/hr for staff time**	**To be deployed through collaboration with other government agencies**	**2007-09**	**BASWA local budgets & grants**
Implement bank stabilization when budget permits **Estimates from SASWA (2005)**	**Stream bank stabilization costs:** **Live staking-$1.50-3.50/stake** **Joint planting-$2-9** **Live fascine-$5-9/ln.ft.** **Live cribwall-$10-25/sq.ft./face** **Brush layer cut-$8-13/ln.ft.** **Brush layer fil-$12-50/ln.ft.** **Vegetated geogrid-$12-30/ln.ft.** **Check dam & filer berm:** Construction-$4,650/ea Maint.-$60/yr Gabion wall, retaining walls & tree revetment-undetermined cost	**To be deployed through local government permits, economic incentives and education**	**2007-12**	**BASWA local budgets & grants**
Monitor construction sites and insure that county ordinances and construction BMPs are enforced	**Undetermined**	**To be deployed through collaboration with other government agencies**	**2007-12**	**BASWA local budgets & grants**
Educate on the importance of downspout disconnection from storm water conveyance systems	**$50 per home Estimate per City of Detroit**	**To be deployed through collaboration with other government agencies**	**2007-12**	**BASWA local budgets & grants**
Ensure proper maintenance of storm water retention systems	**Undetermined**	**To be deployed through collaboration with other government agencies**	**2007-12**	**BASWA local budgets & grants**
Label all public drains that are directly connected to the storm water conveyance systems	**$10 per drain**	**To be deployed through collaboration with other government agencies and volunteer groups**	**2007-10**	**BASWA local budgets & grants**
Educate the public on reducing impervious surface and increasing green space and natural areas adjacent to water courses	**Rain garden:** Construction-$500 per home Maintenance-$100/yr SASWA (2005)	**Promote the use of rain gardens & natural areas**	**2007-12**	**BASWA local budgets & grants**
Educate the public on the proper cleanup of toxic substances and the proper use of spill kits	**Sorbent pads-$75-**150 **Spill booms-$10-75** (SASWA 2005) **Staff time & $150/hr**	**To be deployed through collaboration with other government agencies and volunteer groups**	**2007-12**	**BASWA local budgets & grants**
Ensure all dams within the watershed are being inspected and meet all standards for proper operation	**Undetermined**	**To be deployed through collaboration with other government agencies**	**2007-09**	**State budget**

BMP AND ACTION PLAN OBJECTIVE	*ESTIMATED COST*	*IMPLEMENTATION INFORMATION*	*YEAR*	*FUNDING SOURCE*
Locate areas of Illicit connections and the source of improper waste disposal in storm water systems	**Undetermined**	**Deploy per IDEP (2005) 12, 24 & 36 month goals**	**2007-10**	**BASWA local budgets**
Educate landowners of the importance of proper operation and maintenance of storm water retention systems	**Undetermined**	**To be deployed through collaboration with other government agencies**	**2007-12**	**BASWA local budgets & grants**
Make sure retention basins are functioning properly	**Undetermined**	**To be deployed through collaboration with other agencies**	**2007-12**	**BASWA local budgets & grants**

Table 19

Implementation and Evaluation

Economic constraints to implementation of BMPs are a reality that must be dealt with by the BASWA members. Members work with limited and tight budgets especially in the dramatic economic downturn that Michigan has recently experienced. The five year goals outlined in table 19 are therefore aligned to the priorities established in table 15. The immediate impact of the accomplishment of the short term and long term (five year) objectives would be a reduction in the incidence of warnings by the Bay County Health Department and the State of Michigan (Priority Rank 1, 2&3) relative to the use of the Saginaw Bay and the Saginaw River for public water supply, full and partial body contact recreational use and as a warm water fishery relative to fish consumption.

Accomplishment of the five-year objectives would result in the attainment of the following long term goals:

1. Reduce E Coli bacteria, nutrients and pathogens entering water courses
2. Reduce storm water peak flows
3. Reduce sediment, nutrients and chemicals entering water courses
4. Reduce flood damage and toxic chemical runoff

Staff Training and Public Education

As portrayed in the five year goals, staff training and public education are a priority. Since the BASWA has a limited ability to impact private land and water use, public education on the human impacts of land and water use within the watershed is critical. Staff and volunteer training aligned to the accomplishment of the goals in the IDEP 2005 and to complete needed resource surveys is also a critical first step to improve water quality and restore designated uses. Initial specific steps outlined in the Public Education Plan (PEP), included in the appendix, outlined six areas of emphasis in public education:

1. *Education of the public about their responsibility and stewardship in their watershed will be performed emphasizing pollution prevention and the reduction of the discharge of pollutants in storm water.*
2. *Education of the public on the location of residential separate storm water drainage system catch basins, the waters of the state where the system discharges,*

and potential impacts from pollutants from the separate storm water drainage system.

3. *Encouragement of public reporting of the presence of illicit discharges or improper disposal of materials into the applicant's (BASWA) separated storm water drainage system.*
4. *Education of the public on the need to minimize the amount of residential or non-commercial wastes washed into nearby catch basins, county drains and road ditches.*
5. *Education of the public on the availability, location and requirements of facilities for disposal or drop- off of household hazardous wastes, travel trailer sanitary wastes, chemicals, yard wastes and marine/motor vehicle fluids.*
6. *Education of the public concerning management of riparian lands to protect water quality.*

Staff training and public education are important *first step objectives* to accomplish and must be put in place before the objectives relative to remediation can be implemented. BMPs relative to the structural, vegetative and prevention management are only effective if deployed in coordination with public education and staff training which results in a source reduction in point source pollution. This holistic approach to watershed planning and management provides the best opportunity to reach the desired measurable results and the complete restoration of water quality and desired uses of the Kawkawlin River and the Saginaw Bay.

Evaluating Progress

Evaluating progress and measuring results of Action Plan Objectives will be challenging due to the large geographic size of the entire Saginaw River Watershed and the multiple jurisdictions and up-river human impacts that affect the water quality of the Kawkawlin River Watershed Management Area. As a consequence, the measurement of results will focus more on a *check list* detailing accomplishment of Action Plan Objectives that will be annually reviewed by BASWA rather than direct assessment of the resource through water chemistry, sediment chemistry etc. Water courses and water bodies located entirely within the Kawkawlin River Watershed Management Area can be directly assessed and will be when budget permits or when direct assessment can be assimilated into ongoing assessments already being undertaken by the Bay County Drain Commissioner, Bay County Health Department or other local governmental agencies or the State of Michigan. The effectiveness of BMPs in that circumstance can be accurately evaluated for effectiveness and be confidently deployed through-out the entire Kawkawlin River Watershed.

Revising and Updating the Watershed Management Plan

This Watershed Management Plan will be revised and updated as part of an annual review to be completed in the month of January each year by the BASWA. As part of that review, progress toward the accomplishment of Action Plan Objectives will be assessed and necessary changes made.

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Watershed Management Plan for the Upper Saginaw Watershed, Saginaw Area Storm Water Authority, 2005.

Maps

Maps were created utilizing the *Saginaw Bay Watershed Digital Mapping Demonstration Disk*, Saginaw Bay Watershed Initiative Network, East Central Michigan Planning & Development Regional Commission, July 2000.