Cass River Rapid Watershed Assessment Technical Committee

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1.0 Purpose

The Rapid Watershed Assessment (RWA) Program is designed to identify and organize information into one document that conservation leaders, resource professionals and units of governments can use to identify existing resource conditions and conservation opportunities. This will enable the user to direct technical and financial resources to the most significant needs of the watershed. The RWA provides a brief assessment of the Cass River watershed's natural resources, resource concerns and conservation needs.

As part of the Resource Profile, geographic and statistical data was compiled using Geographic Information System (GIS) database. In addition, past studies were reviewed to provide baseline and trend data where applicable.

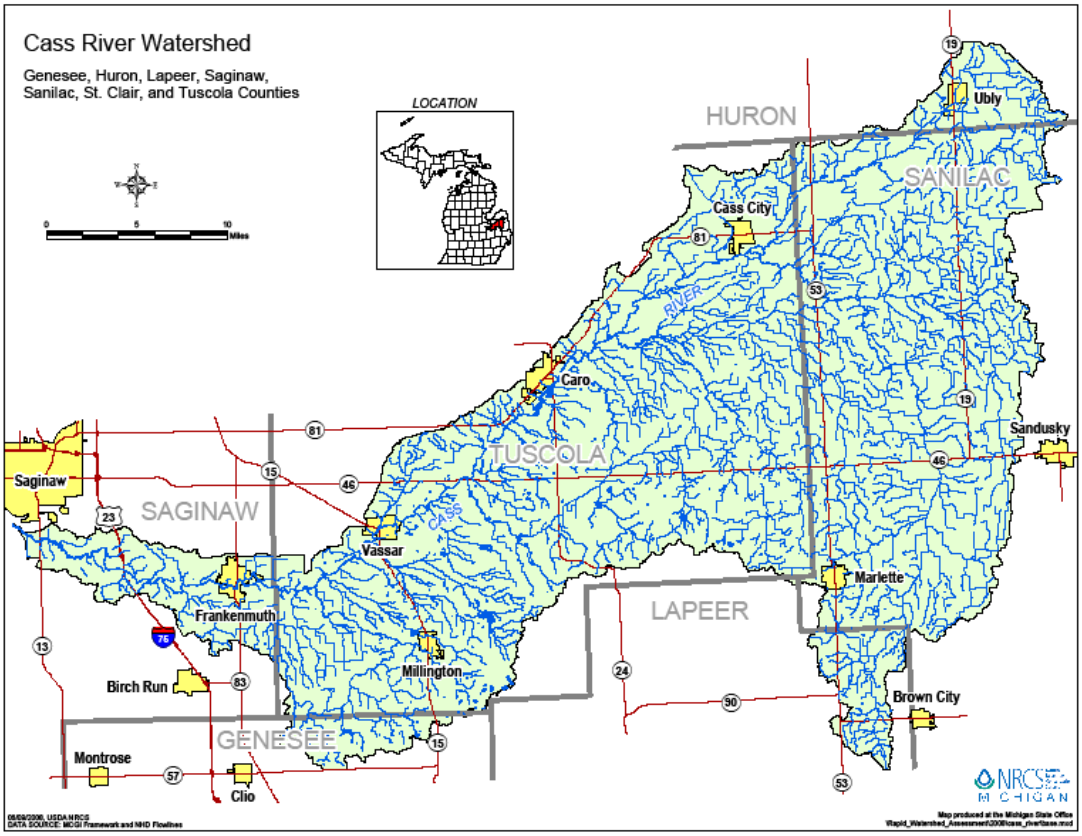
2.0 Introduction

The Cass River Watershed (Map 1) encompasses an area of 908 square miles (approx. 578,812 acres) and contains 1352 total river miles. Of the total river miles, only 352 linear miles are classified as perennial. The Cass River flows to the Saginaw River and eventually to Saginaw Bay. Located in Michigan's Lower Peninsula the watershed includes Genesee, Huron, Lapeer, Saginaw, Sanilac and Tuscola counties. Communities include Bridgeport, Cass City, Caro, Frankenmuth, Marlette, Millington, Tuscola, Vassar, and Ubly. The area is predominately rural with agriculture, tourism and forestry as the main economy.

Most of the topographical features of the watershed are a result of erosion or deposition during the most recent glacial period. The ice from this glacial period began receding from Michigan about 14,000 years ago and completely moved out about 8,000 years ago. Elevations range from 850 feet above sea level in the eastern part of the watershed in Huron County to 580 feet above sea level at it's confluence with the Saginaw River.

There are several organizations in the watershed which coordinate resource protection efforts. These include the Natural Resources Conservation Service, Huron, Sanilac, Tuscola, Lapeer, Genesee, and Saginaw Conservation Districts, Michigan State University Extension, Saginaw Bay Watershed Initiative Network (WIN), Saginaw Bay Resource Conservation and Development Council, Cass River Watershed Restoration Committee, Saginaw Basin Land Conservancy, Michigan Department of Natural Resources (DNR), Michigan Department of Environmental Quality (DEQ), and U.S. Fish & Wildlife Service.

Map 1:
Watershed Base Map



3.0 Physical Description

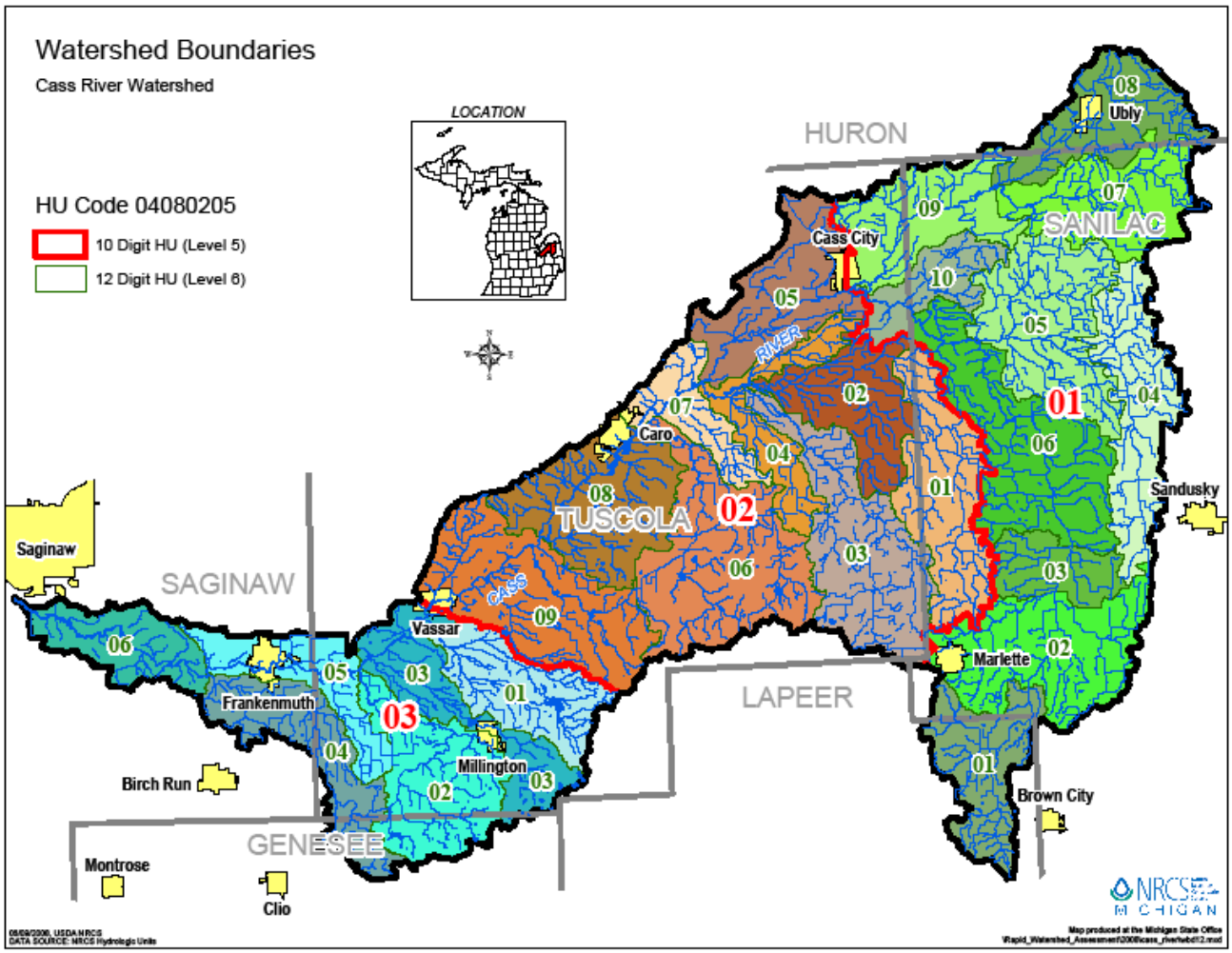
3.1 Sub-basins and River Systems

The Cass River has 3 major sub basins and 25 smaller sub sub basins (map 2 / table 1). The Upper and Middle Cass River sub basins are nearly identical in size covering 39.7% and 39.9% of the basin respectively. Table 1 further defines by acres, square miles and % of watershed the 25 smaller basins.

Eight hundred and thirty-four (834) square miles of this watershed are contained within the Southern Michigan Northern Indiana Till Plains (SMNITP) Ecoregion. The remaining seventy four (74) square miles (western portion) of the watershed are in the Huron and Erie Lake Plain Ecoregion. The Cass River Watershed varies in width from about 15 to 35 miles, and is approximately 55 miles long. In general, the Cass River Watershed is relatively flat with stream flow velocities generally less than one foot per second.

The Cass River is used for industrial water supply, agricultural production, warm water fishing, and navigation.

Map 2:
Watershed Sub-basins



Agriculture and forests are the two major land uses/land covers in the Cass River Watershed, accounting for 57 and 19 percent of the total land area, respectively. Soils in the watershed consist mainly of loamy and silty clays and sands, and are poorly drained in much of the area.

Hydrologic Unit Codes (HUC) for the 10 and 12 digit scales are represented below. As noted below the upper and middle sub basins are nearly identical in size representing almost 80% of the watershed. Table 1: below represent sub basin size. Sub basins are sized on acreage and square miles. Sub basins are also represented as a 10% percentage of the entire basin.

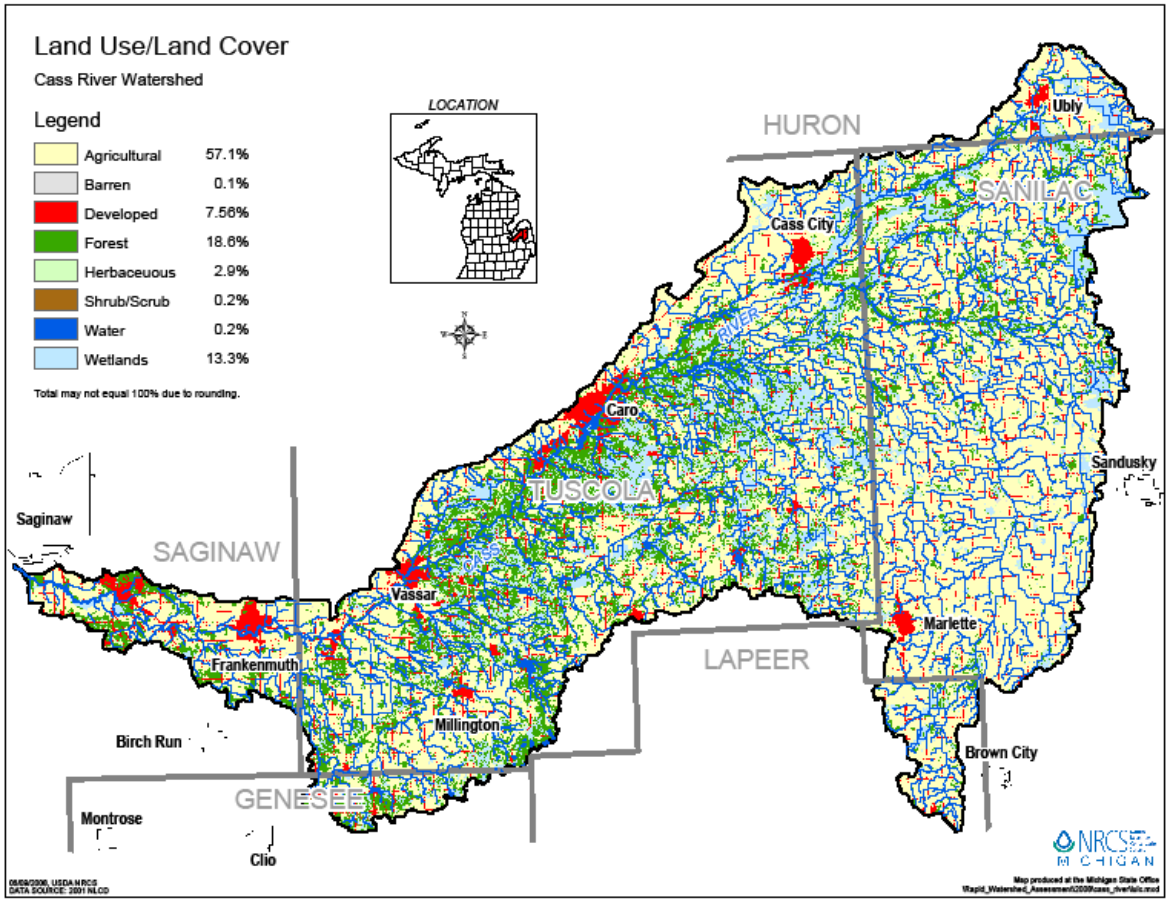
Table 1 – 12 Digit Sub Basin Size

Table 1: Watershed Sub-basins			
Sub-basins	**Acres**	**Sq. Miles**	**% of Total Watershed**
Upper Cass River			39.7
01-Spring Drain	19724	30.8	3.4
02-Duff Creek	31529	49.3	5.4
03-Gerstenberg Drain	11150	17.4	1.9
04-Hartel Drain	25056	39.2	4.3
05-Middle Branch Cass River	29098	45.5	5.0
06-Stony Creek	36500	57.0	6.3
07-South Fork	22757	35.6	3.9
08-Tyre Drain	21164	33.1	3.6
09-North Branch Cass River	22405	35.0	3.9
10-South Branch Cass River	11673	18.2	2.0
Middle Cass River			39.9
01-Clark Drain	25804	40.3	4.5
02-North Branch White Creek	19236	30.1	3.3
03-South Branch White Creek	32449	50.7	5.6
04-White Creek	13917	21.7	2.4
05-Cedar Run	24920	38.9	4.3
06-Sucker Creek	38179	59.7	6.6
07-Butternut Creek	11833	18.5	2.0
08-Scott Drain	29046	45.4	5.0
09-Moore Drain	36078	56.4	6.2
Lower Cass River			20.4
01-Goodings Creek	19761	30.9	3.4
02-Perry Creek	25471	39.8	4.4
03-Millington Creek	20455	32.0	3.5
04-Dead Creek	21462	33.5	3.7
05-Cole Creek	15899	24.8	2.7
06-Cass River	15468	24.2	2.7
Total			**100%**

3.2 Land Cover

Determining current land cover conditions is essential in the watershed assessment process. The type and intensity of land use can contribute to nonpoint source pollution if adequate prevention measures are not implemented. Increasing development places higher demands on the natural resources when forests, riparian lands and open spaces are converted to homes, roads and commercial centers.

Map 3:
Land Use/Cover



Agriculture	57.1%	331,180 Acres
Barren	.1	580
Developed	7.6	44,080
Forest	18.6	107,880
Herbaceous	2.9	16,820
Scrub Shrub	.2	1,160
Water	.2	1,160
Wetland	13.3	77,140

The following definitions describe the land cover classifications.

Developed: Developed land includes residential dwelling structures such as single family or duplexes, multi-family residential and mobile home parks. The total residential land use in the watershed is 43,989 acres (7.6%). The largest concentrations of people in the watershed are located in cities of Bridgeport, Frankenmuth, Vassar, Caro, Cass City Marlette and Ubly.

Herbaceous open land is usually subjected to continuous disturbance such as mowing, grazing, or burning, and typically it can have a variety of grasses, sedges, and covers 16,820 acres (2.9%).

Shrubland is land in transition from being open to becoming forested. It contains native shrubs and woody plants like blackberry, dogwood, willow, sumac, and tag alder. This covers 1,160 acres (.2%).

Agriculture: The agricultural land use category generally includes land that is used for the production of food and fiber. These classes are cropland, orchards (including vineyards and ornamental horticulture), confined feeding operations for livestock of any kind, permanent pasture lands, farmsteads, greenhouse operations, and horse training areas. The total crop land in the watershed is 331,180 acres (57.1%).

Forest: Forest land areas are generally at least 10% covered by trees of any size. The forest category includes upland hardwoods like maple and beech, other upland species like aspen and birch, species of pine like red, white or jack pine, and other upland conifers like white spruce, blue spruce, eastern hemlock, and balsam fir. Lowland forest areas are dominated by tree species that grow in very wet soils. Lowland hardwoods include ash, elm, soft maple, cottonwood and others. Lowland conifers include cedar, tamarack, black and white spruce, and balsam fir. Forested areas in the watershed comprise 18.6% of the area or 107,880 acres.

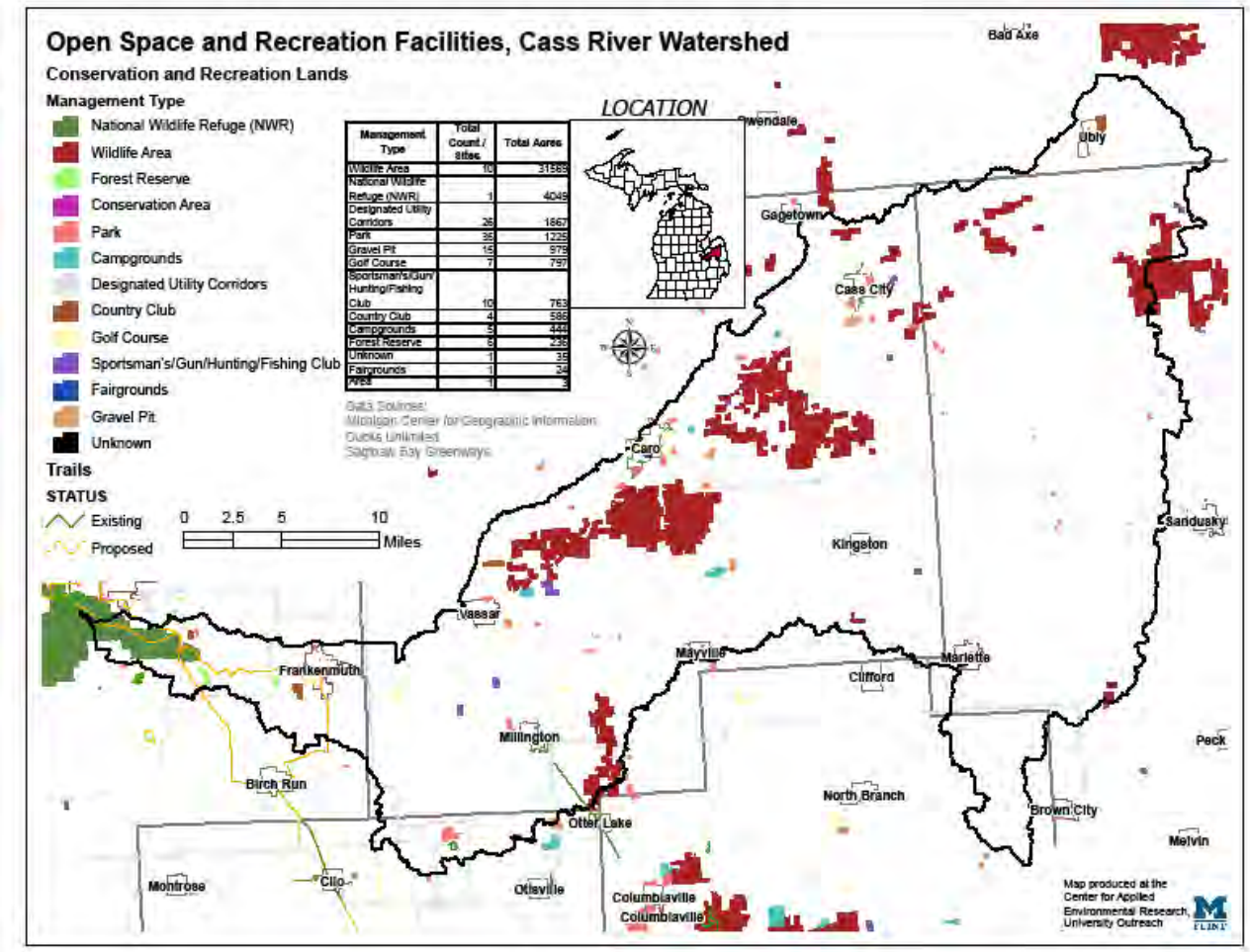
Wetlands: Wetlands are those areas where the water table is at or near the land surface for a significant part of most years. Examples of wetlands are marshes, mudflats, wooded swamps, and shallow areas along rivers, lakes or ponds. Wetlands areas include both non-vegetated mud flats and areas of hydrophytic vegetation. Wetlands in the Cass River Watershed cover 77,140 acres (13.%) of the land.

Surface Water: The surface water category includes areas such as lakes, reservoirs, ponds, rivers and streams. Surface water in the watershed covers 1,160 acres (.2%) of the total land area.

3.3 Public Lands

Recreational lands play an important role in most watersheds. In total 53,761 acres of recreational type lands were identified in the Cass River watershed. Federal Ownership is concentrated on the Shiawassee National Wildlife Refuge in the confluence area of the Cass and Shiawassee Rivers. Refuge acres in the watershed total 4,049. State Game areas comprise another 31,569 acres. Map 4 below indicates additional recreational land.

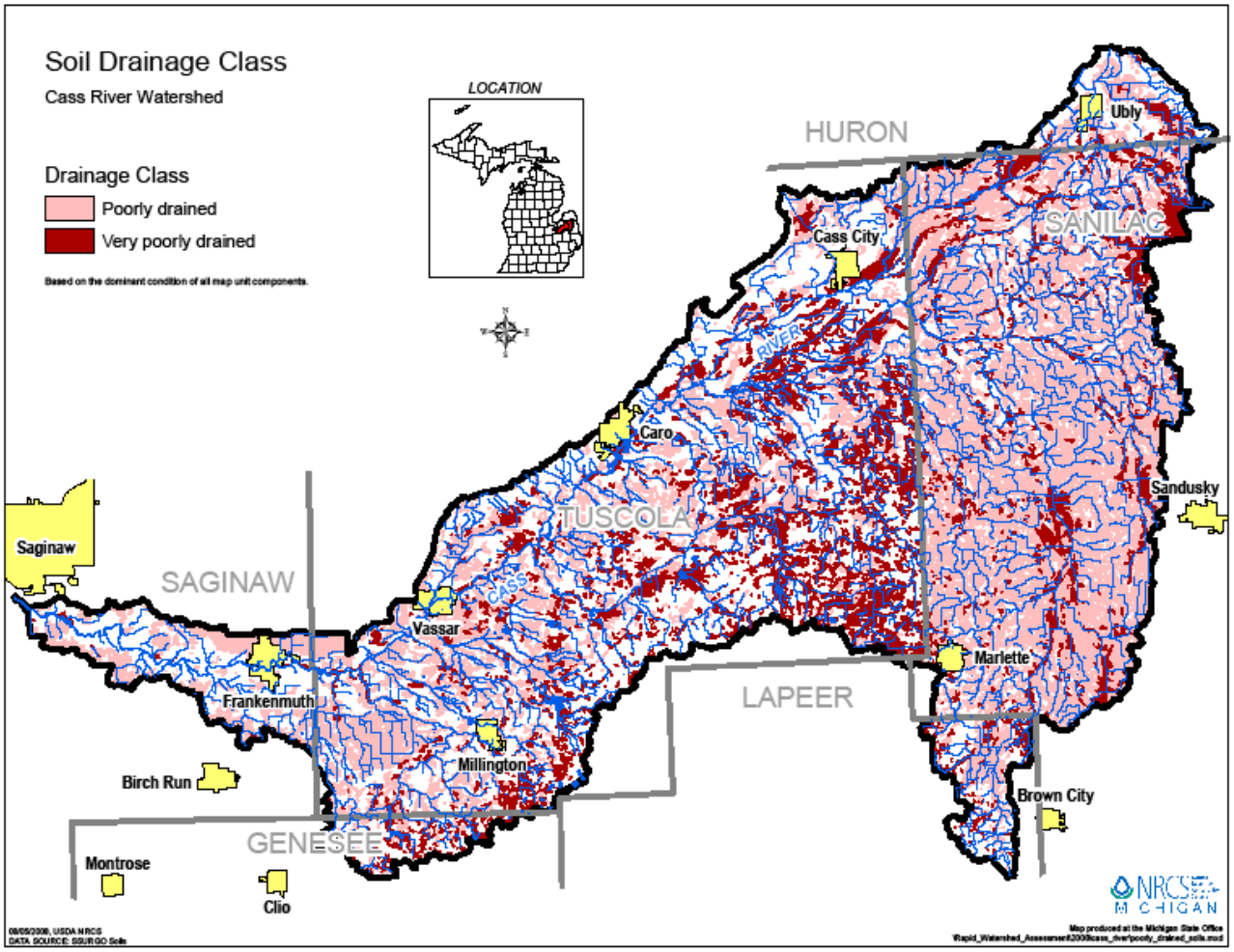
Map 4:
Recreational Lands



3.4 Drainage Classification

Drainage class refers to the frequency and duration of wet periods under conditions similar to those in which the soil formed. Drainage conditions may affect agriculture suitability, dictate what type of vegetation grows and influence building conditions. The Cass River Watershed is dominated by heavy soils as is evidenced by the terms poorly drained and very poorly drained soils on map 5 below. To be productive agricultural lands these soils must be tiled, they then become some of the most productive and fertile soils in Michigan.

Map 5:
Soils Needing Artificial Drainage

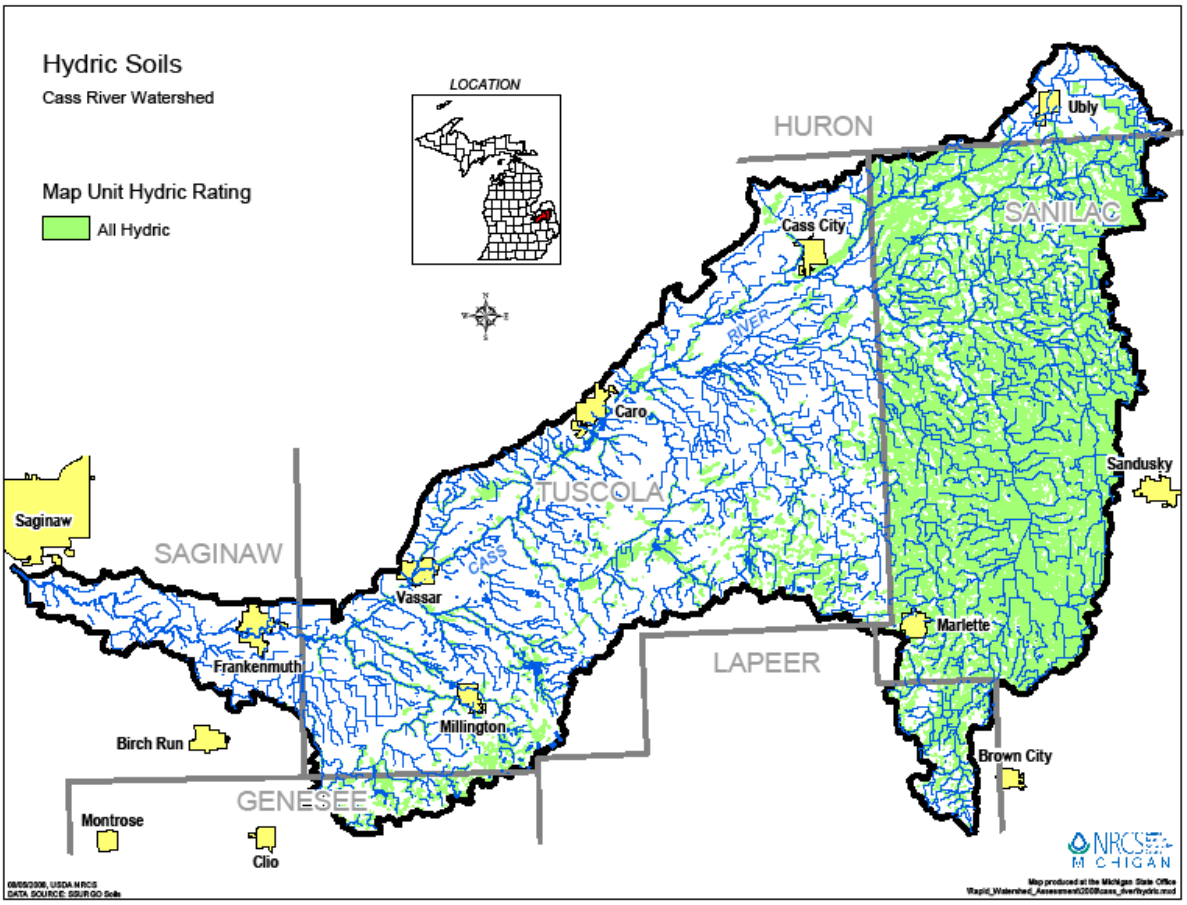


3.5 Hydric Soils

Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils, under natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation. Hydric soils make up part of the criteria for the identification of wetlands.

Map 6:

Hydric Soils

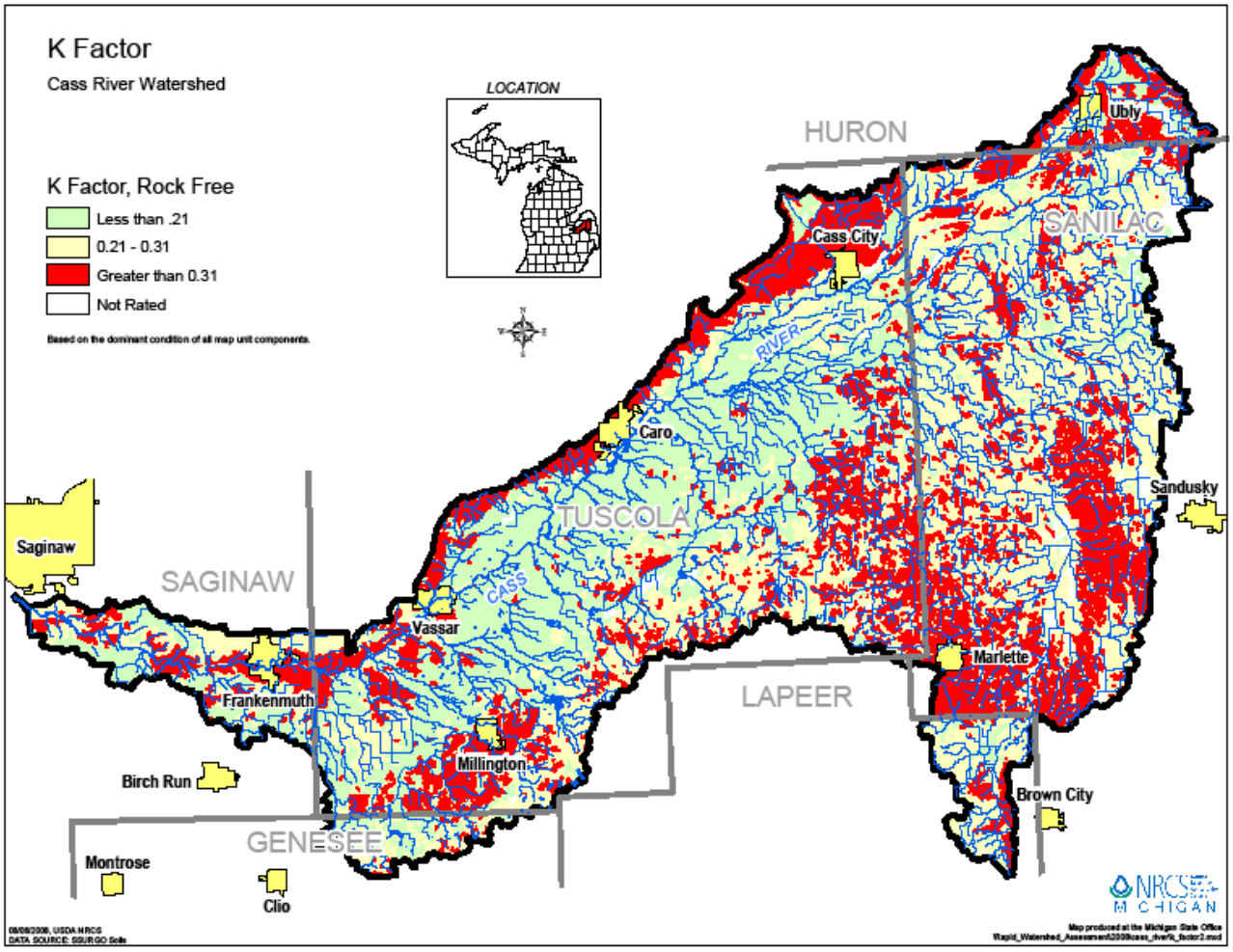


3.6 K Factor

Erosion factor, “K” indicates the susceptibility of a soil to sheet and rill erosion by water. K factor is one of six factors used in the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. K factors were combined into three categories to better visualize erosive potential and determine coverage acreage and percentage.

Map 7:

K Factor



3.7 Land Capability

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming activities that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations that show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.
In the capability system, soils are generally grouped at three levels-capability class, subclass, and unit. Only class and subclass are included in this data set.
Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.
Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.
Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.
Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.
Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

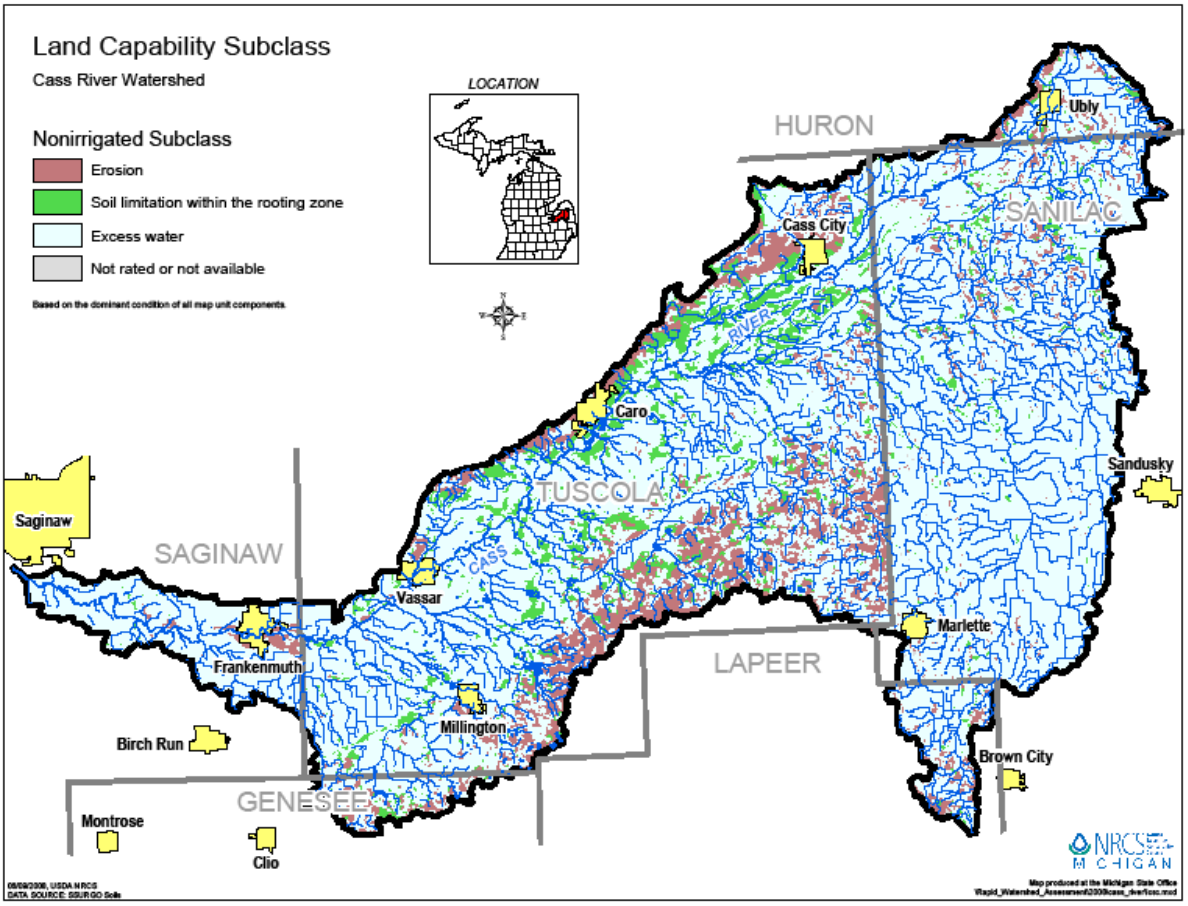
Table 2: Land Capability Classification

Capability Class	Acres in Watershed	Percentage of Watershed
Capability Class I	4,920	.85
Capability Class II	258,439	44.65
Capability Class III	184,120	31.81
Capability Class IV	57,360	9.91
Capability Class V	56,202	9.71
Capability Class VI	9,550	1.65
Capability Class VII	4,283	.74
Capability Class VIII	0	0
Not Rated	3,938	.67
Total	578,812	**100%**

Within the broad classes are subclasses which signify special limitations such as erosion, excessive wetness, and problems in the root zone. These subclasses are represented on Map 8.

Map 8:

Limiting Factors



3.9 Common Resource Area

Common Resource Areas (CRA) are defined as geographical areas where resource concerns, problems, or treatment needs are similar. It is considered a subdivision of an existing Major Land Resource Area (MLRA) map delineation. Landscape conditions, soil, climate, human considerations, and other natural resource information are used to determine the geographic boundaries of a Common Resource Area. The following are the two CRAs for the watershed:

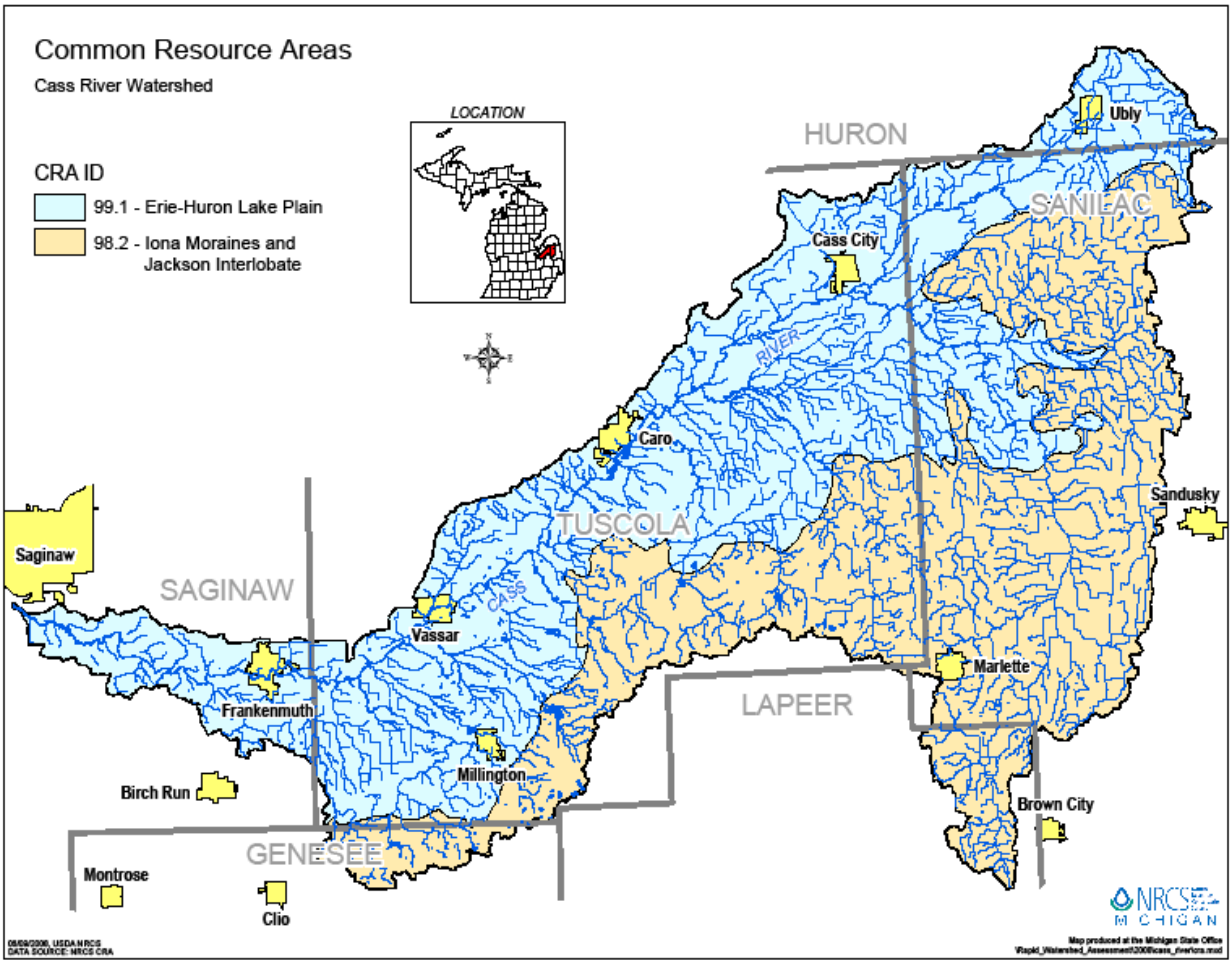
98.2 Ionia Moraines and Jackson Interlobe

Comprising 45.35% of the watershed, common resource area 98.2 is nearly level to gently sloping ground and end moraines. Soils are well drained to somewhat poorly drained loamy and sandy soils. Predominant land use is for cash crops with some area in permanent pasture and woodland. Primary resource concerns are soil erosion, groundwater quality, surface water quality and quantity.

99.1 -Erie-Huron Lake Plain

Comprising 54.65% of the watershed the Erie-Huron Lake Plain is flat-lying, ice-age lake basin with beach ridges, bars, dunes, delta, and clay flats with very low relief. Soils are very poorly drained to somewhat poorly drained, formed in wave-planed, clayey till and lacustrine sediments. Dominant land use includes corn, soybeans, and livestock farming on artificially drained soils with scattered woodlots, residential, commercial, and industrial development near Lake Erie. Urban development is an increasing land use in this area. Primary resource concerns are soil erosion, groundwater quality, surface water quality and quantity.

Map 9:
Common Resource Areas



4.0 Socio-Economic Description

4.1 Population Statistics

The Cass River Watershed is located in a predominantly rural setting in central Michigan. Tables 5,6, and 7 depict the population, median household income, median home value, number of farms and farms size in Huron, Sanilac, Tuscola, Lapeer, Genesee, and Saginaw counties. In 2000, the State of Michigan median income was $44,667, approximately 16%

higher than those counties in the watershed; and has on average 175 persons per square mile, roughly 4 times the population density of the watershed.

The following data is for the Townships that are in the watershed. It is from the U.S. Census Bureau, Census 2000.

Table 3

Demographic Characteristic	Total all Townships
Total Population	122,450
Race, White	94.7%
Race, Black or African American	2.6%
Race, American Indian or Alaska Native	0.5%
Race, Asian	0.2%
Race, Other	0.8%
Two or more races	1.3%
Hispanic or Latino	2.3%
Total Households	44,738

The average of median per household income and median home values is as follows:

Table 4

County Level Census Data for all Counties in the watershed	
Median per household income (County)	$38,522
Median Home Value (County)	$87,200

There are some real differences in values across the watershed. The watershed median home values for Sanilac and Tuscola Counties are $87,200 which is 75% of the state level median home value of $115,600. Median household income in these two counties is 72% of the state average level of $53,457. Lapeer and Genesee counties have higher home values and income due to the urban centers in their counties. Lapeer County has the highest home values. The watershed has pressure for urban development and potential for the types of impairments resulting from development.

4.2 Agriculture Census Data

The census of agriculture is the leading source of statistics about the Nation's agricultural production and the only source of consistent, comparable data at the county, State, and National levels. Census statistics are used by Congress to develop and change farm programs, study historical trends, assess current conditions, and plan for the future. Many National and State programs use census data to design and allocate funding for extension service projects, agricultural research, soil conservation programs, and land-grant colleges and universities. Private industry uses census statistics to provide a more effective production and distribution system for the agricultural community. There are approximately 1510 farms in the watershed with an average farm size of 213 acres. The following table shows the 2002 US Census of Agriculture data for the watershed. Most farms are in the 50 to 999 acre size while almost 35% for farms have 49 areas or less and almost 4% of farms have 1,000 acres or more. Most farms have full time owners with one operator. Almost 35% of farms have women operators.

Table 5

2002 US Census of Agriculture*		
Item	Number	Percent of Farms
Farms	1510	
Farms by Size		
1 to 49 acres	527	34.9%
50 to 999 acres	912	60.4%
1,000 acres or more	54	3.6%
Value of all agricultural products sold		
Less than $50,000 (farms)	1127	74.6%
$50,000 to $249,999 (farms)	247	16.4%
$250,000 or more (farms)	123	8.1%
Farms by tenure		
Full owners	955	63.2%
Part owners	493	32.6%
Tenants	47	3.1%
Farms with one operator	922	61.0%
Farms with multiple operators	588	39.0%
Farms with women operators	527	34.9%
* Census data by zip code and proportioned by percentage of zip code in the watershed		

Counties in this watershed are principal counties for field crops and livestock in Michigan with the following rankings in Michigan agriculture in 2006:

- Huron County ranks 1 for Corn for Grain, Dry Beans, Sugar Beets, Cattle and Calves, and Milk Cows; ranks 2 for Hay and Wheat; and ranks 5 for Hogs and pigs.
- Sanilac County ranks 2 for Hay, Oats, Soybeans, and Cattle and Calves; and ranks 3 for Milk cows.
- Tuscola County ranks 2 for Dry Beans and Sugar Beets; ranks 4 for Wheat; and ranks 5 for Corn for Grain.
- Saginaw County ranks 4 for Corn for Grain and Sugar Beets; and ranks 5 for Dry Beans.

The counties of Genesee, Huron, Lapeer, Saginaw, Sanilac, and Tuscola have over $612,000,000 in total value of agricultural products sold.

5.0 Surveys, Reports and Projects

There have been numerous reports, surveys and projects conducted within the watershed identifying resource concerns. In addition, many projects have taken place to protect water quality, improve wildlife habitat, and preserve farming heritage; the following is a list of those surveys and projects that have been completed.

5.1 Existing Reports Summary

DEQ Water Quality Studies Summary (Cooper, 2006)

Earlier field studies in the watershed described the Cass River as being nutrient enriched, and possibly nitrate limited (Grant, 1974). The source of nutrients was identified as point source contributions from the communities of Bridgeport, Vassar, and Cass City. Additional nutrient loads were described as seasonal NPS related. Phosphorus additions to the Saginaw River from the Cass River Watershed were estimated at 121 tons per year based on flow and nutrient data from 1972-1974 (Grant, 1974).

Subsequent surveys in the Cass River in 1985 and 1988 indicated somewhat improved conditions over those described by Grant in 1974 (Taft, 1989); however, neither the1974 nor the 1985 and 1988 efforts included the major tributaries to the Cass River. In addition, the biological survey work described in the 1989 report was not as intensive as the work done from 1972-1974, making conclusions based on a comparison between the two studies somewhat limited.

Morse (1992a) reported the biological integrity of the Cass River upstream from Bridgeport to be somewhat improved over this same general stretch of river reported by Grant (1974) and Taft (1989). However, urban runoff from the communities of Vassar, Frankenmuth, and Bridgeport was cited as a primary cause of habitat degradation in this (Morse 1992a) report. The biological integrity of the tributaries within the Cass River Watershed ranged from excellent in the North Fork of the North Branch of the Cass to fair in six additional tributaries including the South Fork of the North Branch, portions of both the North and South Branches of the Cass, Sucker, Millington, and Dead Creeks. Poor flow stability and subsequent problems with bank stability were seen as the primary cause for habitat impairment due to excessive sedimentation. The genesis of this flow instability was reported to be the result of intrinsic soil types with poor water infiltration characteristics that are subsequently magnified by agricultural land use that includes extensive drainage systems throughout the watershed (Morse, 1992a). Subsequent surveys of the White Creek Watershed, a subwatershed to the Cass River Watershed found fair to degraded conditions that were similar to other tributaries to the Cass River where extensive channel manipulation to support agricultural drainage was present (Morse 1992b).

An additional watershed survey in 1996 (Cooper and Walterhouse, 2000) did not report substantial changes to the Cass River or its tributaries compared to the 1992 efforts. However,

Duff Creek, a tributary to the South Branch of the Cass River was identified as not attaining its warm water status primarily due to untreated sewage discharges originating from the city of Marlette. In addition, this same report (Cooper and Walterhouse, 2000) continues to cite the same watershed concerns, as described by Morse (1992) and Taft (1989) contributing to overall defects to stream habitat and the biological community.

Water and sediment chemistry results in the Cass River Watershed indicate that nutrients, particularly phosphorus, exceed the average concentration for phosphorus in the SMNITP Ecoregion (Lundgren, 1994). In addition to nutrients, sediment chemistry from 1972-1974 found that arsenic concentrations exceeded Michigan average background levels at all sites sampled in the Cass System and elevated levels of zinc below Cass City. Arsenic concentrations in sediment samples taken in 1996 from the Cass River immediately downstream from the confluence of White Creek exceeded the *severe effect level* as described in sediment quality guidelines (Persaud et al., 1993) and magnesium was nearly eight times the *severe effect level* from portions of the stream (Cooper and Walterhouse, 2000).
Survey efforts in 2001 (Cooper 2001) reported an acceptable macro invertebrate community at all stations sampled with the exception of one station on White Creek and one station on Duff Creek. Both White and Duff Creeks are highly modified agricultural drains. Water chemistry results indicated that nutrient concentrations in the Cass River and most of it major tributaries were not excessive and relatively comparable to sample results from a previous biosurvey in 1996 (Cooper and Walterhouse, 2000). The exception to this trend is Duff Creek near Marlette where nutrient concentrations were well above expected background concentrations and twice the concentration found in 1996. Metals found in water samples were not significant although a spike in copper was found in Duff Creek.

Sediment samples taken in the Cass River and from Duff Creek indicated slightly elevated concentrations of arsenic, copper, mercury, and zinc in the upper portions of the main branch of the Cass River and Duff Creek. In general, metals sample results were not significantly different from samples taken in 1996 (Cooper and Walterhouse, 2000).

Survey efforts in 2006 (Cooper, 2006) determined that ninety percent of the waterbodies monitored in the Cass River Watershed were attaining water quality standards for warm water streams in Michigan. Water quality problems were associated with lack of stable substrates and flow instability resulting from widespread channel modification (dredging and channelization) prevalent throughout the basin. Turtle Creek was identified as having water quality problems due to septic system discharges. Duff Creek was highlighted as exhibiting chronic nutrient loading problems well above expected background conditions. Sediment accumulation from channel modifications was identified as impacting instream habitat in the upper South Branch of the Cass River. Water and sediment samples taken above and below significant municipal wastewater treatment facilities in the watershed demonstrated a general increase in the nutrient load between Cass City and Bridgeport, but did not indicate that any of the municipal dischargers were significantly affecting the concentration of nutrients found in the ambient water or sediment samples.

Bacterial Monitoring

The Saginaw County Health Department conducted weekly sampling beginning in June 2002 through October 2003 to assess water quality for bacterial contamination. There were four stations sited on the Cass River (Heritage Park, Dehmel Road, Dixie Highway, East Road). Of the 49 sampling events monitored, the number above total body contact recreation water quality standards were: 7(14%) at Heritage Park; 7(14%) at Dehmel Road; 10(20%) at Dixie Highway; and 5(10%) at East Road. Bacteria levels were found to be higher following significant rain events.

Modelling Agricultural Nonpoint Source Pollution (He and Shi, 1994)

The study integrated GIS, LANDSAT imagery and AGNPS to estimate the loading potential of agricultural nonpoint sources and to evaluate the impact of agricultural runoff on water quality in the Cass River watershed. The results suggest that the Cass River watershed introduces large amounts of nutrients and sediment into the Saginaw River and Bay. Soil erosion was up to 3.5 tons per acre in some agricultural land area after a single 24-hour storm of 3.7 inches with frequency of one in 25 years. The sediment yield was up to 145 tons per acre in the mouth of the watershed near Saginaw. Total nitrogen and phosphorus runoff was higher in agricultural land. About 25 percent of the total area in the Cass River watershed was subject to medium wind erosion, and 0.4 percent of the watershed (2,155 acres) was vulnerable to severe wind erosion. Streambank erosion was serious in portions of the Cass River watershed. The animal waste loading potential derived from the 1987 Census of Agriculture indicated that approximately 10 million tons of waste, 26 tons of nitrogen, and 21 tons of phosphate were produced each year from the livestock industry in the Cass River watershed, averaging 30 tons of manure, 160 lbs of nitrogen, and 130 lbs of phosphate per acre of agricultural land annually. Estimates of agricultural chemical applications in the Cass River watershed showed that about 15 million lbs of nitrogen fertilizer, 13 million lbs of phosphate, and 206,000 lbs of pesticides were used annually in the agricultural land of the Cass River Watershed. Examination of the combined loading potential of soil erosion, animal waste, and agricultural chemicals showed that the overall nonpoint source pollution potential is highest in the Huron, Sanilac, and eastern Tuscola portion of the Cass River watershed.

Saginaw Bay Watershed Wildlife Habitat Conservation Framework (Nelson, 2000)

This report identifies the Cass River as a valuable corridor for wildlife travel, and recommends that it be evaluated for designation under the Michigan Natural Rivers program from Vassar upstream in order to protect the watershed. The report also recommends safeguarding the corridor through expansion of the five existing game areas in the watershed (Vassar, Deford, Tuscola, Sanilac, and Cass City).

A Vision of Green Report (2005)

The Saginaw Bay Greenways Collaborative (the Collaborative) formed in 1999 to develop the Saginaw Bay Greenways plan “to connect communities to the area’s natural and cultural amenities for the benefits of recreation, transportation, education, health and well being of its citizens. ”The Collaborative’s report, “A Vision of Green”, summarizing the green infrastructure plan for the tri-county (Midland/Bay/Saginaw) area and outlining suggested implementation

steps was released in early 2005. The plan put forth capitalizes on the large tracts of land already protected in the area. The Shiawassee National Wildlife Refuge and the adjoining

Shiawassee River State Game Area form a major hub for the region. Most of the green infrastructure corridors identified by the Saginaw Bay Greenways Plan follow the network of rivers that flows into the bay. The Cass River system is one of the key rivers identified in the plan.

Shiawassee National Wildlife Refuge Additions Final Environmental Assessment, 1995

In 1995, the U.S. Fish and Wildlife Service considered alternative ways to better protect the Refuge resources at Shiawassee National Wildlife Refuge. After evaluating the alternatives, the Service decided to pursue the addition of approximately 7,500 acres to the existing Refuge (Shiawassee National Wildlife Refuge Additions Final Environmental Assessment,1995). If all authorized acres are eventually acquired, the Refuge will include approximately 16,600 acres. The additions will be primarily along the Tittabawassee and Cass River corridors. These waterways are two of the four rivers that converge on the Refuge and make up Michigan's largest *watershed*, and their environmental integrity is vital to the health of the Refuge's core.

Enhancing Fish Passage over Low-head Barrier Dams in the Saginaw River Watershed (Public Sector Consultants, 2005)

This report recommended fish passage over the Frankenmuth Dam to open up roughly 73 miles of river and tributary habitat up to the dam in the City of Caro. Approximately 24 miles of this habitat occurs on the mainstream. The fish passage alternative explored in this report would pass walleye, sturgeon, and other species of fish.

Fisheries Scoping Study (The Conservation Fund, 1999)

This report identified the fish passage over the Frankenmuth Dam as an important step to improve fish habitat. It also noted that the Cass River has not been cultivated as a fishing resource. In addition, the Cass River was identified as a good candidate for a water trail, and it was suggested that it could be promoted as part of a 'Canoe Saginaw Bay' package. One of the critical challenges noted was the lack of significant public access sites and canoe launches in the watershed.

Saginaw County Vision 2020 River Corridor Project – Cass R Field Check (Hoover, 2005)

This report identifies current limitations for boating in the Cass River (boat access, easy stops for food, easy stops for restroom facilities, easy stops for supplies, easy stops for historic sites), and evaluates possible locations to be included in a water trail.

5.2 Threatened and Endangered Species

The following is a table of Federal and State Listed *Endangered, Threatened or Species of Concern.* This information was compiled from the Michigan Natural Features Inventory.

Table 6
Endangered Plant Listing

Plant Name	Federal Status	State Status
Blunt-Loved Woodsia		T
Canadian Milk-Vetch		T
Climbing Fumitory		SC
Cooper's Milk-Vetch		SC
False Hop Sedge		T
Furrowed Flax		SC
Ginseng		T
Hairy Angelica		SC
Hairy Mountain-Mint		T
Jacob's Ladder or Greek-Valerian		T
Mountain Mint		T
Pitcher's Thistle	LT	T
Prairie Fringed Orchid	LT	E
Prairie Indian-Plantain		SC
Purple Prairie-Clover		X
Seedbox		SC
Showy Orchis		T
Small Love Grass		SC
Sullivant's Milkweed		T
Tall Green Milkweed		T
Torrey's Bulrush		SC
Twinleaf		SC
Whiskered Sunflower		SC
White Lady Slipper		T
Whorled Mountain-Mint		SC
Whorled Pogonia		T
Yellow Ladies'-Tresses		SC

Endangered Reptile Listing

Reptile Name	Federal Status	State Status
Black Rat Snake		SC
Blanding's Turtle		SC
Eastern Fox Snake		T
Eastern Massasauga	C	SC
Spotted Turtle		T
Wood Turtle		SC

Endangered Fish Listing

Fish Name	Federal Status	State Status
Black Buffalo		SC
Channel Darter		E
Eastern Sand Darter		T
Lake Sturgeon		T
River Darter		E
Shortnose Cisco		X
Weed Shiner		X

Endangered Bird Listing

Bird Name	Federal Status	State Status

Bald Eagle	(PS: LT, PDL)	T
Barn Owl		E
Black Tern		SC
Common Moorhen	(PS)	SC
Common Tern		T
Cooper's Hawk		SC
Forster's Tern		SC
King Rail		E
Migrant Loggerhead Shrike		E
Piping Plover	(LE, LT)	E

Endangered Invertebrate Listing

Invertebrate Name	Federal Status	State Status
Elktoe		SC
Lake Huron Locust		T
Northern Riffleshell	LE	E
Purple Lilliput		E
Rainbow		SC
Red-Legged Spittlebug		SC
Round Hickorynut		E
Salamander Mussel		E
Silphium Borer Moth		T
Snuffbox		E
Spike-Lip Crater		SC
Spindle Lymnaea		SC
Tamarack Tree Cricket		SC
Watercress Snail		SC
Wavy-Rayed Lampmussel		T

State Status: E = endangered, T = threatened, SC = special concern. Federal Status: LE = listed endanged, LT = listed threatened, LELT = partly listed endangered and partly listed threatened, PDL = proposed delist, E(s/A) = endangered based on similarities/appearance, PS = partial status (federally listed in only part of its range), C = species being considered for federal status.

5.3 NRCS Performance Results System (PRS)

The following table is a product of the NRCS Performance Results System (PRS) and reflects progress made over the past 3 years in several key areas of conservation in each of the common resource areas (CRA).

Table 7

Cass RWA PRS Data 2005 - 2007			
Conservation Practices	**cra 98.2**	**cra 99.1**	**Total**
Agrichemical Handling Facility (309) No.		2	**2**
Comprehensive Nutrient Management Plan (100) No.	3	1	**4**
Conservation Cover (327) Ac.	675.4	497.5	**1172.9**
Conservation Crop Rotation (328) Ac.	2765.5	1703.7	**4469.2**
Early Successional Habitat Development/Management (647) Ac.	60.2	73.6	**133.8**
Fence (382) Ft.	11,000		**11000**
Filter Strip (393) Ac.	85	130.6	**215.6**
Nutrient Management (590) Ac.	828.9	778.4	**1607.3**
Pasture and Hay Planting (512) Ac.	58.2		**58.2**
Pest Management (595) Ac.		221.9	**221.9**
Prescribed Grazing (528) Ac.	63.2	86.8	**150**
Residue and Tillage Management, Mulch Till (345) Ac.	828.9		**828.9**
Residue and Tillage Management, No-Till/Strip Till/Direct Seed (329) Ac.	358.6	1058.3	**1416.9**
Roof Runoff Structure (558) No.	1		**1**
Shallow Water Development and Management (646) Ac.	4.3	11.3	**15.6**
Tree/Shrub Establishment (612) Ac.	66	2	**68**
Upland Wildlife Habitat Management (645) Ac.	610.4	802.5	**1412.9**
Use Exclusion (472) Ac.	128.4	61.5	**189.9**
Waste Storage Facility (313) No.	1	1	**2**
Waste Utilization (633) Ac.	176.8	329.4	**506.2**
Wetland Creation (658) Ac.	1	9	**10**
Wetland Restoration (657) Ac.	45	88.3	**133.3**
Wetland Wildlife Habitat Management (644) Ac.	18.6	43.9	**62.5**
Windbreak/Shelterbelt Establishment (380) Ft.		1525	**1525**

Note: Definitions changed within some of the years. Waste Utilization (633) became incorporated into Nutrient Management (590) and Conservation Tillage practices codes have changed.

6.0 Nonpoint Source Pollution

Nonpoint source pollution is the primary pollution threat facing the water resources of the Cass River Watershed. Nonpoint source pollution is any pollutant carried off the land by water or wind and deposited into surface water.

The most common nonpoint source pollutant in nearly every rural river system is sediment. Sediment degrades habitat for fish and aquatic insects and contributes to the widening of the

stream channel and the associated increase in stream temperature. Sources of sediment typically include runoff at road/stream crossings, and from agricultural operations, streambank erosion, runoff from impervious surfaces and improper construction practices, and shoreline erosion.

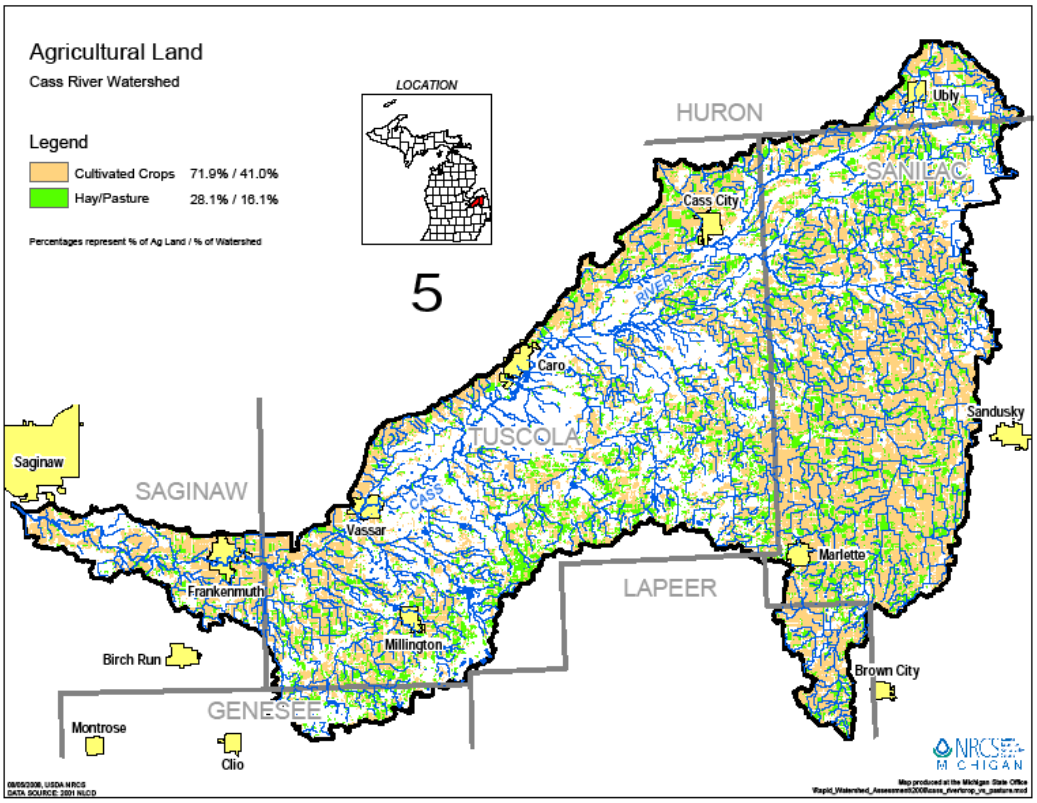
Excessive quantities of nutrients, particularly phosphorus, are also a pollutant of concern in watersheds and are often the major pollutant in lake ecosystems. The addition of artificially high amounts of nutrients contributes to high levels of algae and aquatic plant growth. As these plants eventually die off, they can consume dissolved oxygen and thus degrade fish habitat. Nutrient inputs are often tied closely to agriculture production and residential development, and can come from such sources as fertilizer use, septic systems and animal waste. Often the protective shoreline vegetation is removed as a result of development or production decreasing the filtering capabilities. Loss of the natural shoreline can contribute to erosion, accelerate nutrient runoff, eliminate wildlife habitat, and reduce the effectiveness of nutrient uptake by root systems.

Other common watershed pollutants include such things as thermal pollution, pathogens, oils and greases, fluctuating water levels, salts, metals, animal waste, and organic matter.

6.1 Agriculture Areas

Agriculture is an important land use in the area and makes up 57% of the watershed. Map 10 shows there are 238,118 acres of cultivated cropland and 93,062 acres of hay/pasture in the watershed. The market value of agriculture products for Genesee, Huron, Lapeer, Saginaw, Sanilac and Tuscola counties is nearly 612 million dollars per year according to the 2002 Agriculture Census data. Agriculture plays an important and vital economic role within the watershed. However, agricultural practices on the land, particularly near riparian corridors, may negatively influence water quality and can contribute to soil loss. The over-application of fertilizers and animal waste near the water's edge can introduce excessive amounts of nutrients such as nitrogen and phosphorus into the river system. Animal waste can also contribute to increased bacteria levels in local water bodies. Sediment runoff from cropland and livestock also can contribute to soil loss and increased deposits in the water. When applying a 100' buffer to cropland adjacent to water bodies it was found that there are 14,270 acres of cropland and 5,570 acres of pasture that should be buffered.

Map 10:
Cropland / Pasture



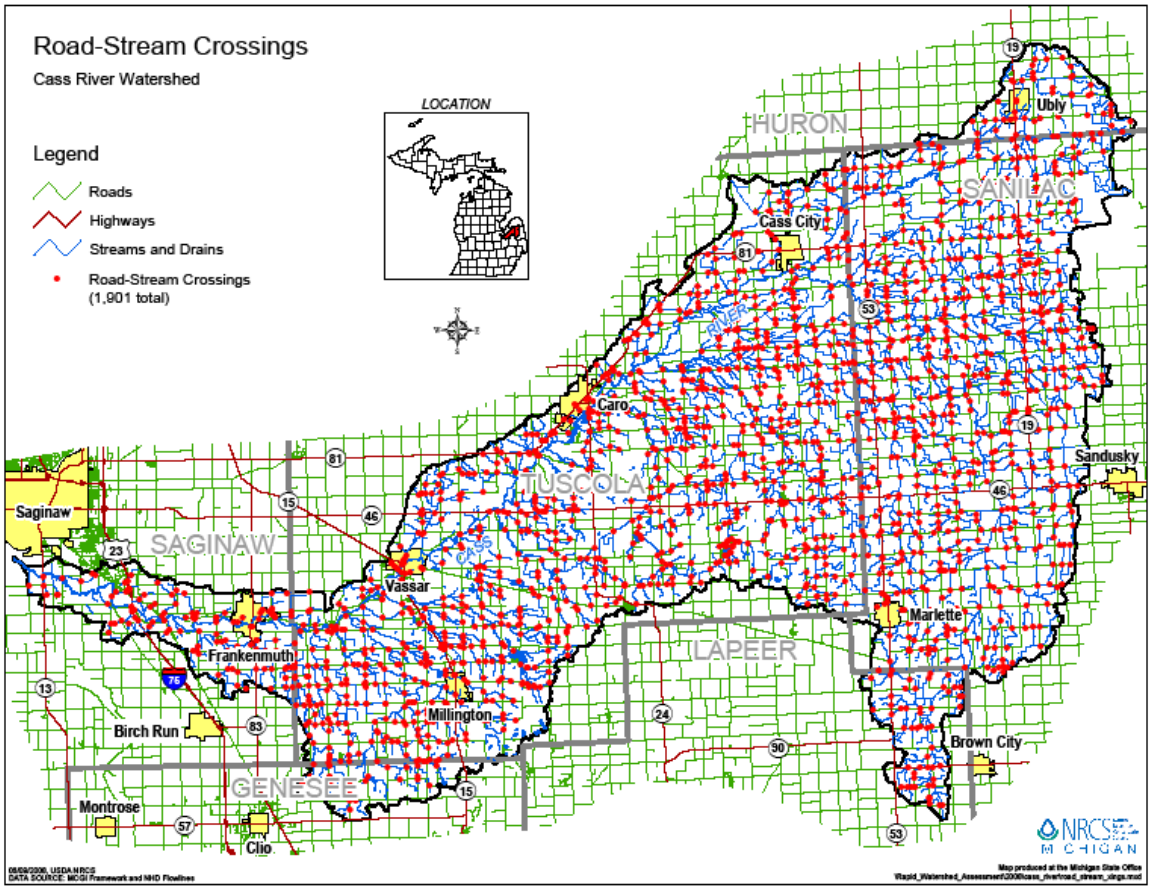
There are several conservation practices that can be applied in order to mitigate agricultural impacts on water quality and habitat loss. These may include vegetative buffers, grade stabilization structures, fencing, water crossings, alternate watering facilities and nutrient management programs.

6.2 Road/Stream Crossings

There are 1,901 road/stream crossings identified within the watershed. Road crossings are often a conduit for nonpoint pollution when excessive soils from roads and/or eroding embankments flow into a stream. For many high-quality coldwater streams, sediment from road/stream crossings is the number one source of pollution. In addition, runoff from roads carry other pollutants such as salt and other deicers and fluids from automobiles including oil, gas and antifreeze. Road crossings located on back roads (gravel or sand surface) and those with steep approaches typically exhibit the most severe runoff and erosion problems.

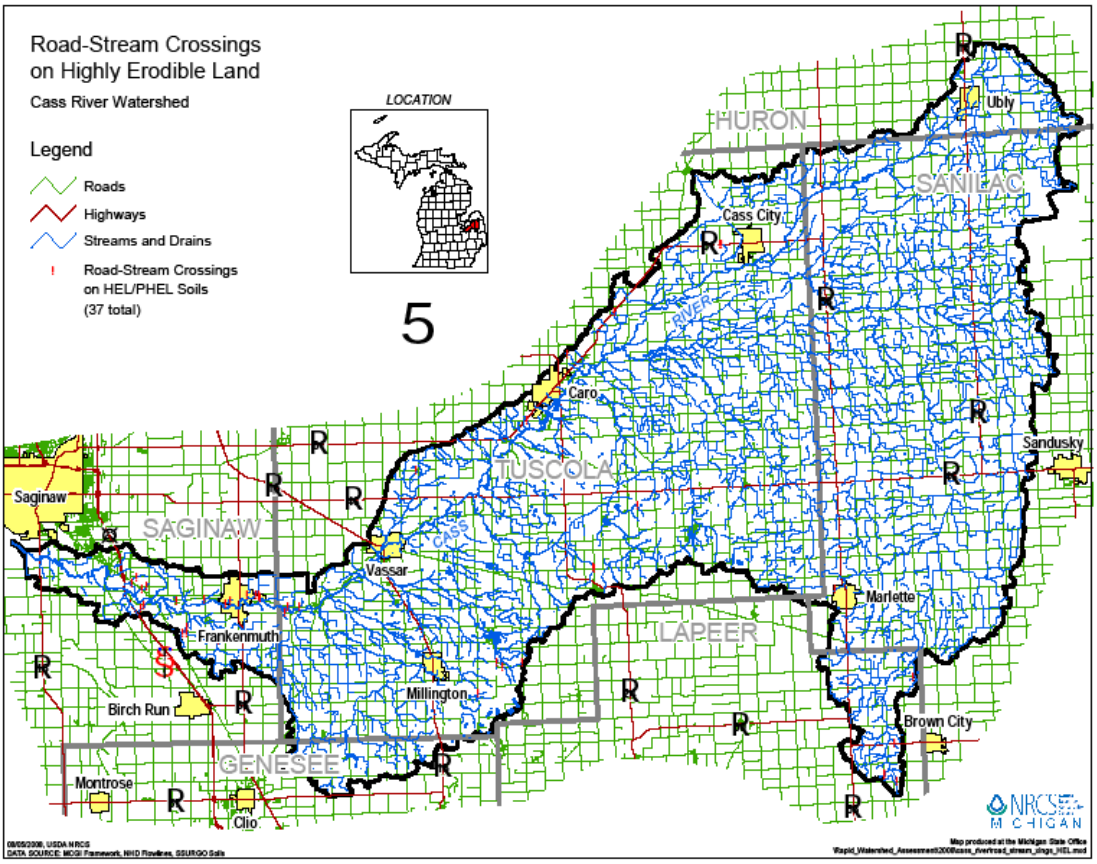
Road crossings are also potential barriers to fish if a culvert is perched or undersized. This is most commonly seen on smaller headwater streams that are typically ideal nursery areas for fish and other aquatic animals. In addition, some road crossings are popular access sites for fishing, canoeing or swimming, contributing to erosion problems.

Map 11:
Road Stream Crossings



Map 12 shows areas where road crossings are located in areas with highly erodible soils. These sites, especially if located on non-paved roads, would be considered a high priority from a water quality standpoint. Soils with higher erodibility are more susceptible to sheet and rill erosion by water. Therefore these are the crossings which should have higher probability of erosion problems and contributing sediment to the streams.

Map12:
Road Crossings with Highly Erodible Soils



There are numerous practices to lessen the impact of road crossings on water quality. Huron Pines developed a Better Backroads Guidebook to encourage and provide guidelines for managerial, structural and vegetative best practices. Road crossing improvements include hardening the approaches, installing diversion outlets, replacing the existing structure with a larger culvert or preferably a bridge, revegetating disturbed areas and stabilizing embankments. Road commissions are also encouraged to improve their grading and de-icing practices at road crossings.

6.3 Dams and Barriers

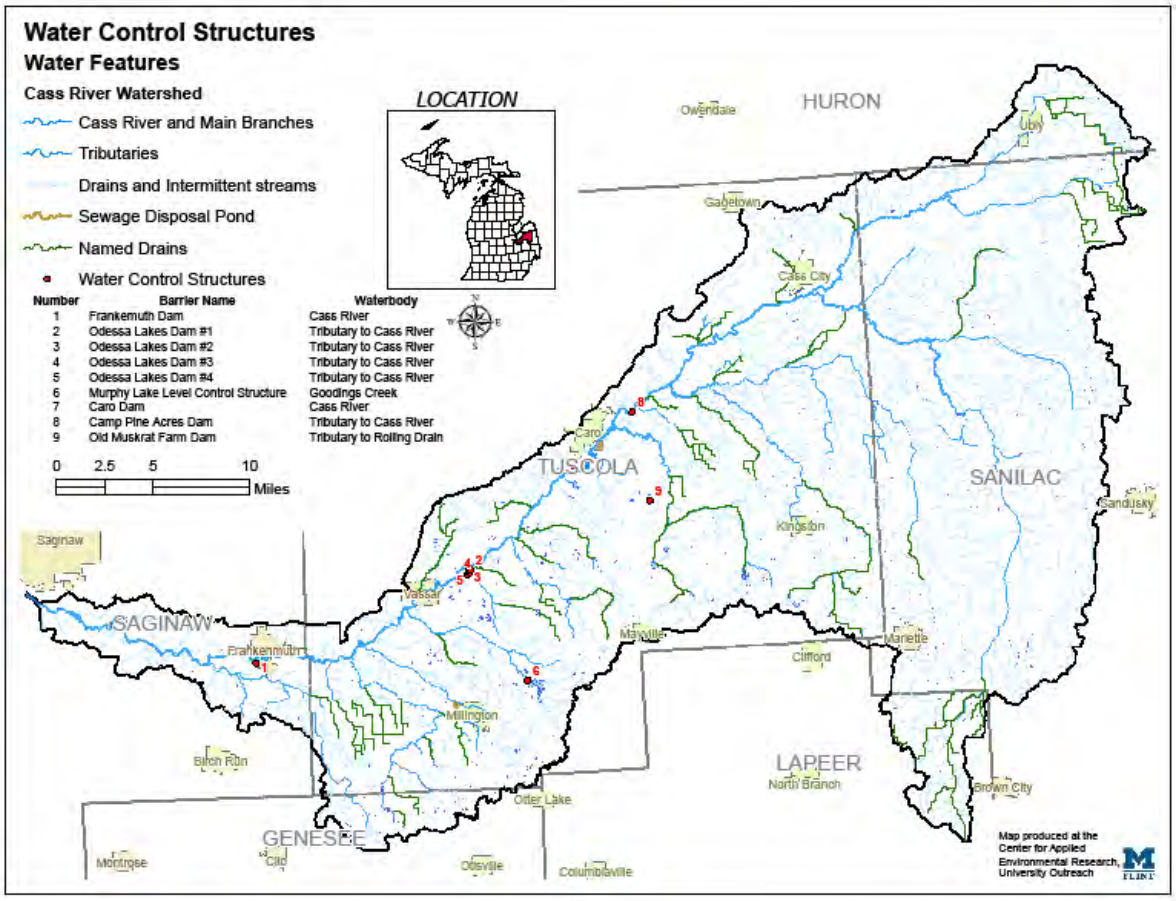
Dams and other physical barriers on rivers and streams can create numerous ecological problems and can contribute to the decline of water quality. Many fish and other species must be able to move throughout the river system in order to successfully fulfill their life-cycle needs. When a dam or other barrier obstructs their passage it can contribute to a degradation of the species.

In addition to impeding fish passage, barriers also contribute to changes in the stream geomorphology and temperature of a river system. Most dams create an upstream

impoundment that can increase the overall river temperature, back up sediment and contribute to downstream erosion.

Map 16 shows the location of 9 dams throughout the watershed. This information was obtained from a database compiled by the DEQ and DNR based on topographic maps and aerial photography.

Map 13:
Dams



6.4 Invasive Species

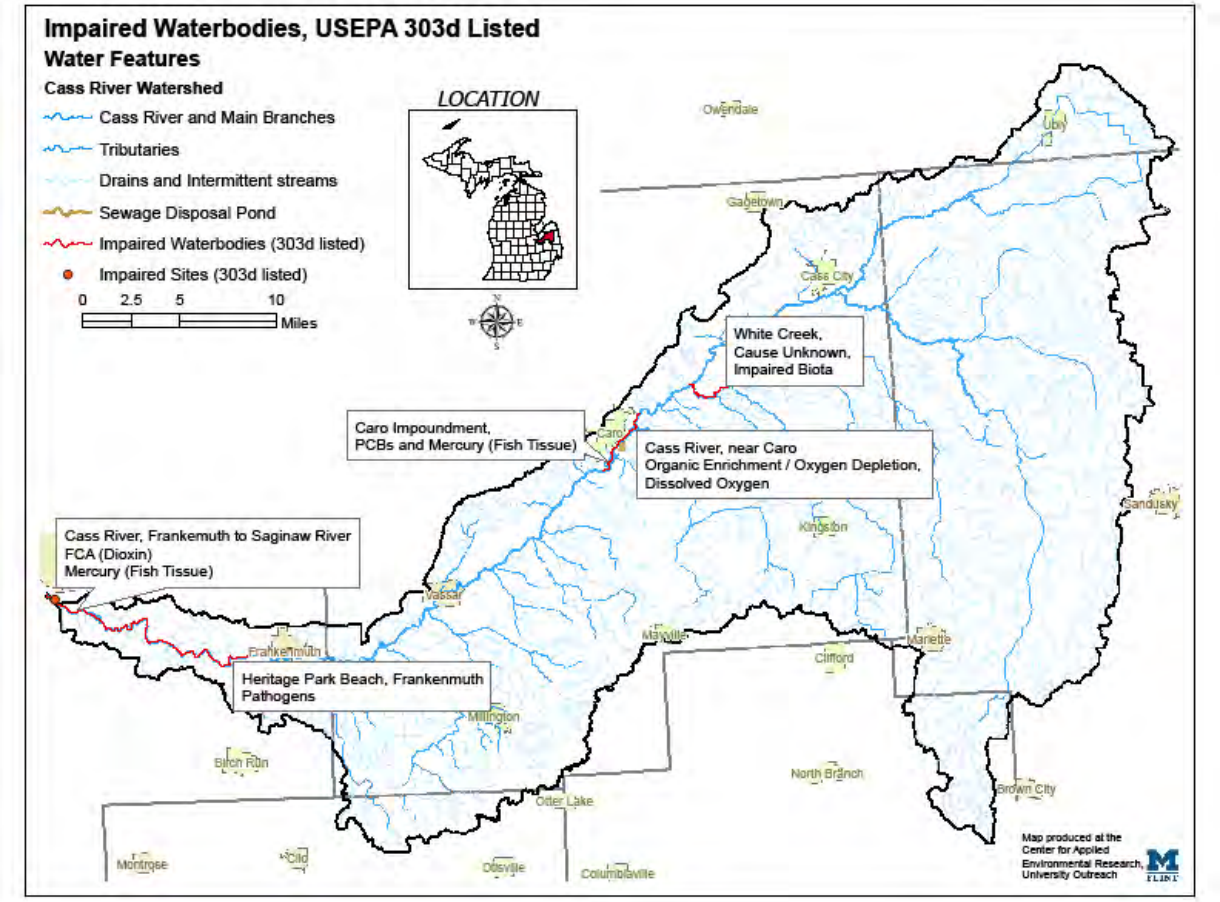
Invasive species, whether plant or animal, are species that are non-native to the Great Lakes basin and were either intentionally or accidentally released. The Great Lakes basin is very susceptible to invasives because of the transatlantic shipping industry, and it is estimated that there are over 180 invasive species now present. Invasive species can be very disruptive to existing ecosystems because they typically have no natural predators. They can outcompete and displace native populations, disrupt the food web, and in some cases can be a threat to human health.

The presence of non-native species also has a significant economic impact. Millions of dollars

have already been spent to control invasive species. There has been an increase in the use of pesticides and herbicides to control non-native plant species, fish populations have declined in areas and many public intake pipes are clogged regularly, resulting in vigilant and costly control programs.

6.5 Impaired Waterbodies

Map 14:
Impaired Waters



The State of Michigan has established water quality standards in which waterbodies must meet established *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 waterbodies meet all designated uses.

1 Agriculture
2 Industrial water supply
3 Public water supply at the point of intake
4 Navigation
5 Warm water fishery
6 Other indigenous aquatic life and wildlife
7 Partial body contact recreation
8 Total body contact recreation between May 1 and October 31
9 *Coldwater fishery
*Only certain waterbodies are designated as coldwater fishery if a waterbody is not meeting one or more designated uses it becomes classified as *impaired.* The following is a list of impaired waterbodies provided by DEQ.

Status Summary (Cooper, 2006)

While most of the Cass River Watershed is considered to be attaining the biological portions of its respective designated uses, nearly the entire watershed exhibits some degree of resource impairment due to the practice of channel modification (dredging or channelization) which is widespread throughout the basin. The greatest limitation(s) to the macro invertebrate community at many of the locations surveyed appeared to be correlated to an obvious lack of hard, stable substrate materials (cobble, gravel, and/or LWD). In addition, many of these modified channels have been dredged to handle high flows which result in very slow flow velocities during base flow conditions. These extremely low-flows deposit rather than carry particulate materials resulting in habitat loss due to siltation and sedimentation and, in some streams, may restrict reaeration rates resulting in biological impairment due to prolonged periods where dissolved oxygen concentrations are insufficient.

There are currently eight listings in the 305(b) report that indicate where there are portions of the Cass River Watershed that are not attaining due to either a poor macro invertebrate community (Category 5), channel modification (Category 4C), or that a previous survey provided inconclusive information and therefore require additional information (Category 3) to determine the attainment status for the other indigenous aquatic life and wildlife designated uses within the watershed. These locations were re-assessed during the 2006 sampling effort with the following results:

- White Creek (Water Body Identification Number [WBID#]210405A) is currently listed as a Category 5 for a poor macro invertebrate community due to flow modifications. Flow conditions were judged to be very good in 2006 (Station 16) with an overall macro invertebrate community considered to be very good. The 305(b) listing for this reach should be updated to a Category 2 which indicates that the stream is attaining the other indigenous aquatic life and wildlife designated use.

- The North Branch White Creek (WBID#210405C) and the South Branch White Creek (WBID#210405D) are both listed as Category 4C due to habitat modification, the result of stream channelization. Stations 17 and 18 on the North Branch and Stations 21 and 22 on the South Branch all contained macro invertebrate communities that were considered to be acceptable. As such, the 305(b) listing should be changed from Category 4C to Category 2.

- Duff Creek (WBID#210406A) is currently listed in the 305(b) report as a Category 4C in combination with the South Branch Cass River upstream of the confluence with Duff Creek. Biosurveys performed in 2006 (Station 41) found a macro invertebrate community that was rated as acceptable. Even though the macro invertebrate community was rated as acceptable, the 305(b) listing should be changed from Category 4C to a Category 3 as there was considerable evidence of extremely high nutrient concentrations throughout the channel with aquatic vegetation at near nuisance concentrations.

- Turtle Creek (WBID#210406B) is currently listed in the 305(b) report as a Category 3. Biosurvey efforts in 2006 indicate that the stream at Station 40 should be listed as a Category 5. Turtle Creek is a channelized stream that is not attaining the other indigenous aquatic life and wildlife designated use and the stream currently exceeds its designated use for total body contact due the presence of pathogens *(E. coli)*.

- Portions of the North Branch Cass River (WBID#210404A), Middle Branch Cass River (WBID#210407A), and the South Branch Cass River (WBID#210406C) are all currently listed in the 305(b) report as Category 4C due to extensive channelization. However, biological survey efforts in 2006 found acceptable macro invertebrate communities at all stations surveyed within these three streams (Stations 27, 28, 29, 32, and 36, respectively), indicating that stream is currently attaining the other indigenous aquatic life and wildlife designated use. The listing for these streams should be changed in the 305(b) integrated report to indicate a Category 2 status.

- Millington Creek (WBID#210402D) is currently listed in the 305(b) report as a Category 3 due to a macro invertebrate community that was considered to be moderately impaired due to excessive sedimentation. Biosurvey results from 2006 found a health and diverse macro invertebrate community at Station 12 that would suggest a significant improvement from conditions previously encountered in 1991. As such, Millington Creek should be re-classified to indicate a Category 2 status.

- The Caro Impoundment is currently listed as a category 5 on the 305(b) listing due to FCA-PCBs and mercury (in fish tissue) but is based on data from October 1998. Fish were collected on July 13, 2006, to provide for a more up-to-date data record for possible TMDL development with sampling results expected in the summer of 2007. In addition, a bioaccumulation study was executed at multiple locations in the Cass River in the summer of 2006 with the sampling results also expected in the summer of 2007.

Additional Considerations

Only Turtle and Duff Creeks in Sanilac County demonstrated obvious signs of water quality impairment. The author of this report considers Turtle Creek at Station 40 to be an obvious health hazard due to the presence of raw sewage in the stream. As such, we highly encourage the Sanilac County Health Department to, at a minimum, post obvious warning signs to prevent any contact with the channel environment until a solution to the septage issues can be found.

Water chemistry samples taken in Duff Creek upstream and downstream of the Marlette WWTP combined with dense concentrations of aquatic vegetation in the stream channel downstream from the city of Marlette strongly suggest that nutrient concentrations are chronically high. This is consistent with water chemistry results from 2001 where nutrients were also considered to be well above expectations (Cooper, 2001).

Dead Creek at Station 10 scored as poor, suggesting that the stream at this portion of its continuum is not attaining the other indigenous aquatic life and wildlife designated uses. However, the channel was in the process of being dredged on the date sampled providing for very poor sampling conditions. As such, this stream should be classified as a Category 4C as the dredging activities will likely impair the macro invertebrate for several years.
The macro invertebrate community in the Moore Drain at Station 14 also scored poor, however this is a highly modified channel in a highly urbanized area. Flow conditions were monitored during a moderate rain event on June 26, 2006, where the volume of flow more than doubled in a relatively short period of time. As such, this stream should be classified as a Category 4C.
The macro invertebrate community in the Franzel Drain (Station 39) also scored as poor, however conversations with residents who live on and near the drain informed us after our survey was complete that the drain typically dries up in the mid- to late summer months. Therefore, this stream should be considered intermittent.

7.0 Resource Concerns

Resource concerns in the watershed include soil loss, water quality impairment, loss of productive farmlands, habitat fragmentation and degradation, increased nutrient input and lack of coordinated land use policies aimed at protecting natural resources.

Table 8

Watershed Concerns		
Concern	Source	Cause
Sedimentation	Eroding streambanks	Removal of Vegetation Livestock access Foot access Ice damage Fluctuating flow
	Poor road / stream crossings	Runoff from steep and/or unpaved approaches Embankment erosion from Undersized and misaligned culverts, road grading practices, foot traffic
	Storm runoff	Artificial drainage, construction sites directing polluted runoff to water bodies
	Cropland erosion	Inadequate buffers, surface drains, lack of residue, no wind breaks, gully erosion sheet and rill erosion
Habitat fragmentation / degradation	Loss of riparian & wildlife corridors	Removal of vegetation Increased development Agriculture practices Recreational use
	Road / stream crossings	Increased water temperature Turbidity Sedimentation Direct conduit of road runoff Perched and undersized culverts
	Loss of wetlands	Increased development Artificial drainage
	Channelization	Farm Drainage Storm Water Management Poor Drain Maintenance
	Mismanaged Wildlife Land	Lack of Timber Stand Improvement, Invasive Specie Knowledge / Skill level of mgmt.
Increased nutrients	Septic effluent	Poor / malfunctioning septic
	Residential fertilizers	Misapplication
	Crop fertilizers	Timing, Runoff event, Placement, Application Rate
	Stormwater runoff	Poor / Inadequate Design due to lack of future planning
	Livestock waste	Runoff from pastures / feed lots Application timing, rates and Placement Animal mortality and composting

Watershed Concerns Continued…		
Concern	Source	Cause
Water quality	Pathogens	Sewage, livestock access / waste Inadequate septic Combined Sewer overflows Inadequate Waste Treatment
	PCB accumulation	Point sources
	Mercury deposition	Atmospheric deposition Stormwater Runoff
	Chemical changes	Pesticide and Nutrient misapplication
	Thermal pollution	Stormwater runoff Impoundments Removal of riparian zone
Unplanned development	Land fragmentation and parcel splits	Lack of coordinated planning which include up-to-date land conservation planning principles
	Increasing development	Lack of coordinated planning which include up-to-date land conservation planning principles
	Lack of proper zoning	Lack of coordinated planning which include up-to-date land conservation planning
Loss of productive farmlands	Parcel subdivision	Increased development
	Invasive species	Inadequate control / prevention measures
	Lack of stewardship	Availability and types of assistance programs isn't widely known Economic and Financial Stability
	Loss of productive soils	Erosion from wind and water Soil health and tilth
	Financial hardship	Demographic changes Land ownership cost /taxes Input cost Availability and types of assistance programs isn't widely known
	Marginal lands	Lands were marginal to begin with compounding farming problems Absentee landowners
Lack of Recreational Access	Ownership	Funding from state Private ownership / property rights
Forest Management		
Loss of Aquatic Habitat		
Air Quality	Livestock	Misapplication Storage Site planning / mgmt

8.0 Priority Goals for 2008-2012

The goals for the Cass River Watershed are based on past studies conducted in the watershed, information gathered in developing the Resource Profile and input provided by the Steering Committee. The goals are aimed at protecting the water quality and wildlife habitat and address resource concerns of the watershed. Milestones were identified indicating the steps needed to reach the objective. Implementing most objectives requires a combination of three types of activities. These include 1) implementing structural and/or vegetative Best Management Practices, 2) reviewing and modifying existing projects, programs and ordinances, and 3) designating and implementing education and information activities.

(Many of the objectives, especially those related to education, will be an ongoing effort. Once the objective is achieved it may be prudent to modify and/or begin the tasks again.)

The following goals are broken into four categories: Land Use, Erosion & Sedimentation, Agriculture, and Outreach & Education.

8.1 Land Use Goal: Institute responsible land use protection and public policy to protect parcels within the watershed that provide groundwater recharge, key wildlife habitats, headwater stream protection, important wetland functions, coastal areas, etc.

1) Identify and map environmentally sensitive parcels and ecological corridors throughout the watershed and prioritize areas to work with landowners on a voluntary basis to improve land stewardship practices on the most critical parcels and enhance recreational opportunities along the Cass River Corridor.

a. Key Partners: Saginaw Bay RC&D, County Foresters, NRCS, U of M Flint, Cass River Committee, Parks and Recreation Departments, US FWS

b. Tasks:
   i. Identify mapping criteria
   ii. Develop GIS database to be used in planning/implementation decisions
   iii. Present data to partners

c. Cost: $25,000 to develop a GIS database

2) Meet individually with at least 20 landowners each year to promote and implement land stewardship practices.

a. Key Partners: Saginaw Bay RC&D, Conservation Districts, NRCS, Saginaw Basin Land Conservancy

b. Tasks:
   i. Compile landowner contact information
   ii. Contact landowners via direct mail, local meetings, etc.
   iii. Prepare land stewardship materials for landowners
   iv. Meet with property owners to address needs and develop a plan for implementation
   v. Promote cost share programs available to landowners

c. Cost: $ 40,000/yr for site visits

3) Assist interested landowners of environmentally sensitive parcels with the voluntary protection of their property through a conservation easement program. Secure 5 easements per year in the watershed.

a. Key Partners: Saginaw Bay Land Conservancy, US FWS

b. Tasks:
   i. Conservancy meets to discuss priorities and opportunities for collaboration
   ii. Target outreach program to key landowners
   iii. Meet with interested landowners and develop permanent deed restrictions
   c. Cost: $5,000/yr

4) Provide sample ordinance language to local planning commissions that incorporates the principles of Better Site Design & Low Impact Development; conduct at least 5 presentations each year on this topic during part of regular planning commission meetings.

a. Key Partners: Cass River Committee, Designscapes, Inc.

b. Tasks:
   i. Review local ordinances to identify gaps
   ii. Provide sample ordinance language to planning commissions
   iii. Actively promote modern solutions including low impact development principles, site plan reviews, schematics, etc.
   iv. Highlight regional planning success stories
   v. Promote rural community character of the watershed
   vi. Conduct presentations at township, county and planning commission meetings
   vii. Make information accessible via the internet

c. Cost: $10,000/yr

5) Provide training for planning and zoning commissioners on issues related to watershed protection; offer programs every year.

a. Key Partners: MSUE Citizen Planner Program

b. Tasks:
   i. Obtain funding to host seminars
   ii. Coordinate training seminars for local planning and zoning personnel
   iii. Conduct periodic follow-up seminars regarding new planning issues
   iv. Complete a “Citizens Planner” program for the area

c. Cost: $5,000/yr

6) Encourage watershed-wide land use collaboration.

a. Key Partners: MSU Extension, Saginaw Bay RC&D, Conservation Districts, ECMPDR

b. Tasks:
   i. Provide watershed information and goals to local decision makers
   ii. Promote regional collaboration
   iii. Encourage local leaders to support conservation efforts and programs

c. Cost: $5,000/yr

8.2 Agriculture Goal: Identify sites contributing to water quality problems and work with producers to implement Best Management Practices.

1) Perform a field inventory and identify agriculture sites contributing nonpoint source pollution to waterbodies.

a. Key Partners: NRCS, US FWS, Conservation Districts, Saginaw Bay RC&D, Univ. Michigan Flint

b. Tasks:
   - i. Begin by inventorying sites within the riparian zone where soils have a higher erodibility factor
   - ii. Prioritize sites based on water quality and habitat impacts
   - iii. Share results with agencies capable of implementing agriculture BMPs
   - iv. Contact producers and make cost share programs available to them

c. Cost: $20,000/yr

2) Direct funding programs to priority agriculture issues within the watershed (e.g. filter strips, livestock access, fencing, tillage practices, soils tests, etc.).

a. Key Partners: NRCS, Conservation Districts

b. Tasks:
   - i. After inventories are completed evaluate the most cost effective way to protect water quality and wildlife habitat
   - ii. Target outreach, workshops and landowner meetings to address primary concerns
   - iii. Develop or direct cost-share programs to priority areas

c. Cost: $200,000/year

3) Reduce confusion among public about the myriad of programs available by focusing on establishing filter strips and other related practices over the next five years.

a. Key Partners: Conservation Districts, NRCS, MSU Extension

b. Tasks:
   - i. Conduct a coordinate effort among agencies and make sure everyone has the same filter strip language and information displayed (avoid jargon, acronyms and complicated issues)
   - ii. Conduct presentations and send out press releases specific to filter strips
   - iii. Identify specific producers that could use filter strips
   - iv. Direct mail to those producers and follow-up by phone

c. Cost: $2,000
   - iii. Determine BMPs
   - iv. Develop cost estimates
   - v. Rank sites
   - vi. Present results to road commission and other partners
   - vii. Make information accessible via the internet

c. Cost: $20,000

4) Make programs more user friendly eliminate the overuse of acronyms for conservation programs.

a. Key Partners: NRCS, Conservation District, and all other partners

b . Tasks:
i. Ensure all conservation providers read, understand and agree to the importance of using language that resonates well with the public
ii. After one year, conduct internal "audit" of outreach materials produced pre- and post-goal and compare number of acronyms
iii. Conduct same assessment with target audience to determine if there is a noticeable difference
iv. Share results with conservation partners

c. Cost: No additional costs

5) Encourage and promote farmland preservation programs where appropriate.

a. Key Partners: NRCS, MDA, land conservancies

b. Tasks:
i. Promote the rural community character of the watershed and how agriculture is a key component
ii. Make programs accessible and understandable to producers
iii. Identify likely participants and send information
iv. Host at least 3 small "town hall" meetings to discuss the program
v. Meet with at least 20 interested landowners
vi. Enroll properties into preservation programs

c. Cost: $15,000/year

6) Promote projects in order to focus attention on success stories.

a. Key Partners: Conservation Districts

b. Tasks:
i. Identify 2-3 agriculture projects in each county
ii. Obtain permission of producers to highlight projects
iii. Post on websites and submit press releases
iv. Host watershed tours to highlight successful implementation projects
v. Make information accessible via the internet

c. Cost: $2,000/year

8.3. Erosion and Sedimentation Goal: Identify sites that are unnaturally adding sediment to the river system and implement a system of Best Management Practices where possible.

1) Conduct a field inventory of all road-stream crossing sites.

a. Key Partners: Saginaw Bay RC&D, US FWS, Univ. of Michigan Flint, road commissions

b. Tasks:
i. Inventory sites, complete data sheets, take photographs
ii. Estimate pollutant loading

c. Cost: $ 25,000

2) Conduct inventory of likely erosion areas on the Cass river, including access sites, locations and abundance of invasive species and streambank erosion.

a. Key Partners: Saginaw Bay RC&D, Cass River Watershed Restoration Committee, US FWS, Univ. of Michigan Flint, US NPS

b. Tasks:
   i. Inventory sites, complete data sheets, take photographs
   ii. Estimate pollutant loading
   iii. Determine BMPs
   iv. Develop cost estimates
   v. Rank sites
   vi. Present results to partners
   vii. Make information accessible via the internet
c. Cost: $20,000 /yr

3) Implement BMPs the 10 most important road stream sites within watershed --(approximately 2 per year throughout the watershed)
a. Key Partners: Road Commissions, U.S. Fish &Wildlife Service, Conservation Districts, Cass River Watershed Restoration Committee, Saginaw Bay RC&D
b. Tasks:
   i. Select priority sites
   ii. Prepare engineer designs
   iii. Raise funds
   iv. Obtain appropriate permits
   v. Install BMPs
c. Cost: 50,000/yr

4) Continue efforts in the Saginaw Area Stormwater Authority boundary to implement stormwater Best Management Practices and expand a voluntary stormwater management phase II-type framework to other urbanized areas in the watershed.
a. Key Partners: SASWA, MDEQ, Cass River Committee
b. Tasks:
c. Cost: $15,000/yr

5) Inventory stormwater outfalls in other potential problem areas throughout watershed.
a. Key Partners: Saginaw Bay RC&D, NRCS
b. Tasks:
   i. Identify high priority areas to conduct an inventory
   ii. Develop BMPs
   iii. Estimate pollutant loading
   iv. Estimate implementation costs
   v. Present general stormwater recommendations to partners
   vi. Make information accessible via the internet
c. Cost: $30,000

6) Continue efforts of Cass River Corridor Committee to stabilize key streambank erosion sites on the Cass River
a. Key Partners: Saginaw Bay RC&D, Cass River Corridor Committee, NRCS, US Fish and Wildlife Service, DNR

b. Tasks:
   i. Visit problem sites and develop BMPs and cost estimates
   ii. Make information accessible via the internet
   iii. Submit a collaborative restoration grant by partners in order to fund work
c. Cost: $50,000/yr

7) Install native plant buffers along lakes and streams to reduce runoff, minimize erosion, and improve the quality of riparian wildlife habitat. Do approximately 5 sites each year and highlight as demonstration projects to help educate landowners.
a. Key Partners: Saginaw Bay RC&D, Conservation Districts, Drain Commissioners, NRCS, US FWS
b. Tasks:
   i. Develop promotional materials for landowners
   ii. Identify potential sites
   iii. Develop conceptual designs
   iv. Create cost-share and maintenance agreements with landowners
   v. Order plant materials
   vi. Install greenbelts
c. Cost: $25,000/yr

8.4 Education & Outreach Goal: Increase and develop citizen involvement/public awareness and responsible use of the watershed through stewardship and education.

1) Establish ongoing education program (workshops, television and radio PSAs, watershed newsletter distributed via community businesses) to promote activities landowners can do to improve water quality and establish green infrastructure.
a. Key Partners: Conservation Districts, Saginaw Bay RC&D, MSU Extension, Cass River Committee, US NPS
b. Tasks:
   i. Focus on greenbelts, rain gardens, exotic species control, soil testing and proper fertilizer use.
   ii. Develop concise and consistent messages
   iii. Create a list of contacts for citizens
   iv. Align educational materials and key messages among partners
   v. Make information accessible via the internet
c. Cost: $5,000/yr

2) Develop and install watershed interpretive signs at 50 key locations
a. Key Partners: Saginaw Bay RC&D, Cass River Committee, road commission, sign company
b. Tasks:
   i. Work with partners to identify key messages & locations for signage
   ii. Solicit bids for development of signs
   iii. Install sign
c. Cost: $5,000 (one time cost)

Footnotes/Bibliography

.1. Hydrologic Unit Boundary maps. Natural Resources Conservation Service Geospatial Data Gateway.
.http://datagateway.nrcs.usda.gov/NextPage.aspx?Progress=1&AValue=1&QuickCounty=*&QuickState=Michigan&ExtentMinX=-125.5&ExtentMinY=16.35&ExtentMaxX=-65.0&ExtentMaxY=59.0&HitTab=2
2. 2. National Land Cover Data (NLCD) – Originator: United States Geological Survey (USGS). Information available http://www.mcgi.state.mi.us/mgdl/?rel=ext&action=cext then navigate to counties of interest, then 1992 National Land Cover Dataset.
3. 3. Public Land information is available from http://www.mcgi.state.mi.us/mgdl/?rel=ext&action=cext then Select County, and look under Ownership.
.4. Soil Survey Geographical Database (SSURGO) tabular and spatial data were downloaded for the following surveys:
5. Metadata and SSURGO data for the above surveys were downloaded from the NRCS Soil Data Mart at https://soildatamart.nrcs.usda.gov/ . Component and layer tables from thetabular data were linked to the spatial data to derive the soil classification found in this section. Visit the online Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app/ for official and current USDA soil information as viewable maps and tables.
6. Common Resource Area (CRA) Map delineations are defined as geographical areas where resource concerns, problems, or treatment needs are similar. It is considered a subdivision of an existing Major Land Resource Area (MLRA) map delineation or polygon. Landscape conditions, soil, climate, human considerations, and other natural resource information are used to determine the geographical boundaries of a CRA. For more information about a CRA visit http://soils.usda.gov/survey/geography/cra.html
7. Population Statistics were obtained from the US Census Bureau, State and County Quick Facts. http://quickfacts.census.gov/qfd/states
8. Agriculture Census Data was downloaded from the National Agriculture Statistics Service (NASS) website. For more information on individual census queries visit the NASS website at http://www.nass.usda.gov/
9. Threatened and Endangered Species information was extracted from Michigan Natural Features Inventory (MNFI) 14 digit Hydrologic Unit Codes (HUC) and inserted into 10 digit HUC. Visit the MNFI website at http://web4.msue.msu.edu/mnfi/ then click on Data Resources and Watershed Element Data to find more information on T&E species.
10. 303d listed streams were derived from Michigan Department of Environmental Quality (MIDEQ) data at the MIDEQ website at http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-12711--,00.html
11. Performance Results System (PRS) data was extracted from the PRS homepage by year, conservation systems and practices and Hydrologic Unit Code (HUC) level. For more information on these and other performance reports visit
.http://ias.sc.egov.usda.gov/prsreport2007/report.aspx?report_id=222
12. Michigan Dams was clipped to the watershed from data generated by the MDEQ. For more information visit
.http://www.glfc.org/glgis/support_docs/html/lake_GISs/LHGIS_index.htm

Agricultural Practices Assessment Matrix

The Cass River Rapid Watershed Agricultural Practices Assessment Matrices and Potential Costs and Benefits Summary Matrix were produced through a consensus process of a NRCS Technical Team. Participants included the District Conservationists and Soil Conservationists assigned to the six counties located within the watershed and who have knowledge of and responsibilities for bringing USDA-Natural Resource Conservation Service (NRCS) programs to the public. Additional assistance was provided by the USDA-NRCS Area Conservationist, the Agriculture Economist and the State Resource Conservationist. The matrix illustration provided in the USDA-NRCS's *Rapid Watershed Assessment* promotion brochure was used as a discussion starting point. As there is no established National or State methodology for this work, the procedure discussed in the next paragraphs was followed.

Watershed-specific data was obtained from the USDA-NRCS Performance Results System (PRS) for Conservation Practices used in 2005, 2006, and 2007. It was assumed that all practices planned for 2007 were implemented. The Technical Team determined that four Land Uses: Cropland, Grazing Land, Wildlife Habitat, and Headquarters were the broad brush categories that most closely reflected agriculture and NRCS programs usage in the Cass River Watershed.

Next, the Technical Team determined which of the practices would best represent current conditions for each of the Land Uses. Current conditions can also be thought of as "baseline" or "existing" conditions as of 2007. The current numbers are the starting measurements used for determining future benefits.

After establishing the Current Conditions, the Technical Team organized the practices into typical Resource Management Systems (RMS). The RMSs represent a collection of practices that an agricultural producer or others might use to produce a desired effect for their business and property. The RMS used for each of the Land Uses in this project is theoretical based on recent usage in the Watershed. The USDA-NRCS program arsenal contains many more practices that could be used, but for the sake of manageability, the practices chosen for this assessment are given in Appendix C. The RMSs practice acres were determined by taking an average of the 3-year PRS data.

Typical installation cost estimates are based on cost list information provided by the USDA-NRCS State Economist for a suite of USDA-NRCS Conservation Practices that is included in Appendix C. The units in the Matrix Tables are the same as the units used by USDA-NRCS to determine the cost of installing a Conservation Practice.

The Resource Concerns for the watershed include: Soil Erosion, Soil Condition, Water Quality, Air Quality, Plant Health, and Animal Habitat. Animal Habitat includes both domestic livestock and wildlife. The Effects of installing RMS practices and for operating and maintaining the current conditions and RMS practices are assumed to have positive benefits on the Resource Concerns.

DISCUSSION OF CPPE.

The relationship of these Assessment Matrices to the Geographic Information System (GIS) Resource Profile is loose due to a lack of easily available data that ties Conservation Practice implementation to the on-the-ground geographic locations. Developing that data set that could illustrate this relationship is beyond the scope of the current project. The acreages given in the Assessment Matrices do not exceed 10% of the land area that appears to be appropriate for the given Land Use as shown on the Resource Profile GIS.

Watershed: Cass River	
Current Conditions	Total Acres
Total Cropland	238,850
Total Hay/Pasture Land	92,330
Total Forest/Wildlife land	203,000
Other Land Use	45,820
0	0
Typical Management Unit (avg farm size)	213
Estimated Current Farm Bill participation %	50%

Future Conditions	Total Acres
Total Cropland	235,000
Total Hay/Pasture Land	90,000
Total Forest/Wildlife land	206,850
Other Land Use	52,000
0	0
Total Watershed Acres with Treatment (Current & New Implementation)	0
Estimated Acres: New Implementation	0
Estimated increase in Participation (potential participation in time frame for implementation).	7%
Total participation Future	57%

Cost Summary

Treatment / Investment	Expected Installation Cost	Annual Maintenance Cost	Total Average Annual Cost of Investment
Total Cropland	$10,007,135	$462,930	$2,162,585
Total Hay/Pasture Land	$274,660	$13,343	$50,971
Total Forest/Wildlife land	$377,058	$18,717	$80,957
Other Land Use	$10,300	$515	$1,841
0	$0	$0	$0
Cost Items and Programs		**Costs**	**O&M Costs**
Maintain the Baseline Conservation - Annual Maintenance			$56,200
Total Investment at estimated rate of participation		$10,658,900	$495,000
Potential Investment from Farm Bill Programs		$5,329,450	
Management Incentives (Incentive Payments in yr 2 & 3)		$1,518,358	
Total Potential Farm Bill Program Costs		$6,847,808	
Operator Investment		$5,329,500	$551,200
Total Average Annual Costs		$131,900	
Present Value of Total Average Annual Costs over 5 years		$573,000	
Summary numbers rounded to even 100s	Cost Basis: 2008	Discount Rate: 4.875%	Time Frame - Years: 5
Total Effects Score		1,559	

Resource Concerns Selected:	CPPE
Wildlife - Threatened and Endangered Fish and Wildlife Species	33
Wildlife - Inadequate Space	111
Wildlife - Inadequate Food	123
Wildlife - Inadequate Cover/Shelter	123
Wildlife - Imbalance Among and Within Populations	107
Water Quantity - Reduced Storage of Water Bodies by Sediment Accumulation	112
Water Quantity - Reduced Capacity of Conveyances by Sediment Deposition	106
Water Quality - Harmful Levels of Pesticides in Surface Water	79
Water Quality - Harmful Levels of Pesticides in Groundwater	46
Water Quality - Harmful Levels of Pathogens in Surface Water	67
Water Quality - Excessive Nutrients and Organics in Surface Water	118
Water Quality - Excessive Nutrients and Organics in Groundwater	65
Soil Erosion - Wind Erosion	106
Soil Erosion – Streambank	54
Soil Erosion – Shoreline	48
Soil Erosion - Sheet and Rill	95
Soil Erosion - Road, Road Sides and Construction Sites	30
Soil Erosion - Ephemeral Gully	107
Soil Erosion - Classic Gully	53
Soil Condition - Damage from Sediment Deposition	68
Soil Condition – Contaminants-Commercial Fertilizer - P	52
Soil Condition – Contaminants-Commercial Fertilizer - N	53
Soil Condition – Contaminants-Commercial Fertilizer - K	49
Soil Condition - Contaminants-Animal Waste and Other Organics - P	45
Soil Condition - Contaminants-Animal Waste and Other Organics - N	49
Soil Condition - Contaminants-Animal Waste and Other Organics - K	45
Soil Condition - Contaminants - Residual Pesticides	32
Plants - Threatened and Endangered Plant Species	16
Plants - T&E Plant Species: Declining Species, Species of Concern	26
Plants - Noxious and Invasive Plants	157
Total Effects Score	1559

Conservation Practices	Baseline (installed)	Total Cropland	Total Hay/Pasture Land	Total Forest/Wildlife land
Agrichemical Handling Facility (309) No.	2	31		
Closure of Waste Impoundment (360) No.		1		
Composting Facility (317) No.		4		
Conservation Cover (327) Ac.	1172	1250		
Conservation Crop Rotation (328) Ac.	4469	6387		20
Constructed Wetland (656) No.		100		
Cover Crop (340) Ac.		1900		
Critical Area Planting (342) Ac.		8	5	
Early Successional Habitat Development/Management (647) Ac.				20
Fence (382) Ft.	11000		40000	
Field Border (386) Ft.				
Filter Strip (393) Ac.	215	1290		
Forage Harvest Management (511) Ac.			100	
Forest Stand Improvement (666) Ac.				16
Grade Stabilization Structure (410) No.		18		
Grassed Waterway (412) Ac.		3		
Heavy Use Area Protection (561) Sq. Ft.		1000		
Manure Transfer (634) No.		4		
Nutrient Management (590) Ac.	1607	1000	115	
Pasture and Hay Planting (512) Ac.	58		165	
Pest Management (595) Ac.	222	5100	15	
Pipeline (516) Ft.			2300	
Prescribed Grazing (528) Ac.	150		115	
Residue and Tillage Management, Mulch Till (345) Ac.	828	2987		
Residue and Tillage Management, No-Till/Strip Till/Direct Seed (329) Ac.				
Residue Management, Seasonal (344) Ac.		300		
Riparian Forest Buffer (391) Ac.		2		2
Riparian Herbaceous Cover (390) Ac.				
Roof Runoff Structure (558) No.	1	3		
Shallow Water Development and Management (646) Ac.				10
Stream Crossing (578) No.			15	
Streambank and Shoreline Protection (580) Ft.				2500
Tree/Shrub Establishment (612) Ac.	68	1		15
Tree/Shrub Pruning (660) Ac.				
Tree/Shrub Site Preparation (490) Ac.				15
Upland Wildlife Habitat Management (645) Ac.	1413	1250		686
Use Exclusion (472) Ac.	190	157	42	
Waste Facility Cover (367) No.		6		
Waste Storage Facility (313) No.	2	12		
Waste Utilization (633) Ac.	506	2925		
Wastewater Treatment Strip (635) Ac.		5		
Water and Sediment Control Basin (638) No.		5		
Water Well (642) No.		2		
Watering Facility (614) No.		10	3	
Well Decommissioning (351) No.		4		
Wetland Creation (658) Ac.	10			2
Wetland Enhancement (659) Ac.		500		
Wetland Restoration (657) Ac.	133	218		12
Wetland Wildlife Habitat Management (644) Ac.	63	500		24
Windbreak/Shelterbelt Establishment (380) Ft.	1525	7300	100	
Windbreak/Shelterbelt Renovation (650) Ft.		500		