CHAPTER 3: WATERSHED INVENTORY AND CONDITIONS

3.1 Summary of Previous Studies (continued in appendix B)

Several studies were reviewed for the Cass River Watershed Management Plan. A summary and key findings from each study is provided below. A majority of this work was completed by the Saginaw Bay Resource and Conservation Development Council in 2008 during the completion of the Cass River Rapid Watershed Assessment, a project funded through the United States Department of Agriculture (USDA) – Natural Resource and Conservation Service (NRCS).

Cass River Rapid Watershed Assessment (RC&D, 2008)

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 roads, road stream crossings, agricultural operations, eroding streambanks, impervious surfaces, improperly managed construction sites, and eroding shorelines.

Excessive quantities of nutrients, particularly phosphorus, are also a pollutant of concern in watersheds and are often the major pollutant impacting lake ecosystems. High concentrations of nutrients contribute to excessive algae and aquatic plant growth. As these plants die off, they can consume dissolved oxygen and degrade fish habitat. Nutrient inputs are often tied to agriculture production and residential development, and can come from such sources as fertilizer use, septic systems and animal waste. Often protective shoreline vegetation is removed as a result of development or agricultural production. Loss of the natural shoreline can contribute to erosion, accelerate nutrient runoff, reduce the effectiveness of nutrient uptake by root systems, and eliminate wildlife habitat. Other common watershed pollutants include thermal pollution, pathogens, oils and greases, fluctuating water levels, salts, metals, animal waste, and organic matter. *(RC&D 2008)*

Michigan Department Natural Resources Fisheries Reports

The 1985 MDNR Cass River Status Report (Leonardi) classifies the Cass River as a second quality, warm water stream. Sections of the Cass River's mainstem were sampled in 1985 and 1988 using rotenone sampling techniques. The fish surveys indicated that large game fish: smallmouth bass, northern pike and rock bass are present in the river. Large numbers of young smallmouth bass and rock bass were also found. Dominate species in the river are non-game species and include carp and sucker species. The study concluded that the Cass River is relatively productive in producing fish though non-game species comprised 84 percent of the total catch.

Key Findings of 1985 MDNR Report

Degradation to the watershed is caused by agricultural run-off, poor municipal waste water treatment, irrigation withdraw, and channel dredging and straightening. Impacts include water level fluctuation, sediment filled pools, nuisance aquatic vegetation, reduced water clarity, and reduced in-stream fish habitat.

Bacterial Monitoring

The Michigan Department of Environmental Quality collected data in 2010 and 2012 to document exceedances of E. coli for total body contact use in the Lower Cass River. The Total Maximum Daily Load (TMDL) report shows that tributaries of the Cass River including Cole, Perry, Dead, and Millington exceed acceptable levels of E. coli for total body contact and occasionally exceed acceptable levels of E. coli for partial body contact. The main branch of the Lower Cass River exceeds acceptable E. coli levels for body contact primarily during and after wet weather events (MDEQ, 2013). E. coli sampling sites in the Lower Cass River are shown in Figure 3.1 and summarized in Table 3.1. The TMDL area is shown in Figure 3.10 with full results detailed in the TMDL.

Figure 3.1: E. coli Sampling Locations, MDEQ

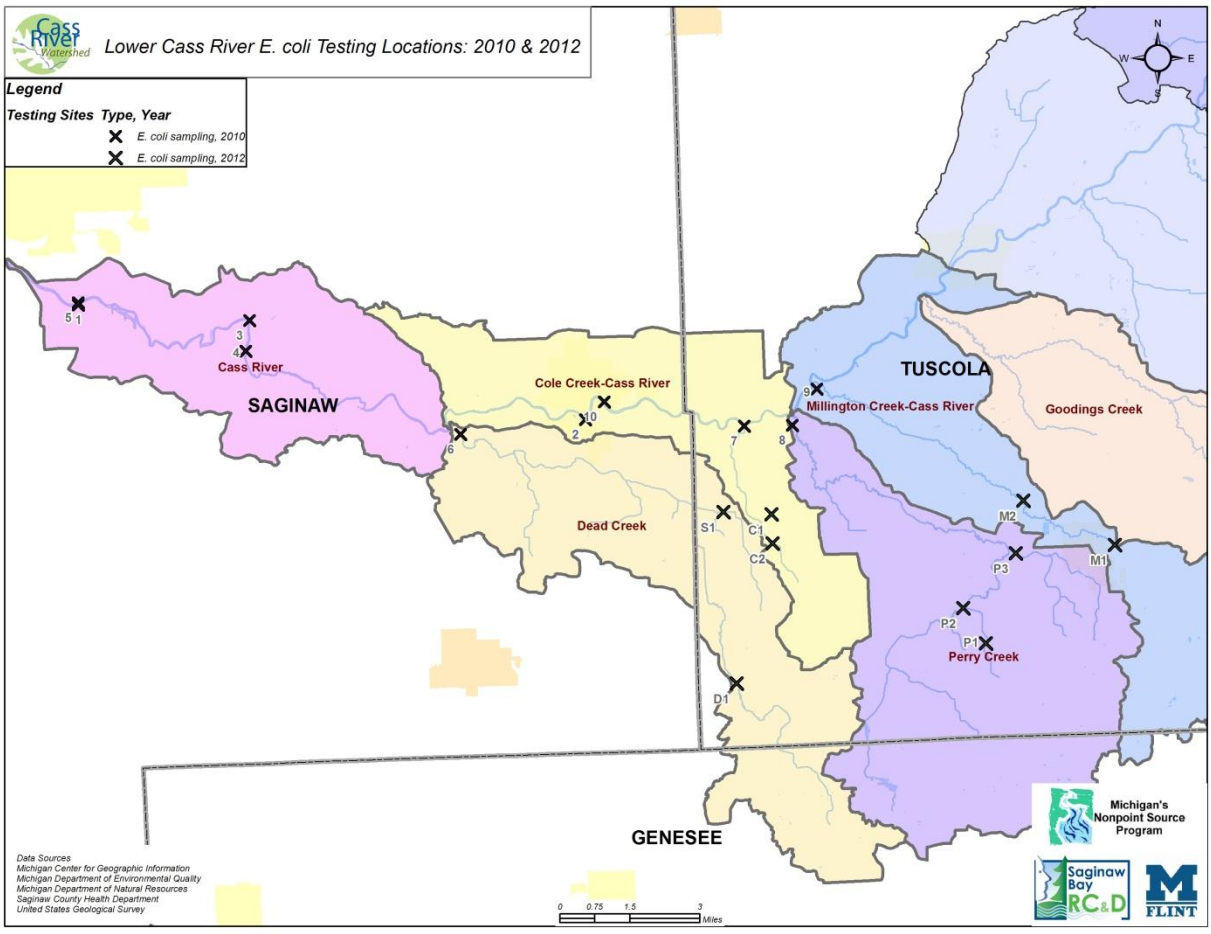


Table 3.1: MDEQ E. Coli Monitoring Locations and Results

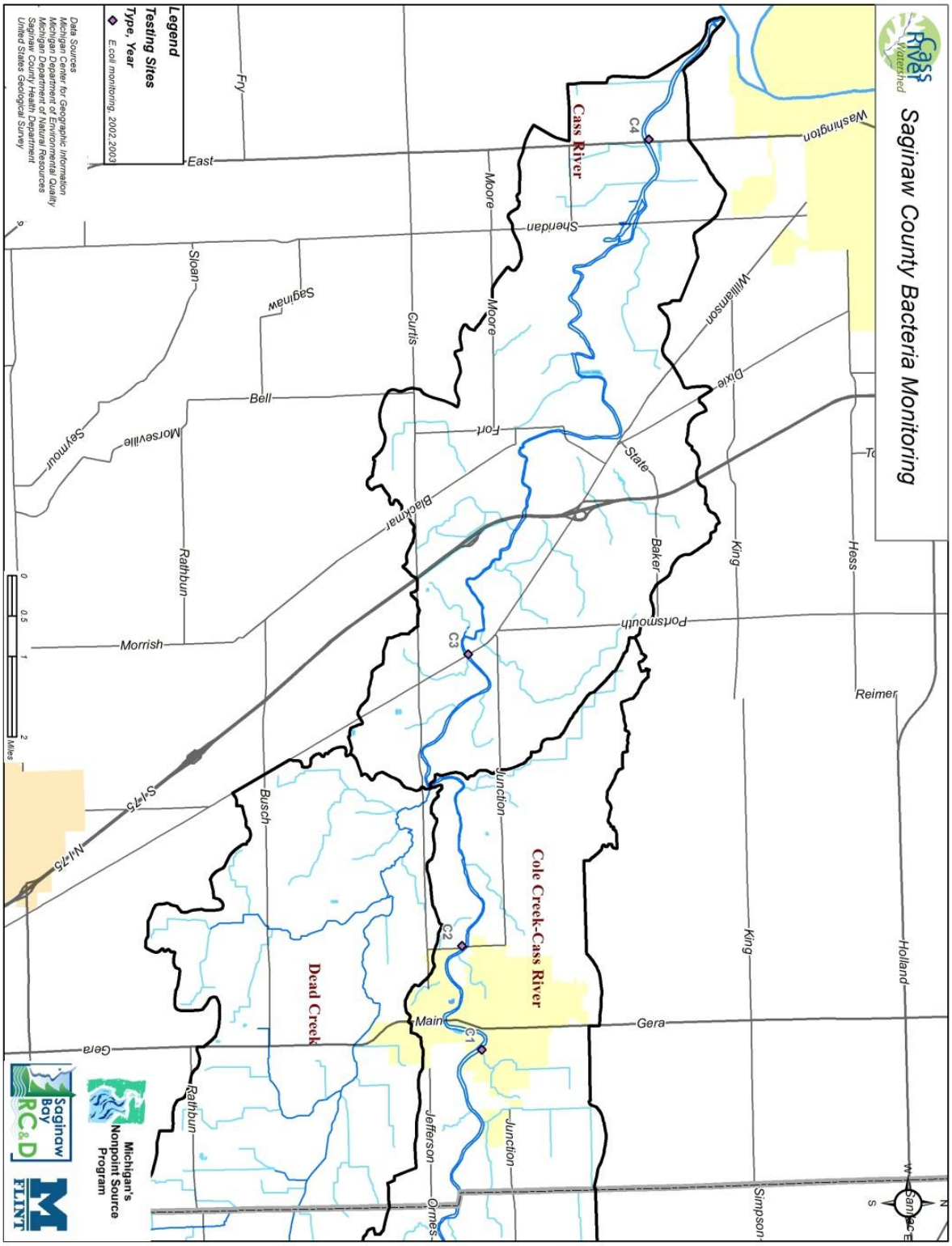
Site ID	Location	AUID	30-day Geometric mean	Partial Body Contact exceedences	Total Body Contact exceedences
C1	Cole Creek @ Bray Rd. (north)	040802050305-05	253	1	1
C2	Calkins Drain @ Bray Rd. (south)	040802050305-05	1981	4	5
S1	Smith Drain @ Murphy Lake Rd.	040802050304-01	2344	5	5
D1	Dead Creek @ Lewis Rd.	040802050304-01	480	0	5
P1	Burns Drain @ Birch Run Rd.	040802050302-01	253	0	2
P2	Perry Creek @ Vassar Rd.	040802050302-01	254	1	5
P3	Pedlow Drain / Perry Creek @ Irish Rd.	040802050302-01	544	1	5
M1	Millington Creek @ Millington Rd.	040802050303-01	920	2	5
M2	Millington Creek @ Murphy Lake Rd.	040802050303-01	399	1	3
1	Cass River @ Bray Rd.	040802050305-01	104.71182	0	0
2	Cass River @ Main St.	040802050305-03	55	0	1
3	Cass River @ Dixie Highway	040802050306-01	132.10813	0	1
4	Cass River @ Fort Rd.	040802050306-01	85	0	1
5	Cass River @ M-13	040802050306-03	58	0	0
6	Zehnder/Dead Creek @ Curtis Rd.	040802050304-01	463.24078	2	14
7	Cole Creek @ Ormes Rd.	040802050305-05	470.43757	2	11
8	Perry Creek @ Ormes Rd.	040802050302-01	340.36529	0	9
9	Millington Creek @ Loren Rd.	040802050303-01	375.51515	1	11
10	Unnamed Tributary @ Van Cleve (Tuscola) Rd.	040802050305-04	1017.0277	7	9

"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 of events 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." (*RC&D 2008*). Full results can be in the 2003 Surface Water Quality Report for Saginaw County, Department of Public Health, Environmental Health Services Division. Figure 3.2 shows the four sampling locations in Saginaw County where e.coli levels were elevated following sampling during a 26-week testing period.

Table 3.2: Saginaw County Surface Water Monitoring Results

Site	Road Crossing	Max E. Coli Value (MPN E. coli per 100 ml)	Date
C1	Cass River at Heritage Park	➢ 1,000	Sep 23-24, 2003
C2	Cass River at Dehmel Road	➢ 1,000	July 9-10, 2002
C3	Cass River at Dixie Hwy	➢ 1,000	July 9-10, 2002; Oct 1-3, 2002
C4	Cass River at East Road	➢ 800	June 25-27, 2002

Figure 3.2 Saginaw County Surface Water Monitoring



The Michigan Department of Environmental Quality sampled four sites in the Duff Creek subwatershed and two sites in the South Branch Cass River in 2002 for the creation of the Total Maximum Daily Load (TMDL) report for *Escherichia coli* in 2004. The TMDL identified that stretch of water from the confluence of Duff Creek and the South Branch Cass River, shown in Figure 3.3 as not attaining the designated uses for partial and total body contact. Since 2004, a majority of the impairment sources have been remediated in the vicinity of Marlette and the Marlette Wastewater Treatment Plant.

Michigan Department of Environmental Quality (MDEQ) bio-surveys

The MDEQ conducted biological surveys in 1996 in watersheds with the least amount of stream habitat alteration. "Previous surveys in the Cass River reported fair to good macroinvertebrate and fish populations with some exceptions in areas where sections of the Cass River or its tributaries had been recently channelized. Sedimentation was reported as the greatest contributor to stream habitat reduction (Morse, 1992). The 1992 report concluded that overall water quality was slightly improved when compared to surveys done by Grant (1976) and Taft (1989)" (Cooper 2000).

Key Findings of 2006 MDEQ Testing

Water chemistry along the main branch indicated a steady increase in nutrients from Cass City to Bridgeport. Phosphorous levels approached problematic levels though excessive amounts of vascular plants or algae were not observed presumably due to the turbidity of the water preventing sunlight reaching the substrate of the river (MDEQ, 2007).

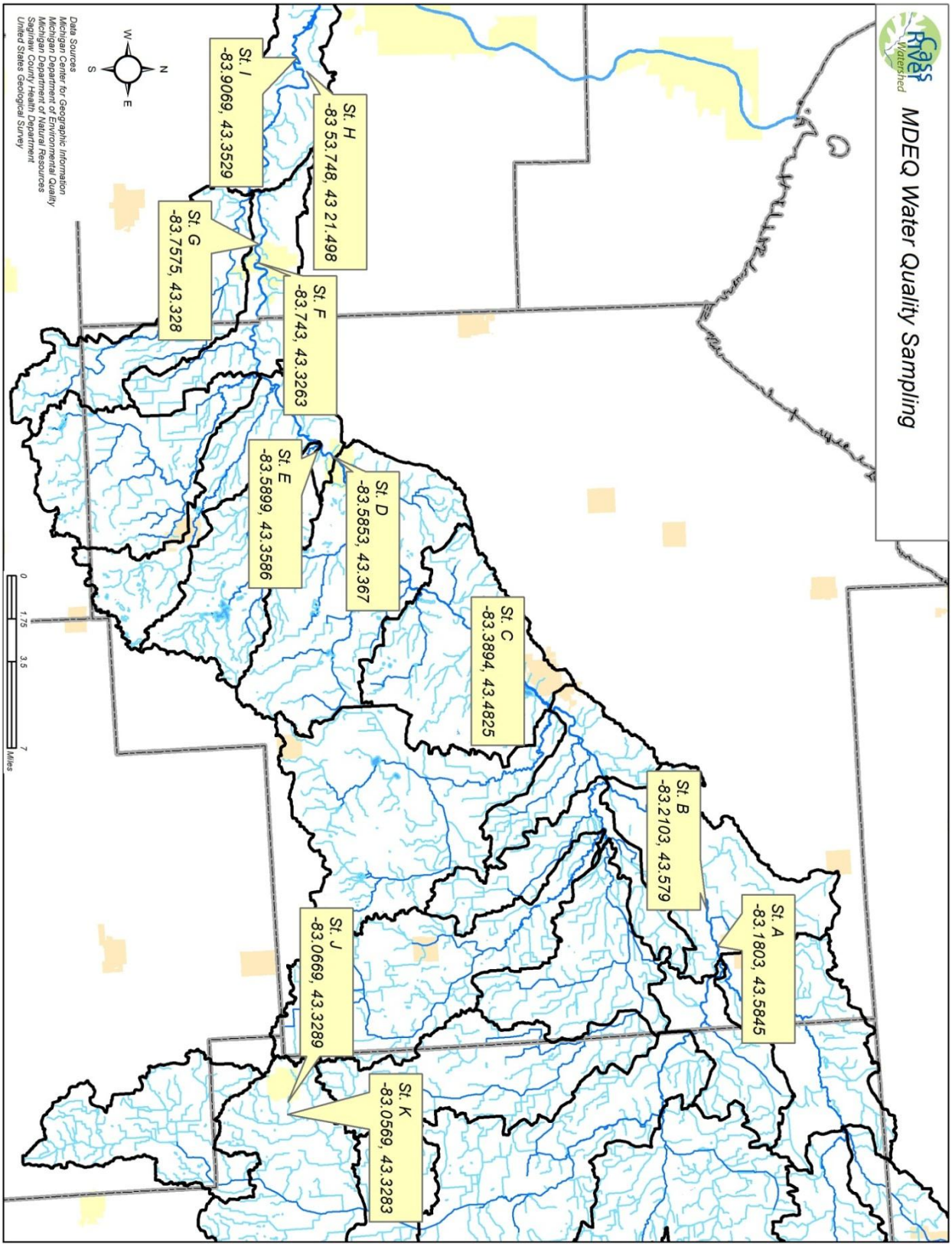
Greatest impacts to the Cass River Watershed appear to be from channel - modification and dredging. The diversity and density of macroinvertebrates are limited by a lack of hard stable substrates and loss of habitat due to siltation and sedimentation.

Nutrient sampling locations are shown in Figure 3.3. Selected data for each site is shown below in Table 3.3.

Table 3.3 Selected Nutrient Sampling Data, Cass River, 2006

Parameter	St. A	St. B	St. C	St. D	St. E	St. F	St. G	St. H	St. I	St. J	St. K
Nitrate + Nitrite (mg/L)	0.49	0.43	1.77	1.87	1.89	1.62	1.63	1.33	1.48	0.44	0.27
Nitrite (mg/L)	0.008	0.007	0.034	0.011	0.009	0.018	0.020	0.028	0.021	0.052	0.006
Nitrogen-Kjeldahl (mg/L)	0.76	0.76	0.83	0.62	0.58	0.82	0.76	0.94	0.90	0.52	1.04
Sol. Reactive Phos. (mg/L)	0.29	0.024	0.025	0.014	0.019	0.010	0.012	0.025	0.006	0.026	0.30
Phosphorous – Total (mg/L)	0.060	0.057	0.060	0.040	0.048	0.060	0.065	0.080	0.070	0.046	0.40

Figure 3.3 2006 Nutrient Sampling Locations, MDEQ



3.2 Watershed Inventory Rationale

The Cass River watershed planning process occurred at a scale larger than typical watershed planning efforts. For this reason the Cass was prioritized at the sub-basin level to assist in prioritizing and organizing information. The Cass River has three sub-basins and a total of 25 subwatersheds. Information is displayed at the sub-basin level: Upper, Middle, and Lower. A majority of the known information about the Cass River was gathered by the Michigan Department of Natural Resources (MDNR) and Michigan Department of Environmental Quality (MDEQ). Within each table, subwatersheds with an asterisk (*) beside them indicate that it is identified by the MDEQ as having an impairment. These subwatersheds were inventoried in 2011 during the watershed planning phase to identify projects that would help achieve water quality restoration goals.

Upper Cass River

Subwatersheds that are listed as impaired by the MDEQ are Spring Drain, Duff Creek, and Stony Creek. Spring Drain and Duff Creek, shown in Figure 3.4, were included in a 2004 TMDL for *E. coli* that identified pollutant source stemming from the Marlette Wastewater Treatment Plan and illicit sanitary connections in the vicinity of the creek. Stony Creek, shown in Figure 3.5, has a TMDL planned to be completed in 2018 for *E. coli* and impacts from ditching and tiling.

Figure 3.4: Spring Drain and Duff Creek, Impaired Reaches

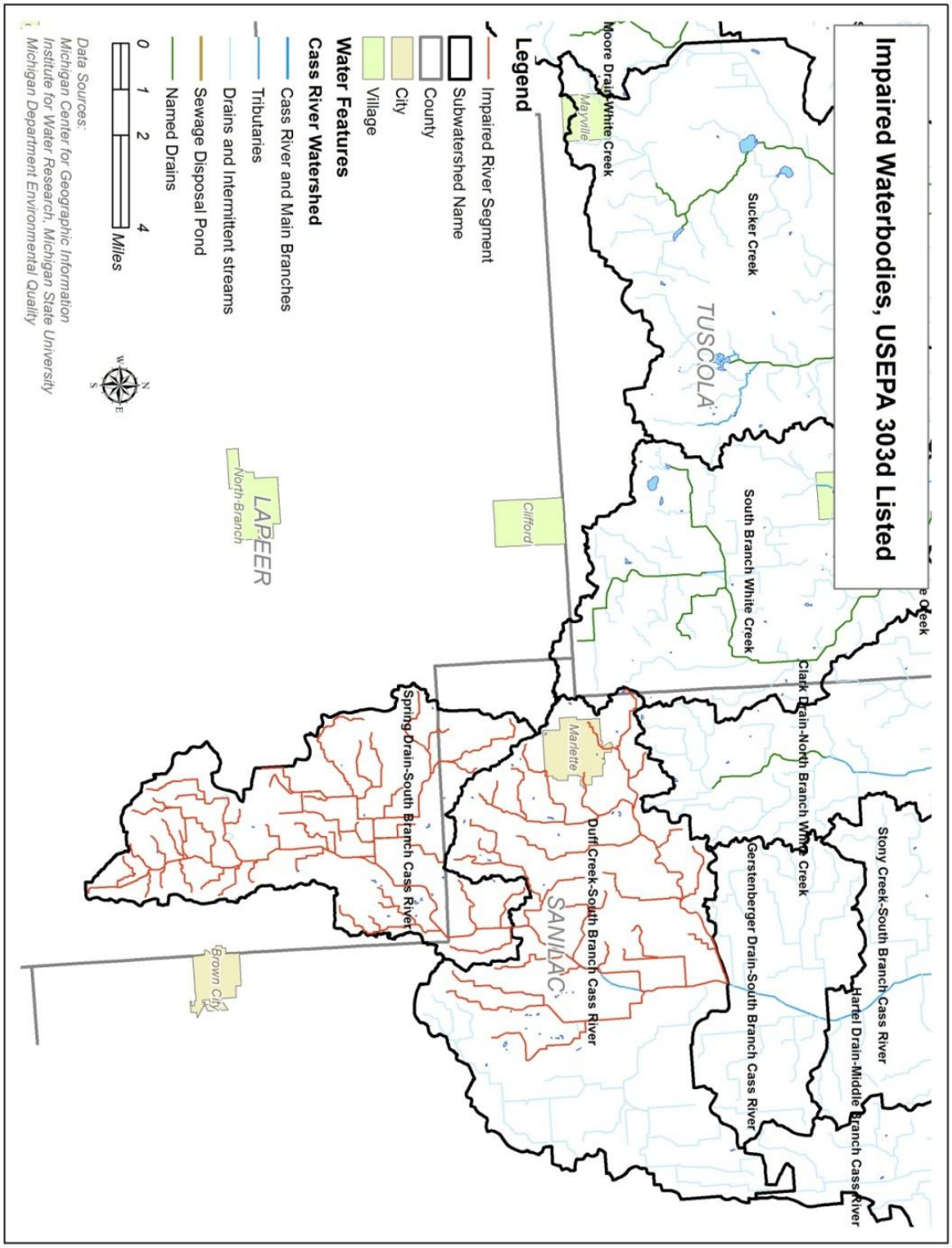


Figure 3.5: Impaired Reaches of Stony Creek, Upper Cass River

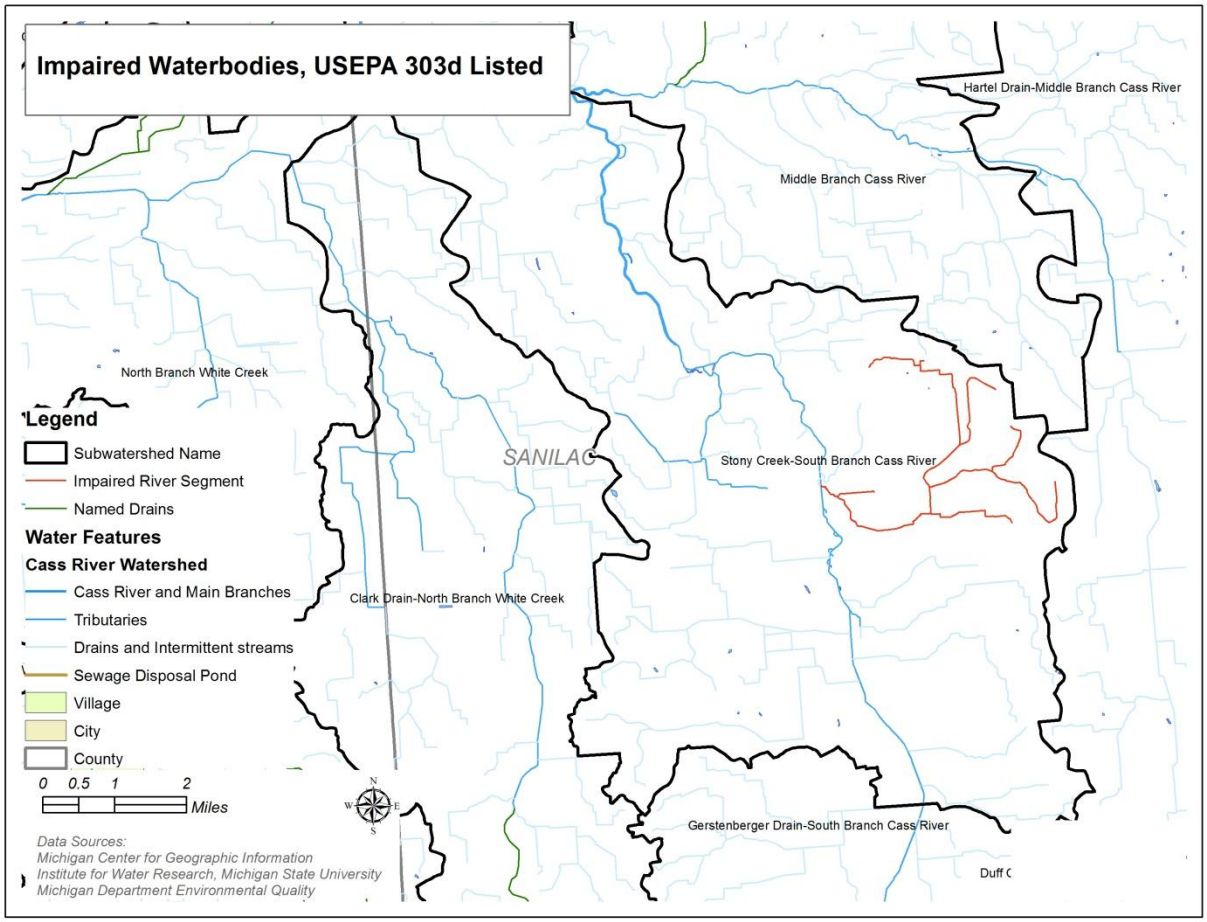


Figure 3.6 and Table 3.4 summarize data that was available for the Upper Cass River prior and during the watershed planning phase. A total of 47 sampling sites are included in the summary spanning years 1985-2006. A majority of the data is from 2006 showing varying ranges of impairment. No data was available for Gerstenberger Drain or Hartel Drain. Duff Creek and Stony Creek have the most data available, presumably due to the known impairments there since 2004 and 2001 respectively.

Figure 3.6: Upper Cass River Location of Testing Sites

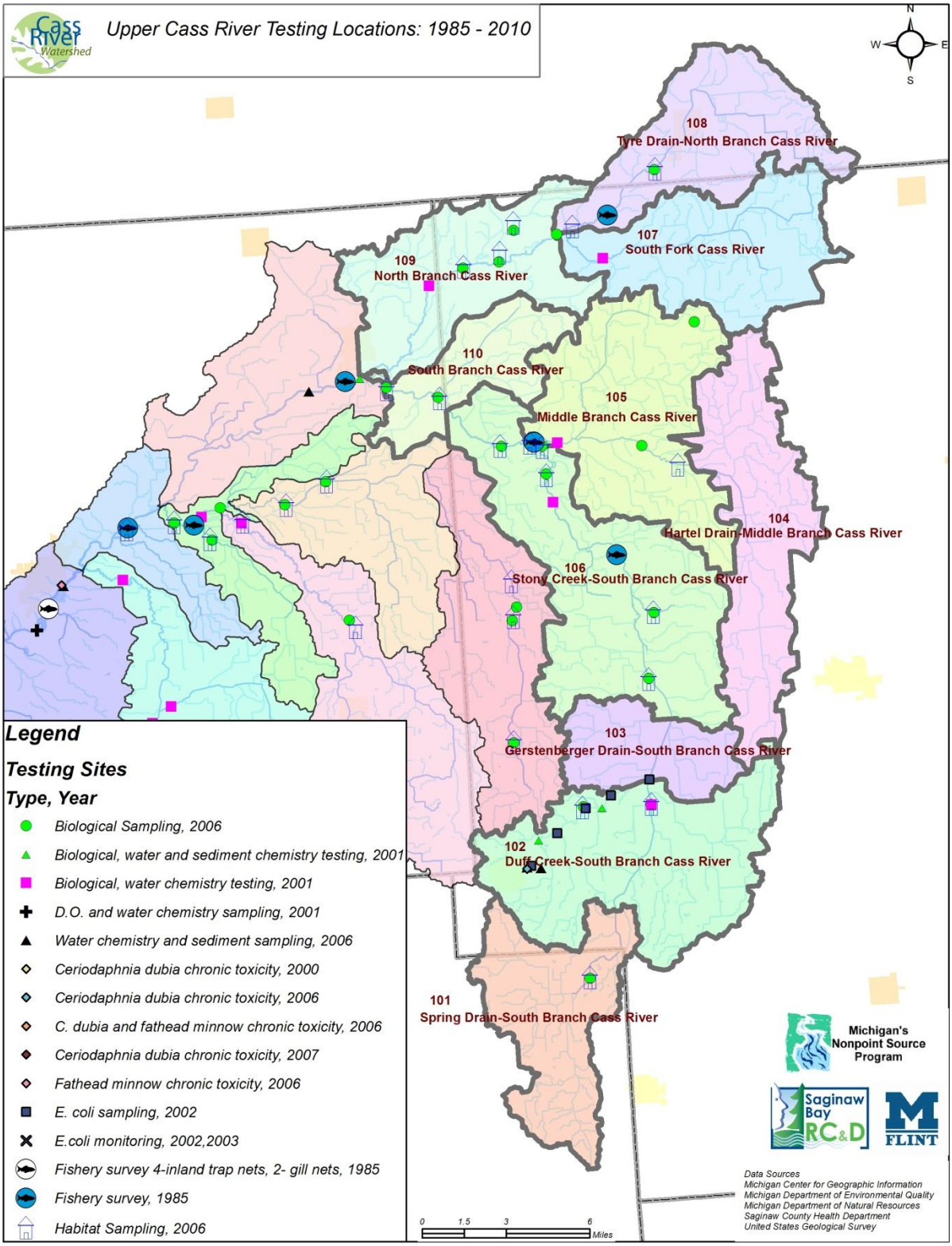


Table 3.4 Upper Cass River Summary of Biological, Chemical, and Habitat Sampling

Sub-basins	Watershed Area %	Total Sites	Site Details (#, type, year, agency)	Results Summary
Upper Cass	39.7	47		
101-Spring Drain*	3.4	2	1-Biological, 2006, MDEQ 1-Habitat, 2006	Marginal(moderately impaired) in-stream habitat, acceptable macroinvertebrate community;
102-Duff Creek*	5.4	16	2-Biological, 2006, MDEQ 2-Habitat, 2006 2-Water & Sediment Chemistry, 2006 1-Chronic Toxicity, 2006 6-E. coli, 2004 TMDL	Marginal (moderately impaired) in-stream habitat, acceptable macroinvertebrate community; 2002 TMDL notes high E. coli levels; Marlette WWTP effluent not toxic to C. dubia
103-Gerstenberger Drain	1.9	0		Not assessed by MDEQ
104-Hartel Drain	4.3	0		Not assessed by MDEQ
105-Middle Branch Cass River	5.0	4	2-Biological, 2006, MDEQ 1-Habitat, 2006 1-Biological & Chemistry, 2002	Slight to moderate impairment of in-stream habitat; Poor to acceptable ratings of macroinvertebrate community
106-Stony Creek*	6.3	10	6-Biological, 2006, MDEQ 6-Habitat, 2006 1-Biological & Water Chemistry, 2001 3-Fishery Survey, 1985, MDNR	Moderate to severe impairment of in-stream habitat; acceptable macroinvertebrate community; High fish productivity: smallmouth bass, northern pike, rock bass; and large amount of non-game species: carp and suckers
107-South Fork	3.9	1	1-Biological & Water Chemistry, 2001	Poor in-stream habitat; acceptable macroinvertebrates

Sub-basins	Watershed Area %	Total Sites	Site Details (#, type, year, agency)	Results Summary
108-Tyre Drain	3.6	6	2-Biological, 2006, MDEQ 2-Habitat, 2006 1-Biological & Water Chemistry, 2001 1-Fishery Survey, 1985, MDNR	Non-impaired and Moderately impaired stretches of in-stream habitat; acceptable macroinvertebrate communities; High fish productivity: smallmouth bass, northern pike, rock bass; and large amount of non-game species
109-North Branch Cass River	3.9	4	3-Biological, 2006, MDEQ 3-Habitat, 2006 1-Biological & Water Chemistry, 2001	Slight to moderate impairment of in-stream habitat; acceptable macroinvertebrate communities
110-South Branch Cass River	2.0	4	2-Biological, 2006, MDEQ 2-Habitat, 2006	No to slight impairment of in-stream habitat; Acceptable macroinvertebrate communities

Middle Cass River

The Middle Cass River subwatershed has the least amount of impaired waterways when compared to the Upper and Lower sub-basins. The water quality information gathered by MDEQ and MDNR note that the majority of the streams in the middle Cass River are attaining designated uses and support acceptable ratings for macroinvertebrate communities. A total of 46 sampling sites are included in the summary and span the years 1985-2006. Butternut Creek (Figure 3.7) and Moore Drain (Figure 3.8) are the two subwatersheds that are listed by the MDEQ as having water quality impairments. Butternut Creek was inventoried to identify projects to restore the warm-water fishery designation while Moore Drain inventory information identified projects to restore the indigenous aquatic life and wildlife designated use. Clark Drain was inventoried due to the density of agriculture, and identified potential pollutions sources and causes. The main stem of the Cass River was also inventoried due to the suspicion of water quality impacts from eroding streambanks.

Figure 3.7: Impaired Reaches of Butternut Creek, Middle Cass River

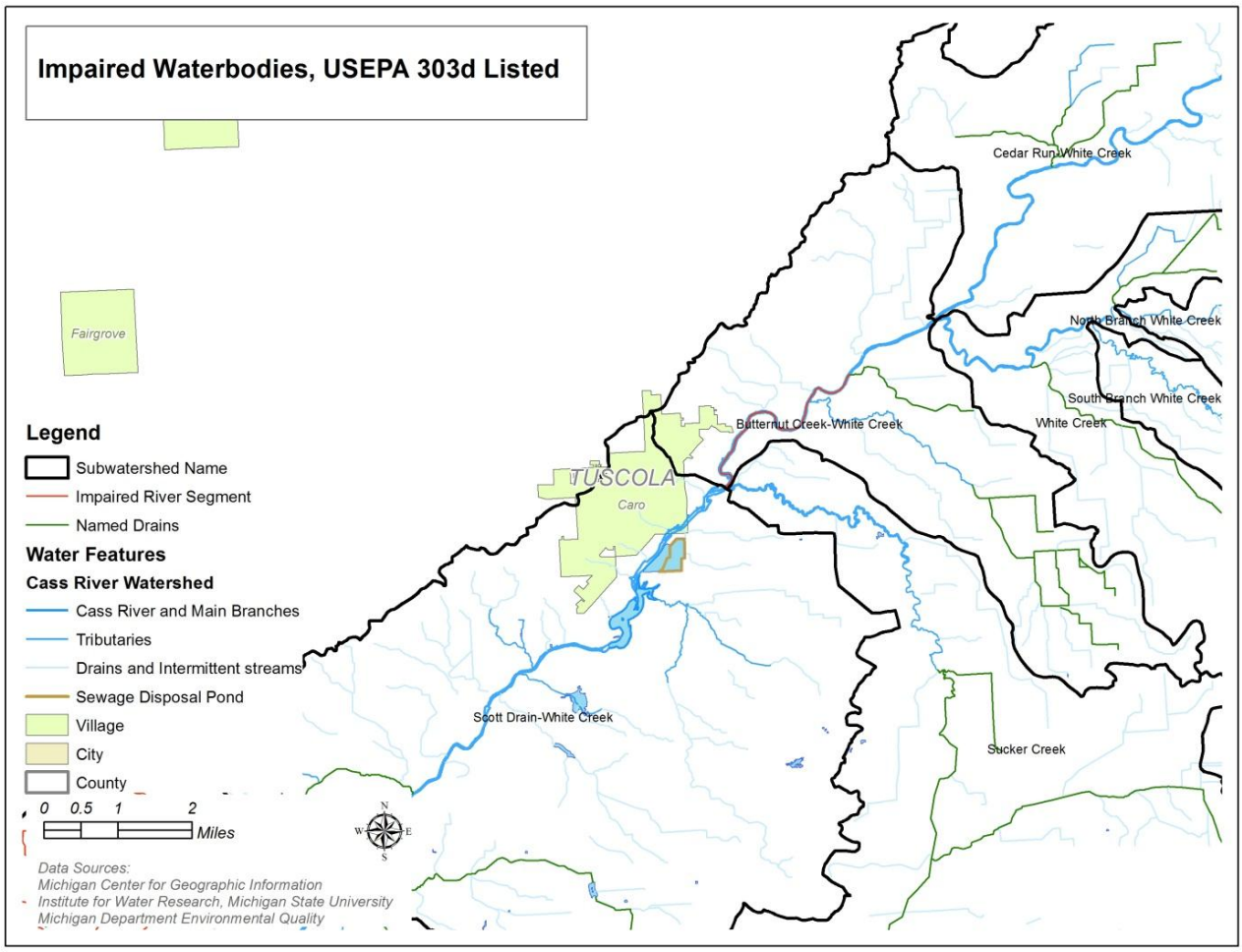


Figure 3.8: Impaired Reaches of Moore Drain, Middle Cass River

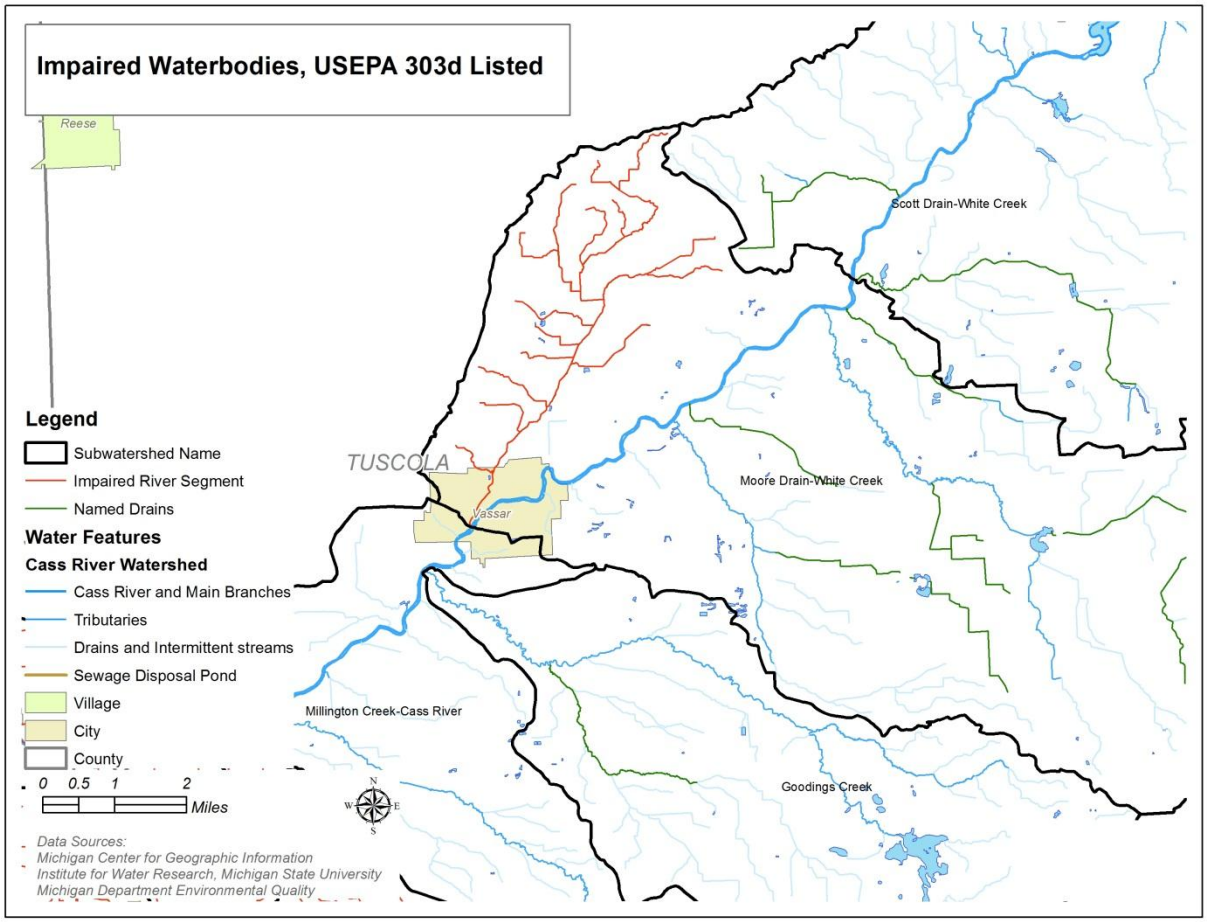


Figure 3.9 and Table 3.5 summarize data that was available for the Middle Cass River prior and during the watershed planning phase. A majority of the data is from 2006 showing varying ranges of impairment.

Figure 3.9: Middle Cass River Testing Locations

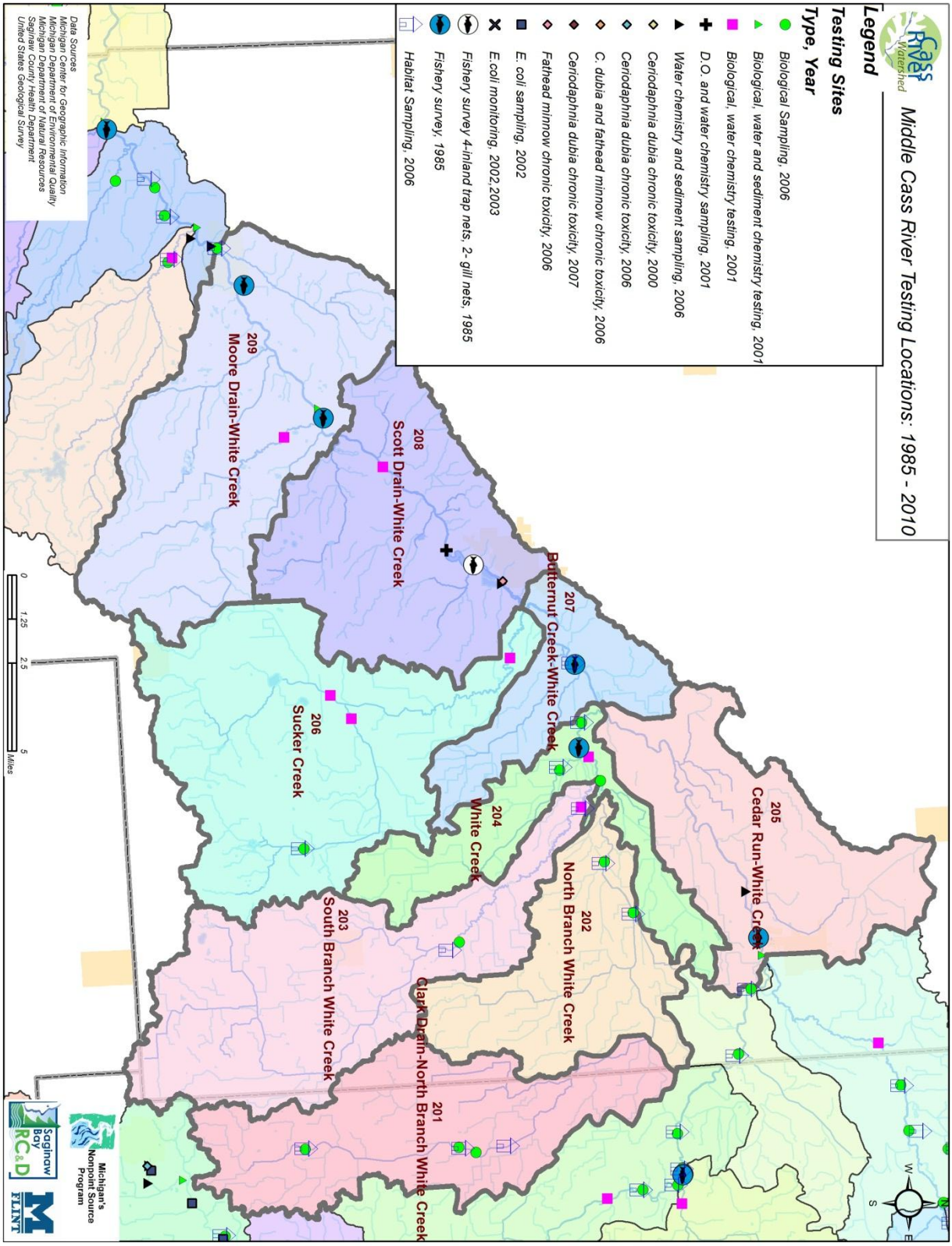


Table 3.5 Middle Cass River Testing Sites by Subwatershed

Sub-basins	Watershed Area %	Total Sites	Site Details (#, type, year, agency)	Results Summary
Middle Cass River	39.9	46		
201-Clark Drain	4.5	6	3-Biological, 2006, MDEQ 3-Habitat, 2006	Moderately impaired in-stream habitat; acceptable macroinvertebrates
202-North Branch White Creek	3.3	4	2-Biological, 2006, MDEQ 2-Habitat, 2006	Slightly impaired in-stream habitat; acceptable macroinvertebrates
203-South Branch White Creek	5.6	5	2-Biological, 2006, MDEQ 2-Habitat, 2006, 1-Biological & Chemical, 2001	Slightly to moderately impaired in-stream habitat; acceptable macroinvertebrates
204-White Creek	2.4	6	2-Biological, 2006, MDEQ 2-Habitat, 2006 1-Biological & Chemical, 2001 1-Fishery Survey, 1985, MDNR	Slightly impaired in-stream habitat; acceptable macroinvertebrates
205-Cedar Run	4.3	4	2-Water & Sediment Chemistry, 2006, MDEQ 1-Biological & Chemical, 2001 1-Fishery Survey, 1985, MDNR	Acceptable nutrient levels – meet water quality standards
206-Sucker Creek	6.6	5	1- Biological, 2006, MDEQ 1-Habitat, 2006 3-Biological & Chemical, 2003	Moderately impaired in-stream habitat; acceptable macroinvertebrate community; extremely low concentrations of nutrients
207-Butternut Creek*	2.0	5	1- Biological, 2006, MDEQ 1-Habitat, 2006 2- Chemical, 2001 1-Fishery Survey, 1985, MDNR	Slightly impaired in-stream habitat; acceptable macroinvertebrate communities; low dissolved oxygen and abundant macrophytic vegetation

Sub-basins	Watershed Area %	Total Sites	Site Details (#, type, year, agency)	Results Summary
208-Scott Drain	5.0	5	1-Water & Sediment Chemistry, 2006, MDEQ 1-Fathead minnow Chronic Toxicity, 2006 2-Biological & Chemical, 2001 1- Fishery Survey, 1985, MDNR	Acceptable nutrient levels; Caro WWTP effluent not toxic to fathead minnows
209-Moore Drain*	6.2	6	1-Biological, 2006, MDEQ 1-Habitat, 2006 2-Biological & Chemical, 2001 2-Fishery Survey, 1985, MDNR	Slightly impaired in-stream habitat; poor macroinvertebrate community; acceptable nutrient ratings; direct habitat alterations

Lower Cass River

Data available for the Lower Cass River is available from 2010 and 2012 for counts of e. coli from the recent draft TMDL that was completed for sections of the Lower Cass River (Figure 3.1, Table 3.1). Dead Creek, Cole Creek, and Cass River subwatersheds are all listed as having impairments to the partial and total body contact designated uses primarily due to high levels of *E. coli* (Figure 3.10). Information available from a water quality consultant working on behalf of the Cass River Greenway committee indicates that levels of fecal coliform are not traceable in the mainstem Cass River.

Figure 3.10: Impaired Reaches of the Lower Cass River

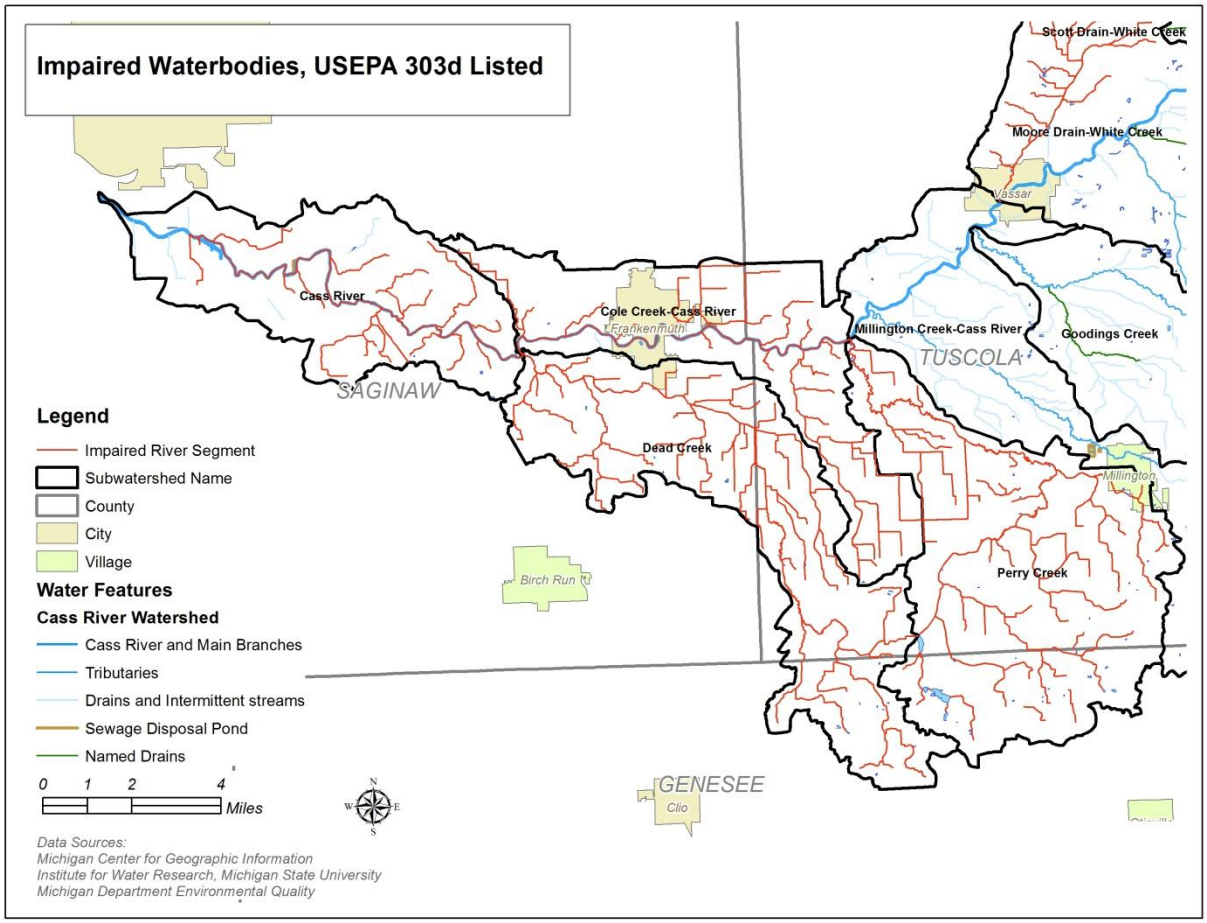


Figure 3.11 shows testing locations and Table 3.6 describes results for each test site. A total of 64 sampling sites are in the Lower Cass River, with the majority taking place in impaired waterways. Data included in the summary spans from 1985-2012.

Figure 3.11: Lower Cass River Testing Locations

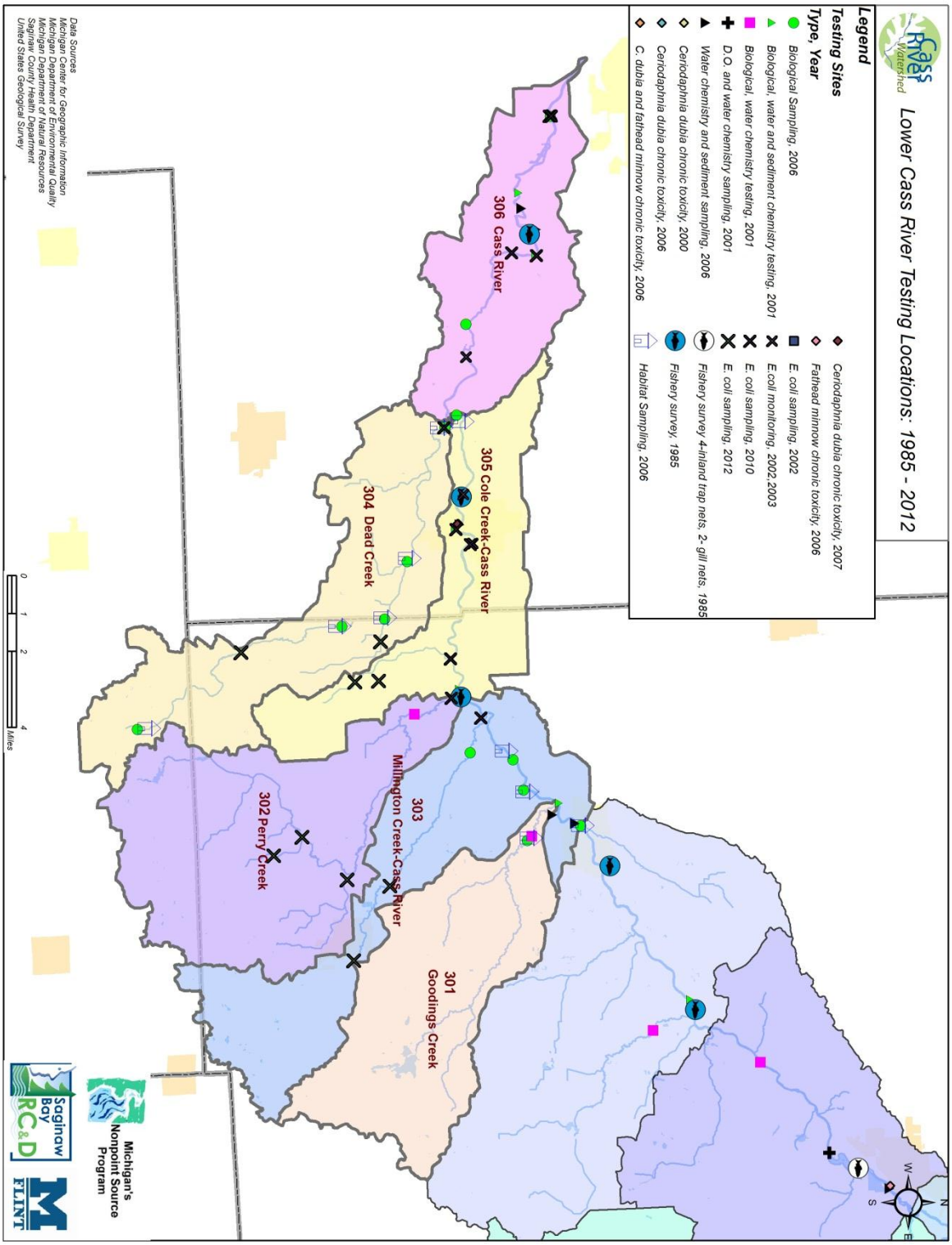


Table 3.6 Lower Cass River Testing Sites by Subwatershed

Sub-basins	Watershed Area %	Total Sites	Site Details (#, type, year, agency)	Results Summary
Lower Cass	20.4	64		
301-Goodings Creek	3.4	3	1-Habitat, 2006, MDEQ 1-Biological, 2006 1-Biological & Chemical, 2001	Slightly impaired in-stream habitat; excellent macroinvertebrate community; acceptable nutrient ratings
302-Perry Creek*	4.4	5	3-E. coli monitoring, 2012, MDEQ 1-E. coli monitoring, 2010 1-Biological &Chemical, 2001	E. coli levels exceed total body contact water quality standard; 5th highest geometric mean of all sites sampled for E. coli in 2010; Acceptable nutrient ratings, good in-stream habitat, acceptable macroinvertebrate community
303-Millington Creek*	3.5	11	2-E. coli monitoring, 2012, MDEQ 1-E. coli monitoring, 2010 2-Habitat, 2006 3-Biological, 2006 2-Chemical, 2006 1-Biological & Chemical, 2001	E. coli levels exceed total body contact water quality standard; 4th highest geometric mean of all sites sampled for E. coli in 2010; slightly impaired in-stream habitat; acceptable-excellent macroinvertebrate communities
304-Dead Creek*	3.7	13	2-E. coli monitoring, 2012, MDEQ 1-E. coli monitoring, 2010 5-Habitat, 2006 5-Biological, 2006	E. coli levels exceed total body contact water quality standard and one site exceeds partial body contact water quality standard; 3rd highest geometric mean of all sites sampled for E. coli in 2010; slightly to moderately impaired in-stream habitat; acceptable-poor macroinvertebrate communities

Sub-basins	Watershed Area %	Total Sites	Site Details (#, type, year, agency)	Results Summary
305-Cole Creek*	2.7	18	2-E. coli monitoring, 2012, MDEQ 2-E. coli monitoring, 2010 1- C. dubia chronic toxicity, 2007 1- Fathead Minnow chronic toxicity, 2006 1-Biological, 2006 1-Habitat, 2006 2-Chemical, 2006 2-E.coli monitoring, 2002-2003, Saginaw County 2-Biological & Chemical, 2001, MDEQ 2-Fishery Survey, 1985,MDNR	E. coli levels exceed total body contact water quality standard; 2nd highest site geometric mean of all sites sampled for E. coli in 2010; Slightly impaired in-stream habitat; excellent macroinvertebrate community; Frankenmuth WWTP effluent not toxic to fathead minnow or acutely toxic to c. dubia;
306-Cass River*	2.7	14	4-E. coli monitoring, 2010, MDEQ 2-E.coli monitoring, 2002-2003, Saginaw County 2-Biological, 2006, MDEQ 2-Chemical, 2006, 2-Biological & Chemical, 2001 1-Ceriodaphnia dubia chronic toxicity, 2000 1-Fishery Survey, 1985, MDNR	No exceedences of e. coli standards for partial body contact in 2010; upstream sites exceed total body contact water quality standards; acceptable macroinvertebrate community; Bridgeport WWTP effluent not toxic to c. dubia;

3.3 Streambank Erosion Inventory of Corridor

A streambank erosion inventory was conducted along the main stem of the Cass River from Cass City to the National Saginaw Wildlife Refuge boundary at M-13 during the 2008 field season (Figure 3.8). Interns from the National Park Service, Rivers Trails and Conservation Assistance Program and the United States Fish and Wildlife Service (USFWS) were trained by USFWS Field staff to assess the erosion conditions along the Cass River and scored each site using a standard streambank erosion severity index.

For each erosion site the following were recorded: condition of the toe and streambank, human impacts, natural impacts, potential causes, obstructions. Streambank erosion sites prioritized for restoration are mapped and described in Chapter 8 for the Middle Cass River and in Chapter 9 for the Lower Cass River. No streambank erosion sites were identified in the Upper Cass River.

Over 204 sites were documented with erosion problems during the 2008 field season. Each site was assigned a score based on the condition of the bank, the physical characteristics of the bank and water, cause of erosion, and problem trend. The physical characteristics of the bank and water includes: slope, height of bank, length of bank, depth of water, water velocity, shade cover, and bank soil type. Each score was then associated with a rating of minor, moderate, or severe.

This study found that the majority of the erosion sites were rated as minor - 108 sites, 75 were rated as moderate and 21 were rated as severe. In addition, only three of the sites examined were existing access sites. These ratings can be examined even further to see common trends that appear within the minor, moderate and severe sites.

The 108 minor sites (Figure 3.12) in this study are located in Saginaw and Tuscola County – 44 are in Saginaw County and 64 are located in Tuscola County. This is reasonable due to the location of the main stem of the Cass River, the majority of which lies in Tuscola County. Of the 108 minor sites, 52 had an average depth of less than 2 feet and 43 sites had a water velocity that were deemed “medium” or “fast”. Those sites rated as minor had some potential causes that were common. Thirty of the minor sites shared a river bend as a potential natural cause, while 26 sites had dropped sediments indicating channel widening as a shared potential cause. Most notably, 52 of the minor sites in this study shared high waters as a potential cause indicating flashy flows occur at this location.

Throughout the collection of this data only 21 sites, 15 in Tuscola County and 6 in Saginaw County, were rated as severe (Figure 3.14). All of these sites have some significant aspects in common. For example, all of the 21 severe sites have an increasing problem trend. In addition, 16 of the sites have banks that are eroding and 18 sites have unstable toes or undercutting occurring. The number of sites that are rated as severe make up only 10 percent of the total number of erosion sites surveyed. While this is a low percentage, there is definitely room for improvement to these severe sites.

In addition to the 204 sites that were documented with erosion problems, there were another 14 sites documented based on other concerns. The majority of these sites were recorded as other sites of concern based on the presence of drains or water pumps. Six of the 14 sites were recorded as having water pumps while 4 of the 14 sites were noted as having drains. Although these sites are not noted for erosion in this study, they still pose concerns to water quality.

75 sites located in Saginaw and Tuscola Counties were rated as moderate (Figure 3.13). Fifty of these moderate sites are located in Tuscola County, while 25 are in Saginaw County. Of the 75 moderate sites, the majority (59) have a slope of 1:1. Another noticeable trend among the majority of these moderate sites is that they often have a clay soil texture; 42 of these sites fit into this majority. Like the sites rated as minor, these sites have some similar potential causes. Both river bends and dropped sediment are thought to be potential causes at approximately the same number of sites – 23 sites and 22 sites respectively. In addition, high water seems to be the largest potential cause for moderate sites as well – having been noted at 43 sites.

Figure 3.12: Minor Streambank Erosion Sites

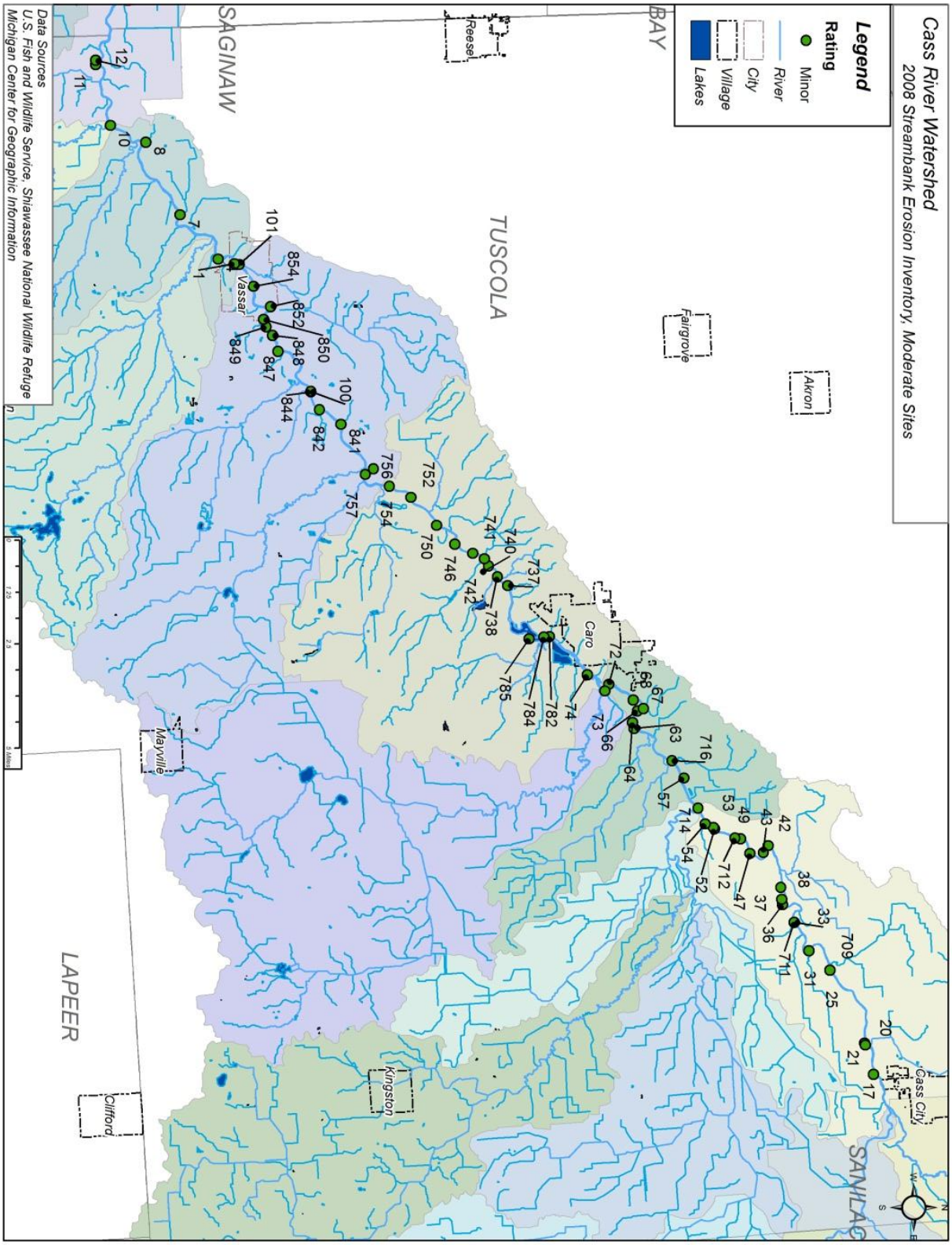


Figure 3.13: Moderate Streambank Erosion Sites

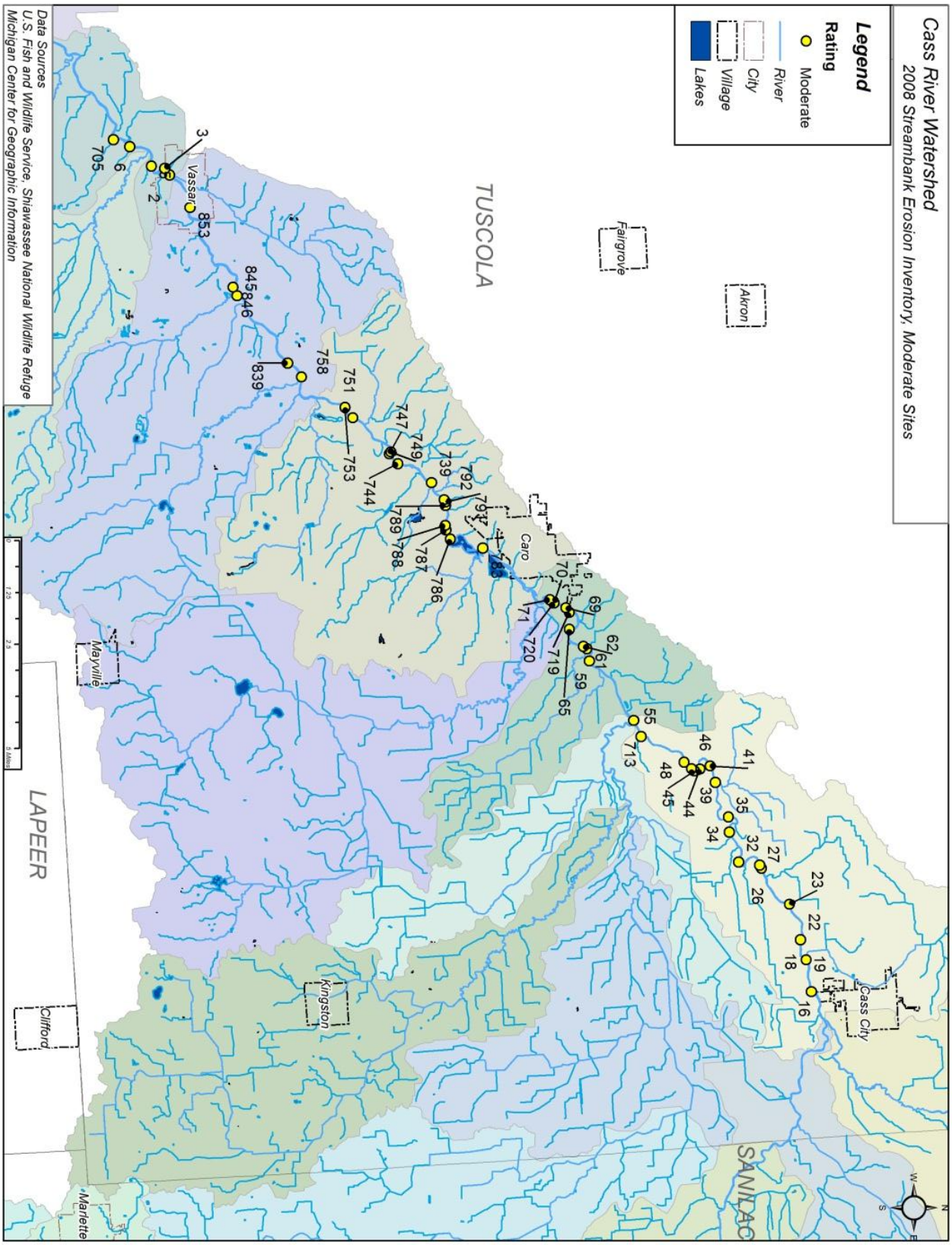
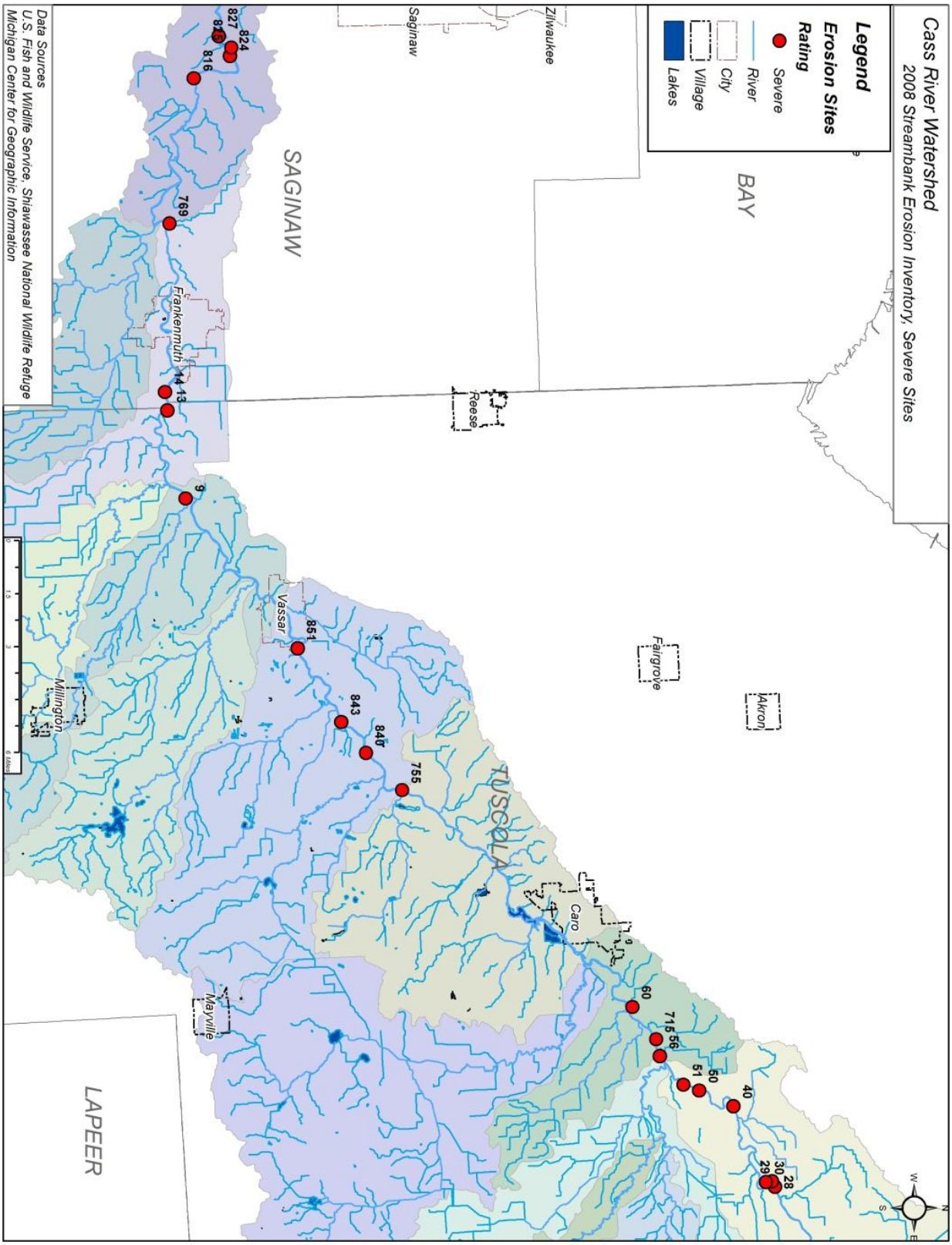


Figure 3.14: Severe Streambank Erosion Sites



3.4 In-Stream Watershed Inventory

In-stream Inventory

Impaired reaches identified by previous MDEQ monitoring were identified as the priority for the walking inventory. Impaired reaches were inventoried by the Tuscola and Saginaw Conservation Districts during the 2011 field season. Below is a listing of impaired reaches that were waded:

- Spring Drain – South Branch, Figure 3.4
- Duff Creek – South Branch, Figure 3.4
- Stony Creek – South Branch, Figure 3.5
- Butternut Creek – White Creek, Figure 3.7
- Moore Drain – White Creek, Figure 3.8
- Dead Creek, Figure 3.10

Table 3.7 provides an overview of the types of impairments that were identified in the watershed during the in-stream inventory. A majority of in-stream impairments identified stem from non-point agricultural sources (field runoff, etc.) Maps and tables showing the locations of pollution sources are shown at the subwatershed scale for the Upper Cass River in Chapter 7, the Middle Cass River in Chapter 8, and the Lower Cass River in Chapter 9.

Table 3.7 In-Stream Inventory Summary

Type	No. of Sites
Non-point Ag. Source	**331**
Gully Erosion	23
Streambank Erosion	13
Livestock Access	3
Urban/Residential (Includes Yard Waste)	3
Stream Crossing	2
Tile Outlet	2
Rill Erosion	2
Debris/Trash Obstructions	1
Sedimentation	1
Other (Phragmites)	1

3.5 Windshield Watershed Inventory

Two initial criteria were looked at to determine which sub-watersheds should be inventoried for agricultural NPS pollution sources and causes.

1. **Does the subwatershed contain an impaired waterway** (as listed in the 2010 Integrated Report)? Yes / No
2. **What percentage of the subwatershed is comprised of agricultural lands**?
   (Visually estimated, 2006 land use/land cover statistics)
   Greater than 75%
   Between 74-50%
   Between 49-25%

Each subwatershed was then assigned a priority between one and three, with priority one subwatersheds having both impaired waterways and agricultural land use at 75% or greater.

Priority One
Impaired Listing and greater than 75% Agriculture
Spring Drain – South Branch (040802050101)
Duff Creek – South Branch (040802050102)
Stony Creek – South Branch (040802050106)

Priority Two
Impaired Listing and between 50-74% Agriculture
Dead Creek (040802050304)
Cole Creek (040802050305)

Impaired Listing and between 25-49% Agriculture
Butternut Creek – White Creek (040802050207)
Moore Drain – White Creek (040802050209)
Cass River (040802050306)

Priority Three
Greater than 75% Agriculture
Gerstenberger Drain – South Branch (040802050103)
Clarks Drain – North Branch White Creek (040802050201)

The windshield survey gave precedence to subwatersheds that were identified as impaired by the MDEQ. Additional subwatersheds surveyed also had a high percentage of agricultural land use. A total of seven subwatersheds were surveyed: Spring Drain – South Branch (040802050101), Duff Creek – South Branch (040802050102), Stony Creek – South Branch (040802050106), Moore Drain-White Creek (040802050209), Dead Creek (040802050304), Cole Creek (040802050305) and Cass River (040802050306).

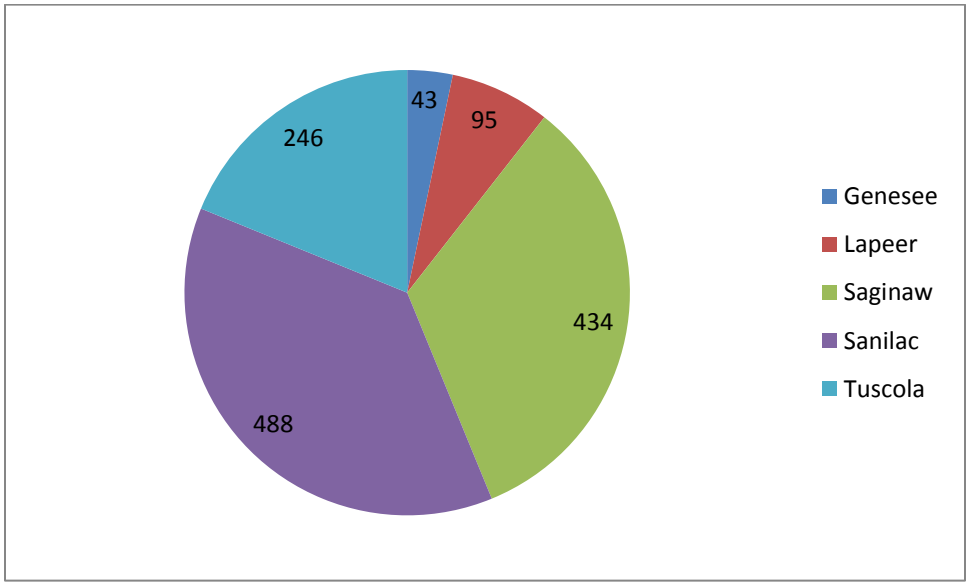
Staff from the Saginaw Bay RC&D, and volunteers affiliated with MDEQ spent much of the 2011 field season conducting the driving inventory to quantify the amount of agricultural NPS occurring in the watershed. The driving inventory focused on documenting impacts agricultural practices (or lack of) have on water quality in the watershed.

Each agricultural site was surveyed for the following practices and/or pollution sources:

1. Tilling: No-till, Minimum or Conventional
2. Percent Residue on Field
3. Crop Planting Method: Cover crop, CREP Land, Contour Farming, Conservation Crop Rotation or Other
4. Application of Waste Nutrients
5. Wind Erosion Potential and Prevention
6. Water Erosion Evidence from Rills/Gullies, Temporary V-ditches, or Exposed Roots
7. Presence of Livestock and Potential Impact on Water Quality
8. Evidence of Manure Storage
9. Type of Land Drainage: Tiled, Surface Drain, or Grassed Waterway
10. Presence of Buffer Strip
11. Evidence of Bank Erosion

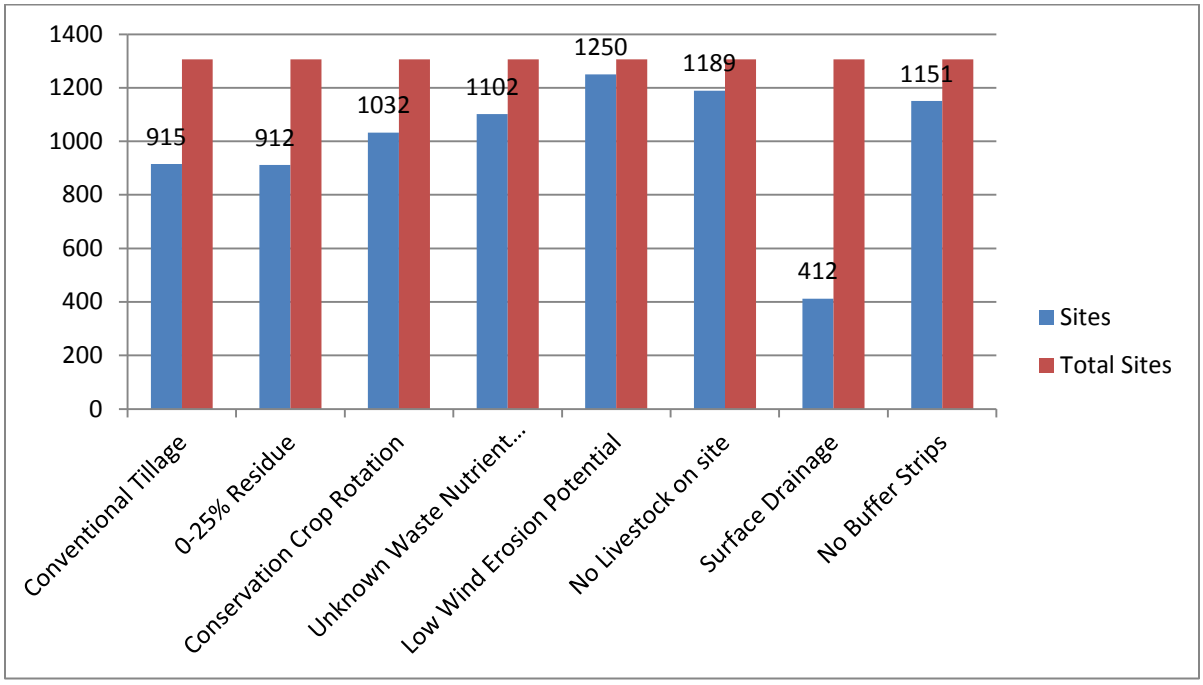
A total of 1,306 sites were identified through the windshield survey. The number of sites per county is shown in Figure 3.15 demonstrating that most NPS problems occur in Sanilac County followed by Saginaw County.

Figure 3.15 Agricultural NPS Inventory, Summary by County



It is important to note that not all 1,306 sites were inventoried for each type of practice that was included on the inventory data collection sheet. It must be assumed that data omissions for certain practices were not recorded out of random error, that the type of practice could not be observed, or that overall visibility was poor at the site. Figure 3.16 summarizes the sites by practice, note how none of the totals equal 1,306.

Figure 3.16: Total Number of Sites for each Practice



When summarized by each *type* of practice, the data show that the majority of growers are using Conventional Tillage (915), and the majority of fields have 0-25% residue on them (912). The most common type of crop planting is Conservation Crop Rotation (1032). In regards to Waste Nutrient Application, the majority (1102) of the sites were unknown to use that practice. The most common Wind Erosion Prevention practice in use are Tree Lines (458); and most sites were identified as having low wind erosion potential (1250). Most sites did not have livestock (1189), of the 78 producer sites that raise livestock, only 7 were identified as having an impact on water quality. There was little to no evidence presented on impacts from Manure Storage and Polluted Runoff. The most common type of Land Drainage was Surface Drain (412). The majority of sites do not have Buffer Strips (1151), however 44 out of the 49 sites that do have buffer strips have well-established vegetation. A listing of each site by subwatershed is presented in a Microsoft Excel table as a part of the chapters for each sub-basin (Chapters 7-9).

3.6 Prioritizing Watershed Restoration Opportunities

Adapted from Ko'olaupoko Watershed Restoration Action Strategy (HI)

Due to the large extent of the Cass River watershed and the amount of impaired sites denoted during the inventory, the steering committee felt it useful to employ a framework to score and rank sites for restoration. Numerous variables can be taken into account; the most realistic factors to rank sites in the Cass River watershed can be done by answering the following questions:

1. Does the Community support the project?,
2. Is the project effective at addressing the source(s) of pollutant(s)?,
3. Is the project technically feasible?, and
4. How severe is the Site ranking in terms of pollutant loading?

1. Does the Community support the project?

Community support is needed to implement restoration projects, whether it is to secure funding, perform outreach, or direct volunteer hours. Various segments of the population should be consulted for support and stakeholder buy-in.

Community Support Metrics	Score
Problem is meaningful to a variety of stakeholders and a plan is being developed by several professionals, agencies, and landowners. Plan includes feedback mechanism and public comment period and/or public meetings	3
Problem is relevant to many and plan circulated and reviewed by citizens, landowners, resource agencies and elected officials	2
Problem is meaningful only to project sponsor with little other public involvement	1

2. Is the project effective at addressing the source(s) of pollutant(s)?

For each project, it should be determined if the source of the pollutant will be removed or reduced. For example, sediment is entering the stream from an adjacent farm field. The recommended practice is to install a vegetated buffer between the drainage ditch and field. The effectiveness of this project depends on the length and width of the buffer along the ditch.

Pollutant Source Metrics	Score
Directly addresses source in a reach with an approved TMDL plan	3
Directly addresses source in a reach without an approved TMDL plan	2
Obliquely addressing source	1

3. Is the project technically feasible?

Project implementation practices can vary widely from innovative and experimental to highly studied and proven techniques. Cost effective projects that utilize highly successful methods are more desirable than experimental or large-capital projects.

Technical Feasibility Metrics	Score
Basic technology such as BMP's could easily be used to solve problem	3
Standard technology can be used and is acceptable to address the problem	2
Technology exists but not widely demonstrated or accepted	1

4. How severe is the Site in terms of impairments and pollutant loading?

The MDEQ has developed Total Maximum Daily Load requirements for several reaches in the Cass River Watershed. These reaches are ranked highest for site severity, along with the extent of pollutant loading being contributed to the waterbody.

Site Severity Metrics	Score
Designated use is impaired and high pollutant loading	3
Designated use is impaired and relative pollutant loading	2
Designated use is impaired and unknown amount of pollutant loading	1

Table 3.8: Project Restoration Ranking

Metrics	Description	Ranking	Score
Community Support	Problem is meaningful to a variety of stakeholders and a plan is being developed by several professionals, agencies, and landowners. Plan includes feedback mechanism and public comment period and/or public meetings	3	
	Problem is relevant to many and plan circulated and reviewed by citizens, landowners, resource agencies and elected officials	2	
	Problem is meaningful only to project sponsor with little other public involvement	1	
Pollutant Source	Directly addresses source in a reach with an approved TMDL plan	3	
	Directly addresses source in a reach without an approved TMDL plan	2	
	Obliquely addressing source	1	
Technical Feasibility	Basic technology such as BMP's could easily be used to solve problem	3	
	Standard technology can be used and is acceptable to address the problem	2	
	Technology exists but not widely demonstrated or accepted	1	
Site Severity	Designated use is impaired and high pollutant loading	3	
	Designated use is impaired and relative pollutant loading	2	
	Designated use is impaired and unknown amount of pollutant loading	1	
Total Score			

Projects that are scored can then be ranked and placed into one of three categories.
High Priority: 12-8 Points
Medium Priority: 7-4 Points
Low Priority: 3-1 Points

Additional factors to be included in prioritizing projects are their cost, amount of regulations and permitting, and the number and disposition of landowners. The following matrix serves as an additional tool for ranking restoration projects.

Figure 3.17: Site Prioritization Matrix