3. Watershed Characteristics

River Quote

"I started out thinking of America as highways and state lines. As I got to know it better, I began to think of it as rivers."

- Charles Kuralt

Subwatersheds

The boundaries of the Red Cedar Watershed and its nineteen subwatersheds are based on United States Geological Survey (USGS) defined boundaries (USGS, 2005). These boundaries, or Hydrologic Unit Codes (HUCs), divide the United States into discrete, nested areas based on common drainage patterns.

The subwatersheds range in size from 10 to 15 square miles. Figure 3-1 presents a map of these subwatersheds. Table 3-1 lists them with corresponding areas and watershed coverage percentages.

Political Jurisdictions

The Red Cedar Watershed is a diverse watershed made up of 15 distinct political jurisdictions. While Alaiedon Township, Meridian Township, Williamstown Township, the City of Lansing, and Delhi Township are the five largest communities in the watershed, they represent very different types of communities.

Figure 3-1. Subwatersheds of the Red Cedar Watershed.

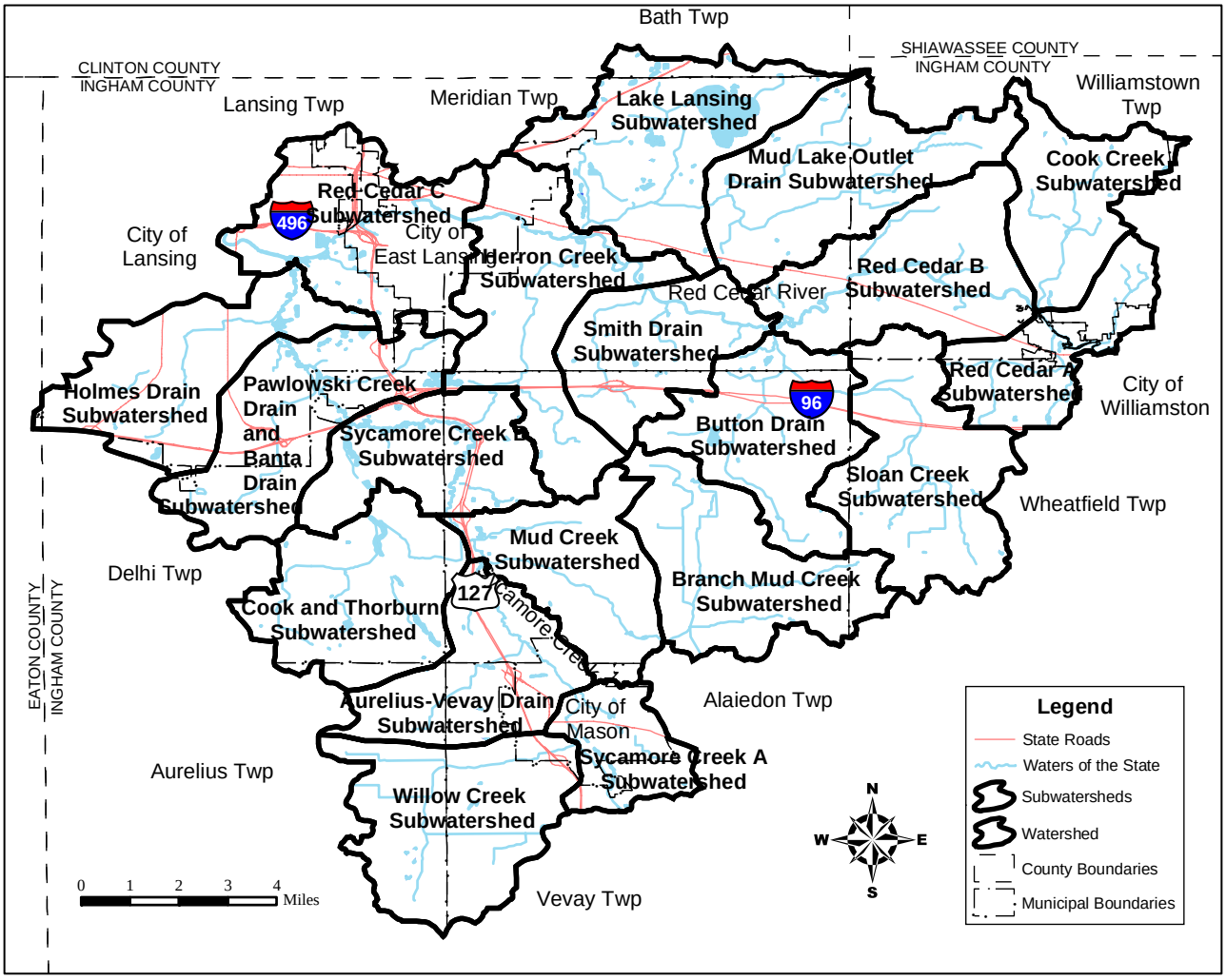


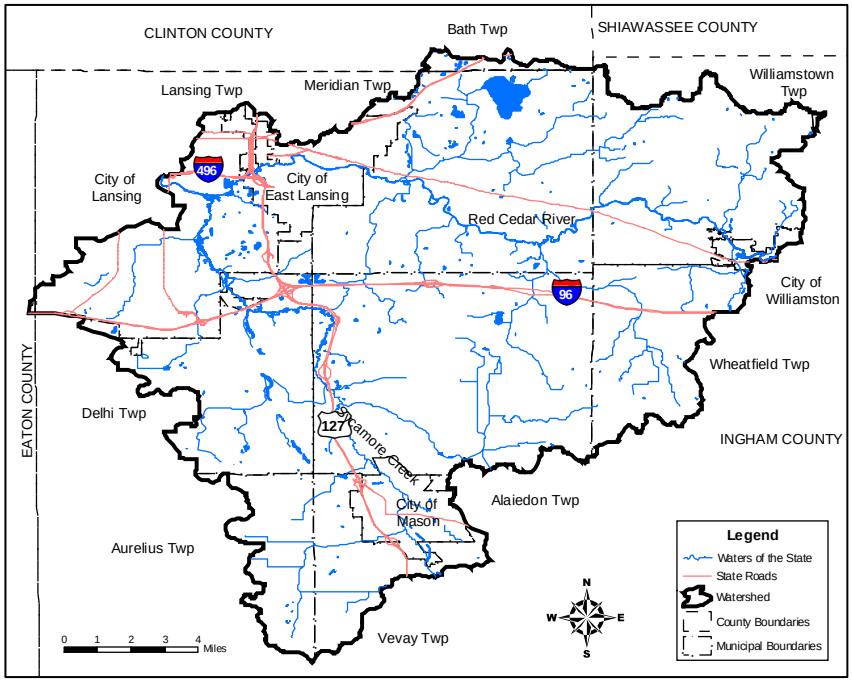
Table 3-1. Political Jurisdictions in the Watershed.

Subwatershed	Alaiedon Township	Meridian Township	Williamston Township	City of Lansing	Delhi Township	Wheatfield Township	Vevay Township	Aurelius Township	City of East Lansing	City of Mason	Lansing Township	Bath Township	City of Williamston	Locke Township	Windsor Township	Total Area (ac)	% of Watershed
Aurelius-Vevay Drain	1,592				8		993	1,263		1,033						4,889	5%
Branch Mud Creek	5,608					518										6,126	6%
Button Drain	4,745	620				150										5,516	5%
Cook and Thorburn	262				5,240			448								5,949	6%
Cook Creek			4,099										3	48		4,150	4%
Herron Creek	1,863	3,442		282					1,263							6,850	6%
Holmes Drain				5,447	249										22	5,718	5%
Mud Creek	4,587				7		109			88						4,791	5%
Pawlowski /Banta Drain		109		2,899	2,824				57		404					6,293	6%
Mud Lake Outlet Drain		3,976	2,639													6,615	6%
Pine Lake Outlet		6,017	14						320			743				7,094	7%
Red Cedar A			1,441			1,613							707			3,761	4%
Red Cedar B		1,501	4,752										11			6,264	6%
Red Cedar C		273		3,197					2,570		540					6,579	6%
Sloan Creek	310	13	458			5,866										6,648	6%
Smith Drain	1,158	3,142		199												4,499	4%
Sycamore Creek A							958			1,598						2,556	2%
Sycamore Creek B	2,099			12	2,564											4,675	4%
Willow Creek							3,196	3,115		343						6,653	6%
Total	22,223	19,095	13,404	12,036	10,892	8,148	5,255	4,826	4,211	3,062	943	743	720	48	22	105,629	100%
% of Watershed	21%	18%	13%	11%	10%	8%	5%	5%	4%	3%	1%	1%	1%	0%	0%	100%	---

Area given in acres. Blank boxes indicate that jurisdiction does not exist in subwatershed.

Alaiedon and Williamstown Townships are both rural areas with increasing development pressure. Meridian and Delhi Townships are more developed but still have rural and agricultural areas that can be protected. The City of Lansing is the center of the metropolitan areas and is almost completely developed. Figure 3-2 presents a map of these local units of government. Table 3-1 shows the acreage of each community in the watershed and watershed coverage percentages.

Figure 3-2. Local units of government in the Red Cedar Watershed.



Early Inhabitants

Lansing, Michigan was first described by British Fur Traders in 1790. They noted: "The banks of red land thence came to a river from the East and a little lower two cabins of Indian from Sagana – they were providing cannots (canoes) for their departure … from high broken land and some pine and cedar" trees. Native Americans, Sagana, were a tribe from the Saginaw band of Chippewa. They had villages or camps at what are now Okemos and Williamston and maintained corn, pumpkins, and beans in surrounding fields. They developed caves in the high, sandy banks of the Red Cedar River and used them as granaries: storing venison, nuts, and other foods for used in the winter.

- Provided by Jerry Lawler from Darling, 1990 & Malik, 1960

Source: UM, 2005.

Demographics

The communities with the highest population in the watershed are the City of Lansing (43%), Meridian Township (24%), Delhi Township (9%), the City of East Lansing (6%), Michigan State University (6%), and the City of Mason (5%). The other municipalities contribute 3% or less to the watershed population.

The fastest growing communities for the period from 1990 to 2000 include Aurelius Township (+24%), Bath Township (+19%), the City of Williamston (+18%), Delhi Township (+18%), Williamstown Township (+13%), Meridian Township (+10%), and Alaiedon Township (+10%). Communities showing population declines over this period include the City of East Lansing (-8%) including Michigan State University (MSU), the City of Lansing (-7%), Lansing Township (-5%), Wheatfield Township (-4%), and Vevay Township (-1%).

Over the next 30 years, the watershed population is expected to grow by 6% every decade with Aurelius Township (+29%), Bath Township (+18%), Windsor Township (+17%), and the City of East Lansing including Michigan State University (+10%) showing the greatest growth per decade.

Source: RSGIS, 2005.

Table 3-2 shows the past, present, and future population in the region and associated population change percentages (non-participating communities shown in italics).

Table 3-2. Population in the watershed.

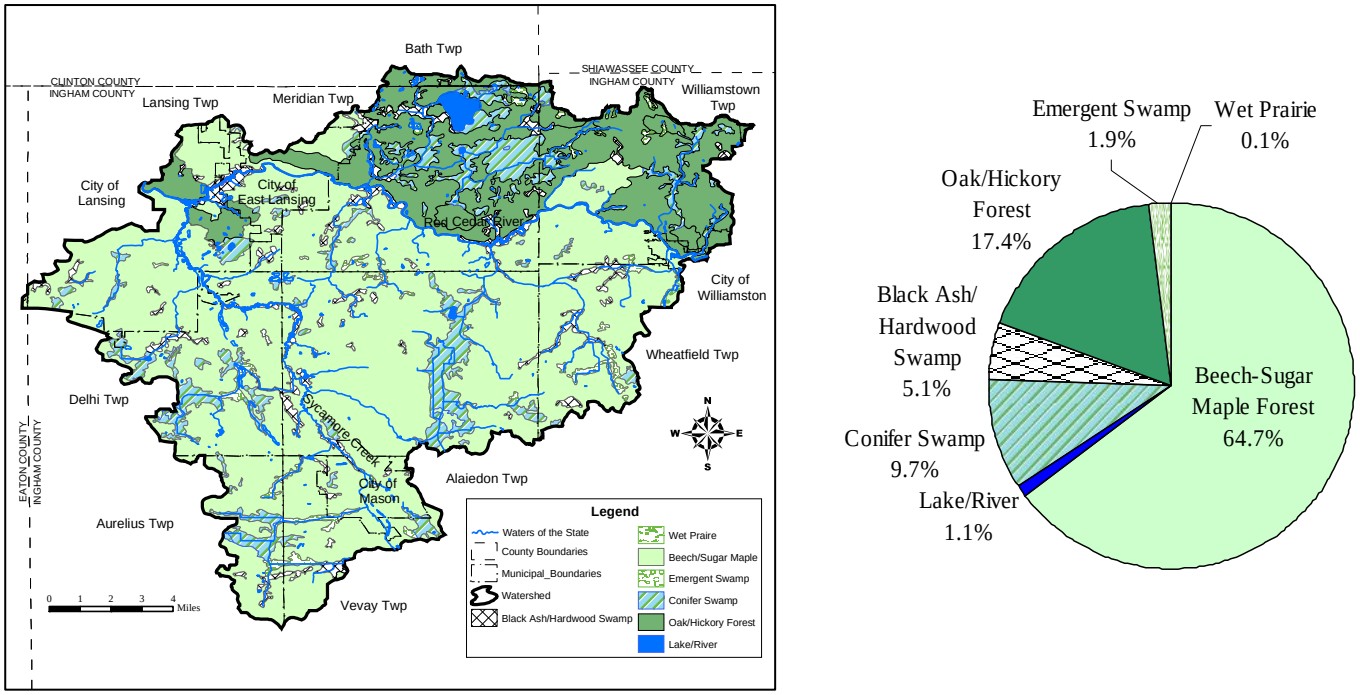
Community	Population in Watershed			Avg. % Change per 10 yr	
	1990	2000	2030	90-00	00-30
Alaiedon Township	3,098	3,415	3,720	10%	3%
Aurelius Township	556	687	1,279	24%	29%
Bath Township	204	242	372	19%	18%
Delhi Township	11,322	13,316	16,494	18%	8%
City of East Lansing	10,275	9,427	12,379	-8%	10%
Lansing Township	1,161	1,101	1235	-5%	4%
City of Lansing	71,254	66,388	71,093	-7%	2%
Locke Township	3	3	3	0%	0%
City of Mason	6,713	7,164	8,052	7%	4%
Meridian Township	33,910	37,216	46,136	10%	8%
Vevay Township	960	946	1,044	-1%	3%
Wheatfield Township	733	701	808	-4%	5%
City of Williamston	1001	1,178	1,379	18%	6%
Williamstown Township	3,137	3,538	3,747	13%	2%
Windsor Township	6	6	9	0%	17%
Michigan State University	10,189	9,354	12,275	-8%	10%
Total	154,521	154,177	180,026	0%	6%
Total (participating)	149,092	148,070	172,809	-1%	6%
Source: USCB, 2004; TCRPC, no date.					

Source: LFC, 2004.

Land Use and Growth Trends

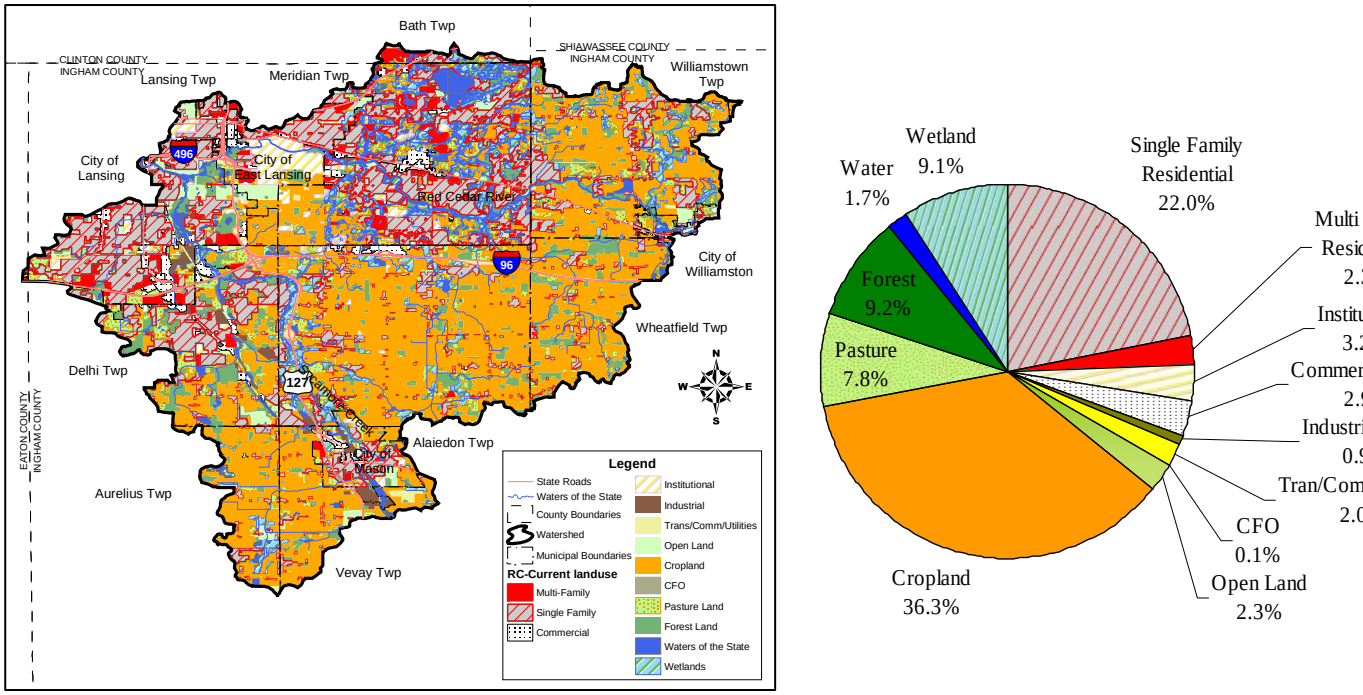
Historically, much of the Red Cedar River watershed was comprised of deep forests and swamps / wetlands. The majority of the upland land ecosystem was comprised of Beech/Sugar Maple Forests, with the area to the north of the Red Cedar comprised of Oak/Hickory Forests with interspersing conifer swamps. Remnants of these conifer swamps can be seen in Lake Lansing Park North. Figure 3-3 shows a map of the land types in the watershed circa 1830 and shows a percentage breakdown of these land types.

Figure 3-3. Land types - circa 1830.



As can been seen in Figure 3-3, a significant portion of the Red Cedar Watershed was forest or swamp/wetland of some type. Permanent human settlement brought great change to the landscape as the land began to be altered for human benefit. One example is that much of the swamps/wetlands were drained to provide land for farming, settlement, and transportation. This and other changes such as urban development, dams, river relocation, and dredging significantly altered the landscape which we now see today (Figure 3-4).

Figure 3-4. Land types – present day.



Source: TCRPC, 2004.

Grand River Plank Road

The construction of the Grand River Plank Road opened up a direct route between Lansing and Detroit. This road provided an easy route for people and goods to travel the area and thus played a role in facilitating settlement and expansion of the areas. Today, this road is called Grand River Avenue.

These changes have resulted in a loss of 90% of the forest cover and 60% of the wetlands.

Based on zoning ordinances for the various watershed communities, the projected future land use indicates that residential, industrial, and commercial land uses will expand in those areas currently seeing such land uses. This includes most of the watershed except for the southern-central area which is projected to be dominated by agricultural use (except for the city of Mason) and the northeastern portion which is projected to show a mix of agriculture and the previously mentioned uses. Figure 3-5 shows the future land use.

Urbanized Land Use

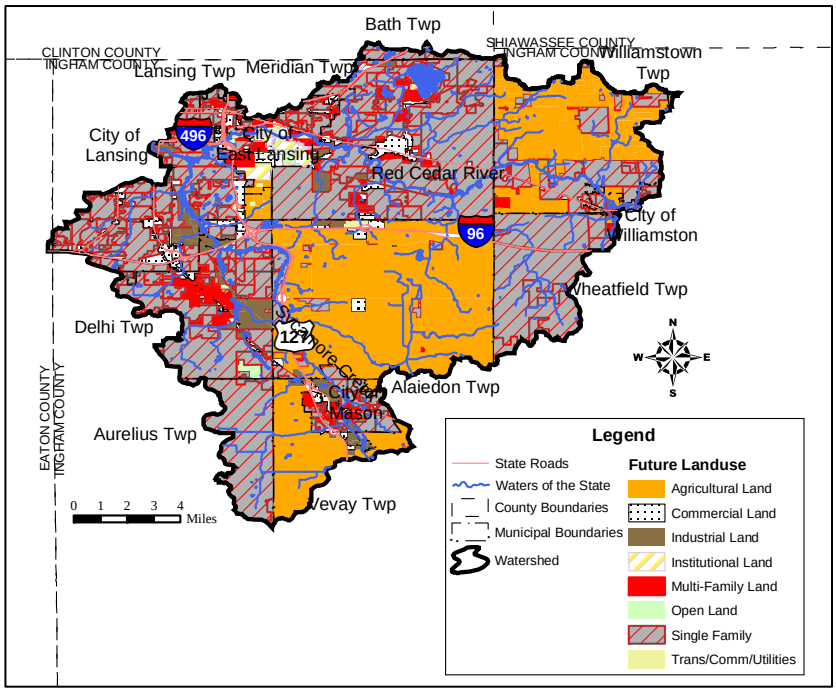
The major urbanization zones of the watershed include the Cities of Lansing, East Lansing, Mason, and Williamston; Meridian, Delhi, and Lansing Townships; and MSU. The predominant land use type within these communities is single-family residential, while the urbanized portion of MSU is dominated by institutional buildings and dormitories or multi-family uses.

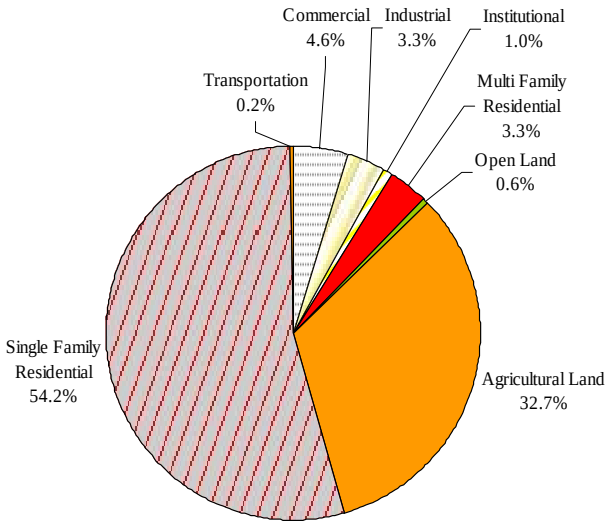
Several major thoroughfares transect the watershed including Interstate 96 (I-96), Interstate 496 (I-496), and US-127. Interstate-69 (I-69) parallels the northern boundary of the watershed, but is not within the boundaries.

Much as the Grand River Plank Road historically served the purposes of travel and commerce, these highways are crucial routes today for transporting people and goods between metropolitan areas in the state. Additionally, they play a role in directing future urbanization by opening up more rural townships and cities to convenient intra- and interstate travel. Consequently, highway access and exit ramps become hubs for development.

Figure 3-5 illustrates that urbanization will become predominant in the Cities of Williamston, and East Lansing; Wheatfield, Aurelius, Bath Townships; and MSU. The population predictions presented in Table 3-2 support the projected land use growth observed in Figure 3-5. Population growth projections for City of Williamston and Wheatfield Township are lower than what might be expected. Substantial development has occurred in this area since 2000 and may not be represented fully in Table 3-2.

Figure 3-5. Land types – future.





Agricultural Land Use

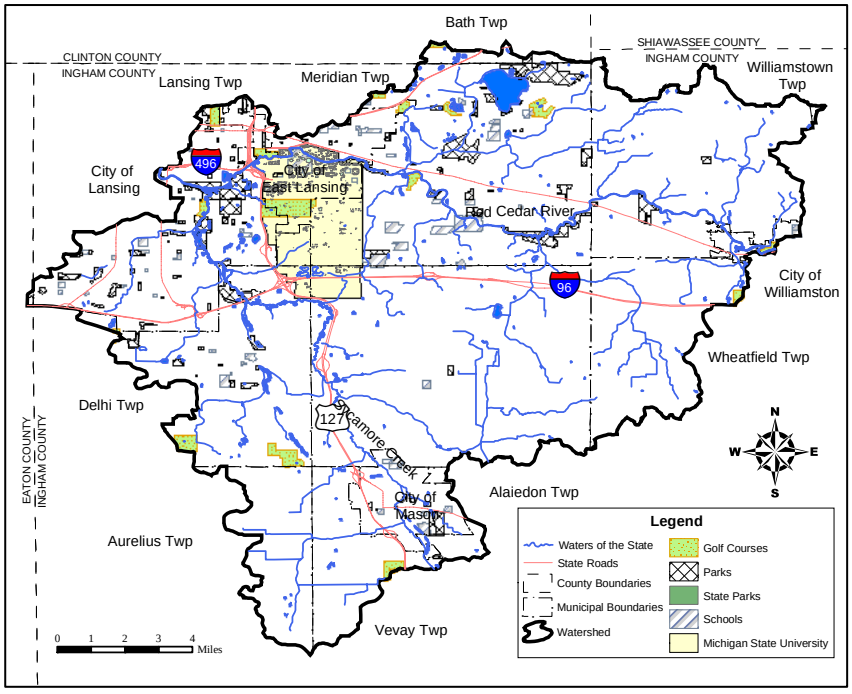
Significant changes in agricultural land use have also occurred in the last century. Although a map is not available, there is data to support this idea. For example, in the 1930s, Ingham County had approximately 350 square miles of cropland. Comparing this to available data for 2002, Ingham County now has 290 square miles still in farmland. This information shows that in 62 years, over 60 square miles of agriculture was converted to another land use type averaging to about one square mile per year.

Public Land

Public land is a valuable component of the land use within the watershed. They provide recreation, resources, and opportunities to improve the watershed through best management practice implementation.

Figure 3-6 shows the location of the known public lands in the watershed. The public land uses include golf courses, parks, state parks, schools, and universities. Approximately 11 percent of the watershed is composed of public lands. Of this 11 percent, MSU makes up about 46 percent of the public lands, local parks - 30 percent, and golf courses and schools - 12 percent each.

Figure 3-6. Public lands.



Source: TCRPC, 2004.

Livestock

Eight-hundred and ninety livestock farms with approximately 68,000 livestock head exist throughout Ingham County. Additional data is presented below:

Livestock	Farms	Head
Cattle / calves	258	15,803
(sold)	206	5,792
Beef cattle	167	2,110
Dairy cattle	44	4,858
Hogs / pigs	31	8,549
(sold)	39	15,578
Sheep / lambs	73	2,502
Layers (20 wks +)	60	9,775
Poultry (sold)	12	3,026
Total	**890**	**67,993**

Crops

Historically, crops grown in Ingham County consisted of oats, wheat and corn.

Today, seven-hundred and thirty-nine farms in Ingham County harvest approximately 143,500 acres of land. Specific crop data is presented below:

Crop	Farms	Acres
Corn for grain	248	49,189
Corn for silage	65	4,325
Sorghum for grain	1	n/a
Wheat for grain	119	14,383
Barley for grain	5	63
Oats for grain	15	311
Sunflower seed	1	n/a

Note that soybean is a main crop in the county although specific data is not available.

Source: Tanner, 2005.

Wetland Types

Aquatic Bed- Areas of shallow permanent water that are dominated by plants that grow on or below the surface of the water

Emergent Wetlands- include marshes, fens, wet meadows, and potholes

Forested- Forested swamps are found throughout the United States. They are often inundated with floodwater from nearby rivers and streams.

Open Water- Deeper, perennial pools within wetlands and shallow portions of lakes and rivers.Typically home to submerged plants

Scrub/Shrub- Shrub swamps, are similar to forested swamps, except that shrubby vegetation predominates.

Wetlands

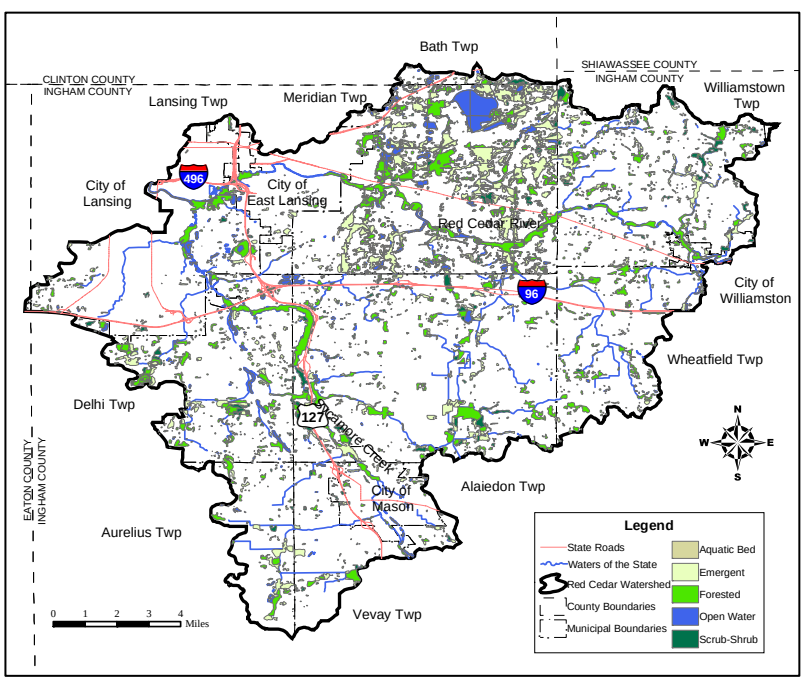
In general terms, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin, 1979).

Wetlands can play critical roles in flood storage, nutrient transformation, and water quality protection and, as part of a healthy riparian corridor, may dampen the effects of impervious cover within the watershed. Important wetland functions and values include:

- Flood prevention and temporary flood storage, allowing the water to be slowly released, evaporated, or percolate into the ground and recharging groundwater.
- Sediment capture and storage.
- Wildlife habitat for a wide diversity of plants, amphibians, reptiles, fish, birds, mammals, and related recreational values.
- Water quality improvement by filtering pollutants out of water.
- The support of approximately 50 percent of Michigan's endangered or threatened species (Cwiekial, 2003).

Figure 3-7 shows the location of wetlands in the watershed. Table 3-3 presents the wetland coverage for the subwatersheds. Currently, wetland coverage in the watershed is 13% of land area. Generally speaking, those subwatersheds that have expansive contiguous areas of residential build-out, such as Holmes Drain, Red Cedar C, Sycamore Creek A have the lowest percentage of land mass existing as wetlands (5%, 6%, and 5%, respectively).

Figure 3-7. Wetlands.



The majority of wetlands in the watershed exist in the subwatersheds of which Meridian Township is a part, including Mud Lake Outlet Drain and Lake Lansing. These subwatersheds also have the highest percentage of land mass existing as wetlands (28% and 34%, respectively). The reason for this, in spite of the development extent and continuing development pressures being placed on the township, is the fact that the township has a wetland ordinance in place that effectively preserves wetlands.

This is an important consideration for the future as development continues to pressure the wetlands in subwatersheds that have not yet experienced extensive development.

Importance of Headwater Streams

Headwater streams and wetlands are often undefined, unmapped, small locations which provide the water that flows and maintains our river systems. The term "headwater" refers to the smallest stream or wetland that flows into a stream network. Regional studies have shown that these headwater streams and wetlands make up more than 80% of the nation's stream network. These waterways provide many of the benefits that scientists call "ecosystem services". They provide groundwater filtering and recharge, recycling of waste products, flood control, spawning and mating grounds for fish and wildlife, and the water for human use. Most importantly, headwater streams and wetlands provide the basis for improved water quality in our watersheds.

"THE PHYSICAL, CHEMICAL, AND BIOTIC INTEGRITY OF OUR NATIONS' WATERS IS SUBTAINED BY SERVICE PROVIDED BY WETLANDS AND HEADWATERS STREAMS"

- Where Rivers are Born: The Scientific Imperative for Defending Small Streams and Wetlands, 2003

Climate

The climate of the Red Cedar Watershed can generally be described as one having a warm summer and a cool-to-cold winter.

The average temperature in the region is highly seasonal. The average temperature for the month of January, the coldest month, is 22.7 °F while August, the warmest month, has an average temperature of 71.2 °F – a difference of 48.5 °F.
The average annual precipitation is 32.82 inches. Like the temperature, it is seasonally variable, with February, the driest month receiving 1.57 inches on average, while June, the wettest month, receives 3.73 inches on average – a difference of about 2.2 inches.

In the months of October through April, a portion of precipitation typically occurs as snowfall. The greatest amount of snowfall occurs in January (13.4 inches on average – approximately equivalent to 1.3 inches of rainfall) and accounts for 75% of the precipitation for the month. The months of June through August average no snowfall, while May and September may receive trace amounts.

The wind in the region generally comes from the west / southwest at 9 mph during the summer and 12 mph during the winter. The peak gusts generally occur in the spring / early summer.

More detailed climatic information is presented in Table 3-4.

Table 3-3. Wetlands.

Subwatershed	Wetland Acres	Wetland Coverage	Subwatershed Wetland (ac) per Watershed Wetland (ac)
Aurelius-Vevay Drain	580	12%	4%
Branch Mud Creek	817	13%	6%
Button Drain	635	12%	5%
Cook and Thorburn	845	14%	6%
Cook Creek	562	14%	4%
Herron Creek	882	13%	6%
Holmes Drain	312	5%	2%
Mud Creek	341	7%	2%
Mud Lake Drain	713	11%	5%
Mud Lake Outlet Drain	1,840	28%	13%
Lake Lansing	2,418	34%	17%
Red Cedar A	420	11%	3%
Red Cedar B	785	13%	6%
Red Cedar C	403	6%	3%
Sloan Creek	435	7%	3%
Smith Drain	739	16%	5%
Sycamore Creek A	124	5%	1%
Sycamore Creek B	588	13%	4%
Willow Creek	530	8%	4%
Watershed Total	**13,967**	**13%**	**100%**

Table 3-4. Climatic variable data for the watershed.

Month	Average Temperature (°F)	Average Precipitation* (inches)	Average Snowfall** (inches)	Prevailing Wind Direction	Average Wind Speed (mph)	Peak Gust Wind Speed (mph)
January	22.7	1.78	13.4	SW	12	55
February	24.4	1.57	9.1	W	12	51
March	33.7	2.28	7.4	W	12	61
April	46.0	3.12	2.0	W	12	70
May	57.4	3.36	Trace	W	10	59
June	67.1	3.73	0.0	W	9	67
July	71.2	3.09	0.0	W	9	60
August	69.2	3.33	0.0	W	8	62
September	61.7	3.27	Trace	S	9	47
October	50.6	2.62	0.3	SW	10	58
November	38.1	2.56	3.6	SW	12	53
December	27.2	2.11	11.3	SW	12	54
Total	---	32.82	46.9	---	---	---

Note: Temperature and precipitation data is an aggregate of data from Ionia, Clinton, Shiawassee, Barry, Eaton, Ingham, Calhoun, Jackson, St. Joseph, Branch, and Hillsdale Counties from 1931-2000. The snowfall data is an average of the 30-year means for stations in Lansing and Jackson. The wind data is from a station in Lansing from 1930-1996.

* - Includes snowfall. ** - As a general rule, divide the snowfall amount by ten to convert to equivalent inches of rainfall.

Source: NOAA, no date; NCDC, 1998; NCDC, 2002.

Soil Associations

The seven soil associations present in the watershed include:

- Urban land/Marlette/Capac
- Marlette/Capac/Owosso
- Houghton/Palms/Edwards
- Oshtema/Houghton/Riddles
- Capac/Marlette/Colwood
- Marlette/Oshtemo/Capac
- Riddles/Hillsdale/Aubbeenanbbee

Geology and Soils

Michigan has been subjected to four glacial periods: Wisconsian, Illinoian, Nebraskan, and Kansian. The last of these continental glaciers, the Wisconsian, existed approximately 11,000 years ago and is responsible for much of the development of Michigan's underlying geology, soils, topography, and the Great Lakes.

In the Red Cedar Watershed the predominant underlying geology is predominantly:

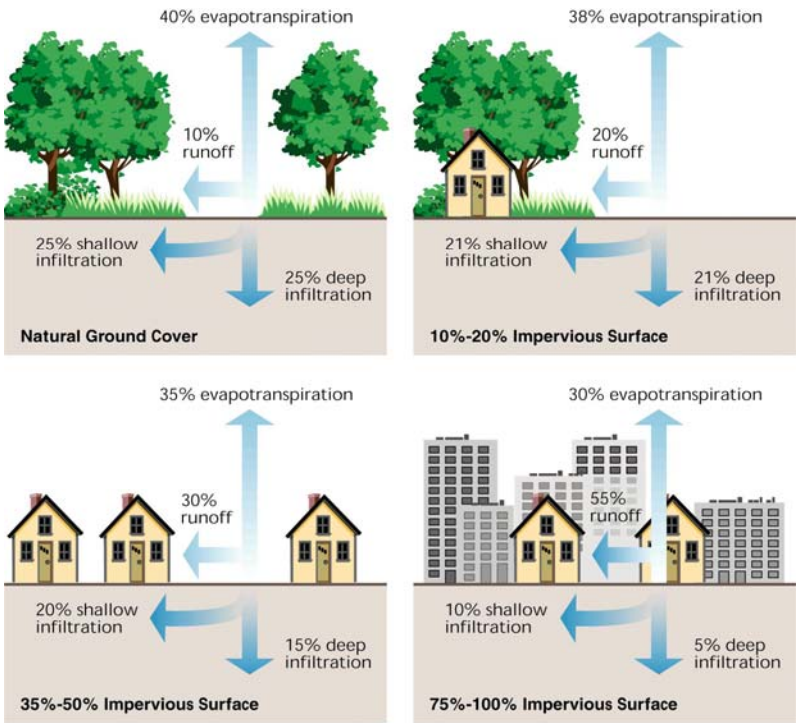
- Glacial till – poorly sorted and poorly rounded material ranging in size from pebbles to boulders
- Glacial outwash – finer material deposited by glacial melt water
- Lacustrian material – fine materials deposited in still or ponded glacial meltwater
- Alluvian material – recently deposited material from local rivers and streams

Each of these deposited materials, along with organic material, are the parent materials of the soils present in the watershed. These soils are predominantly sandy, loamy, or muck soils and are commonly classified as hydrologic soil group B. The topography of the watershed ranges from 800 to 1,000 ft above sea level with rolling plains having slopes ranging from 0 to 30 percent. This, in combination with the soil groups, provides a wide variety of drainage from poorly to very well drained landscape.

Hydrology

Hydrology is the study of water and the circulation of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere. Understanding how hydrologic components respond to land use changes and site development is the basis for developing successful watershed and storm water management programs. Traditional development practices tend to cause a sharp increase in the total volume, peak flow rate and frequency of rainwater reaching the rivers and lakes. In addition, channels experience more bankful flood events each year and are exposed to critical erosive velocities for longer intervals. Since impervious cover prevents rainfall from infiltrating into the soil, less flow is available to recharge ground water. Consequently, during extended periods without rainfall, baseflow levels are often reduced in urban streams. Figure 3-8 illustrates the relationship between impervious cover and surface runoff.

Figure 3-8. Effects of urbanization on runoff.



Source: FISRWG, 1998.

Figure 3-9. Streamflow data for Red Cedar River at East Lansing, MI.

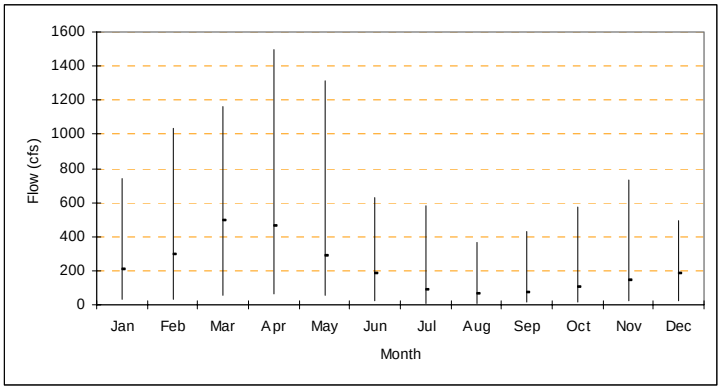


Figure 3-9 provides a summary of USGS stream gauging data from 1902 to 2003 at station 04112500, Farm Lane bridge at Michigan State University in East Lansing, Michigan (USGS, 2005). The presented information is the monthly mean streamflows in cubic feet per second (cfs). The vertical bar above each month illustrates the range of flow recorded and the horizontal tick mark on each vertical bar is the monthly mean stream flow. Stream flow has varied from a low of 6 cfs in July 1934 to a high of 1,500 cfs in April 1947.

Source: Johnson, 2005.

Point Sources of Potential Pollutants

Within the watershed, there exists a number of facilities that are permitted to discharge certain pollutants, such as Waste Water Treatment Plants (WWTPs), others that have the potential for pollutant releases, and sites that are known to be polluted (brownfields). These are identified in Figure 3-10.

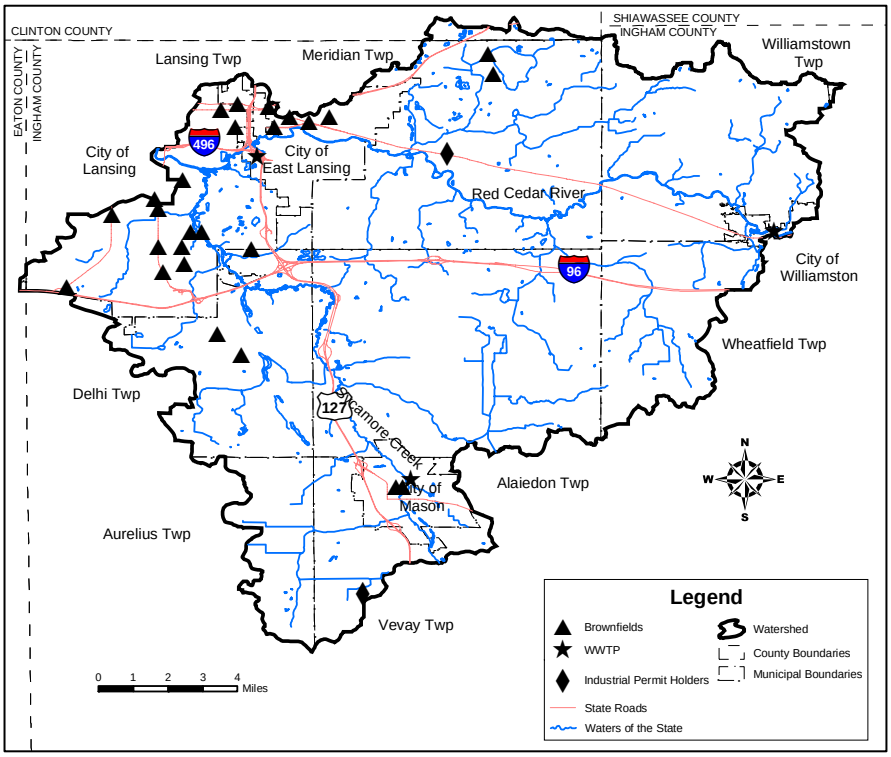
The majority of point source sites in the watershed are brownfields which include such things as abandoned and operating gas stations, commercial business land and development, and convenience stores. The bulk of these are in Lansing with other sites in East Lansing, Meridian and Delhi Townships, and the City of Mason.

Of the five facilities in the watershed having NPDES permits, three of these are WWTPs located in the cities of East Lansing, Mason, and Williamston. The other two facilities are in Meridian Towship and Vevay Township.

Additionally, there are four facilities in the watershed identified as Hazardous Waste Treatment, Storage and Disposal facilities: Americhen Corporation (Mason), Huntsman Advanced Materials / America's Inc. (East Lansing), Michigan State University Waste Storage Facility (East Lansing), and Safety Kleen Systems (Mason) [MDEQ, 2004]. These sites are not included on the map for security reasons.

On a subwatershed basis, point sources are of most concern in the Sycamore Creek A, Cook and Thorburn, Pawlowski Creek Drain and Banta Drain, Holmes Drain, Red Cedar C, Lake Lansing and to a lesser extent, Willow Creek, and Red Cedar A.

Figure 3-10. Point sources.

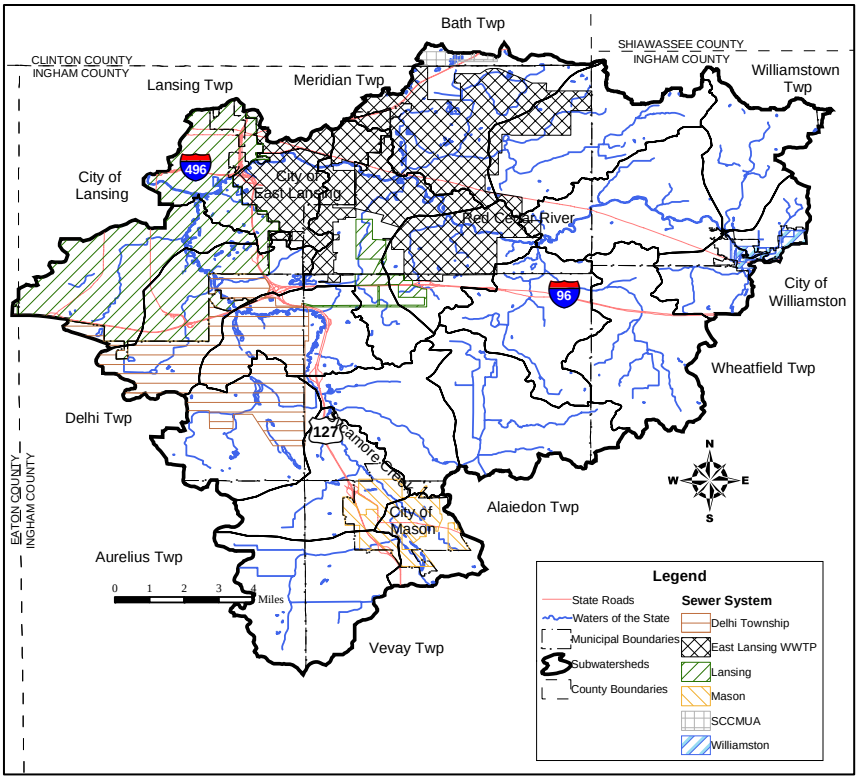


Source: MDEQ, 2004b.

Sewer and Septic System Service Areas

Sanitary sewer service is an important factor that has the potential to affect water quality in the watershed. Where this service does not exist, homes dispose of their waste through a private septic system. Collectively, private systems present a greater risk of pollutant discharge to waters as compared to a centralized treatment facility that is associated with a sanitary sewer system. Sanitary (and combined) sewer service coverage in the watershed is shown in Figure 3-11.

Figure 3-11. Sanitary sewer service.



Generally, the most populous areas of the watershed are those that have sanitary sewer service. The systems serving the watershed include:

- East Lansing WWTP (serving the City of East Lansing, Meridian Township, and Michigan State University)
- Mason (serving the City of Mason)
- Lansing (serving the City of Lansing, Lansing Township, a portion of Delhi Township, and small portions of Meridian and Alaiedon Township)
- Williamston (serving the City of Williamston)
- South Clinton County Municipal Utilities Authority (serving portions of Bath Township)
- Delhi Township (serving Delhi Township)

Some of the above systems serve very small portions of surrounding communities. The Lansing WWTP, SCCMUA WWTP, and Delhi Township WWTP, do not discharge their effluent in the watershed.

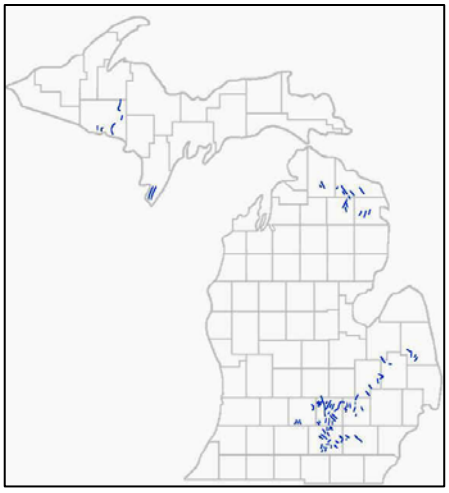
As a whole, only 38% of the watershed land area has sanitary sewer service. On a subwatershed basis, those with the most service include Holmes Drain (100%), Red Cedar C (99%), Pawlowski Creek Drain and Banta Drain (89%), and Lake Lansing (79%). Those with little or no service include Branch Mud Creek (0%), Button Drain (0%), Cook Creek (0%), Mud Creek (0%), Sloan Creek (0%), Red Cedar B (2%), Willow Creek (5%), Red Cedar A (12%), Aurelius-Vevay Drain (15%), and Mud Lake Outlet Drain (20%). The remaining subwatersheds have between 41 and 66 percent sanitary sewer service.

Table 3-5. Sewer service areas.

Subwatershed	Sanitary Sewer	Private Systems
Aurelius-Vevay Drain	15%	85%
Branch Mud Creek	0%	100%
Button Drain	0%	100%
Cook and Thorburn	41%	59%
Cook Creek	0%	100%
Herron Creek	62%	38%
Holmes Drain	100%	0%
Mud Creek	0%	100%
Pawlowski Creek / Banta Drain	89%	11%
Mud Lake Outlet Drain	20%	80%
Lake Lansing	79%	21%
Red Cedar A	12%	88%
Red Cedar B	2%	98%
Red Cedar C	99%	1%
Sloan Creek	0%	100%
Smith Drain	66%	34%
Sycamore Creek A	46%	54%
Sycamore Creek B	54%	46%
Willow Creek	5%	95%
Total	**38%**	**62%**

Heron Rookery

Esker Locations in Michigan



Source: Schaetzl , 2005.

Significant Natural Features to be Protected

Michigan has a number of significant natural features located across the State. These natural features can provide public benefits which may include recreation, bird watching, hunting, fishing, camping, hiking, off-roading, and water sports. These areas also include critical habitat for different species of plants, mammals, amphibians, reptiles, birds, fish, and macroinvertebrates. The features identified in the watershed are presented in Table 3-6.

Threatened and Endangered Species

The Michigan Department of Natural Resources (MDNR) provides information on threatened and endangered species in Michigan by watershed. This work is coordinated by the Michigan Natural Features Inventory (MNFI).

A species is classified as **endangered** if it is near extinction throughout all or a significant portion of its range in Michigan.

A species is **threatened** if it is likely to become classified as endangered within the foreseeable future throughout all or a significant portion of its range in Michigan.

A species is of **special concern** if it is extremely uncommon in Michigan or if it has a unique or highly specific habitat requirement and deserves careful monitoring of its status. A species on the edge or periphery of its range that is not listed as threatened may be included in this category along with any species that was once threatened or endangered but now has an increasing or protected, stable population.

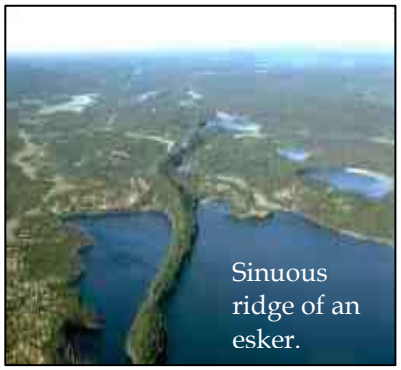
A species is **extinct** if it can no longer be found anywhere in the world. An **extirpated** species is one which doesn't exist in Michigan, but can be found elsewhere in the world.

A species is **stable** if it is not included in the above categories and the population is not declining drastically. A stable species is breeding and reproducing well enough to maintain current population in a given area.

Table 3-6 includes the species of plants and animals found in the watershed which are listed as threatened, endangered, or of special concern.

Eskers

An esker is a geographic natural feature that is formed when glacial meltwater carves subsurface river tunnels within the ice sheet. As the flow of water descreases or is blocked, sediment accumulates beneath the glacier. When the glacier recedes, a snake-like ridge composed of sand and gravel remains. The longest esker in Michigan extends from DeWitt to Mason running through Holt and Lansing. Much of the Mason Esker has been excavated for concrete roadway construction (Schaetzl 2005).



Sinuous ridge of an esker.

Source: Geological Survey of Canada

Table 3-6. Threatened and endangered features in the watershed.

Feature Type[1]	Name	Scientific Name	Federal Status[2]	State Status[2]	Aurelius – Vevay Drain	Branch Mud Creek	Buutton Drain	Cook and Thorburn	Cook Creek	Herron Creek	Holmes Drain	Mud Creek	Pawlowski /Banta Drain	Mud Lake Drain Outlet	Lake Lansing	Red Cedar A	Red Cedar B	Red Cedar C	Sloan Creek	Smith Drain	Sycamore Creek A	Sycamore Creek B	Willow Creek
F	Rich Forest, Central Midwest Type									X	X		X							X		X	
G	Esker										X		X					X				X	
H	Great Blue Heron Rookery																		X				
O	Barrens Buckmoth	Hemileuca maia		SC						X	X		X	X	X			X		X		X	
O	Beak Grass	Diarrhena americana		T		X	X		X	X	X		X	X	X	X	X	X		X		X	
O	Blanchard's Cricket Frog	Acris crepitans blanchardi		SC										X	X								
O	Blanding's Turtle	Emys blandingii		SC					X					X	X	X	X						
O	Bog Bluegrass	Poa paludigena		T										X	X								
O	Cat-tail Sedge	Carex typhina		T							X		X					X				X	
O	Clinton's Bulrush	Scirpus clintonii		SC										X	X								
O	Cooper's Hawk	Accipiter cooperii		SC						X				X	X			X		X			
O	Cooper's Milk-vetch	Astragalus neglectus		SC						X				X	X			X		X			
O	Cup-plant	Silphium perfoliatum		T														X					
O	Davis's Sedge	Carex davisii		SC							X		X					X				X	
O	Dwarf-bulrush	Hemicarpha micrantha		SC										X	X								
O	Eastern Box Turtle	Terrapene carolina carolina		SC	X	X		X				X									X		X
O	Elktoe	Alasmidonta marginata		SC														X					
O	Ellipse	Venustaconcha ellipsiformis		SC					X							X	X	X					
O	False Hop Sedge	Carex lupuliformis		T						X	X		X	X	X			X		X		X	
O	Ginseng	Panax quinquefolius		T						X										X			
O	Goldenseal	Hydrastis canadensis		T						X										X			
O	Green Violet	Hybanthus concolor		SC														X					
O	Hairy Angelica	Angelica venenosa		SC										X	X								
O	Hairy-fruited Sedge	Carex trichocarpa		SC							X		X					X				X	
O	Indiana Bat or Indiana Myotis	Myotis sodalis	LE	E						X	X		X					X		X		X	
O	Kentucky Coffee-tree	Gymnocladus dioicus		SC						X	X		X					X		X		X	
O	King Rail	Rallus elegans		E	X	X	X	X	X	X		X		X	X	X	X	X	X	X	X		X
O	Least Shrew	Cryptotis parva		T	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
O	Pugnose Shiner	Notropis anogenus		SC										X	X								
O	Rainbow	Villosa iris		SC					X		X		X			X	X	X				X	
O	Raven's-foot Sedge	Carex crus-corvi		T	X			X		X	X	X	X	X	X			X		X	X	X	X
O	Red Mulberry	Morus rubra		T						X										X			
O	Regal Fern Borer	Papaipema speciosissima		SC			X		X	X	X		X	X	X	X	X	X		X		X	
O	Regal Fritillary	Speyeria idalia		E					X					X	X	X	X						
O	Round Pigtoe	Pleurobema coccineum		SC														X					
O	Showy Orchis	Galearis spectabilis		T					X	X	X		X	X	X	X	X	X		X		X	
O	Slippershell Mussel	Alasmidonta viridis		SC														X					
O	Small Skullcap	Scutellaria parvula		T						X				X	X					X			
O	Splendid Clubtail	Gomphus lineatifrons		SC						X								X		X			
O	Torrey's Bulrush	Scirpus torreyi		SC			X		X	X				X	X	X	X	X	X	X			
O	Virginia Spiderwort	Tradescantia virginiana		SC						X	X		X	X	X			X		X		X	
O	Virginia Water-horehound	Lycopus virginicus		T		X	X		X	X				X	X	X	X		X	X			
O	White or Prairie False Indigo	Baptisia lactea		SC			X		X	X				X	X	X	X	X	X	X			
O	Woodland Vole	Microtus pinetorum		SC			X		X	X	X		X	X	X	X	X	X		X		X	

[1] – F = Forest, G = Geographical, H = Habitat, O = Organism
[2] – LE = Listed as endangered, LT = Listed as threatened, SC = Special concern, T = Threatened, E = Endangered

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