SECTION 3 - CHARACTERISTICS OF THE WATERSHED

SUBWATERSHEDS

It was decided that each of the 4 subwatershed that comprise the Middle Flint River Watershed needed to be divided into smaller subwatersheds each with an area from 2mi^2 to 20mi^2. This would allow specific areas within the Middle Flint River Watershed to be looked at based on their unique conditions. This assisted with Total Maximum Daily Loads (TMDL) & identifying problems that may be specific to that location. Most of the Middle Flint watershed within Genesee County contained existing drainage districts. These existing drainage districts were used to divide the 4 watersheds into smaller subwatersheds. Any drainage districts Smaller than 2mi^2 were incorporated within larger drainage districts. Because the Main Channels of the Swartz Creek, Thread Creek and Kearsley Creek were natural watercourses and extremely long, the watercourses were divided into more manageable lengths. Areas without a drainage district used contours whenever possible to divide districts. Otherwise a jurisdictional boundary was used when necessary. Within Oakland County, subdistricts were established based on natural contours or a jurisdictional boundary not drainage districts. Within Lapeer County the county line was used to create 3 subwatersheds. In total 52 subwatersheds were developed.

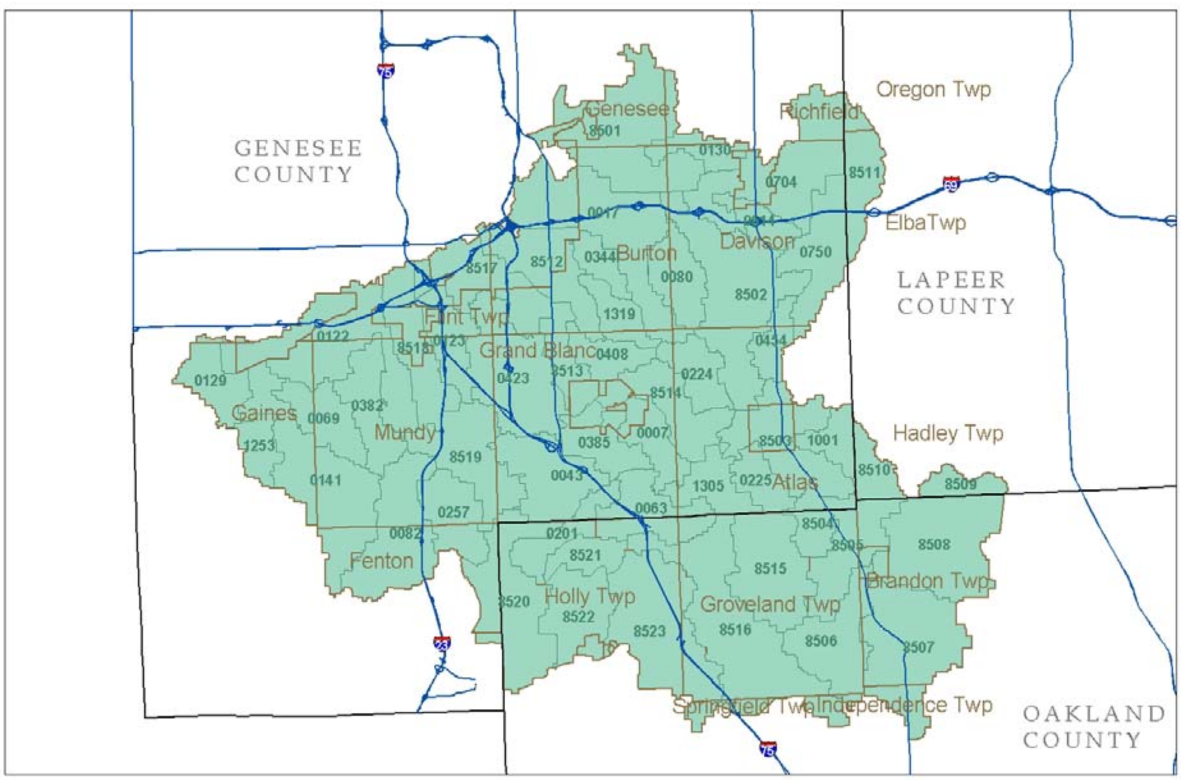


Figure 3-1 Subwatersheds

POLITICAL JURISDICTIONS

Table 3-1 Political Jurisdiction by Subwatershed

	Atlas Twp	Brandon Twp	City of Burton	Clayton Twp	City of Davison	Davison Twp	Elba Twp	City of Fenton	Fenton Twp	*City of Flint	Flint Twp	Gaines	Genesee Twp
0043 Seaver													
0069 Lum & Extension												1.38	
0082 Indian Creek & Ext.									5.38				
0122 Swartz Creek West Br				0.16						0.19	2.68	1.96	
0123 Call										0.63	1.56		
0129 Crapo & Ext.				0.15								3.73	
0141 Alger Creek & Ext									2.35			5.40	
0201 Bare IC													
0257 Dawe									1.77				
0382 Howland											0.06		
0423 Gibson			0.76								0.82		
1253 Slocum												2.46	
8517 Swartz Cr Outlet			1.88							3.82	1.15		
8518 Swartz Cr 2										1.60	1.56		
8519 Swartz Cr 3									0.12				
8520 Swartz Cr Oakland 1								0.30	2.53				
8521 Swartz Cr Oakland 2													
8522 Swartz Cr Oakland 3													
8523 Swartz Cr Oakland 4													
Swartz Creek Total	**0.00**	**0.00**	**2.64**	**0.31**	**0.00**	**0.00**	**0.00**	**0.30**	**12.15**	**6.24**	**7.83**	**14.93**	**0.00**
0007 Bush	0.33												
0063 Slack Lake	0.51												
0224 Lasalle	3.16												
0225 Liscomb & Stanton	2.63												
0344 Robinson & Curtis			2.11										
0385 Layman													
0408 Myers			0.14										
1305 Thread Creek	3.33												
1319 Thread Creek, Pierson Br			2.11										
8512 Thread Cr Outlet			2.38							4.18			
8513 Thread Cr 2			0.82										
8514 Thread Cr 3	3.00												
8515 Thread Cr Oakland 1													
8516 Thread Cr Oakland 2													
Thread Creek Total	**12.97**	**0.00**	**7.55**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.18**	**0.00**	**0.00**	**0.00**
0017 Gilkey Creek & Br.	**0.25**	**0.00**	**8.01**	**0.00**	**0.00**	**0.12**	**0.00**	**0.00**	**0.00**	**4.01**	**0.00**	**0.00**	**0.00**
0080 Phillips			1.33			3.04							
0130 Brier Creek			0.36		0.11	1.44							0.09
0454 Cummings	1.82					0.64							
0614 Long Lake					0.19	2.21							
0704 Black Creek IC					1.62	7.36							
0750 Big Swamp IC	0.19					6.15							
1001 Kipp - IC	2.49												
8501 Kearsley Cr Outlet			3.32			1.37				1.19			6.95
8502 Kearsley Cr 2	3.45					9.51							
8503 Kearsley Cr 3	6.16												
8504 Kearsley Cr 4	0.65												
8505 Kearsley Cr Oakland 1	0.46	1.71											
8506 Kearsley Cr Oakland 2		0.60											
8507 Kearsley Cr Oakland 3		9.45											
8508 Kearsley Cr Oakland 4		10.94											
8509 Kearsley Cr Lapeer 1													
8510 Kearsley Cr Lapeer 2													
8511 Kearsley Cr Lapeer 3							3.89						
Kearsley Creek Total	**15.22**	**22.70**	**5.02**	**0.00**	**1.92**	**31.73**	**3.89**	**0.00**	**0.00**	**1.19**	**0.00**	**0.00**	**7.04**
Total area in square mile	**28.43**	**22.70**	**23.22**	**0.31**	**1.92**	**31.85**	**3.89**	**0.30**	**12.15**	**15.62**	**7.83**	**14.93**	**7.04**
% of Watershed	**8.65%**	**6.91%**	**7.07%**	**0.09%**	**0.58%**	**9.69%**	**1.18%**	**0.09%**	**3.70%**	**4.75%**	**2.38%**	**4.54%**	**2.14%**

Village of Goodrich	City of Grand Blanc	Grand Blanc Twp	Groveland Twp	Hadley Twp	Holly Township	Village of Holly	Independence Twp	Mundy Twp	Oregon Twp	Village of Ortonville	Richfield Twp	Springfield Twp	City of Swartz Creek	**Total Area in Square mile**	**% of Watershed**
		6.71						0.06						6.76	2.06%
								3.04						4.42	1.34%
								3.45						8.83	2.69%
								4.47					3.14	12.60	3.83%
								1.93						4.12	1.25%
														3.88	1.18%
								4.57						12.31	3.75%
		1.03			2.32									3.35	1.02%
								3.00						4.78	1.45%
								4.81						4.87	1.48%
		6.71						1.70						9.99	3.04%
														2.46	0.75%
														6.86	2.09%
								2.95						6.11	1.86%
		1.21						6.11						7.44	2.26%
		0.36			7.16			0.03						10.38	3.16%
					2.53									2.53	0.77%
					5.34	0.50								5.83	1.77%
			2.88		8.99	0.12						0.70		12.70	3.86%
0.00	**0.00**	16.02	2.88	0.00	26.34	0.61	0.00	36.10	0.00	0.00	0.00	0.70	3.14	130.19	
	0.76	2.52												3.61	1.10%
		2.72	0.77		1.76									5.75	1.75%
		0.36												3.53	1.07%
0.11														2.74	0.83%
														2.11	0.64%
	0.73	3.15												3.87	1.18%
		2.76												2.90	0.88%
		0.29												3.63	1.10%
		0.67												2.78	0.85%
		0.17												6.72	2.04%
	0.88	1.73												3.43	1.04%
	1.12	2.47												6.59	2.00%
			8.22											8.22	2.50%
			12.55		0.98							1.76		15.29	4.65%
0.11	**3.49**	16.83	21.54	0.00	2.73	0.00	0.00	0.00	0.00	0.00	0.00	1.76	0.00	71.16	
0.00	**0.00**	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.67	3.86%
														4.37	1.33%
											0.60			2.61	0.79%
														2.46	0.75%
														2.40	0.73%
											2.53			11.52	3.50%
														6.34	1.93%
0.01														2.50	0.76%
											0.82			13.66	4.16%
0.05														13.01	3.96%
2.07														8.23	2.50%
			1.88											2.53	0.77%
			3.77							0.34				6.28	1.91%
			5.86							0.21		0.24		6.91	2.10%
			0.06				1.97							11.48	3.49%
										0.44				11.38	3.46%
				1.94										1.94	0.59%
				2.49										2.49	0.76%
									0.65					4.54	1.38%
2.13	**0.00**	0.00	11.57	4.42	0.00	0.00	1.97	0.00	0.65	0.98	3.96	0.24	0.00	114.62	
2.24	**3.49**	33.13	35.99	4.42	29.08	0.61	1.97	36.10	0.65	0.98	3.96	2.70	3.14	328.64	100.00%
0.68%	**1.06%**	10.08%	10.95%	1.35%	8.85%	0.19%	0.60%	10.98%	0.20%	0.30%	1.20%	0.82%	0.96%	100.00%	

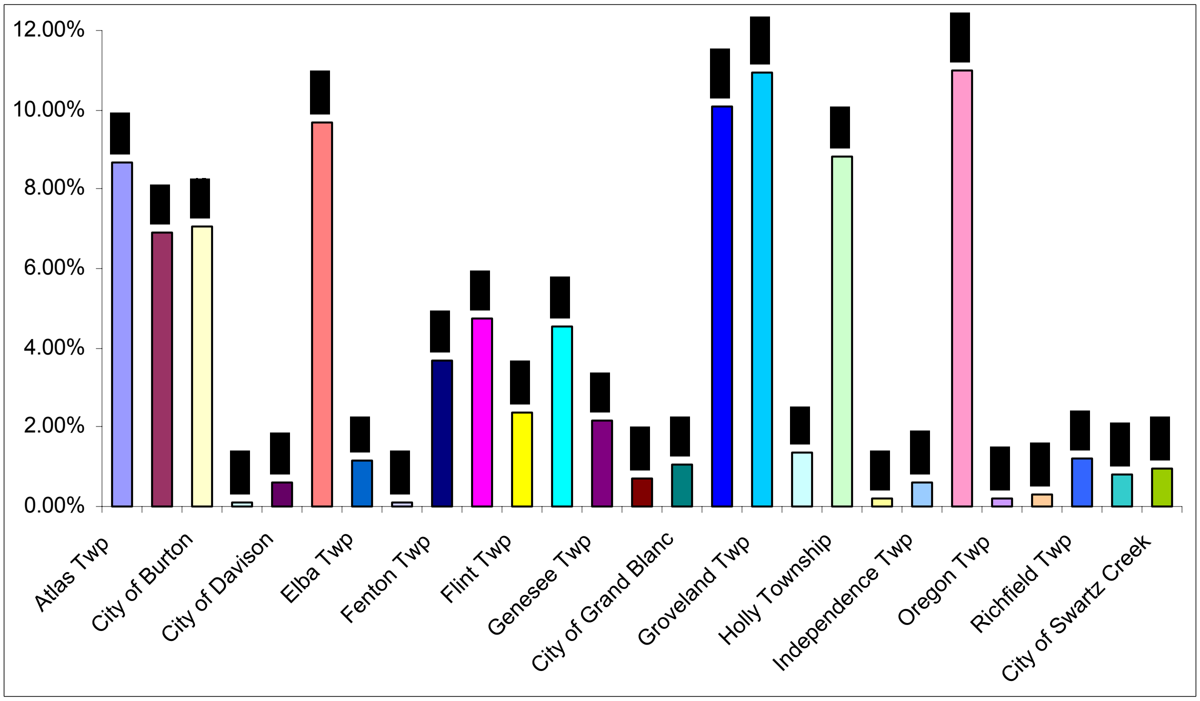


Figure 3-2 Political Jurisdiction by percentage

Political jurisdiction regarding the Flint River and it's tributaries are controlled by federal and state laws, county and municipal ordinance, and municipal by-laws. Regulatory and enforcement responsibility for water quantity and quality is multi-layered. Within the Middle Flint River Watershed alone there are 27 Cities, Townships, and Villages and 3 counties. Of the 27 communities, only 18 are Phase 2 communities, and although the City of Flint is included in the Middle Flint River Watershed area calculations, it is a Phase I community.

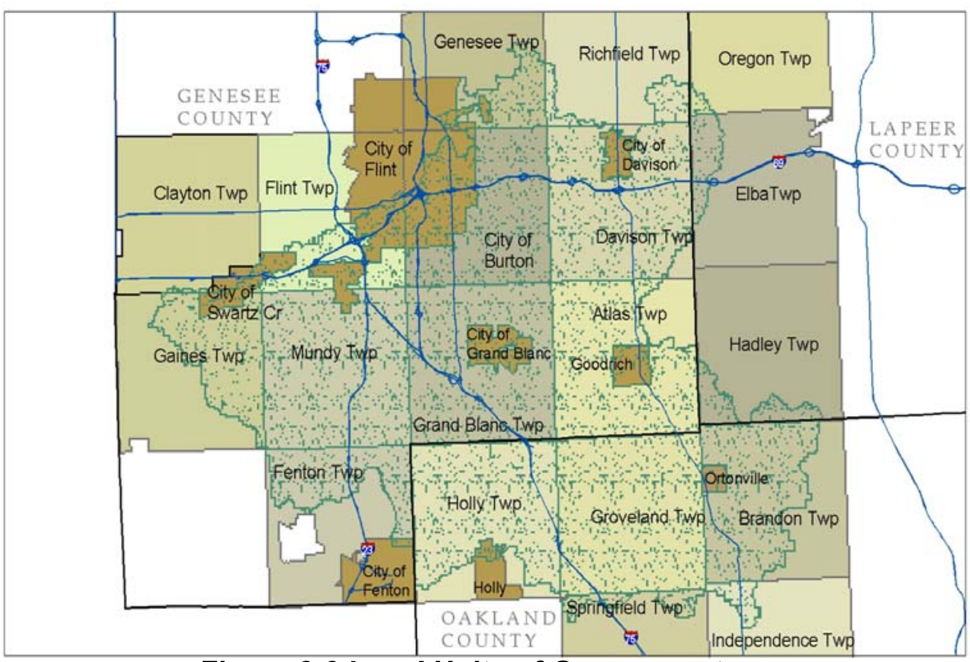


Figure 3-3 Local Units of Government

DEMOGRAPHICS

The Middle Flint River Watershed population has grown in the last 15 years. Most of that growth has occurred along the major state road corridors. As the land is developed along these corridors the communities in these areas are experiencing large growth. Development has grown along the expressway corridors outward from the urban areas. Within the last 15 years the developed area along 75 and 23 has been moving south from Flint and north from Detroit and Ann Arbor within the Middle Flint Watershed. The largest population increase by percent has been along State Road (M-15).

Table 3-2 Population Changes

Community	1990 Population within watershed	2000 Population within watershed	% Change from 1990 - 2000	Area within watershed Square Miles
Atlas Township	3,818	4,990	30.7%	28.43
Brandon Township	6,941	8,503	22.5%	22.70
City of Burton	27,617	30,308	9.7%	23.22
Clayton Township	45	46	2.4%	0.31
City of Davison	5,693	5,536	-2.8%	1.92
Davison Township	14,671	17,238	20.8%	31.85
Elba Township	579	625	7.9%	3.89
City of Fenton	453	568	25.3%	0.30
Fenton Township	3,718	4,796	29.0%	12.15
Flint Township	10,228	10,115	-1.1%	7.83
Gaines Township	2,171	2,614	20.4%	14.93
Genesee Township	7,859	7,867	0.1%	7.04
Village of Goodrich	1,032	1,349	30.7%	2.24
City of Grand Blanc	7,760	8,242	6.2%	3.49
Grand Blanc Township	25,392	29,827	17.5%	33.13
Groveland Township	4,699	6,141	30.7%	35.99
Hadley Township	247	296	19.8%	4.42
Holly Township	2,998	3,400	13.4%	29.08
Village of Holly	1,147	1,258	9.7%	0.61
Independence Township	674	888	31.8%	1.97
Mundy Township	11,511	12,191	5.9%	36.10
Oregon Township	108	131	21.2%	0.65
Village of Ortonville	1,589	1,948	22.6%	0.98
Richfield Township	919	1,033	12.4%	3.96
Springfield Township	975	1,311	34.4%	2.70
City of Swartz Creek	3,682	3,873	5.2%	3.14
Total	**146,526**	**165,094**		

U.S. Census Bureau Data,

LAND USE AND GROWTH TRENDS

Land Cover – Past, Present and Future

Prior to European settlement of the area, vegetation of the Middle Flint Watershed consisted of forested land with Beech-Sugar Forest (sugar maple, basswood, red oak, and white ash) to the north and Oak-Hickory Forest (red oak, white oak, hickory) in the south of Genesee County and Oakland County. Isolated pockets of Mixed Oak Savannah are present in Grand Blanc and Groveland Townships. Black Oak Barren is predominant in the headwaters of the Kearsley Creek in Groveland, Brandon, Hadley and Atlas Townships. Swamp Forest are scattered throughout the watershed in depressed areas, but most of the deeper water bodies are located in the headwaters in the south half of the watershed.

When the first European explorers arrived in the Saginaw Valley, they found it populated by Chippewa and Ottawa Indians, with the Chippewas being more numerous (Ellis 1879). However, Chippewa history tells that when they came into the area the Sauks and Onottoways inhabited the valley.

When early French fur traders moved into the Flint River Valley, they established an encampment at a natural river crossing used by Native Americans. The Indian name for this river was Pewonigowink meaning "river of fire stone" or river of flint. The crossing was located on the "southern bend" of the Flint River on the “Saginaw Trail” that ran between villages at the outlet of Lake St. Clair (Detroit) and encampments at the mouth of the Saginaw River. It was located very near the mouth of the Swartz Creek. This crossing became known as the “Grand Traverse” or great crossing place. A permanent trading post was established when Jacob Smith arrived in 1819 (Crowe 1945).

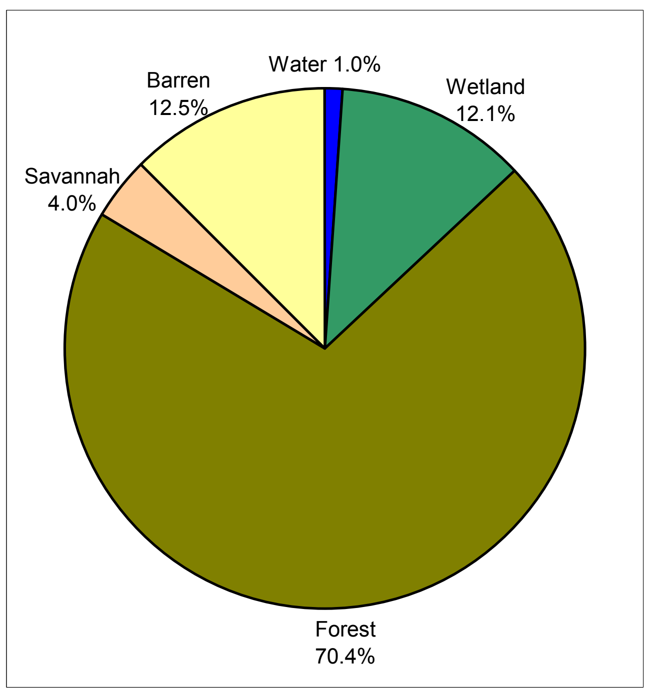


Figure 3-4 Ecosystems, circa 1830s by percentage

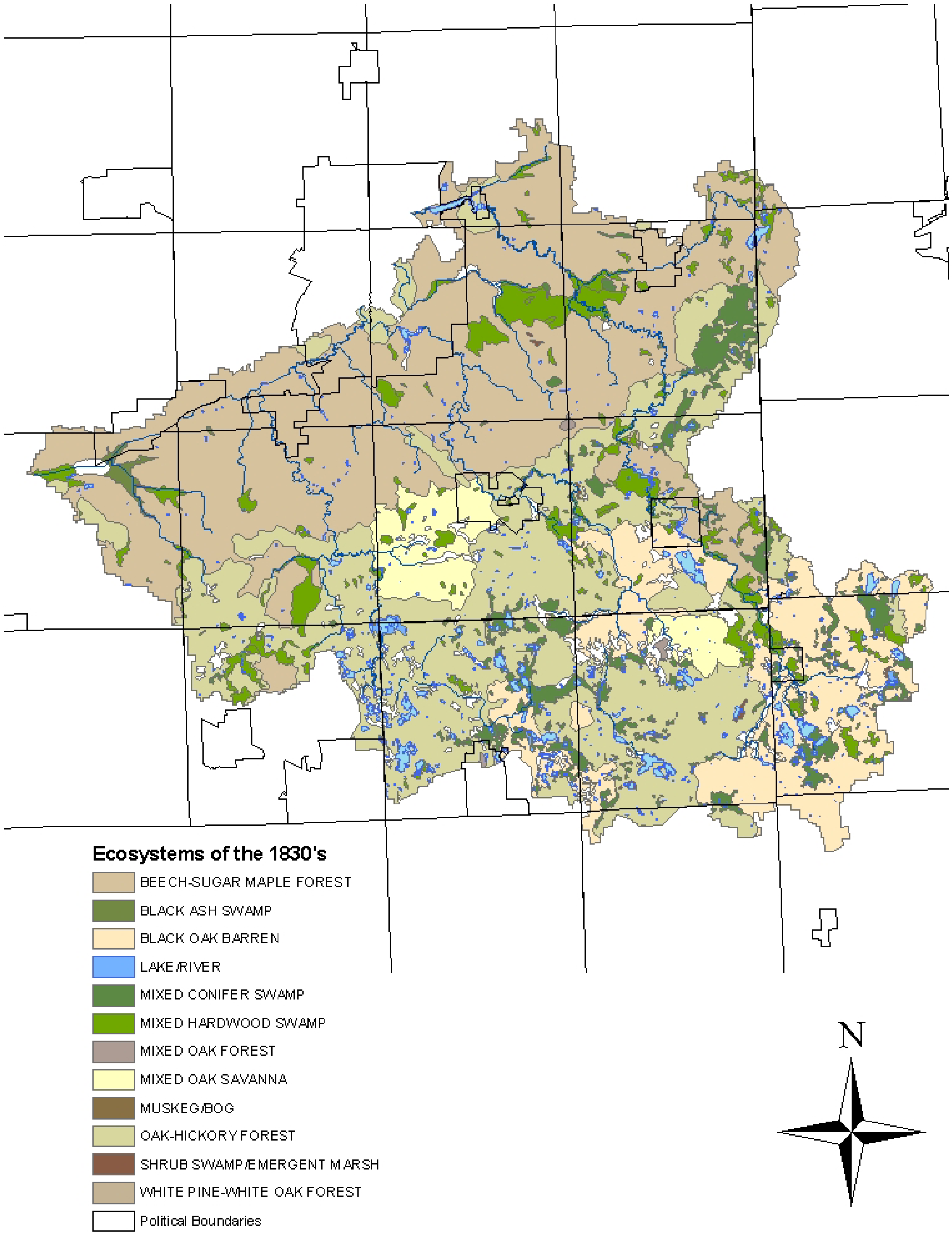


Figure 3-5 Ecosystems, circa 1830s

The City of Flint grew up at the site of the "Grand Traverse" and the pioneer immigrants who were largely from the "Genesee Country" of Western New York, concentrated along the banks of the Flint River, taking up farming, lumbering, and manufacturing. Permanent human settlement brought great change to the landscape as the land began to be altered for human benefit.

In the 1830's, much of the County of Genesee, including most of the Middle Flint River Watershed, had been sectioned off and land sold, mostly in parcels of 80 to 200 acres. Much of this area was first logged for personal use and farming. Through the 1800's and most of the 1900's farming remained the predominant land use in the Middle Flint River.

Although Michigan was primarily an agricultural state, including much of Genesee County, before the Civil War, lumbering became the principal economic activity in the new state during the second half of the 19th century. Within Genesee County, the completion of the railroad in 1862 afforded practicable communication with outside markets; and this, with increased demand created by the great civil war, inaugurated for the lumber interests an era of prosperity from 1866 to 1873, such as they had never known before.

With a good supply of high quality lumber and the ability to move supplies from town to lumbering camps, it is not surprising that Flint became a center for transportation producing horses, horse harnesses, horse drawn vehicles and ox carts. By 1900, Flint was building 150,000 vehicles per year, both wagons and carts. As the pine forests were exhausted, Flint's attention turned to other industries and the transition to automobile manufacturing was natural (Crowe 1945). In 1903, Buick Motor Company began production of the Buick automobile. Under the business genius of Will Durant, formerly of Durant-Dort Carriage Company, Buick Motor Company convinced suppliers such as Champion Spark Plug Company, Weston-Mott (Axle) Company, and Fisher Body Company to relocate in Flint. Flint became the birthplace of General Motors and the United Auto Workers (UAW) union. Even today, Flint is often referred to as Buick City and its prosperity centered on the manufacture of automobiles.

After World War II, prosperity fostered population increase and diversifying communities. Gasoline was inexpensive, new highways were built, and General Motors, the UAW and Flint flourished. Outlying communities of Lapeer, Davison and Grand Blanc experienced growth and were desirable locations to live and work. Advancements in the gasoline engine allowed for increased agriculture and farming dominated watershed land use.

Presently the Middle Flint River Watershed is changing. A community, whose economic welfare traditionally was tied to the prosperity of General Motors, has had to seek economic stability through diversification. New businesses have become important and development of industrial properties to attract new business has been a challenge. More recently, the increased demand for new residential and small commercial development is being built alongside agriculture.

There is no consistent source for future land cover within the Middle Flint River Watershed. The Genesee County Land Bank has been compiling a comprehensive inventory of Master Plans and Ordinances for Municipalities within Genesee County. The inventory covers all ordinances including environmental. This can provide a resource to measure a community's ordinance for effectiveness against what other communities are doing. This inventory will be made available once it is complete.

Currently each Municipal Master Plan may have a future land use. It may be for ultimate build out or for a defined period of time. Currently there is no standardized method for classifying Current or Future Land Use among the Municipalities. Below is a list of Community Master Plans with future land use and when they were prepared. Each community has their master plan on file.

<u>1990</u>
Village of Goodrich

<u>1995</u>
Richfield Township

<u>1997</u>
Mundy Township

<u>2001</u>
Genesee Township
Clayton Township

<u>2002</u>
Atlas Township
City of Burton
City of Davison
Davison Township
Elba Township
Fenton Township
City of Grand Blanc
Springfield Township

<u>2004</u>
City of Fenton
Grand Blanc Township
Hadley Township
Holly Township
City of Swartz Creek

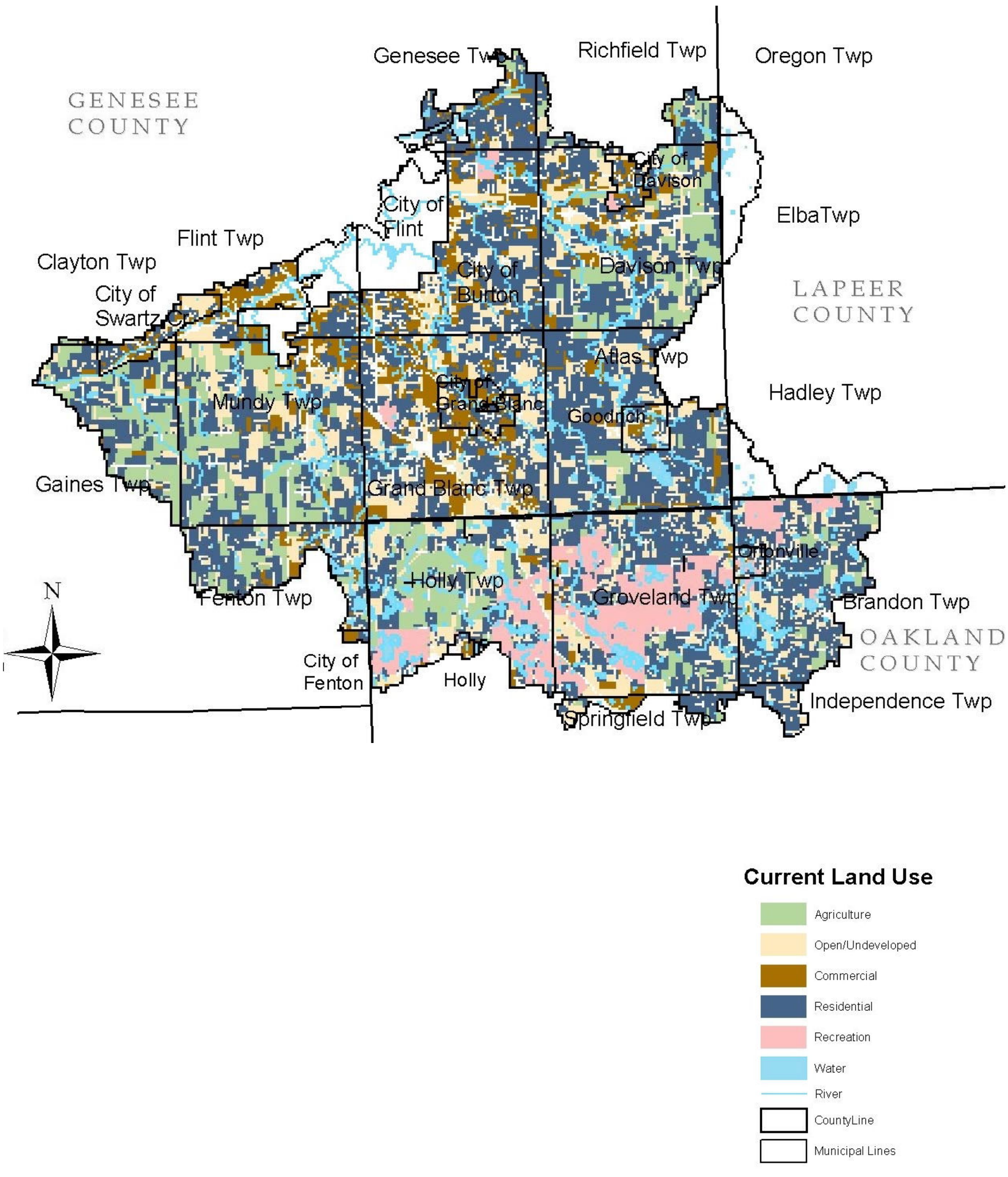
<u>2005</u>
Groveland Township

<u>2005-2006</u>
Village of Holly
Oregon Township

<u>2007</u>
Gaines Township

<u>2008</u>
Flint Township

Figure 3-6 Current Land Covers



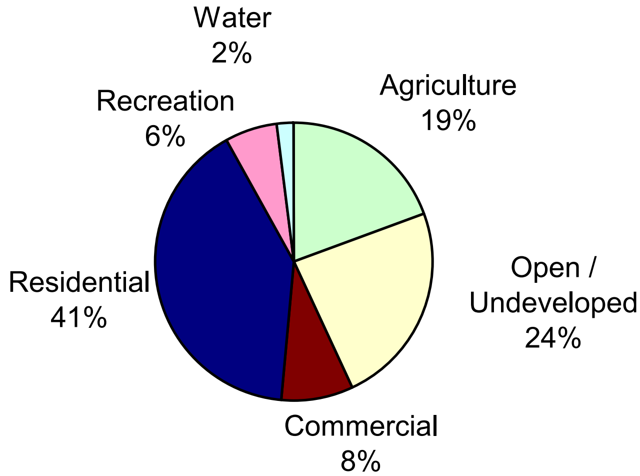


Figure 3-7 Current Land Cover by percentage

Current land use for Genesee and Oakland Counties was determined by using the assessment classification for each parcel of land. Open/ Undeveloped areas are undeveloped residential and commercial properties. Open water and recreation were merged with the parcel map and given their own classifications. In Genesee County the Recreational land was determined to be County/ Municipal Parks only, golf courses are considered developed property. It is unclear what was included in the recreational land layer supplied by Oakland County.

City of Flint is a NPDES Phase I community and was not included. Within the City of Flint boundaries, the land is largely developed with residential and some commercial. There are several City Parks spread throughout the populated areas. In the southwest corner of the City's boundary is Bishop Airport.

Current parcel information for Lapeer County was not available to determine land use. Based on 1998 aerials, Hadley Township within the Middle Flint River watershed is predominantly open area/ undeveloped with approximately 25% of the total area being agriculture. There is some residential, both large and small lot, but they are clustered around the lakes.

In Elba and Oregon Townships within the Middle Flint River watershed is predominantly agricultural with only 20% of the land undeveloped/ open, and that is concentrated to the north. There are several large residential parcels spread throughout the area, but most of the small residential parcels are clustered around Potter Lake and along Davison Road.

Urbanized Land Use

Within the Middle Flint River Watershed the largest increases to population within the watershed have been along the state road corridors. When comparing the individual communities current land uses to future land use, many areas that are current open areas or agriculture are classified in the future land use as residential or commercial. Many of the open/undeveloped areas in figure 3-7 are already zoned and assessed as residential or commercial but as of 2003, they have not been developed.

Agricultural Land Use

Around the edges of the Middle Flint River Watershed, the land becomes more agricultural. According to the USDA office the 2 predominant cash crops are corn and soybean. On a much smaller scale other cash crops within the watershed are hay, wheat, and small grains.

Based on Conversations with the local USDA office, of the 15 diary operations in Genesee County approximately 10 of them are within the Middle Flint. Most of the dairy farms have an average of 50-150 head with the largest operation being 250 head of cattle.

The census of agricultural data for the below table is based on the entire Flint River watershed. It is broken up by County. Although there is census data for Lapeer County it has not been included because, the Flint River Watershed encompasses over half of Lapeer County, but less than 9 mi^2 is located within the Middle Flint River Watershed. Within Oakland County the agricultural boundary lines follow the Middle Flint River watershed boundary and this information is very accurate. Within Genesee County the numbers below reflect the Upper, Middle and lower Flint River Watersheds combined.
There are no known Concentrated Animal Feeding Operations (CAFO's) in the Middle Flint River Watershed.

Table 3-3 Livestock

Subwatershed	Beef Cattle	Dairy Cattle	Swine	Sheep	Horse	Chicken	Turkey	Duck
Genesee	896	1535	2485	853	1828	166	47	18
Oakland	60	38	43	100	314	110	6	2

USDA Census of Agriculture 1997

Riparian Buffer

Studies of impervious cover impacts to surface waters indicate that one of the key variables influencing watershed response is the presence or absence of an intact (wooded) riparian corridor or buffer. These riparian buffers act as a filter for storm water entering the stream corridor though overland flow. The riparian buffers are able to reduce erosive water velocities; extract sediment, nutrients, and other contaminants; and allow additional storm water to be infiltrated into the soil.

The Conservation Reserve Enhancement Program (CREP) is a state program through the Michigan Department Of Agriculture. This program has stabilized over 400 acres of erodible soil within Genesee County. The CREP program seeks to improve water quality and wildlife habitat by bringing conservation practices onto agricultural land. Of the 400 acres half has been stabilized by installed buffer strips and the other half has stabilized highly erodible soil with steep slopes by a practice called solid field. Most of the 400 acres that has been entered into CREP has been in the north half of Genesee County and not within the Middle Flint River Watershed.

Currently Buffer strips along sensitive areas are recommended as a Best Management Practice (BMP), but there are no current requirements. Within the Action Plan in Chapter 8 there is an action item to draft a buffer strip ordinance.

Wetlands

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 (Cwikiel, 2003).

Other than the National wetland Inventory maps or the Michigan Department of Environmental Quality (MDEQ) assessments, locally there are not any wetland inventories or assessments. The Drain Commissioner's Office has on file MDEQ permits and wetland assessments for individual development properties that have been submitted for review. This information has not been compiled.

Another action item that is being proposed is to identify existing floodplains and wetlands that will then be ranked for value. This would allow a mechanism to choose which areas need to be protected first.

As the below map shows, most of the wetlands are in the southern half and outer edges of the watershed. The wetlands on the below map were identified in the Wetland Inventory Map from 1979. By then much of the City of Flint and surrounding area had already been developed and the land had been altered.

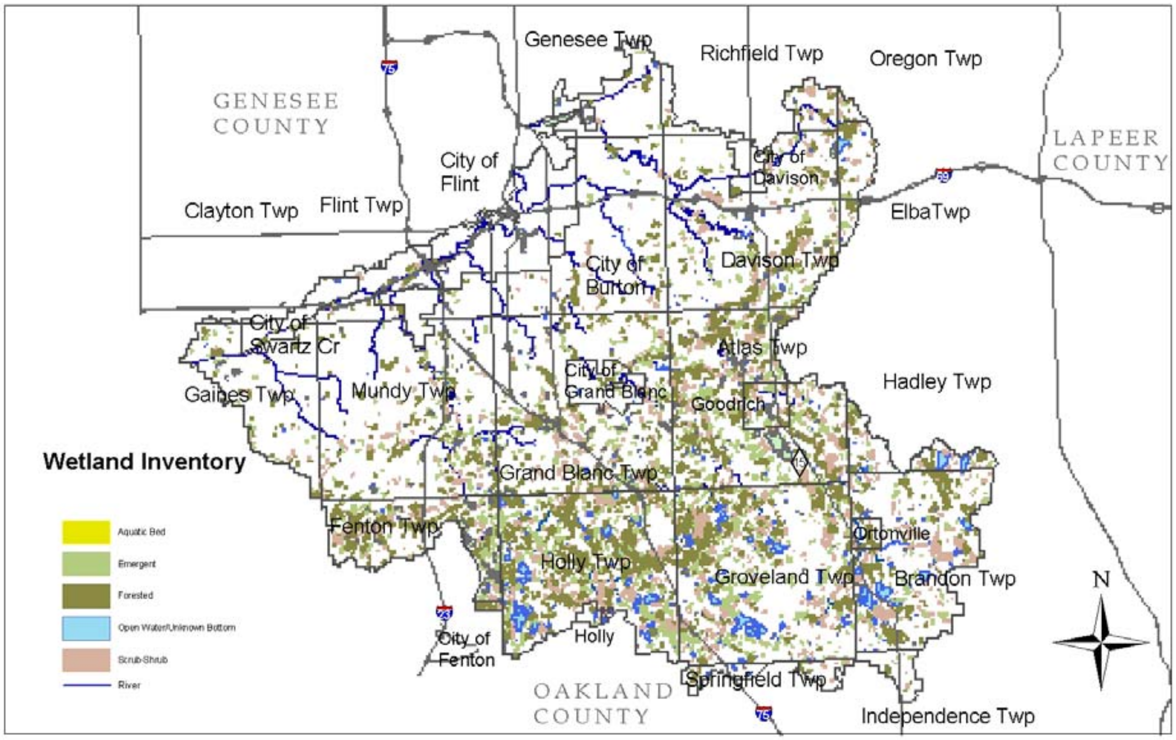


Figure 3-8 Wetlands

CLIMATE AND TOPOGRAPHY

Table 3-4 Temperature & Precipitation

	Average High	Average Low	Average Precipitation	Record High	Record Low
January	29°F	13°F	1.57 in	65°F (1950)	-25°F (1976)
February	32°F	15°F	1.35 in	63°F (1984)	-22°F (1967)
March	43°F	24°F	2.22 in	78°F (1990)	-12°F (1978)
April	56°F	35°F	3.13 in	87°F (1990)	6°F (1982)
May	69°F	45°F	2.74 in	93°F (1988)	22°F (1966)
June	78°F	55°F	3.07 in	101°F (1988)	33°F (1998)
July	82°F	59°F	3.17 in	101°F (1995)	40°F (1965)
August	80°F	57°F	3.43 in	98°F (1988)	37°F (1982)
September	72°F	49°F	3.76 in	97°F (1953)	26°F (1991)
October	60°F	39°F	2.34 in	89°F (1963)	19°F (1974)
November	46°F	30°F	2.65 in	79°F (1950)	-7°F (1949)
December	34°F	19°F	2.18 in	67°F (1982)	-12°F (1989)

The Middle Flint River Watershed is predominantly made up of gently rolling hills with relatively flat areas. The highest elevation is in Brandon Township at 1140 per the USGS 5' contour map. Most of the southern boundary within Oakland County is consistently near elevation 1100. As the watershed outlets to the Flint River, the elevations range from 725 to 710 and, as it leaves the City of Flint to the west, the lowest elevation is 690. Water erosion of the glacial formations produced the present landscape.

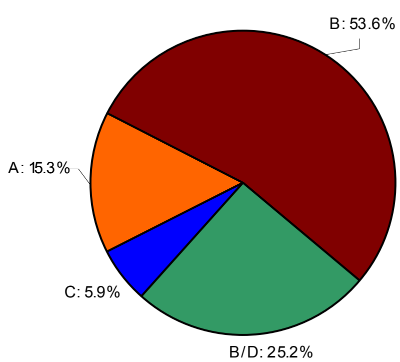
GEOLOGY AND SOILS

Several ice sheets advanced over Genesee County and retreated during the glacial period. The most recent ice sheet or glacier was during the Late Wisconsin glacial period, some 9,000 or more years ago. Several distinctive geological features were formed in Genesee County during this last period of glaciation. Soon after the southernmost part of Genesee County emerged from the retreating Saginaw ice lobe, the lobe halted and built the Fowler Moraine. This moraine starts in Lapeer County, continues southwesterly across Genesee County until it reaches the western part of Grand Blanc Township, and then turns west. Melt waters from the ice lobe were dammed up by the Portland Moraine, and following the path of least resistance, they flowed westward to form the Shiawassee River. This would be the southwest Border of the Middle Flint River Watershed. Masses of material known as glacial till were deposited from the melt off. Later the climate changed again, and the Saginaw lobe halted and built the Flint Moraine. This moraine is marked by a line running through Genesee, and Flint Townships and through the corner of Clayton and perhaps Gaines Townships. Creating the northwest border of the Middle Flint River Watershed. The Flint Moraine dammed up the water draining from the northeast and formed a large glacial lake that covered most of Burton, Mundy, Grand Blanc, Davison, and Richfield Townships. As the glaciers retreated, they left openings for lake waters to move northward. As a result, most drainage of the southern half of Genesee County, except for the Shiawassee River, comes to one point where the Flint River cuts through the Flint Moraine in the western part of the City of Flint.

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geological forces. The characteristics of a soil are determined by 1) the physical and mineral composition of the parent material; 2) the climate under which the soil material has accumulated and existed since accumulation; 3) the plant and animal life on and in the soil; 4) the relief or lay of the land; 5) the length of time the forces of soil development have acted on the soil material.

The Middle Flint River Watershed is made up of the below soils.

Figure 3-9 Hydrologic Soil Groups by percentage



BOYER-OAKVILLE-COHOCTAH (MI024)	1.1%
LENAWEE-TOLEDO-FULTON (MI008)	1.6%
SPINKS-HOUGHTON-BOYER (MI014)	12.6%
MARLETTE-CAPAC-PARKHILL (MI035)	11.1%
MIAMI-CONOVER-BROOKSTON (MI017)	20.6%
MIAMI-MARLETTE-LAPEER (MI016)	20.4%
MIAMI-SPINKS-OAKVILLE (MI015)	1.5%
CONOVER-BROOKSTON-PARKHILL (MI025)	25.2%
LENAWEE-DEL REY-KIBBIE (MI009)	5.9%

The USDA Natural Resources Conservation Service (Formerly the Soil Conservation Service) produced a soil survey for each county. The survey has classified and named the soils. Adjacent soils have been grouped into soil associations based on their landscape that has a distinctive proportional pattern of soils. These soil associations are useful for a general idea of what kinds of soils are present over a large area. Each soil has a corresponding hydraulic classification ranging from A-D and is referred to as hydraulic soil groups. The hydraulic soil groups are defined as:

A: (low runoff potential). Soils having high infiltration rate even when thoroughly wetted and consisting chiefly of deep, well to excessively drained soils with moderately fine to moderately coarse texture.
B: Soils having a moderate infiltration rate when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse texture.
C: Soils having a slow infiltration rate when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water or soils with moderately fine to fine textures.
D: (High Runoff potential). Soils having a very slow infiltration rate when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material.

HYDROLOGY

The Middle Flint River Watershed contains 745 lakes, covering approximately 4235 acres and more than 406 miles of rivers and drains. Of the larger water courses that have base flow all year long there is the West Branch of the Swartz Creek, Swartz Creek, Thread Creek, Gilkey Creek, Kearsley Creek & its branch called the Black Creek. All these watercourses flow into a 7.5 mi stretch of the Flint River that flows through the City of Flint. Refer to Figure 3-11. Each of these watercourses is fed through a series of swales, road ditches and county drains. Many of the smaller drains and watercourses have intermittent flow and are dry most of the time. Many of the watercourses have been dedicated as county drains over the years and have had maintenance done on them. As areas are developed, it is common for enclosures to be placed to cross the drain watercourse or sometimes relocations are made. Some of the drains that have been petitioned for are entirely man made, meaning a ditch may be constructed where one did not exist before or a new storm system is placed in pipes. Historically since large areas of the Middle Flint River Watershed were agricultural there are many unmapped private farm tiles that drain low areas within the watershed.

The USGS has 3 stream gages within the watershed. Two are in the City of Burton for the Kearsley Creek and the Thread Creek. Within the City of Flint there is the Swartz Creek gage. Details on theses gauges are located in Chapter 4. When reviewing the flows from a Flint River gage located downstream of the City of Flint there were some dramatic flow changes. (Flow data reviewed from 2001) On several occasions a rapid increase in flow was recorded in the Flint River. The flow increase was compared to nearby rain gage data located upstream of the stream gage. During times where there were 3 or more days of no rain followed by a quick 0.5-inch rain event this resulted in a rapid increase of flow. For example the flow went from 401cfs on April 5, 2001 to 1450 cfs on April 6, 2001. In May the flow went from 420cfs to 1360cfs in 1 day under similar conditions. In June of the same year the flow went from 1180cfs to 2030cfs for a 0.8-

inch rain event. The Flint River has doubled or tripled its flow very quickly in response to what are relatively small rain events. This is called flashiness. This is a problem because stream flow is linked to and regulates ecological integrity. Changes in stream flows and flow regimes limit and sometimes eliminate many aquatic species within a stream system. Flow stability is critical to support balanced diverse fish communities and is an important component of habitat suitability.

There are four characteristics to hydrology, which become important for a watershed plan: volume, peak flow, time to peak (flashiness), and frequency of flows (particularly bankfull conditions). Development typically increases the volume, the peak, and the frequency and decreases the time to peak.

Development in a watershed changes the hydraulic characteristics. Urbanization tends to fill in low areas, that previously provided storage and pave over pervious areas, that had provided infiltration into the soil. Less flow is available to recharge ground water. Storm sewer pipe systems along with curb and gutter speed up how fast the water is concentrated and transported to the outlet. These activities change the four characteristics to hydrology. Volume and the peak flow are increased. The time to peak occurs quicker. And smaller rain events produce a larger frequency of flows. In addition, channels experience more bankfull flood events each year and are exposed to critical erosive velocities for longer intervals.

The physical, chemical, and biological integrity of a given stream system has been shown to be strongly correlated to the amount of impervious cover (the area covered by rooftops, streets, parking facilities, and other hard surfaces) in the subbasin or watershed (Schueler, 1994). Imperviousness appears to be one of the principal indicators of watershed “health,” and analysis of stream systems across the country seems to indicate that there are thresholds at which watershed imperviousness results in degradation of water quality and physical stream processes.

The conversion of natural landscapes (i.e. farmland, forests, and wetlands) into urban landscapes creates a layer of impervious surface. Urbanization has a significant impact on hydrology, morphology, water quality and ecology of surface waters. The amount of impervious cover in a watershed can be used as an indicator to predict how severe differences are in character of urban watersheds and natural watersheds.

In natural settings, there is very little runoff, with most of the rainfall being filtered by the soils, and supplying deep-water aquifers. In urbanized areas, however, less and less rainfall is infiltrated, and as a result, less water is available to streams. Additional changes in urban streams due to increased impervious cover includes enlarged channels, upstream channel erosion contributing greater sediment load to the stream, in stream habitat structure degrades and declining water quality.

“Even small increases in impervious change stream morphology and degradation of aquatic habitat. The relationship between impervious cover and Subwatershed quality can be predicted by a simple model, projecting current and future quality of streams and other water resources.” (CWP)

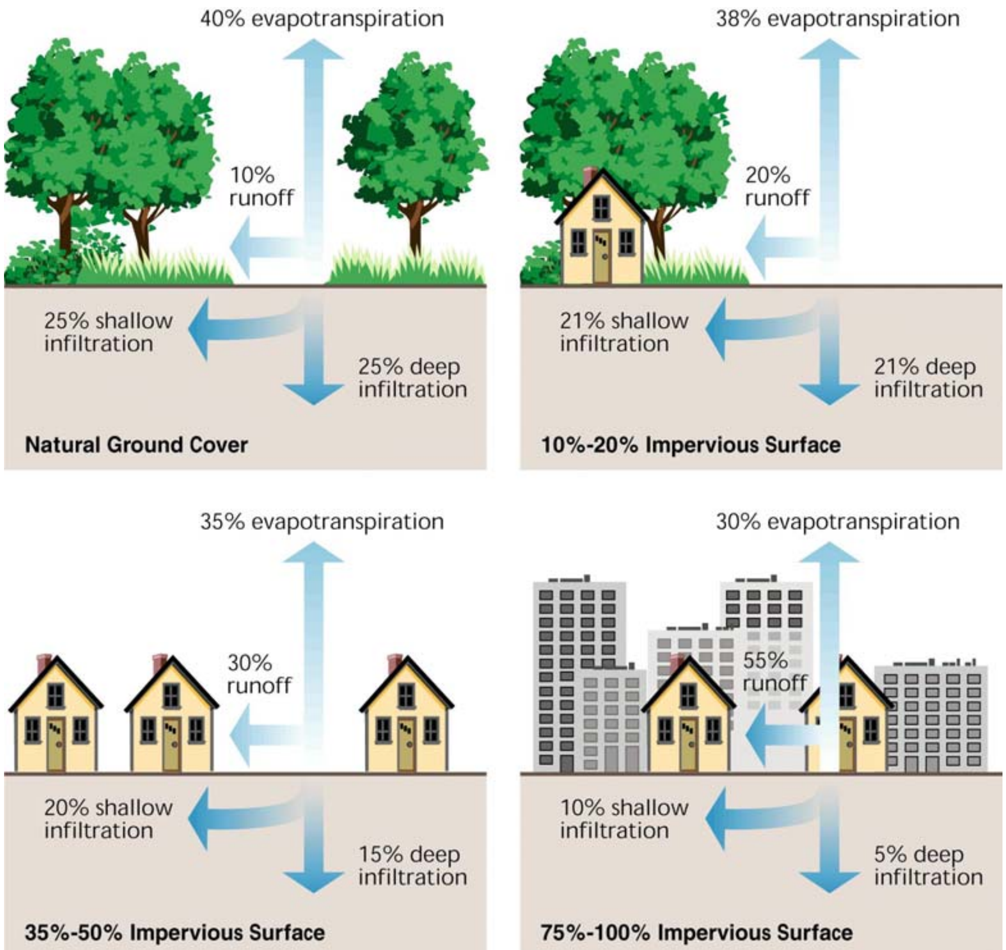


Figure 3-10 Effect of urbanization on runoff
Source: FISRWG, 1998

Research indicates that zones of stream quality exist, most noticeably beginning around 10% impervious cover, with a second threshold appearing at around 25-30% impervious cover. These thresholds are powerfully modeled in The Impervious Cover Model, classifying streams into three categories, sensitive, impacted, and non-supporting. Watersheds with less than 10 percent imperviousness appear to exhibit natural chemical, physical, and biological quality. Between 10 and 25 percent imperviousness river systems show signs of degradation. Beyond 25 percent imperviousness, the damage to physical, chemical, and biological integrity may be irreversible It is important to understand the Impervious Cover Model, a powerful model predicting quality of streams based on impervious cover change, is not without its limitations. (Schueler, 1994).

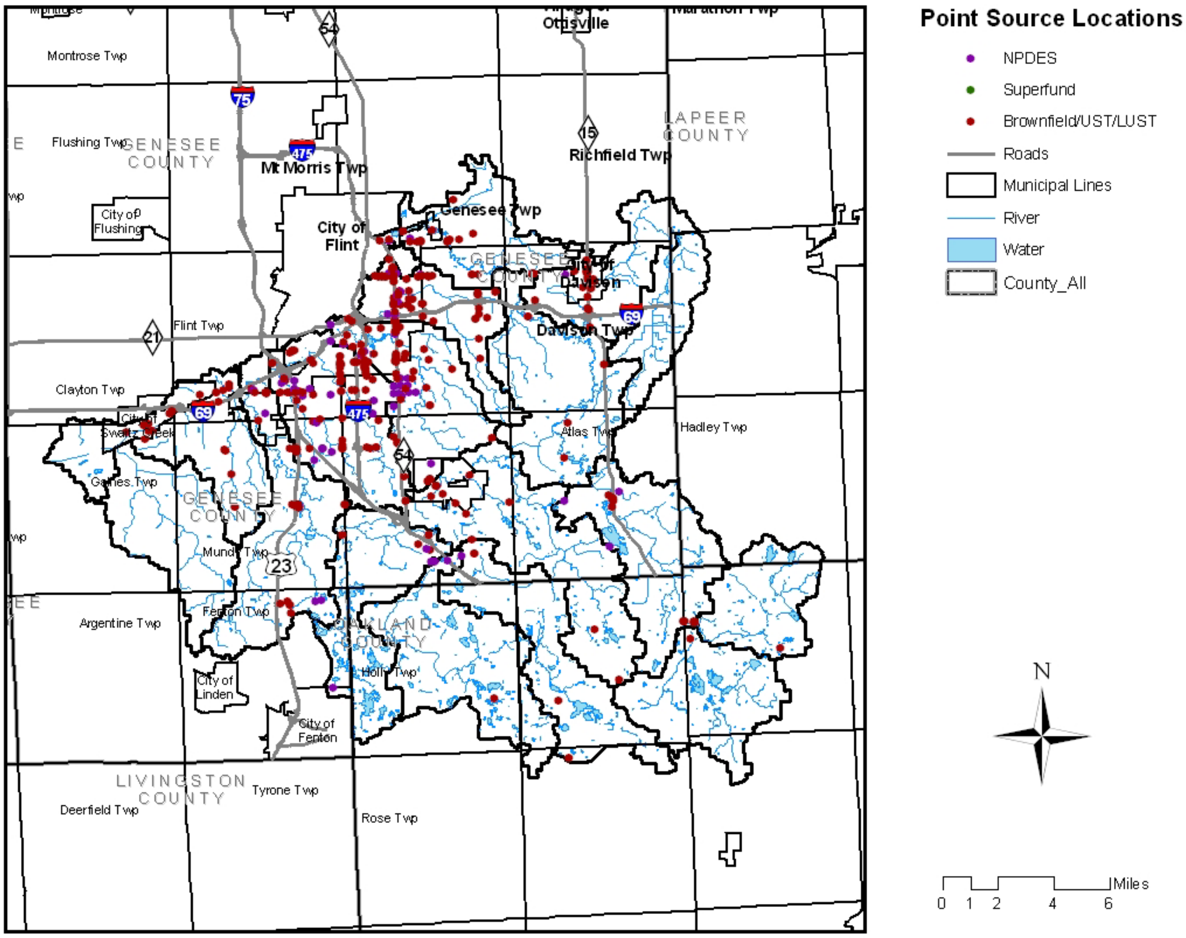


Figure 3-11 Point Sources

POINT SOURCES OF POTENTIAL POLLUTANTS

Table 3-5 Point Sources (in Appendix "A")

SEWER AND SEPTIC SYSTEM SERVICE AREAS

Wastewater is dealt with by either a system of sanitary sewers leading to a wastewater treatment plant or by on-site sewage disposal systems (OSDS). On-site sewage disposal systems typically include a septic tank and an absorption field. OSDS typically serve single-family residences in less urbanized settings, although community septic systems are becoming more common in newer developments. The Sewer Service Areas Map Figure 3-11 depicts the areas within the watershed that currently have access to sanitary sewers.

Within Genesee County the sanitary sewer systems has been predominantly constructed since 1960's. . This system has been extended into Oakland County to serve isolated developments, and also has been extended into Lapeer County around Potter Lake to help correct high e-coli levels from failed septic systems. The only other sanitary system within the Middle Flint River Watershed is operated by the Village of Holly has their own sanitary system.

If properly designed, constructed and maintained, both OSDS and sanitary sewers can provide for disposal of sewage in a safe and environmentally responsible manner. If either type of system fails, inadequately treated sewage can be a threat to aquatic ecosystems and human health due to harmful bacteria and excess nutrients. Along with regulation, education is often considered central to addressing potential issues with OSDS. Owners, particularly those moving from areas with sanitary sewers to those with OSDS, often have limited understanding of the functioning and maintenance of OSDS. This lack of knowledge can lead to poor function and premature failure, leading to contamination of the ground and surface waters. Several action items in chapter 8 have been proposed to address both sanitary and OSDS.

The installation and maintenance of septic systems within the watershed are regulated by the Health Departments of each County; however there is no system currently in place to monitor the functioning and maintenance of these systems following installation. A solution is proposed in section 8.

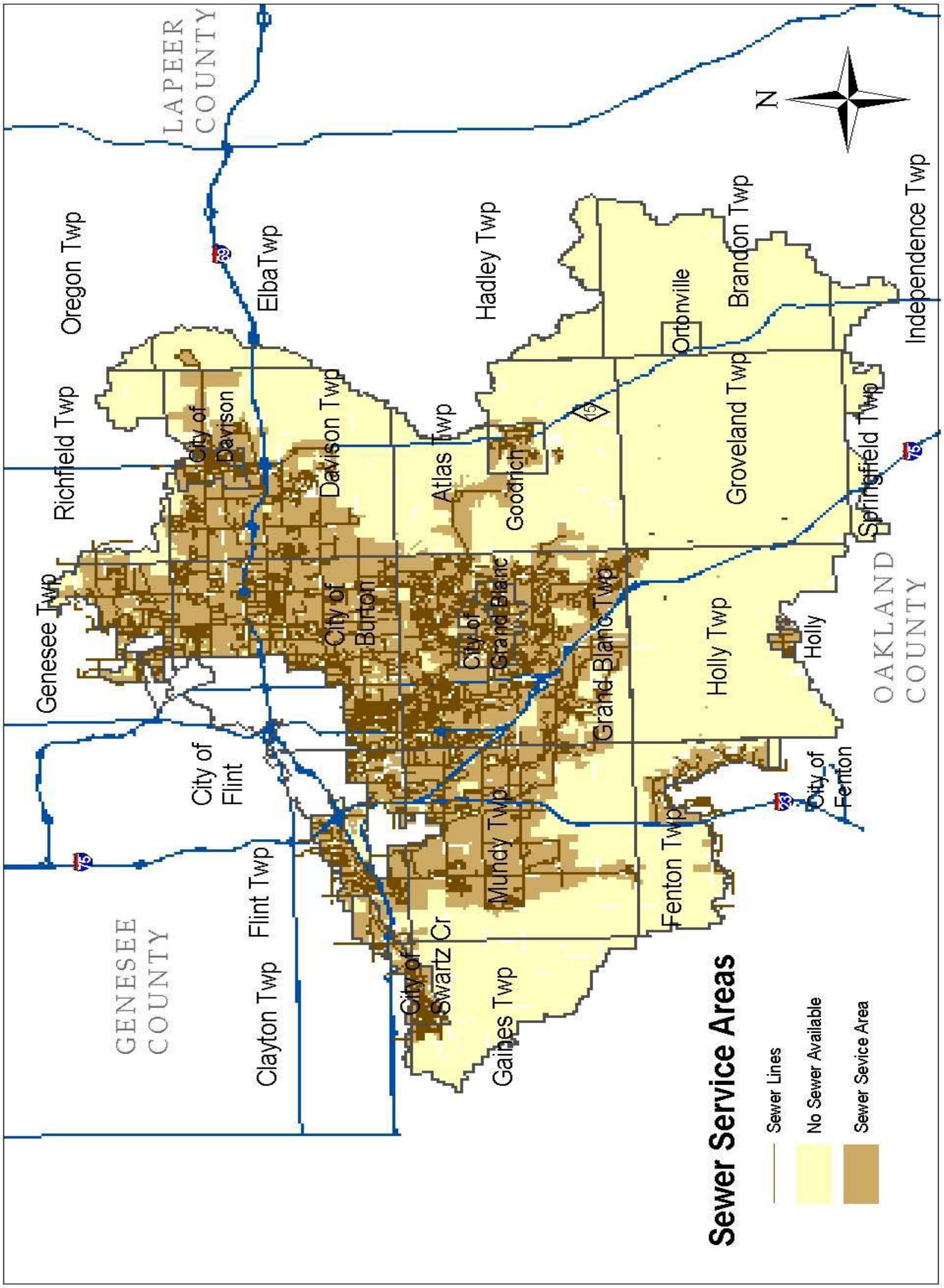


Figure 3-12 Sewer Service Areas

SIGNIFICANT NATURAL FEATURES TO BE PROTECTED

Michigan has a number of significant natural features located across the State. These natural features can provide a number of 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 Michigan Department of Natural Resources provides information on threatened and endangered species in Michigan by watershed. This work is coordinated by the Michigan Natural Features Inventory.

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.

A review of the Michigan Natural Features Inventory did not show any occurrence of species of plants or animals, which are listed as threatened, endangered, or of special concern within the Middle Flint River Watershed.

Table 3-6 shows the species of plants and animals, which are listed as threatened, endangered, or of special concern. Since the watershed has experienced urbanization and population growth, certain types of land are less common than in the past. In order to protect these areas and species, sensitive areas in the watershed have been identified.

Threatened and endangered species information was taken from the Michigan Natural Features Inventory. Those animals/plants listed above are within the Middle Flint River Watershed. Most of the above animals/plants are found in southern Genesee and Oakland Counties.

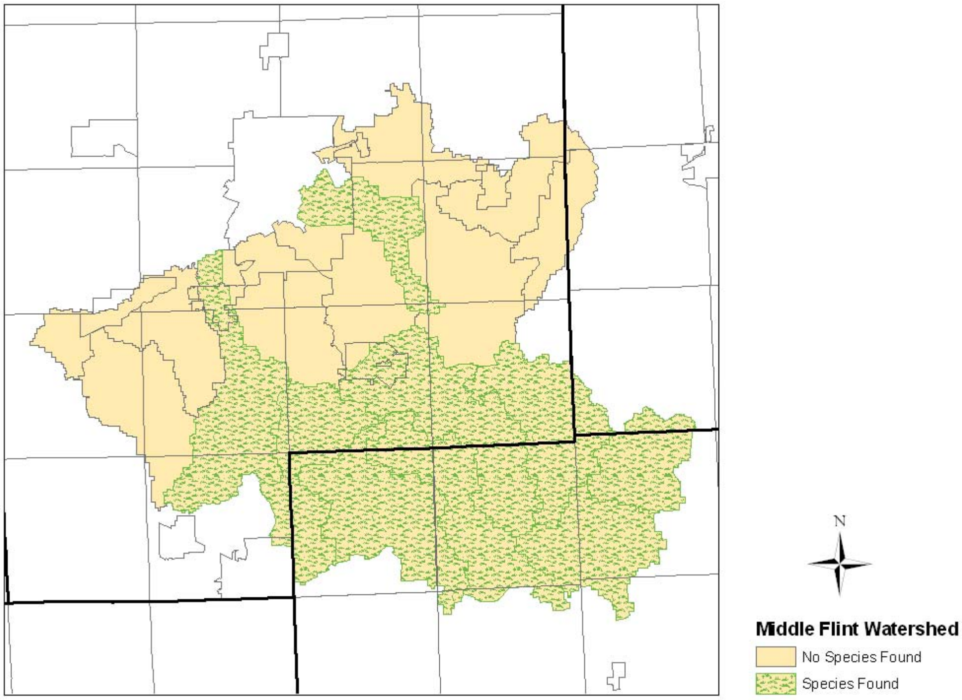


Figure 3-13 Natural Features Area(s)

Table 3-6 Threatened and Endangered Species

Scientific Name	Common Name	Federal Status	State Status
Astragalus neglectus	Cooper's Milk-vetch		SC
Buteo lineatus	Red-shouldered Hawk		T
Calephelis mutica	Swamp Metalmark		SC
Carex lupuliformis	False Hop Sedge		T
Carex richardsonii	Richardson's Sedge		SC
Cypripedium candidum	White Lady-slipper		T
Emys blandingii	Blanding's Turtle		SC
Falco peregrinus	Peregrine Falcon		E
Flexamia huroni	Huron River Leafhopper		SC
Isotria verticillata	Whorled Pogonia		T
Jeffersonia diphylla	Twinleaf		SC
Linum sulcatum	Furrowed Flax		SC
Muhlenbergia richardsonis	Mat Muhly		T
Oarisma poweshiek	Poweshiek Skipperling		T
Panicum microcarpon	Small-fruited Panic-grass		SC
Platanthera ciliaris	Orange or Yellow Fringed Orchid		T
Platanthera leucophaea	Prairie Fringed Orchid	LT	E
Potamogeton vaseyi	Vasey's Pondweed		T
Scirpus torreyi	Torrey's Bulrush		SC
Sistrurus catenatus catenatus	Eastern Massasauga	C	SC
Wilsonia citrina	Hooded Warbler		SC

(Source: Michigan Natural Features Inventory)

Key: SC = Special Concern E = Endangered T = Threatened
PE = Proposed Endangered C2/C3 = Candidate

SECTION 4 - WATER QUALITY INDICATORS

RIVERINE HABITAT STUDIES

Fisheries Studies

The original fish communities of the Great Lakes region are of recent origin. Melt water from the Wisconsinan glacier created aquatic environments for fish. Original fish gained access through migration from connecting waterways. A description of the fish community in the Flint River Watershed at the time of European settlement (early 1800's) is not available. However anecdotal accounts of the time mention several species. Surveys on the Flint River and several tributaries in 1927 provide a reasonable account for additional indigenous fish species (MDNR, Fishery Division). Seventy-seven species are believed to indigenous to the Flint River Watershed. The Original fish habitat of the Flint River watershed has been greatly altered by human settlement. The 1900's gave rise to the industrial era and the urbanization of the Flint River watershed. City's and towns located near the river became more developed as their population increased. The discharge of human wastes and synthetic pollutants into the river degraded water quality to the extent that only the most tolerant fish species could survive. Dams were built for flood control, flow augmentation, and water supply to municipalities and industry. The biologic communities in the Flint River and its tributaries have improved significantly since the 1970's with water quality improvements. Continued efforts to improve water quality will most probably result in greater biological integrity. Although 77 species of fish remain present, at least 5 fish species that once used the Flint River for spawning (lake sturgeon, muskellunge, lake trout, lake herring, lake whitefish) are believed extirpated from the river. The status of 8 other fish species remains unknown. Present day biological communities must adapt to human alteration of the watershed. The geological and hydrological characteristics of the watershed and the development of an extensive drainage system result in an unstable flow and reduce habitat and only biological communities that can adapt will persist. Management options are available to minimize stream degradation and preserve biological integrity.

Fish communities have been altered through intentional and inadvertent introduction of exotic species. Fish stockings by the MDNR, Fisheries Division has focused on improving recreational fishing opportunities. In the early 1920's, many headwaters tributaries were stocked with brook trout. Although brook trout are indigenous to Michigan, no evidence exists to suggest they were native to the Flint River. Brown trout stocking in the Kearsley and Thread Creeks continue as successful recreational fishery programs. No other non-indigenous species introduction has altered or affected the Flint River watershed fish communities like the common carp. This exotic was first introduced into Michigan waters in 1885 and spread rapidly.

Advisories to limit the consumption of certain fish species and sizes (fish contaminant advisories [FCAs]) have been published by MDEQ and the Michigan Department of Community Health for portions of the Flint River and the Thread Creek. All inland lakes, reservoirs, and impoundments within the State of Michigan are also under a fish advisory for mercury contamination. The latter is a general advisory applied to all inland lakes in Michigan since not all inland lakes, reservoirs, and impoundments have been tested or monitored. Table 4-1 lists the FCAs published for watershed.

Table 4-1 Fish Advisory Information

Water Body	Location	Fish Species	Restricted Population	Restriction
Flint River	Holloway Reservoir	Channel Catfish	Women and children	One meal per month
Thread Creek	Thread Lake	Carp	General population	One meal per week
			Women and children	<14 inches - One meal per month
			Women and children	14-22 inches – 6 meals per year
Flint River	Downstream of City of Flint	Carp	Women and children	<30 inches - One meal per month
All inland lakes, reservoirs, and impoundments	Entire watershed	Crappie	General population	8-22inches - One meal per week
			Women and children	8-22 inches - One meal per month
All inland lakes, reservoirs, and impoundments	Entire watershed	Largemouth and Smallmouth Bass	General population	14-30+ inches - One meal per week
			Women and children	14-30+ inches - One meal per month
All inland lakes, reservoirs, and impoundments	Entire watershed	Muskellunge	General population	30+ inches - One meal per week
			Women and children	30+ inches - One meal per month
All inland lakes, reservoirs, and impoundments	Entire watershed	Northern Pike	General population	22-30+inches - One meal per month
			Women and children	22-30+ inches - One meal per month
All inland lakes, reservoirs, and impoundments	Entire watershed	Rock Bass	General population	8-18 inches - One meal per week
			Women and children	8-18 inches - One meal per month
All inland lakes, reservoirs, and impoundments	Entire watershed	Walleye	General population	14-30+ inches - One meal per week
			Women and children	14-30+ inches - One meal per month
All inland lakes, reservoirs, and impoundments	Entire watershed	Yellow Perch	General population	8-18 inches - One meal per week
			Women and children	8-18 inches - One meal per month

* Michigan Department of Community Health, 2001. Michigan 2001 Fish Advisory., Michigan 2001 Flint River Assessment

Macroinvertebrate Studies

In the spring of 1999 the Flint River Watershed Coalition (FRWC) and the Center for Applied Environmental Research (CAER) at UM-Flint established a twice-yearly volunteer monitoring program for the Flint River watershed. The program was funded originally by a grant from MDEQ. Benthic monitoring assesses the quality of the Flint River watershed and educates the public. The volunteer monitoring program uses trained volunteers to gather information about the relative health of the areas stream and rivers. In the past five years over 100 volunteer monitors have participated in the program. The volunteers have helped to build awareness of pollution problems, been trained in pollution prevention, provided valuable data for waters that may otherwise be unassessed, and increased the amount of water quality information available to citizens and decision makers. The data collected thus far has been used to characterize various watersheds, screen for water quality problems, and measure existing conditions and trends.

The major element of the program is the collection and analyzing of benthic macroinvertebrates at 30 locations across the whole **Flint River Watershed**, 8 of those sites are within the Middle Flint River Watershed. Invertebrates are valuable subjects for water quality studies because they stay put. They are not very mobile and unlike fish they cannot move to avoid pollution. Using these creatures to identify water quality conditions is based on the fact that every species has a certain range of physical and chemical conditions in which it can survive. The kinds of benthic invertebrates living in a stream indicate conditions within the stream because they cannot migrate to a different location if conditions are not conducive to survival. Some organisms can survive in a wide range of conditions and are more tolerant of pollution, and so are labeled "**tolerant**". Other species are very sensitive to changes in conditions and are "**intolerant**" of pollution. These are labeled "**sensitive**". The presence of tolerant organisms and few or no sensitive organisms indicates the presence of pollution, because pollution tends to reduce the number of species in a community by eliminating the organisms that are sensitive to changes in water quality.

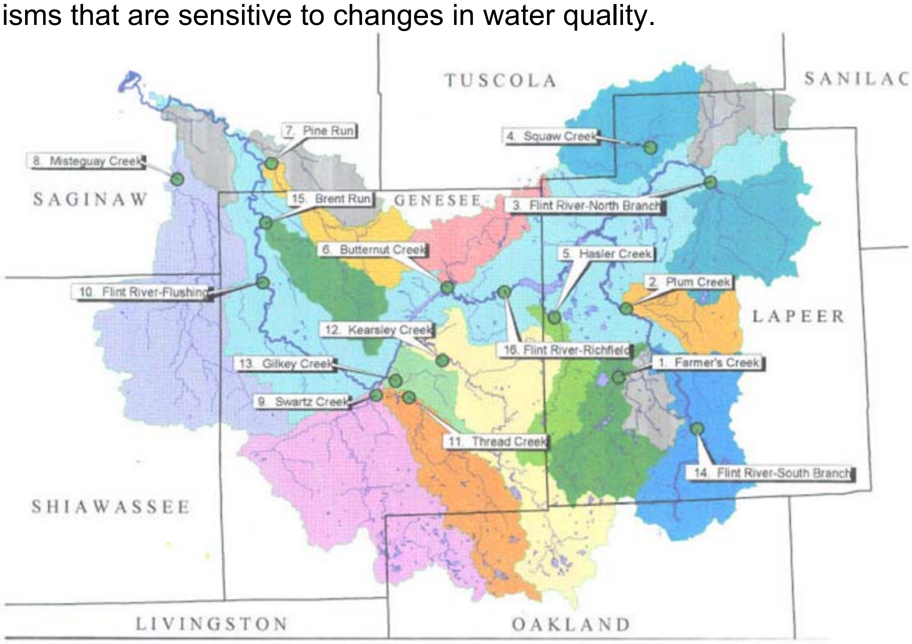


Figure 4-1 Flint River Watershed

Table 4-2 Benthic Monitoring Results

Site/Location	Jun 1999	Sep 1999	May 2000	Oct 2000	Apr 2001	Oct 2001	Apr 2002
Brent Run Montrose Twp	43.3 Good	38.6 Good	31.8 Fair	33.4 Fair	33.6 Fair	38.6 Good	38.1 Good
Brent Run Headwaters Mt. Morris Twp	N/M	20.2 Fair	17.2 Poor	10.2 Poor	N/M	N/M	N/M
Butternut Creek Genesee Twp	31.5 Fair	10.5 Poor	39.4 Good	N/M	39.9 Good	49.4 Excellent	26.6 Fair
Butternut Creek, Headwaters Forest Twp	N/M	N/M	42.8 Good	N/M	47.9 Good	34.7 Good	49.2 Excellent
Flint River, Flushing Twp	N/M	34.8 Good	26.0 Fair	N/M	27.5 Fair	N/M	29.5 Fair
Flint River, Richfield Twp	41.1 Good	41.6 Good	43.0 Good	22.4 Fair	16.5 Poor	29.9 Fair	26.5 Fair
Gilkey Creek City of Flint	29.5 Fair	11.2 Poor	13.3 Poor	18.8 Poor	5.1 Poor	15.3 Poor	9.5 Poor
Gilkey Creek Headwaters Burton Twp	N/M	N/M	N/M	N/M	N/M	N/M	N/M
Kearsley Creek Burton Twp	23.5 Fair	36.5 Good	N/M	N/M	23.2 Fair	N/M	42.0 Good
Kearsley Creek Headwaters Atlas Twp	N/M	21.2 Fair	10.1 Poor	32.6 Fair	40.8 Good	43.5 Good	49.7 Excellent
Misteguay Creek Headwaters Clayton Twp	N/M	32.0 Fair	40.0 Good	N/M	N/M	N/M	N/M
Pine Run Headwaters Vienna Twp	N/M	22.7 Fair	39.5 Good	N/M	N/M	N/M	N/M
Swartz Creek Flint Twp	26.9 Fair	5.1 Poor	11.3 Poor	41.5 Good	15.0 Poor	10.2 Poor	11.2 Poor
Swartz Creek Headwaters Fenton Twp	N/M	30.4 Fair	25.7 Fair	51.0 Excellent	N/M	N/M	N/M
Thread Creek Burton Twp	23.2 Fair	33.4 Fair	11.2 Poor	N/M	24.3 Fair	28.3 Fair	37.5 Good
Thread Creek Headwaters Grand Blanc Twp	N/M	41.7 Good	44.1 Good	46.8 Good	40.8 Good	37.3 Good	48.8 Excellent

Oct 2002	Apr 2003	Oct 2003	Apr 2004	Oct 2004	Apr 2005	Oct 2005	Apr 2006
53.0 Excellent	28.8 Fair	10.1 Poor	N/M	N/M	31.9 Fair	30.3 Fair	35.3 Good
N/M	N/M	N/M	4.3 Poor	N/M	30.1 Fair	N/M	26.7 Fair
45.0 Good	40.5 Good	45.0 Good	33.4 Fair	38.0 Good	40.2 Good	35.5 Good	36.3 Good
24.8 Fair	43.4 Good	31.0 Fair	38.2 Good	46.4 Good	45.5 Good	51.6 Excellent	60.9 Excellent
N/M	40.1 Good	24.5 Fair	26.8 Fair	40.0 Good	34.1 Good	N/M	27.2 Fair
N/M	28.2 Fair	24.7 Fair	26.3 Fair	N/M	23.4 Fair	N/M	N/M
23.8 Fair	11.3 Poor	4.4 Poor	16.4 Poor	N/M	15.6 Poor	17.5 Poor	19.4 Fair
24.5 Fair	N/M	30.9 Fair	N/M	35.8 Good	44.2 Good	N/M	34.8 Good
43.2 Good	54.0 Excellent	N/M	32.1 Fair	N/M	17.2 Poor	N/M	35.2 Good
18.1 Poor	N/M	31.2 Fair	N/M	N/M	26.4 Fair	N/M	N/M
N/M	N/M	N/M	35.5 Good	27.0 Fair	30.1 Fair	N/M	15.4 Poor
N/M	18.1 Poor	N/M	35.7 Good	N/M	19.3 Fair	N/M	25.6 Fair
18.5 Poor	30.8 Fair	N/M	9.4 Poor	N/M	40.6 Good	N/M	31.7 Fair
11.3 Poor	18.4 Poor	N/M	33.6 Fair	N/M	N/M	30.4 Fair	30.4 Fair
33.4 Fair	19.4 Fair	17.2 Poor	23.4 Fair	N/M	19.3 Fair	24.1 Fair	12.2 Poor
N/M	37.8 Good	21.2 Fair	31.5 Fair	N/M	22.2 Fair	N/M	40.0 Good

Source: Flint River Watershed Coalition
N/M: Not Monitored

Water testing with Project GREEN

Global Rivers Environmental Education Network (GREEN) is a curriculum based, mentored program designed to propose solutions to local environmental problems using water quality testing. This project has been in existence for fourteen years in Genesee County under the direction of the Genesee County Intermediate School District (GISD). In late 2003 the Flint River Watershed Coalition was approached by Earth Force Green and General Motors to be the coordinator of the GREEN in the Flint River Watershed. FRWC was identified as the primary organization that could help improve program participation and effectiveness because of its focus on water quality monitoring and environmental education. The FRWC Board of Directors has endorsed this vision and has agreed to take full administrative control over the next two years. In 2004 the Genesee County Drain Office on behalf of the Phase II program partnered with the FRWC with funding and mentors. In the spring of 2005 and 2006, Hundereds of students had a combination of class time and field experience on the local rivers. The students learned about water quality and testing procedures and went to various sites on the Flint River and tributaries to take water samples for the following indicators.

- Dissolved Oxygen
- Nitrates
- PH
- Fecal Coliform
- Temperature
- Total Solids
- Turbidity
- Total Phosphorus

By testing for the above indicators the students can compare the results to the "norm" and draw conclusions on the health of the water. Chemical testing is a snapshot of water health, and the results should not be taken alone. By using chemical testing and other water quality indicators such as benthic monitoring or photo/ physical observations, changes to the water can be shown.

Although the data has not compiled at this time within Genesee County there was 16 school (24 teachers) and hundreds of students that had the opportunity to participate.

E. Coli Water Sampling (Health Department or Local Agencies)

The following language from the Michigan Water Quality Standards regulates the allowable limits of *E. coli* bacteria in surface waters of the State:

> "R 323.1062 Microorganisms.
>
> Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 Escherichia coli (E. coli) per 100 milliliters, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of 3 or more samples taken at representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of 300 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sampling area.

(2) All waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples, taken during the same sampling event, at representative locations within a defined sampling area.”

The Genesee County Health Department performs Weekly e. coli test from May through September on the following water bodies within the Middle Flint River Watershed:

Thread Creek	Potter Lake
Kearsley Creek	Lake Helena
Lake Linda	Lake Shinagaug

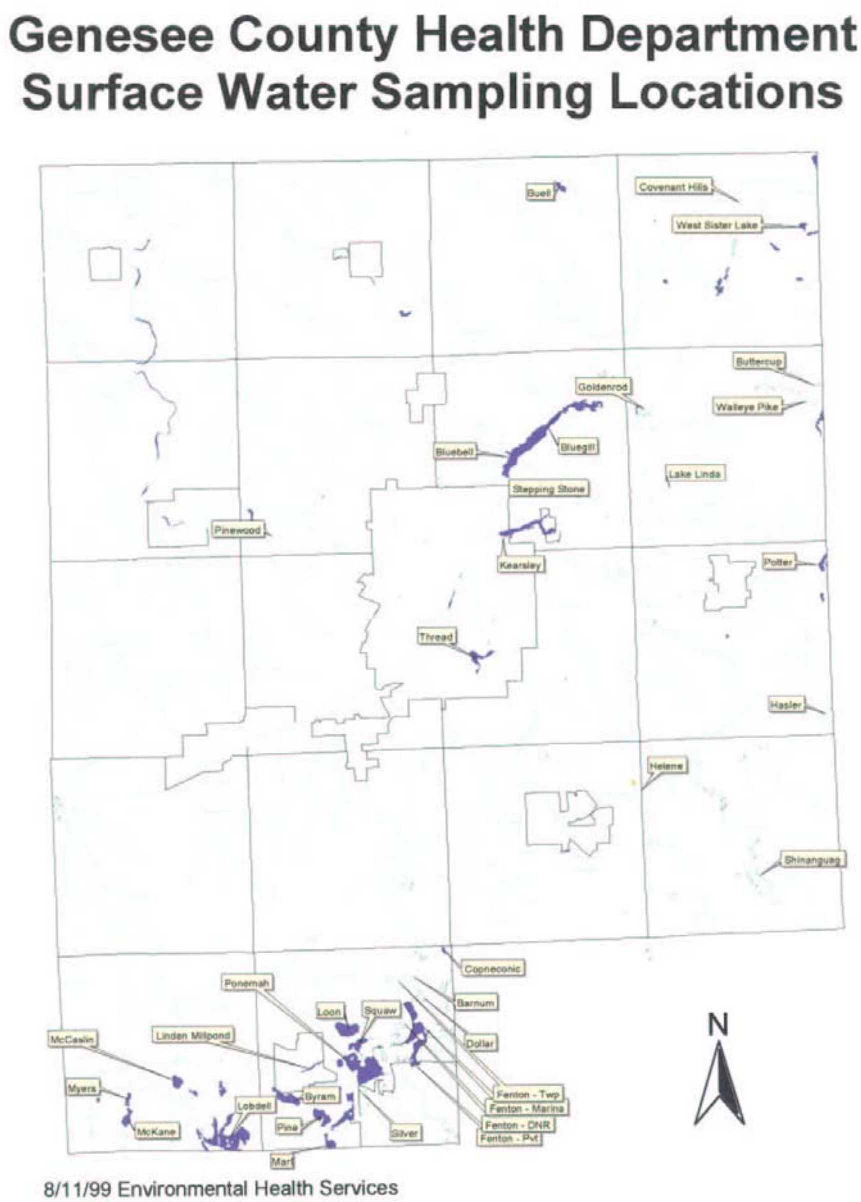


Figure 4-2 E. Coli Test Sites Within Genesee County

WATER CHEMISTRY AND HYDROLOGY STUDIES

Table 4-3 Michigan Section 303d TMDL Water Bodies

Water Body	**Observations and Conditions**	**Pollutants**	**Suspected Pollution Source**	**Expected TMDL Date**
Burdick Drain	Water tests	Pathogens Rule 100	Untreated sewage discharge	2004
Flint River	Water tests	FCA-PCB's	Historic	2010
Heron Lake	Fish Tissue	Mercury		2011
Potters Lake	Water tests	Pathogens Rule 100	Untreated sewage discharge	2004
Thread Creek	Water tests	FCA-PCB's	Historic	2010
Thread Creek & Thread Lake	Water tests	FCA-PCB's	Historic	2005

USGS Monitoring

There are 3 USGS stream gages within the Middle Flint River Watershed.

04148140 KEARSLEY CREEK	NE1/4 sec.12 City of Burton	October 1965 to current year.
04148300 SWARTZ CREEK	NW 1/4 sec. 26 City of Flint	January 1970 to December 1983 (operated as a continuous- record gauging station), October 1990 to current year operated as a crest-stage partial-record station.
04148440 THREAD CREEK	SE1/4 sec.28 City of Burton	January 1970 to December 1983 operated as a continuous-record gaging station, October 1990 to current year operated as a crest-stage gage partial-record station.

POLLUTANT LOAD ANALYSIS

The pollutant load analysis was conducted utilizing the Environmental Protection Agency's Spreadsheet Tool for Estimating Pollutant Loads (STEPL). Phosphorus, 5-day Biological Oxygen Demand (BOD), and sediment loadings were all calculated on a subwatershed basis, using this program. The methods used to calculate urban loadings of phosphorus, sediment, and BOD primarily utilized the runoff volume and land use specific pollutant concentrations for each Subwatershed to provide an average annual loading. Agricultural sediment calculations utilized the universal soil loss equation (USLE), widely used to calculate average annual soil losses from sheet and rill erosion (EPA, 2004). Phosphorus and BOD were calculated for agricultural areas by multiplying the soil load by a pollutant concentration for nutrients in the sediment. Graphical results of these calculations are presented in Figure 4-3 through Figure 4-5 and numerically in **Error! Reference source not found.**. In **Error! Reference source not found.** the top five unit area loadings are highlighted in yellow with the number one loadings bolded.

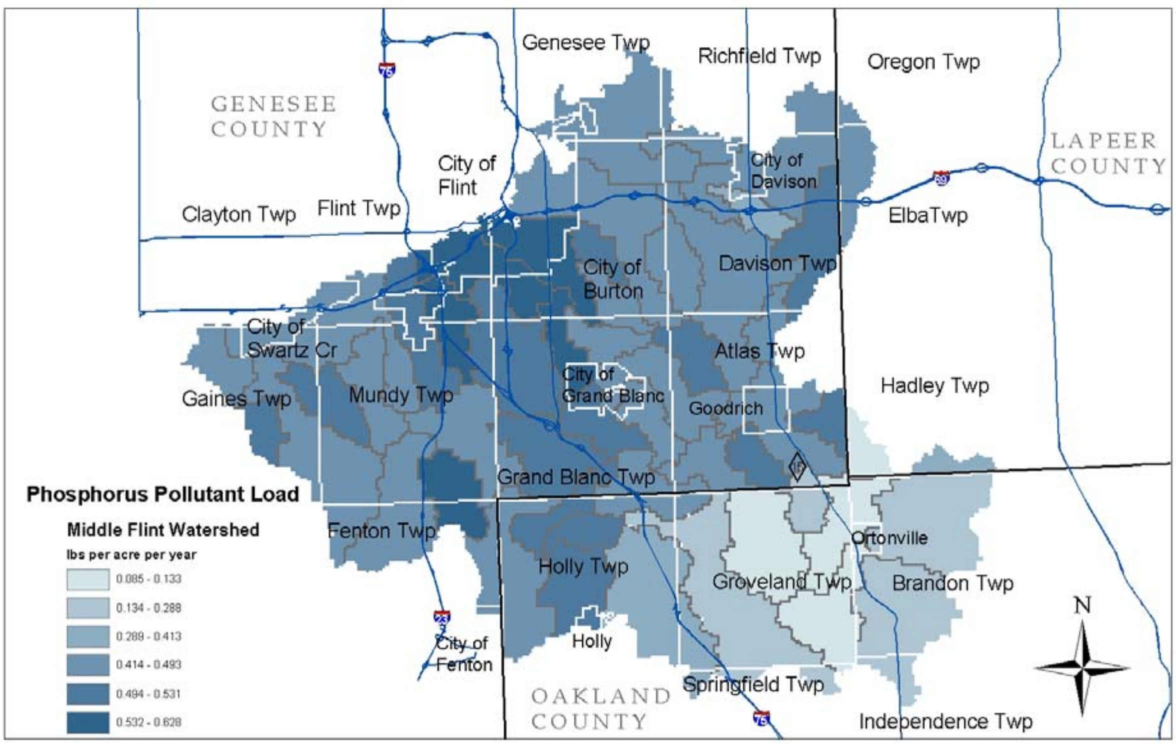


Figure 4-3 Phosphorus Pollutant Load

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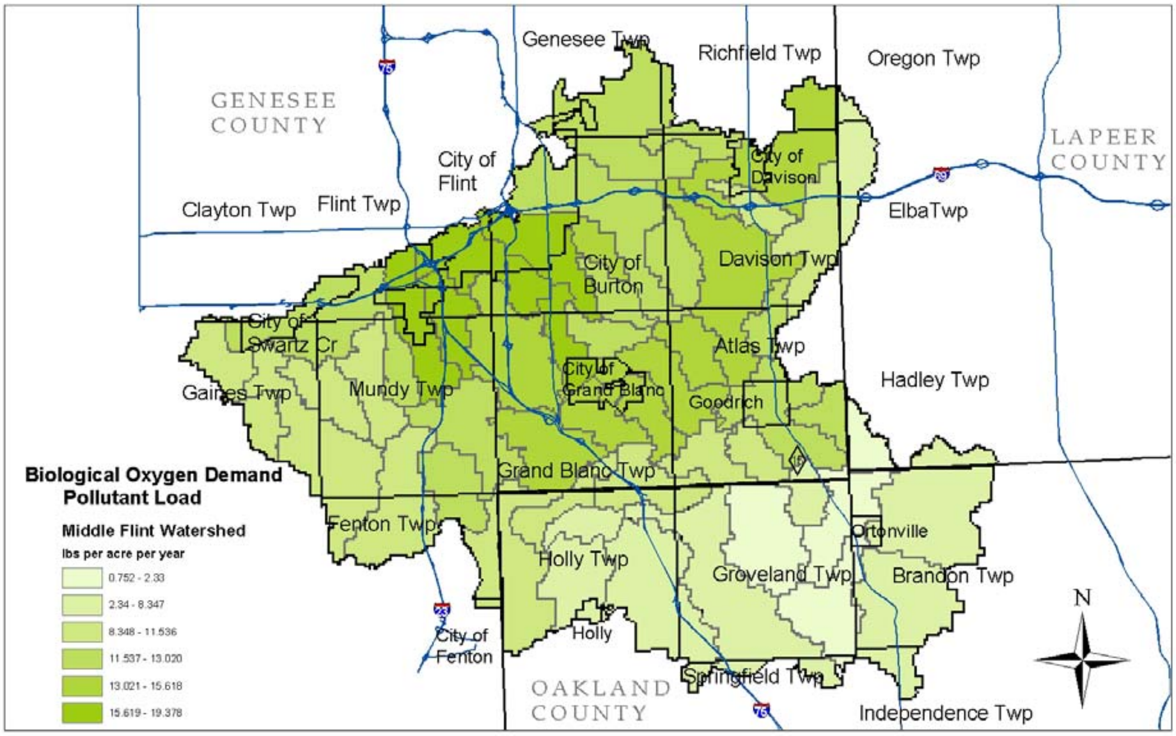

Figure 4-4 BOD Pollutant Load

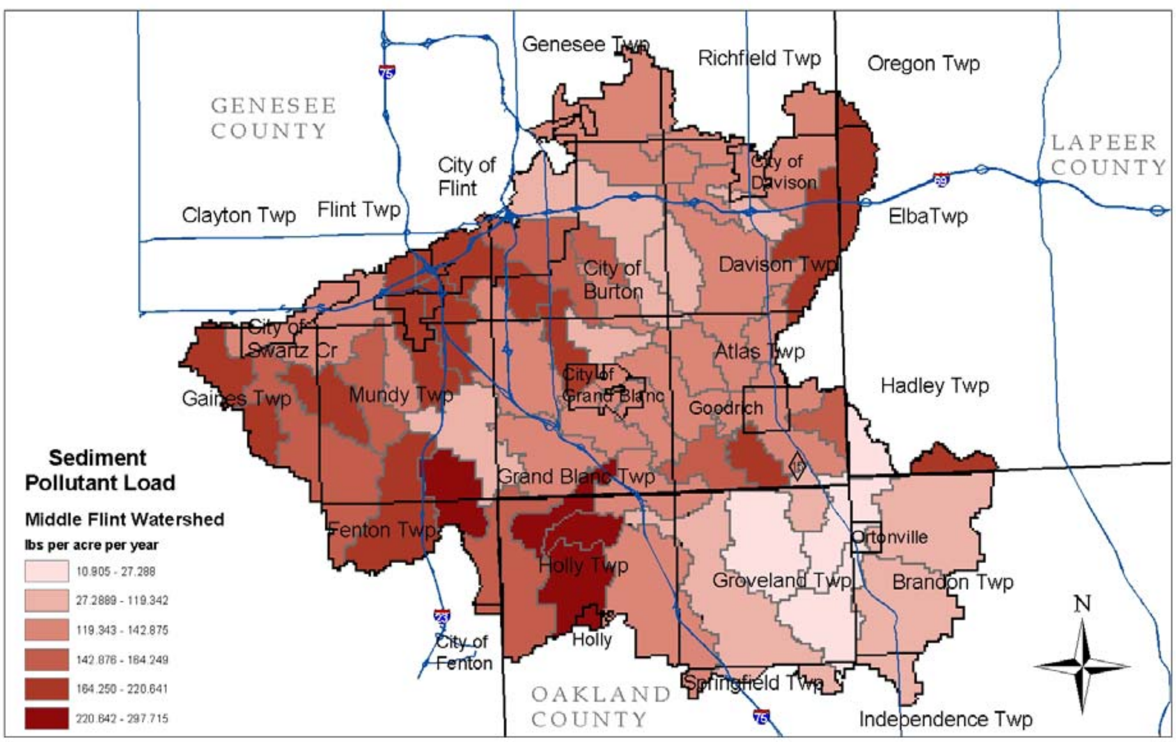

Figure 4-5 Sediment Pollutant Load