2 Description of the Middle Grand River Watershed

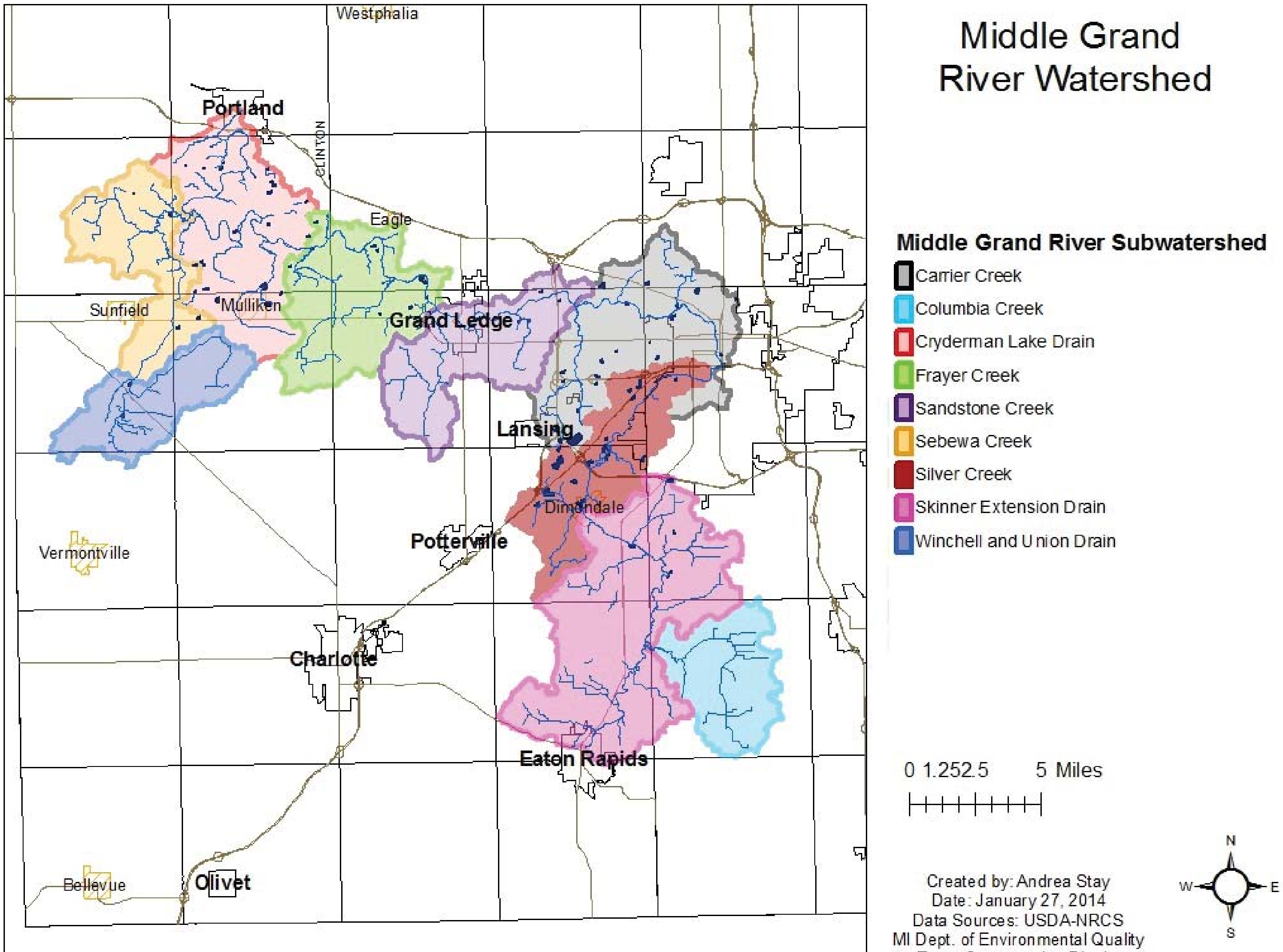
2.1 Watershed Characteristics

2.1.1 Geographic Scope

The Middle Grand River Watershed is approximately 258 square miles (165,000 acres) in Mid-Michigan's Eaton, Ingham, Clinton, and Ionia counties (Figure 2). The Middle Grand Watershed begins in Eaton Rapids and flows north, crossing back and forth the Ingham and Eaton county line, and then flows through downtown Lansing and Old Town. Just north of Old Town Lansing, the Grand River begins to flow westerly, crossing the Clinton and Eaton county line to Grand Ledge and continues westerly into the City of Portland in Ionia County. The Middle Grand River Watershed is one small subwatershed of the entire Grand River Watershed, which is the second largest watershed in Michigan (5,570 square miles). Nine HUC12 creeksheds (Columbia Creek, Skinner Extension Drain, Silver Creek, Carrier Creek, Sandstone, Frayer Creek, Winchell and Union Drain, Sebewa Creek, and Cryderman Lake Drain) compose the Middle Grand River Watershed (Figure 2).

The Watershed includes twenty-one local units of government that make decisions influencing the land uses, and subsequent water quality, of the Watershed. The Middle Grand River section is approximately 129 miles in stream length, has nine subwatersheds (HUC 12), and joins together the Upper Grand River and the Lower Grand River. Together, the entire Grand River Watershed, comprising the Upper, Middle, Lower, Red Cedar, Looking Glass, Thornapple, Flat, Rogue, and Maple rivers, make up the second largest watershed in Michigan. The Middle Grand River WMP is only one part of the entire Grand River Watershed; however, there are several nonpoint source pollutants that this section is contributing to the overall water quality of the Grand River and Lake Michigan.

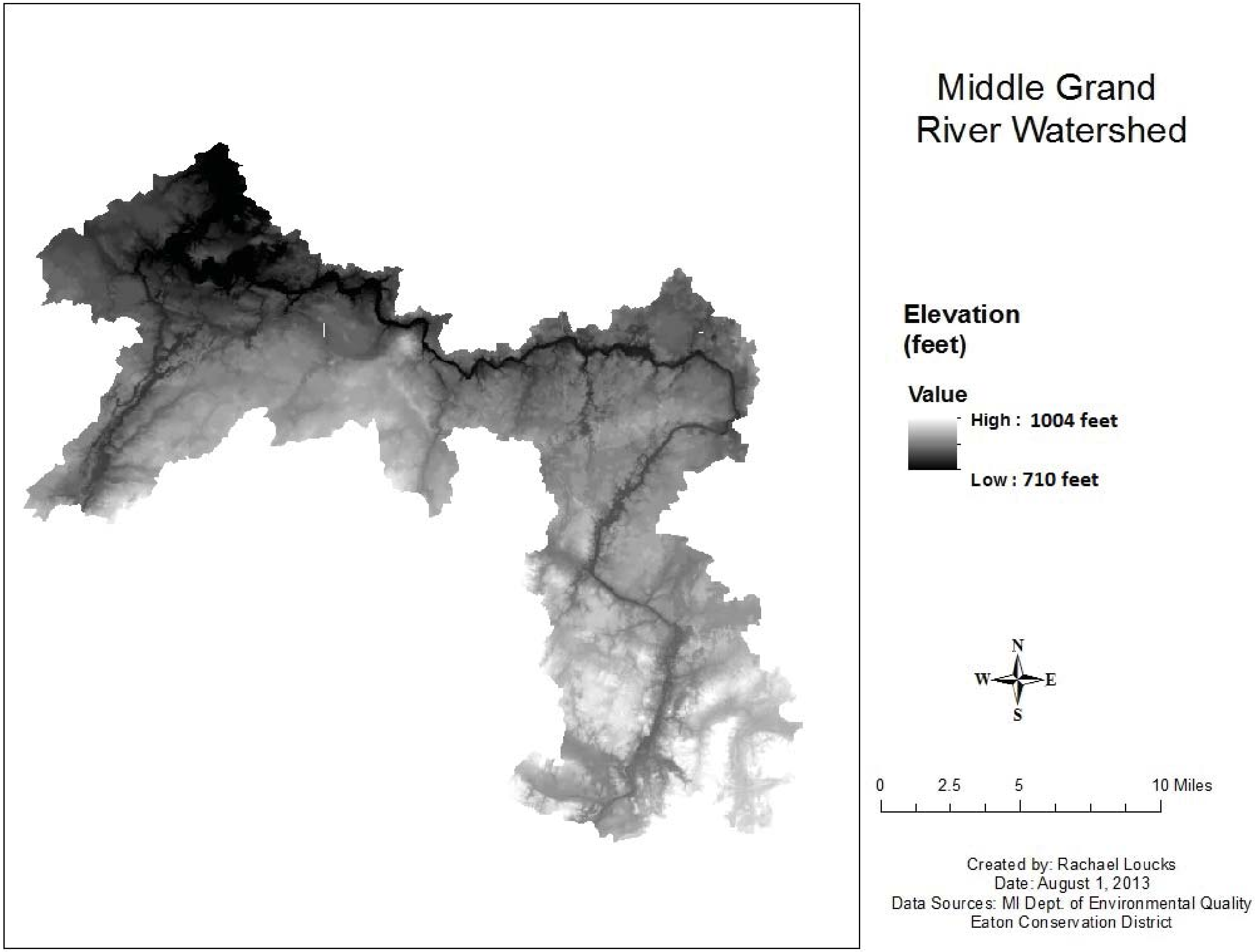
Figure 2. Middle Grand River Watershed Planning Area



2.1.2 Topography

The relief, or topography, across the watershed was created by movement of the glaciers. They left the Charlotte Morainic System, which consists of three ridges that begin in Kent County and continue southeasterly across Eaton County into Ingham County, where they diminish. Elevation in the watershed ranges from 710 to 1004 feet (Figure 3). Higher elevations are found in the south-east part of the watershed with lower elevations in the north-west portion. The local topography is described as ranging from nearly level to steep. However, the majority of the watershed is level to gently rolling slopes of 10% or less. Most of the steeper slopes occur in relation to extractive activities or the sandstone formations along the Grand River at Grand Ledge.

Figure 3. Elevation of the Middle Grand River Watershed



2.1.3 Soils

Soils in the watershed are a product of many influences: existing mineral parent material lain down by the glaciers; pre-settlement forest vegetation that grew in the watershed before it was logged and cleared; surface and groundwater action; wind; and in most recent times, human influences of using the soils for row crops, orchards, hay, pastures and other products and urban development.

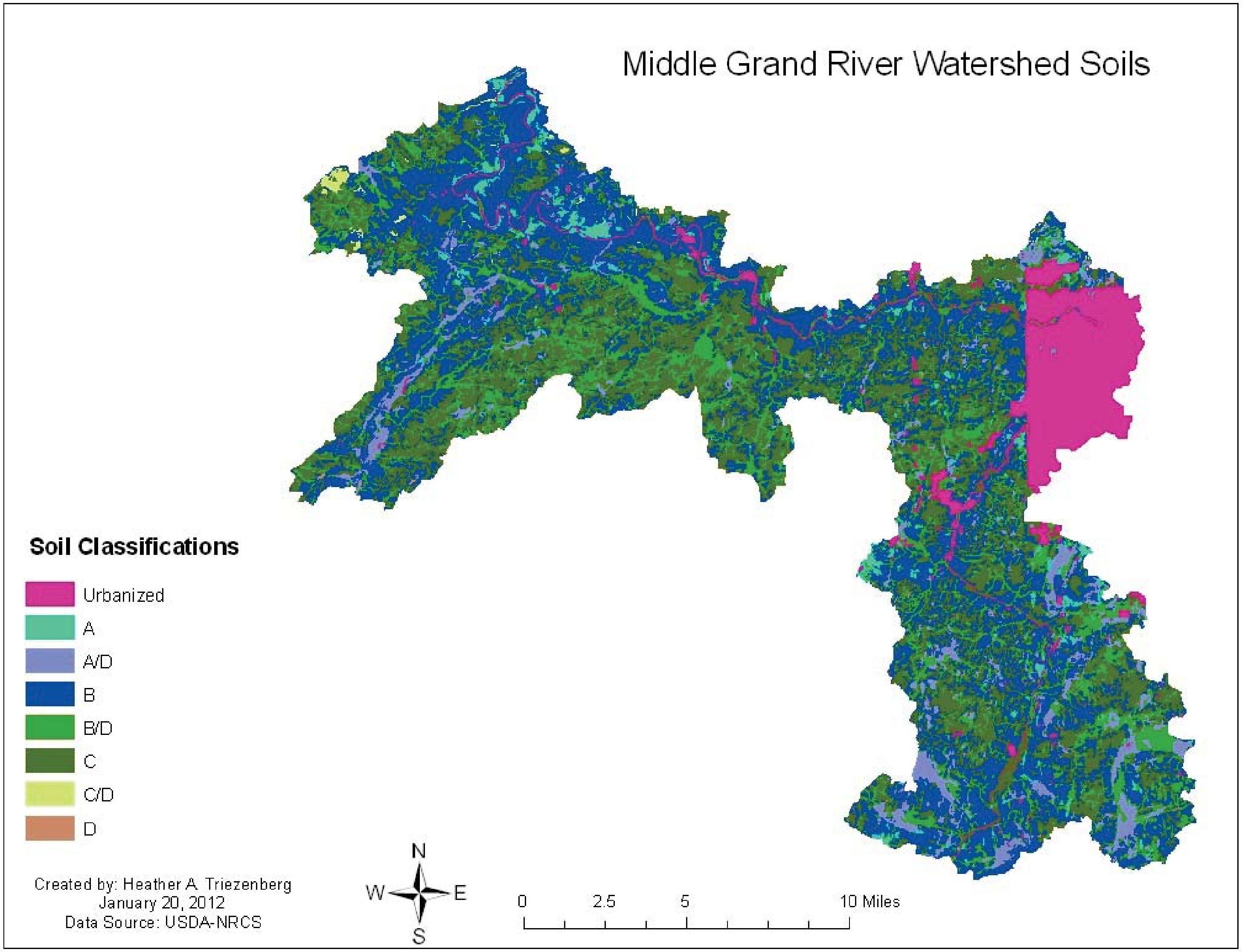
Soils are valuable natural resources and directly relate to water quality issues and concerns within the watershed. Soils that are impermeable create wetlands that store floodwaters, and help filter pollutants from stormwater runoff before it reaches rivers and streams. Soils infiltrate precipitation and recharge underground aquifers, a main source of drinking water.

The Watershed is primarily a mixture of groups B, B/D and C soils (Table 3 and Figure 4). Soils in the Watershed have a moderately low runoff potential unless thoroughly wet due to rainfall. In rainfall conditions the soils have a higher runoff potential. Areas in the Watershed with higher rates of groups C and/or D soils do not allow for the water to move down through the soil as readily. This increases the likelihood of runoff in a rain event carrying with it potential pollutants.

Table 3. Hydrologic Soil Groups in the Watershed

Hydrologic Soil Group	Total Acres	Percent in Watershed
No Data	15,099.40	9.2%
A	3,288.30	2.0%
A/D	8,300.40	5.0%
B	70,335.74	42.6%
B/D	25,299.75	15.3%
C	41,977.05	25.5%
C/D	518.11	0.3%
D	101.33	0.1%
Total	164,920.08	100.0%

Figure 4. Soil types of the Middle Grand River Watershed.



Hydrologic soil types defined by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) (2007):

- Group A –Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures.
- Group B -Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. Group B soils typically have between 10 and 20 percent clay and 50 percent to 90 percent sand and have loamy sand or sandy loam textures.
- Group C –Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures.
- Group D –Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures

When soils are classified with two groups (e.g., A/D), the first letter represents the artificially drained condition, and the second letter represents the soil's natural drainage condition. For example, if a Group D soil is artificially drained with a resulting hydrologic characteristic of a Group A soil, the soil would be classified as a Group A/D soil.

2.1.4 Geology

The Middle Grand River Watershed geology was created by glacial activity during late Wisconsin time (35,000-10,000 years before present). Glacial eskers are present in northern Ingham County and northeastern Eaton County. Glacial deposits vary in the region from 10 feet to over 300 feet (USDA Soil Survey, 1978). These glacial deposits are composed of silt, sand, clay, and gravel. The ledges of Grand Ledge are composed of exposed bedrock.

Groundwater flow in this region travels from south to north and towards surface water. A majority of the region relies on groundwater from the Saginaw aquifer, with a small portion of the region depending on shallow wells in glacial outwash. Due to the bedrock aquifer source, the water is generally hard to very hard and includes Iron deposits.

The bedrock geology of the Watershed is largely characterized by the Saginaw Formation (Figure 5). In the northwestern portion of the Watershed there is a pocket of the Grand River Formation (Figure 5). Bayport Limestone and Michigan Formation are found in the southwestern area of the Watershed (Figure 5).

The quaternary geology of the Watershed is largely characterized by medium textured glacial till (Figure 6). Pockets of glacial outwash sand and gravel and post glacial alluvium and end moraines of medium textured till are scattered throughout the Watershed (Figure 6).

Figure 5. Middle Grand River Watershed Bedrock Geology

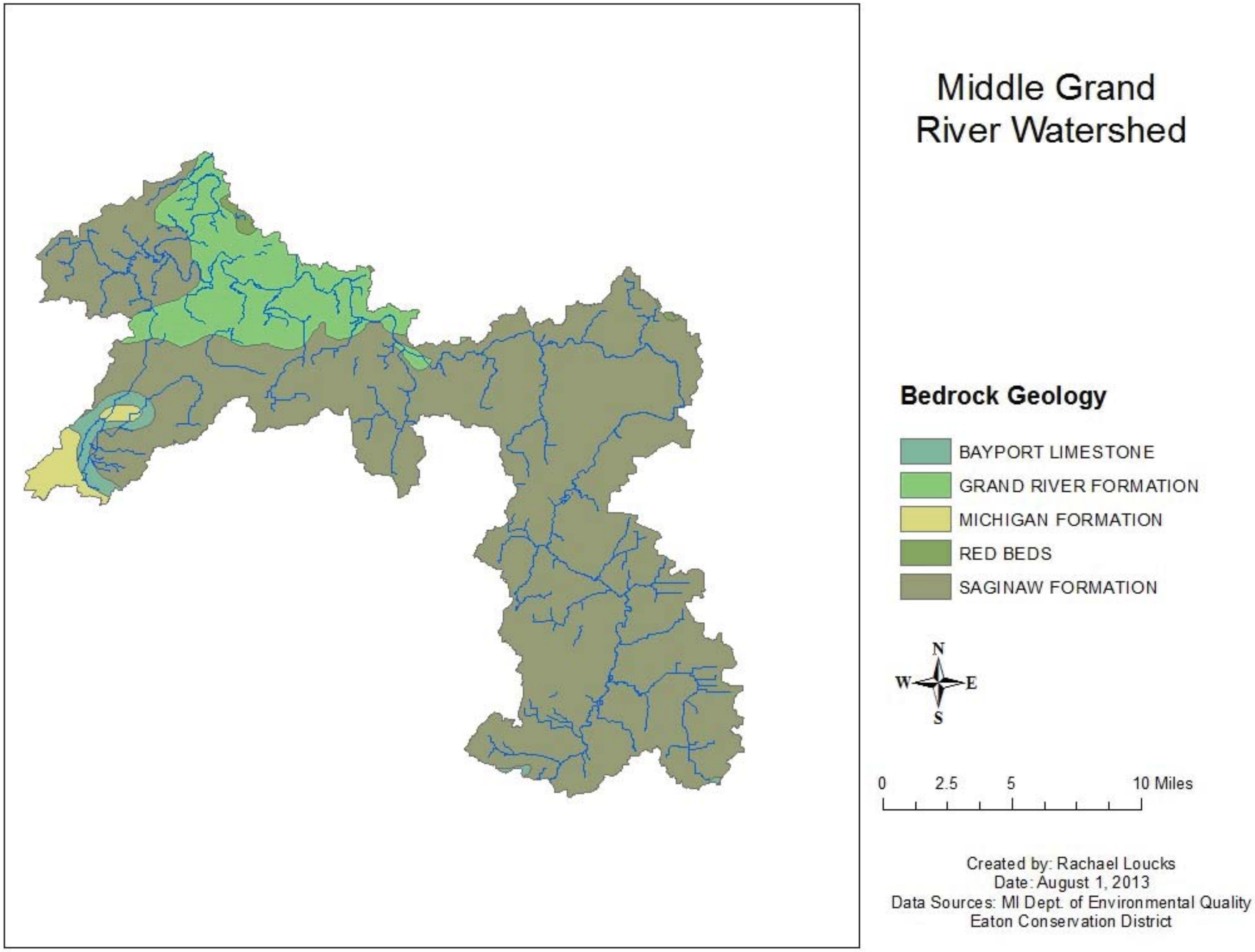
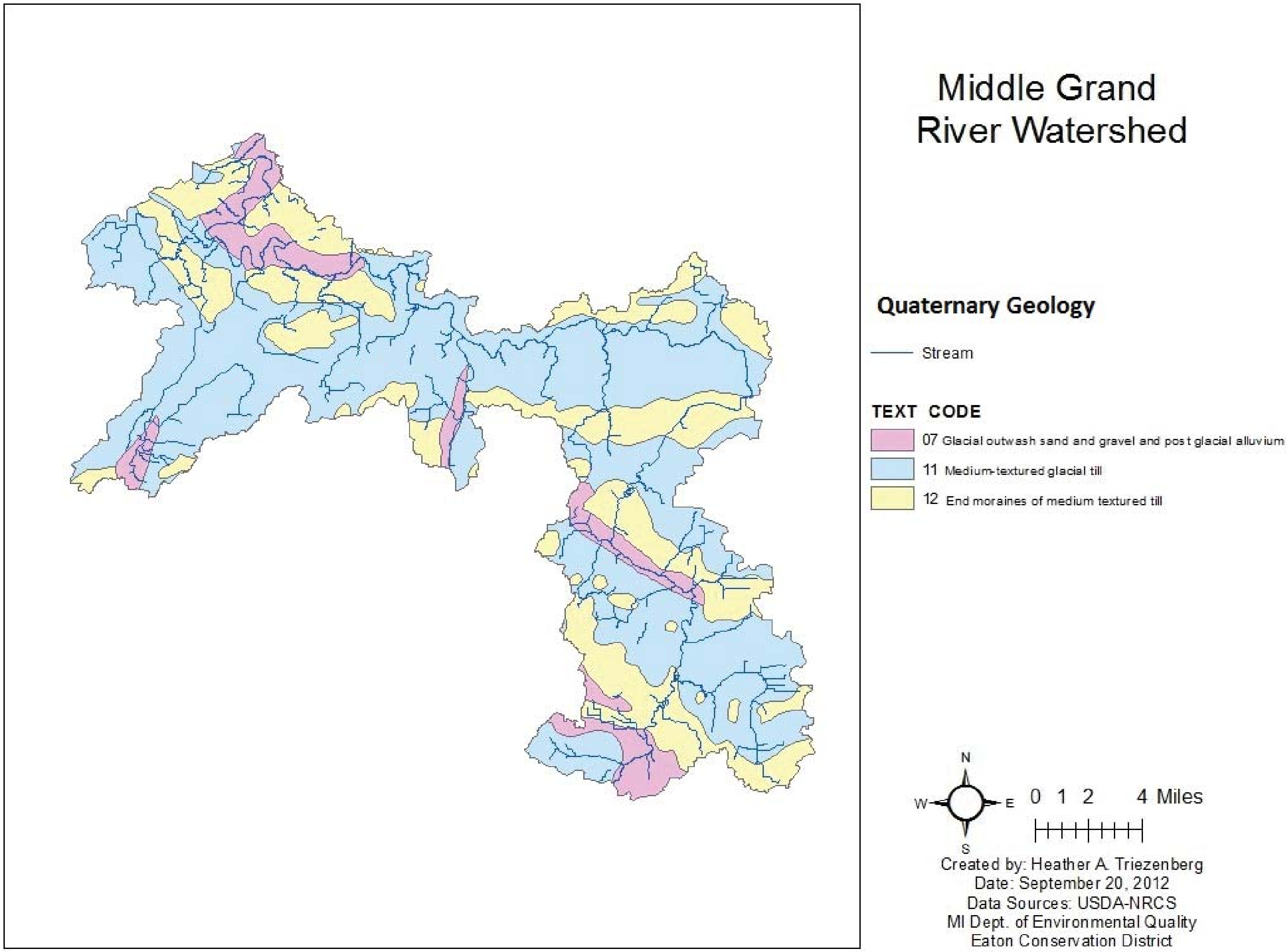


Figure 6. Middle Grand River Watershed Quarternary Geology



2.1.5 Hydrology

A hydrology study for the Watershed has not been conducted to date. Hanshue and Harrington have described portions of the Watershed in their Draft Grand River Assessment (Michigan Department of Natural Resources, Fisheries Division, 2011).

The mainstem catchment area at the Eaton Rapids gauging station is approximately 660 square miles and includes the discharges of several tributaries: Portage River, Perry Creek, Huntoon Creek, Sandstone Creek, and Spring Brook. The headwaters of these tributaries have been modified to promote drainage of the fine-textured soils for agricultural land use; here the mainstem is slightly flashier.

Carrier Creek, an urban stream in the City of Lansing, displays unstable flow patterns. This stream is one of the flashiest gauged tributaries in the Watershed. Groundwater loading to Carrier Creek is the lowest in the Watershed. There are extreme high and low flows which are likely a result of the surrounding urban land use.

Grand River streamflow is monitored at two locations in the middle segment: downstream of the Red Cedar River confluence in City of Lansing and upstream of the confluence with the Looking Glass River near the City of Portland. Baseflow at these locations is slightly less than measured in the headwater and upper segments. The mainstem at the Lansing gauge location shows the least stable flow patterns. As the river nears the Portland gauge the mainstem begins to descend toward the elevation of the former glacial river valley. As slope increases, groundwater loadings begin to increase as the geology becomes coarser.

2.1.6 Climate

The average annual high temperature is 56.9° Fahrenheit, and the average low temperature is 36.7° Fahrenheit, as reported by the National Weather Service. However, they also report that 2007 was the 12th warmest year since 1895 (past 113 years), and seven of the past 10 years are in the top 20 warmest on record for southwest Michigan.

Precipitation (rain) averages 31.35” annually in the Watershed. While past years have shown a general trend for higher average precipitation (1940-1990), this trend has generally leveled off since 1990. The average annual snowfall in the Watershed is 54.5”. Snowfall in 2007 was almost 10” below normal on average, but higher than usual snowfall was experienced along Lake Michigan.

2.1.7 Land Use and Development Trends

Land use varies across the Watershed, however, agriculture is dominant. Winchell Union Drain and Sebewa Creek subwatersheds have the highest percentage of agriculture land use in the Watershed (Table 4). Seven of the nine subwatersheds have greater than 55% agriculture land use.

The Greater Lansing Metropolitan Region (Silver Creek and Carrier Creek subwatersheds) by far has the most intense land development when comparing the amount of open space and urban areas. Infrastructure includes transportation corridors, sewer and water services. The Capital City Airport, located North of Lansing, is the largest in the area. It is a full-service, all-weather, commercial-airline airport, serving the entire Lansing metropolitan area. The I-96/Grand River Corridor is 15 miles long and stretches across the Watershed. The I-69 corridor also runs through the Watershed. Development along these areas includes small to medium sized industrial parks, businesses and residential areas.

Development within the Watershed has gradually pushed outward from the Greater Lansing Metropolitan Region. Smaller urban centers include City of Eaton Rapids and City of Grand Ledge. Townships within the Watershed are more largely characterized as rural and agricultural with pockets of housing developments popping up as agricultural land is purchased.

Table 4. Land Use Percentages by Subwatershed

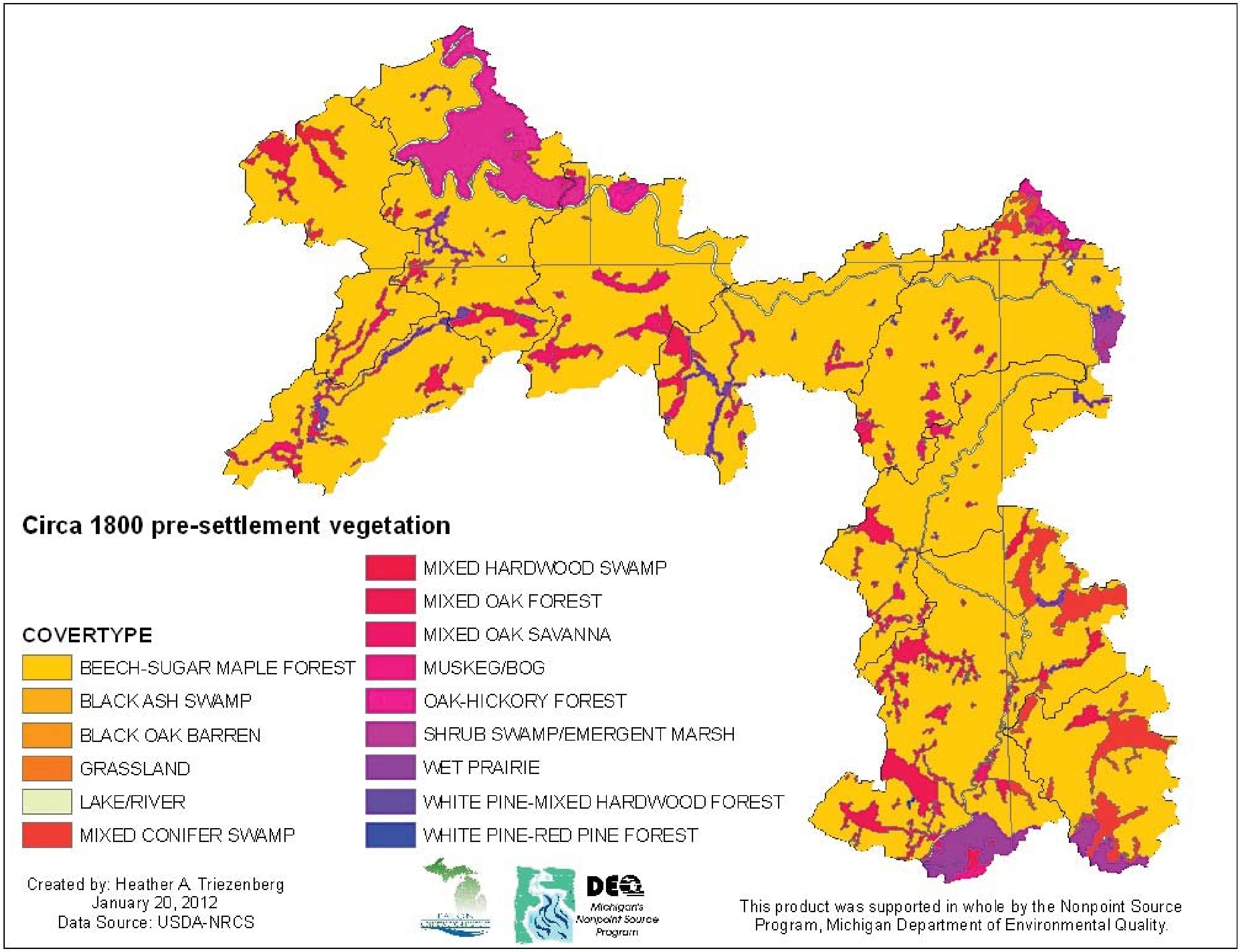
Subwatershed	**Urban**	**Agriculture**	**Open Field**	**Forest**	**Water**	**Wetland**
Columbia Creek	6.63	73.91	4.8	12.27	0.06	2.33
Skinner Extension Drain	11.56	56.08	12.56	17.56	0.76	1.5
Silver Creek	35.7	31.9	17.2	12.13	0.03	0.4
Winchell Union Drain	0.21	81.3	6.1	12.11	0.13	0.18
Cryderman Lake Drain	5.2	68.14	5.3	17.7	2.35	1.4
Sandstone	20.1	57.3	9.35	12.14	1.04	0.12
Frayer Creek	4.78	71.63	5.5	15.73	1.8	0.32
Sebewa Creek	1.74	79.5	5.13	11.93	0.09	1.63
Carrier Creek	59.4	15.93	14.18	8.88	1.19	0.42

2.1.8 Natural Resources

Across the Watershed, pre-settlement vegetation was dominated by beech-sugar maple forest with pockets of mixed hardwood swamp, mixed conifer swamp, shrub swamp/emergent marsh, oak-hickory forest, wet prairie and white pine-mixed hardwood forest (Figure 7).

The current landscape has changed drastically as human populations have grown and drove modern development. Many of the current natural resources are managed on public property such as county or city parks. Private lands also play an important role in managing natural resources throughout the Watershed.

Figure 7. Pre-Settlement Vegetation Cover Types of the Watershed.



2.1.8.1 Landscape-Level Wetland Functional Assessment

The MDEQ has developed a Landscape Level Wetland Functional Assessment (LLWFA) tool. The LLWFA tool identifies historically lost wetlands, determines the functions they once provided, and helps to prioritize wetlands for restoration to obtain the most significant water quality improvements.

Through the analysis of the LLWFA tool it can be estimated during pre-settlement there were 39,467 acres of wetlands with an average size of 17 acres in the Watershed. As of 2005 data, there is now an estimated 12,557 acres of wetlands with an average size of 3.8 acres. This equates to 31% of original wetland acreage remaining. This results in a loss of 69% of total wetland resource and 26,910 acres.

Research has shown that through the filtration function of wetlands, contaminated runoff containing pollutants such as *E.coli* can be reduced.

The LLWFA tool compares functional wetland acres from pre-European settlement to 2005. The wetland functions with the greatest predicted change in capacity are fish habitat, amphibian habitat, streamflow maintenance, interior forest bird habitat, stream shading and flood water storage (Table 5). All of these functions had a predicted percent change greater than 70 (Table 5). Sediment and other particulate retention and nutrient transformation relate to potential pathogen retention functions of wetlands. Sediment and other particulates have lost 59% of its predicted functional capacity (Table 5). Nutrient transformation has lost 60% of its predicted functional capacity (Table 5). When keeping in mind the pollutants of concern for the WMP (*E.coli*, sediment and low dissolved oxygen), flood water storage, nutrient transformation, streamflow maintenance and sediment and other particulate retention, are important wetlands functions to restore in order to achieve water quality improvements.

The LLWFA tool was used to determine potential wetland restoration and protection areas by subwatershed.

Table 5. Functional Acres Comparison in the Watershed

Function	Pre-European Settlement Functional Acres	2005 Functional Acres	Predicted % of Original Capacity Left	Predicted % Change in Functional Capacity
Flood Water Storage	42,429.33	12,390.61	29	-71
Streamflow Maintenance	58,818.36	15,910.12	27	-73
Nutrient Transformation	51,391.06	20,750.52	40	-60
Sediment and Other Particulate Retention	24,823.68	10,245.43	41	-59
Shoreline Stabilization	36,571.66	11,446.38	31	-69
Fish Habitat	61,314.54	10,366.16	17	-83
Stream Shading	11,518.45	3,368.28	29	-71
Waterfowl and Waterbird Habitat	7,192.84	11,471.00	159	59*
Shorebird Habitat	39,466.73	12,611.30	32	-68
Interior Forest Bird Habitat	42,662.56	12,046.56	28	-72
Amphibian Habitat	38,639.01	9,670.45	25	-75
Carbon Sequestration	12,980.94	6,014.81	46	-54
Ground Water Influence	6,979.92	3,300.54	47	-53
Conservation of Rare & Imperiled Wetlands Species	0	9,633.50	100	100

Note: *Increases in the predicted percent change functional capacity in the functions above can be attributed to the mapping differences in the two wetland layers and may not represent the current conditions on the ground. Data provided by MDEQ LLWFA tool.

2.1.8.2 Potential Conservation Areas

In 2008, the Potential Conservation Areas Report was created for Ingham, Eaton and Clinton Counties. Potential Conservation Areas (PCA) are defined as places on the landscape dominated by native vegetation that have various levels of potential for harboring high quality natural areas and unique natural features. In addition these areas may provide critical ecological services such as maintaining water quality and quantity, soil development and stabilization, wildlife travel corridors, stopover sites for migratory birds, sources of genetic diversity, and floodwater retention. However, the actual ecological value of these areas can only be ascertained through on the ground biological surveys (Paskus and Enander 2008).

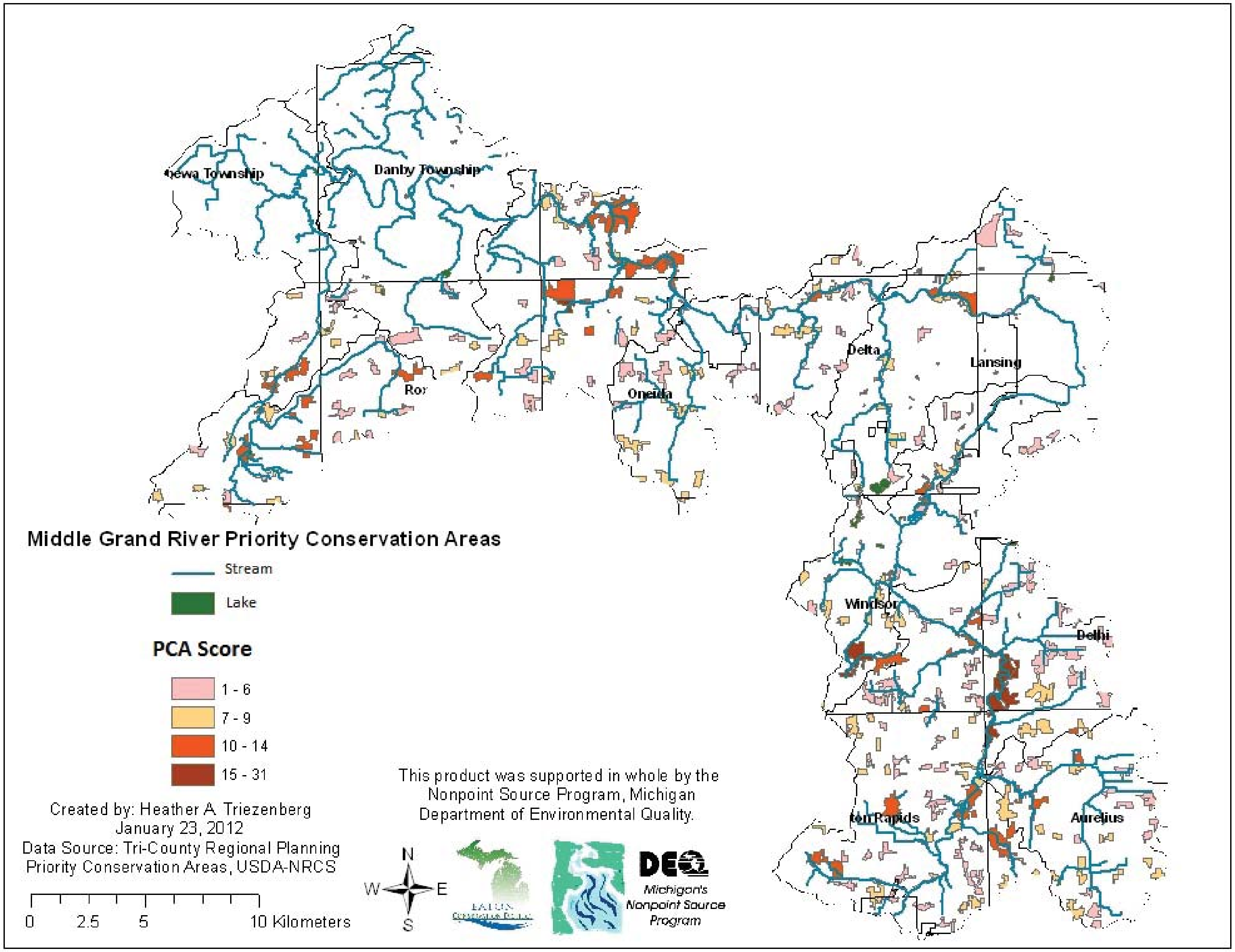
The PCAs are identified and scored based on the following criteria:

A scoring system was created that allows a range of 0 to 45 points per PCA

- Area : Points for 20+ acres
- Core Area: Points for 60+ acres
- Stream Corridor: Point scale for any length
- Connectivity: % of land that is within a ¼ mile or 100 feet proximity to next PCA
- Restorability: Based on type of use within ¼ mile of the PCA
- Vegetation Quality: Based on change between MNFI's Circa 1800 Vegetation and TCRPC's land cover circa 2000 A.D. Points awarded at 10% or more of unchanged area.
- Bio-Rarity Score: Location of quality natural communities and rare species tracked by MNFI.
- Parcel Fragmentation: The area of the largest parcel within a site.

Figure 8 highlights the PCAs identified in the Watershed with a score ranging from 31 to 1. Many of the higher ranking areas are located along riparian areas. Note: Ionia County is not covered in the Report.

Figure 8. Priority Conservation Areas of Middle Grand River Watershed.



2.1.9 Recreational Uses

The Watershed has an active recreational paddling community that enjoys utilizing the meandering Grand River. There are both public and private access points to the Grand River. Every 10 years, paddlers organize the Grand River Expedition. Paddlers from across Michigan participate and take a trip down the 225 navigable miles of the Grand. A major goal of the Expedition is to document and explain to the public the recreational, economic and environmental benefits the Grand River Watershed provides. These efforts contribute to the public's knowledge and appreciation of the Grand River, and how it connects communities across the region. It helps generate enhanced stewardship of the river and watershed related values (Middle Grand River Organization of Watersheds 2014).

Outside of paddling, recreational opportunities such as fishing, hiking, and biking along the river, are also available through the extensive park systems managed by county and municipal entities.

2.1.10 Political Landscape

Within the Watershed there are numerous layers of government that influence and affect water quality. Each local community is unique with their own source of identity and character. Broadly speaking the Watershed can be characterized as having a mix of urban and rural communities with varying degrees of infrastructure and development.

The Watershed consists of twenty-one local units of government that make decisions affecting the water quality through land use, zoning, and ordinance decisions as well as, public works and infrastructure projects.

Within the Watershed there are three cities, three villages, five charter townships and ten other townships. They are as follows:

Cities: Lansing, Eaton Rapids and Grand Ledge

Villages: Dimondale, Sunfield and Mulliken

Charter Townships: Delta, Lansing, Delhi, Windsor and Oneida

Other Townships: Sebewa, Sunfield, Roxand, Danby, Eaton Rapids, Watertown, Eagle, Aurelius, Dewitt and Portland

The Watershed spans across portions of four counties: Eaton, Ingham, Clinton and Ionia. Within each county there are Health Departments, Road Commissions, Drain Commissions, Parks and Recreation Departments and Community Development and Planning Departments making decisions that directly or indirectly affect water quality. Throughout the Watershed there are also Michigan State University Extensions, County Conservation Districts and Natural Resource Conservation Service Field Offices working with landowners and partners to improve water quality through outreach and conservation practices.

2.1.11 Demographics

The largest amount of the population in the Watershed is located in Carrier Creek which includes portions of the City of Lansing, Delta Charter Township and extends into Clinton County (Table 6). As the distance from the Greater Lansing Metropolitan Area increases the population decreases. Frayer Creek and Cryderman Lake Drain subwatersheds have experienced the highest positive percent population change, while Winchell Union Drain subwatershed has experienced the highest negative percent population change in the Watershed (Table 6).

Table 6. 2000 – 2010 Percent Population Change of the Watershed.

Subwatershed	Population 2000	Population 2010	Percent Change
Columbia Creek	1,704	1,809	6.16
Skinner Extension Drain	14,412	14,315	-0.67
Silver Creek	24,271	23,219	-4.33
Carrier Creek	70,648	69,571	-1.52
Sandstone	12,582	13,128	4.33
Frayer Creek	2,596	2,874	10.7
Cryderman Lake Drain	3,653	3,983	9.03
Sebewa Creek	1,149	1,118	-2.69
Winchell Union Drain	767	716	-6.64
Total	131,782	130,733	-2.27

2.1.12 Point Sources

The primary purpose of a WMP is to identify nonpoint source pollution; however, the plan would be remiss if it did not discuss the contribution of point source pollution to the overall picture of water quality. Point source can be defined as a stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution, such as a pipe or factory.

The Watershed has forty-six point source facilities. These facilities also fall under the National Pollution Discharge Elimination System (NPDES) Program. The NPDES program is a provision of the Clean Water Act that prohibits the discharge of pollutants into waters of the United States unless a special permit is issued by EPA, a state, or, where delegated, a tribal government on an Indian Reservation.

In late 2012, the DEQ began implementing a new stormwater permit issuance process. In the past either a general permit or a jurisdictional permit was issued. Moving forward, each MS4 will receive an individual permit. In the Greater Lansing area, the GLRC coordinates efforts of permitted MS4s, this provides efficiency and consistency of stormwater pollution prevention activities.

See Appendix 1 for a listing of the NPDES Facilities in the Watershed.