

Chapter One: Inventory of Resources

Chapter One provides a general overview of the District. It inventories the physical, social, and economic characteristics that are important to understanding the unique nature of the District. The Chapter is divided into four sections: District Setting, Environmental Context, Water Resources, and Land Resources. Information presented herein is further assessed in Chapter Two.

A. District Setting

Location and Size

The general location of the District is displayed in Map 1A. Notice that political boundary of the District closely resembles the hydrological boundary of the Middle Fork Crow River Watershed. The Watershed is part of the much larger Upper Mississippi River Watershed; the Middle Fork of the Crow River outlets to the North Fork of the Crow River near Manannah, which eventually outlets to the Mississippi River near Dayton. According to Table 1A, the District encompasses 270.7 square miles (173,220 acres) across portions of four counties. The overwhelming majority of the District is located within Kandiyohi County (72.1%), with lesser percentages in Meeker (16.2%), Stearns (11.3%), and Pope (0.5%) Counties. In addition, the cities of Atwater, Belgrade, New London, and Spicer are all entirely located within the District.

**Table 1A
District Area per County**

County	Area (mi ²)	Area (ac)	District (%)
Kandiyohi County	195.0	124,826	72.1
Meeker County	43.8	28,062	16.2
Pope County	1.3	801	0.5
Stearns County	30.5	19,531	11.3
<i>District Total</i>	<i>270.7</i>	<i>173,220</i>	<i>100.0</i>

Demographic Context

The population and household estimates provided in Table 1B were developed through the detailed analysis of 2005 Minnesota State Demographic Center data for each city and township in the District using a Geographic Information System (GIS). There are approximately 11,546 residents, occupying 4,633 households, in the District. Spicer (1,174) is the most populated city, followed closely by New London (1,105), Atwater (1,089), and Belgrade (739). The vast majority of the District's residents live in Kandiyohi County (9,930), with lesser amounts in Stearns (1,021), Meeker (589), and Pope (6) Counties. Future population and household projections are provided in Chapter Two.

**Table 1B
Population and Household Estimates for Cities and Counties (2005)**

City	2005 Estimates	
	Population	Households
Atwater	1,089	471
Belgrade	739	337
New London	1,105	478
Spicer	1,174	551
<i>City Total</i>	<i>4,107</i>	<i>1,837</i>
County*	2005 Estimates	
	Population	Households
Kandiyohi County	9,930	3,994
Meeker County	589	202
Pope County	6	2
Stearns County	1,021	435
<i>District Total</i>	<i>11,546</i>	<i>4,633</i>

* County totals include city figures.

Economic Context

Economic data for the District was derived from the U.S. Census Bureau and estimated using a GIS. According to Table 1C, there was an estimated available labor force of 6,029 in the District in 2000, much of which was located in Kandiyohi County. A majority of this labor force commutes to regional employment hubs outside of the area, including Litchfield, St. Cloud, and Willmar. A total of 212 people (3.5%) were estimated to be unemployed. The median household income for the District was \$42,336.

**Table 1C
Labor Force and Unemployment (2000)**

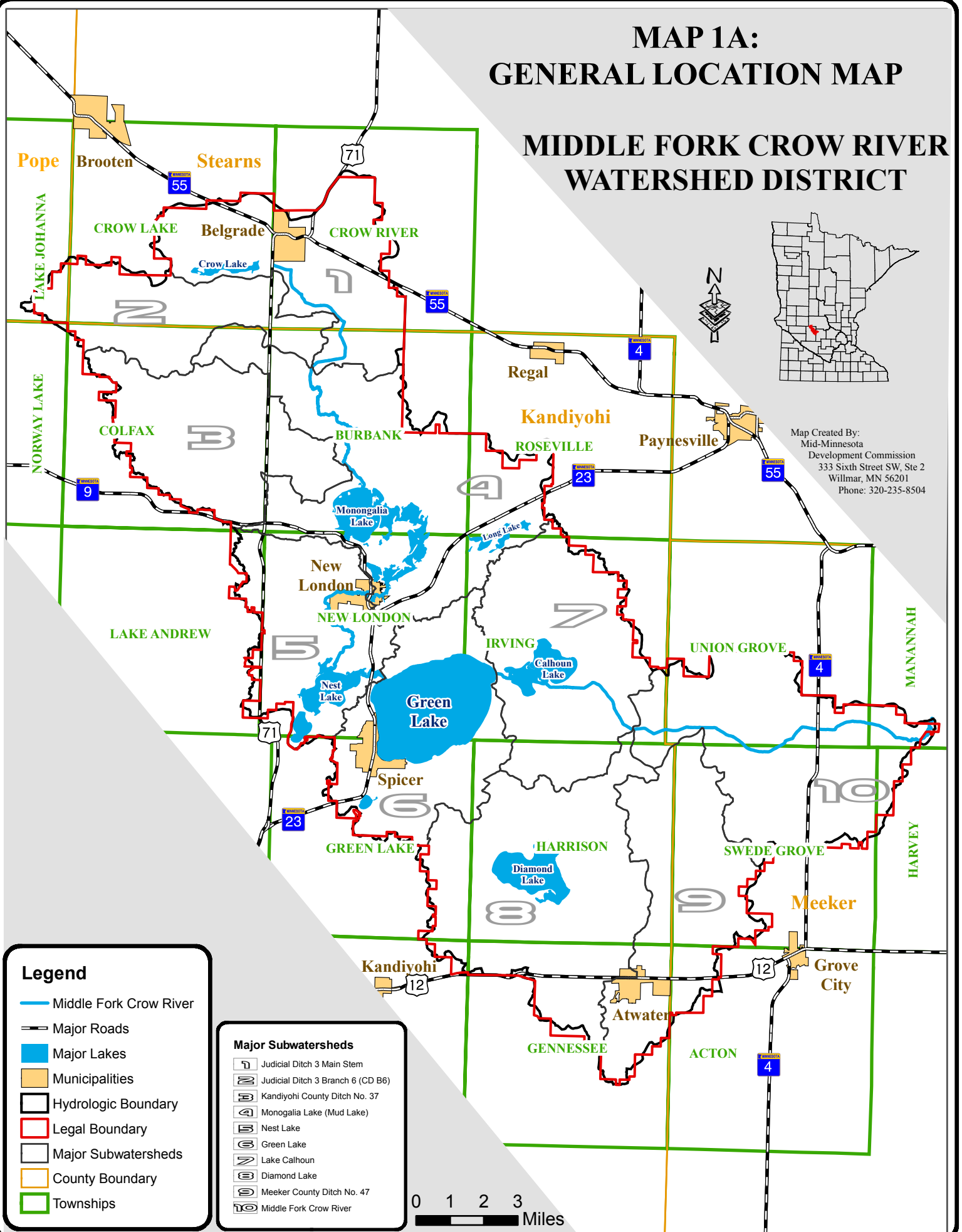
County*	Labor Force	Unemployed	Median Household Income
Kandiyohi	5,235	174 (3.3%)	\$44,054
Meeker	315	16 (5.1%)	\$41,819
Pope	2	0 (0.0%)	\$32,813
Stearns	479	21 (4.5%)	\$27,192
<i>District Total</i>	<i>6,029</i>	<i>212 (3.5%)</i>	<i>\$42,336</i>

* County totals include city figures.

Table 1D provides employment by industry data for the residents of the District, based upon the 2000 U.S. Census. There are three industries that comprise a majority of the District's employment base: education, health, and social services (1,431), manufacturing (781), and retail trade (742). This is a noticeable shift from past decades, when the agricultural industry was among the prominent employers in the area. However, because of poor commodity prices and improvements in technology, there are fewer farms, employing fewer people. Unless factors within the agricultural industry change, this trend is likely to continue in the future.

MAP 1A: GENERAL LOCATION MAP

MIDDLE FORK CROW RIVER WATERSHED DISTRICT



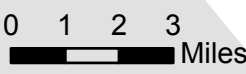
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Legend

- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Hydrologic Boundary
- Legal Boundary
- Major Subwatersheds
- County Boundary
- Townships

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
- Kandiyohi County Ditch No. 37
- Monongalia Lake (Mud Lake)
- Nest Lake
- Green Lake
- Lake Calhoun
- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River



**Table 1D
Employment by Industry (2000)**

Industry	County*				District	
	Kandiyohi	Meeker	Pope	Stearns	Total	Percent
Agriculture, Forestry, Fishing, and Mining	246	53	0	39	338	5.8
Construction	443	27	1	16	487	8.4
Manufacturing	585	80	0	116	781	13.4
Wholesale Trade	194	7	0	8	209	3.6
Retail Trade	641	31	0	70	742	12.7
Transportation and Warehousing	272	12	0	13	297	5.1
Information	88	3	0	12	103	1.8
Finance, Insurance, and Real Estate	221	10	0	18	249	4.3
Professional, Scientific, and Management	271	10	0	20	301	5.2
Education, Health, and Social Service	1,304	36	1	90	1,431	24.6
Arts, Entertainment, and Food Services	299	13	0	20	332	5.7
Other Services	292	13	0	19	324	5.6
Public Administration	205	4	0	17	226	3.9
<i>District Total</i>	<i>5,061</i>	<i>299</i>	<i>2</i>	<i>458</i>	<i>5,820</i>	<i>100.0</i>

* County totals include city figures.

B. Environmental Context

Climate

The climate of the District is characterized as continental. During the winter months, cold, dry polar air dominates the region. Hot, dry air masses from the desert southwest, along with warm, moist maritime tropical air masses that originate over the Gulf of Mexico, are common during the summer months. The spring and fall months serve as transition periods between the summer and winter, with alternating intrusions of air from various sources.

The National Weather Service operates a climate monitoring station in New London, the only station of its type in the District. The 30-year (1971-2000) average annual temperature for the station was 43.5 degrees F. Over the same time period, the average maximum daily temperature was 53.8, while the mean minimum daily temperature was 32.9 degrees F. Average annual precipitation was 31.7 inches.

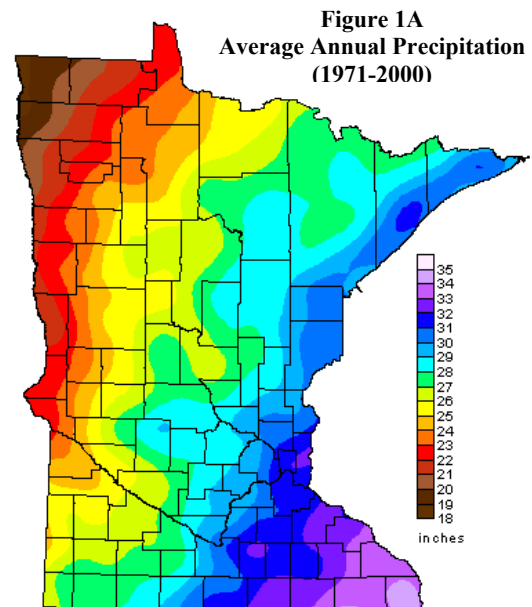


Figure 1A displays the State's average annual precipitation (1971-2000), as determined by the Minnesota Climatology Working Group. Notice that the District received between 28 and 30 inches of precipitation annually over this period. Seasonal precipitation, the total precipitation between the

months of May and September, for the District was approximately 18 inches annually. Annual snowfall for the area was approximately 45 inches; however, this represents only a small portion of the annual precipitation due to the low moisture content of snow.

Generally, when precipitation reaches the earth it moves along one of three hydrologic pathways: 1) it may evaporate/evapotranspire back into the atmosphere, 2) it may infiltrate into the soil profile, or 3) it may runoff into a body of water. According to the USGS, approximately 78 percent of Minnesota's annual precipitation is lost to evaporation/evapotranspiration. The remaining 22 percent of precipitation either infiltrates the soil profile or becomes surface runoff. Runoff is vital to many streams and lakes, as it represents a significant water input source.

Figure 1B displays the average annual runoff for the State, based upon data collected by the Minnesota Climatology Working Group between 1961 and 1990. According to the Figure, runoff is approximately 4 inches per year in the District.

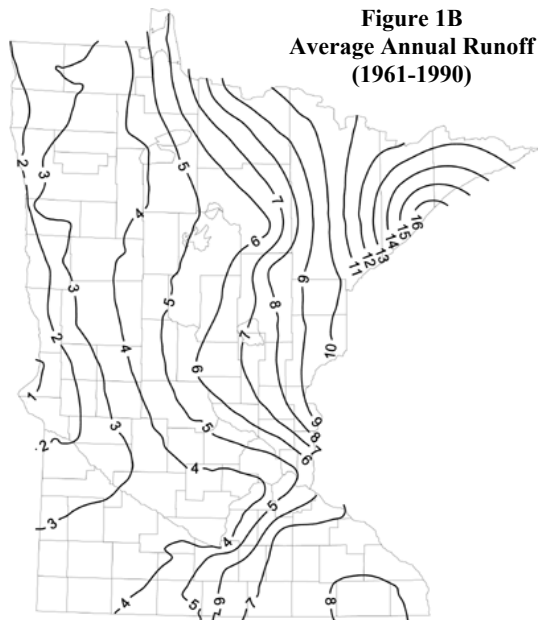


Figure 1B
Average Annual Runoff
(1961-1990)

Ecological Setting

The EPA has mapped the major ecoregions of the United States based upon information on soils, landform, potential natural vegetations, and land use. Ecoregions are important because they provide the scientific context in which to compare surface water resources in terms of quality. Water quality standards have been established for water bodies and courses within each of the ecoregions. These standards can be used as targets in water resource management.

The seven ecoregions of the State are illustrated in Figure 1C. The District is found entirely within the North Central Hardwood Forests Ecoregion. The presettlement ecology of this area consisted largely of hardwood tree species, such as maple and basswood, growing on moraines and outwash plains, surrounded by relatively shallow glacial lakes.

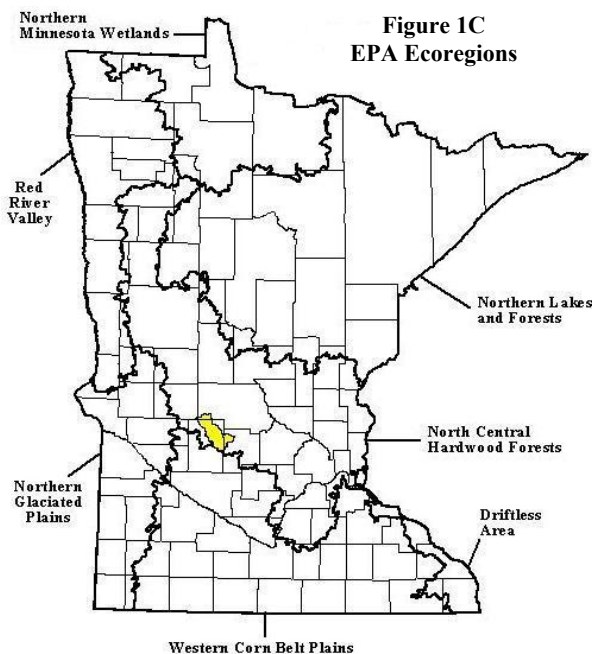


Figure 1C
EPA Ecoregions

C. Water Resources

Subwatersheds

The 10 major subwatersheds and 51 minor subwatersheds of the District are displayed in Map 1B. The hydrologic boundary of each subwatershed was derived from the USGS's Hydrologic Unit Codes (HUC) file, which is widely accepted amongst the scientific community. A complete listing of the District's subwatershed is provided in Table 1F. It is important to note that for subwatersheds that the River flows through, the entire drainage area may be larger than the immediate subwatershed. For instance, the Green Lake Subwatershed has an immediate size of 16,376 acres, but because of the River, it actually receives water from other subwatersheds (Judicial Ditch 3, Judicial Ditch 3 Branch 6, Kandiyohi County Ditch 37, Monongalia Lake, and Nest Lake). As a result, the entire drainage area of Green Lake is actually 94,504 acres.

Rivers and Streams

The stream network of the District primarily consists of the Middle Fork of the Crow River, which extends approximately 48.8 miles through the District. The River originates near Crow Lake in Stearns County and outlets to the North Fork of the Crow River near Manannah in Meeker County. Many sections of the River have been channelized for drainage purposes. In fact, only two extensive segments of the River remain relatively unaltered by human activity. The first segment extends from the New London Dam to Nest Lake, while the second is found upstream of Monongalia Lake. It is important to note that while these sections resemble the state of the River prior to settlement, flows have been anthropogenically modified. An elevation profile of the River is included in Appendix A (Figure 1).

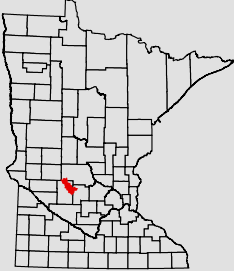
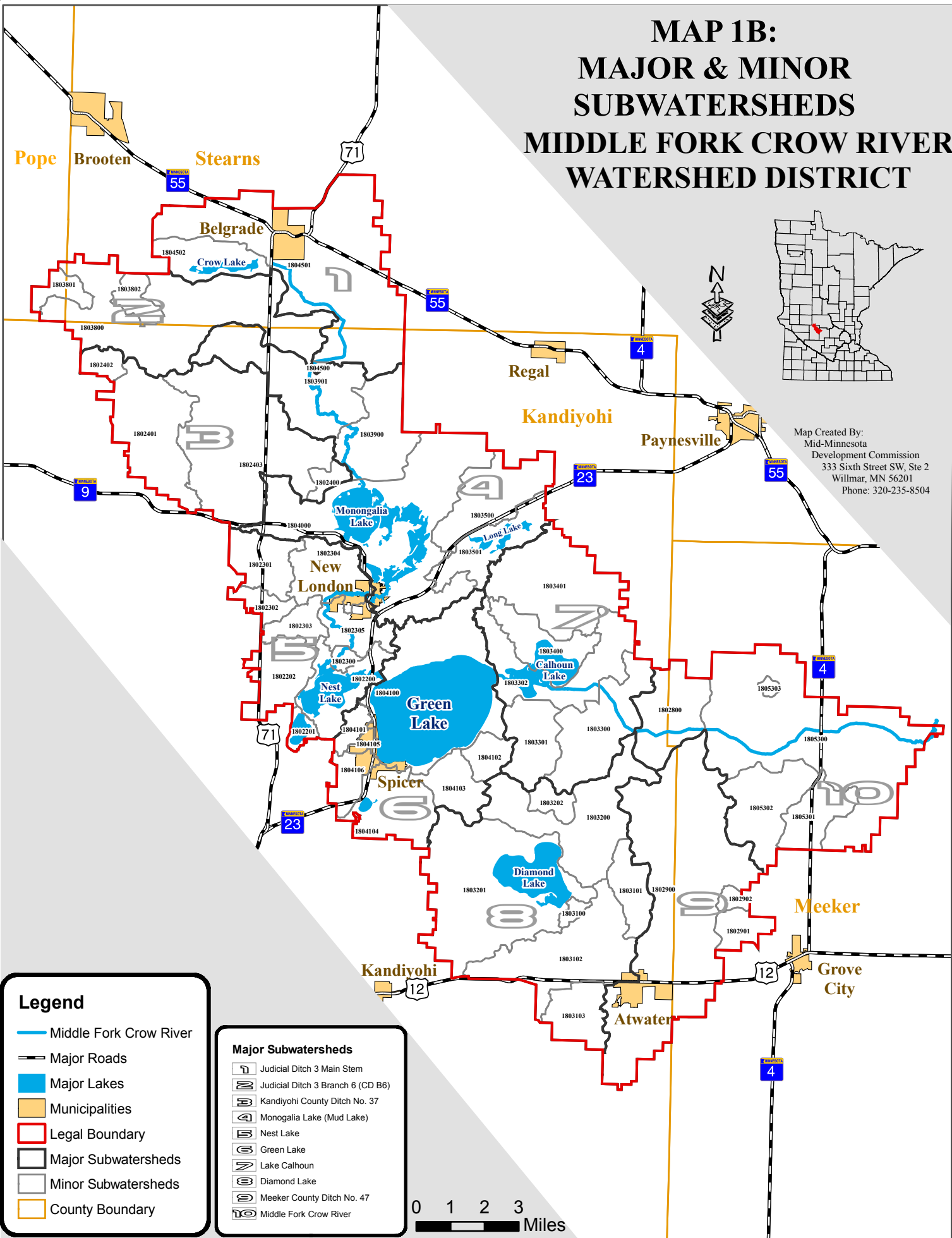
Lakes

Lakes are important resources in the District, supporting a high quality of life for residents and providing thousands of people with a wide range of recreational opportunities. The major lakes of the District are displayed in Map 1B. Notice that a majority of the lakes are found in the central portion of the District, specifically in the New London-Spicer Area. Information on the area and maximum depth of each lake is provided in Table 1E. Green Lake is the largest (5,585 ac.) and deepest (110 ft.) basin in the District. Elkhorn Lake is the smallest (73 ac.) of these lakes, but ranks third in maximum depth (41 ft.). Calhoun and Monongalia Lakes are the shallowest basins (≤ 14 ft.) in the District; both the lake area and littoral area of these basins are equal.

Table 1E
Major Lakes

Lake (DNR ID)	Lake Area (ac)	Littoral Area (ac)	Max. Depth (ft)
Calhoun (34-0062)	635	635	13
Diamond (34-0044)	1,565	635	27
Elkhorn (34-0119)	73	32	41
George (34-0142)	231	114	34
Green (34-0079)	5,585	2,035	110
Long (34-0066)	310	127	44
Monongalia (34-0158)	2,255	2,255	14
Nest (34-0154)	981	525	40

MAP 1B: MAJOR & MINOR SUBWATERSHEDS MIDDLE FORK CROW RIVER WATERSHED DISTRICT



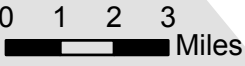
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Legend

- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Legal Boundary
- Major Subwatersheds
- Minor Subwatersheds
- County Boundary

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
- Kandiyohi County Ditch No. 37
- Monogalia Lake (Mud Lake)
- Nest Lake
- Green Lake
- Lake Calhoun
- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River

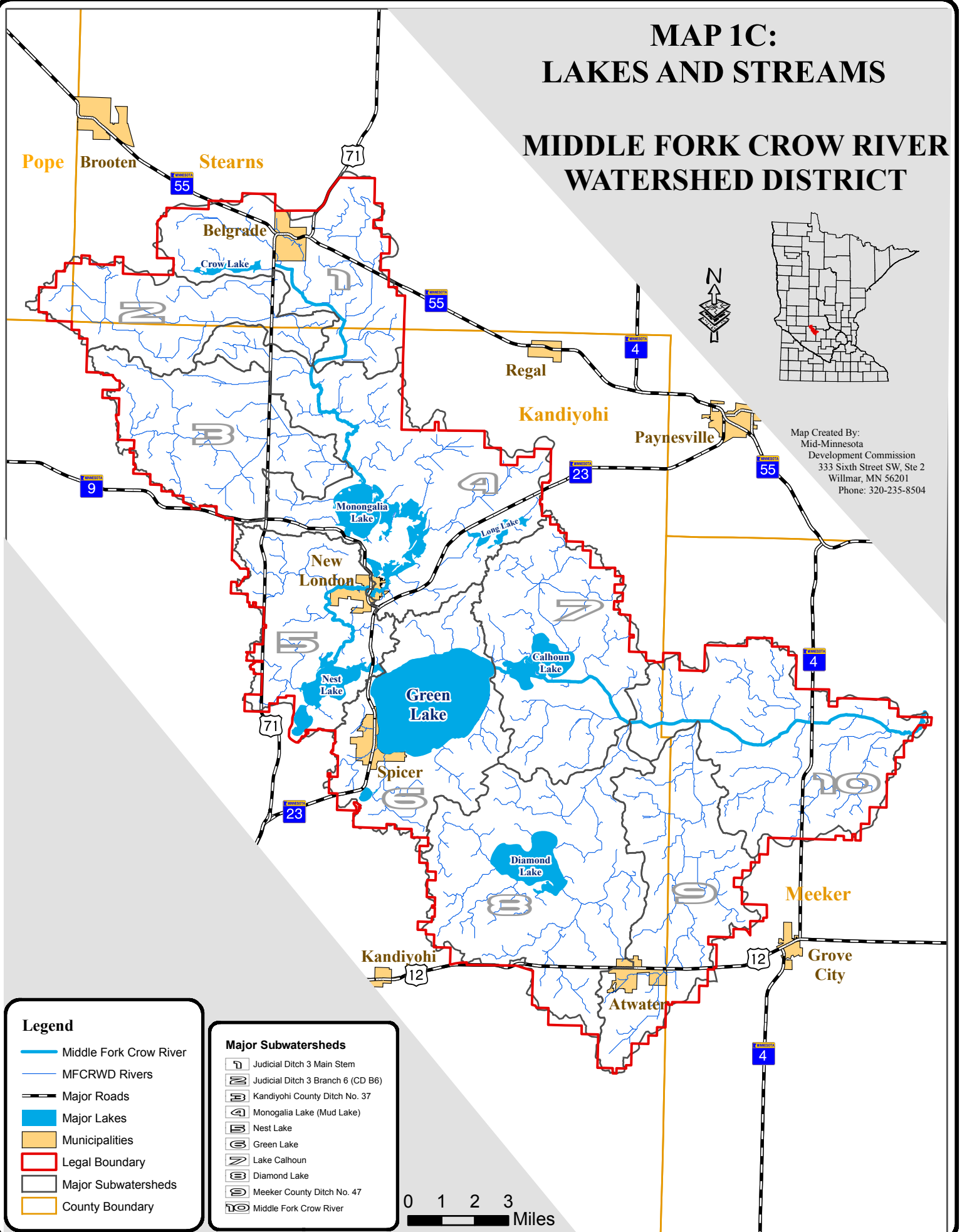


**Table 1F
Major and Minor Subwatersheds**

Major Subwatershed Name Minor Subwatershed #	Area (ac)		Major Subwatershed Name Minor Subwatershed #	Area (ac)	
	Immediate	Total		Immediate	Total
Judicial Ditch 3, Mainstem	14,719	14,719	Green Lake (Continued)	16,376	94,504
1804500	69		1804101	576	
1804501	12,608		1804102	923	
1804502	2,042		1804103	1,637	
Judicial Ditch 3, Branch 6	10,900	10,900	1804104	2,858	
1803800	9,296		1804105	223	
1803801	767		1804106	1,066	
1803802	837		Calhoun Lake	17,459	111,963
Kandiyohi County Ditch 37	14,463	14,463	1803300	3,890	
1802400	519		1803301	2,230	
1802401	4,500		1803302	3,898	
1802402	644		1803400	2,236	
1802403	8,800		1803401	5,205	
Monongalia Lake	25,000	65,082	Diamond Lake	24,151	24,151
1803900	3,241		1803100	261	
1803901	4,839		1803101	1,518	
1804000	11,330		1803102	5,169	
1803500	3,180		1803103	1,828	
1803501	2,410		1803200	5,091	
Nest Lake	13,046	78,128	1803201	9,580	
1802200	2,512		1803202	704	
1802201	450		Meeker County Ditch 47	16,402	16,402
1802202	2,208		1802900	15,128	
1802300	290		1802901	957	
1802301	1,912		1802902	317	
1802302	753		Middle Fork Crow River	20,704	173,220
1802303	973		1805300	12,533	
1802304	2,357		1805301	1,792	
1802305	1,591		1805302	3,248	
Green Lake	16,376	94,504	1805303	161	
1804100	9,093		1802800	2,970	

MAP 1C: LAKES AND STREAMS

MIDDLE FORK CROW RIVER WATERSHED DISTRICT



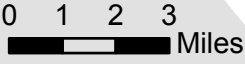
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Legend

- Middle Fork Crow River
- MFCRWD Rivers
- Major Roads
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Major Subwatersheds

- Judicial Ditch 3 Main Stem
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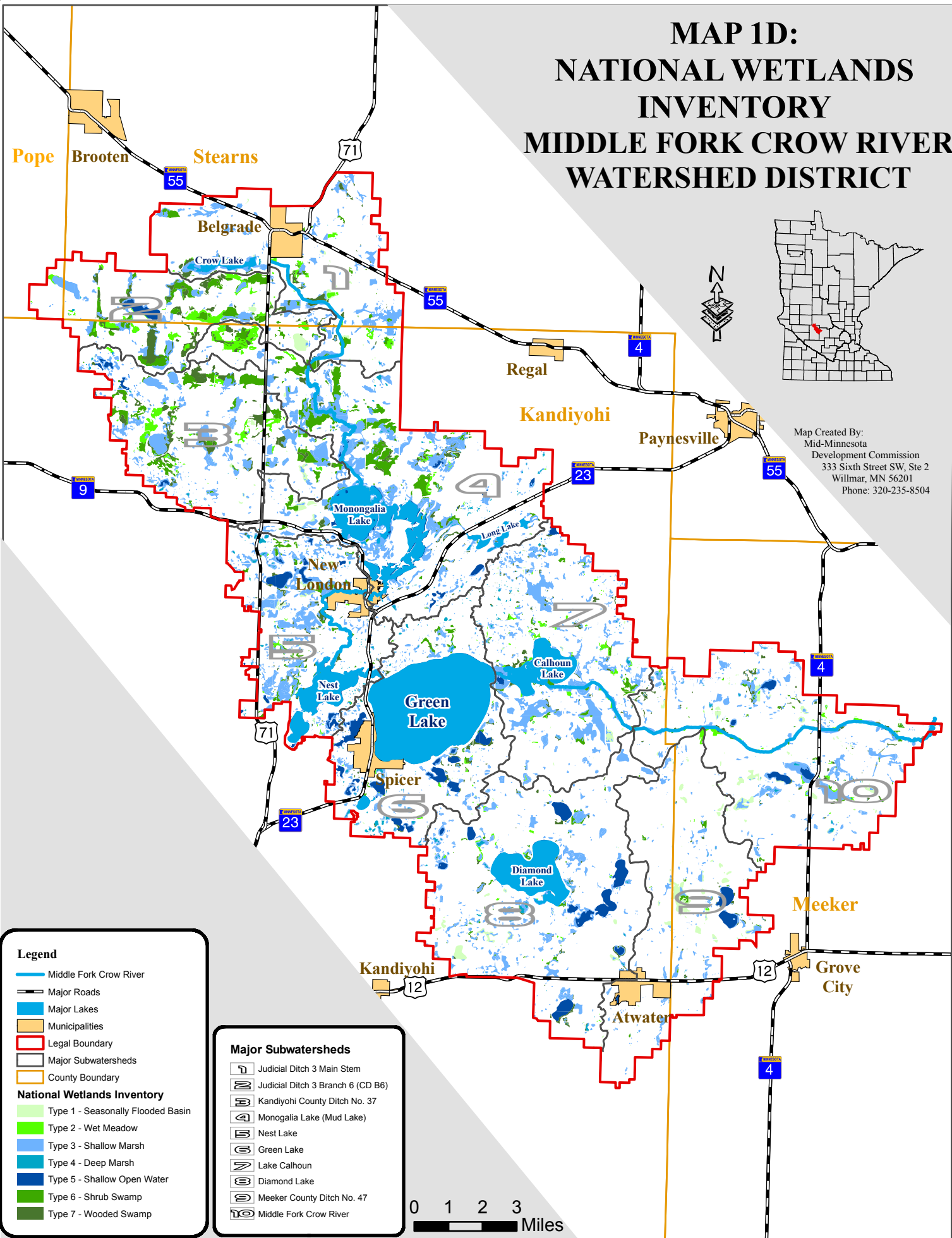
Wetlands

Wetlands provide many natural resource functions including storage of runoff during storm and snowmelt events, filtration of pollutants and sediment, groundwater and aquifer recharge, fish and wildlife habitat, and aesthetic appeal. Much of the wetland drainage in the District occurred prior to the 1980s, before policies were enacted to prevent future loss. Examples of such policies include the Swampbuster Provision of the USDA Farm Program and Minnesota Wetland Conservation Act.

There are three primary sources of wetland inventory maps for the District: USFWS, NRCS, and DNR. The USFWS has identified wetlands through its National Wetlands Inventory. Wetlands located within cropland have been inventoried by the NRCS. Finally, the DNR has identified wetlands as part of the Protected Waters Inventory. Map 1D displays the USFWS National Wetlands Inventory (NWI) for the District. The following provides a description of each of the wetland types.

- **Type 1: Seasonally Flooded Basins** - Soil is covered with water or is waterlogged during variable seasonal periods, but usually is well drained during much of the growing season. Vegetation varies greatly according to season.
- **Type 2: Inland Fresh Meadows** - Soil is usually without standing water during most of the growing season, but is waterlogged within at least a few inches of the surface. Vegetation includes grasses, sedges, rushes, and various broad-leaf plants.
- **Type 3: Inland Shallow Fresh Marshes** - Soil is usually waterlogged early during the growing season; often covered with as much as six inches or more of water. Vegetation includes grasses, bullrushes, spike rushes, and various other plants such as cattails, arrowheads, and smartweed. These marshes may nearly fill shallow basins, or may border deep marshes.
- **Type 4: Inland Deep Fresh Marshes** - Soil is usually covered with six inches to three feet or more of water during the growing season. Vegetation includes cattails, reeds, bullrushes, etc. Deep marshes may completely fill shallow basins, or may border open water.
- **Type 5: Inland Open Fresh Water** - Shallow ponds and reservoirs are included in this type. Water is usually less than ten feet deep and fringed by a border of emergent vegetation similar to open areas of Type 4.
- **Type 6: Shrub Swamps** - Soil is usually waterlogged during the growing season and is often covered with as much as six inches of water. Vegetation usually includes alders, willows, dogwood, etc. Swamps occur mostly along sluggish streams and on floodplains.
- **Type 7: Wooded Swamps** - Soil is waterlogged within a few inches of the surface during the growing season and is often covered with as much as one foot of water.
- **Type 8: Bogs** - Soil is usually waterlogged and supports a spongy covering of moss. Vegetation is woody, herbaceous, or both.

MAP 1D: NATIONAL WETLANDS INVENTORY MIDDLE FORK CROW RIVER WATERSHED DISTRICT



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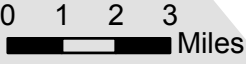
- Middle Fork Crow River
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- Legal Boundary
- Major Subwatersheds
- County Boundary

National Wetlands Inventory

- Type 1 - Seasonally Flooded Basin
- Type 2 - Wet Meadow
- Type 3 - Shallow Marsh
- Type 4 - Deep Marsh
- Type 5 - Shallow Open Water
- Type 6 - Shrub Swamp
- Type 7 - Wooded Swamp

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
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According to Table 1G, there are 41,843 acres of wetlands in the District; this is approximately 24% of the District's area. A majority of these wetlands are found in and north of the New London-Spicer Area. Nearly 75 percent of the wetlands in the District are classified as either Type 3 or 5. Many of the smaller Type 1 and 2 wetlands that were once common in the agricultural areas have been drained.

**Table 1G
USFWS National Wetlands Inventory**

Wetland Type	Area (ac)
Type 1: Seasonally Flooded Basins	1,281
Type 2: Inland Fresh Meadows	1,750
Type 3: Inland Shallow Fresh Marshes	17,112
Type 4: Inland Deep Fresh Marshes	1,075
Type 5: Inland Open Fresh Water	13,976
Type 6: Shrub Swamps	3,855
Type 7: Wooded Swamps	2,794
<i>District Total</i>	<i>41,843</i>

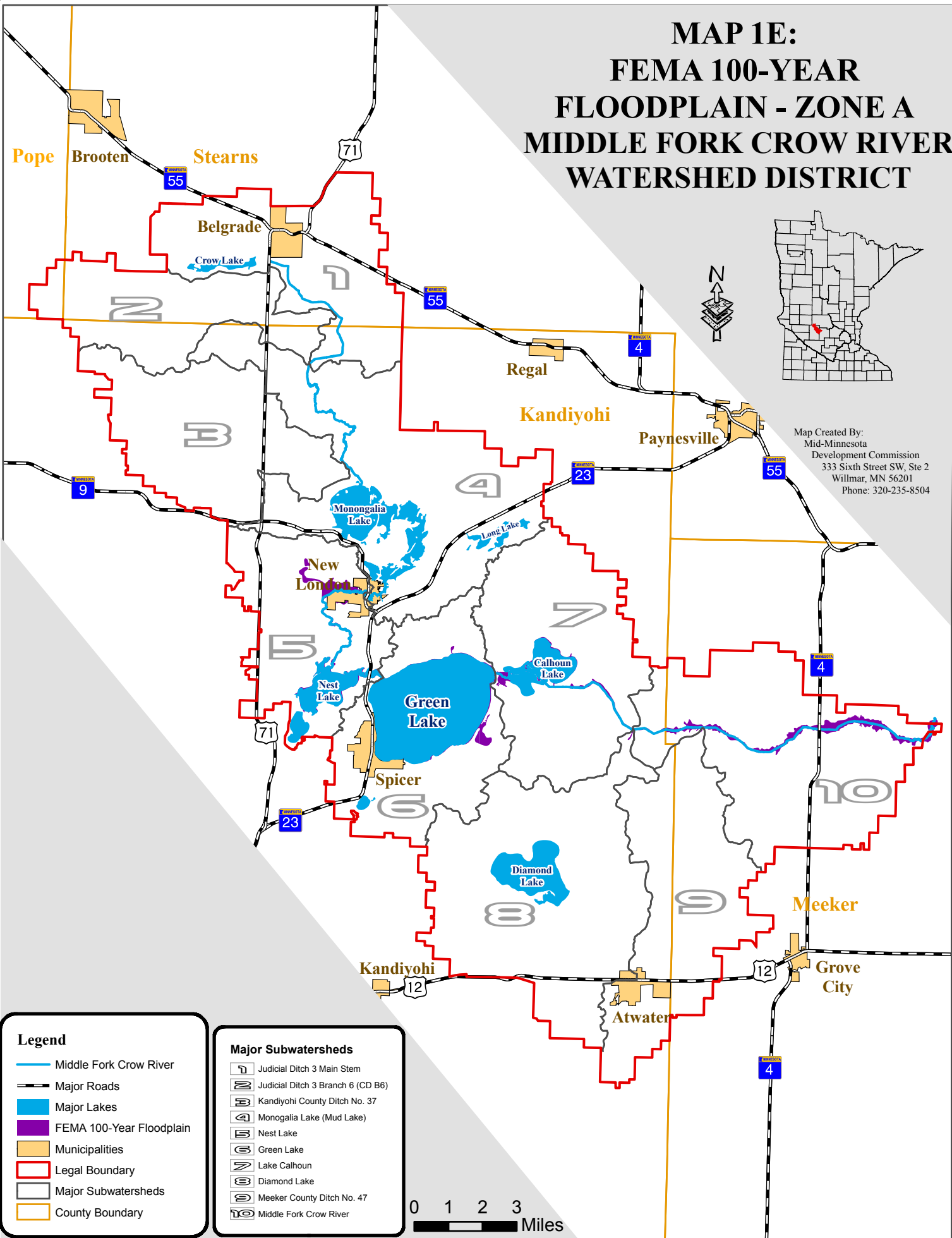
Floodplains

Historically, development has occurred adjacent to waterways and lakes, areas that are often subject to flooding. In order to protect existing property and structures within these areas, the Federal and State governments have enacted laws regulating floodplains. The DNR and the Federal Insurance Administration, under the Federal Emergency Management Agency (FEMA), are responsible for regulating and defining areas of flood hazard, known as the 100-year floodplain. The FEMA 100-year floodplain for the District is identified in Map 1E. Notice that the majority of the designated floodplain is found along the River. Flooding along the River generally impacts adjacent agricultural land and natural areas. The City of New London is the only municipality that is found within the floodplain. The area below the New London Dam is considered vulnerable to flooding. An emergency response plan has been developed for the Dam in the event of a failure. As required by the Floodplain Management Act, all four of the counties within the District have adopted a floodplain ordinance; however, the City of New London has yet to enact its own ordinance.

Public Drainage Ditches

An extensive network of public drainage ditches has been established in the agricultural areas of the District, primarily north of Monongalia Lake and east of Green Lake. As previously mentioned, several segments of the River have also been channelized as part of ditch projects. These systems serve as conveyance systems for surface water and as outlets for subsurface tile line. Nonpoint source pollutants, including bacteria, nutrients, and sediment, commonly degrade drainage systems. These pollutants can impact the quality of other water resources in the District, due to the interconnectiveness of ditches, lakes, and streams. Drainage ditches can also pose a water quantity threat. Ditches are designed to remove large quantities of water in a relatively short duration. As a result, flooding can occur, especially following major storm events and during the spring snowmelt. To minimize potential flooding, upland storage, including wetland restoration, needs to be increased to reduce the overall volume of water transported by ditch systems.

MAP 1E: FEMA 100-YEAR FLOODPLAIN - ZONE A MIDDLE FORK CROW RIVER WATERSHED DISTRICT



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Legend

- Middle Fork Crow River
- Major Roads
- Major Lakes
- FEMA 100-Year Floodplain
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Major Subwatersheds

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0 1 2 3
Miles

Map 1F displays the fifteen public drainage ditches, totaling a combined length of approximately 137 miles, which are found in the District. A complete listing of these ditches and their associated lengths is provided in Table 1H. Drainage systems are regulated under Minnesota State Statutes, Chapter 103E (also known as The Drainage Law). All of the systems are operated under the authority of their respective county(s).

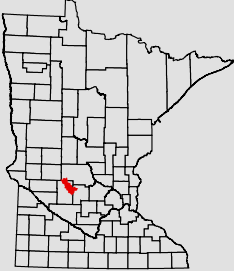
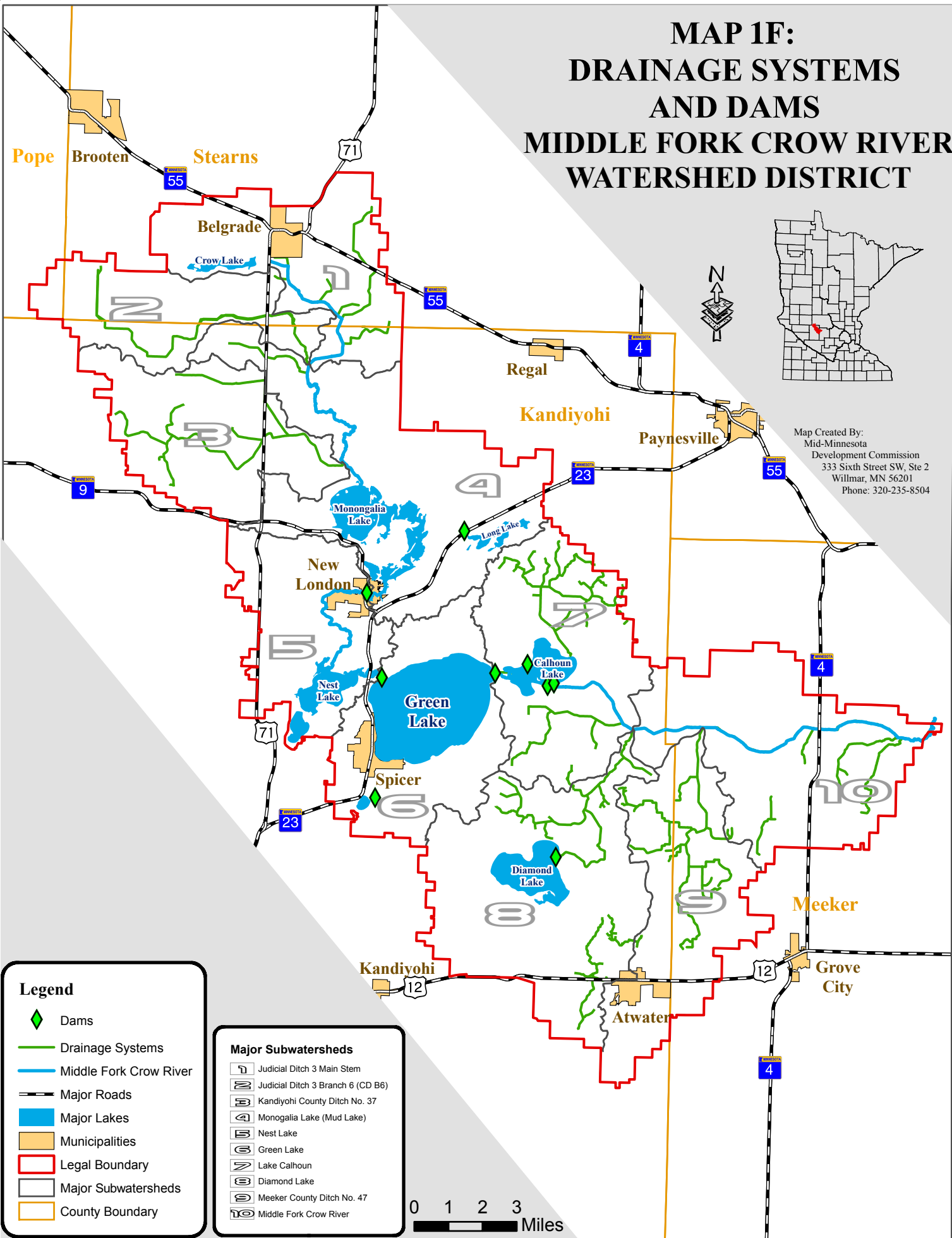
**Table 1H
Public Drainage Ditches**

Ditch	County(s) Served	Length (mi)
County Ditch 9	Kandiyohi	6.7
County Ditch 20	Kandiyohi	6.1
County Ditch 26	Kandiyohi	17.3
County Ditch 28	Kandiyohi	17.0
County Ditch 37	Kandiyohi	18.2
County Ditch 42	Kandiyohi	3.1
County Ditch 45	Kandiyohi	3.9
County Ditch 50	Kandiyohi	2.9
County Ditch 7	Meeker	3.4
County Ditch 11	Meeker	0.8
County Ditch 31	Meeker	2.1
County Ditch 41	Meeker	3.4
County Ditch 47	Meeker	10.9
Judicial Ditch 3	Kandiyohi and Stearns	18.3
Judicial Ditch 17	Kandiyohi and Meeker	22.9
<i>District Total</i>		<i>137.0</i>

Water Control Structures

The water control structures of the District are displayed in Map 1F. Table 1I lists nine water control structures that have been classified as dams by the DNR. All of these dams have been assigned a hazard potential. A dam's hazard potential is rated 1 to 3. The lower the rating a dam receives, the higher the risk for structural, economic, and human life loss if it were to fail. Eight of the structures in the District have been classified as having a hazard potential rating of 3 (the safest rating). Only the New London Dam, which received a hazard potential rating of 1 (the highest risk), received a rating lower than 3. Funding for reconstruction of the New London Dam has been secured and work on the project is expected to begin as early as 2008. The new Dam will have an emergency spillway and will require less overall operation; this will increase overall safety.

MAP 1F: DRAINAGE SYSTEMS AND DAMS MIDDLE FORK CROW RIVER WATERSHED DISTRICT



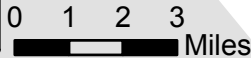
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Legend

- Dams
- Drainage Systems
- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Legal Boundary
- Major Subwatersheds
- County Boundary

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
- Kandiyohi County Ditch No. 37
- Monogalia Lake (Mud Lake)
- Nest Lake
- Green Lake
- Lake Calhoun
- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River



**Table II
Kandiyohi County Dams**

DNR ID	Name	Section	Township	Range	Hazard Potential
MN00067	Calhoun Lake Diversion	28	121N	33W	3
MN00066	Calhoun Lake Outlet	28	121N	33W	3
MN00075	Calhoun Lake West	20	121N	33W	3
MN00069	Diamond Lake	NA	NA	NA	3
MN00498	Elkhorn Lake	25	120N	35W	3
MN00370	Green Lake	30	121N	33W	3
MN00065	Long Lake	6	121N	33W	3
MN00061	Nest Lake	27	121N	34W	3
MN00062	New London	10	121N	34W	1

Aquifers

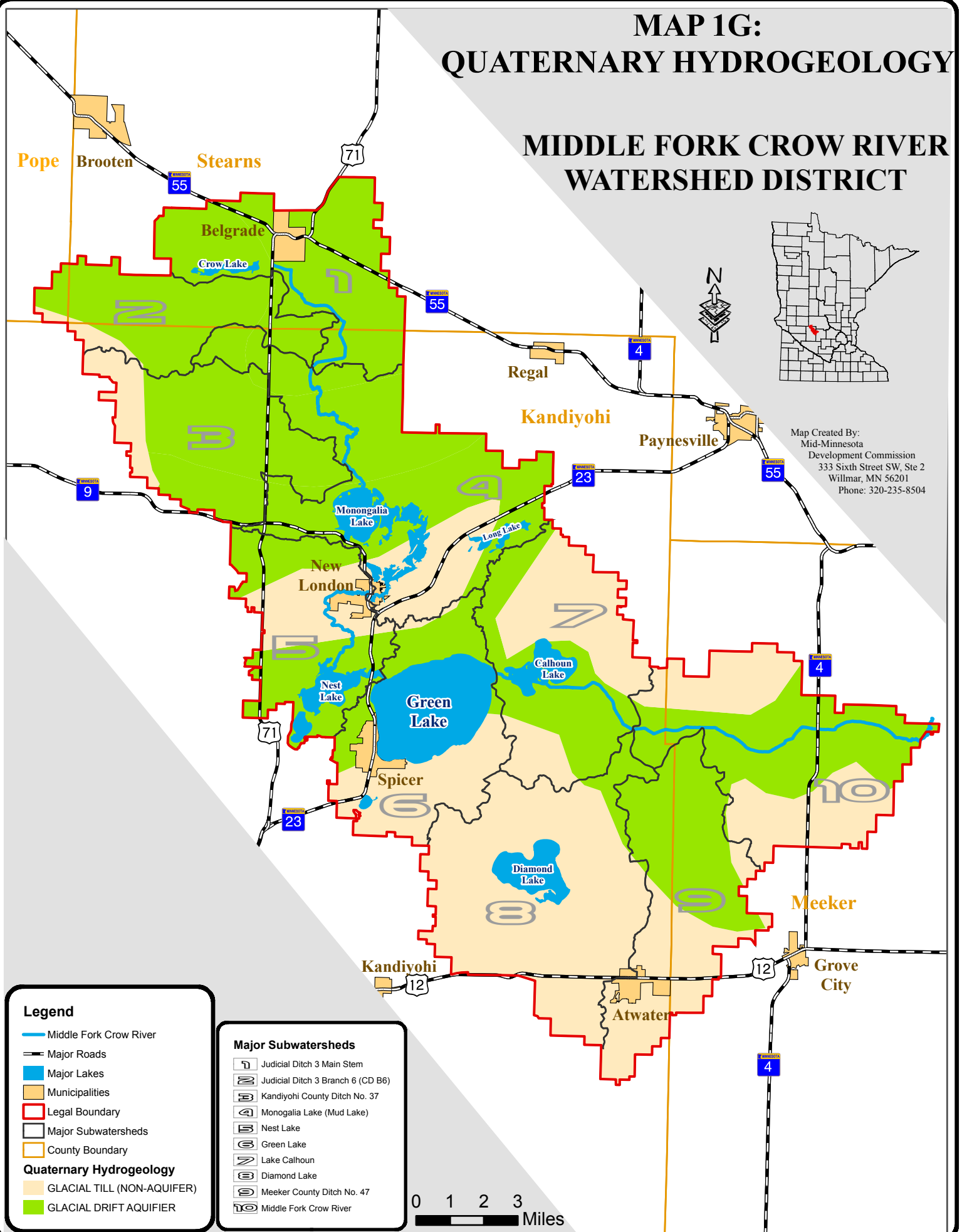
Aquifers are defined as water-bearing porous soil or rock strata that yield significant amounts of water to wells. The two principal aquifer types in the District are glacial drift and bedrock. Glacial drift aquifers, which are the most commonly used domestic and agricultural water sources, include surficial-drift aquifers and buried-drift aquifers. Surficial-drift aquifers are made up of sand or gravel deposits located at or near the surface. These aquifers are generally unconfined and have well depths ranging from 30-240 feet deep, with yields ranging from 25-500 gallons per minute. The water of these aquifers is generally of good quality, with high concentrations of iron and manganese present in some areas. Nitrate contamination is also a significant concern. Buried-drift aquifers are comprised of sand or gravel deposits, but because of repeated glaciation, are confined beneath layers of silt and clay. Well depths in these aquifers range from 80-500 feet deep, with yields of approximately 25-500 gallons per minute. Water from these aquifers generally contains high concentrations of iron, manganese, sulfate, and chloride.

Bedrock aquifers consist of two types in the District: Cretaceous and Precambrian. Cretaceous aquifers are made up of sandstone lenses near the base of a predominant shale section. The water associated with these aquifers is commonly hard and is generally confined. Large sulfate, chloride, and dissolved solids concentrations exist in many areas. Depth to bedrock is approximately 350 feet. These aquifers typically yield 10-250 gallons per minute. Precambrian aquifers are undifferentiated and only exist in faults and fractures. Found at depths of 340 to 500 feet, these aquifers commonly yield 5 to 25 gallons per minute.

Map 1G evaluates the hydrogeologic, or water-bearing, units for the Quaternary deposits (1.6 millions years ago to the present) in the District, as delineated and classified by the MGS. Most of the District is underlain by glacial drift aquifers. These aquifers consist of both surficial and buried drift deposits. The aquifers in the Belgrade Area are largely comprised of unconfined outwash, making them susceptible to groundwater contamination. There are several areas that are void of Quaternary aquifers, especially in the Diamond Lake Area. These areas are served by aquifers within older geologic deposits.

MAP 1G: QUATERNARY HYDROGEOLOGY

MIDDLE FORK CROW RIVER WATERSHED DISTRICT



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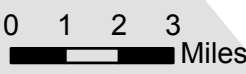
- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Legal Boundary
- Major Subwatersheds
- County Boundary

Quaternary Hydrogeology

- GLACIAL TILL (NON-AQUIFER)
- GLACIAL DRIFT AQUIFER

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
- Kandiyohi County Ditch No. 37
- Monongalia Lake (Mud Lake)
- Nest Lake
- Green Lake
- Lake Calhoun
- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River



D. Land Resources

Geology

The District is underlain with rocks and geologic deposits of pre-Cambrian age (older than 500 million years), Cretaceous age (65 to 130 million years), and Quaternary age (Pleistocene, 1.8 million years to the present). The pre-Cambrian rocks consist of a complex of crystalline granite and mica schist, which represent the basement rock of the region. Their upper surface has weathered to a soft kaolinitic clay that is white where it overlies granite and grayish-green where it overlies schist. Wells drilled by the Green Lake Sanitary Sewer and Water District (GLSSWD) near New London encountered granite at approximately 340 feet.

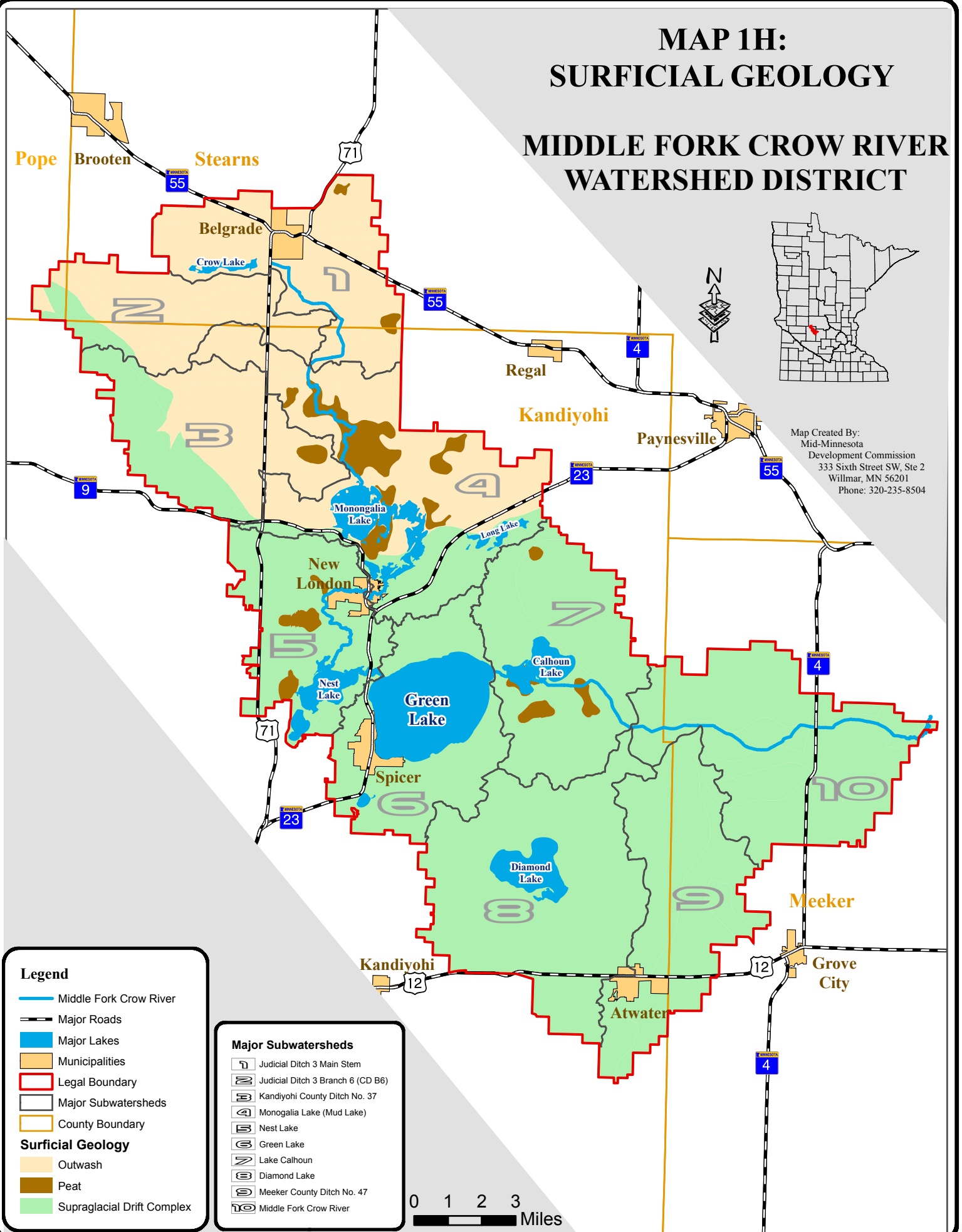
In many locations, a relatively thin layer (<100 ft.) of sedimentary rock overlies the pre-Cambrian rocks. These rocks are of Cretaceous age and generally consist of soft blue or black shale, interbedded with loosely cemented siltstone and sandstone. These sediments were deposited when the Cretaceous sea covered much of the western interior of the North American continent. A test well at the New London fish hatchery encountered sandstone at a depth of 350 feet.

A mantle of Quaternary age glacial drift overlies the bedrock of the entire District. This material was deposited during the pre-Wisconsin (more than 35,000 years ago) and Wisconsin (20,000 to 11,000 years ago) glaciations and ranges in thickness from about 125 to 500 feet. As glaciers advanced southward, they scoured the landscape picking up everything in their path from huge boulders to fine clay particles. As they melted and retreated northward, the material carried by the glaciers accumulated, forming a series of marginal, terminal end moraines. These moraines are part of the Alexandria Moraine Complex, which extends from the west, southeastward through the center of the District. South of the moraine complex the drift is undifferentiated, unsorted, calcareous, primarily gray, silty till. These deposits are commonly 200 to 500 feet thick. North of the moraine complex the drift consists of surficial outwash comprised of fine to coarse-grained sand and gravel, intermixed with some silt and clay. This outwash plain, which extends from Glenwood southeast to Lake Koronis, ranges from 0-100 feet thick (commonly 20 to 50 feet) and overlays drift of an earlier glacial advance. The surficial geology of the District is shown in Map 1H.

The water resources of the District were formed as a result of glacial action and subsequent geomorphic processes. In the past 10,000 years, the River has eroded its way through a gap in the moraine complex, thereby establishing the present stream network. The New London and Nest Lake dams are located where the complex intersects the River. These are areas where the effort required to build a dam would be minimal. Many of the lakes in the District, including Green Lake and Nest Lake, are categorized as “ice-block basins in till” (Zumberge, 1952). This means the basins were created as a result of the melting of huge ice blocks that were buried in the glacial drift some 10,000 years ago. Zumberge, in discussing the glacial geology of the rugged moraine belt that runs through the area, mentions that it was formed by the “concentrated deposition of drift at the ice edge during extended pauses in the general retreat of the ice front. At each pause a ridge of hills was built along the ice margin, and ice blocks that became stagnated and detached from the main ice mass were buried under debris that was heaped into the moraines. Later, when the main glacier retreated back to a new position, the buried ice blocks melted and left depressions now occupied by water. These ice-block basins in till, or ice-block basins in outwash, make up the bulk of the lakes in the huge end-moraine belt.”

MAP 1H: SURFICIAL GEOLOGY

MIDDLE FORK CROW RIVER WATERSHED DISTRICT



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Legend

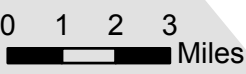
- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Legal Boundary
- Major Subwatersheds
- County Boundary

Surficial Geology

- Outwash
- Peat
- Supraglacial Drift Complex

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
- Kandiyohi County Ditch No. 37
- Monogalia Lake (Mud Lake)
- Nest Lake
- Green Lake
- Lake Calhoun
- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River



Topography

The topography of the District is depicted in Map 1I. Generally, elevations within the District range from approximately 1,150 to 1,300 feet above sea level. The highest point is found in Section 18 of Irving Township, at an elevation of 1,411 feet above sea level. The lowest point in the District is found at the mouth of the River, at an elevation of 1,092 feet above sea level.

Soils

Soils develop from the breakdown of unconsolidated parent material, intermixed with plant and animal remains. Their formation is an extremely long process, taking place over hundreds to thousands of years. The soils of the District developed from glacial drift materials that were deposited during the last glaciation more than 10,000 years ago. Besides parent material, factors influential in soil genesis include climate, organisms, topography, and time.

An intricate relationship exists between soil and water resources. Properly managed, soil can act as a filter for pollutants, chemically fixing or degrading contaminants; septic systems and wetlands function in this manner. Conversely, soil can be a source of pollution if improperly managed. Without adequate vegetative cover, soil can be eroded by the action of water and wind. When sediment is deposited in a water body, clarity decreases and temperature increases. In addition, nutrients adsorbed to soil particles can contribute to eutrophication.



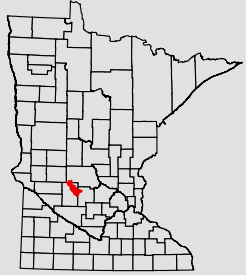
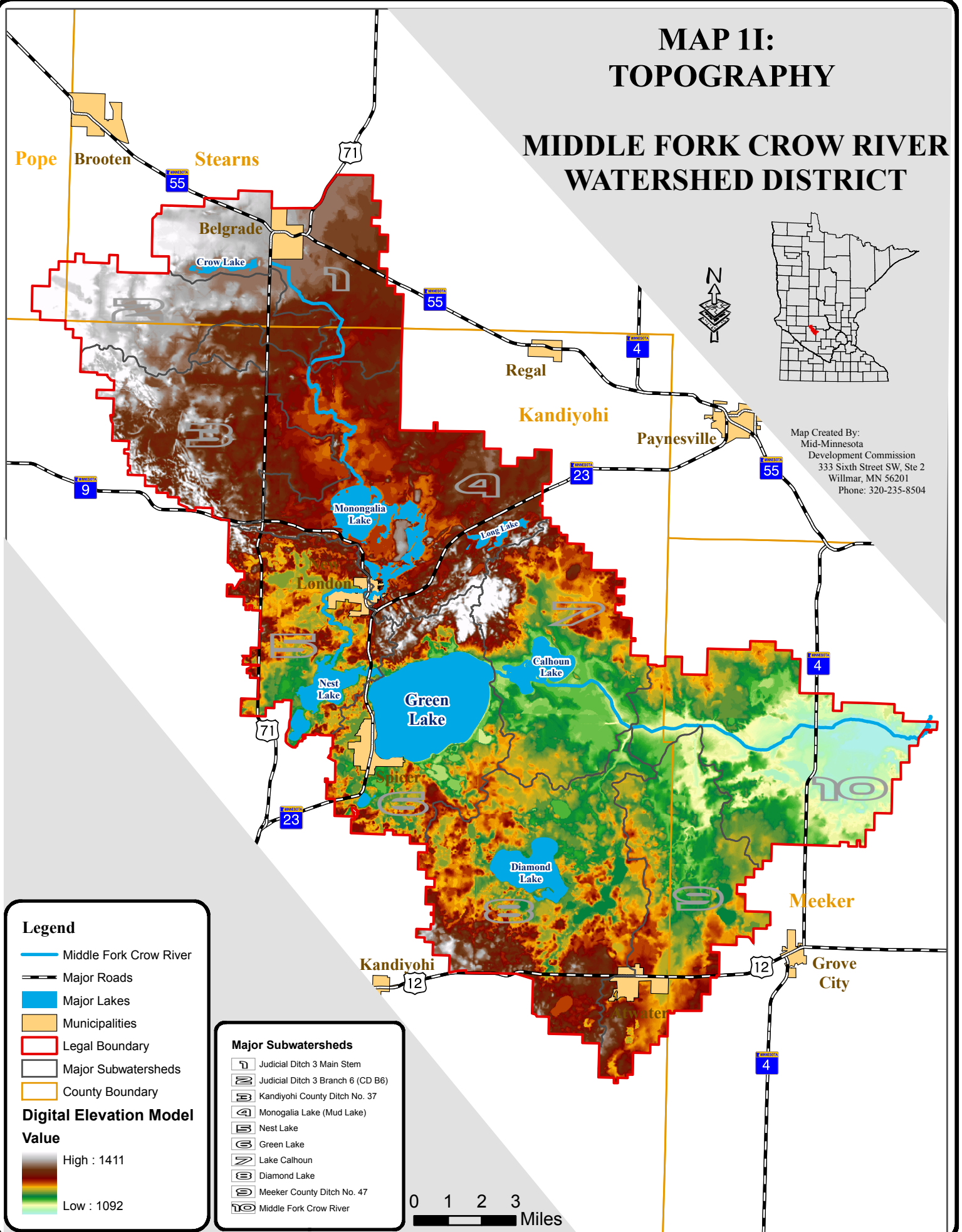
*Profile of Wadena loam
(Photo courtesy of NRCS)*

The 11 major soil associations of the District are shown in Map 1J. A brief description of each association is also provided.

1. ***Cohoctah-Muskego-Estherville Association.*** Soil textures for this association include sandy loam, loam, and muck. Infiltration is generally good to poor. Common landform settings for this association include floodplains and terraces. Slopes range from 0 to 6 percent. This association comprises 0.1 percent of the District.
2. ***Estherville-Hawick-Lena Association.*** Soil textures for this association include loam and sandy loam. Infiltration is generally poor. Common landform settings for this association include moraines and outwash plains. Slopes range from 0 to 18 percent. This association comprises 39.2 percent of the District.
3. ***Fieldon-Litchfield-Dassel Association.*** Soil textures for this association include sandy loam and loam. Infiltration is generally good to poor. Common landform settings for this association include outwash plains and terraces. Slopes range from 0 to 6 percent. This association comprises 0.7 percent of the District.
4. ***Guckeen-Marna Association.*** Soil textures for this association include loam and clay loam. Infiltration rates range from good to poor. Common landform settings for this association include moraines and till plains. Slopes range from 0 to 18 percent. This association comprises 1.1 percent of the District.

MAP 11: TOPOGRAPHY

MIDDLE FORK CROW RIVER WATERSHED DISTRICT



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Legend

- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Legal Boundary
- Major Subwatersheds
- County Boundary

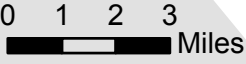
Digital Elevation Model Value

High : 1411

Low : 1092

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
- Kandiyohi County Ditch No. 37
- Monogalia Lake (Mud Lake)
- Nest Lake
- Green Lake
- Lake Calhoun
- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River



5. ***Kanaranzi-Estherville-Biscay Association.*** Soil textures for this association include silt loam, loam, and clay loam. Infiltration is generally fair to poor. Common landform settings for this association include floodplains and terraces. Slopes range from 0 to 40 percent. This association comprises 4.5 percent of the District.
6. ***Koronis-Forestcity-Houghton Association.*** Soil textures for this association include sandy loam, loam, and muck. Infiltration is good to poor. The common landform setting for this association is moraines. Slopes range from 0 to 12 percent. This association comprises 0.4 percent of the District.
7. ***Koronis-Hawick-Sunburg Association.*** Soil textures for this association include loam and sandy loam. Infiltration is generally good. The common landform setting for this association is outwash plains. Slopes range from 2 to 35 percent. This association comprises 14.9 percent of the District.
8. ***Regal-Osakis Association.*** Soil texture for this association is a loam. Infiltration rates generally range from fair to poor. The common landform setting for this association is outwash plains. Slopes range from 0 to 3 percent. This association comprises 3.1 percent of the District.
9. ***Swedegrove-Grovecity-Lundlake Association.*** Soil textures for this association include loam and silty clay loam. Infiltration ranges from fair to poor. The common landform setting for this association is moraines. Slopes range from 0 to 3 percent. This association comprises 3.5 percent of the District.
10. ***Wadenill-Sunburg-Delft Association.*** Soil texture for this association is a loam. Infiltration ranges from good to poor. Common landform settings for this association include moraines and till plains. Slopes range from 2 to 35 percent. This association comprises 25.7 percent of the District.
11. ***Wadenill-Swedegrove-Muskego Association.*** Soil textures for this association include loam and muck. Infiltration ranges from good to poor. The common landform setting for this association is moraines. Slopes range from 0 to 12 percent. This association comprises 6.8 percent of the District.

Land Cover

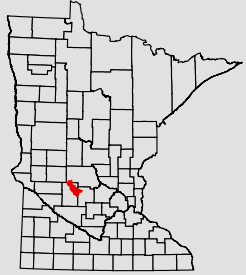
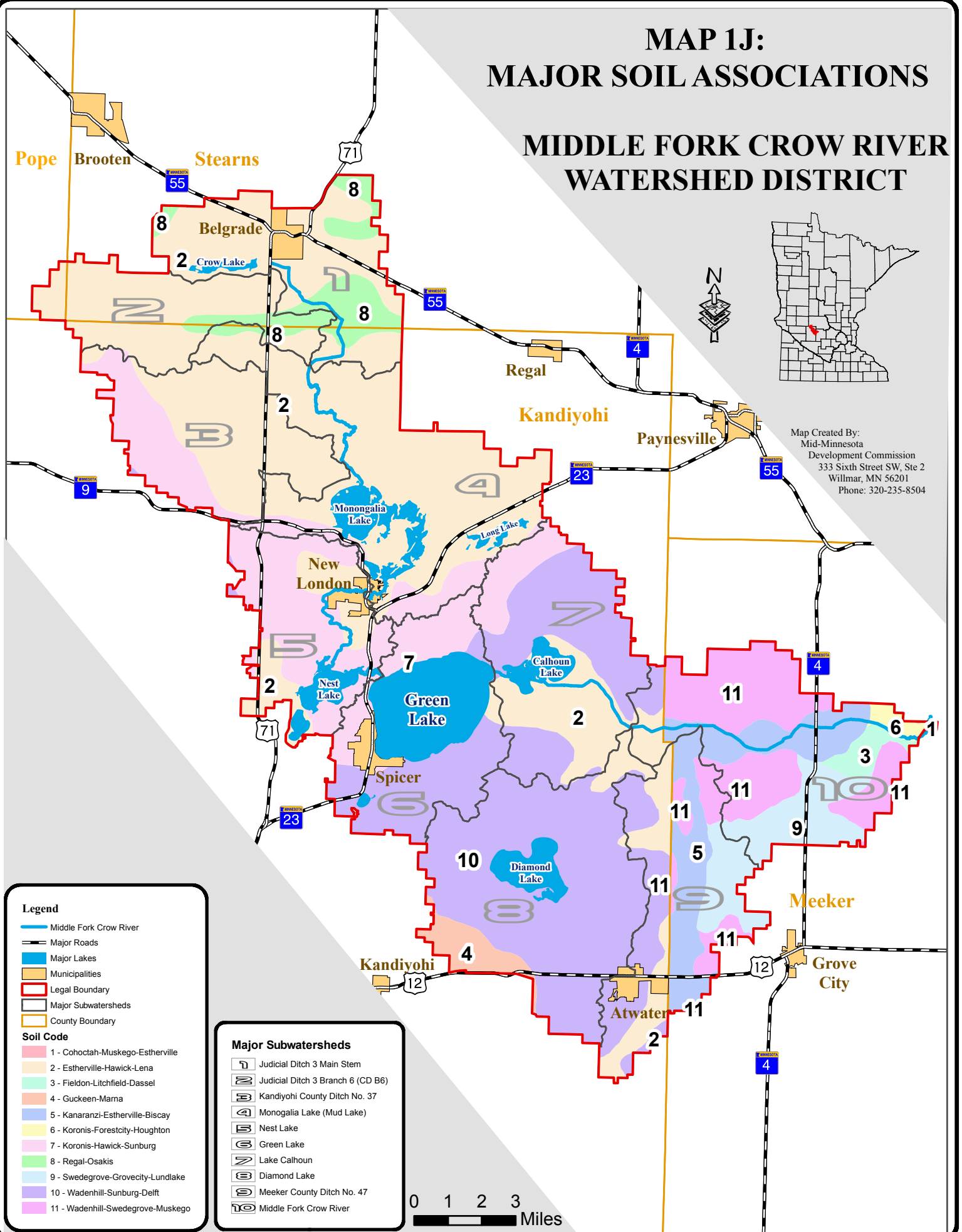
Presettlement Vegetation

The DNR has inventoried the original vegetation of the State through its Presettlement Vegetation Database. Presettlement vegetation was determined by analyzing the detailed maps and records of early surveyors (circa 1895). The purpose of this database was to enable analysis of presettlement vegetation patterns for determining natural community potential and patterns of disturbance. The presettlement vegetation of the District is presented in Map 1K.



MAP 1J: MAJOR SOIL ASSOCIATIONS

MIDDLE FORK CROW RIVER WATERSHED DISTRICT



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Legend

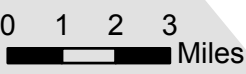
- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Legal Boundary
- Major Subwatersheds
- County Boundary

Soil Code

- 1 - Cohoctah-Muskego-Estherville
- 2 - Estherville-Hawick-Lena
- 3 - Fieldon-Litchfield-Dassel
- 4 - Guckeen-Marna
- 5 - Kanaranzi-Estherville-Biscay
- 6 - Koronis-Forestcity-Houghton
- 7 - Koronis-Hawick-Sunburg
- 8 - Regal-Osakis
- 9 - Swedegrove-Grovecity-Lundlake
- 10 - Wadenhill-Sunburg-Delft
- 11 - Wadenhill-Swedegrove-Muskego

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
- Kandiyohi County Ditch No. 37
- Monogalia Lake (Mud Lake)
- Nest Lake
- Green Lake
- Lake Calhoun
- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River



Much like today, the District contained a unique mixture of forest and prairie prior to settlement. A large area of forested land stretched through the heart of the basin, from Belgrade to Diamond Lake. Deciduous trees including aspen, oak, maple, basswood, and hickory were common in this area. The oak openings and barrens vegetation type served as a common transition between prairie and forest ecosystems. Fire, more so than topography and climate, was the primary factor influencing the location and extent of this vegetation type. The outer margins of the District were dominated by prairie vegetation. Big bluestem and Indian grass occupied the deep soils of the moist uplands, while little bluestem and side oats grama covered the thin soils of the dry uplands. In general, bluejoint, prairie cordgrass, rushes, and sedges dominated the lowland areas and wetlands.

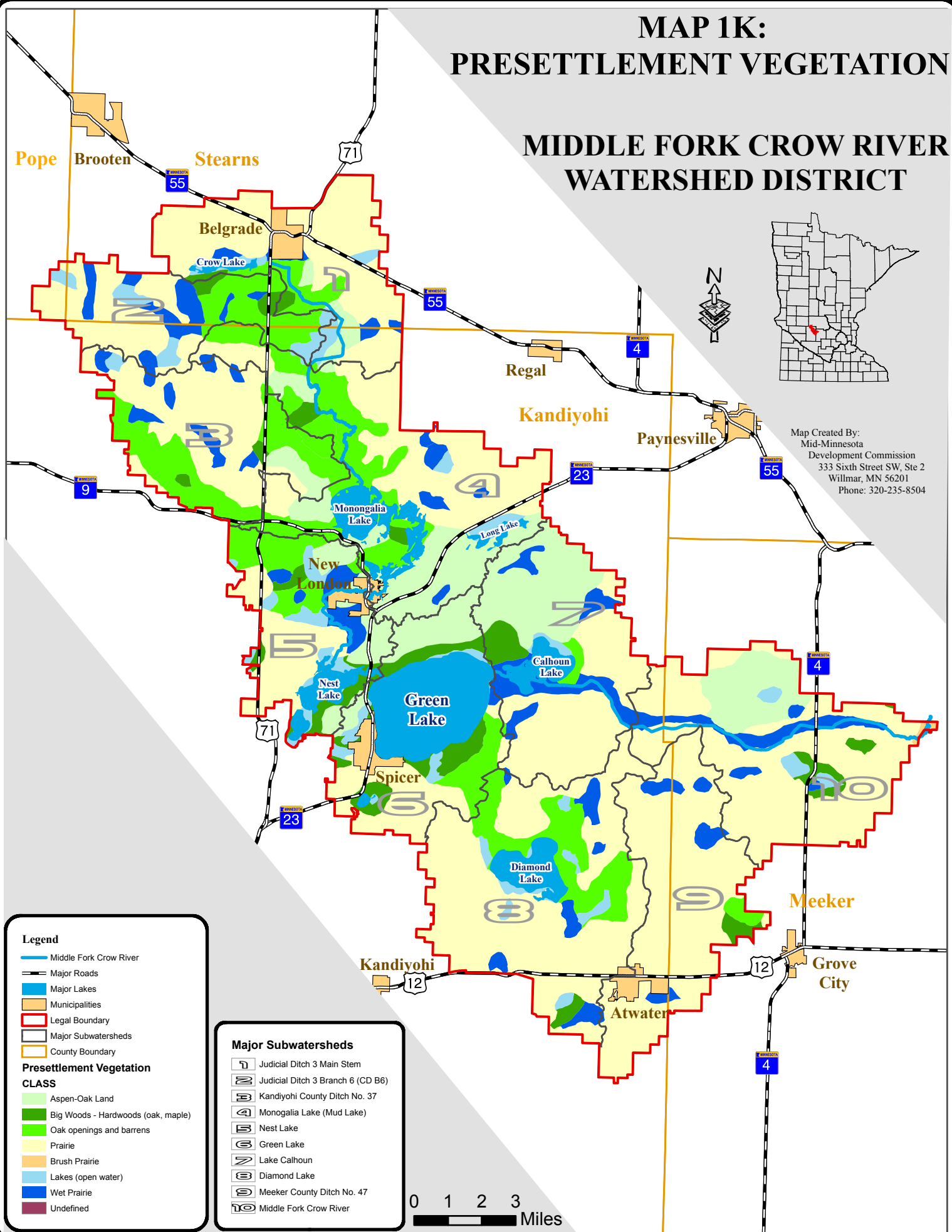
Land Use (2000)

The University of Minnesota, Remote Sensing and Geospatial Analysis Laboratory developed the *Minnesota 2000 Level 1 Landsat Landcover Classification*, which offers the most recent land use data for the District. The landcover type was derived via multitemporal, multispectral supervised image classification of satellite imagery acquired by the Landsat TM and Landsat ETM+ satellites. The results of the inventory are reproduced in Map 1L. A seven-category classification scheme was developed to categorize data. The following describes the types of land uses found in each category.

- ***Agriculture*** - An area where the primary cover type during the growing season is an agricultural covertype, including row crops, forage crops, and small grains. Examples: corn, soybeans, alfalfa, oats, wheat, and barley.
- ***Forest*** - An upland area of land covered with woody perennial plants, the tree reaching a mature height of at least 6 feet tall with a definite crown. To be considered a forested cover type the stand must have a combined species minimum of 3 cords/acre or 1,251 bdf/acre or 251 stems per acre depending on size class (MNCSA Standards). Examples: white pine, red pine, oak, mixed conifer, and mixed deciduous.
- ***Grassland*** - An upland area covered by cultivated or non-cultivated herbaceous vegetation predominated by grasses, grass-like plants, and forbs. Includes non-agricultural upland vegetation dominated by short manicured grasses and forbs, as well as non-cultivated herbaceous upland vegetation dominated by native grasses and forbs. Examples: golf courses, lawns, athletic fields, dry prairies, and pastures.
- ***Shrubland*** - An upland or lowland area with vegetation that has a persistent woody stem, generally with several basal shoots, low growth of less than 20 feet in height. Area has less than 251 stems per acre of commercial tree species, the shrub species are fairly uniformly distributed throughout and the density of the coverage is moderate to high. Examples: alder, willow, buckthorn, hazel, sumac, and scrub oak.
- ***Urban/Developed*** - An area containing any amount of impervious cover of man-made solid materials or compacted soils, including areas with interspersed vegetation. Examples: parking lots, shopping malls, warehouses, industrial parks, highways, sparse development, single family residential developments, single lane roads, and mines.
- ***Water*** - An area of open water with none or very little above surface vegetation. Examples: lakes, streams, rivers and open wetlands.
- ***Wetland*** - A lowland area with a cover of persistent and non-persistent herbaceous plants standing above the surface of wet soil or water. Examples: cattails, marsh grass, sedges, and peat.

MAP 1K: PRESETTLEMENT VEGETATION

MIDDLE FORK CROW RIVER WATERSHED DISTRICT



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Legend

- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Legal Boundary
- Major Subwatersheds
- County Boundary

Presettlement Vegetation CLASS

- Aspen-Oak Land
- Big Woods - Hardwoods (oak, maple)
- Oak openings and barrens
- Prairie
- Brush Prairie
- Lakes (open water)
- Wet Prairie
- Undefined

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
- Kandiyohi County Ditch No. 37
- Monogalia Lake (Mud Lake)
- Nest Lake
- Green Lake
- Lake Calhoun
- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River



**Table 1J
Land Use Analysis (2000)**

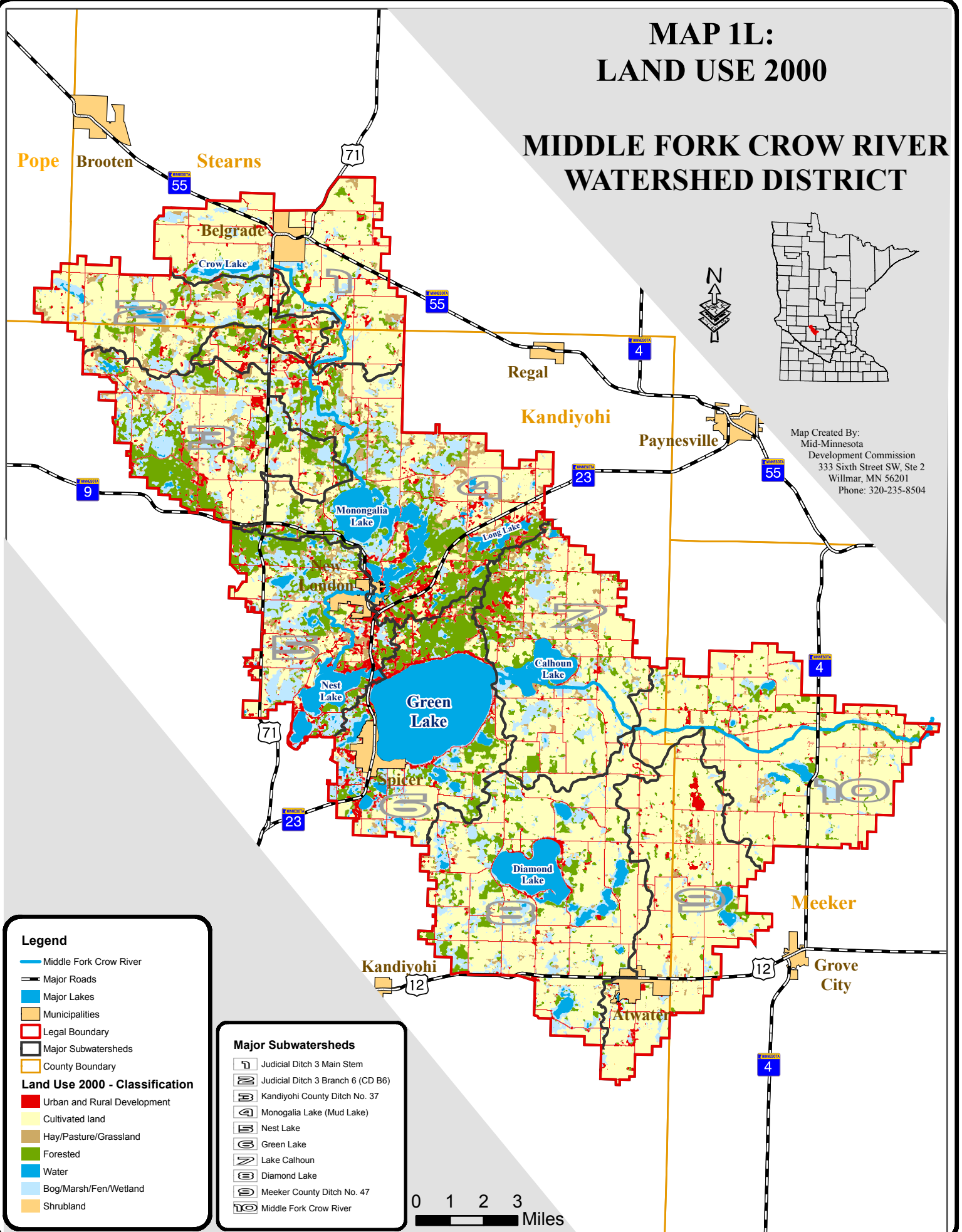
Land Use	Area (ac)	District (%)
Agriculture	88,998	51.4
Forest	23,318	13.5
Wetland	22,599	13.0
Urban/Developed	14,596	8.4
Water	13,940	8.0
Grassland	9,143	5.3
Shrubland	22,599	0.4
Total	173,220	100.0

According to Table 1J, agricultural land is the predominant land use in the District, comprising more than half of its area (51.4%). Much of this land is found north of Monongalia Lake and east of Green Lake. Other major land uses include Forest (13.5%), Wetland (13.0%), Urban/Developed (8.4%), and Water (8.0%). These land uses are primarily distributed in the central portion of the District, specifically the New London-Spicer Area. Grassland (5.3%) and Shrubland (0.4%) are relatively minor land uses.

Several other estimates exist for the amount of water in the District. The USGS's publication *Physical Characteristics of Stream Subbasins in the North Fork Crow-Crow River Basin, South-Central Minnesota* states that cumulative storage area of the Watershed, which includes lakes and wetlands, is 24.8%. In addition, a land use inventory was conducted as part of the Middle Fork Crow River CWP. The inventory found that water represented 34% of the land area of the Watershed. However, it is important to note that this inventory did not take into consideration the heavily agricultural eastern portion of the Watershed. The "true" percentage of water in the District likely resides somewhere between the three estimates.

MAP 1L: LAND USE 2000

MIDDLE FORK CROW RIVER WATERSHED DISTRICT



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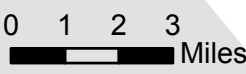
- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Legal Boundary
- Major Subwatersheds
- County Boundary

Land Use 2000 - Classification

- Urban and Rural Development
- Cultivated land
- Hay/Pasture/Grassland
- Forested
- Water
- Bog/Marsh/Fen/Wetland
- Shrubland

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
- Kandiyohi County Ditch No. 37
- Monongalia Lake (Mud Lake)
- Nest Lake
- Green Lake
- Lake Calhoun
- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River



Public Land Ownership

The majority of land in the District is privately owned. Based on available data from local, State and Federal agencies, public land accounts for only 3.2 percent of the area of the District. Table 1K presents an inventory of the major public lands. The DNR, Division of Fish and Wildlife (2,057) and USFWS (1,685) manage the most public land. Map 1M displays the major public lands in the District.

**Table 1K
Public Lands Inventory**

Public Agency	Number of Tracts	Area (ac)
DNR, Division of Fish and Wildlife	10	2,057
USFWS - Waterfowl Production Areas	12	1,685
DNR, Division of Parks and Recreation	1	877
County	8	525
DNR, Division of Forestry	4	199
MnDOT	4	158
<i>District Total</i>	<i>39</i>	<i>5,501</i>

Wildlife Management Areas

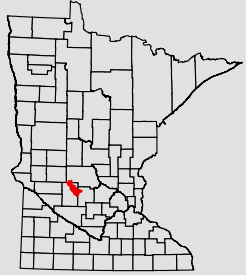
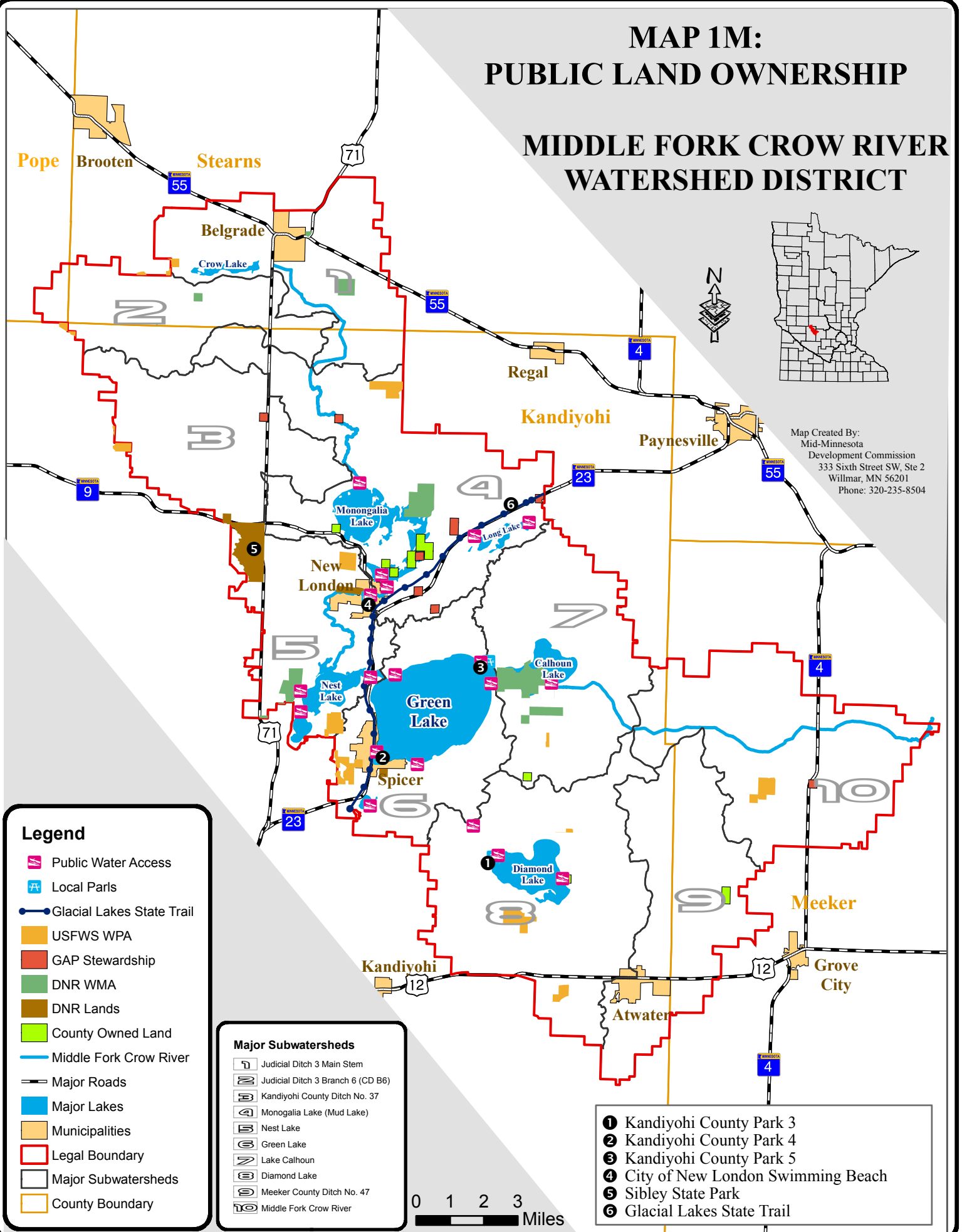
Wildlife Management Areas (WMA) are State owned lands that are managed by the DNR, Division of Fish and Wildlife for wildlife production. These areas are open to public hunting and wildlife watching. Funding for the acquisition and maintenance of WMAs primarily comes from a surcharge on small game licenses. Conservation clubs also donate money to support habitat projects on these lands. According to Table 1L, there are 8 WMAs in the District, totaling 1,919 acres.

**Table 1L
Wildlife Management Areas**

WMA Name	Township	Range	Section	Area (ac)
Burbank WMA	122N	34W	26	447
Crow River WMA	123N	34W	28	155
Dietrich Lange WMA	121N	33W	29	902
Fish Lake WMA	123N	35W	34	1
Follies WMA	122N	34W	2	2
Gravel Pit 1062 WMA	123N	34W	20	15
Norman Dahlman WMA	123N	35W	34	41
Ringo-Nest WMA	121N	34W	29	356
<i>District Total</i>				<i>1,919</i>

MAP 1M: PUBLIC LAND OWNERSHIP

MIDDLE FORK CROW RIVER WATERSHED DISTRICT



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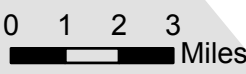
Legend

- Public Water Access
- Local Parks
- Glacial Lakes State Trail
- USFWS WPA
- GAP Stewardship
- DNR WMA
- DNR Lands
- County Owned Land
- Middle Fork Crow River
- Major Roads
- Major Lakes
- Municipalities
- Legal Boundary
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- County Boundary

Major Subwatersheds

- Judicial Ditch 3 Main Stem
- Judicial Ditch 3 Branch 6 (CD B6)
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- Diamond Lake
- Meeker County Ditch No. 47
- Middle Fork Crow River

- 1** Kandiyohi County Park 3
- 2** Kandiyohi County Park 4
- 3** Kandiyohi County Park 5
- 4** City of New London Swimming Beach
- 5** Sibley State Park
- 6** Glacial Lakes State Trail



Waterfowl Production Areas

Waterfowl Production Areas (WPA) are a component of the National Wildlife Refuge System and are managed by the USFWS. The overall goal of the WPA program is to preserve wetlands and grasslands that are critical to waterfowl and other wildlife. Among the recreational opportunities that these areas provide to the public include hunting, fishing, and wildlife watching. Funding for the program comes from a surcharge on all Duck Stamp sales. Table 1M lists the 12 WPAs that are located within the District.

Table 1M
Waterfowl Production Areas

WPA Name	Township	Range	Section(s)	Area (ac)
Allen	121N	34W	33	200
Burbank	122N	34W	9	222
Carlson Lake	120N	34W	3,10	267
Colfax	122N	35W	23	90
Crow Lake	123N	35W	27,28	69
Harrison	120N	33W	3	25
Miller Hills	122N	36W	6	43
Miller Lake	120N	32W	10	225
New London	121N	34W	3	162
Sperry Lake	120N	33W	15	16
Summit Lake	119N	33W	10	99
Uncle Matt's Lake	120N	33W	32	265
<i>District Total</i>				<i>1,685</i>

Public Water Accesses

Public water accesses in the District are operated through a cooperative effort between local governmental units and State agencies. These accesses provide free access for boating activities on lakes and streams. In addition, several accesses have amenities for non-boaters, including fishing piers and shore fishing sites. Funding for the development and maintenance of access sites primarily comes from a fee on boat licenses and the local tax base. Information on each of the 19 public water accesses in the District is provided in Table 1N. The DNR and Kandiyohi County operate the majority of accesses.

**Table 1N
Public Water Accesses**

Waterbody	Ramp Type	Administrator
Bass Lake	Gravel	Green Lake Township
Calhoun Lake	Plank	DNR
Diamond Lake (E)	Plank	Kandiyohi County
Diamond Lake (W)	Plank	Kandiyohi County
Elkhorn Lake	Plank	DNR
George Lake	Plank	DNR
Green Lake (E)	Plank	Irving Township
Green Lake (NE)	Plank	Kandiyohi County
Green Lake (NW)	Asphalt	New London Township
Green Lake (S)	Plank	Green Lake Township
Green Lake (SW)	Plank	DNR
Long Lake (E)	Gravel	Roseville Township
Long Lake (W)	Plank	DNR
Middle Fork Crow River, CSAH 9	Plank	Kandiyohi County
Middle Fork Crow River, CSAH 31	Plank	Kandiyohi County
Middle Fork Crow River, Mill Pond	Plank	DNR
Monongalia Lake	Plank	DNR
Nest Lake (E)	Asphalt	MnDOT
Nest Lake (W)	Plank	DNR

State Parks and Trails

Sibley State Park - is located at the western edge of the District, three miles west of New London. Approximately 30% of the 2,500-acre park is within the District. The Park is named after Henry Hastings Sibley, Minnesota's first governor, who used the surrounding woods as his hunting grounds. This land was purchased by the State in 1919. One of the main attractions of Sibley State Park is Lake Andrew, which is not in the District. The Park provides a boat access, swimming beach, and fishing pier, along with numerous other water-related activities. A total of 138 family campsites are also available.

Glacial Lakes State Trail - extends from Willmar to Hawick and is located on the former Burlington Northern Railroad grade. The trail is paved with asphalt for 12 miles between Willmar and New London. From New London to Hawick is a 6-mile long trail surfaced with crushed granite. Primary uses of the trail include hiking, bicycling, horseback riding, in-line skating, and snowmobiling. The trail connects many of the parks in the New London-Spicer Area.

County and Municipal Parks

Kandiyohi County Park 3 - is located on the western shore of Diamond Lake, approximately four miles north of the City of Atwater or six miles southeast of the City of Spicer. Diamond Lake is known for its good walleye and northern populations. The park has 70 paved campsites, most with electricity.

Kandiyohi County Park 4 - is located on the southern shore of Green Lake in the City of Spicer. The park has an excellent swimming beach and a shady picnic area. There are also changing rooms and toilet facilities, but no campsites are available. The park attracts many daytime users due to its close proximity to the many amenities that Spicer offers.

Kandiyohi County Park 5 - is located on the northeastern shore of Green Lake, approximately five miles from the City of Spicer. The park has 45 paved camping sites with electricity.

City of New London Swimming Beach - is located at 12 Second Avenue Southwest. It has a sandy beach, a covered shelter with a fireplace, picnic tables, and a restroom. A lifeguard is also on duty during the summer months.