Cedar River Watershed District

Watershed Management Plan

Chapter 2: Physical Environment Inventory

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2.0 Physical Environment Inventory

This chapter of the Cedar River Watershed District (CRWD) *Watershed Management Plan* (Plan) provides a technical description of the CRWD. General concepts and data related to land use, climate, topography, watersheds, soils, geology, surface water resources data, pollutant sources, recreational areas, and habitat are discussed.

2.1 Land Use

The CRWD covers 435 square miles or 278,463 acres. Pre-settlement vegetation in this area was bur oak savanna, with areas of tallgrass prairie and maple-basswood forest. Tallgrass prairie was concentrated on level to gently rolling topography. Bur oak savanna was found on rolling moraine ridges. Maple-basswood forest was found in areas protected from fire, typically in steep ravines or near streams.

Figure 2-1 shows current land use, as taken from the 2001 National Land Cover Dataset (NLCD). Cultivated crops occupy 82.8 percent of the watershed's total land area, developed open space occupies 6.6 percent of the watershed's total land area, and grasslands occupy 4.1 percent of the watershed's total land area. According to the *Mower County Local Water Management Plan 2006-2015,* Mower County ranked 10th and 13th in 1999 in Minnesota for corn and soy bean production, respectively. Very few acres in the CRWD have been issued permits for agricultural irrigation. A summary of the 2001 NLCD land use for CRWD is listed in **Table 2-1**.

Table 2-1 Cedar River Watershed District Land Use Areas

Land Use	Area (acres)	Percent Area of Watershed District
Barren Rock (Rock/Sand/Clay)	66	0.02%
Cultivated Crops	230,645	82.83%
Deciduous Forest	2,952	1.06%
Developed Open Space	18,428	6.62%
Developed, High Intensity	343	0.12%
Developed, Low Intensity	4,690	1.68%
Developed, Medium Intensity	980	0.35%
Emergent Herbaceous Wetlands	775	0.28%
Evergreen Forest	36	0.01%
Grassland	11,390	4.09%
Open Water	354	0.13%
Pasture/Hay	3,473	1.25%
Woody Wetlands	4,330	1.55%
Total	278,463	100%

Land use data is an important factor for estimating surface water runoff. The hard or impervious surface areas associated with each land use greatly affect the amount of runoff generated from an area. Significant changes in land use can increase runoff due to added impervious surfaces, soil compaction and changes to drainage patterns. Row crops, such as corn and soy beans, increase the risk of erosion and of elevated total suspended solids levels in streams because the land can be without vegetation cover for major periods of time due to the short Minnesota growing season.

Although Dodge and Steele Counties are expected to experience a large percent increase in population growth by 2035 (as seen in **Table 2-2)**, it is expected that the majority of this growth will be in Owatonna and Dodge Center, outside of the CRWD. It is expected that the land use in the CRWD will remain largely agricultural for at least the next 30 years. The City of Austin adopted a Comprehensive Growth Plan in 2000 that focuses on the planned growth of the city for the subsequent 10 years.

Table 2-2 Estimated Future Population by County

County	2005 Population	2035 Population	% Change Population
Dodge	19,833	28,800	45.2
Freeborn	32,266	31,940	-1.0
Mower	39,210	41,210	5.1
Steele	36,165	47,200	30.5

Source: Minnesota State Demographic Center, June 2007, *Minnesota Population Projections,* (http://www.demography.state.mn.us)

2.2 Climate and Precipitation

Because of its location near the center of the North American continent, the CRWD (and Minnesota) has a continental climate, meaning it experiences a wide variation in climate conditions (e.g., droughts and floods, heat and cold).

The mean annual temperature for Austin is 43.2°F, as measured at the Austin Wastewater Treatment Facility for the time period of 1971-2000 (National Oceanic and Atmospheric Administration (NOAA) Cooperative Station Austin 3 S, ID 210355, in service since December 1, 1948). Mean monthly temperatures vary from 10.9°F in January to 70.0°F in July (1971-2000). Extreme temperatures recorded were a high of 100°F on June 21, 1988 and a low of -42°F on January 15, 1963 and January 19, 1970. For the period 1971-2000, the average date for latest occurrence of freezing temperatures is May 2, while the average date for the first autumn frost is September 29. The average frost-free period (growing season) is approximately 150 days.

Table 2-3 summarizes precipitation data for the Austin station. Average total annual precipitation (1971-2000) is 31.97 inches at the Austin station and has ranged for the period of record since 1948 from a low of 17.73 inches in 1976, to a high of 46.01 inches in 1993. The mean monthly precipitation (1971-2000) varies from 4.51 inches in August to 0.96 inches in January. From May to September, the growing season months, the average rainfall (1971-2000) is 20.4 inches at Austin or about 64 percent of the average annual precipitation. Average annual lake evaporation is about 33 inches according to the *Minnesota Hydrology Guide* (NRCS, 1975).

Table 2-3 Precipitation Summary—Austin Station A*verages: 1971-2000*
Extremes: 1937-2001

Total Precipitation, Inches								Snow, inches			# Days with Precip		
Month	**Mean**	**High—Yr**		**Low—Yr**		**1-Day Max**		**Mean**	**High—Yr**		**≥ .10**	**≥ .50**	**≥ 1.0**
Jan	0.96	3.68	1976	0.00	1983	2.53	1/22/1973	11.8	25.2	1996	2.2	0.5	0.1
Feb	0.57	3.02	1971	0.00	1975	1.04	2/27/1948	6.5	23.1	1959	1.6	0.3	0.0
Mar	1.62	4.31	1995	0.00	1984	1.94	3/26/1950	5.4	27.3	1951	3.8	1.3	0.3
Apr	3.11	7.09	1999	0.18	1983	2.67	4/23/1990	2.5	13.8	1962	6.6	2.0	0.7
May	4.05	7.69	2000	1.05	1949	3.50	5/30/1980	0	1.0	1954	7.4	3.0	1.0
Jun	4.07	11.07	1954	0.71	1950	3.30	6/16/1954	0	0.0	-	7.6	2.7	1.3
Jul	4.49	10.20	1999	0.71	1937	4.32	7/2/1944	0	0.0	-	6.9	3.1	1.4
Aug	4.51	10.23	1980	0.40	1949	4.55	8/29/1947	0	0.0	-	6.7	3.0	1.3
Sep	3.28	11.32	1965	0.39	1940	3.83	9/19/1983	0	0.5	1961	5.8	2.2	0.8
Oct	2.30	7.38	1970	0.00	1952	2.18	10/12/1966	0.3	2.0	1981	4.8	1.5	0.4
Nov	2.00	5.46	1975	0.00	1983	2.50	11/25/1993	4.7	21.0	1985	3.3	1.3	0.6
Dec	1.01	3.43	1975	0.00	1943	1.36	12/12/1965	9.7	36.5	2000	2.8	0.7	0.1
Annual	31.97	46.01	1993	17.73	1976	4.55	8/29/1947	40.9	76.2	1961-62	61.8	22.6	8.5
Winter	0.85	6.71	2001	0.00	1987	2.53	1/22/1973	NA	NA		6.6	1.5	0.3
Spring	2.93	15.96	1945	4.18	1967	3.50	5/30/1980	NA	NA		18.0	6.3	1.9
Summer	4.36	26.05	1990	4.37	1976	4.55	8/29/1947	NA	NA		21.2	8.7	4.0
Fall	2.53	17.59	1970	1.54	1952	3.83	9/19/1983	NA	NA		13.9	5.0	1.9

NA – Not Available
Source: Midwest Regional Climate Center Website (http://mcc.sws.uiuc.edu)

Average annual snowfall (1971-2000) is 40.9 inches at the Austin station. Extreme snowfall records range from 76.2 inches during the 1961-1962 season to 17 inches at Austin during the 1986-1987 season.

Austin Climate & Precipitation Facts	
Mean annual temperature	43.2° F
Average annual precipitation	31.97 inches
Average annual snowfall	40.9 inches
Average annual lake evaporation	33 inches

The major sources of information regarding rainfall in the region are publications TP-40 and TP-49 issued by the National Weather Bureau (now the National Weather Service) in 1961 and 1964, respectively. These data are generally consistent with the specific analysis of the intensity-frequency data compiled by USDA Miscellaneous Publication 204 (1944). The sources give information on storm durations of up to 10 days. Runoff from spring snowmelt is also important in this region. The Soil Conservation Service (now the National Resource Conservation Service (NRCS)) *National Engineering Handbook*, Hydrology, Section 4, presents maps of regional runoff volume. The information from all of these sources (except for the USDA analysis) is summarized in the *Minnesota Hydrology Guide*, published by the USDA's Soil Conservation Service (now the NRCS) in 1975. **Table 2-4** lists many of the precipitation and runoff events used for design purposes. The Rainfall Frequency Atlas (TP-40) is in the process of being updated with more recent precipitation data and is expected to be completed in 2011.

Table 2-4 Selected Precipitation and Runoff Events Used for Design Purposes

Type and Frequency	Duration	Amount (Inches)
Rainfall		
10-year	24 hour	4.4
25-year		5.0
50-year		5.5
100-year		6.2
25 year	10 day	9.0
50-year		10.4
100-year		11.2
Runoff (snowmelt)		
10-year	10 day	4.3
25-year		5.2
50-year		5.9
100-year		6.5

Source: *Minnesota Hydrology Guide* (USDA Soil Conservation Service)

Major flooding has occurred in the Cedar River watershed five times in the past 60 years. A summary of major flood events with flood crests of over 20 feet on the Cedar River at Austin are listed in **Table 2-5**. Flood stage at Austin is 15.0 feet. Two to three inches of rain fell over the headwaters of the Cedar River on July 5-6, 1978 and produced significant flooding. Ten days later, July 16-17, 1978, the already-soaked ground was deluged by a severe storm with an unofficial record precipitation of 9.5" in Waltham Township that produced a record flood at the time of 12,400 cubic feet per second as measured at the USGS station on the Cedar River south of Austin near the 29th Ave SE/County Road 28

bridge (USGS Station 05457000). The record flooding that occurred in early summer 1993 over much of the Mississippi River basin caused some flooding in the Cedar River watershed as well. A subsequent torrential rainfall occurred in the Cedar River watershed on August 15, 1993. Wet conditions from June storms and two nights of heavy rain on July 9-10, 2000 produced flash floods, estimated as a 200-year flood event. Evacuations were necessary in Austin; however, damage from the 2000 flood was less than the 1978 event due to extensive mitigation measures completed in the 1980's and 1990's. In 2004, after a month of relatively dry weather, a huge late summer storm brought record rainfall to the area. Residents banded together in sand bagging campaigns against this record flood. Two deaths were associated with this flooding event. In June 2008, strong storms and wet antecedent conditions caused extensive flooding. Property damages in the City of Austin were lower than previous floods due to buy-outs of houses and businesses in the flood plain. Interstate 90, along with other major roads in the area had to be closed for several days. One death was associated with this flooding event.

Table 2-5 Major Cedar River Flood Events

Year	Date	Maximum Storm Event Precipitation in Cedar River Watershed	Peak Flow at USGS Station (cfs)	Crest Height at USGS Station
1978	July 6-7	3.25" Austin	10,000	18.14'
1978	July 16-17	9.5" Waltham	12,400	20.35'
1993	August 15	8" Lyle	10,800	19.43'
2000	July 9-10	7" Austin	15,300	21.49'
2004	Sept. 14 &15	11.5" Blooming Prairie	20,000	23.26'
2008	June 12	3 – 5" over entire area	15,500	22.40'

Source: NOAA's National Weather Service at La Crosse, WI Major Historical Floods webpage (http://www.crh.noaa.gov/arx/historicalfloods.php) Minnesota Climatology Working group Minnesota Flash Floods: 1970-2006 flash floods webpage (http://climate.umn.edu/doc/flashflood.htm) and USGS's Peak Streamflow for the Nation webpage for Station 05457000 (http://nwis.waterdata.usgs.gov/usa/nwis/peak)

Even with wide variations in climate conditions, climatologists have found four significant climate trends in the Upper Midwest (see right).

Upper Midwest Climate Trends

1. **Warmer winters**
2. **Higher minimum temperatures**
3. **Higher dew points**
4. **Changes in precipitation trends**

(more rainfall from heavy thunderstorm events; increased snowfall)

Source: *Minnesota Weather Almanac,* Seeley, 2006.

According to the Soil and Water Conservation Society's (SWCS) 2003 report on climate change, total precipitation amounts in the United States (and in the Great Lakes region) are trending upward, as are storm intensities. Precipitation records in the area show the annual average precipitation has increased, as shown in the following

examples with data from the High Plains Regional Climate Center website (http://hprcc.unl.edu/wrcc/states/mn.html):

- Austin, Minnesota station – the average annual precipitation has increased from 31.02 inches (1961-1990 average) to 31.97 inches (1971-2000 average), a 3.1 percent increase
- Albert Lea, Minnesota station – the average annual precipitation has increased from 31.71 inches (1961-1990 average) to 33.15 inches (1971-2000 average), a 4.5 percent increase
- Grand Meadow, Minnesota station – the average annual precipitation has increased from 32.96 inches (1961-1990 average) to 34.65 inches (1971-2000 average), a 5.1 percent increase
- Osage, Iowa station – the average annual precipitation has increased from 33.70 inches (1961-1990 average) to 34.43 inches (1971-2000 average), a 2.2 percent increase

As noted by the SWCS, increased storm intensities result in increased soil erosion and increased runoff. The Minnesota Pollution Control Agency's (MPCA) global warming website (http://www.pca.state.mn.us/hot/globalwarming.html) states that increased flooding could also result from more intense precipitation events. When the updated Rainfall Frequency Atlas (TP-40) is released in 2011, it will incorporate the increased precipitation noted above.

Climate information can be obtained from a number of sources, such as the following websites:

- For a wide range of Minnesota climate information: http://climate.umn.edu/
- For additional Minnesota climate information: http://www.dnr.state.mn.us/climate/index.html

2.3 Topography

The topography of the CRWD is gently rolling. **Figure 2-2** shows the 10-foot USGS contour intervals of the CRWD. The lowest point in the watershed is 1140 feet above mean sea level at the border of Iowa and Minnesota on the Cedar River and the highest point in the watershed is 1440 feet above mean sea level in the southeastern corner of the watershed near Elkton, Minnesota. The CRWD includes only areas in Minnesota. The Cedar River continues to flow southeast through Iowa and merges into the Iowa River, which discharges into the Mississippi River.

2.4 Watersheds and Drainage Patterns

Figure 2-3 is an index map showing all of the 11 major subwatersheds and 36 minor subwatersheds of the watershed district. The major watersheds in the CRWD are

- Upper Cedar River watershed
- Roberts Creek watershed

- Wolf Creek watershed
- Dobbins Creek watershed
- Schwerin Creek watershed
- Rose Creek watershed
- Orchard Creek watershed
- Woodbury Creek watershed
- Mud Lake Creek watershed
- West Beaver Creek watershed
- Lower Cedar River watershed

The Upper Cedar River, Roberts Creek, Wolf Creek, Dobbins Creek and Turtle Creek watersheds, and some small portions of the Lower Cedar River watershed were included in the *Upper Cedar River Surface Water Management Plan* (UCRSWMP) completed in September 2007. The UCRSWMP plan divided these watersheds into 435 subwatersheds delineated to every major creek and river crossing such as roads, railroads and dams. Turtle Creek is a major tributary to the Cedar River that discharges into the Cedar River just south of Austin, Minnesota. However, as the Turtle Creek Watershed District was formed in 1968, separately from the CRWD, Turtle Creek and its watershed are not under the jurisdiction of the CRWD. The remaining subwatersheds outside of the UCRSWMP study area (Schwerin Creek, Rose Creek, Orchard Creek, West Beaver Creek, Mud Lake Creek, Woodbury Creek and the remaining portions of the Lower Cedar River Watershed watersheds) have not been further delineated beyond the larger subwatersheds already delineated by the Minnesota Department of Natural Resources (MDNR). **Figures 2-4 and 2-5** are maps of these subwatersheds and their minor subwatershed numbers. **Table 2-6** lists the major and minor subwatersheds areas as delineated by the MDNR.

Table 2-6 Major and Minor Subwatersheds

Major Subwatershed Name	Minor Subwatershed Name (if named) and MDNR Hydrologic Unit Code	Area (acres)	
		Immediate	Total
Upper Cedar River	Upper Cedar River - 4848001	7,944	97,652
	Upper Cedar River - 4848021	4,939	
	Upper Cedar River - 4848023	24,727	
	Upper Cedar River - 4848056	7,755	
	Little Cedar River - 4848054	6,042	
	Westfield-Ripley Ditch - 4848052	4,151	
	4848053	3,621	
	4848039	6,256	
	4848055	4,326	
	4848057	4,348	
	4848037	8,058	
	4848022	3,358	
	4848025	7,839	
	4848026	4,288	
Roberts Creek	Roberts Creek – 4848003	8,341	24,980
	4848002	9,505	
	4848038	7,134	
Wolf Creek	Wolf Creek - 4848004	7,605	7,605
Dobbins Creek	Dobbins Creek - 4848005	13,453	24,645
	4848006	11,192	
Schwerin Creek	Schwerin Creek - 4848009	5,984	5,984
Rose Creek	Rose Creek - 4848007	20,311	36,326
	Rose Creek - 4848008	5,617	
	Rose Creek - 4848019	4,415	
	4848028	5,983	
Orchard Creek	Orchard Creek - 4848030	7,636	20,413
	4848029	5,870	
	4848031	6,907	
West Beaver Creek	West Beaver Creek - 4848018	6,723	6,723
Mud Lake Creek	Mud Lake Creek - 4848050	9,256	9,256
Woodbury Creek	Woodbury Creek - 4848033	8,214	17,613
	Woodbury Creek - 4848034	9,399	
Lower Cedar River	Lower Cedar River - 4848020	8,355	27,355
	Lower Cedar River - 4848032	13,117	
	Lower Cedar River - 4848036	1,742	
	4848035	4,141	
Total		**278,552**	**278,552**

2.4.1 Upper Cedar River Watershed

The Upper Cedar River watershed, as delineated by the MDNR, is the largest subwatershed in the CRWD, covering 97,652 acres in Freeborn, Steele, Dodge and Mower counties. It includes the Ramsey Mill Pond. The subwatersheds were further delineated at road and railroad crossings in the *Upper Cedar River Surface Water Management Plan* (UCRSWMP) completed in September 2007. This watershed includes the towns and cities of Blooming Prairie, Hayfield, Lansing and portions of Mapleview and Waltham. The upper Cedar River flows into the lower Cedar River just north of Austin.

2.4.2 Roberts Creek Watershed

The Roberts Creek watershed covers 24,980 acres in Mower County. The subwatersheds were further delineated at road and railroad crossings in the UCRSWMP. This watershed includes portions of Brownsdale, Sargeant and Waltham. Roberts Creek flows into the Cedar River approximately six miles north of Austin.

2.4.3 Wolf Creek Watershed

The Wolf Creek watershed covers 7,605 acres in Mower County. The subwatersheds were further delineated at road and railroad crossings in the UCRSWMP. This watershed includes portions of Austin, Brownsdale and Mapleview. Wolf Creek flows into the Cedar River approximately one mile north of downtown Austin.

2.4.4 Dobbins Creek Watershed

As delineated by the MDNR, the Dobbins Creek watershed covers 24,645 acres in Mower County. It includes East Side Lake in Austin. The East Side Lake Water Quality Improvement Study was completed in October 1992. The study aimed to characterize water quality, sediment and nutrient loading to East Side Lake and Dobbins Creek and to develop an implementation plan to improve water quality in order for the lake to be suitable for swimming. Mower County SWCD conducted the Dobbins Creek Watershed Project Streambank Inventory in 1993 to study the causes of sedimentation of East Side Lake. The study found that almost all of the Dobbins Creek stream banks are somewhat eroded and areas with direct traffic from livestock are the most eroded. The subwatersheds were further delineated at road and railroad crossings in the UCRSWMP. This watershed includes portions of the city of Austin. Dobbins Creek flows into the Cedar River in Austin.

2.4.5 Schwerin Creek Watershed

The Schwerin Creek watershed, as delineated by the MDNR, is the smallest subwatershed in the CRWD, covering 5,984 acres in Mower County. This watershed includes the town of Elkton. Schwerin Creek flows into Rose Creek approximately 2 miles northwest of Elkton, near I-90 and County Highway 13.

2.4.6 Rose Creek Watershed

The Rose Creek watershed covers 36,326 acres in Mower County. This watershed includes the town of Rose Creek and portions of Dexter. Rose Creek flows into the Cedar River approximately four miles south of downtown Austin.

2.4.7 Orchard Creek Watershed

The Orchard Creek watershed covers 20,413 acres in Mower and Freeborn counties. This watershed includes the southwestern-most portions of the city of Austin. Orchard Creek flows into the Cedar River approximately 6.5 miles south of downtown Austin.

2.4.8 Woodbury Creek Watershed

The Woodbury Creek watershed covers 17,613 acres in Mower and Freeborn counties. This watershed includes unincorporated portions of Oakland, London and Lyle Townships. Woodbury Creek flows into the Cedar River just north of the Iowa border.

2.4.9 Mud Lake Creek Watershed

The Mud Lake Creek watershed covers 9,256 acres in Mower and Freeborn counties. This watershed includes unincorporated portions of Oakland, London, Hayward and Shell Rock Townships. Mud Lake Creek flows into Woodbury Creek at the county line, near Mower County Highway 5.

2.4.10 West Beaver Creek Watershed

The West Beaver Creek watershed covers 6,723 acres in Mower County. This watershed includes unincorporated portions of Nevada, Windom, Austin and Lyle Townships. West Beaver Creek flows into the Cedar River less than a half of a mile south of the confluence with Orchard Creek, less than seven miles south of Austin.

2.4.11 Lower Cedar River Watershed

The Lower Cedar River watershed, as delineated by the MDNR, covers 27,355 acres in Mower County. It includes Mill Pond in Austin. The northernmost portions of this watershed located in the city of Austin were further delineated at road and railroad crossings in the UCRSWMP. This watershed includes portions of the cities of Austin and Lyle. The upper Cedar River flows into the lower Cedar River just north of Austin. The lower Cedar River leaves the watershed district at the Iowa border.

2.5 Soils

The general soil type of the eastern portion of the CRWD is loam to clay-loam textured glacial till. The general soil type of the southern portion of the CRWD is loam to sandy-loam textured glacial till. The general soil type of the western portion of the CRWD is the loam- to sandy-loam textured Sheldon Creek till and sand/gravel outwash. The thickness

of the glacial drift in CRWD is between 0 and 200 feet deep. The NRCS updates information presented in soil surveys on a continuing schedule. More up to date information for all four counties can be found on the NRCS Soil Survey webpage (http://soils.usda.gov/survey/) and the NRCS Soil Data Mart (http://soildatamart.usda.gov/). Six broad soil associations reported in the 2002 Mower County Comprehensive Plan include:

1. Marshan-Waukee-Hayfield Association: This association is nearly level to gently sloping with poorly-drained to well-drained soils. The Cedar River and its floodplain are found in this association.
2. Rossfield-Taopi-Faxon Variant Association: These soils are nearly level to gently sloping and well- to poorly-drained. They cover only 2 percent of Mower County and are generally found in close correlation with creek systems. They offer considerable relief but generally have slight to moderate limitations for urban development.
3. Udolpho-Schley-Clyde Association: Nearly level and somewhat poorly- to poorly-drained, these soils comprise 14 percent of Mower County, typically in the southwest corner.
4. Sargeant-Brownsdale Association: These soils are nearly level and are somewhat poorly- to poorly-drained. They comprise only 4 percent of Mower County and offer severe limitations for building development.
5. Tripoli-Oran Readlyn Association: Nearly level and gently sloping, these soils are poorly- to somewhat poorly-drained. They comprise over half of Mower County's soils (typically in the center of the county) and represent some of the County's finest agricultural land.
6. Blooming-Maxcreek-Havana Association: Nearly level to modestly steep, these soils are well- to poorly-drained. These are excellent soils for agricultural activities. These soils are located in the western portion of the county.

Infiltration capacities of soils affect the amount of direct runoff resulting from rainfall. The higher the infiltration rate is for a given soil, the lower the runoff potential. Conversely, soils with low infiltration rates produce high runoff volumes and high peak discharge rates. According to the soil surveys, most of the underlying soils in Mower, Dodge, Freeborn and Steele Counties are classified as hydrologic soil group B, with moderate infiltration rates. Some soils are classified as group C and D, with lower infiltration rates and very few soils are classified as group A, with high infiltration rates. **Figure 2-6** shows the hydrologic soil groups in the CRWD.

After farmland has been tilled, it lays bare from fall to spring. This means there are no plants available to intercept rainfall to hold it on their surface for later evaporation, or to slow the velocity of the raindrops before they hit the bare ground. In addition to the mechanical weathering of the higher velocity raindrops hitting the ground, erosion is more likely to occur due to the lack of roots holding the soil in place. The upper soil layers are the most fertile and the most likely to be eroded. Erosion of these top soil layers causes

high levels of turbidity and total suspended solids in streams and rivers. However, some farms in CRWD utilize minimum till or no-till techniques to reduce erosion.

2.6 Geology and Groundwater Resources

The bedrock underlying the CRWD is part of the Upper Devonian and Upper Ordovician Series, which formed 375-450 million years ago. The Cedar Valley Group underlies the southern portion of the watershed district. The Wapsipinicon Group and Maquoketa and Dubuque Formations are mostly found in the northern portion of the watershed district. These groups and formations are composed of mainly limestone, dolostone and shale. More information about geology is available in the *Geologic Atlas of Mower County* from the Minnesota Geological Survey.

The terminal moraine of the Wisconsin Glaciation forms a north-south boundary approximately in the center of the watershed called the Bemis moraine. Approximately 8 percent of wells tap into glacial deposits, according to the USGS's 1975 report, *Water Resources of the Cedar River Watershed, Southeastern Minnesota*. East of the Bemis moraine, pre-Wisconsin Kansas drift of Leverett underlies most of the surface, and less than 3 percent of wells tap into thin glacial deposits. Near the Cedar River, surficial aquifers are categorized by glacial outwash and alluvium of sand and gravel and are at or near the land surface. The vast majority of wells tap into the Cedar Valley-Maquoketa-Dubuque-Galena Aquifer that underlies the entire watershed.

Most of the municipalities in the CRWD rely on groundwater from bedrock aquifers for their drinking water supply. **Table 2-7** lists the number and depths of wells for the municipalities in the CRWD. Brownsdale is the only municipality that is in the process of preparing a wellhead protection plan, as defined under Minnesota Rules Chapter 4720.

Table 2-7 Municipal Well Depths

Municipality	Number of Wells	Depths of Wells (feet)
Austin	7	110, 132, 578, 992, 1010, 1017 and 1075
Waltham	1	275
Sargeant	2	340 and 400
Mapleview	1	383
Elkton	2	306 and 324
Rose Creek	3	179 and 197
Blooming Prairie	2	220 and 223
Hayfield	2	341 and 678
Brownsdale	2	150 and 171

In addition to these municipalities, the Minnesota Department of Health also conducted source water assessments for private water supply systems for campgrounds, churches, golf courses, industrial facilities, etc.

Figure 2-7 presents data from the Mower County Geologic Atlas regarding the sensitivity of groundwater to contamination in the uppermost bedrock aquifer. The County Geologic Atlas Regional Assessment Program is a joint program between the MDNR and the Minnesota Geological Survey (MGS). The MDNR defines a sensitive area as a geologic area characterized by natural features where there is significant risk of groundwater degradation from activities conducted at or near the land surface. The MDNR has designated five classes of geologic sensitivity (very high, high, moderate, low, and very low) that are based on time of travel ranges. Travel time is the approximate time that elapses from when a drop of water infiltrates the land surface until it enters an aquifer or a specific target such as a spring or river. The pollution sensitivity of an aquifer is assumed to be inversely proportional to the time of travel through the aquifer. Therefore, a short travel time indicates that an aquifer is highly sensitive to contamination. Of the four counties in the CRWD, the MNDR County Geologic Atlas has only been completed for Mower County.

2.7 MDNR Public Waters

MDNR Public waters
MDNR Public waters are all water basins and watercourses, natural or altered, that meet the criteria set forth in Minnesota Statutes, Section 103G.005, subd. 15 that are identified on Public Water Inventory maps and lists authorized by Minnesota Statutes, Section 103G.201.
MDNR Public waters wetlands
MDNR Public waters wetlands include all type 3, type 4, and type 5 wetlands (as defined in U.S. Fish and Wildlife Service Circular No. 39, 1971 edition) that are 10 acres or more in size in unincorporated areas or 2 ½ acres or more in size in incorporated areas (see Minnesota Statutes Section 103G.005, subd. 15a and 17b).
MDNR Public waters as ditches
MDNR Public waters include natural and altered watercourses with a total drainage area greater than two square miles (see Minnesota Statutes Section 103G.005, subd. 15a9). This definition can include ditches that are privately held and not under the jurisdiction of the county drainage system.

The MDNR designates certain water resources as public waters to indicate those lakes, wetlands, and watercourses over which the MDNR has regulatory jurisdiction. By statute, the definition of public waters includes "public waters" and "public waters wetlands" (see box at left).

The MDNR uses county-scale maps to show the general location of the public waters and public waters wetlands (lakes, wetlands, and watercourses) under its regulatory jurisdiction. These maps are commonly known as Public Waters Inventory (PWI) maps. The regulatory "boundary" of these waters and wetlands is called the ordinary high water level (OHWL). PWI maps are available on a county-by-county basis from the MDNR's website: (http://www.dnr.state.mn.us/waters/watermgmt_section/pwi/maps.html)

There are three uniquely identified public waters (lakes) partially or completely within CRWD: Ramsey Mill Pond, East Side Lake, and Mill Pond. In addition to these waters, there are numerous uniquely identified public watercourses (streams and rivers) within the watershed district, as shown on **Figure 2-8**. There are no public waters wetlands in CRWD.

2.8 Wetlands

The U.S. Fish & Wildlife Service established the National Wetland Inventory (NWI) to document the characteristics, extent and status of the United States' wetlands. **Figure 2-9** shows the wetlands identified by the NWI as emergent, forested or shrub wetlands; pond wetlands or lake/riverine wetlands. More information about NWI wetlands can be found on the NWI website (http://www.fws.gov/nwi/index.html).

2.9 Water Resource Monitoring Information

Water resource monitoring information is collected by a variety of different agencies within CRWD. **Figure 2-10** shows the water quality and water quantity monitoring locations in the CRWD. Chapters 2.9.1 through 2.9.3 provide information about these monitoring programs.

2.9.1 Water Quality Data

The United States Geological Survey (USGS) operates one sampling site in the CRWD. It is located on the Cedar River south of Austin near the 29th Ave SE/County Road 28 bridge (USGS Station 05457000). The USGS measured suspended sediment concentration from 1979-1981. Additional water quality field measurements were made between 1961 and 1984. The MPCA has conducted additional water quality monitoring at this site after 1984. Parameters measured include total suspended solids, conductivity, total phosphorus, ortho phosphorus, dissolved oxygen, pH, temperature, turbidity, sulfate, chloride, ammonia, and nitrates. USGS data can be found on the USGS National Water Information System website (http://waterdata.usgs.gov/nwis/).

In addition to the numerous MPCA stream and lake water quality monitoring locations with intermittent records as seen in **Figure 2-10**, there are two MPCA "milestone" monitoring sites on the Cedar River—one is located a half-mile east of Lansing near the 270th Street bridge (MPCA Station ID S000-137) and the other is located three miles south of Austin near the 170th Street Bridge (MPCA Station ID S000-136). The water quality data span from 1967—present. Parameters measured include total suspended solids, fecal coliform, total phosphorus, biological oxygen demand, chlorophyll-*a*, dissolved oxygen, pH, temperature, turbidity, E. coli, and nitrates. These and other water quality data can be found in the MPCA Environmental Data Access website (http://www.pca.state.mn.us/data/edaWater/index.cfm).

Holders of NPDES permits, such as wastewater treatment plants, power plants and quarries (see Chapter 2.11) are required to monitor their discharges to surface waters. This monitoring data can also be found in the MPCA Environmental Data Access website (http://www.pca.state.mn.us/data/edaWater/index.cfm).

The *Water Quality Study of the Cedar River and Tributaries in Mower County, Summer of 2001* (Mostrom, 2001) summarizes water quality data from 15 sites within the Cedar River watershed. Thirteen of these sites were used in a similar study during 2000. The data show the same general pattern as reported in the 2000 study: the Cedar River becomes more polluted as it flows south and picks up water from Turtle Creek and flows through Austin. Parameters measured include total suspended solids, fecal coliform, transparency, nitrates and stream stage. This data can also be found in the MPCA Environmental Data Access website (http://www.pca.state.mn.us/data/edaWater/index.cfm).

The Mower County SWCD also has data for four sampling locations of Turtle Creek and its tributaries (Deer Creek, Rice Lake Branch, Turtle Creek at Highway 30, and Turtle Creek in Austin). Although not part of CRWD, Turtle Creek flows into the Cedar River near Austin and therefore affects the water quality of the Cedar River. Parameters measured include total suspended solids, fecal coliform, transparency, total phosphorus, ortho phosphorus nitrates and flow.

The MPCA Environmental Monitoring and Assessment Program randomly selects monitoring sites within a watershed to assess the status and trends of surface waters by integrating biological, physical and chemical components. Twelve locations in the CRWD were measured once in 2004. Physical and chemical parameters measured include substrate, mean depth, mean width, drainage area, flow, temperature, field turbidity, dissolved oxygen, pH, nitrogen, total phosphorus, total suspended solids, and ammonia. Biological parameters measured include invertebrate and fish species, and their count. This data can be found in the MPCA Environmental Data Access website (http://www.pca.state.mn.us/data/edaWater/index.cfm).

Secchi depth measurements were taken from 1989-1997 in East Side Lake as part of the MPCA Citizen Lake Monitoring Program. These data can be found on the MPCA Citizen Lake Monitoring Program website (http://proteus.pca.state.mn.us/water/clmp.html).

There are two major sampling programs underway in 2008 and 2009. The first program is in cooperation with the Cedar River Turbidity TMDL Project in which three sites will be monitored continuously for flow and turbidity: Cedar River at USGS Station 05457000 south of Austin, Cedar River at County Highway 2 north of Austin, and Dobbins Creek at the J.C. Hormel Natural Center. The second program is funded by a Clean Water Legacy (CWL) grant in which 11 sites throughout the watershed will be sampled. All sites associated with both programs will be sampled by the Mower County Soil and Water Conservation District (SWCD) once every

2 weeks or after rain events for total suspended solids, dissolved oxygen, sulfate, chloride, nitrate-nitrite, ammonia nitrogen, total phosphorus, ortho phosphorus, TKN, turbidity, pH, temperature, and conductivity (in total about 20 samples per season). Fecal coliform and flow data for the CWL grant sites will be collected but on a less frequent basis (approximately seven times per season).

2.9.2 Water Quantity Data

There are two USGS water quantity monitoring sites in the CRWD. However, the USGS operates only one monitoring station, USGS Station 05457000, located on the Cedar River south of Austin, near the 29th Ave SE/County Road 28 bridge. (The DNR/MPCA Cooperative Stream Gaging database identifies this station as 48020001). Discharge data are available from 1909 to present for this drainage area of 399 square miles. The mean average annual flow was 245 cubic feet per second (cfs) for the period of record. The USGS operated Station 05457080 on Rose Creek near Dexter from 1962 to 1985. The drainage area of this station is 1.17 square miles. USGS data can be found on the USGS National Water Information System website (http://waterdata.usgs.gov/nwis/).

In addition to the USGS stations, there are two DNR/MPCA Cooperative Stream Gaging stations in the CRWD. Station 48005001 is located on Dobbins Creek in Austin at County Road 61, approximately 1.7 miles upstream of the confluence with the Cedar River. Data has been collected for this site since 1998 (the National Weather Service identifies this site as DOBM5). Station 48023001 is located on the Cedar River near Lansing, at County Road 2 north of Austin. Data has been collected for this site since 1998. (The National Weather Service identifies this site as LANM5, the USGS station number is 05455950). DNR/MPCA Cooperative Stream Gaging data can be found on the MPCA webpage (http://www.dnr.state.mn.us/waters/csg/index.html).

The USGS published the *Water Resources of the Cedar River Watershed, Southeastern Minnesota* in 1975. Included in this publication are flow-duration curves, discharge-recurrence interval curves, and historic stream flows from 1909-1971.

According to the MDNR Lake Finder webpage, East Side Lake was monitored for lake levels from 1989 to 2001. The average water level is 1,191.5 feet.

2.9.3 Stream Inventory Data

The Minnesota Conservation Corps completed an inventory of streams in the CRWD in October 2007. The Clean Water Legacy provided $24,000 of grant money to inventory Cedar River, Wolf Creek, Dobbins Creek (north and south branches), Rose Creek, Woodbury Creek and Mud Lake Creek for streambank erosion, adjacent land use, buffer width, hazards (e.g., garbage, fences and rock piles) and impediments (e.g., trees and beaver dams). Inventory results are presented in **Table 2-8**. It was unknown if all garbage items found in the stream were a result of illegal dumping or previous flooding.

Table 2-8 Minnesota Conservation Corps Stream Inventory Results

Reach	Survey Length (miles)	Average Stream Width (feet)	Average Buffer (feet/side)	Adjacent Land Use	Bank Erosion (sq. ft./mile)	Impediments	Waste
Cedar River	36	83	500	90% trees, 10% grass	862	121 trees, 14 beaver dams	6 dump sites, 12 misc. large garbage items
Wolf Creek	3	14	225	70% trees, 16% grass, 14% shrubs	560	19 trees, 22 beaver dams	None found
North Branch Dobbins Creek	13	16	340	39% trees, 52% grass, 6% pasture, 3% shrubs	1,383	86 trees, 3 beaver dams	3 metal drums
South Branch Dobbins Creek	10	13	235	37% trees, 44% grass, 17% pasture, 2% shrubs	589	18 trees, 5 beaver dams	None found
Rose Creek	14	59	300	82% trees, 5% crop, 6% grass, 7% pasture	3,016	113 trees, 12 beaver dams	1 dump site, 5 misc. large garbage items, 2 rock piles, 2 fences
Woodbury Creek	6	24	170	45% trees, 9% grass, 23% pasture, 23% shrubs	1,210	37 trees, 24 beaver dams	1 dump site
Mud Lake Creek	5.7	12	328	43% trees, 36% grass, 21% shrubs	700	37 trees, 8 beaver dams	2 dump sites, 1 rock pile, 1 wire pole

2.10 Impaired Waters

The federal Clean Water Act (CWA) requires states to adopt water quality standards to protect the nation's waters. Water quality standards designate beneficial uses for each water body and establish criteria that must be met within the water body to maintain the water quality necessary to support its designated use(s). Section 303(d) of the CWA requires each state to identify and establish priority rankings for waters that do not meet the water quality standards. The state in turn requires watershed districts, cities and counties to participate in pollutant loading, or TMDL studies, and implement measures to reduce pollution. The list of impaired waters, or 303(d) list, is updated by the state (the Minnesota Pollution Control Agency/MPCA) every two years. **Figure 2-11** shows the impaired streams in CRWD. **Table 2-9** lists these impaired streams. There are no impaired lakes or wetlands in CRWD.

Table 2-9 CRWD Water Bodies Included in the 2008 Impaired Waters List

Reach	Description	Year added to list	River ID	Affected Use	Pollutant or Stressor	TMDL Target Start	TMDL Target Completion	Category
Cedar River	Rose Creek to Woodbury Creek	2002	07080201-501	Aquatic life	Turbidity	2008	2012	5B
Cedar River	Roberts Creek to Upper Austin Dam	2002	07080201-502	Aquatic consumption	PCB in Fish Tissue	2002	2015	5B
Cedar River	Roberts Creek to Upper Austin Dam	2002	07080201-502	Aquatic life	Turbidity	2008	2012	5B
Cedar River	Headwaters to Roberts Creek	2006	07080201-503	Aquatic recreation	Fecal Coliform	2012	2014	5B
Cedar River	Headwaters to Roberts Creek	2002	07080201-503	Aquatic consumption	PCB in Fish Tissue	2002	2015	5B
Cedar River	Upper Austin Dam to Wolf Creek	1998	07080201-511	Aquatic consumption	PCB in Fish Tissue	1998	2011	5B
Cedar River	Wolf Creek to Lower Austin Dam	2006	07080201-512	Aquatic consumption	PCB in Fish Tissue	2006	2021	5B
Dobbins Creek	T103 R18W S36, east line to East Side Lake	2006	07080201-535	Aquatic recreation	Fecal Coliform	2012	2014	5C
Dobbins Creek	East Side Lake to Cedar River	2006	07080201-537	Aquatic recreation	Fecal Coliform	2012	2014	5A
Dobbins Creek	East Side Lake to Cedar River	2006	07080201-537	Aquatic life	Turbidity	2008	2012	5A
Orchard Creek	T101 R18W S5, north line to Cedar River	2006	07080201-539	Aquatic recreation	Fecal Coliform	2012	2014	5C
Roberts Creek	Unnamed Creek to Cedar River	2006	07080201-504	Aquatic recreation	Fecal Coliform	2012	2014	5C
Rose Creek	Headwaters to Cedar River	2006	07080201-522	Aquatic recreation	Fecal Coliform	2012	2014	5C
Unnamed creek	Unnamed Creek to Cedar River	2006	07080201-533	Aquatic recreation	Fecal Coliform	2012	2014	5C

Table 2-9 CRWD Water Bodies Included in the 2008 Impaired Waters List

Reach	Description	Year added to list	River ID	Affected Use	Pollutant or Stressor	TMDL Target Start	TMDL Target Completion	Category
Wolf Creek	Headwaters to Cedar River	2006	07080201-510	Aquatic recreation	Fecal Coliform	2012	2014	5C
Woodbury Creek	Headwaters to Cedar River	2006	07080201-526	Aquatic recreation	Fecal Coliform	2012	2014	5C

Source: Minnesota Pollution Control Agency Website (http://www.pca.state.mn.us/water/tmdl/index.html)

Category 5A indicates that the water is impaired by multiple pollutants and no TMDL study plans are approved by the EPA.

Category 5B indicates that the water is impaired by multiple pollutants and at least one TMDL study plan is approved by the EPA.

Category 5C indicates that the water is impaired by one pollutant and no TMDL study plan is approved by the EPA.

A separate TMDL must be completed for each listed impairment. A TMDL is a threshold calculation of the amount of a pollutant that a waterbody can receive and still meet water quality standards. A TMDL establishes the pollutant loading capacity within a waterbody and develops an allocation scheme amongst the various contributors, which include point sources, non-point sources and natural background contributions, as well as a margin of safety. As a part of the allocation scheme, a waste load allocation (WLA) is developed to determine allowable pollutant loadings from individual point sources (including loads from storm sewer networks), and a load allocation (LA) establishes allowable pollutant loadings from non-point sources and natural background levels in a water body. Unlike point sources, non-point source pollution cannot be traced to a single source or pipe. Instead, pollutants are carried from land to water in stormwater or snowmelt runoff, in seepage through the soil, and in atmospheric transport.

The *Revised Regional Total Maximum Daily Load (TMDL) Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota* was approved by the EPA on April 5, 2006. This TMDL study included 39 stream reaches classified as "impaired" by fecal coliform, used as an indicator of pathogens from fecal material. These impaired reaches span the 4.65 million-acre Lower Mississippi River Basin from Hastings to the Iowa/Minnesota border. For purposes of the study, the Lower Mississippi River Basin included the greater Cedar River Basin (and, therefore, the CRWD). Monitoring showed the problem was virtually everywhere. The core of the TMDL study was a pollutant source inventory and an allocation of the total pollutant load among major source categories. Failing septic systems and overgrazed pastures contribute the bulk of pollution during dry weather; surface-applied manure is the biggest contributor in spring wet periods; while feedlots, surface-applied manure and overgrazed pastures dominate summer wet periods. See Chapter 3.2.3.1 for a discussion of the implementation issues for this TMDL study.

The Cedar River in eastern Iowa has been listed as impaired by nitrate. Nitrate-N in the Cedar River has consistently measured above the 10 mg/L drinking water standard near the City of Cedar Rapids. Due to the impairment, a TMDL was completed in 2006, *Total Maximum Daily Load for Nitrate Cedar River Linn County, Iowa*. This TMDL also details potential sources and loadings of total nitrogen directly to the stream and the watershed. In this part of Iowa the Cedar River is designated for the following uses: primary contact recreation; significant resource warm water; and as a drinking water supply. The impaired use and subsequent 303(d) listing is for high nitrate concentrations in the drinking water supply for the City of Cedar Rapids. The listed impaired segment starts at the water intake located along the Cedar River, and extends upstream 11.6 miles, parallel to Cedar Rapids' shallow alluvial wells. The Cedar Rapids water utility provides drinking water to over 120,000 residents. The Cedar River was a "high priority" on the list for TMDL development because of the excess levels of nitrates and uses of river water. See Chapter 3.2.3.2 for a discussion of the implementation issues for this TMDL study.

In a separate study, the U.S. Geological Survey (Fields, 2004) modeled discharge and nitrate flux from six of the major tributaries of the Iowa portion of the Cedar River during the 2001-2004 calendar years. Models used were the Diffusion Analogy Surface Water Flow (DAFLOW) model and the chemical transport model WASP (Water Quality Simulation Program). Results from these models were paired with empirical methods to determine quantity of loads per source. The results of this report indicate that nonpoint source pollution is the significant contributor (>90 percent) of nitrate discharged from the Cedar River, with fertilizer and legume fixation the principal sources. It also found that dams and wetlands have had significant impact on decreasing nitrate levels in the tributaries.

The Cedar River Watershed Turbidity, Excess Nutrient and pH TMDL Study is currently underway. This TMDL study is being undertaken as a joint effort of the CRWD, the Turtle Creek Watershed District (TCWD), and the Shell Rock River Watershed District (SRRWD). The MPCA is providing $300,000 to fund the multi-year TMDL study, which includes the following four steps:

1. Step one began in spring 2008 and includes a three-year monitoring program and field inventory work to measure the levels of pollutants in, and entering, the streams in the watershed.
2. Step two includes using computer modeling to identify pollutant sources, using the data collected in step one.
3. Step three includes writing a plan to reduce the pollutant loading to the river, and involving the public in the development of the plan.
4. Step four includes starting to implement the identified water quality improvement measures activities, such as conservation practices on farm fields and erosion and sediment controls in urban and rural areas.

The first 3 steps of the TMDL process will be completed in June 2010. The TMDL study will be completed by the end of 2011.

The CRWD, TCWD, and the SRRWD are completing a joint TMDL for the Cedar River to provide the following benefits:

- Increase funding opportunities
- Start a comprehensive monitoring program
- Build cooperation with other government agencies and individual citizens
- Retain local control over the cleanup plan
- Increase efficiency by sharing expenses and holding joint meetings.

2.11 Pollutant Sources

In addition to non-point sources of runoff, such as surface water runoff from urban and agricultural areas, there are numerous permitted point source discharges located within the CRWD; these are listed in **Tables 2-10 to 2-14**.

Table 2-10 Wastewater Treatment Facilities in CRWD

Name	Permit Number	Design Load (million gallons per day)	Waste Load Allocation (t-orgs/month)
Lansing Township WWTP Improvements	MN0063461	0.026	0.006
Blooming Prairie WWTP	MN0021822	0.899	0.20
Brownsdale WWTP	MN0022934	0.184	0.04
Elkton WWTP	MNG580013	0.017	0.004
Austin WWTP	MN0022683	8.475	1.92
Sargeant WWTP	MN0021601	0.0106	0.002
Waltham WWTP	MN0025186	0.027	0.01
Rose Creek WWTP	MNG580072	0.065	0.01
Total		**9.76**	**2.22**

Source: MPCA, January 2006, *Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota*. Note that the Hayfield WWTP discharges to the Zumbro River watershed via a pumping system.

The county feedlot program is an arrangement between the MPCA and county governments where the county is responsible for the implementation of feedlot rules and regulations such as registration, permitting, inspections, education and assistance and complaint follow-up. Dodge, Freeborn, Mower and Steele Counties all have developed databases of the feedlots in their jurisdiction. **Table 2-11** lists the total number of feedlots per township that lay within or partially within CRWD. Freeborn and Dodge Counties have GIS databases of feedlots; whereas Steele County is in the process of creating a GIS database. Mower County currently does not have a GIS database of feedlots. The MPCA provides program oversight, and policy, technical and enforcement support. Minnesota Rules chapter 7020 requires owners of an animal feedlot or manure storage area with 50 or more

animal units, or 10 or more animal units if in a shoreland area (less than 300 feet from a stream or river, less than 1,000 from a lake) to register every four years. Typically, the swine facilities that dominate Mower, Freeborn and Steele counties confine livestock under a roof with a pit for liquid manure. Feedlot runoff tends not to be a problem from these facilities; however, land application of manure can be a major source of non-point pollution runoff. Large feedlots with NPDES permits are listed in **Table 2-12**.

Table 2-11 Total Number of Feedlots per Township Completely or Partially within CRWD

Mower County		Freeborn County		Dodge County		Steele County	
Adams Township	89	Hayward Township	13	Ashland Township	0	Blooming	5*
Austin Township	25	London Township	31	Hayfield Township	2		
Clayton Township	32	Moscow Township	28	Ripley Township	0		
Dexter Township	32	Newry Township	26	Westfield Township	40		
Grand Meadow	25	Oakland Township	29				
Lansing Township	47	Shell Rock Township	40				
Lyle Township	42						
Marshall Township	59						
Nevada Township	64						
Red Rock Township	44						
Sargeant Township	38						
Udolpho Township	45						
Waltham Township	49						
Windom Township	52						

* Only Feedlots within CRWD boundary are listed for Blooming Prairie Township

Source: Mower, Dodge, Freeborn, and Steele County SWCDs

Table 2-12 Livestock Facilities with NPDES Permits in Townships Completely or Partially within CRWD

Facility	County, Township	Registration Number	Description
Roland Kittleson Farm	Dodge, Westfield	039-50003	3,600 swine – 55 lbs. or more
Scott Masching Farm	Dodge, Westfield	039-82079	3,040 swine – 55 lbs. or more
Jim Masching Farm	Dodge, Westfield	039-82084	2,732 swine – 55 lbs. or more
Jason Masching Farm	Dodge, Westfield	039-112217	4,800 swine – 55 lbs. or more
Butler Enterprises	Freeborn, Newry	047-50005	3,830 swine – 55 lbs. or more
MHF of Freeborn County Inc - Farrowing	Freeborn, Newry	047-50007	12,138 swine – 55 lbs. or more
Dennis Magnuson Farm – Sec 23	Freeborn, Newry	047-50008	8,350 swine – 55 lbs. or more
Lukes Bros Inc	Freeborn, London	047-60153	6,013 swine – 55 lbs. or more, 5,120 swine - 55 lbs. or under
G & B Hog Farm	Freeborn, Moscow	047-68633	4,080 swine – 55 lbs. or more
MHF of Freeborn County Inc - Nursery	Freeborn, Newry	047-96991	14,780 swine – 55 lbs. or under
James O'Connor Feedlot	Freeborn, Newry	047-111170	4,800 swine – 55 lbs. or more
Geoff Stroup Hog Barns	Mower, Windom	099-50001	4,000 swine – 55 lbs. or more
David Reuter Farm	Mower, Nevada	099-50002	4,400 swine – 55 lbs. or more
Nielsen Farm Albert Lea	Mower, Lansing	099-50007	2,400 swine – 55 lbs. or more
Steven Felten Farm	Mower, Nevada	099-50008	5,000 swine – 55 lbs. or more
Bob Bartel Farm Sec 22	Mower, Udolpho	099-60649	4,800 swine – 300 lbs. or more
Larson Products Inc Sec 5	Mower, Sargeant	099-61683	60,000 turkeys
J & L Farms	Mower, Adams	099-80380	5,800 swine – 55 lbs. or more
James K Sathre Farm	Mower, Marshall	099-83048	4,500 swine – 55 lbs. or more
Hormel Foods Corporation	Mower, Lansing	099-83267	7,686 swine – 55 lbs. or more
Yunker Farms	Mower, Marshall	099-83464	6,000 swine – 55 lbs. or more
Jax Dairy Farm Inc	Mower, Nevada	099-83642	960 dairy cows – 1000 lbs. or more
Jamie Jax Farm	Mower, Nevada	099-83694	290 dairy heifers & 80 calves
Sun Prairie Pork	Mower, Le Roy	099-83798	14,500 swine – 55 lbs. or under
Justin Larson Farm – Sec 10	Mower, Marshall	099-93975	2,800 swine – 55 lbs. or more
Richard Gerber Farm 2	Mower, Adams	099-100204	
Nick, Nate & Tyler Holden Farm - Kingston	Mower, Lyle	099-110100	4,832 swine – 55 lbs. or more
MJC Farms	Steele, Blooming Prairie	147-50001	3,000 swine – 55 lbs. or more

Source: MPCA, October 2008

Table 2-13 Other NPDES Permits for Direct Surface Water Discharge

Facility	Permit Number	Description	Location
Austin Utilities	MN0025801	Electric Services	Austin
Austin Utilities Northeast Power Station	MN0025810	Electric Services	Austin
David Spinler Construction Incorporated	MNG490076	Asphalt Paving Mixtures and Blocks	Austin
Hormel Foods Corporation	MN0050911	Meat Packing Plants	Austin
Richard Jones Sand Pit	MNG490175	Dimension Stone	Brownsdale
Bishop Excavation Inc	MNG490128	Asphalt Paving Mixtures and Blocks	Blooming Prairie
Atofina Chemical Incorporated Viking Chemical Company Division	MN0041521	Industrial Organic Chemicals	Blooming Prairie
Wondra Pit	MNG490130	Construction Sand and Gravel	Blooming Prairie

Source: US EPA Envirofacts Data Warehouse website http://www.epa.gov/enviro/index.html

Table 2-14 Direct Toxic Releases to Surface Water

Facility	EPA TRI Facility ID	Description of 2006 Releases to Surface Water	Location
Austin Utilities Northeast Power	55912STNTL37011	5 lbs/yr of Barium, Copper and Zinc Compounds	Austin
Hormel Foods Corporation	55912GHRML500NE	Last release of Chlorine & Sulfuric Acid in 1987-1989	Austin

Source: US EPA Envirofacts Data Warehouse website http://www.epa.gov/enviro/index.html

The MPCA identified some communities in the CRWD as direct dischargers of untreated wastewater, through illegal straight pipes or drain tiles into water bodies; these are listed in **Table 2-15**.

Table 2-15 Straight-pipe Communities in CRWD

County	Community	Township	Number of Homes	Number of Businesses	Straight Pipe*	Receiving Body
Mower	Andyville	Lansing	21	1	Community	County Ditch
Mower	Cedar Dale	Lansing	14	0	Community	Cedar River
Mower	Nicolville	Red Rock	16	1	Community	Dobbins Creek
Mower	Woodhaven	Lansing	65	0	Individual	Cedar River

*Individual indicates that at least one home in a community has a straight pipe. Community indicates multiple buildings are connected to a straight pipe.

At the time when the article, *Archaic sewage lines tainting lakes, rivers,* was published in the Minneapolis-St. Paul Star Tribune on February 26, 2008, Nicolville and Woodhaven were taking steps to repair the discharge, including applying for funding. According to the report, *Small Community Wastewater Needs in Minnesota*, four small communities located in the CRWD completed wastewater improvements to nonconforming septic systems and straight pipes between 1996 and 2006. Lansing Township (population 200) and Sargeant (population 78) in Mower County completed new wastewater treatment ponds. Belleman's and Dinsmore Additions (populations of 55 and 115, respectively) connected their discharges to the Austin Wastewater Treatment Plant.

In addition to these straight pipe communities, households and communities with nonconforming septic systems can be a pollution source (mainly fecal coliform and nitrogen), especially during periods of low flows in the streams. Septic systems are called subsurface treatment systems (SSTS) by the MPCA and are also known as individual sewage treatment systems (ISTS). These nonconforming SSTS may provide partial settling and treatment, but on the whole do not fully treat the wastewater, whether due to inadequate soils, undersizing of the system, or improper maintenance.

There are an estimated 2,000 SSTS in the Mower County portion of CRWD. Mower County Environmental Services has estimated that approximately 25 percent of the population in the Mower County portion of CRWD is on SSTS. Of the 2,000 SSTS in the Mower County portion of CRWD, it is estimated that 30 percent are compliant, 60 percent are failing to protect groundwater, and 10 percent are failing and imminent public health threats (IPHT). The largest concentration of SSTS in CRWD, consisting of 120 homes and a business, is in Lansing Township just north of Austin. This area has recently been annexed by the City of Austin and will be connected to the city sewer system by 2010.

The MPCA adopted new SSTS Rules in February 2008 requiring counties to verify the subsurface soil conditions prior to issuing a "notice of compliance" for each new and repaired SSTS. All counties in the CRWD require a SSTS compliance inspection prior to home sales, if a complaint has been filed, or discharge observed during construction within the road right-of-way. Mower County is in the process of conducting an inventory of SSTS classified as IPHT in a ½ mile corridor along the length of the Cedar River.

2.12 Water Quality Modeling

Very little water quality modeling of the CRWD has been completed in the past. In the early 1990s, Mower County, the Mower County Soil and Water Conservation District, the MPCA, and others coordinated on a Phase I clean water partnership project for the Dobbins Creek watershed and East Side Lake. The Agricultural Nonpoint Source Pollution (AgNPS) model was used for the Dobbins Creek area during that project. Additional water quality modeling will be conducted for the Cedar River Watershed Turbidity, Excess Nutrients and pH Total Maximum Daily Load study that will be completed in 2011.

2.13 Water Quantity and Floodplain Information

Water quantity modeling, including floodplain delineation, of the areas within CRWD has been completed for flood insurance studies and a surface water management plan. Chapters 2.13.1 and 2.13.2 provide information about these water quantity and floodplain modeling efforts.

2.13.1 Flood Insurance Studies

A Flood Insurance Study (FIS) contains information regarding flooding in a community, including flood history of the community and information on engineering methods used to develop Flood Insurance Rate Maps (FIRM) for a community. Homeowners within Federal Emergency Management Agency (FEMA) designated floodplains are required to purchase flood insurance separate from their homeowners insurance policy. Homeowner and renters outside of the official flood plain can also qualify for flood insurance. Three different types of zones are identified in **Figure 2-12**:

- Special Flood Hazards (FEMA Zone A) - The area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year (i.e., 100-year flood). No depths or base flood elevations are shown within these zones because detailed analyses were not performed.

- 100-Year Floodplain (FEMA Zones AE, AH, AO, etc.) - The area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year (i.e., 100-year flood). Depths or base flood elevations are shown within these zones.

- 500-Year Floodplain – (FEMA Zone B) - The area that will be inundated by the flood event having a 0.2-percent chance of being equaled or exceeded in any given year (i.e., 500-year flood).

The most current flood information and maps for areas within the CRWD are and outlines of the floodplains can be seen in **Figure 2-12**:

- Freeborn County – May 1982 FIRM maps & November 1981 FIS

- Dodge County – September 1982 FIRM maps

- Hayfield – January 1982 FIRM maps & July 1981 FIS

- Steele County – November 1981 FIRM maps & May 1981 FIS

- Mower County – July 1979 FIRM maps & FIS

- Austin – August 1992 FIRM maps & FIS

- Mapleview – May 1984 FIRM maps & November 1983 FIS

- Rose Creek – July 1979 FIRM maps & January 1979 FIS
- Waltham – October 1979 FIRM maps & FIS

In some cases, homes within FEMA-designated floodplains on the FEMA floodplain maps may actually not be in the floodplain. In order to waive the mandatory flood insurance requirements for their homes, residents must remove their homes from the FEMA-designated floodplain by obtaining Letters of Map Amendment (LOMA). The following is a list of LOMAs within the CRWD:

- Freeborn County – two structures
- Dodge County – one structure, one portion of property
- Hayfield – one property
- Mower County – four structures & one portion of property
- Austin – five structures, one property & one portion of property

The following is a list of the counties and cities in the CRWD that have floodplain regulations:

- Mower County – the floodplain ordinance is Article III of the county's Zoning Ordinance and can be found on the Mower County website (http://www.co.mower.mn.us/).
- Dodge County – the floodplain ordinance is Section 15 of the county's Zoning Ordinance.
- Freeborn County – the floodplain ordinance is Article 5 of the county's Zoning Ordinance.
- Steele County – the Floodplain Ordinance can be found on the Steele County website (http://www.co.steele.mn.us).
- City of Austin – the floodplain zoning regulations are in Chapter 12 of the City Code of Ordinances, which can be found on the City of Austin's webpage (http://www.ci.austin.mn.us/).

2.13.2 Upper Cedar River Surface Water Management Plan

In response to chronic flooding on the Cedar River and some of its tributaries, an Ad Hoc Committee was formed to develop a Surface Water Management Plan (SWMP) for the Upper Cedar River Watershed. The Ad Hoc Committee was formed prior to the formation of the CRWD and included representatives of the Mower Conservation District, Mower County, Turtle Creek Watershed District and the City of Austin. Barr Engineering completed the *Upper Cedar River Surface Water*

Management Plan in September 2007. The prime goal for the SWMP was to provide for flood protection throughout the entire Upper Cedar River Watershed through a 20 percent reduction in the Cedar River's peak 100 year flood discharge rate in and near the City of Austin, Minnesota. Therefore, only areas upstream (north) of Austin were investigated, including the entire Turtle Creek Watershed District.

The Upper Cedar River Watershed was delineated into 435 subwatersheds with divides delineated to every major creek and river crossing such as roads, railroads and dams. Barr Engineering developed an Army Corps of Engineers' HEC-HMS computer model of the existing conditions that was linked with the GIS databases of subwatershed maps, soils maps, topographic maps, and existing hydraulic structures such as culvert and bridge opening dimensions. The existing conditions model was calibrated to the USGS gaging station on the Cedar River near Austin (ID number 05457000). In order to reduce the 100 year flood discharge rate, 104 regional detention basin locations were ultimately modeled. The SWMP recommended creating these regional detention basins through flow restrictions at culverts or bridges; with these restrictions accomplished by 1) creating a ring dike upstream of the existing culvert or bridge through which a reduced sized culvert would be constructed; or 2) removing or filling in the existing bridge or culvert and replacing it with the necessary reduced sized culvert.

The SWMP reported that implementing these 104 regional detention basins, starting with the upstream-most subwatershed, would reduce the peak flow of the 100-year 24-hour storm event by 17.5 percent (17,100 cubic feet per second vs. 14,100 cubic feet per second) at the southern edge of Austin. Results from the SWMP revealed that the Ramsey Mill Dam currently reduces the Cedar River's peak 100-year, 24-hour storm runoff flow rate in the city of Austin by 9,000 cubic feet per second. It would be difficult to achieve additional flow reduction by modification of that dam and any such modifications would likely result in the detriment of the upstream river reach habitat. It was found that the greatest flood reduction benefit would come from installing 59 regional detention basins in the Wolf Creek and Dobbins Creek watersheds.

2.13.3 Other Hydrologic Modeling

Barr Engineering completed the *Drainage Plan for Mower County* in 1973. The plan consisted of an evaluation of the existing storm drainage facilities and a preliminary design of recommended additions to the existing storm drainage facilities. Most of these recommendations included increasing storm sewer sizes within the towns to decrease localized flooding and installing storm water ponds. The areas were modeled with the hydrograph method developed by Barr Engineering in the 1950's.

There have been no additional studies completed by the City of Austin that have included hydrologic modeling.

2.14 Surface Water System

In contrast to the majority of the state of Minnesota, the CRWD is unique, in that there are no natural lakes and few wetlands in the watershed.

The City of Austin is included in a group of communities with populations greater than 10,000 (the population of Austin was 23,314 in 2000) that are federally required to obtain a Municipal Separate Storm Sewer System (MS4) permit for managing non-point source stormwater. The permitting process requires cities such as Austin to file a Phase II NPDES permit with the Minnesota Pollution Control Agency (MPCA) which addresses how the city will regulate and improve stormwater discharges. MS4s are required to develop and implement a stormwater pollution prevention program (SWPPP) to reduce the discharge of pollutants from their storm sewer system to the maximum extent practicable and submit an annual report as a part of the NPDES permit. Austin's SWPPP addresses the six Minimum Control Measures outlined in the permit requirements. The six Minimum Control Measures required by the permit and addressed by the SWPPP are:

1. Public Outreach and Education
2. Public Participation/Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post Construction Runoff Control
6. Pollution Prevention/Good Housekeeping

The City of Austin provides a comprehensive inspection program of all surface waters, including lakes, streams and ditches within the city limits. Maintenance activities are coordinated with the watershed districts and ditch authorities.

2.14.1 Lakes

All three lakes within the CRWD (Ramsey Mill Pond, East Side Lake and Mill Pond) were created through dam construction. For more information about lakes please see the MDNR Lake Finder webpage (http://www.dnr.state.mn.us/lakefind/index.html).

The 52-acre Ramsey Mill Pond is located north of Austin on the Cedar River and has a maximum depth of 18 feet. Access to the Ramsey Mill Pond is maintained by the Ramsey Golf Club. The Ramsey Dam was originally constructed in 1872 for mill power. The dam was modified in the 1920's, 1940's and 1960's. The original mill was turned into the Old Mill restaurant in 1948. The length of the overflow structure is 138 feet and the height from the top of the dam to the streambed at the centerline of the dam is approximately 10 feet. The dam is privately owned. The U.S. Army Corps of Engineers (USACE) *1978 Dam Inspection Report* reports the hazard classification as significant.

East Side Lake is approximately 40 acres and is on Dobbins Creek. The maximum depth of the lake is 10 feet. The City of Austin maintains a boat landing and fishing dock on this lake in East Side Lake Park. The concrete East Side Lake Dam (MN No. 13) was constructed in the 1934 by the Federal Civil Works Administration and Works Progress Administration Programs. The lake was filled in 1939 after excavation of the pasture land behind the dam. Repairs and modifications were made in 1962, 1969 and 1975. The length of the dam is 70 feet and the height is 11 feet. The dam is owned by the City of Austin. The *National Dam Safety Program 1980 Inspection Report* reports the hazard classification as significant. After the July 2000 flood, the dam was inspected by Short Elliott Hendrickson Inc (SEH) for damage. SEH recommended that a 13 foot deep scour hole immediately downstream of the dam and horizontal cracking of the downstream right abutment wall be repaired.

The 19-acre Mill Pond is located in downtown Austin on the Cedar River and has a maximum depth of 17 feet. The City of Austin maintains a boat ramp on the north side of the pond in Horace Austin Park. Mill Pond is impounded by the concrete Cedar River Dam (MN No. 256) that was constructed in the 1918 to provide hydropower for an adjacent mill. The impoundment presently provides water supply for the City of Austin power plant and recreational opportunities. Modifications were made to the dam in 1924, 1961 and 1975. The dam is a concrete gravity type structure 22 feet high and 200 feet long and has 3 spillways. The dam is owned by the City of Austin. The April 1983 *National Dam Safety Program Inspection Report* reports the hazard classification of the Cedar River Dam as significant. After the July 2000 flood, the dam was inspected by SEH for damage. SEH recommended that grouted riprap at the upstream end of each bridge abutment and downstream end of the right abutment wall be repaired.

2.14.2 Streams

The CRWD contains 166.1 miles of perennial streams/drainage ditches and 32.0 miles of intermittent streams/drainage ditches identified as MDNR public waters. The predominant substrate of the Cedar River is sand according to the MPCA environmental monitoring and assessment program biological surveys. The MDNR requires a 50 foot wide permanent vegetation buffer strip in shoreland districts (agricultural areas adjacent to lakes, rivers and streams - see Minnesota Statutes, Section 103E.021).

2.14.3 Ditches

Many ditches were constructed in the early part of the 20th century to aid in land development for agriculture. The goal of these ditches is to remove water from agricultural lands. There are 41.1 miles of perennial and 1.6 miles of intermittent drainage ditches identified as MDNR public waters and shown on **Figure 2-8**. The Minnesota Statutes, Section 103G.005 Subd. 15a9 defines public waters as natural and altered watercourses with a total drainage area greater than two square miles.

Ditches identified as public waters may be part of private drainage systems or public drainage systems (also known as judicial or county ditches). A public drainage system is one administered under Chapter 103E of Minnesota Statutes and is under the jurisdiction of a drainage authority (e.g. county, watershed district). The land associated with an open ditch that is part of a public drainage system remains privately held. Some ditches identified by the MDNR as public waters due to their drainage areas are part of private drainage systems and are not under the jurisdiction of the county drainage system.

There are six county ditches in Mower County within CRWD. No county ditches in Dodge County are within CRWD. County ditch maps for Freeborn and Steele Counties are available for viewing at the county courthouses. At present, the CRWD has no direct authority over public drainage systems; the counties maintain jurisdiction over the ditches. For any new ditches or ditch improvements, the land adjacent to public ditches is required by the MNDR to include a buffer strip of permanent vegetation that is usually 1-rod (16.5 feet) wide on each side (Minnesota Statutes, Section 103E.021). Additional requirements for public drainage systems are included in Minnesota Statutes 103E.015, 103E.215, 103E.215, 103E.411, and 103E.701 Subdivision 6.

2.15 Recreational Areas

There are 30 municipal parks in the city of Austin. They include Decker Park, Lafayette Park, East Side Lake Park, Sterling Park, Early Morning Lions Park, Sulton Park, Cullen Park, Kaufman Park and J.C. Hormel Nature Center. The main park in Hayfield is the Earl B. Himle Memorial Park. Blooming Prairie parks include Central Park, Victory Field, East Side Park and the Blooming Prairie Firefighters' Park. There are no County Parks within the watershed district.

Golf Courses in the CRWD include Meadow Greens Golf Course and Ramsey Golf Club in Austin, and the Oaks Golf Club in Hayfield.

The Shooting Star State Trail is a multi-use trail that will stretch from Leroy to Austin. Currently eight miles have been paved. It is planned to connect this trail to the future Blazing Star State Trail in Austin.

Wild Indigo Prairie Scientific and Natural Area is a 12 mile long strip of abandoned railroad right-of-way containing mesic tallgrass prairie that extends between Ramsey and Dexter in Mower County. Iron Horse Prairie Scientific and Natural Area is a 35-acre mesic tallgrass prairie located approximately 2 miles south of Hayfield.

MDNR Wildlife Management Areas (WMA) within the CRWD include:

- Red Cedar River WMA – 74-acre wooded area containing mainly oaks managed for riparian hardwood along the Cedar River and their associated wildlife including deer, small game, forest game birds, pheasant and waterfowl.

- Lyle-Austin WMA – 116-acre, 10 mile long prairie with some aspen along a former railroad bed managed for deer, small game, and pheasant.
- Schottler WMA – 164-acre former row crop farm that is currently native grassland managed for deer, small game and doves.
- Ramsey Mill Pond WMA – 335 acre mixture of wetland, upland woods and established native prairie managed for deer, small game, pheasant, waterfowl and other non-game species. There is no boat access to the Cedar River from this area.
- Schwerin Creek WMA – 37 acre riparian grassland with pockets of shrubs and small trees along Schwerin Creek managed for pheasants and deer.

There are no state parks or state forests in CRWD.

2.16 Fish and Wildlife Habitat

According to the MPCA Environmental Monitoring and Assessment Program, game fish species found in the Cedar River and tributaries are largemouth bass, northern pike, carp, catfish, walleye, smallmouth bass, redhorse sucker, white bass, white crappie, black crappie, bluegill, and yellow perch. None of the streams within the CRWD are designated trout streams. In 2009, the MPCA reported finding an Ozark minnow and Redfin shiners in Turtle Creek for the first time since 1964. Ozark minnows were also found in large numbers in the main stem of the Cedar River south of Austin.

The MDNR has conducted fish surveys in East Side Lake in the past and most recently in 2007 (http://www.dnr.state.mn.us/lakefind). The 2007 survey identified black bullhead, black crappie, bluegill, common carp, golden shiner, green sunfish, largemouth bass, orangespotted sunfish, walleye, white crappie, white sucker, and yellow bullhead. The MDNR stocked walleye fingerlings in 2006, and walleye fingerlings and adults in 2007. Additional stocking of walleye was proposed in East Side Lake for 2008.

The MDNR completed a statewide mussel survey in 1999 that included the Cedar River and its tributaries. Surveys revealed that rivers and streams in the southern one-third of Minnesota do not support their historical assemblage of mussel species. The exception to this statement included Rose Creek and Otter Creek in CRWD. Historically, the Cedar River and Rose Creek contained 17 and 10 species of freshwater mussels, respectively. The 1999 survey found 10 and eight species, respectively. Spike (*Elliptio dilatata*) is a species of special concern that has declined in most portions of Minnesota but has a healthy population in Rose Creek. For more information about freshwater mussels in Minnesota's waters, see *Field Guide to the Freshwater Mussels of Minnesota,* published by the MDNR.

The Cedar River is also habitat to the Wood Turtle and represents the western limit of this species in Minnesota. The Wood Turtle was designated as a threatened species by the MDNR in 1984. This species occupies forested rivers and streams and adjacent upland habitats. It will forage in the upland forest habitat, but also uses grassy openings to feed and nest. Threats to this population include loss of forest habitat, reduced water quality,

and flooding of nesting and feeding areas. More information is available from the MDNR's webpage (http://www.dnr.state.mn.us/rsg/profile.html).

The U.S. Fish and Wildlife Service currently has no fish or wildlife listed as endangered or threatened in the counties encompassed by the CRWD. However, three plant species are listed as federally endangered or threatened. The endangered Minnesota dwarf trout lily (*Erythronium propullans*) historically observed in Dodge and Steele Counties is typically found on north-facing slopes and floodplains in deciduous forest. The threatened prairie bush clover (*Lespedeza leptostachya*) historically observed in Dodge and Mower Counties is typically found in native prairies on well-drained soil. The threatened western prairie fringed orchid (*Platanthera praeclara*) historically observed in Mower County is typically found in wet prairies and sedge meadows. For more information visit the U.S. Fish and Wildlife Service website (http://www.fws.gov/endangered/).

A survey of recently delisted fish species and of fish species of special concern was completed in southeastern Minnesota in 1998 and 1999 (Schmidt, 2000). A species of special concern is classified by MDNR as extremely uncommon in Minnesota or as requiring unique habitat that deserves careful monitoring of its status. Two redfin shiners (*Lythrurus umbratilis)* were found in the Cedar River near Austin. Numerous species of special concern and recently delisted species were observed in Otter Creek, including the least darter (*Etheostoma microperca)*, Ozark minnow (*Notropis nubilis*), slender madtom (*Noturus exilis)*, and largescale stoneroller (*Campostoma oligolepis)*. However, Otter Creek and its watershed are not under the jurisdiction of the CRWD, as the confluence of the Cedar River and Otter Creek is in Iowa.

According to the USGS Nonindigenous Aquatic Species website (http://nas.er.usgs.gov/) Common carp (*Cyprinus carpio*) is an invasive species that has been established in the greater Iowa River drainage, of which the Cedar River is a tributary.

The MDNR maintains a database of rare plants, animals, native plant communities and other rare features in its Natural Heritage Information System (NHIS). **Figure 2-13** presents the general location of these features within CRWD as provided in the NHIS Rare Features Database. The Rare Features Database contains historical records from museum collections, published information, and field work observations, especially from the MDNR Minnesota County Biological Survey. The survey is proposed to begin in 2008 for Dodge, Freeborn, Mower and Steele Counties. Hence, the amount of data provided in the NHIS Rare Features Database within CRWD will be expected into increase as these surveys are completed. More information can be found on the MDNR NHIS website (http://www.dnr.state.mn.us/eco/nhnrp/nhis.html) and the MDNR Minnesota County Biological Survey website (http://www.dnr.state.mn.us/eco/mcbs/index.html).