

# Nine Mile Creek Watershed District Water Management Plan

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## 2.0 Land and Water Resource Inventory

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### 2.1 General Watershed Boundaries

The NMCWD consists of the land that drains into Nine Mile Creek. The District encompasses approximately 50 square miles in southern Hennepin County and it includes portions of the cities of Bloomington, Eden Prairie, Edina, Hopkins, Minnetonka, and Richfield (see Figure 2-1).

Nine Mile Creek flows approximately 15 miles from its headwater, where it crosses County Road No. 3 in Hopkins, to its mouth at the Minnesota River. The South Fork of Nine Mile Creek, joining the North Fork of the creek in Bloomington just south of Interstate Highway 494, is approximately 8.5 miles long. The Governmental Boundaries Map, Figure 2-2, shows the location and the legal boundary of the District. The legal boundaries of the District were modified in 1984 and again in 1994 to approximate more closely the natural topographic boundaries.

### 2.2 History

The NMCWD was established in 1959 by the Minnesota Water Resources Board acting under the authority of the Watershed Law. The authority granted to the District included authority to address flooding and water quality problems and was supplemented by planning authority delegated in the Metropolitan Surface Water Management Act. In 1961, the District established a floodplain management ordinance. This District effort complemented the authority and efforts of municipalities.

The Floodplain Management Act of 1969 encouraged municipalities to adopt, enforce and administer floodplain ordinances similar to those established by the District. Each of the District's municipalities adopted floodplain ordinances. This District and municipal regulation proved successful in that no significant flooding has occurred in the District even during the major flooding events that occurred in 1977, 1987, and 1993. The District's floodplain is based on ultimate development of the watershed tributary to the creek, according to municipal land use plans. The District flood elevations, because they were calculated based on total urbanization, are equal to or higher than the flood elevations shown in Flood Insurance Studies, which are based on development conditions when the Flood Insurance Study was undertaken.

Another reason that flooding problems do not occur within the NMCWD is because the District has completed several important basic water management projects in anticipation of ultimate watershed land use development. Completed flood control projects (see Figure 2-2) include the following:

- More than 30 years ago, the Board of Managers undertook wetland and habitat preservation by implementing the Marsh Lake Basic Water Management Project. Lying east of France Avenue in the vicinity of 94<sup>th</sup> Street in the City of Bloomington, the marsh was the last chance to detain and store floodwaters before they entered the steep channel now stabilized and restored by the Lower Minnesota Valley Restoration Project. This first major project

was completed in 1970. In addition to its function as a stormwater detention basin, the area was designated as a wildlife refuge to ensure that wildlife habitat was protected from development. Since its inception, the District supported, promoted, and adhered to a policy of multi use projects involving its water resources, wherever possible.

- The Mount Normandale Lake Basic Water Management Project created an artificial 135-acre lake in 1978. The Lake stores floodwater during high-intensity rainstorm events. This storage regulates the extreme fluctuations, or bounce in the flow regime of the creek, which can erode sediments. That fluctuation is recognized as an important factor in maintaining water quality. Two other basic water management projects serve this purpose, the Bredesen-Mud Lake Project, completed in 1985, and the Anderson and Bush Lakes Project, portions of which were completed in 1978 and 2000. In addition, all three projects also created and enhanced recreation, aesthetic nature uses, and wildlife habitat.
- One of the more recent basic water management projects, the Lower Minnesota Valley Restoration Project, finished in 1991, restored and stabilized the streambank through its final steep descent to the mouth of the creek at the Minnesota River. By stabilizing the streambank, erosion was significantly reduced. The nonpoint source pollution monitoring program for the creek documents this reduction. The benefits of this project directly address the problems identified by the Minnesota River Assessment Project (MRAP) and anticipate the planning of the Minnesota River Implementation Program (MRIP).
- Another recent project was the Hopkins Culvert Improvements Basic Water Management Project, completed in 1993. These improvements substantially improved the flow of the creek through the City of Hopkins. The changes significantly reduced local flooding of many properties and streets within the city. By lowering the flood elevation, previously flooded property became available for new and expanded commercial uses. That flooding had endangered both people and property during storm events.
- The District also completed the Smetana Lake Basic Water Management Project in 2002. That project created additional flood storage for the south fork of the creek. Besides this flood protection, the aesthetic and recreational uses of the lake were improved, as was creek water quality below Smetana Lake.

Currently, the District is completing yet another basic water management project, the Minnetonka Lakes Improvement Project, primarily designed to improve lake water quality conditions. This project is expected to be completed in 2006. As is discussed in later sections of this Plan (Chapter 5—Assessment of Problems, and Chapter 8—Implementation Priorities), numerous other lake and stream water quality improvement projects are planned for future years. Now that watershed land use development has largely reached its ultimate state, and potential flooding problems have been resolved, the primary focus of future District basic water management projects will be on the improvement of lake and stream water quality conditions.

## 2.3 Inventory of Water Resource and Physical Factors

Many local, regional, and state resource management documents were consulted during preparation of this section of the Plan. These publications are listed in the references section, at the end of this Plan.

## 2.4 Precipitation

The precipitation data normally used in the seven-county metropolitan area for hydrologic and hydraulic design are incorporated by reference in this Plan or may be included in the local plans of the municipalities within the District. These data are recorded and maintained by the United States Weather Service, located at the Minneapolis/St. Paul Metropolitan Airport, and are published in the following U.S. Weather Bureau technical papers and updates, which are used for hydrologic and hydraulic design:

Hershfield, D.M. 1961: Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. *Weather Bureau Technical Paper 40*, U.S. Weather Bureau. Washington, D.C., 115 pp.

Miller, J.F. 1964. Two- to ten-day precipitation for return periods of 2 to 100 years in the contiguous United States, *Technical Paper No. 49*, U.S. Weather Bureau and U.S. Department of Agriculture, 29 pp.

Following is a map (Figure 2-3) showing average annual precipitation totals for areas within the NMCWD. Rainfall in the lower portion of the watershed generally exceeds that of the upper portion.

In 2002, the NMCWD conducted a review of rainfall data they have collected since 1964 to determine local rainfall patterns within the watershed. Until now, only regional data have been available, which provide an average of rainfall patterns within a large regional area, not specific to the District. The results of the March 2002 rainfall study are very important because they can be used to predict more accurately expected rainfall amounts that are used to estimate the expected flows and flood levels. The District plans to use this information in designing flood control and water quality structures in the future.

## 2.5 General Geology and Topographic Data

Nine Mile Creek is a small stream tributary to the Minnesota River, and is located within the Lower Minnesota major watershed of the Minnesota River basin. The District is within the Big Woods portion of the Central Hardwood Forests Ecoregion as determined by the MDNR and Minnesota Pollution Control Agency (MPCA). According to the MRAP land use assessment, most of the District is assessed as having a low potential for nonpoint source pollution.

The topography of the District varies from relatively flat land in much of Bloomington and along the North Fork of the creek through Edina and Hopkins, to very hilly land along the west boundary of the District in Bloomington, the southwest corner of Edina, and most of Eden Prairie and Minnetonka. The remainder of the District is moderately rolling topography. There is an elevation difference of approximately 430 feet between the creek's outlet into the Minnesota River, at Elevation 700 feet

above mean sea level (MSL) and the highest point, located in the northwest corner of the District. Despite the extremes in elevation, about 90 percent of the land within the District ranges from 800 to 950 MSL.

The direction of stormwater flow and the location of watershed divides were determined through use of topographic maps with 2-foot contour intervals. Two-foot topographic mapping for the entire District is available from the municipalities. Figure 2-4, showing surface elevation contours and interior watershed divides follows. Additional information is available from the Geologic Atlas of the Minnesota Geological Survey, which is incorporated by reference. Also, the District will use Hennepin County's groundwater plan as a guide for making watershed management planning decisions that may have impacts on groundwater (see Section 2.7).

## 2.6 Surface Water Resource Data

### 2.6.1 Wetlands

1. The Minnesota Department of Natural Resources “Protected Waters Inventory Map” is incorporated by reference.
2. The “National Wetlands Inventory Map”, produced by the United States Fish and Wildlife Service is incorporated by reference.
3. Most District cities have approved local wetland management plans by which they regulate development impacts on wetland resources. Pending completion of comprehensive wetland protection and management plans by the remaining cities, the District adopts as an interim regulation on a case-by-case process based upon the Minnesota Rapid Assessment Method. The nondegradation policy, Minn. Rules §7050.0185, and wetland mitigation principles, Minn. Rules §7050.0186, promulgated by the MPCA are also adopted.

Each municipality must develop a local wetland management plan within 2 years of approval by the Board of Water and Soil Resources (BWSR) of the last watershed management organization plan that affects that municipality. The plan must (1) incorporate Minnesota Statutes Sections 103A.201, Subdivision 2, and 103G.222; (2) be adopted as part of an approved local water plan under Minnesota Statutes Section 103B.3355. The Plan must contain an executive summary, resource inventory, assessment of problems, goals and policies and implementation.

The local unit of government must inventory the public value, location, size and type of wetlands under its jurisdiction. Wetland boundaries must be determined using the methodologies in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (January 1989). Wetland type must be identified according to Cowardin, et al., 1979, Classification of Wetlands and Deepwater Habitats of the United States and according to United States Fish and Wildlife Service Circular No. 39 (1971 edition) “Wetlands of the United States.” Wetlands must be separately identified that are:

#### A. Outstanding resource value waters<sup>1</sup>; including calcareous fens<sup>2</sup>

<sup>1</sup>Minn. Rules §7050.0180 defines the term “Outstanding resource value waters”. In pertinent part the term means “waters of the state with high water quality, wilderness characteristics, unique scientific or ecological significance, exceptional recreational value, or other special qualities which warrant stringent protection from pollution”. Minn. Rules §7050.0180, Subp. 2A.

<sup>2</sup>Minnesota Rules Sections 8420.1010 through 8420.1060 state standards and criteria for identification, protection, and management of calcareous fens

#### B. Designated scientific and natural areas<sup>3</sup>

<sup>3</sup>Minn. Stat. §86A.05 classifies and states the purposes for state scientific and natural areas:

(a) A state scientific and natural area shall be established to protect and perpetuate in an undisturbed natural state those natural features which possess exceptional scientific or educational value.

(b) No unit shall be authorized as a scientific and natural area unless its proposed location substantially satisfies the following criteria:

(1) Embraces natural features of exceptional scientific and educational value, including but not limited to any of the following:

- (I) natural formations or features which significantly illustrate geological processes;
- (ii) significant fossil evidence of the development of life on earth;
- (iii) an undisturbed plant community maintaining itself under prevailing natural conditions typical of Minnesota;
- (iv) an ecological community significantly illustrating the process of succession and restoration to natural condition following disruptive change;
- (v) a habitat supporting a vanishing, rare, endangered, or restricted species of plant or animal;
- (vi) a relict flora or fauna persisting from an earlier period; or
- (vii) a seasonal haven for concentrations of birds and animals, or a vantage point for observing concentrated populations, such as a constricted migration route; and

(2) Embraces an area large enough to permit effective research of educational functions and to preserve the inherent natural values of the area.

**C. Habitat for species of wild animal or plant designated endangered, threatened or of special concern<sup>4</sup>.**

<sup>4</sup>Minn. Stat. §84.0895 provides protection of threatened and endangered species of wild animal or plant. The following designations apply:

(1) endangered, if the species is threatened with extinction throughout all or a significant portion of its range;

(2) threatened, if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range; or

(3) species of special concern, if although the species is not endangered or threatened, it is extremely uncommon in this state, or has unique or highly specific habitat requirements and deserves careful monitoring of its status. Species on the periphery of their range that are not listed as threatened may be included in this category along with those species that were once threatened or endangered but now have increasing or protected, stable populations.

**D. State wildlife management areas<sup>5</sup>.**

<sup>5</sup>Minn. Stat. §86A.05, Subd. 8 provides in pertinent part:

A state wildlife management area shall be established to protect those lands and waters which have a high potential for wildlife production and to develop and manage these lands and waters for the production of wildlife, for public hunting, fishing, and trapping, and for other compatible outdoor recreational uses.

No unit shall be authorized as a state wildlife management area unless its proposed location substantially satisfies the following criteria:

(1) Includes appropriate wildlife lands and habitat, including but not limited to marsh or wetlands and the margins thereof, ponds, lakes, stream bottomlands, and uplands, which permit the propagation and management of a substantial population of the desired wildlife species; and

(2) Includes an area large enough to ensure adequate wildlife management and regulation of the permitted recreational uses.

**E. Aquatic management areas<sup>6</sup>.**

<sup>6</sup>Minn. Stat. §86A.05, Subd. 14 classifies and states the purposes of aquatic management areas:

Aquatic management areas may be established to protect, develop, and manager lakes, rivers, streams, and adjacent wetlands and lands that are critical for fish and other aquatic life, for water quality, and for their intrinsic biological value, public fishing, or other compatible outdoor recreational uses.

**F. Within any other unit which is part of the state outdoor recreation system<sup>7</sup>.**

<sup>7</sup>Minn. Stat. §86A.05 states the classifications and purposes for the state outdoor recreation system.

**G. High priority areas for wetland preservation, enhancement, restoration, and establishment<sup>8</sup>.**

<sup>8</sup>Minnesota Rules §8420.0350, Subp. 2 states considerations relevant to identifying high priority.

Local wetland management plans must identify and assess the significance of runoff discharges into wetlands in accordance with standards for protection of quality and purity established by the MPCA. Point sources and nonpoint sources must be separately identified and their significance determined.

Existing beneficial uses must be identified in accord with the applicable water use classifications for waters of the state as stated in Minnesota Rules §7050.0200. The public value for wetlands must also be identified in accord with Minn. Stat. §103B.3355 and Minnesota Rules §8420.0110, Subp. 38. State of Minnesota Storm Water Advisory Group (1995) "Guidance for Evaluating Urban Storm Water and Snowmelt Runoff Impacts to Wetlands" shall be used in identifying beneficial uses and public values. These guidelines provide a process that enable municipalities to effectively manage storm water inputs to wetlands and to make responsible decisions on the designated uses of wetlands. The process primarily consists of the following steps:

- Inventory Wetlands
- Conduct hydrologic analyses
- Assess water quality impacts
- Determine wetland susceptibility
- Develop management strategy to avoid, minimize, and mitigate wetland impacts.

Flexibility is intended in implementing these guidelines. Municipalities must incorporate wetland mitigation policy and principles as established in Minnesota Rules 7050.0186. The wetland mitigative sequence incorporates impact avoidance, impact minimization and impact compensation. District-wide, wetland loss must be replaced at a 2:1 ratio, at a minimum, although municipalities and the District may require a higher mitigation ratio. Wetlands replacement or compensation shall occur within the watershed as feasible and practical.

Otherwise the mitigation of wetland loss must occur in as close proximity as possible, per Wetland Conservation Act (WCA) requirements.

Discharges and other activities that affect wetlands continue to be regulated in accordance with State and Federal wetland regulations. The District will continue to work with the appropriate regulatory agencies in the enforcement of these regulations. Stormwater discharges into wetlands must maintain existing beneficial uses and public values and may not degrade those uses or values. In situations where it is not feasible or practical to maintain all functions and values, the District will give priority to water quality and flood control while maintaining as many other functions and values as possible.

### **2.6.2 Hydrologic System Characteristics**

1. Records of the Minnesota Department of Natural Resources (MDNR) with respect to the major hydrologic characteristics of public waters are incorporated by reference.
2. Maps showing the areas served by each existing stormwater system and identifying existing stormwater ponds and the location of all stormwater outfalls are incorporated by reference and can be obtained at each of the municipal offices. Stormwater plans shall be incorporated in local plans.
3. Information summarizing available data on the 100-year flood levels and peak discharges of existing and proposed stormwater ponds, as well as flood profile information that corresponds to the peak discharges of channelized flow passing through the watershed, is incorporated by reference. The information can be obtained at each of the municipal offices with respect to systems within each community and shall be incorporated in local plans.

The flood profile information developed by the District is wholly consistent with flood profile information published in all Federal Emergency Management Agency (FEMA) flood insurance studies. In accordance with the U.S. Department of Housing and Urban Development's Flood Insurance Program, floodplain studies by other governmental agencies have been completed for portions of or all of the municipalities within the District. Each of these studies was based on existing development conditions. Because of the significant effect that urbanization will have on flood levels in the District, the District does not use existing conditions but rather future, ultimate development conditions based on the adopted comprehensive plans of municipalities within the District. According to the Metropolitan Council Water Resources Plan, all watershed plans must indicate how surface water management will be managed under existing conditions and expected for future development. The District's assumption avoids inadequate regulatory controls over developments in and near floodplain areas and fulfills the direction of the Metropolitan Council.

Flood profile information encompasses all of the FEMA flood profile and additional areas necessary to manage the floodplain as future development progresses. The delineated floodplain is an envelope profile necessary to define the potential floodplain and establish guidelines for building elevations. This delineation is not a set of static elevations, but rather

a profile that can be adjusted as channel constrictions are removed or altered. This delineation allows as many land use alternatives as possible. Figure 2-5 shows the 100-year frequency floodplain limits along Nine Mile Creek and Figure 2-6 shows the floodplain profile.

4. The District does not have any known flood-prone areas outside of the established flood profile as part of their local water management planning. Municipalities are required though to assess and report whether local flood-prone areas exist. The Hopkins Culvert Improvements Basic Water Management Project rectified a widely known local problem.
5. In accordance with the U.S. Department of Housing and Urban Development's Flood Insurance Program, floodplain studies have been completed for portions or all of the municipalities within the District and may be viewed at the city hall of each respective municipality.
6. In 2005, the District completed an XP-SWMM, hydrologic and hydraulic model of the creek system and a P8 water quality model of the entire Nine Mile Creek Watershed District (NMCWD).

### 2.6.3 Lakes and Streams

There are numerous lakes and ponds, and many miles of streams within the NMCWD. All of these water bodies are viewed as valuable resources. Annually, the District conducts lake and stream water quality monitoring programs that gage the conditions of both. The locations of lake and stream water quality monitoring stations are shown on Figure 2-7. Hydrologic monitoring stations are also shown.

1. **Lakes.** Major lakes within the District are sampled on a rotating basis, once every four years. One-third of the lakes are sampled in each of three consecutive years. A summary report on the results of the preceding three years of lake monitoring is then written every fourth year.

The lake water quality reports concentrate upon the three principal water quality indicators: total phosphorus, chlorophyll *a*, and Secchi disc transparency. Phosphorus is a biologically active element whose concentration often determines the productivity (i.e., algae and/or weed growth) of a lake. Chlorophyll *a* is the photosynthetic pigment of phytoplanktonic algae present in a lake, and an indicator of algal standing crop and photosynthetic rates. Secchi disc transparency is a measure of the depth to which one can see a standard 20-centimeter-diameter white (or black and white-patterned) disc lowered into the water. A detailed discussion of lake management strategies is included in Section 5.0, and the collected lake water quality data are summarized there, along with similar data from the MCES and the MDNR.

Beginning in 1997, lakes within the NMCWD were monitored more intensively in support of Use Attainability Analyses (UAAs) that diagnose water quality problems and their causes and recommend feasible alternative remedial measures. Over the 10-year period from 1997 to 2006, 15 lakes and their watersheds were analyzed through the UAA process, beginning with headwaters lakes and proceeding downstream.

2. **Streams.** The District also monitors Nine Mile Creek water quality each year, in terms of both its chemical and biological conditions. Chemical parameters monitored have generally been restricted to those included in the MPCA Class 2.b. water quality standards, although total phosphorus and flow gaging has recently been added to the annual stream water quality monitoring program. Benthic macroinvertebrate and fish samples have also been collected from eight stream monitoring sites each year to assess stream water quality in terms of its biological diversity and health. The location of hydrologic and benthic monitoring stations are shown on Figure 2-8. The latter biological monitoring has been done to look for changes in stream water quality that may be caused by nonpoint source pollution. This has been done to complement the chemical water quality sampling that is largely based on fair-weather sampling, not during storm events when stream water quality would typically be degraded.

In addition to this District data collection, as part of MRAP, the Metropolitan Waste Control Commission (MWCC) studied the Creek from 1989–1992 and established a continuous monitoring station near the mouth of the Creek. Observations appear in the report of the MWCC to MRAP. These data include extensive flow gaging information. The MWCC's (i.e., now Metropolitan Council Environmental Services, MCES) creek monitoring station at 106th Street in Bloomington continues to operate now as part of the MCES Watershed Outlet Monitoring Program (WOMP), and the District has supplemented this monitoring effort by establishing three additional WOMP-type stations at upstream locations, including 98th Street (Main Stem, Bloomington) Metro Boulevard (North Fork, Edina), and West 77th Street (South Fork, Bloomington).

#### **2.6.4 Shoreland Ordinances**

The Minnesota Department of Natural Resources has approved the Shoreland Ordinance for the City of Eden Prairie and is continuing to work with the City of Minnetonka on their ordinance.

#### **2.6.5 Surface Water Appropriations**

Records of the MDNR with respect to permitted surface-water appropriations are incorporated by reference.

### **2.7 Groundwater Resource Data**

The BWSR approved a groundwater plan for Hennepin County, though the County has yet to adopt this Plan. As approved by BWSR, the Hennepin County Groundwater Plan requires the District to coordinate preparation of standards and to implement programs that are uniform throughout each city, except where hydrologic conditions require variations. The District agrees to cooperate in fulfilling the following tasks:

- Within one year after adoption by Hennepin County, amend this Plan for consistency with requirements of the Adopted Groundwater Plan.
- Encourage cooperation by cities within the jurisdiction to fulfill the purposes of the Adopted Groundwater Plan.
- Forward copies of local water management plans or planned amendments to Hennepin County and Hennepin Conservation District for comment.
- Within two years after adoption by Hennepin County, attempt to identify District lands that do not meet the requirements of applicable state and federal standards intended to prevent groundwater contamination.

The District acknowledges that there is an interrelationship between surface water and groundwater resources and recognizes that surface water must be managed with a concern for proper management of groundwater resources.

The groundwater system in the District is comprised of the glacial drift water table and the underlying bedrock aquifers that are partially in an artesian condition, meaning that water in the bedrock is maintained under pressure by confining upper layers.

The general contours of the glacial drift groundwater are shown on Figure 2-8, which depicts location of hydrological gaging stations previously referenced. This map was developed using data from the District's groundwater monitoring program. The pressure levels in the Jordan Sandstone aquifer are also shown on this map. This information is taken from Technical Paper No. 2, published in 1961 by the Minnesota Department of Conservation. Since groundwater flows from a high-pressure area to a low-pressure area, the relative magnitude of the groundwater contour determines the direction of flow between the aquifers. This indicates that, in the absence of a confining layer, a groundwater flow from the glacial drift to the Jordan Sandstone exists.

The District must provide for the protection of groundwater and regulate its use to preserve it for beneficial purposes. This authority is presently exercised by comment upon groundwater appropriation permits issued by the MDNR. In commenting upon MDNR permits, even though the District does not possess permitting authority, the Board of Managers opposes groundwater appropriations for nonessential purposes. Upon petition, the District will consider as a basic water management project the identification and protection of groundwater sensitivity areas, recharge areas, and wellhead protection zones within the watershed.

## **2.8 Soil Data**

The distribution of soil types in the District is the direct result of glaciations. The surficial soils of the area predominately consist of till and outwash deposits from Late Wisconsinan glaciations, as well as more recent postglacial organic, lacustrine, and alluvial deposits. The currently topography and surficial geology of the area are mostly due to the last of these glacial advances, which consisted of the Des Moines Lobe and Grantsburg Sublobe advances. The Grantsburg Sublobe of the Des Moines Lobe crossed through the area and reached its furthest extent in Grantsburg, WI approximately 16,000 years ago. Near surface till deposits of the Grantsburg Sublobe, and the Des Moines Lobe appear brown due to oxidation, however, in deeper reaches the till deposits have a distinctive grey coloring. The moraine areas are typified by hummocky topography, which consists of rolling hills and depressions usually filled with lakes and marches..

Underlying the Des Moines Lobe and Grantsburg Sublobe deposits are a series of deposits from older glaciations, including deposits from the Superior Lobe. Although the more recent Des Moines Lobe and Grantsburg Sublobe deposits account for the majority of the surficial soils in the area, there are a few outcrops of Superior Lobe deposits at the surface in the NMCWD. Till deposits from Superior Lobe are more reddish brown to brown in color, and have a different lithology than deposits from the Des Moines Lobe and Grantsburg Sublobe. During the advances of the Des Moines Lobe and Grantsburg Sublobe, some mixing of their till deposits with the underlying Superior Lobe deposits occurred to varying degrees.

During the periods when the glaciers receded, there were numerous areas where blocks of ice were left in place while adjacent ice melted or was carried away. Later, after the deposition of materials had ended, the ice blocks melted, leaving depressions in the landscape. Many of these depressions filled with water, resulting in the lakes and potholes that prevail throughout the District.

Soil boring information in the area indicates that the subsurface soils are intermixed and do not exhibit aerial continuity. Many soil borings indicate layers of sand embedded with till layers, which indicate that the area had been subjected to outwash or ice-contact depositional environments typical of stagnating or retreating glaciers.

Soils information for the District can be found on "Soil Survey of Hennepin County, Minnesota," United States Department of Agriculture (1974) by R.A. Lueth, and the distribution of hydrologic soil types within the District is shown on Figure 2-9. Surficial geology information can be found in the Minnesota Geological Survey's Geologic Atlas of Hennepin County (1989), edited by N.H. Balaban.

## **2.9 Land Use and Public Utility Services**

The entire NMCWD is within the Metropolitan Urban Service Area (MUSA) and is completely urbanized. Each of the municipalities within the District maintains zoning ordinances, or other regulatory controls, and comprehensive plans that include general maps of existing land uses and anticipated land uses. City zoning maps and comprehensive planning maps are incorporated by reference and can be obtained through each municipality at the respective municipal offices.

## **2.10 Water-Based Recreation Areas and Land Ownership**

Figure 2-10 shows the location and land ownership for publicly owned water-based recreation areas. Shady Oak Lake Park is a municipal beach operated by the cities of Hopkins and Minnetonka. Bryant Lake Regional Park is owned and operated by Three Rivers Park District as is Hyland Lake Regional Park. Hyland Regional Park extends into the Riley Purgatory Bluff Creek Watershed District. Bush Lake Park is owned and operated by the City of Bloomington.

## **2.11 Fish and Wildlife Habitat**

The District's lake management classification tables (see Table 5-1, pages 5-28 through 5-33; and Table 5-2, page 5-35) list the ecological and management classifications for lakes of the District as designated by the MC, the MPCA, the MDNR, the municipalities of the District, and the District's Board of Managers. These designations include the available conclusions and recommendations from biological surveys or reconnaissance studies. The tables incorporate all state management plans for fish and wildlife. An extensive discussion of the purpose and uses of this table is presented as part of the Lake Management Strategy.

The MDNR has prepared the Minnesota Comprehensive Wildlife Strategy (CWCS) that is found in January, 2006 DNR publication entitled *Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife*. As part of the development and implementation of District projects, the District will utilize this document in the improvement/restoration of fish and wildlife habitat.

## **2.12 Unique Features and Scenic Areas**

The records of the MDNR that identify unique features and scenic-area information, including state-designated natural and scientific areas containing county, state, and federal rare and endangered species as well as other features such as waterfalls, springs, historic mills, and heritage elements identified by the MDNR Heritage Program, are incorporated by reference.

## **2.13 Pollutant Sources**

The records of the MPCA that list known closed and open sanitary landfills, closed and operating dumps, and hazardous waste sites, as well as feedlots, abandoned wells, registered underground and above ground storage tank sites, and permitted wastewater discharges, are incorporated by reference. To the extent that any of this information may be included in a future county groundwater plan, that information is also incorporated by reference.

The District abides by a policy of requiring permit applicants and project petitioners to identify and abandon wells in accord with the rules of the MPCA and the Minnesota Department of Health (MDH).