

3.0 Land and Water Resource Inventory

3.1 Climate and Precipitation

The climate of the Minneapolis St. Paul area is a humid continental climate, characterized by moderate precipitation (normally sufficient for crops), wide daily temperature variations, large seasonal variations in temperature, warm humid summers, and cold winters with moderate snowfall.

The mean annual temperature for the Bassett Creek watershed is 45°F, as measured at the Minneapolis/St. Paul (MSP) airport station (1961-1990). Mean monthly temperatures vary from 12.8°F in January to 73.1°F in July (1961-1990). Extreme temperatures recorded were a high of 108°F on July 14, 1936 and a low of -34°F on January 1, 1936 and January 19, 1970. For the period 1948-1992, the average date for latest occurrence of freezing temperatures is April 29, while the average date for the first autumn frost is October 6. The average frost-free period (growing season) is approximately 160 days.

Table 3-1 summarizes precipitation data for the MSP airport station. Average total annual precipitation at the MSP airport station is 29.4 inches (1971-2000) and has ranged from a low of 11.5 inches in 1910 to a high of 40.2 inches in 1911. The mean monthly precipitation varies from 4.3 inches in June to 0.8 inches in January (1971-2000). From May to September, the growing season months, the average rainfall (1971-2000) is 18.4 inches, or about 62 percent of the average annual precipitation. Precipitation amounts vary across the Minneapolis St. Paul metropolitan area. For example, the average annual precipitation measured at a local volunteer weather observation site in New Hope (within the Bassett Creek watershed) is 32.2 inches (1971-2000). At this site, the average monthly precipitation varies from 4.7 inches in June to 0.8 inches in January, and the average May-September rainfall is 20.0 inches, or 62 percent of the average annual precipitation at the site.

Snowfall averages 56 inches annually at the MSP airport station (1961-1990). Extreme snowfall records range from 98.6 inches during the 1983-1984 season to 14.2 inches during the 1930-1931 season.

Average weather imposes little strain on the typical drainage system. Extremes of precipitation and snowmelt are important for design of flood control systems. The National Weather Service has data on extreme precipitation events that can be used to aid in the design of flood control systems.

Extremes of snowmelt most often affect major rivers, the design of large stormwater storage areas, and landlocked basins, while extremes of precipitation most often affect the design of conveyance facilities.

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 Minneapolis-St. Paul intensity-frequency data compiled by Yarnell (USDA Miscellaneous Publication 204). 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's *National Engineering Handbook*, Hydrology, Section 4, presents maps of regional runoff volume. The information from all of these sources (except for the Yarnell analysis) is summarized in the *Hydrology Guide for Minnesota*, published by the USDA's Soil Conservation Service. Table 3-1 lists many of the precipitation and runoff events used for design purposes.

3.2 Topography

Topographic relief in the Bassett Creek watershed is about 210 feet. The watershed boundary rises from Elevation 980, west of Parkers Lake to Elevation 1010, west of Schmidt Lake. From this point east, the northern and southern watershed boundaries drop to approximately Elevation 800 at the point where the creek enters the Mississippi River. The land within the watershed is now nearing full urbanization. This extensive urbanization has greatly altered the natural topography of the watershed. With these alterations, drainage patterns have become more defined. Many of the wetland areas that existed prior to urbanization have been eliminated or altered, especially in the older developed areas downstream of Medicine Lake.

3.3 Soils

Surface soils throughout much of the Bassett Creek watershed are principally of the Hayden series and are predominantly found in two major associations – the Hayden-Cordova-Peaty Muck Association and the Hayden-Peaty Muck Association. Hayden soils comprise 40 to 50 percent of these associations. Hayden soils are found on low knolls and hills and generally well-drained and have a surface layer of grayish loam or clay loam and a subsoil of light clay loam. They are moderately permeable and have high available moisture capacity.

Of the Hayden-Cordova-Peaty Muck Association, the Hayden soils make up about 40 percent, Cordova soils about 10 percent, Peaty Muck soils about 5 percent, and minor soils about 45 percent of the association. Poorly-drained Cordova soils in swales and on flats have a surface layer of black silty clay loam and a subsoil of clay loam. They have a high available moisture capacity and a moderately low permeability. The very poorly-drained Peaty Muck soils in depressions consist of deep organic materials. Important minor soils in this association include the very poorly-drained Glencoe soils in depressions, the poorly-drained Hamel, Dundas, Minnetonka and Shields soils in drainageways and on the flats, and the moderately well-drained Dalbo soils on the low knolls and hills.

Of the Hayden-Peaty Muck Association, the Hayden soils comprise about 50 percent, the Peaty Muck soils about 10 percent, and minor soils about 40 percent of the association. The very poorly-drained Peaty Muck soils consist of deep organic materials. They have a very high available moisture capacity and a low fertility. The minor soils in this association include the Glencoe, Cordova, Dundas, Hamel, Nessel, and Dalbo soils. The very poorly-drained Glencoe soils are found in shallow depressions and the poorly-drained Hamel, Cordova, and Dundas soils are found in drainageways. The moderately well-drained Nessel and Dalbo soils occur in low knolls and on the crowns of the larger hills.

In the vicinity of Parkers Lake in the western portion of the Bassett Creek watershed, the surface soils tend to be of the Estherville series. Estherville soils have a surface layer of very dark brown sandy loam and a subsoil of dark yellowish-brown sandy loam. The underlying material is calcareous sand and gravel.

Surface soils downstream of Cedar Lake Road in Minneapolis are of the Hubbard series, which are common in the Mississippi River Valley Train. Hubbard soils formed under prairie vegetation have a dark surface horizon that grades into bright brown-colored subsoil. Larger medium sands are typical of the Hubbard profile.

Soil composition, slope and land management determine the effect of soils on stream and lake water quality. Soil composition and slope are important factors affecting the rate and amount of stormwater runoff. The shape and stability of aggregates of soil particles—expressed as soil structure—influence the permeability, infiltration rate, and erodibility of soils. Slope is important in determining stormwater runoff rates and susceptibility to erosion.

Infiltration capacities of soils affect the amount of direct runoff resulting from rainfall. The higher the infiltration rate for a given soil, the lower the potential for runoff from the land. Conversely, soils with low infiltration rates produce high runoff volumes and high peak discharge rates.

Four general soil hydrologic groups have been established by the Natural Resources Conservation Service (NRCS—formerly the Soil Conservation Service). These groups are:

- Group A Low runoff potential—high infiltration rate
- Group B Moderate infiltration rate
- Group C Slow infiltration rate
- Group D High runoff potential—very slow infiltration rate

The hydrologic grouping symbols (A through D) are combined with land use and used to estimate the amount of runoff that will occur over a given area for a particular rainfall amount. The Hennepin County soil survey lists the hydrologic soil groups in tables, but does not map the soils according to these groupings.

As land is developed for urban use, much of the soil is covered with impervious surfaces, and soils in the remaining areas are significantly disturbed and altered. Development often results in consolidation of the soil and tends to reduce infiltration capacity of otherwise permeable soils, resulting in significantly greater amounts of runoff.

3.4 Geology and Groundwater Resources

The Bassett Creek watershed is located in the northwestern portion of a bowl-like bedrock structure underlying the Minneapolis-St. Paul metropolitan area (called the Twin Cities basin), which has a gentle slope to the southeast. The generalized geologic section is presented in Figure 3. The bedrock is overlain by a layer of glacial drift, which tapers from up to 250 feet thick in the western portion of the watershed and up to 400 feet thick along the eastern border of the watershed, to less than 50 feet thick in the southeastern portion of the watershed in Minneapolis. Generally, there is no uniform relationship between the existing surface topography and the bedrock structure. The watershed is underlain by up to 40 feet of Platteville and Glenwood Formation limestone and shale in the southern and eastern portions of the watershed. As shown in the generalized geologic section, the northern portion of the watershed is underlain by up to 160 feet of St. Peter Sandstone, except in the northwest

portions and in the extreme eastern portions, where preglacial Mississippi River valleys cut through the sandstone and into the Prairie du Chien Dolomite. Three buried erosional valleys cut deep into the bedrock and bisect the tapered glacial drift. One valley extends north and southeast from Medicine Lake. The north branch cuts into the Prairie du Chien Dolomite and the southeast branch cuts into the St. Peter Sandstone. These valleys are filled with up to 250 feet of drift. Another valley extends northerly from Wirth Lake to the watershed border, cutting into the St. Peter Sandstone and filled with up to 200 feet of drift. The other valley extends through the very southeastern portion of the watershed between Highway 55 and Interstate 394. It cuts through the Prairie du Chien Dolomite and is filled with up to 400 feet of drift.

The watershed is underlain by four major bedrock aquifers: St. Peter Sandstone, Prairie du Chien-Jordan, Iron-ton-Galesville Sandstones, and Mt. Simon-Hinckley Sandstones. In addition, there are numerous aquifers in the glacial drift. Some groundwater from the glacial drift and the St. Peter aquifer discharges into Bassett Creek. The remaining aquifers discharge into the Minnesota and Mississippi rivers, the movement of which is complicated by the intersecting buried bedrock valleys.

The cities within the BCWMC obtain their water supplies from the following groundwater sources:

- Plymouth – 14 wells in the Jordan aquifer
- Minnetonka – 16 wells in the Prairie du Chien Jordan aquifer
- Robbinsdale – 5 wells in the St. Peter, Prairie du Chien Jordan, and Franconia aquifers
- St. Louis Park – 11 wells in the St. Peter, Prairie du Chien Jordan, and Mount Simon Hinckley aquifers
- Medicine Lake – private wells

3.5 Land Use and Public Utilities

Almost all of the land in the BCWMC is now fully developed. Figure 4 shows the existing land use in BCWMC (source: Metropolitan Council, 2000). The currently vacant areas that are planned for development are located in western Plymouth and other scattered infill locations within BCWMC (note that the “vacant” land use designation includes undevelopable land such as wetlands). Scattered throughout the watershed are areas of proposed redevelopment. The comprehensive plans for the BCWMC member cities contain more information about these redevelopment areas.

Figure 5 shows the allowable impervious coverage in BCWMC for the Bassett Creek Flood Control Project (see the background description of the flood control project in the Flooding & Rate Control section). This is the same information shown on the (future) land use map in the 1990 *Water Management Plan*. The future land use projected in the 1990 Plan (as updated from the 1969 Plan) was the basis for the design of the flood control project. Therefore it was very important for the BCWMC to track any discrepancies between the 1990 projected future land use and actual land use in the watershed. Any discrepancies between the impervious coverage assumed in Figure 5 and actual land use have been mitigated, when necessary. For example, in the city of Plymouth, some areas developed to a lesser intensity than anticipated in the 1990 Plan. This means there is a smaller amount of impervious area than was projected and no mitigation was required. Some areas developed to a higher intensity than was projected. In such situations, mitigation in the form of additional storage was provided. Any future developments or redevelopments that would result in more impervious coverage than shown on Figure 5 will require mitigation.

Except for a very small amount of land along the western edge of the BCWMC, in western Plymouth, all of the land in the BCWMC is within the 2020 Metropolitan Urban Service Area (MUSA). The MUSA is the area delineated by the Metropolitan Council, where urbanization is expected to occur and where metropolitan service systems (particularly sanitary sewer service and major highways/interchanges) will be provided to accommodate growth.

The city of Minneapolis obtains its water supply from the Mississippi River for municipal and industrial purposes. In addition, Minneapolis supplies the cities of Golden Valley, Crystal and New Hope with their municipal water supplies. The cities of Plymouth, Robbinsdale, Minnetonka, St. Louis Park, and Medicine Lake obtain their water supplies from groundwater aquifers (see the Geology and Groundwater Resources section). In the extreme western portions of the Bassett Creek watershed, outside of the MUSA, some residents still obtain their domestic water supplies from private supply wells.

Wastewater collection facilities are available to most of the watershed except for a small area in western Plymouth. Land use in the area not served with wastewater collection facilities is primarily agricultural. Based on an estimate by city of Minneapolis Public Works, approximately 8 acres of Minneapolis in the Bassett Creek watershed is served by a combined storm sewer and sanitary sewer system. The city is implementing a sewer separation program that will provide separate facilities for that area by the year 2007. The Bassett Creek Flood Control Project design assumed that the entire

300 acres was separated and that the stormwater drains to the creek rather than to wastewater treatment facilities.

3.6 Surface Water Resource Information

Bassett Creek originates upstream of Medicine Lake in western Plymouth as a branch called Plymouth Creek. This branch flows generally east and south, generally parallel to Highway 55, until it reaches the southwest bay of Medicine Lake. This branch drains large portions of south and central Plymouth. The Main Stem of Bassett Creek begins downstream of the Medicine Lake outlet, at the south end of the southeast bay of the lake. The Main Stem flows southeast through Plymouth, then easterly through Golden Valley, Crystal, and Minneapolis to the Mississippi River, the last portion of which is through a 1.7-mile long tunnel. The creek enters the Mississippi River less than 1 mile upstream of the Upper St. Anthony Falls Lock and Dam, near River Mile 855. Two branches of Bassett Creek, the North Branch and the Sweeney Lake Branch, join the Main Stem between Medicine Lake and its confluence with the Mississippi River. The North Branch drains portions of eastern Plymouth and southern portions of New Hope and Crystal, and joins the Main Stem immediately upstream of Highway 100. The Sweeney Lake Branch drains northern St. Louis Park and southern portions of Golden Valley, and joins the Main Stem in Theodore Wirth Park near Golden Valley Road. Figure 2 is a map of the Bassett Creek watershed, showing its major subwatersheds and drainage patterns. Figures 2-a, 2-b, 2-c, and 2-d show the minor watersheds within each major subwatershed.

Figure 6 shows the DNR -protected waters, wetlands and streams, the National Wetlands Inventory wetlands located in the BCWMC, and additional ponding areas identified during the BCWMC's lake and watershed management planning process (described in Section 4). Figure 7 shows the public ditches within the BCWMC, which includes a large portion of the Main Stem of Bassett Creek between Medicine Lake and Brookview Golf Course, and downstream of Highway 100. Some of the systems shown as public ditches are no longer in existence, but the public ditch designation has not been removed. One such system is located along Highway 100 in Golden Valley and Crystal. The public ditch system shown following Highway 100 is currently all in a storm sewer pipe and is no longer ditched.

In its 1972 *Watershed Management Plan*, the BCWMC established a "management envelope" for the BCWMC trunk system and major inundation areas (see the Administration and Implementation Program section for the definition of the trunk system). The BCWMC used the management envelope

to regulate development in the floodplain in order to preserve options for flood control projects. The management envelope elevations were at least as high as the flood elevations for existing channel conditions under ultimate urbanization conditions in the watershed. The “management envelope” concept was carried through into the 1990 *Water Management Plan*. Now that all of the flood control project features that affect regulatory flood profiles are in place and the flood elevations set, there is no longer a need for the management envelope. The BCWMC worked with the COE to approve revised flood profiles along sections of Bassett Creek for the National Flood Insurance Program’s Flood Insurance Rate Map (FIRM). The Federal Emergency Management Agency (FEMA) approved the proposed revisions to the FIRM for Bassett Creek in 2002. Minor adjustments to the mapping are still being made and will eventually be incorporated into the Hennepin County FIRM, expected to be finalized in 2003. The BCWMC is using the revised flood profiles in its review of improvements and development proposals. Table 5-3 lists the flood profiles that are now in effect.

The member cities (except for Crystal, Medicine Lake, and Minneapolis) have prepared stormwater management plans. These plans have more detailed information regarding storm sewer systems and localized flooding issues. Additional flooding information is also available from the Flood Insurance Studies (FIS) for the cities within the BCWMC.

The BCWMC, the member cities, and Three Rivers Park District have collected water quality monitoring data within the watershed. This monitoring is described in Sections 4.3.2 and 4.3.3.

3.7 Natural Communities and Rare Species

Prior to settlement, two major cover types covered the watershed. From the Mississippi River to Medicine Lake, a predominantly oak forest interrupted by tall grass prairie and marsh covered the watershed. A dense deciduous climax forest known as the “Big Woods” covered the area west of Medicine Lake. Elm, sugar maple, and basswood are representative tree species. Although scattered remnants of this forest are still present throughout much of its original range, only two remnants are present within the BCWMC, according to the map *Natural Communities and Rare Species of Carver, Hennepin, and Scott Counties* (Minnesota County Biological Survey, 1998). Minnesota Land Cover Classification System (MLCCS) information is currently only available for the city of Golden Valley limiting its use as a source of information and as a management tool.

Natural vegetation in the Bassett Creek watershed has been greatly altered by agricultural development and urbanization. Remaining vegetation in the watershed is typical of that found at the

interface between the Eastern Deciduous Forest and the Temperate Grassland. With agriculture gone from the watershed, urbanization has occurred in former agricultural areas. In addition to the forested areas, numerous wetlands were once present in the central and eastern portions of the watershed, but the majority have been drained or filled for development. Remaining wetland areas are concentrated in the western part of the watershed and some are the remnants of approximately 1,500 acres of marsh, which once existed between Medicine Lake and the southeast corner of the watershed. The county biological survey map notes the presence of a tamarack swamp in Theodore Wirth Park. This map also notes the presence of three federally- or state-listed rare animals and species in the watershed. One location is near Ridgedale, another is just south of Medicine Lake, and the other is near Turners Crossroad and Interstate 394. Blanding's turtles, trumpeter swans, peregrine falcons, and hooded warblers are rare species that occur in the watershed, and the habitat for these species should be protected and improved where feasible. Typically, the actual species and specific locations are not publicly available.

3.8 Pollutant Sources

Section 4.3 presents background information about water quality. The section includes summaries of the BCWMC's lake and watershed management plans, which identify the pollutant (nutrient) sources for the major water bodies in the watershed.

Table 3-1. Precipitation Summary—Minneapolis/St. Paul Airport Station

Averages: 1971-2000 Extremes: 1891-2001

Month	Total Precipitation, Inches					Snow, inches			# Days with Precip		
	Mean	High—Yr	Low—Yr	1-Day Max		Mean	High—Yr		≥ .10	≥ .50	≥ 1.0
Jan	1.04	3.63 1967	0.05 1892	1.21 1/24/1967		13.7	46.4 1982		3.6	0.3	0.0
Feb	0.79	3.25 1922	0.03 1894	1.90 2/4/1930		8.2	26.5 1962		2.7	0.3	0.0
Mar	1.86	4.75 1965	0.09 1910	1.62 3/1/1965		10.5	46.1 1965		5.1	0.8	0.2
Apr	2.31	7.00 2001	0.16 1987	2.22 4/27/1975		3.1	21.8 1983		5.5	1.4	0.2
May	3.24	10.33 1906	0.21 1934	3.16 5/21/1906		0.1	2.4 1954		7.2	2.2	0.7
Jun	4.34	9.82 1990	0.22 1988	2.91 6/7/1984		0.0	0.0 1949		7.5	3.0	1.1
Jul	4.04	17.90 1987	0.11 1936	9.15 7/23/1987		0.0	0.0 1948		6.2	2.4	0.9
Aug	4.05	9.31 1977	0.20 1925	7.28 8/30/1977		0.0	0.0 1948		6.5	2.6	0.9
Sep	2.69	7.77 1903	0.41 1940	4.96 9/12/1903		0.0	0.4 1985		5.6	1.7	0.6
Oct	2.11	6.42 1911	0.01 1952	2.75 10/19/1934		0.6	8.2 1991		4.4	1.3	0.4
Nov	1.94	5.29 1991	0.02 1939	2.52 11/11/1940		10.0	46.9 1991		4.5	1.1	0.2
Dec	1.00	4.27 1982	0.00 1943	1.50 12/14/1891		10.2	33.5 1969		2.9	0.2	0.1
Annual	29.41	40.15 1911	11.54 1910	9.15 7/23/1987		56.3	101.5 1983		61.8	17.1	5.3
Winter	2.83	6.24 1967	0.69 1958	1.90 2/24/1930		32.1	71.7 1967		9.3	0.8	0.2
Spring	7.41	16.13 1965	2.12 1910	3.16 5/21/1906		13.7	48.1 1965		17.8	4.3	1.0
Summer	12.43	23.52 1987	1.73 1894	9.15 7/23/1987		0.0	0.0 1949		20.2	8.0	3.2
Fall	6.74	13.50 1911	1.71 1952	4.96 9/12/1903		10.6	55.1 1991		14.5	4.0	1.3

Source: Midwest Regional Climate Center Website (<http://www.mcc.sws.uiuc.edu>) – Climate of the Midwest

Table 3-2. Selected Precipitation and Runoff Events

Type of Event and Frequency	Duration	Amount (Inches)
<i>Rainfall</i>		
10-year	24 hour	4.2
25-year		4.8
50-year		5.3
100-year		6.0
25 year	10 day	8.8
50-year		10.0
100-year		11.0
<i>Runoff (snowmelt)</i>		
10-year	10 day	4.7
25-year		5.7
50-year		6.4
100-year		7.1

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