Changes in Soil Moisture Storage
Current Plan

The soils of the Coon Creek watershed developed from glacial outwash and organic deposits (USDA 1977). The differences in glacial deposits account for many of the differences in soils.

Permeability/Infiltration And Texture

Permeability is the rate at which water moves downward through the soil profile (Brady 1974). Permeability is measured as the number of inches per hour that water moves downward when the soil is saturated. Soils with low permeability are easily ponded and may develop wetland characteristics (Brady 1974, USDA 1977, NTCHS 1987).

Soils with high permeability can contribute greatly to groundwater recharge and the sensitivity of groundwater to pollution (DNR 1991). An accepted cut-off between high and low permeability soils is 6 inches per hour (NTCHS 1987). The permeability of soils within the watershed are shown in the following table (USDA 1977, NTCHS 1987).

District Soils by permeability factor (K)

K	*Drain Class*	*Rate (in./hr)*	*Texture*	*Soil Series*
0.00	Low	< 6	Muck (Sapric)	Markey Muck
0.00	Low	< 6	Muck (Hemic)	Millerville Mucky Peat
0.00	Low	< 6	Muck (Hemic)	Rifle Muck
0.00	Low	< 6	Muck (Sapric)	Rondeau Muck
0.00	Low	< 6	Muck (Sapric)	Seelyeville Muck
0.00	Low	< 6	Loamy fine sand	Alluvial Land, Mixed
0.15	High	≥ 6	Sandy loam	Isan Sandy Loam
0.15	High	6 - 20	Coarse sand	Hubbard Sand
0.15	High	6 – 20	Fine sand	Sartell Fine Sand
0.15	High	6 - 20	Fine sand	Soderville Fine Sand
0.17	High	≥ 6	Fine sandy loam	Isanti Fine Sandy Loam
0.17	High	6 - 20	Loamy fine	Anoka Sand

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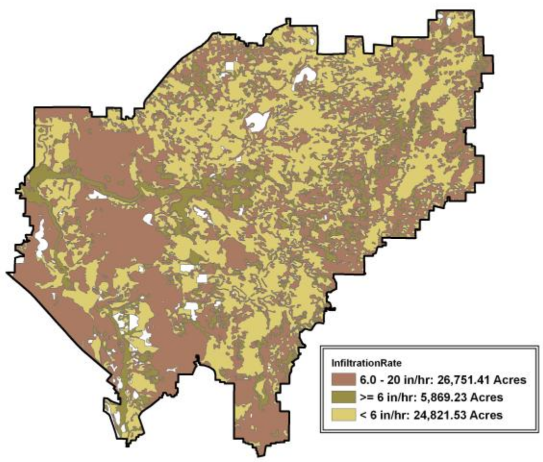
			sand	
0.17	High	6 - 20	Loamy fine sand	Lino Loamy Fine Sand
0.17	High	6 – 20	Loamy sand	Nymore Loamy Sand
0.17	High	6 - 20	Fine sand	Zimmerman Fine Sand
0.28	High	6 - 20	Loamy coarse sand	Duelm Sand

Acres of permeability classes



Seasonal Soil Moisture Variation

Soil water can be analyzed by dividing the year into four stages; grand consumption, fall recharge, frozen stage, and spring recharge. These stages, in turn, influence runoff and groundwater recharge (Baker, et. al. 1979)

Stages of Soil Moisture

Stage	Significance
Frozen stage (Dec-Apr)	During a normal year, the soil moisture will be high enough to result in a concrete frost. The exception to this occurs following excessively dry years that result in soils with low soil moisture contents at freeze-up. Under these conditions, only the smallest soil pores contain water, leaving the larger pores open, which results in a granular frost.
Spring recharge (Apr-Jun)	During this time precipitation exceeds ET, and soil water is again recharged.
Grand consumption (summer stage)	Results in the soil water reserves becoming depleted over the summer to make up the difference.

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(Jun-Sep)	
Fall recharge	Normally this is the most significant period for soil water recharge, with a majority of precipitation remaining in the soil for use the following growing season. The remainder of the rainfall is lost as evapotranspiration or runoff.

Hydrologic Soil Grouping Four hydrologic soil groups classify soils according to their infiltration and transmission rates (USDA 1977). Three soil groups occur within the watershed. They are:

Group A Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission (greater than 0.30 in./hr.).

Group B Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately course textures. These soils have a moderate rate of water transmission (0.15 to 0.30 in./hr.).

Group C Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately coarse textures. These soils have a moderate rate of water transmission (0.05-0.15 in./hr.).

Group D Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0.00 to 0.05 in./hr.).

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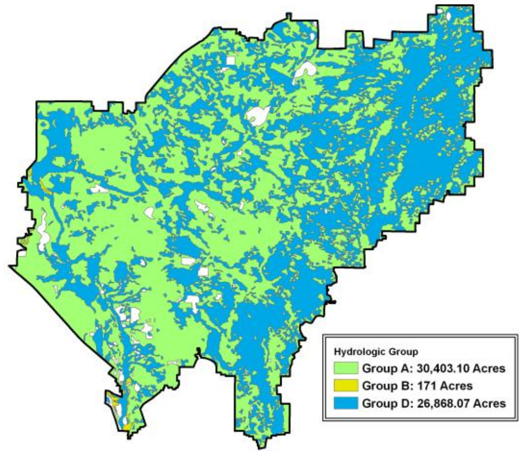

Hydrologic Soil Group	Acres	Pct of District
A	30,403	52%
B	171	-
D	26,868	46%

Antecedent Moisture Conditions

The volume of stormwater runoff is generally determined by the soil's characteristics, as classified in the SCS hydrologic groups and by its hydrologic condition (Brady 1974). The hydrologic condition of the runoff depends on the antecedent moisture conditions (AMC) of the soil at the time of the storm, the soil's hemic and organic content, and temperature.

Antecedent moisture conditions (AMC) is the amount of water within the soil, and thus not available for storage, prior to the design storm. For convenience in hydrologic modeling, it is often defined as the amount of rainfall in a period of five to thirty days preceding the design storm. In general the heavier the antecedent rainfall, the greater the runoff potential. Three levels of AMC are considered:

AMC 1: Soils are dry, but not to the wilting point. Available water capacity (AWC=inches of water per inches of soil) is below published values. This is the lowest runoff potential.

AMC 2: Soils moisture and available water capacity is average.

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<u>AMC 3</u>: Soils are at, or near field capacity. Heavy or light rainfall and low temperatures have occurred during the previous five days. This is the highest runoff potential.

Trends in Soil Hydrology

Decrease in Permeability As land is developed soils tend to be compacted thereby reducing the void space between soil particles and restricting the movement of water

Change to predominantly 'A' HSG Class Soils The decrease in both precipitation and the surficial water table have led to many organic soil modeled as Hydrologic Soil Group D soils (very slow infiltration rates - <6 in/hr) to behave as A soils (high infiltration rates-6 to 20 in/hr)

Decrease in Antecedent Moisture Conditions Dry fall and spring conditions have left soils dry (AMC 1) over the past five years. However, the horizontal disposition of peat soils within the soil profile may well leave the soils dry but in some areas result in increased runoff if the soils have become hydrophobic.

Implications of Changes in Soil Moisture Storage

Increase in Hydrophobic Soils Fibric soils, particularly Peats, tend to lie horizontally on the landscape. As these, as well as other organic soils dry (from drainage or prolonged declines in the water table) they can become hydrophobic and repel water thus decreasing their water holding capacity.

Decrease in Volume of Infiltration Peats, because of how they lie in the landscape can act as a retardant to the vertical movement of water, by readily moving water horizontally, parallel with how the peat deposit occurs. The result is a highly conductive system that tends to move water laterally better and faster than it moves water vertically.

Contribution to Increased Flashiness In areas close to open channels and ditches The horizontal conductivity and A HSG classification of drained peats contributes to additional discharges, versus the "water retaining sponge on the landscape" so often referenced.

Management Needs

Keep Organic Soil Saturated It is vital to keep organic soils saturated in areas where the District hopes to capitalize on the water storage abilities of wetlands and organic soils

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Mitigate to ≥ Predevelopment Site Infiltration

Infiltration is vital to the watershed's water resources for the following reasons:

1. Recharge of the surficial aquifer
2. Maintaining absorptive and storage capacity of organic soils

Mitigating infiltration to predevelopment volumes is essential to the conservation and utilization of these soils. Mitigating to greater than predevelopment volumes would be essential in returning the water table to levels needed to sustain dependent surface water features.