Demand for Groundwater Recharge

Requirements for Groundwater Recharge

Ground water recharge is a hydrologic process where water moves downward from surface water to groundwater. The goal is the augmentation for replenishment of groundwater by encouraging or modifying the movement of surface waters through suitable techniques

This process usually occurs in the vadose zone below plant roots and is often expressed as a flux to the water table surface. Recharge occurs both naturally (through the water cycle) and artificially (through construction or modification of natural or man-made features), where rainwater and or reclaimed water is routed to the subsurface.

Groundwater Recharge Goals

Groundwater recharge is usually intended to address the following issues:

1. To enhance sustainable yield in areas where groundwater is depleted.
2. Conservation and storage of excess surface water for future requirements (seasonal or hydrologic conditions)
3. To improve the quality of existing groundwater through dilution
4. To remove bacteriological or other impurities so that water is available for re-use

Basic Requirements for Groundwater Recharge

The basic requirements for groundwater recharge are:

1. Availability of non-committed surplus of precipitation run-off in space and time
2. Identification of suitable hydrogeological environment and sites for utilizing or creating cost effective recharge practices

Natural Recharge

Groundwater is recharged naturally by rain and snow melt and to a smaller extent by surface water (rivers and lakes).

How much water infiltrates depends on

- vegetation cover
- slope (Flat topography)
- soil composition (Permeability)
- depth to the water table
- the presence or absence of confining beds

Artificial Recharge

Artificial recharge of groundwater aims at augmentation of ground water by modifying the natural of existing movement of surface water utilizing suitable management practices.
The basic purpose of artificial recharge of groundwater is to

restore supplies from aquifers depleted due to excessive groundwater use or development.

Groundwater recharge is an important process for sustainable groundwater management, since the volume-rate abstracted from an aquifer in the long term should be less than or equal to the volume-rate that is recharged.

Wetlands can help maintain the level of the water table and exert control on the hydraulic head (O'Brien 1988; Winter 1988). This provides force for ground water recharge and discharge to other waters as well. The extent of ground water recharge by a wetland is dependent upon soil, vegetation, site, perimeter to volume ratio, and water table gradient (Carter and Novitzki 1988; Weller 1981). Ground water recharge occurs through mineral soils found primarily around the edges of wetlands (Verry and Timmons 1982) The soil under most wetlands is relatively impermeable. A high perimeter to volume ratio, such as in small wetlands, means that the surface area through which water can infiltrate into the ground water is high (Weller 1981). Ground water recharge is typical in small wetlands such as prairie potholes, which can contribute significantly to recharge of regional ground water resources (Weller 1981). Researchers have discovered ground water recharge of up to 20% of wetland volume per season (Weller 1981).

Recharge Capacity

Source Water Availability

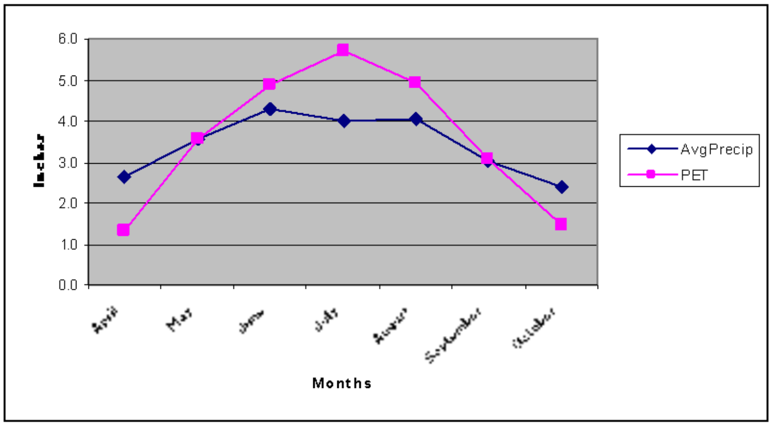
The availability of source water, one of the prime requisites for ground water recharge, is assessed in terms of non-committed surplus runoff. This component can be analyzed using

- Rainfall patterns
- Rainfall intensity
- Potential evapotranspiration levels

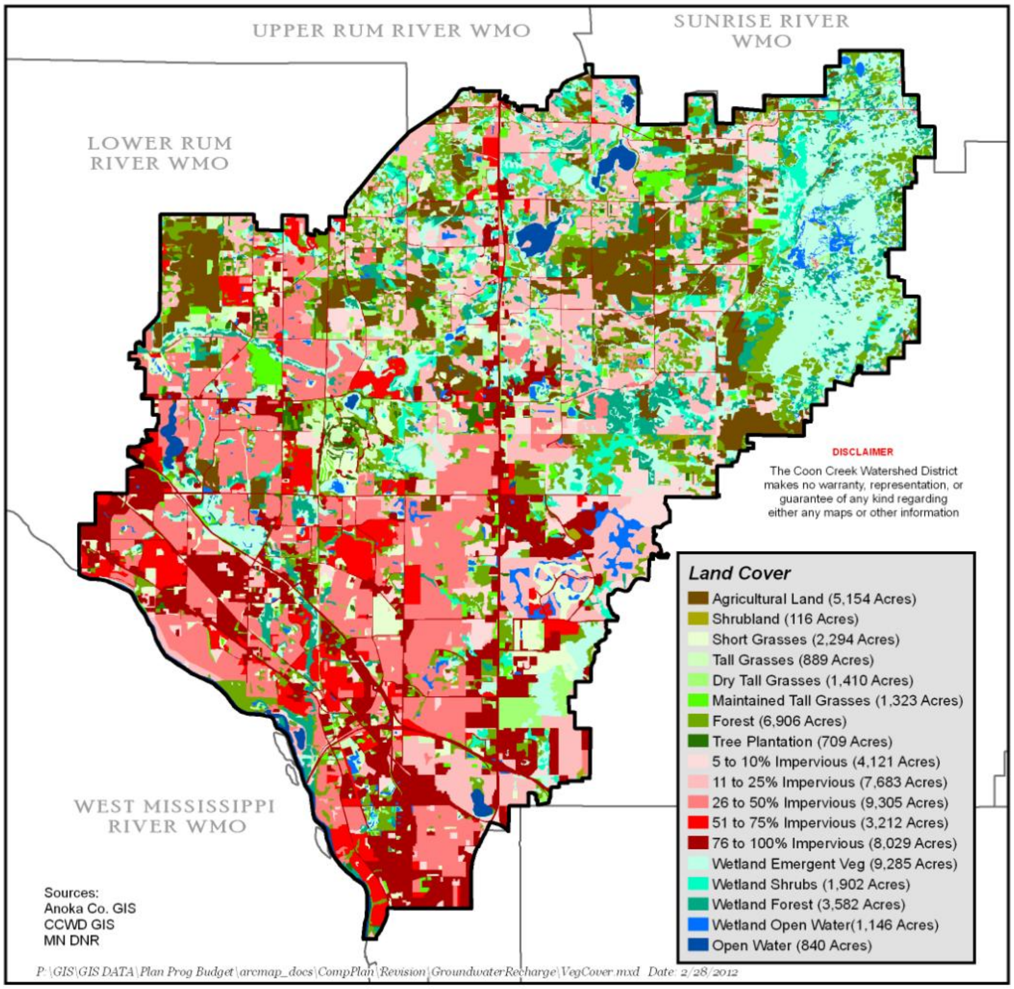
Can all be assessed to determine the amount of water available for ground water recharge during the frost free period of the year.

The chart below shows that there is approximately 2.2 inches of water per year available for ground water recharge based on the Thornthwaite equation, which indicates an approximately 99% potential evapotranspiration rate during the growing season.

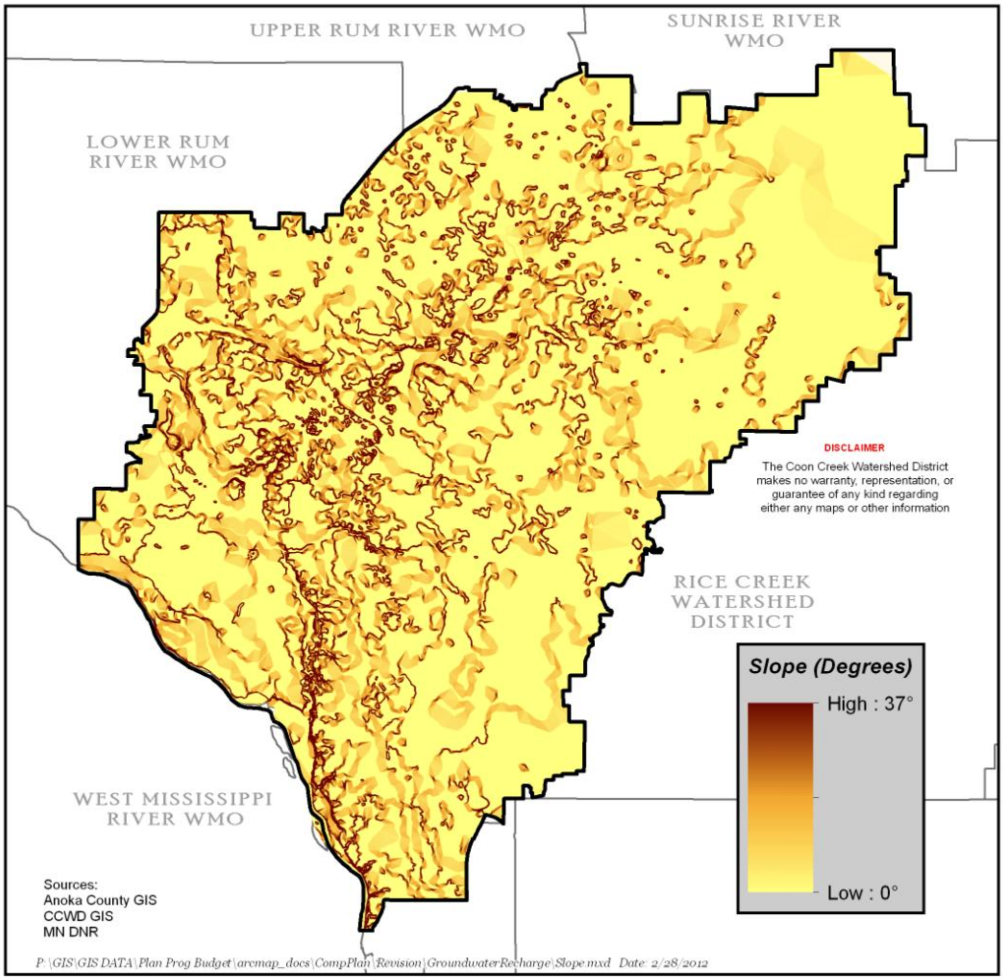
However if we use the MPCA estimates in their water quality literature, we find between 10 and 17 inches of the 24 inches normally occurring during this period.



Vegetation Cover



Slope


UPPER RUM RIVER WMO
SUNRISE RIVER WMO
LOWER RUM RIVER WMO
DISCLAIMER
The Coon Creek Watershed District makes no warranty, representation, or guarantee of any kind regarding either any maps or other information
RICE CREEK WATERSHED DISTRICT
Slope (Degrees)
High : 37°
Low : 0°
WEST MISSISSIPPI RIVER WMO
Sources:
Anoka County GIS
CCWD GIS
MN DNR
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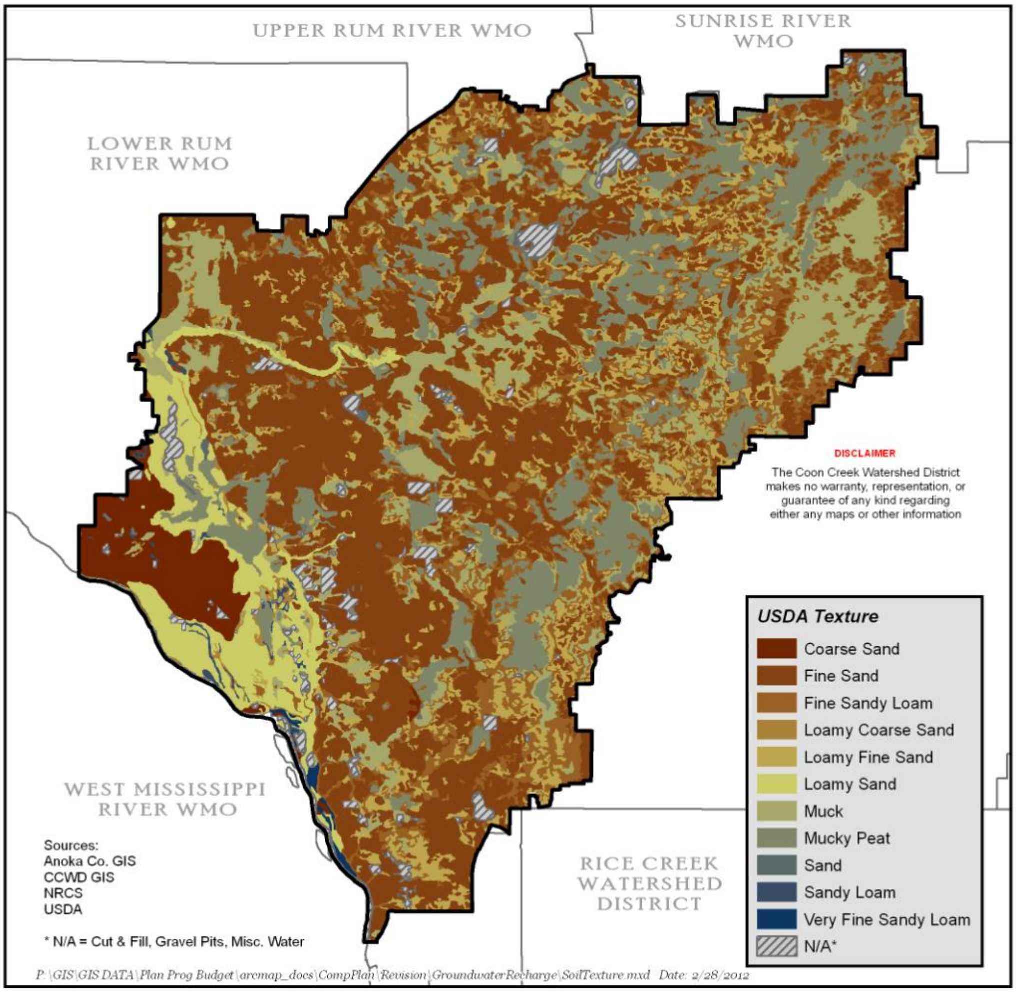
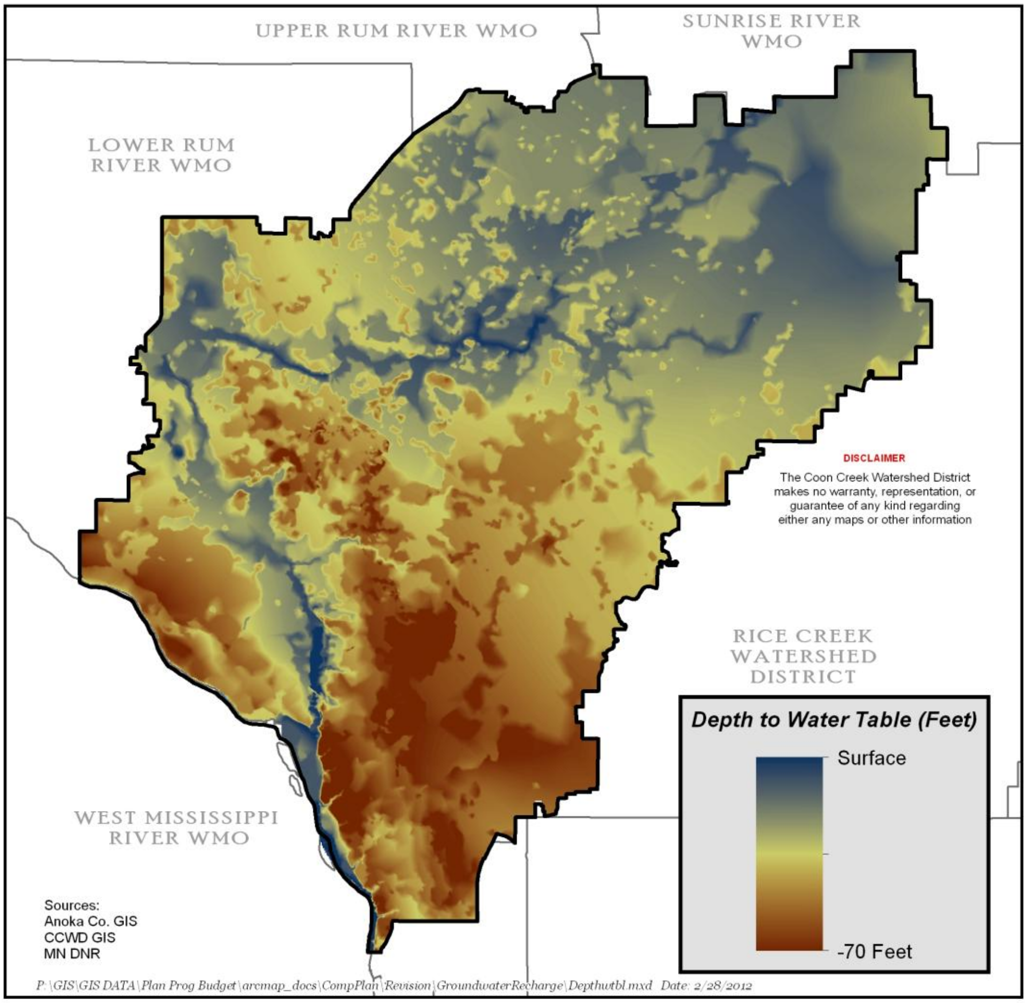
Soil Composition

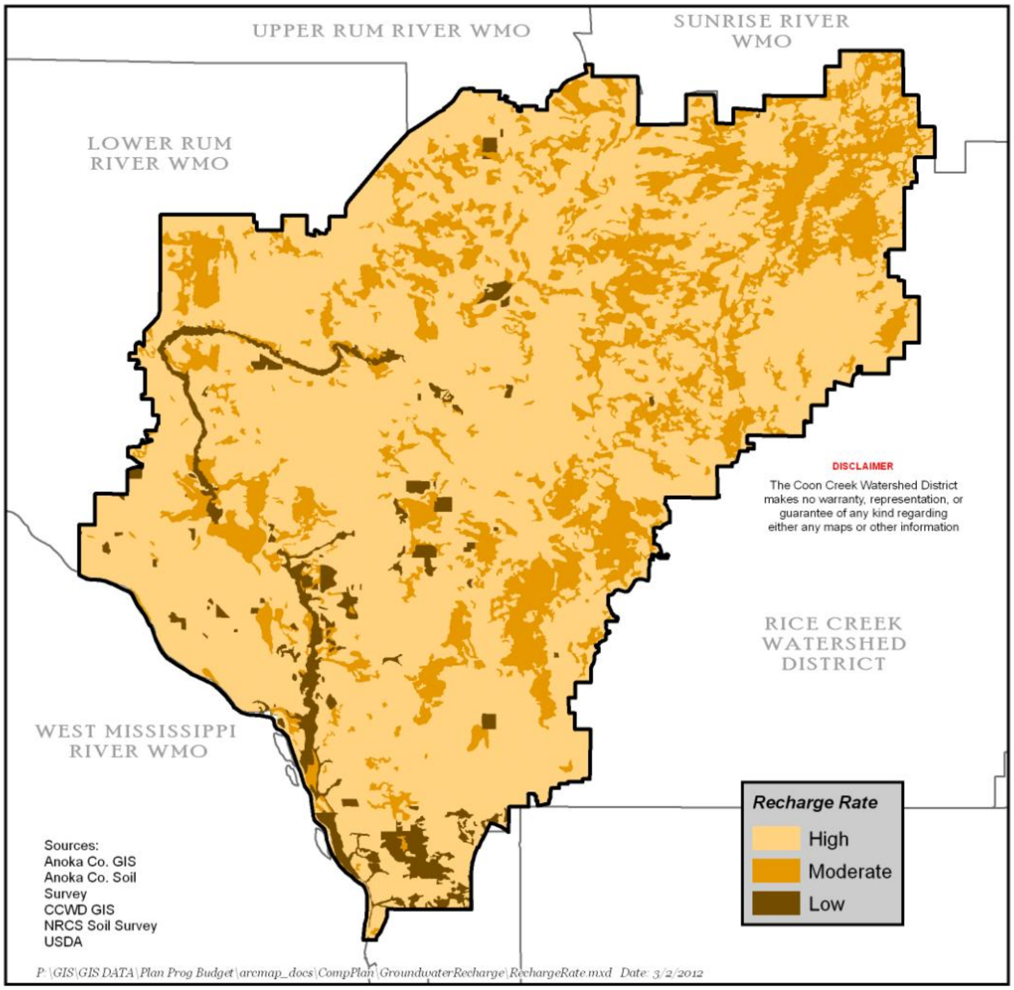


Depth To The Water Table



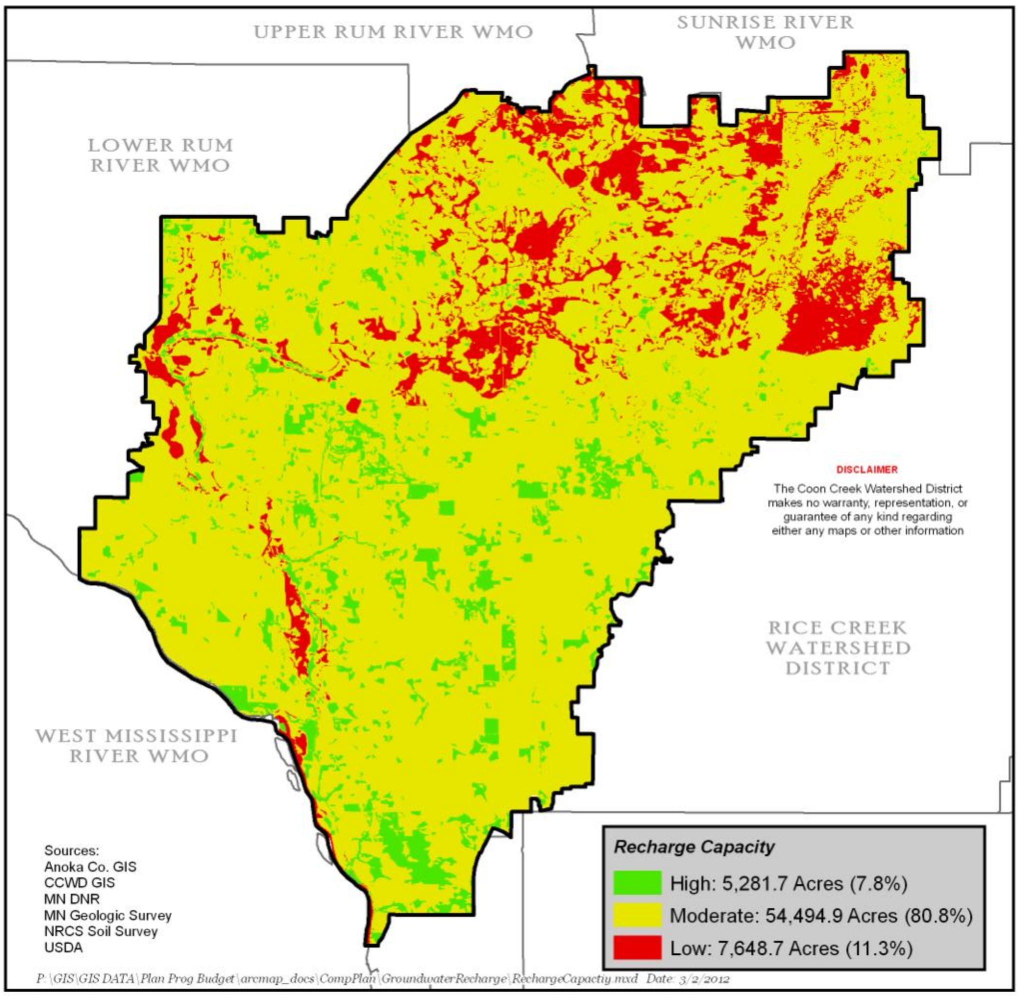
Recharge Capability

Soil properties such as depth, texture and permeability help determine the rate of groundwater recharge, as well as protection from groundwater contamination. Land surface factors such as topography, geology and vegetation in addition to soil properties determine the potential for groundwater contamination.



Attenuation and Filtering	The soil acts as a natural filter. In this context filtering means more than capturing solid particles. Filtering also means retaining chemicals or dissolved substances on the soil particle surface, transforming chemicals through microbial biological possessing, and retarding movement of substances.
	The soils ability to lessen the amount of or reduce the severity of groundwater contamination is called soil attenuation. However, the soils ability to filter contaminants is limited. Contaminant attenuation in soils

	depends on water moving through the top two layers of the soil profile (horizons A and B) at a rate that ensures maximum contact between the percolating water that contains the contaminants and the soil paticles.
	Deep, medium and fine textured soils are the best. Coarse textured soils are the worst in terms of contaminant removal. In coarse materials, like sand, water moves through rapidly, reducing contact between the water and the soil particles.



Value of Groundwater Recharge

Value of Groundwater Recharge

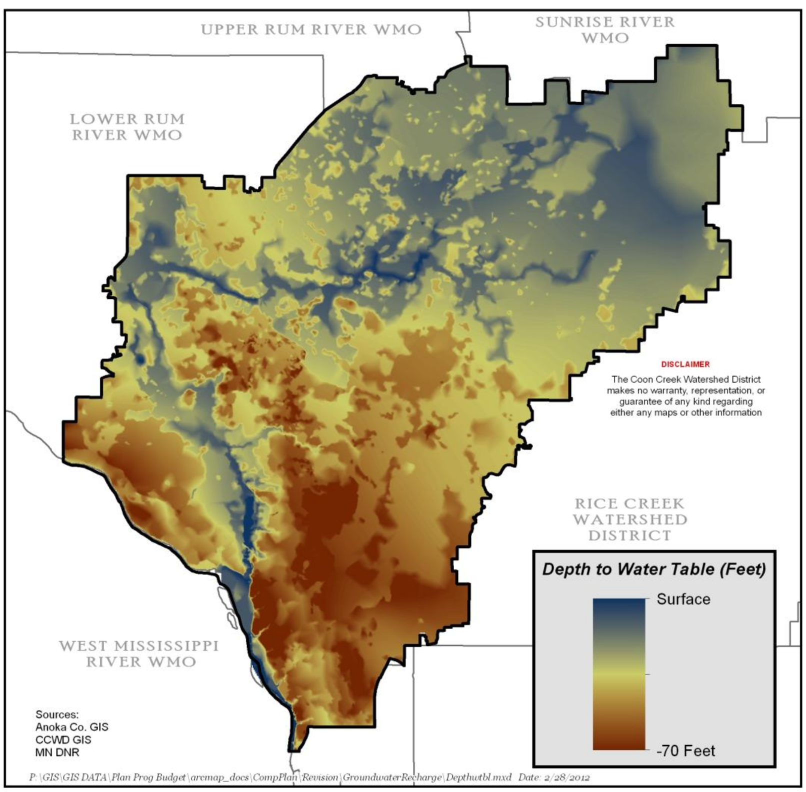
The necessary factors and conditions that affect aggregate demand for a service within the Coon Creek Watershed.

The initial value is based on the expected value per unit of service and is used to modify the level of service.

The value and importance of groundwater recharge should be based on the local hydrogeological and hydrological environments. The value of groundwater recharge is normally associated with the following areas or conditions:

1. Areas where groundwater levels are declining on a regular basis
2. Areas where a substantial amount of the aquifer has already been desaturated
3. Areas where groundwater is scarce (i.e. the availability is less than demand)
4. Population Benefiting from Recharge
5. Type of recharge-structure or facility facilitating infiltration
6. Additional recharge occurring
7. Additional area brought under irrigation
8. Increase in benefit due to assured water supply

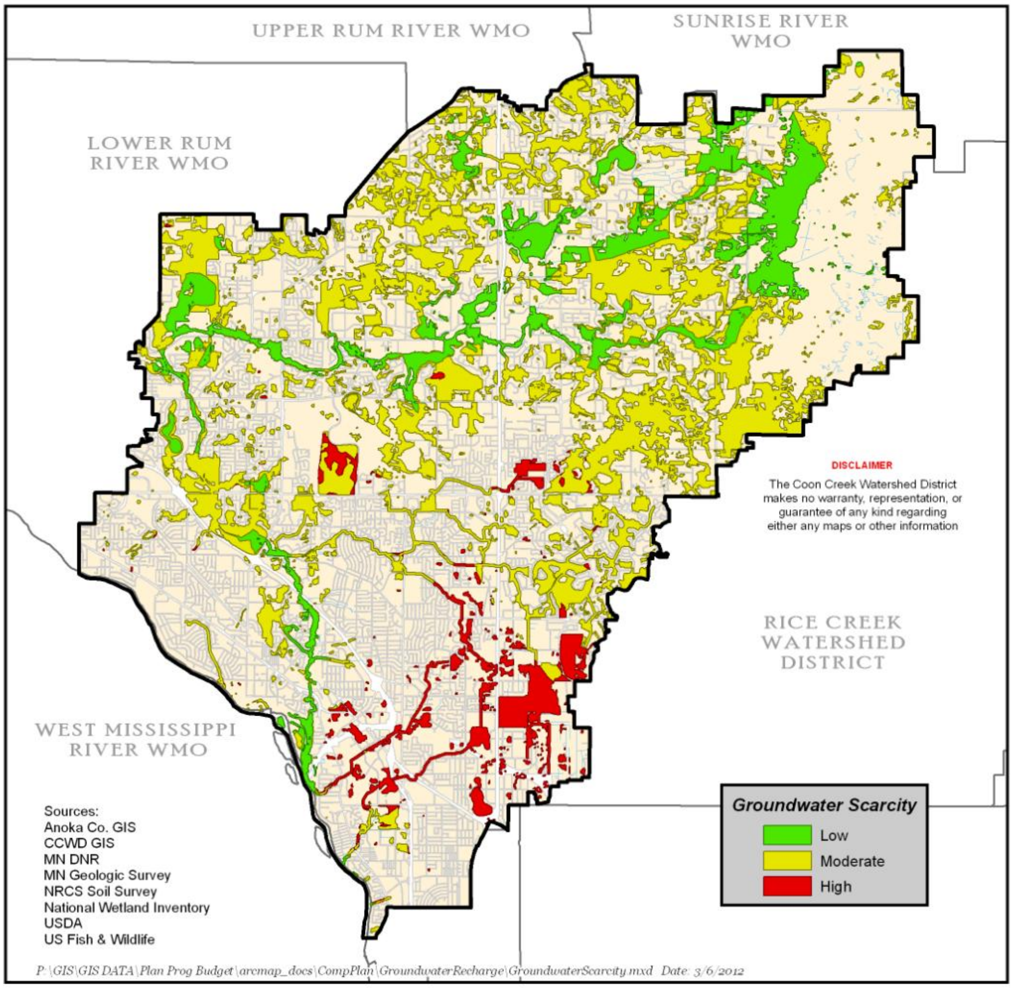
Areas of Water Table Decline



Areas of Groundwater Scarcity Areas where the supply of water due to surficial water table declines is greater than the demand for water are shown below and involve the following acreages

Groundwater Scarcity	Acreage
Low	4,550.6
Moderate	13,177.5
High	1,749.9

Areas of Potential Water Scarcity



Population Approximately 17.4 thousand people live in areas of high to medium scarcity where groundwater recharge may be of immediate benefit.

Groundwater Scarcity	Approximate Population
Low	3,052
Moderate	14,763
High	2,630

Type of Recharge Occurring

A variety of techniques are currently used to encourage groundwater recharge. These techniques can be broadly categorized as follows:

Direct Surface Techniques

- Flooding
- Infiltration basins
- Ditch or furrow system

Direct Sub-Surface Techniques

- Injection and recharge wells
- Recharge pits & shafts
- Groundwater dams
- Subsurface dykes

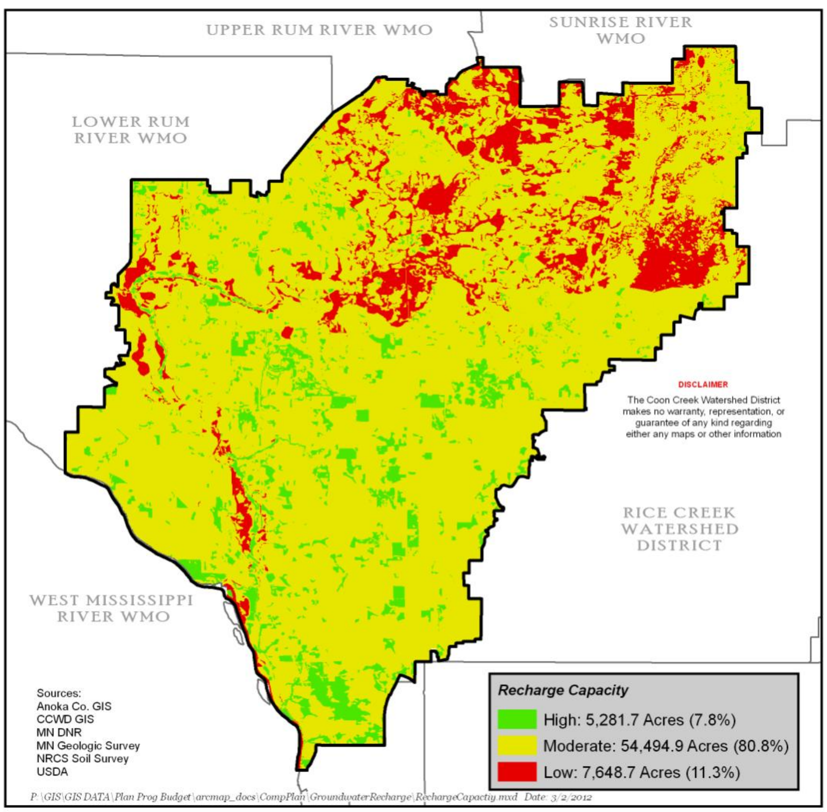
Combination of Surface and Sub-Surface Techniques

- Basin or percolation tanks with shaft or well

Indirect Techniques

- Induced recharge from water source
- Aquifer modification

Amount of Recharge Occurring



After runoff and baseflow are accounted for in the watershed, approximately 1 to 6 inches may be available for groundwater recharge.

If those figures are applied to the information above, a watershed wide estimate would be 3.5 inches, which is 5,564 acre feet, or 1.8 billion gallons per year.

Uses Benefiting from Recharge

The two largest users benefiting from groundwater recharge would be:

- Golf Courses
- Agriculture

Aesthetics
Aquatic Life and Recreation
Irrigation
Water Quality

Risk to Groundwater Recharge

Over Use of Groundwater

Use of groundwater, especially for irrigation, may also lower local water tables and benefit from local groundwater recharge.

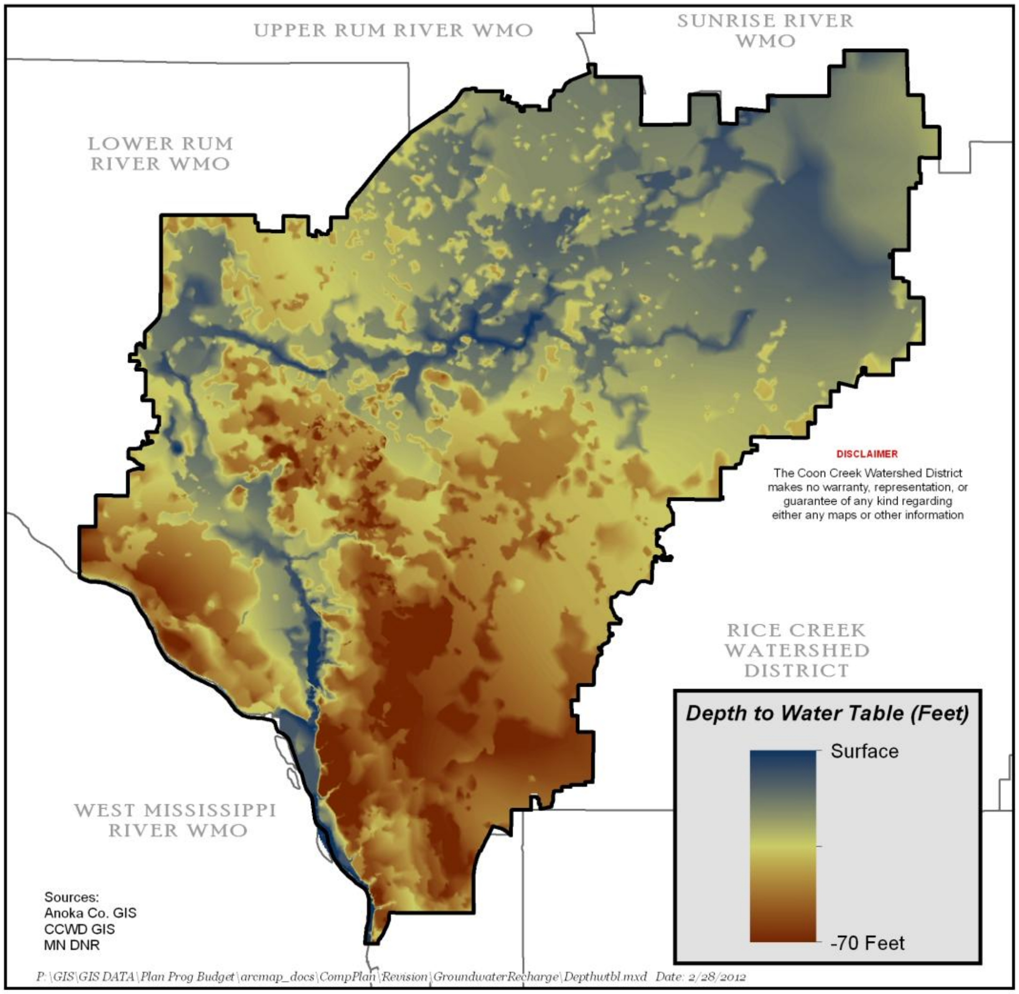
Increase in Impervious Surfaces

Recharge may be impeded somewhat by human activities including paving, development, or logging. These activities can result in enhanced surface runoff and reduction in recharge.

Suspended Solids and Clogging

To facilitate groundwater recharge, the recharge zone should be silt free. Silt and clay are the smallest soil particles that may settle out when water is stilled.

Once settled out, these particles may clog the pores of the underlying soil structure, inhibiting or preventing percolation and recharge from taking place and making the standing water more susceptible to loss through evaporation.



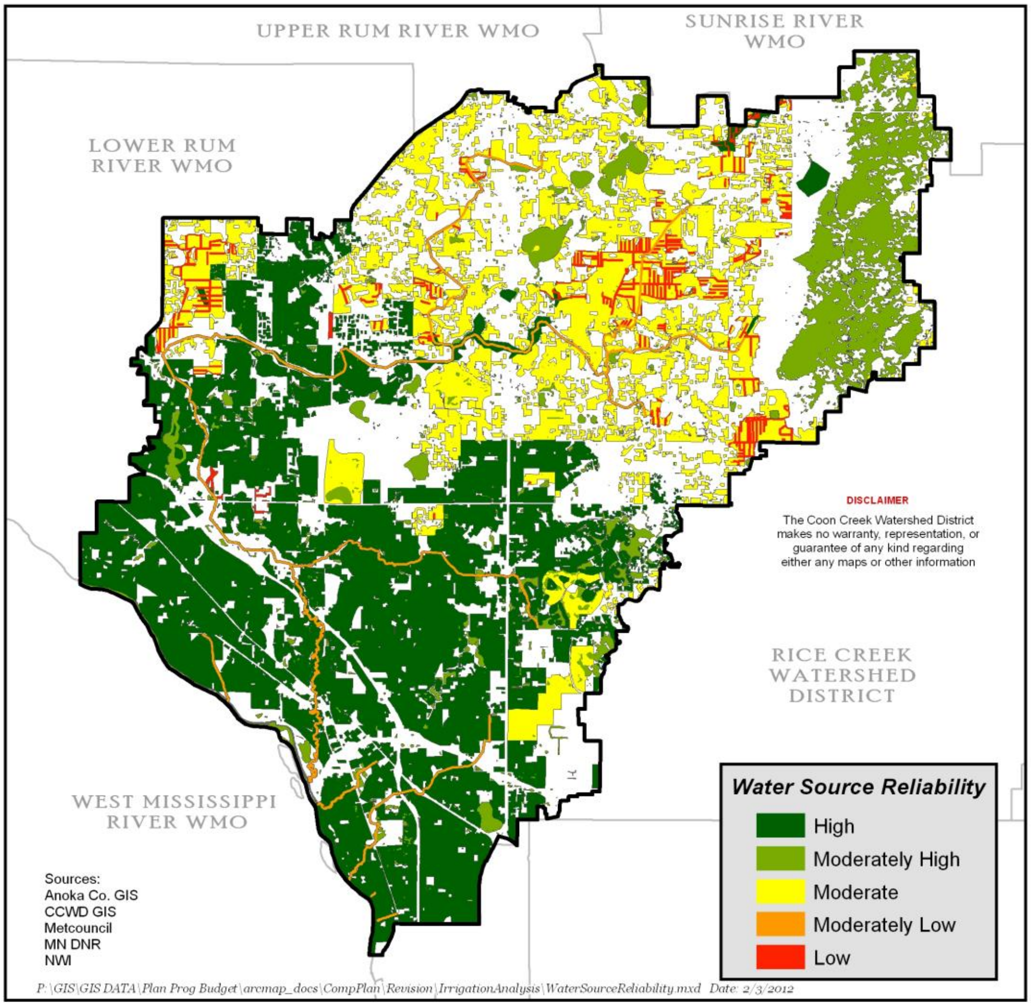
Expected Service Level

Population

Groundwater Scarcity	Approximate 2010 Population	Approximate 2020 Population
Low	3,052	3,357
Moderate	4,763	5,000
High	2,630	2,630

Acreage

Groundwater Scarcity	Approximate 2010 Acres	Approximate 2020 Acres
Low	4,550	5,000
Moderate	13,177	13,386
High	1,750	1,925



As water levels decline the value of each inch of recharge will increase

Service Preferences

Reflects the preferences expressed in a survey of citizens, City Engineers and water resource professional conducted in April and May of 2011.

In April and May 2011 29 citizens, engineers from the seven cities within the watershed and water resource professionals who are members of the 'planning advisory committee' were administered a paired comparison survey of the beneficial uses of and the demands on water resources.

While Aquatic life was ranked third on the national level, it was ranked 8th by citizens and local professionals and 5th

by all water resource professionals.

	Citizens	City Engineers	Water Professionals	National
Drinking water	1	1	1	1
Water Quality	2	2	2	2
Flood Control	2	2	3	5
Groundwater Recharge	**4**	**4**	**4**	**7**
Storm Protection	6	5	6	6
Drainage	5	8	7	8
Aquatic life and recreation	8	8	5	9
Hunting and Fishing	8	8	9	10
Irrigation	9	9	10	4
Livestock and wildlife watering	10	10	8	11
Aesthetics	**11**	**11**	**11**	**12**
Industrial use and cooling	13	13	12	3