Demand for Irrigation

Requirements for Irrigation

During most years it is not uncommon for the watershed to receive sufficient rainfall for good plant growth while at other times reduced yields or quality may occur because of water stress from insufficient soil moisture.

Irrigation is the artificial application of water to the land or soil. It is used to assist in the

- Growing of agricultural crops
- Maintenance of landscapes
- Revegetation of disturbed soils in dry areas and during periods of inadequate rainfall.

Irrigation is used to provide a dependable yield every year. It is also used on plants where water stress affects the quality of the plants.

Irrigation Requirement

The irrigation requirement for crop production and landscape maintenance is the amount of water, in addition to rainfall, that must be applied to meet a plant's evapotranspiration needs without significant reduction in quality or yield.

Irrigation as practiced in the Coon Creek Watershed is "supplemental irrigation" because it is used to augment the rainfall that occurs during the growing season

Factors Influencing the Need for Irrigation

For irrigation planning purposes, average precipitation during the growing season is not a good yardstick for determining the need for irrigation. Factors which influence the need for irrigation include:

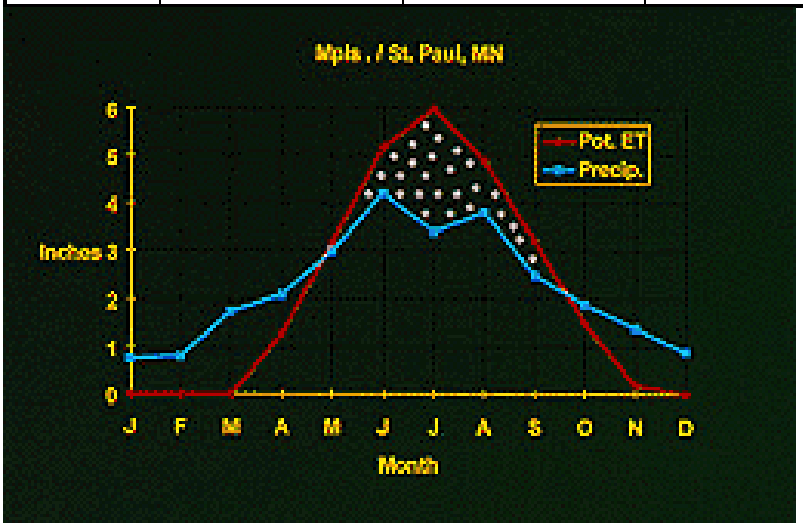
1. The timing and amounts of rainfall during the growing season
2. Influence of other climatic factors
3. The soil's ability to hold water
4. Plant types grown
5. The plant water requirements during different growth stages

Rainfall During the Growing Season

The agronomic growing season (Period between the last and the first killing frost) within the Watershed District is approximately April 15 to October 15.

Average Growing Season Precipitation & Evapotranspiration

Month	Average Precip. (in)	Thornthwaite PET (in.)	Avg. Precip. minus PET (in)
April	2.6	1.3	1.3
May	3.6	3.6	0.0
June	4.3	4.9	-0.6
July	3.9	5.7	-1.7
August	4.0	4.9	-0.9
September	3.0	3.1	-0.1
October	2.4	1.5	0.9
Total	**23.9**	24.9	-1.0



Other Climatic Factors

A certain pant grown in a sunny and hot environment needs, per day, more water than the same plant grown in a cloudy and cooler environment. There are, however - apart from sunshine and temperature – other factors which influence a plant's water needs. These factors are:

- Humidity
- Wind Speed

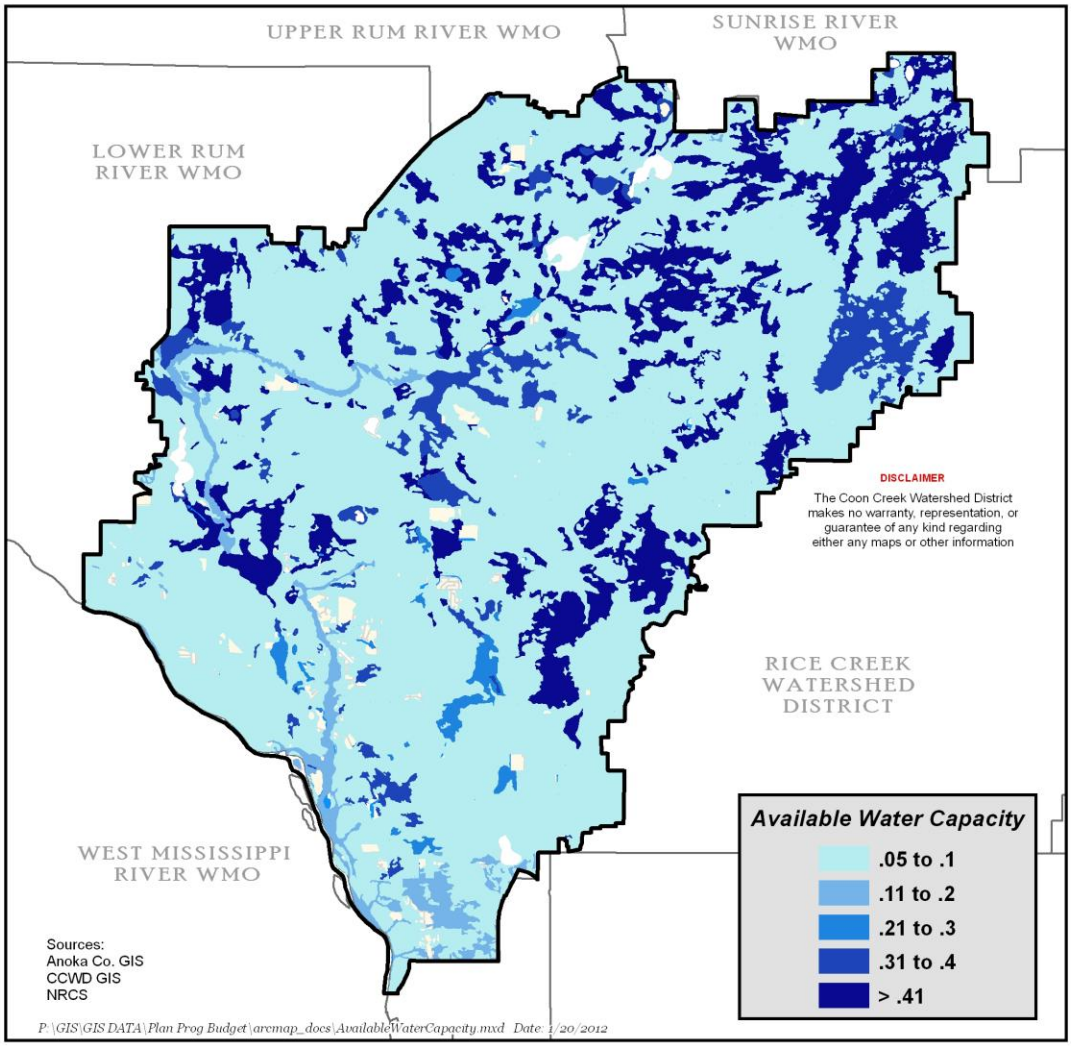
The effect of these four climatic factors on the water needs of plants is shown below

	Plant Use of Water	
	Low	**High**
Sunshine	Cloudy (no sun)	Sunny (no clouds)
Temperature	Cool (<60°F avg Daily)	Hot (>60°F avg Daily)
Humidity	High (humid)	Low (dry)
Windspeed	Little Wind	Windy

Soil Water Holding Capacity

Available Water Capacity (AWC) is the amount of water available to plants from the time the soil stops draining water to the time the soil becomes too dry to prevent permanent wilting.

The water retention of a soil relates the amount of water retained in a soil to the energy state (potential) of that water. The AWC of the watershed's soils are shown below.



Influence of Plant Growth Stage on the Demand for Water

A fully grown carrot crop, mature lawn or golf course will need more water than plants that have just been planted.

When the plants are small the evaporation will be more important than the transpiration. When plants are fully grown or mature, the transpiration is more important than the evaporation.

Approximate Duration of Growth Stages

	Duration of Growth stages (Days)				
Plant	**Initial**	**Develop**	**Mid-Season**	**Late-Season**	**Total (days)**
Sod	18	37	79	49	183
Vegetables					
Carrots	20-25	30-35	30-70	20	100-150
Corn	20	25-30	25-50	10	80-110
Potato	25-30	30-35	30-50	20-30	105-145
Radish	5-10	10	15	5	35-45
Landscape	20-25	35	45	25	125-130
Trees	18-20	37-39	79-85	49-53	183-197

Influence of Plant Types Grown on Seasonal Water Needs

The plants grown within the District have an influence on:

1. Daily water needs
2. Seasonal water needs

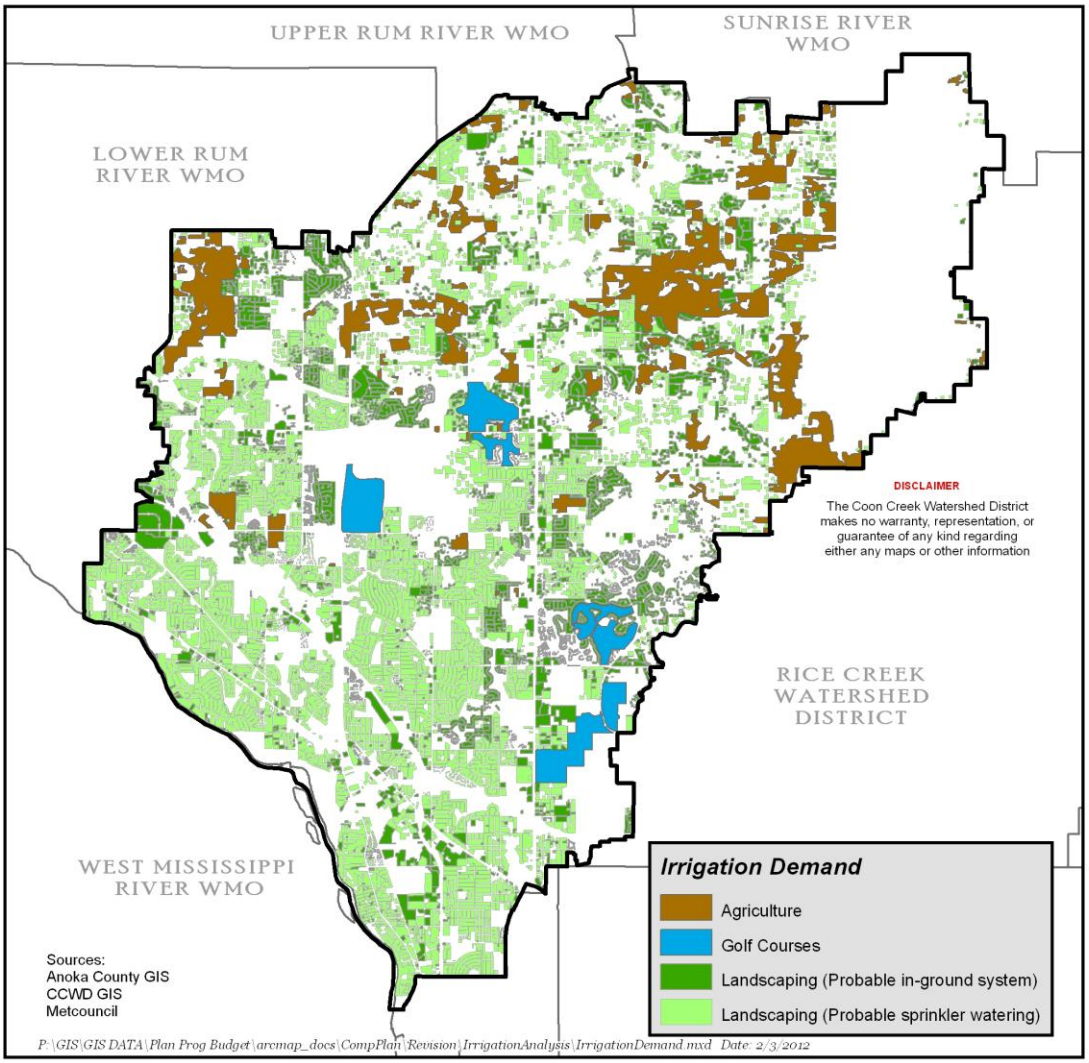
The agronomic growing season (period between the last and the first killing frost) within the Watershed is approximately 183 days (April 15 to October 15.).

	Seasonal Plant Water Needs (in/day)			
Plant	**Initial**	**Develop**	**Mid-Season**	**Late-Season**
Sod	0.1	0.3	0.6	0.4
Vegetables				
Carrots	0.8	1.5	2.0	1.0
Corn				
Potato	1.2	1.4	1.4	1.0
Radish				
Landscape	0.3	0.5	1.1	0.7
Trees	0.3	0.5	1.1	0.7

Irrigation Potential

Assessing the irrigation potential of the watershed, based on soil and water resources, can only be done by assessing the quantity of water necessary for plant and crop growth.

Areas of Potential Plant Irrigation Needs



Plant Water Needs

The approximate seasonal water needs of major plant crops growing in the watershed are:

	Seasonal Plant Water Needs	
Plant/Crop	**Inches of Water/ Growing Period**	**Feet of Water/ Growing Period**
Sod	22 – 59	1.8 - 5
Vegetables		
Carrots	15 – 40	1.3 – 3.3
Corn	12.5 – 33.4	1.0 – 2.8
Potato	16.5 – 44.0	1.4 – 3.7
Radish	4.3 – 11.5	0.4 – 1.0
Landscaping	17.0 – 48.0	1.4 – 3.7
Nursery/Trees	17.0 – 48.0	1.4 – 3.7

Irrigation Water Requirements

Irrigation water requirement is the quantity of water necessary for crop growth.

	Seasonal Plant Water Needs	
Plant/Crop	**Feet of Water/ Growing Period**	**Thousands Acre Feet of Water/ Growing Period**
Sod	1.8 - 5	4.8 - 13.5
Veg		
Carrots	1.3 – 3.3	3.0 – 7.6
Corn	1.0 – 2.8	2.3 – 6.5
Potato	1.4 – 3.7	3.2 – 8.6
Radish	0.4 – 1.0	2.8 – 6.9*
Landscaping	1.4 – 3.7	9.0 – 23.8
Nursery/Trees	1.4 – 3.7	20.1 – 53.2
* Assumes multiple crops in one year		

Water Loss and Irrigation Efficiency

Information on irrigation efficiency is necessary to calculate Total Water Requirement, which is the quantity of water to be applied, taking into account water losses.

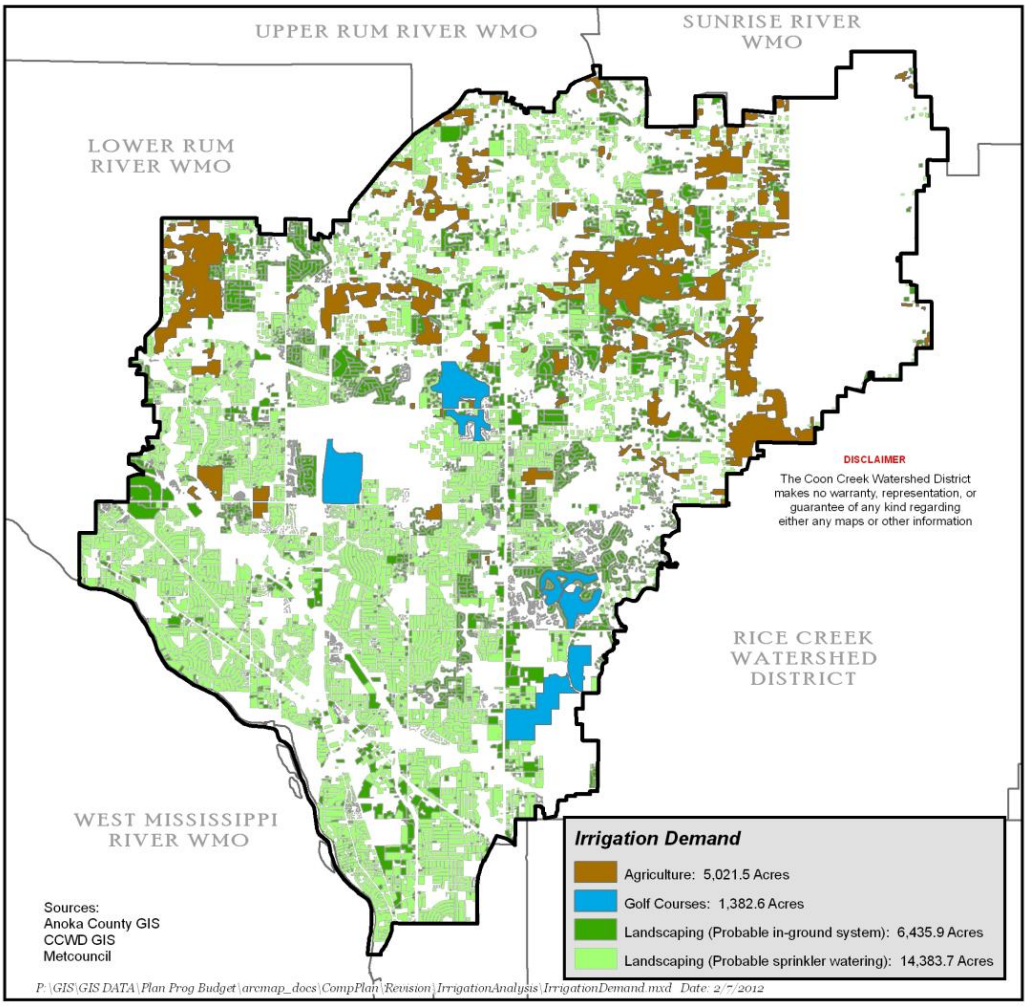
Irrigation efficiency is defined in terms of

1. Irrigation system performance
2. The uniformity of water application
3. The response of the crop/plants to irrigation

	Percent Efficiency (%)		
Method	**Average**	**Range**	**Attainable**
Sprinkler			
Periodic move	75	60-85	80
Side Roll	75	60-85	80
Moving big gun	65	55-75	75
Center Pivot			
Impact heads w/ end gun	80	75-90	85
Spray heads w/o end gun	90	75-90	95
Lateral Move			
Spray heads w/ hose feed	90	75-95	95
Microirrigation			
Surface drip	90	70-95	95
Microspray	85	70-95	95
Water Table Control			
Surface ditch	65	50-80	80

Total Water Requirement Multiplying TWR by the area that is suitable for irrigation gives the total water requirement for that area

Land Uses Potentially Needing Irrigation



Level of Irrigation

Water supply is the heart of any irrigation development. The degree to which water can be made available is a function of the following:

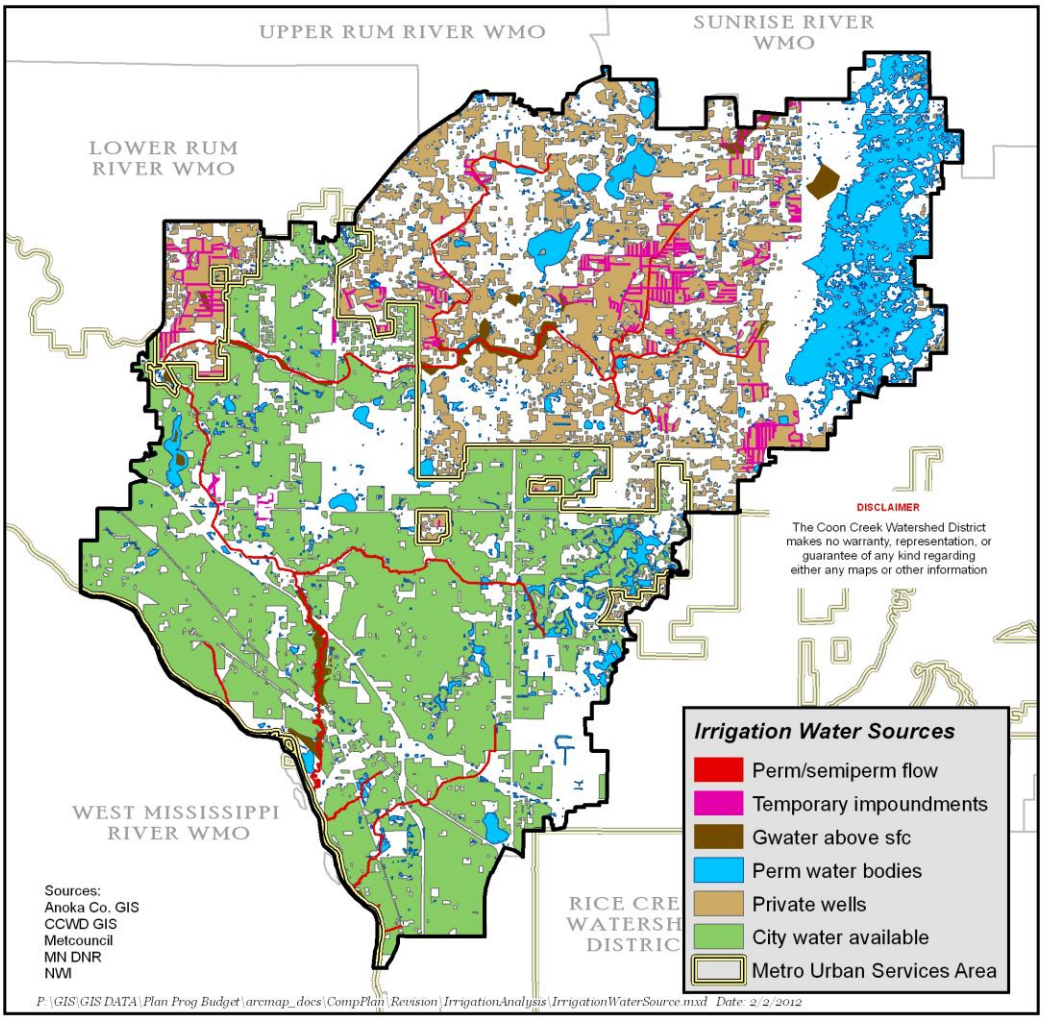
Water Source	Need
Surface	Sufficient water available during the summer months.
Ground	The depth, availability and recovery time need to known.

Irrigation within the Coon Creek Watershed has four main sources:

- Groundwater
- Ditches

- Ponds
- Municipal Water Supply

Availability of Irrigation Water sources



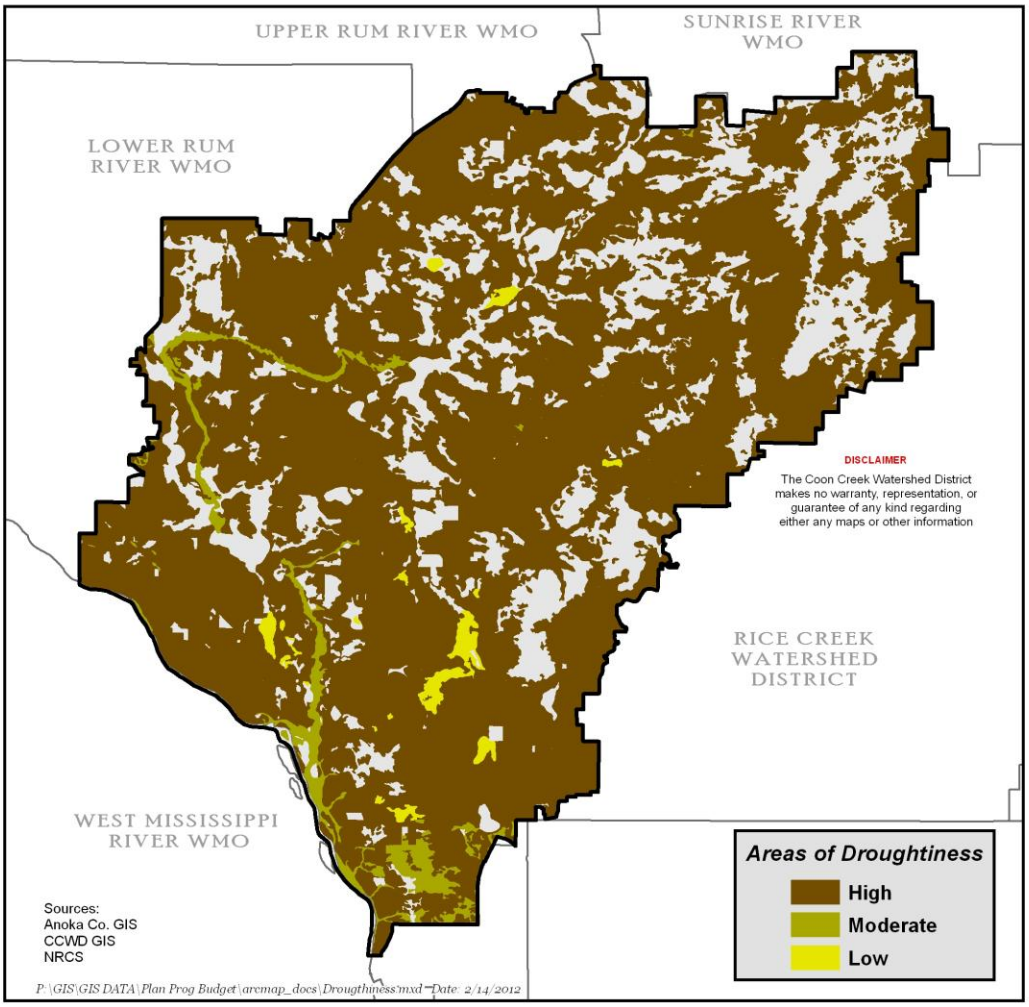
Acres Irrigated

Use	Acres	MGY*
Agriculture	5,022	166
Golf Courses	1,383	500
Landscaping	20,820	150

Value of Irrigation

The factors that contribute affect the aggregate demand for irrigation within the Coon Creek Watershed are:

Acres of Droughty Soils

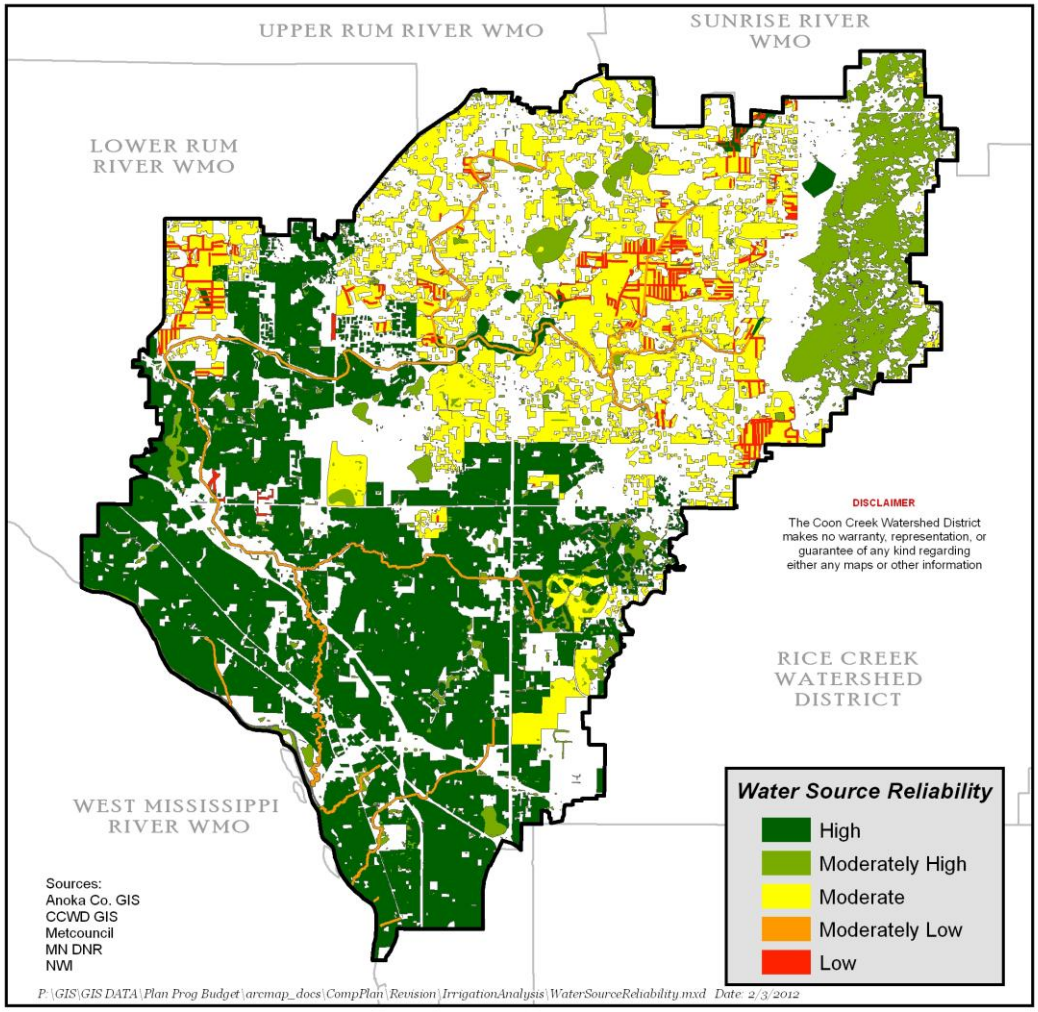


Acres Irrigated

Use	Acres	MGY*
Agriculture	5,022	166
Golf Courses	1,383	500
Landscaping	20,820	150

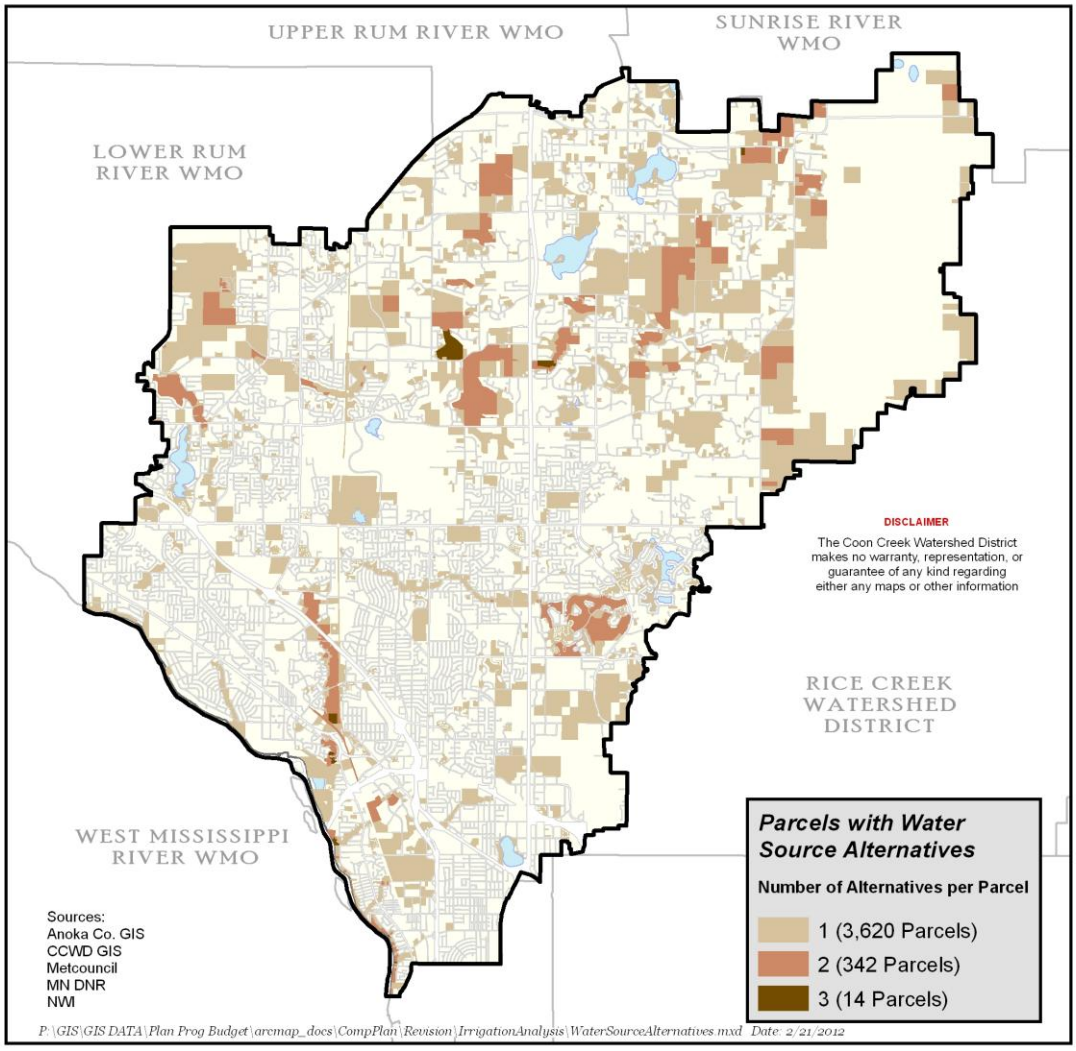
*** Three year average (2006-08) of DNR permitted appropriations**

Reliability of Water Source



Alternatives/ Substitutes

Areas with alternatives or substitutes (such as ponds, impoundments or ditches) for irrigation water are shown below. The vast majority of the watershed relies on a single source (typically municipal or private wells).



Risks to Irrigation

Risks of disruptions to irrigation differ from site to site and are associated with the exposure and vulnerability of the water supply and the vulnerability and exposure of important landscape features that effect the functional capacity of the system. Threats that cause risk can arise from physical, social or managerial actions or processes.

Groundwater Depletion

Due to over pumping, over-use or general declines in water table elevation. In any case the volume of water removed is greater than the volume recharged to the system.

Curtailment of Appropriations to Protect Minimum Flows

Coon Creek has a protected or minimum flow below which the MDNR has the power to cease all appropriations which may affect the water supply needed to maintain or protect that flow.

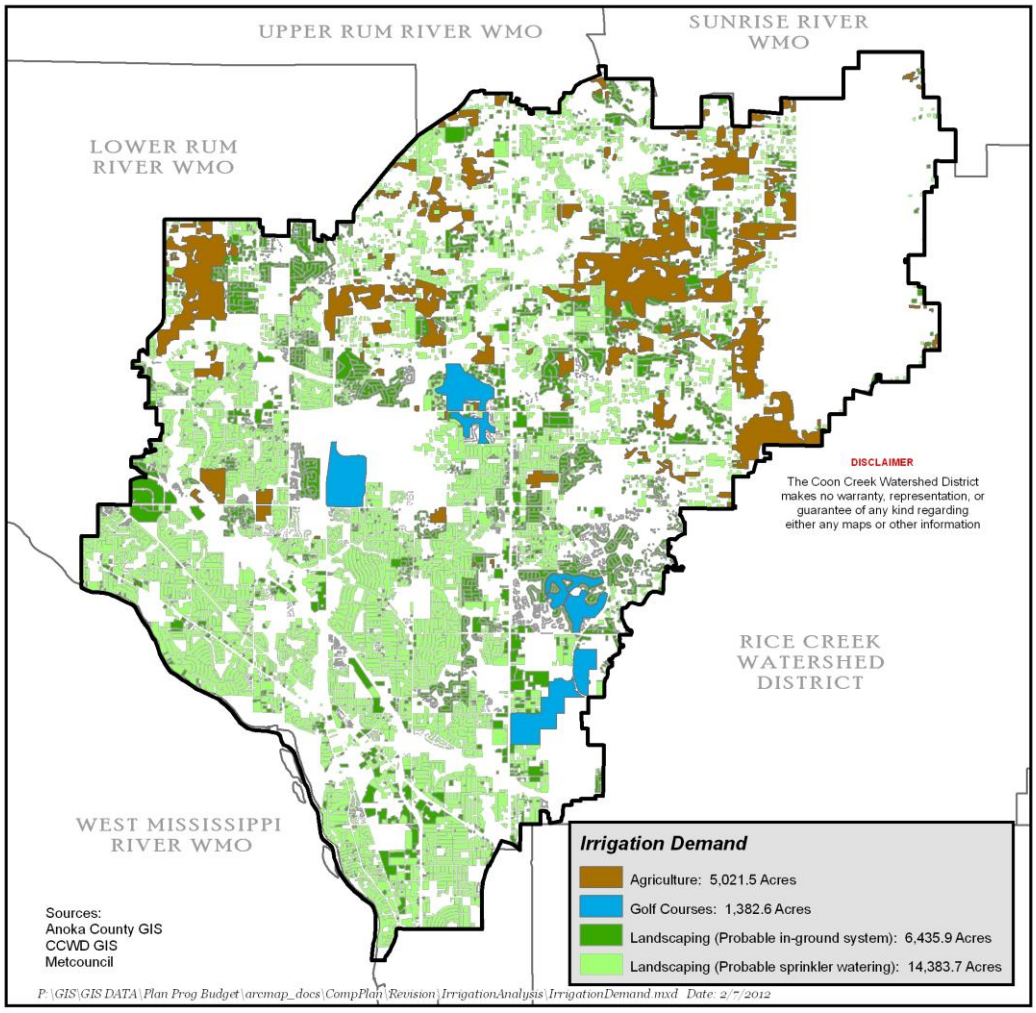
Expected Future of Irrigation

Population

	2010	2020
Agriculture	2,744	2,716
Golf Courses	810	810
Landscaping: In-ground System	18,791	18,920
Landscaping: Probable Sprinkler Watering	67,891	67,891

Projected Demand for Irrigation Water

Use	2010 MGY	2020 MGY
Agriculture	166	163
Golf Courses	500	500
Landscaping	150	165



Expected
Externalities

Competition with Surface Water Uses

Due to pumping rates and or volumes which effectively lower the water supply to surface waters such as lakes and wetlands.

Ground Subsidence

The use of lowlands, such as organic flats and peat bogs requires drainage. The resulting aeration of the soil leads to the oxidation of its organic components, such as peat, and this decomposition process may cause significant land subsidence.

This decomposition applies especially when ground water levels are periodically adapted to subsidence, in order to maintain desired unsaturated zone depths, exposing more and more peat to oxygen. In addition to this, drained soils consolidate as a result of increased effective stress. In this way, land subsidence has the potential of becoming self-perpetuating; having rates up to 5 cm/yr.

Water management used to be tuned primarily to factors such as crop optimization but, to varying extents, avoiding subsidence has come to be taken into account as well.

Service Preferences

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

	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