Southeastern Wisconsin Regional Aquifer Modeling and Water Supply Planning Program – "An Intergovernmental-Interagency Cooperative Effort"

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

2005 WCA Annual Conference

"What Are We Doing to Solve Our Drinking Water Problems?"

September 19, 2005

Southeastern Wisconsin Regional Aquifer Modeling and Water Supply Planning Program

A Cooperative Program…

SE Wisconsin Water Utilities

USGS
science for a changing world

Seven Southeastern Wisconsin Counties

WISCONSIN DEPT. OF NATURAL RESOURCES

UNIVERSITY of WISCONSIN UWMILWAUKEE

UW Extension
Wisconsin Geological and Natural History Survey

Southeastern Wisconsin Regional Aquifer Modeling and Water Supply Planning Program

- Regional Setting
- Regional Water Supply Planning Program – Focus on Groundwater Model Development and Initial Results
- Water Supply Planning Challenges
- Conclusions and Recommendations for Counties to Consider

Complex Area Example of Regional Water Supply Planning Program for Southeastern Wisconsin.

- It is Recognized That This Level of Regional Planning Will Not Be Carried Out in Most Areas of the State. However, the Concepts and Challenges Involved Can Be Applicable to Subregional, County, and Local Water Supply Planning in Less Complex Areas

Southeastern Wisconsin Regional Aquifer Modeling and Water Supply Planning Program Overview

Areas Served by Public and Private Water Supply Systems in Southeastern Wisconsin: 2000

2,700 Square Miles
(62% west of Divide)

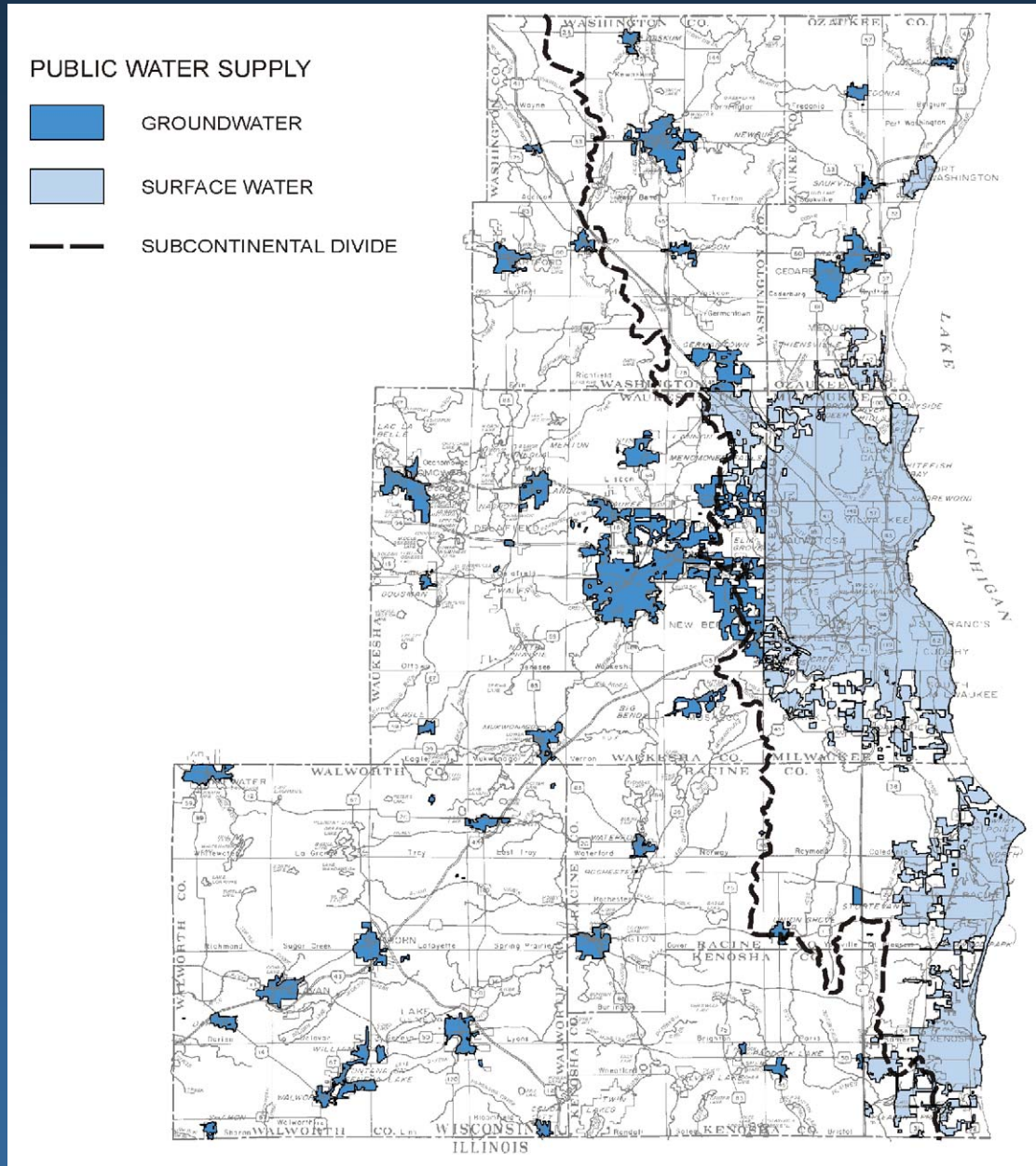
2.0 Million People

Public Water Supply

- Lake Michigan
  - Nine Plants (30 systems)
  - 1.2 Million People
  - 210 mgd
- Groundwater
  - 50 Systems
  - 400,000 People
  - 55 mgd

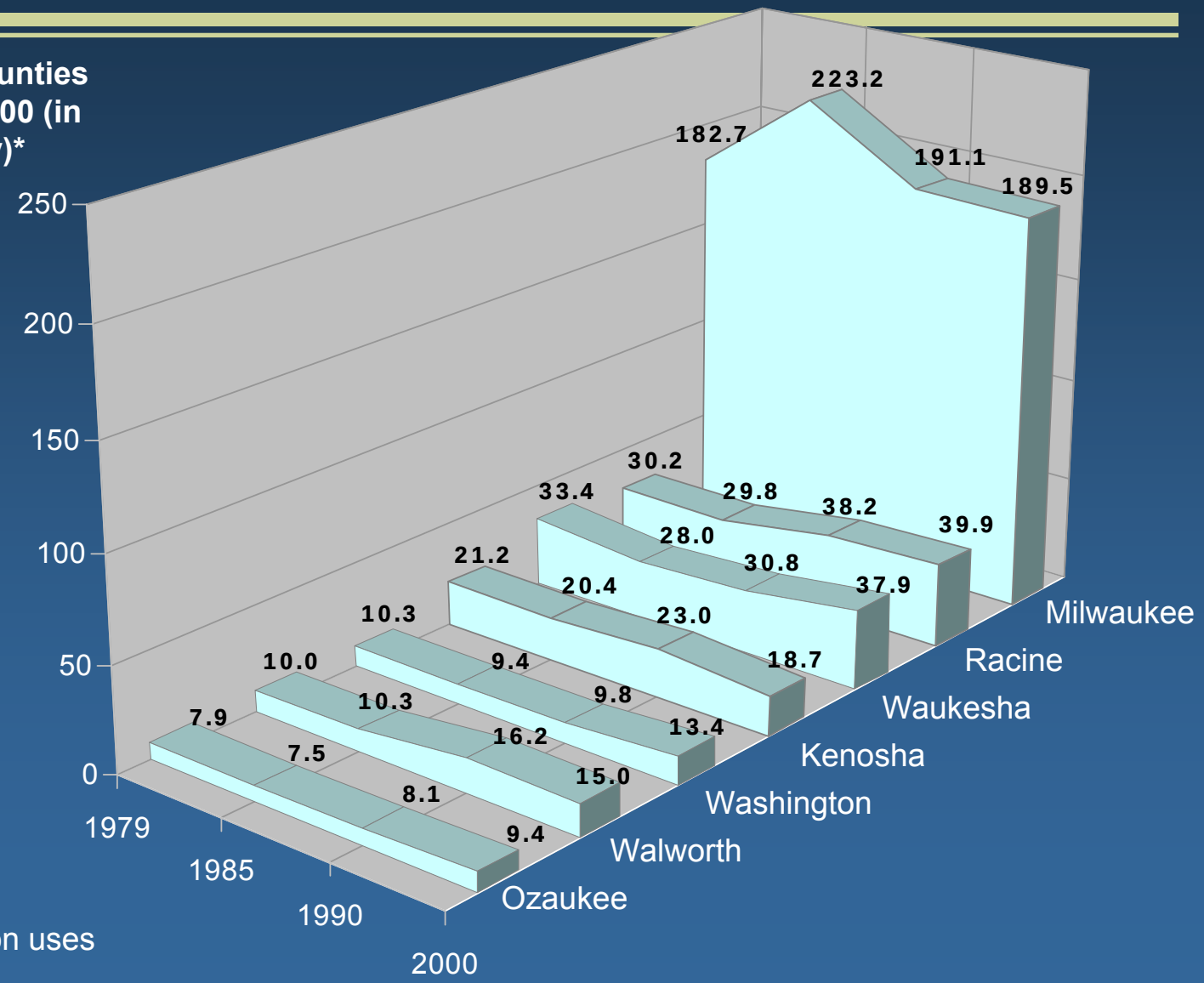
Private Water Supply

- 400,000 People
- 40 mgd



Southeastern Wisconsin Regional Aquifer Modeling and Water Supply Planning Program Overview

Trends in Water Use for Counties Within the Region: 1979-2000 (in Million Gallons Per Day)*



* Excludes power generation uses

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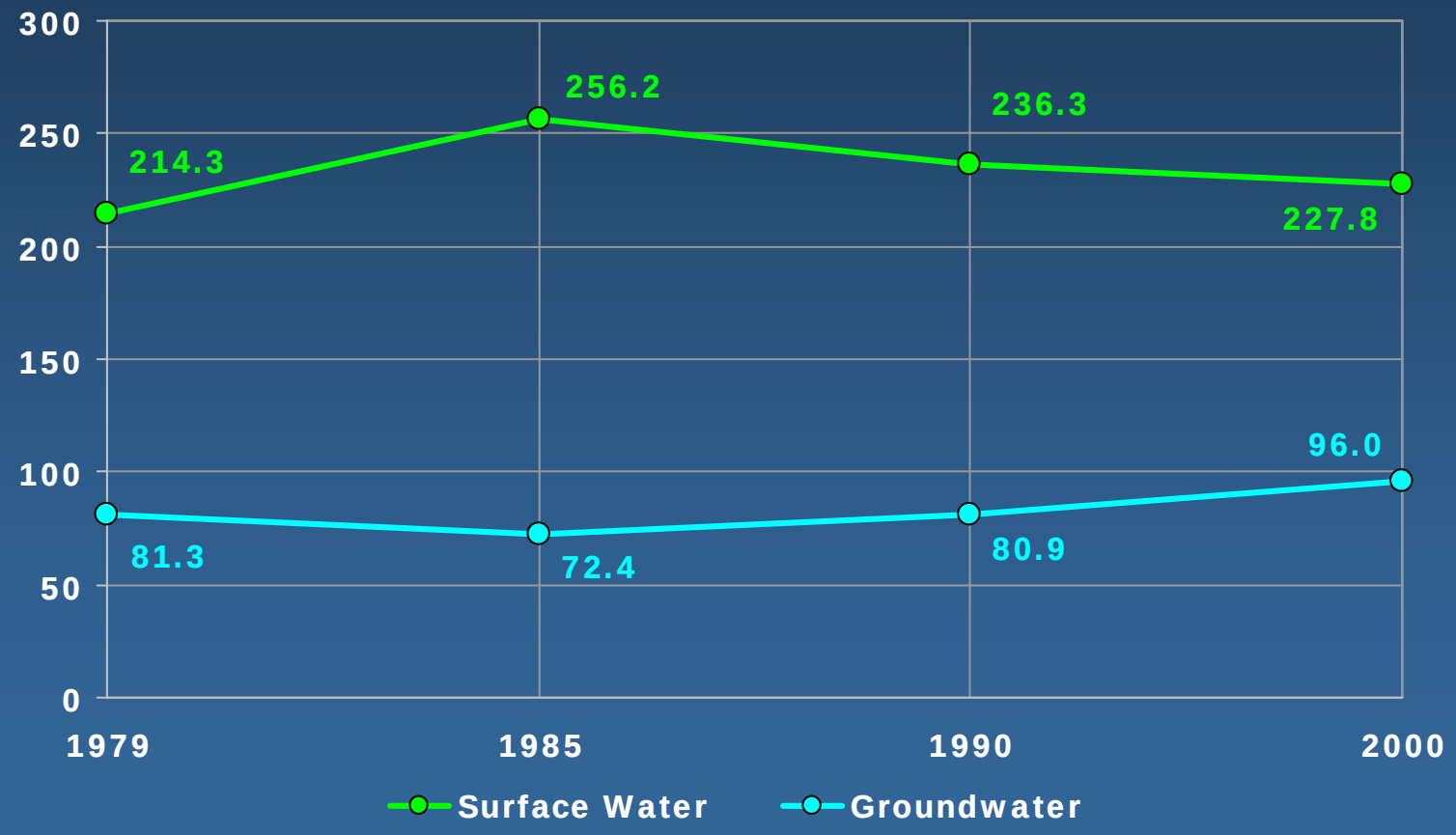

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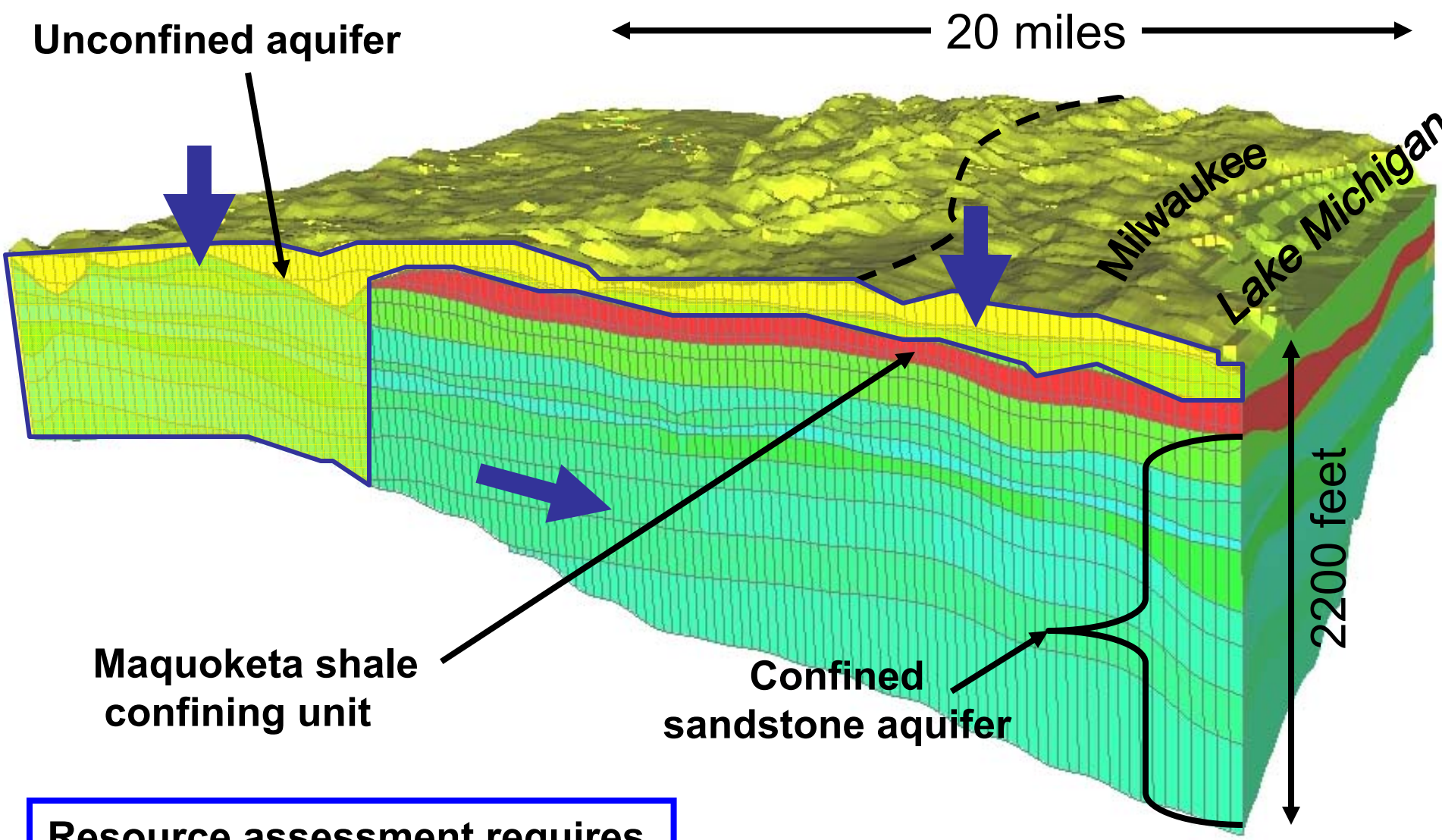
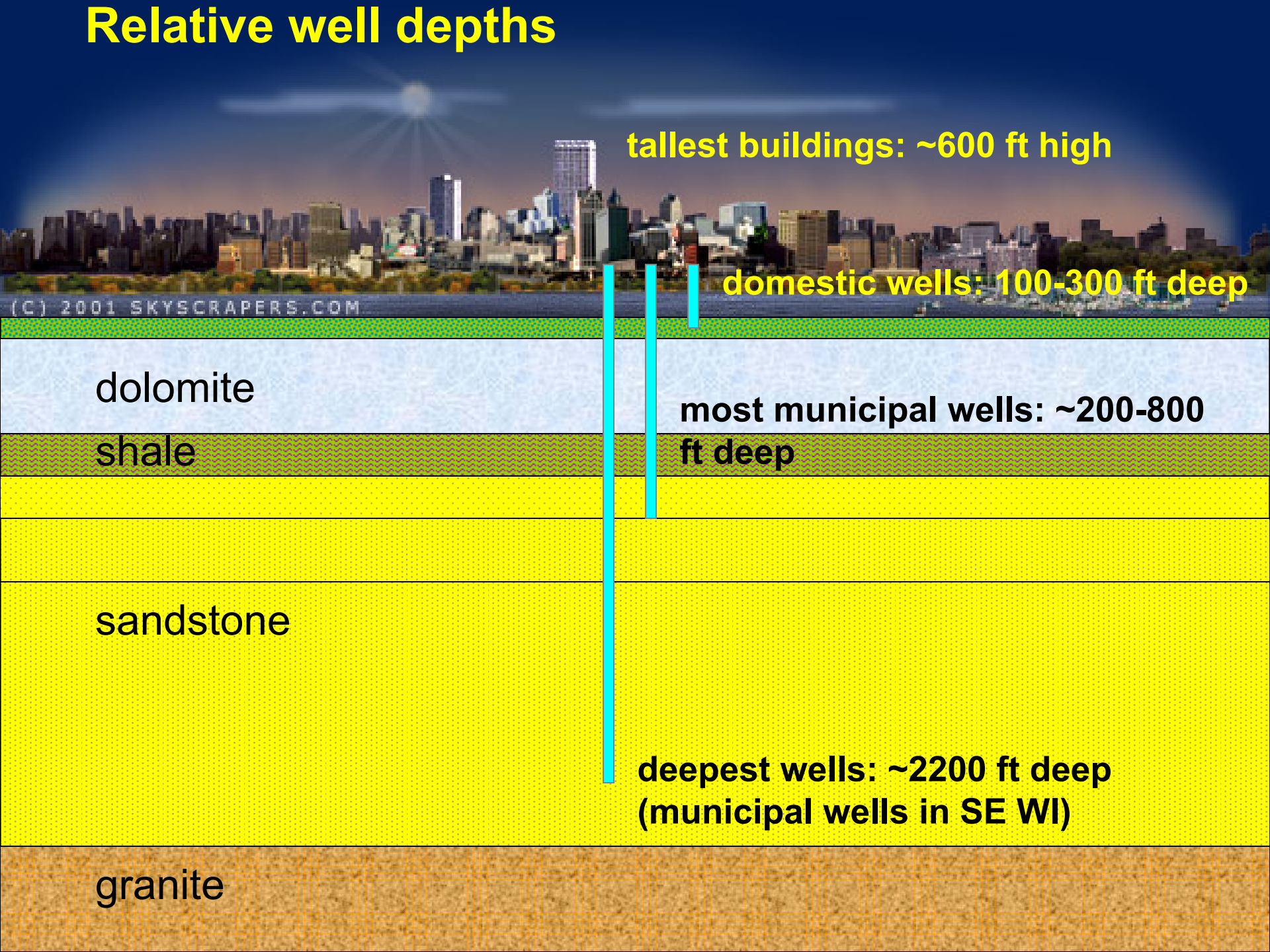
General Hydrogeology of Southeast Wisconsin



Resource assessment requires knowing recharge and inflows

Source: USGS

Relative well depths



Southeastern Wisconsin Regional Water Supply Planning Program Overview

Major Issues

- Groundwater Supply Demand is Rising
- Overuse of the Deep Sandstone Aquifer Has Caused Large Cone of Depression – Up to 500 Feet of Drawdown
- Current Radium Exceedance Issues (22 systems in Southeastern Wisconsin and 53 in State)
- Quality of Deep Sandstone Aquifer Water Is Declining in Some Wells
- Potential for Contamination and Surface Water Impacts with Increased Use of the Shallow Aquifer

Southeastern Wisconsin Regional Water Supply Planning Program Overview

Regional Water Supply Planning Program – Three Elements (Coordinated With And Designed To Complement Local Actions)

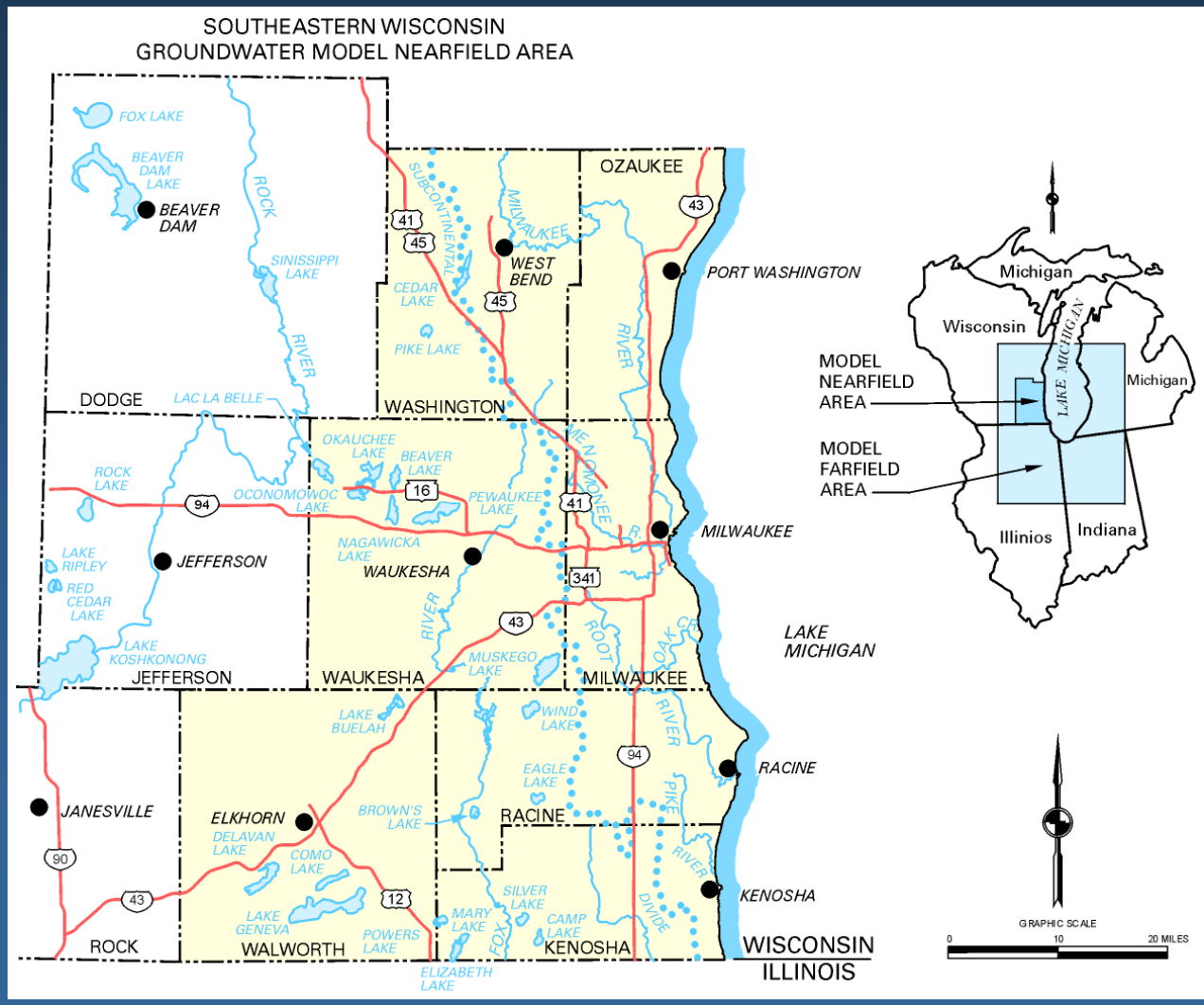
- Conduct Basic Groundwater Inventories (Completed in 2001 With Partners—WGNHS and WDNR)
- Collect Additional Inventory Data and Develop Regional Aquifer Simulation Model (Completed with Partners—USGS, WGNHS, UW-Milwaukee, WDNR, and SE Wisconsin Water Utilities)
- Prepare Regional Water Supply System Plan (Planning is Underway With Support from Seven Counties in Southeastern Wisconsin)

Southeastern Wisconsin Regional Water Supply Planning Program Overview – Second Element Groundwater Model Objectives

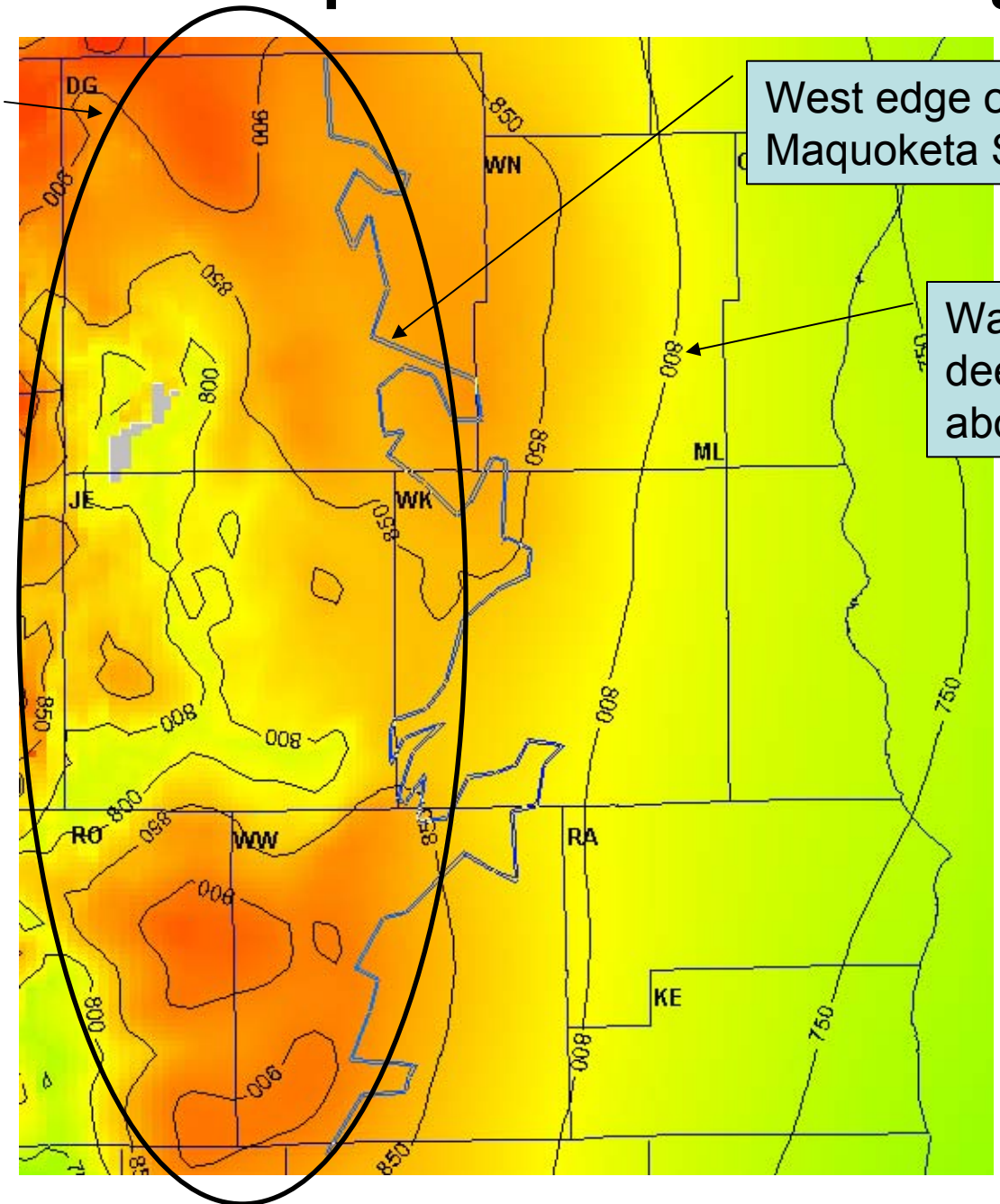
- Understand Present GW System
- Study Current and Future Impacts of Groundwater Use
- Water Supply Plan--Simulate Alternative Management Options
- Delineate Contributing Areas for Wellhead Protection
- Provide a Framework for Site-Specific Models and Studies

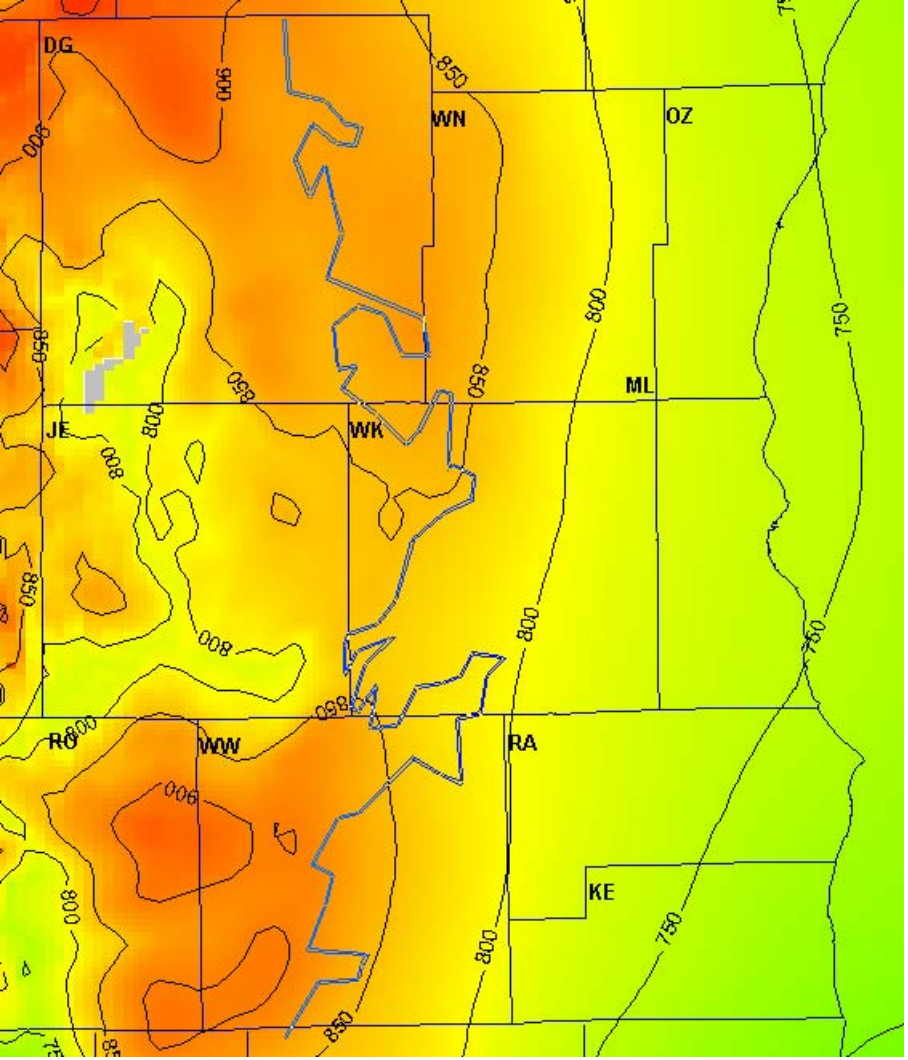
Southeastern Wisconsin Regional Water Supply Planning Program Overview – Area Groundwater Model Covered By

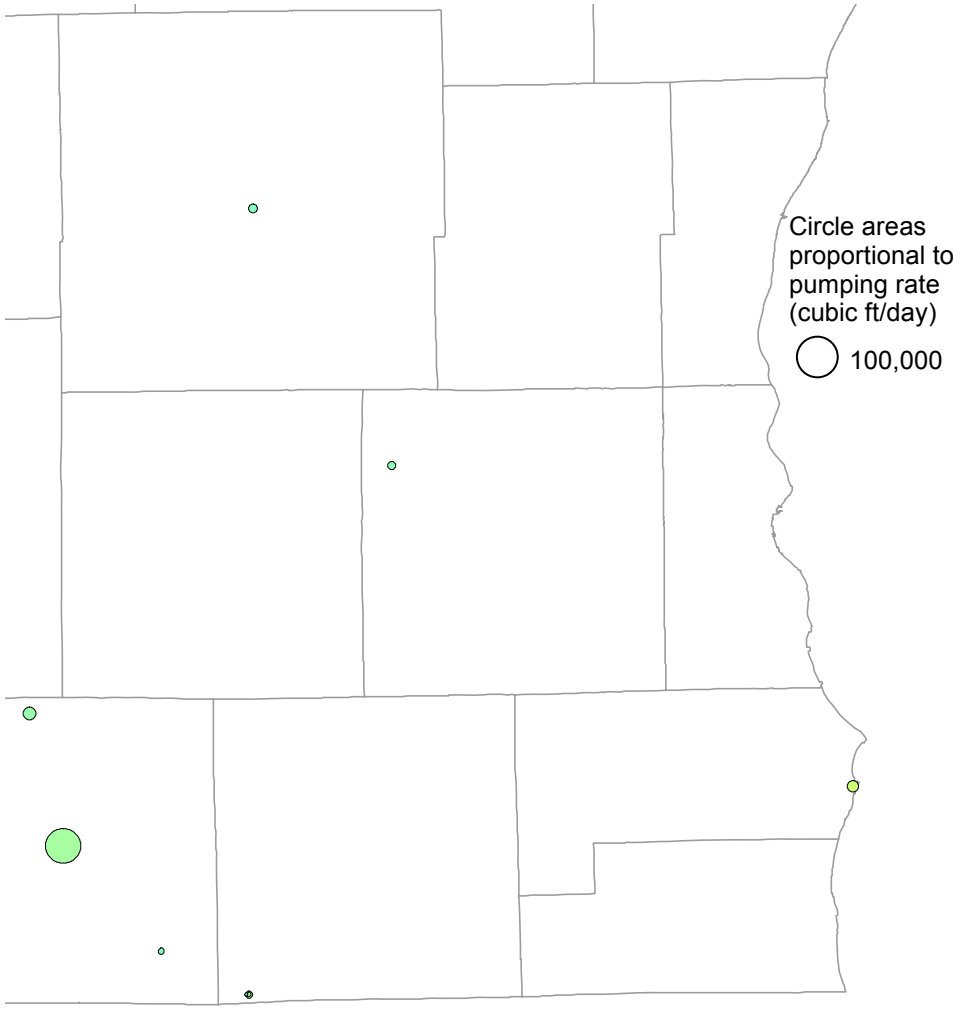
- Basic Grid Spacing 2,500 feet, or an average of one quarter square mile
- Includes 18 Layers
- Total of about 600,000 cells



Simulated Deep Water Levels through Time







Water Levels in the Sandstone Aquifer
(feet above sea level)

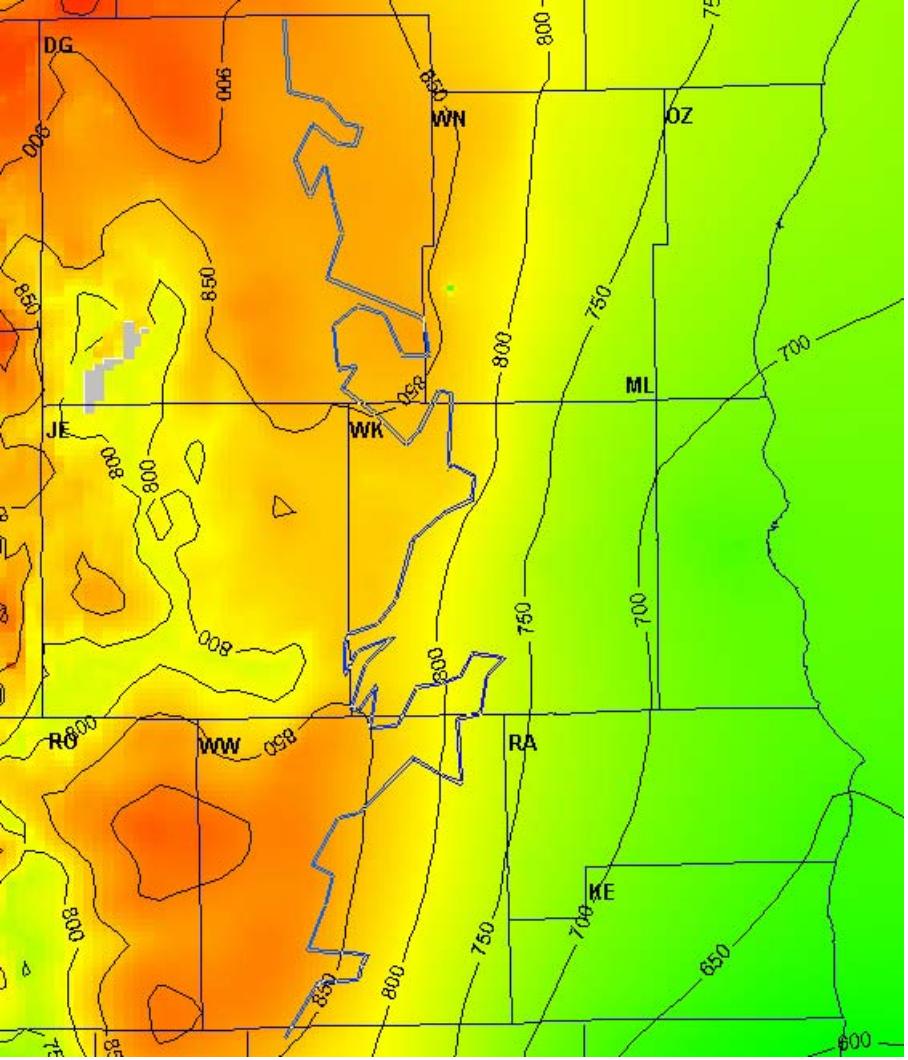
Well Locations and Pumping Rates

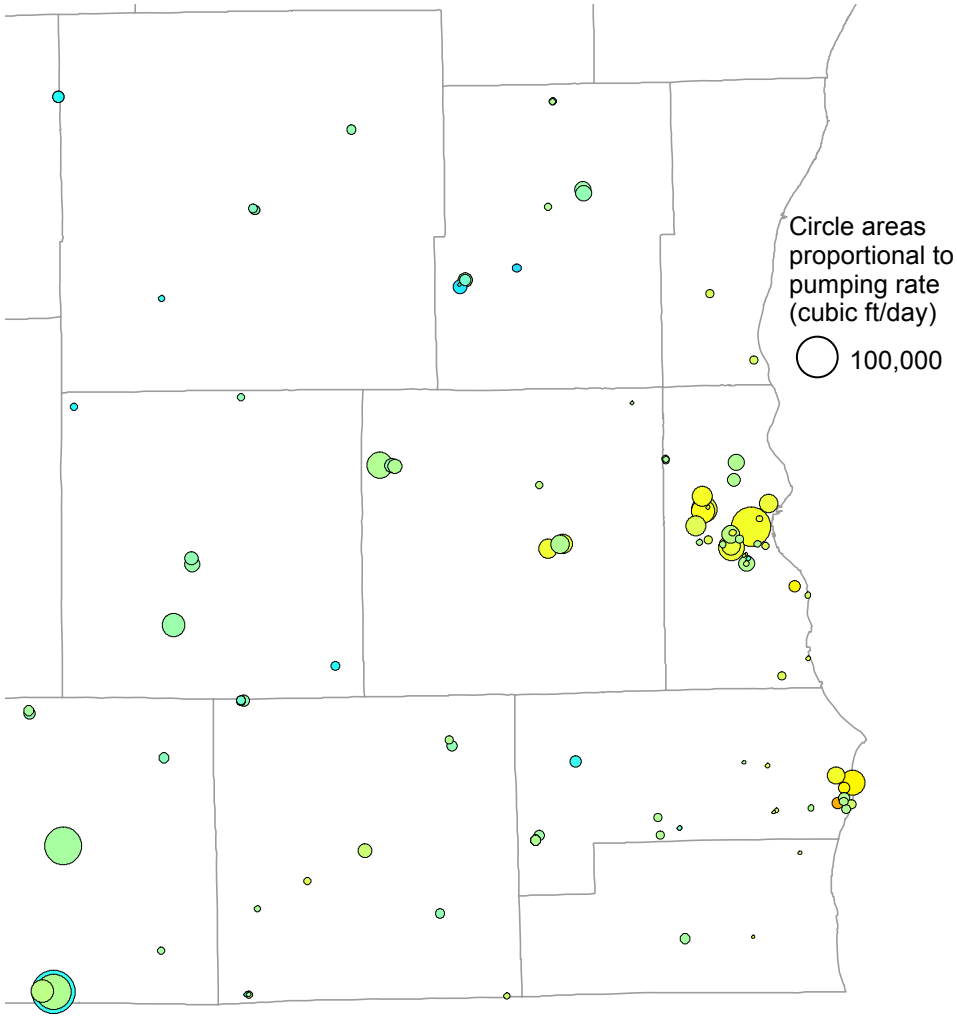
Shallow

Mixed or Intermediate Depth

Deep

1880-1900





Water Levels in the Sandstone Aquifer
(feet above sea level)

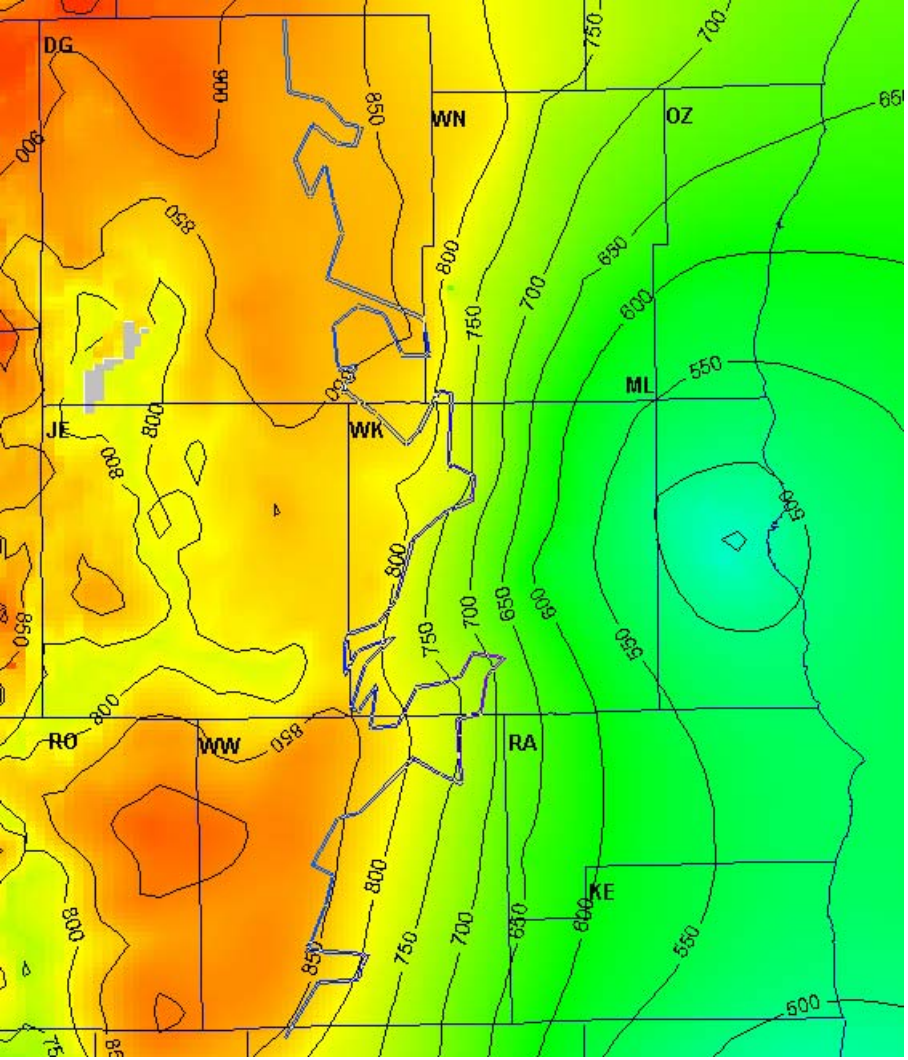
Well Locations and Pumping Rates

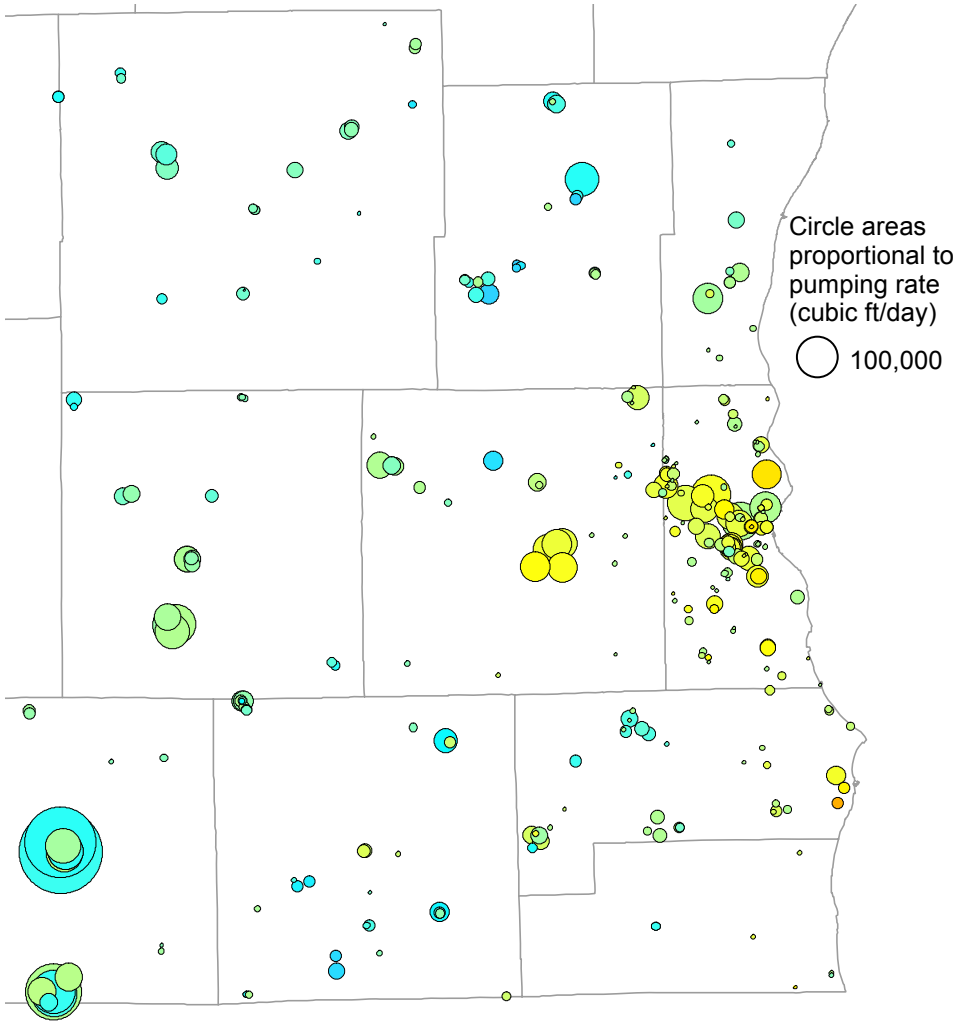
Shallow

Mixed or Intermediate Depth

Deep

1920-1930





Water Levels in the Sandstone Aquifer
(feet above sea level)

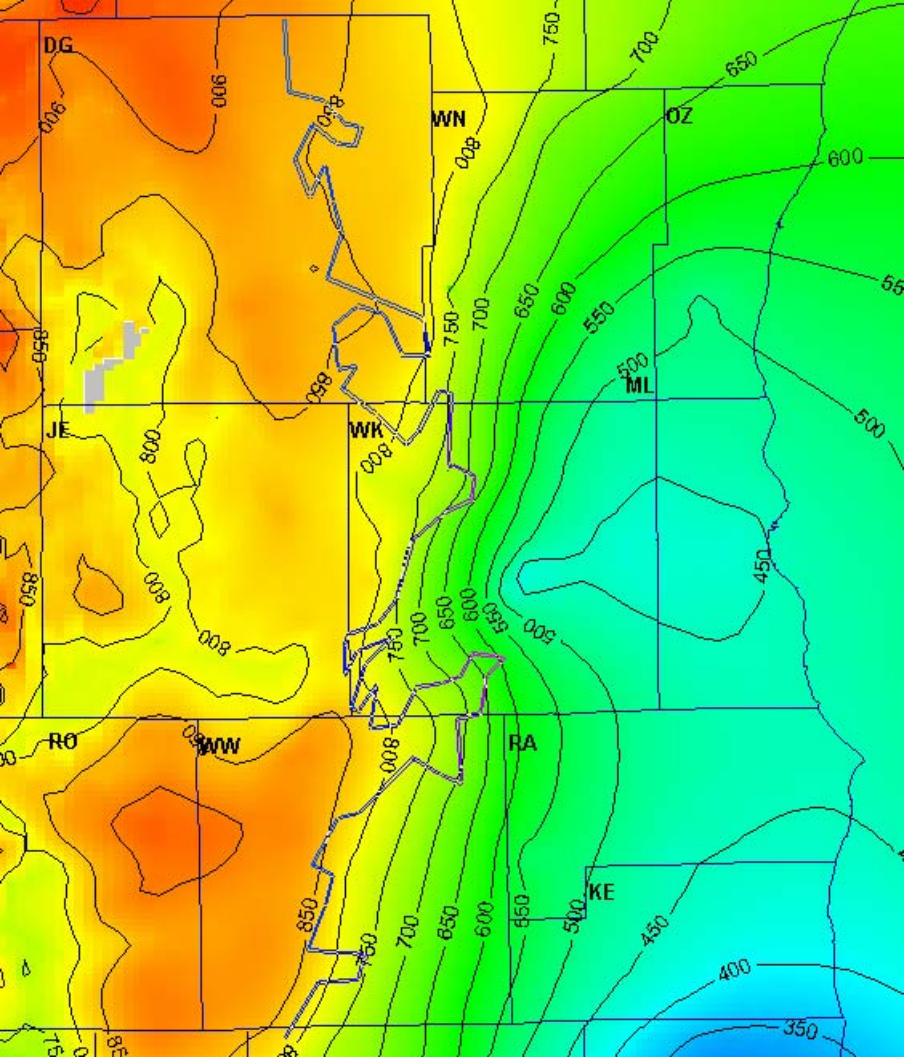
Well Locations and Pumping Rates

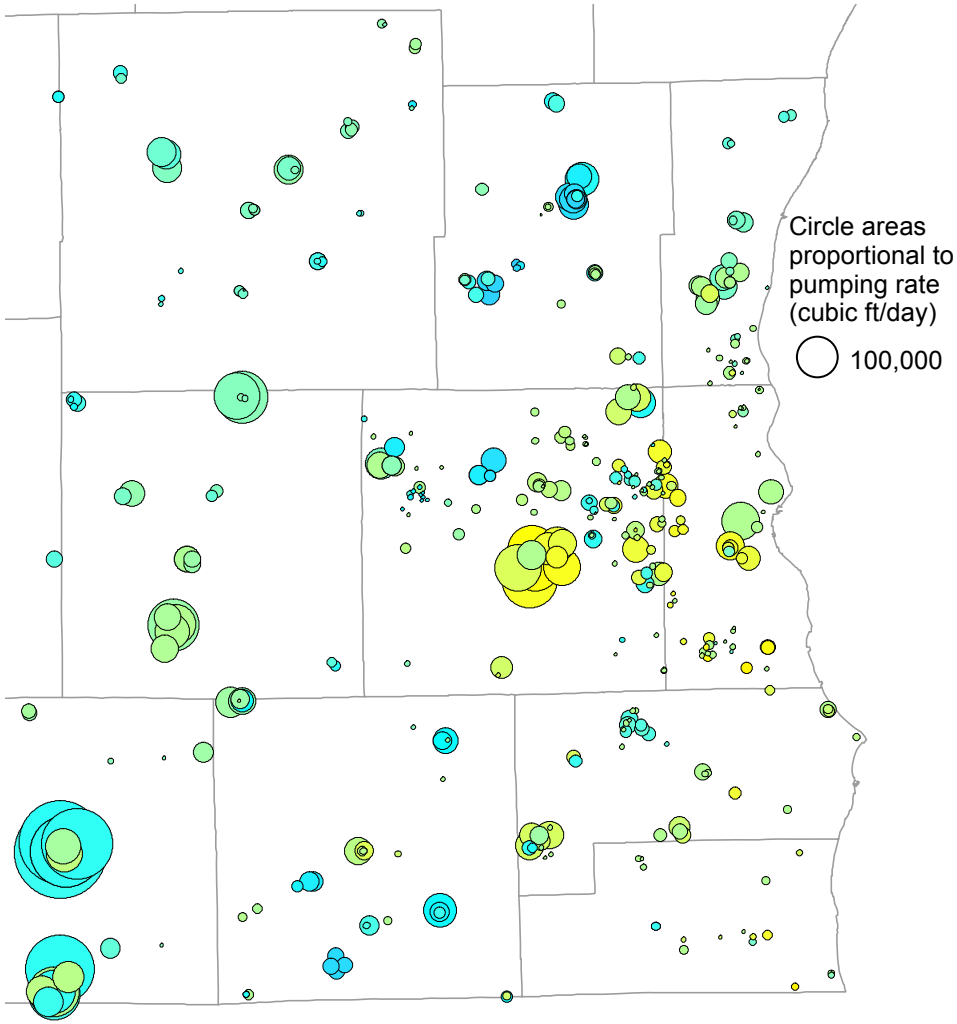
Shallow

Mixed or Intermediate Depth

Deep

1950-1961





Water Levels in the Sandstone Aquifer
(feet above sea level)

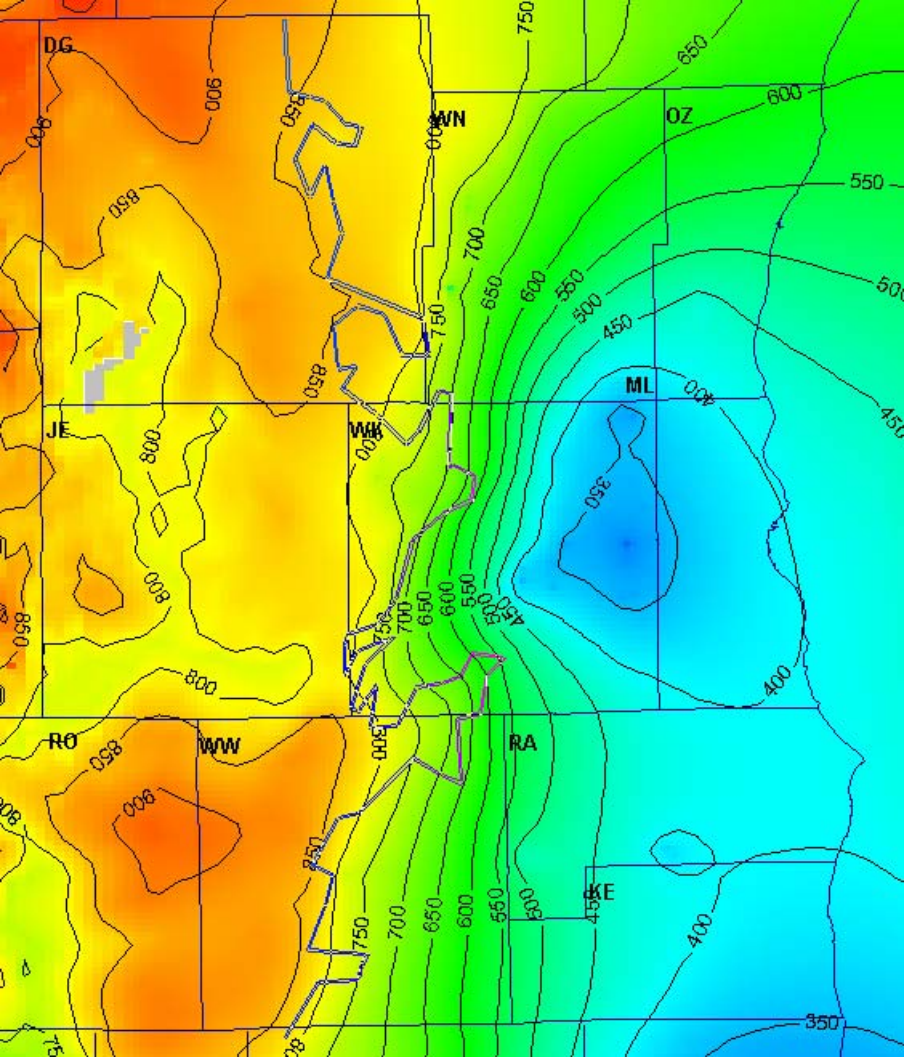
Well Locations and Pumping Rates

Shallow

Mixed or Intermediate Depth

Deep

1970-1980



Water Levels in the Sandstone Aquifer
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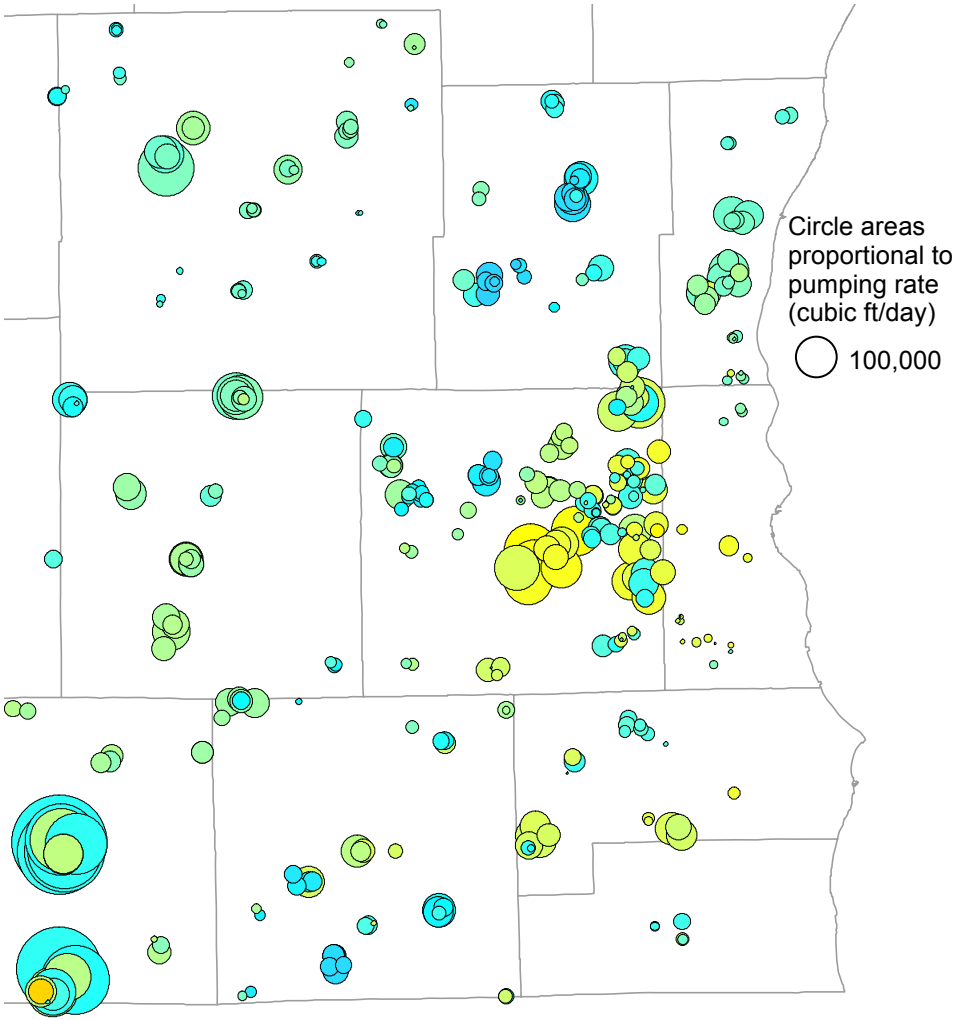


Well Locations and Pumping Rates

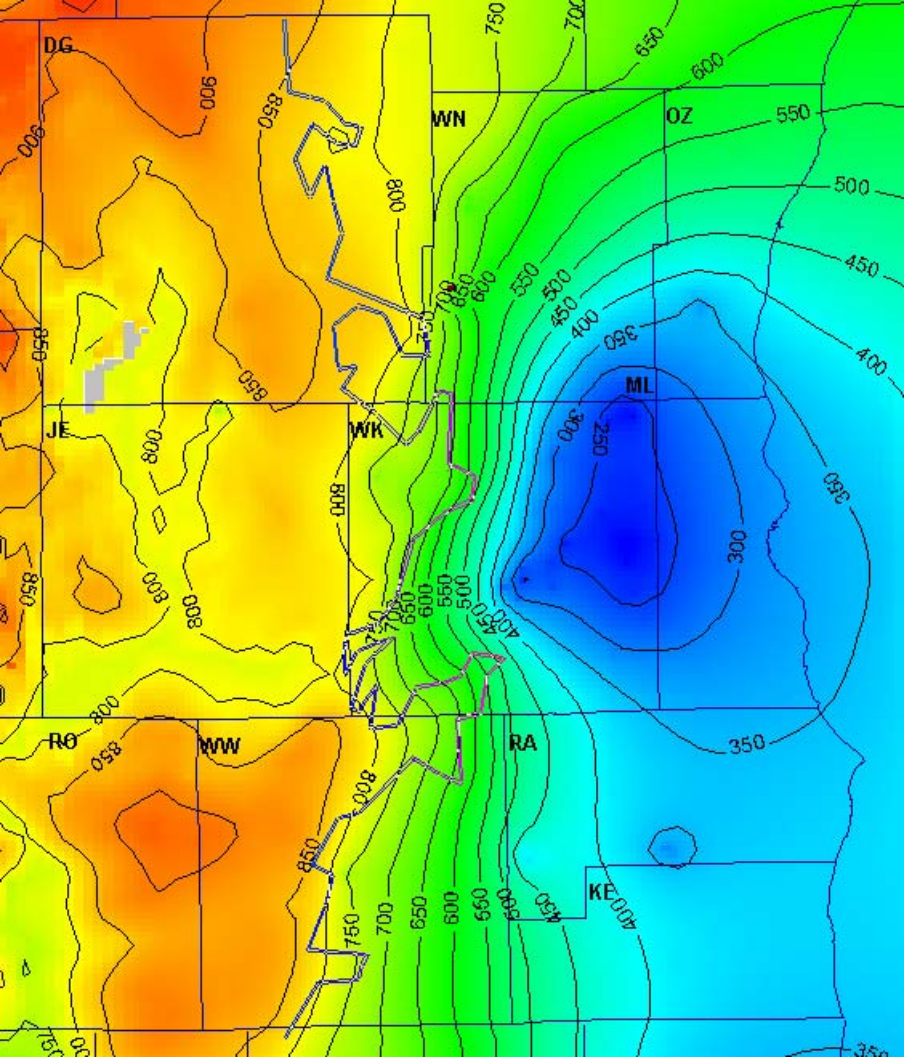
Shallow

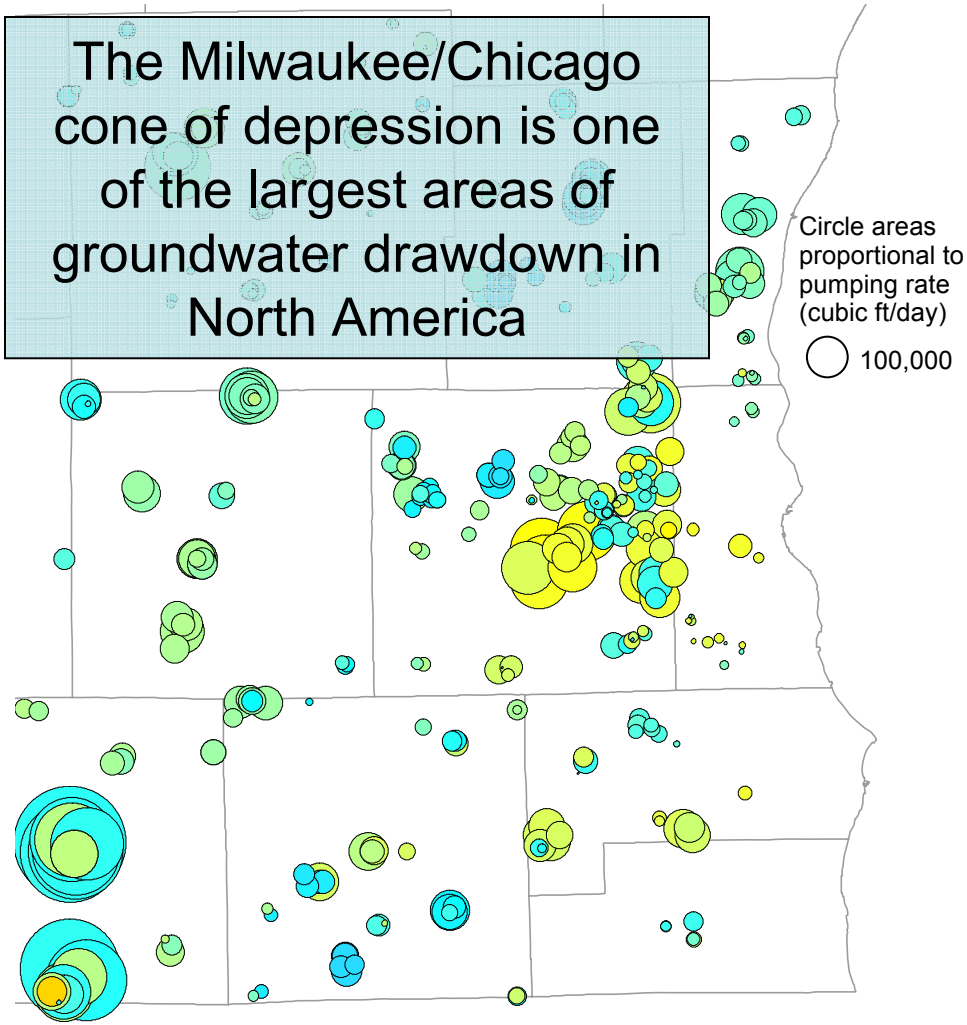
Mixed or Intermediate Depth

Deep

1990-2000

The Milwaukee/Chicago cone of depression is one of the largest areas of groundwater drawdown in North America





Water Levels in the Sandstone Aquifer (feet above sea level)

Well Locations and Pumping Rates

Shallow

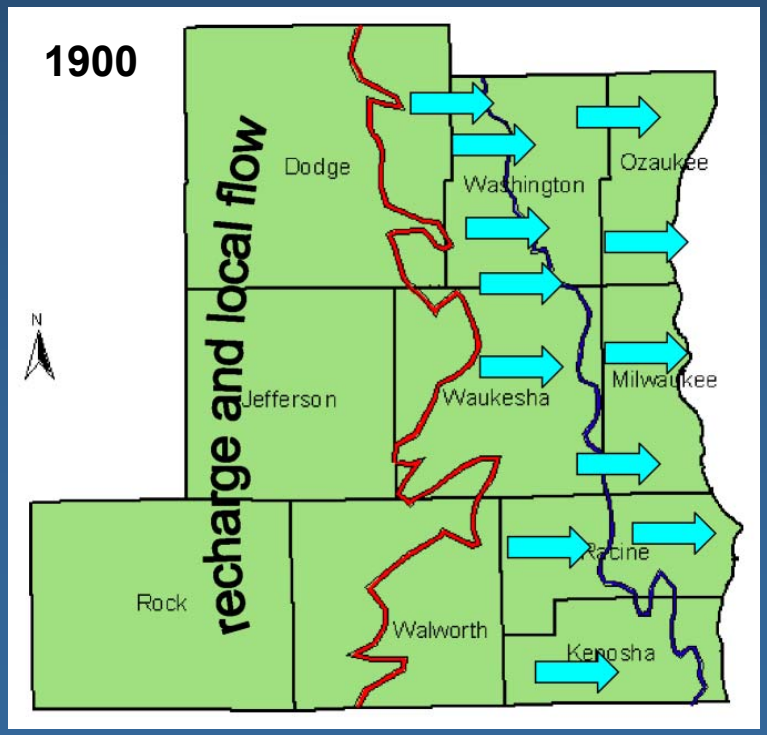
Mixed or Intermediate Depth

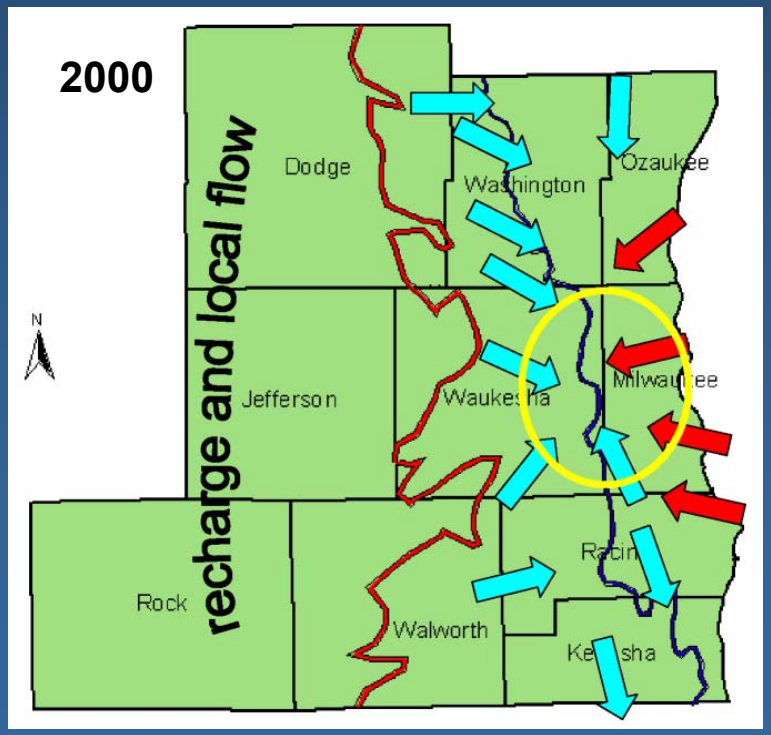
Deep

2010-2020

Regional Groundwater Modeling – Important Initial Findings

- Pumping Has Altered Groundwater Flow Directions
- Groundwater that Once Flowed Toward Lake Michigan is Now Intercepted by Pumping and Diverted West Under the Surface Water Divide Where, After Use, it is Ultimately Discharged to Surface Water Within the Mississippi River Basin

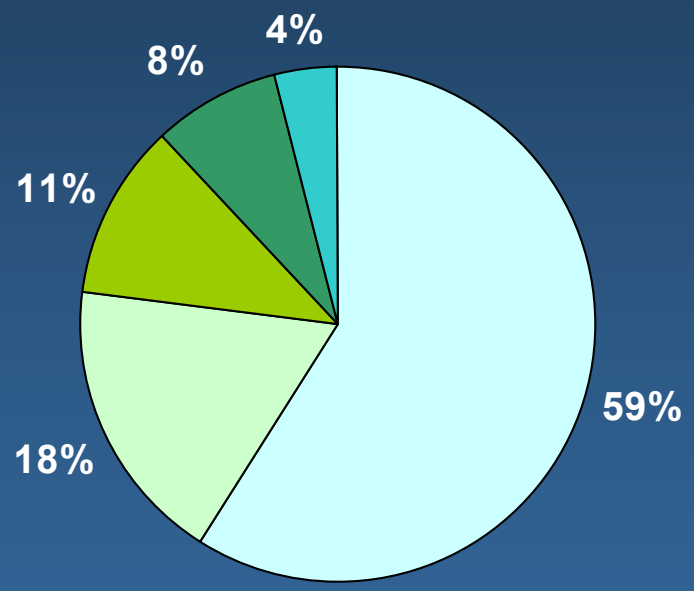




Southeastern Wisconsin Regional Water Supply Planning Program Overview – Regional Groundwater Modeling – Important Initial Findings

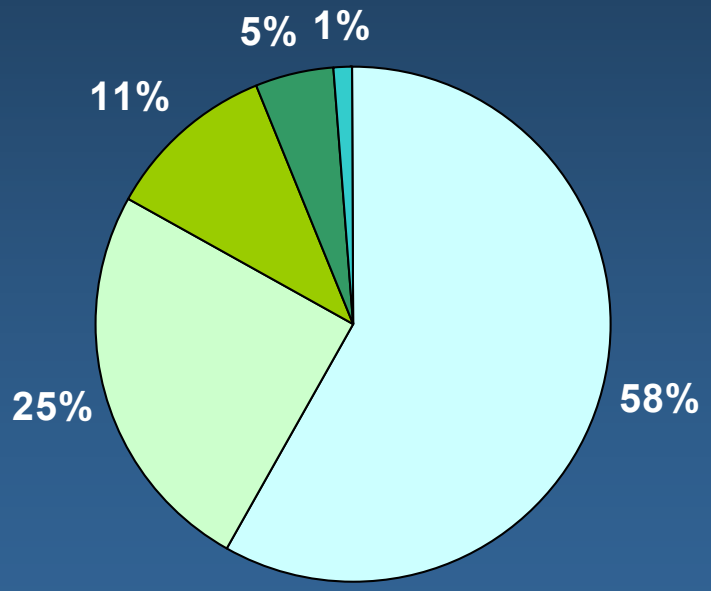
Water Transferred from Surface Water Within the SEWRPC Region Accounts for 80% of Combined Shallow and Deep Pumping

Deep Pumping: 33.3mgd



- Reduced flow to inland surface water
- Groundwater flow from outside SEWRPC region
- Reduced groundwater storage
- Reduced groundwater flow toward Lake Michigan
- Groundwater flow out of Lake Michigan

Shallow Pumping: 32.5mgd



- Reduced flow to inland surface water
- Flow out of inland surface water
- Reduced groundwater storage
- Reduced groundwater flow into Lake Michigan
- Groundwater flow out of Lake Michigan

Southeastern Wisconsin Regional Water Supply Planning Program Overview – Third and Final Element – Proposed Regional Water Supply Plan

- Development of Public Water Supply Service Areas and of Forecast Demand for Water Use (2035)
- Development of Recommendations for Water Conservation Efforts to Reduce Water Demand
- Evaluation of Alternative Sources of Supply, Culminating in Identification of Recommended Sources of Supply for Each Service Area and in Recommendations for Development of the Basic Infrastructure Required to Deliver that Supply

Southeastern Wisconsin Regional Water Supply Planning Program Overview – Third and Final Element – Proposed Regional Water Supply Plan (continued)

- Identification of Groundwater Recharge Areas to Be Protected from Incompatible Development
- Specification of Any New Institutional Structures Found Necessary to Carry Out the Plan Recommendations
- Identification of Any Constraints to Development Levels in Subareas of the Region that May Emanate from Water Supply Sustainability Concerns

Southeastern Wisconsin Regional Water Supply Planning Program Overview – Planning Challenges

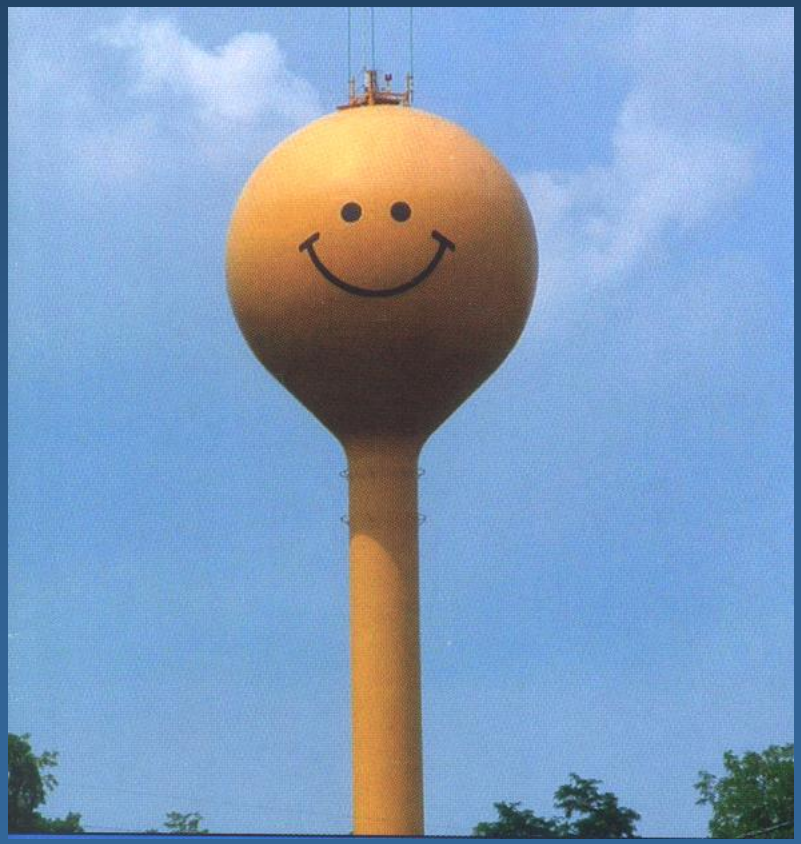
OVERALL CHALLENGE – To Develop a Plan for the Provision of Long-Term Sources of High-Quality Water for the Southeastern Wisconsin Region

- Determine a Balance and an Efficient Management Program for Sources of Supply:
  - Lake Michigan
  - Shallow Aquifer
  - Deep (Regional) Aquifer (with treatment)
  - Precipitation
  - Infiltration Systems
    - Enhanced Precipitation
    - Wastewater (?)

Southeastern Wisconsin Regional Water Supply Planning Program Overview – Planning Challenges

All Groundwater Use Has Consequences

Balance Groundwater Water Supply Needs With Surface Water Impacts–Reasonableness



Southeastern Wisconsin Regional Water Supply Planning Program Overview – Planning Challenges

CHALLENGE–Integration of Water Supply Planning with Land Use and Comprehensive ("Smart Growth") Planning

- Link Reasonably Expected Water Supply Capacities As One of Several Factors Considered in Future Land Use Decisions
- Take Into Account Important Water Supply Considerations in Establishing Land Use Patterns
  - Preserve Important Groundwater Recharge Areas (Areas to be Identified in Regional Plan)
  - Protect Existing and Future Well Zone of Contribution Areas
  - Promote Local Zoning to Protect Areas Most Susceptible to Groundwater Contamination (Areas Identified in Regional Plan)

Southeastern Wisconsin Regional Water Supply Planning Program Overview – Planning Challenges

CHALLENGE – Water Conservation

- Determine What Levels Are Achievable and At What Cost
- Balance Conservation and Economic Development Objectives
- Implementation – How to Achieve

Southeastern Wisconsin Regional Water Supply Planning Program Overview – Conclusions and Recommendations

Integrate Water Supply Planning With "Smart Growth Planning"

- Prepare Regional, County, and/or Local Water Supply Plans (Be Prepared)
- Look at a Measure of Sustainability – Evaluate Water Budget for Your Local Hydrogeology
- Coordinate Water Supply Planning With Any Available Regional or County Level Planning, i.e. Planned Population, Land Use, Service Areas
- Integrate Water Supply and Comprehensive Planning
  - Water Supply (Utility) Service Areas Matched to Future Capacity
  - Protection of Existing and Future Well Zones of Contribution Areas
  - Preserve Important Groundwater Recharge Areas
  - Promote Low-Impact (Conservation) Development and SWM Practices

Southeastern Wisconsin Regional Water Supply Planning Program Overview – Conclusions and Recommendations

Water Conservation Measures

- Implementation – Consider Regional or Countywide Approach to Public Education