Groundwater interactions with the Madison lakes, Dane County, Wisconsin
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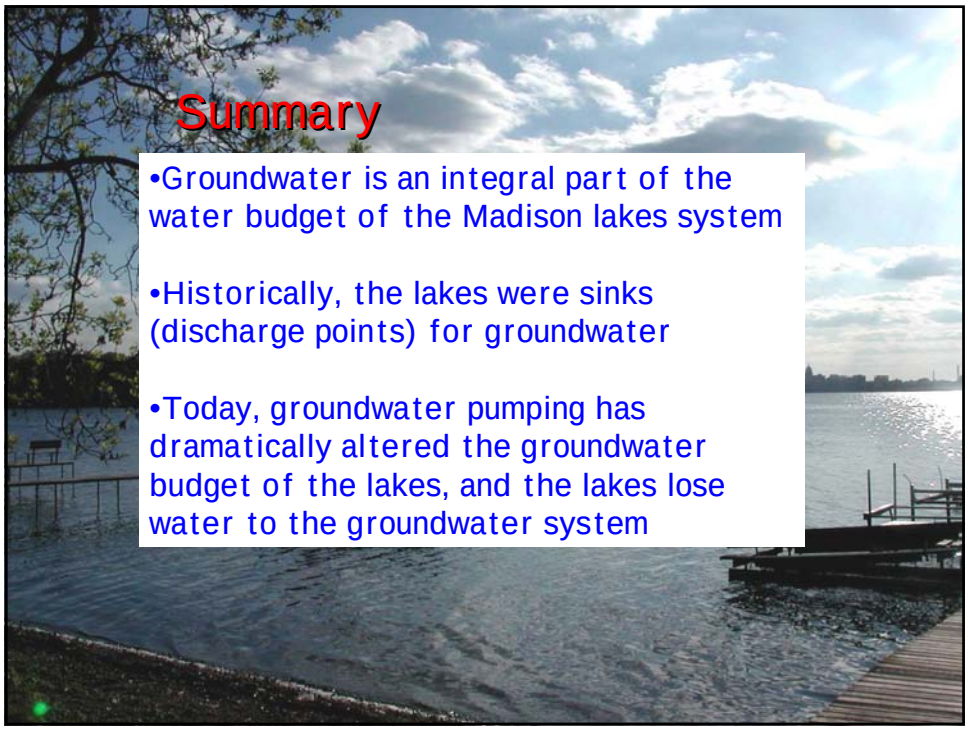
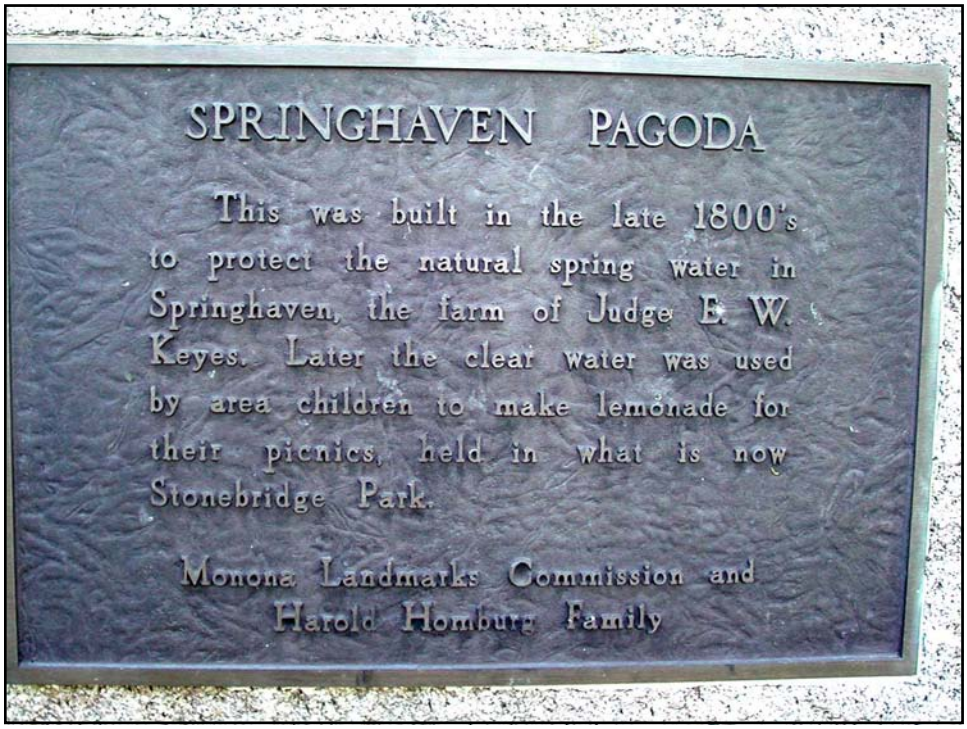
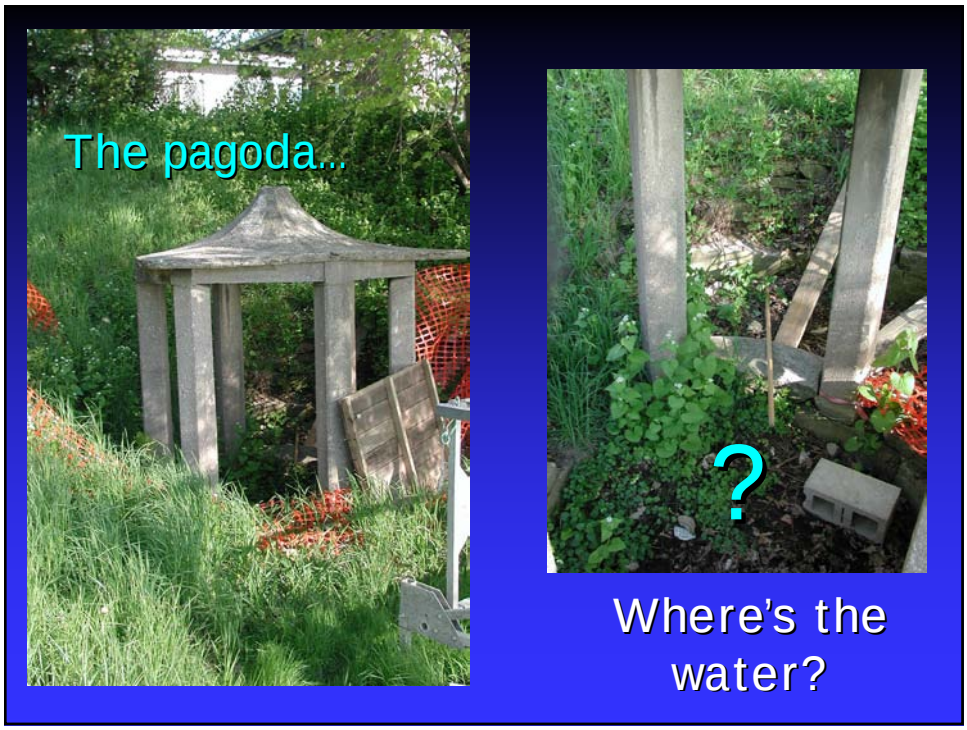
Wisconsin Geological and Natural History Survey, UWEX

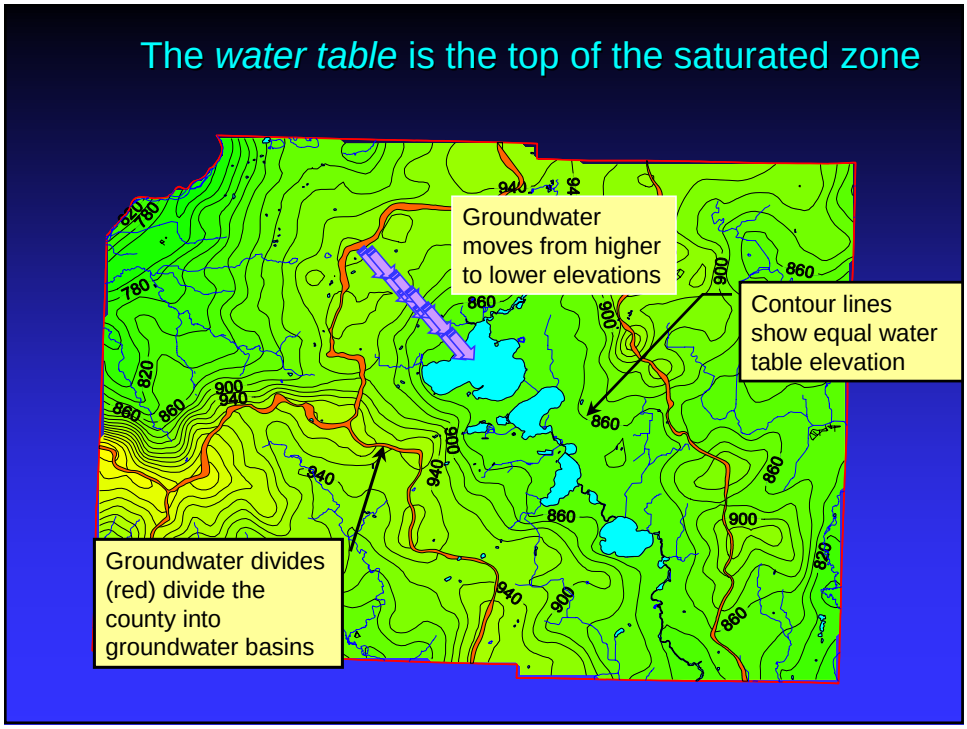

Summary
•Groundwater is an integral part of the water budget of the Madison lakes system
•Historically, the lakes were sinks (discharge points) for groundwater
•Today, groundwater pumping has dramatically altered the groundwater budget of the lakes, and the lakes lose water to the groundwater system

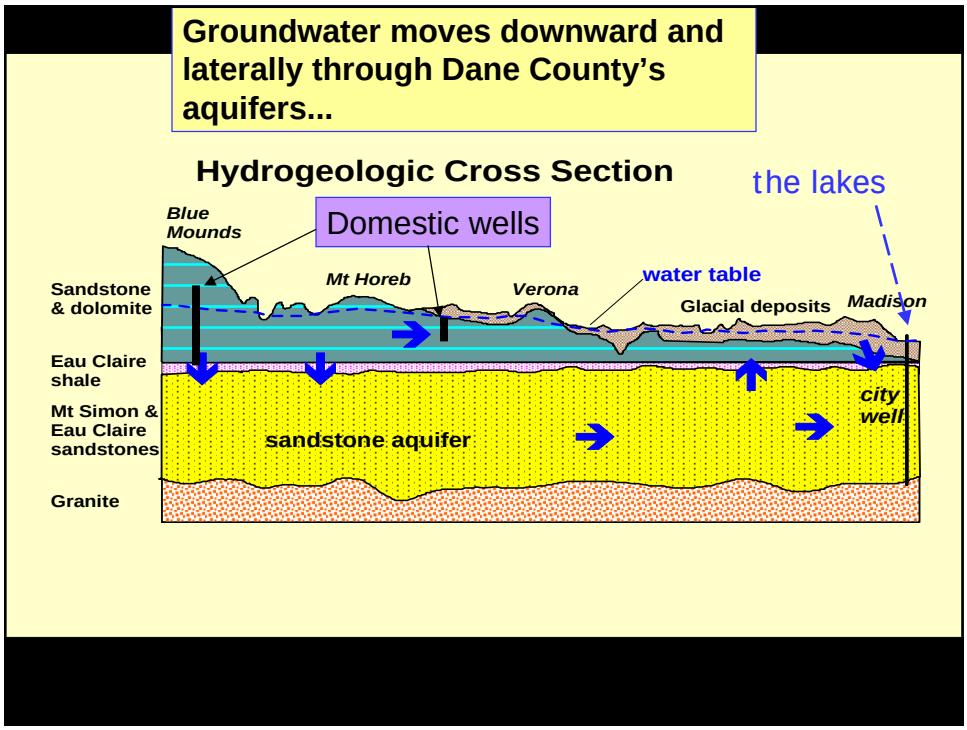
Lake Monona

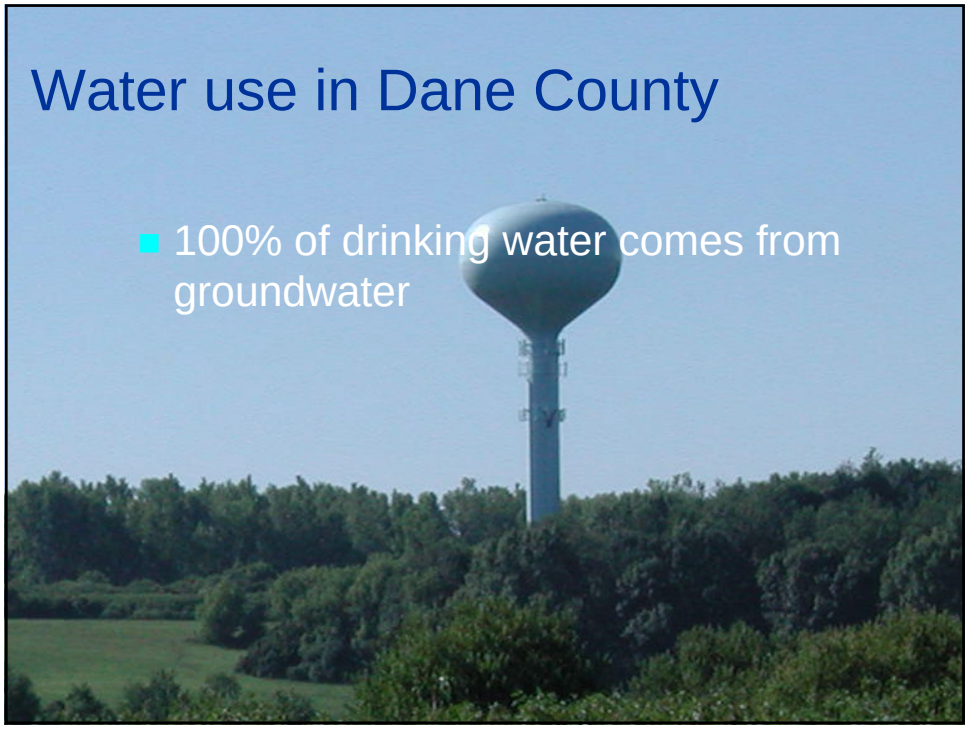
Dane county…
Stonebridge Park…

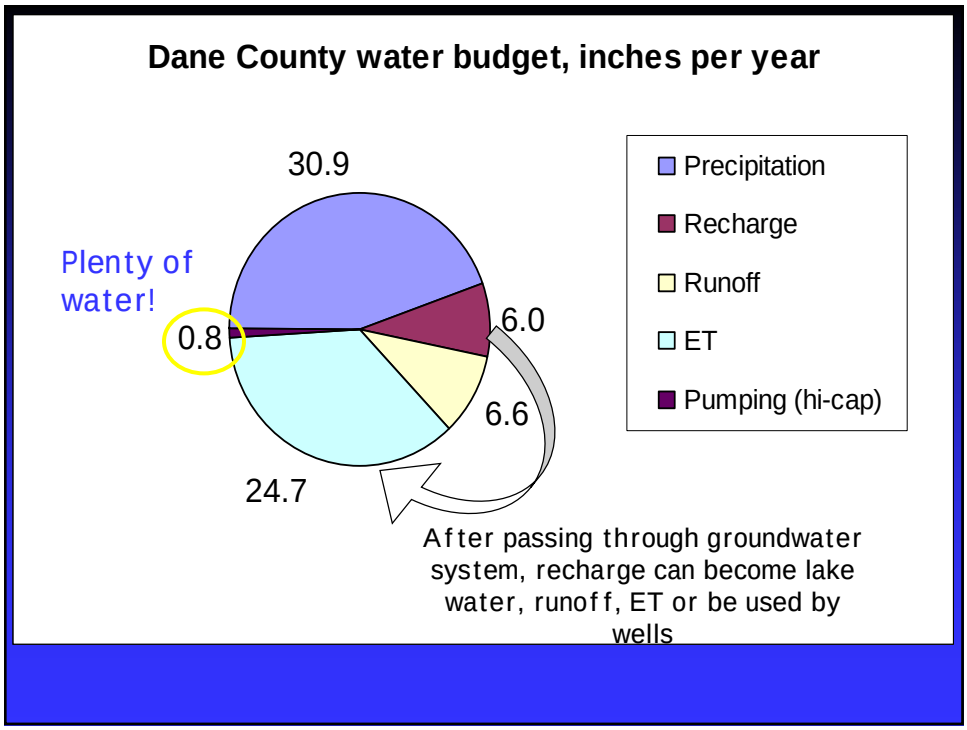

SPRINGHAVEN PAGODA
This was built in the late 1800's to protect the natural spring water in Springhaven, the farm of Judge E. W. Keyes. Later the clear water was used by area children to make lemonade for their picnics, held in what is now Stonebridge Park.
Monona Landmarks Commission and
Harold Homburg Family


The pagoda…
?
Where's the water?


The *water table* is the top of the saturated zone
Groundwater moves from higher to lower elevations
Contour lines show equal water table elevation
Groundwater divides (red) divide the county into groundwater basins

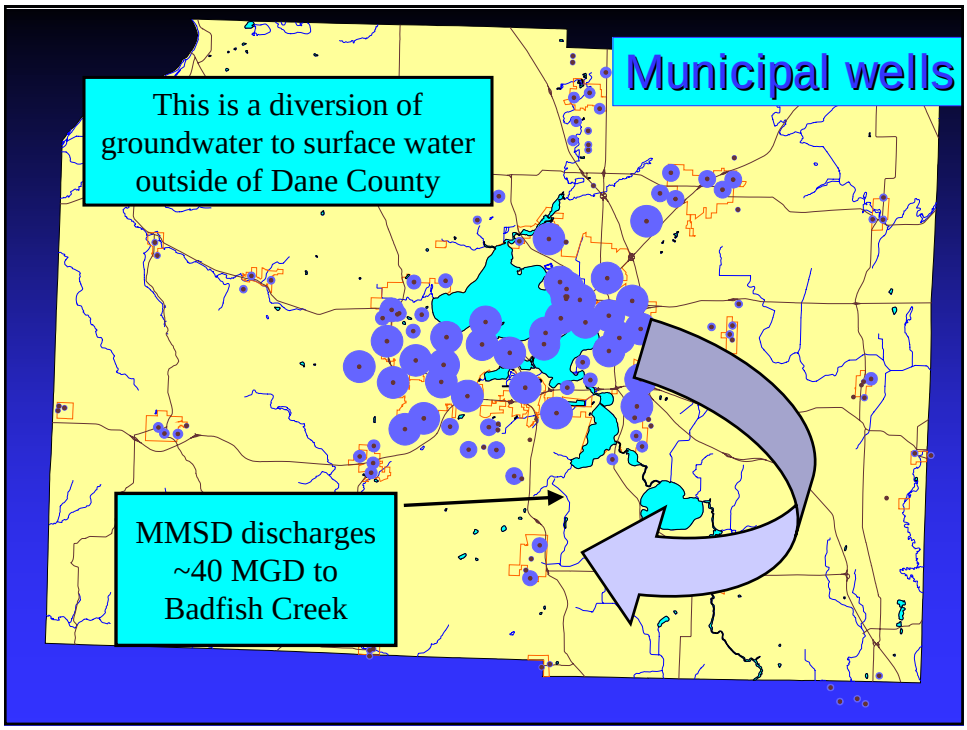

Groundwater moves downward and laterally through Dane County's aquifers...
Hydrogeologic Cross Section
the lakes
Blue Mounds
Domestic wells
Mt Horeb
Verona
water table
Glacial deposits
Madison
Sandstone & dolomite
Eau Claire shale
Mt Simon & Eau Claire sandstones
Granite
sandstone aquifer
city well

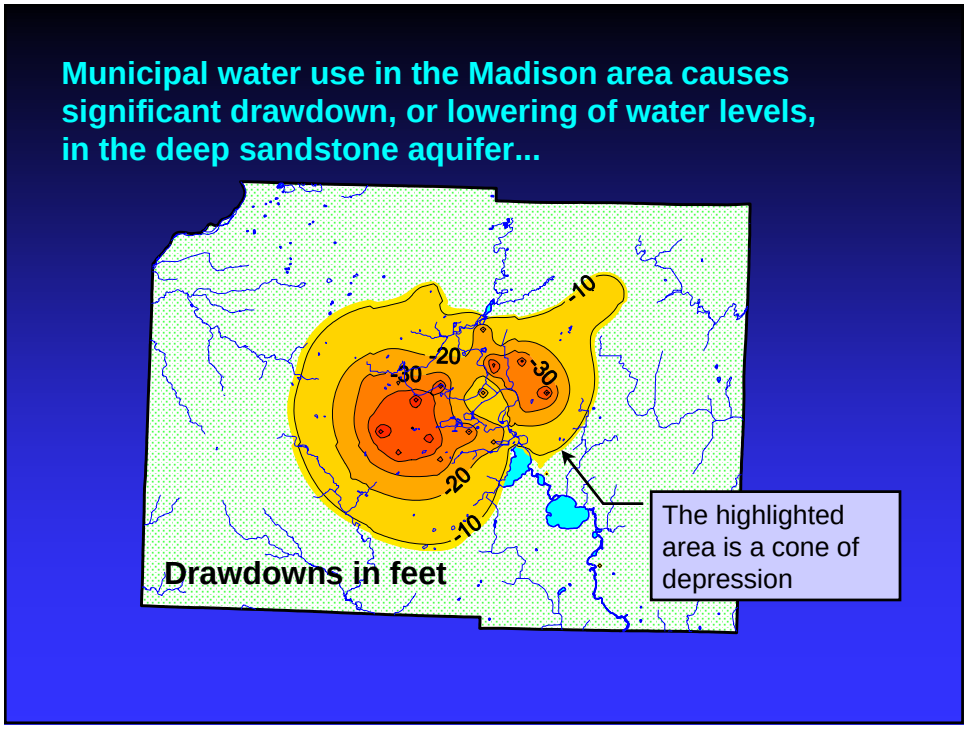

Water use in Dane County
100% of drinking water comes from groundwater

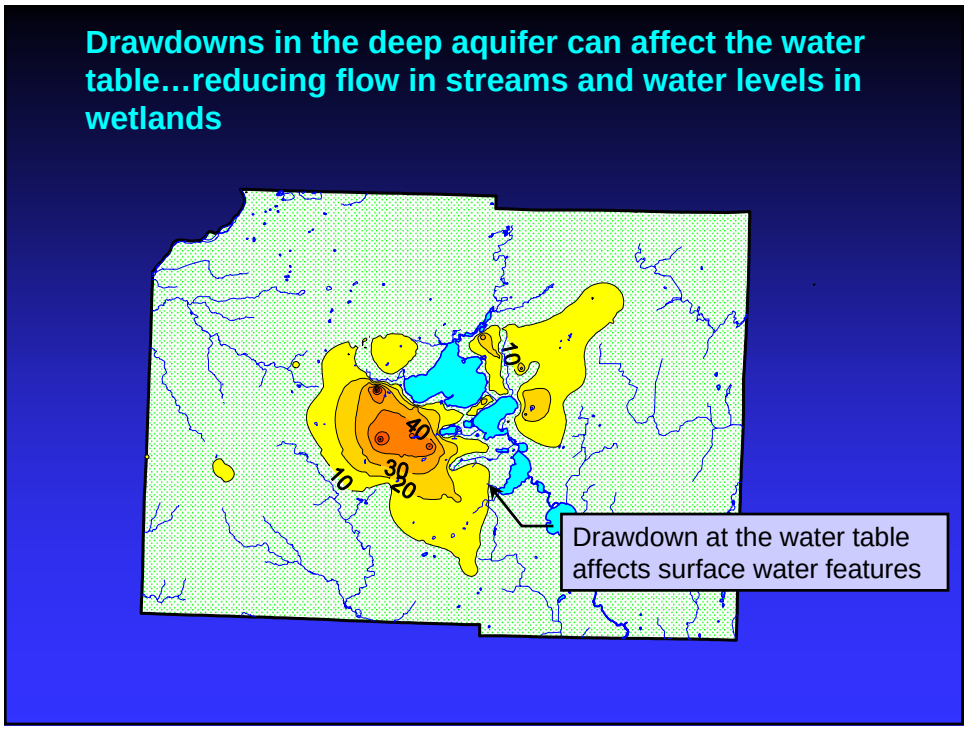

Dane County water budget, inches per year
30.9
6.0
6.6
24.7
0.8
Plenty of water!
Precipitation
Recharge
Runoff
ET
Pumping (hi-cap)
After passing through groundwater system, recharge can become lake water, runoff, ET or be used by wells

Groundwater use in Dane County

- Municipal and Industrial water use:
  - About 50 million gallons per day (MGD)
  - 0r…about 75 cubic feet per second (CFS)
- For comparison:
  - Wingra Creek at Beld St: ~2 CFS
  - Badger Mill Creek at Verona: ~13 CFS
  - Black Earth Creek at Black Earth: ~27 CFS



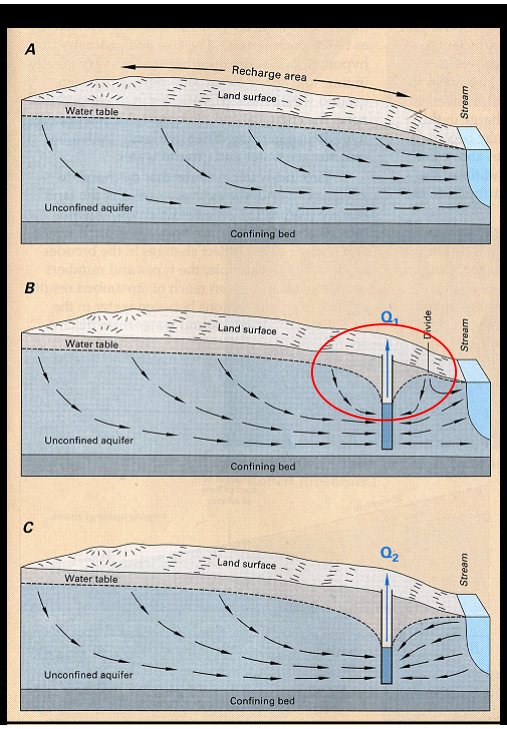

Municipal water use in the Madison area causes significant drawdown, or lowering of water levels, in the deep sandstone aquifer...
-10
-20
-30
-30
-20
-10
Drawdowns in feet
The highlighted area is a cone of depression


Drawdowns in the deep aquifer can affect the water table…reducing flow in streams and water levels in wetlands
10
40
30
20
10
Drawdown at the water table affects surface water features

Pumping wells affect groundwater movement

The well causes a cone of depression

Well pumping can reduce flow to surface water



Lake groundwater budgets

Lake	historic	current	change	pct change
	(cfs)	(cfs)	(cfs)	
Mendota	23.9	4.4	-19.5	-82%
Monona	8.7	-1.5	-10.2	-117%
Waubesa	10.3	6.5	-3.8	-37%
Kegonsa	10.2	8.8	-1.4	-14%
Wingra	3.3	1.2	-2.1	-64%
total	*56.4*	*19.4*	*-37*	*-66%*

Simulated changes in direct groundwater contribution to Madison Lakes resulting from onshore pumping *(note that total Dane Co pumping is about 75 CFS)*

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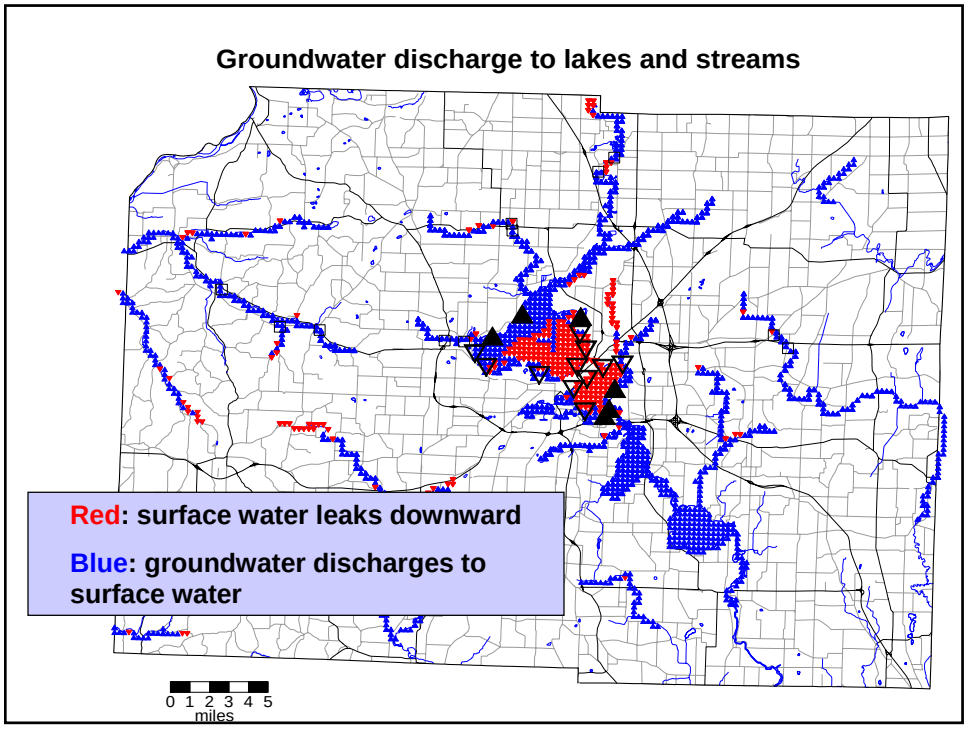
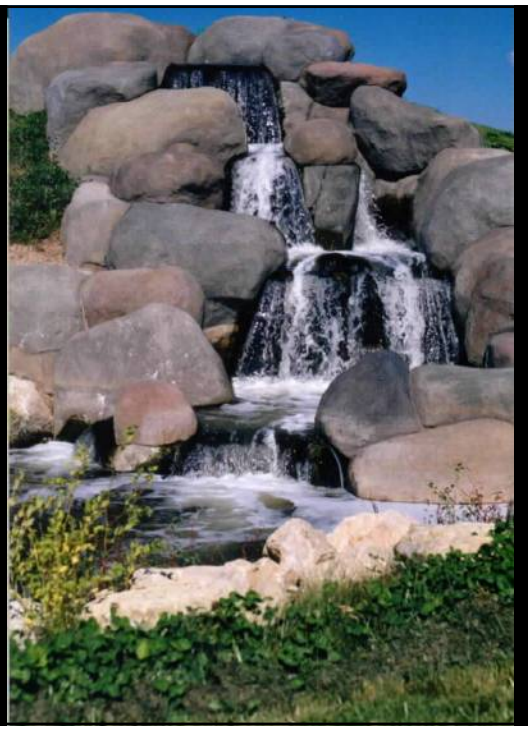


Drawdown could be alleviated, in part, by returning water to the basin

Treated effluent return flow to Badger Mill Creek near Verona



Summary

- Pumping is influencing *lake budgets*
- Increased lakebed seepage has little impact on lake levels, but does affect downstream baseflow in the Yahara River
- Long-term water management should emphasize returning effluent to the basin and promoting groundwater recharge

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