Wisconsin Geological
and Natural History Survey
DIVISION OF EXTENSION
UNIVERSITY OF WISCONSIN–MADISON

Groundwater and geology of Dane County

November 18, 2025

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Wisconsin Geological and Natural History Survey (WGNHS)

- WGNHS provides objective scientific information about the geology, mineral resources, and water resources of Wisconsin

- 660,000 linear feet of rock cores
- 2.7M linear feet of rock cuttings

Outline

- Introduction to groundwater
- Dane County geology & aquifers
- Groundwater susceptibility to contamination
- Resources for private well owners

Introduction to groundwater

Groundwater and geology of Dane County

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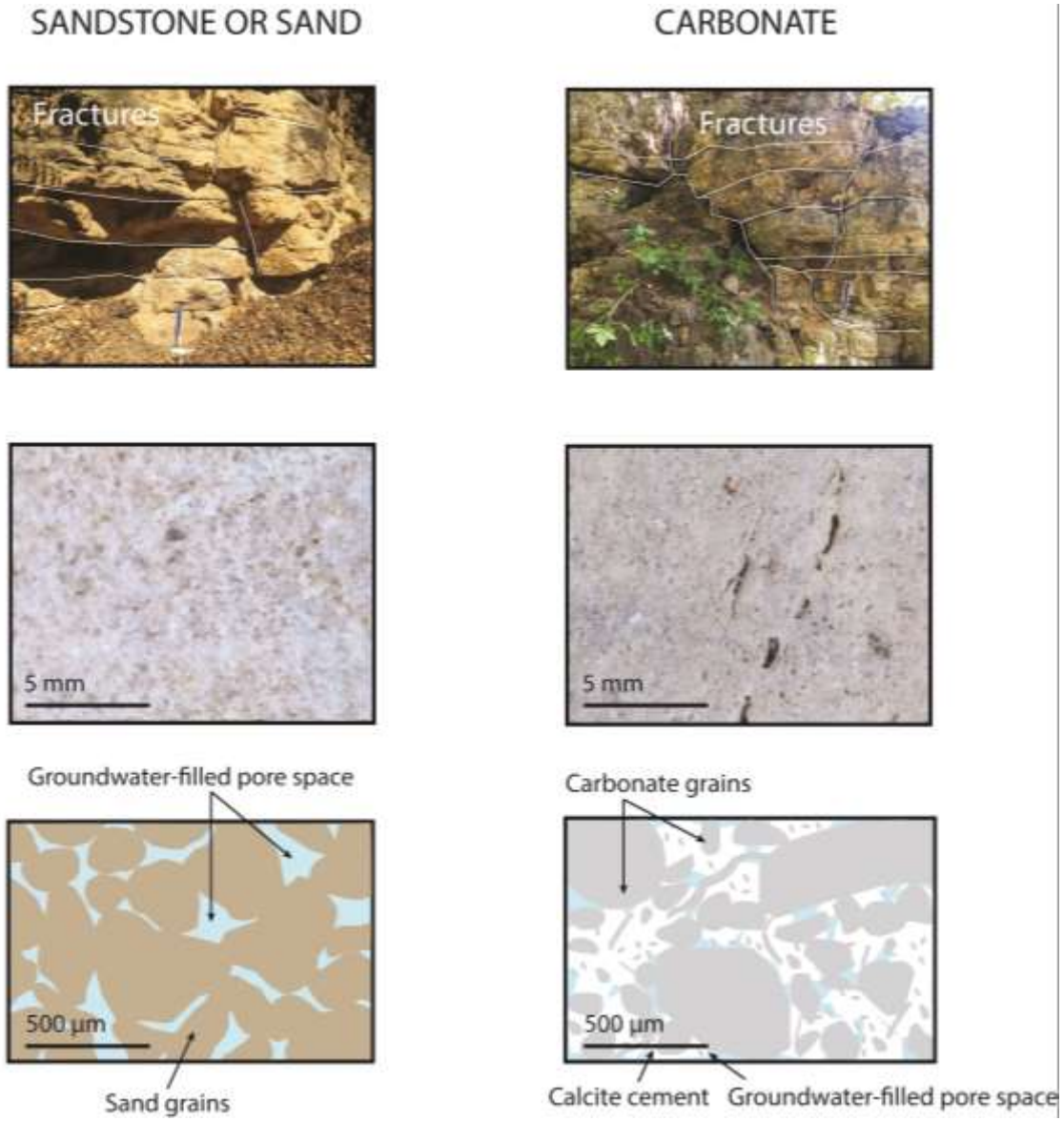
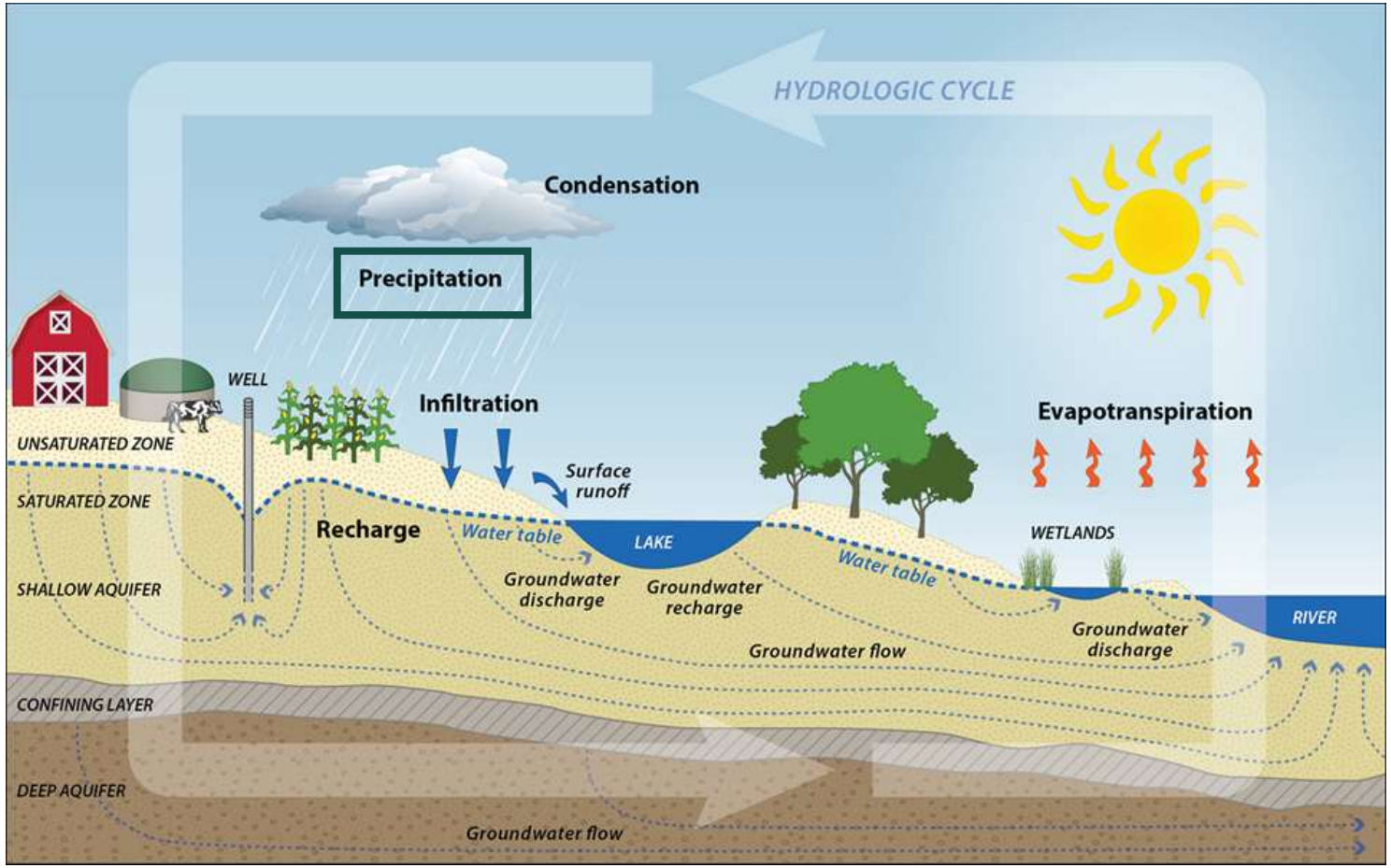
What is groundwater?

- *Groundwater* is water filling pores, cracks, fractures, and other voids in geologic materials beneath the land surface



Groundwater is part of the water cycle



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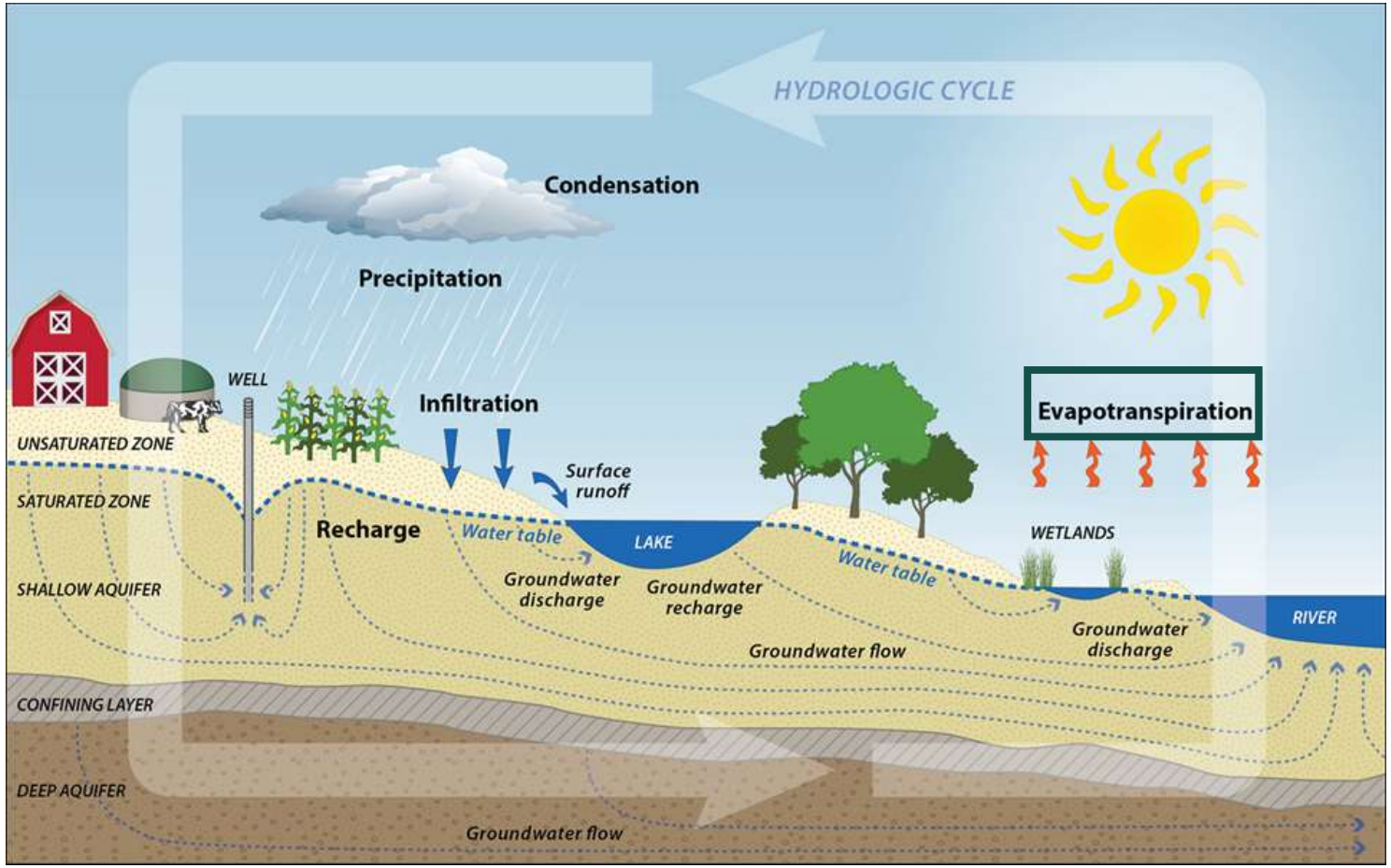

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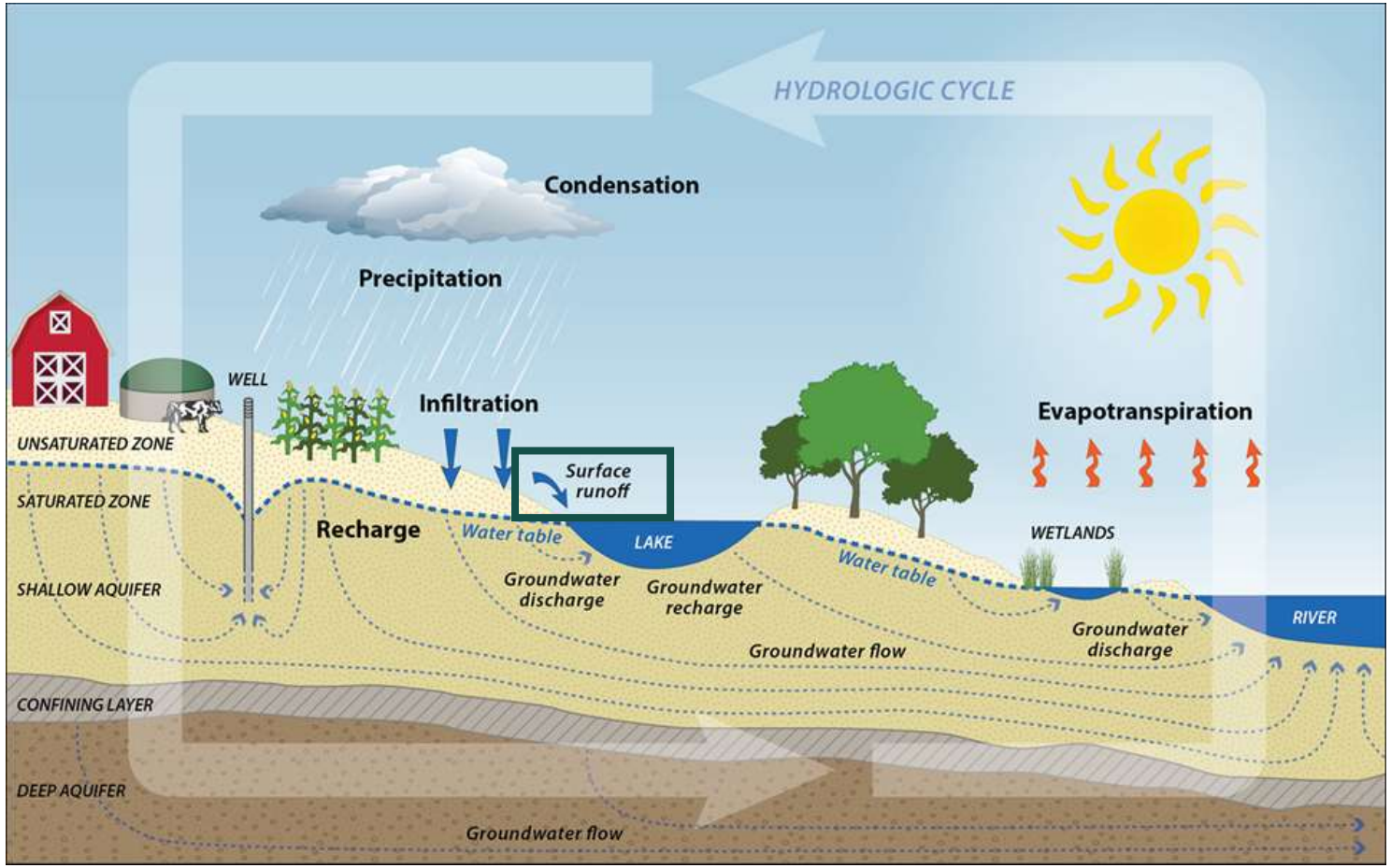

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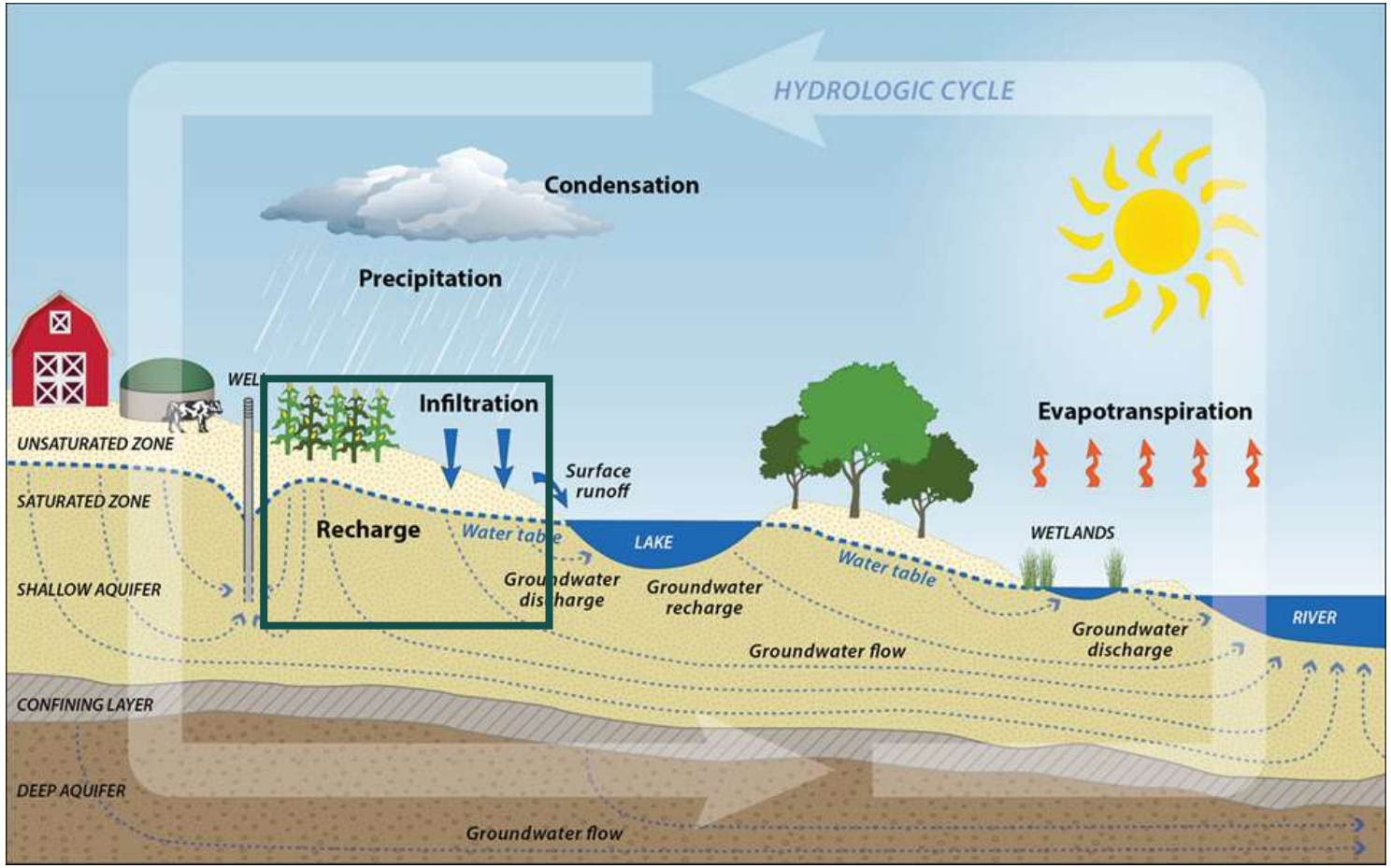

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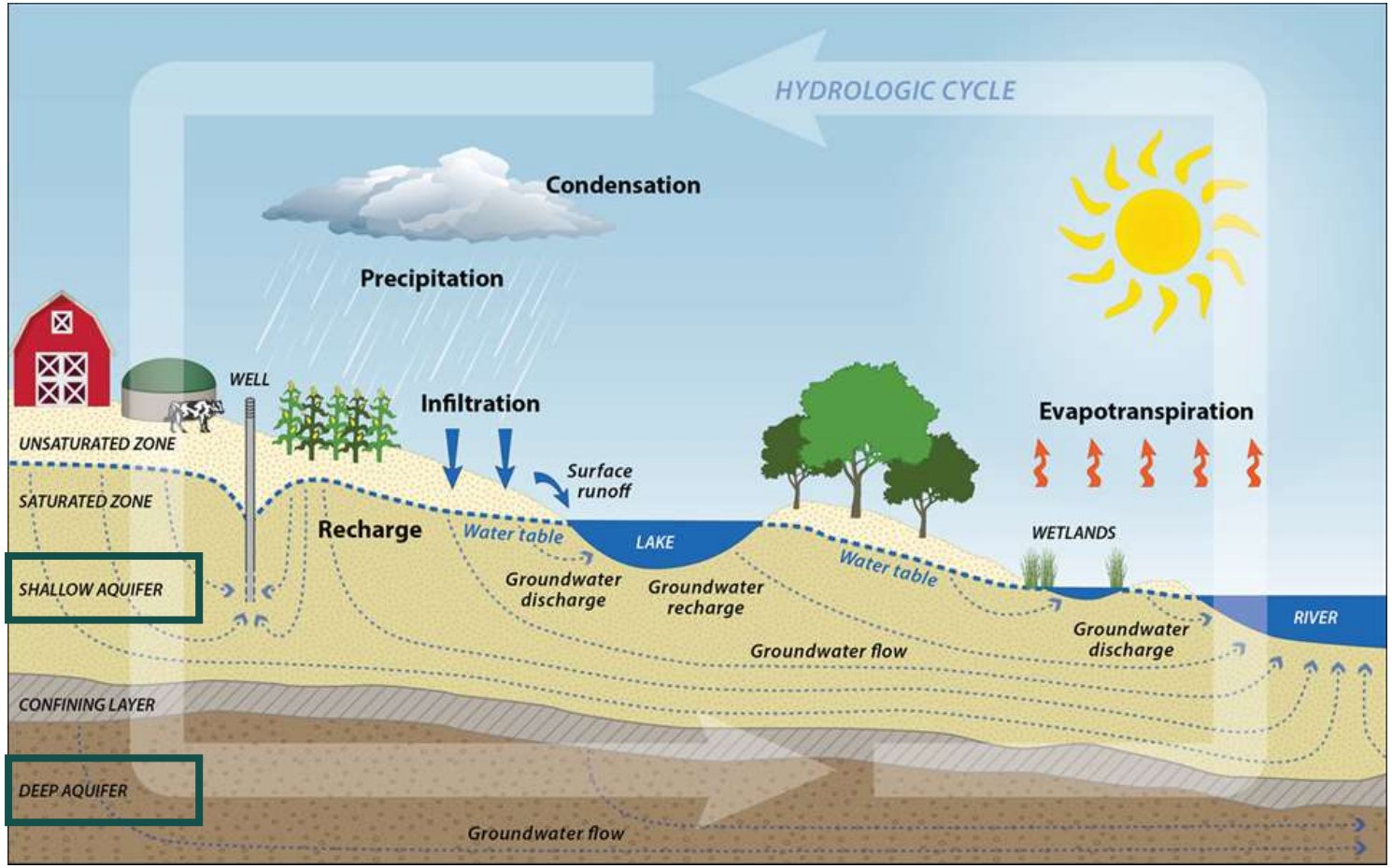
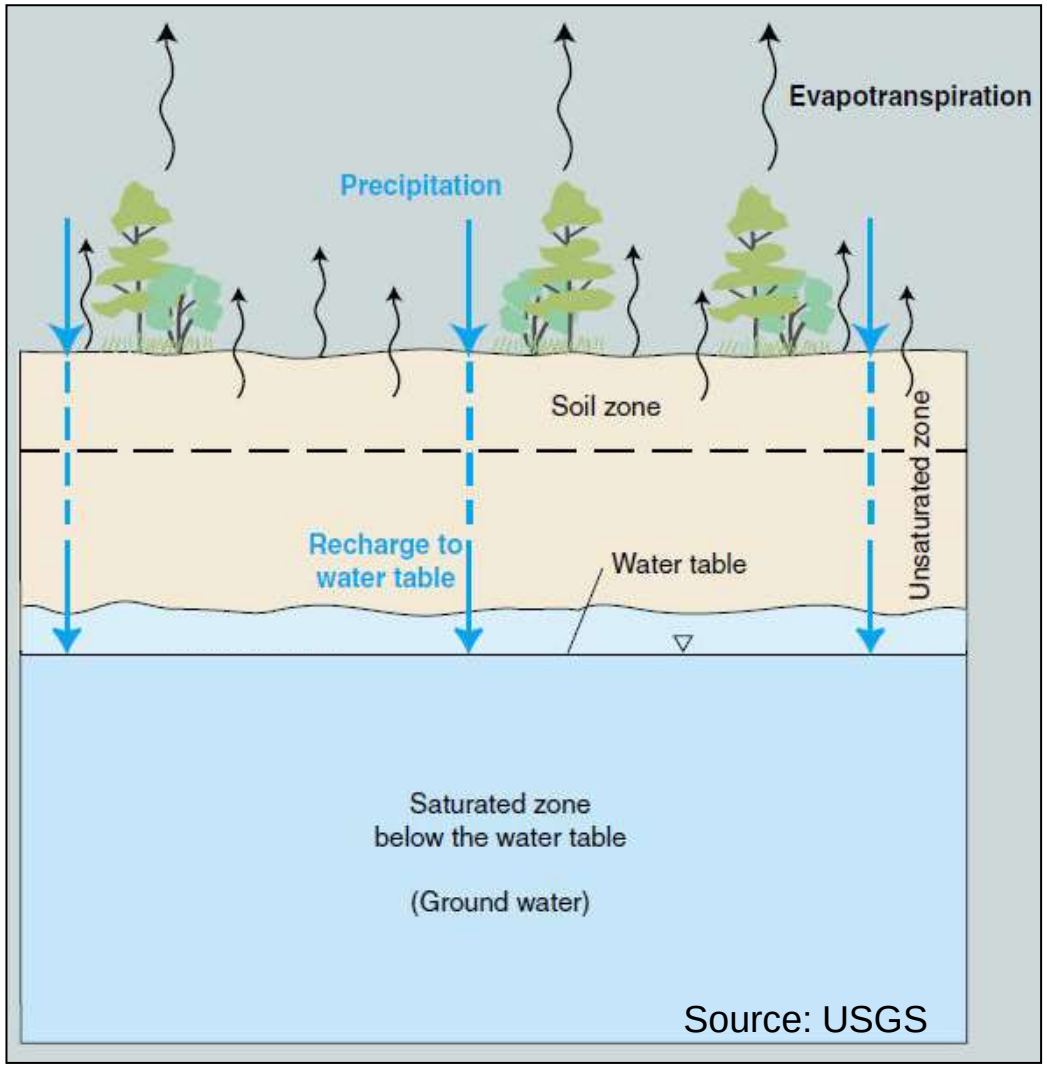


- *Aquifers* are geologic layers that store and transmit useable quantities of groundwater

The water table marks the top of groundwater

- *Groundwater recharge* is water that soaks into the ground and makes it to the water table
- Most recharge occurs during spring snowmelt



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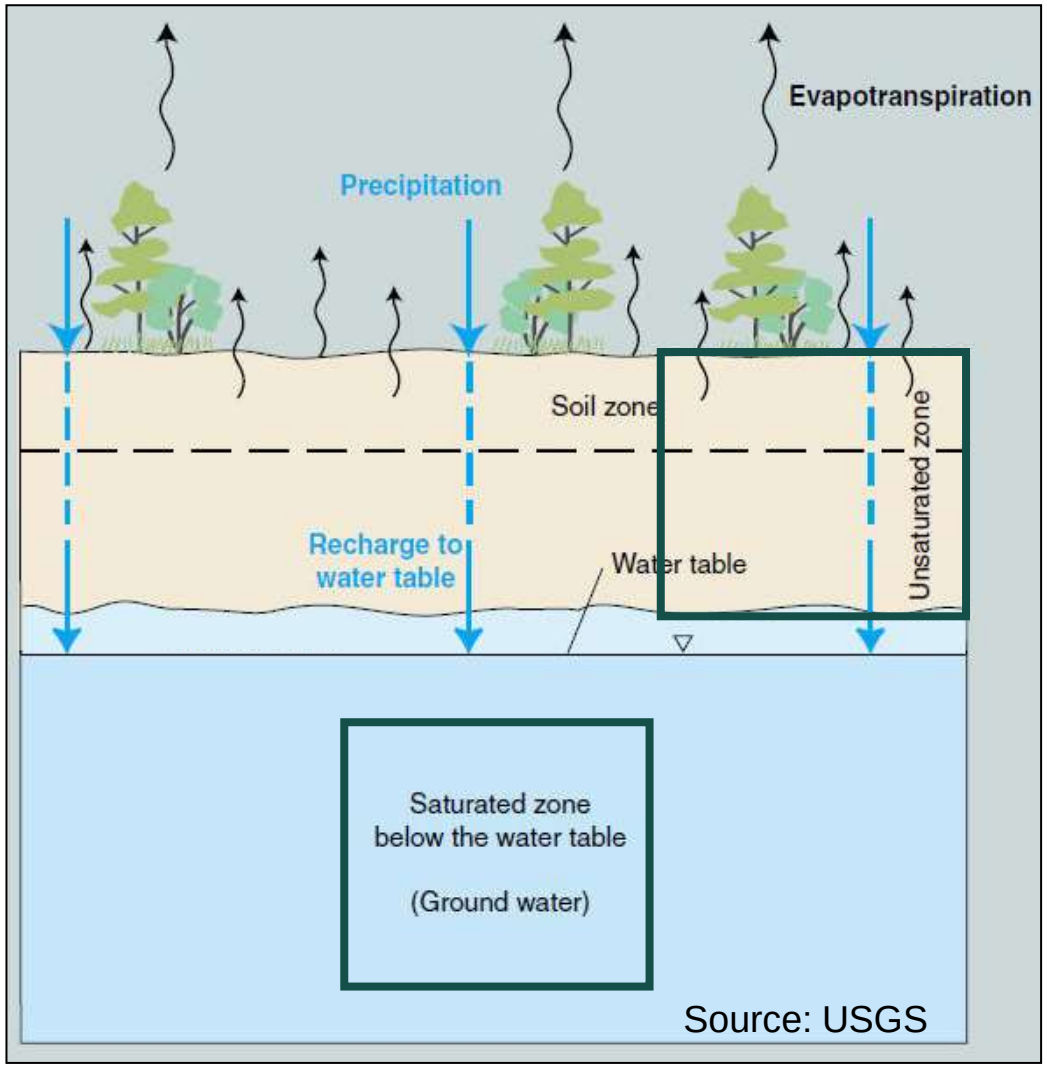

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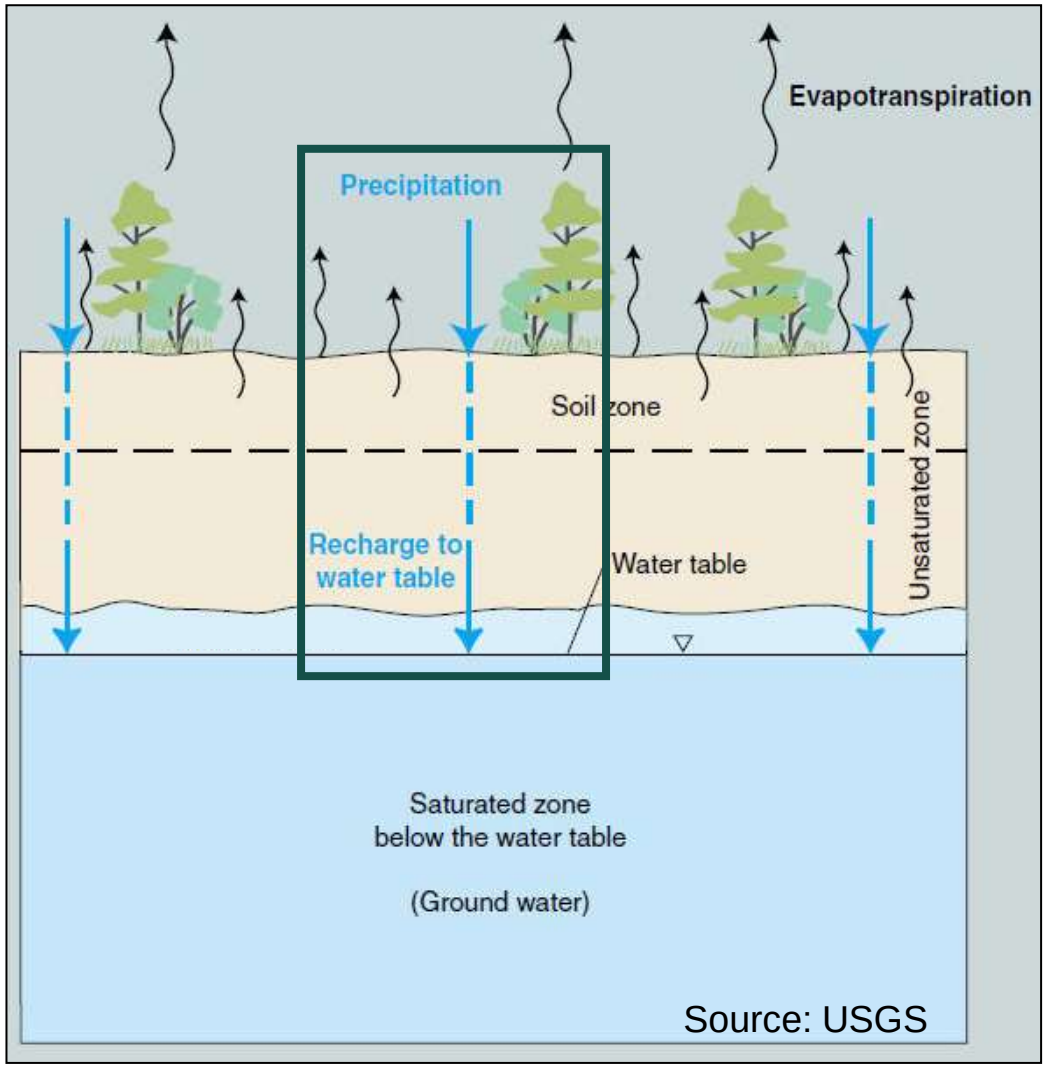
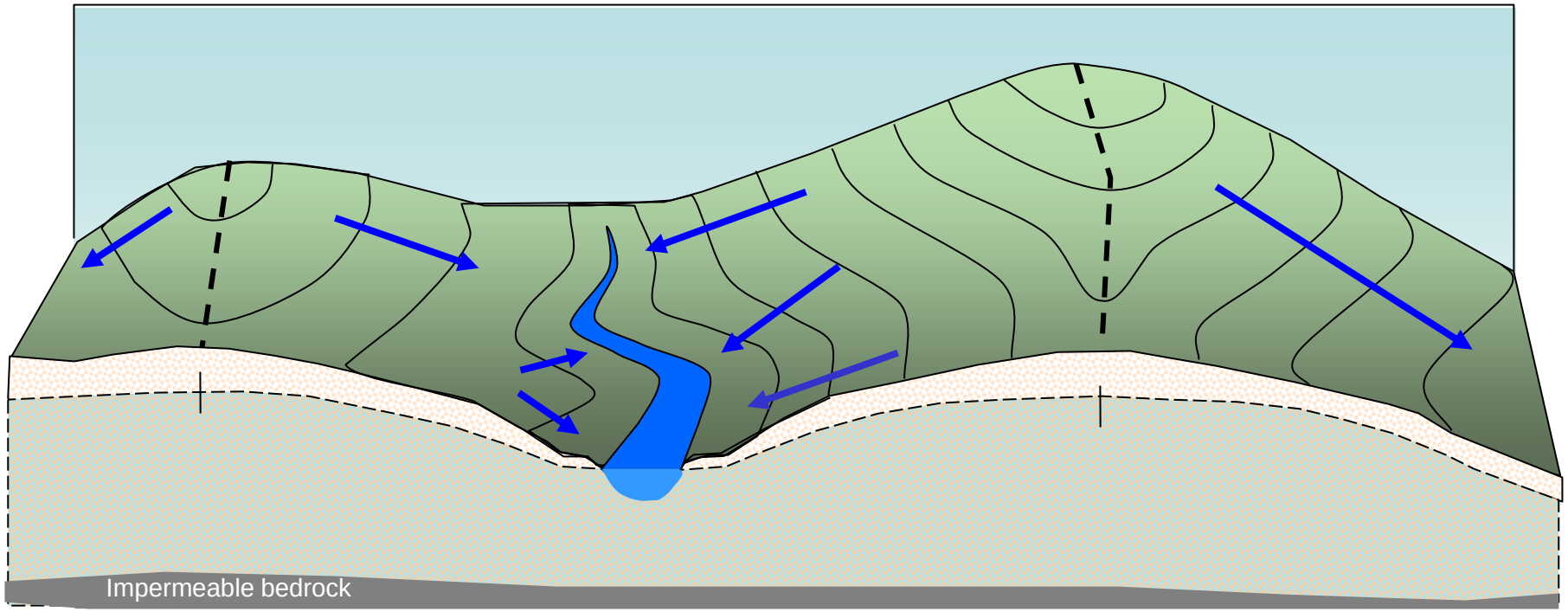


Groundwater moves from high to low elevations



Source: UW-Madison Division of Extension

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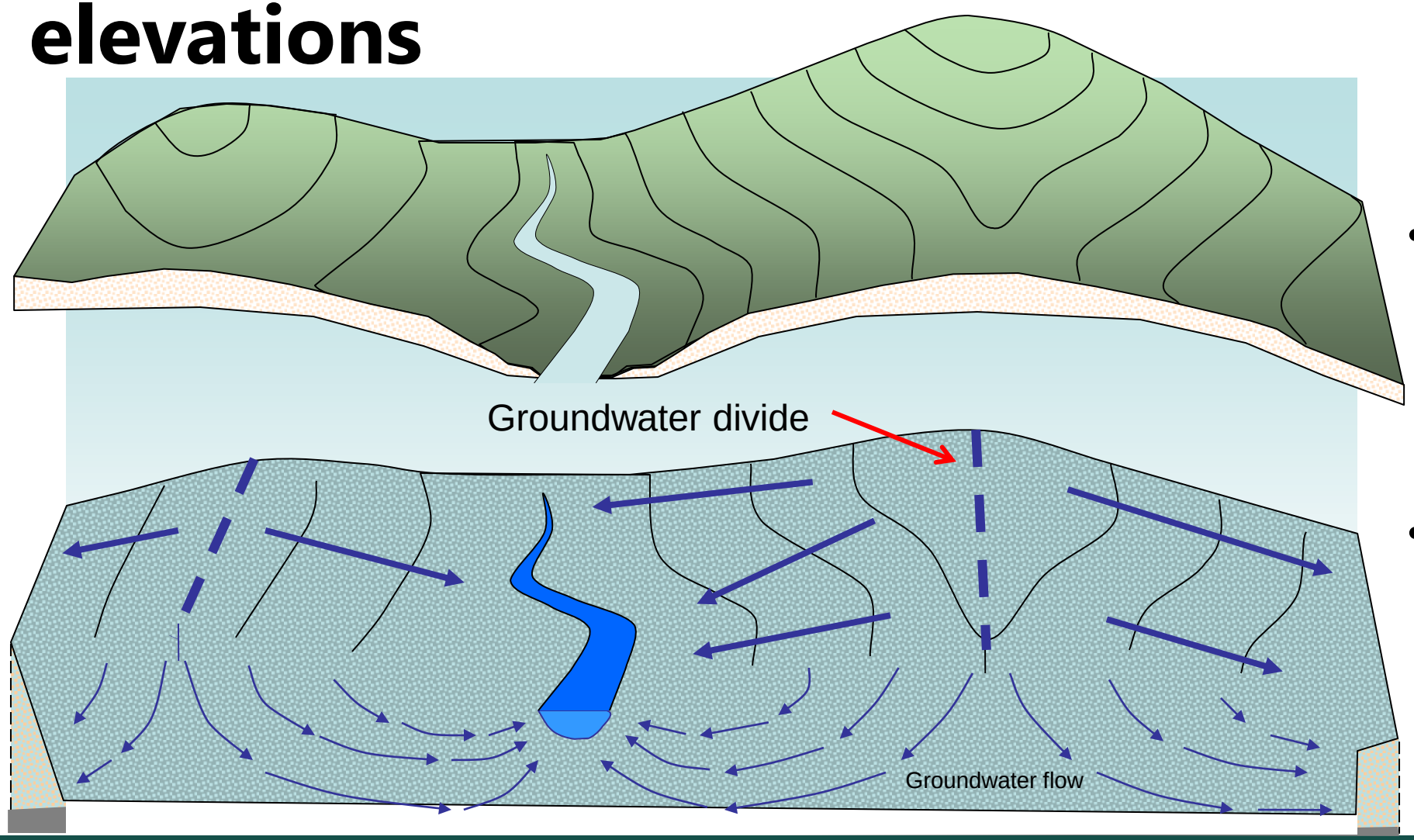
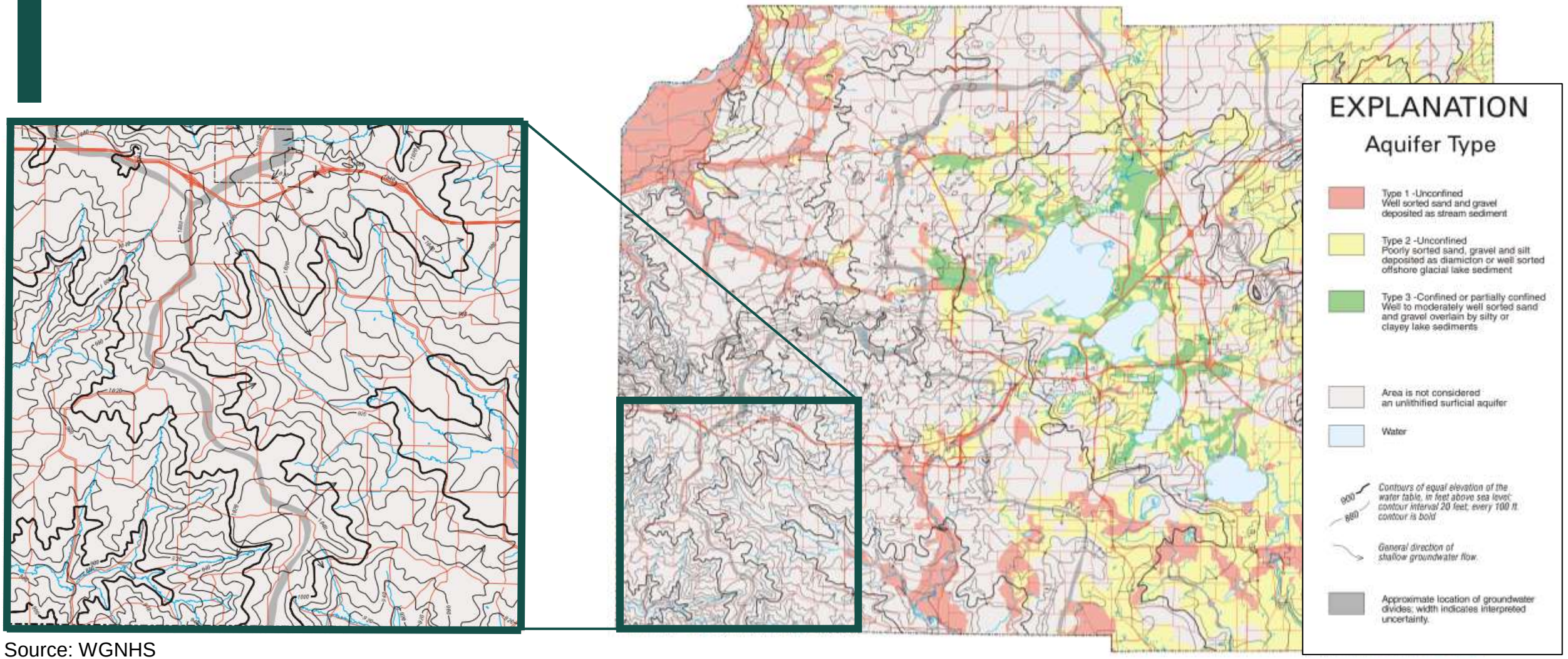


- Flow is perpendicular to lines of equal water table elevation
- Groundwater and surface water are connected!

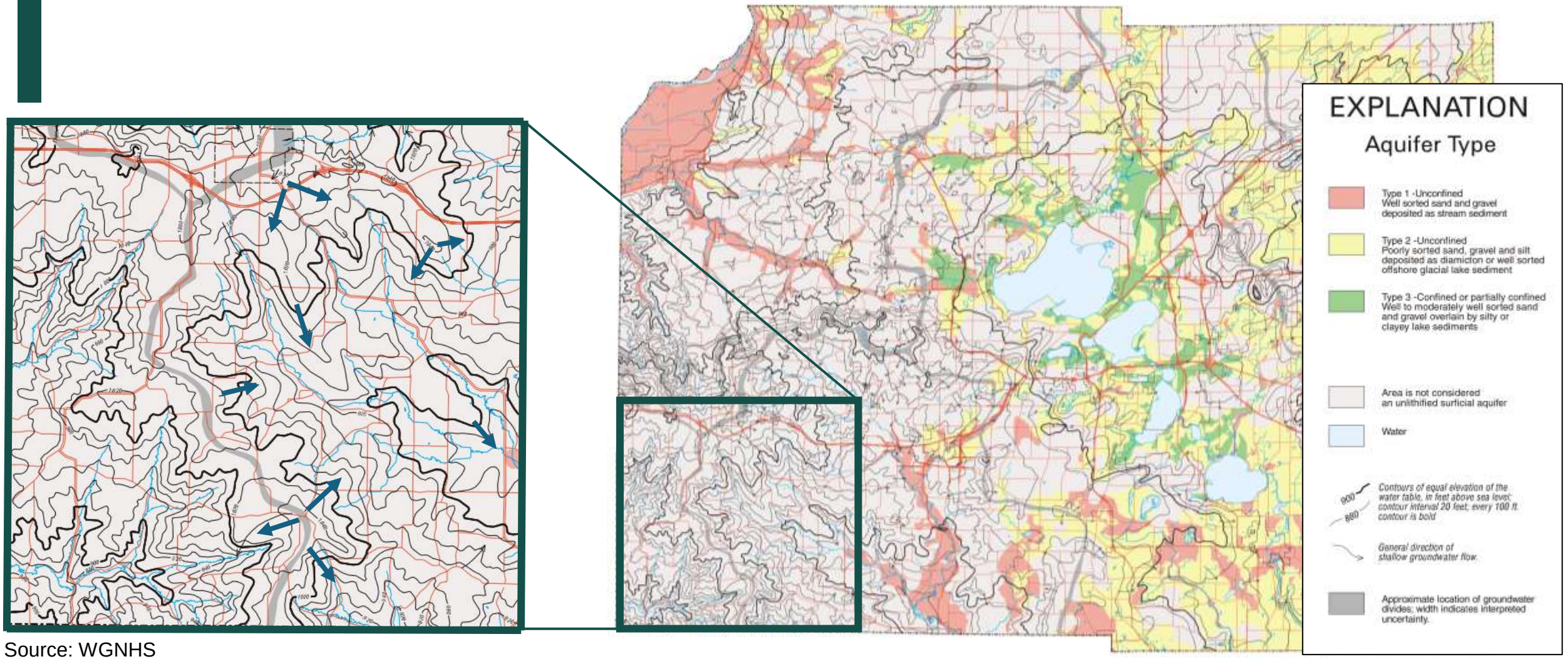
Source: UW-Madison Division of Extension

Water-table maps indicate flow direction



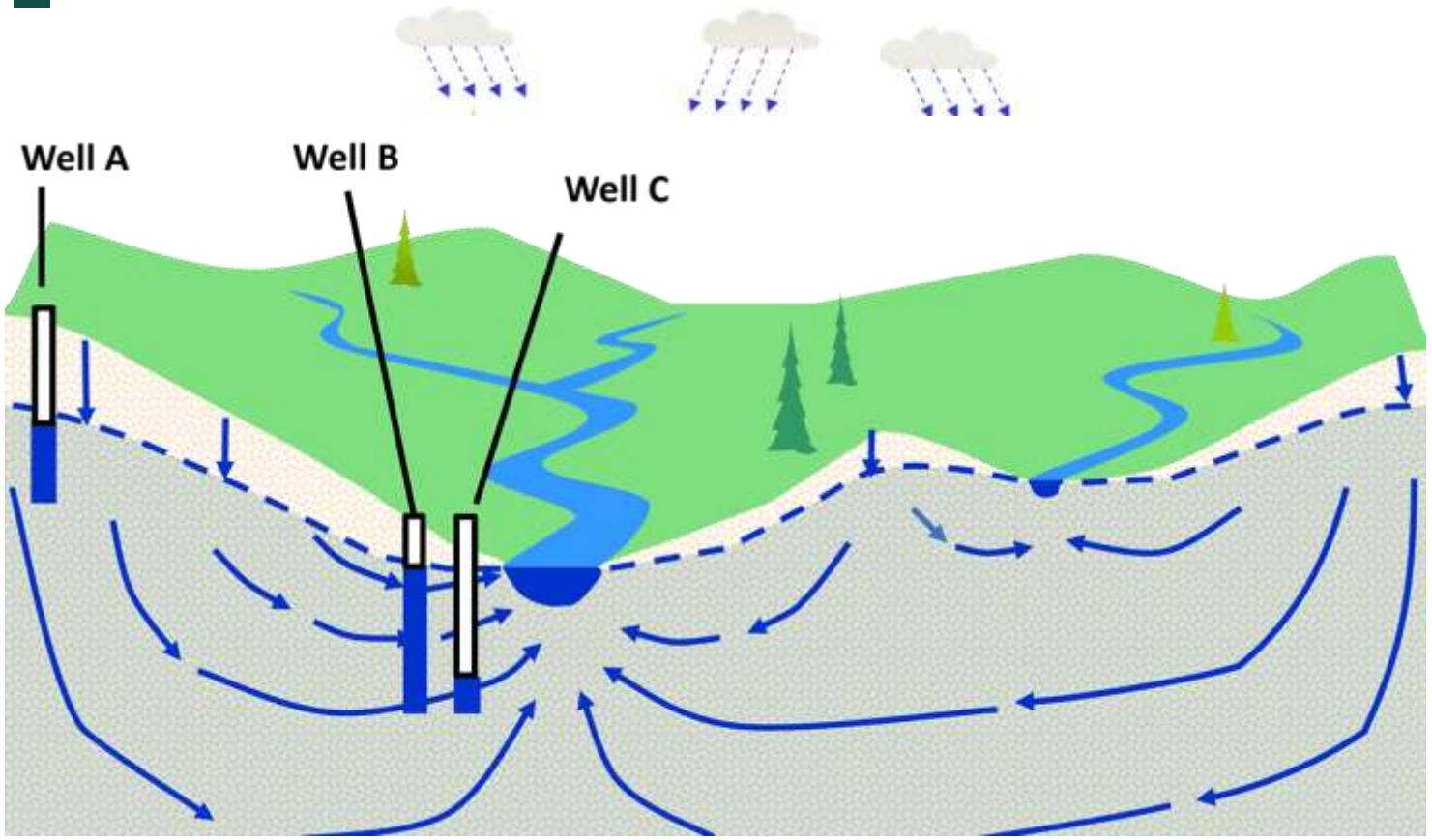
Source: WGNHS

Water-table maps indicate flow direction



Source: WGNHS

Wells are an access point to groundwater



Source: Water WELLness: Managing your private well water system (online guide)

- Well construction information can help determine what part of the aquifer your well is accessing
- Most wells access water that recharged within a few miles of the well

Dane County geology & aquifers

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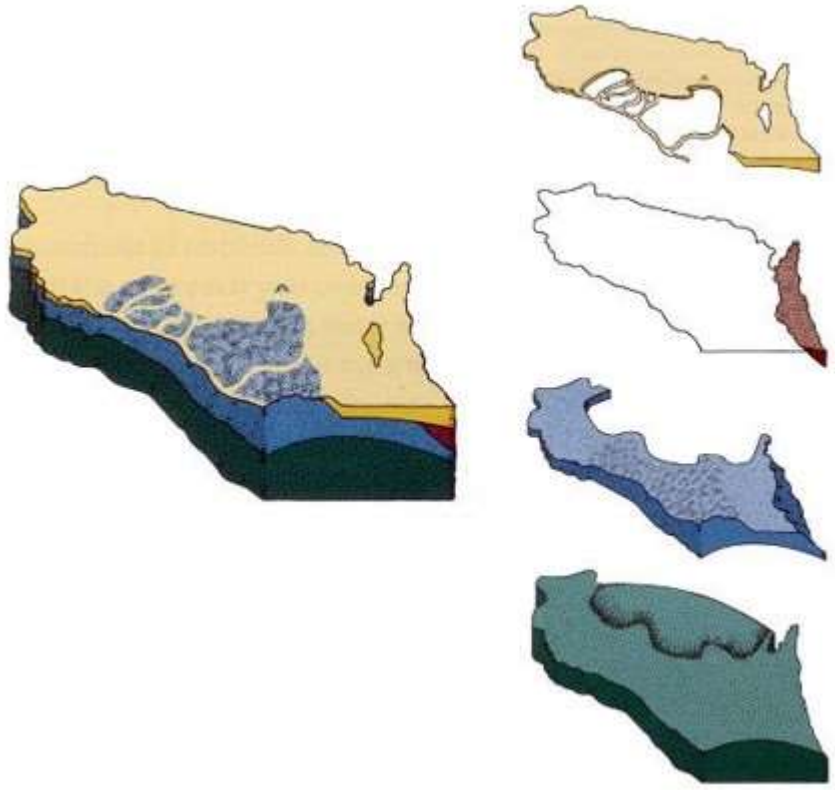
Wisconsin's aquifers



Sand & gravel aquifer

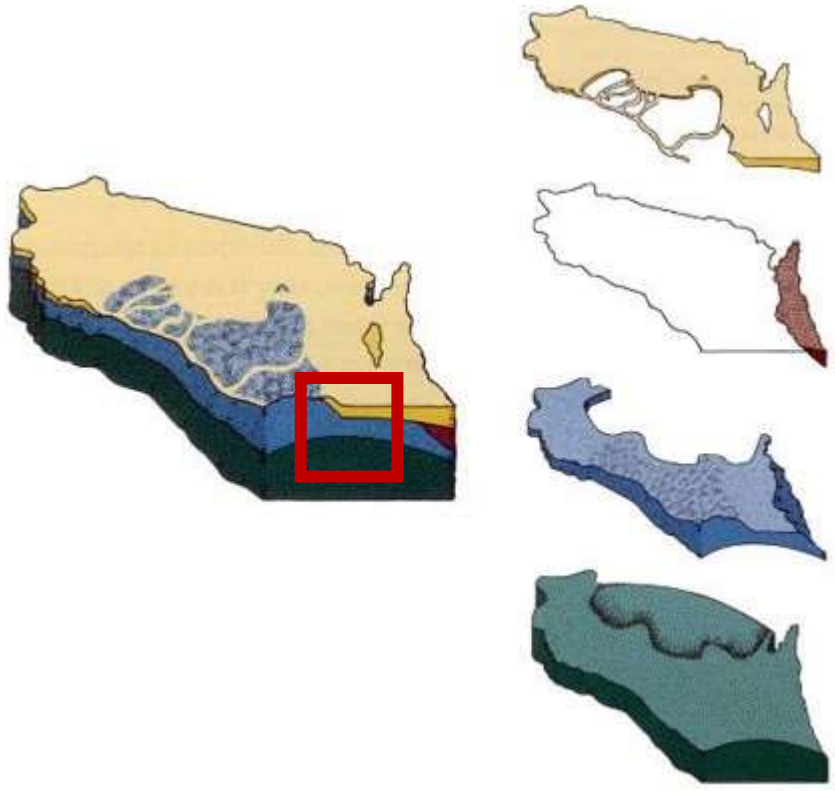
Eastern dolomite aquifer

Sandstone & dolomite aquifer

Crystalline bedrock aquifer

Source: *Wisconsin Natural Resources Magazine*

Wisconsin's aquifers



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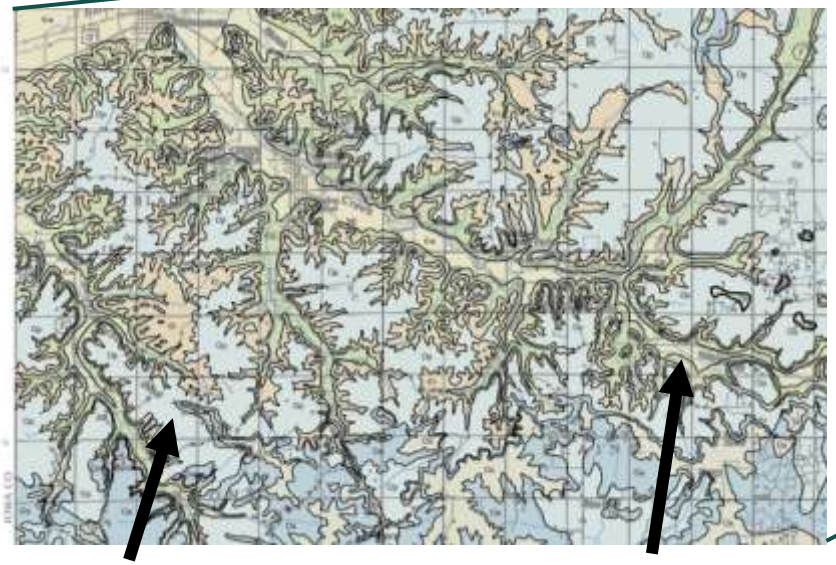
Bedrock geology

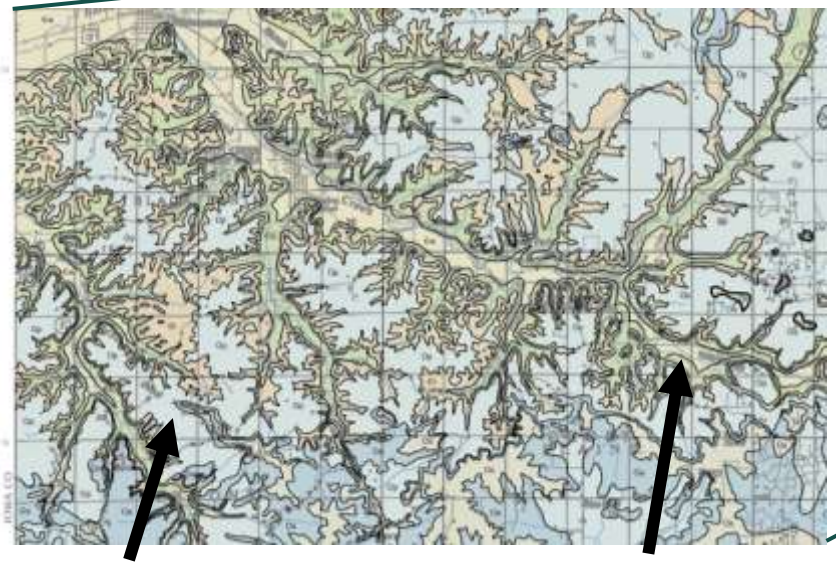


Dolomite Ridges (light blue)

Sandstone valleys (dark brown, green)

Source: WGNHS

Bedrock geology



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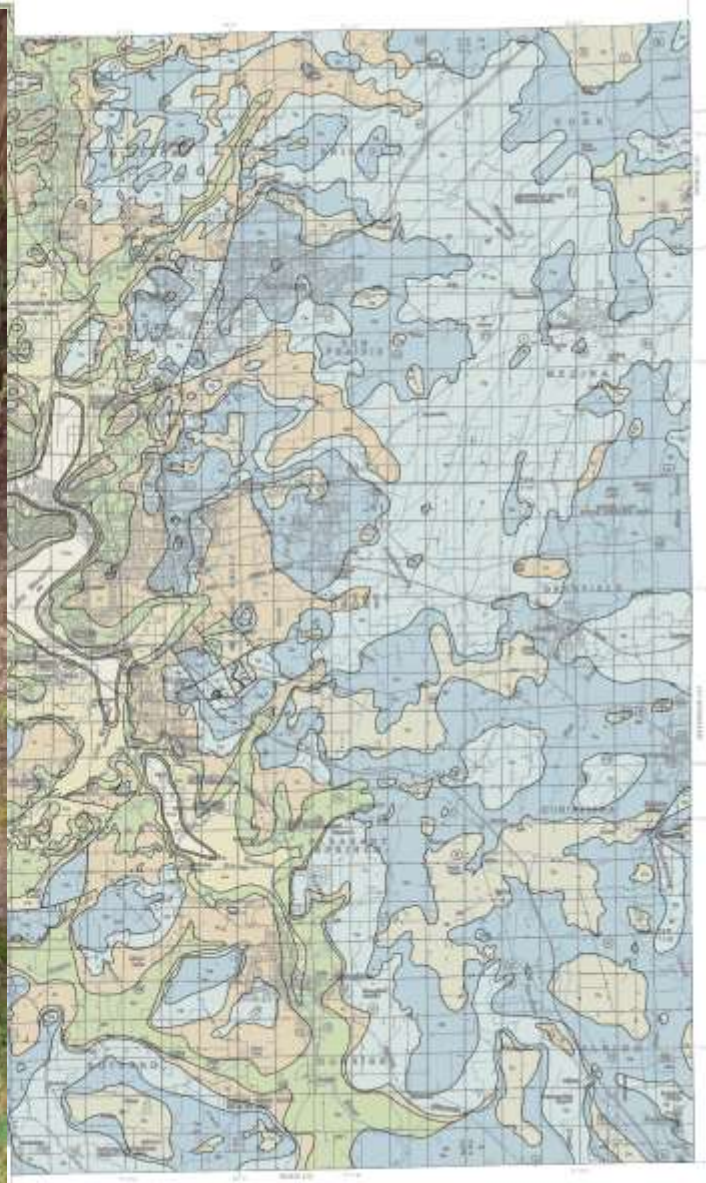
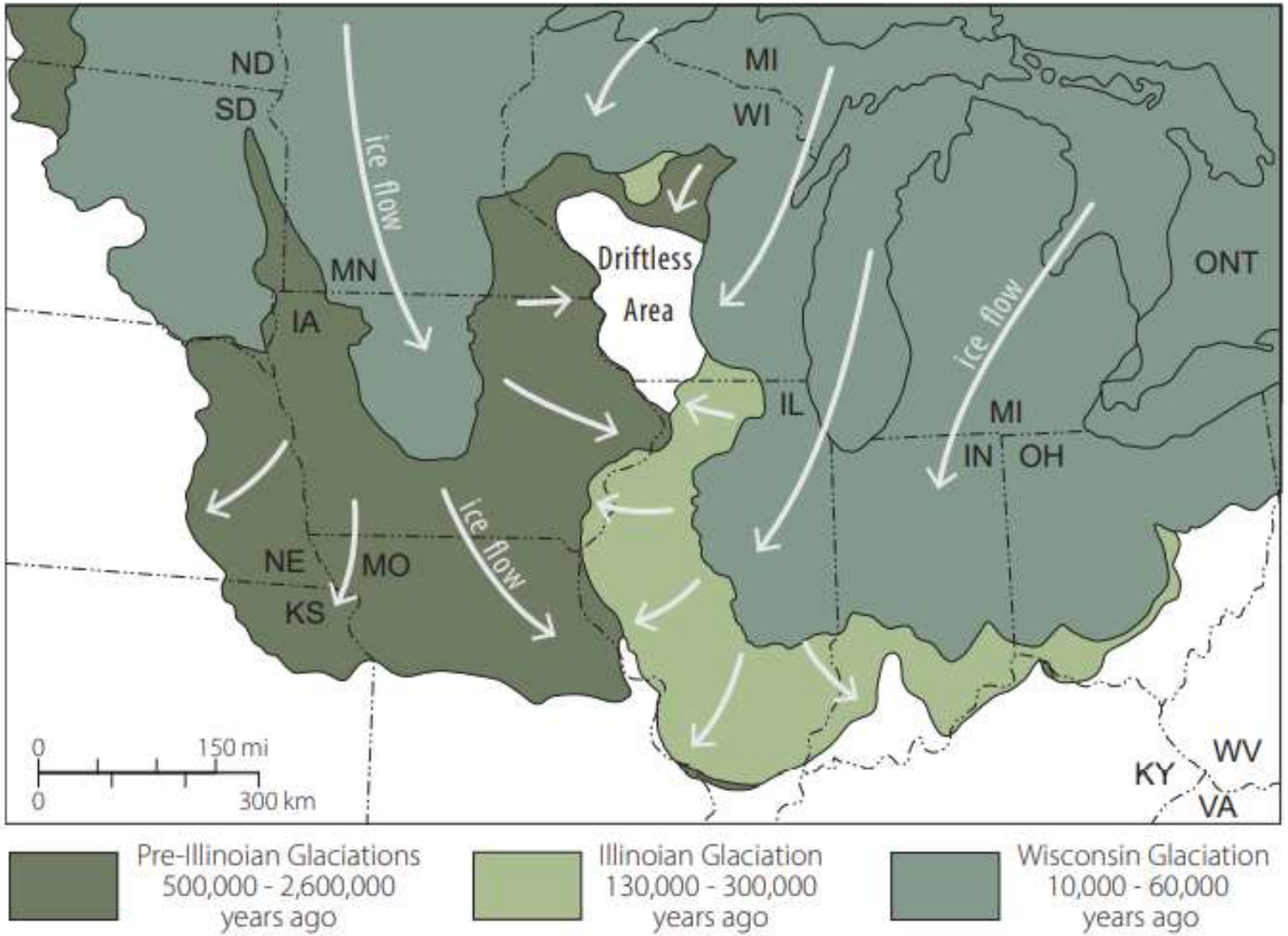
Sandstone valleys (dark brown, green)



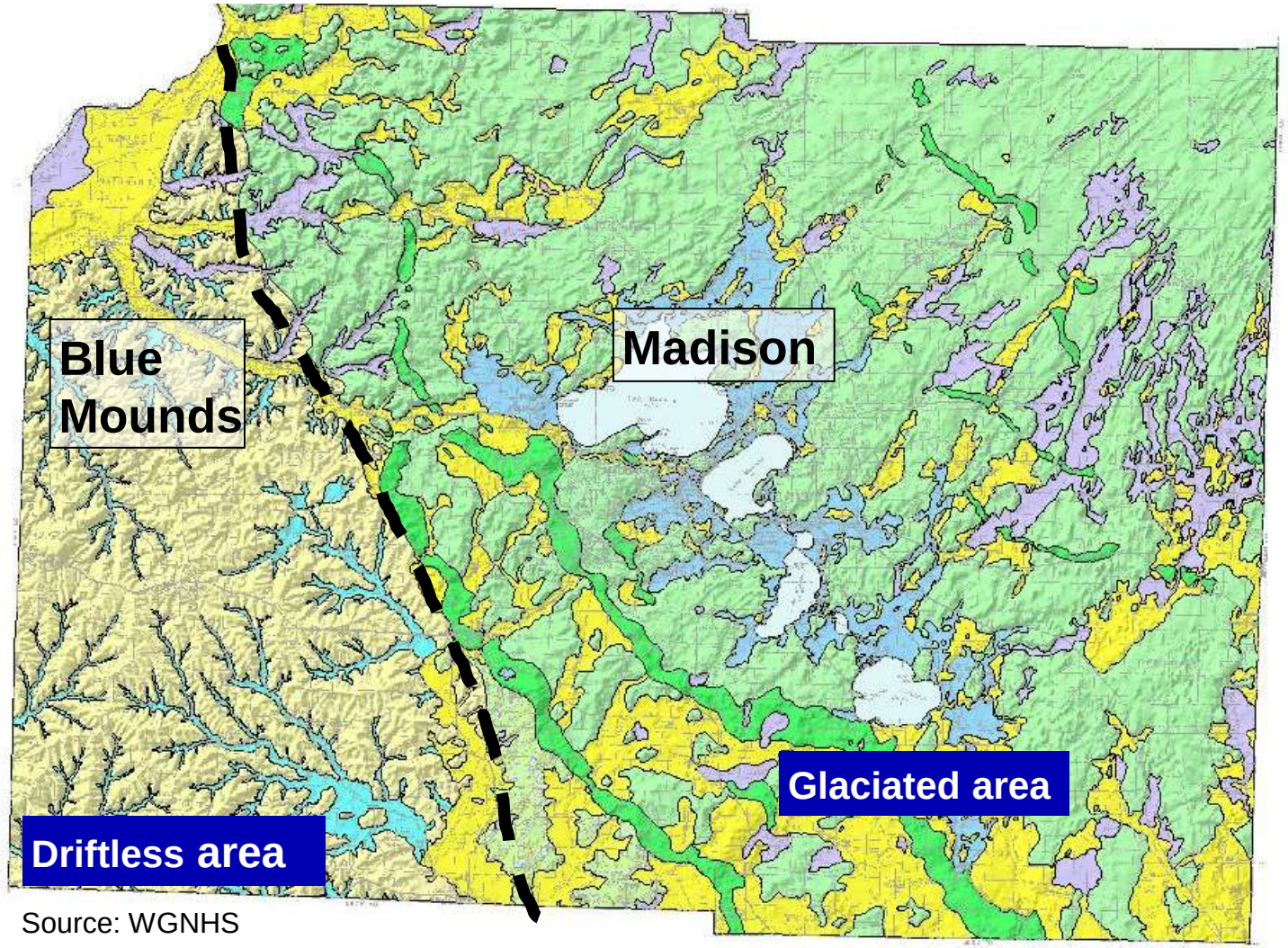
Glaciation history

- Glaciers did not reach the driftless area



Source: WGNHS

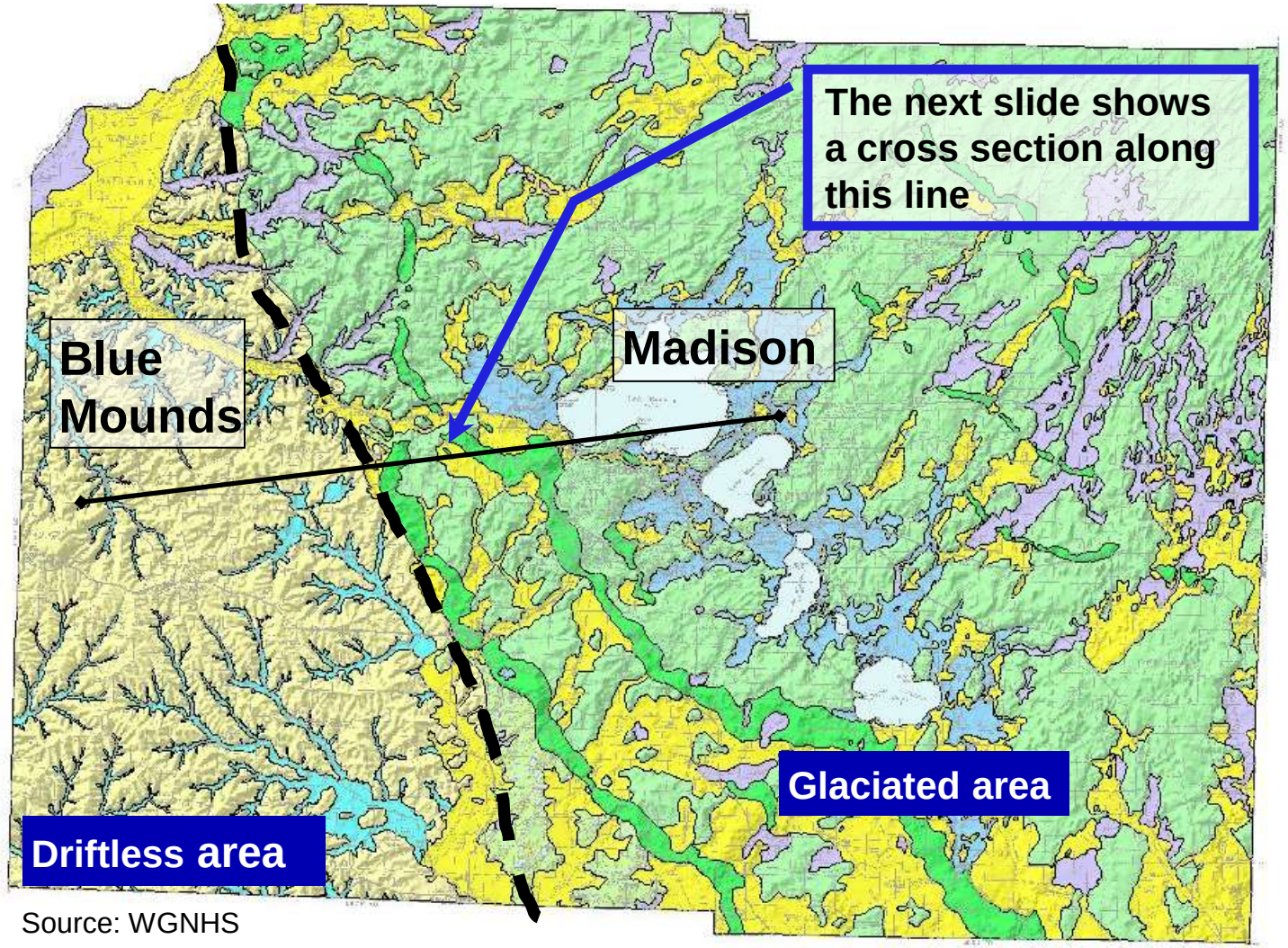
Glacial geology



Source: WGNHS

- Glaciers did not reach western Dane County, leaving bedrock aquifers exposed at the land surface

Glacial geology



Source: WGNHS

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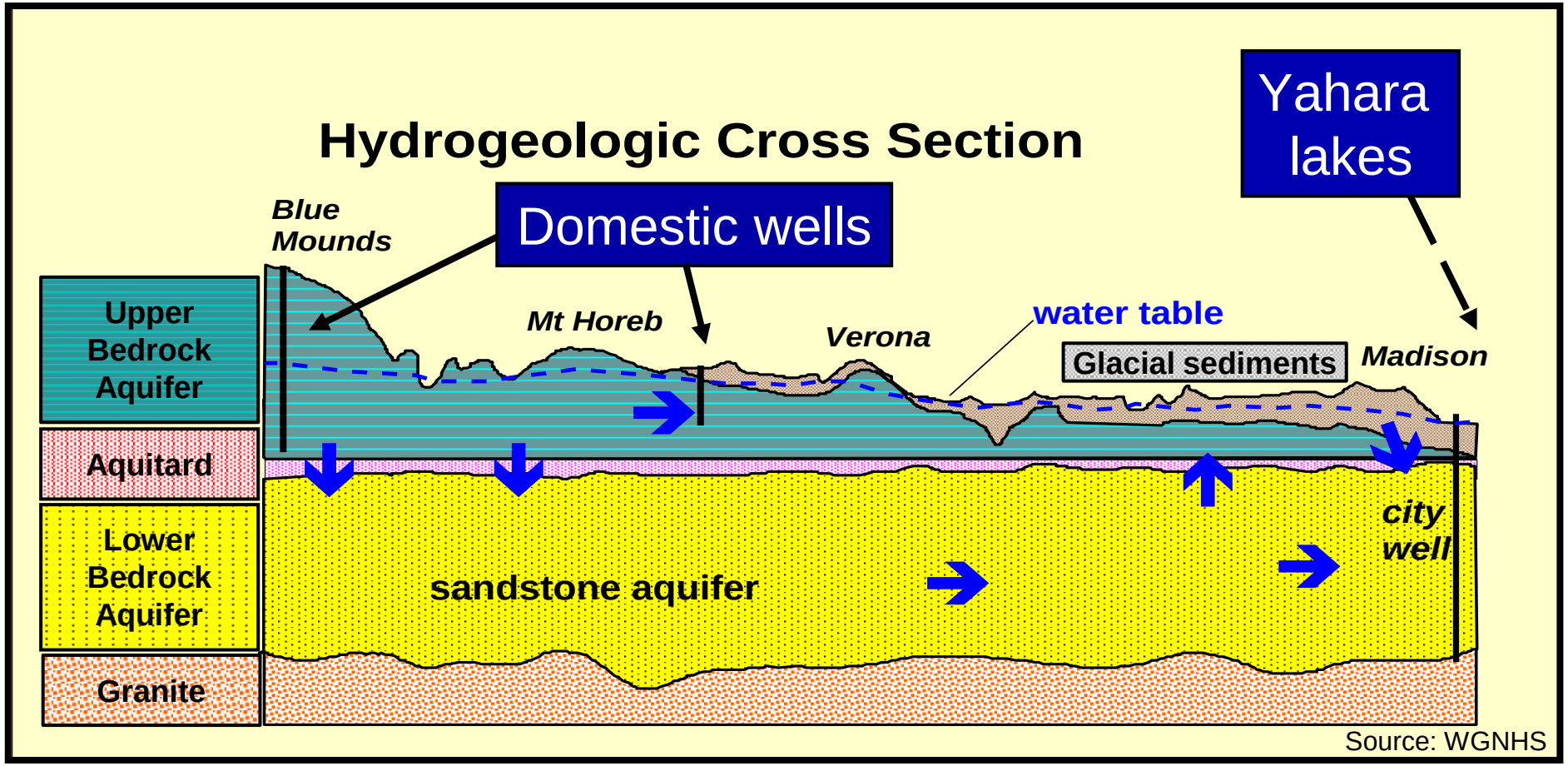
Dane County aquifers



- Domestic wells in western Dane County are completed in the upper bedrock aquifer

The upper bedrock aquifer: dolomite and sandstone

- Primary source of drinking water for private wells in the driftless area

Dolomite, Fort Atkinson

Sandstone, Rockbridge

The lower bedrock aquifer: sandstone

- Primary source of drinking water for municipalities in Dane County

Sandstone, Wisconsin Dells

Groundwater susceptibility to contamination

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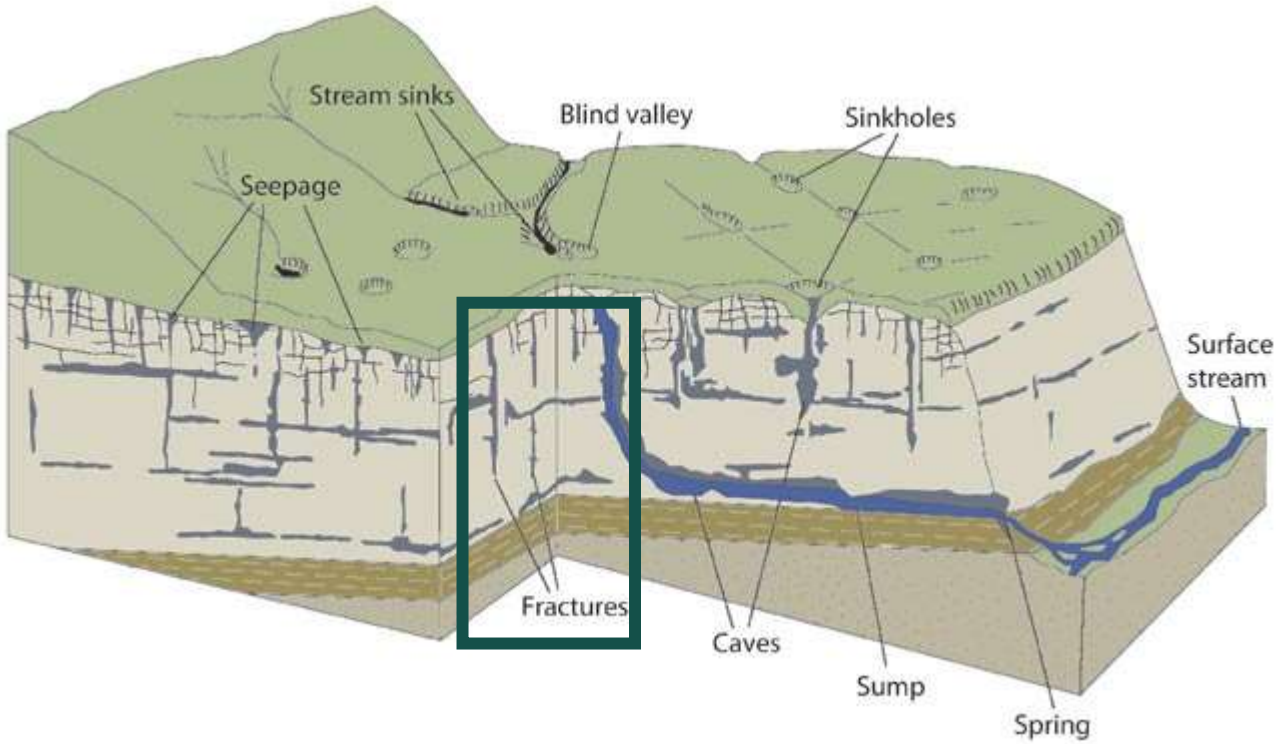
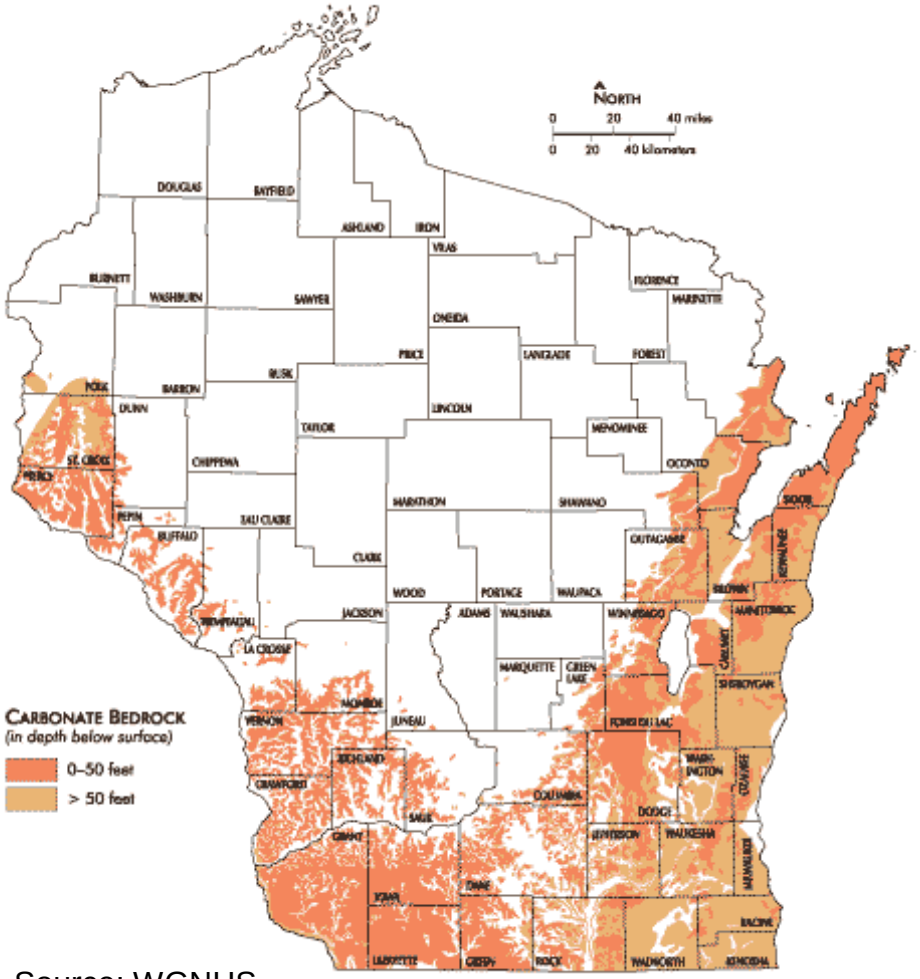
Carbonate aquifers are highly susceptible



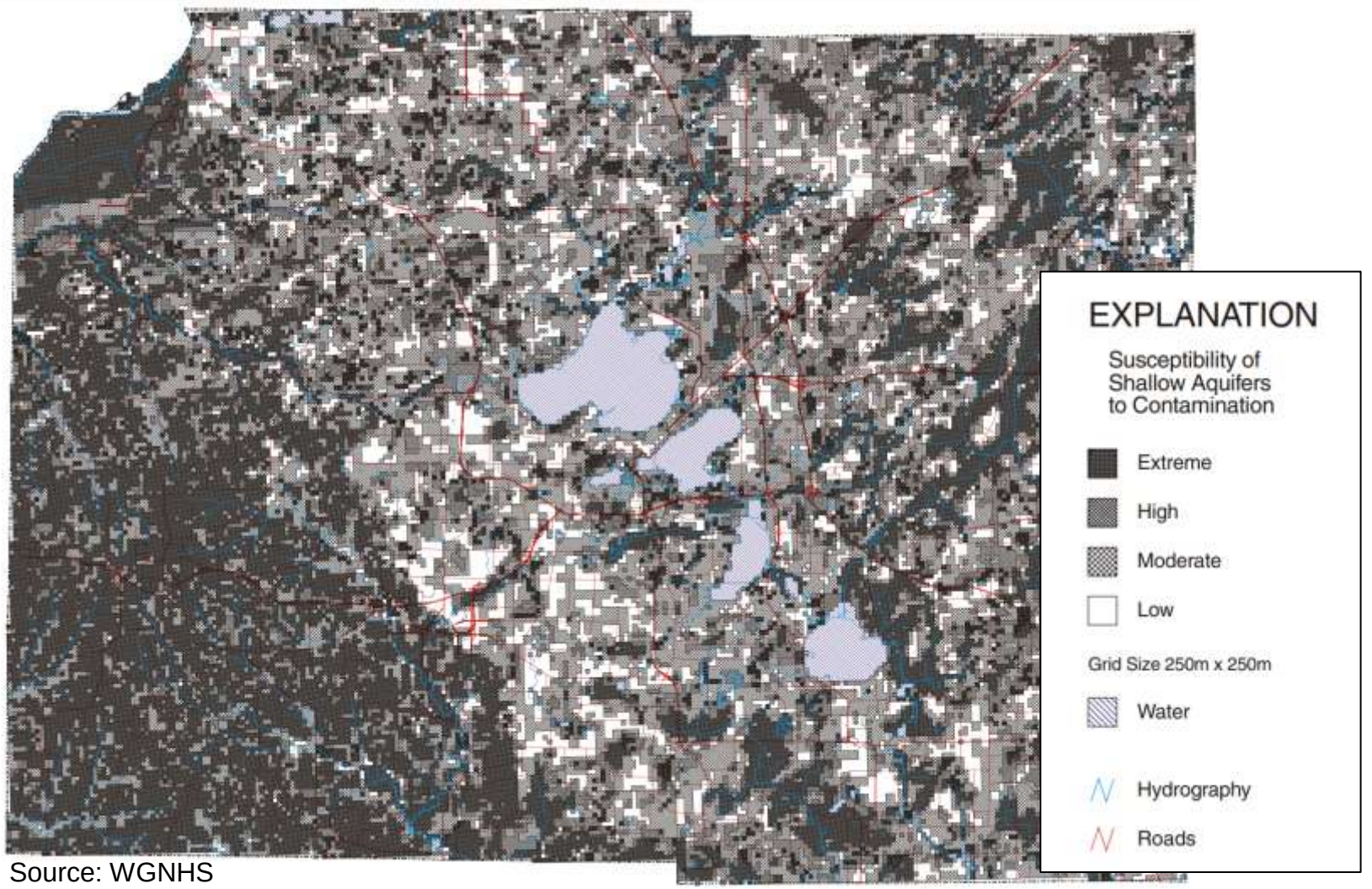
- *Karst* -- a landscape created when water dissolves rocks such as dolomite and limestone



Source: WGNHS

Groundwater susceptibility map for Dane County

- The driftless area is highly susceptible!
  - No overlying glacial sediments for protection
  - Thin soils
  - Fractured carbonate rock at the surface



Source: WGNHS

Factors affecting well water quality

1. The geology and the types of rocks and minerals that groundwater moves through

2. Land use

3. Plumbing/packaging and well construction and maintenance

Resources for private well owners

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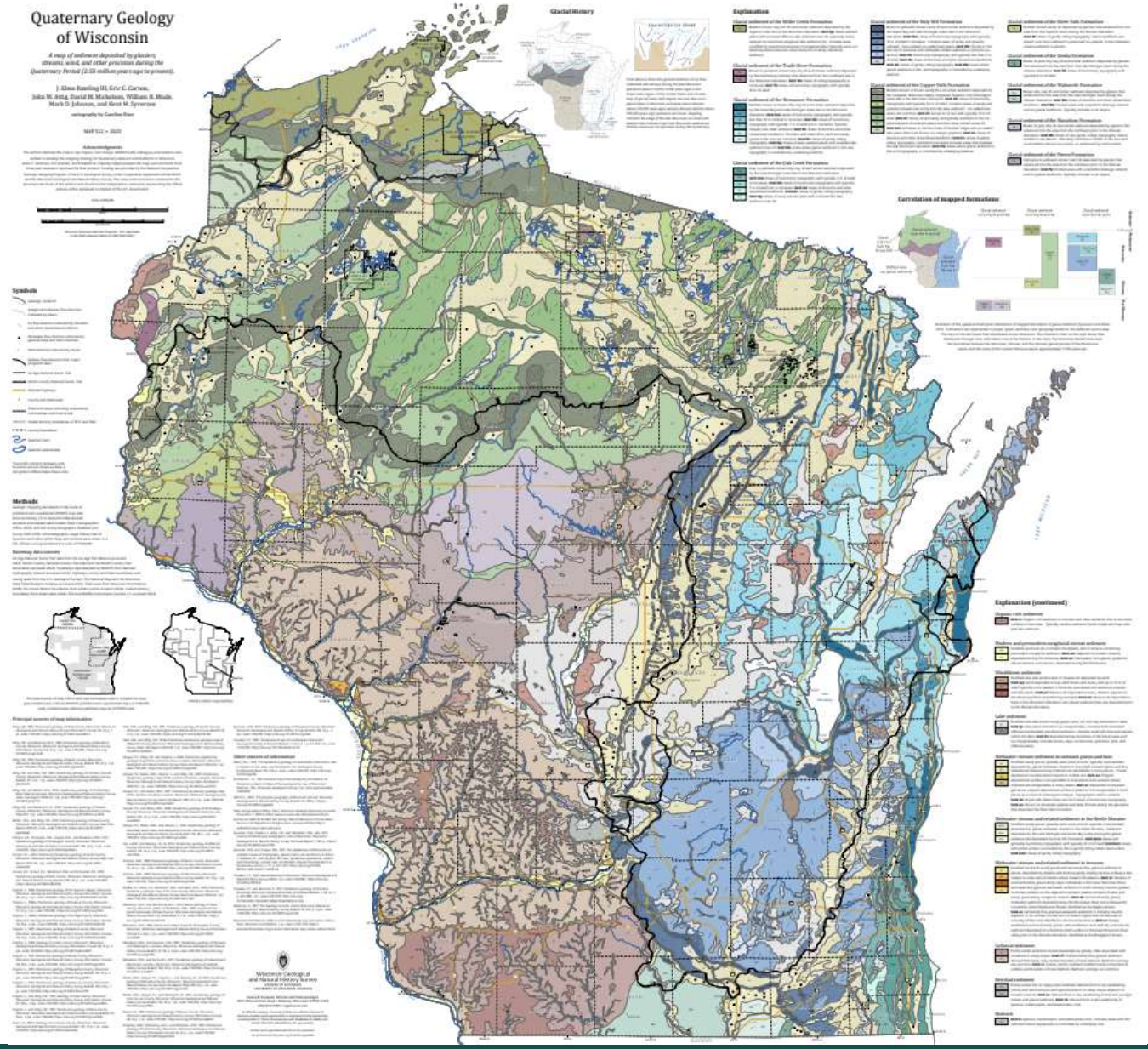
Resources

- **Well construction report**: WI DNR well lookup tool
- **Wisconsin private well water quality data**: UW-Stevens Point WI Well Water Quality Viewer
- **Online guide for private well owners:** Water WELLness by UW-Madison Division of Extension
- **Wisconsin geology and groundwater maps**: WGNHS mapping status portal

Recent WGNHS publications



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Thank you!

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Additional slides

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Actions to protect well water quality

- Get your well tested for nitrate and bacteria every year.
- Avoid mixing or using pesticides, fertilizers, herbicides, degreasers, fuels, and other pollutants near the well.
- Limit pesticide and fertilizer application on your yard. If you must use chemicals, spray individual weeds rather than applying a fertilizer/herbicide blend to the entire lawn.
- Reduce household chemical use and properly dispose of motor oil and unwanted or unused chemicals and medications.
- Reduce the amount of salt you apply to sidewalks and driveways in the winter.
- Pick up pet waste.
- Have your septic tank pumped regularly and inspected at least every 3 years.
- Regularly inspect the area around your well and the well cap for cracks.
- Properly seal unused wells on your property as soon as possible.

Agricultural practices to help groundwater quality

- Apply fertilizer at the right rate, time, source, and place to maximize profitability and minimize excessive losses of nitrogen to groundwater.
- Conduct your own on-farm rate trials to develop customized fertilizer response curves for your farm. You may not need as much nitrogen fertilizer as you think.
- Utilize conservation incentive programs to take marginal land or under-performing parts of fields out of production.
- Diversify crop systems to include less nitrogen-intensive crops in the rotation.
- Explore the use of cover crops, perennial cropping systems, or managed grazing to reduce nitrate losses to groundwater.
- Keep in mind it may take several years or decades to see improvements in groundwater nitrate concentrations following the implementation of such agricultural practices.