

# **Subterranean Water: Groundwater**

Slides from lecture preceding  
Sulphur Springs Groundwater Exercise

Eileen Herrstrom

[herrstro@illinois.edu](mailto:herrstro@illinois.edu)

2018

# What Is Groundwater?

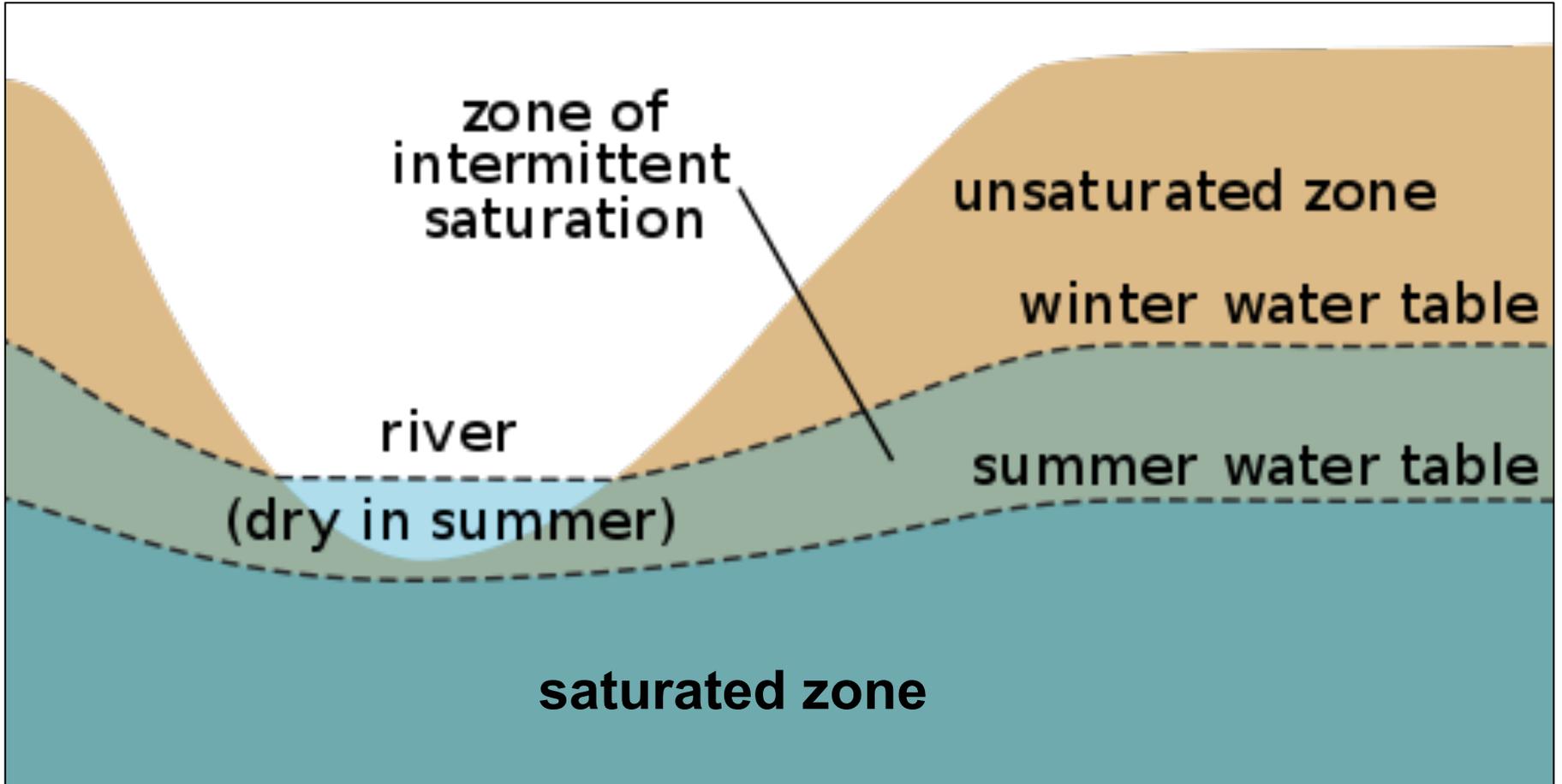
- **Def: water below Earth's surface**
  - **In pore spaces & cracks**
  - **Mostly not in underground rivers or lakes**



# GW Terms

- ***Infiltration***: water soaks into ground, fills pores
  - ***Saturated zone***: all pores filled with water
  - ***Unsaturated zone***: some pores filled with water, some with air
  - ***Water table***: boundary separating saturated & unsaturated zones

# GW Illustration



[https://commons.wikimedia.org/wiki/File:Water\\_table-season\\_fluctuation.svg](https://commons.wikimedia.org/wiki/File:Water_table-season_fluctuation.svg)

# Porosity

- **Def: % of pore space in rock or sediment**
  - **High = 30 - 50%**
    - **Loose sediment**
  - **Medium = 15 - 30%**
    - **Sandstone or fractured rock**
  - **Low = 1%**
    - **Unfractured granite or chert**

# Porosity Illustrated

High



[https://commons.wikimedia.org/wiki/File:Cobbles\\_Nash\\_Point.jpg](https://commons.wikimedia.org/wiki/File:Cobbles_Nash_Point.jpg)

Medium



<https://commons.wikimedia.org/wiki/File:Bentheimer-Sandstein.jpg>

Low



<https://commons.wikimedia.org/wiki/File:ChertUSGOV.jpg.jpg>

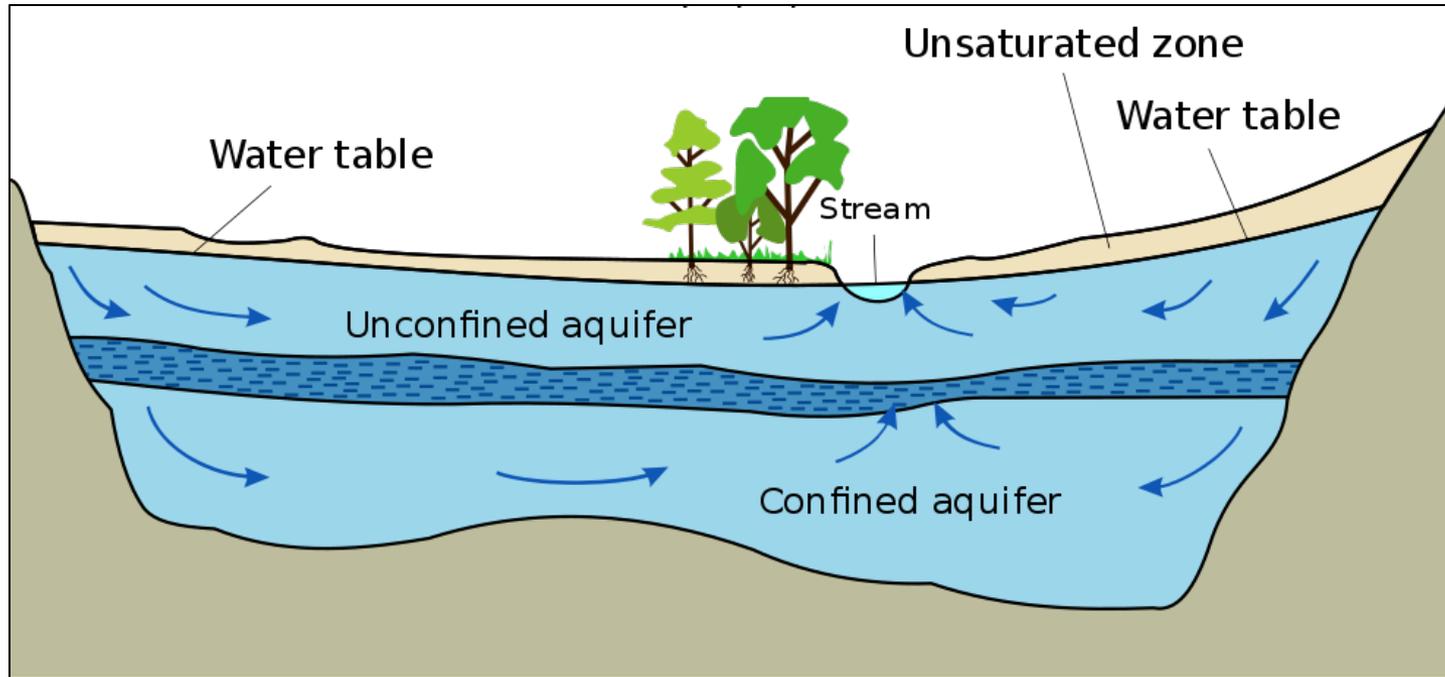
# Permeability

- **Def: ability to transmit fluid**
- **High: large, well-connected pores**
  - **Ex: gravel, sandstone, fractured granite**
- **Low: small, poorly-connected pores**
  - **Ex: mud, shale, unfractured gneiss**

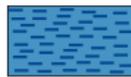
# ***Aquifer***

- **Def: porous & permeable layer with water**
  - **Porous, so it holds lots of water**
  - **Permeable, so water can be pumped out**
- ***Aquitard: impermeable layer***

# Aquifers and Aquitards



High permeability aquifers



Low permeability aquitard



Very low permeability bedrock

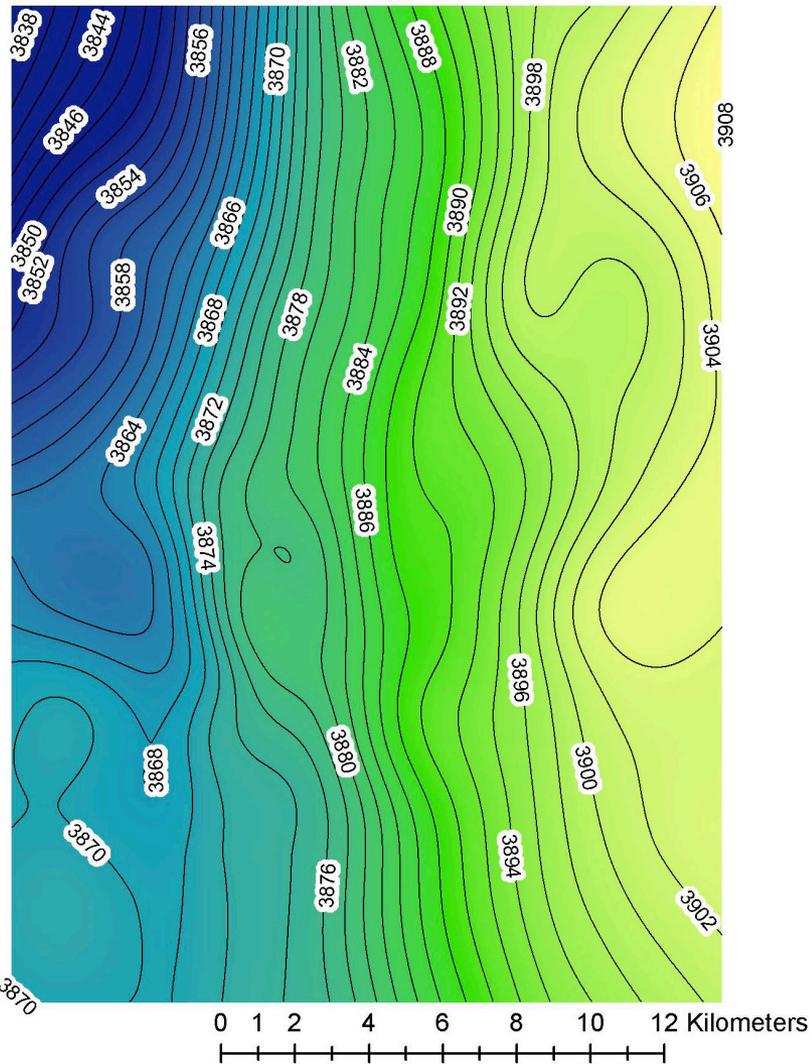


Direction of groundwater flow

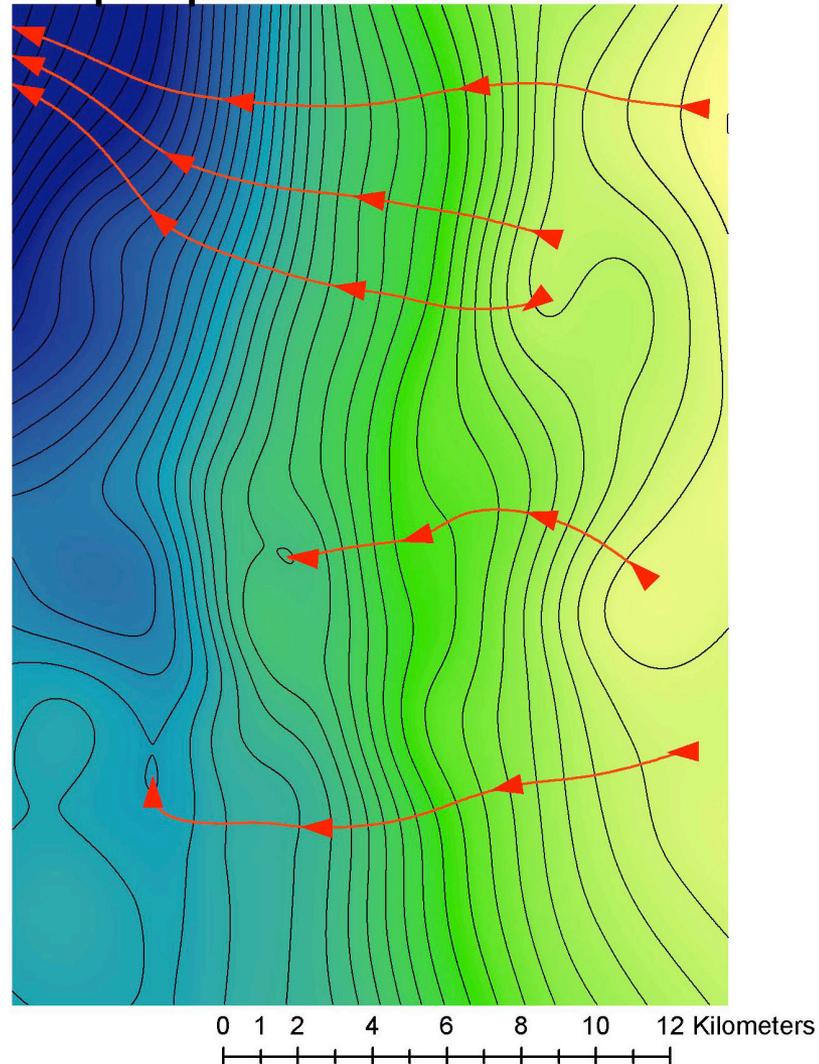


# GW Flow in Map View

## Contour lines on water table

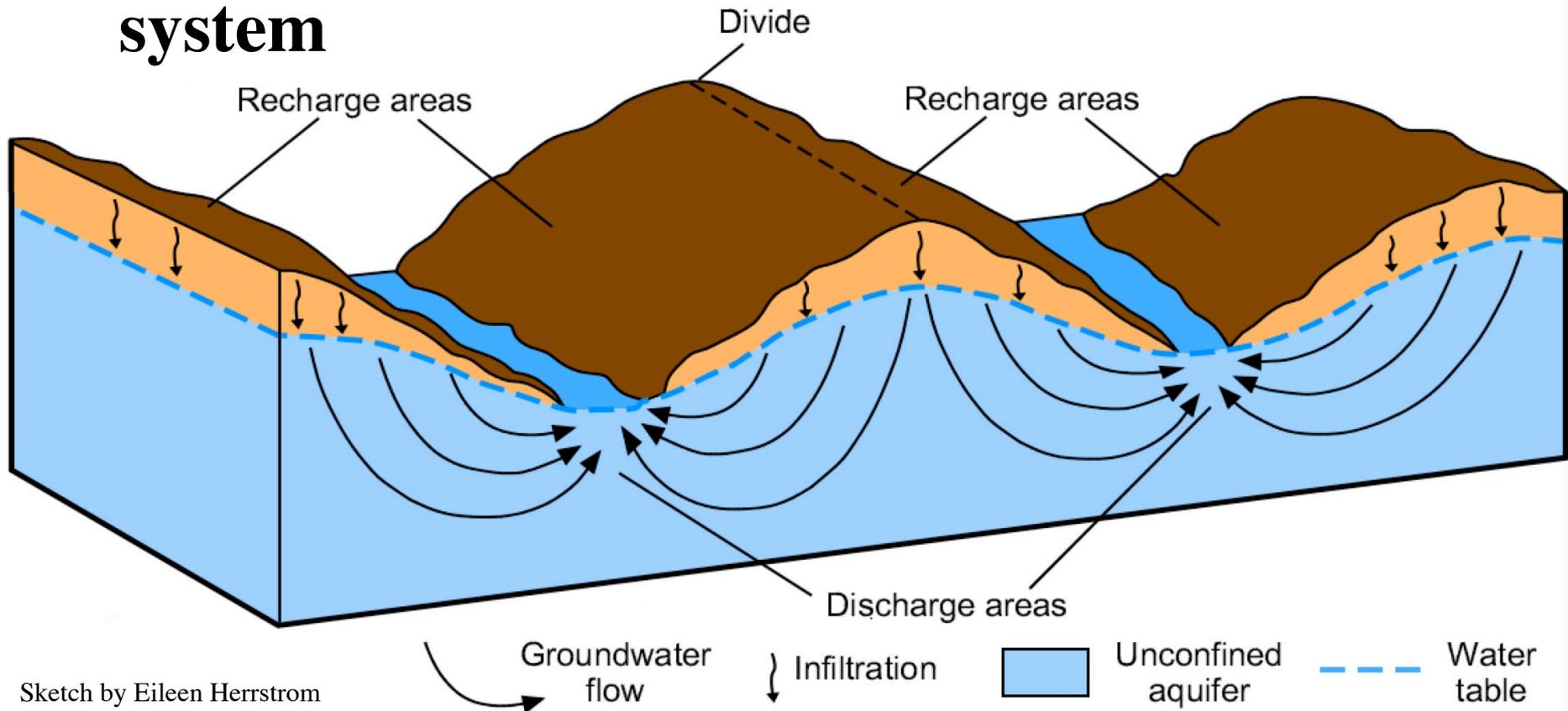


## Flow perpendicular to contours

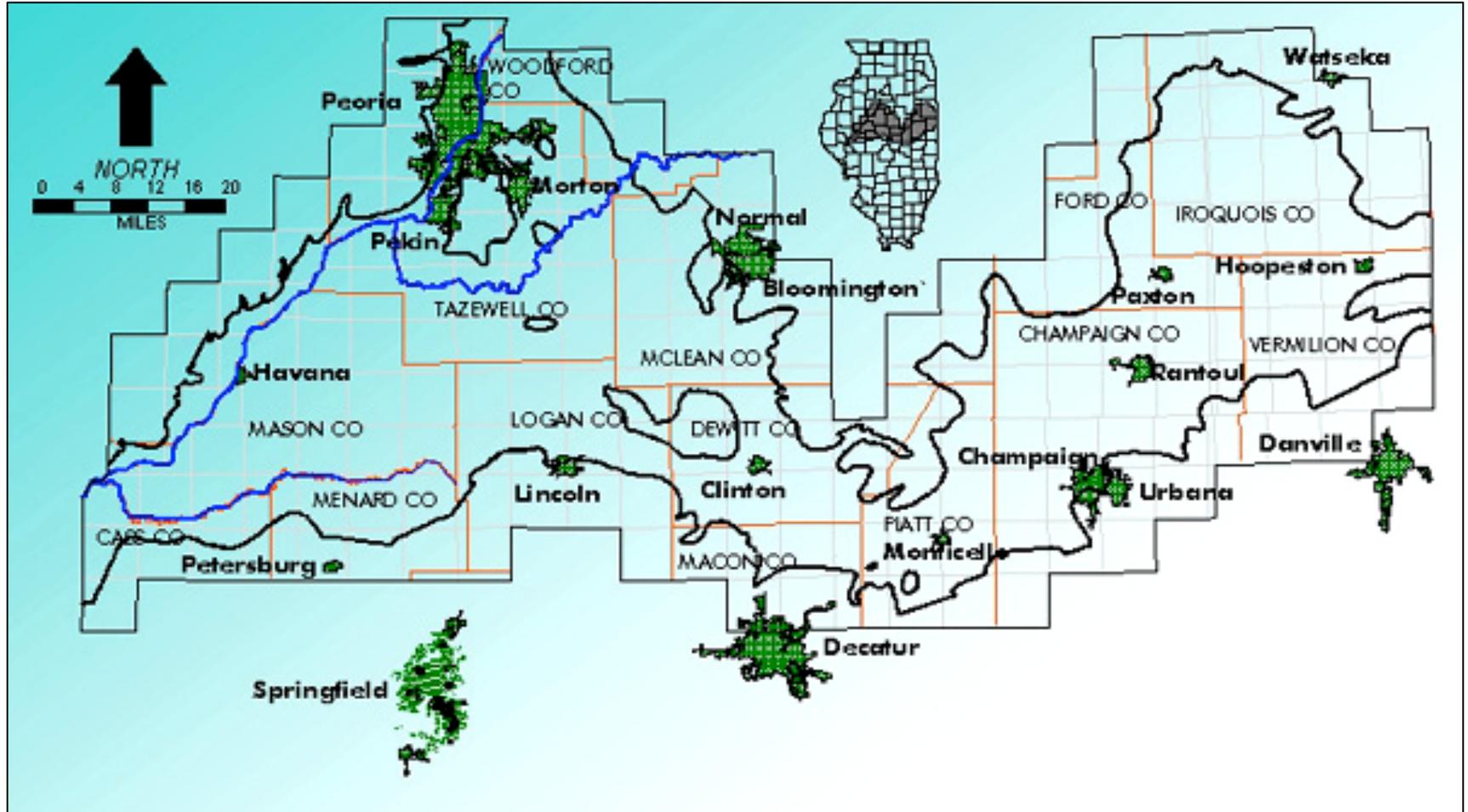


# More Terms

- ***Recharge area***: place where water enters GW system
- ***Discharge area***: place where water leaves GW system

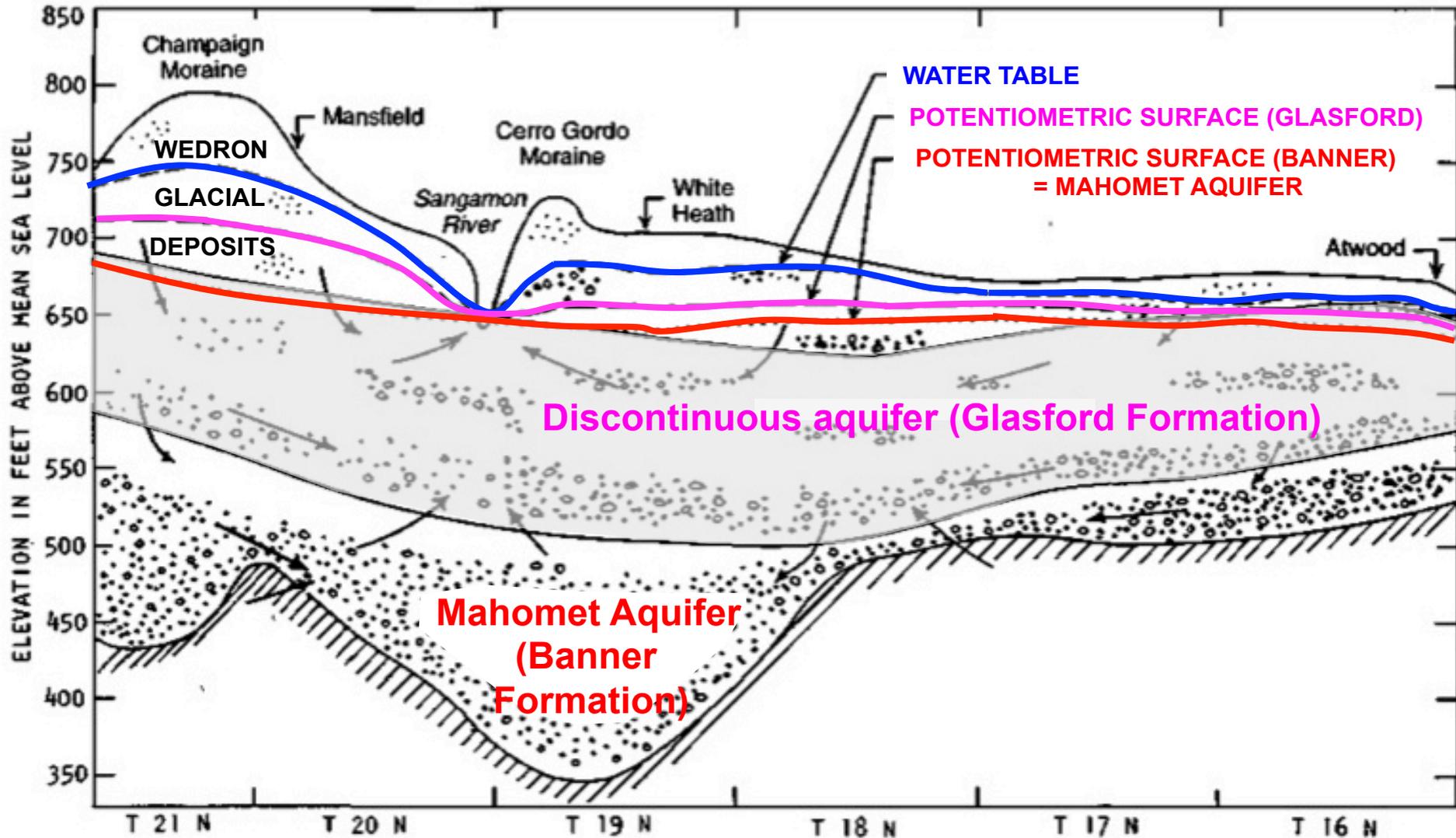


# Mahomet Aquifer, East Central IL



<http://mahometaquiferconsortium.org/info-maps.html> (Map showing aquifer boundaries overlying political boundaries)

# Vertical Cross Section

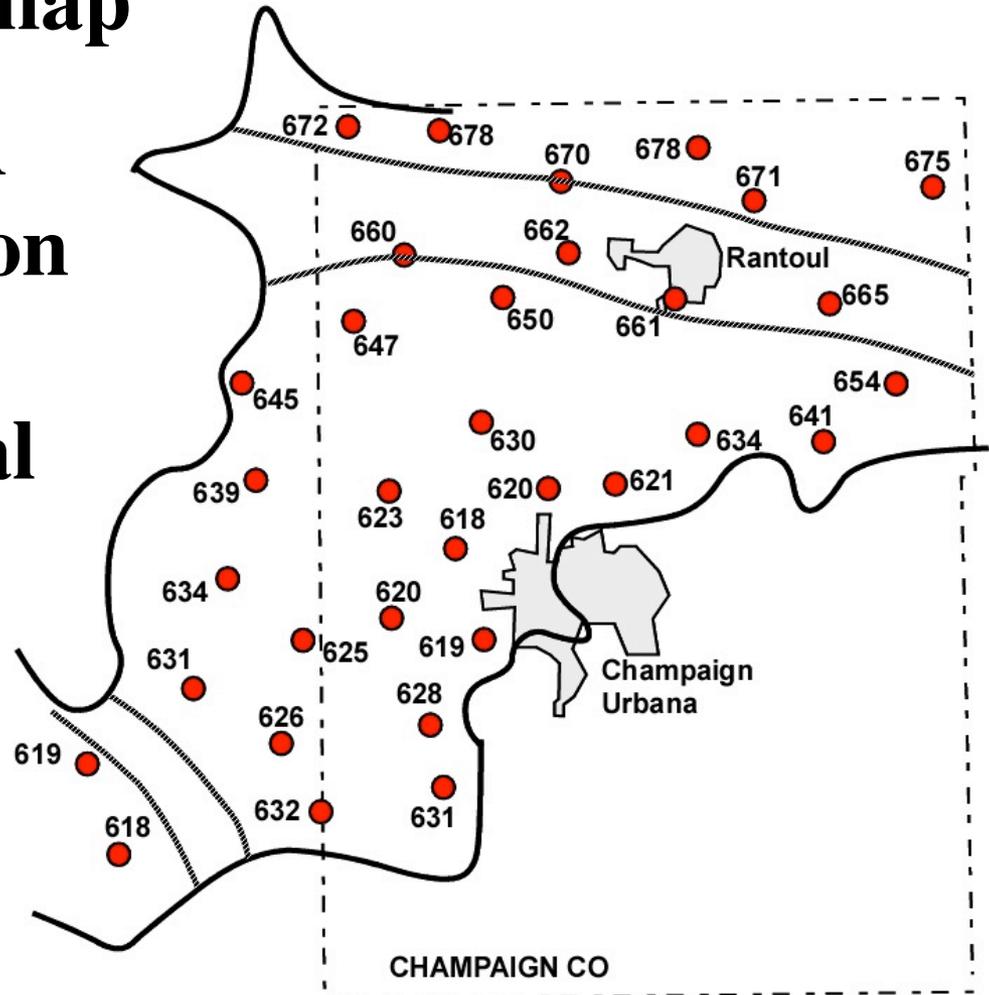


Source unknown (modified by Eileen Herrstrom)

# Lecture Tutorial

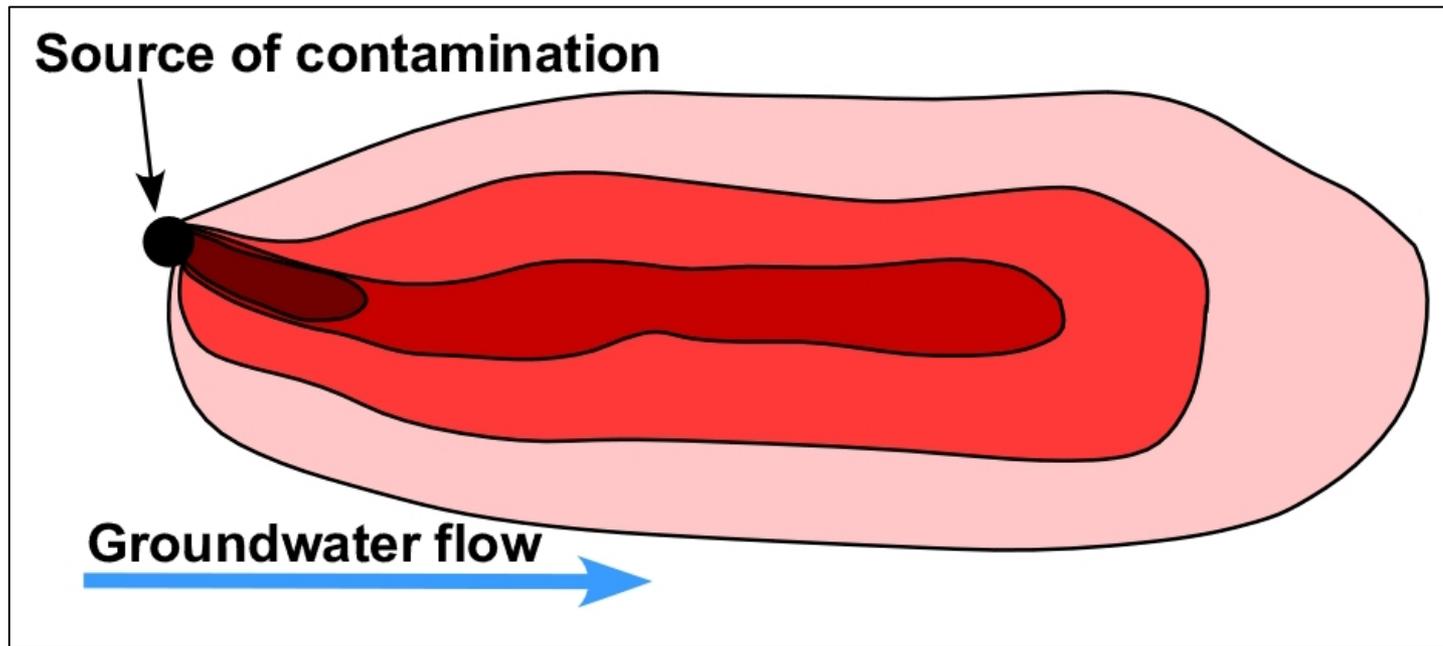
- In-class activity that introduces how to draw contour lines on a map
  - For details, see: A Lecture Tutorial on the Mahomet Aquifer in Central Illinois

[https://serc.carleton.edu/earth\\_rendezvous/2016/program/demos/tuesdayB/136698.html](https://serc.carleton.edu/earth_rendezvous/2016/program/demos/tuesdayB/136698.html)



# Groundwater Pollution

- Point source releases contaminants into groundwater system
  - Plume follows flow, spreads out



## **Teaching Notes and Tips**

This exercise is divided into three complementary sections. The exercise may be completed in one extended laboratory period, or individual sections may be assigned as separate, shorter activities or as homework.

Note that students need access to a printer to complete this exercise, as they must print the sketch map of the Sulphur Springs quadrangle in Part II and the completed cross section in Part III. Alternatively, the instructor may provide the map as a handout and the cross section may be submitted electronically.

Some students have difficulty visualizing the landscape from a topographic map on a computer screen. Making physical maps available helps with this problem. The electronic files provided with the teaching materials use the 1995 version of the map.

Because computer software changes so rapidly, the instructions for accomplishing certain tasks with Excel might differ from those given in the student instructions. Thus, the instructor should be aware of possible difficulties using Excel.