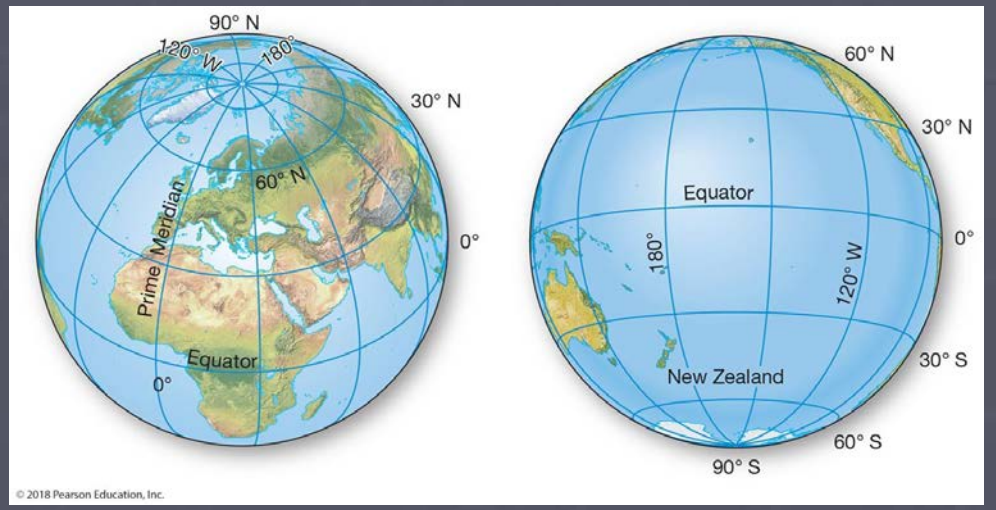
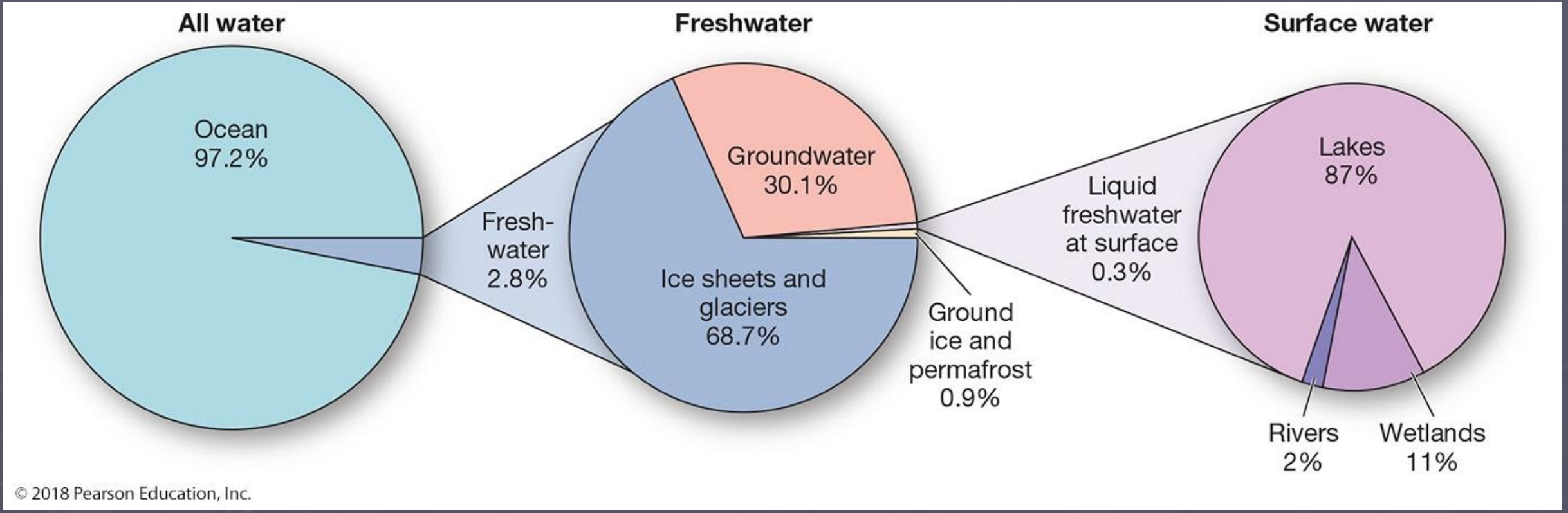
Earth’s Hydrosphere and Water Resources

Chapter 8: Water Resources

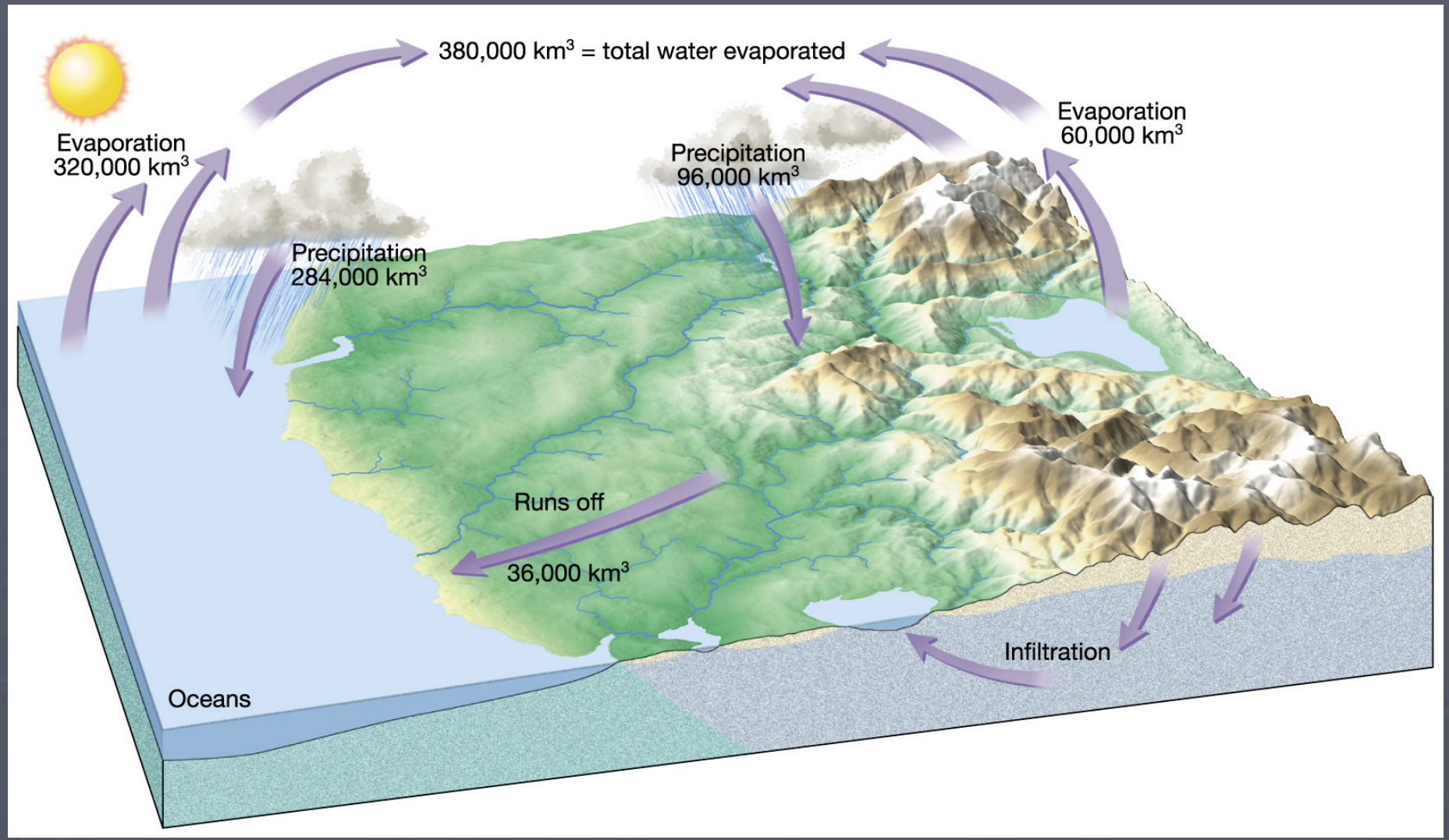
Earth: The Blue Marble



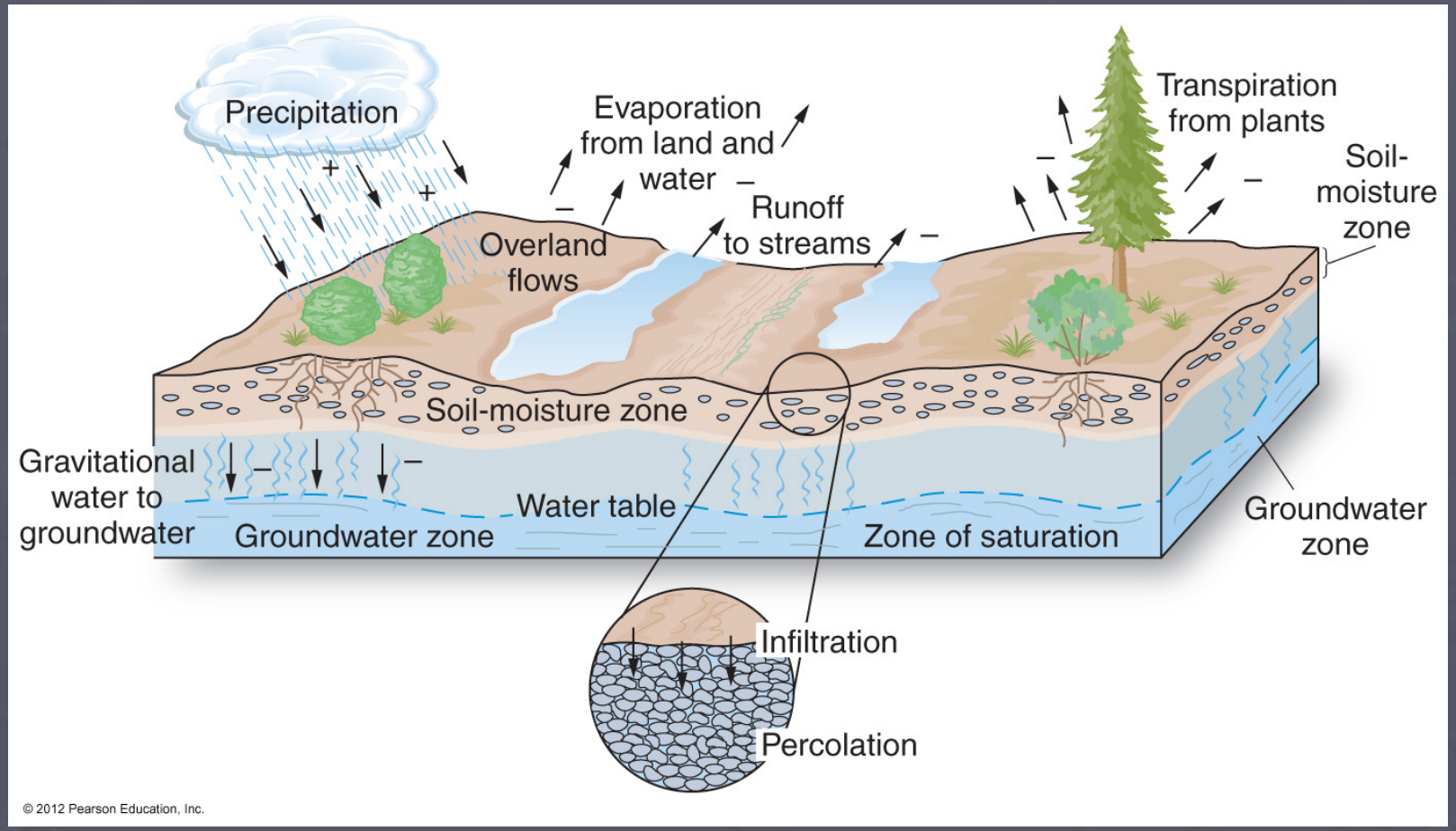
Breakdown of Earth's Water



The Hydrological Cycle

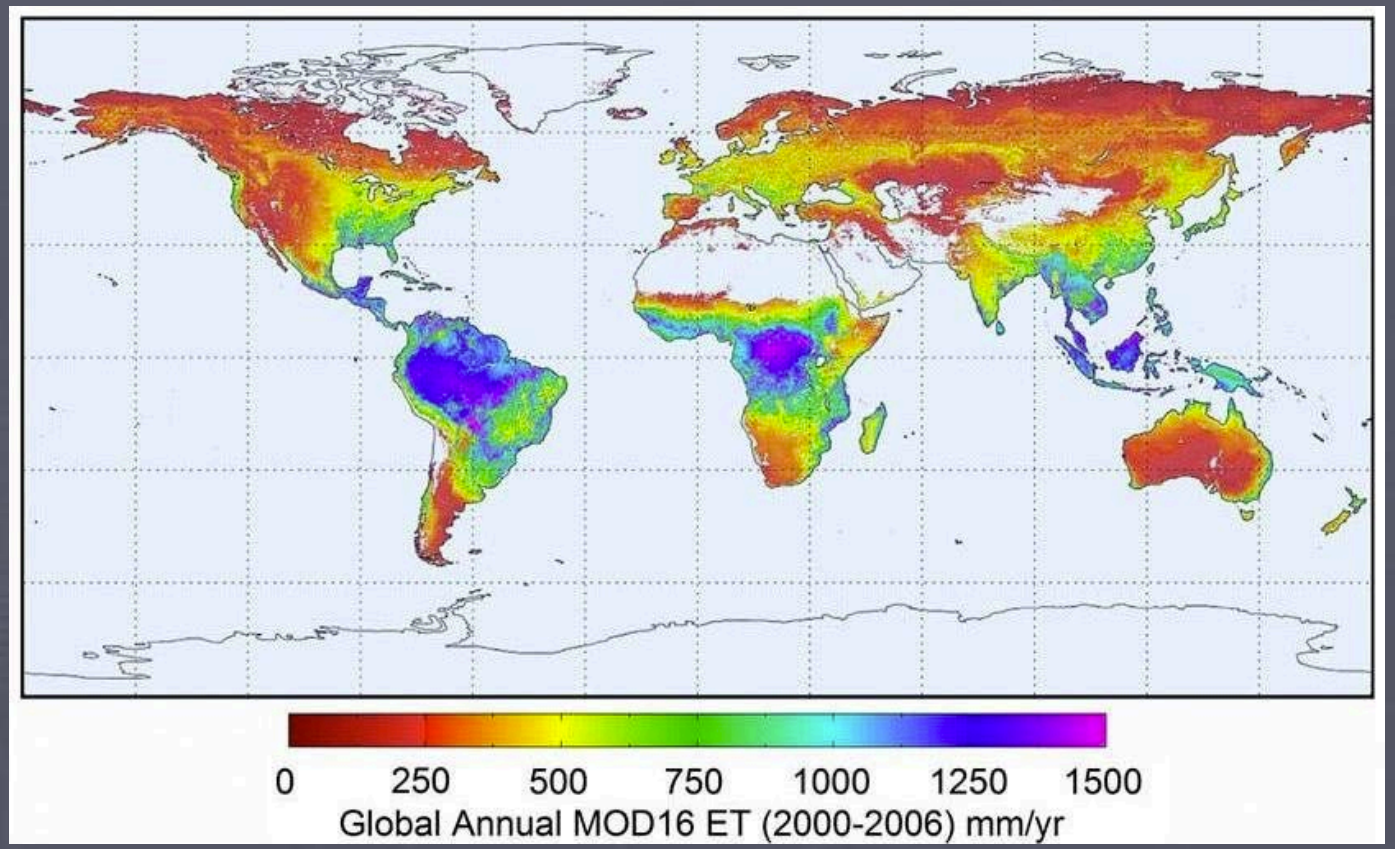


Water in the Subsurface



The Water Budget: Evapotranspiration

- **Evapotranspiration** = Evaporation (water evaporating from soils and water + transpiration (water evaporating from plants)

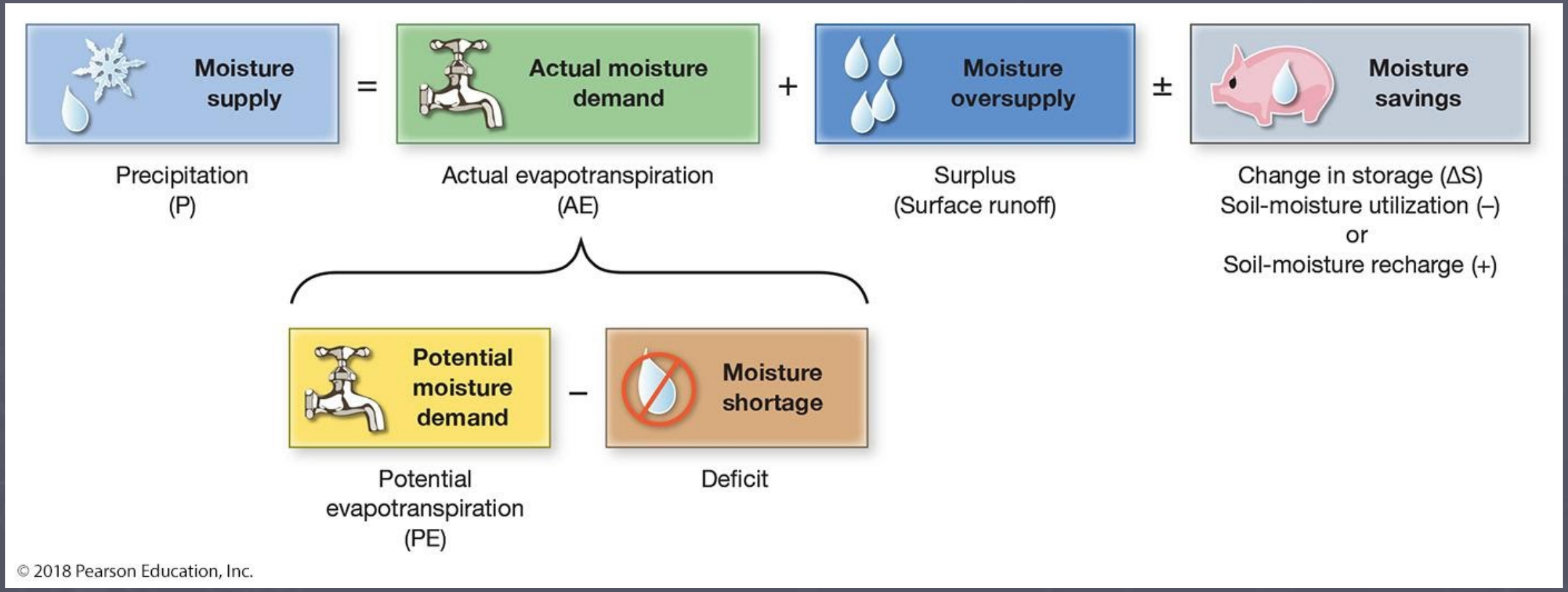


The Water Budget: Evapotranspiration Deficit

- **Potential Evapotranspiration** - The amount of Evapotranspiration that can take place under optimum conditions
- **Actual Evapotranspiration** – The actual amount of Evapotranspiration that can take place

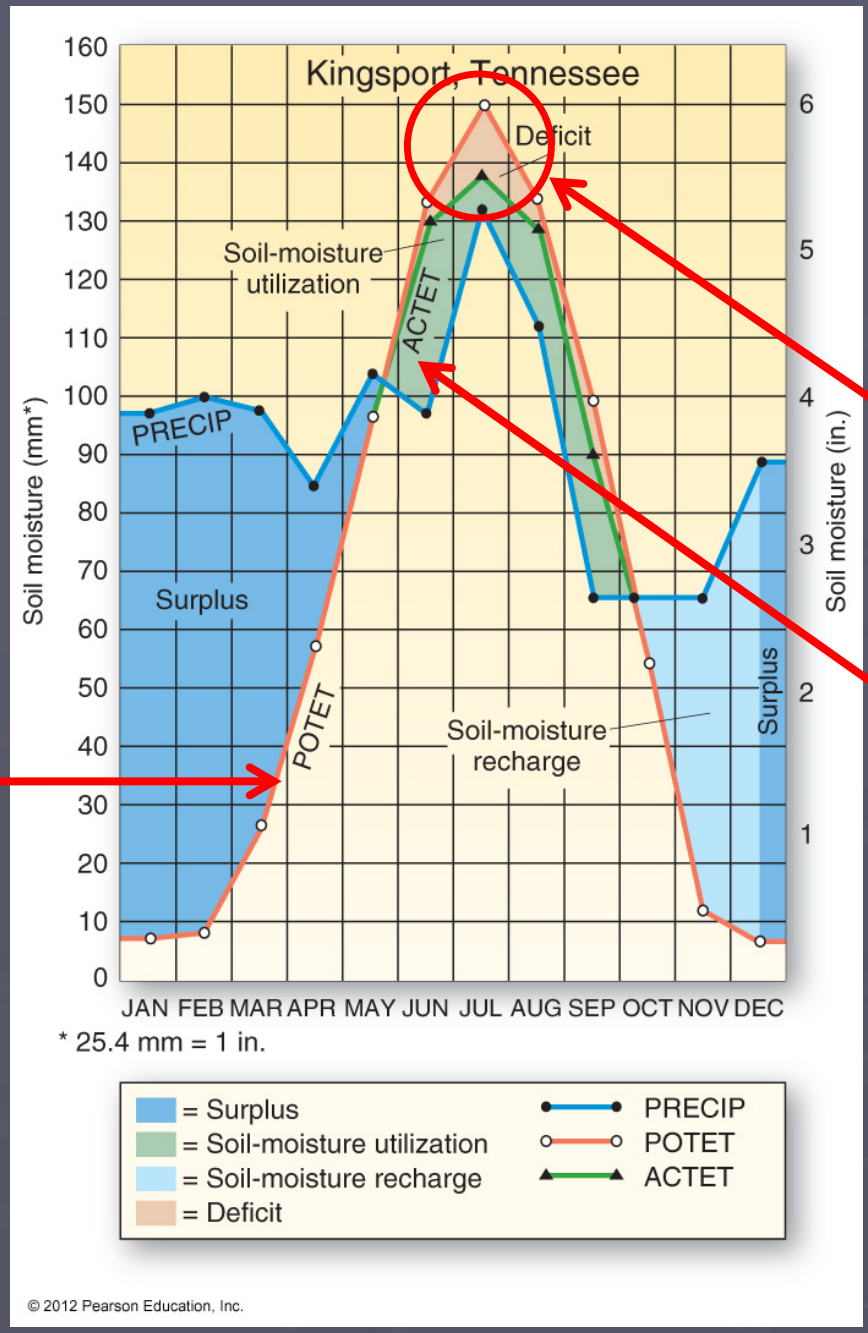
- If PE is higher than AE than a deficit exists and soil moisture supply is used to make up deficit

The Water Budget Equation



Evapotranspiration in Practice

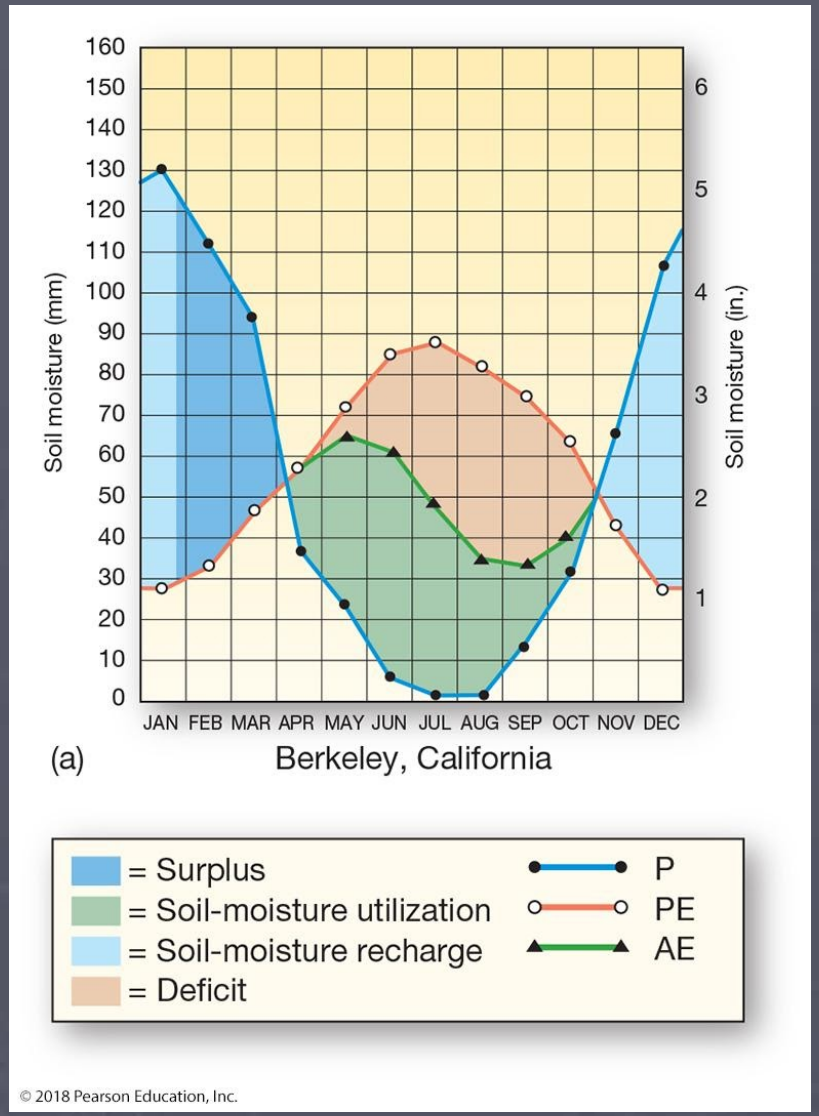
Potential Evapo-transpiration

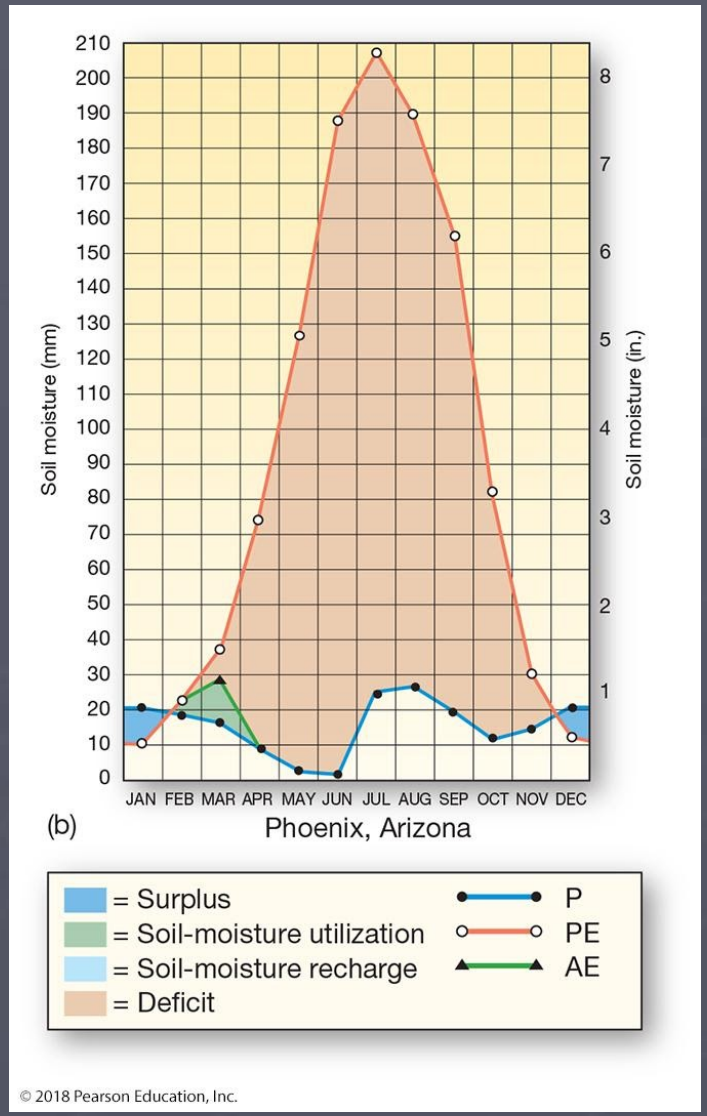


Drought

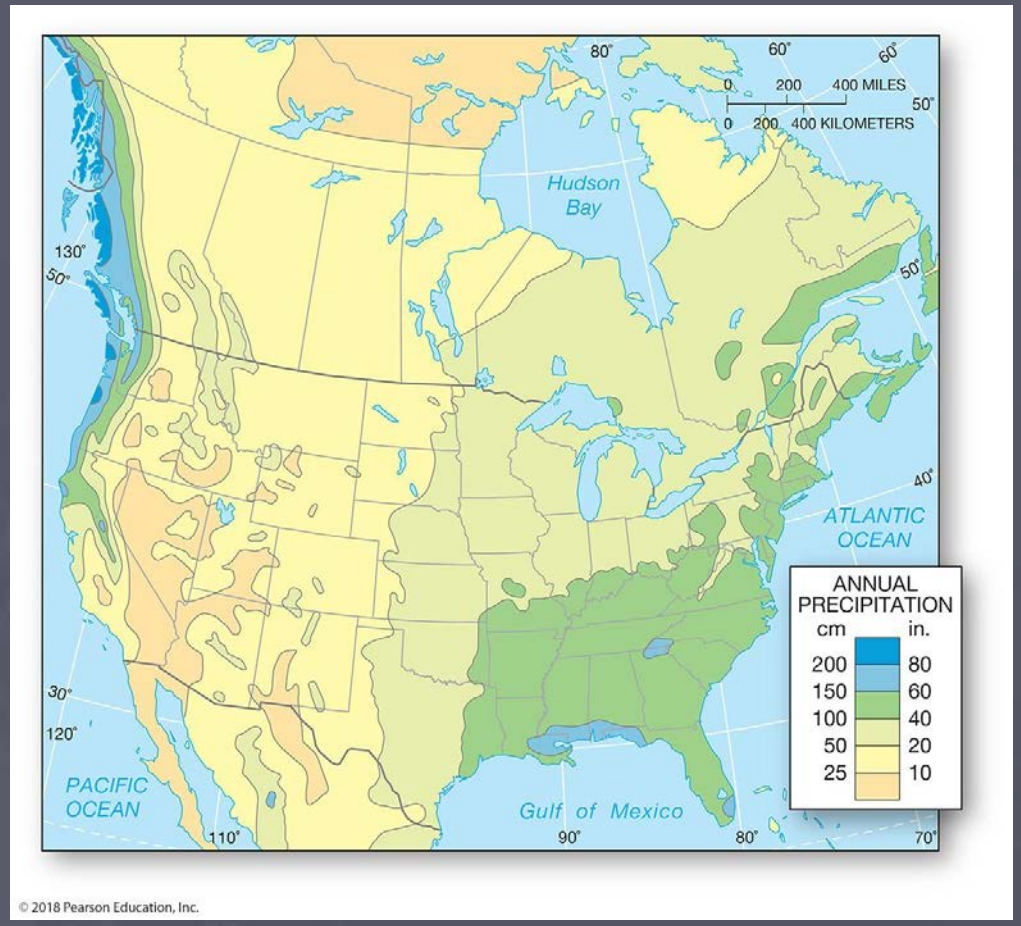
Actual Evapo-transpiration

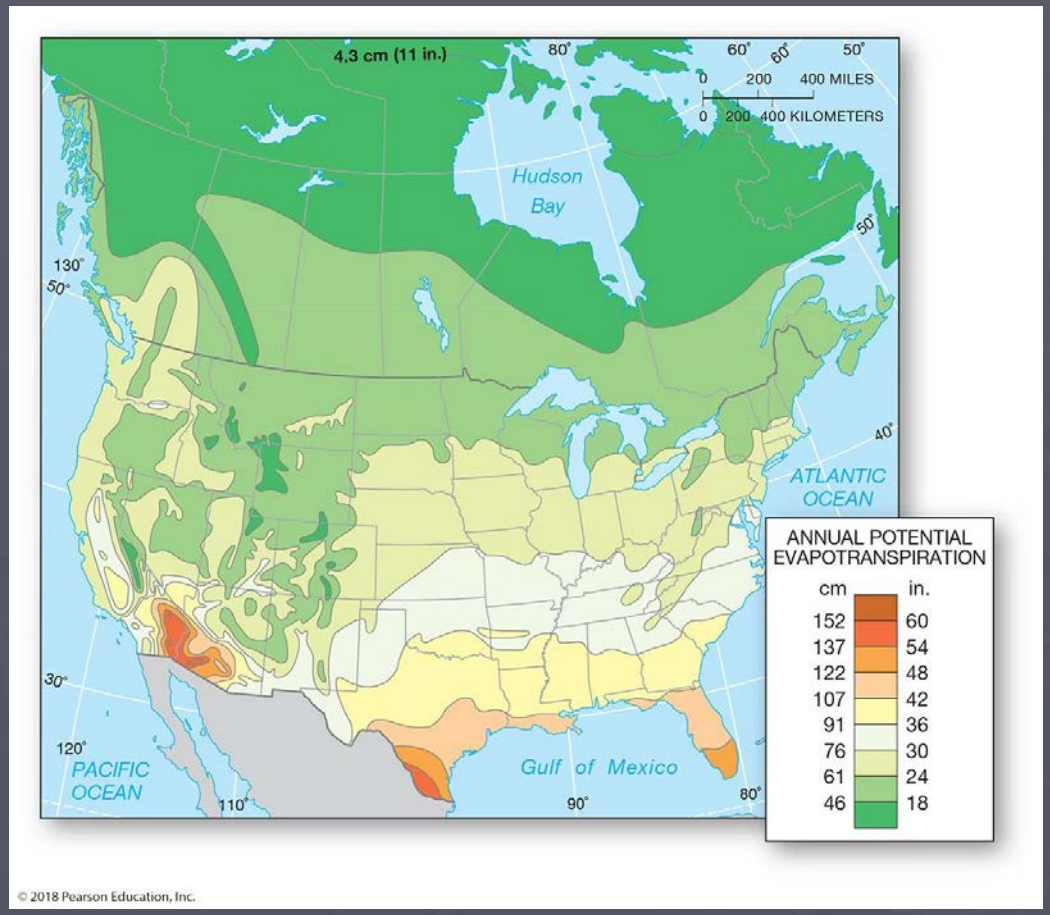
Evapotranspiration Case Studies



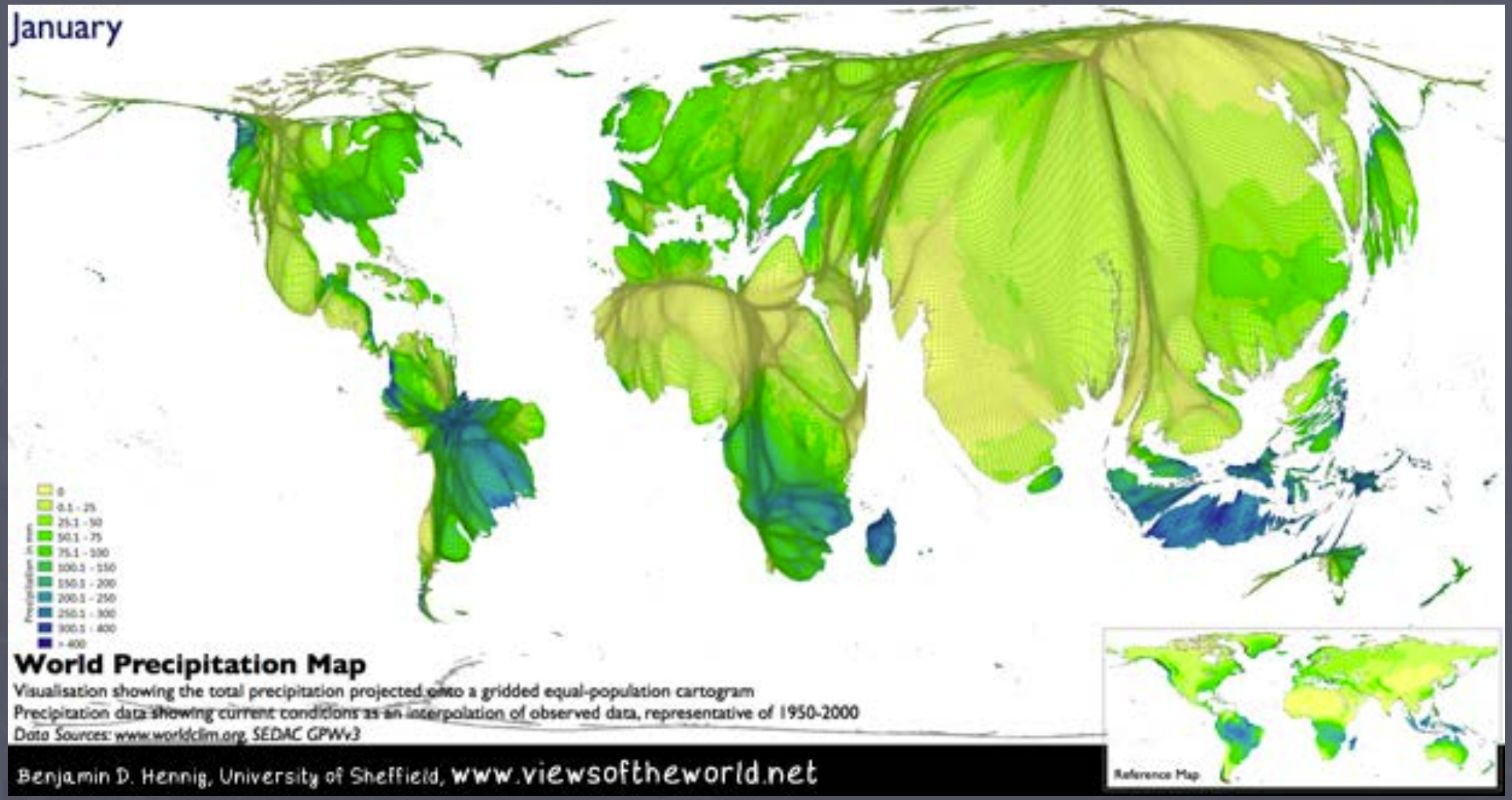


Average Precipitation & Potential Evapotranspiration

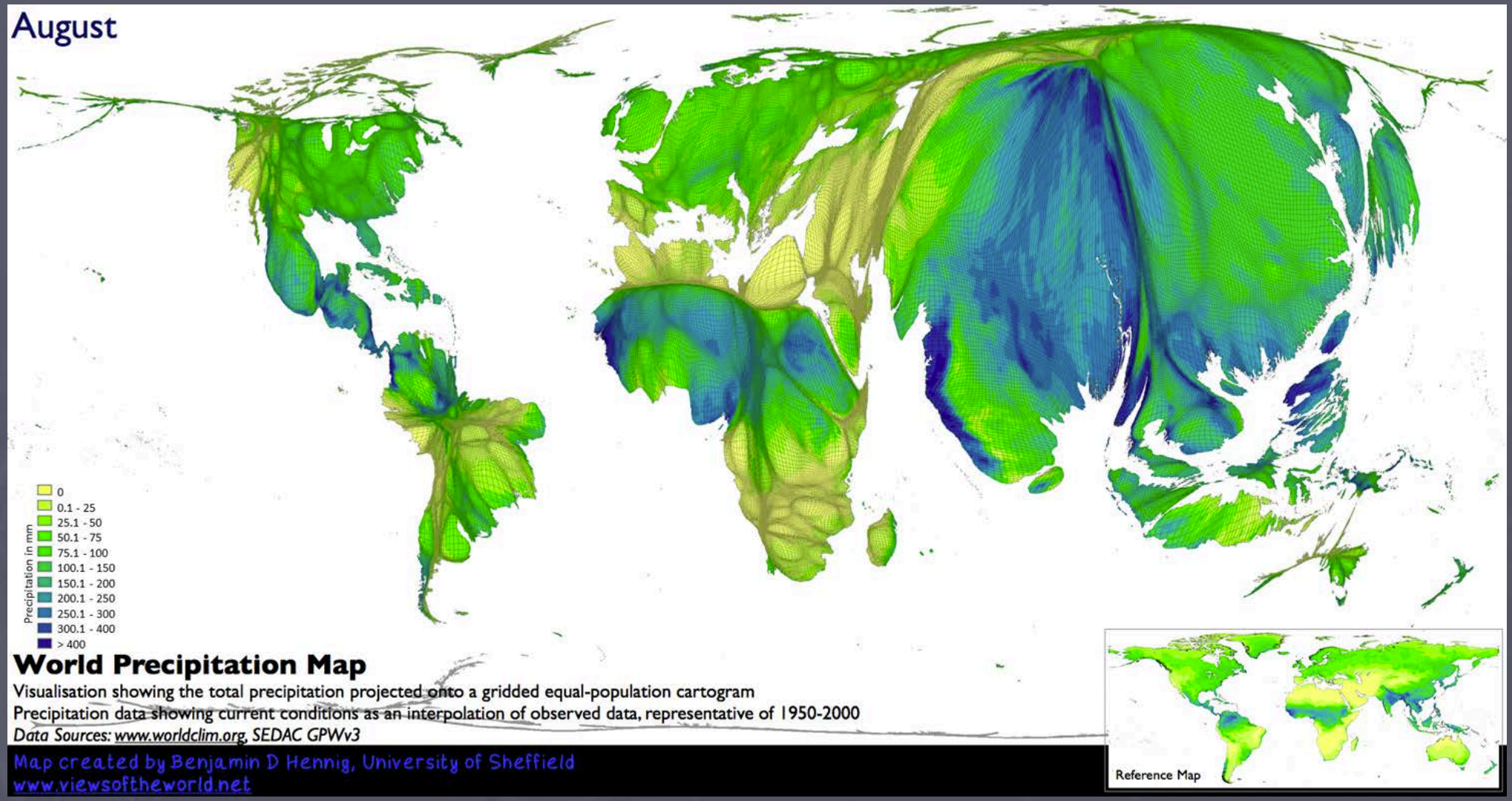




Global Precipitation as Connected to Population

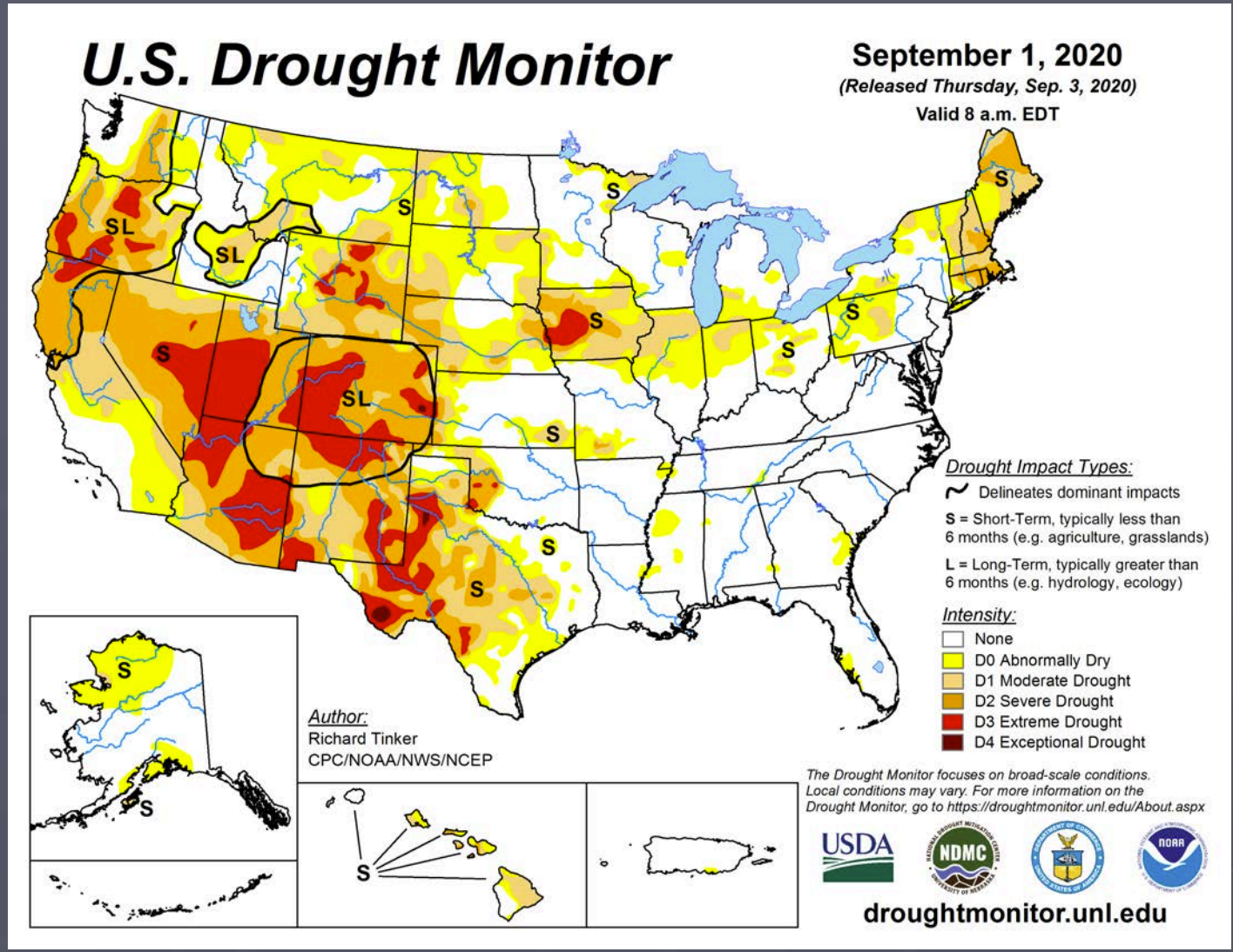


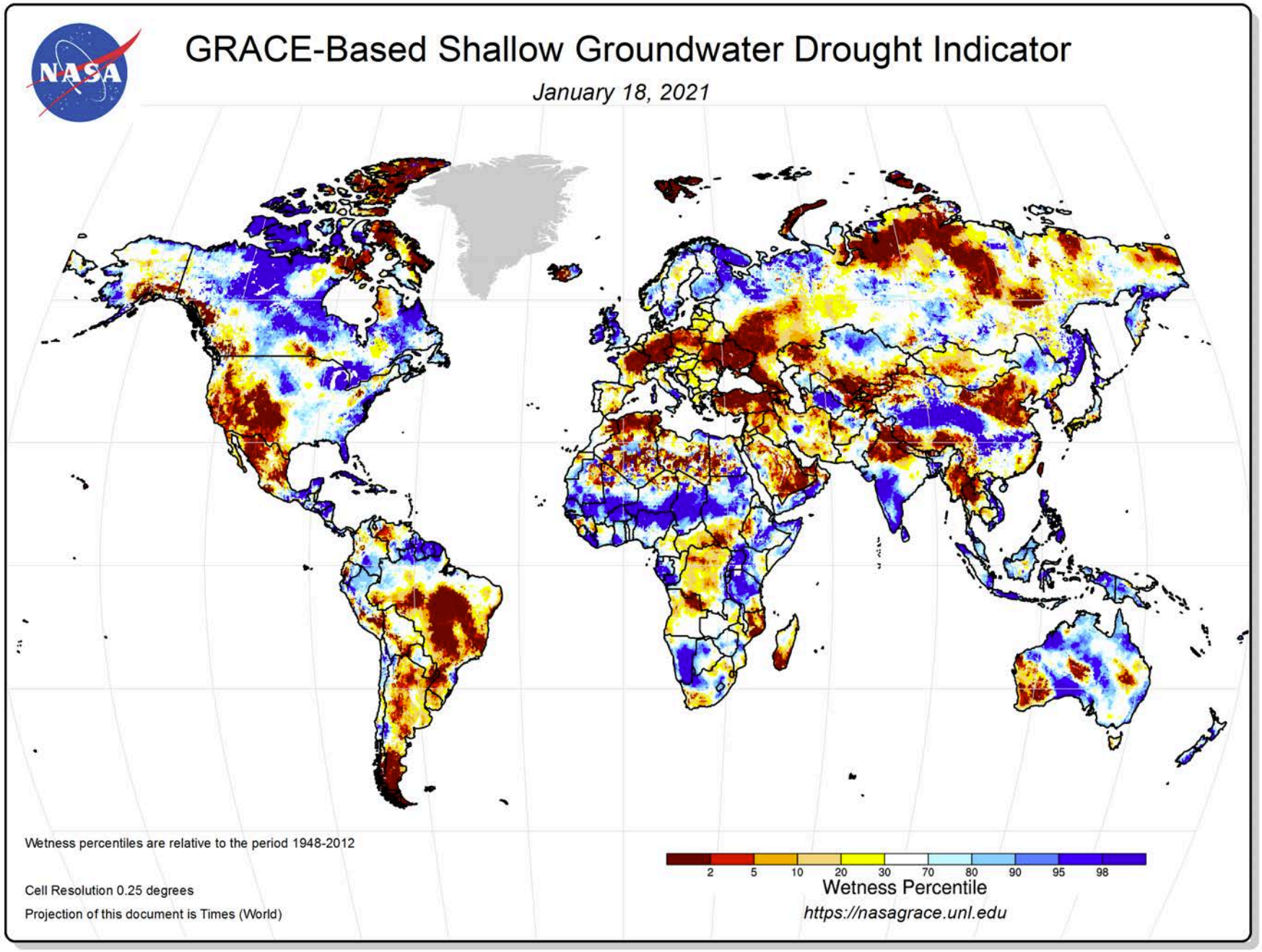
Global Precipitation as Connected to Population



Drought

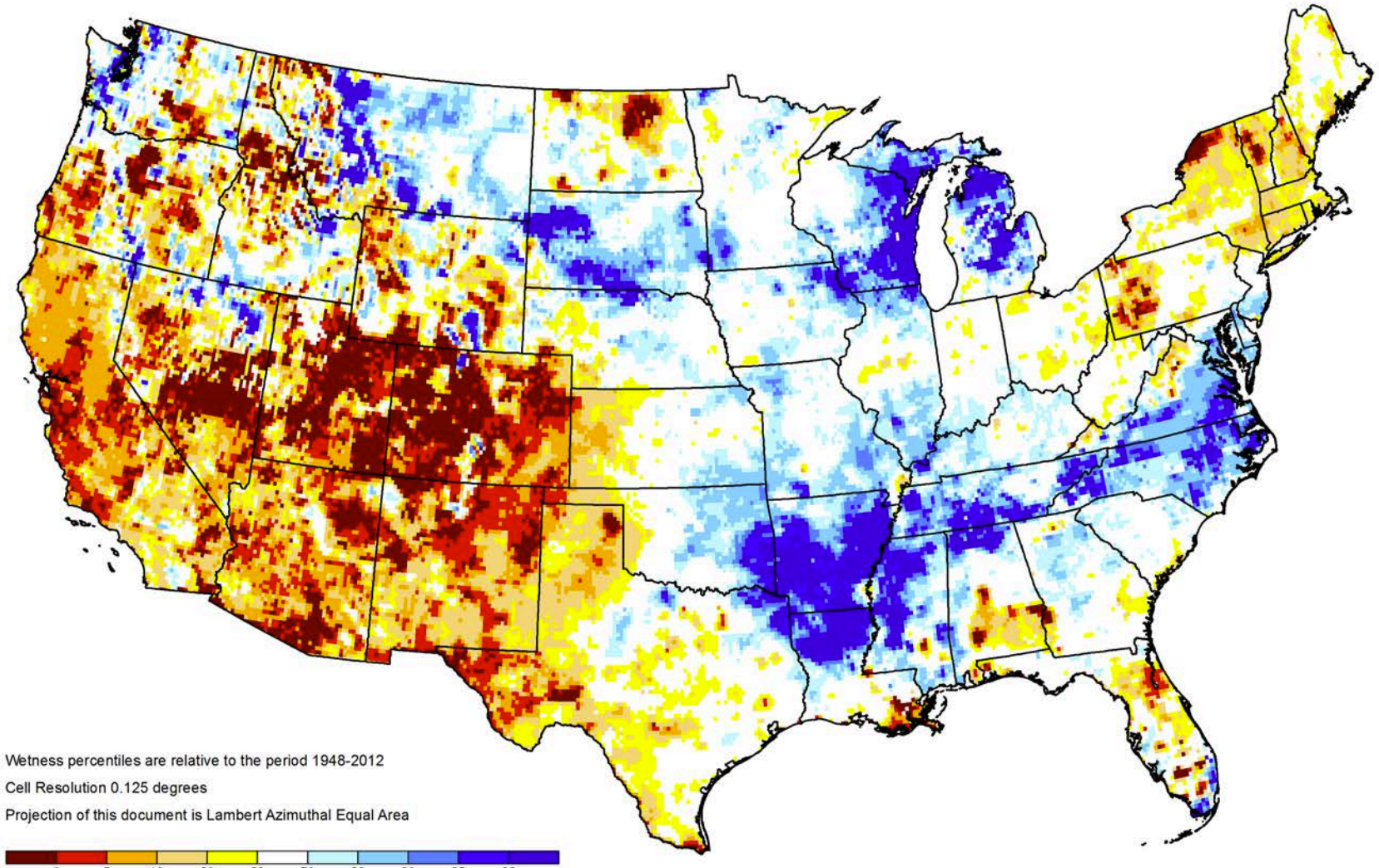
- Long periods of time in which Potential Evapotranspiration exceeds Actual Evapotranspiration without recharge from precipitation



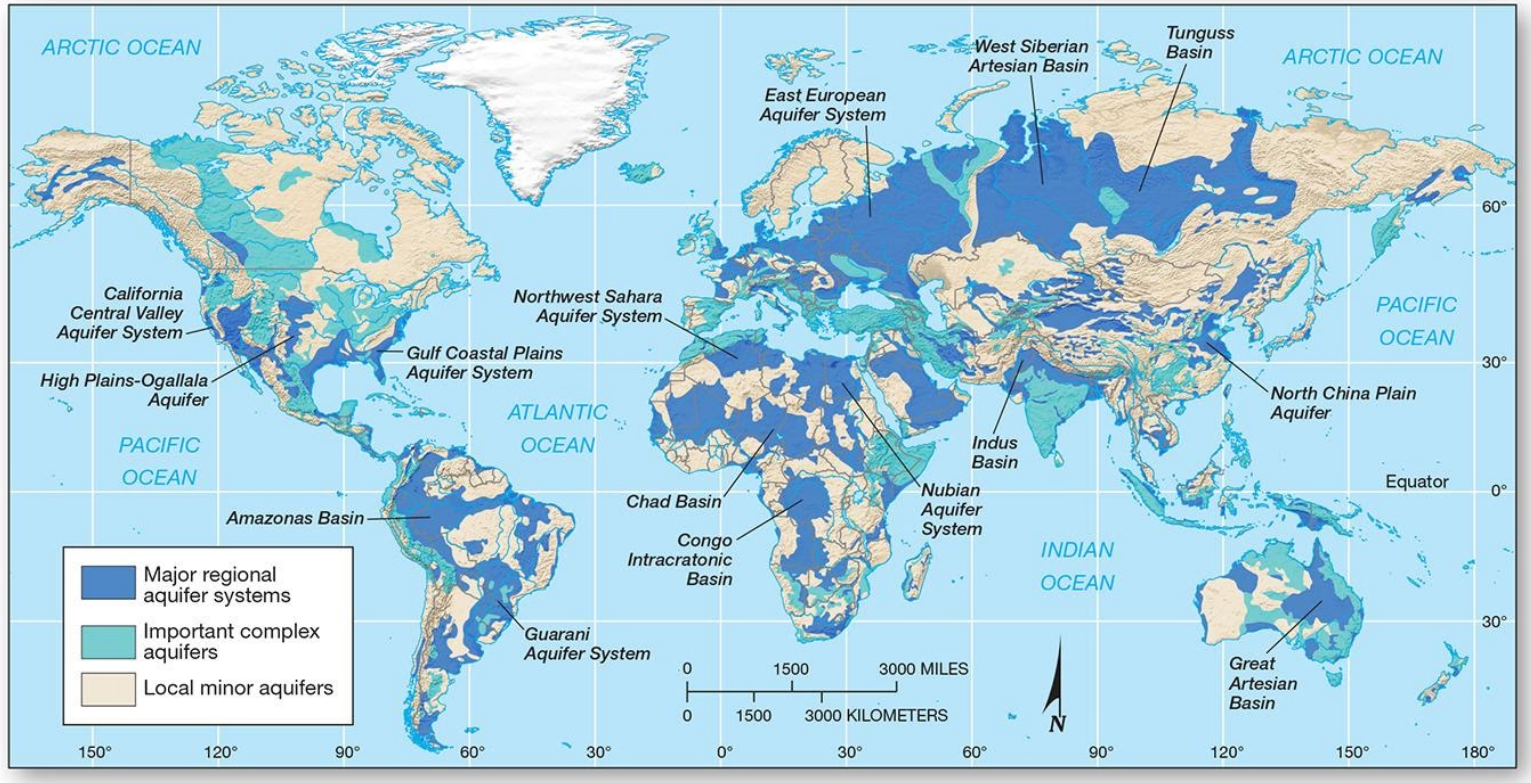

GRACE-Based Shallow Groundwater Drought Indicator
January 18, 2021
Wetness percentiles are relative to the period 1948-2012
Cell Resolution 0.25 degrees
Projection of this document is Times (World)
2 5 10 20 30 70 80 90 95 98
Wetness Percentile
https://nasagrace.unl.edu

GRACE-Based Shallow Groundwater Drought Indicator

January 18, 2021



Groundwater



- Groundwater dependent upon surface water to recharge
- Source of Clean drinking water
  - Too deep and it Brines
- Less affected by short-term droughts

Layers of Ground Water

- Zone of Aeration – Unsaturated zone where pore spaces mainly filled with air
- Zone of Saturation – Pore spaces filled with water (water in these areas classified as Ground Water)
  - Water Table – Upper limit of Zone of Saturation

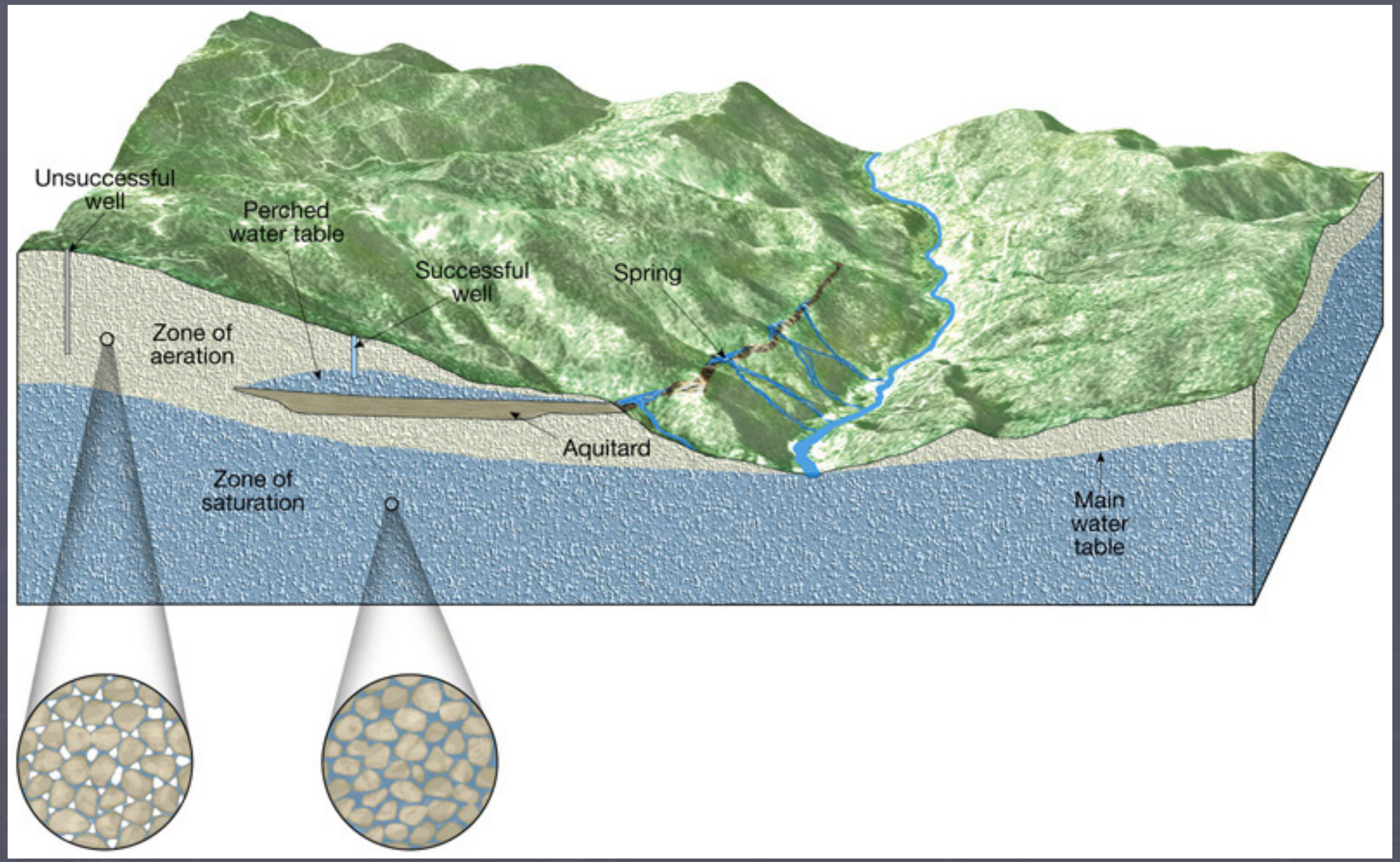
Groundwater Distribution and Movement

Porosity: Percentage of pore spaces

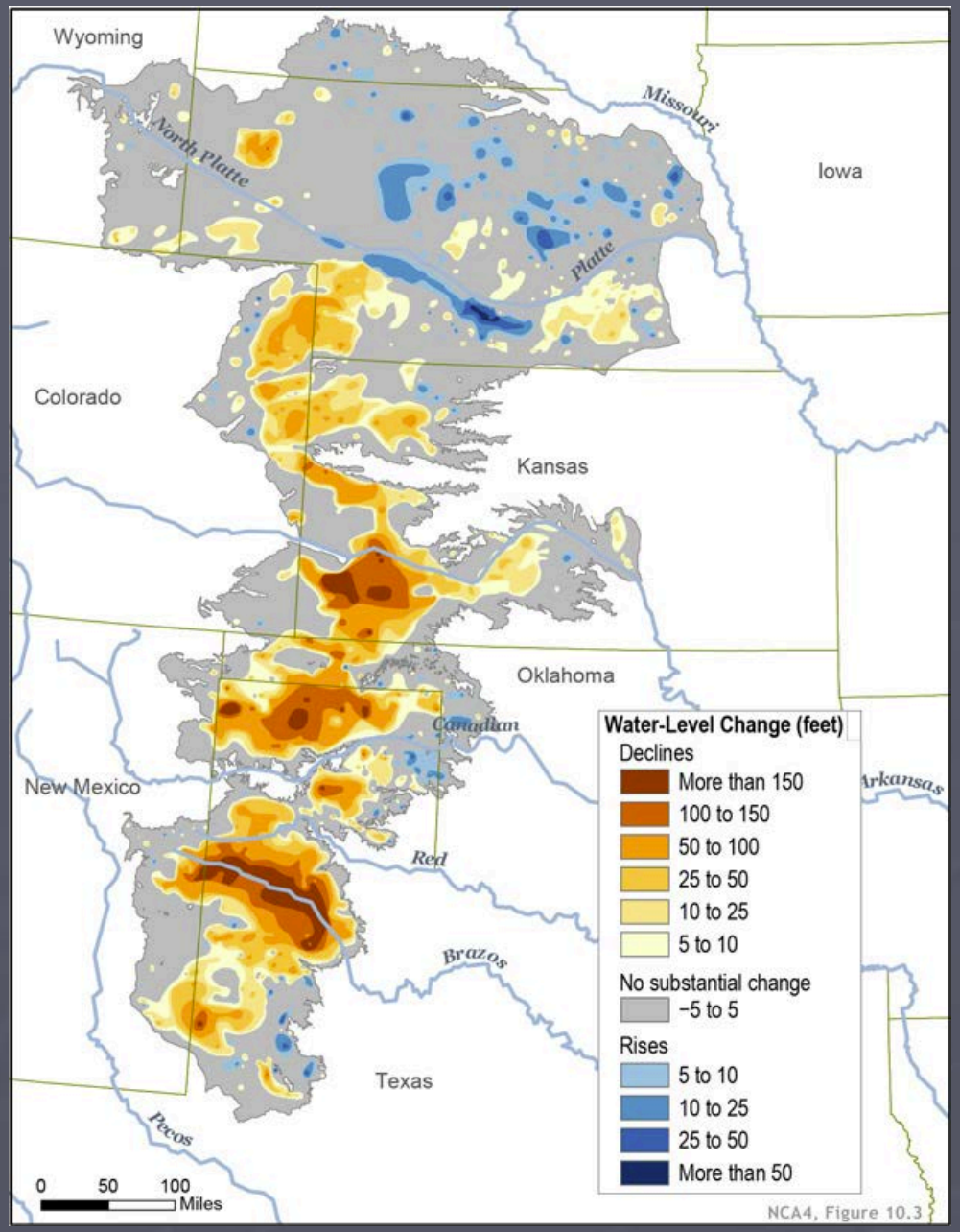
- Determines how much groundwater can be stored

Permeability: Ability to transmit water through pore spaces

- Aquitard/Aquiclude – an impermeable layer of material
- Aquifer – a permeable layer of material

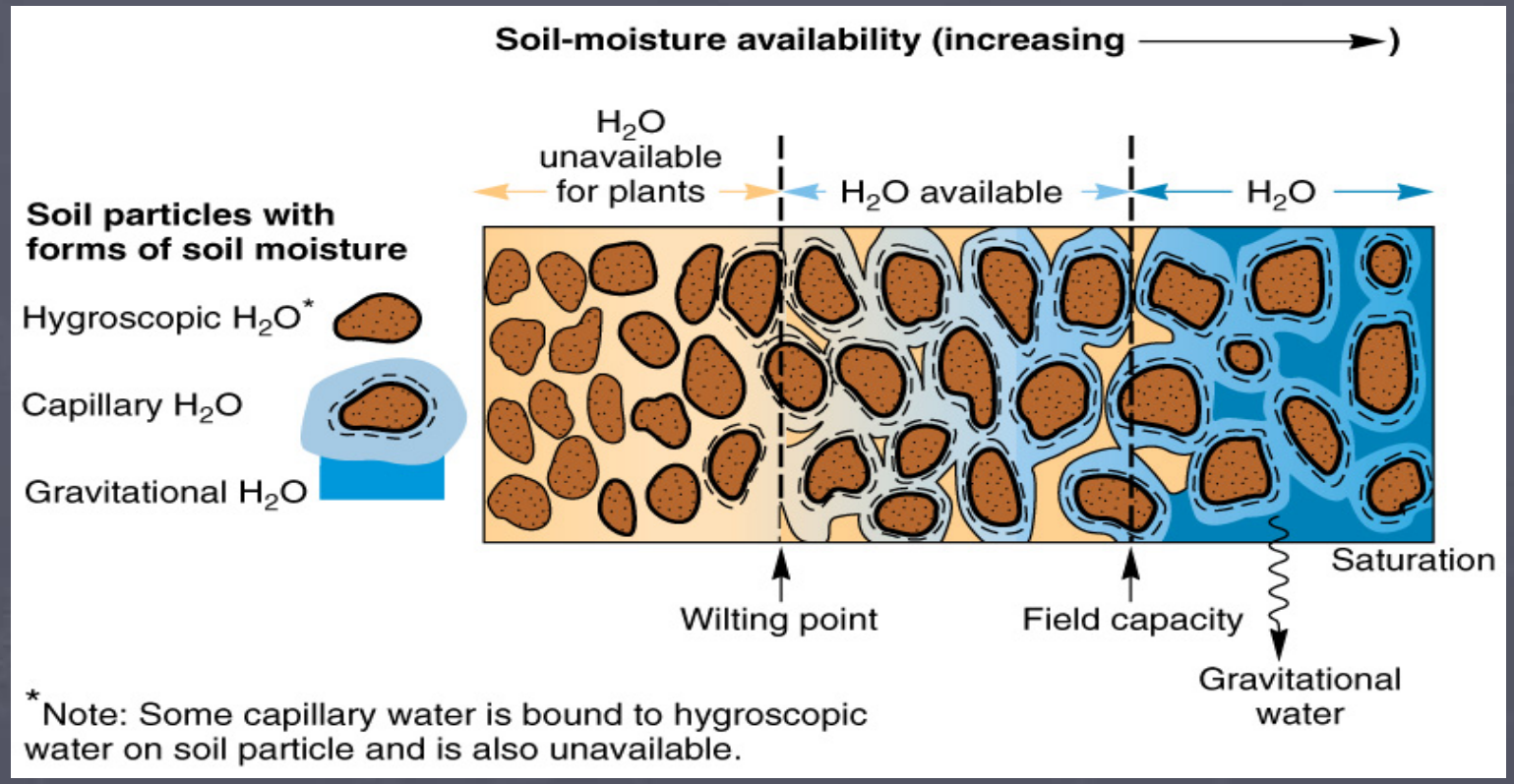

Unsuccessful well
Perched water table
Successful well
Spring
Zone of aeration
Aquitard
Zone of saturation
Main water table

Ogallala Aquifer

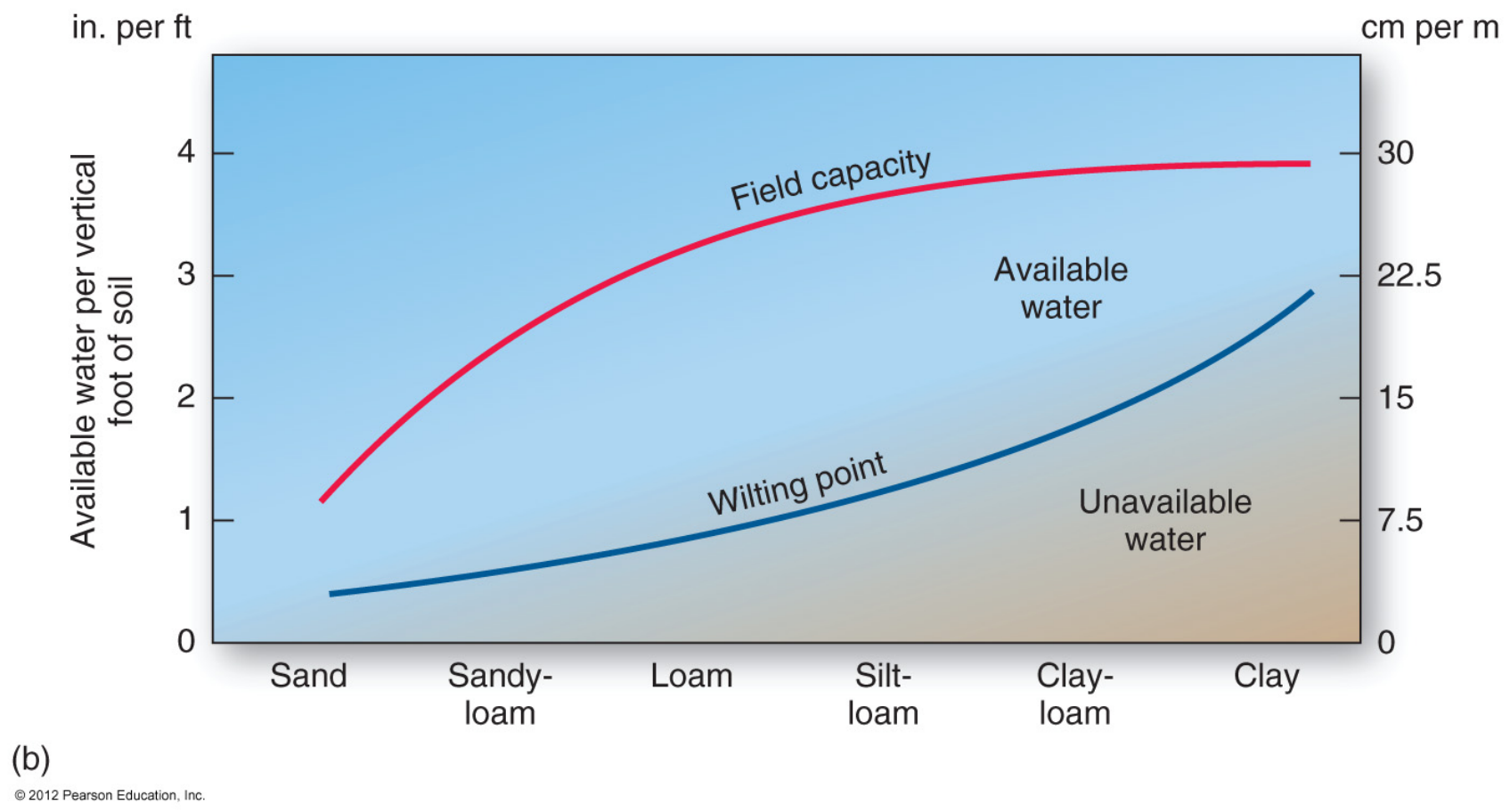


Soil-moisture Availability

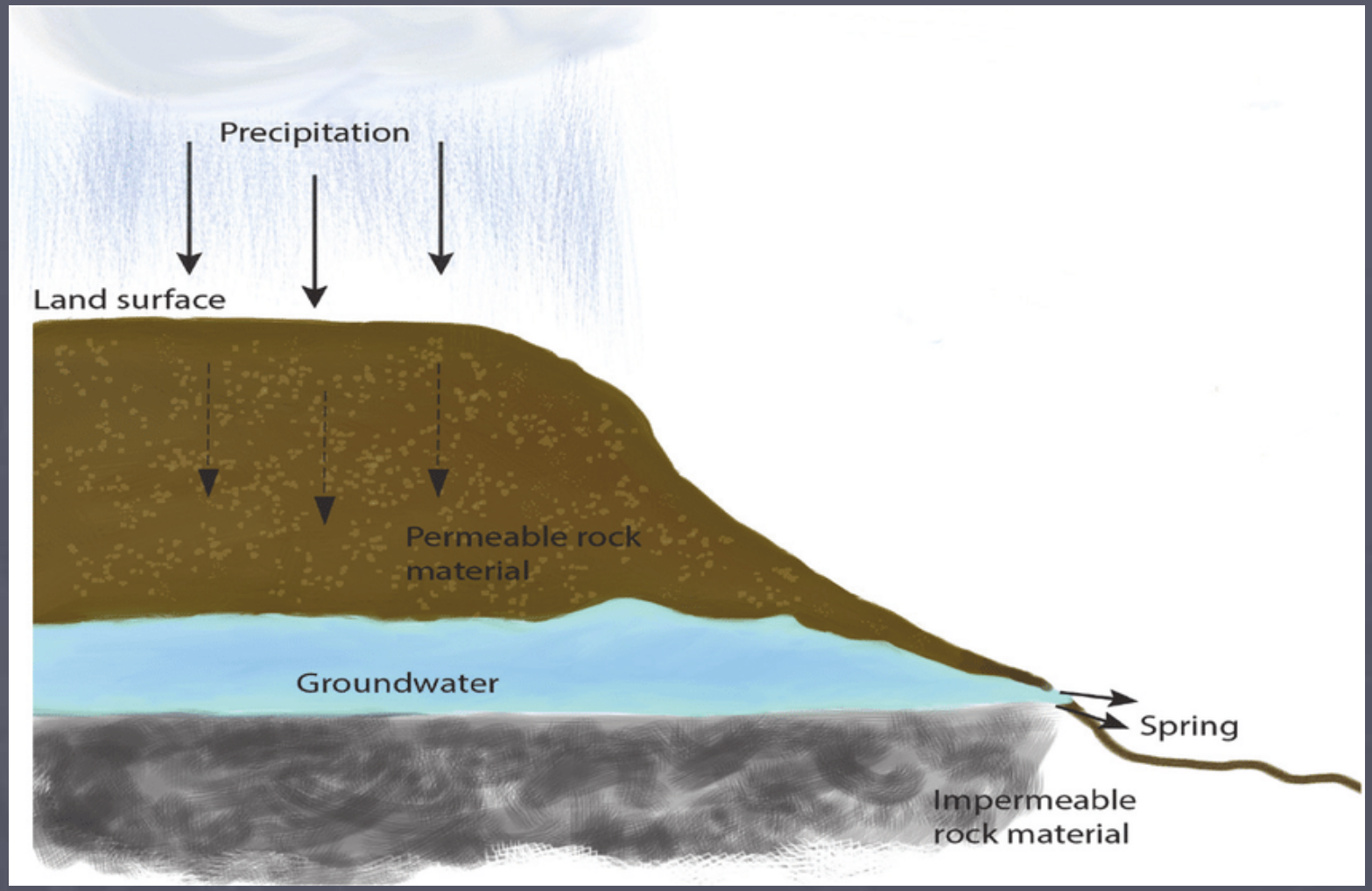
- Soil moisture is either hygroscopic (bound tightly to soil particles and inaccessible to plants) or capillary (accessible to plants)

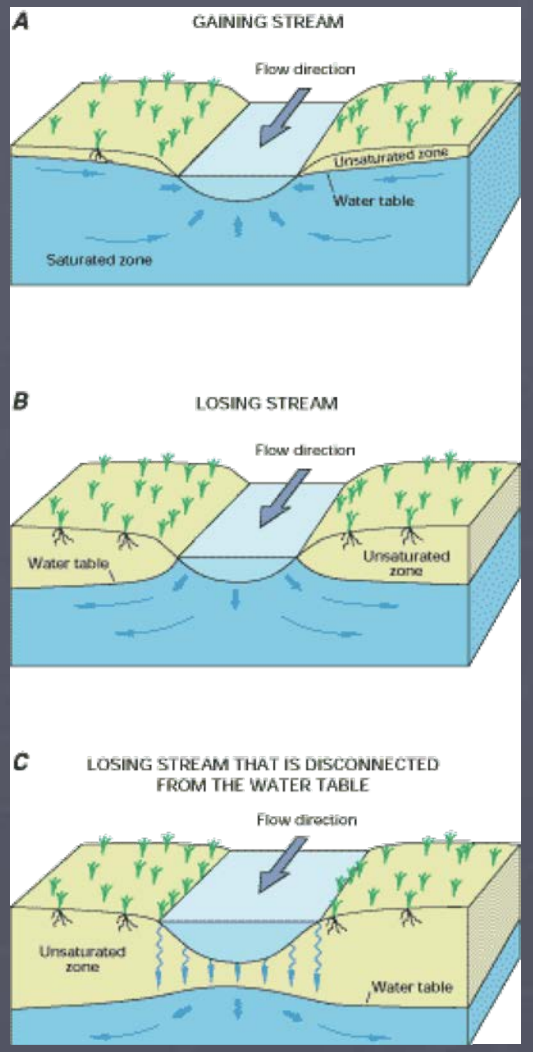


Soil type and Water Availability



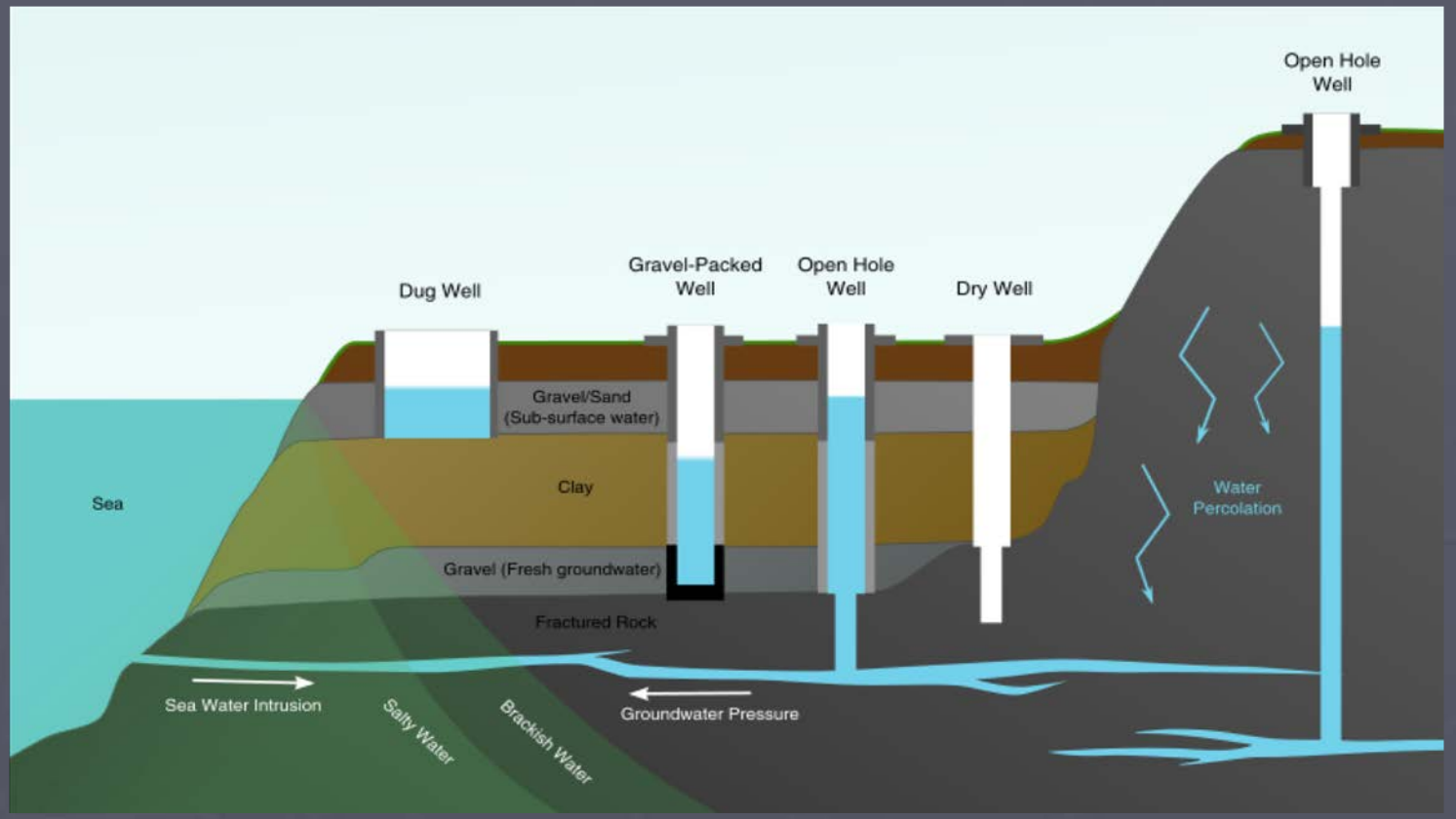
Groundwater's effects on Springs & Streamflow





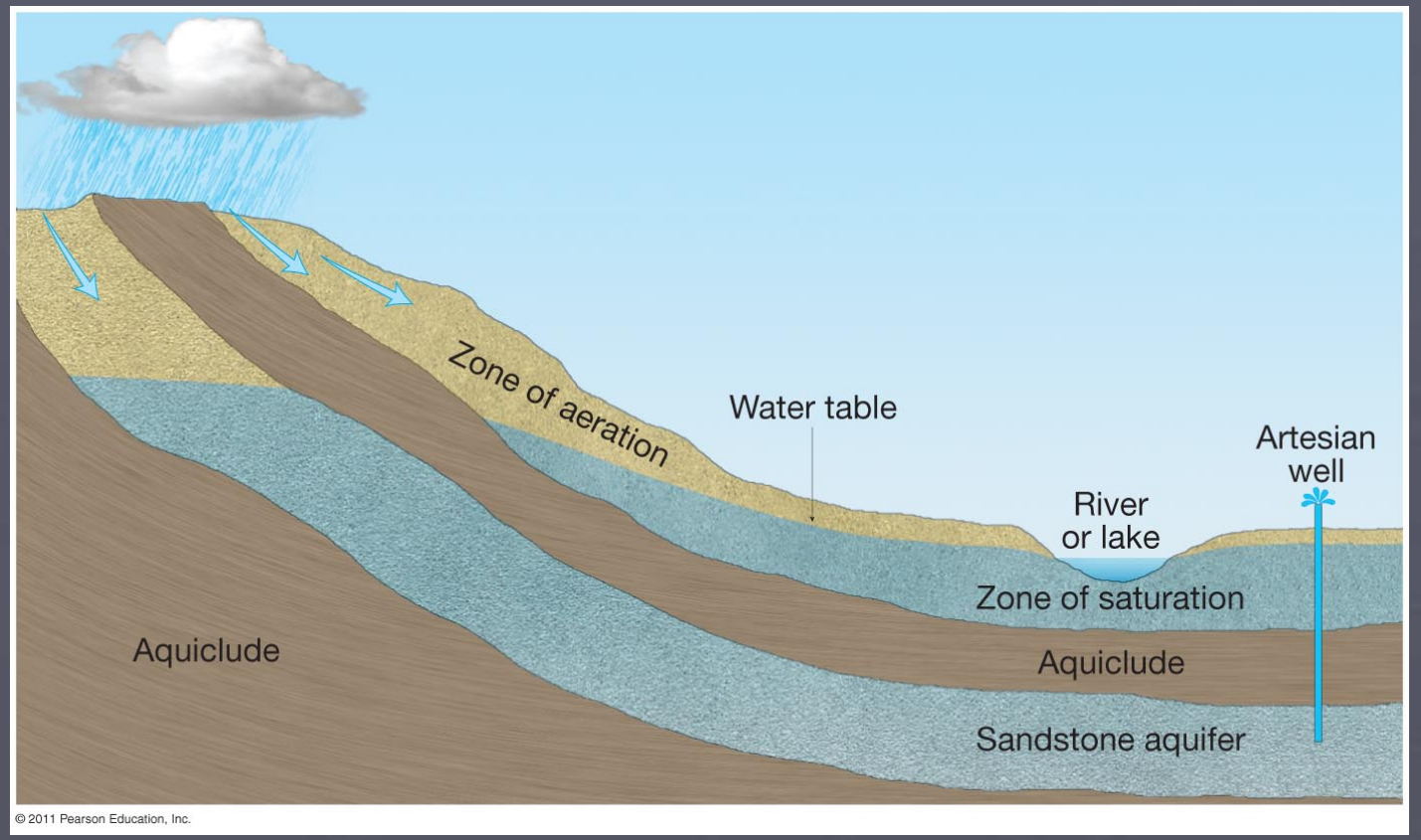
Accessing Groundwater: Wells

- Wells – Holes dug into the surface to reach saturated ground and groundwater

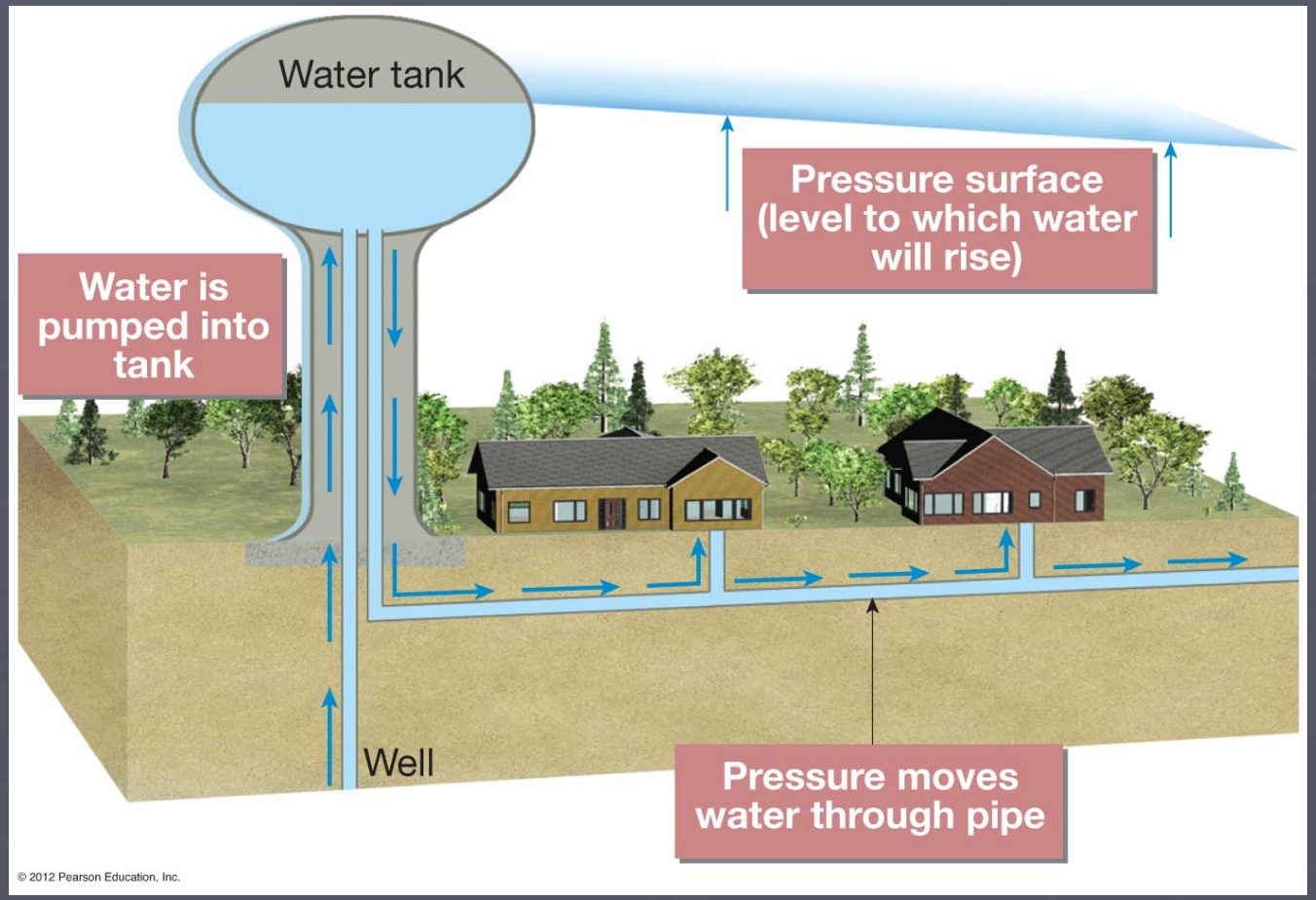


Artesian Wells

- Wells in which ground water rises higher than the well itself
  - Gravity helps create pressure



Wells and Pressure

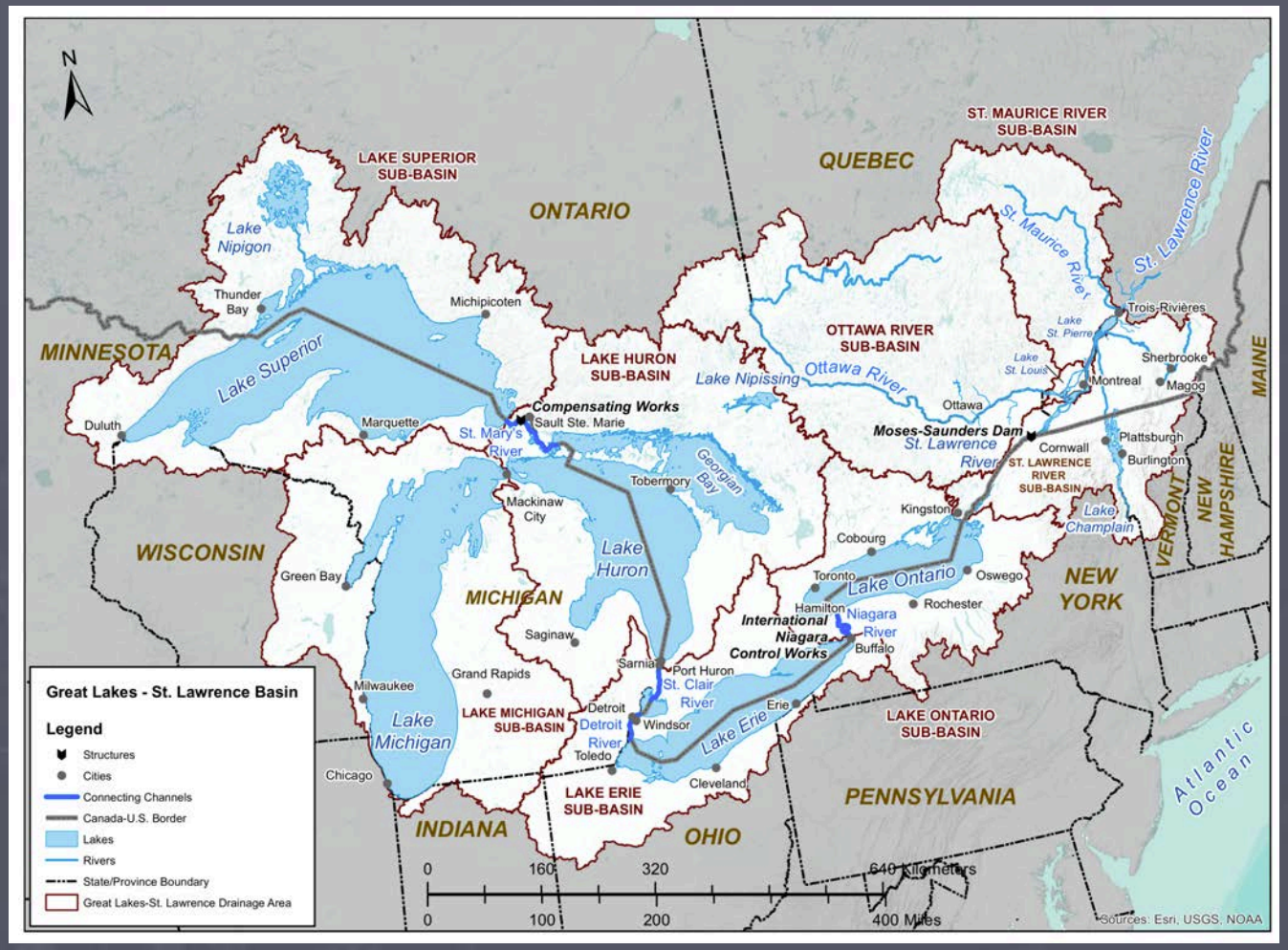


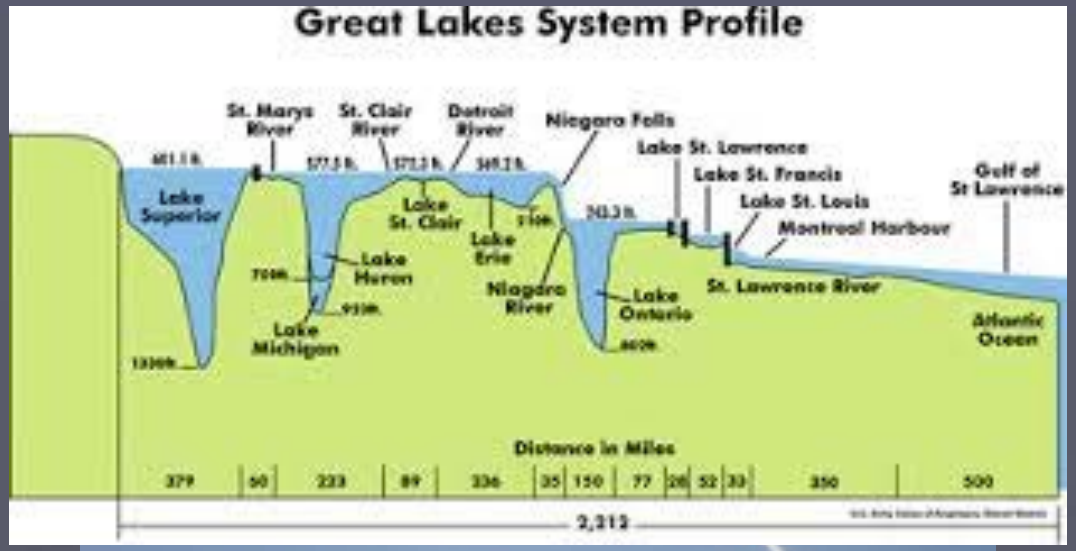
Lakes and the Water Supply

- Freshwater Lakes makeup the largest percentage of accessible fresh water
  - .009% of all water is in freshwater lakes
  - .008% is in saline or saltwater lakes
- Lakes either spring fed, seepage fed, or stream fed

Case Study: Caspian Sea

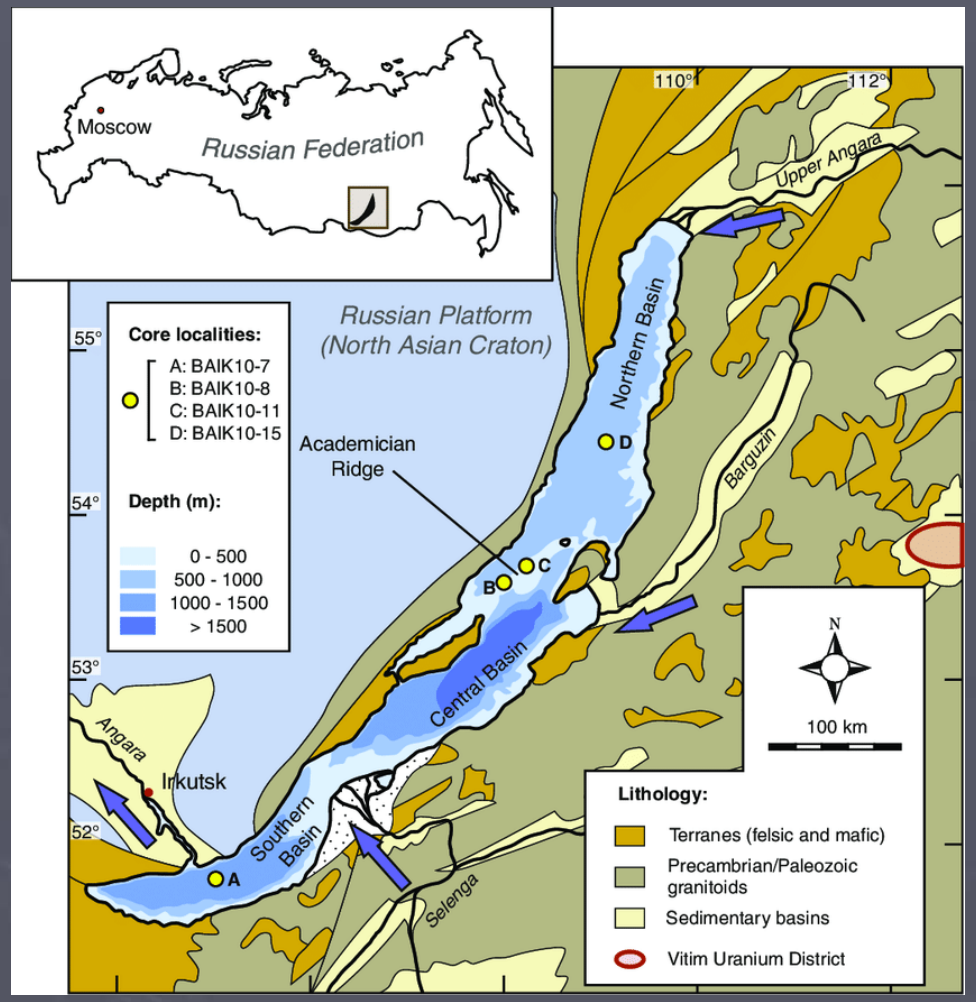
Case Study: Great Lakes

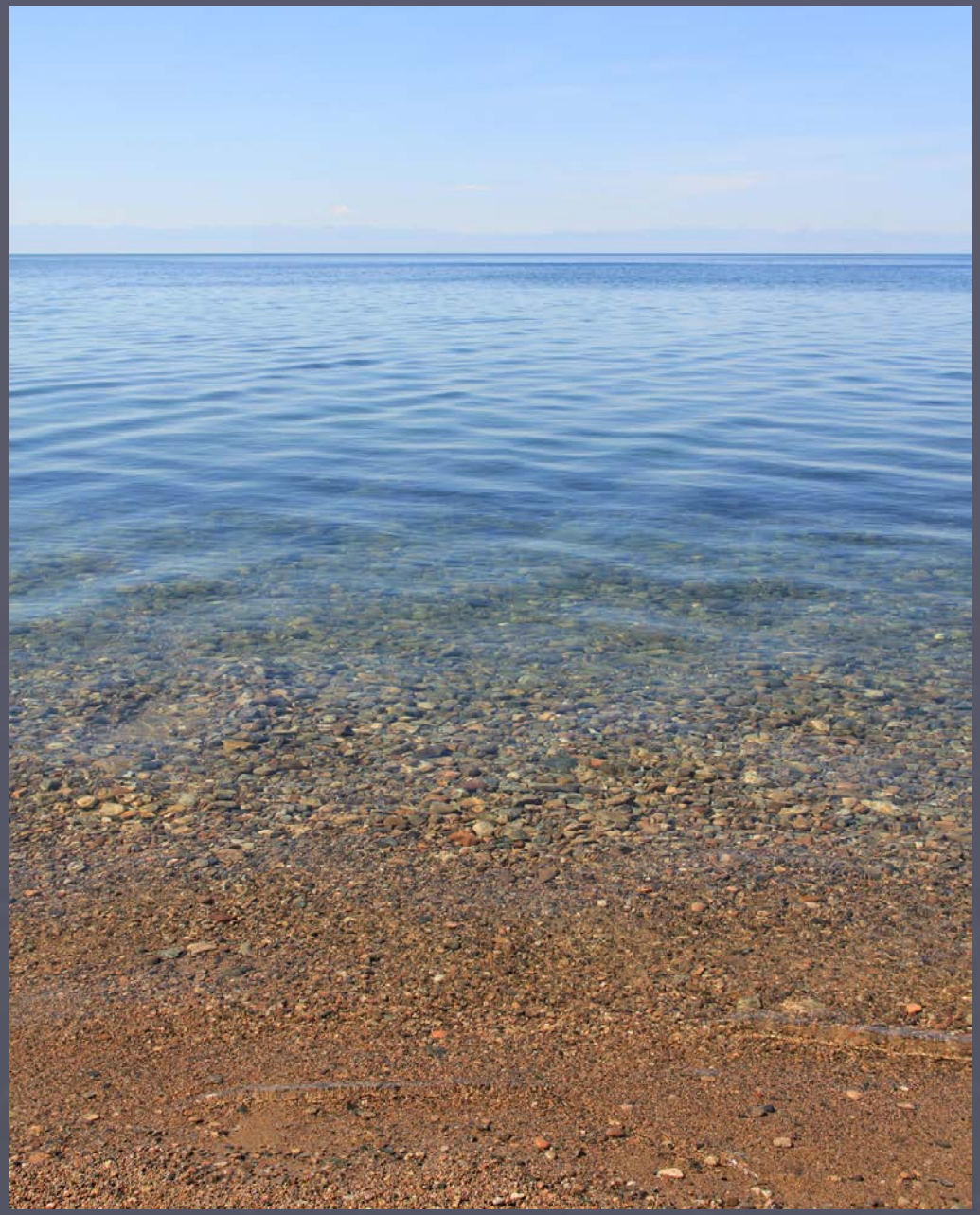




Lake Superior as seen from Two Harbors, Minnesota

Case Study: Lake Baikal



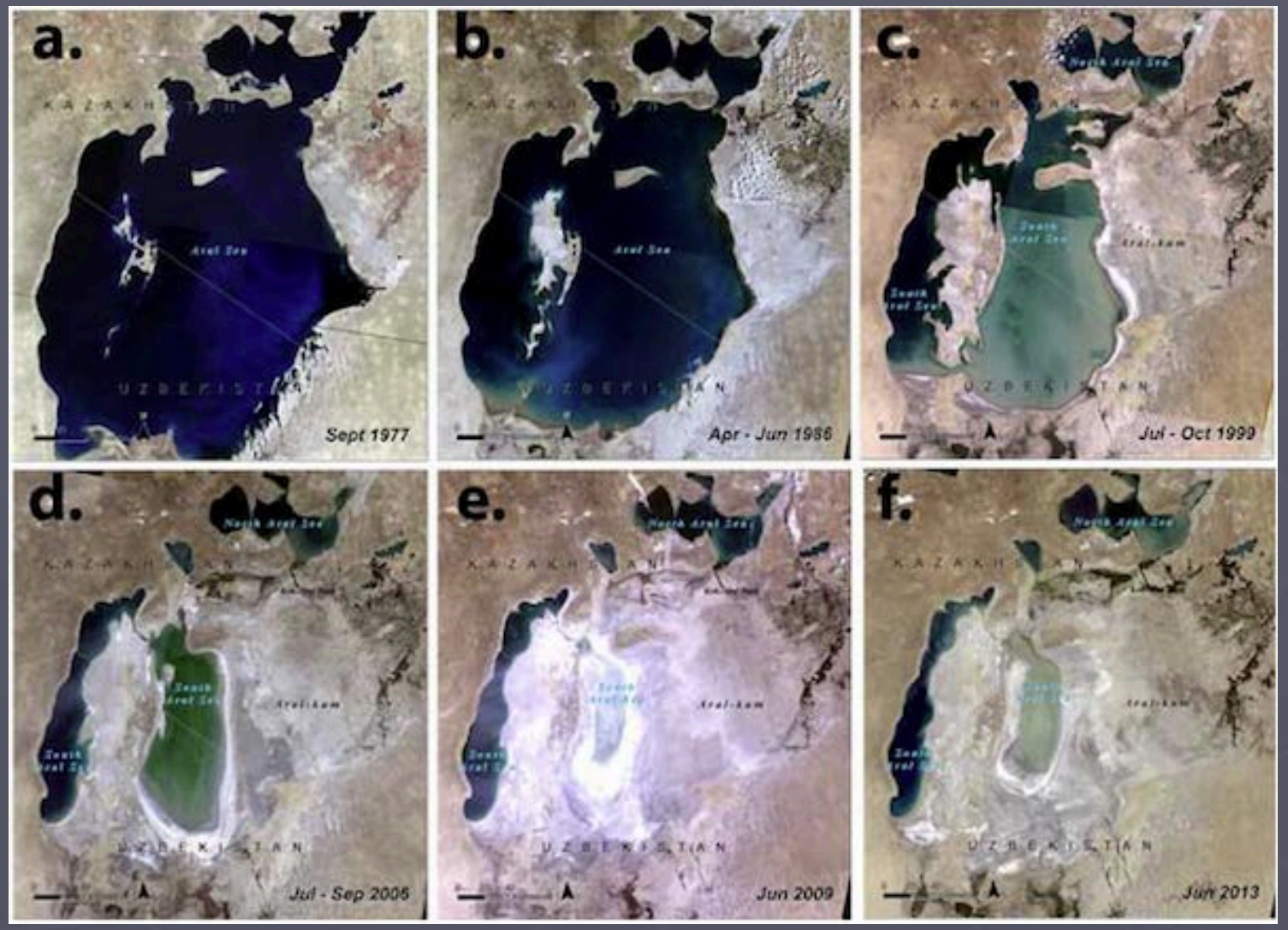


Lake Baikal as seen from Listvyanka, Russia

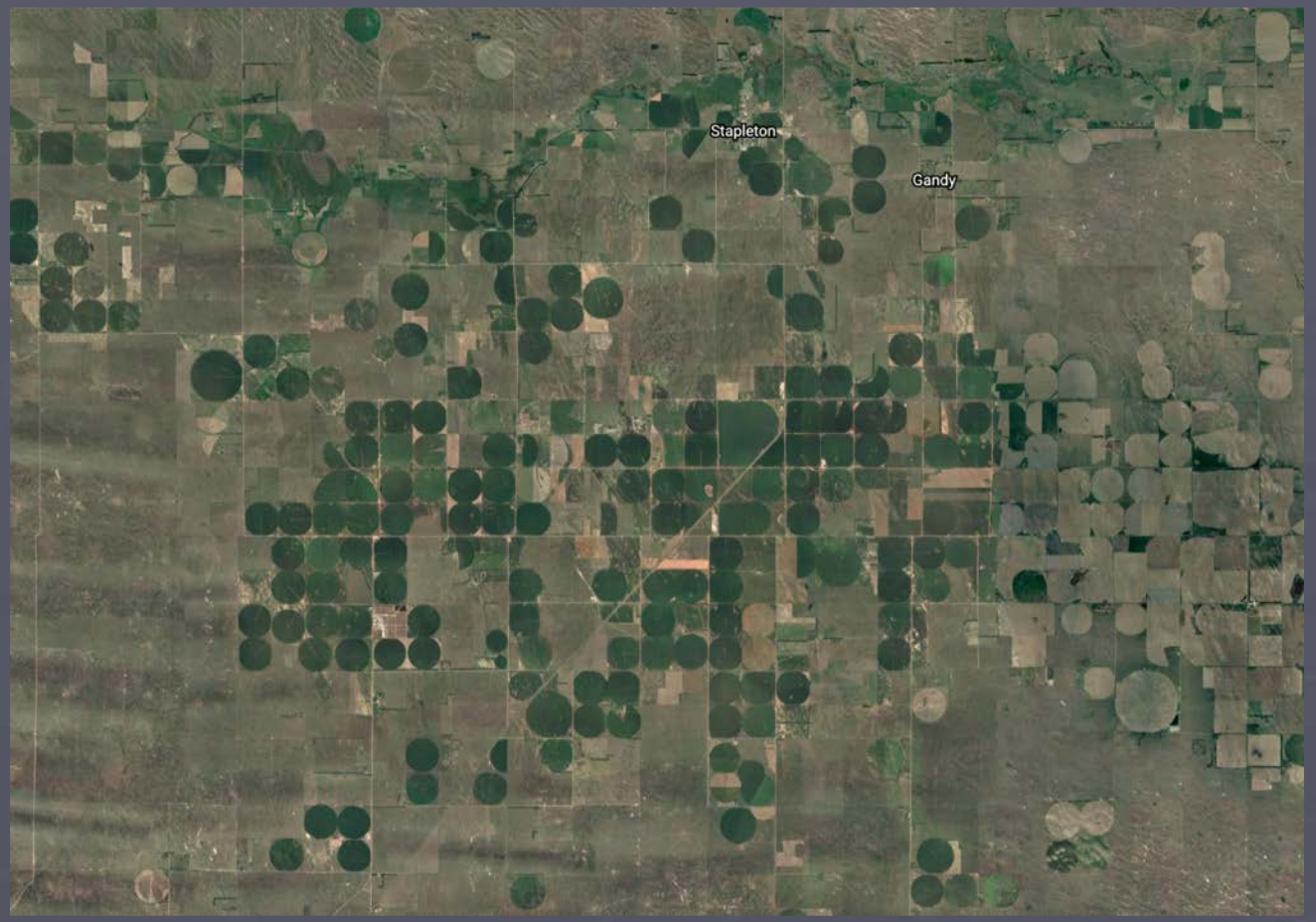
Issues with Water Supply: Overuse

Aerial View of Suburban Las Vegas, Nevada

Case Study: The Aral Sea

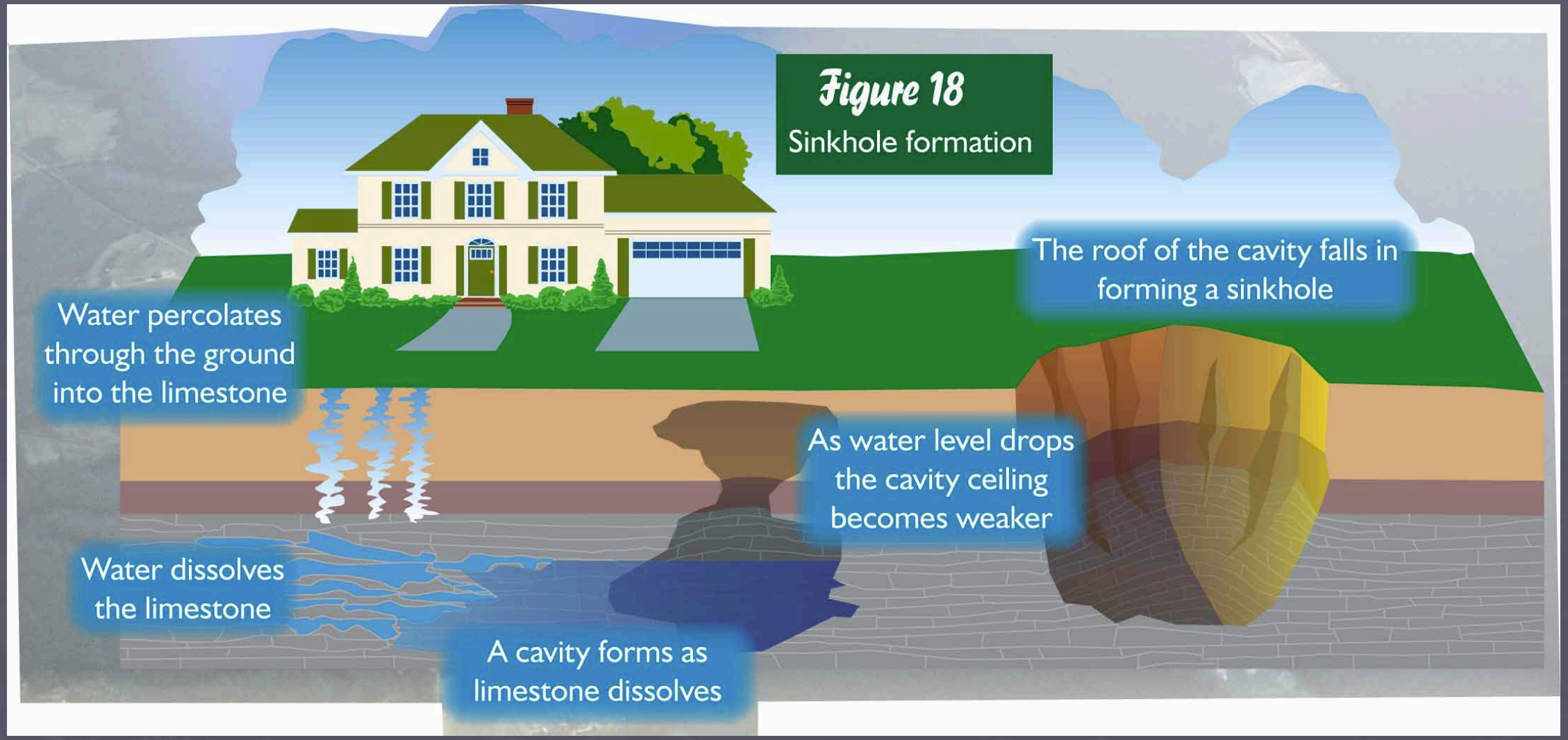


Dependence on Ground Water



Satellite Image from Stapleton, Nebraska

Issues of Groundwater: Sinkholes



Sinkhole in Omaha, Nebraska (2014)

Issues of Groundwater: Contamination