Aquifer Depletion in the United States

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What is an aquifer?

- A body of saturated rock through which groundwater can easily move.

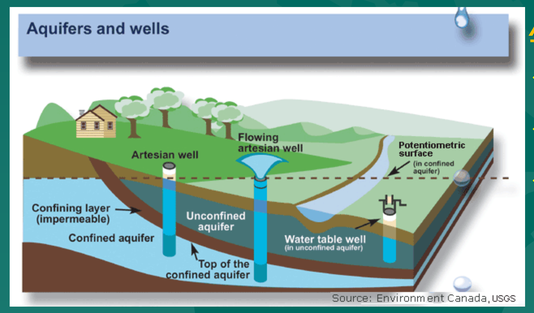

Figure 1: Types of aquifers and wells. Credit: Environment Canada, USGS.

Groundwater from Aquifers

- An aquifer fills with water from rain or melted snow until reaching less permeable rock.
- Wells are drilled into aquifers to extract groundwater.
- Calculating the volume of available groundwater is important.
  - Specific yield (SY) is related to porosity.
  - Saturated thickness (SY) helps convert to actual volume.
  - Volume = Area x ST x SY (Schloss and Buddemeir).

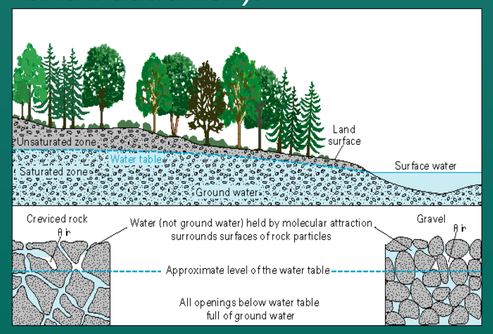

Figure 2: Underground water storage. Credit: USGS

Aquifer types

- Unconfined
- Confined
- Artesian
  - Confined but with water under positive pressure (Altaner).

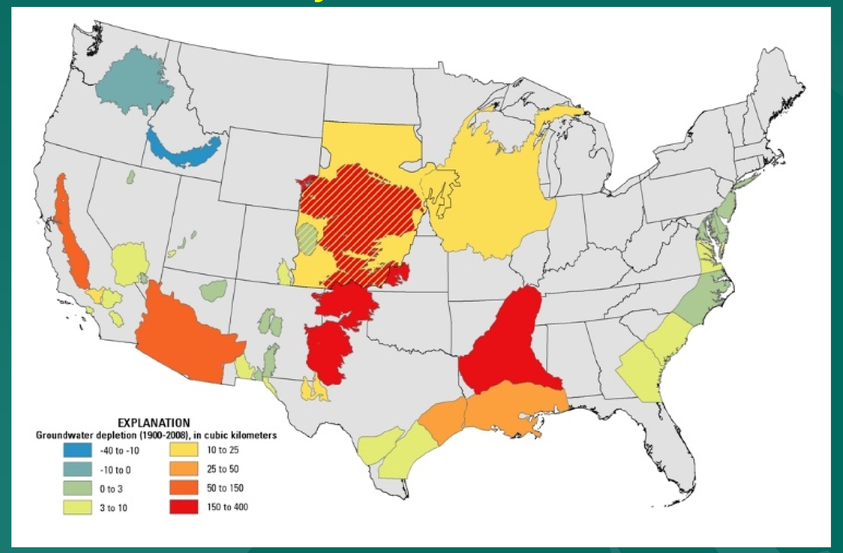

Figure 3: Estimated groundwater depletion in the United States from 1900-2008. Credit: USGS.

Current Usage

- There are 64 aquifer systems in the U.S. -- 30 of them account for 94% of the total water withdrawals.
- Estimated that 79.6 billion gallons of freshwater are removed from these aquifers daily.
- 44% of the U.S. population depends on groundwater for its drinking water.
- Groundwater is withdrawn at 4x the rate it can be replenished (Kenny et al.).

Recent Aquifer Levels

- Some have shown a net increase since 1900, but all have decreased sharply since 1950 (of the 40 in the USGS study).
- Estimated that since 2000 we are depleting groundwater at an average rate of 20 million acre-feet per year (Konikow).

Figure 4: Groundwater removal leads to sinking ground. San Joaquin Valley, CA. Credit: USGS.

Future Issues

- Overuse of groundwater causes the soil to collapse.
  - Ground loses support and dangerous fissures may begin to form.
  - Is expensive; damages from land subsidence in Santa Clara Valley, California approaches $800M (Moran et al.).
- Depleted groundwater leads to expensive drilling in order to reach deeper water reserves.
  - Harmful contamination of groundwater is more likely at greater depths—radium, barium, etc.

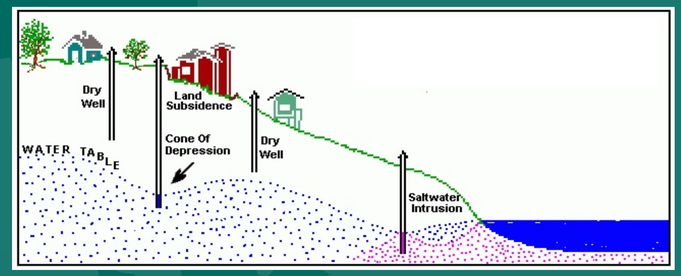

Figure 5: Impacts of over pumping groundwater. Credit: College of Alameda, Physical Geography.

Conclusions

- Aquifers are vital to our water needs.
- Current groundwater usage is not sustainable.
- Costs associated with aquifer depletion are wide-ranging and impactful.
- Water conservation, recycling, and reuse is necessary to ensure future reserves.
- Governmental oversight/privatization may be needed to help regulate usage.

References

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