FWP 73235

Water Quality and Regional Considerations for Class VI Permitting

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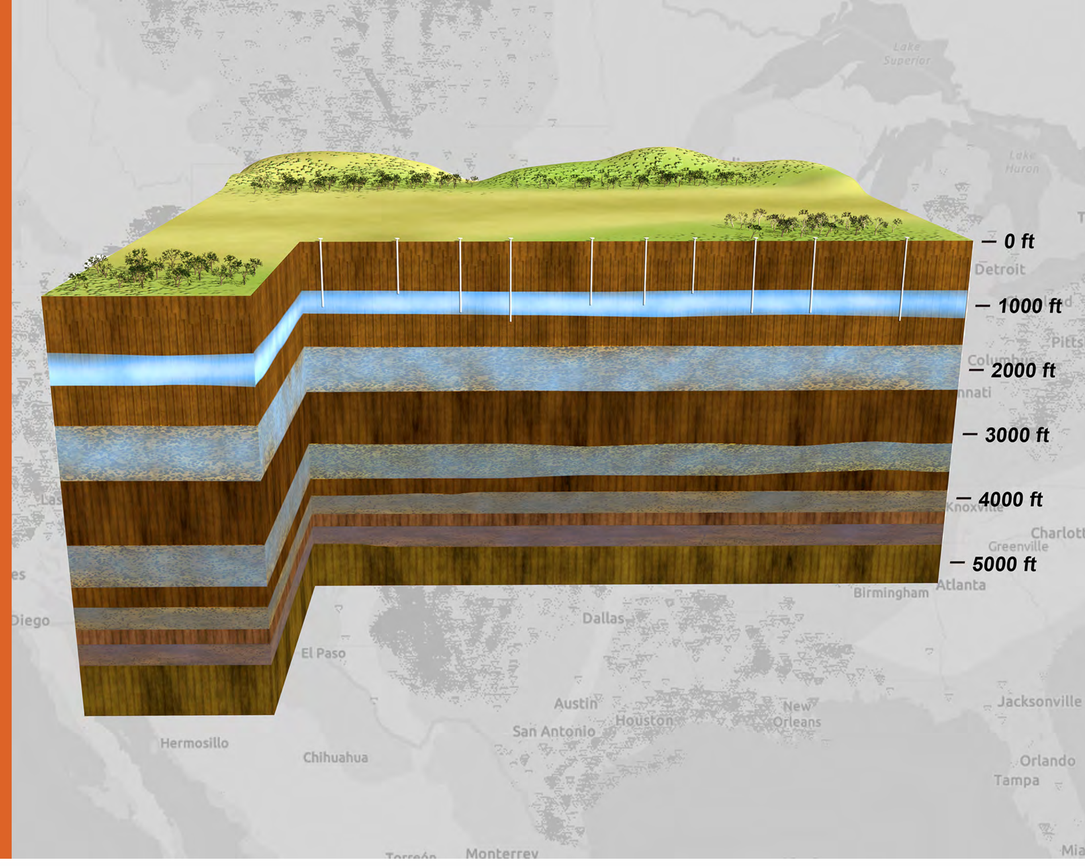
Fundamental Processes → Reservoir Simulations → Deployment & Monitoring



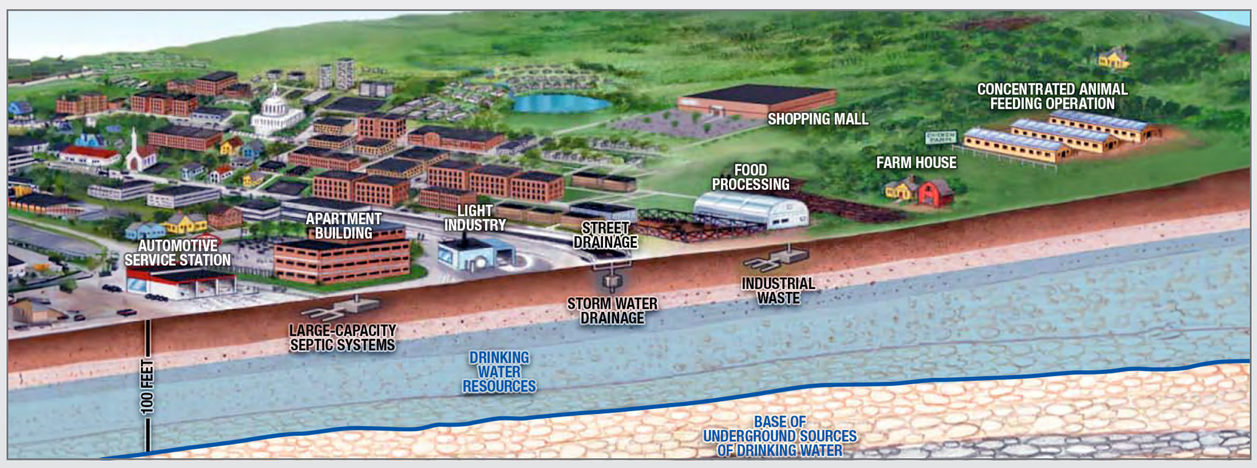
Background

Geologic storage projects traditionally target deep (>800 m), sedimentary, saline (>10,000 mg/L total dissolved solids (TDS)) aquifers per EPA Class VI regulatory guidelines. In geologic settings where sedimentary basins are not available, transport of CO_2 offsite is the primary option for point source emissions.

- Transport expands the project footprint and increases overall project timeline, environmental risk, social impact, and financing requirements.
- Geologic basins in the western U.S. (for example, Washington, Oregon, California, and Wyoming) can experience deep freshwater zones, stranding point source emissions and limiting commercial scale development of CO_2 sequestration.
- Characterizing overlying underground sources of drinking water (USDWs) and injection formation water quality introduces significant uncertainty without stratigraphic test well data.
- Projects risk cancelation if the injection formation fluids are found to be considered a USDW (<10,000 mg/L TDS).

Zonal Isolation: The Key to Aquifer Protection

- Safe and permanent geologic sequestration depends on injection zone hydrologic isolation i.e. prospective CO_2 injection formations be free of faults and fracture and underlie a thick continuous impermeable formation (the confining zone).
- Zonal isolation ensures that injected CO_2 stays within the proposed storage formation and is not in communication with overlying USDWs.



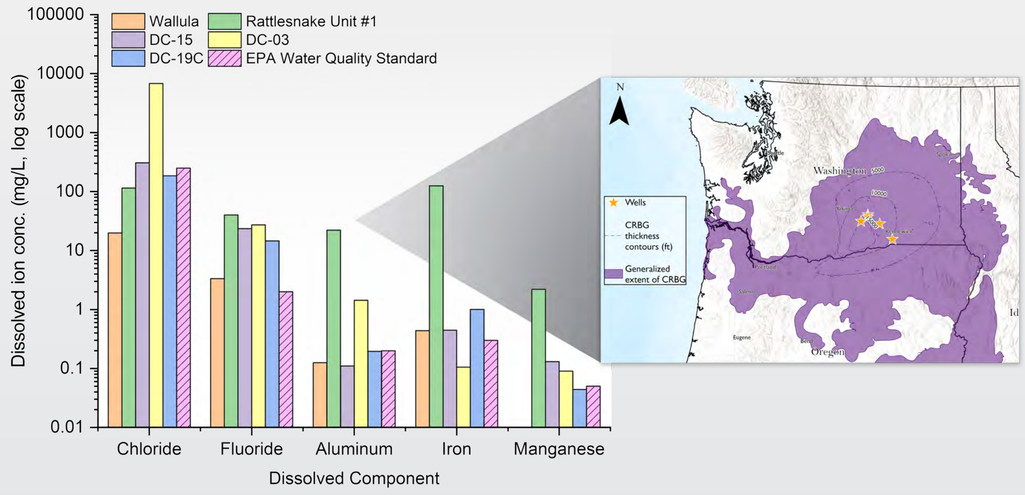
In your community, there may be industrial waste disposal wells, storm water drainage wells, large-capacity septic systems, and other Class V wells. They are regulated and are not allowed to endanger drinking water resources. Source: EPA, Class V Wells for Injection of Non-Hazardous Fluids into or Above Underground Sources of Drinking Water, *https://www.epa.gov/uic/class-v-wells-injection-non-hazardous-fluids-or-above-underground-sources-drinking-water*

Underground Injection Control (UIC) Program & Aquifers

- The EPA's UIC program outlines operational requirements for various types of injection wells spanning Class I through Class VI well types.
- In some states, certain well types can be permitted via state regulatory authorities. Classes I, II, III, and V project developers can apply for an aquifer exemption if the proposed injection interval is not a current or future drinking water source under criteria outlined in CFR146.4.
- Class I, II, III and V injection activities include municipal and industrial wastewater disposal (Class I), saltwater disposal, gas storage, enhanced oil recovery (EOR) (Class II), solution mining (Class III), and non-hazardous fluid disposal (Class V).
- Aquifer exemptions are not available for new Class VI wells or projects that are re-permitted from well classes other than Class II EOR.

Case Study: Columbia River Basalt Aquifers

- Basalt flows typically contain predictable, continuous, low-permeability zones uniquely suited to act as a caprock for geological carbon storage.
- The Grande Ronde formation of the Columbia River Basalt Group (CRBG) is zonally isolated from overlying formations and is a hydraulicly separate and distinct flow.
- Low groundwater flow rates suggest very little aquifer recharge or flow.
- Depth specific hydrochemical data, compiled from deep wells across the CRBG Grande Ronde, suggest water quality is likely unsuitable for irrigation or domestic use (e.g., high fluoride content).
- New technology enables pumping, treatment, and artificial aquifer recharge strategies which could work synergistically with dedicated CO_2 storage and brine extraction to bring water to communities who need it today and into the future.



Conclusions & Outlook

- Zonal isolation is key factor to USDW protection.
- Aquifer related impacts on site selection, characterization, and Class VI permit development: aquifer recharge, community water use, hydraulic communication, hydraulic head, and water quality factors apart from salinity.
- Consideration for CO_2 mineralization water requirements and pressure management strategies.
- Treatment options for aquifers which contain constituents that impact public health but are less than <10,000 TDS salinity and therefore considered USDWs.
- Evaluate water recharge strategies to facilitate public access to water resources while storing CO_2 in deeper formations.
- Future work needed to better understand water quality evolution in a CO_2 mineralization system.

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July 2024