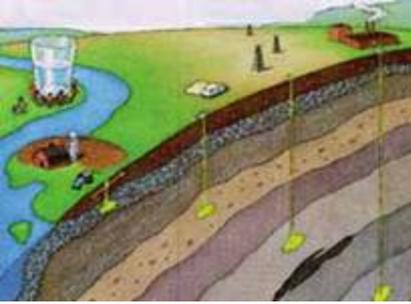


Geologic Sequestration of Carbon Dioxide EPA Proposed Rulemaking



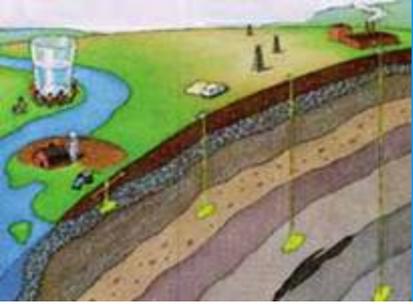
**U.S. Environmental Protection Agency Region 7
Drinking Water Management Branch
UIC Program**

December 16, 2008



Proposed Rule: *Statutory Authority*

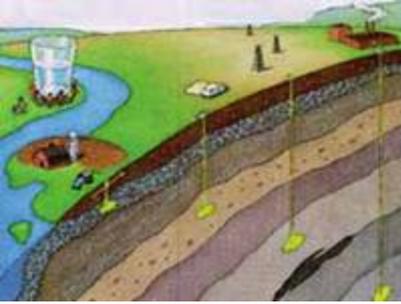
- 1974 SDWA
 - Regulating Nation's Drinking Water Supply
 - Amended 1986 and 1996
 - Protect Drinking Water and Its Sources
 - USDW:
 - Any aquifer or portion of an aquifer that contains water that is less than 10,000 PPM total dissolved solids or contains a volume of water such that it is a present, or viable future, source for a Public Water Supply System
- UIC Program Provision of SDWA
 - Regulates underground injection of *all fluids* – liquid, gas, or slurry
 - Baseline for GS of CO₂



UIC Background: *Contaminant Pathways*

- Faulty Well Construction
- Abandoned Wells Penetrating Injection Zone
- Faults or Fractures in Confining Strata
- Direct Injection into USDW
- Displacement of Fluid into Hydraulically Connected USDWs

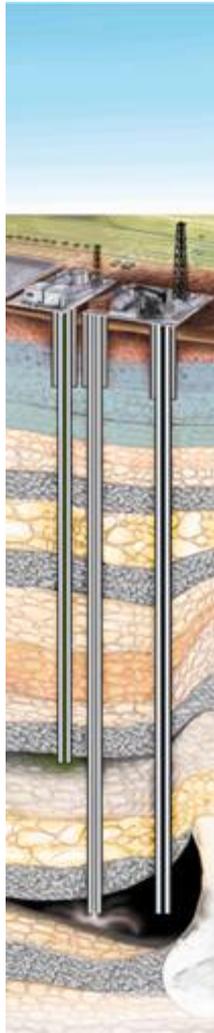
UIC Background: *UIC Well Classes*



Class I



Class II

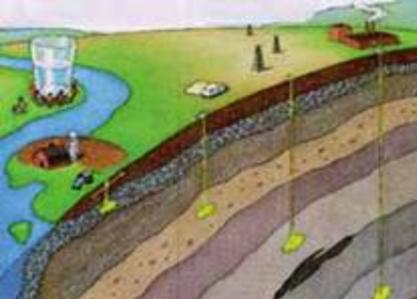


Class III



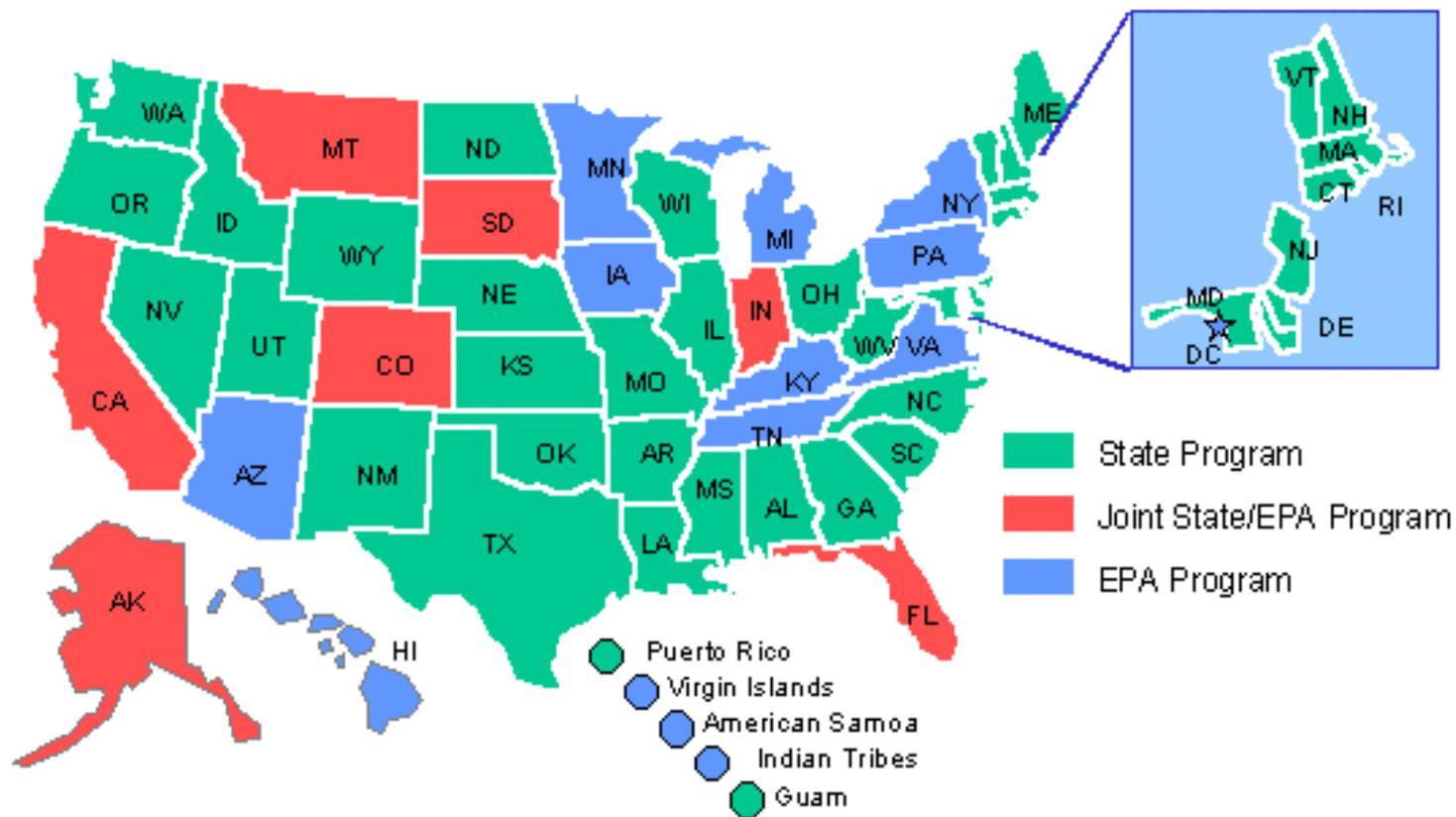
Class V

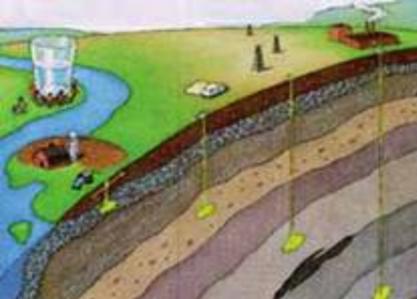




UIC Background: *Primacy*

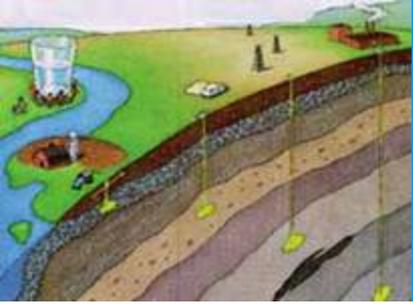
- 33 States have primary enforcement authority (primacy) for the UIC program; EPA and States share program implementation in 7 States; EPA directly implements the entire UIC Program in 10 states





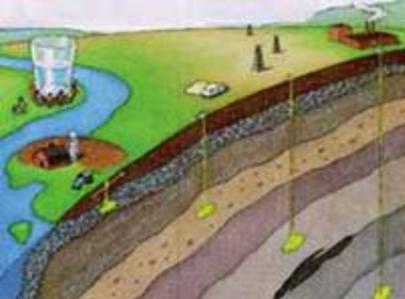
Proposed CO₂ GS Rule: *Schedule of Development*

- October 11, 2007: EPA Announces Plans for Developing Proposed Rule for Geologic Sequestration (GS) of CO₂
- November 2007: Regulatory Workgroup Convenes
- December 2007 & February 2008: Stakeholder Meetings
- May-June 2008: Interagency Review
- July 15, 2008: Signed by Administrator
- July 25, 2008: Federal Register Public Notice on Proposed rule
 - 120 day Public Comment Period Ends November 24, 2008
 - Extended Until December 30, 2008
 - Public Hearings September 30 and October 2
- Notice of Data Availability (if appropriate) in 2009
- Final UIC Rule for GS of CO₂ in Late 2010/Early 2011



Proposed CO2 GS Rule: *Scope*

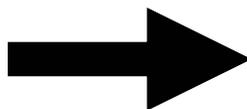
- Limited to SDWA Authority
- Does Not Address Accounting for Climate Impacts
- Takes Into Consideration Unique Properties of CO2
- Adapts to Existing UIC Program Framework
- Creates New Class of Injection Well



Proposed CO₂ GS Rule: *Approach to Rulemaking*

Special Considerations for GS

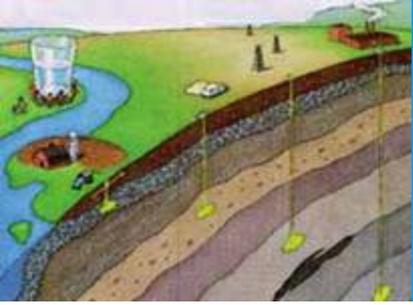
- Large Volumes
- Buoyancy
- Viscosity (Mobility)
- Corrosivity



UIC Program Elements

- Site Characterization
- Area Of Review
- Well Construction
- Well Operation
- Site Monitoring
- Well Plugging and Post-
Injection Site Care
- Public Participation
- Financial Responsibility
- Site Closure

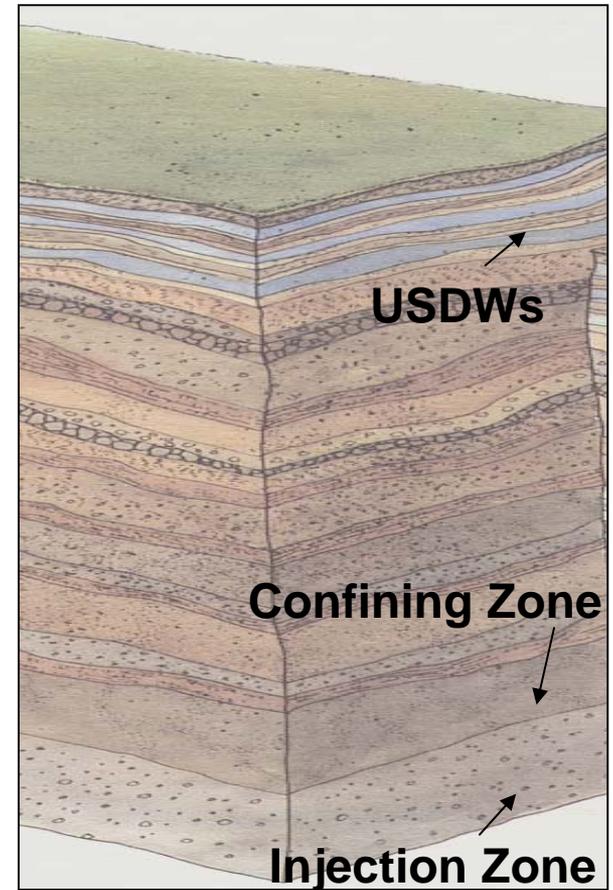
Develop new well
class for GS –
Class VI

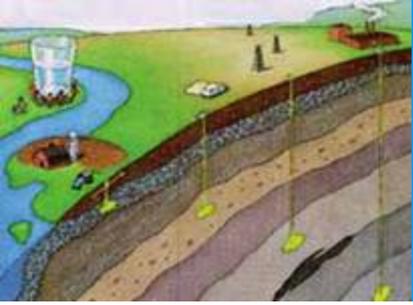


Proposed CO2 GS Rule: *Site Characterization*

Basic requirements:

- Injection zone that can accept fluids
- Confining zone (system) above the injection zone, that contains all fluids

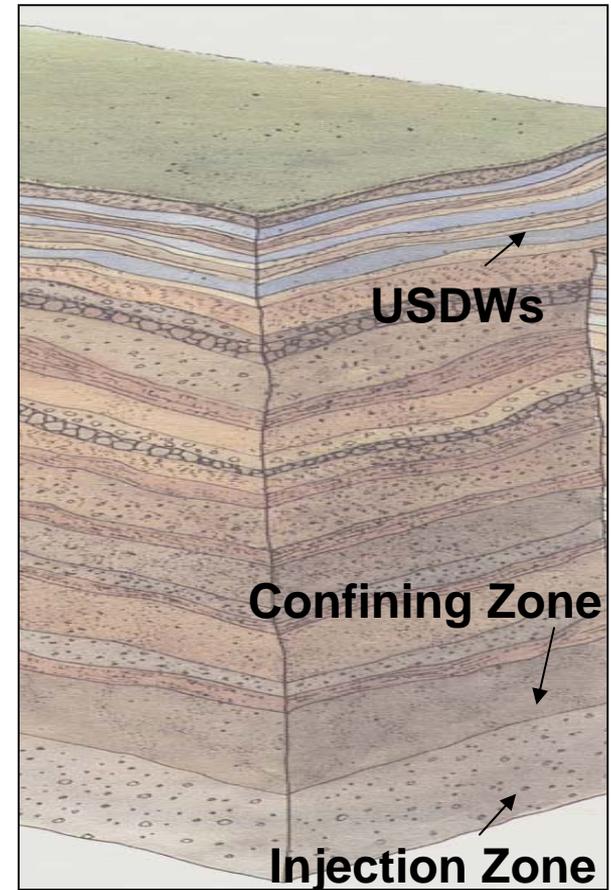




Proposed CO2 GS Rule: *Site Characterization*

Proposed Approach

- Director has discretion to require identification of additional confining zones
- Owners and Operators submit information on the following:
 - Structure and stratigraphy
 - Seismicity
 - Baseline geochemistry

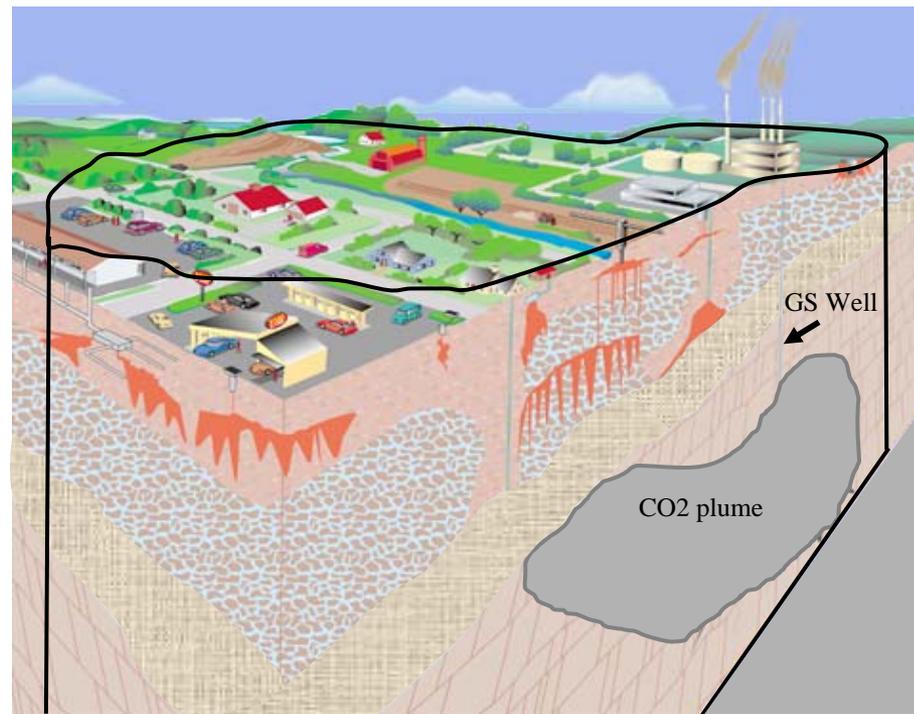


Proposed CO2 GS Rule: *Area of Review (AoR)*

AoR: The region surrounding the project that may be impacted by injection activity

Basic requirements

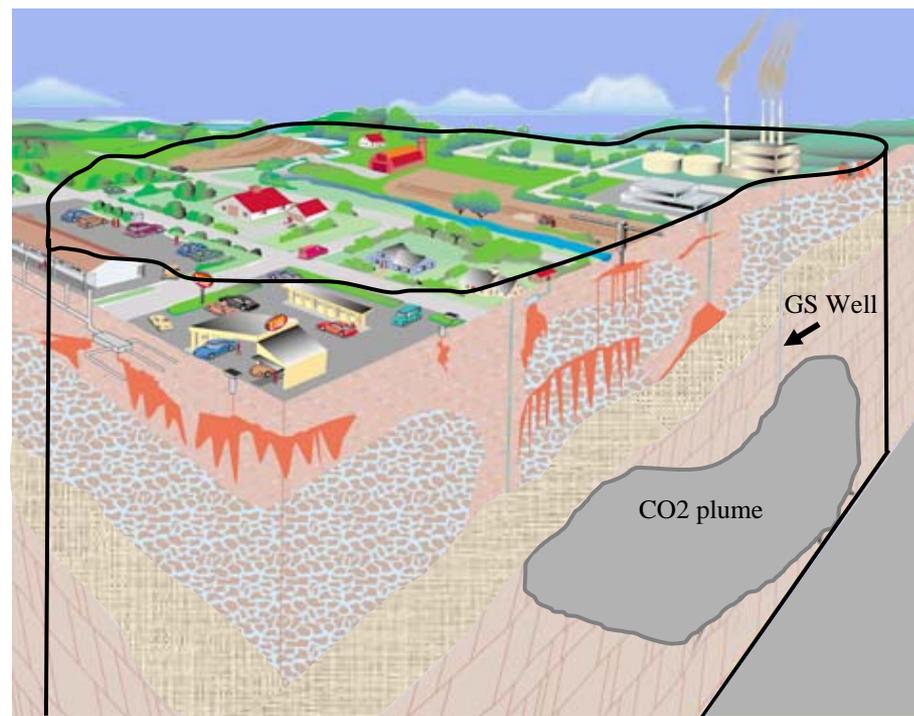
- Delineate the AoR
- Identify and evaluate all artificial penetrations and other features that may allow upward migration of fluids
- Plug and or remediate as appropriate

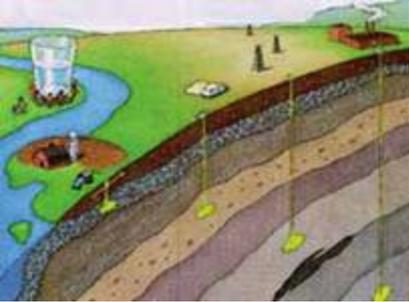


Proposed CO2 GS Rule: *Area of Review (AoR)*

Proposed Approach

- Use computational modeling
- AoR reevaluation at a minimum of every 10 years
- Use phased corrective action at Director's discretion

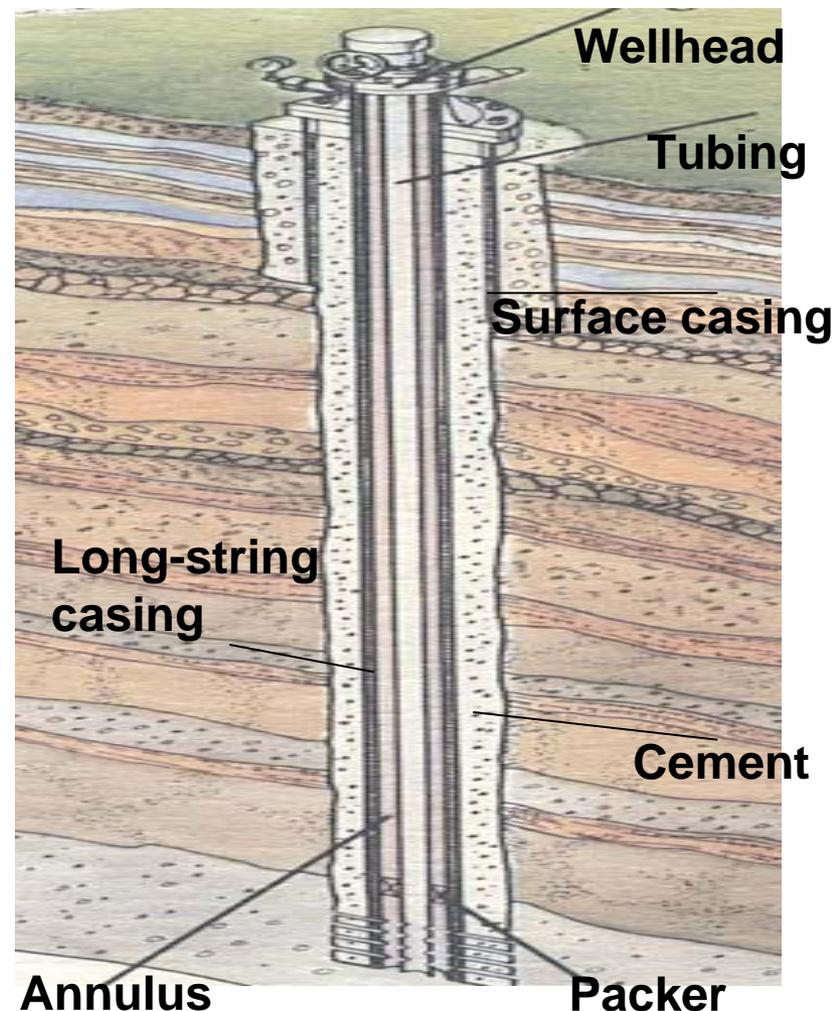


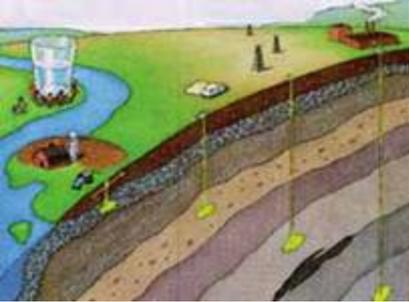


Proposed CO2 GS Rule: *Well Construction*

Basic requirements

- Well components engineered to ensure protection of USDWs
 - Cased and cemented to prevent movement of fluids into an USDW
 - Surface casing and long string casing
 - Tubing and packer

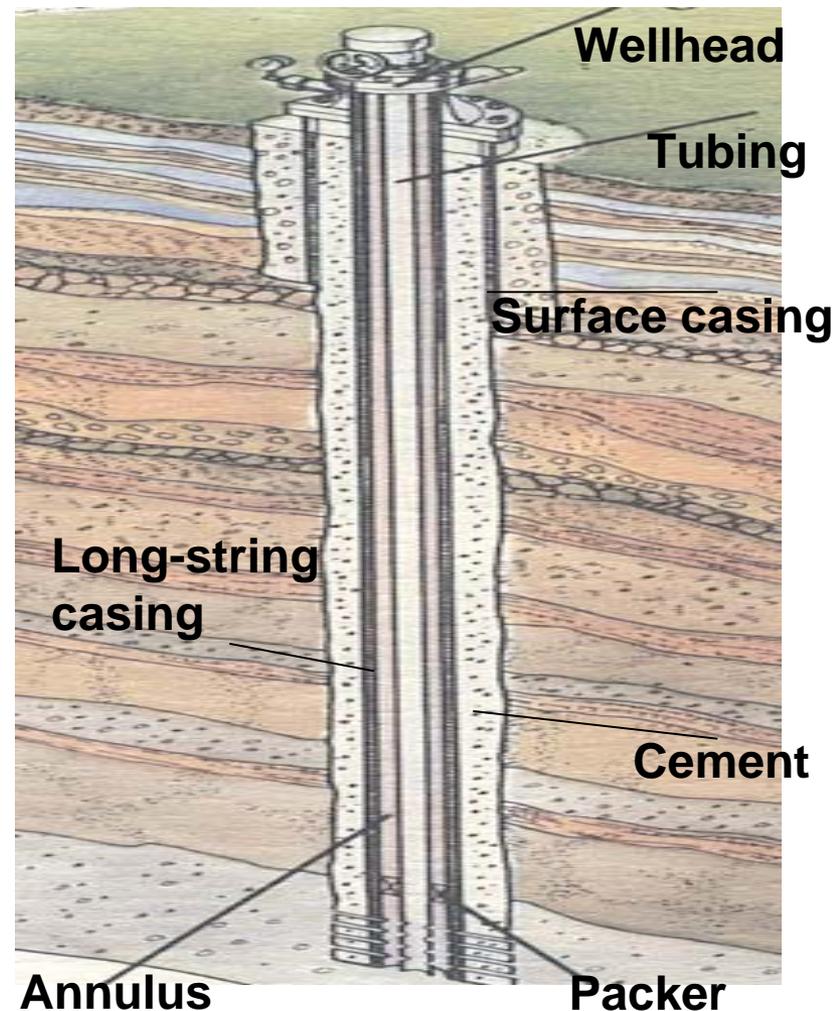


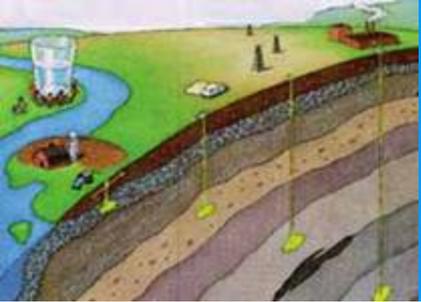


Proposed CO2 GS Rule: *Well Construction*

Proposed Approach

- Inject below the lowermost USDW – Seeking comment
- Long-string casing cemented in place for entire length
- Surface casing through the base of the lowermost USDW and cemented to surface
- Well materials must be compatible with injectate and formation fluids



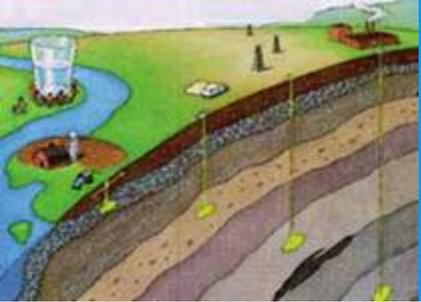


Proposed CO₂ GS Rule: *Well Testing and Operation*

Basic requirements

- Procedures to ensure integrity of the well before, during, and after injection
 - Injection may not fracture confining zone
 - Monitor injection pressure, flow rate and volumes, and the nature of the injected fluid
 - Perform mechanical integrity tests





Proposed CO2 GS Rule: *Well Testing and Operation*

Proposed Approach

- Continuous internal well mechanical integrity tests (MIT) and annual external MITs
- Injection pressure should not exceed 90 percent of fracture pressure in the confining system

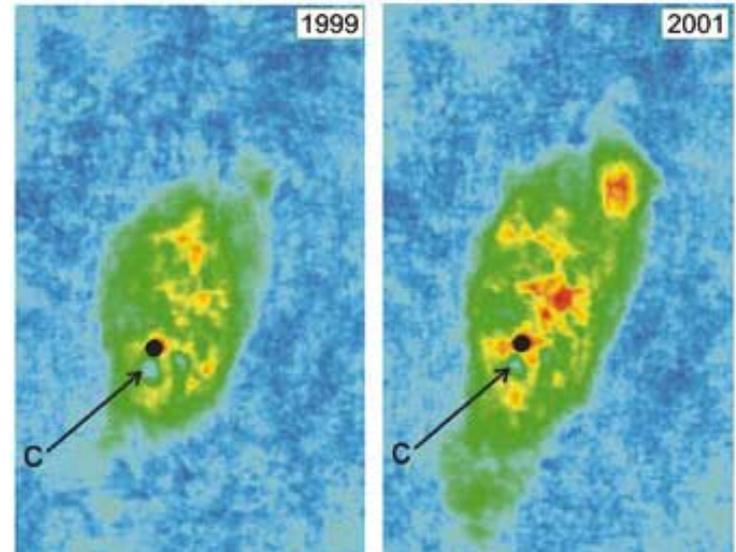
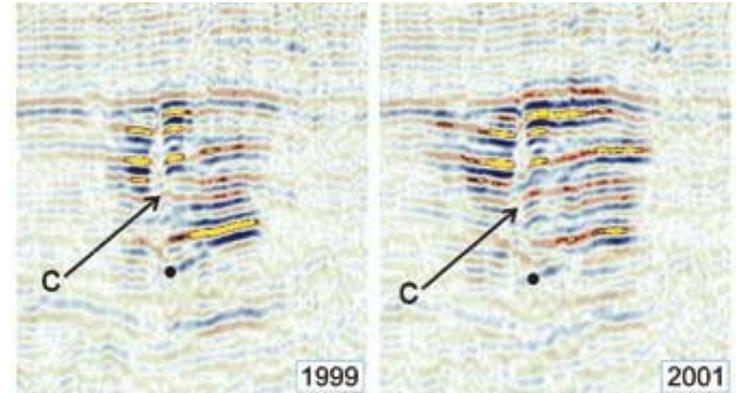




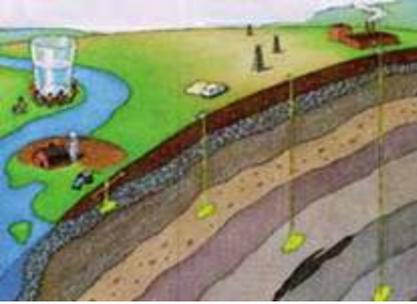
Proposed CO2 GS Rule: *Site Monitoring*

Basic requirements (for Class I Hazardous Wells)

- Director has discretion to require site specific monitoring
- If required, determine the movement of fluid and area of elevated pressure



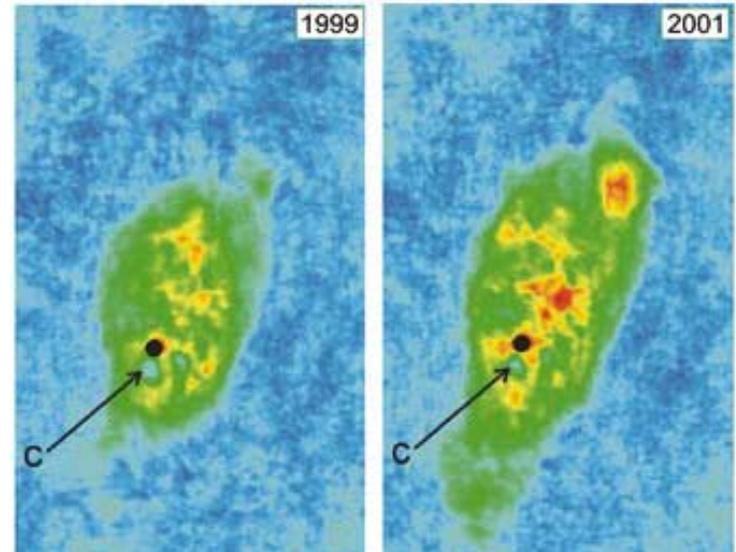
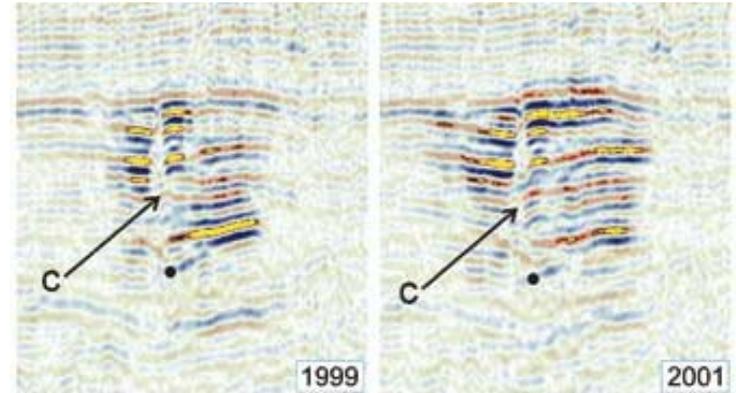
Seismic Monitoring Results, Sleipner



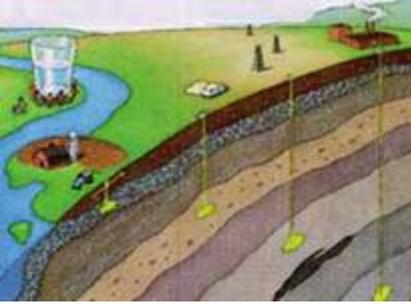
Proposed CO₂ GS Rule: *Site Monitoring*

Proposed Approach

- Determine extent of CO₂ movement and associate area of pressure (pressure front)
- Tracking of the plume and pressure front is required, but techniques, frequency, and spatial resolution are not specified
- Tracers are not required
- Surface-air and soil-gas monitoring are at the Director's discretion



Seismic Monitoring Results, Sleipner

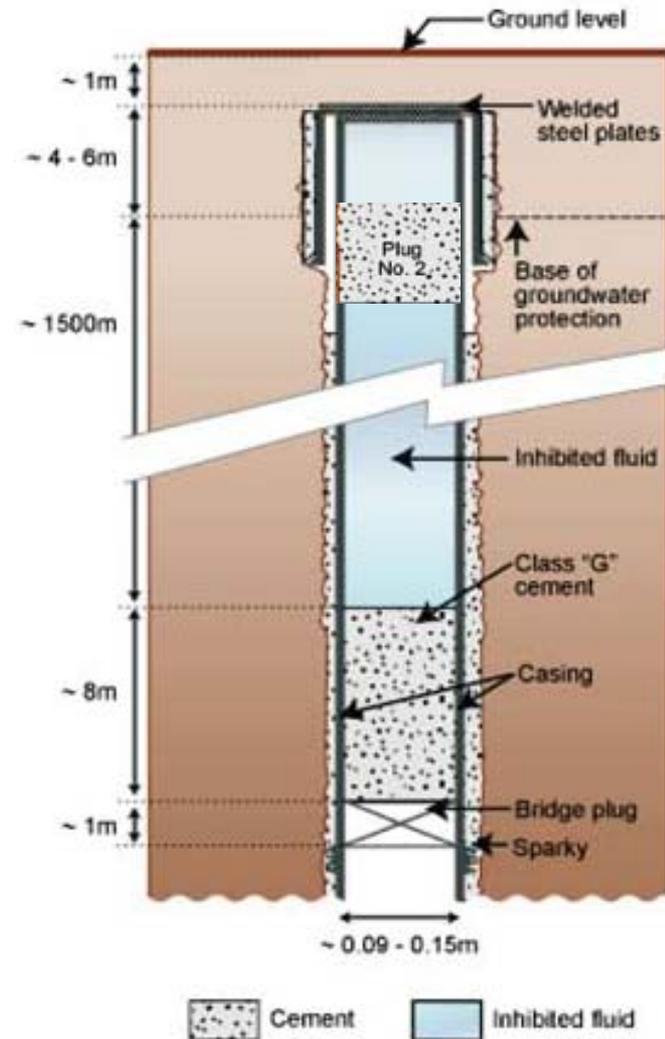


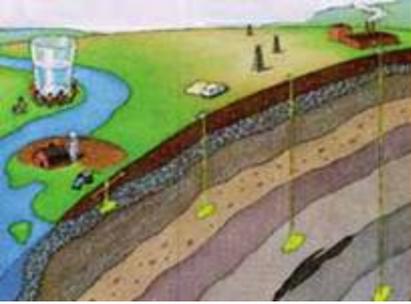
Proposed CO₂ GS Rule:

Well-Plugging and Post-Injection Site Care

Basic requirements

- Appropriate well-plugging, monitoring and other actions following cessation of injection
 - Wells must be closed in a manner that protects USDWs from endangerment
 - Owner/operator must demonstrate and maintain financial assurance to close and abandon the injection operation
 - Liability stays with owner/operator



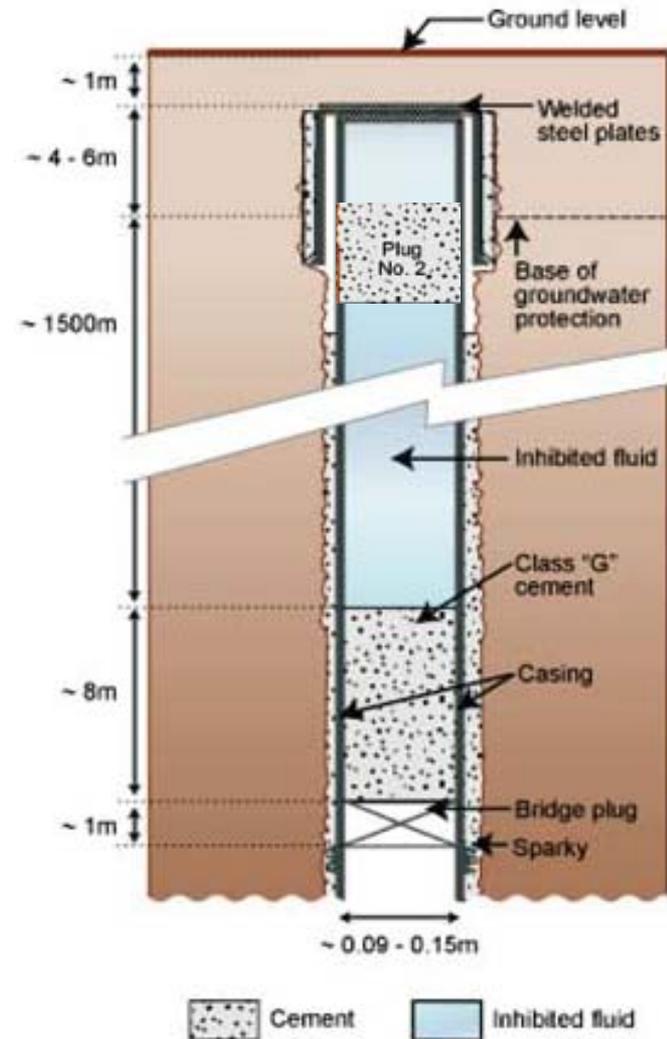


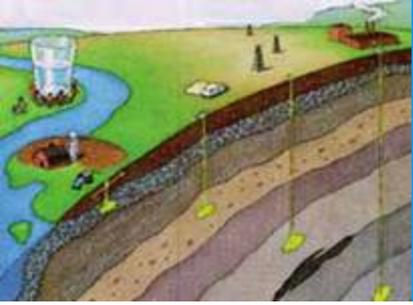
Proposed CO₂ GS Rule:

Well-Plugging and Post-Injection Site Care

Proposed Approach

- Well-plugging materials must be compatible with CO₂ stream
- Post-injection site care is set at 50 years; however, it may be modified with a demonstration that the plume has stabilized and the pressure has dissipated sufficiently
- The owner or operator must demonstrate financial assurance through the end of post-injection site care





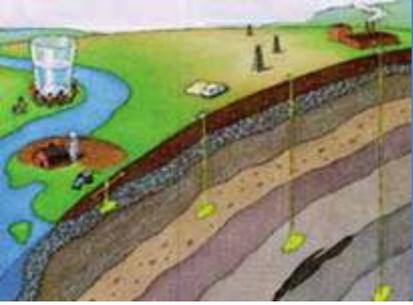
Proposed CO2 GS Rule: *Financial Responsibility*

Basic Requirements

- Show financial responsibility for well plugging and corrective action and for nominal site closure care

Proposed Approach

- Demonstrate and maintain financial responsibility for plugging and corrective action, injection well plugging, substantive post-injection site care, site closure, and emergency and remedial response

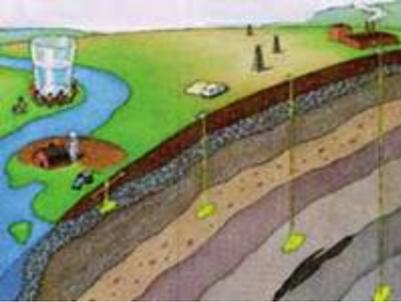


Proposed CO2 GS Rule: *Public Participation*

Proposed Approach

- 30-day comment period for permits following public notice
- Preparation of a responsiveness summary for the public record
- Seeking rule comment on:
 - Appropriate outreach techniques and technologies
 - Engaging the public early in permitting process before siting





More Information about the UIC Program

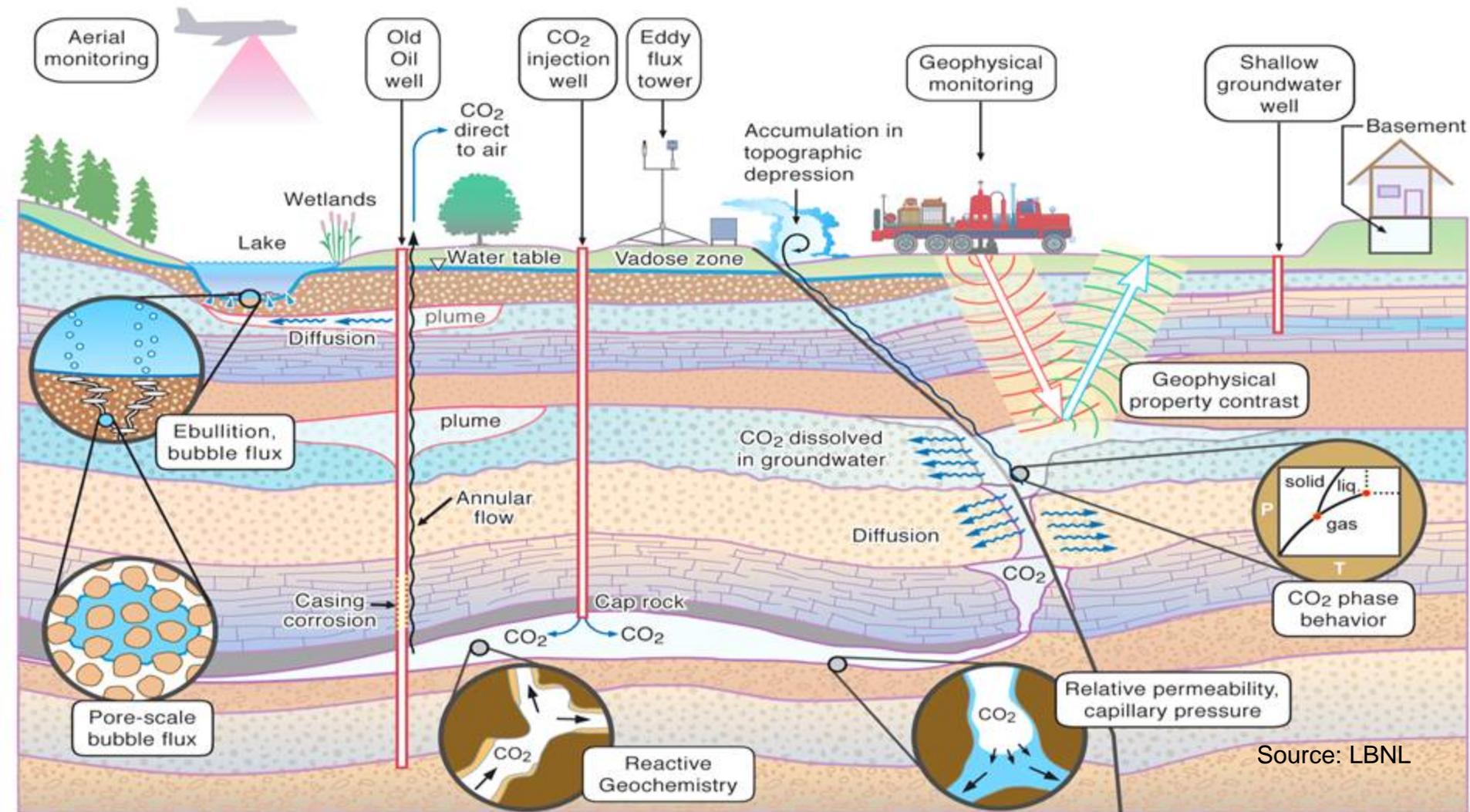
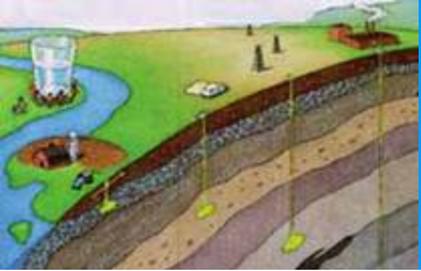
- EPA Geologic Sequestration of Carbon Dioxide Website

http://www.epa.gov/safewater/uic/wells_sequestration.html

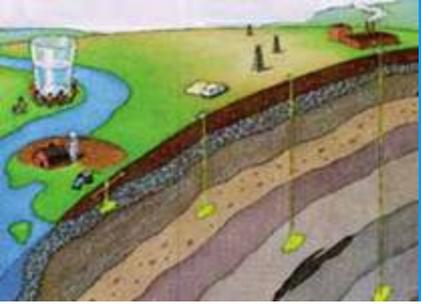
- Code of Federal Regulations: Underground Injection Control Regulations 40 CFR 144-148

http://ecfr.gpoaccess.gov/cgi/t/text/text-id?sid=d6ee71a544eca89c533c825135913f13&c=ecfr&tpl=/ecfrbrowse/Title40/40cfrv22_02.tpl

Storage Effectiveness is Critical



Source: LBNL



What is GS?

