United States Environmental Protection Agency

How EPA's UIC Class VI Regulations Work to Ensure the Protection of Groundwater Resources

What is geologic sequestration?

Geologic sequestration (GS) of carbon dioxide (CO_2) is the injection of CO_2 deep underground to prevent it from entering the atmosphere, thereby helping to mitigate climate change. The CO_2 is injected through specially constructed wells that extend into deep rock formations. These formations have been tested and selected based on geologic characteristics indicating that they can safely contain the CO_2 for long-term storage.

How does the UIC program protect drinking water near geologic sequestration sites?

Under the Safe Drinking Water Act, EPA is tasked with protecting public health by regulating and overseeing the nation's public drinking water supplies. The EPA's Underground Injection Control (UIC) program regulates six classes of wells for the injection of fluids such as water, wastewater, brines, and CO_2 into the subsurface. *UIC regulations are designed to protect underground sources of drinking water (USDWs) by preventing the movement of contaminants out of injection formations and into USDWs. (The diagram on the second side of this pamphlet shows USDWs as the uppermost geologic formations in the figure.) Wells injecting CO_2 for GS are classified as UIC Class VI wells.*

The UIC program regulates all aspects of the injection wells of a GS project including project siting, well construction, injection operations, testing and monitoring, emergency response, financial responsibility, and eventual plugging and closure of the wells and injection sites. The UIC program implements the regulations through permitting, site inspections, required reporting, and compliance reviews to ensure that well owners/operators comply with the regulations. Regulations for Class VI wells are the most rigorous of the UIC program. **The sections below describe how UIC regulations for GS projects protect our underground drinking water resources, with additional details shown in numbered items on the diagram on the second page of this pamphlet.**

How can the public participate?

Public participation and transparency are important components of the UIC regulatory framework. Draft injection well permits for GS projects are published for public review. The public may comment on the draft permits, request and attend public hearings, and in some cases file appeals with the Environmental Appeals Board. Transparency is promoted through communications with communities and providing information from project start through closure.

What are key steps for planning GS projects, and how do they protect USDWs?

The Class VI regulations provide multiple safeguards to protect USDWs, beginning at the initial permitting stage. The owner/operator submitting a permit application for a Class VI well must:

- ***Evaluate the project site*** to document that the geology is suitable for GS and that CO_2 will not leak and migrate to USDWs. This includes identifying both a geologic confining layer to prevent the CO_2 from leaking upward (#1 in diagram on page 2) and an injection formation that can dependably hold and provide long-term storage of the injected CO_2 (see #2). Other geologic features (such as faults) are evaluated to confirm that they will not compromise storage and containment and affect USDWs (#3).
- ***Determine the Area of Review (AoR)***, which is the footprint on the land surface above the subsurface area that could be influenced by CO_2 injection. This is the area where owners/operators will take measures to protect USDWs by identifying other wells, and possibly remediating old or abandoned wells (#9) to ensure that CO_2 does not leak through them.
- ***Meet financial responsibility requirements*** that ensure that the private costs associated with a Class VI well are not passed along to the public and that funding is available to address any problems that could affect USDWs.

How is an injection well constructed and operated to be protective of USDWs?

- ***Construction requirements*** include multiple protective layers of corrosion resistant steel casing and cement (#7 and #8). These requirements help to ensure that CO_2 does not leak out of the well or out of the injection formation along the well itself and migrate to a USDW. The wells are tested for leaks and to confirm proper construction before injection begins. Wells are tested routinely during operations (#14),
- ***Operational requirements***, including safe injection pressure and rate (#6, #13), are established by testing prior to starting injection. Maintaining safe injection pressure and rate avoids fracturing the injection formation. This helps ensure that the injected CO_2 remains where intended and does not migrate to other formations, including those containing USDWs. Safe pressures and rates are set in permit conditions and are continuously monitored at the wellhead during operations (#15).

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What other activities are required for Class VI well operations that help protect USDWs?

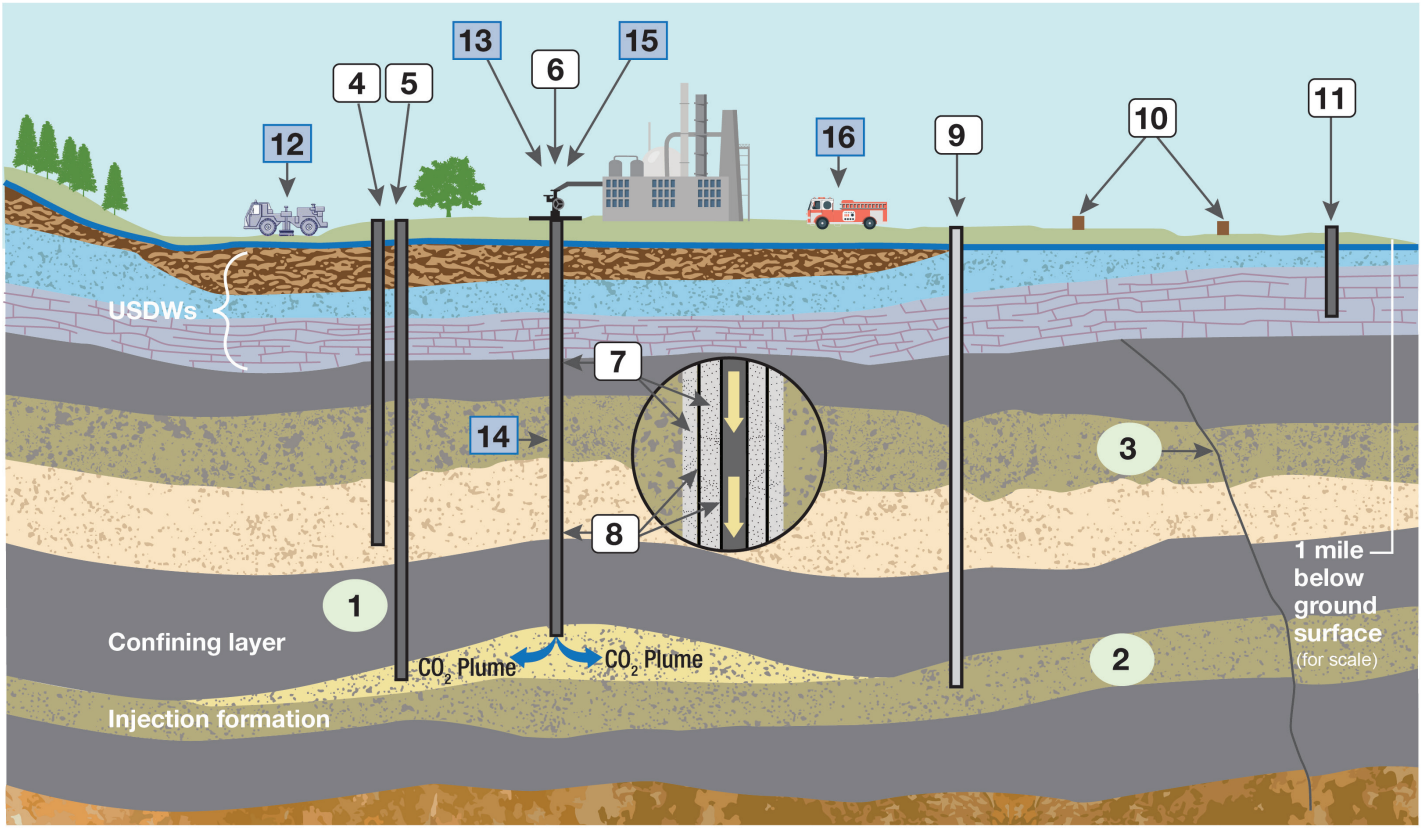
- ***Testing and monitoring*** will provide early warning or evidence in the event of well leaks, unexpected pressure changes, or movement of CO_2 out of the injection formation that could impact USDWs. The injection well is periodically tested for physical integrity and corrosion (#14). The owner/operator uses deep monitoring wells to measure the subsurface pressure and CO_2 in the injection formation (#5). Other monitoring wells are used to monitor groundwater quality above the confining layer (#4). Surface-based seismic surveys (#12) also help track the CO_2 plume.

- ***Emergency response*** requirements require that owners/operators report any evidence of potential dangers to USDWs within 24 hours, including evidence of CO_2 leakage, noncompliance with permit conditions, or malfunction of the injection system (#16).

What activities are required after injection is complete?

- ***Post-injection site care*** begins with well plugging according to an approved well plugging plan. This ensures that CO_2 will not migrate up through the injection well. Testing and monitoring continue according to an approved post-injection site care (PISC) plan. The default period of post-injection site care is 50 years, but the UIC Director can approve a shorter time if the owner/operator demonstrates no danger to USDWs.

- ***Site closure*** can take place when monitoring indicates that the plume and formation pressure are stable and there will be no danger to USDWs. Closure includes removal of surface equipment and site restoration (with grading, planting of vegetation) to conditions approved by the UIC Director. The UIC Director will not authorize the site to be permanently closed until data demonstrate no danger to USDWs.



Through the Underground Injection Control (UIC) program, EPA protects underground sources of drinking water (USDWs) by regulating the construction, operation, permitting, and closure of injection wells that are used for the underground storage or disposal of fluids. Class VI wells are specifically used to inject carbon dioxide (CO_2) into deep rock formations. The UIC permitting authority reviews Class VI permit applications to ensure that injected CO_2 will remain within deep, isolated formations, protecting human health and the environment.

KEY

Site geology
Injection, monitoring, and other wells
Drinking water resource protection practices
Water table

1 Thick, impermeable confining layer prevents CO_2 from leaking upward
2 Permeable injection formation will hold injected CO_2
3 Testing shows that the fault is inactive and sealed against movement of CO_2
4 Water quality is tracked in the permeable formation above the confining layer using a monitoring well
5 Pressure and CO_2 in the injection formation are tracked using a monitoring well
6 CO_2 injection well is permitted for safe operation with many safeguards
7 Cementing prevents CO_2 from moving outside of the well
8 Well materials are corrosion-resistant
9 Properly plugged and abandoned well prevents CO_2 movement between formations
10 Seismic activity is monitored using surface equipment as needed
11 Shallow groundwater well is isolated from the injection formation by multiple impermeable layers
12 Seismic surveys are used to study the geology and track the location of CO_2 through images of the subsurface
13 Safe CO_2 injection pressure avoids damaging the injection formation
14 Regular testing confirms the physical integrity of the well
15 Injection pressure and flow are continually monitored
16 Emergency response plan is in place and ready to be implemented

For general UIC questions, email safewater@epa.gov;
for Class VI questions, email UIC-ClassVI@epa.gov, or send a letter to:

U.S. Environmental Protection Agency
Underground Injection Control Program
Office of Water, Office of Ground Water and Drinking Water
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