

## **INJECTION WELLS FOR ENHANCED RECOVERY AND DISPOSAL**

Two types of injection wells are used in oil and gas operations in Pennsylvania – enhanced recovery and disposal injection wells. Each type is used for a particular purpose and both types of wells are considered Class II injection wells by the United States Environmental Protection Agency (EPA), the environmental agency primarily responsible for regulating these sites, although the Department of Environmental Protection (DEP) does also issue a permit for such wells. Enhanced recovery injection wells are designated Class IIR wells, whereas disposal injection wells are considered Class IID wells.

### **Enhanced Recovery Injection Wells (Class IIR)**

The first and most common is an injection well used to enhance production or stimulate oil production from other wells. An enhanced recovery injection well may be a formerly productive well whose production has decreased over time or a well specifically drilled as an injection well. This type of injection well is used to inject fluid into the oil producing rock, displacing oil towards a second well where the oil is extracted. When the fluid injected into the well is water, the practice is commonly referred to as “water flooding.”

In Pennsylvania, water flooding is thought to have first occurred by accident in the late 1870s. This occurred on the Columbia Oil Company property along Oil Creek in Venango County when fresh water entered an oil producing sand as a result of pulling a pipe during a well abandonment or from deterioration of the seed bags placed around the tubing to keep fresh water from entering the oil sand. The flooding of the oil sand was first noticed on adjoining lands when wells there began producing more oil. By the early 1890s, some intentional water flooding was occurring in the Bradford Oil Field.

Because Pennsylvania law at that time required plugging of abandoned and dry holes to prevent water from entering the oil and gas sands, the flooding was done secretly. In 1921, a special act was passed legalizing the flooding practice in the Bradford Oil Field and certain other specifically named sands. The act was amended in 1923 and again in 1929 to add other sands to the list. Over the years, several thousand enhanced recovery injection wells have been drilled in Pennsylvania. Only approximately 2,000 remain listed as active throughout the state.

### **Disposal Injection Wells (Class IID)**

The second type of injection well is for disposal of fluids produced along with oil or gas. DEP promotes recycling as a first option when it is technically and economically feasible. However, some liquid waste must ultimately be disposed of and deep underground injection has been identified as one of the safest ways to manage such wastes. These produced fluids designated for disposal may be similar to freshwater in quality or water high in chloride and other dissolved solids. They include both flowback water and brine (deep water found naturally in geologic formations). Such wastes are a byproduct of oil and gas operations and are pumped back into the ground deep within the earth as a means of permanent disposal. In Pennsylvania, the rocks that can contain these fluids in pore spaces are typically depleted oil or gas reservoirs and are usually more than a mile below the earth’s surface. There is no discharge onto the land surface or into nearby surface waterways. Care also is taken to ensure that underground near surface sources of drinking water that are part of the hydrologic cycle are not affected when these fluids are pumped back into the ground.

Several successful disposal wells are operating in Pennsylvania and options for more sites are always being considered. The history of underground disposal shows that it is a practical, safe and effective method for disposing of fluids from oil and gas production. Industry organizations like the American Petroleum Institute and interstate organizations like the Interstate Oil and Gas Compact Commission prefer injection wells to other means of wastewater disposal because the wastewater is returned to where it originated, thus eliminating the need to find an alternate disposal location. DEP also carefully regulates the surface operations at disposal well sites requiring that pollution, prevention, contingency and erosion and sediment control plans be developed prior to the commencement of disposal operations.

The best locations for developing successful disposal wells are depleted oil or gas fields that have sufficient permeability to accept large volumes of produced water, including flowback and brine. However, unplugged

abandoned wells near the disposal well location must first be located and plugged. In addition, many of these depleted fields have been converted into natural gas storage reservoirs, limiting the available capacity for liquid waste disposal in certain areas of Pennsylvania.

To address the concern of induced seismicity (earthquakes) associated with disposal injection wells throughout the country, EPA requires that the applicant for an injection well permit provide as much information as possible about any faults that exist in the area of injection and whether they pose a seismic risk. EPA also conducts research and limits injection pressures to ensure that if a disposal well is permitted, waste injection will remain at a rate that is not anticipated to be capable of triggering an earthquake. Thus, potential seismicity for each proposed injection well site is evaluated independently. DEP also co-funds a public seismic network ([PASEIS](#)) with the Department of Conservation and Natural Resources (DCNR) that is capable of detecting earthquakes anywhere in the commonwealth at levels that generally will not be felt at the surface. It is important to note that no induced seismic events have been observed in Pennsylvania in association with injection wells at the time of this publication.

Two permits are needed for injection wells: a well permit from DEP and an Underground Injection Control permit from the EPA. Prior to issuing a permit, DEP must first receive confirmation of EPA's authorization for injection from the operator, although DEP's permit review may commence as soon as EPA has an administratively complete permit application. For disposal wells, DEP's review includes a geologic analysis based on 25 Pa. Code section 91.51 and a mechanical integrity assessment of the well, including analysis of the Casing and Cementing Plan. For both disposal and enhanced recovery wells, DEP performs a review of the Control and Disposal Plan to confirm compliance with 25 Pa. Code section 91.34; and a review of the Erosion and Sedimentation Control Plan to ensure compliance with 25 Pa. Code Chapter 102 and section 78.53. Information on these permits is contained in 25 Pa. Code section 78.18 of the rules and regulations.

Prior to preparation and submission of an injection well application, the applicant should arrange a preliminary technical conference with the oil and gas staff at the appropriate DEP oil and gas district office. Federal requirements for injection wells can be obtained from the EPA, Region III, Source Water Protection Program, 1650 Arch St., Philadelphia, PA 19103, or by calling 215-814-3367.



## Oil and Gas Districts

### ★ Northwest District

230 Chestnut St.  
Meadville, PA 16335-3481  
814-332-6860

### ★ Eastern District

208 West Third St.  
Williamsport, PA 17701-6448  
570-327-3636



### ★ Southwest District

400 Waterfront Drive  
Pittsburgh, PA 15222-4745  
412-442-4024

### ● Central Office

Bureau of Oil and Gas Planning and Program Management  
P.O. Box 8765  
Harrisburg, PA 17105-8765  
717-772-2199

For more information, visit [www.dep.pa.gov/O&G\\_factsheets](http://www.dep.pa.gov/O&G_factsheets).