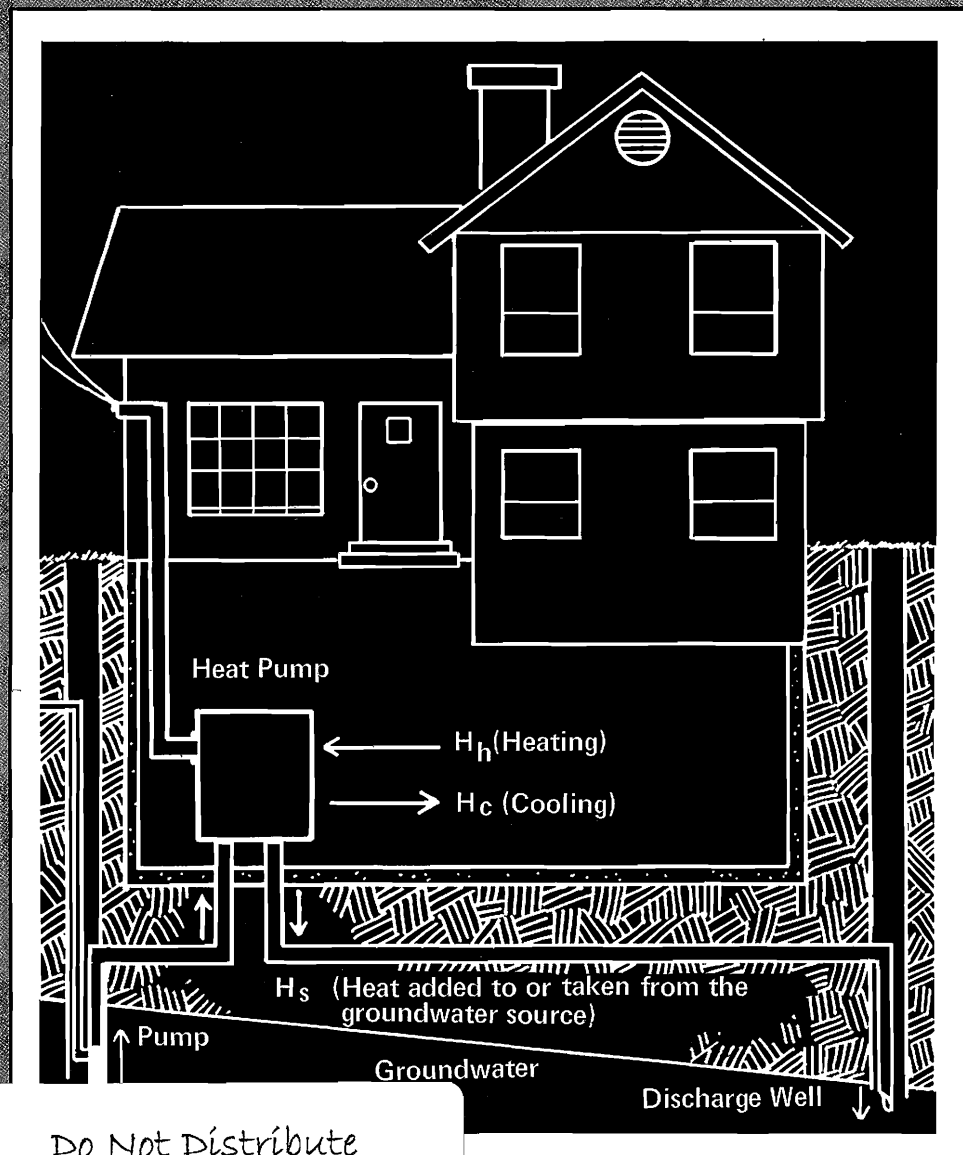


Underground Injection Control in Virginia

Virginia Water Resources Research Center • Virginia Tech



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About this book:

This handbook, written for state and local officials, is designed to provide a nontechnical overview of the underground injection control (UIC) program in Virginia. A little-known section of the federal Safe Drinking Water Act, the UIC program affects activities that previously were unregulated or were considered the province of state and local government. Under the UIC program, activities such as disposal of wastes through certain types of septic systems are now the concern of the federal government as well.

Although only some injection wells require permits for legal operation, all injection wells must be reported to the U.S. Environmental Protection Agency for a national well inventory. This handbook defines underground injection, explains its effects on groundwater, describes underground injection regulations, and lists the types of wells in Virginia that should be reported.

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On the cover: Illustration of a groundwater heat pump by George V. Wills. Although not considered a priority problem by EPA, groundwater heat pump return wells are classified as Class V underground injection wells. There are more than 1,700 of them in Virginia

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What is underground injection?

Underground injection is the placement of fluids into the ground through a well. Injection wells typically are used to discharge wastes into the ground—in fact, nearly 60 percent of hazardous waste disposal on land is by underground injection. But the definition of underground injection includes wells *not* used for waste disposal, too. For example, groundwater recharge wells and heat pump return flow wells, through which clean water is returned to a groundwater source, are classified as underground injection wells. According to the U.S. Environmental Protection Agency (EPA), more than 280,000 underground injection wells are in use nationwide.

The term “underground injection well” can be confusing. Although “well” is usually defined as a hole in the ground that is deeper than it is wide, the definition of underground injection well also includes the drainfields of large capacity, commercial, or industrial septic systems. The term “injection” can be misleading, too; some injection wells have fluids forcibly injected into them, but many work with only the assistance of gravity.

Are all injection wells the same?

No. In fact, the EPA recognizes five different classes of injection wells. Wells used to inject hazardous or nonhazardous wastes below the lowermost formation containing an underground source of drinking water are termed **Class I**. **Class II** wells are associated with gas and oil production, and **Class III** wells are used for solution mining of minerals. Wells used to inject hazardous or radioactive wastes into or above a geological formation containing potential drinking water are termed **Class IV**. Class IV wells have been banned.

Most of Virginia's injection wells are **Class V**, a catchall category that includes more than 32 types of wells that do not fit into the first four classes. Virginia's more than 2,000 Class V wells include at least 1,700 air conditioning/cooling water return wells and more than 100 stormwater drainage wells. The state also has aquifer recharge wells, wells used to store liquid propane, and many mass drainfields and septic systems that receive other than sanitary wastes. At this time,

the only injection wells in Virginia that do not fit into the Class V category are 24 abandoned solution mining wells used to inject water or other fluids underground to dissolve minerals (Class III). A complete list of Class V well types can be found on pages 6-9.

Does underground injection affect groundwater?

Underground injection wells can discharge wastes deep beneath the earth's surface, below any source of potable groundwater, or they may discharge wastes directly into or above groundwater. Injection wells that are properly constructed, sited, and operated contribute to groundwater protection by providing a way to dispose of wastes that might otherwise be stored less securely. But injection of wastes into or above groundwater can permanently contaminate drinking water supplies. Even injection that seems harmless at first glance may cause problems for groundwater:

- Stormwater drainage wells collect salts, lead, grease, oil, and animal wastes from streets and highways.
- Excess water from farm fields that runs into agriculture drainage wells often carries pesticides and fertilizers.
- Industries can introduce contaminants to groundwater through waste disposal wells that collect spillage and process wastes.
- Cesspools that are excessively deep or excavated in an area with a high water table can allow human wastes and other contaminants to reach groundwater.
- Rural automobile service stations that use septic systems for sanitary waste disposal can also allow anti-freeze, gasoline, and oil to reach soils and groundwater.
- In towns without public sewage service, print shops, dry cleaners, car washes, and other small businesses often use septic systems or drain pits to dispose of potentially hazardous wastes.

The Class V category encompasses such a variety of well types that their effect on groundwater is difficult to assess. The EPA is working to establish an inventory of underground injection wells in Virginia; a complete database may help

make an assessment of the effects of Class V wells on groundwater possible in the future.

How is underground injection regulated?

The Safe Drinking Water Act in 1980 established a national program to prevent underground injections that endanger drinking water. This program, the Underground Injection Control (UIC) program, was created specifically to ensure that the subsurface emplacement of fluids in injection wells does not threaten present and future drinking water sources. Injecting hazardous wastes—wastes that are ignitable, corrosive, toxic, or explosive—into or above underground sources of drinking water is prohibited. Injecting these wastes below groundwater is regulated by provisions of the UIC program. Regulations of the federal UIC program are spelled out in the Code of Federal Regulations (Title 40, Code of Federal Regulations, Parts 144-147).

The primary objective of the UIC program is to protect groundwater—specifically, to protect underground sources of drinking water. Some groundwater is not useful as a drinking water source because it is naturally salty or otherwise undrinkable, so “underground source of drinking water” is carefully defined. An underground source of drinking water is an aquifer or portion of an aquifer that

1. supplies any public water system; or
2. contains a sufficient quantity of groundwater to supply a public water system; and
 - a. currently supplies drinking water for human consumption; or
 - b. contains fewer than 10,000 milligrams per liter total dissolved solids and is not an exempted aquifer.

Aquifers can be exempted if they do not currently serve as sources of drinking water and will not do so in the future.

The Safe Drinking Water Act mandated that a federally approved UIC program be developed for every state. If states choose not to develop their own programs, the EPA is required to develop programs for them. That is the case in Virginia, where the underground injection control program was developed and is being administered by EPA Region III.

How can I meet regulatory requirements?

Submit appropriate inventory information. One of the requirements of the Underground Injection Control (UIC) program is the establishment and maintenance of an inventory, and the EPA is doing so for Virginia. **Owners or operators of Class V wells must report the existence of the wells to the EPA** to provide the federal agency with information for its Virginia inventory. Information that must be reported to the EPA includes facility name and location, a legal contact, and information about well type and whether it is abandoned or in use.

Inventory information should be reported to:

Underground Injection Control Section
U.S. Environmental Protection Agency
Region III
841 Chestnut Street
Philadelphia, PA 19107
telephone (215) 597-9928

Apply for appropriate state and federal permits. Builders of injection wells other than Class V must apply for federal permits before construction, but Virginia's antidegradation policy makes it highly unlikely that the required state permits would be granted even if federal permits were obtained. The antidegradation policy prohibits the discharge of any pollutants into or adjacent to state waters, including groundwater, except as authorized by the Virginia Water Control Board.

In general, Class V wells do not need a federal permit. Injection into Class V wells is authorized at the federal level until further requirements under future regulations become applicable. However, state agencies require permit applications for a variety of waste disposal systems that also are classified as Class V wells. For example, the use of septic tanks and drainfields for domestic wastewater disposal requires authorization from the Virginia Department of Health.

Virginia's permitting program for discharges to surface water has been in operation for years. Under a new program, the

Virginia Pollution Abatement (VPA) program, management of pollutants may require authorization from the Virginia Water Control Board even if no discharge to surface water is planned. Such authorization is now required for industrial waste drainfields, and many VPA permits will include requirements for the installation of wells to monitor for groundwater contamination.

Although permits generally are not required for Class V wells, immediate action will be taken by the EPA or the state on any Class V well that poses a risk to human health or the environment. The EPA is inspecting Class V injection wells in the state to determine the potential for groundwater contamination. Responses to wells that threaten an underground source of drinking water may include closing wells, civil or criminal penalties, or requirements to apply for a permit.

How can I find out more about UIC?

Underground injection regulations are specified in the Code of Federal Regulations (Title 40, Code of Federal Regulations, Parts 144-147). EPA personnel can answer questions about the federal program and its implementation in Virginia. They can be reached at the Underground Injection Control Section of the U.S. Environmental Protection Agency, Region III, 841 Chestnut Street, Philadelphia, PA 19107; telephone (215) 597-9928. Two publications, *Fact Sheet on EPA's Underground Injection Control Program in Virginia* and *UIC Class V Injection Wells, Public Information Bulletin for EPA Region III*, are available to interested persons from the above address.

What is included in the Class V category?

At least 32 different wells, drainfields, and other disposal systems are classified as Class V injection wells and must be reported to the EPA for its inventory. The following list, adapted from EPA's 1987 *Executive Summary of the Report to Congress: "Class V Injection Wells: Current Inventory, Effects on Ground Water, Technical Recommendations"* (EPA 570/9-87-007), describes each well type and provides the EPA well code number.

CLASS V INJECTION WELL TYPES

WELL CODE	NAME OF WELL TYPE AND DESCRIPTION
DRAINAGE WELLS (a.k.a. DRY WELLS)	
5F1	Agriculture Drainage Wells receive irrigation tailwaters, other field drainage, and animal yard, feedlot, or dairy runoff.
5D2	Storm Water Drainage Wells receive storm water runoff from paved areas, including parking lots, streets, residential subdivisions, building roofs, and highways.
5D3	Improved Sinkholes receive storm water runoff from developments located in karst topographic areas.
5D4	Industrial Drainage Wells include wells located in industrial areas that primarily receive storm water runoff but are susceptible to spills, leaks, or other chemical discharges.
5G30	Special Drainage Wells are used to dispose of water from sources other than direct precipitation, such as landslide control drainage wells, potable water tank overflow drainage wells, swimming pool drainage wells, and lake level control drainage wells.
DOMESTIC WASTEWATER DISPOSAL WELLS	
5W9	Untreated Sewage Waste Disposal Wells receive raw sewage wastes from pumping trucks or other vehicles that collect such wastes from single or multiple sources.
5W10	Cesspools include multiple dwelling, community, or regional cesspools or other devices that receive wastes and have an open bottom and sometimes have perforated sides. Must serve more than 20 persons per day if receiving solely sanitary wastes.
5W12	Domestic Wastewater Treatment Plant Effluent Disposal Wells dispose of treated sewage domestic effluent from facilities ranging from small package plants to large municipal treatment plants; provide secondary or further treatment.
5W31	Septic Systems (Well Disposal Method) are used to inject the waste or effluent from a multiple dwelling, business

CLASS V INJECTION WELL TYPES

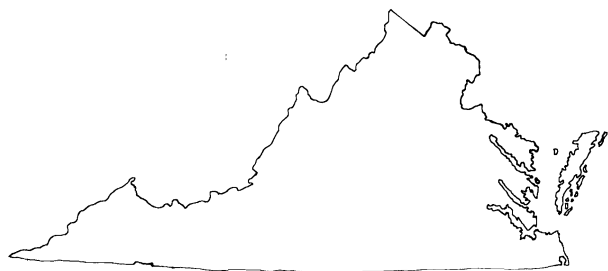
WELL CODE	NAME OF WELL TYPE AND DESCRIPTION
	establishment, community, or regional business establishment septic tank. Must serve more than 20 persons per day if receiving solely sanitary wastes. Provides less treatment per square area than 5W32 and includes seepage pits and actual wells. The largest surface dimension is less than or equal to the depth dimension.
5W32	Septic Systems (Drainfield Disposal Method) are used to inject the waste or effluent from a multiple dwelling, business establishment, community, or regional business establishment septic tank. Must serve more than 20 persons per day if receiving solely sanitary wastes. Provides more treatment per square area than 5W31 and includes drain or tile lines and trenches.
5W11	Septic Systems (Undifferentiated Disposal Method) are used to inject the waste or effluent from a multiple dwelling, business establishment, community, or regional business establishment septic tank. Must serve more than 20 persons per day if receiving solely sanitary wastes. Catchall category for wells that don't fit under other domestic wastewater disposal well categories; provides at least primary treatment.
GEOTHERMAL REINJECTION WELLS	
5A5	Electric Power Reinjection Wells are deep wells for reinjection of geothermal fluids used to generate electric power.
5A6	Direct Heat Reinjection Wells are deep wells for reinjection of geothermal fluids used to provide heat for large buildings or developments.
5A7	Heat Pump/Air Conditioning Return Flow Wells are shallow wells for reinjection of groundwater used to heat or cool a building.
5A8	Groundwater Aquaculture Return Flow Wells reinject groundwater or geothermal fluids used to support aquaculture. Nongeothermal aquaculture disposal wells are also included in this category.

CLASS V INJECTION WELL TYPES

WELL CODE	NAME OF WELL TYPE AND DESCRIPTION
MINERAL AND FOSSIL FUEL RECOVERY RELATED WELLS	
5X13 Mining, Sand, or Other Backfill Wells	are used to inject a mixture of fluid and sand, mill tailings, and other solids into mined out portions of subsurface mines whether what is injected is a radioactive waste or not. Also includes special wells used to control mine fires and acid mine drainage wells.
5X14 Solution Mining Wells	are used for in-situ solution mining in conventional mines, such as stopes leaching.
5X15 In-situ Fossil Fuel Recovery Wells	are used for in-situ recovery of coal, lignite, oil shale, and tar sands.
5X16 Spent Brine Return Flow Wells	are used to reinject spent brine into the same formation from which it was withdrawn after extraction of halogens or their salts.
OIL FIELD PRODUCTION WASTE DISPOSAL WELLS	
5X17 Air Scrubber Waste Disposal Wells	inject wastes from air scrubbers used to remove sulfur from crude oil burned in steam generation for thermal oil recovery projects. (If injection is used directly for enhanced recovery and not just disposal, this is a Class II well.)
5X18 Water Softener Regeneration Brine Disposal Wells	inject regeneration wastes from water softeners used to improve the quality of brines used for enhanced recovery. (If injection is used directly for enhanced recovery and not just disposal, this is a Class II well.)
INDUSTRIAL, COMMERCIAL, AND UTILITY DISPOSAL WELLS	
5A19 Cooling Water Return Flow Wells	are used to inject water used in both open and closed loop cooling processes.
5W20 Industrial Process Water and Waste Disposal Wells	are used to dispose of a wide variety of wastes and wastewater from industrial, commercial, or utility processes. Industries include refineries, chemical and pharmaceutical plants, smelters, laundromats, dry cleaners,

CLASS V INJECTION WELL TYPES

WELL CODE	NAME OF WELL TYPE AND DESCRIPTION
	tanneries, laboratories, petroleum storage facilities, electric power generation plants, car washes, and electroplating industries.
5X28 Automobile Service Station Disposal Wells	inject wastes from repair bay drains at service stations, garages, and car dealerships.
RECHARGE WELLS	
5R21 Aquifer Recharge Wells	are used to recharge depleted aquifers and may inject fluids from a variety of sources such as lakes, streams, domestic wastewater treatment plants, and other aquifers.
5B22 Saline Water Intrusion Barrier Wells	are used to inject water into freshwater aquifers to prevent intrusion of salt water.
5S23 Subsidence Control Wells	are used to inject fluids into a non-oil or gas producing zone to reduce or eliminate subsidence associated with overdraft of fresh water and not used for the purpose of oil or natural gas production.
MISCELLANEOUS WELLS	
5N24 Radioactive Waste Disposal Wells	include all radioactive waste disposal wells other than Class IV wells.
5X25 Experimental Technology Wells	include wells used in experimental or unproven technologies such as pilot scale in-situ solution mining wells in previously unmined areas.
5X26 Aquifer Remediation Related Wells	include wells used to prevent, control, or remediate aquifer pollution, including but not limited to Superfund sites.
5X29 Abandoned Drinking Water Wells	include those abandoned water wells used for disposal of waste.
5X27 Other Wells	include any other unspecified Class V wells.



Groundwater Protection — It's Up to You!

The Virginia Water Resources Research Center
has general-audience booklets and brochures
on groundwater protection and residential water conservation.
To obtain a list of these publications write:

Publications Services
Virginia Water Resources Research Center
Virginia Polytechnic Institute and State University
617 North Main Street
Blacksburg, Virginia 24060-3397