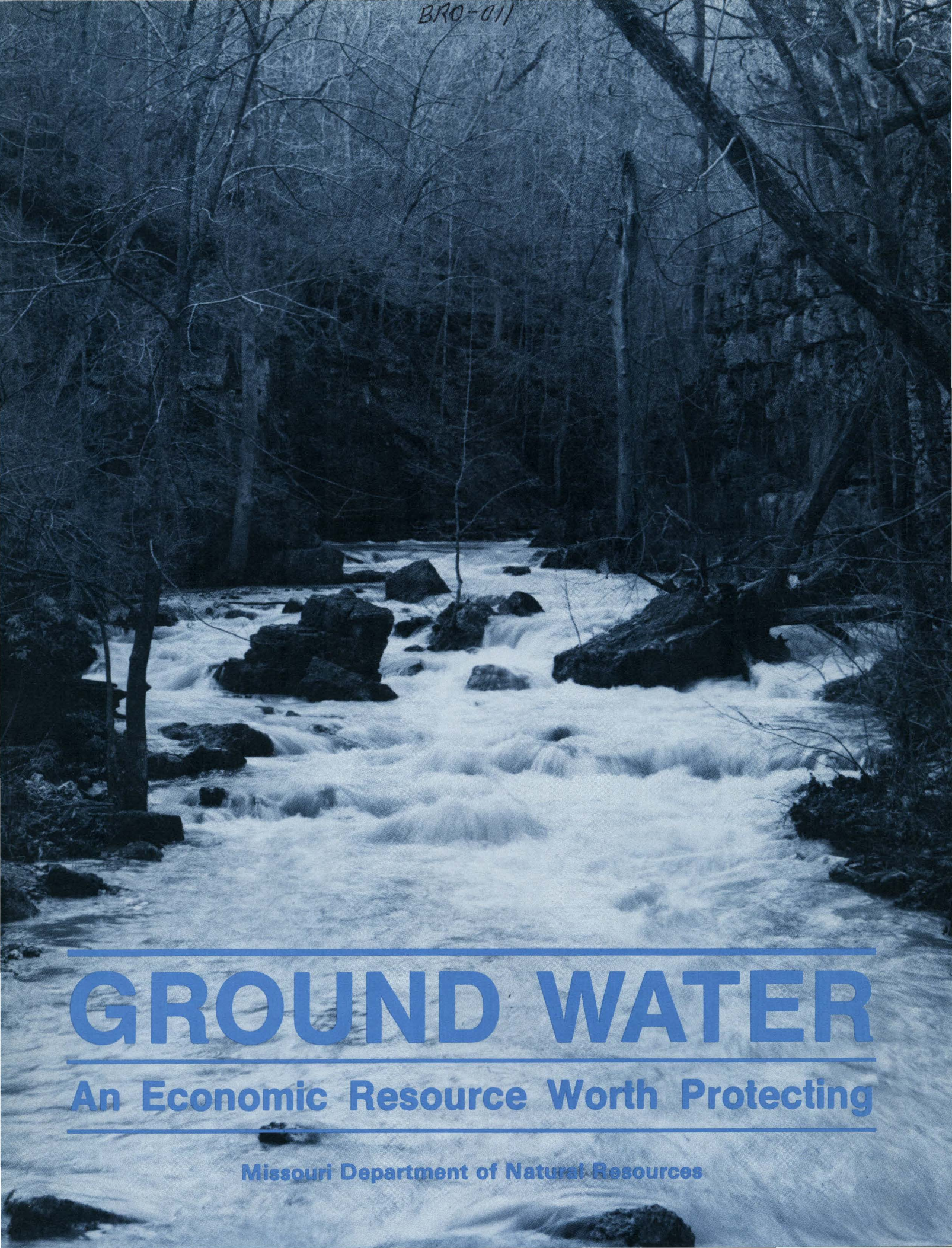


GROUND WATER

An Economic Resource Worth Protecting

Missouri Department of Natural Resources

GROUND WATER

An Economic Resource Worth Protecting

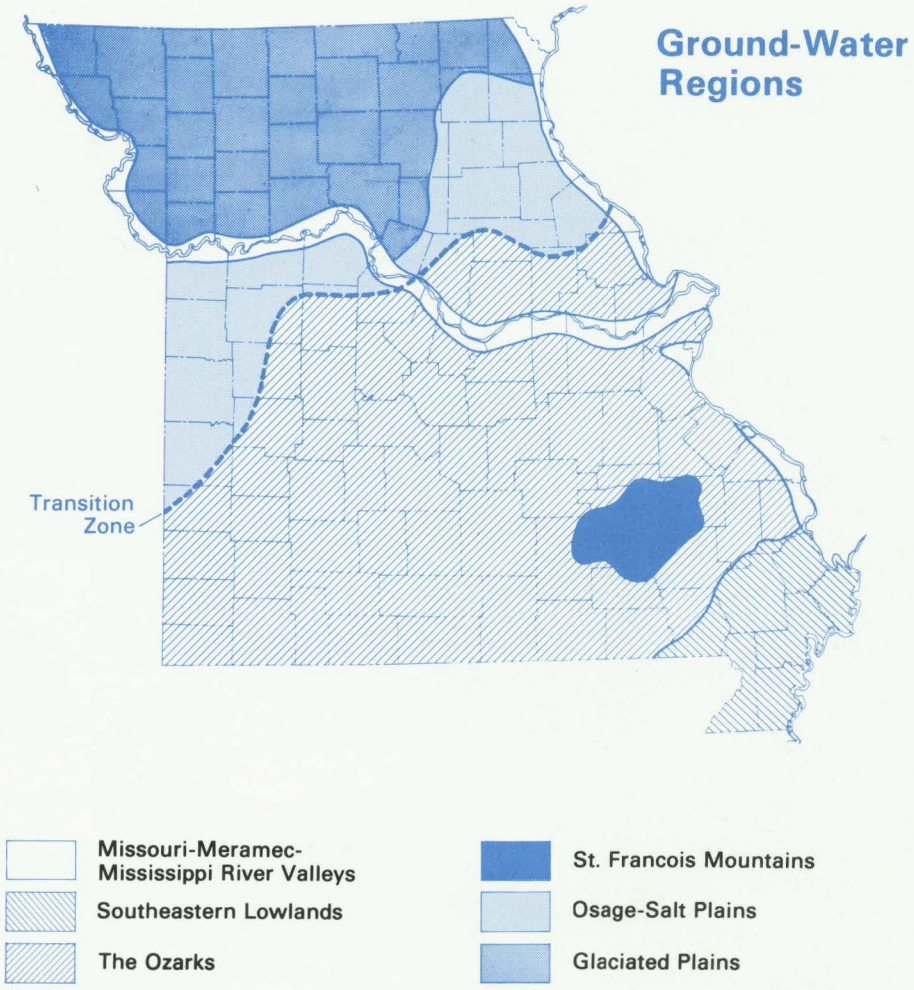
INTRODUCTION

Missouri's ground-water resources may seem infinite — a vast, inexhaustible underground reservoir replenished by underground rivers flowing from distant sources and purified by natural filtration. Unfortunately, there is little truth in that picture.

Ground water, like any other natural resource, is limited. If more water is removed from aquifers than is returned to them, the amount of stored ground water decreases. Most Missouri aquifers are primarily recharged by local rainfall, not from faraway underground sources.

Ground water receives very little natural filtration. Ground-water contamination is spreading. Today we are paying the price of poor waste-disposal practices. Contaminants introduced into aquifers remain unless they are flushed out by natural or artificial means.

Ground water is an essential resource, and the Missouri Department of Natural Resources is committed to protecting its quality and integrity. The Division of Geology and Land Survey conducts research to identify ground-water recharge areas and to promote wise use of Missouri's ground water.



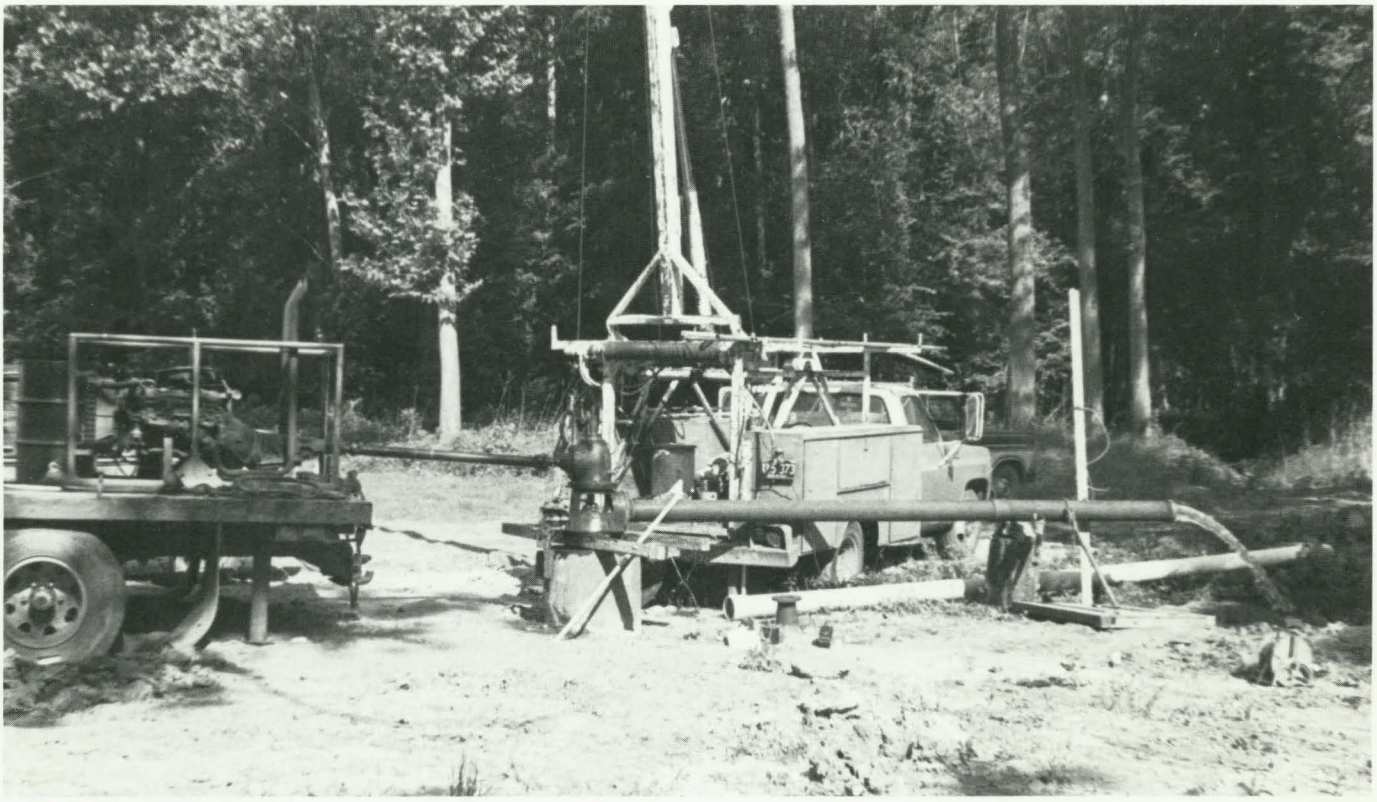
Ground water varies greatly throughout the state. Missouri can be divided into different ground-water areas, based on similarities in geology and the types of soils and rocks through which ground water moves. The southern fresh-water regions are separated from the northern mineralized regions by a zone called the freshwater-saltwater transition zone.

THE RESOURCE

Ground water is stored beneath the earth's surface in formations of saturated rock, sand, gravel, and soil. Unlike surface water, ground water does not flow in a series of lakes and rivers. Instead, the precipitation that seeps into the ground fills rock pores and the crevices between rocks, rather like water fills a sponge.

Formations that yield usable amounts of water to springs or wells are called aquifers. Two factors determine the amount of water that aquifers yield: porosity and permeability. Porosity refers to the ability of the material to store water, and permeability is the material's ability to transmit ground water through its pores and cracks. Sandstone, a highly porous material, allows water to seep through easily. Limestone,

FRONT COVER: Greer Spring, one of many Missouri springs where ground water surfaces.



Carefully controlled pumping tests measure performance of both the well and aquifer. These tests help ensure well longevity and continuing ground-water availability.

however, is permeable but not porous; water can flow only through its cracks and fissures.

Missouri's ground-water resources are used by most central-, eastern-, and southern-Missouri towns and by most rural residents. Missouri contains about 42 trillion gallons of potable ground water. About 55 percent, or 23 trillion gallons, is in bedrock aquifers: limestone, dolomite, and sandstone; 45 percent, or 19 trillion gallons, is in sand and gravel deposits along rivers. All this water is sufficient to cover the state to a depth of three feet.

Though aquifers underlie nearly all of Missouri, ground water in some areas is highly mineralized and is not usable without extensive treatment.

THE RISK

Ground-water resources can be lost in two ways: by removing too much water and by chemical or bacterial contamination of the aquifers. Both are potentially disastrous.

Ground water is being depleted in several regions of Missouri. Irrigation, industry, and municipal water supplies have lowered ground-water levels in east-central and central Missouri. Levels in Greene County have declined because of pumping in the Springfield area. Declines also have occured in extreme western and southwestern Missouri, north and south of Joplin, because of irrigation in Barton and Vernon counties and heavy pumping as far away as Miami, Oklahoma.

Ground water is contaminated by accidental spills, leaking underground storage tanks, improperly designed and constructed wells, illegal waste disposal, and from other sources. In each case, new water supplies or expensive ground-water cleanups are necessary before the area can have water safe for human use.

THE ROLE

The Missouri Department of Natural Resources' Water Resources Program collects and evaluates ground-water information to assess and protect the resource and promote wise use.

Research projects include identifying spring- and aquifer-recharge areas, classifying and characterizing aquifers, monitoring ground-water levels in aquifers throughout Missouri, and evaluating ground-water contamination problems.

The Water Resources Program also administers the Water Well Drillers Act of 1986, which requires well drillers and pump installers to be licensed and that all wells must be certified. Each well must conform to minimum construction standards. The Department of Natural Resources maintains records on all wells.

The program also addresses contamination problems with the department's Division of Environmental Quality by providing technical information on ground water and on well construction.

The Water Resources Program also assists citizens by providing estimates of total depth and casing necessary for private wells and by working with the public on ground-water problems.

Underground Injection Control Program

The Missouri Department of Natural Resources' Underground Injection Control program (UIC) protects the state's ground water by preventing improper injection of contaminating fluids into the subsurface environment, through wells.

Fluid injection, has become a widespread practice in the oil industry as demand for petroleum products continues to grow. It is primarily a secondary-recovery operation for restoring depleted reservoirs to producing status or for extracting viscous oil that cannot be withdrawn by conventional flowing and pumping methods.

The number of new injection wells in Missouri is increasing as extraction of heavy oil increases.

Injection wells are also used to circulate ground water and extract heat. A heat pump, which operates like a giant reversible refrigerator, transfers heat from ground water to houses during the winter and from houses back into the ground in the summer. Increasing numbers of people building more energy-efficient homes place additional burdens on ground-water supplies as a source of latent heat.

The Underground Injection Control program is conducting inventories and assessments of each type of well in the state. Such information will aid in making decisions critical to protecting ground-water quality; wise management of this vital resource depends on knowing where potential problems exist.

Protecting our ground water by monitoring the amount of fluids injected or disposed into the subsurface is also a part of the UIC program. Inventories of improved sinkholes and stormwater drainage wells allow the department to assess the effects of fluids from those sources on the subsurface environment.

As mandated by the U.S. Congress through the Safe Drinking Water Act of 1974, all states must protect ground water in cooperation with the U.S. Environmental Protection Agency (EPA). The UIC program divides injection wells into five main classes:

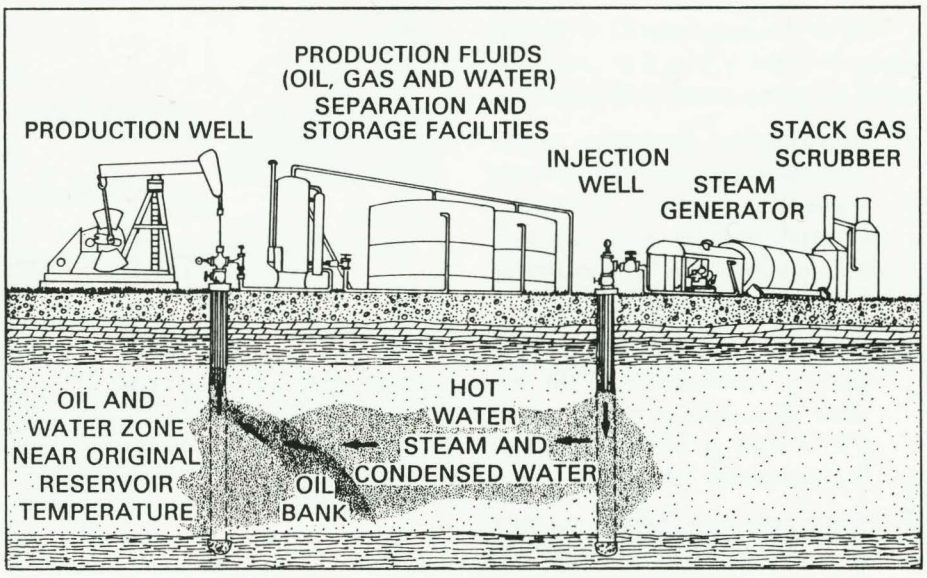
Class I: Wells used to inject hazardous wastes or dispose of industrial and municipal fluids beneath the lowest under ground source of drinking water (USDW). Such wells are banned in Missouri.

Class II: Wells used to inject fluids associated with oil and natural gas production, or fluids and compounds used for enhanced hydrocarbon recovery. There are 400 such wells in Missouri, in Bates, Cass, Jackson, Platte, St. Charles, St. Louis, and Vernon counties.

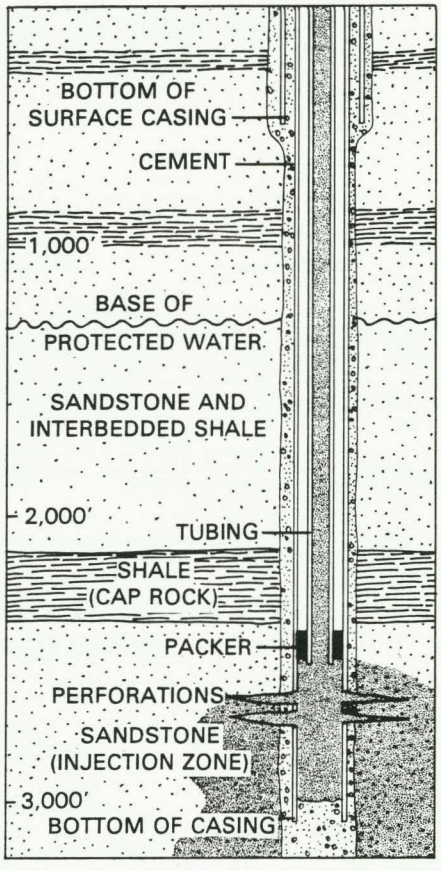
Class III: Wells used to inject fluids to extract minerals. Such wells are allowed, but the Missouri Department of Natural Resources has issued no permits for them.

Class IV: Wells used to dispose of hazardous or radioactive wastes into or above a USDW. Such wells are banned in Missouri.

Class V: Wells not otherwise classified. They are generally used to inject non-hazardous fluid into or above a USDW. There may be about 5,000 Class V wells in Missouri.



Class II Wells: Typical enhanced oil recovery process in western Missouri.



A properly cased Class II injection well. When a well is drilled, steel pipe is cemented in the hole. The cement prevents underground fluids from mixing with each other or with injected fluids. The casing and cement are perforated in the injection zone. To provide extra protection, tubing is lowered into the well to a point just above the perforations. A packer is sealed against the casing near the bottom of the tubing. The packer prevents water from entering the space between the tubing and the casing.

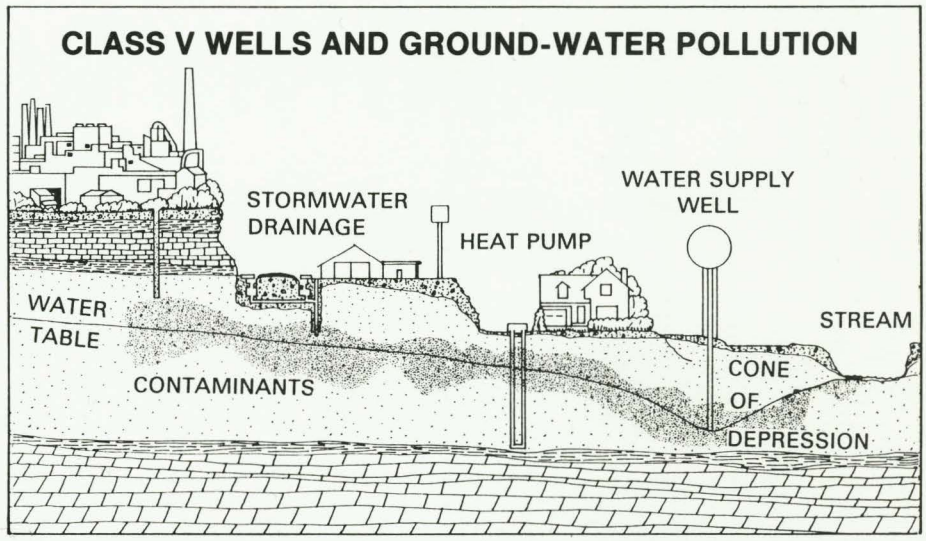
Types of Class V Wells in Missouri

The EPA recognizes 32 different types of Class V injection wells. At least six types exist in Missouri.

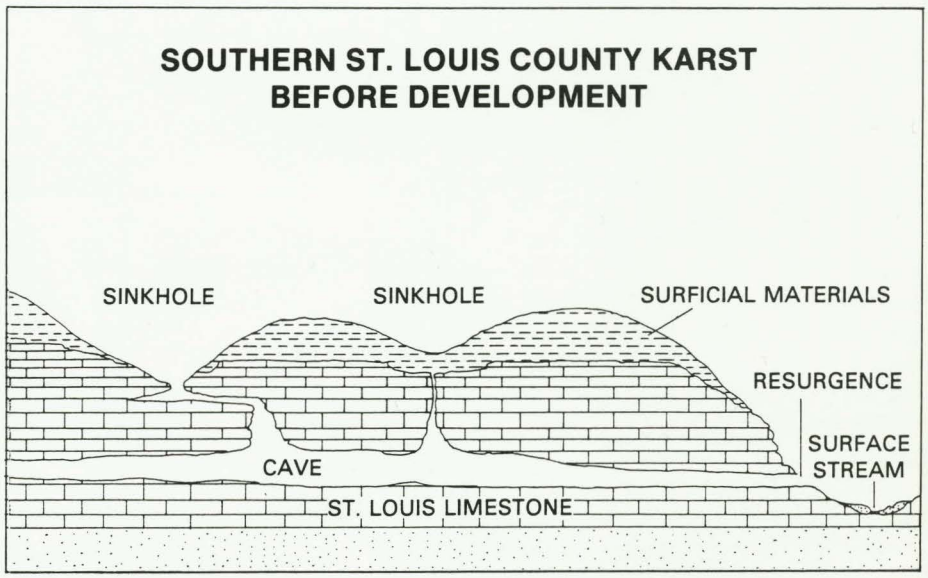
- **Stormwater drainage wells** receive stormwater runoff from areas that include highways, streets, parking lots, residential subdivisions, and building roofs.
- **Heat-pump and air-conditioning return-flow wells** are used to reinject ground water that heats or cools buildings in heat-pump systems.
- **Improved sinkholes** receive stormwater runoff from developments in karst areas.
- **Mining, sand, or backfill wells** are used to inject a mixture of water and sand, mill tailings, or other solids into mined out portions of subsurface mines.
- **Septic systems and wastewater systems** include actual wells, seepage pits, and other systems. They must be as deep as they are wide. Each must serve more than 20 persons daily if the system receives only sanitary wastes.
- **Aquifer-remediation-related wells** are used to prevent, control, or remedy aquifer pollution including but not limited to Superfund sites.

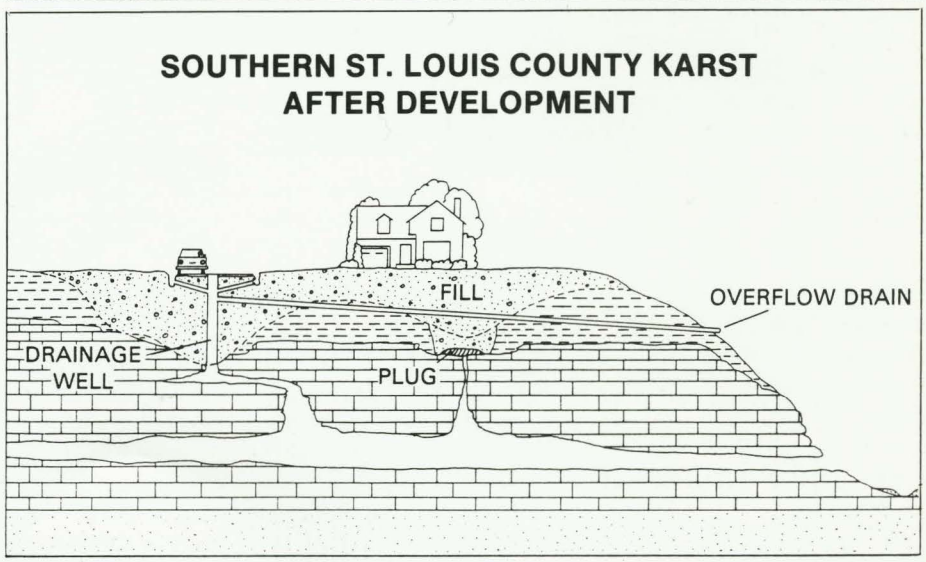
Owners of Class V injection wells in Missouri are required to report the location of such wells to the following:

MISSOURI DEPARTMENT OF NATURAL RESOURCES
Division of
Geology and Land Survey
Underground Injection Control Program
P.O. Box 250
Rolla, MO 65401
(314) 364-1752



Improperly designed and constructed Class V wells can cause ground-water contamination in drinking water aquifers.





As in this before-and-after illustration high land values in urban karst areas encourage use of drainage wells to improve sinkhole drainage. This type of well would be designated a Class V well.

Major Water User's Program

The purpose of the major water user's program is to protect the state's future water supplies and ensure that they will meet demands. The program identifies major users in the state and their needs, including individuals, industries, and municipalities; evaluates the economic value of water for different uses; develops economic incentives for water conservation; and analyzes financial aspects of water projects.

All major water users in Missouri are legally required to report their water use annually to the Missouri Department of Natural Resources. A major water user is defined as anyone who uses or is capable of using 100,000 gallons or more daily (the equivalent of about 70 gallons or more per minute) from ground or surface waters.

A major water user may draw from a stream, river, lake, well, spring, or any other source. Classified water uses include irrigation, industry, municipal and domestic uses, drainage, recreation, hydropower, and wildlife management.

It is very important for the state of Missouri to keep an accurate record of how much water is being used and the purpose of its use. These data are not only useful in protecting the quantity of water but the quality of water available to users.

REGISTRATION OF MAJOR WATER USERS

Who is required to report?	All self-supplied water users capable of producing 100,000 gallons or more per day.
How often is registration required?	Location of wells and surface diversions are registered once; then, annual water use reports are required.
Where can forms be obtained?	Department of Natural Resources, Division of Geology & Land Survey Major Water User's Program P.O. Box 250, Rolla, MO 65401 (314) 364-1752

January 1988

Missouri Department of Natural Resources
Division of Geology and Land Survey
P.O. Box 250, Rolla, MO 65401
(314) 364-1752