

# Geothermal Heating and Cooling Systems



## Do I need a DNR Waters permit for my geothermal system?

**Public Waters Permit\***. A permit is required if the coil assembly (facility) is located on the bed of a public water. The requirements for permitting this facility in a lake or body of water include the following conditions:

- A government agency accepts responsibility for future maintenance of the facility or its removal if the owner fails to maintain or abandons the facility.
- No alternative sites exist that would have less environmental impact.
- A closed-loop system is used.
- The facility is not located in a designated trout stream or lake or a designated wild and scenic river.
- The facility's design and location will not cause a navigation hazard.
- The facility will not exceed more than a minimum encroachment, change, or damage to the environment, particularly the ecology of the waters.
- The facility will not contain substances, if released into public waters, that would be detrimental to water quality or plant or animal life.

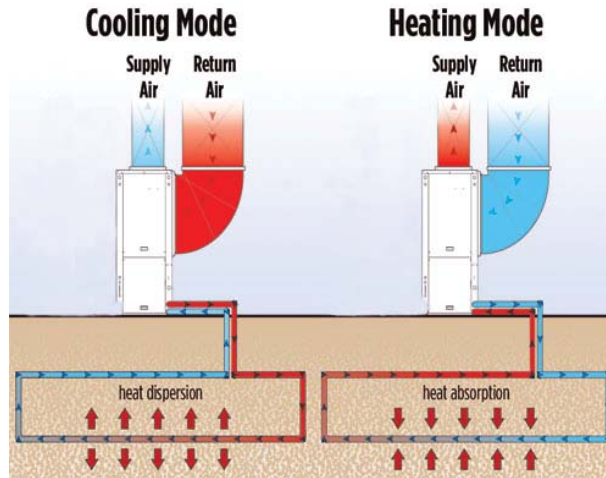
**Water Appropriations Permit\*\***. A water use permit is required for all users, including an open-loop system, withdrawing more than 10,000 gallons of ground water or surface water per day or 1 million gallons per year.

**Questions?** If you have questions, contact your DNR Area Hydrologist. See contact information on reverse side.

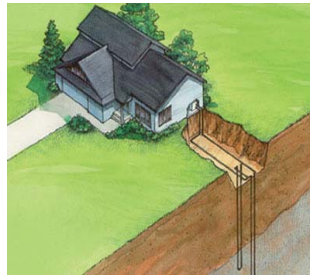
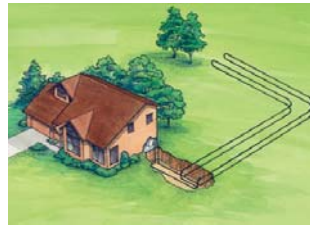
\*Minnesota Rules, Chapter 6115.0211, Subp. 6b.

\*\*Minnesota Rules 6115.0620

## What should I know about installing a geothermal system?



In cooling mode, a loop in the earth disperses warmth and distributes cooled air through a conventional duct system. In heating mode, the same loop absorbs heat for distribution in the ductwork.



**Closed-loop systems:** (top) horizontal coils or loop in a trench, (middle) a loop in a vertical bore hole, and (bottom) horizontal loop into a body of water. Permits may be needed for installing coils or loops in a bore hole or body of water.

Energy exchangers and geothermal systems can provide homeowners significant savings in both heating and cooling costs. When homeowners evaluate these systems, it is important for them to consider impacts on the environment in their comparisons. Permits are required for some of these systems because of their potential impacts on lakes, ponds, streams, and ground water.

## What are geothermal systems?

Ground-source or geothermal pumps are electric-powered systems that use the earth's relatively constant temperature to provide heating in winter and cooling in summer. The two basic types of systems are closed loop and open loop.

### Closed-loop geothermal systems

Closed-loop geothermal systems usually circulate a heat-transfer fluid, typically a food-grade antifreeze, through pipes or coils buried beneath the land surface. During winter, the fluid collects heat from the earth. During summer, the system cools the building by pulling heat from the building, carrying it through the system, and leaving it in the ground.

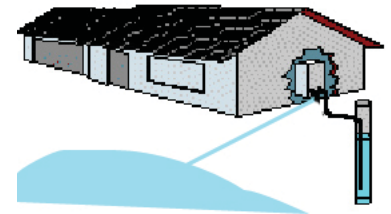
The closed-loop geothermal systems can be installed horizontally or vertically beneath the land surface, or in the bed of a body of water. Homeowners choose one of those systems based on availability of land, cost, soil types, and other factors. A horizontal system may require enough land for a 100- to 300-foot-long trench. A vertical system requires less land but may require numerous well holes drilled deep enough vertically for the geothermal loops. Another closed-loop system involves using a body of water, such as a lake, for installation of the system's geothermal loops or plates. The loops or plates are anchored to the bottom in a body of water and operate similar to the land-based loops of horizontal or vertical systems. Like those systems, the loops or plates use the energy stored in the body of water, rather than in the earth.

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**Potential concerns.** Generally, no concerns are associated with inground, closed-loop systems. However, impacts of closed-loop system on lakes, rivers, or ground water could include the following:

- A submerged heat exchanger could be damaged by motorboat propellers or anchors even if it is well marked, especially during periods of low water.
- A poorly installed or maintained structure may break down, causing the heat-transfer fluid to spill into surface water or ground water.
- A line break in the lake could degrade water quality, fish, and plants. If several homeowners have loops submerged in a lake, habitat and navigation on the lake could be affected by the loops.

**Permit requirements.** A public waters work permit is required for installation of a geothermal heat exchanger in public waters (see sidebar on page 1). A permit may only be issued if a government agency such as a township, city, or county accepts responsibility for future maintenance or removal of the equipment in public waters if the owner abandons the equipment or fails to maintain it. To avoid navigation obstacles in public water basins, a horizontal or vertical system on land is preferred. No permits from the Department of Natural Resources (DNR) are required for installation of a closed-loop system in a pond that is not regulated by the DNR. Installation of closed loop systems that are placed in vertical bore holes are regulated by statutes and rules administered by the Minnesota Department of Health.



**Open-loop system.** During winter, ground water is drawn from a well to the heat pump for “once-through” use, then discharged to a pond (shown above), onto land, or into an injection well. This system may require one or more permits from DNR or other agencies. Regular maintenance may be needed to descale the heat exchanger, or installation of a higher cost heat exchanger resistant to corrosion may be needed.

## Open-loop geothermal systems

Open-loop geothermal systems operate on the same principle as closed-loop systems but typically use ground water as the heat-exchange fluid. After it circulates through the system, the water is discharged over land or directly into lakes, wetlands, streams, or ditches. By reducing the burning of fossil fuels, an open-loop system seems environmentally friendly, but it is considered a wasteful use of ground water. Some single-family homes with an open-loop system may use more than a million gallons of ground water per year. Ground water usually is our source of drinking water and the supply for our household needs.

**Potential concerns.** Ground water typically is run through the open-loop system once and then discharged to a field, lake, stream, or ditch. The discharged water will be a higher or lower temperature, depending on the season, than the ground-water source and the surface water to which it may be discharged. Environmental concerns resulting from open-loop systems include the following:

- Open-loop (once-through) cooling is not considered a wise use of ground water that may be needed for higher priority uses.
- The risk of contamination is an increasing concern. Improperly installed wells or plumbing can be a path to carry pesticides, fertilizers, organic materials, and other contaminants into underlying aquifers.
- Open-loop systems that discharge warmed water may have an impact on surface-water quality, plants, fish, winter oxygen levels, and the integrity of the ice surface during winter (a safety issue).

**Permit requirements.** The DNR requires a water appropriation permit if the total water use from a supply well, including the geothermal system and other uses, is more than 10,000 gallons per day or more than 1 million gallons per year. Discharge of water may require a permit from the Minnesota Pollution Control Agency and possibly from a local government unit.



## DNR Contact Information

DNR Waters website lists Area Hydrologists:  
[www.mndnr.gov](http://www.mndnr.gov)

DNR Waters in St. Paul:  
500 Lafayette Road  
St. Paul, MN 55155-4032  
(651) 259-5700

## DNR Information Center

Twin Cities: (651) 296-6157  
Minnesota toll free: 1-888-646-6367  
Telecommunication device for the deaf (TDD): (651) 296-5484  
TDD toll free: 1-800-657-3929

This information is available in an alternative format on request. Equal opportunity to participate in and benefit from programs of the Minnesota Department of Natural Resources is available regardless of race, color, national origin, sex, sexual orientation, marital status, status with regard to public assistance, age, or disability. Discrimination inquiries should be sent to Minnesota DNR, 500 Lafayette Road, St. Paul, MN 55155-4049; or the Equal Opportunity Office, Department of the Interior, Washington, DC 20240.