

# Underground Geothermal System

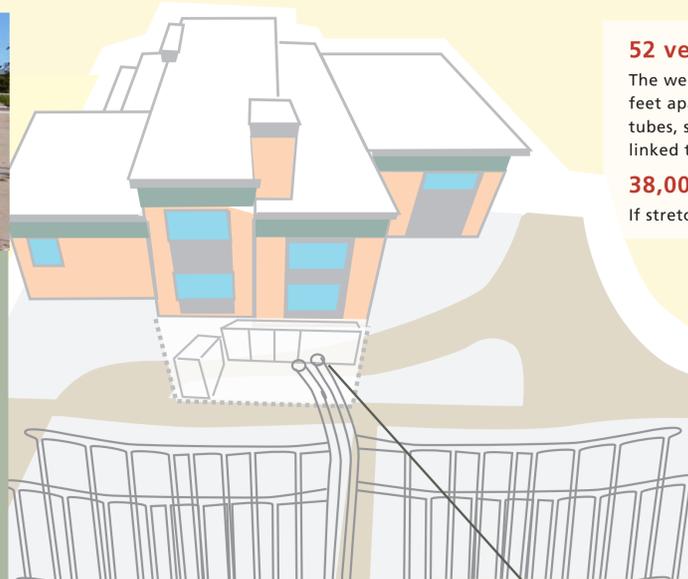


The City of Fitchburg is committed to building sustainable communities by reducing our community's dependence on fossil fuels. Geothermal energy systems optimize the energy-efficiency of our municipal buildings.



## HOW THE LIBRARY'S GEOTHERMAL SYSTEM WORKS

Below this plaza lies a vertical underground network of sealed plastic piping. The closed loop begins ten feet below the surface and extends almost 400 feet into the earth.



### 52 vertical closed-loop wells

The wells are spaced in a grid, approximately fifteen feet apart. The wells are linked together by horizontal tubes, six feet below the surface. Six or eight wells are linked together to form a loop.

### 38,000 linear feet of pipe

If stretched out, this system would be seven miles long.

### Forced-air ventilated cooling system

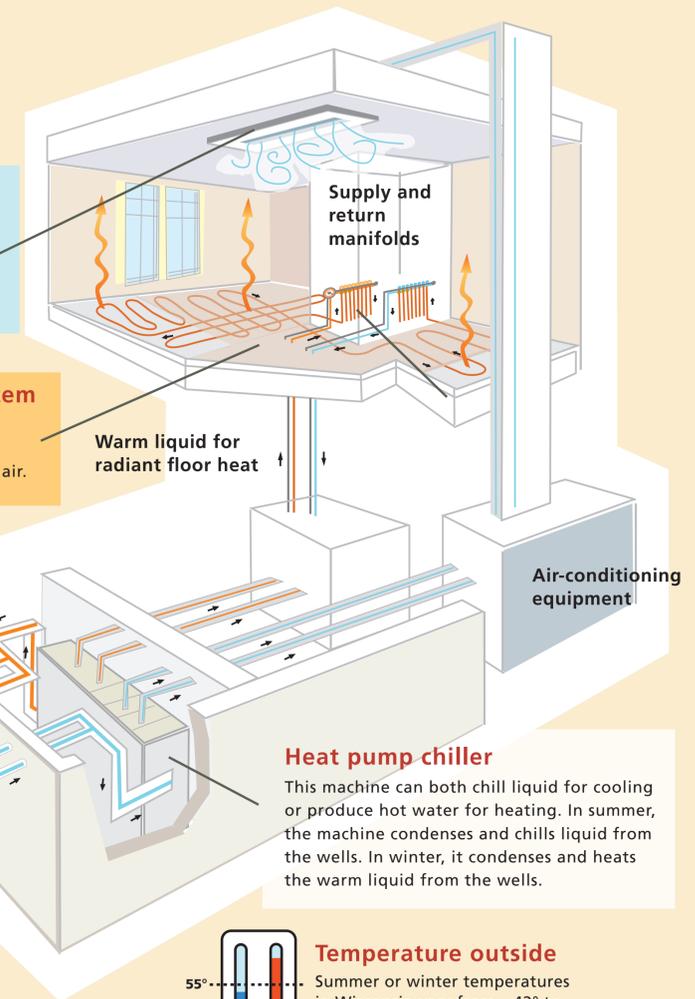
In summer, the electric heat pump chiller produces super-chilled liquid from the cool fluid from the geothermal wells. The air-conditioning equipment then blows air over super-chilled coils and sends it into the library via insulated ducts.

### Radiant floor thermal heating system

The library is heated by a radiant floor heating system. Warm water flows through tubes and the heat is conducted through the floor to warm the air.

## Heating and cooling the public library

The Fitchburg Public Library is a high-performance building. It is designed for optimum energy-efficiency.



This geothermal heating and cooling system was installed in 2010 during the construction of the Fitchburg Public Library.



Drilling the bore holes



Horizontal tubes, facing east



Facing west



Facing north

## Clean energy from the earth

### Investing in reduced energy consumption

This system will significantly reduce the public library's dependence on local energy utilities.

Because the system requires capitol expenditures during installation, the City of Fitchburg anticipates a long-term return on this investment over a 30-year period.

### Life-cycle costs and the carbon footprint

Geothermal systems have lower year-to-year operating costs than conventional systems. During the exploratory phase of library planning, this system was modeled, planned and tested for energy-efficiency. The study determined the Library's energy needs, the life-cycle cost and analyzed the carbon footprint.

## CIRCULATING-FLUID SYSTEM

This closed loop of piping is filled with a working fluid that is continuously re-circulated through the interlinked plastic pipes.



### 75% water, 25% glycol

The fluid in the pipe has no contact with the soil or water.



### Thermal exchange

The fluid absorbs thermal heat from the earth through a putty material filled around the pipe bore hole.



### U-shaped tubes

At the bottom of the well, the pipe pairs form a U-shape. The liquid is pumped down, flows around the U and then flows up the tube.



### Circulation Speed

The liquid takes approximately twenty minutes to circulate through each of the six or eight well mini-loops.

## CONTROL ROOM

The Control Room, located in the basement of the Library, contains mechanical equipment that runs the system. Components of the system include:

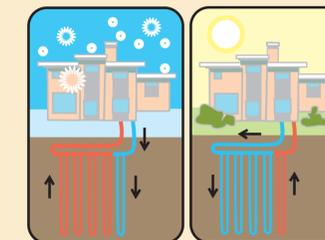
1. Heat Pump Chiller Machinery
2. Thermal Radiant Floor System
3. Forced-Air, Air-Conditioning System
4. Thermal Sidewalk Heating System

## GROUND SOURCE HEAT PUMP SYSTEM

In this process, liquid colder than 54 degrees is warmed, and liquid hotter than 54 degrees is cooled by the surrounding earth.

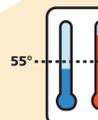
### Ground used as warmth in winter

During the winter, the fluid absorbs heat from the earth and carries it through the system and into the building.

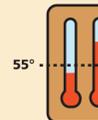


### Ground used as a heat sink in summer

During the summer, the system is reversed. The building is cooled by pulling heat from the building and dispersing it in the ground.



**Temperature outside**  
Summer or winter temperatures in Wisconsin vary from - 42° to 105° F degrees.



**Temperature of the earth**  
The temperature of the earth, below 20 feet remains constant at 54 degrees year-round. Temperatures inside the well range between 42-75 degrees.