

# Geothermal Heat Exchange Systems

Presented to  
Environmental Advisory  
Commission  
February 22<sup>nd</sup>, 2011

## Overview of Presentation

- Types of Geothermal Systems
- Geothermal HVAC Process for Residential Installation
- Components of the Ordinance
- Next Steps

## What is Geothermal?

- The term geothermal literally means Earth/Ground (Geo) Heat (thermal). Geothermal, or ground source heat pumps, take advantage of the constant ground or groundwater temperatures. These heat pumps use geothermal energy to heat and/or cool a home.
- A refrigerant loop with a compressor extracts heat from one side (the ground) and pumps it to the heating loop in your home. It is essentially the same process that happens in your refrigerator: heat is extracted via a compressor and refrigerant loop from the inside of your refrigerator/freezer and rejected into your house.
- In the summer the geothermal heat pump reverses its cycle, if you have an air-conditioning system, and heat from the home is rejected into the ground or ground water.

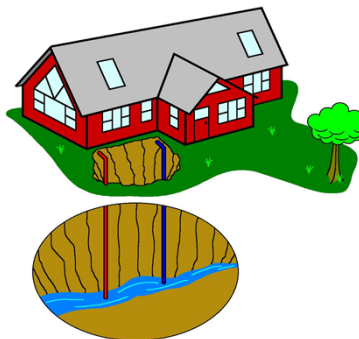
## Geothermal Systems

- There are two major types of residential and commercial systems for geothermal HVAC.
  - Open Loop
  - Closed Loop (Vertical or Horizontal)
- Geothermal can also be used in large scale capacities such as a direct use system. Direct-use systems typically include three components:
  - A production facility, a mechanical system, and a disposal system
  - These systems are used in energy production on a large-scale

## Open Loop Systems

- Utilize water derived from aquifers below the ground through a series of wells.
- Water is pumped from the ground into a heat exchanger where the heat pulled from the building side is transferred to the well-water and re-introduced into the Earth.
- Two major issues: abundance of fresh water within the aquifer and the quality of water that can be extracted.

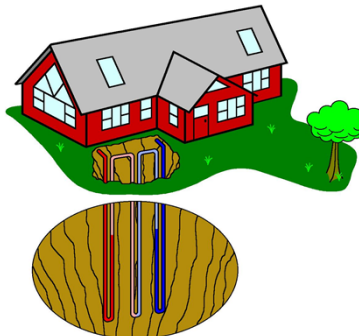
## Open Loop Systems



## Closed Loop Systems

- Vertical:
  - Most common geothermal heat pump system utilized in a HVAC system.
  - Water is pumped through piping in the ground where it can transfer heat to the surrounding soil. (Holes are drilled 150-300 feet into the ground)
  - Water is not open to potential contaminants.
  - Soil conditions need to be examined for the ability to conduct heat from the pipe to the surrounding grounds.

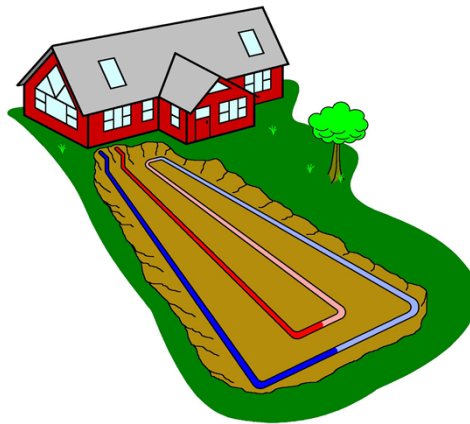
## Closed Loop Systems - Vertical



## Closed Loop Systems

- Horizontal
  - Piping is laid at a shallow depth of 5 to 20 feet. Same amount of piping is required as a vertical system.
  - Typically installed with a vast amount of space available for HVAC piping (approx. 2500 square feet per ton).
  - As with Vertical, water is not open to contaminants and soil conditions need to be examined.

## Closed Loop Systems - Horizontal



## Pond Loop System

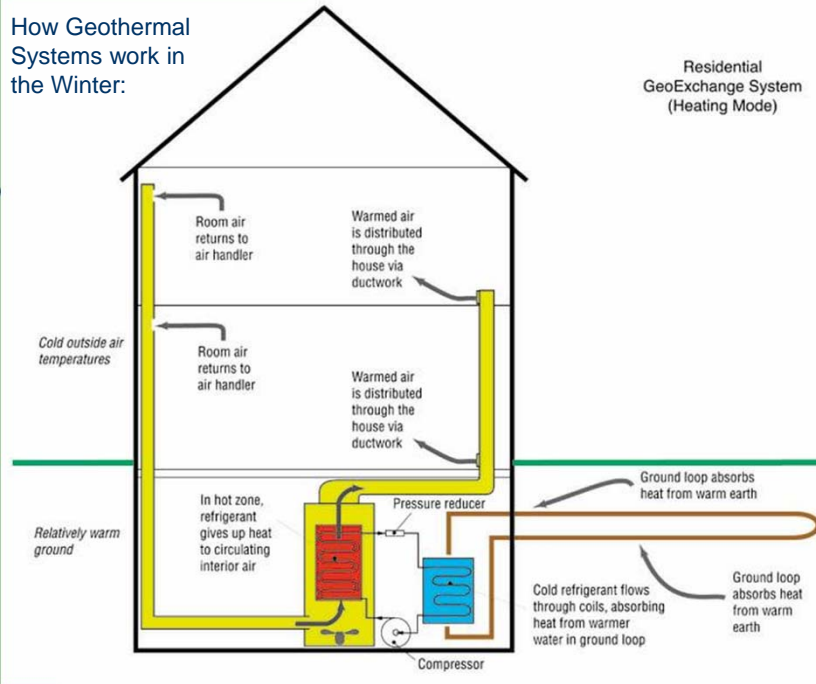
- In a pond-loop system, fluid is circulated through a closed loop of pipe lying at the bottom of an open body of water. The fluid within the pipe never comes into contact with the open water, such as a pond, lake, creek or swimming pool. This system is excellent where a sufficiently-sized body of water is available.
- During the heating season, the fluid is warmed by the lake, river, or pond and brought into the heat-pump to heat the house. The cycle is reversed during the air-conditioning season, using the fluid to reject unwanted waste-heat into the lake, river, or pond.

## Pond Loop System



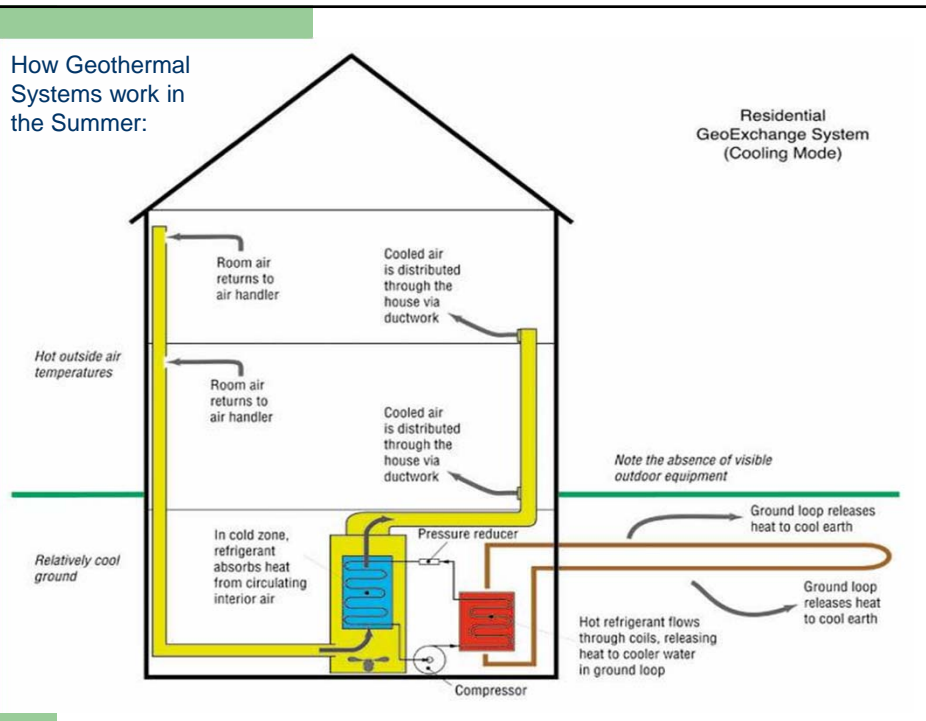
How Geothermal Systems work in the Winter:

Residential GeoExchange System (Heating Mode)

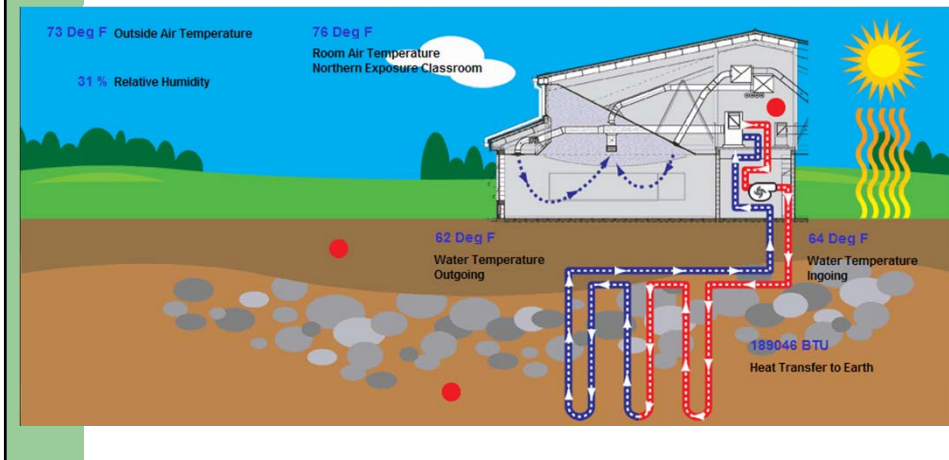


How Geothermal Systems work in the Summer:

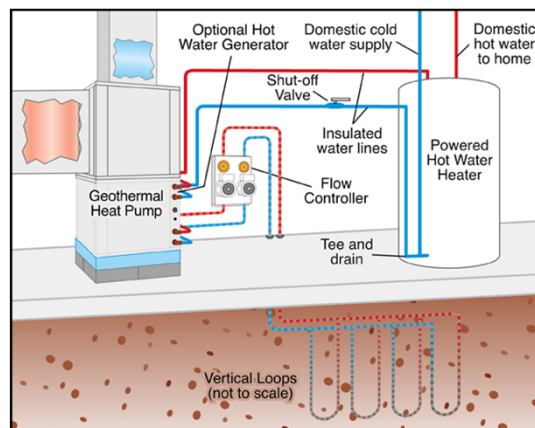
Residential GeoExchange System (Cooling Mode)



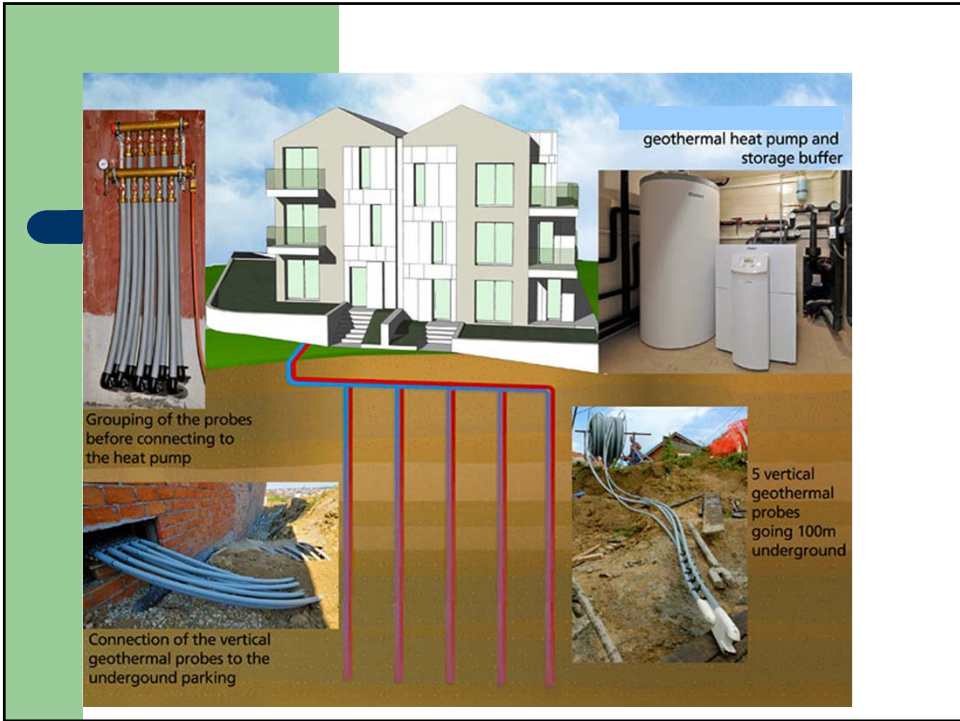
## Example of a Closed Loop System in a Home



## In-home components







# Construction



This drilling rig is 8 ft wide and would be a typical drilling rig used in a residential geothermal installation.

## Estimated Costs for a Geothermal System

- Cost of the HVAC Component - \$5,000-7,000.
- Cost of Drilling - \$2,000-2,500 per ton of system capacity. Typical home HVAC system is 4 tons, thus drilling would cost between \$8,000-10,000.
- Cost of Permit - \$25
- Other costs to consider – Maintenance
- Average total cost expected - \$15,000

## The Process for a Resident Interested in Geothermal

- Residents interested in Geothermal Systems should
  - Thoroughly research potential vendors and systems before moving forward.
  - Consider the costs and benefits of geothermal
  - Make sure the vendor they choose is a member of IGSHPA and has a TDLR license for closed-loop geothermal drilling.
  - Contact the City of Richardson's Building Inspection Department for a permit.

## Components of the Ordinance

- Valid License Required
- Permits Required
- Inspection and Fee
- Construction and Maintenance
- Restrictions and Limitations

## Valid License Required

- Any person who installs a geothermal exchange system must hold a valid water well driller license, as defined by Title 12, Texas Occupations Code, Chapter 1901 and required by the Texas Department of Licensing and Regulation. Geothermal boreholes shall be drilled by a registered or licensed water well driller with the Texas Department of Licensing and Regulation with a geo-thermal designation.

## Permits Required

- Obtained from Building Inspection Department.
- Will be a Residential Building Permit with a Mechanical Voucher to inspect the installation of the system and the HVAC system.
- Building Inspection will collect the driller's TDLR number and IGSHPA number for verification.
- Plans and Specifications for the location of the system must be submitted to Building Inspection.

## Inspection and Fee

- Fee for the Residential Building Permit and Mechanical Voucher will be at the trade permit rate of \$25.
- The fee is established by City Council and could be subject to change in the future.

## Construction and Maintenance

- Must comply with State Regulations set by the TDLR and must follow the standards established by IGSHPA.
- Must be installed as per manufacturers specifications.
- All debris from construction must be contained within the site and cannot contaminate ground water or storm water.

## Restrictions and Limitations

- Open Loop Systems are Prohibited.
- Systems can only service one property, and systems must be located within the property boundaries.
- A copy of the well log sent to TDLR must also be sent to Building Inspection (Includes GPS coordinates of the system).
- Setback from any easement (utility, drainage, etc.) shall be a minimum of 10 feet.

## Restrictions and Limitations Cont.

- Systems must be tested as per the manufacturer's specifications and IGSHPA requirements.
- The system must be maintained to keep the system functioning as designed and as not to create a health hazard.
- System abandonment must comply with TDLR rules and regulations.

## Next Steps

- Review, discussion, and consideration by Environmental Advisory Commission.
- Upon approval from Environmental Advisory Commission, Ordinance will be sent to City Council for approval.

Note: Additional CPC review is not needed, as geothermal systems are considered HVAC systems, not as an accessory use.

**Questions?**