

INFORMATION FOR THE PROSPECTIVE GEOTHERMAL HOME BUYER

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INTRODUCTION

This paper was written to assist new homeowners with geothermal heat in Klamath Falls. If you are not from the area, a geothermally-heated home may be something unfamiliar to you. This paper is intended to provide some background information to guide you through the purchase of a home equipped with a geothermal system.

Geothermal energy resources and their use are not unique to the Klamath Falls area. Although our area is characterized by a high degree of development, many other areas of the western U.S. (Reno, NV; Boise, ID; Susanville, CA, for example) also have extensive geothermal resources and development. The geothermal hot water available here in Klamath Falls results from surface water circulating, through faults to a great depth at which the rock temperature is very high. Passing through this rock, the water is heated. Since hot water is less dense than cold water, it tends to rise toward the surface where it can be accessed through wells. Much of the geothermal water in town issues from a fault roughly oriented northwest to southeast between OIT on the north and Olene Gap on the south. The depth of hot wells in this area varies from just a few hundred feet to as much as 2000 ft. Temperatures are in the range of 100°F to 230°F with most home heating wells in the 150°F to 200°F range.

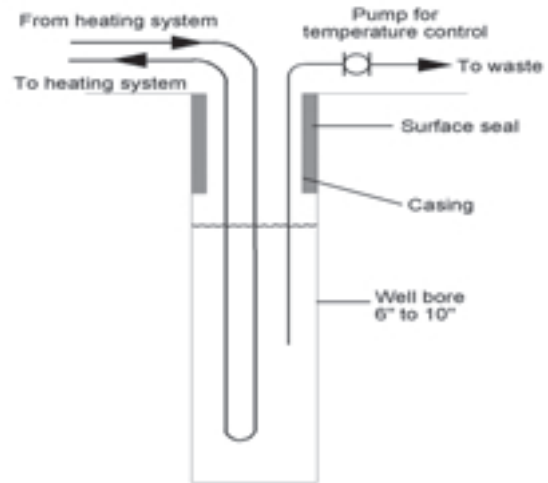
One aspect of geothermal that is somewhat unique to Klamath Falls is the use of the Downhole Heat Exchanger (also known as a DHE or a "loop"). This is simply a loop of pipe which is installed in the well and connected to the home's heating system. Water passes through the DHE, is heated and then passes through the home's heating system giving up its heat to the space. It is then returned to the DHE to repeat the process. This arrangement eliminates the need to pump water from the well (only heat is removed) and simplifies the system. It is limited to relatively small systems of the type that heat one home or a group of homes. It is also limited geographically. The performance of DHE's has been poor in other regions of the U.S. (notably Reno) where they have been tried.

The following paragraphs offer some more detailed comments on the systems and some suggestions for questions to ask of your agent or the existing homeowner which appear in **bold** type. There is little to be gained in having a well driller, plumber or Geo-Heat Center Staff inspect a system such as this. Asking the questions suggested below is a far more effective approach.

WELLS

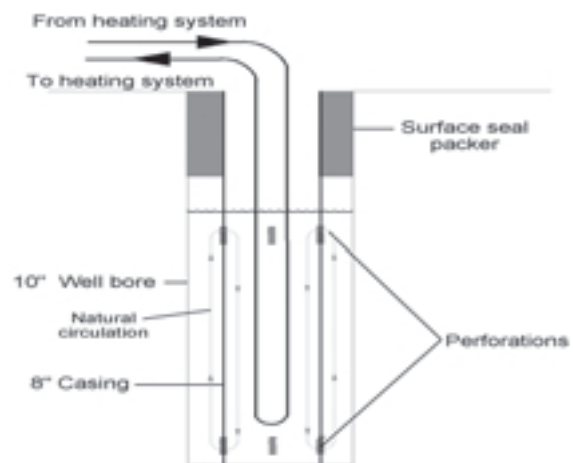
There are two basic types of hot well construction. The older wells are simply a borehole in which a small amount of casing (20 ft to 100ft) is installed in the upper portion to seal off any cold water. The balance of the borehole is "open

hole" - simply a cylindrical hole in the rock. In many of these wells, a small quantity of water was continuously pumped from the well to maintain temperature. This practice is no longer permitted under city ordinance (any water pumped from a geothermal well must be injected into another well).



Older Wells

Newer wells use a larger borehole diameter (12" or so) and a smaller diameter casing is subsequently installed to the bottom of the well. Perforations are made in the casing just below the water level and near the bottom of the well. This leaves an annular space between the larger borehole and the smaller casing. The DHE is installed inside of the casing. As heat is removed from the well, the water around the DHE (inside the casing) is cooled and tends to fall to the bottom of the well. As this happens hot water entering the well rises up in the annular space. This natural movement of the water eliminates the need to pump water from the well to maintain temperature.



Newer Wells

Wells very rarely fail - at least to the extent that they are no longer useable. One condition that does occur from time to time in wells in the hillside area is referred to as a "cave in." The reality is a good deal less catastrophic than it sounds. Due to ground vibrations and natural erosion, an accumulation of soil and rock fragments can accumulate in the bottom of the well. Over a period of many years this material can build up and cut off or reduce the flow of hot water into the well thus reducing its heating capacity. The remedy to this is to remove the DHE from the well, and have a driller "bail" the well. This is a procedure in which the driller lowers a tool called a bailer into the well to pick up the loose material that has collected in bottom. This procedure could be accomplished in a single day but most likely would require two days to complete. This is not a common problem. Of the 600 hot wells in Klamath Falls, probably less than 10 require bailing in any given year.

Buyers unfamiliar with geothermal often ask about the possibility of the geothermal resource cooling off over a period of years. This has not occurred in any well in the Klamath Falls area to our knowledge. The size of the heat source relative to the demands placed on it by the various uses is such that no detectable temperature change occurs.

DOWNHOLE HEAT EXCHANGER (DHE)

The DHE is usually constructed of ordinary carbon steel (sometimes called "black iron") piping. In most systems it is either 2" or 2 1/2" diameter. If a domestic hot water heat exchanger is used, it is normally 3/4" or 1" in diameter. The length of the DHE varies with the depth of the well and the practices of the contractor at the time it was installed. A rule of thumb used in the past was that 1 foot of DHE was required for each 1500 Btu/hr of heating load.

The major concern with respect to the DHE is corrosion on the outside surface of the pipe. Because the pipe is submerged in hot water and exposed to air, corrosion is a natural occurrence. The result of this is that most DHE's will require replacement of the piping near the water line at intervals of 10 to 15 years. This is an average, with some wells causing failure of the pipe in as little as 5 years. Replacement of the piping requires the services of a water well pump company or a driller. A truck equipped with a tall "mast" and a winch is brought in and the piping is removed from the well and the corroded pipe replaced. This operation can normally be accomplished in 1 day. While the pipe is out of the well, it is a good opportunity to have a temperature log of the well performed. Time and equipment permitting, this is a service the Geo-Heat Center can perform at no cost to the homeowner.

Corrosion of the DHE piping, as mentioned above is a result of the exposure of the wetted pipe surface to the air. For many years, well owners poured old motor oil, paraffin and other substances down the well to coat the pipe in an attempt to reduce corrosion. For obvious environmental reasons this practice is not recommended. Recent research has indicated that simply sealing the top of the well to prevent the entrance of air (which is the fuel for the corrosion reaction) is a more effective strategy. This can be easily accomplished with the "foam in a can" type products often used for home weatherization.

Obviously one of the pieces of information that you would want to request from the seller is the last time the DHE piping was serviced and/or replaced.

HOMES CONNECTED TO A MULTI-HOME SYSTEM

There are many systems in Klamath Falls in which several homes are connected to a single well. In most cases, these systems serve from 2 to 5 homes. There are several areas about which you should seek information.

Most multi-home systems involve a network of buried pipe to deliver the hot water to each home. This piping is usually uninsulated carbon steel pipe. Just as in the case of the DHE, external corrosion of this pipe is a common occurrence. Several of the systems have experienced leaks in the buried piping after approximately 15 years of service. Repair of these leaks requires first locating the leak and then excavating the site (the pipe is normally about 3 to 4 ft deep) and replacing the failed pipe. **For homes on such a system it would be advisable to determine the age of the system, whether there is an accurate layout of the buried piping and if there have been any failures to date.**

As a result of the need to periodically maintain the system, it is useful to have a formal agreement between the owners of homes connected to such a system. In this way, there can be no confusion as to the equitable distribution of costs when repairs are necessary. **You should determine whether such an agreement is in place and you may wish to have your attorney review the document.**

The agreement may also cover the distribution of costs associated with the operation of the main circulating pump. Some systems have a single circulating pump which delivers hot water from the well to all the homes connected to the system. This is the least complicated and most trouble free arrangement. A second design involves the use of a pump at each home. This design can result in the individual pumps "fighting each other" and the most water going to the home with the largest pump.

CONTROLS AND SEQUENCE OF OPERATION

Each geothermal system is unique and the specifics of its installation are a reflection of the contractor responsible for it and the period in which it was installed.

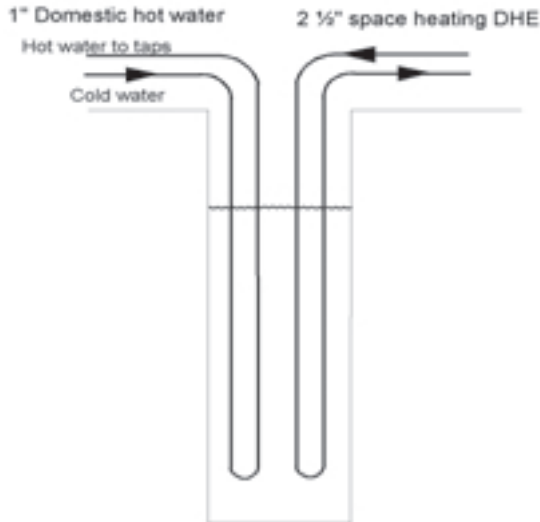
The simplest systems are the so called "thermosyphon" designs. These systems operate without the use of a circulating pump and rely only on natural convection to circulate the water through the piping. In most cases, the only controls are individual hand valves on the radiators or a main control valve that responds to the thermostat. These are the oldest systems and are generally found only in homes served by a single well.

Newer systems that use a pump to circulate the hot water, often have more complex controls. In addition, systems serving more than one home have the added complexity of controls to assure that the water is distributed evenly among the individual homes. Since no two systems are the same, it is important for the existing owner (who is the most familiar with the operation) to pass this information along to the new owner.

It is important that the seller provide a complete set of instructions (and preferably a diagram identifying the control and shut off valves) along with any periodic or seasonal adjustments that are necessary.

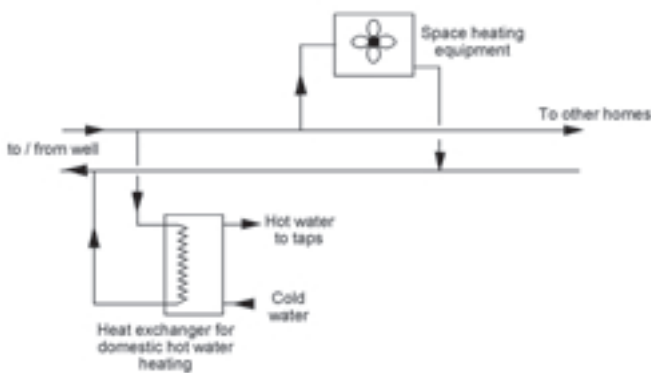
DOMESTIC HOT WATER

As discussed above, one method for heating domestic hot water is the use of a separate DHE specifically for that purpose.



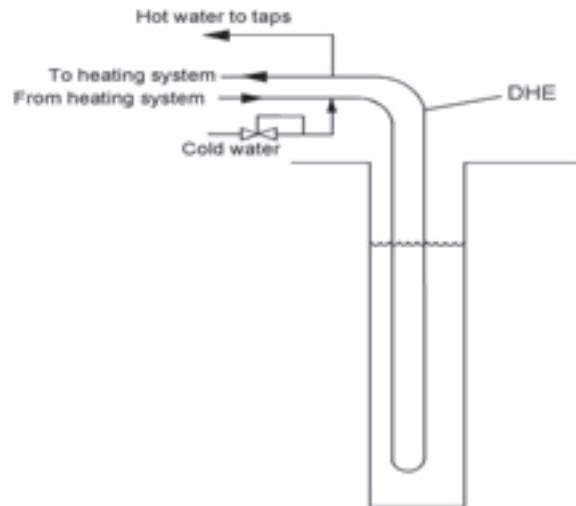
Separate Domestic Hot Water with DHE

The second approach to domestic hot water heating is the use of a heat exchanger. This is the design used on most systems serving more than one home. A heat exchanger is a device that transfers heat from one stream of water to another without the two streams mixing. For the heating systems in Klamath Falls, water from the DHE loop is passed through one side of the heat exchanger and cold city water is passed through the other side to be heated.

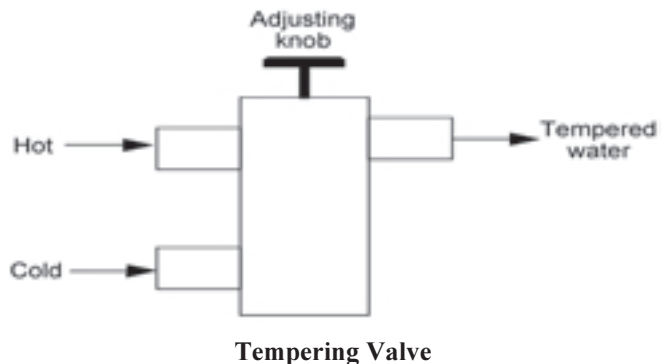


Multi-Home System

A third approach is to draw water directly from the space heating DHE. As hot water is drawn from the taps, cold water is admitted to the loop to make up the difference. This method was common in the earliest systems but is rare today.



With all three of these designs it is possible for the water at the tap to approach the well water temperature. In some cases, this would result in a temperature of 180°F or more. In most homes, plumbing systems have been equipped with a device called a tempering valve. This valve serves to limit the maximum water temperature delivered to the taps by mixing hot and cold water. If small children will be living in the home, it would be advisable to verify that a tempering valve is in place.



Tempering Valve

FOR MORE INFORMATION

If you have additional questions, please don't hesitate to contact the Geo-Heat Center at 541-885-1750 voice, 541-885-1754 FAX or geoheat@oit.edu.