



**GeoExchange in Deep Bedrock Earth Coupling Observations  
Technical Bulletin 2007-19**

<b>GENERAL</b>	<b>NOTES</b>
<p>Below is a discussion for the use of well water open systems in Cape Cod and on Long Island. Long Island Lighting Marketing<sup>1</sup> has indicated there are well over 1,000 open-type geothermal heat pump systems on LI today. Some open geothermal heat pump systems have been active since the late 1950's.</p> <p>Well water/Open Well geothermal heat pump systems as compared to closed loop systems are generally</p> <ul style="list-style-type: none"> <li>✓ Most Efficient</li> <li>✓ Lowest First Cost Heat Pumps</li> <li>✓ Lowest First Cost Earth Side</li> </ul> <p style="text-align: center;"><b>Table 1 – What Well Water Systems Have to Offer</b></p> <p><b>EFFICIENCY IS HIGHEST</b></p> <p>Geothermal heat pump efficiency can be measured by the difference between the temperature of the hot side (condenser) and the cold side (evaporator) of the heat pump. The smaller difference the less power is consumed in compressing the refrigerant gas – and consequently, the lower the electric costs and the higher the heat pumps output. Both are measurements of efficiency.</p> <p>In its simplest terms:</p> <ul style="list-style-type: none"> <li>• Long Island's 52°F well water is closer to 100°F heat pump output winter temperature than the 32°F design temperature for a closed loop GT system.</li> <li>• In the summer, the 52°F well water temperature is closer to the 77°F design temperature for a closed loop ST system.</li> </ul> <p style="text-align: center;">Table 2 – Why More Stable Ground Water Temperatures are More Efficient</p> <p style="text-align: center;"><i>Open Wells Provide Highest Efficiency Equaling Lowest Operational Costs.</i></p> <p><b>LOWEST FIRST COST – Heat Pump</b></p> <p>Rating a heat pump at 50°F<sup>2</sup> well water temperatures water for both heating and air conditioning results in a smaller, less costly heat pump as the higher winter and lower summer temperatures are more stable. Rating an installation at 32°F (heating) and 77°F (cooling)<sup>3</sup></p>	

<sup>1</sup> LILCO survey 1988, also in NYSERDA survey mid 1980's

<sup>2</sup> ARI ISO 13256-1-325 is the "Well Water" Air Conditioning & Refrigeration Institute's Standard, both heating & air conditioning are rated at 50°F water in the northeast.

<sup>3</sup> ARI ISO 13256-1-330 is the "Closed Loop" ARI spec for standard design at 32°F Heating and 77°F A/C



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often results in the next larger and consequently higher priced heat pump. Temperatures for the Closed Loop applications requires more power in the winter and in the summer, making the heat pumps less efficient and have lower output – requiring usually a one step larger model.

As an example, taking a four ton model ClimateMaster geothermal heat pump with a building load of 41,000BTUH heating and 32,000 BTUH cooling. The required heat pump used for well water is smaller and less costly.

Type GTHP	Model (Well Water)	Model (Closed Loop)
Standard	GSH048 \$6,196	GSH060 \$6,432
High Efficiency	TTH049 \$7,952	TTH064 \$8,298

**Table 3 – Difference in GTHP Sizing & List Cost for Well Water and Closed Loop**

### ***A Well Water Heat Pump Can be Smaller and Less Costly***

#### **LOWEST FIRST COST – Wells & Closed Loops**

The above 41,000 BTUH heat loss would result in a requirement for approximately  
1,200 feet of closed loop in 550 feet of **vertical**<sup>4</sup> bore hold at \$5,100  
3,500 feet of closed loop pipe in a 350 feet of **Slinky**<sup>5</sup> trench, at \$4,800

**Table 4 – Typical HDPE Pipe Required for Example Installation**

***Closed Loops Have Been Approximately \$500-\$800 More Per Nominal Ton***

#### **DESCRIPTION OF OPEN SYSTEMS**

The well water/open system can have several configurations, some of the more popular configurations are:

- Open Well to Responsible Surface Discharge
- Open Well to Diffusion well
- Open to Return to Same Well (Standing Column Well)

#### **Open Well to Responsible Surface Discharge**

This design requires two important facts:

1. That the well can produce 3pgm per ton of load, with the dominant load being the design requirement.
2. There is a responsible place to recycle the water back into the aquifer.

<sup>4</sup> Based upon the damp soil minimum depth of 150Lft/ton and has been \$1,400-\$1,900/ton, \$1,500 was used in this example.

<sup>5</sup> As above, this is the low end of the Slinky type closed loop, a recent system on Martha's Vineyard cost \$2,200/ton, \$1,400 was used in this example. Although easier to dig, it requires about \$1,000 more pipe.



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Although there maybe some of these designs on LI, we are not aware of any surface discharge with any of the very old LI systems as Solargy, TempMaster, Friedrich, or ClimateMaster geothermal heat pumps. We have been designing and supplying GTHPs on the Island since 1975. A basic problem can be the lack of a stream, pond, or other surface water entity for a responsible return to the environment. Assuming a sufficiently large well yield and a responsible recycle point, the open well can be the lowest cost and highest efficiency GT System. There is a preponderance of these systems in the Northeastern States.

We understand there are some old sites with commercial Florida Heat Pumps that are recycling directly to LI sound.

Recycle to a "navigable stream/body of water" will require a National Pollution Discharge Elimination System permit (NPDES). The NPDES for a geothermal system is not a difficult task and we have yet to have any problems with this type of system.

### Open Well to a Diffusion Well

A very popular method for geothermal heat pump earth coupling in LI. We have been involved in many installations since 1978. The water tables in many areas on the Island are near the surface and the soil is exceptionally permeable.

Spacing two wells at a proper distance with one well providing the necessary 3 gpm/ton and the second well accepting this amount of water is a relatively low cost and unambiguous design. Providing the water from the well is drinking quality the EPA categorizes this type of well as a "Class V" Underground Injection Criteria (UIC) well. The EPA considers this type of well to be environmentally beneficial and does not require permitting.

We would recommend this type of system in any application on the Island. F note, this last winter, Long Island Lighting retrofitted its Riverhead Office to a geothermal heat pump system and drilled a second diffusion well. LILCO's Brentwood facility was installed as a geothermal heat pump with a single supply and diffusion well. The original 200-ton installation pumped over 500gpm to their heat pump since 1955! We updated the system about four years ago and have integrated the new ClimateMaster equipment to the old supply and diffusion well.

Supply and Diffusion Well(s) are Recommended for Long Island Installations

### STANDING COLUMN WELLS

Residential Standing Column Wells (SCW) return the water to the same bore hold after passing through the heat pump. These wells are generally categorized as Class V wells and are regulated by "rule" – viz. a permit is not normally required.



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The SCW usually employs about 50-60 Lft of bore hold per ton, or approximately 2 ½ times less bore depth than a vertical closed loop (150 Lft/ton). The SCW are normally employed in areas where there is near-surface bedrock and are often 1,500 Lft deep (supporting 30-40 tons). The SCW method is useful in areas where the bedrock is within approximately 60-100 feet of the surface and commensurate casing lengths and costs are minimized.

There are no SCW on LI as the sand/gravel over-burden is 600-800 feet deep. Nearby Queens, Brooklyn, and Manhattan are prime candidates for SCWs. Cape Cod, likewise, has few areas where there is near-surface bedrock.

For the past 50 years, the *open* geothermal heat pump systems on Long Island have been exemplary. There has been a history of lowest first cost, low maintenance, low operating costs and harmony with the environment.