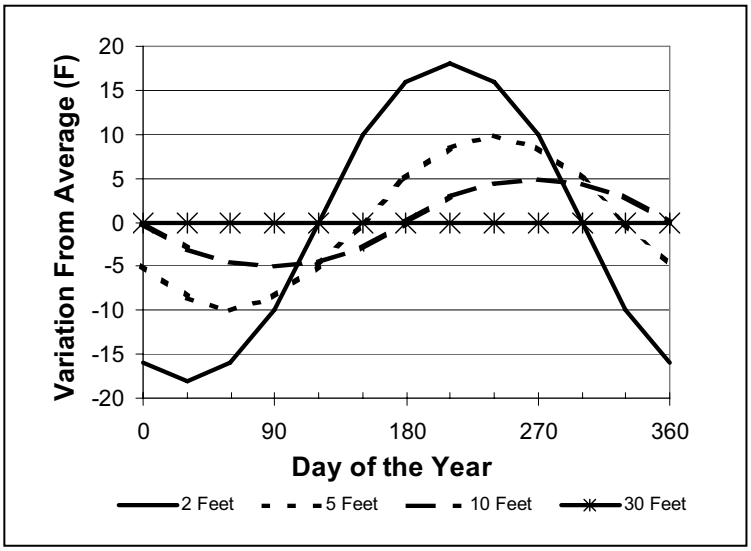
Figure 10 – Shallow Ground Temperature Variation with Season[8]



The graph shows the variation from undisturbed ground temperature for various depths. For instance, horizontal systems usually stay within 5 ft. of the surface, which can swing by as much as 20°F from summer to winter.

Annual Energy Load and Balance

Key issues with Geothermal systems are the annual energy load and balance. If the building rejects more heat into the ground than it removes, then the borehole field average temperature will climb over time. Even if the heating and cooling loads are balanced, the amount of the energy rejected will affect the monthly ground temperature.

How fast and how much the temperature changes will depend on building usage, borehole spacing and ground water movement. Close borehole spacing will restrict the ability of the borehole to dissipate heat. On the other hand, good ground water movement will help carry away heat. If the building uses more heat then it rejects, the reverse will be true.

Monthly Effects and Equivalent Full Load Hours

The amount of energy transferred to or from the field will affect the ground temperature and the future performance of the field. This effect is generally considered on a monthly basis. A key factor is building use. Consider a school and a hospital, both with a 200-ton design load. Even though they have the same number of heat pump tons, the hospital operates around-the-clock and moves much more energy to and from the field than the school.

Most loop sizing software uses Equivalent Full Load Hours (EFLH) for heating and cooling to estimate the energy transfer effect. Equivalent full load hours are the annual heating and cooling loads divided by the installed capacity. For the hospital and school example given above, even though the installed capacity would be the same, the annual loads for the hospital will be much higher and the equivalent full load hours will be higher.

Estimating the equivalent full load hours requires some judgment and understanding of how the building is used. ***Appendix 4 – Equivalent Full Load Hours***, page 39, provides Equivalent Full Load Hours for various cities and building types based on constant temperature setpoints. The following will provide the designer with some guidance on factors that affect Equivalent Full Load Hours.[9]

[8] Copyright 1997, American Society Of Heating, Air-conditioning and Refrigeration Engineers Inc., www.ashrae.org. Reprinted by permission from Ground-Source Heat Pump Systems: Design of Geothermal Systems for Commercial and Institutional Buildings

[9] Carlson, Steven W., Jeff W. Thornton. *Development of Equivalent Full Load Heating and Cooling Hours For GCHPs.* RP-1120. ASHRAE. Atlanta, Ga. 2002.