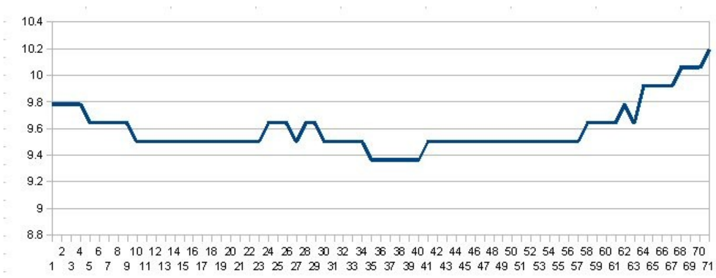
Progress Report (July/09)

The two central injection holes for the prototype AE-Street system in Kingston are 1.7 metres apart and initially almost all of the heat has been injected into one of the holes (designated Yellow) so that we could observe when the heat reached the second hole (designated Blue). On July 1 it was observed that the temperature of the Blue hole began to increase, and its temperature has continued to increase as shown in the graph below.



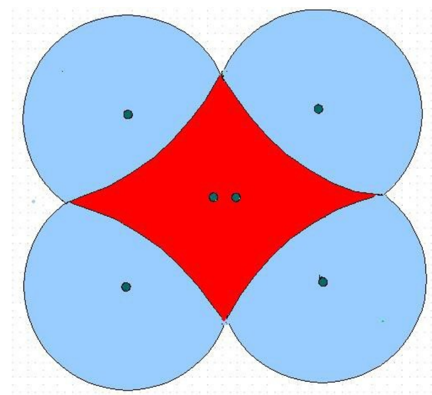
The increase started after an elapsed time of 58 days from the start of heat injection (the initial blips were caused by small amounts of heat that were injected directly into the blue hole during startup tests).

For that 58 day period all of the heat that was injected into the Yellow hole was retained by the ground within the 1.7 metre radius. However, the radius will continue to expand so that over the period from the start of injection until the end of the heating season the outer limits of the warmed volume would increase to about 17 metres in diameter if there were only a single borehole. In that case the single borehole could not recover much of the injected heat because it will only recover heat that has been retained within the central few metres as dictated by the rate of heat flow.

In other ground storage systems, like the solar collection system at Drake Landing in Okotoks AB this has been dealt with by using a large number of boreholes in a large storage field but that solution precludes the potential for using ground storage for a single home and it entails substantial heat losses, a much higher cost per home, and the loss of features like the ability of the system to both heat and cool the homes.

In contrast the AE-Street system traps the heat in the volume between the central injectors and the outer thermal wells, which are below the ambient ground temperature so the heat flows into them. That defines the storage volume and the heat storage capacity.

The storage volume is outlined by the pincushion shape in the isotherm map (below):



If the four outer boreholes are supplying the heat needed for domestic hot water (DHW) then the shape of the isotherm map remains almost constant throughout the year. In the summer the injected heat will “fill up the tank” by creating a thermal wave that will not reach the pincushion periphery until the fall. The temperature profile across the pincushion will change as the heat is injected but the shape of the perimeter will barely change at all.

If the four outer boreholes are not being used to supply the heat for DHW then they will gradually fade away during the summer and fall and will need to be reconstructed in the winter. To do that it is desirable to ensure that heat from the center does not reach the outer extraction points until after the well-building process has started. That makes it essential to be able to predict that timing, hence the importance of this test. The timing of the injection start can be deferred if necessary* but that obviously introduces a new question – “Can sufficient heat be injected in the abbreviated period?”

Because of the need to know the heat flow velocity we have been injecting heat into only one of the central holes. Now that the velocity is known we can begin to inject heat into both holes. The air temperatures have been so extraordinarily cool this spring that we could not in any event have determined the maximum or average rates of heat injection anyway. Those tests can now proceed and will be reported on next month.

* Injecting extra heat would not reduce the amount of heat available for winter heating. It just implies that some of that heat would be lost to the surrounding ground. Since the energy expenditure (electricity) required to inject the heat is very small that loss would not be very significant.