Comments on the GW Solutions preliminary study of the aquifer conditions on Gabriola Island, dated February 20, 2007, and made available (generously) by Dan Foley.

Studies of Gabriola's groundwater by professional hydrologists go back to at least 1962. Like all previous studies, the study by GW Solutions adds interesting new data, contains questionable assumptions about the Island's hydrology, and ends with a precautionary note that there's a lot we don't know.

No previous work is cited in this new study. It relies entirely on generally available information from the BC of Environment; on geological information from Peter Mustard's dissertation on the Nanaimo Group (GSC Bull. 481, 1994); and on a thesis by Emmanuel Appiah-Adjei of Lund University published in 2006 on the impact of climate change on Gulf Island groundwater. This thesis is concerned with computer modelling of groundwater in the Gulf Islands in general and contains no new observational data specific to Gabriola.

Gabriola is introduced in the new study as being composed of "thick bedded, coarse- to medium-grained sandstone". This is actually a description of the Gabriola Formation (Mustard, p.90), not the bedrock of the Island as a whole. Any consideration of the Island's hydrology has to include all four geological formations present here.

The mean annual recharge is said to be 45% of the mean annual precipitation. This figure is from Table 5.1 (p.74), of the referenced thesis and is a several-island-wide average of numbers that, the thesis notes, may vary between 20% and 60% (p.72). My estimate, based on actual runoff flow-rate measurements, evapotranspiration estimates for the type of landscapes we have, and on measurement data provided by the Ministry of Environment for the purposes of surface water resource allocation, is that the annual recharge here is only 19%. This figure is supported by Allen and Suchy, 2001 (p.6) who independently estimate 20%. Other studies (I'm told) have suggested that even this may be too high and that as little as 5-15% may infiltrate below the watertable.

The study's high figure of 45% arises because Appiah-Adjei makes no distinction between groundwater recharge that enters the aquifer and leaves below sea level and groundwater recharge that enters the aquifer and then leaves as springwater runoff. If this later is counted as recharge, then my estimate would rise to 44% which agrees very nicely with his figure. This neglect of springwater runoff can give the impression that this water is available for withdrawal in the summer, when in fact, most of it by then has returned to the sea.

The recharge during the summer is said to be 13% (120mm of 924mm) of the mean annual precipitation. In my estimation, there is no net recharge in summer, as evidenced by the drop in the watertable. My studies show that loss of groundwater in summer due in part to the on-going flow to the sea below sea level and in part to increased evapotranspiration (as estimated by UBC forestry researchers), amounts to 30% more than the mean summer rainfall. The quoted reference makes no reference to

evapotranspiration in the Gulf Islands; the figure used is a default that happens to be for Victoria Airport (p.95).

The runoff is assessed in the study as being 5% of the mean annual precipitation. Again, this figure is from Table 5.1 (p.74), of the referenced thesis and is an average produced by a computer model. My own field measurements on Gabriola do not agree with this estimate. On an annual basis, surface runoff, not including runoff from springs, was measured as being 12%.

The referenced thesis relies to some extent on a thesis by Meggan Surrette (2006) which reports the results of a computer-model assessment of the hydrological properties of fractured and faulted Nanaimo-Group bedrock. However, her estimates of hydraulic conductivity and porosity are two orders of magnitude less than what is generally considered to be the case on Gabriola. This may be because her model considers only tectonic fracturing and ignores fracturing of mudrock due to weathering, but this is speculation on my part.

Computer simulations and field studies have confirmed to my own satisfaction that you cannot draw conclusions about Gabriola's groundwater without taking into account the Island's detailed geology, principally that the sandstone and mudrock formations have different hydrological properties; that sandstone-dominant formations have mudrock interbeds and vice-versa; that the Island sits in a syncline; that there are two major faults (a thrust and strike-slip fault) and that these influence groundwater flow locally; that the bedrock is hydrologically anisotropic and heterogeneous; that aquifers can be confined, partially confined, or unconfined; and that many aquifers are perched aquifers relying on clay as an aquiclude.

Well data contained in sales literature for lots on the False Narrows Bluffs show that within this relatively tightly-clustered group of 20 wells with depths ranging from 8 to 134 metres, estimated transmissivity shows a variation of 300 to 1. This huge variation within a small area is not unusual in fractured- and faulted-rock aquifers. It could not be predicted, other than in general statistical terms, by a computer model of any practical complexity and sophistication.

The study acknowledges that it cannot advance our understanding of the complexities of Gabriola's groundwater as this requires "detailed studies and numerical modelling" that "have not been completed".

I would question the value of such studies for the purposes of establishing the zone of influence of wells. Quite apart from the enormous cost and length of time required to complete such studies, they would ultimately have to be validated by field tests. It would seem more logical therefore, if establishing zones of influence is such a high priority, to go ahead and locate the zones (they'll likely be far from circular) without first trying to estimate where they might be.

In short, while the study asks interesting questions, provides new data, and makes attempts at interpreting sparse information (as do all previous studies), the hard fact remains that the available information is insufficient to draw any conclusions as to the likely local effects of high-volume pumping of groundwater. The study itself reaches the same conclusion: "the impact [of Summer Rain] can only be assessed following detailed investigation, as flow in fractured bedrock is complex to define".

The only way to find out is to pump and observe the effects. The Islands Trust's policy of requiring zones to be established in advance of high-volume pumping is unrealistic. Nobody knows, or can predict, even after extensive Island-wide study, what the local effects of high-volume pumping might be.

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