Summary of Crystal Geysers' claims about Mt. Shasta hydrology

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Crystal Geyser (CG) claims that their pumping will have negligible effect on the water supply for neighboring residential wells and on nearby city-operated wells that (in part) supply the entire city. Is that reassuring claim justified? Or, will CG pumping deplete the water supply for local residents and nearby city wells?

This brief document examines the CG claim from a scientific viewpoint. We find that CG's claims are based on "studies" that are incomplete, illogical, performed for a different purpose, and largely secret.

The Big Springs distraction

Since the flow of Big Springs (the tourist attraction in the Mt. Shasta City Park, promoted as the "headwaters" of the Sacramento River) is ~50-100x greater than the projected CG pumping rate, CG argues that there can be no effect of their pumping. This conclusion invokes several unjustified assumptions.

Southwestward flow?

CG claims that water accessed by their main production well flows SW into the source that supplies Big Springs. However, there is ***no*** publicly-available convincing evidence that water they take was otherwise headed toward Big Springs. Does such data even exist? If DEX-6 water was not headed toward Big Springs, comparison of CG pumping rates with Big Springs flow rates are irrelevant.

CG implies that their (still secret) groundwater elevations show a downward slope toward the SW, and therefore the water flows that way. This conclusion is unwarranted, in part because (a) it is not known for sure that the boreholes and wells at which they claim to have measured elevations all tap into the same single channel, and (b) water in a sealed channel can be driven from lower to higher ground water elevation in some local regions because of a pressure head from water much farther upstream in the channel. The structure of the underground channels needs to be much better mapped before any conclusions can be drawn. No expert hydrogeologists we know of, and certainly none we have spoken with, claim that Mt. Shasta hydrogeology is well-understood.

CG's consultant firm Geosyntec notes that the surface topography slopes to the SW. However, deep groundwater flow tapped by DEX-6 is directed through fractured andesite channels which were laid down in a winding and sloping pattern during eruptions tens or hundreds of thousands of years before the surface topology took its present shape. A corollary is that underground flow might NOT occur through some areas where there can be surface flow. So present surface topography tells us almost nothing about how and where water is directed by fractures in deep andesite.

Similar isotope composition?

CG suggests that isotope composition at their production well matches that of Big Springs. It is implicitly suggested (and wisely, not explicitly stated) that this is evidence that the borehole water and Big Springs water are from the same channel or aquifer. However, similarity is unsurprising even if the channels were distinct because both sources are clearly from the same type of source: snowmelt on Mt. Shasta, percolating through the same type of rock. Similarity of composition from two different locations proves exactly nothing: the two sources could be the same or they could be different. All it actually says is the following: if isotope and chemistry compositions were very different between two sites, then those two sites could not possibly be fully connected.

The age of the CG "spring water and groundwater" is estimated at 24-81 years (presumably in 1998) and Big Springs springwater at >50 years in 2010. Exactly where these measurements were made is not stated: 24 years to 81 years is quite a large range. Are those figures taken from different spots within the width of Big Springs? If so, one would conclude that Big Springs would have several separate sources, converging only at Big Springs itself, undercutting the previously preferred conclusion that DEX-6 and Big Springs water are one and the same. If the Big Springs figure was the same all across its width, then where did the 24-81 year range come from? The unstated implication is that both the 1998 and 2010 readings give "old" water in very roughly the same range (decades), but that is hardly enough relevant data to conclude anything about hydrological connections.

CG's consultants from CH2MHILL explicitly claimed that 50 year old water implied that there was a 50 year supply of water in the "aquifer". This is untrue because: (a) water aging based on isotope composition is at best a crude average (for example, isotope ratios consistent with 50 year old water could be a mix of 0 year and 100 year old water); and (b) not all of that "50 year old" water is immediately accessible or immediately replenishable. For example, if all 50 years of that supply were withdrawn, it might take 50 years for the water level to recover to a level where it can be accessed again.

Hydraulic and tracers studies?

An incomplete tracer study was performed by an early consultant group SECOR in 1998 but not reported by them, evidently because the results were ambiguous. The intent was to directly see what wells, boreholes and springs are hydraulically interconnected by injecting fluorescent dye at one place and seeing if (and when) it appears elsewhere. SGI (Source Group) in 2005 revived that old data and tried to make conclusions, which upon careful reading, are dubious at best. Fluorescent dye was injected into DEX-1 and it was subsequently (how much time lag?) detected in "three of five samples locations" at Big Springs. The sample locations (presumably across the width of Big Springs) are not specified. Nonetheless, these results clearly show that Big Springs water comes from multiple channels, only one of which passes near DEX-1. The other locations, which remained dye-free, do not contain water passing near DEX-1.

But why report the tracer results only for DEX-1? The CG production well is DEX-6, not DEX-1. Although a tracer study may have been done directly between DEX-6 and Big Springs, which would be the most relevant pair to see if DEX-6 and Big Springs are substantially connected, the results have not been publicly reported. Instead, a 1998 SECOR study showed there exists at least a partial hydraulic (not tracer) connection between DEX-1 and DEX-6, based on a high-rate 63 hour drawdown test at DEX-6. Sure enough, groundwater levels dropped slightly in DEX-1 (about 1/2 foot) upon a 1.1 foot drop in DEX-6. Based on this result, SGI concluded that a partial hydraulic connection of DEX-6 to DEX-1 and a partial tracer connection of DEX-1 to part of Big Springs was enough to conclude that DEX-6 water and Big Springs water were one and the same. This was deemed sufficient to prove to the state that the water bottles could be labeled "spring water".

But even the latest water bottling company-hired consultant firm (Geosyntec) points out that this conclusion is “unclear” ; i.e., the evidence is weak. This is because vigorous pumping from one well (the production well DEX-6) lowers groundwater levels from their ordinary heights, and that could easily cause backflow from DEX-1. Such backflow would not normally occur were the levels unperturbed. In other words, in normal forward flow, water in DEX-6 might never appear in DEX-1. The tracer connection between DEX-1 and Big Springs is thereby irrelevant for the production well DEX-6's possible connection to Big Springs.

Why is tracer data on a direct connection between DEX-6 and Big Springs unavailable? According to the Source Group (as quoted by Geosyntec), “The results of the (SECOR) tracer study were not presented in SECOR’s 1998 report …the tracer study was conducted because there was not conclusive evidence of the hydraulic connection between the production borehole DEX-6 and Big Springs during aquifer pump testing.” Instead of a DEX-6 - to - Big Springs tracer result (which would have been reported if it came out the way Dannon wanted it to come out), the only tracer study that actually was done concerned the wrong pair (DEX-1 and Big Springs).

Evidence of a direct connection between DEX-6 and Big Springs is meager indeed. The meager evidence that does exist was gathered for a different purpose entirely: to claim that DEX-6 water could be labeled "spring water" on the bottles, not to examine the safety of pumping to neighboring wells. This question needs to be examined by further testing.

Direct tests of groundwater depletion

The only reported tests of the effect of rapid pumping (at a rate roughly equivalent to two production lines) are the 63-hour test in 1998 (mentioned above) and a 4-hour test in 2012. Neither test is nearly long enough for the depletion zone to expand nearly as much as it would under continual pumping. After an initial very rapid drawdown in the first minute in 2012, a slower drawdown ensues for approximately the first hour. But then the *drawdown continues* with *no evidence at all of approaching a steady state!* Based on this data, there *might* be a steady state that sets the final drawdown level, but it is not clear when this steady state would be reached. The final measured rate of drawdown loss is 0.04 ft/hr (about 0.5”/hr). If that rate continued unabated for just a week, the loss would be about 6 feet! This suggests (but does not prove) that continual CG pumping would have a significant impact on groundwater levels in the area. (This test was done on both DEX-6 and on an unidentified "domestic well", but the results on each are not separated out in Geosyntec's report, which tends to omit crucial details.)

Apart from tests, what about actual experience under Dannon/Coca-Cola pumping in the period from The crucial “Figure 8” in the GR report shows the groundwater level between the beginning of 2008 to the end of 2010. In that three year period there is a rather steady loss of 1.3 feet. This loss also shows no evidence of slowing down: if extrapolated, it would be equivalent to a loss of 4 feet over a ten-year period. It is hardly “negligible” for one single user to drop groundwater levels that much.

CG's Geosyntec states that by doing 9 years of actual pumping at DEX-6, "in essence a 9 year test was run." However, almost no data has been provided as to the actual pumping rate during those nine years, or how it varied, or what portion of the water input was imported by truck from Dunsmuir, and when. In the time period 2005-10, DEX-6 levels fluctuated by 3/4 foot. (There is indirect evidence that pumping rates increased from 2007-10, correlated with an observed decrease in DEX-6 levels). But what was observed (and reported in data from the Regional Water Quality Control Board) in this same time period were large swings in the monitoring well level of DEX-3A, on the order of a six feet drop between 2007 and 2010! DEX-6 is deep drilled into fractured andesite, whereas DEX-3A is shallow drilled in glacial alluvial soil, as are most neighborhood wells. So what we do know is that a relatively small down-fluctuation in deep wells is correlated with 5x deeper down-fluctuation in the groundwater level that neighbors use. This again does not reassure anyone that CG pumping will have no significant effect.

Reports for neighbors indicate several incidences of well problems (dry or muddy flow) that occurred exactly during the period of Coca-cola's heaviest pumping. Once Coca-Cola ceased operations, these problems have disappeared, even during the increasingly severe drought. This correlation is no proof, but is a sufficient reason (and warning) to justify further investigation.

A scientific "test" would need to compare the actual pumping rate with the level at local wells of interest. But pumping rates have not been divulged and only the data at one monitoring well has been provided (and that one looks worrisome). This is not a serious "9-year test" and certainly not a scientific one, from which we can draw projections to the future.

Effect of drought

One study (Golder and Associates, 2010) shows that heavy rainfall years cause a rapid spike in groundwater levels. This of course contradicts the incorrect CG-promoted notion that a 50-yr age of water implies a 50 year accessible supply. It does, however, provide evidence of the "other side of the coin" effect: that a drought could cause a precipitous and fairly quick drop in groundwater levels.

Projected pumping levels

It is difficult to evaluate what will be the impact of CG on the environment in part because CG does not "come clean" on their plans, nor does it allow public monitoring of eventual pumping rates, nor does it recognize any caps.

At first, CG (in a 2013 grant application with the Mt. Shasta City to the Federal Economic Development Agency, EDA) said they would use 1,000,000 gallons/per day. They then "discovered" a new bottle-washing protocol (already known for years) that would reduce the usage to 115,000 gallons/day, for ***one*** production line. But the building plans and plans for a local power station are consistent with at least three production lines, to be phased in after the one line operation begins. So we are likely looking at an eventual 345,000 gallons/day, with no prohibition or regulation whatsoever against increasing beyond that.

Secrecy

In the meager information made available to the public, CG's Geosyntec quotes the Source Group (SGI) 2005 report. It appears that SGI did not do any new measurements of their own, but only had the objectives to “Review previous work…”; “Re-examine the previous data…”, and “Summarize pertinent information…”. In fact, all SGI does is review the rather indirect and incomplete results of SECOR (1998), for which the data is also not available to the public. This is hardly a case where hydrogeology “is very well evaluated” as claimed by CG. If there is more data to substantiate such a claim, that data must be made available to the public.

Conclusion

The efforts of the community group (We Advocate Thorough Environmental Review, W.A.T.E.R.) are directed solely toward making CG completely open and honest with the community and toward making them support environmental review, mitigations, and enforceable regulations for the protection of the region’s water. Thus far, CG does not recognize the need for an EIR nor for mandatory monitoring and usage caps; i.e., they are opposed to public oversight of the planned facility. Their stance needs to change to achieve broad community support.