

May 21, 2015

Dear Chairperson Wolff and Board Members,

I am writing once again regarding concerns about sewage contamination of the Morro Basin aquifer. I have read the most recent RWQCB staff report on this subject and found some major errors in claims used to support staff conclusions. These errors include:

1. Incorrect assertion that tested well 13 is upgradient of Morro Bay sewer lines
2. Invalid assumptions regarding sucralose concentrations in groundwater
3. Inappropriate reliance on a specific nitrate concentration figure
4. Failure to consider nitrification in regard to nitrate concentrations in groundwater

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Each of these issues is discussed in detail below.

1. Incorrect assertion that tested well 13 is upgradient of Morro Bay sewer lines

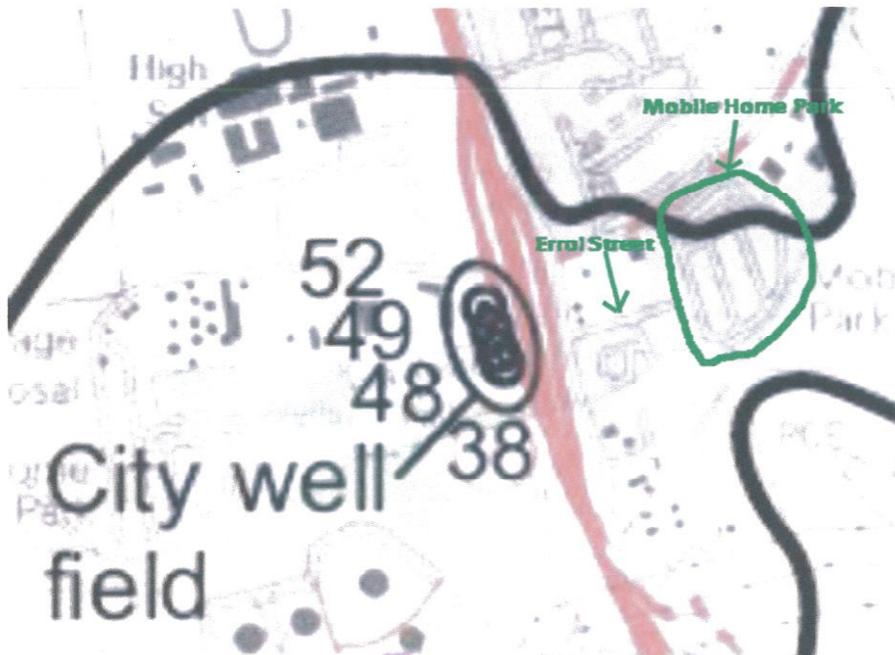
It appears that RWQCB staff has, in making its arguments, relied heavily on the premise that well 13 is upgradient of Morro Bay sewer lines. It is not. In fact, the well is downgradient of sewer lines in a large, occupied mobile home park. The "Technical Analysis" section, the RWQCB staff report states,

"Well No. 13 had a sucralose concentration of 110 ng/L. Note that this well is not used as a supply well and is located hydraulically upgradient of the City's sewer lines in the "narrows" of Morro Valley (Figure 1). It is the well located closest to irrigated agriculture in the east-west groundwater flow path. Also note that the nitrate concentration in this well was 146 mg/L as nitrate according to a December 2014 analysis, which was higher than concentrations measured in downgradient wells during the same month."

and,

"Detections in lower Morro Valley groundwater are widespread; however, it was also detected in State supply water and in an upgradient well (Well No. 13) at similar concentrations. This suggests that the source of sucralose in groundwater is not from sewage from Morro Bay's collection system, but possibly from 1) septic systems in unincorporated areas located upgradient of Well No. 13 and/or 2) percolation of landscape irrigation water from the City's water supply (that mostly comes from State-supplied water)."

The reader may recognize the following image which shows, in black, boundaries of the Morro Basin aquifer in Morro Bay. The narrower portion is appropriately called "the narrows". Well 13 is at the northeast end of Errol Street, which runs from Main Street to the edge of a very large mobile home park. Much of the park is occupied, and there is also storage for RV's not in use.



Most of the park is clearly upgradient from the well. Using Google Earth data, the latitude, longitude, and surface elevation of any point can be determined. We know that well 13 is at the end of Errol Street adjacent to the mobile home park. The highest elevation found at this end of the street was 33 feet. The lowest elevation found in the park was 29 feet (a small spot at the southeast corner), but most of the park is at an elevation of 33 feet or higher.

We do not know the exact depth of the sewer lines, and they may all be upgradient of the portion of the aquifer from which well 13 draws water, even in the areas of the park where surface elevation is less than 33 feet.

Here is an aerial image of the same area:



As previously noted, much of the park is occupied. Thus, well 13, at the end of Errol Street, and adjacent to the mobile home park is downgradient of Morro Bay sewer lines.

2. Invalid assumptions regarding sucralose concentrations in groundwater

The staff report says,

"Sucralose was detected in 8 of 9 supply wells at concentrations between 64 and 170 ng/L, and in State water at 120 ng/L (Table 1). The northern-most supply well (Well No. 3) had a sucralose concentration of 100 nanograms per liter."

and

"Because sucralose is a conservative tracer, the City also had the samples analyzed for sucralose. Detections in lower Morro Valley groundwater are widespread; however, it was also detected in State supply water and in an upgradient well (Well No. 13) at similar concentrations. This suggests that the source of sucralose in groundwater is not from sewage from Morro Bay's collection system, but possibly from 1) septic systems in unincorporated areas located upgradient of Well No. 13 and/or 2) percolation of landscape irrigation water from the City's water supply (that mostly comes from State-supplied water)."

This analysis ignores some critical facts:

- As discussed in item 1, above, well 13 is downgradient of sewer lines.
- A well east of town, at 1301 Little Morro Creek Road, contained no sucralose at all
- Most of the State water used in the City ends up in the sewer system, not as landscape irrigation water
- Assuming the State water started out at the 120 ng/l level detected in the test sample, IF State water were the only contributor of sucralose to the water drawn by the wells, we would expect the well water sucralose levels to be much lower, as the State water would have been diluted by water in the aquifer. Instead, sucralose levels in the wells were comparable and in two, they were higher.

3. Inappropriate reliance on a specific nitrate concentration figure

In regard to well 13, the well discussed in item 1, above, the staff report says,

"It is the well located closest to irrigated agriculture in the east-west groundwater flow path. Also note that the nitrate concentration in this well was 146 mg/L as nitrate according to a December 2014 analysis, which was higher than concentrations measured in downgradient wells during the same month."

These statements appear to have been made in support of the theory that the nitrate level reading of 146 mg/L indicates that the nitrates are coming from the agricultural areas to the east. As previously discussed, the well lies adjacent to a large mobile home park and is downgradient from many of the occupied homes in the park. Hence, an elevated nitrate level could very likely be more evidence that sewage from the sewer lines and connections in the park are contaminating the well.

While that is very significant, there is another important issue. Staff's analysis appears to ignore the fact that in late November, nitrate levels in the Morro Basin well field were also very high. In October, 2014, the nitrate level in well 03 was 186. In November, it was 169 and in December, it was 140. Thus, staff's apparent implication that the well 13 nitrate concentration in December, 2014 is significant appears to be based on incomplete information and analysis.

4. Failure to consider nitrification in regard to nitrate concentrations in groundwater

The Staff report says,

"The sucralose concentration in raw sewage was a factor of between 20 to 50 times higher than the sucralose concentrations in the sampled wells. This compares with a nitrate concentration in raw sewage having a factor of between five times lower to three times higher than nitrate in sampled wells¹. This indicates that the source of elevated nitrate is from discharges located east of City well No. 13 and upgradient of the City's sewer lines."

Staff appears to be saying that since the relative concentrations of nitrates in wastewater and well water are much closer than those for sucralose in wastewater and well water, the nitrates must be coming from someplace other than sewage. This assumption ignores the process of nitrification and the possibility that significant nitrification may be occurring after sewage leaks into the groundwater. This could potentially be increasing nitrate levels in the groundwater, making them more comparable to those in the sample drawn from the sewer lines.

Sucralose is a very stable compound, and that is why it is considered such a reliable tracer of wastewater. Nitrates are also indicative of wastewater, but they are not so stable.

An EPA paper on the subject of nitrification says,

"Nitrification is a microbial process by which reduced nitrogen compounds (primarily ammonia) are sequentially oxidized to nitrite and nitrate."

According to the Abstract section of the paper, "Assessment of Nitrification Potential in Ground Water Using Short Term, Single-Well Injection Experiments", nitrification can and does occur within aquifers:

"Nitrification was measured within a sand and gravel aquifer on Cape Cod, MA, using a series of single-well injection tests. The aquifer contained a wastewater-derived contaminant plume, the core of which was anoxic and contained ammonium. The study was conducted near the downgradient end of the ammonium zone, which was characterized by inversely trending vertical gradients of oxygen (270 to 0 μ M) and ammonium (19 to 625 μ M) and appeared to be a potentially active zone for nitrification."

This does, of course, support the hypothesis that the relative nitrate concentrations between raw wastewater and well water samples are closer than those for sucralose simply means that nitrification continues in the aquifer as sewage leaks into it.

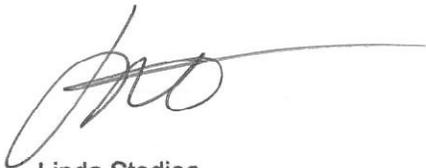
Finally, I would like to address staff's statement that,

"Staff searched the State Water Board's Compilation of Water Quality Goals and found no listing for sucralose; therefore, sucralose is not recognized as an ecological or human health risk."

I don't believe that we said it was. What we said was this:

"As you know, on January 22, 2013, the SWRCB adopted a policy for recycled water. That policy contains very specific monitoring and reporting levels for a variety of contaminants of emerging concern (CEC's), and one of those is sucralose. The reporting level for sucralose is ".1 µg/l". This is, of course, equivalent to 100 ng/l."

In closing, I would like to state that I do not believe RWQCB staff's comments present any valid arguments refuting our claims that sewage is the likely source of most of the nitrates in the Morro Basin aquifer. I believe that the preponderance of evidence clearly shows that there is a serious problem with exfiltrating sewage in Morro Bay, and that the sewage is contaminating our drinking water supply.



Linda Stedjee
Morro Bay

cc: Daniel Robinson, Dan Carl, David Buckingham