COMMENTS & RECOMMENDATIONS ON:
ADDRESSING NITRATE IN CALIFORNIA'S DRINKING WATER
HARTER & LUND, ET AL.

by
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The following are in no particular order.

1. An isotope study needs to be initiated. The N^{14}/N^{15} ratios may allow a better understanding of the various pathways and volumes of different nitrate inputs, for example: human septic and water treatment plants, dairy, commercial (Haber process), legumes, and other biologic derived nitrates (e.g. *Azotobacter sp.*). {*Azotobacter* in the sand dunes of Los Osos, San Luis Obispo County, apparently are a major source of nitrate to that community. Could this also happen in the sandy soils of the paleo-stream channels of the San Joaquin Valley, such as the paleo-Kings River channel which extends from Reedley out between Fowler and Selma towards the axis of the valley?}

   Perhaps this would be undertaken by UC Davis or possibly UC Berkeley, where they have recently used N^{14}/N^{15} ratios to differentiate agricultural vs. oceanic derived nitrogen gas (April, 2012 - Nature Geoscience).

2. It might help, with determining the origins of nitrate in some of the disadvantaged communities, to actually do some groundwater tracer tests. This might show if there is a septic-domestic well connection that needs to be remedied. If some of the communities are now on a community wide water system it might still show where the nitrates originate.

3. Get UC Co-op Extension to do detailed studies of nitrate with depth. Many of the referenced nitrate studies show nitrate losses to groundwater over huge ranges (little to large). {See Journal of Plant Physiology, v. 160, No. 12, p. 1429-1434, Effects of 15N application frequency on nitrogen uptake efficiency in Citrus trees, A.n.a. Quinonesa, el al., to see how little nitrate is escaping below the trees.} It would be preferable to have Coop Extension do some studies here in California. Use the best sampling practices on different soil types, under different irrigation methods and with different crops.

   Most likely, if Coop Extension came up with some good results it would easily be transferred to the agricultural community. If it could save money for the farmer, fertilizer costs have more than doubled since 2008 for my own farm, and increase yields, at the same time decreasing nitrate losses to groundwater it would be a win for all parties.

4. Map the groundwater nitrate concentrations. I know there are privacy issues and unknown well perforation data, but it would allow UC Extension and farmers to know where there are higher levels of nitrate in the groundwater. If ag would then test their own wells they

might find that it is advantageous to apply this water and not fertilize. The map would at least identify areas where this would be of interest to the ag community.

5. Even though waste water treatment plant nitrate is small compared to agriculturally applied nitrate, it can have a wide aerial distribution. This does not seem to show up on your maps (see Figure 11 which does not show the Fresno WWTP). The Ken Schmidt 1975 article shows a minimum affected area of 5440 acres (2176 ha) with nitrate levels >45 mg/l for the Fresno WWTP (see attached figure). I don't know what is happening at the other treatment plants but it should be looked at.

6. There seems to be a geologic component to some of the nitrate distribution. Figure 17 shows rural household nitrate concentrations. On the east side of the San Joaquin Valley two areas, the first between the Kings River and the Kaweah River, the second between the Kaweah and Tule Rivers, are on interfan deposits of the frontal streams. These interfan sedimentary deposits are thin, thickening toward the west, and draped on top of the underlying hard rock of the Sierras, forming thin aquifers, with poorly sorted sediments. The closer these aquifers are to the mountain front, the more rapidly they fill and empty, as there is little storage capacity in these sediments. There should be a third interfan with high nitrates, it would be found between the San Joaquin and Kings Rivers, but it is currently obscured by the Fresno-Clovis municipal water systems providing water to much of the area.

7. There is poor visual correlation between nitrate hazard index, Figure 9, and polluted wells, Figures 1, 11, 12, & 17. There is also poor visual correlation between nitrate hazard index, Figure 9, and N loading, Figure 4. This needs to be explained. It is most likely due to geology and well perforation depths.

8. Figure 4 shows typical fertilizer rates based on crop type not sedimentary geology or soil types. Depending upon geology/soil type fertilizer loading can vary hugely. The sandy soils of the paleo-Kings River probably take more N than would loamy soils. But differing irrigation methods on the sandy soils will also likely give a wide range of applied N.

   The N loadings of Figure 4 do not visually correlate with high N wells of Figure 1. The high N wells along Highway 99 north of Bakersfield are related to the communities that are along Highway 99, is this ascribed to agricultural N?

9. When discussing disadvantaged communities, there was no discussion of capturing rainfall in cisterns for domestic drinking and cooking. There are organizations in New Mexico and Texas that are promoting cistern systems for domestic use. This seems like another place UC Co-op Extension might play an important roll by studying this application as a low cost solution for disadvantaged communities.

In general, it seems that there is a place for UC Co-op Extension to do multiple studies that would help the nitrate situation, both for agriculture and rural domestic use. UC Extension could

identify methods that would decrease N losses to groundwater, decrease fertilizer costs, and improve farming yields.

10. That the authors and the regional water quality control boards highly recommend to county boards of supervisors and county planning commissions that rural residential parcels with septic systems should only be allowed on parcels of 16 acres or larger. When septic densities become greater than one septic system per 16 acre parcel (40 septic systems per square mile) there is a high potential/probability for nitrate problems with domestic drinking water.

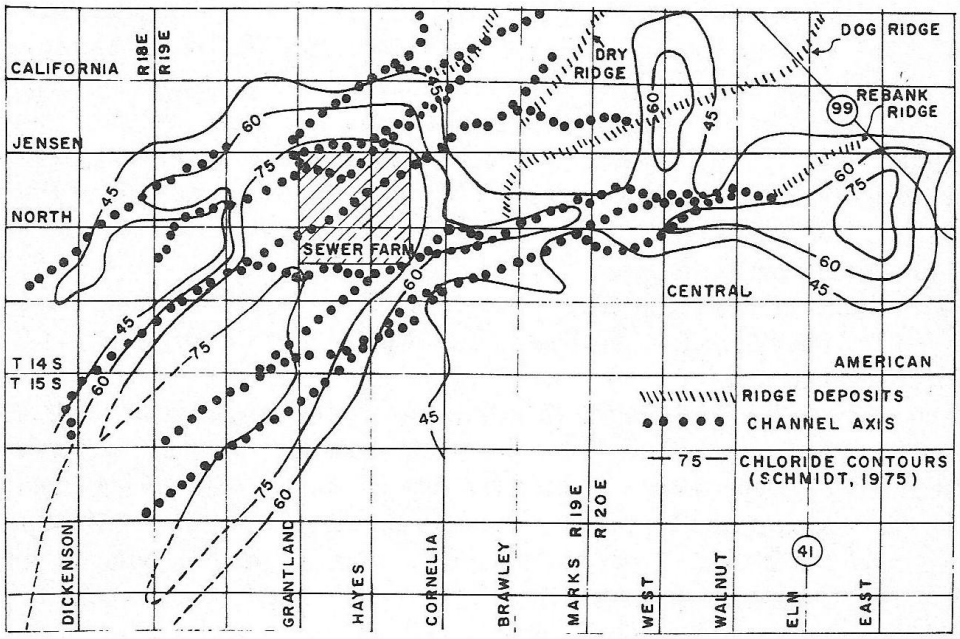

Figure 2. Relationship of Chlorides to Ancient Stream Channels and Ridges in the Vicinity of the Fresno Sewer Farm.