Analysis of TDS concentration in relation to oil and gas produced water disposal ponds in Kern County, California

Valerie Petela¹, Charuleka Varadharajan², Preston Jordan ²

¹ Geology Department, California State University, Sacramento
² Lawrence Berkeley National Laboratory, Berkeley, CA

Introduction and Background

California ranked third in the nation for oil and gas production in 2016 (EIA, 2017). Groundwater is a vital resource for California, supplying approximately 40% of the drinking supply and 43% of water for irrigation in the Central Valley (Faunt et al., 2015). With California’s dependence on groundwater, it is crucial that water practices be assessed to determine impacts on groundwater quality. The Environmental Protection Agency (EPA, 2018) has defined standards for drinking water quality for total dissolved solids in TDS of 500 mg/L. EPA (2018) and Federal California regulations generally protect aquifers with less than 10,000 mg/L TDS as underground sources of drinking water (USDW).

Most oil and gas production (72%) in 2016 occurs in Kern County, located in the San Joaquin Basin (DOGGR, 2016). On average, every barrel of oil produced there is 17 barrels of water extracted with it (DOGGR, 2016), known as produced water. Produced water from conventional oil production is usually 10,000–30,000 mg/L TDS (EPA et al., 2014), much higher than protected aquifer and EPA standards. The excess, low quality water is either stored or disposed. 40% of the water not injected into the subsurface for disposal is disposed in unlined ponds which allow for percolation and evaporation (DOGGR, 2017). Unlined ponds are a direct pathway for contamination of the shallow aquifer system. High TDS water with unknown chemical composition or hazards could be percolating and contaminating groundwater.

California Senate Bill 4 (SB4), which passed in 2013, mandated an independent scientific assessment of hydraulic fracturing and well stimulation practices in California. It recommended produced water be analyzed for hazardous constituents and if they are present or not proven to be present in high or increasing amounts. These chemicals were chosen because their monitoring is commonly requested during oil and gas regulatory procedures and may act as a proxy for produced water indicators when present in high or increasing amounts.

Objective

The objective of this research study was to determine if groundwater quality near ponds exhibits higher or increasing TDS concentrations due to migration of high salinity produced water. This research used public data sources to assess impacts to groundwater near produced water disposal ponds using Python programming script in a Jupyter notebook (https://github.com/charuleka/URL-CA-ProducedWaterDisposal). It is important to note that it may be difficult to identify trends on the western side of the valley where groundwater has a naturally higher TDS concentration.

Conclusions

- Shallow wells are more likely to be influenced by produced water ponds due fluid migration
- Of 1,956 wells with TDS observations, 1,956 had three or more measurements
- More continuous time-series data are required to further test hypothesis
- Mann-Kendall trend analysis showed 190 wells with increasing trends and 67 wells with decreasing trends
- 46% percent of wells with three or more TDS measurements and 42 percent of shallow wells with increasing TDS trends were within 10 km of a disposal pond

References