Evaluating Non-potable Water Usage for Oil and Gas Purposes in the Permian Basin

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Oil and gas company water usage is currently an area of concern in the water stressed western United States. 87% of recent wells in the Permian Basin are located in areas of high or extreme water stress. Using recycled produced water or groundwater that does not meet the USDW drinking water standards for oil and gas purposes could assist in relieving both water stress and tension between oil and gas companies and the public. However, non-USDW drinking water (TDS over 10,000 ppm) has the potential to react with formation water causing mineral precipitation, reducing the permeability of the producing formation. To evaluate the potential of non-potable water usage in the Permian Basin, available groundwater chemistry data was compiled into a database. Data was collected from the NETL-run NATCARB database, the USGS Produced Water and NWIS Databases, and the Texas Water Development Board. The created database went through a system of quality assurance and control for pH, TDS, depth and charge balance. Data was used to make a set of waters representative of Permian Basin groundwater based on TDS, Ca/Mg ratio and Cl/SO_4 ratio. Low, medium and high of these three characteristics; representing the 25^{th}, 50^{th} and 75^{th} percentile respectively; was used to make a matrix of 27 waters. Low TDS is 64,660 ppm, medium TDS is 98,486 ppm, and high TDS is 157,317 ppm. Ca/Mg ratios range from 1.98 to 7.26, and Cl/SO_4 ratios range from 32.96 to 62.34. Geochemist's Workbench was used to create mixing and titration models these 27 waters reacting with an average water, specifically examining for possible precipitation. Results are positive, with the highest total precipitation being 1.815 cm^3 in 1 L of water with high TDS, high Ca/Mg ratio and low Cl/SO_4 ratio. This indicates a maximum of approximately 0.18% of porosity filled with mineral precipitation during the mixing of chosen Permian Basin waters. We further investigate the possibility of mineral precipitation using reactive transport modeling. PFLOTRAN models simulate the injection of high-TDS waters into the pay formation and the possible effects over the lifetime of a well.