Estimating Groundwater Salinity Using the Alger-Harrison Method in the Hill Country Trinity Aquifer, Texas

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ABSTRACT

In this study we mapped groundwater salinity using historical measured water quality samples and total dissolved solids (TDS) calculated from resistivity logs using the Alger-Harrison method. A significant departure from previous brackish groundwater studies by the TWDB is that we used TDS and conductivity of water (Cw) relationships derived directly from measured water quality to estimate TDS from calculated water resistivities, rather than converting the measured water quality to a NaCl equivalent concentration. Equivalent concentrations of NaCl are considered to have the same resistivity as the native groundwater chemistry. Additionally, we used full bicarbonate values to calculate TDS from measured water quality to create more accurate TDS–Cw relationships. We calculated Cw of synthetic water quality points with the USGS software PHREEQC to develop TDS–Cw relationships beyond the range of measured water quality, and we also calculated Cw for water quality samples with conductivity values derived from the inappropriate diluted conductance methodology.

One challenge in applying the Alger-Harrison method is that many older well logs in the study area lack the necessary resistivity of mud filtrate (Rmf) measurements. To estimate missing Rmf values, we established a linear relationship between resistivity of mud (Rm) and Rmf measurements from available well data (spanning seven decades) in the Hill Country of Texas.

We compared the TDS estimation routine from this study to a similar routine that utilizes NaCl equivalent chemistries, and found that the NaCl equivalent routine underestimated salinity in the fresher ranges, which we attribute to the NaCl equivalent resistivities not accounting for ion pairing in calcium-magnesium-bicarbonate and calcium-magnesium-sulfate groundwaters of the study area.

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