Mapping suitability for managed aquifer recharge in Albuquerque, New Mexico

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We used weighted overlay analyses to map suitability for managed aquifer recharge (MAR) by the Albuquerque Bernalillo County Water Utility Authority (ABCWUA). The study area extends from the Rio Grande eastward to the Sandia Mountains, and from Sandia Pueblo southward to ~2 km south of Tijeras Arroyo. The subsurface Santa Fe Group stratigraphy consists of axial-fluvial sediment that interfingers westward with the Rio Puerco distributive fan system and eastward with piedmont sediment from the Sandia Mountains. The Santa Fe Group is overlain by up to 51 m of weakly consolidated mid- to late Quaternary piedmont alluvium, Rio Grande terrace deposits, and valley fills. Long-term pumping by the city has created a large, trough-like cone of depression centered in the study area, with up to 120 m of unsaturated, relatively permeable sediment that could be used to store excess surface water allotted to ABCWUA from the San Juan-Chama Drinking Water Project.

We produced two suitability maps with a grid cell resolution of 100x100 m: one showing the suitability for deep (saturated zone) injection recharge and the other for shallow (infiltration or vadose zone injection) recharge. Unsuitability buffers were *a priori* assigned to fault zones (due to potential barrier effects), the Rio Grande floodplain (due to potential for injected water to reach the river or induce swamping), and 1/2 mile around known groundwater contamination sites. Initial steps included: (1) compiling hydraulic data from pump and infiltration tests; (2) studying outcrop analogs of lithologic units comprising the aquifer units; (3) drawing structural contours of 10 lithologic units under and near the study area; (4) assessing the proportions of sand, clayey sand, and clay layers for these units (primarily using interpretation of wireline logs); and (5) using ARCGIS tools to construct a 3-D geologic model. For the weighted overlay analyses, we considered several criteria that could impact MAR. For deep injection recharge, these include transmissivity, the typical storage zone thickness (thickness of permeable beds between clay layers), allowable injection rates, water table gradient, density of ABCWUA and non-ABCWUA wells, and distance to existing water pipelines. For shallow recharge, criteria include surface soil characteristics (hydraulic conductivity and drainage classes from NRCS soil maps), surface slope, depth to groundwater, percolation time to reach the water table, and the proportion of clay layers. Each criterion were subdivided into classes (binned), which were ranked from 0 to 2 based on their impact to MAR (2 being most favorable and 0 being least). For criteria that vary with geologic unit (e.g., transmissivity, storage zone thickness), each individual geologic unit's score was thickness- and depth-weighted, summed, then normalized to between 0 and 2 at each grid cell location to produce a single score. All criteria at each cell were then weighted, summed, and normalized (to 0-2) to produce an overall rating. We compared the overall ratings to previous maps and known locations of MAR-suitable sites, and then used histogram analysis to translate the scores to qualitative MAR suitability ratings. A separate map showing soil hydrocompaction susceptibility will also be produced.

Keywords:

managed aquifer recharge, artificial recharge, aquifer storage and recovery, geologic model, Albuquerque, New Mexico, weighted overlay, San Juan-Chama Drinking Water Project, hydrocompaction, collapsible soils

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