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CONCEPTUAL MODELS OF FACTORS AFFECTING WATER QUALITY IN BASIN-FILL AQUIFERS IN THE SOUTHWESTERN UNITED STATES

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ABSTRACT: Several sources and factors commonly affect the vulnerability of basin-fill aquifers in the arid to semiarid Southwestern United States (Southwest) to elevated concentrations of dissolved solids, nitrate, arsenic, uranium, volatile organic compounds (VOCs), and pesticides. Conceptual models of the most important factors likely to affect these contaminants in groundwater were developed with information synthesized from 15 basins studied by the National Water-Quality Assessment (NAWQA) Program. Saturated unconsolidated deposits in these basins represent the Basin and Range basin-fill aquifers in California, Nevada, Utah, and Arizona; the Rio Grande aquifer system in New Mexico and Colorado; and the California Coastal Basin and Central Valley aquifer systems in California. Important natural hydrogeologic factors that affect groundwater quality in the Southwest include the presence/absence of protective confining layers, the direction of natural vertical hydraulic gradients, evapotranspiration, and geochemical conditions within the aquifer, such as redox and pH. The composition of rocks and sediments within and surrounding the basin-fill aquifers influences concentrations of dissolved solids, arsenic, and uranium.The development of land and water has generally made basin-fill aquifers more vulnerable to contamination. Human activities resulting in artificial recharge and well discharge have changed groundwater-flow systems affecting water levels and vertical hydraulic gradients, allowing preferential groundwater flow along wellbores, and changing geochemical conditions within the aquifer. Artificial recharge of excess irrigation water in agricultural areas can transport dissolved solids, nitrate, and pesticide compounds to the water table. Sources of dissolved solids, nitrate, VOCs, and pesticides related to urban land use include chlorinated municipal-supply water infiltrating through irrigated landscaped areas or leaking from distribution pipes, seepage of water from sewer and septic systems, infiltration of urban runoff and engineered recharge water, and point sources such as chemical spills.The conceptual models of the primary natural and human factors commonly affecting groundwater quality with respect to nitrate and arsenic served as a foundation for statistical models that relate concentrations in groundwater from across the region to factors. These statistical models then can be used to predict nitrate and arsenic concentrations in groundwater in unstudied areas of the Southwest.

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