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PREDICTED NITRATE CONCENTRATIONS IN BASIN-FILL AQUIFERS IN THE SOUTHWESTERN UNITED STATES

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ABSTRACT: Human-health concerns and economic considerations associated with meeting drinking-water standards motivated the development of a statistical model for characterizing the spatial distribution of nitrate in basin-fill aquifers of the southwestern United States. The model used the random forest classifier algorithm and was calibrated on the basis of nitrate concentration data for 5,787 wells. The model was used to predict concentrations of nitrate within the upper 200 feet of the basin-fill aquifers across the 190,612 square mile study area, which included parts of Arizona, California, Colorado, New Mexico, Nevada, and Utah. While results are preliminary, predicted nitrate concentrations exceeded the U.S. Environmental Protection Agency';s drinking-water standard of 10 mg/L in only 2.4 percent of the basin-fill aquifer area. Predicted concentrations were less than 1.0 mg/L in over half of the basin-fill aquifer area, and were less than 5.0 mg/L in 93 percent of the area. Natural and human factors in the model that increased the vulnerability of basin-fill aquifers to nitrate contamination included: high nitrogen loading rates from fertilizers and livestock, high density of agricultural and(or) urban land use, prevalence of soils with high infiltration rates, high rates of surface-water or groundwater use for irrigation or public supply, low natural recharge rates from precipitation, high air temperatures, and high potential evapotranspiration rates. Vulnerability decreased for areas where soils were hydric and contained organic matter as these conditions generally support denitrification.Model predictions were used to establish background concentrations of nitrate in basin-fill aquifers in undeveloped land-use settings. Background concentrations were less than 2.0 mg/L for basin-fill aquifers overlain by most biotic communities. In aquifers beneath the Sonoran Desertscrub, Mojave Desertscrub, and Semidesert Grassland biotic communities, however, background concentrations were as high as 5.0 mg/L due to nitrate production by desert legumes. Nitrate concentrations exceeded background concentrations only in areas overlain by agricultural and(or) urban lands, and predicted concentrations increased with the density of those land uses. Of the basin-fill aquifer area in the Southwest overlain by lands used entirely for agricultural and(or) urban uses, 48 percent had predicted nitrate concentrations that exceeded the background concentrations.

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