

## ABSTRACT

An efficient approach to assessing ground-water aquifer sensitivity is to employ a regional Geographic Information System (GIS) to determine and map the relative sensitivity of aquifers to contamination sources. A pilot study in the Mesilla Valley of Doña Ana County, New Mexico was initiated to develop the most appropriate approach and format. The Mesilla Valley was selected based on the intensity of the area's pesticide applications and the availability of information required for analysis. Experience and added insight were expected to be gained in how to gather, process, and analyze data most efficiently. The DRASTIC model was used to assess aquifer sensitivity by combining data sets that describe the depth-to-ground water, recharge rates, aquifer material, soils composition, land slope, vadose zone materials, and saturated hydraulic conductivity for the Mesilla Valley in Doña Ana County. The study evaluated the data requirements and techniques necessary to employ the DRASTIC model in other regions of New Mexico. GIS layers were developed for each of the DRASTIC parameters and combined into a natural sensitivity coverage for the study area. The resulting natural sensitivity values were grouped into six categories: *very slight* - indicating that the ground-water aquifer is very well protected and risk of contamination from nonpoint sources is very low; *slight* - the ground-water aquifer is reasonably well protected, but because one or more of the hydrologic parameters are conducive to contaminant transport, there is a higher level of risk of nonpoint pollution; *low* - the ground-water aquifer is somewhat protected, but more than one of the parameters are conducive; *moderate* - the ground-water aquifer is susceptible to contamination because few natural protections exist; *severe* - the ground-water aquifer is much more susceptible to contamination due to several hydrologic conditions; and *extreme* - all hydrologic parameters are conducive to the rapid transport of contamination to the ground-water aquifer. Results indicated that of the 2,282 km<sup>2</sup> included in the study area, less than one percent was classified as *extreme*, slightly over 10 percent as *severe*, almost 19 percent as *moderate*, nearly 43 percent as *low*, about 16 percent as *slight*, and over 12 percent as *very slight*.

Possible nonpoint source pollution from agricultural operations necessitates that farming practices be evaluated for their potential impact on water quality. Time and cost constraints favor a modeling approach for the evaluation process, especially in regional-scale studies. The Irrigation Scheduling Model (IRRSCHM) was used to evaluate local farmers' practices and irrigation scheduling management practices for their potential impact on ground-water contamination in the Mesilla Valley. The irrigation management practices included tensiometer-based irrigation scheduling with porous cup position fixed at 30-cm soil depth or moving with the dynamic root zone, and irrigation scheduling at "50 percent plant available water depletion." The objective was to monitor cyanazine (Bladex) and metolachlor (Dual) concentrations at 180-cm below the soil surface during a 30-year cropping period. The main input parameters required by IRRSCHM are field capacity, permanent wilting point, soil profile organic matter, and pesticide half-life value distributions. Because the study was regional in nature, most of the soil series were grouped into appropriate textural classes. Results showed that Bladex and Dual concentrations at the 180-cm depth generally increased with increasing soil sand content. Also, Bladex and Dual concentrations were lowest and insignificant, relative to the corresponding drinking water Health Advisory Level, under farmers' management practices. In contrast, scheduling irrigation with tensiometers based on Natural Resources Conservation Service recommendations, resulted in the higher Bladex and Dual concentrations at the same 180-cm depth. For example, current management practices resulted in the mean maximum Bladex concentrations of  $2.42 \times 10^{-6}$  for sandy soil class and  $1.20 \times 10^{-18}$  for clayey soil class, relative to the  $1.30 \times 10^{-2}$  mg L<sup>-1</sup> Health Advisory Level. For Dual, the mean maximum concentrations were  $1.63 \times 10^{-3}$  and  $4.89 \times 10^{-9}$  relative to the  $5.25 \times 10^{-1}$  mg L<sup>-1</sup> Health Advisory Level, for sandy and clayey soil classes, respectively. Consequently, the study showed that current farmers' management practices do not pose a threat to ground-water quality in the study area.

Key Words: Aquifer Sensitivity, Mesilla Valley, DRASTIC, Simulation, Geographic Information System, Best Management Practices, Water Quality.