Combining numerical modelling and field-based methods to obtain spatially and temporally variable recharge to a semi-arid coastal aquifer: Uley South Basin, South Australia

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ABSTRACT

This study explores the recharge processes within the coastal, semi-arid Uley South Basin (USB), South Australia, and attempts to quantify the spatial and temporal variability in recharge fluxes to the system. This aquifer presents significant management challenges, because it supplies around 70% of the Eyre Peninsula's water demand, and yet there have been historical declines in groundwater levels approaching mean sea level in places. USB has been managed entirely based on recharge estimates, and reliable recharge estimates remain central to the sustainable allocation of pumping from the basin. A predictive tool capable of simulating recharge across the basin is required, partly for direct management applications, but also to underpin proposed groundwater models of USB.

Field-based estimates of recharge are often inadequate for assessing groundwater management options at the basin scale, due to the need to account for spatial and temporal variability in recharge in devising water-use strategies. One-dimensional (1D) unsaturated zone models are commonly advocated to provide temporally and spatially fine resolutions of recharge. Although 1D models are associated with large uncertainties in recharge quantification, they are rarely validated with independent field-based estimates. In this study, field-based methods are combined with numerical modelling to estimate basin-scale recharge to USB. The 1D LEACHM code was adopted in an integrated-GIS framework to simulate recharge according to depth to water table, topographical slope, substrate characteristics and vegetation type. Variations to the conceptual model that reflect uncertainties associated with complex recharge processes are considered. Results show that selected combinations of unsaturated zone lithologies and representations of preferential flow produce spatially and temporally averaged recharge rates that fall within the range estimated using the chloride mass balance method, and recharge timing consistent with the water-table fluctuation method. Because very little unsaturated zone data are available to parameterise and validate

the 1D model, the field-based methods proved to be vital to validate the recharge model's predictions.