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Modeling Groundwater Flow and Dynamics of the Dendron Area, Limpopo River Basin, South Africa

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The area around Dendron town (officially Mogwadi), located 60 km north of Polokwane city is one of the most important agricultural production regions in South Africa. Agricultural production is heavily dependent on groundwater irrigation and an increase in demand for abstraction has resulted in significant declines in groundwater levels. To better understand the effect of irrigation and groundwater flow dynamics in the area, a transient groundwater flow model was constructed using MODFLOW 2005 and Farm Process Package (FMP). The model was discretized horizontally into a uniform grid of 100 m, and vertically into two layers representing the upper and lower aquifers. Dykes that were thought to act as horizontal flow barriers were simulated in the model. Groundwater abstraction for irrigation was estimated on the basis of irrigated crop area delineated using multispectral Landsat satellite data, and crop consumptive use. Abstraction for public supply was compiled from different sources. The model was calibrated to simulate the transient conditions of 1995-2015 water levels. Initial estimates of the aquifer system properties obtained from previously published reports were modified during the calibration process. The calibrated model was used to simulate the various components of the flow budget, the recharge, present status of the groundwater resource and how these resources have changed over time, and the impacts of different management scenarios. These analyses are fundamental for managing the groundwater resources sustainably, and for maintaining resilience in the context of increasing water demand and climate change.