

A groundwater-planning toolkit for the main Karoo basin: Identifying and quantifying groundwater-development options incorporating the concept of wellfield yields and aquifer firm yields

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Abstract

This paper provides an overview of groundwater-planning tools that were developed during a Water Research Commission project that was initiated due to the need to place the significant knowledge on groundwater of the Karoo Basin within the realms of water resource planning. In essence, the project aimed to identify favourable areas of groundwater potential for bulk municipal water supplies, to provide a method to quantify them, and to package the information so that it is assessable for planning purposes. In identifying favourable groundwater areas, the focus turned to developing a detailed transmissivity map of the Main Karoo Basin. In order to present yields in an accessible manner to water-supply planners, the same concept used in surface-water resource assessments and dam or reservoir design were adapted and applied to groundwater. Two methods were developed, namely the Aquifer Assured Yield Model and the Aquifer Firm Yield Model (the latter of which was developed into a software package together with the other products). The Aquifer Firm Yield Model provides the historical firm yield and uses historical monthly rainfall data together with recharge, evapotranspiration and baseflow to determine aquifer storage in any given month. The firm yield can be considered to define the upper limit of the groundwater resource. In order to establish possible wellfield yields, the C-J Wellfield Model (based on the Cooper-Jacob approximation of the Theis groundwater-flow equation) was developed whereby borehole spacing can be optimised after inputting estimated transmissivity values from the transmissivity map. To aid the planning process, groundwater-quality maps were produced together with the Wellfield Cost Model which provides an easy way to obtain first-order cost estimates of the wellfield options. This paper briefly describes these 'tools' that were produced and provides slightly more detail on how the transmissivity maps were developed.

Keywords: aquifer yield, wellfield yield, transmissivity, water-balance models, groundwater quality, well-field costs