

EXECUTIVE SUMMARY

This report represents the final report on the Water Research Commission funded consultancy project K8/679:

'Ephemeral Rivers Hydrology'

The report is divided into 7 main sections (plus references) which largely reflect the main deliverables that were proposed for the project. The first section concentrates on the definition of ephemeral, or non-perennial systems, as well as identifying some of the characteristics that differentiate non-perennial systems of different types.

Section 2 examines the hydrological (quantity and quality) characteristics of non-perennial river systems and attempts to identify those which are likely to be ecologically significant. The main characteristics are high degrees of variability in time and space, coupled with extended periods of zero flow during which the storage and quality dynamics of static pools (if present) may play a significant ecological role. The frequency and extent of longitudinal connection of flow is thought to be of major significance and will affect other hydrological processes (pool storage and quality) as well as ecological processes. The characteristics of individual ephemeral systems will depend to a large extent on the nature of the interactions between surface and ground water processes. Ephemeral rivers developed on extensive alluvial aquifers are expected to have very different characteristics to those that are developed on or above hard rock aquifers. The depth of the regional ground water table will be very significant in the latter case. The development of in-channel weirs and dams, together with ground water abstractions through riparian boreholes, are expected to be the most likely anthropogenic impacts on water quantity, which could also impact on water quality. However, land use practices may also affect the sediment dynamics of the channel environments and therefore the geomorphology.

Part of section 2 refers to the specific processes in the Seekoei River system and notes that the observed streamflow response at the outlet of the catchment is dominated by the lower part of the catchment where a dolerite ridge and steep topography promote the occurrence of interflow springs above the regional water table. There is general agreement on the mechanisms leading to the development of these springs between the surface and ground water hydrology specialists.

Section 3 discusses the available continuous models that could potentially be used to simulate the relevant hydrological variables, such as flow and pool dynamics. The section discusses the concepts of flow processes within the Seekoei River and the implications for quantifying the parameters of available models. The applications of the Pitman monthly model (with recent modifications to the surface-ground water interaction routines), as well the daily VTI model are presented. While there exist a number of uncertainties related to the lack of information to validate certain aspects of the model results, the section concludes that the models can be applied successfully in the Seekoei River catchment for some of the purposes of EWR determination.

One of the issues not adequately covered by the continuous modelling approaches is the hydrology of flood events and their propagation through the channel systems of ephemeral rivers. Section 4 therefore investigates the use of relatively simple flood routing models. Simple models are referred to as the effort required to collect enough

channel cross-section data for more complex models is considered to be beyond the resources of most EWR determinations.

During the course of the project a simple water quality model, focusing on TDS, was developed. This model (section 5) has been linked to the detailed runoff and storage component outputs from both of the continuous simulations models (Pitman and VTI). The results, measured against observed TDS values at the catchment outlet, are encouraging. The additional model parameters required are the TDS signals of the different runoff components (surface water, interflow springs and ground water). These have been quantified from the limited number of field observations that are available.

Section 6 discusses the use of the models in the analysis of future development scenarios. The conclusions about the usefulness of the models rather depend upon how well the hydrological impacts of the scenarios can be conceptualized. This emphasizes the need for a sound conceptual understanding of the hydrology of ephemeral systems, from both surface and ground water points of view.

The final section addresses a series of questions that were posed during the introductory section and attempts to use the example of the Seekoei River to provide answers. The overall conclusion is that existing hydrological analysis and modelling tools are appropriate for ephemeral systems, but that they may have to be applied in somewhat unconventional ways.