

A simple model for assessing utilisable streamflow allocations in the context of the Ecological Reserve

DA Hughes

Institute for Water Research, Rhodes University, Grahamstown 6140, South Africa

Abstract

A simple model is proposed that simulates the water balance in small- to medium-sized water resource systems (without major storage) and displays the results as flow duration curves so that they can be compared with the standard information available for the Ecological Reserve requirements. The model is designed to account for the impacts of streamflow reduction activities (afforestation), small farm dams and run-of-river abstractions under both present-day and future scenario situations. The paper presents the operation of the model and its data requirements, as well as discussing possible sources of uncertainty associated with either the model approach or the quality of the data inputs. The majority of the uncertainty in the ability of the model to generate reliable results is expected to be associated with the quality of the input data, and specifically the information available on existing water use. It should be noted, however, that any water resource systems model is faced with the same uncertainties and this highlights the need to improve the South African database on existing water use. Without such information, future planning of water allocations will be extremely difficult and highly uncertain.

Keywords: water allocations, environmental water requirements, water resource modelling

Introduction

In terms of the National Water of 1998 (NWA, 1998) all existing and future water users will eventually have to be licensed and this licensing process must account for the water requirements of both the basic human needs and Ecological Reserves. In simple terms these are the water requirements that must be met before other users are permitted to abstract water. They are designed to provide a basic source of water to communities living in the vicinity of the resource, as well as ensuring the environmental sustainability of the resource. Utilisable streamflow allocations, in the context of this paper, are therefore the difference between the total natural resource and the requirements of the two Reserves. One of the main difficulties with determining water availability lies in the inherent natural variability of river flows and South Africa is known to have some of the most variable river flow regimes in the world (McMahon, 1979; Görgens and Hughes, 1982). This characteristic frequently makes it very difficult to design sustainable abstraction schemes and suggests that abstractions for certain purposes can only be permitted with limited levels of assurance. The concept of assurance of water supply becomes extremely important in highly variable flow regimes where there is a great deal of competition for the limited amounts of water that are available during dry periods (dry seasons or drought periods). In simple terms, this concept means that during dry periods users will not be able to gain access to their normal water requirements and will necessarily have to curtail their abstractions. This is clearly the reason why reservoirs are constructed to store water during wet periods and sustain abstractions (from the stored water) during dry periods. The approach to defining environmental water requirements (the Ecological Reserve) in South Africa recognises the natural variability of flow regimes and that some of that variability needs

to be preserved to ensure some level of protection for the riverine biota (King and Louw, 1998; Puckridge et al., 1998). The advantage from a water supply point of view is that the water requirements of the Reserve should be at a minimum when the natural flow is at a minimum and there is the greatest competition for water.

Even without the added complication of allowing for the Ecological Reserve, determining water allocations and associated assurance rules for a range of users distributed throughout a river basin can be a relatively complex process. The Reserve adds to that complexity and one of the criticisms that have been levelled at the Reserve and the outputs of the RDM (resource directed measures) process is that it is very difficult to implement. One of the steps within a typical Reserve determination process is to assess the feasibility of satisfying the Reserve as well as present-day and future water-user requirements (Louw et al., 2000). Typically, this type of analysis has been undertaken using a system yield model in which the Ecological Reserve is treated as a high priority user and one of the objectives is to identify possible conflicts. This type of approach has proved to be very successful and allows different scenarios of water abstraction and conservation management to be examined and recommendations made to decision makers (including water resource managers and river basin stakeholders). System yield models available within South Africa have been designed to account for a wide variety of basin and water-use configurations including streamflow reduction activities (SFRA – afforestation, for example), reservoirs (and associated abstractions and releases), inter-basin transfers, distributed small farm dams, run-of-river abstractions, return flows (from agriculture and wastewater treatment works) and the Ecological Reserve (Janse van Rensburg and Görgens, 2001). There is little doubt that models of this type represent the most thorough and appropriate approach to assessing various water resource development options within a basin. However, they can also be time-consuming to establish and require substantial resources in terms of human technical expertise.

☎ +2746 6224014; fax: +2746 6229427;

e-mail: denis@iwr.ru.ac.za

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