# Towards the incorporation of magnitude-frequency concepts into the building block methodology used for quantifying ecological flow requirements of South African rivers

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## Abstract

The current approach to setting the water quantity component of the ecological reserve for rivers in South Africa is based on the building block methodology (BBM) and carried out by a group of specialists in an IFR workshop. The BBM concentrates on setting flow magnitudes and there has been no formally defined approach to specify the frequency of exceedance relationships for these flows. This is a problem when attempts are made to implement the recommendations within the context of a water resource plan or management scheme for the river. In such situations information on how often flows of different magnitudes should occur is required. This paper offers a suggestion for improving the BBM by using a model to simulate a representative time series of modified flows and extract from the results assurance levels, or frequency of exceedance, for the different building block components. The implications of adopting such an approach, from both ecological and water resource development perspectives, are discussed.

## Abbreviations

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| BBM | building block methodology |
| BFI | baseflow index |
| DWAF | Department of Water Affairs and Forestry |
| EMC | ecological management class |
| CV | coefficient of variation |
| IFR | instream flow requirement |
| MAR | mean annual runoff |
| WRYM | water resources yield model |

## Introduction

The BBM (King and Louw, 1998) has become one of the accepted approaches that is used in South Africa to establish the quantity of water needed to satisfy the ecological flow requirements of rivers. With the new South African Water Act (DWAF 1997a), a great deal of attention has been focused on the methods used to establish these requirements, which are now referred to as the 'environmental reserve'. Together with the use of water to satisfy basic human needs, the quantity component of the environmental reserve will become that proportion of a river's flow regime that has to be satisfied before allocations to other potential users can be considered.

The BBM is applied through a relatively complex process of interaction between various ecological, geomorphological, hydraulic and hydrological specialists whose task is to establish the components of a river's flow regime (instream flow requirement or IFR) that are required to maintain the river in a pre-determined sustainable condition (now referred to as the ecological management class or EMC). The EMC can vary from unmodified (category A) to largely modified (category D) and the responsibility for determining the specific state of any river will lie with the Minister of Water Affairs and Forestry. The IFR is defined as seasonal distributions of low and high flow values for river maintenance, applicable to 'normal' years, and a further set which are applicable during drought years. These four seasonal distributions are essentially the 'building blocks' and the concept is illustrated in Fig.1 using the results from the workshop held to determine the IFR for the Mkomazi River in KwaZulu-Natal (Louw, 1998).

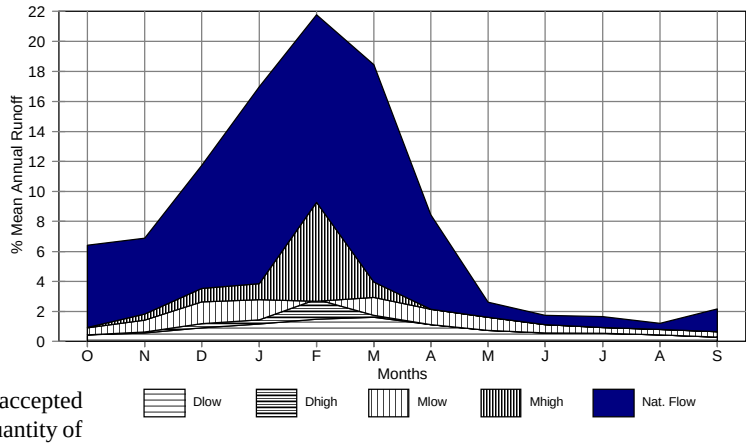


***Figure 1***
*Monthly distributions of total natural flow (Nat. Flow), drought low- and high-flow (Dlow, Dhigh) and maintenance low- and high-flow (Mlow, Mhigh) requirements determined for Site 1 during the Mkomazi River IFR workshop held in 1998.*

For the results of the BBM to be of use in the planning and management of water resource schemes, it is clearly necessary to define when the modified flows in the river should be at or close to the maintenance values and when (as well as how often) it is ecologically acceptable for the flows to drop to the drought requirements. It has always been understood by the developers and practitioners of the BBM that the rules for controlling these flow variations should be related in some way to the natural flow regime, which is in turn a reflection of the climate variations occurring over

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