A framework for addressing the information needs of catchment water quality management

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Abstract

The process of catchment water quality management must be built on sound philosophies and appropriate information. Over the last few years, the Department of Water Affairs and Forestry in South Africa has been reviewing and developing the philosophical support for catchment water quality management and has initiated a number of catchment plans. The translation of these philosophies into management information needs, which is supported by appropriate assessment of data obtained by monitoring the physical catchment, requires concomitant development. This paper provides a framework to anchor the scientific-technical support to catchment water quality management. The first part of the framework deals with the classification of the physical system, providing the conceptual "platform" for monitoring, assessment and management. This is based on the definition of four physical process elements representing the components of water quality management, namely production, delivery, transport and use. The second part of the framework involves the definition of an assessment "super-structure", building on these elements. This provides the link between the physical system and management information needs, through monitoring and assessment. The paper ends by providing an integrated framework, which indicates possible types of assessment associated with the different phases of the catchment water quality management process.

Introduction

The changing environment within which South Africa's water quality must be managed caused the Department of Water Affairs and Forestry (DWAF) to reassess water quality management philosophies over the last decade (DWAF, 1991). This has led to the adoption of a precautionary approach to water quality management, based on a hierarchy of management beginning with options to prevent and minimise pollution, followed by receiving water quality objectives, and only resorting to remediation of water bodies and treatment for use as a last resort (DWAF, 1994). Along with these developments has been the realisation that water quality (and all water resource) management must be tackled at a catchment scale, which is the philosophy behind catchment management (DWAF, 1995). The aim of catchment water quality management (as part of water resource management) is to ensure the availability of water of adequate quality (fit-for-use) to provide basic human needs and support economic production.

Integrated catchment management (ICM) attempts the holistic and sustainable management of socio-economic development and all resource utilisation within a catchment, which is the ultimate goal of water resource management. Therefore, catchment water quality management is a central component of ICM, as it provides an important linkage between the socio-political-economic and physical environments. Furthermore, it represents a major factor influencing the achievement of sustainable resource use, particularly in a water-scarce country such as South Africa, because water quantity and its quality represent the primary physically-based linkage between land, air and water resources. Catchment management must address all the elements of the physical catchment, focusing on the causes associated with the sources (i.e. catchment perspective), as well as the impacts on the receiving water bodies and their users (i.e. riverine perspective). This then provides the basis for holistic understanding and sustainable management of the physical environment, upon which catchment management should be based.

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The purpose of this paper

Water resource managers are ultimately responsible to the social, political and economic values and concerns of the society which they serve. Therefore, water resource management philosophies should reflect societal goals. The definition of these philosophies is the responsibility of the DWAF and is continuously being attended to at appropriate levels of government (Van der Merwe and Grobler, 1990; DWAF, 1991 & 1995; Quibell et al., 1997). Such management philosophies imply information needs associated with the physical world (i.e. catchment) which they address, shown schematically in Fig. 1. Data are obtained through monitoring the natural catchment characteristics (e.g. slope and soils), anthropogenic influences (e.g. land use and demographics), hydrometeorology (e.g. rainfall and streamflow), water quality (e.g. physical, chemical and microbiological) and aquatic environment (e.g. habitat and biotic health). These data in themselves do not provide appropriate information for management purposes, but rather are the basis of the assessment and analysis which does provide this information.

This paper proposes a framework for the monitoring, assessment and management of the physical environment in support of catchment water quality management. It extends the point and nonpoint source-oriented framework presented by Pegram et al. (1995) and Pegram and Bath (1995) and supports the management approach presented by Quibell et al. (1997). The framework links the management information needs to the physical catchment through the assessment of monitored data. As such, it provides an integrated approach to the technical-scientific support for