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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

# Groundwater

## A new groundwater management framework has been developed for South Africa.

### Managing groundwater as a sustainable resource for bulk domestic supply

Groundwater has historically been given limited attention and has not been perceived as an important water resource in South Africa. This is reflected in general statistics showing that only 13% of the nation's total water supply originates from groundwater. Public perception that groundwater is not a sustainable resource for bulk domestic supply and cannot be managed properly lingers. Despite this, a growing number of municipalities utilise groundwater on a regular basis, and provide examples of successful management of this resource.

A number of guidelines for groundwater management have been developed internationally and for the South African context. Among the most significant of recent examples are the NORAD toolkit, the Water Research Commission's (WRC's) ***Guidelines for the monitoring and management of ground water resources in rural water supply schemes*** and the Department of Water Affairs' (DWA's) ***Guideline for the Assessment, Planning and Management of Groundwater Resources in South Africa***. Other relevant documents include water quality management protocols, minimum standards, regional groundwater plans and DWA's ***Framework for a National Groundwater Strategy***, ***National Water Resources Strategy*** and ***Guidelines for Catchment Management Strategies towards Equity, Sustainability and Efficiency***.

### Laying the foundation for a Groundwater Management Framework

In order to commence the production of a consolidated framework for groundwater management at local authority level, these various guidelines and other relevant publications were reviewed with respect to compliance with the legal framework, completeness, feasibility of implementation and functionality.

The review concluded with a gap analysis, revealing aspects and management functions that required particular attention. These comprised:

- Comprehensive definition of "groundwater management" and all its relevant aspects;
- Comprehensive definition of the relevant management functions with respect to groundwater management, as defined;
- Mapping of roles and responsibilities of water institutions for the different groundwater management activities, as defined;
- Outlining the skills required for the different groundwater management activities;
- Integrating the different groundwater management guidelines into one document.

The next step was to carry out case studies of best practice at selected towns in four local municipalities, namely Emthanjeni LM (De Aar), Overstrand LM (Hermanus, Stanford), Cederberg LM (Elands Bay) and Baviaans LM (Willowmore).

The main success factors for effective groundwater management that emerged from the different case studies were:

- Appropriate technology for groundwater monitoring and management;
- Scientific support from external consultants on request;
- An efficient management structure;
- Committed staff; and
- An adequate funding mechanism.

## The Groundwater Management Framework

Based on the literature review and case studies, a Groundwater Management Framework has been designed to be applicable at the level of responsibility of a local Water Service Authority (WSA), Water Service Provider (WSP) and Water User Association (WUA). Hence, the assigned responsibilities and available tools to achieve sustainable groundwater management are appropriate for that level. However, the principles of the Framework can be applied at all levels and all scales.

Groundwater management includes one or more of the following aspects:

- Aquifer protection
- Groundwater quality management
- Groundwater remediation
- Groundwater assessment
- Groundwater monitoring
- Wellfield planning and design
- Wellfield operation and maintenance.

These different aspects of groundwater management, however, relate to two main categories, viz., ***Aquifer Protection*** and ***Aquifer Utilisation***. Monitoring and data management is a critical part of both these categories of groundwater management. Its crosscutting importance requires that attention be given to standardisation of the monitoring and data management process.

Monitoring and data management comprise six distinct, but linked tasks, namely:

- Development of a Monitoring Protocol
- Design and Set-up of a Monitoring Network
- Data Collection and Collation
- Data Processing
- Data Analysis and Evaluation
- Data Management.

The framework identifies various role players who need to be responsible for some of the above aspects of groundwater management at different levels, these being DWA, the Department of Environmental Affairs, Catchment Management Agencies, WUAs, WSAs, WSPs, Water Boards, water users and water polluters.

For each groundwater management category, the framework provides a description of each aspect of groundwater management as well as the associated tasks and assigned responsibilities of the relevant institutions.

## Aquifer economics

One of the major challenges in valuing aquifers is how to integrate the hydrologic and physical components of groundwater resources into a valuation scheme. An appropriate conceptual basis for valuation identifies service flows as the central link between economic valuation and ground water quality and quantity.

Defining the best long-term management of the resource requires balancing the needs of the present with those of the future. In theory, the balancing is done daily by markets and reflected in the discount rate. The discount rate is what a water utility employs when valuing aquifers reflects perceptions of risk, returns, and possibly inter-generational equity. A high discount rate implicitly places a low value on the water's value to future generations. A low rate implies the opposite.

The valuation of the range of ecosystem services of an aquifer requires an understanding of geology, geohydrology and ecology of a certain groundwater resource based on hydrological and geohydrological information. Such information includes factors such as rainfall, runoff, depth to groundwater, whether the aquifer is confined or unconfined, the groundwater flow rates and direction, type of vadose and water-bearing zone materials and water quality associated with different strata.

## Implementation in Overstrand Municipality

The Groundwater Management Framework and aquifer valuation methodology were tested and implemented as a case study in the Overstrand Municipality, focusing on the groundwater supply to towns of Hermanus (derived from the Peninsula Aquifer of the Table Mountain Group) and Stanford (derived from the quaternary sands and limestones of the Bredasdorp Group).

The Overstrand Municipality was selected because of its separation of the WSA and WSP functions within the municipal structure. This is the preferred structure for compliance with relevant legislation, which requires that a WSP should not supervise and police itself. The structure not only enables a clear tracking of roles and responsibilities, but also of the skills required for the WSA and WSP functions.

The implementation of the Framework confirmed that the split between WSA and WSP is useful, if both parties are fully involved in the groundwater development and well-field

planning. The aquifer valuation methodology provides a useful tool for the Local Government to emphasise the value of protecting and utilising the aquifers in a sustainable manner.

## Recommendations

The framework has proven to be of considerable significance in enabling local government structures to understand their responsibilities and required actions with regard to groundwater management. Hence, it is of utmost importance to introduce municipalities to this framework and train the relevant officials in using the guidelines to achieve sustainable groundwater management.

Furthermore, it is strongly suggested that the Department of Water Affairs adopts this framework as an overarching guideline and incorporates the existing suite of guidelines into this framework.

The following work is recommended in support of the above suggestions and to achieve the successful implementation of the framework:

- Roll out the framework to local government;
- Train municipal officials in elements of the framework;
- Update DWA Guideline for Assessment and Management to incorporate relevant detail relating to levels of assessment and planning;
- Develop guidelines for monitoring, data handling and processing, quality control and storage and sharing of data;
- Develop a guideline for adaptive management (Monitor – Model – Manage);
- Refine the valuation methodology to include ecosystems and aquifer characteristics.

**Further reading:**
To obtain the report, ***Groundwater Management Framework*** (**Report No: 1917/1/10**) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; E-mail: orders@wrc.org.za; or Visit: www.wrc.org.za