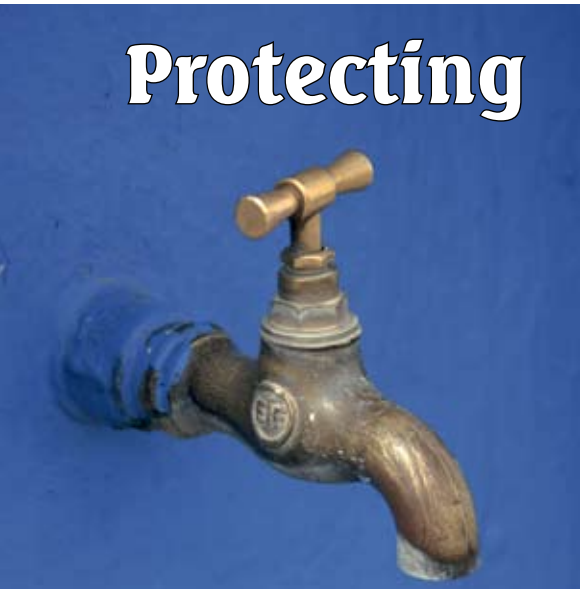
Protecting What's Underneath the Tap



Protecting groundwater resources, especially those used for domestic purposes, remains a challenges in South Africa. Harrison Pienaar and Yongxin Xu explore the fundamental principles and challenges of groundwater protection while proposing a framework model for undertaking groundwater source and aquifer protection zoning in South Africa.

Today, almost 60% of the country's rural communities are directly dependent on underground resources. This figure is set to rise as more effort is being put into ensuring all citizens' access to basic water supply.

At the same time groundwater resources must be protected. Pollution of groundwater resources can affect both groundwater and surface water quality in streams fed by baseflow. Remediation of polluted aquifers is expensive and technically difficult. Groundwater moves slowly so the impact of human activities can potentially last a long time.

However, there is currently no policy in South Africa that directly addresses the protection of groundwater used for drinking water. Groundwater protection is addressed to a limited extent through resource directed measures (RDM), however, although often on an *ad hoc* basis.

As protection of all aquifers is considered impossible in South Africa, a differentiated protection policy, where priority is given to important and vulnerable aquifers, has been proposed as the optimum solution.

The groundwater component of the Reserve is the part of the groundwater resource that sustains basic human needs and aquatic ecosystems. Since groundwater is far more widespread geographically than surface water resources, that component of the geohydrological system which sustains the Reserve is only a part of the greater system considered on RDM for groundwater.

Groundwater can only be allocated to users once the volume of groundwater that contributes to sustaining the Reserve has been quantified and the resource quality objectives (RQOs) have been met. RQOs can be based on both the Reserve and the classification of water resources (which delineates resources as Protected, Good, Fair or Severely Modified). These four classes imply different levels of protection and impacts to stakeholders of the resource. Figure 1 summarises the RDM for groundwater protection.

GROUNDWATER AND SERVICE DELIVERY – THE DELMAS CASE

The Delmas community, in Mpumalanga, is supplied with treated water from underground water resources (a dolomitic aquifer). The water is abstracted from a number of boreholes, chlorinated and reticulated.

While residents living within the formalised stands of Botleng have access to reticulated water and waterborne sanitation, those living in informal dwellings surrounding the area get their water from standpipes. These residents are also still dependent on the bucket system.

On average, the local municipality empties the buckets twice a week. If a household requires the bucket to be emptied between visits from the municipality, they have to do it themselves. This is most often done by excavating a small hole in the ground behind the dwelling at a point adjacent to a low lying marshy flood plain area.

It has been reported that the converted skip, used to collect the waste, requires repair work, and that no disinfection takes place when the buckets are emptied. Residents have also voiced their concern over the fact that emptied buckets are merely thrown outside the houses. The waterborne sanitation system of the town is serviced by two wastewater treatment works (Delmas and Botleng); sewage pumps stations and septic tanks in some villages.

TYPHOID OUTBREAK

On 5 September 2005, a typhoid outbreak was confirmed in Delmas resulting in five reported deaths and the hospitalisation of 17 others. An increased number of diarrhoeal cases were also reported. Various steps were taken immediately to ensure a safe water supply to people, to find the possible source of infection and to promote improved health and hygiene practices in the communities.

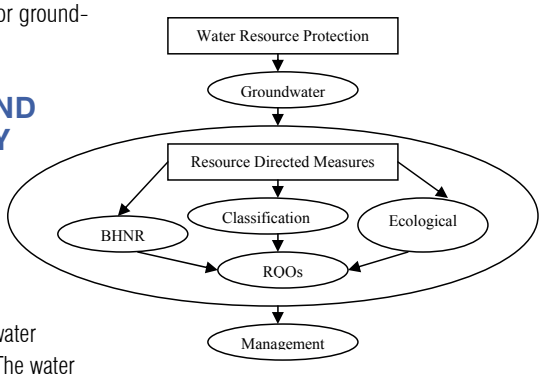


Figure 1: RDM for groundwater protection.

A Joint Operation Committee was formed, including representatives of the municipality and national and provincial sector departments (such as Health and Social Services, Local Government and Housing, Water Affairs & Forestry, and Agriculture). This committee met regularly and coordinated efforts to curtail the outbreak.

Investigations found untreated water from one borehole to be polluted by faecal pollution. In addition, the use of a novel rapid, highly specific molecular analytical technique indicated the possible presence of Salmonella typhi in untreated water from one borehole and adenovirus from another borehole.

LESSONS LEARNT

1. DWAF as sector leader

The events at Delmas have emphasised the importance of DWAF's role as regulator, the need for support for municipalities to implement water resource protection, and the urgency around fully fledged implementation of the department's new functions.

Water resource management is often viewed as a much lower priority at municipal levels as it is often superseded by those priorities concerned with basic services provision despite the inextricable links between these two processes. A perception exists that water resource management is the key function of DWAF and catchment management agencies (CMAs) only. This has resulted in a lack of integrated planning from local authorities, with integrated development plans focusing only on the provision of basic water and sanitation services. Addressing this gap should receive priority especially as DWAF is preparing to hand over more of its traditional implementation functions.

While the existence of an Intergovernmental Relations Framework Bill enables DWAF as regulator and sector leader to execute its mandate at all levels of government, a lack of skilled resources at local government level cannot go unnoticed. A more vigorous bottom-up capacity building approach among local communities on water resource management (groundwater protection in particular) is therefore eminent to ensure

"There is currently no policy in South Africa that directly addresses the protection of groundwater used for drinking water."

that they are able to assist water managers at grassroots level when implement integrated water resources management (IWRM).

2. Cooperative governance

A concerted effort was made by various government departments to assist the local municipality to bring the typhoid outbreak in Delmas under control. Efforts focused on the treatment of the disease, providing safe drinking water, providing education on the importance of proper hygiene and sanitation, and locating the possible origin of the epidemic.

3. Water governance monitoring and compliance

It remains the legislative responsibility of the municipality to perform water quality monitoring and compliance at regular frequencies, however, more attention should be paid to resource support to this municipality in terms of its own ability to continue with compliance monitoring in the long term.

To ensure adequate groundwater supply as well as an acceptable resource quality, groundwater protection zoning is deemed a necessity. This will allow the area of land included in a protection zone to be managed in such a way as to minimise the potential of groundwater contamination by human activities.

FUNDAMENTAL PRINCIPLES FOR UNDERTAKING GROUNDWATER PROTECTION IN SOUTH AFRICA

1. Public consultation and transparency

Public participation in decision-making, especially focusing on historically disadvantaged and marginalised communities, concerning water resource protection is one of the basic principles of IWRM in South Africa. To sustain public participation and stakeholder involvement in overall groundwater management, transparency and openness is required.

2. Differentiated and risk-based approach

Authorities should strongly consider a differentiated and risk-based approach to groundwater protection. Its implementation can be achieved through careful consideration of the following legal provision reflected in the National Water Act (NWA):

- Implementation of source-directed control measures to prevent and minimise wherever possible, at source, the impact of development on groundwater quality by imposing regulatory controls and by providing incentives;
- Implementation of RDM to manage such impacts to protect the Reserve, and ensure suitability for beneficial purposes;
- Remediation of groundwater resource quality where practicable to protect the Reserve and ensure at least fitness for the purpose served by the remediation.

3. Practicable and phased implementation

As there is a legislative requirement for the protection of ground and surface water resources, groundwater source and aquifer protection zoning initiatives must be practical and robust to be implemented at a catchment level by trained DWAF staff, supporting local municipalities and established CMAs. There should be equilibrium between the costs of implementation and the confidence levels associated with the determination of a class.

4. Sustainability

The principal reason for protecting water resources is to maintain the ecosystem integrity at a level that ensures the continued delivery of the desired ecosystem goods and services (i.e. direct socio-economic benefits of society). The concept of limited trade-offs between costs and benefits should be considered in classification, for example, allowing development of one part of a resource

in exchange for rehabilitation of another degraded section of the same resource (thereby adding protection value).

5. Analysis of scale

If a process (such as a groundwater protecting zoning policy initiative) is to be legally defensible, it will be required that it is scientifically rigorous, and that all the concepts and information provided can be backed up by hard science that is able to provide a defendable and transparent decision. It is therefore important to assess the level of scale at which groundwater protection needs to be undertaken, especially in a country such as South Africa, where technical or geographical boundaries (in this case aquifers) are not always aligned with that of water resource management boundaries.

Different information available in various areas of the country and different levels of risks are associated with decisions. It is therefore prudent to have a number of methodological approaches that would assist in decision making accounting for these factors. It is suggested that a set of methodologies be adopted for different levels of information available when decisions are made with respect to the level or approach for protection zoning to be undertaken within a catchment.

The following three levels of decision making could be introduced at this stage:

"The Delmas incident, as an example, could have been prevented if strategic advocacy from all key roleplayers was considered upfront during the municipal planning phase, rather than a compulsory intervention or reactive approach by those roleplayers."

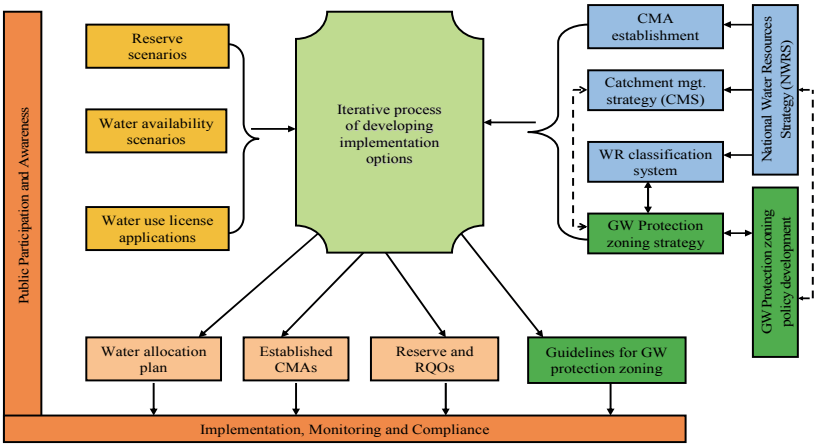


Figure 2: Overarching IWRM framework

- Protection at all costs;
- Protection as best as possible and reasonably practical; and
- Pollution is acceptable where absolutely necessary.

It must be recognised that the framework for groundwater protection needs to embody the changing physical and base conditions in a certain water management area. It is from this perspective that a risk-based approach is suggested. It is also recognised that the groundwater protection process needs to have a set of consistent measures which allow stakeholders in the catchment to assess the present situation and the future situation in terms of RQOs. The protection process should also embody three different entities, namely where we currently are; where we want to be; and how do we intend to reach the planned destination.

PROPOSED FRAMEWORK MODEL FOR GROUNDWATER PROTECTION

Figure 2 illustrates how water resources protection within an overarching IWRM framework should unfold. It is important to note the iterative process required for developing a cross-sector policy for groundwater protection zoning in particular. A further parallel process is also proposed whereby a strategy for groundwater protection zoning could be developed simultaneously while establishing a water resources classification system.

The various linkages between other IWRM processes are also outlined to illustrate that groundwater protection initiatives are considered during the planning processes of IWRM (i.e. water availability and Reserve scenarios). The ultimate outcome of such an approach is that elements of both the policy and strategy development process are being considered for the establishment of interim or preliminary guidelines for undertaking groundwater protection zoning.

The following three-tier approach should be considered in undertaking this mammoth task of groundwater protection zoning in South Africa:

- Implementation of guidelines/regulations to ensure that potential sources of contamination, such as inappropriate sanitation and poor borehole construction are dealt with immediately;
- An area planning and site-specific licensing of abstraction and discharges based on an aquifer classification system, which can differentiate between the required levels of groundwater protection. This classification will focus firstly on the importance of the aquifer, and secondly on its vulnerability; and
- A programme of special protection of vulnerable groundwater sources supplying domestic water to communities.

DISCUSSION

Interim measures as well as existing policy and legal instruments while developing a groundwater policy that enables the

protection of groundwater resources are critical, taking its account the time it takes to develop such a policy. DWAF is also in the process of updating its national water resources strategy during which process a number of shortcomings on groundwater can be addressed.

Important groundwater protection procedures include:

- Public involvement – awareness among communities is seen as the only permanent guard against degradation of groundwater resources.
- Reserve determinations – allow for the role of groundwater in sustaining aquatic ecosystems to be understood and promoted within the context of a balance between use and protection;
- Aquifer classification – provides a framework for implementing differentiated protection, and should be implemented at a catchment level;
- Land-use zoning – an effective source-based control that restricts potentially polluting developments on important or sensitive aquifer systems.
- Environmental management plans and environmental impact assessments – should be mandatory for activities known to induce groundwater contamination, or in areas of important or sensitive aquifer systems.

Processes involved in aquifer depletion and pollution, and related aquifer protection and conservation, are complex and require specialist input for correct management. IWRM is considered essential therefore to protect the country's groundwater resources.

Aquifer protection, however, is a public issue, and all water and land users have a role to play therein. The primary responsibility for groundwater protection therefore rests with any institution or person (i.e. local municipality) who is carrying out an activity that poses a threat to groundwater.

CONCLUSION

There is a definite need for a proactive approach to protecting the country's groundwater resources. The Delmas incident, as an example, could have been prevented if strategic advocacy from all key roleplayers was considered upfront during the municipal development planning process, rather than a compulsory intervention or reactive approach by those roleplayers.

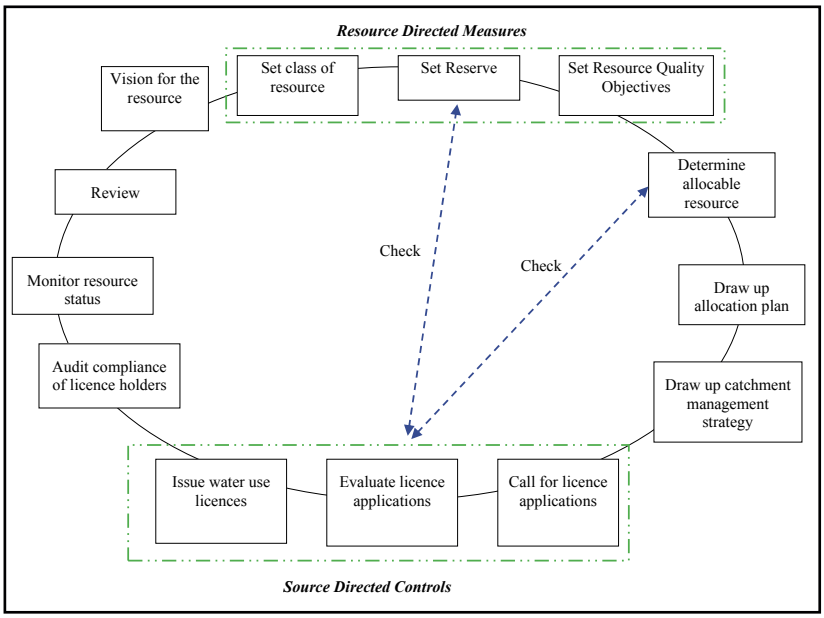


Figure 3: IWRM as adopted by DWAF

Protection zoning provides guidelines for local planning and water use licensing authorities in carrying out their functions. It also provides a framework to assist in decision making on the location, nature and control of developments and activities to protect groundwater as well as maintain the beneficial use of groundwater. Such a framework also aims to maintain the quantity and quality of groundwater, and in some cases improve it by applying a risk assessment-based approach to groundwater protection and sustainable development. In this way, it will greatly assist local municipalities in particular to meet their responsibilities in protecting groundwater.

It is believed that the protection of groundwater under IWRM as adopted by DWAF (Figure 3) is adequately addressed under the RDM and that mitigating measures dealing with associated impacts on groundwater is dealt with under source directed controls. In practice, however, this presumption carries little weight as there is limited skilled capacity within DWAF and the wider water sector to cope with overall groundwater management.

The department's incomplete restructuring initiatives have led to groundwater management being addressed in a fragmented manner.

The intention of this approach was to ensure that groundwater is adequately incorporated into other IWRM disciplines. However, it appears that this approach was a bit premature given the lack of sufficient groundwater expertise throughout the department and the water sector, let alone the limited understanding of this subject given the lack of qualified data and information on groundwater issues. Furthermore, the adopted IWRM approach by DWAF only assumes an iterative approach to water resource management.

It is therefore necessary to propose an overarching framework that clearly illustrates groundwater management and its relevance to effective IWRM. This will ensure that less assumption is made to groundwater management and its role within the context of IWRM, and that real meaning is added to its meaningful contribution in making IWRM a reality.

- Harrison Pienaar is from the Department of Water Affairs & Forestry. Prof Yongxin Xu is from the Department of Earth Sciences at the University of the Western Cape.