TECHNICAL BRIEF

November 2016
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.

New protocol to monitor the Ecological Reserve

A Water Research Commission (WRC) study has developed an elementary tool for Ecological Reserve monitoring in South Africa's Freshwater Ecosystem Priority Areas (FEPAs).

Study overview and rationale

Extensive research and development has gone into methodologies aimed at determining the Ecological Reserve in South Africa, i.e. into quantifying the volumes, timing and frequency of flows required to support ecosystem processes in local rivers.

Considerably less attention has been accorded its operationalisation; with some managers alleging that Reserve determination methodologies have been developed in a vacuum without any serious consideration for their practicability.

This study was undertaken in response to the need to develop simple tools to monitor the Reserve that can be broadly applied in rural catchments with limited water resource management capacity and monitoring, a decentralised water storage and transfer infrastructure, but which have a high conservation and biodiversity value, i.e. Freshwater Ecosystem Priority Areas (FEPAs).

One of the fundamental premises of this study is the notion that operationalisation of the Reserve in river catchments stands a better chance of succeeding if more knowledge and control is placed in the hands of Water User Associations (WUAs) (representing both established commercial and emerging farming sectors) since they play a critical day-to-day role in the management of local water resources.

By providing a set of easily interpretable tools and the basic skills required to manage their water resources more efficiently, this project aims to play a role in their institutional development through providing a significant link at the science-management interface.

The primary aims investigate elementary, cost-effective monitoring tools and protocols for monitoring the Reserve in catchments of high ecological importance that can be applied broadly by non-technical personnel within catchment management areas (CMAs,) WUAs and conservation extension officers throughout South Africa.

Study area

The Koue Bokkeveld study area falls within the Olifants-Doring catchment (see Figure 1). It is located at the southern end of the of this water management area where it forms the headwaters of the Doring River which flows in a northerly direction, draining the eastern flanks of the Cederberg mountains, before joining the Olifants River at the downstream end of quaternary catchment E24M near the town of Klawer.

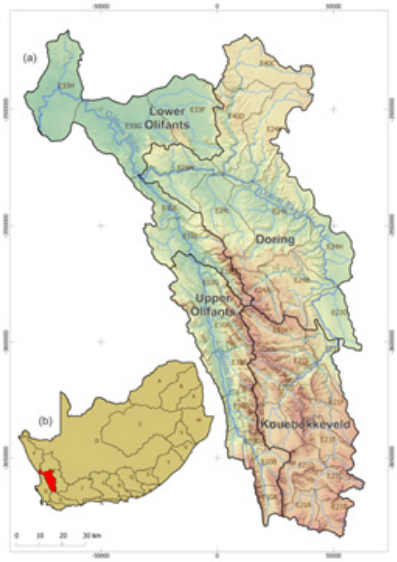

Figure 1. The Koue Bokkeveld study area.

This study focused on three main rivers within the Koue Bokkeveld catchment, namely: the Twee, Leeu and Riet Rivers which confluence with the Groot River before this river joins the Doring River at De Mond.

The Mean Annual Runoff (MAR) for the Koue Bokkeveld has been estimated at 281.6 Mm^3/a – accounting for roughly 66% of the flows at the confluence of the Doring and Olifants Rivers (423 $Mm^3.a^{-1}$) and 33% of the flows at the mouth of the Olifants River (1073 Mm^3/a).

The runoff from this region therefore plays a critically important role in supporting the health of the mainstem of the Doring, as well as that of the estuary. The Koue Bokkeveld is one of the most intensively farmed areas in the Olifants-Doring Water Management Area (WMA), having the third highest registered surface water use (20.9%).

Developing an ecological reserve monitoring tool

Observed daily average flows from existing Department of Water and Sanitation gauging weirs on the Leeu and Doring Rivers, WRC reports, water resources assessments and some rainfall data, collectively provided flow data and information from 1920 to 2010.

This data was used to developed an elementary method – the STandardised REserve Analysis and Monitoring tool (STREAM) – for monitoring the Reserve in catchments characterised by run-of-river abstractions, limited flow monitoring infrastructure decentralised water resource infrastructure (i.e. rural catchments without large dams with release mechanisms and that control water by means of extensive reticulation systems).

The proposed method assesses deviations from Reserve requirements at coarse spatial and temporal resolutions and does so retrospectively. It is not intended for monitoring real-time compliance in complex catchments with major water resource infrastructure, or for developing operating rules for dams. It has been developed with the budget and skills limitations in mind of managers in smaller catchments that have high conservation value.

As it currently stands, STREAM comprises a series of Excel spreadsheets incorporating a combination of data entry templates, mathematical and logical functions, together with pivot tables and graphic outputs that require basic Excel skills to generate.

The study generated guidelines on how to execute calculations. In this study flow gauging network in the Koue Bokkeveld was to broaden by using water level loggers housed in stilling wells and located at natural control sites at critical monitoring nodes on the Twee and Riet Rivers, see Figure 2.

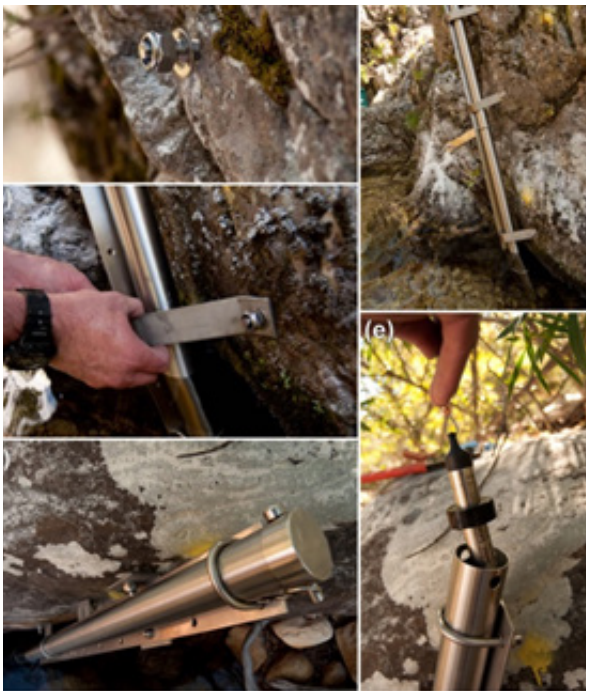

Figure 2. (a) Rawlbolt insertion into bedrock , (b) Fitting the mounting bracket to the mounting plate, (c) cap on the stilling well held in place with a bolt and clinch pin (d) installed stilling well with mounting brackets, (e) inserting the Solinst water level logger

The advantages of this approach are firstly, the low cost relative to the construction of more traditional crested weirs, and secondly the minimal impact on the river and its biota – particularly the fact that natural controls don't alter migratory corridors.

Rather than necessitating the constructing an artificial weir, natural control methods make use of the natural shape of the river for discharge estimation. Like any method in development (prototype), STREAM has constraints which can be resolved with further research, such as Real-time monitoring of the reserve is not possible with STREAM, rather, the Reserve is reviewed retrospectively at quarterly, six-monthly or annual intervals.

Results

A simply, non-technical method was developed. This

prototype needs further testing, thereby improving its usefulness. STREAM is not intended to assess whether the Reserve is being legally complied with in terms of the National Water Act.

The issue of compliance needs to be interrogated beyond the simple fact of whether a certain hydrological value has exceeded a threshold or not, i.e. whether non-compliance equates to 'anything below the Reserve'.

As an alternative to 'compliance', the Reserve be approached as a 'working hypothesis' that requires monitoring in order to assess whether it is achieving the state desired for the system at the outset of the classification process.

Rather than a threshold, the Reserve be assessed by tracking trends, setting Thresholds of Potential Concern (TPCs), testing outcomes against realistic management interventions and adjusting these where necessary within the framework of an iterative, adaptive management approach.

Conclusions and recommendations

Improving hydrological certainty and regularly reviewing and updating rainfall-runoff relationships should be an important component in further application or development of this and any other similar model.

Concomitant efforts to reinforce and expand rainfall monitoring infrastructure will go a long way towards achieving the former objective.

Should software be considered in the future, the possibility then exists of increasing the sophistication of the integrated rainfall-runoff model.

In terms of immediate research and development needs, a priority is to continue testing the model in an adaptive management framework in the Koue Bokkeveld, to develop monitoring and response protocols around its use and to test these in a different catchment with a different set of water resource challenges.

STREAM does not currently assess high flows (floods), but should these be included in future versions. High flow requirements must be made explicit in the gazette, this includes their classes, expected and required frequencies, as well as their timing.

This study has demonstrated that perceptions that operationalisation of the Reserve is impossible, are false. While there are limits, it is not completely unachievable if good quality and up-to-date data is at hand, that appropriate tools are available and that these are effectively applied in an adaptive management context.

In high conservation priority catchments (i.e. FEPAs or Fish Sanctuaries), where hydrological routing has been used to determine the EWR, these data should be interrogated and reviewed and suitable methodologies applied to increase the confidence in EWR outputs.

Water resources management is a complex field private landowners and public institutions will continue to require considerable support to ensure that adaptive management systems are functional and sustainable.

Further reading:

To obtain the report, *on Developing an elementary tool for Ecological Reserve monitoring in South Africa's Freshwater Ecosystem Priority Areas (FEPAs): A pilot study in the Koue Bokkeveld* (**WRC Report No. 2340/1/16**), contact Publications at Tel: (012) 761-9300; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.