

# Water resource management

## Counting the drops – SA’s water resource assessment project completed



*South Africa’s latest comprehensive national water resource assessment has been completed. Funded by the Water Research Commission (WRC), the Water Resources Study (WR2012) is the sixth national study to be undertaken since 1952, its main objective being to assist decision-makers at all levels of government to make informed choices about all policies concerning South Africa’s water resources. Article by Allan Bailey, Bill Pitman and Wandile Nomquphu.*

Each water resource assessment study builds on the technology and knowledge gained from the one that preceded it. The latest study, which covers South Africa, Lesotho and Swaziland, builds on the previous assessment (WR2005) by using updated and new data and information as well as new tools and technology.

A significant feature of WR2012 is the fact that, for the first time, a publicly-accessible water resources website was created ([www.waterresourceswr2012.co.za](http://www.waterresourceswr2012.co.za)) which allows for Web-based and interactive reporting on both surface and groundwater. The website contains all the GIS maps, WRSM/Pitman (previously known as WRSM2000 or the Pitman catchment model) and other hydrological models, time series data, spreadsheets and WRSM/Pitman associated networks containing all data. This is a big step forward for water resource practitioners.

### **GIS maps**

Rainfall, runoff, water quality (in terms of total dissolved solids),

WRSM/Pitman calibration parameters, land use and population maps have all been updated in the WR2012 study. GIS maps are available in hard copy and electronic format (from the website).

A statistical analysis was carried out on approximately 600 usable streamflow stations and the outcome was used to show six categories of streamflow gauging station on the map. This will help the user ascertain the quality of streamflow gauges and the reliability of data.

There is a totally new map based on the new present day analysis which analysed current levels of land use. Comparison were made against natural flow at 84 key locations throughout the country.

### **WRSM/Pitman model**

The rainfall-runoff WRSM/Pitman model named after its innovator and developer, Dr Bill Pitman was a key part of this project and has underwent further enhancements during the

study. Outputs from this model are used as the primary inputs to the Department of Water and Sanitation's water resources planning models.

The WRSM/Pitman monthly time-step model was used to analyse all catchments in South Africa, Lesotho and Swaziland with data up to September 2010. These networks and data sets are included on the website for users to develop their own analyses.

A number of additional user-friendly features were added:

- Enhanced graphical tools for zooming, panning, log scale and data inspection
- Addition of the latest irrigation methodology by Dr Chris Herold
- Ability to calibrate the storage at a dam with observed and simulated storage trajectories
- Additional graphs for massplot and cusum plots for rainfall and naturalised streamflow
- Calibration of numerous runoff models in one step

### Present-day analysis

The study made comparisons of naturalised streamflow versus present day streamflow at 84 key locations throughout South Africa. This provides an indication of the human influence on our river flows. While there are many return flows in the system, the study indicates that there are many catchments in South Africa that have outflows that are, on average, considerably lower than they would have been under naturalised conditions.

The previous water resources appraisals have shown a decreasing trend of the estimate of average naturalised mean annual runoff, but the WR2012 study has come out virtually the same as the previous one (WR2005). Analysis shows the Vaal catchment to be the most heavily utilised, where the mean annual runoff (MAR) has been reduced by 66%, despite several transfers into the basin from the Lesotho Highlands, Thukela and Usuthu catchments. The least utilised catchment was found to be the Mzimvubu, where the MAR is reduced by only 8%.

### Water quality analysis

During the WR2012 study, the simplified salt balance model SALMOD was analysed and calibrated for the entire Upper Vaal, Middle Vaal and Lower Vaal sub-water management areas (which have now been combined into the new Vaal WMA). This catchment is the most highly developed in South Africa with a great deal of land use/water use which impacts on water quality. Observed data was extended from 1974 to 2009. The final report provides data on flow, TDS concentration and TDS load at all the relevant water quality stations through the WMA.

### Groundwater

Karim Sami compiled a comprehensive report on groundwater verification studies carried out in various parts of the country. Of particular interest was the updating of default groundwater parameters for every quaternary catchment (around 1 960) that are used in the Sami input screen of WRSM/Pitman.

### Challenges and innovations

By far the biggest challenge of the study was the deterioration of data in the form of rainfall, observed streamflow, reservoir



*The latest water resources assessment study shows that land use in the Vaal River has reduced the mean annual runoff by 66%.*

records (dam balances), land use/water use and water quality. Rainfall is the most important and shows the biggest decline in terms of rainfall stations which have closed down.

This deterioration of data makes it harder for hydrologists and water resources practitioners to enter data of the necessary quality into water resource models. These models produce hydrological information on streamflow, yields of dams, water quality trends, future demand versus supply trends, ecological water requirements etc.

Obviously, the accuracy of the above information will become compromised should this very distressing situation continue. Although the number of streamflow stations that is used in the appraisals since 1969 has increased with every appraisal, already 200 of the 600 have closed down. Their historical records were used, but no new data are becoming available.

Rainfall data is the most important data source for all water resources models. Raw rainfall data is of little use as it normally has some missing and unreliable months. The website contains all usable rainfall station data which has been patched. Similarly, observed streamflow data has also been patched up to September 2010.

It is expected that the WR2012 website with all its available tools and datasets will greatly facilitate water resources studies in South Africa.

[www.waterresourceswr2012.co.za](http://www.waterresourceswr2012.co.za)