October 2013

TECHNICAL BRIEF

Climate change

Potential climate change impacts on Karoo aquifers

A completed WRC-funded research project offers a first step in assessing the potential impact of climate change on Karoo aquifers.

Background

South Africa is viewed as a water-stressed country, with an average annual rainfall of less than 500 mm. As a result any climatic change could have adverse impacts on the water resources of the country.

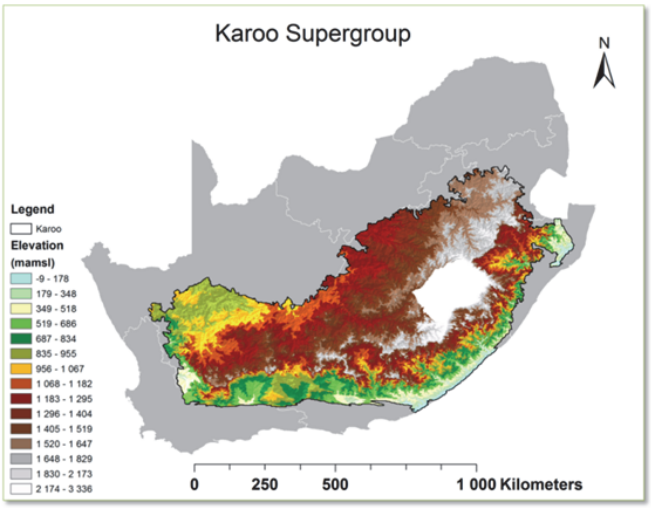
The potential impacts of climate change on water resources and hydrology for Africa and southern Africa have received considerable attention in the last decade. However, very little research has been conducted on the future impact of climate change on groundwater resources in South Africa.

Climate change can affect groundwater levels, recharge and groundwater contribution to baseflow. The WRC study serves as a first step in assessing the impact of climate change on South Africa is Karoo aquifers.

About 50% of South Africa is underlain by the so-called Karoo Supergroup of geological formations. A major characteristic of the Karoo Supergroup, which consists mainly of sandstone, mudstone, shale and siltstone, is their low permeability. The majority of boreholes drilled in Karoo formations therefore have very low immediate yields (<1 ℓ/s), nevertheless, these aquifers supply numerous towns and rural communities.

Potential impacts of climate change

Climate change impacts can play a role in the sustainability of Karoo aquifers. For example, the sensitivity of groundwater to drought depends on the amount of recharge. The western part of South Africa is semi-arid and has a low recharge rate. This makes these rural areas more susceptible to drought. Drought events also typically serve to extend



Location of the Karoo Supergroup

existing environmental problems, such as soil erosion and desertification.

On the other hand, floods occur because of heavy rains falling over unusually long periods of time. In arid or semi-arid areas, when the ground surface is baked hard during dry conditions, extensive areas may be flooded by heavy rainfall ponding on the surface. Floods increase the mobilisation of pollutants in groundwater due to the increased water table.

Methodology

The first step in the project team's approach involved the creation of a climate change vulnerability profile. The so-called DART methodology was developed by analogy with the DRASTIC methodology.

The parameters considered in the DART methodology are as follows:

D = Depth of water level change
A = Aquifer type (storativity)
R = Recharge
T = Transmissivity

The DRASTIC methodology was developed to express aquifer vulnerability with reference to the threat of pollution. The DART methodology focuses more on typical parameters used in sustainability studies, but also indirectly accommodates the issue of quality due to the fact that water quality is likely to deteriorate with a drop in water level over time, as the salt load will concentrate.

Two scenarios are considered: current and future. the current scenario is representative of current precipitation patterns and the future scenario is representative of a predicted scenario based on the selected global climate model.

Results

At first glance, the results indicate that there is not a significant difference between current and future average indices, which indicate that the change in climate does not alter the average water level (i.e. the recharge) that much. There seems to be very little change in the indices of the dry months, due to the fact that the recharge model shows very little recharge over similar months. This is a worst-case scenario, as episodic recharge events will take place and, if the recharge is significant, this will result in a better index value that currently portrayed.

The results presented in the final report demonstrate a method of mapping vulnerability that can be used to assess the impacts of climate change on both a regional and national scale. In developing a new approach for climate vulnerability mapping, we contribute to a growing body of literature on vulnerability science.

Further reading:
To order the report, *Potential climate change impacts on Karoo aquifers* (**Report No. KV 308/12**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.