INDEX
- March/April 1997
- July/August 1997
- Jan/Feb 1998
- March/April 1998
- June/July 1998
- Aug/Sep 1998
- Oct/Nov 1998
- Dec 1998
- Jan/Feb 1999
- March/April 1999
- May/June 1999
- July/Aug 1999
- Sept/Oct 1999
- Nov/Dec 1999
- Jan/Feb 2000
- March/April 2000
- May/June 2000

SA WATERBULLETIN

Possible deterioration of groundwater quality in the Olifants River catchment investigated

Two researchers from the Institute for Groundwater Studies at the University of the Orange Free State, FDI Hodgson and RM Krantz, have carried out an investigation in the Olifants River catchment in Mpumalanga to try and quantify the possible contribution of the various activities in the area such as mining, power generation, municipal waste disposal, etc., to the worsening water quality and groundwater pollution in the catchment. This was after elevated sulphate and low pH levels provided clear indications that the quality of the surface waters of the Olifants River, specifically the Witbank Dam sub-catchment, was deteriorating.

A final report summarising the findings of the project is currently available free of charge from the Water Research Commission in Pretoria. It is titled: **Groundwater Quality Deterioration in the Olifants River Catchment above the Loskop Dam with Specialised Investigations in the Witbank Dam Sub-Catchment** (WRC report 291/1/98). (Overseas price of the report: US$ 30, via surface mail).

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The University of the Orange Free State, through its Institute for Groundwater Studies, entered into a research contract with the Water Research Commission, the Department of Water Affairs and Forestry, the Chamber of Mines of South Africa and Eskom to study the groundwater quality deterioration in the Olifants River catchment. The aims of the investigation were to:

- Quantify the contribution of various activities which may result in a deterioration of the groundwater resources in the catchment above Loskop Dam, with special emphasis on the Witbank Dam sub-catchment.
- Predict future salt loads in groundwater, based on projections of probable development in the area, and extrapolate information to other catchments that supply water to the Olifants River catchment.
- Investigate and research improved management and precautionary measures which could be utilised to minimise groundwater quality deterioration.
- Integrate groundwater information with other investigations in the area, including the water management programme of the Department of Water Affairs and Forestry, with the aim of deriving a catchment management programme at the end of the project.

RESULTS

The researchers say several studies on specific water related issues have

been conducted by other investigators since this project was initiated. Where appropriate, use has been made of the findings of these studies to supplement this project's investigations. A massive amount of data were gathered and interpreted to satisfy the aims of the project. The main findings were:

- **Groundwater**

Natural groundwater quality in the weathered aquifer used by farmers is excellent. Since yields are low groundwater is sufficient for domestic use, but not for irrigation.

- **Surface water**

There exists a direct link between the water quality in many of the surface streams and development (mostly mining) in the catchment. Sulphate levels in several streams have over the past twenty years increased from about 20 mg/*l* to between 100 and 900 mg/*l*.

- **Opencast mining**

Of all the activities in the Olifants Catchment, opencast mining has the greatest impact on groundwater quality. The following is a selection of the main research findings: m Methodologies have been developed to quantify the acid-base potential of opencast coal-mines. Seven of the mines which were tested have severe acidic tendencies, two are borderline cases and one is alkaline. m The rate of sulphate generation in backfilled opencast areas, as calculated from this investigation, is between 5 - 10 kg/ha/d. On the basis of the present scale of opencast mining in the Witbank Catchment, this amounts to 70 t/d of sulphate. This amount is over and above the 33 t/d presently entering into the Witbank Dam on average from other sources. m Pits that have been mined out, fill up with water to their decant level within 5 - 10 years after mining has ceased. m Three water management options at opencast coal mines stand out. These are selective spoil handling, flushing under certain conditions and containment.

- **Underground mining**

Shallow underground mining has, in many instances, mined into the weathered aquifer, with the result that rain water actively recharges these mines. Most of the shallow underground mines west of Witbank are currently full of water and are decanting acid water onto surface.

- Deep bord-and-pillar underground mining does not pose a long-term threat to groundwater pollution. On the other hand, high extraction underground mining results in the collapse of overlying strata, usually resulting in the overlying strata and aquifers adjacent to these areas being dewatered. As a rule, the effect of dewatering is not noticeable more than 500 m away from current high extraction mining. Water in high extraction areas has any of a range of chemistries, depending on the evolutionary stage of the water. The quality of this water is inadequate for disposal into public streams. A viable disposal option is to create underground storage space.

- **Power generation**

Possible sources of groundwater pollution at power stations are mainly that of fly ash disposal, coal stockpiling and dirty water dams. The investigation concluded that the disposal facilities at the power stations are well managed and groundwater pollution is minimal.

- **Municipal waste disposal**

Although general waste of municipal origin may pose a threat to ground-water pollution, this threat is very localised.

- **Sewage effluent disposal**

Sewage works do not significantly impact on groundwater quality. Treated sewage effluent, which is discharged into streams, has ameliorating effects on the acid-mine drainage.

- **Metal industry**

Metal industries, comprising mainly steel, stainless steel, ferrosilicate and vanadium producing plants have little regional impact on groundwater quality. Locally, problems are experienced with the disposal of saline liquids, slimes, slags, phenol and in the case of the stainless steel industry, chromium and nickel. Groundwater pollution is of a localised but intense nature.

- **Agriculture**

Agricultural pollution of groundwater is local and isolated. Nitrate (N) and phosphate (PO) levels in the groundwater are generally less than 2 mg/l. Groundwater pollution at feedlots is localised and site-specific. Pesticide and herbi- cide levels are low in surface water and very low in groundwater.

The researchers say a sufficient understanding of processes within the various activities in the Olifants Catchment has been obtained to enable conceptualisation, description, modelling and ranking of all issues that contribute to groundwater pollution. All relevant data have been entered into the HydroCom database.

Prediction of future salt loads has been done through chemical equilibrium, mixing cell and finite element mass transport modelling. These models are sufficient to describe chemical reactions and pollution plume modelling at any of the waste management facilities in the Olifants Catchment. As part of this modelling exercise, management options at opencast mines and fly ash dams have been evaluated. By superimposing this information onto the average annual run-off for the Witbank Catchment, extrapolation on a catchment basis has been accomplished.

Very few improvement management options are available at existing facilities due to cost considerations. Where considered necessary, options that need further investigation have been identified on a site-specific basis in the report..

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