

# THE USE OF RESERVE DETERMINATION IN ASSESSING GROUNDWATER QUANTITY

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## PRESENTATION OUTLINE

- INTRODUCTION
- OBJECTIVES
- METHODS
- CONCLUSION

## INTRODUCTION

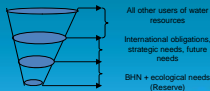
- South Africa is a water Scarc country and in order to manage this scarce resources, we need to know how much water is used, by whom and where. Once this is known , we will be able to measure it against how much water is actually available for use.
- The National Water Act (Act 36 of 1998) gives the Department of Water Affairs the tools to gather information for the optimal management of our water resources.
- The registration of water use is one of the tools.
- The registration of water use is required for all water users who do not receive their water from a service provider, local municipality, water board, irrigation board, government water scheme or other bulk supplier and who is using water for irrigation, mining purposes, Industrial use, feedlots, or in terms of General Authorisation\*.

## INTRODUCTION (CONT'D)

- This covers both surface and groundwater
- When a water use licence is been applied for and the water use deals directly or indirectly with groundwater, a geohydrological report is required with the license application for those water uses.
- To assess the licence, the geohydrological report needs to be assessed or commented on.
- The NWA, Chapter 3, makes provision for water required for basic human needs and the water required to maintain aquatic ecosystem functioning
- The two above are referred to as the Reserve

## WHAT IS A RESERVE

- Refers to both the **quantity** and the **quality** of water in a resource, and will vary depending on the class of a resource.
  - The Reserve is required to provide for BHN
  - Protect aquatic ecosystems so as to secure ecologically sustainable development and utilization.
- \* (If all the water in the country could be put into a bucket, the Reserve is the water that must be left in the bucket for BHN and sustaining the aquatic ecosystems)



## TYPES OF RESERVE REQUIREMENTS

There are two types of Reserve requirements :

- Surface water Reserve requirements (streams, wetlands, estuaries)
- Groundwater Reserve requirements (aquifers)

## LEVELS OF GROUNDWATER RESERVE DETERMINATION AND PROCESS

- **Low confidence (desktop) Reserve determination** (Process done in the office, using softwares such as GRDM; Spatism; Arc View and existing data from various databases i.e. NGA)
- **Rapid Reserve determination** (Process done in the office, using softwares such as GRDM; Spatism; Arc View and existing data coupled with consultation and verification with regional offices)
- **High confidence Reserve determination:**
  - a) Intermediate
  - b) Comprehensive(Process involves the use of above mentioned softwares and on a larger scale, field visits, and modeling)

## OBJECTIVE

- To develop a set of tools which can be used to comment or assess Water Use license application which might have direct or indirect impact to groundwater resources

## TOOLS DEVELOPED

- Assessment questionnaire for integrated water use licence (This is used mostly for IWULA's where we look at both groundwater quality and quantity quite complex due to the severe impact and possible irreversible conditions at some locations)
- \* The groundwater was not well managed in the past and this lead to a lot of problems.
- \*\*Some of these problems include but not limited to Acid mine drainage (AMD), overflowing artesian aquifer and flooding of the closed mines.



UNCONTROLLED LEAKAGE FROM ARTESIAN AQUIFER SYSTEM

## IMPACT OF GOLD MINE CLOSURE ON GROUNDWATER RESOURCES: RSA



## Result of not managing groundwater processes on land



### Acid mine drainage:

pH = 1.5-2.5

SO<sub>4</sub> = 8000mg/l

Fe = 450 mg/l

Flows into ALL SURFACE WATER COURSES



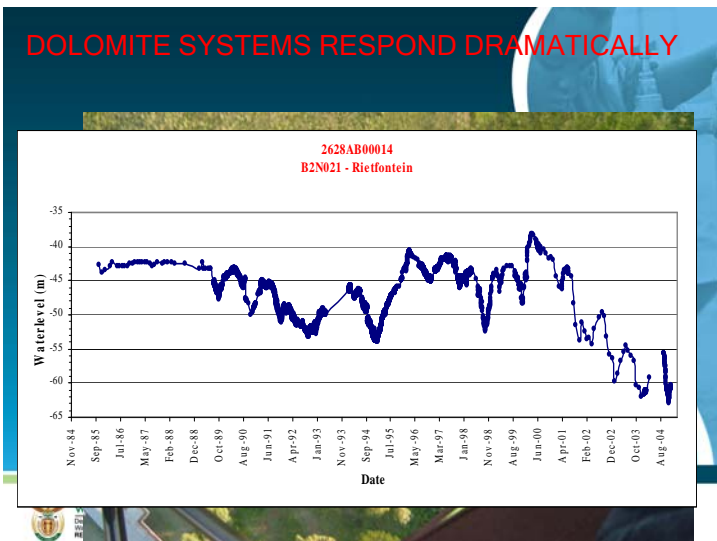
CURRENTLY, SOME 15 km's DOWNSTREAM



## TOOLS DEVELOPED

- Groundwater abstraction assessment Template (The volume to be extracted is usually given and Impact is only on resource volume, but the worst scenario is ground stability issues).
- This usually occurs when the groundwater supports the ground stability and it is dewatered, it leads to sinkholes because the water especially in dolomitic aquifer is in cavities.
- Some examples are shown with pictures

Initial ground stability problem developing due to dewatering of aquifer (irrigation)



## METHOD

1. Assessment questionnaire for integrated water use license Process:
  - A set of questions were developed to give any idea of the geohydrological conditions on site as well as the status of groundwater monitoring
  - A closure and rehabilitation plan was also added after considering the number of mines requiring these licenses.
  - Google Earth was also included to give a aerial view of the area being assessed.
  - Questionnaire

\*The assessment questionnaire could not help in assessment of groundwater abstraction especially for irrigation purposes. This lead to the development of a tool to deal with groundwater abstraction.

## METHOD CONT'D

- The questionnaire is divided into geohydrological background, monitoring, groundwater management and post closure plans
2. Groundwater abstraction assessment template.
- Process:
- The country was divided into quaternary catchment and each quaternary was studied in terms of its hydrogeological properties.
  - The groundwater abstraction is grouped into three categories in terms of information requirement for the license application.
  - Category A- For small scale abstraction(<60% annual, average recharge on property)
  - Category B- medium scale abstraction(60-100% recharge on property)
  - Category C- Large scale abstraction(>100% recharge on property)

## CALCULATIONS

- $AREA_{PROP} * RE = RE_{AREA} (m^3/a)$
- $ABS_{EX} + ABS_{NEW} = ABS_{TOTAL} (m^3/a)$
- $ABS_{SCALE} = (ABS_{TOTAL} / RE_{AREA}) * 100$
- Size of property ( $AREA_{PROP}$ )
- Recharge-HP(RE)
- Existing use volume ( $ABS_{EX}$ )
- New use volume ( $ABS_{NEW}$ )
- Scale of abstraction ( $ABS_{SCALE}$ )

## METHOD CONTINUED

- This tool deals strictly on the groundwater recharge potential of the property on which the water use is to be developed and used. This tool also incorporates figures from the ground water Reserve determination.
- [Template](#)

## IMPLEMENTATION OF A COMPLETE RESERVE INTO A LICENSE APPLICATION

- For license application (quantity), use the results on the quantity component  
Allocable portion = Recharge – (Reserve + EU + strategic needs + future needs + international obligations)  
Reserve = Basic Human Needs + Ecological Water Requirements
- For license application (quality), use the results on the quality component [table](#)  
The concentrations of the elements have to be maintained by the water users as reflected by the table ( last column).  
Recommendations and advises on the letter and the memo provided by Resource Directed Measures: GW Reserve Requirements need to be considered and incorporated to the license document by the regional office.

## EXPRESSION FOR GW QUANTITY RESERVE

- Reserve  $q = (MLF_{EWR} + BHN) / \text{Recharge } \%$
- MLF = maintenance low flow
- EWR = ecological water requirements (High Flow, M Low Flow, Drought)

## CONCLUSION

- The assessment questionnaire has helped a great deal in assessing the licenses
- It is very helpful especially for new employees in the section that need to assess license because it requires minimal supervision.
- It is reviewed every year and more questions added to make the assessment easier.
- The template has also helped in assessing groundwater abstraction because it is site specific.
- It also gives an estimate of the groundwater allocated in each quaternary and the reserve quantity available as water use are allocated.
  - Allocation cut-off for a more in-depth investigation of the geohydrological status from 65% allocation

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