1. INTRODUCTION

Groundwater is rapidly growing in importance in South Africa, but not enough information concerning this resource is reaching planners, decision-makers and users. Although groundwater is a reliable resource when properly managed, ignorance regarding its occurrence and characteristics commonly results in a continuing bias toward surface water resources.

To address the problem of the lack of groundwater knowledge, a countrywide groundwater characterisation programme was initiated in the early 1990’s. Groundwater data were entered into the National Groundwater Data Bank (NGDB), and where areas of scarce information were identified, investigations were, where possible, conducted to fill the gaps. The compilation of a countrywide 1 : 500 000 scale Hydrogeological map series was subsequently embarked on as a means of presenting the characterisation material. Other countries have produced such maps for several decades. In South Africa this was a pioneering project for which GIS (Arc/INFO 7.1.1) was used as the map-compilation tool.
Although every effort was made to adhere to international conventions, it was soon realised that this project was unique in terms of scientific, technological and cartographic challenges. Apart from the numerous challenges the project also presented creative opportunities.

2. CHALLENGES

2.1 Scientific challenge

- A comprehensive Working Document was first of all compiled to put standards and specifications in place.
- Individual map sheets consists of the following components:
  (typical 1:500 000 Hydrogeological map)

- A main map on a scale of 1 : 500 000
  - The main map depicts the aquifer types (of which there are four, namely Intergranular Aquifers, Fractured Aquifers, Karstic Aquifers and Intergranular and Fractured Aquifers) and their expected immediate borehole yields (of which there are five yield categories). Provision was also made for multi-layered aquifers.
  - The general methodology of compiling the yield map was as follows: The lithology background and the analyses of the borehole data can be regarded as the basis for determining the different groundwater units and for resolving yield categories. An overlay of the yield data in terms of different coloured yield category data points onto the lithology map were provided by GIS. The distribution of these data points also allowed for the identification of areas of sparse information. The median method of data analyses was applied, where the number of data points within a groundwater unit were calculated to determine a median value. The same method was used to compile the groundwater quality maps.
  - a groundwater quality map on a 1 : 1 500 000 scale
  - schematic cross sections to illustrate typical groundwater occurrence pertaining to the map area
  - a chronostratigraphic column to depict all the geological groupings and units within the map area and to provide a time perspective
  - three inset maps, each on a 1 : 2 000 000 scale, depicting borehole data distribution, elevation above sea-level and annual precipitation
  - The rest of the legend depicts, amongst others, the aquifer types, yield categories, lithology, groundwater abstraction, springs, thermal springs, roads, rivers, dams, etc. The map series utilises an adapted international UNESCO legend, with a few alterations considered appropriate to South African conditions.
2.2 Cartographic challenges

The series presented the following cartographic challenges:

- Due to the dearth of cartographers in South Africa specialized cartographic training was given to Learner Cartographers, GIS Specialists and Technicians.
- Map layout: A concept layout with specified perimeters was established. But the challenge was to present each map sheet at its best advantage.
- All though Namibia is not longer part of RSA some maps still display large areas of Namibia. Large areas of international states are displayed on the 1:500 000 Topographical Maps Series and was not use full or applicable to this series. Adjustments were necessary for this map series. Circumstances also changed in RSA while the series was in production and name changing was for example part of the process.
- South Africa is a water scarce country and abstraction point symbols were for example designed to alert map-readers to the dangers of uncontrolled groundwater abstraction and pollution.
- With the compilation of map symbols the scope needed to allow for unexpected requests. Example: Additional roads to be allowed for orientation purposes.

2.3 Technological challenges

The technological challenges faced were mainly software related and included the following:

- Readability: Text masking had to be used for text as the lithology shown on the maps was indicated with complicated hatching, and text was extremely difficult to read.

- Buffering: Thick lines, for example the international line, tend to give a zig-zag effect, and not a smooth line symbol. Buffering gave a solution to the problem.

- Plotters: Different plotters interpret colours and symbols differently and as different plotters were used to distribute the proposed map to the members of the MMT and Editorial Board, interpretation of the map contents sometimes created difficulties and confusion.
- Paper size / Image setter: There is no A0 image setter in South Africa, setting had to be done in Australia.
3. CREATIVE OPPORTUNITIES

3.1 Progress report

Making use of the technology available, the compilation of a progress report and the distribution of it was an exiting bonus and a creative opportunity. This progress report was called the “Mapping Status” and contained information on the following:

- The progress on each map.
- The Map author of each map
- The GIS Specialist responsible for each map
- The Cartographer of each map
- A Timetable indicating:
  - the time allowed for each process,
  - the progress,
  - Due dates, and
  - Dates on which individual maps were printed.

3.2 Map symbols were designed, keeping South African conditions in mind.
3.3 Over view on the geohydrology in RSA.

With the map series still in progress, generated digital data can, prior to completion of the series, be applied:

- to produce, by means of data manipulation, various map models for display on international occasions such as the conference of the International Association for Hydrogeologists, held in Cape Town in 2000, and the recently held Third World Water Forum in Japan,

- to compile a proposed 1:1 000 000 scale montage of the 1:500 000 scale Hydrogeological Map Series, which could prove to be a convenient tool for the groundwater fraternity to examine the diverse hydrogeological conditions country-wide, and

- to provide a compound map as a token of recognition to all the individuals who were involved in the mapping venture.

4. The Mapping Team

The mapping team consisted of 33 people (Geohydrologists, GIS specialists, Cartographers and Technicians) stationed at departmental offices around the country. The mapping team for each individual map sheet was made up of a Map Author (Geohydrologist), GIS Specialist and Cartographer and the project as a whole was managed by a Mapping Management Team and guided by an Editorial Board.

5. Conclusion

This project was initiated in the mid-1990s and completed in 2002. It is envisaged that the data generated and expertise developed by this project will lead to further large and small scale hydrogeological mapping projects in South Africa.