DEPARTMENT: WATER AFFAIRS

EASTERN CAPE GROUNDWATER PLAN

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TABLES

FIGURES

1. INTRODUCTION

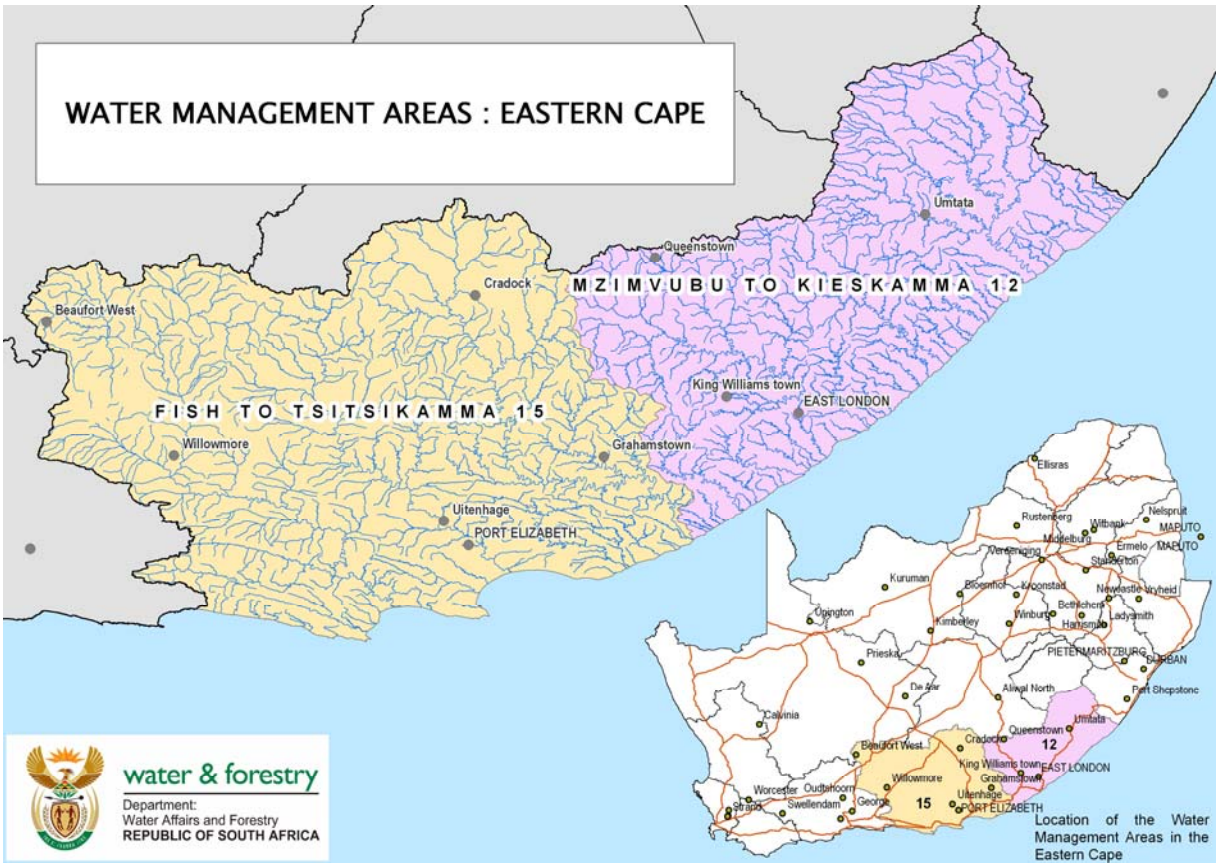

Figure 1: Location of the Eastern Cape Water Management Areas

This document will serve as a master plan to be used by Eastern Cape's Regional Management to structure the tasks of the groundwater staff component related to the water functions as set out by the National Water Act of 1998.

A comprehensive discussion of the water functions, as defined in the NWA (1998), in relation to groundwater is found in Appendix B. The different geohydrological regions (Vegter regions) will be discussed and where possible, any groundwater activities identified and actions needed to execute these functions proposed.

None of the functions and/or management actions however, can be executed effectively without the necessary data and information. See Appendix C for a comprehensive discussion on sound data/information management principles. One chapter in this document will deal exclusively with data and information management.

Without the necessary staff and the appropriate structures none of the above will be possible - thus a staff structure within to execute these groundwater functions in the region will also be proposed.

Typical information products and reports in relation to the strategic and operational decisions that the department has to make regarding groundwater will also be addressed.

1.1 Purpose

The purpose of this document is to assist the management cadre in the Eastern Cape Region, to effectively execute the required groundwater functions.

At the same time this document can serve as a communication tool between the adjacent Regions and/or Clusters, with overlapping aquifers and the relevant Head Office components..

This document can also serve as an input to the Cluster Manager and Regional Director's work plan/performance agreements.

1.2 Scope

Groundwater Master Plan addressing all water functions as defined by National Water Act (1998) for the Eastern Cape Region.

Other related activities and projects that have relevance also need to be recognised and as the document progresses, these will be added. The relevance and potential impacts these projects might have on the improvement of the execution of the functions must be addressed as well.

1.3 Audience

Before the audience of the document is stated, the term 'Eastern Cape Region' needs to be defined. The term 'Eastern Cape Region' will in the context of this report, means the areas of jurisdiction for water resources management that is the Water Management Areas of Fish to Tsitsikamma (No. 15) and Mzimvubu to Keiskamma (No. 12).

Management cadre of the Eastern Cape Region
Directorate: IE
Directorate: R&S

It is recognised that the areas of jurisdiction relating to water services, differ from the above. In the overall scheme of things it is envisaged that will cause duplication and gaps to appear and needs to be addressed.

1.4 Revision

Version 1 (this document) is only a draft, to kick start the required groundwater functions and it is strongly recommended that it be revised and adapted every six months in close conjunction with the Eastern Cape Region's management structure.

As more detail becomes available and good quality data and information is gathered both the structure and contend this document must be adapted.

1.5 Applicable Documents

1. ISP documents for the
   1) Fish to Tsitsikamma (Tsitsikamma to Coega and Fish to Sundays).
   2) Mzimvubu to Keiskamma (Amatole to Kei and Mzimvubu to Mbashe) Water Management Areas.
2. National Water Resources Strategy
3. Groundwater Resources Strategy

1.6 Acronyms and Abbreviations

Acronym/Abbreviation	Definition
D:WQM	Directorate: Water Quality Management
DWA	Dept Water Affairs (from 2009)
DWAF	Dept Water Affairs and Forestry (pre 2009)
GA	General Authorisation
GRIP	Groundwater Resource Information Project
IE	Institutional Establishment
ISD	Institutional Support and Development
ISP	Internal Strategic Perspective
NGA	National Groundwater Archive (used to capture all groundwater-related data) which will be replacing the Open-NGDB soon.
NMBM	Nelson Mandela Bay Municipality
NWA	National Water Act (1998)
Open-NGDB	National Groundwater Database running on an open server
P&I	Planning and Information
R&S	Regulation and Support
RBN	Regional Borehole Number
Schedule 1	Water used for domestic purposes.
SGD	Standard Geosite Descriptors
WARMS	Water Authorisation and Management System
WMA	Water Management Area
WMS	Water Management System (chemistry database)
WSA	Water Services Authority – usually the District Municipality
WU	Water Use

2. WATER FUNCTIONS AS PER NATIONAL WATER ACT (NWA) IN EASTERN CAPE

2.1 Introduction

The water functions as identified in the NWA (1998) are the following: - i) development, ii) utilisation, iii) protection, iv) conservation, v) management and vi) control. In order to create a common understanding of these terms, a comprehensive discussion about them and the tasks related to these water functions, is attached in Appendix A.

2.2 Current situation

2.2.1 Monitoring

When talking of groundwater monitoring the reader of this document should understand that it entails the monitoring of groundwater abstractions, water level fluctuations and chemical quality. (A good document on monitoring by Nomquphu, Braune and Mitchell is cited in the bibliography of this document.)

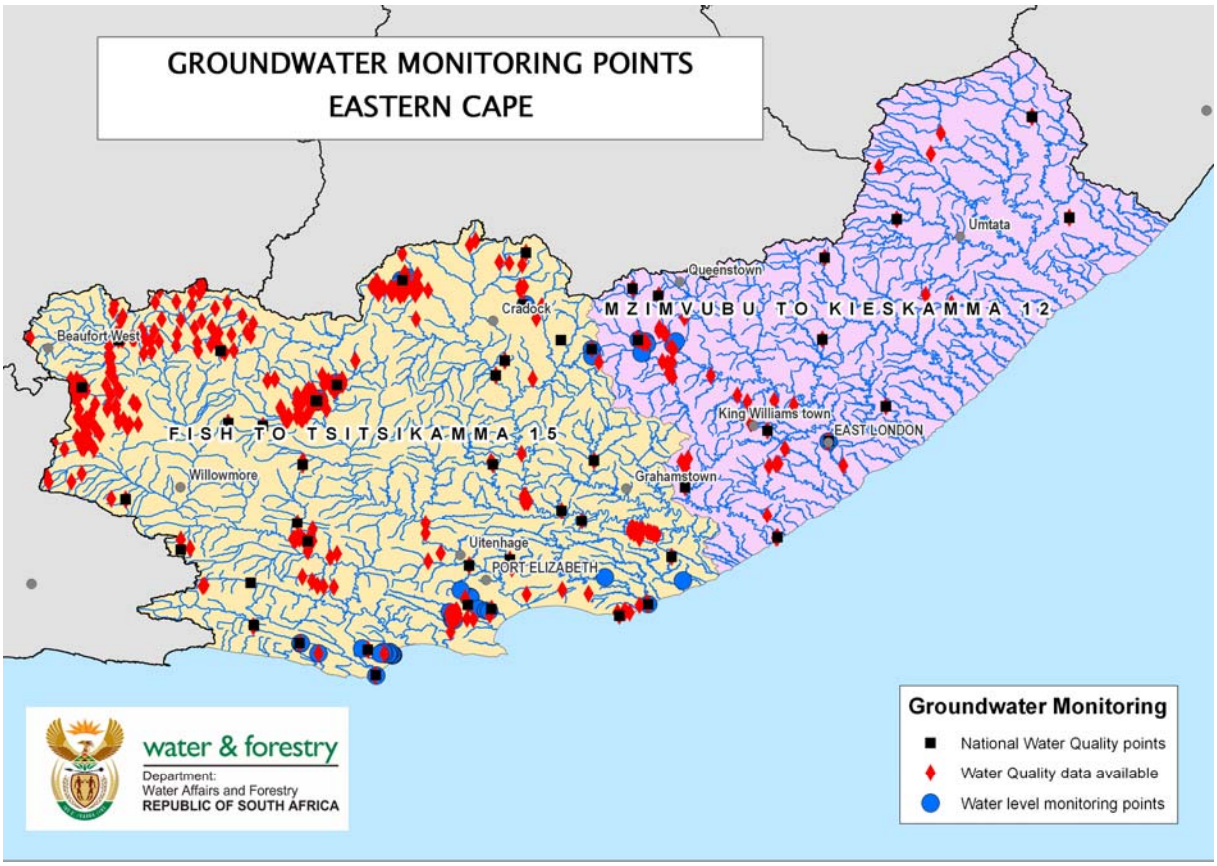

Figure 2: Location of monitoring geosites.

Currently 57 points are being monitored actively for water level fluctuations. The spatial distribution of these points is very uneven and most being in WMA 15, 50 compared to 7 in WMA 12. (See figure 1). The placement of these points are generally linked to previous hydrogeological investigations. The concentration of the points around Uitenhage/ Port Elizabeth stems from the creation of the groundwater control area in the artesian basin around Uitenhage.

There are 59 national water quality monitoring points which are sampled every 6 months. There are 15 points in WMA 12; 44 in WMA 15. In terms of the envisaged

plan (Simonic, circa 2000, pers. comm. to E Bertram) there should be between three and five monitoring points per hydrogeological region. In WMA 12 there 4 ; 6 in WMA 15.

There is little abstraction monitoring taking place. Returns on use are made to DWA from Humansdorp and Jeffreys Bay which are captured to database. Returns are available on request from the NMBM regarding the yield at the Uitenhage springs. Use reporting pertaining to license conditions is returned in only one known case and not from any of the towns / municipalities that have their groundwater use licensed.

Currently there is a study underway to develop monitoring networks for water level, water quality and water use compliance. Some of the sites recommended from this study have been drilled for water level monitoring but are not yet equipped. Other sites will be drilled as funds become available.

2.2.2 Data management

The data from the monitoring points are collected to a regular schedule and populated into the Hydstra database and to the Water Management System.
Since 2002 all boreholes located in the field through hydrocensus or a newly drilled borehole are issued a Regional Borehole Number by the regional office. Any other borehole numbers are linked to this RBN. A local database links these numbers with the consultant / DWAF official. When the report referenced to the RBN is available the data is coded and entered onto the National Groundwater Database.
Currently there is Groundwater Resource Information Project (GRIP) under way. The first phase of this project collected groundwater reports from a variety of stakeholders. The borehole data they contained was coded and entered into the National Groundwater Archive (NGA). The stakeholders contacted in this process are continuing to supply relative reports as they become available.
The second phase is underway with a hydrocensus of identified areas of concern. The data collected will be entered into the NGA.

A concern is that there is no feedback from groundwater users on their actual water use. This applies to large scale irrigators, WSAs, municipalities etc. Groundwater use licenses are issued with reporting conditions attached. There is no dataflow established to capture data that is returned to DWAF.

For a comprehensive discussion on the data capturing functions refer to Appendix C Additional guidelines and information on data management can be gained from the ‘Groundwater Data Acquisition and Capturing Strategy’.

2.3 Conclusion

The groundwater level monitoring is slowly being established. Groundwater use is an area where there needs to be attention paid to getting return of data from users. This is essential for water balance studies and reserve determinations.

There is a generally good flow of data to centralised databases, namely the NGA, Hydstra and WMS.

- Consultants obtain RBNs from Information. This number is used to follow up with the consultant to obtain the report and the borehole data.
    - Geosite data is coded and entered into the NGA.
    - Reports are archived in the hard copy filing system and scanned onto the network.
    - Copies of the reports are made available to HO for their archives.

- Groundwater level monitoring data collection is carried out by R&S with some assistance from WU (Geohydrology) due to staff constraints. The data is stored in Hydstra.

- Groundwater use data which is returned to us is also stored in Hydstra.
- Groundwater quality monitoring for the national monitoring network is collected by a team under R&S. This data is stored on the WMS. Additional groundwater quality data collected by WU (WQ) is stored in the WMS.

3. GEOHYDROLOGICAL REGIONS

A description of the geohydrological regions will hopefully give a clear picture of the economic activities of the areas and the use and potential risks to the groundwater sources. Aquifer properties, potential and an estimate of groundwater use.

3.1 Introduction

Vegter (1990) divided the RSA into 64 homogeneous hydrogeological regions based on lithology and climatology. At least five of these regions falls either wholly or largely within the Eastern Cape Region and another four falls partially in this Region. Colloquially these hydrogeological regions are referred to as the Vegter-regions.

The Vegter-regions that fall largely within the Eastern Cape WMAs are 1) Southeastern Highland 2) Transkeian Coastal Foreland and Middlevlei 3) Willomore-Grahamstown Belt 4) Algoa Basin 5) Lower Gamtoos Valley 6) Ciskeian Coastal Foreland and Middleveld 7) Eastern Great Karoo 8) Southern cape Mountains Ranges. Only a partial section of the Kwazulu-Natal Coastal Foreland region falls into the East Cape region and will be dealt with under the Kwa-Zulu Natal regional plan.

For a comprehensive discussion on each of the Vegter-regions, refer to Vegter (1990). Cognisance must be taken of the subsequent name and rank changes; i.e. sub-region is now a full region, which is treated in detail in Vegter (June 2001).

The Vegter-regions will be discussed individually in terms of known groundwater activities and potential functions to be executed in relation to the activities. As the levels of detail regarding these activities are either scarce there is little actual data in the document.

3.2 Hydrogeological Map Series

Three 1:500 000 scale hydrogeological maps cover the majority of the two WMAs in Eastern Cape Province, Port Elizabeth, Queenstown and Beaufort West.

These maps depict the groundwater occurrences in terms of three aquifer types, i.e. 1) fractured, 2) intergranular, and 3) intergranular & fractured. Five borehole yield classes were used, i.e. 0-0.1*l/s,* 0.1-0.5*l/s*, 0.5-2.0*l/s*, 2.0-5.0*l/s* and >5.0*l/s*.

When classifying the different regions in terms of ‘development potential’ the terms extremely low, very low, low, medium and high will be used respectively for the aforementioned yield classes.

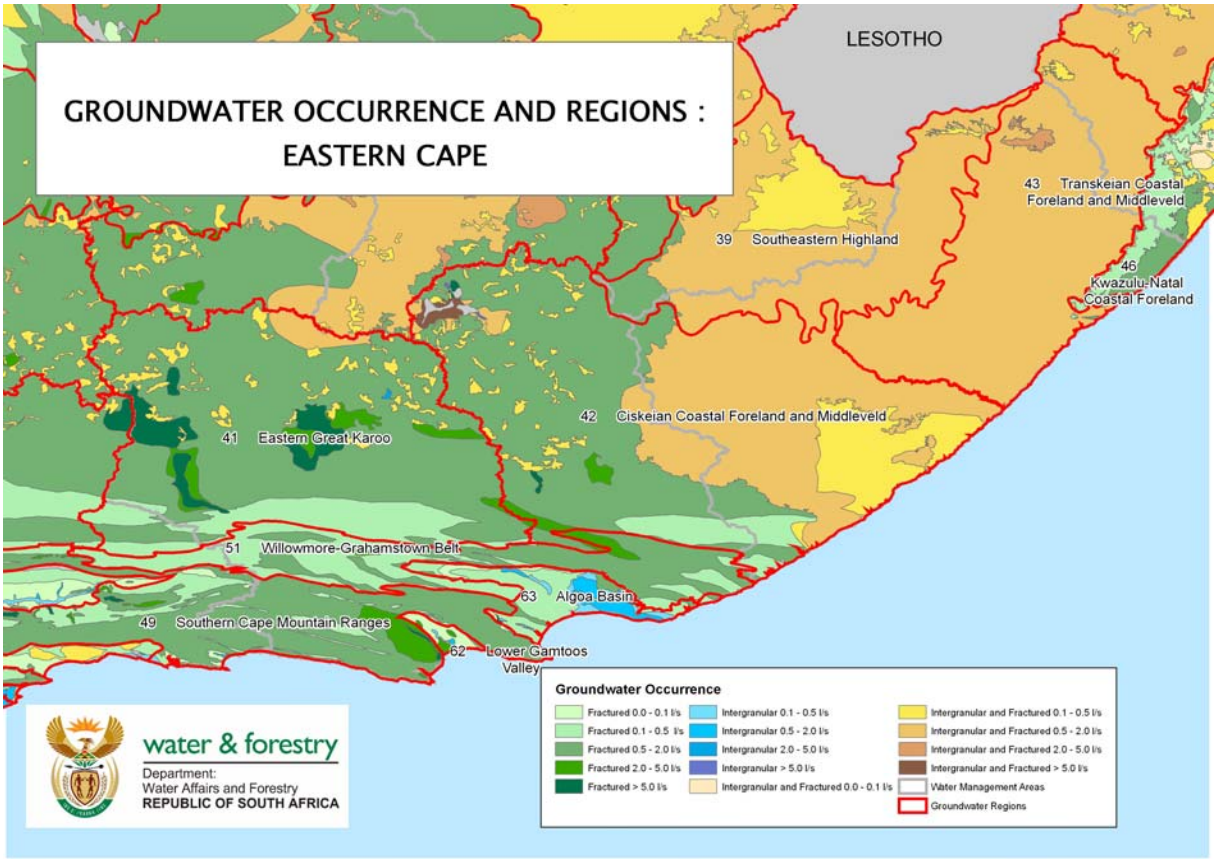

Figure 3: Groundwater Occurrence and Regions

Extremely low: - virtually no groundwater can be found in these aquifers and should still there be any water, a wind pump or hand pump could be installed. At best this could be enough for individual household supplies.

Very low development potential - one can generally expect enough water for either hand- and/or wind pumps, i.e. small supplies for small communities and/or stock watering or single households. Little additional groundwater could be available for community gardening or other poverty alleviation actions. Many boreholes will have to be drilled to obtain a yield at the high-end of the range.

Low development potential - enough water for either hand- and/or wind pumps, i.e. small supplies for small communities and/or stock watering or single households can easily be achieved. Additional groundwater for community gardening or other poverty alleviation actions will be available. At the high-end of the yield range larger communities from single boreholes and wellfields supplying large communities would be possible. However, due to large variability in borehole yields, an appreciable amount of boreholes will have to be drilled to obtain a yield at the high-end of the range. Pumping at 2*l/s* for 8hours per day, 2000 persons, @25*l/day* can be supplied comfortably.

Medium development potential – domestic water supplies for large villages, towns and small-scale irrigation from several boreholes, would be achievable in aquifers with medium development potential. The amount of boreholes to be drilled before high-end yields that can be expected depends on the variability of borehole yields. Wellfields and the concomitant benefit for the management of aquifer(s) make the development of groundwater within medium high potential aquifers very attractive. Pumping at 5*l/s* for 8hours per day 5000 persons, @25*l/day*, can be supplied comfortably.

High development potential – Large-scale irrigation and/or large village and even large town supplies can be obtained from these aquifers.

3.3 Southern Cape Mountain Ranges (Western Area)

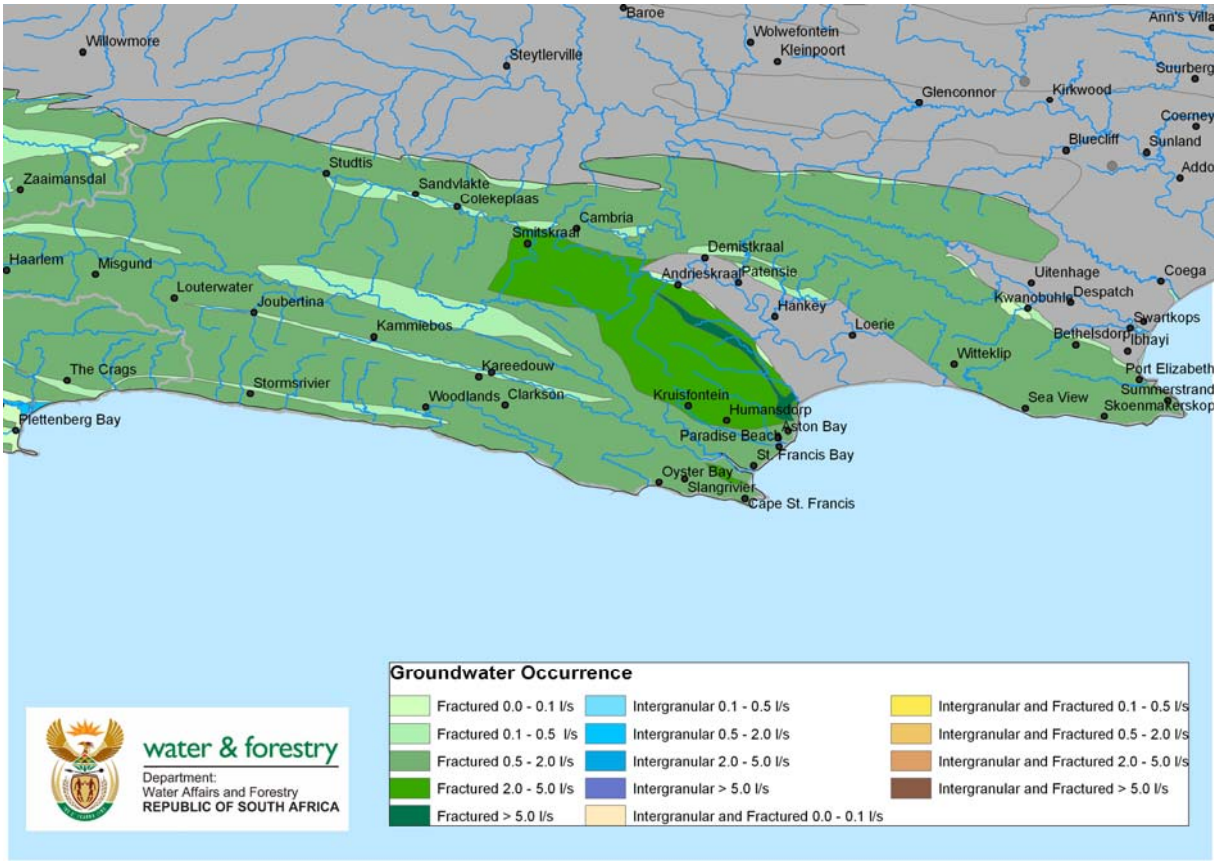

Figure 4 : The distribution of the Southern Cape Mountain Ranges Hydrogeological Region.

3.3.1 Economic activities

This is a predominately agricultural area. The Langkloof and the Krome areas are intensively cultivated mostly with deciduous fruit orchards. In the area toward the coast there is mixed farming and pastures for dairy farming.

The coastal towns of Oyster Bay, St Francis, Jeffreys Bay and further inland Humansdorp, Louterwater, Misgund etc., are largely or wholly dependent on groundwater. However, the level of groundwater use is currently largely questionable.

3.3.2 Aquifer properties and protection measures

The geology consists of quartzites and conglomerates of the Table Mountain Group forming the mountain ranges, shales and sandstones of the Bokkeveld and Witteberg and unconsolidated coastal deposits.
The development potential from the fractured aquifers is medium to high as shown on Figure 3.

Development:
The potential for development of the groundwater resources is good. However the current level of groundwater use needs to be determined. This should become clearer when the GRIP process is completed and WARMS data has been verified.

Utilisation:
Apart from the town use groundwater is used in conjunction and as back up to the surface water from rivers and farm dams. Again the actual quantity is unknown.

Protection:

This type of aquifer is vulnerable to pollution and needs a high level of protection measures. Sources of pollution would be from waste sites and from the agricultural use of fertilisers. Currently there is no sign of contamination from either of these sources.

Management:
The management of the wellfields for the supply of towns show that in many instances the recommended management practices are not adhered to. This is solely a management issue that could be assisted by insisting on the return of monitoring data and regularly reviewing it as part of the licensing or registration procedure for WARMS.

Data/information management:
The fact that there are so many unknowns as set out above reflect on a lack return of monitoring data.

3.3.3 Summary of known problems and risks

- The Table Mountain Group Aquifer is a major water source and vulnerable to pollution.
- The level of groundwater use needs to be determined before any groundwater management actions can be initiated;
- The groundwater quality in this region is very good.

Actions: -

- Survey of the level of dependence on groundwater for irrigation through WARMS verification.
- Check all towns dependant on groundwater are registered / licensed.
- Review the management plans and license conditions of the groundwater dependant towns.

3.4 Lower Gamtoos Valley Hydrogeological Region

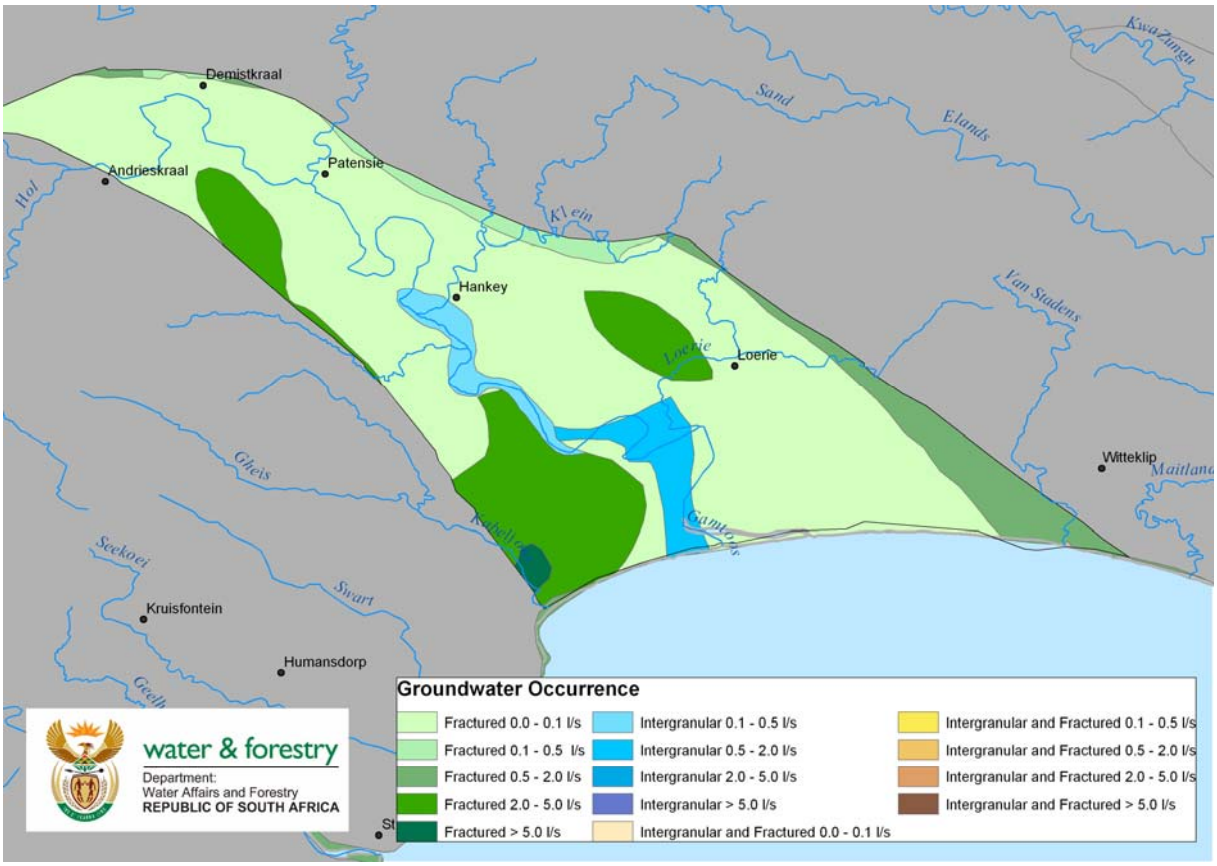

Figure 5 : The distribution of the Lower gamtoos Valley Hydrogeological Region

3.4.1 Economic activities

Citrus fruit grown in the area is the main form of export and other crops include potatoes, vegetables, tobacco and even avocados.

3.4.2 Aquifer properties and protection measures

This region coincides with the Gamtoos Basin as defined in the WRC report, High Yielding Groundwater Areas around NMBM (TT327/08).
Enon conglomerates are overlain by Kirkwood formation and both overlain by river gravel terraces.

Development:
According to Murray et al, the development potential would be the best in the buried river gravels with an estimated yield of 2.5Mm3/a
According to the ISP for this area there is a groundwater yield of 1.6 Mm3/a. This does not match any registered water use for that secondary catchment. The Gamtoos Irrigation board report that very little groundwater is in use for irrigation of approximately 30ha.

Utilisation:
The groundwater is underutilised.

Protection:
Considering the thriving state of agriculture the river gravel aquifer would be susceptible to infiltration by commercial fertilisers.

Management:

Currently, according to the irrigation board, groundwater use is very small. No groundwater/aquifer management actions need to be defined at the moment.

Data/information management:
Borehole data is available on the NGA and there are a few boreholes for irrigation back-up.

3.4.3 Summary of known problems and risks

- A small project to look at the water quality from any boreholes in the gravel could reveal any contamination from fertilisers.

Actions: -

- Update all available groundwater-related data from the irrigation board.

3.5 Algoa Basin Hydrogeological Region

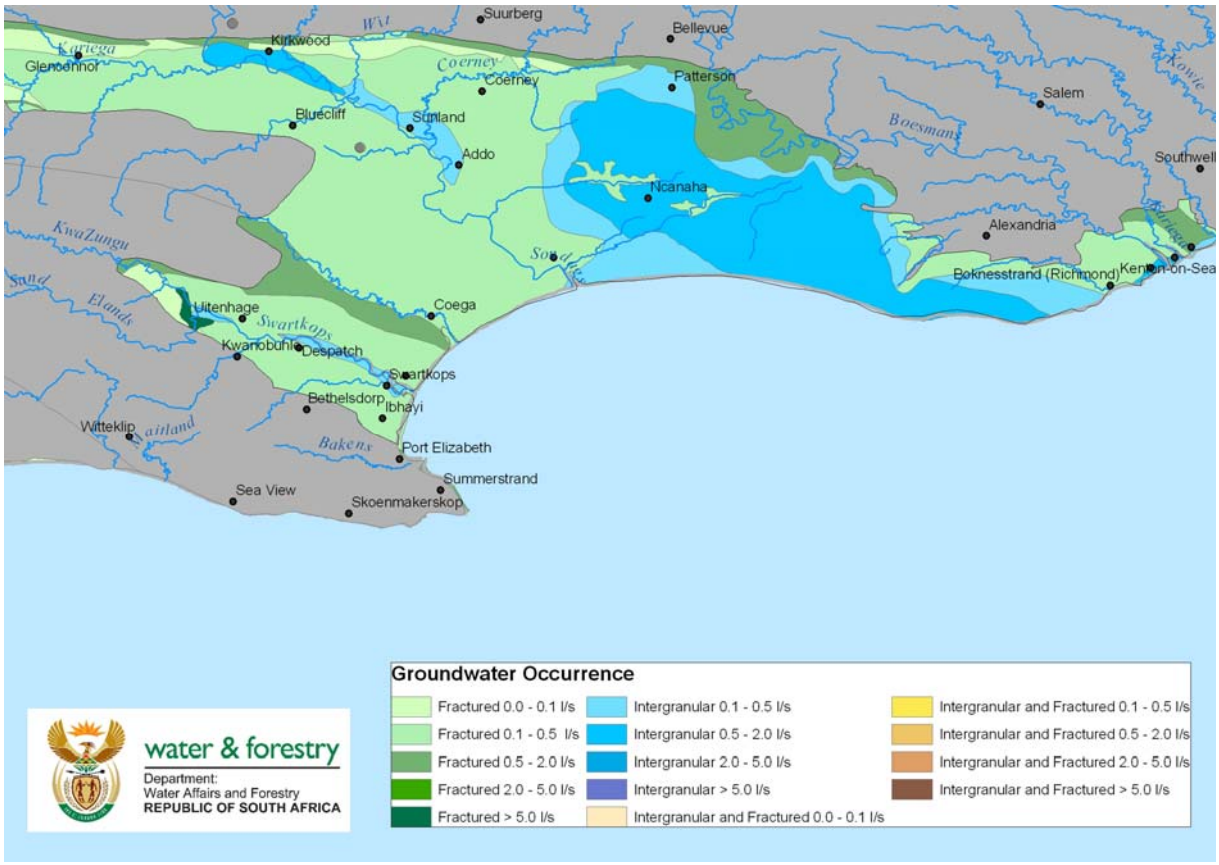

Figure 6: The distribution of the Algoa Basin Hydrogeological Region

3.5.1 Economic activities

This area is home to the Nelson Mandela Bay Metropolitan Municipality the 5th largest in the country. Tourism is well developed along the coastal strip and game farms inland. The Greater Addo national park extends from Addo down to the Woody Cape coast.
The Coega deep water harbour and IDZ are being developed.

Agriculture around the Uitenhage and Sunday's river area produce mainly citrus. The coastal area is predominantly dairy farming. Further inland dry land farming focuses

on cattle and game. In the upper reaches of the Swartkops River catchment there is some forestry activity.
Sand and stone mining occur in the river valleys and stone quarries within the Table Mountain Group sandstones.

3.5.2 Aquifer properties and protection measures

The Uitenhage aquifer is one o f the well know artesian aquifers in the country. The springs at Uitenhage provide 10% of the bulk water for the Uitenhage area. This aquifer is excluded from GAs and a license is required for anything other than a Schedule 1 use.

The hydrogeological map shows this area as having intergranular and fractured aquifer with a medium to high development potential. There is some irrigation from groundwater.
In terms of the pollution risk the Uitenhage aquifer is a protected area due to the vulnerability of the fractured aquifer and the fact of its strategic use in the NMBM. The unconsolidated aquifers have no major groundwater development on them but could be at risk from industries on the Swartkops River and from fertilisers in the Sunday's River area.

Development
There is potential for groundwater development in the unconsolidated sediments along the coast.

Utilisation
Groundwater use in the Uitenhage area is mainly captured on WARMS and a recent data comparison highlighted areas where groundwater use should be investigated.
Groundwater is used as a supply of water in the small coastal towns such as Bokness.

Protection
The Uitenhage aquifer is protected to a certain extent under the General Authorisations. However the level of groundwater use needs to be accurately determined. The yield of the Uitenhage has been determined and is quoted in Maclear as being 80l/s.

Management
There are leaking artesian boreholes in the NMB municipal area. In the 1980's some of the leaking boreholes were sealed and there was an increase in the yield of the springs at Uitenhage. If these remaining boreholes were sealed there should be a further improvement in the yield of the springs.

Data/information management
There are monitoring boreholes throughout the Uitenhage aquifer keeping a track of the groundwater levels. At least one of these boreholes has collapsed and is now measuring the alluvial water level rather than the main aquifer.
The groundwater chemistry in the alluvium of the Swartkops River was monitored for a short time in a project to assist in drawing up a water quality plan for the area.

3.5.3 Summary of known problems and risks

- Leaking artesian boreholes should be sealed to increase the yield of the Uitenhage springs
- Data verification on groundwater use should be done for the Uitenhage aquifer.
- Check that the monitored groundwater level information is being utilised and studied against groundwater use and rainfall.

3.6 Willomore-Grahamstown Belt Hydrogeological Region

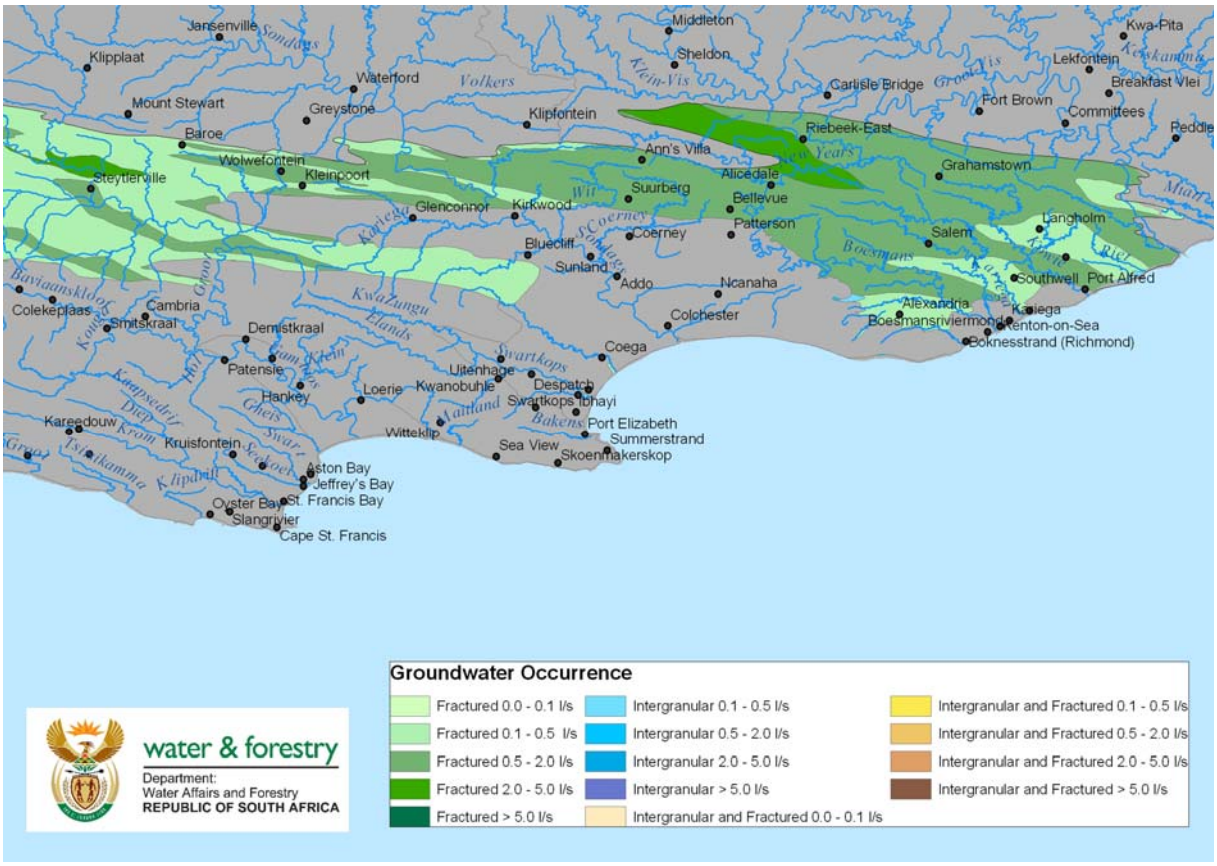

Figure 7: The distribution of the Willomore-Grahamstown Hydrogeological Region

3.6.1 Economic Activities

Farming forms the brunt of the economic activities of this region.

3.6.2 Aquifer properties and protection measures

The aquifer types are mapped as fractured with a low to fairly high development potential. The higher yielding areas are structurally controlled.

Development
The development potential of this region is fairly low but good success has been met with proper borehole siting and development, for instance in the Steylerville area.

Utilisation
Many of the small towns are dependant on groundwater. In all probability all the rural settlements is totally or largely dependent on groundwater.

Protection
Proper monitoring of the wellfields which supply towns should be instituted and followed up as part of the licensing conditions.

Management
Proper monitoring of the wellfields which supply towns should be instituted and followed up as part of the licensing conditions.

Data/information management
DWA need to establish links with the towns using groundwater and establish a monitor return path as well as legalising their water use.

3.6.3 Summary of known problems and risks

- Poor management of well-fields leading to dry boreholes is the most significant risk for the small towns.

Actions: -

- Train the town engineer or other responsible officer in the use of the simple monitoring software available from national office.

3.7 Eastern Great Karoo Hydrogeological Region

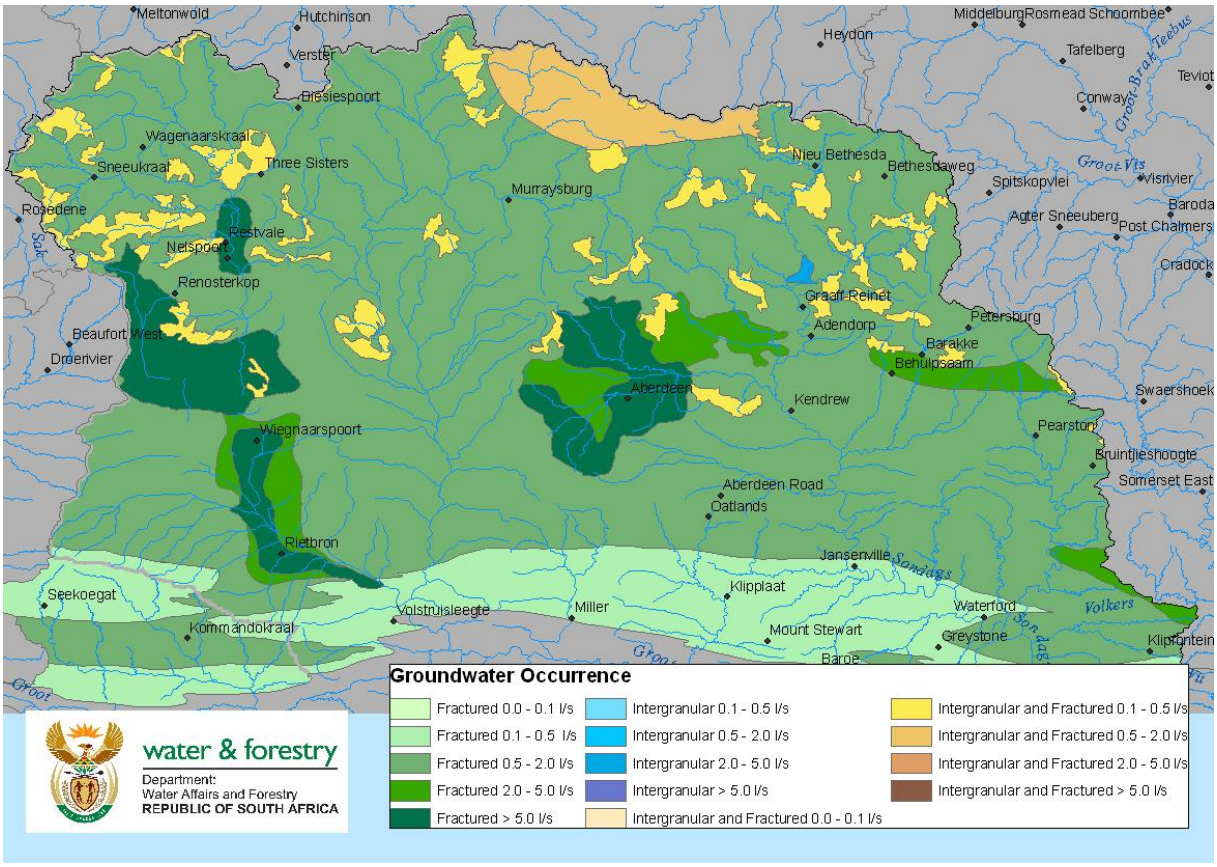

Figure 8: The distribution of the Eastern Great Karoo hydrogeological Region.

3.7.1 Economic Activities

Dry land farming, game ranching and mohair and wool production are the main economic activities in the area. There is some tourism activity around Graaff-Reinet and Nieu-Bathesda.

3.7.2 Aquifer properties and protection measures

The aquifer types are mapped as fractured with mostly a fairly high development potential. There is a small area of high yielding intergranular aquifer near Graaff-Reinet.

Development

The development potential of this region is being utilised. The 1:500 000 groundwater Occurrence Map 3122 (Beaufort West) indicates 15 – 30 million m^3 /a is used for irrigation around the high yielding groundwater area at Aberdeen. There are lesser amounts of irrigation from the other high yielding zones around Rietbron and to the east of Beaufort West.

Utilisation
Many of the towns in this region rely on groundwater as a sole-source. For others, such as Graaff-Reinet, groundwater is used in times of drought as a sole source or in conjunction with surface water.

Protection
Proper monitoring of the wellfields which supply towns should be instituted and followed up as part of the licensing conditions.

Management
Proper monitoring of the wellfields which supply towns should be instituted and followed up as part of the licensing conditions.

Data/information management
Once wellfield management reports are set-up the data should be returned to DWA and stored on the Hydstra and WMS databases.

3.7.3 Summary of known problems and risks

- Poor management of well-fields leading to dry boreholes is the most significant risk for the small towns.

Actions: -

- Train the town engineer in the use of the simple monitoring software available from national office.

3.8 Ciskeian Coastal Foreland and Middleveld Hydrogeological Region

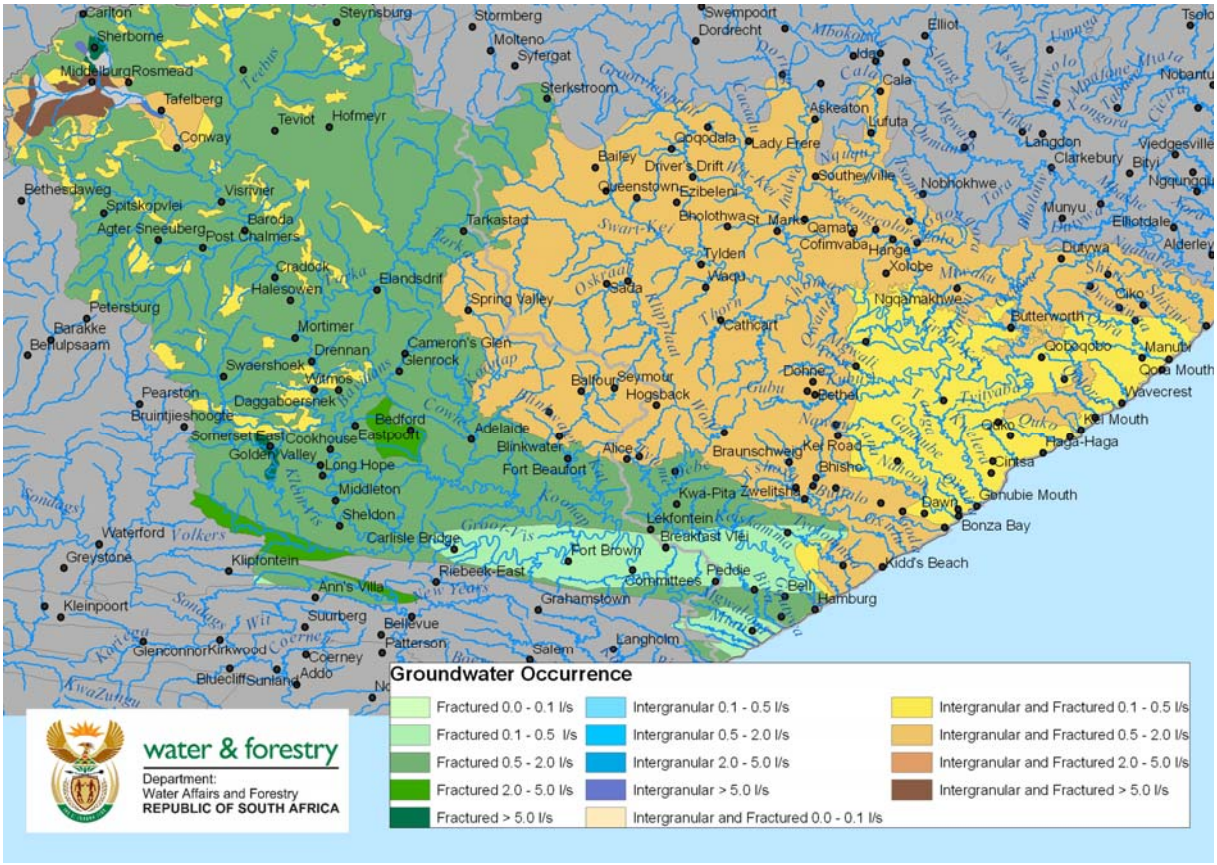

Figure 9: The distribution of the Ciskeian Coastal Foreland and Middleveld Hydrogeological Region

3.8.1 Economic Activities

There is some agricultural activity; private stock farming and communal subsistence farming and grazing. The area at the coast is developed for tourism.
Forestry forms a part of the economic activity in the west of this region.
Rural settlements are largely dependent on groundwater from boreholes or springs in this region.

3.8.2 Aquifer properties and protection measures

The hydrogeological map indicates poor development prospects. In the west of the area intergranular and fractured aquifers with yields expected in the 0.5l/s to 2l/s. In the east the intergranular aquifers show the same yield range but with isolated patches of higher yields.

Development:
There is a little potential for development around the Bedford and Klipfontein areas. The lower yielding aquifers can, and are, utilised as local community supply.

Utilisation:
The groundwater is utilised for local communities and the tourist areas of the coastal towns.

Protection:
Specifically in the coastal areas where there is extensive use of septic tanks there should be awareness of the potential to contaminate the aquifer. Where communities are utilising springs, they should be protected in accordance with the NORAD toolkit

guidelines.
(http://www.dwaf.gov.za/groundwater/NORADToolkit/3.2%20Guide%20for%20protecting%20springs.pdf)

Data/information:
Many areas here have been covered by the GRIP programme hydrocensus and the data is being captured to the National Databases.

3.8.3 Summary of known problems and risks

- There possible pollution to potential groundwater resources from inadequate sanitation.

Actions: -

- DWA sanitation programme is addressing this.

3.9 Southeastern Highland Hydrogeological Region

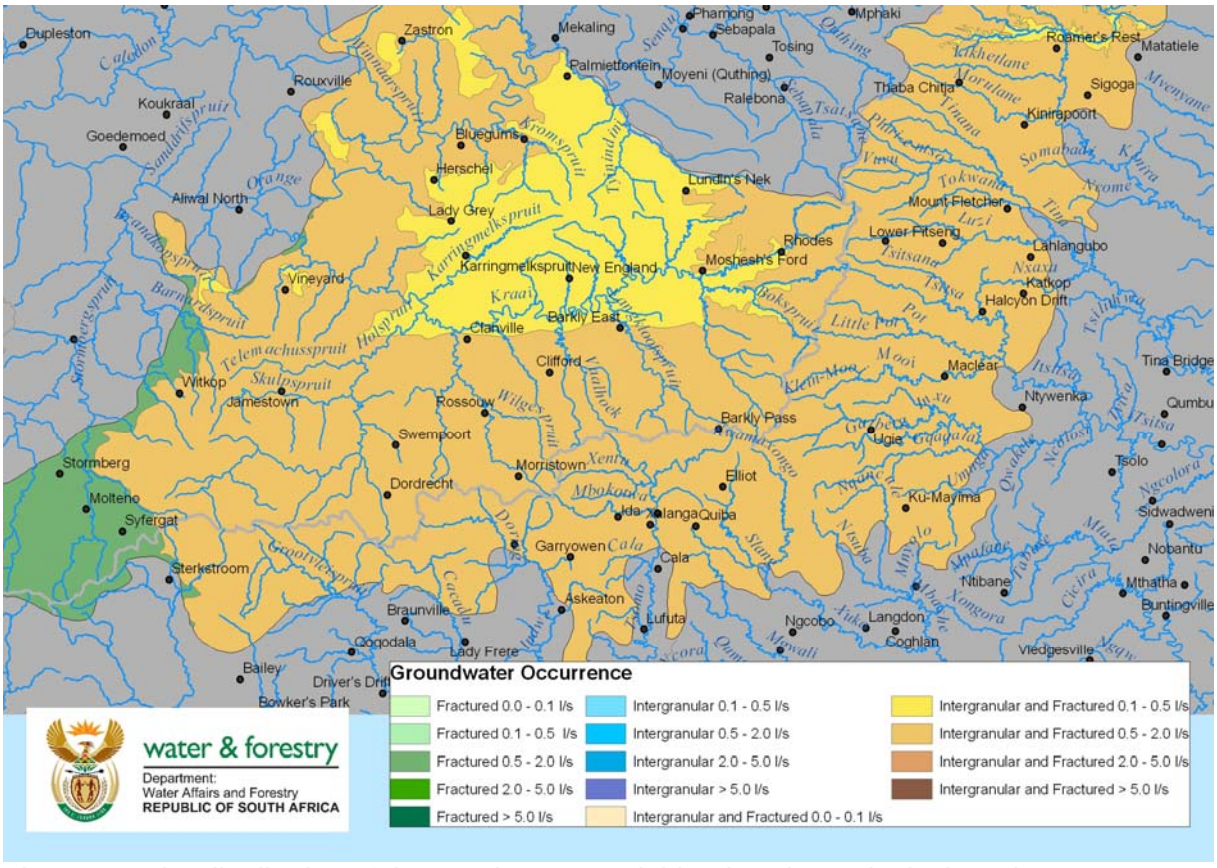

Figure 10: The distribution of the Southeastern Highland Hydrogeological Region

3.9.1 Economic Activities

There is some agricultural activity; private stock farming and communal subsistence farming and grazing.

3.9.2 Aquifer properties and protection measures

There are poor groundwater prospects in this area although there are some good boreholes successes on properly sited boreholes. Isolated towns and communities do use some groundwater including springs as a supplement in the drier months.

Utilisation:
Mainly Schedule 1 and stock watering.

Protection:
Minimal protection is required due to lack of use at any scale. The NORAD toolkit applies here.

Management:
Most of this hydrogeological region, to the north and east, falls in the Upper Orange WMA.

Data/information management:
Data from this area would come from consultants and dept of Agriculture who channel their groundwater information to DWA.

3.9.3 Summary of known problems and risks

- Maclear, Ugie and Mount Fletcher have had problems with sewage treatment.

Actions: -

- DWA assistance to municipalities is addressing this issue of poor water sewage scheme management.

3.10 Transkeian Coastal Foreland and Middleveld Hydrogeological Region

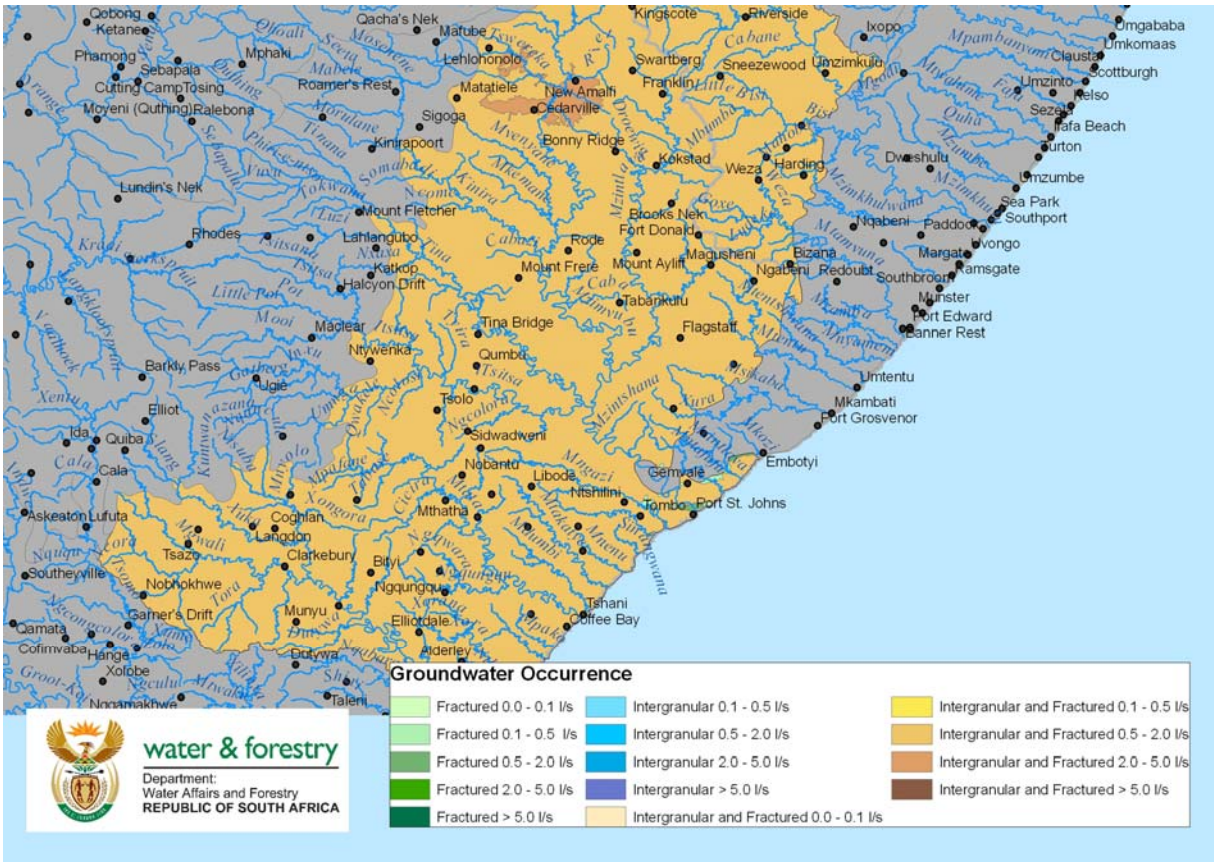

Figure 11: The distribution of the Transkeian Coastal Foreland Middelveld Hydrogeological Region

3.10.1 Economic Activities

Many rural settlements occur within the boundaries of this region. It seems that in general groundwater is accepted as a reliable source but still no groundwater

management is executed. Many springs occur throughout the Eastern Cape Province and a large portion of these is being used for domestic water supplies especially in this region.
There are large areas of forestation.

3.10.2 Aquifer properties and protection measures

The aquifer types occurring in this region are mapped as low potential and the geology consists of mostly argillaceous rocks

Development:
Nothing is known about any further development potential of the region and thus no comments can be made regarding possible augmentation.

Utilisation:
The area has in the order of 3500 settlements many of which will use boreholes or springs to supplement the surface water resources.

Protection:
The standard guidelines from the NORAD projects should be utilised.

Management:
No known management of groundwater is taking place. When the GRIP hydrocensus has been completed and the volume of groundwater being used is available, it would be possible to prioritise some management actions, which could include the incorporation of groundwater monitoring within the relevant irrigation boards.

Data/information management:
The GRIP hydrocensus will augment the 2003 data survey carried out by DWA Water Supply planning on the status of water used by the communities.

3.10.3 Summary of known problems and risks

- Possibility of groundwater contamination from poor sanitation facilities.

Actions:-

- DWA sanitation programme addressing this issue.

4. REPORTING OF DATA AND INFORMATION

As stated previously the required information and type of reporting must suit the operational and strategic needs of the department in support of its mission and objectives.
However, no clear-cut definition of what and/or which information products and how often these are required are available. The following Directorates need to be contacted to find out their needs: -

- Water Use Authorisation: Input on license conditions with reference to groundwater conditions and current use;
- Resource Protection: Input on known groundwater / surface water interaction;
- Systems Planning: Identification of areas for investigation where groundwater could be used to augment current water supplies;
- Hydrological Services: Involvement on additional monitoring points to be added to their routes;
- Water Quality Services: Co-operation and data sharing on groundwater quality monitoring;
- Geohydrological Services: reporting of groundwater levels and groundwater quality at regular intervals.

- Senior Management requirements for an annual, or at more regular intervals, for a groundwater status report.

5. SUMMARY

5.1 Rural water use

From a 2003 study for Water Services Planning, 5652 rural settlements fall within the Eastern Cape area. Refer to Figure 9 for the spatial distribution of the rural settlements. At that date nearly 1500 of the settlements used groundwater as a sole or mixed source. However, very little, or no data is available on a) their dependence on groundwater, b) their vulnerability to droughts and c) the volumes being abstracted, all of which is needed to define the level of the impact on the groundwater resources of the underlying areas. Furthermore, no proactive action can be taken in terms of mitigating either vulnerability or augmentation of the supply where there are shortages.

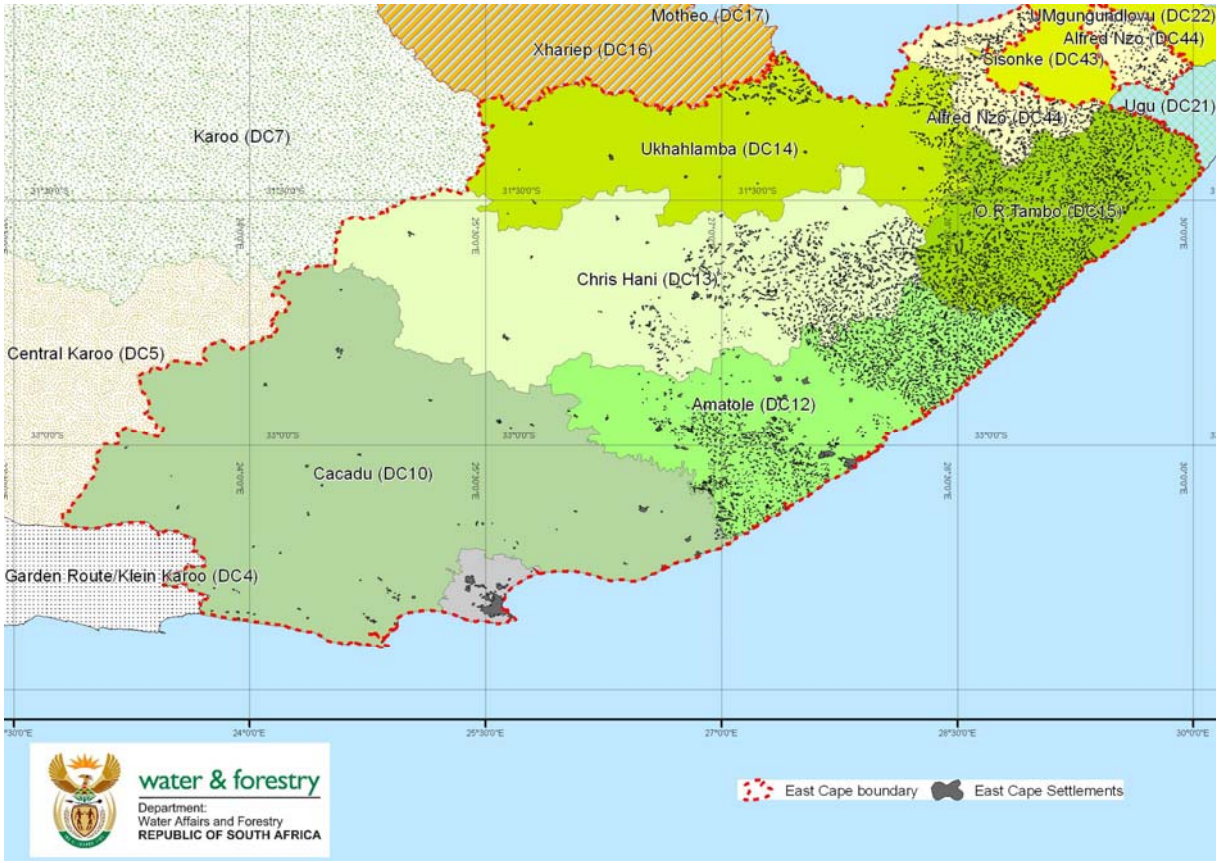

Figure 12: Spatial distribution of rural settlements in Eastern Cape

In 2006 a Groundwater Resources Information Project (GRIP) commenced. The project was broken up into three phases, to run over a three to four year period.

- Phase 1 was the collection of all the available groundwater data in reports, files and whatever other media and the capturing of all this onto the National Groundwater Database.

This phase is largely completed and is continuing with data coding and entry to the NGA as new reports become available.

- Phase 2 was only partially completed due to lack of funds. Geosites positions were collected and markers with the Regional Borehole Number established at the site. Data was collected on all existing geosites, such as water levels, status of pumping equipment and water use data. Only selected areas were

chosen for this where there was an identified need in the DM. The data forms used to collect the data can be viewed on the GRIP website.

- Phase 3 would entail the testing of boreholes to determine the transmissivity and the storativity of the relevant geohydrological strata (if and where unavailable), production of relevant information products to support the district municipalities and the setting up of a well defined regional monitoring network.

The full involvement of all the DMs, consultants and other government departments is an integral and indispensable part of the whole GRIP.

5.2 Municipal water use

There are many towns in the Eastern Cape which are wholly or partially dependant on groundwater for their inhabitants needs. Many of these towns do not report on their abstraction and status of their water levels. Most of these towns should have their water supply use registered or licensed and this generally not the case.
Recommendation:

- Compliance and Use to engage with those municipal managers to have their use legalised and their actual use confirmed.
- This could also be the time to offer some training in groundwater management.

5.3 Agricultural water use

Little is known about the level of agricultural groundwater use. WARMS data is does not always give an accurate location of the use but under and over reporting of amounts abstracted are common. Many users are simply not registered.
Attempts have been made by various studies to estimate the amount groundwater use for irrigation, such as the GRA2 study but actual field verification is needed.
Establishment of water user associations are the only reliable way to monitor, report and protect groundwater use by irrigators. The association's members appreciate the value of the resource and the need to monitor in order to ensure continuity of supply. The following is recommended

- Prioritise the areas were groundwater management is needed the most urgently and ask ISD to initiate the establishment of WUAs.
- Areas where there is WARMS data showing irrigation use could be verified by field visits from IE Water Use or IE Compliance and Verification.

5.4 Other groundwater related issues

5.4.1 Data management

The monitoring data is well managed by R&S who collect and archive the water level data. An amount of groundwater use data is returned to them by some municipalities. The data is stored in the Hydras system.
The GRIP process has yielded many reports from which geosite information was copied to the NGA. Reports continue to be archived and coded as they are submitted by consultants and DWA personnel.
Consultants and other stakeholders are required to obtain Regional Borehole Numbers (RBN) from DWA. This number is used to label the borehole on-site and also serves to track the submission of a report to us on completion of the project.
Recommendations

- The RBN should be obtainable on-line with notification of the request and issue sent to the regional representative.
- Data is also returned to IE in compliance with license conditions. This data should also be stored in Hydras and the WMA.

- Data and information obtained from field work required for a comprehensive reserve determination should be used to update the NGA and verify the GRA2 dataset.

5.4.2 Groundwater Resources Assessment Phase II

This project had five components, which are a) Groundwater use, b) Classification, c) Groundwater/surface water interaction, d) Recharge and e) Planning potential. The scale of the project was at the national level although the calculations were done per quaternary catchment. The result is that data is of low resolution and of low confidence in areas of low borehole coverage and/or inappropriate data.

In spite of this low confidence level the promotion of the results of this project is important as it fills a gap in our knowledge about groundwater. Most of the methodologies developed in this project can be used to improve the results by using local level data.

5.5 Summary of actions

In order to prioritise the tasks and functions as discussed in the previous text a table with tasks and its priority follows.

Table 1: Table of prioritised long-term tasks

Task description	Actions	Priority
Survey of Schedule 1 groundwater use	1. Identify rural and formal settlements either wholly or largely dependent on groundwater for domestic supplies; 2. Determine the level of groundwater use (devise methodology to calculate water use based on pump type, known boreholes (from GRIP) and population figures); 3. Determine the exploitation potential of project area; 4. Calculate the value of groundwater taking into account the volumes of groundwater used and still available for use. This could be carried out by P&I in-house.	1
Survey of agricultural groundwater use	1. Identify all areas where irrigation is taking place from sources such as WARMS, GRIP and the landuse maps; 2. Choose well demarcated area and determine volumes for both surface and groundwater use; 3. Test SAPWATs capability to calculate same figures; 4. Calculate the value of the contribution ground-water is making. 5. Apply methodology to other areas under irrigation. This could be carried out by P&I with WU in-house.	1
Survey of Uitenhage Aquifer	This area is being treated on separately due to its high importance. 1. Follow up on the study previously done to identify farms with unregistered use but existing legal use. 2. Conduct a hydrocensus to determine actual	2

	groundwater use, quantity and quality. 3. Determine from this the amount of groundwater left available in the aquifer.	
Extend the monitoring network based on the outcomes of the above two projects	1. Domestic water sector: - Start monitoring in areas where there is mixed use of a common source as this poses the highest potential conflict. Ambient and high use areas to be targeted. 2. Agricultural sector: - Start monitoring to in both potential impacted areas and pristine areas. Current WU staff could be used to identify the specific monitoring borehole sites once a general area has been chosen.	3
Study of groundwater dependant and co-dependant towns and the WSAs.	1. Formally identify the towns and WSAs. 2. Clarify the amount of groundwater being used and the seasonal pattern of use. 3. Assist the WSA with registration and licensing. 4. Implement a reporting path for return of monitoring data. This could be carried out by P&I in collaboration with WARMS , Authorisation and R&S.	1
Aquifer Protection	The following steps are needed to implement this actions: - 1. Identify all WSD, WTW, sewage works and possible polluting industries. 2. Identify areas where monitoring is required. 3. Determine the level of monitoring these are already doing. 4. Check monitoring boreholes are captured and data is collected. 5. Identify and train staff that can do the capturing of water quality data onto the WMS.	3

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DWAF 1997 Queenstown Groundwater Occurrence Hydrogeological Map Series 3126 1:500 000

DWAF 1997 Beaufort West Groundwater Occurrence Hydrogeological Map Series 3122 1:500 000

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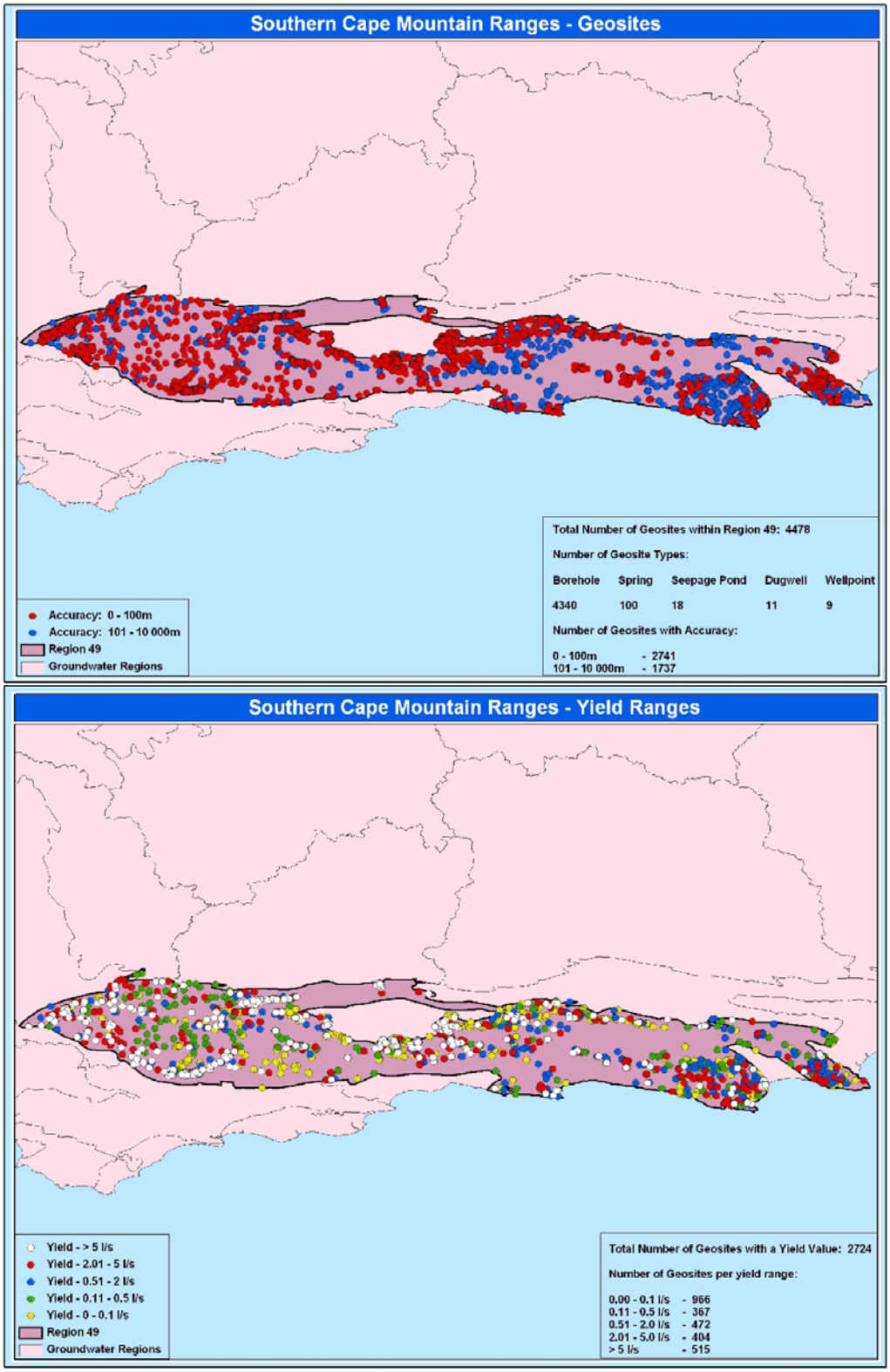
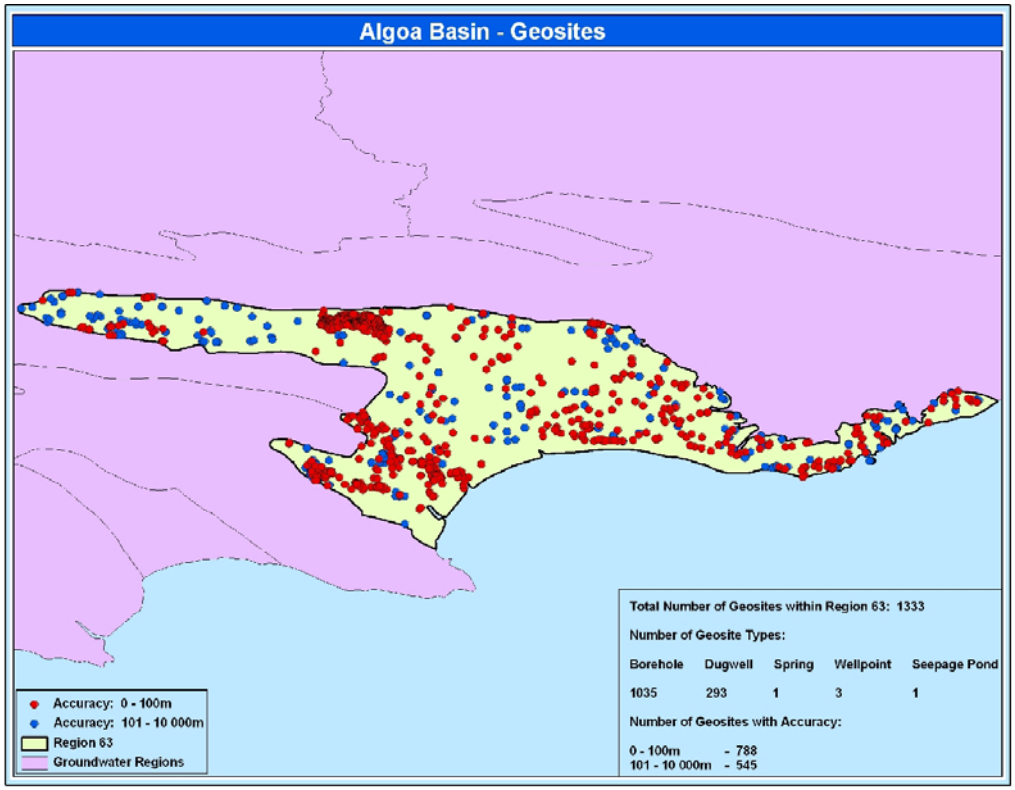
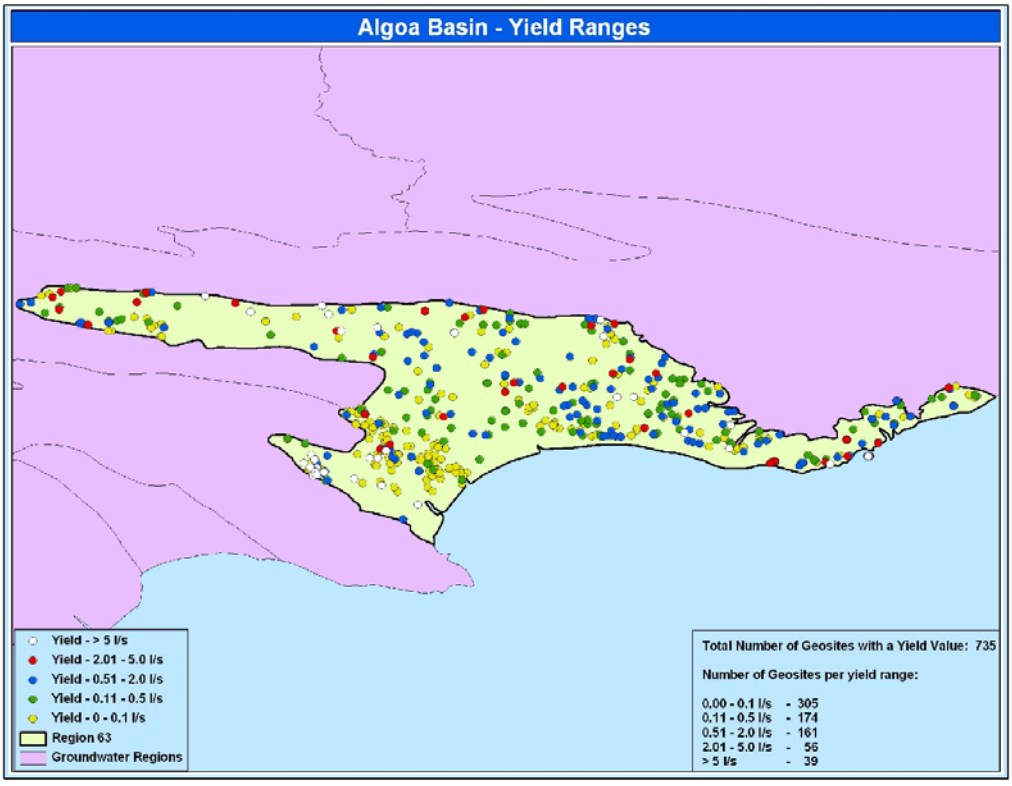
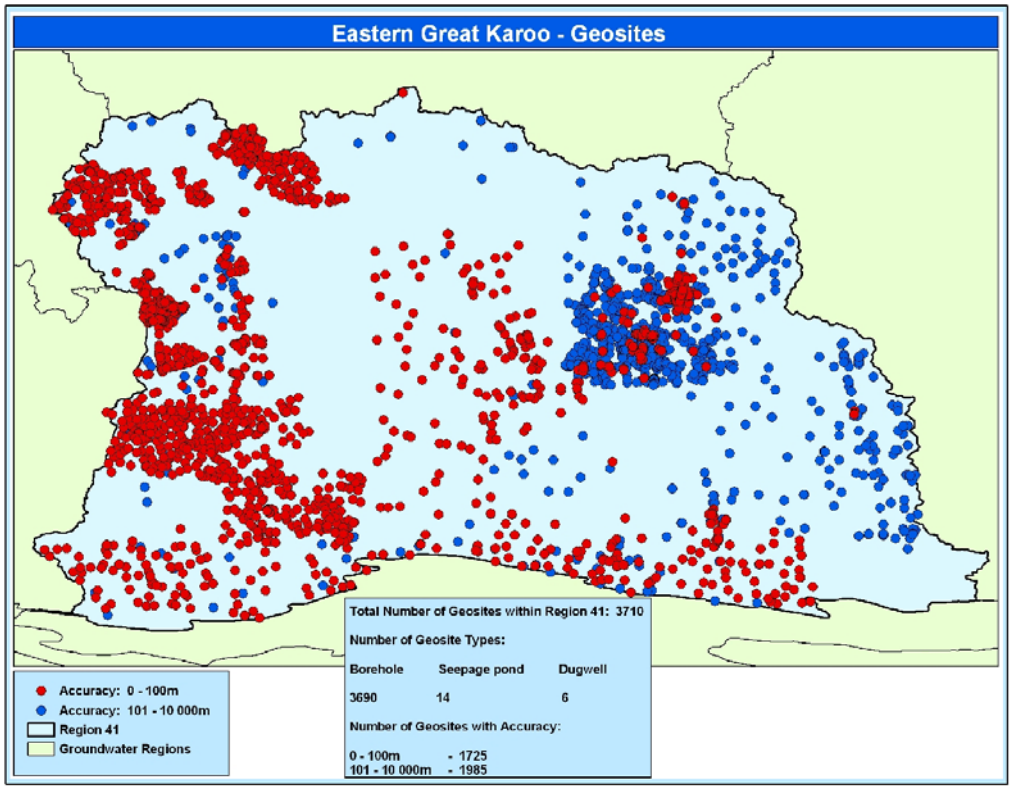
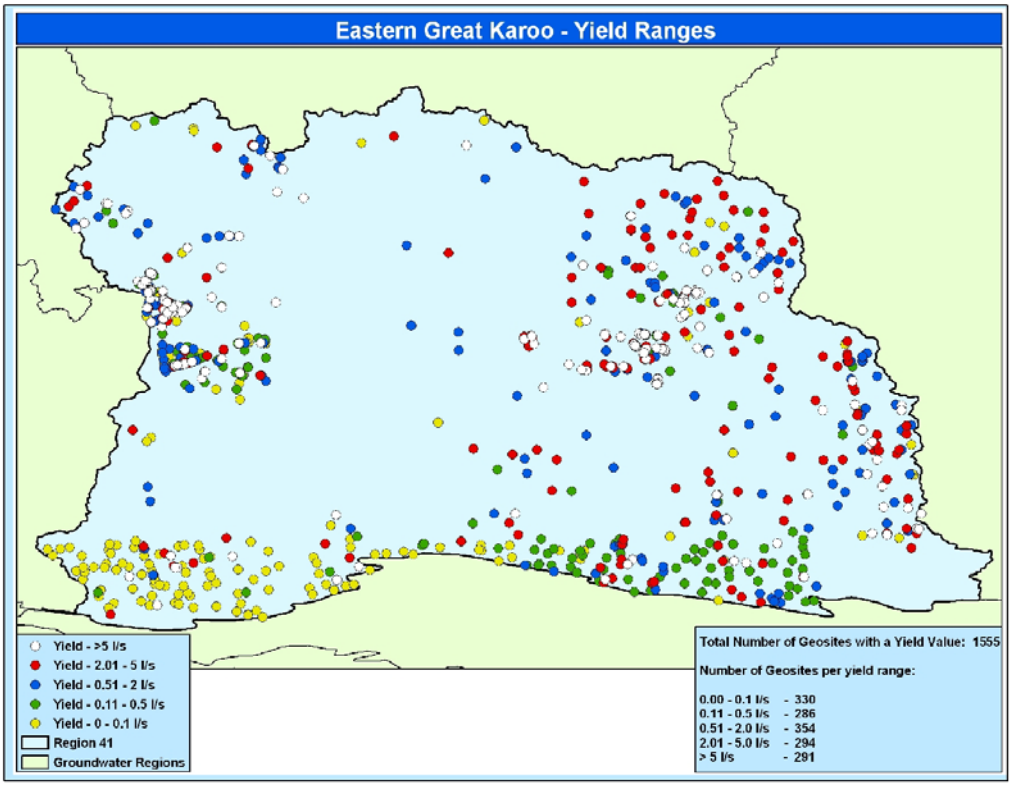
APPENDIX A: ANALYSES OF THE GEOSITES ON THE NGA AND THEIR YIELD RANGES BY GEOHYDROLOGICAL REGION

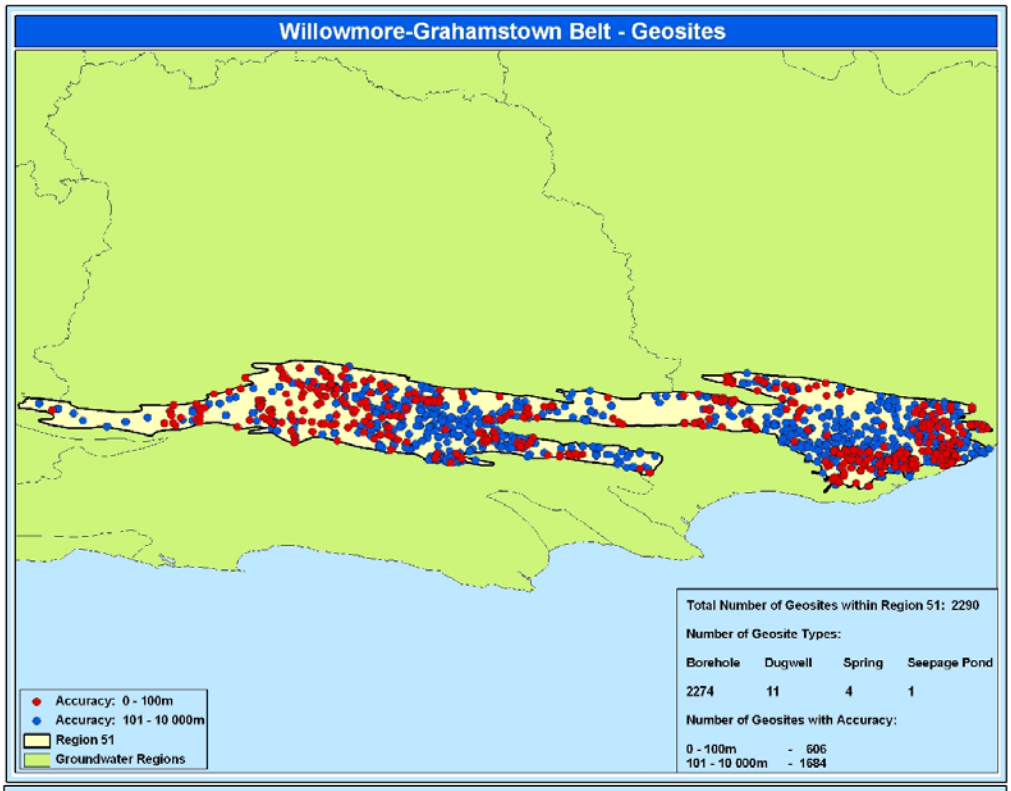


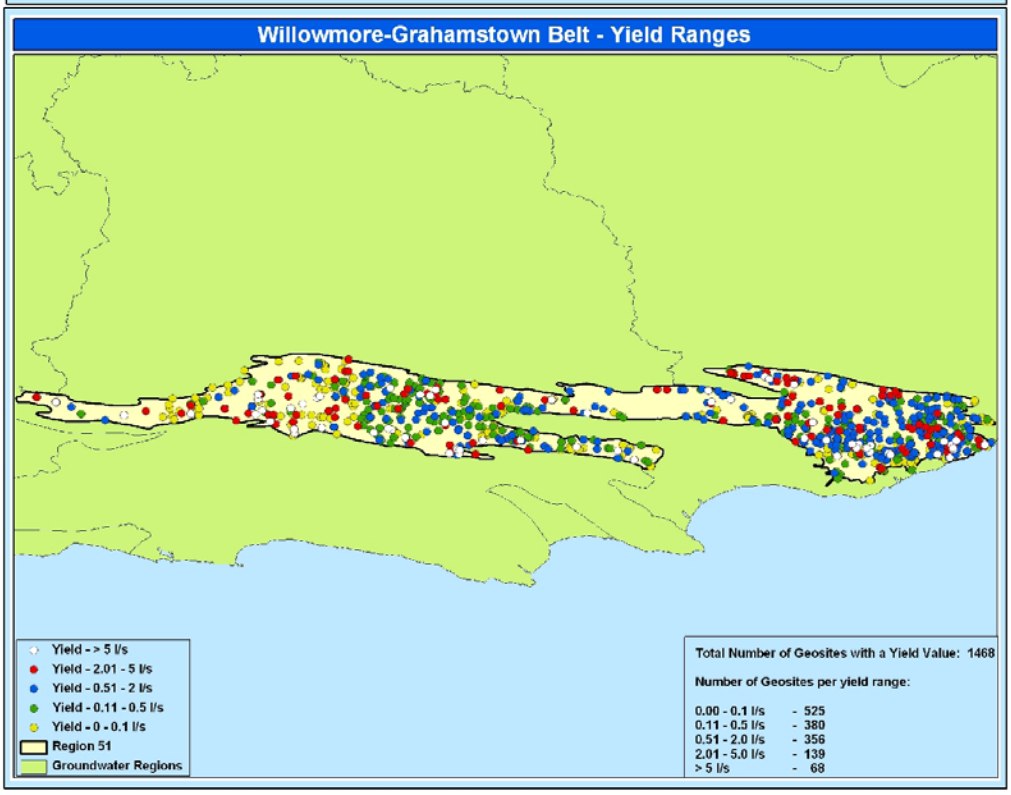

Algoa Basin - Geosites
Total Number of Geosites within Region 63: 1333
Number of Geosite Types:
Borehole Dugwell Spring Wellpoint Seepage Pond
1035 293 1 3 1
Number of Geosites with Accuracy:
0 - 100m - 788
101 - 10 000m - 545
Accuracy: 0 - 100m
Accuracy: 101 - 10 000m
Region 63
Groundwater Regions

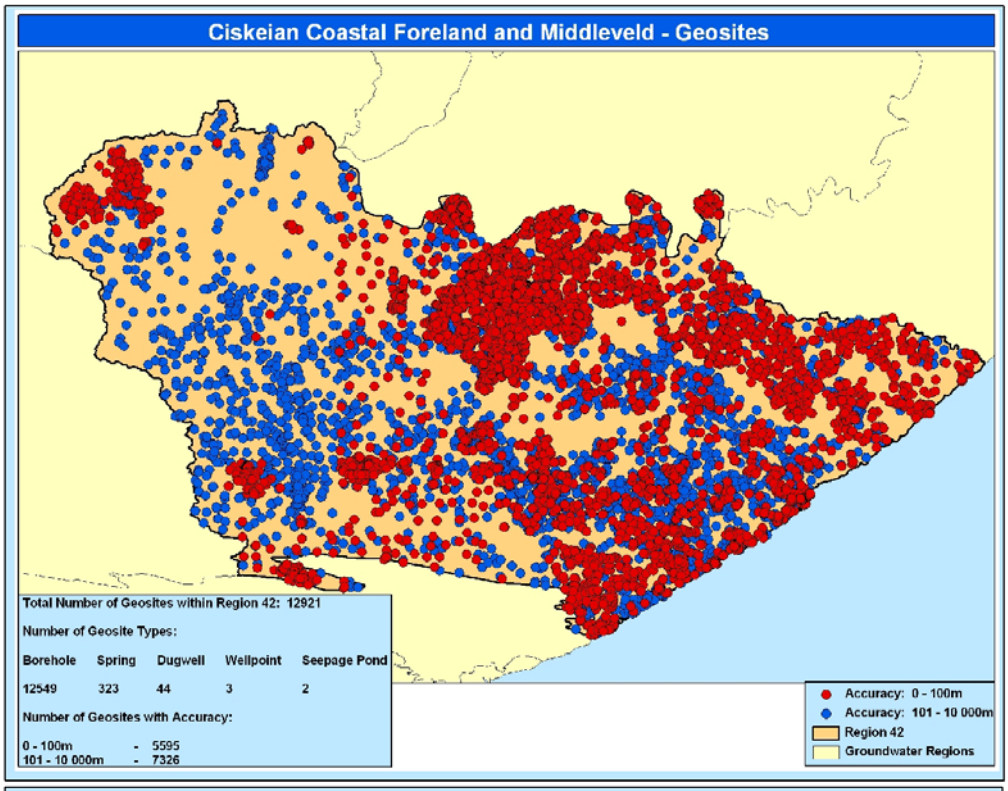

Algoa Basin - Yield Ranges
Total Number of Geosites with a Yield Value: 735
Number of Geosites per yield range:
0.00 - 0.1 l/s - 305
0.11 - 0.5 l/s - 174
0.51 - 2.0 l/s - 161
2.01 - 5.0 l/s - 56
> 5 l/s - 39
Yield - > 5 l/s
Yield - 2.01 - 5.0 l/s
Yield - 0.51 - 2.0 l/s
Yield - 0.11 - 0.5 l/s
Yield - 0 - 0.1 l/s
Region 63
Groundwater Regions

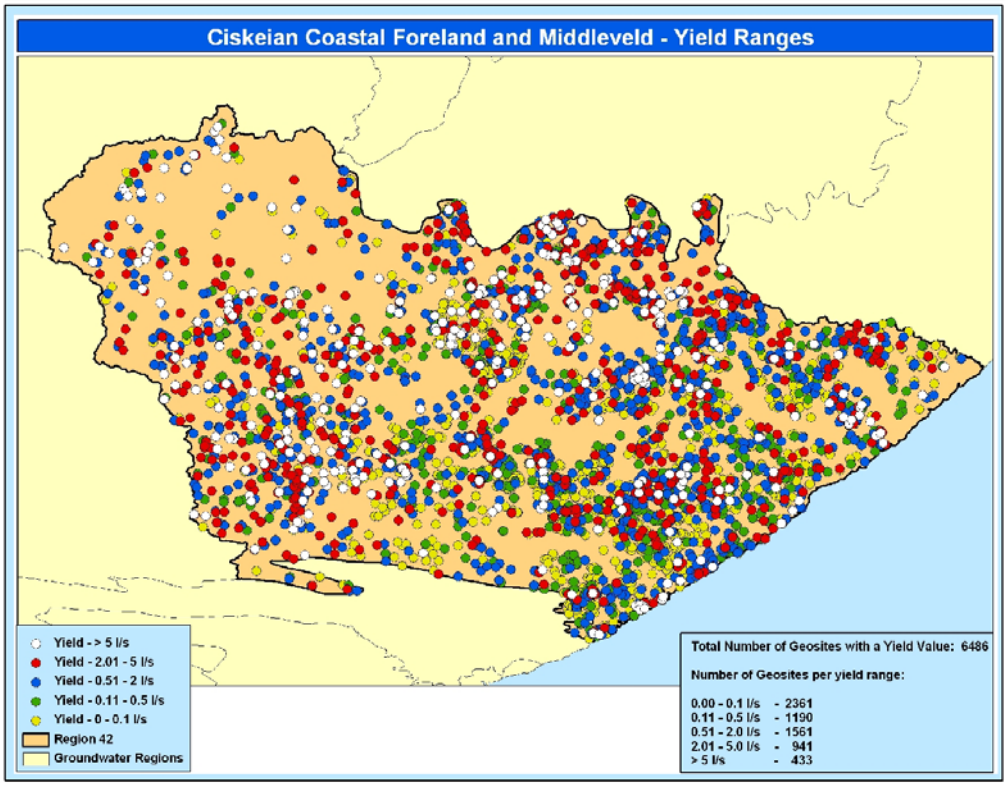

Eastern Great Karoo - Geosites
Total Number of Geosites within Region 41: 3710
Number of Geosite Types:
Borehole Seepage pond Dugwell
3690 14 6
Number of Geosites with Accuracy:
0 - 100m - 1725
101 - 10 000m - 1985
Accuracy: 0 - 100m
Accuracy: 101 - 10 000m
Region 41
Groundwater Regions

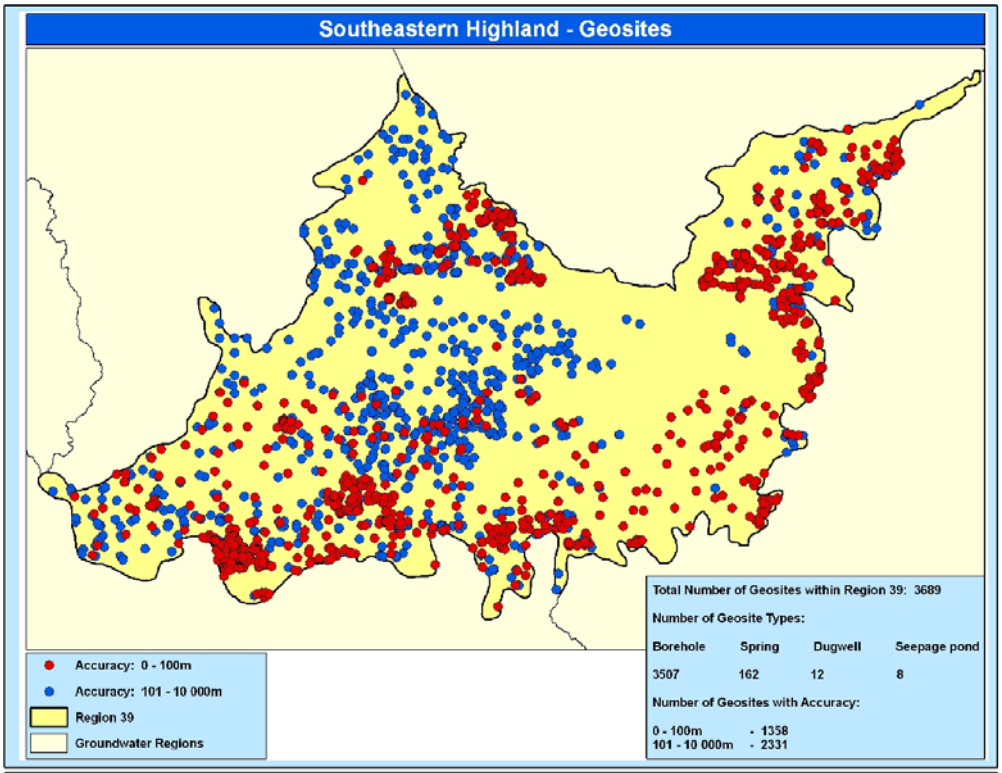

Eastern Great Karoo - Yield Ranges
Total Number of Geosites with a Yield Value: 1555
Number of Geosites per yield range:
0.00 - 0.1 l/s - 330
0.11 - 0.5 l/s - 286
0.51 - 2.0 l/s - 354
2.01 - 5.0 l/s - 294
> 5 l/s - 291
Yield - >5 l/s
Yield - 2.01 - 5 l/s
Yield - 0.51 - 2 l/s
Yield - 0.11 - 0.5 l/s
Yield - 0 - 0.1 l/s
Region 41
Groundwater Regions

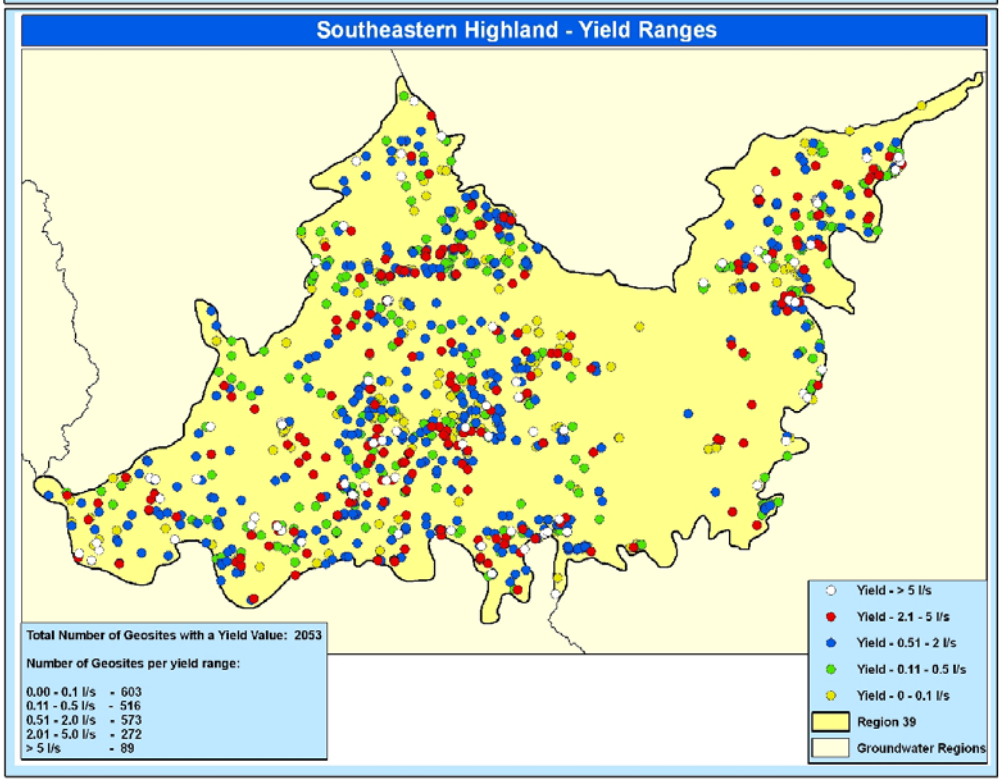

Willowmore-Grahamstown Belt - Geosites
Total Number of Geosites within Region 51: 2290
Number of Geosite Types:
Borehole Dugwell Spring Seepage Pond
2274 11 4 1
Number of Geosites with Accuracy:
0 - 100m - 606
101 - 10 000m - 1684
Accuracy: 0 - 100m
Accuracy: 101 - 10 000m
Region 51
Groundwater Regions

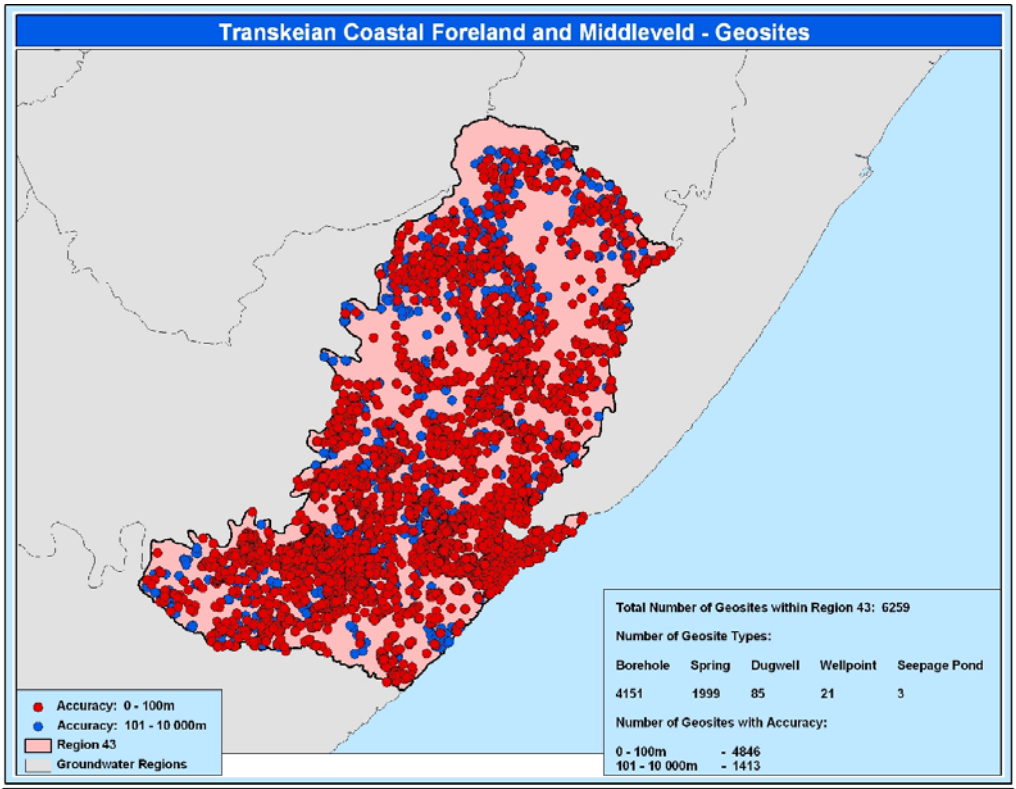

Willowmore-Grahamstown Belt - Yield Ranges
Total Number of Geosites with a Yield Value: 1468
Number of Geosites per yield range:
0.00 - 0.1 l/s - 525
0.11 - 0.5 l/s - 380
0.51 - 2.0 l/s - 356
2.01 - 5.0 l/s - 139
> 5 l/s - 68
Yield - > 5 l/s
Yield - 2.01 - 5 l/s
Yield - 0.51 - 2 l/s
Yield - 0.11 - 0.5 l/s
Yield - 0 - 0.1 l/s
Region 51
Groundwater Regions

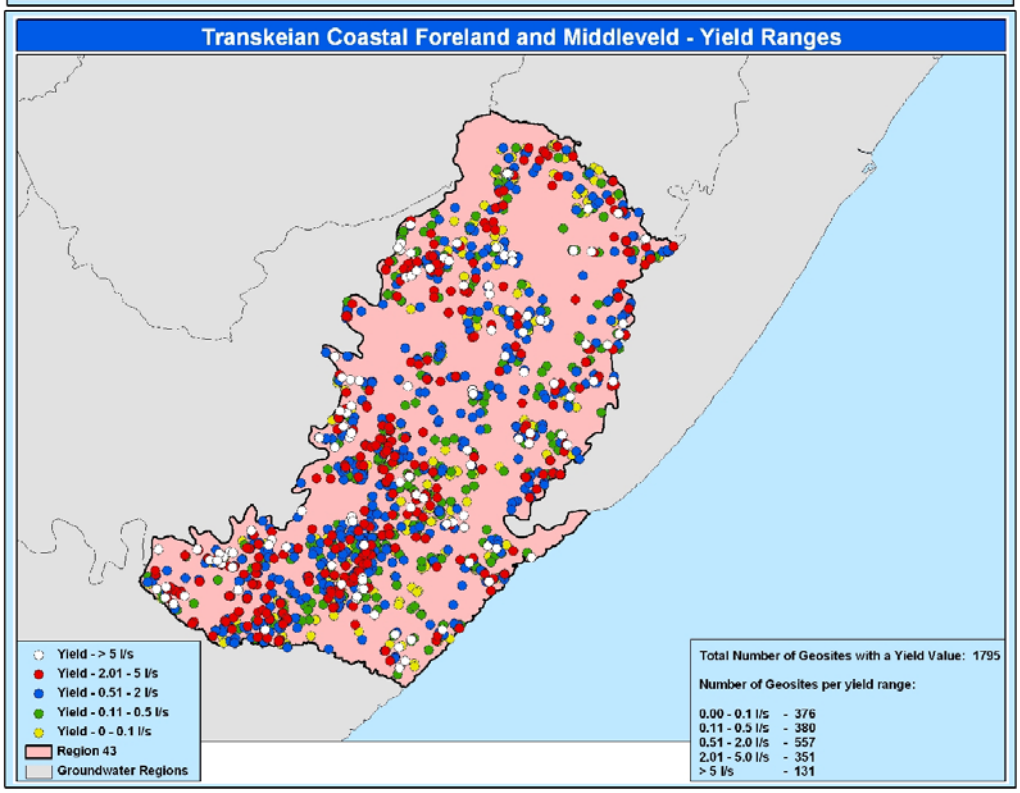

Ciskeian Coastal Foreland and Middleveld - Geosites
Total Number of Geosites within Region 42: 12921
Number of Geosite Types:
Borehole Spring Dugwell Wellpoint Seepage Pond
12549 323 44 3 2
Number of Geosites with Accuracy:
0 - 100m - 5595
101 - 10 000m - 7326
Accuracy: 0 - 100m
Accuracy: 101 - 10 000m
Region 42
Groundwater Regions


Ciskeian Coastal Foreland and Middleveld - Yield Ranges
Yield - > 5 l/s
Yield - 2.01 - 5 l/s
Yield - 0.51 - 2 l/s
Yield - 0.11 - 0.5 l/s
Yield - 0 - 0.1 l/s
Region 42
Groundwater Regions
Total Number of Geosites with a Yield Value: 6486
Number of Geosites per yield range:
0.00 - 0.1 l/s - 2361
0.11 - 0.5 l/s - 1190
0.51 - 2.0 l/s - 1561
2.01 - 5.0 l/s - 941
> 5 l/s - 433


Southeastern Highland - Geosites
Total Number of Geosites within Region 39: 3689
Number of Geosite Types:
Borehole Spring Dugwell Seepage pond
3507 162 12 8
Number of Geosites with Accuracy:
0 - 100m - 1358
101 - 10 000m - 2331
Accuracy: 0 - 100m
Accuracy: 101 - 10 000m
Region 39
Groundwater Regions


Southeastern Highland - Yield Ranges
Total Number of Geosites with a Yield Value: 2053
Number of Geosites per yield range:
0.00 - 0.1 l/s - 603
0.11 - 0.5 l/s - 516
0.51 - 2.0 l/s - 573
2.01 - 5.0 l/s - 272
> 5 l/s - 89
Yield - > 5 l/s
Yield - 2.1 - 5 l/s
Yield - 0.51 - 2 l/s
Yield - 0.11 - 0.5 l/s
Yield - 0 - 0.1 l/s
Region 39
Groundwater Regions


Transkeian Coastal Foreland and Middleveld - Geosites
Total Number of Geosites within Region 43: 6259
Number of Geosite Types:
Borehole Spring Dugwell Wellpoint Seepage Pond
4151 1999 85 21 3
Number of Geosites with Accuracy:
0 - 100m - 4846
101 - 10 000m - 1413
Accuracy: 0 - 100m
Accuracy: 101 - 10 000m
Region 43
Groundwater Regions


Transkeian Coastal Foreland and Middleveld - Yield Ranges
Total Number of Geosites with a Yield Value: 1795
Number of Geosites per yield range:
0.00 - 0.1 l/s - 376
0.11 - 0.5 l/s - 380
0.51 - 2.0 l/s - 557
2.01 - 5.0 l/s - 351
> 5 l/s - 131
Yield - > 5 l/s
Yield - 2.01 - 5 l/s
Yield - 0.51 - 2 l/s
Yield - 0.11 - 0.5 l/s
Yield - 0 - 0.1 l/s
Region 43
Groundwater Regions

APPENDIX B: DEFINITION OF THE WATER FUNCTIONS AS DEFINED IN THE NWA (1998) IN RELATION TO GROUNDWATER

1. INTRODUCTION

The functions as defined by the NWA (1998) are 'development', 'utilisation', 'protection', 'conservation' and 'management'. What was left out but underpins all these functions is the data/information management. Data management must at all time form an irrevocably part of these functions and will be discussed in the main text in this context.

In the following paragraphs these functions will be discussed in detail in order to create a common understanding of what is meant.

2. DEVELOPMENT

Groundwater in the South Africa, although it played an important role, was never brought into the planning stages right from the reconnaissance phase of any water supply project. The aim under this function would be to entrench groundwater into the planning processes from the Reconnaissance- through to the Feasibility Study phases with the concomitant funding of groundwater studies.

Issues under this heading relate to questions like: -

- 'Is there enough groundwater for development locally and what would it costs in relation to surface water supplies?'
- 'Can groundwater augment the surface water supplies, i.e. conjunctive use?'
- 'Why is groundwater not considered as a source of domestic water in a particular area?'
- 'Is there a potential for the further development of groundwater sources in a particular area?'
- 'Is there still some untapped groundwater sources that needs to be discovered?'

Guidelines for groundwater pre- and feasibility studies have been drawn up. These studies are mostly in the form of desk studies. However, a feasibility study could include exploration drilling in areas where not enough is known about groundwater occurrences and exploitation potential.

Most of these questions can be answered through the execution of reconnaissance and pre-feasibility studies. The aim of these studies is to put the decision to use groundwater or not, on the par with that of surface water. The 1:500 000 scale geohydrological maps can serve as inputs to the Reconnaissance and Pre-Feasibility phase studies. However, due a

lack of data in particular areas, and being a large-scale map, some generalisations had to be made on each Hydrogeological map. The guidelines for executing and implementing of groundwater feasibility studies address the shortcomings at both a local and regional scale.

Conceptual models of groundwater occurrences are important as well, as these might identify potential additional untapped aquifers.

3. UTILISATION

Is to ensure that where adequate groundwater resources are available, it is not neglected in favour of more expensive surface water schemes due to lack of an understanding of the role groundwater can play, or due to cultural issues.

Issues under this heading relates to questions like; -

- 'To what extent are the available groundwater resources being utilised to its full potential?'
- 'To what extent is a particular aquifer over abstracted?'
- 'What opportunities are there to utilise available groundwater and surface water conjunctively?'

With aquifer management in place and supported by sound data management practices, most of the above questions can be answered. Other aspects like the execution of groundwater feasibility studies and mathematical modelling can assist in answering some of the questions posed above. The NWA (1998) of the RSA demands judicious use of the available source, whether ground- or surface water, as we live in a water scarce country.

Furthermore, in the utilisation of groundwater one must guard against the perception that groundwater and surface water are two separate sources. The hydrological cycle is a unit and double counting of the resources can lead to problems in the future. In the case of artificially induced recharge run-off will be affected.

4. PROTECTION

Protection is about save-guarding the groundwater resources of this country against pollution and over-abstraction and the aquatic-ecosystems. The aim is to maintain the quality of the water for domestic, aquatic ecosystems and agricultural, industrial and commercial use. Bredenhan and Braune (1996) equate the level of protection to the value of aquifer being protected and an aquifer classification system was thus devised by Parsons (1998).

Issues under this heading relate to questions like: -

- 'How valuable is a particular aquifer or aquifer system?'
- 'Against what must this aquifer be protected?'
- 'For what purpose must this aquifer be protected?'

It is a well-known fact that the coal mining industry is polluting surface water sources (acid mine drainage) but the extent of groundwater pollution on the Highveld still needs to be quantified. A starting point would be to draw up a coherent list of mines and industries and identify the pollution potential of these industries also showing which of the industries are doing any monitoring and what are the monitoring; i.e. abstraction, water level fluctuations and/or water quality.

The function of groundwater protections has very strong ties with the Water Quality Management function and the links between the department's National Groundwater Archive and Water Management System must be promoted actively.

5. CONSERVATION

Conservation is about the long-term view of the availability of resources for the future generations. The water resources of the RSA need to be conserved for the next generations and is well encapsulated in the logo 'Some for all, forever'. In this regard the main issue would be the establishment of a water conservation culture through the e3ntrenchment of demand management practices at local and district municipal level and within WUAs. Conservation is not unique to groundwater, for example the SA Parks has been involved in conservation of the fauna and flora of the RSA for more that a century.

Conservation offers us all the best possible opportunity to co-operate in different spheres like nature conservation with multiple purposes; thus a multidisciplinary approach. A case in hand is the Mpumalanga Plateau where restrictions on the extension of plantations can safeguard, not only unique habitats, but also the groundwater sources that feed perennial rivers.

6. MANAGEMENT

To be able management one must measure. Generically the aspects to be measured can be defined as inputs, outputs and changes to the system due the aforementioned two. For groundwater these translates to recharge, abstraction (natural and artificial) and water level fluctuations.

The biggest obstacle to the management of the groundwater resources of the Eastern Cape Region and to greater or lesser extent for the whole of the RSA, is the fact that very little is known about who is abstracting where and how much. The biggest priority in this regard thus

is to determine where, by whom and how much groundwater are being abstracted, i.e. quantifying the groundwater use. Only then can coherent and systematic groundwater monitoring programmes be devised.

Issues under this heading relate to questions like: -

- 'How much groundwater is the irrigation farmers using?'
- 'Is the mining industry using any groundwater?'
- 'Do the mines pump out excess groundwater and do the dispose this water?'
- 'Do the mines who abstract groundwater affect the surrounding farmers at all?'

To be able to identify any possible negative impacts within areas of groundwater use, the behaviour of the natural system needs to be characterised. From this it is clear that different levels of monitoring are needed. Monitoring the natural conditions not only help to determine baseline conditions from which recharge can be calculated, but also can assist to evaluate and quantify the effects of changing weather patterns.

Fortunately the NWA (1998) has supplied the necessary instruments to assist the department in its management functions - these being Water Users Associations. The aim of the Act is to devolve the management of a source down to the lowest possible level, i.e. the users tapping a common source like an aquifer and being mutually dependent of this particular source. The challenge would be to convince these users to the value of this source and the necessity to manage it for the benefit of the whole group.

7. DATA/INFORMATION MANAGEMENT

Broken down into the smallest possible denominators, data is about the acquisition, capturing and dissemination of data and information to support the strategic and operational decisions of the department in order to fulfil its mission and objectives.
Without active data and information management in place, none of the above endeavours will come to fruition.

For a more detailed explanation of good data management practices, refer to Appendix C.

APPENDIX C: GOOD DATA MANAGEMENT PRACTICES

1. INTRODUCTION

Data collection must be managed as part of a value chain. This chain starts with a) *data* from which b) *information* is generated and based on this information c) *knowledge* and insight is acquired to resolve questions in support of d) *strategic* and/or *operational decisions*, which should support the organisation's e) *mission and objectives*. The mission and objectives of an organisation clearly provide a long-term focus and the data collection has a short-term focus.

2. DATA MANAGEMENT WITHIN AN ORGANISATION

To be able to manage data an organisation needs a) people, b) services, c) facilities, d) technologies, e) applications and last but not the least f) data. A set of questions one has to ask oneself, in order to test whether I am managing my data well, is: -

- What a, b, c, d, e & f do I have?
- Where do I have my a, b, c, d, e & f?
- How well does my a, b, c, d, e & f work in support of my organisation's mission and objectives?
- How much does my a, b, c, d, e & f costs?

The following two mission statements of the DWAF contain issues related to data management issue. These are: -

- **Conserving, managing and developing our water resources and forests in a scientific and environmentally sustainable manner in order to meet the social and economic needs of South Africa, both now and in the future; and**
- **Educating the people of South Africa on ways to manage, conserve and sustain our water and forest resources;**

The objectives for the DWAF were drawn from the National Water resources Strategy. These are: -

3. SITUATIONAL ANALYSIS

In an attempt to evaluate the performance and highlight priority action areas, a data management matrix, based on the described elements and proposed questions, has been drawn up. This is shown in table 1.

4. SUMMARY

The lack of groundwater data and data capturing staff is the two priority areas of concern.

5. CONCLUSIONS

To effectively manage data, a dedicated data group of staff members needs to be established together with a dedicated supervisor. However, to motivate a dedicated supervisor for such a group, they must consist of at least five to six persons. The benefits of such a large group is that they can serve the data capturing needs of all the systems, e.g. WMS, NGA and WARMS at the same time.

Furthermore, a well-managed archive of the original data, whether in paper or electronic format, is a prerequisite.

DOCUMENT ACCEPTANCE			
Role	**Name**	**Signature**	**Date**
Producer	J Baron		
Accepted by	I Viljoen		
Project Leader/Sponsor			