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PREFACE

This overview of the water resources availability and utilisation in the Mzimvubu to Keiskamma water management area, is one of a series of similar reports covering all 19 water management areas in the country, and results directly from work performed in preparation of the First Edition National Water Resource Strategy, which is to be published in its final form during 2003. It is further complemented by a report giving a national perspective on the water resources of the country.

The information contained in this series of reports, reflects the combined efforts and contributions by a wide spectrum of people. Most of the data follow from water resource situation assessments with respect to each of the water management areas as well as from demographic, economic, environmental and other related studies, which were performed under assignment of the Department of Water Affairs and Forestry. The reports also summarise the knowledge and insights gained through a series of workshops (several per water management area) conducted during the years 2000 and 2001, in which strategic perspectives were developed with respect to the reconciliation of requirements for and availability of water, then and into the future.

It is the objective of the report to, in a non-technical style, provide an overview of the current and expected future water resources situation in the Mzimvubu to Keiskamma water management area, highlight the key issues of relevance and provide broad strategies with regards to the management of water resources in the water management area. Although an internal document by the Department of Water Affairs and Forestry, it should also serve as valuable background to officials from other government departments and institutions, members of catchment management agencies and water user associations, regional and local authorities, consultants and others.

It is important to note that the information, strategies and priorities given are not static. All relate to a certain point in time, and should be regularly reviewed in future as improved information becomes available and to adjust to changing circumstances. Greater technical detail can be obtained from the documentation referenced.

ACKNOWLEDGEMENTS

Invaluable contributions to the contents of the water management area reports were made by several individuals and through the combined knowledge and wisdom of many others. Only a few can be named here, and this note serves as a rather incomplete recognition to them and our other professional colleagues for what they have done and for what the authors have learned from them.

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MZIMVUBU TO KEISKAMMA
WATER MANAGEMENT AREA

OVERVIEW OF WATER RESOURCES AVAILABILITY AND UTILISATION

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MZIMVUBU TO KEISKAMMA WATER MANAGEMENT AREA

OVERVIEW OF WATER RESOURCES AVAILABILITY AND UTILISATION

1. GENERAL DESCRIPTION OF WATER MANAGEMENT AREA

1.1 Natural characteristics

The Mzimvubu to Keiskamma water management area lies predominantly within the Eastern Cape Province, with a small portion in Kwazulu-Natal. It borders on the Fish to Tsitsikamma, Upper Orange and Mvoti to Umzimkulu water management areas, as well as on Lesotho in the north. The Mzimvubu River with its main tributaries the Tsitsa, Tina and Mzimtlava Rivers, is the largest river in the water management area and also the largest undeveloped river in South Africa. The Kei River drains a relatively large catchment and other significant rivers in the water management area are the Keiskamma, Buffalo, Mbashe and Mtata Rivers, all of which flow in a general south-easterly direction towards the Indian Ocean. Several small coastal rivers and streams drain directly to the ocean, as shown on the base map of the water management area in **Figure 1**.

Climate over the water management area varies considerably, from humid and sub-tropical in the east to semi-arid in the west. Rainfall occurs mainly in summer and the mean annual rainfall ranges from 400mm to nearly 1 500mm. Potential evaporation is well in excess of the rainfall over much of the water management area as shown in **Figure 2**. Occasional snowfalls occur over the higher terrain in the north-west of the water management area. Vegetation is strongly influenced by the climate and varies from lush coastal forests to Karoo shrubbery and sparse grass in the west, with Savannah grassland covering most of the water management area. Rolling hilly terrain extends over most of the water management area, with the southern Drakensberg Mountains on the border with Lesotho as the main topographic feature. Some of the rivers are deeply incised near the coast. The geology mainly consists of sedimentary rocks from the Karoo Supergroup, intruded by dolerite sheets and dykes, and is of limited water bearing capacity. Mineral deposits are limited to the occurrence of heavy metals in some of the coastal dunes.

Despite the natural beauty of the region, only a few nature reserves are found in the water management area. Many of the estuaries are still largely unaffected by human activity and are of a high conservation status.

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1.2 Development

Nomadic people first roamed the area, and in the early 1800's it was the scene of conflict between European settlers and Africans over the possession of cattle and grazing land. In the inland parts the economy is still strongly dependent on livestock farming. Large areas have also been developed under cultivation, mainly for the growing of annual crops. In many areas though, either the terrain, soils or rainfall are not favourable for cultivation. Several irrigation schemes have been developed, mainly in the western parts where the rainfall is lower. Attributable to various reasons, which include social and institutional aspects, limited success has been achieved and many of the schemes are in a poor state of operation.

Industrial development was stimulated by the harbour at East London where a number of large industries were established. There are no mining operations of note in the water management area. Several large towns have been established in the water management area to serve the needs of local people and of regional economic activities, such as Kokstad, Umtata, Queenstown and Bisho. Two hydro-electric power stations were constructed on the Mtata River near Umtata (at First Falls and Second Falls) as well as the Collywobbles hydropower station on the Mbashe River.

The present land use in the water management area is shown in **Figure 3**. Of particular importance is the large number of rural villages and settlements which occur throughout most of the water management area, and where large numbers of people live with relatively little economic activity in support. Cultivation is practised in most parts of the water management area, with most of the irrigation in the vicinity of Kokstad and Matatiele to the north, and in the Queenstown/Elliot area. Large areas have also been planted with commercial forests, corresponding to areas of highest rainfall in the water management area.

1.3 International

The Mzimvubu to Keiskamma water management area borders on Lesotho, with the border being formed by the divide between the Mzimvubu River catchment and the catchment of the Upper Orange River (known as the Senqu River in Lesotho). Not sharing any rivers and with no transfers of water between Lesotho and the Mzimvubu to Keiskamma water management area, there are no international obligations (on water matters) binding the water management area.

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1.4 Sub-areas

Significant spatial variations in climate, water availability, level and nature of economic development and growth are typical of South Africa, and are also evident in the Mzimvubu to Keiskamma water management area. To enable improved representation of the water resource situation in the water management area under such varied conditions, and to facilitate the applicability and better use of information for strategic management purposes, the water management area was divided into sub-areas. Delineation of the sub-areas was judgementally based on practical considerations such as size and location of sub-catchments, homogeneity of natural characteristics, location of pertinent water infrastructure (e.g. dams), and economic development. The catchment management agency may later introduce smaller or alternative subdivisions.

Consequently, six sub-areas were identified as shown on Figure 1, to facilitate the presentation and management of key issues in the water management areas. These are :

- The Mzimvubu sub-area, which corresponds to the catchment of the Mzimvubu River.
- The Mtata sub-area, which comprises the catchment of the Mtata River together with the coastal rivers between the Mzimvubu and Mbashe Rivers.
- The Mbbashe sub-area, which includes the catchment of the Mbashe River together with coastal rivers between the Mbashe and Kei Rivers.
- The Kei sub-area, corresponding to the catchment of the Kei River.
- The Amatola sub-area, which includes all the rivers in the water management area to the west of the Kei River.
- The Wild Coast sub-area, which includes all the rivers in the water management area to the east of the Mzimvubu River.

2. NATIONAL PERSPECTIVE

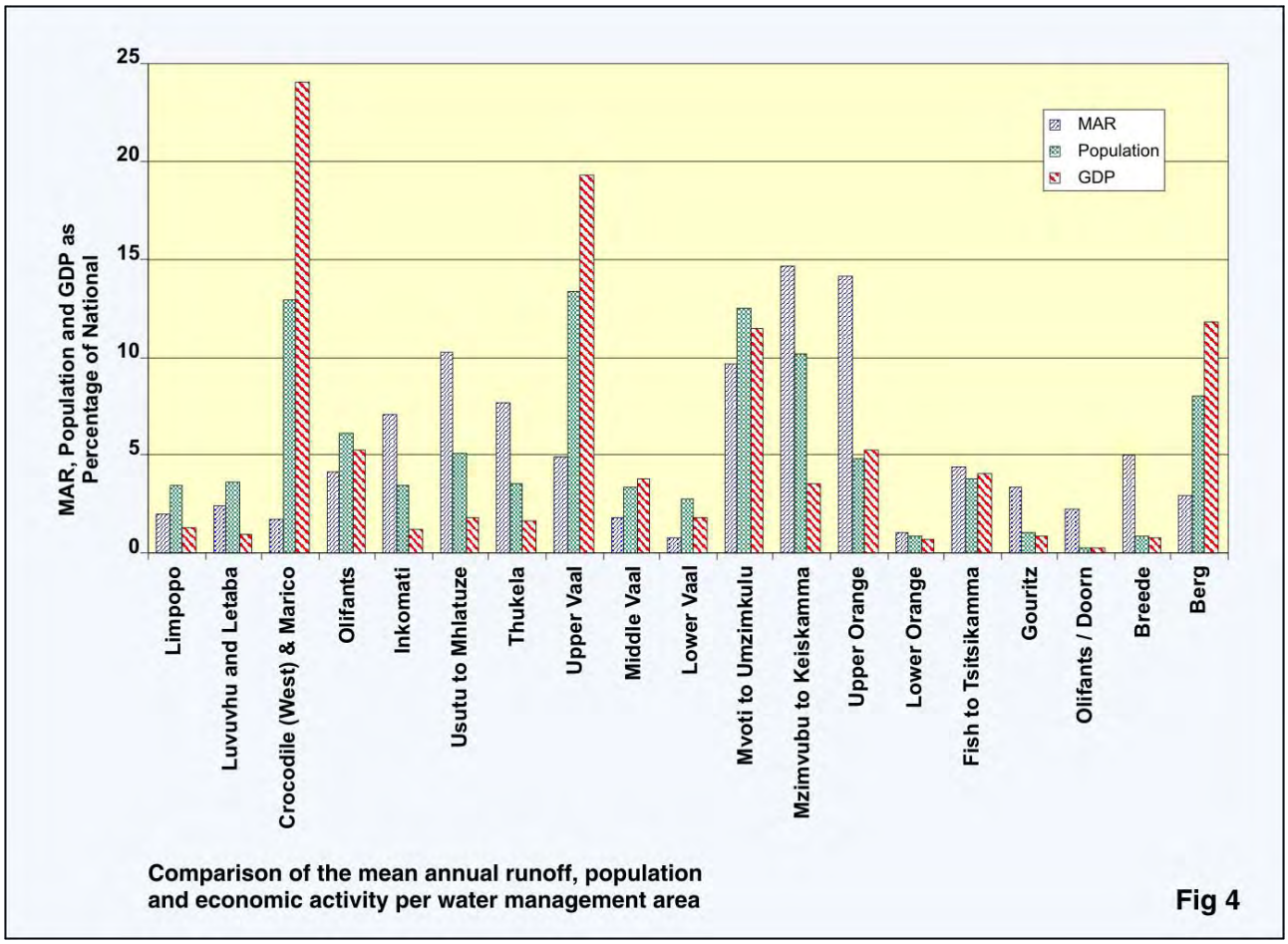
South Africa is located in a predominantly semi-arid part of the world. The climate varies from desert and semi-desert in the west to sub-humid along the eastern coastal area, with an average rainfall for the country of about 450 mm per year, well below the world average of about 860 mm per year, while evaporation is comparatively high. As a result, South Africa's water resources are, in global terms, scarce and extremely limited in extent. More than 90% of the water use in the country is supplied from surface resources, whereas groundwater plays a pivotal role in especially rural water supplies. Due to the predominantly hard rock nature of the South African geology, few major groundwater aquifers exist that could be utilised on a large scale.

Attributable to poor spatial distribution of rainfall over South Africa, the natural availability of water across the country is also highly uneven. This is compounded by the strong seasonality of rainfall over virtually the entire country as well as the high within-season variability of rainfall and consequently of runoff. As a result, streamflow in South African rivers is at relatively low levels for most of the time, with sporadic high flows occurring; characteristics which limit the proportion of streamflow that can be relied upon to be available for use. To aggravate the situation, most urban and industrial development, as well as some dense rural settlements, have been established in locations remote from large watercourses; dictated by the occurrence of mineral riches and influenced by the political dispensation of the past, rather than by the plentiful availability of water. As a consequence, the requirements for water already far exceed the natural availability of water in several river basins. Widely spread and often large-scale transfers of water across catchments have, therefore, been implemented in South Africa in the past.

Of the 19 water management areas in the country, only the Mzimvubu to Keiskamma water management area is currently not linked to another water management area through inter-catchment transfers, giving effect to one of the main principles of the National Water Act which designates water as a national resource. Eleven water management areas share international rivers.

A graphical comparison of the natural occurrence of water, the population and the economic activity per water management area is given in **Figure 4**, clearly demonstrating the exceedingly varied conditions among the water management areas.

Water, which is naturally of poor quality, also occurs in some areas, which limits its utilisation. This applies to both surface and groundwater. Where feasible, special management techniques may be applied to improve water quality to appropriate standards for particular uses.



Comparison of the mean annual runoff, population and economic activity per water management area

Fig 4

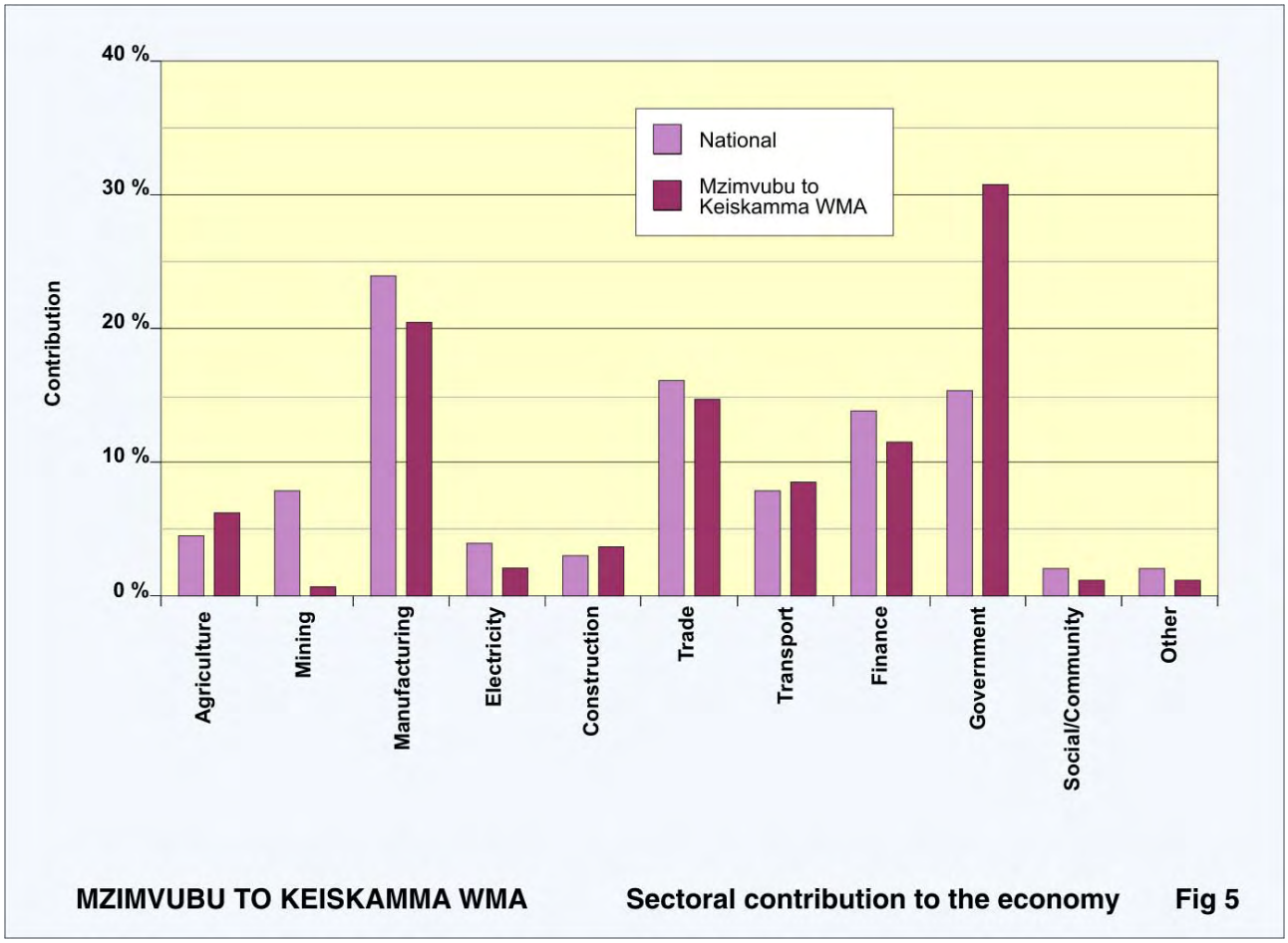
Whereas attention in the past was mainly focussed on the development of new resources as the requirements for water increased, partly as large unused potential was still available, the efficiency of water use has not developed to the same level of sophistication as resource management. With the current high degree of water resource utilisation in the country, the efficiency of water use must be substantially improved. The Department of Water Affairs and Forestry is developing an extensive programme for water conservation and water demand management which forms an important element of the National Water Resource Strategy. In addition, measures are being introduced to ensure the most beneficial utilisation of water in the country, both from a social and economic perspective. This will include the re-allocation of some water from low benefit uses to higher benefit uses over time.

3. ECONOMIC ACTIVITY AND POPULATION

3.1 Regional Economy

About 3,5 % of the Gross Domestic Product (GDP) of South Africa originates from the Mzimvubu to Keiskamma water management area, which is relatively small compared to the large population in the water management area (refer to 3.2). The composition of the economy in the Mzimvubu to Keiskamma water management area in terms of the contribution to the Gross Geographic Product (GGP), and in comparison to the national averages, is shown in **Figure 5**. Explanations of the sectors is given in Addendum 2. The largest economic sectors (1997) in the water management area, in terms of GGP, were:

- Government 30,8 %
- Manufacturing 20,4 %
- Trade 14,7 %
- Finance 11,4 %



MZIMVUBU TO KEISKAMMA WMA Sectoral contribution to the economy Fig 5

The government sector contributes the largest share of the gross geographic product. One of the factors contributing to the importance of this sector is the presence of government services in the capital of the former Ciskei, Bisho, which now houses the provincial legislature. It can be expected that some of these activities will decline as East London plays an increasingly important role in accommodating the Eastern Cape provincial government offices. The relative importance of the government sector is also partly attributable to the relatively small contribution of the primary production sectors of the economy.

Activity in the manufacturing sector is dominated by the automotive, and textile and clothing industries. Mercedes Benz South Africa (MBSA) is the largest truck horse manufacturer in Africa and is the third largest Mercedes Benz manufacturing plant outside Germany. It also is one of the leading auto export companies in South Africa. Da Gama Textiles, which manufactures polyester-cotton fabrics, is one of the largest of its kind in the country. The food industry is also strong and the country's largest pineapple processing plants are operating in the East London area.

Trade is an important element of the activities around the East London harbour, while the finance sector mainly operates in support of other activities.

Tourism is also active along the coast at places like Port St Johns and Coffee Bay along the Wild Coast, and Hogsback in the Amatola Mountains. Sheep and cattle farming provide a living for rural subsistance farmers. There is extensive commercial forestry in the water management area, while crops such as citrus, pineapples and chicory are grown on commercial farms.

Most of the economic production is concentrated in the East London area from where more than 35% of the gross geographic product in the water management area originates.

Of the work force of just over one million people in the water management area in 1994, 42% were active in the formal economy and 48% were unemployed, which is substantially higher than the national unemployment average of 29%. Of those formally employed, 40% were active in the community services sector, i.e. government and social services, while 17% were involved in manufacturing and 16% in agriculture.

Attributable to the generally favourable climate a wide variety of products can be grown in the water management area, which gives a comparative advantage to the agricultural sector compared to the remainder of South Africa. The transport sector benefits from the East London harbour and airport as major assets as well as the Umtata airport. A current advantage has been identified with respect to the construction industry which could be ascribed to the numerous housing projects initiated in the area.

The main opportunities for potential economic growth in the water management area are with respect to increasing industrialisation, intensification of agriculture, expansion of

afforestation and tourism. Potential also exists for mining of heavy metals in the coastal sands.

3.2 Demography

A detailed study of the population distribution in the country and of the expected future demographic and economic changes was conducted to serve as background to the estimation of future water requirements. Different scenarios were developed as described in Addendum 1. Demographic information pertinent to the Mzimvubu to Keiskamma water management area is captured below.

The Mzimvubu to Keiskamma is the third most populous water management area in the country which, when compared to the economic production in the water management area, indicates a lower per capita economic contribution than the average for the country. However, distribution of wealth is highly varied in the water management area and large differences in standard of living prevail. The population is distributed throughout most of the water management area, with over 70% of the population classified as rural. In the Mbashe, Wild Coast and Mzimvubu sub-areas the rural portion of the population can be as high as 95%. In the Amatola sub-area which includes East London, 66% of the population is regarded as living in an urban environment. Part of the reason for the large rural component of the population can be ascribed to the decentralisation policy of the previous government.

The future demography of the water management area will largely be influenced by economic opportunities and potential as well as the general trends towards urbanisation in the country. Projections therefore are for continued growth in the Amatola sub-area, attracted by the greater economic activity and employment opportunities in the East London area. The population in the other sub-areas as well as for the water management area as a whole is expected to have a slow decline after 2005 as shown in **Figure 6**. This is attributable to a combination of factors which include the lack of strong economic stimulants in most parts of the water management area together with the impacts of HIV/AIDS and migration towards cities (also outside the water management area).

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4. WATER REQUIREMENTS

4.1 Current requirements (year 2000)

Despite the large population, the Mzimvubu to Keiskamma water management area is one of the water management areas with the lowest total requirements for water in the country. This can largely be attributed to the relatively high rainfall in the water management area as well as the generally low level of economic activity.

About 50% of the total water requirements in the water management area is for irrigation, nearly 30% for urban and industrial use and the remainder for rural water supplies (domestic and stock watering) and afforestation. A summary of the sectoral water requirements in each of the sub-areas is given in **Table 1** and is diagrammatically shown in **Figure 7**. All the requirements are given at a standard 98% assurance of supply, as explained in Addendum 3.

Table 1: Year 2000 Water Requirements (million m³/a)

Sub-area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Power generation (3)	Affore-station (4)	Total local require-ments	Transfers out	Grand Total
Mzimvubu	15	6	9	0	0	3	33	0	33
Mtata	4	15	5	0	0	29	53	0	53
Mbashe	3	2	6	0	0	0	11	0	11
Kei	135	18	10	0	0	11	174	85	259
Amatola	33	57	5	0	0	4	99	0	99
Wild Coast	0	1	3	0	0	0	4	0	4
Total	190	99	38	0	0	47	374	0	374

1) Includes component of Reserve for basic human needs at 25 ℓ/c/d.
2) Mining and bulk industrial water uses which are not part of urban systems.
3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
4) Quantities given refer to impact on yield only.

The bulk of the urban and industrial requirements for water is in the Amatola sub-area, mainly for supply to East London and environs. Irrigation in the water management area is mostly practised in the Kei sub-area, with significant irrigation developments also in the Amatola sub-area and in the northern parts of the Mzimvubu River catchment. Water requirements in the Mbashe and Wild Coast sub-areas are small, with most of the water being used for rural domestic purposes and stock watering.

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A feature of irrigation in the drier parts of the Kei River catchment is that, although large areas can be irrigated, this only occurs in years of high runoff when sufficient water is available. In most years therefore, only part of the total area developed for irrigation, will actually be irrigated. As a consequence, water use by irrigation in these parts is highly variable from year to year, with much of it at a very low assurance of supply. Some supplementary irrigation of tea is practised in the Wild Coast sub-area. Included in Table 1 is the estimated average water use by irrigation, expressed at the standardised 98% assurance of supply, which is substantially less than the volume of water which may be used when sufficient water is available (refer to Appendix 3 for more detail on irrigation water requirements).

Substantial quantities of water are also used for hydropower generation in the Mtata and Kei River catchments; the power generation in the Mbashe River catchment being with water transferred from the Kei River catchment. As the water which flows through the power generation turbines remains available for other uses downstream, it is not regarded as a primary use and is therefore not reflected in Table 1.

A substantial proportion of water used in the urban and industrial sectors is used non-consumptively and again becomes available as effluent. At the larger centres, most or all of the effluent is discharged back to the rivers after appropriate treatment, from where it can potentially be re-used. Effluent from smaller towns typically evaporates from maturation ponds, or may be absorbed by irrigation and infiltration. In the case of East London, the urban effluent is discharged offshore into the ocean.

Estimates of return flows for the urban sector are given in Appendix 1, which also shows the quantities of water estimated to be lost through the urban distribution systems. Similar information with respect to irrigation is contained in Appendix 3.

4.2 Future requirements

There are many factors which influence the requirements for water. These include climate, nature of the economy (i.e. irrigated agriculture, industrialised) and standards of living. Of these, climate is relatively stable, while in most cases control can be exercised over the growth in irrigation water requirements. Population and economic activity, however, have their own inherent growth rates which are dependent on a wide spectrum of extraneous influences. Population growth and economic growth, which also relates to socio-economic standards, are therefore regarded as the primary determinants with respect to future water requirements.

Based on the scenarios for population and economic growth, initial estimates of possible future water requirements were made for the period until 2025. In addition, provision was made for known and probable future developments with respect to power generation, irrigation, mining and bulk users as described under the respective sub-areas where

applicable. (Specific quantities, rather than a general annual growth rate, were allowed for in these sectors.)

Within the spectrum of population and economic growth scenarios, a base scenario was selected for estimating the most likely future water requirements. This is built on the high scenario of population growth and more equitable distribution of wealth leading in time to higher average levels of water services. The ratio of domestic to public and business (commercial, communal, industrial) water use for urban centres in the year 2000, for the respective centres, is maintained. A possible upper scenario of future water requirements, is also given, based on the assumption that there will be high population growth and a high standard of services (socio-economic development); together with a strong increase in the economic requirements for water, where the public and business use of water would increase in direct proportion to the gross domestic product. The purpose of the upper scenario is to provide a conservative indicator in order to prevent the occurrence of possible unexpected water shortages. No adjustments have been made for reflecting the impacts of increased water use efficiency.

General trends in the Mzimvubu to Keiskamma water management area are the continued concentration of economic development in the East London area and increasing urbanisation of the population. Growth in the urban water requirements can therefore be expected in the Amatola sub-area, with the rate of growth strongly dependent on the rate of economic development. Some growth in urban water requirements is also expected in the Mtata and Kei sub-areas because of expected improvements in the urban water supply systems and standards of living.

No meaningful change in the urban and rural requirements for water is foreseen in the Mzimvubu, Mbashe and Wild Coast sub-areas as well as with respect to the rural requirements in the Mtata and Kei sub-areas. Refurbishment of existing (but neglected) irrigation schemes as well as possible new irrigation developments and expansion of commercial afforestation could significantly impact on the requirements for water. Localised growth in water requirements could also occur along the coast because of tourism and possible mining development.

Quantification of the projected future requirements for water is presented in **Tables 2** and **3** for the base and high scenarios respectively, and is further discussed in Section 6.

Table 2: Year 2025 base scenario water requirements (million m³/a)

Sub-area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Power generation (3)	Affore-station (4)	Total local require-ments	Transfers out	Grand Total
Mzimvubu	15	8	8	0	0	3	34	0	34
Mtata	4	24	4	0	0	29	61	0	61
Mbashe	3	2	5	0	0	0	10	0	10
Kei	135	23	10	0	0	11	179	85	264
Amatola	33	83	5	0	0	4	125	0	125
Wild Coast	0	1	3	0	0	0	4	0	4
Total	190	141	35	0	0	47	413	0	413

1) Includes component of Reserve for basic human needs at 25 ℓ/c/d.
2) Mining and bulk industrial water uses which are not part of urban systems.
3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
4) Quantities given refer to impact on yield only.

Table 3: Year 2025 high scenario water requirements (million m³/a)

Sub-area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Power generation (3)	Affore-station (4)	Total local require-ments	Transfers out	Grand Total
Mzimvubu	15	9	8	0	0	3	35	0	35
Mtata	4	17	4	0	0	29	54	0	54
Mbashe	3	2	5	0	0	0	10	0	10
Kei	135	29	10	0	0	11	185	85	270
Amatola	33	119	5	0	0	4	161	0	161
Wild Coast	0	1	3	0	0	0	4	0	4
Total	190	177	35	0	0	47	449	0	449

1) Includes component of Reserve for basic human needs at 25 ℓ/c/d.
2) Mining and bulk industrial water uses which are not part of urban systems.
3) Includes water for thermal power generation only. (Water for hydropower, which represents a small portion of power generation in South Africa, is generally available for other uses as well.)
4) Quantities given refer to impact on yield only.

5. WATER RESOURCES

5.1 Surface Water

The Mzimvubu to Keiskamma water management area is the water management area with the highest mean annual runoff in South Africa, representing nearly 15% of the total river flow in the country. About 40% of the total surface runoff from the water management area is from the Mzimvubu River catchment, and about 14% each from both the Kei and Mbashe River catchments (excluding the small coastal rivers between). The remainder of the runoff being from rivers such as the Keiskamma and Mtata together with smaller coastal rivers. Due to the rolling topography there are no natural lakes in the water management area, although some wetlands are found in the vicinity of Kokstad. Many of the estuaries in the water management area are still in a relatively pristine state, although not of a particularly high ranking from a species conservation perspective. There are extensive commercial forests in several parts of the water management area, while relatively large areas of invasive alien vegetation are also found. (Refer to Appendix 4). Excessive sediment runoff is experienced in some catchments as a result of over-grazing. A summary of the natural mean annual runoff (MAR), together with the estimated requirements for the ecological component of the Reserve, are given in Table 4. More detail on the estimation of the Reserve is also given in Addendum 4.

Table 4: Natural Mean Annual Runoff and Ecological Reserve (million m³/a)

Sub-area	Natural MAR (1)	Ecological Reserve (1, 2)
Mzimvubu	2 897	338
Mtata	836	163
Mbashe	1 126	203
Kei	1 027	154
Amatola	559	116
Wild Coast	796	148
Total	7 241	1 122

1) Quantities given are incremental, and refer to the sub-area under consideration only.
2) Total volume given, based on preliminary estimates. Impact on yield being a portion of this. Refer to Appendix 4.

It is important to note that the data with respect to the mean annual runoff as well as the ecological component of the Reserve have been taken from national data sources, for the purpose of compatibility of the water management area information in the National Water Resource Strategy. In many instances more detailed studies have been conducted or are under way, from which improved information may be obtained (also on items other than the MAR and Reserve), and which should be referred to with respect to detail planning and design work.

In the natural state the quality of surface water is good over most of the water management area, except for high turbidity during flood flows. Water in some of the tributary rivers in the western part of the water management area is of natural high salinity, due to the geology and arid climate in the region. In many of the densely populated rural areas, bacteriological pollution of streams occur as a result of insufficient sanitation services. Severe water quality problems are also experienced in the lower reaches of the Buffalo River as a result of effluent (mainly from the textile industries) being discharged into the river.

Various surface water projects have been developed in the water management area. The main storage dams, for which more details are given in Appendix 5, are:

- Sandile, Rooikrantz, Laing, Bridle Drift, Nahoon and Binfield Park Dams in the Amatola sub-area.

- Wriggleswade, Waterdown, Xonxa, Doringrivier, Lubisi, Ncora and Butterworth (Xilinxa) Dams in the Kei sub-area.

- Mtata Dam in the Mtatu sub-area.

In addition, hydropower stations have been constructed at Collywobbles (42 megawatts) in the Mbashe River catchment which receives water from Ncora Dam (2,4 megawatts) in the Kei River catchment, and at First Falls (7 megawatts) and Second Falls (11 megawatts) on the Mtata River. There are no large dams in the Mbashe, Mzimvubu and Wild Coast sub-areas.

Significant potential for further development of surface water resources exists in the Mzimvubu to Keiskamma water management area, particularly in the Mzimvubu River catchment which is one of the rivers with the highest mean annual runoff in the country and which has not been regulated yet. Suitable sites for the possible construction of large dams have been identified on all the major tributaries of the Mzimvubu River as well as on the main stream of the river. Conceptual studies have been conducted for the possible transfer of water to the Vaal River System and other water management areas, and with respect to possible hydropower developments. Potential for further development of surface water resources also exists in the other sub-areas. (Refer to Table 7 in Section 6.1).

5.2 Groundwater

Although significant quantities of water could be abstracted from groundwater in the water management area, the actual utilisation is relatively small over most of the water management area. This is mainly attributable to the generally well-watered nature of the water management area and the wide occurrence of perennial surface streams, which reduces the need for groundwater abstraction.

Strong inter-dependence between surface water and groundwater also occurs over most of the water management area, with a large portion of the surface flow (base flow) originating from groundwater, particularly in the coastal areas. Large abstraction of groundwater will therefore have substantial impacts on surface water flows.

Greater use is made of groundwater in the drier western parts of the water management area, and relatively large quantities of groundwater are abstracted in the Kei sub-area. Groundwater is mainly used for rural domestic purposes and stock watering as well as for supplies to towns and rural settlements. Substantial irrigation from groundwater is practised in the vicinity of Queenstown, where some over-exploitation of groundwater is also experienced.

The quality of groundwater is generally of a high standard. Water of high salinity, however, is found along part of the coast and at some inland locations where the rainfall is low and the geology not favourable. No pollution of groundwater has been recorded.

5.3 Summary

The total water available for use in the Mzimvubu to Keiskamma water management area at the year 2000 development levels, is schematically presented in **Figure 8** and summarised in **Table 5**. Details on factors which influence the yield such as the impacts of the Reserve, invasive alien vegetation, river losses and urban runoff are contained in Appendix 4.

Table 5: Available water in year 2000 (million m³/a)

Sub-area	Natural resource		Usable return flow			Total local yield (1)	Transfers in	Grand Total
	Surface water	Ground-water	Irrigation	Urban	Mining and bulk			
Mzimvubu	84	3	2	2	0	91	0	91
Mtata	129	1	0	6	0	136	0	136
Mbashe	112	1	0	1	0	114	85	199
Kei	325	14	14	6	0	359	0	359
Amatola	122	1	2	24	0	149	0	149
Wild Coast	4	1	0	0	0	5	0	5
Total	776	21	18	39	0	854	0	854

1) After allowance for the impacts on yield of: ecological component of Reserve, river losses, alien vegetation, rain-fed agriculture and urban runoff.

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Particularly evident from Figure 8 and the information presented, is the small yield available from the Mzimvubu River, which is attributable to the lack of any significant water resource developments in the catchment. The water available for abstraction and which can practically be put to use, is essentially only the run-of-river yield, estimated to be about 3% of the MAR (after allowance for the ecological component of the Reserve). Substantial potential for development of surface water resources as well as of groundwater therefore remains in this sub-area. Potential for further water resource developments (surface and groundwater) also exists in the better watered parts in the remainder of the water management area.

Also of importance is the large transfer of water from the Kei to the Mbashe River catchment for hydropower generation at the Collywobbles hydropower station.

6. RECONCILIATION OF REQUIREMENTS AND AVAILABILITY

6.1 Water Balance

A reconciliation of the available water and total requirements for the year 2000 (and 2025), including transfers between sub-areas, is graphically presented in **Figure 9** with quantifications given in **Table 6**. The main transfers with associated quantities are also shown on Figure 1 and summarised in Appendix 6. As the only exception in the country, the Mzimvubu to Keiskamma water management area is presently not linked to any other water management area through the transfer of water.

Table 6: Reconciliation of requirements and available water for year 2000 (million m³/a)

Sub-area	Available water			Water requirements			Balance
	Local yield	Transfers in (2)	Total	Local require-ments	Transfers out (2)	Total	(1)
Mzimvubu	91	0	91	33	0	33	58
Mtata	136	0	136	53	0	53	83
Mbashe	114	85	199	11	0	11	188
Kei	359	0	359	174	85	259	100
Amatola	149	0	149	99	0	99	50
Wild Coast	5	0	5	4	0	4	1
Total	854	0	854	374	0	374	480

1) Brackets around numbers indicate negative balance. Surpluses are shown in the most upstream sub-area where they first become available.

2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. Addition of the transfers per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA. The same applies to Tables 7 and 8.

In general, there is ample water available in the water management area and surpluses exist in all the sub-areas as shown in **Table 6**. However, localised shortages occur in several parts, but which are masked by the averaging over the sub-areas.

In the Amatola sub-area, an overall surplus exists mainly due to some irrigation schemes in the Kei River catchment not being fully operational, whilst the requirements for water from the Rooikrantz Dam are in excess of the yield from the dam. The surplus reflected for the Kei sub-area is also attributable to some of the irrigation schemes not being fully operational and some soils not being suitable for irrigation, resulting in surplus yield being available from the relevant dams. A similar situation exists in the Mbashe and Mtata sub-areas, where all the water potentially available for irrigation is not being fully utilised. Water is also transferred into the Mbashe River catchment for hydropower generation and without the downstream utilisation thereof. Surplus water is also shown to be available in the

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Mzimvubu and Wild Coast sub-areas, where most of the water is abstracted from run-of-river.

A perspective on the possible future situation is given by **Table 7** for the base scenario, and **Table 8** as a possible high water use scenario. (Refer to Addendum 1.) It is also graphically presented in Figure 9. Commensurate with the small decline in population projected for the rural parts of the water management area, little change in the requirements for water is expected over most of the water management area. The growth in water requirements in the Mtata and Kei sub-areas being attributable to an expected increase in standards of living. (For the high scenario, where water use is more directly linked to economic growth, a smaller growth in water requirements is expected in the Mtata sub-area than under the base scenario, due to the lack of stimulants for economic growth in this area.) Growth in water requirements is also shown for the Amatola sub-area due to urbanisation and industrial development expected in the East London area. Localised needs for additional water are foreseen at Queenstown as well as for tourism and mining developments along the coast.

Table 7: Reconciliation of water requirements and availability for the year 2025 base scenario (million m³/a)

Sub-area	Available water			Water requirements			Balance	Potential for development
	Local yield (1)	Transfers In	Total	Local requirements (2)	Transfers out	Total	(3)	(4)
Mzimvubu	91	0	91	34	0	34	57	1 200
Mtata	141	0	141	61	0	61	80	45
Mbashe	115	85	200	10	0	10	190	65
Kei	360	0	360	179	85	264	96	135
Amatola	159	0	159	125	0	125	34	55
Wild Coast	5	0	5	4	0	4	1	0
Total	871	0	871	413	0	413	458	1 500

1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from growth in requirements.
2) Based on growth in water requirements as a result of population growth and general economic development. Assumed no general increase in irrigation.
3) Brackets around numbers indicate negative balance.
4) Based on construction of a number of dams within the WMA.

In general, surplus water will continue to be available throughout the water management area, much of which will be taken up through the revitalisation of existing irrigation schemes (and which has not been allowed for in the above tables). Significant potential also exists for the expansion of commercial forests and possible new irrigation developments in the water management area.

Compared to the natural MAR of 7 241 million m^3 per year which originates from the water management area, an estimated 6 668 million m^3 per year or 92% of the MAR still flows out of the water management area towards the ocean.

Table 8: Reconciliation of water requirements and availability for the year 2025 high scenario (million m³/a)

Sub-area	Available water			Water requirements			Balance	Potential for develop-ment
	Local yield (1)	Transfers In	Total	Local require-ments (2)	Transfers out	Total	(3)	(4)
Mzimvubu	92	0	92	35	0	35	57	1 200
Mtata	138	0	138	54	0	54	84	45
Mbashe	115	85	200	10	0	10	190	65
Kei	362	0	362	185	85	270	92	135
Amatola	174	0	174	161	0	161	13	55
Wild Coast	5	0	5	4	0	4	1	0
Total	886	0	886	449	0	449	437	1 500

1) Based on existing infrastructure and infrastructure under construction in the year 2000. Also includes return flows resulting from growth in requirements.
2) Based on high growth in water requirements as a result of population growth and high impact of economic development. Assumed no general increase in irrigation.
3) Brackets around numbers indicate negative balance.
4) Based on construction of a number of dams within the WMA.

6.2 Key issues

Key considerations with respect to the Mzimvubu to Keiskamma water management area are:

- Significant potential for further water resource development exists in the water management area, with the Mzimvubu River as the largest undeveloped river in the country.

- Much of the water resources already developed are not being fully utilised, mainly because of disrepair and neglect of existing irrigation schemes as well as due to soils not being suitable for irrigation. Distribution losses of as high as 90% has been recorded.

- Poor water quality in the lower reaches of the Buffalo River, resulting mainly from the discharge of industrial effluent into the river.

- Further growth in urban and industrial water requirements is expected to largely be concentrated in the East London area. Small quantities of water are needed to provide

for growth in urban requirements at Queenstown and for tourist developments along the coast, while shortages currently occur downstream of Rooikrantz Dam. There is also a strong likelihood of mining developments at locations along the coast.

- With much of the rural and village requirements for water being supplied from unregulated run-of-river yields, some dry-season deficits may occur with respect to the provisions for the ecological component of the Reserve, once it is implemented.

- Significant potential exists for additional afforestation as well as for possible hydropower and irrigation developments. Water may over the long term also in future be required for transfer to other water management areas (such as for augmentation of the Vaal River System).

- There is a strong need for improved hydrological observation in parts of the water management area.

6.3 Strategic perspectives

Despite the abundant availability of water and a large population, economic activity is of a relatively low intensity over most of the water management area. Expectations are that economic production and growth will continue to be dominated by activity in the East London area, and that a small decline in population is likely to occur over the remainder of the water management area. Potential exists for additional afforestation, the intensification of agriculture and some mining and tourism developments along the coast.

Strategic perspectives on the main interventions and options with respect to the future availability and optimal utilisation of water in the Mzimvubu to Keiskamma water management area are concisely described below. A general description of options for the reconciliation of the requirements for and availability of water is given in Addendum 5.

Mzimvubu sub-area

Significant potential for large-scale water resource developments exists in the Mzimvubu River catchment, and several options for development have been identified. The economic feasibility thereof will, however, depend on investments by large anchor users and new developments are unlikely to be affordable for irrigation alone.

Large areas suitable for afforestation are also found in this sub-area. Expansion of afforestation will, however, result in a reduction in runoff and the impacts thereof on the ecological component of the Reserve as well as on run-of-river users will have to be carefully assessed and appropriate remedial measures be implemented.

Wild Coast sub-area and coastal rivers

Mainly small-scale developments are foreseen along the coast, such as for tourism and irrigation of specialised crops. Afforestation can also be viable in some parts, while mining of the coastal dunes is likely along the strip between the Mbashe and Kei Rivers.

All these developments are to be dealt with on a localised basis. Groundwater, run-of-river abstraction and small surface water developments being the most likely sources of water.

Mtata sub-area

Potential exists for the expansion of afforestation in the coastal area, subject to the same considerations as apply to the Mzimvubu sub-area.

Some pollution of the Mtata River occurs as a result of urban wash-off and return flows. The strict enforcement of effluent standards is required.

Mbashe sub-area

Similar to the Mzimvubu sub-area and some other parts, potential exists for the expansion of afforestation. The irrigation potential with water transferred from the Ncora Dam has also not been fully developed.

Kei sub-area

Several irrigation schemes are in a poor state of repair and are largely under-utilised. Priority should be given to the revitalisation of these schemes; which will require that aspects such as land tenure, technical extension services, organisational and business structures, etc. be appropriately addressed.

Augmentation from Xonxa Dam has been identified as a feasible option for the supply of additional water to Queenstown (after the implementation of water demand management). Water may also be re-allocated (purchased) from irrigation.

Amatola sub-area

The effective implementation of water demand management is a standard pre-requisite, before resorting to further resource development and transfers. The main options for augmentation of the water supply to urban and industrial users in the East London area are the transfer of water from Wriggleswade Dam and thereafter from Sandile Dam. Other options include further regulation of some local rivers and the possible re-use of effluent. No further afforestation should be allowed in this sub-area, while the feasibility of eradicating invasive alien vegetation should be investigated.

Current deficits below Rooikranz Dam should be addressed through compulsory licensing and possible transfers from Wriggleswade Dam. The management of water quality in the Buffalo River will require strict enforcement of effluent standards, and could be further improved through blending with water from Wriggleswade Dam.

Attention should be given to the revitalisation of irrigation schemes in the catchment of the Keiskamma River.

General

Improved estimates of the water requirements for the ecological component of the Reserve is essential to the evaluation of water use allowances and to determine possible compensatory measures. A programme should therefore be developed for determination of the Reserve in order to support initiatives for development in the water management area. A programme is also required for improvement of the hydrological database.

Estimates of future water requirement for domestic and urban/industrial use in the water management area should be reviewed against the latest demographic and economic scenarios.

6.4 Transfers and reservation of water

The transfer of water between water management areas as well as provisions for future growth and strategic use resort under national control.

In view of the fact that the Mzimvubu River is the largest undeveloped water resource in the country, the benefits to be derived from the development of this river will potentially be of national importance. It is prudent therefore, for large-scale development of the Mzimvubu River to be made subject to authorisation at national level. With appropriate planning, possible new dams for hydropower generation and irrigation for example, can be located and designed in such a way to also enable future abstraction of water for transfer to other water management areas. The possibility of such future developments of national importance should not be jeopardised unduly by other developments in the interim – Reservation with respect to large-scale development of the Mzimvubu River therefore applies to the Mzimvubu to Keiskamma water management area.

There are no international or inter-water management area transfers of water into or from the Mzimvubu to Keiskamma water management area which resorts under national control.

REFERENCES

1. *First Edition National Water Resource Strategy*, DWAF, for publication in 2003.

2. *Reports on Water Resources Situation Assessment Studies:*
Water Resources Situation Assessment - Mzimvubu to Keiskamma WMA: DWAF Main Report No 12000/00/0301. August 2001.

3. *The Distribution of South Africa's Population, Economy and Water Usage into the Long Term Future***:** Schlemmer,L; and Markdata (Pty) Ltd for DWAF, 2001.

4. *Water Situation Assessment Model: Data Preparation and Processing*: Craig, AR and Taviv, I. DWAF Report P.RSA/00/2401, March 2001.

5. *Economic Information System 2000.* Urban Econ for DWAF, 2000.

6. *Alien Invading Plants and Water Resources in South Africa: A Preliminary Assessment*. Versveld, DB; Le Maitre, DC; and Chapman, RC. Water Research Commission, September 1998.

7. *The Impacts of Timber Plantations on Runoff in South Africa: A Handy Reference Manual*, Le Maitre, DC; Scott, DF; and Fairbanks, DHK. CSIR Stellenbosch, July 1, 1997.

8. *Preparation of Climate Data and Information for Application in Impact Studies of Climate Change over South Africa*: (Report to South African Country Studies for Climate Change Programme), School of Bioresources Engineering and Environmental Hydrology, University of Natal, Pietermaritzburg, ACRUcons. Report 32 January 2000. Perks, LA; Schulze, RE; Kiker, GA; Horan, MJC; Maharaj, M.

9. *Assessment of the Impact of Climate Change on Hydrology and Water Resources in South Africa*: (Report to South African Country Studies for Climate Change Programme), School of Bioresources Engineering and Environmental Hydrology, University of Natal, Pietermartizburg, ACRUcons Report 33 January 2000. Schulze, RE; and Perks, LA.

10. *National Water Resource Quality Status Report: Inorganic Chemical Water Quality of Surface Water Resources in South Africa – The Big Picture;* Hohls, Silberbauer, Kühn, Kempster, van Ginkel; DWAF Report N/0000/REQ0801, April 2002.

11. *Assessment of the conservation priority status of South African estuaries for use in management and water allocation.* J K Turpie et al, Water SA Vol 28 No 2, April 2002.

12. **Reports on Overview of Water Resources Availability and Utilisation:**

12.1 Limpopo Water Management Area
Report No. P WMA01000/00/0203

12.2 Luvuvhu and Letaba Water Management Area
Report No. P WMA02000/00/0203

12.3 Crocodile (West) and Marico Water Management Area
Report No. P WMA03000/00/0203

12.4 Olifants Water Management Area
Report No. P WMA04000/00/0203

12.5 Inkomati Water Management Area
Report No. P WMA05000/00/0203

12.6 Usutu to Mhlatuze Water Management Area
Report No. P WMA06000/00/0203

12.7 Thukela Water Management Area
Report No. P WMA07000/00/0203

12.8 Upper Vaal Water Management Area
Report No. P WMA08000/00/0203

12.9 Middle Vaal Water Management Area
Report No. P WMA09000/00/0203

12.10 Lower Vaal Water Management Area
Report No. P WMA10000/00/0203

12.11 Mvoti and Umzimkulu Water Management Area
Report No. P WMA11000/00/0203

12.12 Mzimvubu to Keiskamma Water Management Area
Report No. P WMA12000/00/0203

12.13 Upper Orange Water Management Area
Report No. P WMA13000/00/0203

12.14 Lower Orange Water Management Area
Report No. P WMA14000/00/0203

12.15 Fish to Tsitsikamma Water Management Area
Report No. P WMA15000/00/0203

12.16 Gouritz Water Management Area
Report No. P WMA16000/00/0203

12.17 Olifants/Doorn Water Management Area
Report No. P WMA17000/00/0203

12.18 Breede Water Management Area
Report No. P WMA18000/00/0203

12.19 Berg Water Management Area
Report No. P WMA19000/00/0203

APPENDICES

APPENDIX 1 : URBAN WATER REQUIREMENTS (year 2000)

APPENDIX 2 : RURAL WATER REQUIREMENTS (year 2000)

APPENDIX 3 : IRRIGATION WATER REQUIREMENTS (year 2000)

APPENDIX 4 : FACTORS INFLUENCING RUNOFF AND YIELD (year 2000)

APPENDIX 5 : MAJOR DAMS DATA

APPENDIX 6 : DETAILS OF MAIN TRANSFERS (year 2000)

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ADDENDA

ADDENDUM 1 : BACKGROUND ON DEMOGRAPHIC AND ECONOMIC STUDIES

ADDENDUM 2 : ECONOMIC SECTOR DESCRIPTION (for GGP and Labour Distribution)

ADDENDUM 3 : YIELD, RELIABILITY, AVAILABLE WATER AND ASSURANCE OF SUPPLY

ADDENDUM 4 : ECOLOGICAL COMPONENT OF RESERVE

ADDENDUM 5 : RECONCILIATION INTERVENTIONS

ADDENDUM 6 : PRIORITIES FOR ALLOCATING WATER

ADDENDUM 7 : INTER CATCHMENT TRANSFER OF WATER

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