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THE DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE CROCODILE WEST WATER SUPPLY SYSTEM

Water Resource Reconciliation Strategy

Version 1
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THE DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE CROCODILE (WEST) WATER SUPPLY SYSTEM

VERSION 1 OF THE CROCODILE (WEST) RECONCILIATION STRATEGY

EXECUTIVE SUMMARY

Background

The first edition of the National Water Resource Strategy (NWRS) for South Africa, published in 2004, gives clear directives and strategies for the overall management of the country's water resources, and provides the framework within which catchment management strategies are to be developed.

The catchment area of the Crocodile (West) River is one of the most developed in the country. It is characterized by the sprawling urban and industrial areas of northern Johannesburg and Pretoria, extensive irrigation downstream of Hartbeespoort Dam and large mining developments north of the Magaliesberg. As a result, the Crocodile River is one of the rivers in the country that has been most influenced by human activities, and where more specific management strategies are of paramount importance.

Following on the NWRS and subsequent supporting work, the purpose of this study is to formulate a detailed strategy to ensure the sufficient and reliable supply of water of appropriate quality to all existing as well as future users. This should be achieved within the framework of the best utilisation of water resources, at the lowest cost and in an environmentally sustainable manner.

Current Situation

The water resources that naturally occur in the catchment have already been fully developed and most of the tributaries as well as the main stem of the Crocodile (West) River are highly regulated. Because of the extensive developments and level of human activity in the catchment, however, water use in the catchment by far exceeds the water available from the local sources – already by a factor of more than fourfold. Most of the water used in the catchment is therefore supplied from the Vaal River system via Rand Water, mainly to serve the metropolitan areas and some mining developments. This in turn results in large quantities of effluent from the urban and industrial users, most of which is discharged to the river system after treatment, for re-use downstream. In many of the streams and impoundments, water quality is severely compromised by the proportionate large return flows.

Future Scenarios

The Strategy should cater for existing and future needs. It should therefore be cognisant of possible future scenarios and impacts to ensure that it be sufficiently comprehensive and flexible to enable quick response under changing circumstances.

Scenarios with respect to population growth, economic growth, socio-economic changes and possible transfers of water are covered in the report.

It is anticipated that the current development trends will continue for the foreseeable future. Strong growth in the urban/industrial sectors is expected to continue in and around the existing metropolitan areas located in the upper parts of the catchment. New mining developments will mainly occur in the middle and lower parts of the catchment. Large new developments related to mining, power and petro-chemical industries are also being planned in the neighbouring Mokolo River catchment, with the expectation that water could be supplied from or via the Crocodile River.

No nett increase in irrigation water use is foreseen.

Key factors

The Strategy should be responsive to key factors that may influence achieving the goals of the Strategy. The key factors which were identified as relating to the current situation and with particular relevance to the scenarios that may be anticipated, are:

- *Growth in water requirements*
- *Natural water resources already fully developed*
- *Strong dependence on transfers from the Vaal River system*
- *Already large and increasing volumes of return flows*
- *Implementation of the Reserve*
- *Water quality*
- *Linkages to neighbouring catchments*

It is recognised that these influencing factors are inextricably linked together through various complex inter-relationships and are not to be viewed in isolation.

Water balances

Given the underlying purpose of the Strategy to reconcile the requirements for water with the availability thereof, various water balance scenarios were developed.

Estimates were made of the current and future requirements for water, for the following sectors:

- *Urban, which comprise (i) domestic or household use of water and (ii) commercial, industrial and public use of water.*
- *Rural water requirements, which includes domestic use and stock watering.*
- *Irrigation requirements for commercial agriculture.*
- *Mining water requirements.*
- *Power generation.*
- *Transfers of water to neighbouring areas. This mainly relates to the Lephalale area, for which different development scenarios were also considered.*

The following main components were considered with respect to the availability of water:

- *Local resources, which comprise (i) surface water, (ii) groundwater and (iii) increases in runoff from paved urban areas.*
- *Return flows from urban areas as well as from irrigation.*
- *Transfers of water from the Vaal River system.*

Specific consideration was given to Water Conservation and Demand Management (WCDM), and the influences of different levels of WCDM were investigated.

Water balances were determined for different reference dates for the following representative scenarios with respect to the Crocodile River catchment, and with the later superposition of the development scenarios for the Lephalale area:

- *High population growth, medium efficiency water demand management.*
- *Base population growth, medium efficiency water demand management.*
- *Low population growth, medium efficiency water demand management.*
- *High population growth, high efficiency water demand management.*

Reconciliation and Management Strategy

Potential options to reconcile the requirements for water with the availability thereof are covered in Chapter 9 of this report. Water quantity as well as water quality are taken into account, with due cognisance also to geographic location. These options form the core elements from which Version 1 of the Strategy was distilled.

The Strategy is not intended to be a singular master plan with fixed sequencing and time scales, but should cater for a spectrum of plausible future scenarios, and also be both flexible and robust under changing conditions.

The Strategy as formulated comprises:

(1) certain general items and ongoing activities that need to be attended to as primary functions in support of the implementation of other components of the Strategy;

(2) strategies of general nature, directed at key issues or components, and

(3) specific strategies, other than the above, for addressing of other key issues.

The <u>general items and ongoing activities</u> include:

- *The validation and verification of water use licenses.*
- *Regular review as well as constant monitoring and enforcement of water use licenses.*
- *Setting of assurance of supply requirements for different categories of water users.*
- *The allocation and management of water resources to meet user quality objectives.*
- *Management of the water resources in the Crocodile River catchment in order to minimise excess discharges to the Limpopo River as well as to minimise the overall transfers from the Vaal River system.*

The <u>general strategies</u> provide broad directives for dealing with the following items or issues:

- *Increased water requirements*
- *Water conservation and demand management*
- *Direct recycling of effluent*
- *Indirect re-use of effluent*
- *Groundwater*
- *Water quality*
- *Implementation of the Reserve*
- *Alien vegetation*

<u>Specific strategies</u> are proposed with respect to the following:

- *Regulation of return flows: The efficient control and re-use of return flows is of primary importance with respect to the proper management of water resources in the Crocodile River catchment. To facilitate this, it is proposed that a new regulation dam be investigated on the main stem of the Crocodile River at a location downstream of the* *confluence of the Moretele River, which is the last main tributary that contributes return flows.*

- *Re-use of effluent below Hartbeespoort Dam: Most of the effluent return flows in the Crocodile catchment are discharged to the river system upstream of Hartbeespoort Dam, with the resultant surplus availability of water at that point. Most of the mining developments north of the Magaliesberg can best be supplied with water from the Hartbeespoort Dam. This will lessen the need for use of higher quality potable water from Rand Water, which could better be allocated to urban use.*
- *Water supply to Madibeng and Rustenburg municipalities: Potable water supply to these areas should best be from Rand Water and Magalies Water. The number of small wastewater treatment plants should be rationalised, and the option be investigated of routing effluent to downstream of Hartbeespoort Dam.*
- *Water for transfer to the Lephalale area: The abstraction of water from the Crocodile River for the augmentation of resources in the Lephalale area could (probably best) be made at or downstream of the proposed new balancing dam. However, sufficient water (from return flows) will not be available in the Crocodile River to meet all the needs with respect to the water requirement scenarios for the Lephalale area.*

  For the higher water use scenarios in the Lephalale area, additional water will have to be transferred from the Vaal River system. Several options need to be investigated in this respect.

  Other smaller scale as well as interim options to augment the resources include:

  - *The raising of the Mokolo Dam*
  - *Freeing up of water through improvements to irrigation distribution systems in the Crocodile River catchment*
  - *Re-allocation (purchase) of water from irrigation in the Crocodile and/or Mokolo catchment*
  - *Interim use (purchase) of irrigation water in the Crocodile and/or Mokolo catchment*

Further Investigations

Several items, that as a priority need to be further investigated, are listed in the report.

Implementation of the Strategy

Priorities and responsibilities for the implementation of the Strategy still need to be determined.

THE DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE CROCODILE (WEST) WATER SUPPLY SYSTEM

VERSION 1 OF THE CROCODILE (WEST) RECONCILIATION STRATEGY

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1. INTRODUCTION

1.1 BACKGROUND AND PURPOSE OF THE STRATEGY

General

The first edition of the National Water Resource Strategy (NWRS) was published in September 2004. Apart from clear strategies and directives on a national basis, the NWRS contains strategic perspectives on each of the 19 Water Management Areas (WMA) in the country. It also directs the management of inter-WMA interdependencies in the national interest and provides the overall framework within which catchment management strategies are to be developed by the catchment management agencies.

The Crocodile (West) River is the largest and most important river in the Crocodile (West) and Marico WMA. It is also one of the rivers in the country that has been most influenced by human activities, and where more specific management strategies are of paramount importance.

As a first step towards the development of a formal Catchment Management Strategy for the Crocodile (West) River, following on the NWRS, an Internal Strategic Perspective (ISP) which focussed on this catchment, was developed by the DWAF in 2004. The ISP identified the need for a reconciliation strategy, as basis for the Catchment Management Strategy. This document containing Version 1 of the Crocodile (West) Reconciliation Strategy represents a further step towards the development of the formal Catchment Management Strategy.

BKS (Pty) Ltd (Lead Consultant) and Arcus Gibb (Pty) Ltd were appointed by the Department of Water Affairs and Forestry (DWAF) to undertake a study to develop a reconciliation strategy for the Crocodile (West) River catchment water supply system, hereafter referred to as the *Crocodile (West) Reconciliation Strategy*. The same team was also appointed to execute a related and supporting study namely "*The Assessment of Water Availability in the Crocodile (West) River Catchment by Means of Water Resource Related Models in Support of the Planned Future Licensing Process*" (hereafter referred to as the *Modelling Study*).

The development of the *Reconciliation Strategy* has largely been based on information obtained through the *Modelling Study*, which will also generate much of the information required for the implementation of the *Reconciliation Strategy.* The studies are therefore executed in close liaison with each other. Cognisance is also taken of the *Crocodile (West) River Return Flow Analysis Study* that has been undertaken in the catchment

Reference made in the remainder of the document to the Crocodile River, should be read as implying Crocodile (West) River.

Objective of the study

The objective is to <u>formulate a detailed strategy</u> to ensure the sufficient and reliable supply of water of appropriate quality to all existing and future users together with the best utilisation of resources in the catchment, at the lowest cost and in an environmentally sustainable manner. Both water quantity and quality need to be considered, currently and into the future.

The Strategy is targeted at water related issues. It caters for existing as well as future needs and is sufficiently comprehensive and flexible to enable quick response to changing circumstances. The Strategy is cognisant of possible future scenarios and impacts, and must identify preferred options and interventions that could be implemented as being most appropriate to the situation. Although a chronology of events and time scales should be considered, the Strategy should not be viewed as a rigid singular plan with fixed sequencing and time scales. Rather, it should be both flexible and robust under changing conditions.

In order to inform the Strategy, it was necessary that the relevant information on the following aspects be documented and be well understood:

- Background on the Crocodile (West) River catchment;
- Water requirements and water availability;
- Current water balance and water quality situation;
- Potential for and impacts of water conservation and demand management;
- Possible future development scenarios;
- Key factors that may influence the Strategy,
- Water balances for future scenarios; and
- Potential reconciliation options, with associated time scales and impacts.

These are addressed in the chapters that follow, as building blocks for the development of the Strategy that is covered in Chapter 10.

Because of the strong inter-dependence between the Crocodile River catchment and neighbouring catchments due to the large scale inter-basin transfer of water, as well as the complex water situation within the Crocodile River catchment, the Reconciliation Strategy was developed at a catchment scale. The Water Resources Yield Model (WRYM) and the Water Resources Planning Model (WRPM) which are set up as part of this study, will facilitate assessment of license applications at the individual user level within the framework of the broader strategy.

This interim Strategy is based on the near final information. This will be used as reference for consultation with key stakeholders towards formulation of the Final Strategy, whilst also providing guidance on the management of the water resources of the Crocodile River catchment during the interim.

Description of study area

The study area covers the Crocodile (West) River catchment, which forms the major part of the Crocodile (West) and Marico WMA, but excludes the Marico River catchment. It extends northwards from the Witwatersrand catchment divide in central Johannesburg (where the Crocodile River originates), to the confluence of the Crocodile and Marico rivers. The catchment area includes part of the Gauteng, North West and Limpopo Provinces.

From the confluence of the Crocodile and Marico rivers, the river is known as the Limpopo River, which forms the northern border of South Africa with Botswana and then with

Zimbabwe, before flowing into Mozambique where it discharges into the Indian Ocean. The Limpopo River basin thus is an international basin, shared by South Africa, Botswana, Zimbabwe and Mozambique. The total catchment area is approximately 29 000 km^2. A locality map is included as **Figure 1**.

Historic development

The history of human habitation in the Crocodile River catchment dates back to some of the earliest in the world, as attested by the Cradle of Man World Heritage Site found in the upper part of the catchment. The reliable availability of water from the dolomites in the area probably was a pivotal consideration in the location of the site, as was the case with the later founding of Pretoria along the Apies River.

The discovery of gold along the Witwatersrand at the southern divide of the catchment was the single most influential event which impacted on the modern economic development of the region initially stimulated by the needs for mining, strong commercial and industrial activities established around Johannesburg. This expanded to other areas and large urban and industrial complexes now exist at several locations in the upper part of the Crocodile River catchment (and in the adjoining part of the Vaal River system). The construction of the Hartbeespoort Dam, which was completed in 1923, gave rise to one of the largest irrigation schemes in the country, which was followed by several other irrigation developments in the catchment. More recently, extensive mining developments occurred in the west and north-west of the catchment, related to platinum group metals.

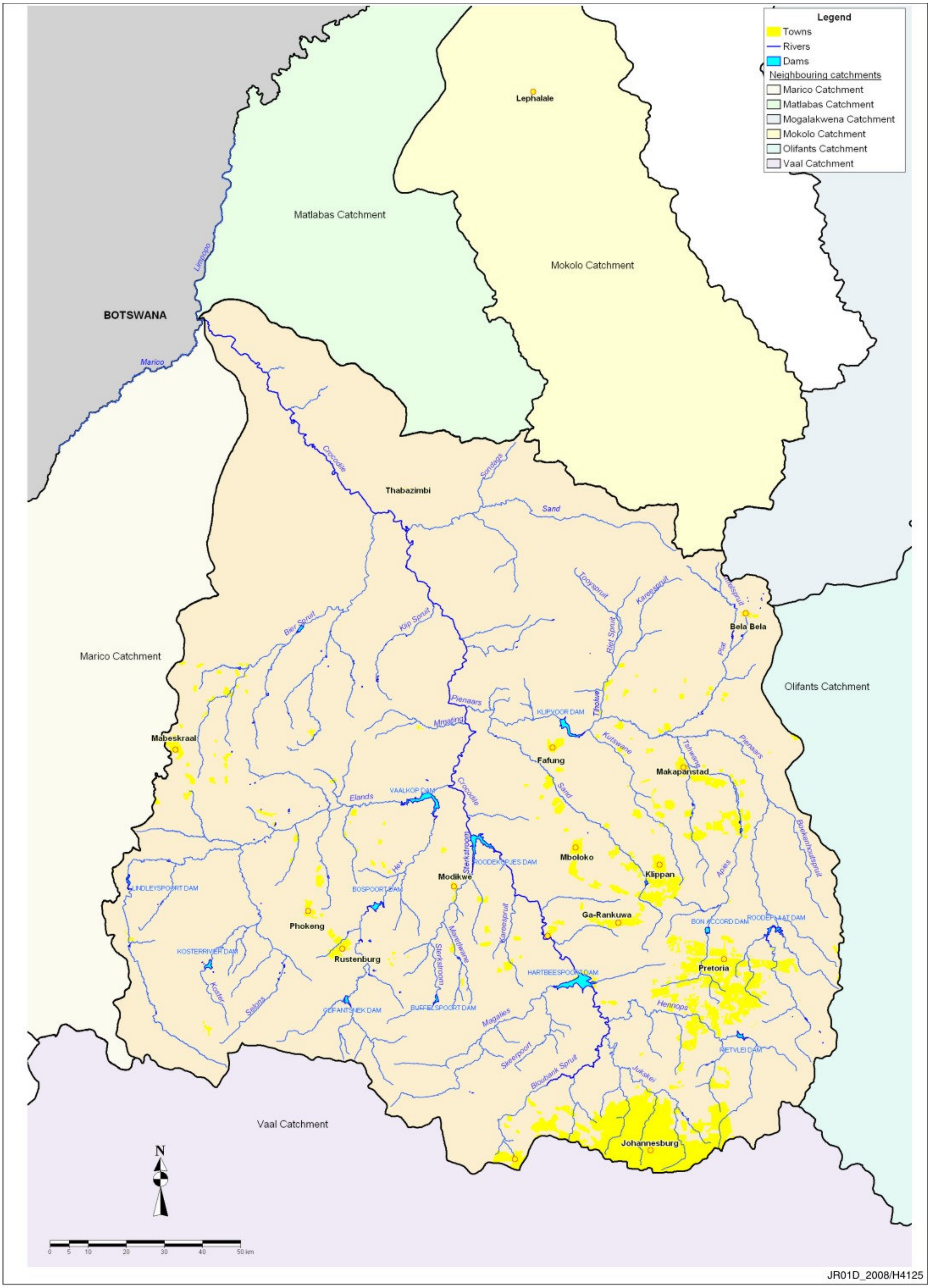
Economic activity

Attributable to the above developments, roughly 70% of the GDP for the Gauteng Province is generated in the confines of the Crocodile catchment. Also about 80% of the GDP of North West Province, mostly from platinum mining, and of the order of 20% with respect to Limpopo Province, is generated in this catchment. In total, of the order of 25% of the National GDP is generated in the Crocodile catchment. The current economic growth rate in the catchment is close to 1½ times the national average.

Approximately 5,5 million people reside in the catchment. Attracted mainly by economic opportunities, strong migration is experienced into the catchment, resulting in a population growth rate also of about 1½ times the national average. A strong trend towards further urbanisation is therefore experienced, mainly in the Johannesburg-Pretoria area.

Water situation

The natural occurrence of both surface and groundwater in the catchment is limited, and those resources are already highly developed and utilised, with little further potential remaining. The water available from resources naturally occurring in the catchment is only about 240 million m^3 per year, compared to the current requirements for water of well in excess of 1 000 million m^3 per year. Most of the water used in the catchment is for urban and industrial purposes (representing 50% of the total), followed by irrigation (33%) and mining (8%). The strongest growth in requirements is experienced in the urban/industrial and mining sectors.



CROCODILE (WEST) RECONCILIATION STUDY **Locality Map** **FIG 1**

As a result, a large proportion of the water used in urban areas as well as for some of the mining developments is transferred in from the Vaal River system, currently amounting to about 550 million m^3 per year. Water used in the urban areas in turn give rise to large quantities of effluent return flows which represents a major source of water for re-use that substantially contributes to the overall water balance. The return flows, however, also significantly impact on the water quality of receiving streams and impoundments.

In addition to the extensive requirements for water within the Crocodile River catchment, there is also a strong need for the augmentation of resources in the Lephalale River catchment by means of transfers from the Crocodile River. A quantity of 45 million m^3 per year was provisionally earmarked in the NWRS for this purpose. However, current indications are that as much as 160 million m^3 per year may be required by 2030.

It is evident from the above background that, apart from the legal directives of the National Water Act, sound strategies for the management of the water resources in the Crocodile (West) River Catchment are urgently needed.

1.2 STRUCTURE OF THE REPORT

Version 1 of the Strategy summarises the background information from the *Modelling Study* and other supporting documentation, leading to the formulation of a strategy for reconciling the requirements for water in the Crocodile River catchment with the availability thereof.

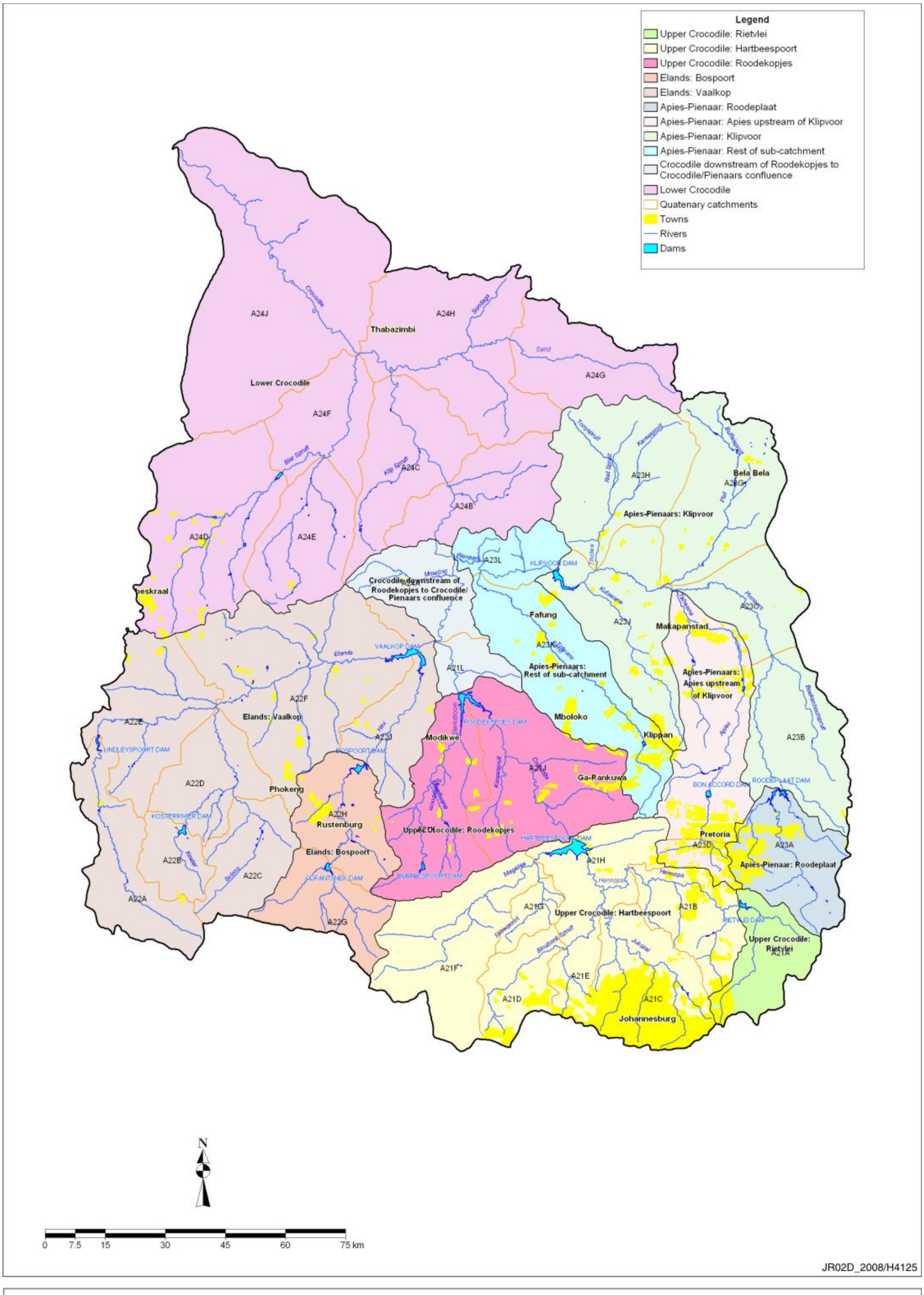
Water balances were determined for the period 2005 to 2030 at 5-year intervals to facilitate the development of a robust strategy that would be stable over time. These were done for each of eleven representative sub-areas, as presented in **Figure 2**. A detailed definition of the sub-areas is given in **Appendix A**.

Further perspective with respect to water related developments is provided by **Figure 3** which shows the irrigation boards, irrigated land, the Rand Water pipelines as well as the positions of waste water treatment plants.

Chapter 2 gives an overview of the current water balance and water quality situation, which serves as reference point for future scenarios. Chapter 3 then describes representative possible future development scenarios that the strategy should be able to provide for. Key factors that may influence the strategy are identified and described in Chapter 4.

Core information and statistics on the main variants to be reconciled – water requirements and availability – are summarised in chapters 5 and 6 respectively, with specific focus on the future scenarios. Water conservation and demand management, which impacts on both the requirements for and availability of water, is discussed in Chapter 7. This is followed by various water balance scenarios in Chapter 8.

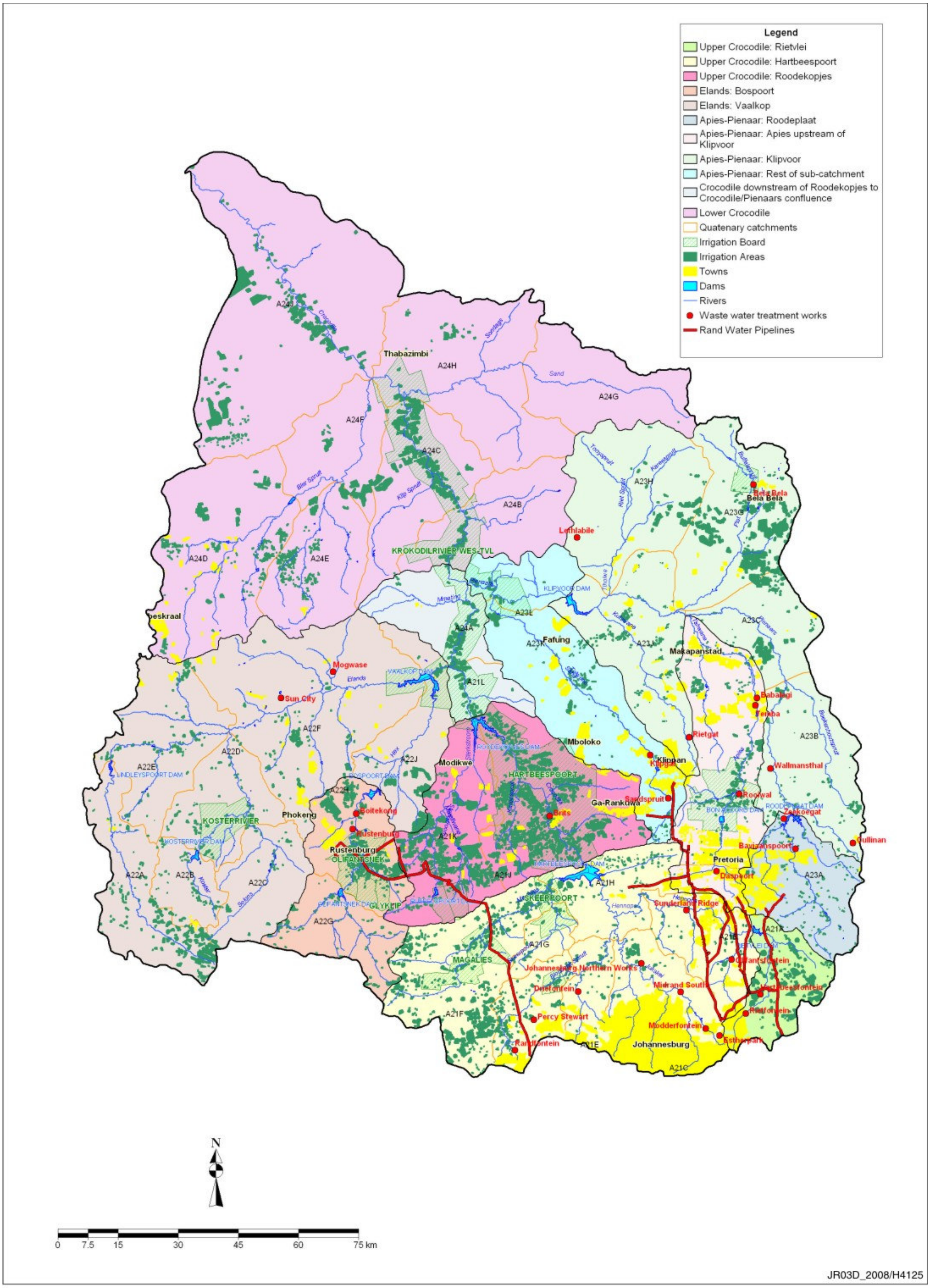
Potential reconciliation options are described in Chapter 9, whilst the various elements of the strategy are described in Chapter 10. Guidance on the implementation of the strategy is given in Chapter 11.



CROCODILE (WEST) RECONCILIATION STUDY

Map with sub-catchments split into sub-areas

FIG 2



CROCODILE (WEST) RECONCILIATION STUDY

Map with irrigation boards and areas, Rand Water pipeline and the waste water treatment works **FIG 3**

2. CURRENT WATER BALANCE AND WATER QUALITY SITUATION

Based on information from the NWRS and the ISP, and updated with information already available from the *Modelling Study*, a clear picture on the water management situation in the Crocodile River catchment emerges.

The information already updated include: - the current and future water requirements for the relevant sectors; quantification of return flows; water quality assessments; review of water losses; review of water demand management by the main user groups; a preliminary estimation of the requirements for the Reserve; as well as a re-assessment of the groundwater potential and current usage. Most of the information on surface water yield currently available still stems from earlier work and is in the process of being updated. The relevant statistics and further background with respect to the above, are given in the chapters that follow.

Core observations are:

- The local surface water resources that naturally occur in the catchment are fully developed and utilised. Several large dams were built in the past and very few, if any, sites for further regulation remains.
- Groundwater resources are in general also highly developed and are mainly utilised for irrigation and rural/village water supplies. Over-exploitation of groundwater occurs in some areas, with severe impacts e.g. at Maloney's Eye.
- The total water requirements in the catchment exceed the water available from local surface and groundwater resources by more than fourfold. The largest water use sector being for urban/industrial purposes, followed by agricultural irrigation. Mining also constitutes a prominent and growing water use sector. Smaller quantities of water are used for power generation, for domestic purposes in rural areas and for stock watering.
- Because of the limited availability of local water resources, substantial quantities of water are transferred into the catchment, amounting to nearly 1½ times the yield from local resources. All the existing transfers from the Vaal River System to the Crocodile River catchment are as potable water via the Rand Water network, and are supplied to the main urban areas as well as some mines in the Rustenburg area.
- Attributable to the secure transfer of water from the Vaal River System, sufficient water is available in all the urban areas.
- The volume of return flows, which mainly originate from the urban areas, is approximately equal to the yield from local resources, and is growing due to growing water requirements in urban areas. These return flows are discharged to various tributaries of the Crocodile River, most of which enter the river upstream of Hartbeespoort Dam. A large proportion of the return flows is used for irrigation purposes.
- Mainly as a result of the large quantities of urban effluent, some surplus water occurs in the lower reaches of the catchment. The increased re-use of effluent therefore offers opportunity for further optimisation of the water management.

- Water quality in streams and impoundments downstream of the major urban areas is poor as a result of the return flows and urban wash-off. This has serious environmental impacts and can also limit the potential for re-use. The poor quality of water at Hartbeespoort Dam being of major concern.
- Irrigation return flows and runoff from highly fertilized rain-fed cultivation also impact on downstream water quality.
- As a result of the above impacts, some water bodies (Hartbeespoort Dam, Roodeplaat Dam) are highly eutrophic.
- Due to the high degree of development and regulation of the water resources in the catchment, together with the large quantities of return flows to many tributaries and eventually to the main stem of the river, the natural flow regime of streams in the catchment has been highly altered. This will limit the extend to which natural variability can be re-instated through the implementation of the Reserve.

In summary, because of the already full development and utilisation of the water resources naturally occurring in the Crocodile River catchment, the only options to increase the availability of water would be through increasing transfers from the Vaal River system and through the greater re-use of effluent. Water conservation and demand management would contribute towards reducing the requirements for water, but should not be viewed as a solution on its own.

3. POSSIBLE FUTURE DEVELOPMENT SCENARIOS

It is anticipated that the current development trends will continue for the foreseeable future. Strong growth in the urban/industrial sectors is expected to continue in and around the existing metropolitan areas located in the upper parts of the catchment (and contributing to return flows downstream). New mining developments will mainly be in the middle and lower parts of the catchment, whilst a strong need also exists for the abstraction of water in the lower part of the Crocodile River catchment for transfer to large new developments in the Lephalale area which is located in the Mokolo River catchment.

The primary elements that would impact on the growth in water requirements are concisely summarised below.

3.1 POPULATION GROWTH

Although the birth rate in the catchment is below the national average (attributable to urbanisation and socio-economic conditions), the overall population growth will continue to exceed the national average, mainly as a result of migration into the area stimulated by economic opportunities.

The Statistics SA population projection provided to DWAF in 2007 was based on the best information available at the time, and provides total population numbers at the municipal level in urban and rural categories. The time span covered is 2001 to 2030. The Statistics SA population projection was used as the "base population scenario" driving the updating of water requirements.

Population growth in an area has two main components: internal growth (due to the fertility and mortality patterns of the resident population) and migration (due to the movement of people in and out of the area).

High and low variants of the Statistics SA population projection were developed in order to provide a planning envelope.

Provisional indications are that the current (2005) total population (urban plus rural) in the catchment of about 5.5 million could grow to between 6.4 million and 8.3 million by year 2030. Virtually all of the population growth is expected to be in the urban areas.

3.1.1 Urban population growth

Population projections for the urban areas were determined for high, base and low growth scenarios. The total urban population projections for the study area for these scenarios are summarised in **Table 3.1**.

Table 3.1: Total urban population figures

Population growth	2005	2010	2015	2020	2025	2030
High	4 522 991	5 080 331	5 642 253	6 157 285	6 595 470	7 066 329
Base	4 454 641	4 933 355	5 372 455	5 770 617	6 131 279	6 515 899
Low	4 444 190	4 760 665	5 015 475	5 164 539	5 251 068	5 340 822

The urban population projections for the high, base and low scenarios per sub-area are presented in **Appendix B**.

3.1.2 Rural population growth

Population projections for the rural areas were also made for high, base and low growth scenarios. The total urban population projections for the study area for these scenarios are summarised in **Table 3.2**.

Table 3.2: Total rural population figures

Population growth	2005	2010	2015	2020	2025	2030
High	1 029 640	1 062 190	1 068 341	1 092 439	1 121 118	1 215 986
Base	1 021 543	1 043 424	1 039 056	1 051 981	1 068 929	1 147 613
Low	1 013 493	1 024 953	1 010 518	1 012 943	1 019 073	1 082 959

A detail breakdown of the rural population figures for the high, base and low scenarios per sub-area is presented In **Appendix B**.

3.2 ECONOMIC GROWTH

Economic growth of well above the national average is expected to continue, mostly as a result of population growth and inherent economic growth factors such as economics of scale, and also as a result of the large new mining developments being planned. In the urban areas the growth is mainly expected to be in the service and knowledge sectors (trade, finance and government), manufacturing (light and high technology industries), transportation and construction. Little growth in heavy and wet industries is foreseen. Continued strong growth is expected in the mining and beneficiation of platinum group metals.

Following the national trend, and also as a result of land being taken up by urbanisation and which is partly compensated for by intensification of agricultural practices, little overall change in agricultural activity is foreseen.

3.3 SOCIO-ECONOMIC CHANGES

The proportion of people in the middle socio-economic classes is growing, with comparatively fewer people in the poorer households. In the middle and upper classes there is a trend towards smaller stand sizes and denser living (smaller gardens). In the less privileged communities, the provision of services is improving rapidly (water supply and water borne sanitation). These changes need to be accounted for in the estimation of future water requirements.

3.4 GROWTH CENTRES/LOCATIONS

The key growth areas with respect to urbanisation are:

- The areas adjoining the Johannesburg metropole (north, north-east and north-west), in the upper Crocodile River catchment.
- The Midrand area, broadly representing the band of urbanisation between Johannesburg and Pretoria. Also in the upper Crocodile River catchment.
- The eastern and northern parts of Pretoria, mainly in the Pienaars River catchment.
- The Rustenburg area in the Elands River catchment, as a result of the mining developments.

Improved water supply services and water borne sewage systems are rapidly being installed in peri-urban areas north of Pretoria and north-west towards Brits, in the Pienaars River catchment.

Extensive further mining and related developments occur in the Rustenburg-Brits area, and in the Elands and Upper Crocodile sub-catchments. Large investments and growth in the mining sector also occur north of the Pilanesberg towards Thabazimbi in the Lower Crocodile sub-catchment.

3.5 NEIGHBOURING WATER MANAGEMENT AREAS

Large scale mining and energy related developments by Eskom and Sasol are being planned in the Lephalale area in the Mokolo River catchment. The local water resources in the area are insufficient to meet the requirements for such developments, and a provisional reservation was made in the National Water Resource Strategy for the transfer of 45 million m^3 per year from the Crocodile (West) River to the Lephalale area. Current indications are that the developments are likely to be bigger than previously anticipated and that in the order of 160 million m^3 per year may be required by 2030.

No significant change is anticipated in the existing and smaller transfers to other catchments, which are mainly for domestic purposes.

3.6 NEIGHBOURING COUNTRIES

A new dam is under construction on the Shashe River in Botswana whilst other dams are in the planning stage, which would impact on the overall water balance in the Limpopo River System.

Indications were that Botswana may need more water than could be supplied from their own resources, to enable some mining and power generation developments in the north-eastern part of the country, and that they may request support from South Africa. However, Botswana are expanding their North-South Carrier to supply their growing water requirements, whilst no formal request for water has been received from them. No provision for transfer of water from the Crocodile River catchment to Botswana has been taken into consideration in the Strategy.

3.7 RESULTING IMPACTS

All of the above will impact on the requirements for water as well as on the return flows generated, and consequently on water quality and the aquatic environment. These impacts and inter-dependencies are further captured in Chapter 4.

4. KEY FACTORS THAT MAY INFLUENCE THE STRATEGY

The Strategy should be responsive to key factors that may influence achieving the goals of the Strategy which are "to ensure the sufficient and reliable supply of water of appropriate quality to all users together with the best utilisation of resources in the catchment, at the lowest cost and in an environmentally sustainable manner".

Key factors that may influence the Strategy were identified and debated at a workshop attended by representatives of the main stakeholders on 27 March 2006. These factors, as listed below, relate to the current situation and with particular relevance to the scenarios that may be anticipated.

- Key factor 1: Growth in water requirements
- Key factor 2: Natural water resources already fully developed
- Key factor 3: Strong dependence on transfers from the Vaal River system (via the Rand Water network)
- Key factor 4: Growing volumes of return flows
- Key factor 5: Implementation of the Reserve
- Key factor 6: Water quality
- Key factor 7: Linkages to neighbouring WMAs and the Limpopo River (with co-basin countries)

These influencing factors are inextricably linked together through various complex inter-relationships and cannot be viewed in isolation. On the macro or catchment scale, it is important to note that water management within the Crocodile catchment is hugely impacted upon by its position between the Vaal River catchment from where large quantities of water are transferred into the upper parts of the Crocodile catchment, and the Lephalale area bordering the lower reaches and to which large quantities of water need to be supplied in future.

For each key factor, the main contributing sub factors were identified, together with the sector of the economy or component of the water balance most related. These were linked to the relevant location/geographic area, with concise comments given where applicable. The key factors together with the above inter-dependencies are summarised in **Table 4.1**.

Table 4.1: Key factors that may influence the strategy

Factors	Sector / component	Location	Comments
Key factor 1: Growth in water requirements			
Population and economic growth	• Urban / industrial	• Upper Crocodile (Northern Johannesburg, Midrand, Centurion) • Apies-Pienaars (Tshwane) • Elands (Rustenburg, Brits)	• Current use patterns results in average 45% return flows • Due to mining development
Growth in platinum mining	• Mining	• Elands (Rustenburg, Brits, Garankuwa) • Lower Crocodile (North of Pilanesberg)	• Water use by mining largely consumptive
Urban WCDM	• Urban areas		• May reduce requirements
Key factor 2: Natural water resources already fully developed and utilised			
No potential for significant further resource development	• Surface water • Groundwater	• Total catchment • Total catchment	• Small localised potential
Over-exploitation	• Groundwater	• Rural areas	
Key factor 3: Strong dependence on transfers from Vaal (bulk potable water from Rand Water system)			
Need for resource optimisation	• Urban, industrial, mining	• Upper Crocodile, Apies-Pienaars, Elands	• To prevent unnecessary transfers from Vaal and inefficient use of scarce national resource
Need for cost optimisation	• Urban / industrial, mining	• Upper Crocodile, Apies-Pienaars, Elands	
Socio-economic			• May wish to allow for some expansion of irrigation
Key factor 4: Growing volumes of return flows			
Increase re-use to optimise (minimise) transfers from Vaal	• All sectors	• Mainly Upper Crocodile, Apies-Pienaars	• Uncertainty about where growth centres will be and where return flows will manifest / discharge
Control illegal abstraction of return flows	• Irrigation	• All areas	
Impacts of WCDM		• Johannesburg, Midrand, Tshwane, Rustenburg	

Factors	Sector / component	Location	Comments
Key factor 5: Implementation of the Reserve			
Rivers highly regulated, flow regimes altered, water quality impacted		• Total catchment	• Could make use of growth in return flows to minimise impacts on existing users
May reduce yields from local sources	• Urban, irrigation	• Elands, (Swartruggens, Koster, Vaalkop) • Apies-Pienaars (Bela Bela)	
Key factor 6: Water quality			
Naturally poor quality	• Groundwater	• Apies-Pienaars, Lower Crocodile	• High Fluoride in some areas harmful for human use (rural domestic)
Deterioration due to urban / industrial return flows	• Surface water (streams, impoundments)	• Originates mainly in Upper Crocodile, Apies-Pienaars	
Pollution from mines	• Surface water • Groundwater	• Elands, Upper Crocodile	• Mine closures in Upper Crocodile
Agricultural impacts	• Surface water	• Total catchment	• Diffuse loads (fertilizers, irrigation return flows)
			• Point loads (feed lots)
Key factor 7: Linkages to neighboring WMAs and the Limpopo River (co-basin states)			
Requirements from Vaal system strongly influenced by management in the Crocodile		• Total catchment	• WCDM in Vaal also to impact on water availability to the Crocodile
Quantity / quality of water reaching the Limpopo dependent on water management in the Crocodile	• Surface water (streams, impoundments)	• Total catchment	
Needs for water from Crocodile catchment in Limpopo and Olifants WMAs	• Urban, rural domestic • Mining • Power generation	• Apies-Pienaars (Modimole, KwaMhlanga, Ekangala • Lower Crocodile (Mokolo, Lephalale) • Lower Crocodile (Mokolo, Lephalale)	
Dependence and impacts on Vaal River System	• See Key Issue 3	• See Key Issue 3	• See Key Issue 3

5. WATER REQUIREMENTS

The key variables that determine the requirements for water are population and economic activity. The main drivers of growth in water requirements therefore are population growth and economic growth. Other key variables are the socio-economic standard of living and the efficiency of water use. All of these were accounted for in determining the water requirements for the different scenarios as described below.

This report includes updated (February 2008) water requirements for the mining sector in the Crocodile River catchment itself, and updated water requirements supplied by Eskom and SASOL between January and March 2008.

The water requirements have been subdivided into different water user groups, which are discussed and summarised below. All the requirements are given at 1:50 assurance of supply levels.

5.1 URBAN WATER REQUIREMENTS

Urban water requirements comprise two main components, which are (i) domestic or household use of water and (ii) the commercial, industrial and public use of water. The domestic use of water is directly related to the population, as well as the standard of living which determines the per capita water use of water. Population projections and changes in standard of living were therefore used for the estimation of future water requirements. The commercial/industrial use of water in urban areas can normally be expressed as a ratio of the domestic use. In this regard the ratio as observed in the past was assumed to remain unchanged during the period of projection.

In order to be compatible with the Vaal River Reconciliation Strategy Study currently also being prepared for DWAF, the same scenarios of water requirements and return flow projections are used in both the Vaal and the Crocodile Reconciliation Strategies.

As mentioned in Chapter 3 of the report initial population figures were based on the August 2007 Statistics SA urban and rural population projections. The initial water requirements and return flows associated with these population figures were referred to as Scenario A. During October 2007 some changes were made on the split between urban and rural population. The water requirements and return flow figures were updated accordingly and are referred to as Scenario B. Scenario A therefore became obsolete and no further reporting on Scenario A is included in this report.

The requirements and return flow model, used for the *Vaal River System: Large Bulk Water Supply Reconciliation Strategy Study* (DWAF, 2007), was also used for the Crocodile River catchment using the urban population figures derived from the Statistics SA information. Requirements for areas where the model had not been set up previously were calculated drawing on per capita water requirements for similar areas that had already been modelled in detail. The October 2007 urban water requirement projections were calibrated to match the latest available observed water use data.

Urban water requirements linked to high, base and low population growth projections were prepared for three water demand scenarios: Scenario B (no demand management), Scenario C (high efficiency demand management) and Scenario D (medium efficiency demand management).

No water demand management *(Scenario B)*

This scenario is referred to as the reference scenario. The water requirements were based on the latest population projections compiled from the statistics from the 2004 Census data.

High and medium efficiency water demand management *(Scenarios C and D)*

Water demand management can have a significant influence on the efficiency of water use and thus on the requirements for water, and warrants specific consideration.

Two water demand management scenarios for urban water users, similar as those determined for the *Vaal River Reconciliation Strategy Study*, have also been included.

Assumptions for high efficiency water demand management (Scenario C):

- Water losses can be controlled within the next 5 years (2005 to 2010) and maintained afterwards.
- Water use efficiency is implemented by targeting billed consumption. This includes the promotion of the use of water efficient appliances (washing machines, toilet cisterns etc) as well as low flow shower heads, and water efficient gardens where irrigation is either not required or significantly reduced.

Assumptions for medium efficiency water demand management (Scenario D):

- Water losses can be controlled within the next 5 years (2005 to 2010) and maintained afterwards.
- No water use efficiency is introduced.

The three scenarios of water demand management for the Crocodile (West) Reconciliation Strategy are based on the same principles and assumption as those reported on in the *Vaal River Reconciliation Strategy*. The combination of the three scenarios of population (high, base and low) and the three scenarios of demand management (no, high efficiency and low efficiency) results in nine scenarios which were evaluated and water balances were determined for them.

Given the strong drive in the *National Water Resources Strategy* towards the implementation of water conservation and demand management the scenario based on the assumption of no demand management, is regarded as not realistic. This scenario will therefore not be further considered, as was also done in Vaal River Reconciliation Strategy. Similarly, it was not regarded as realistic to enforce the most stringent demand management measures under conditions of medium (base) and low population and economic growth, which implies the omission of high efficiency demand management for base and low population growth.

Therefore, only the following four scenarios are regarded as realistically representative of the possible future situation and are further considered:

- high population growth and medium efficiency demand management
- base population growth and medium efficiency demand management

- low population growth and medium efficiency demand management
- high population growth and high efficiency demand management

At a discussion held between representatives from DWAF and the study team on 8 February 2008 it was confirmed to reduce the nine scenarios to the above four scenarios.

The total urban water requirements projections for the study area for the four possible future scenarios are summarised in **Table 5.1**.

Table 5.1: Total urban water requirements (million m^3/a)

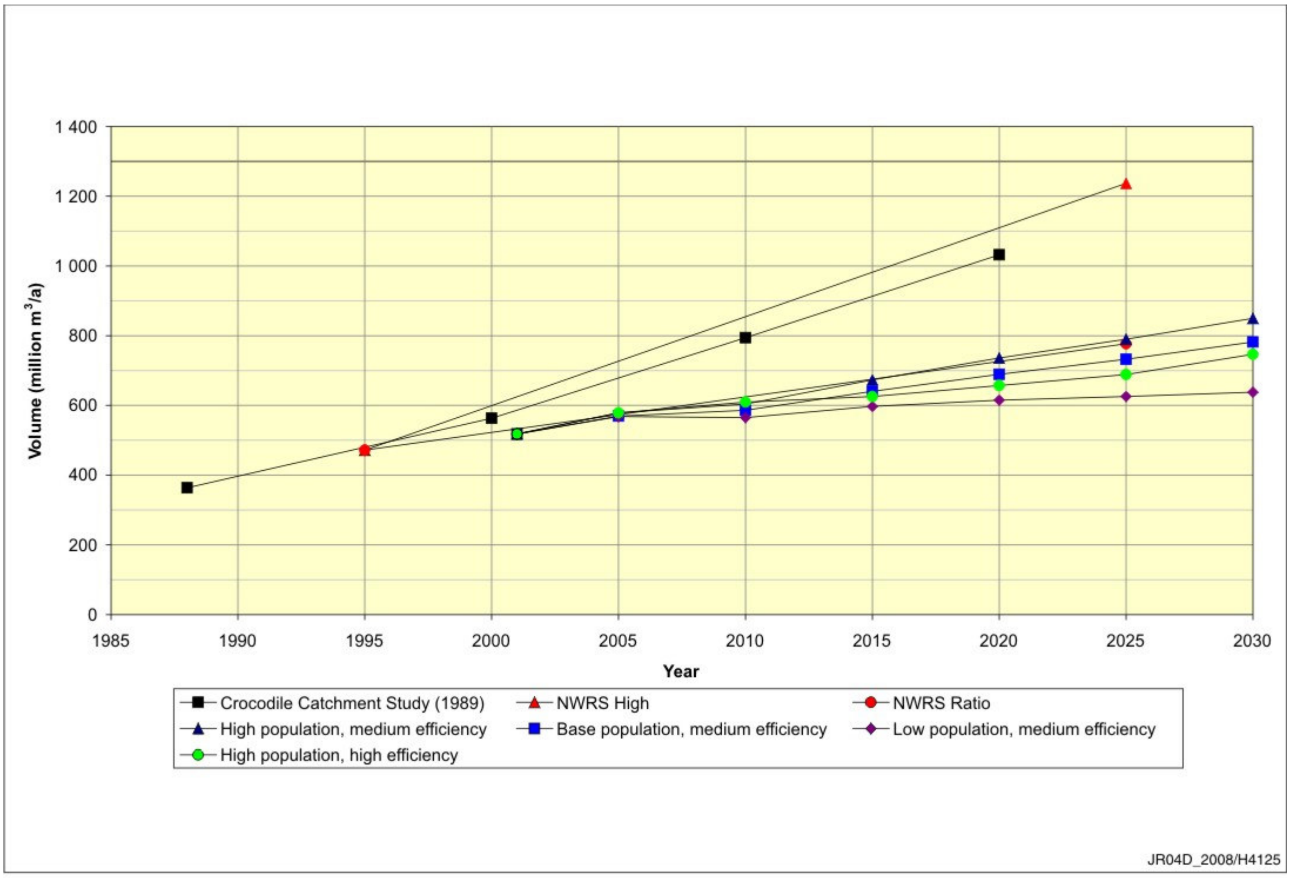
Scenario	2005	2010	2015	2020	2025	2030
High population growth, medium efficiency demand management	579	604	673	736	790	850
Base population growth, medium efficiency demand management	570	586	640	689	733	782
Low population growth, medium efficiency demand management	568	565	597	615	626	638
High population growth, high efficiency demand management	579	609	626	657	688	746

The urban water requirements for the high, base and low population projections per sub-area are included in **Appendix C**.

Figure 4 represents a comparison of the upper and lower range of urban water requirements of this study with that of previous studies:

- The CWCS (1989) black line presents the projections of the *Crocodile West River Catchment Study* done by DWAF in 1989.
- The two red lines (NWRS High and NWRS Ratio) presents the upper and lower projections from 1995 to 2025 as reported on in the *National Water Resource Strategy*. (Note: These two projections do not include water demand management and are thus not directly comparable to the other projections).
- The other four lines (in dark blue, light blue, purple and bright green) are the four scenarios being reported on:
  - high population growth and medium efficiency demand management
  - base population growth and medium efficiency demand management
  - low population growth and medium efficiency demand management
  - high population growth and high efficiency demand management

It has been observed that the projected NWRS High water requirement figures were probably unrealistic high and that the actual water use between 1995 and 2005 were very close to the NWRS Ratio figures. The projected water requirements for the high population growth and medium efficiency demand management scenario are slightly higher and the other three scenarios are slightly lower than the NWRS Ratio projections.



CROCODILE (WEST)
RECONCILIATION STUDY

Comparison of different estimates of urban water requirements

FIG 4

5.2 RURAL WATER REQUIREMENTS

Rural water requirements were calculated based on stepped per capita water requirements. Discussions with the Chief Directorate: Water Services indicated that this was more reasonable than an assumption of a constant unit requirement. The increase in per capita rural water requirements to 2010 is in line with the commitment of DWAF to progressively increase the minimum level of water supplied to at least 50 ℓ/capita/day, to clear the sanitation backlog and eradicate the bucket system by that date. The rural water requirements were assumed to increase from 40 ℓ/day in 2001 to 60 ℓ/day in 2010, to 80 ℓ/day in 2020 and to 100 ℓ/day in 2030 to reflect rising levels of service for water services provision. The total rural water requirements projections for the study area for the high, base and low scenarios are summarised in **Table 5.2**.

Table 5.2: Total rural water requirements (million m^3/a)

Population growth	2005	2010	2015	2020	2025	2030
High	15	23	23	32	33	44
Base	15	23	23	31	31	42
Low	15	22	22	30	30	40

The rural water requirements for the high, base and low population projections per sub-area are included in **Appendix C**.

5.3 IRRIGATION WATER REQUIREMENTS

Irrigation water requirements were determined from actual irrigation areas as determined from satellite images linked to crop types. A study to validate and verify the existing lawful irrigation areas and linked irrigation water use for licensing purposes is currently being executed for DWAF.

Irrigation areas, as well as the irrigation water requirements, are accepted to remain constant between 2005 and 2030. Distribution losses for irrigation supply between the source of the water and point of application was based on best estimates as provided by representatives from DWAF and the Irrigation Boards. Distribution losses associated with water supply to irrigation areas in the study area are in some areas accepted to be as high as 50%. These very high distribution losses could lead to mis-conceptions of the water balance situation and resultant mismanagement of the water resources due to, amongst others, large water surpluses that exist in some areas, such as at Hartbeespoort Dam, which may lead to inefficient management of the resource. The effect of reduction in distribution losses on total water requirements, water availability and the water balance should be addressed as one of the reconciliation strategies. The high distribution losses should also be evaluated and investigated in more detail and could probably be addressed in the *Validation and verification of existing lawful use in the Crocodile (West) River Study*. Distribution losses were assumed to be lost from the system.

The irrigation water requirements, including distribution losses, summarised per sub-area, is presented in **Table 5.3**. For the purpose of direct comparison in the water balance calculations all the water requirements were converted to one common 1:50 assurance of supply level. It is accepted that larger quantities may be abstracted in practice for irrigation, but at a lesser assurance of supply.

Table 5.3: Irrigation water requirements and distribution losses

Sub-catchment	Irrigation area	Irrigation requirement	Distribution losses	Total irrigation requirement		Irrigation return flows	
				Volume	1:50 assurance		
Unit	**ha**	**million m³/a**				**%**	**million m³/a**
Upper Crocodile	20 260	115	57	172	147	10	11
Elands	1 514	8	2	10	8	12	1
Apies-Pienaars	6 164	32	3	36	30	10	3
Lower Crocodile	28 036	153	76	229	191	9	15
TOTAL	**55 974**	**308**	**138**	**447**	**376**	**10**	**30**

5.4 MINING WATER REQUIREMENTS

Mining water requirements include the mines that are not supplied through the municipal supply systems. Information was collected in a format to distinguish between industrial and potable requirements. It should be noted that the mining requirements currently include a portion of potable requirement for on-site residential areas.

The water requirements of the mining industry, both the historical data and future projections, were very difficult to obtain. Data gathered by UWP Consulting Engineers for water supply in the Rustenburg area (between Hartbeespoort Dam and Rustenburg as well as the areas beyond Rustenburg to the northern parts of the study area), supplemented by data gathered in the Upper Crocodile and Apies-Pienaars sub-catchments, were assumed to be the best available data for this study. Due to the sensitive nature of the requirements of individual mines, the mining water requirements were lumped together representative geographic sub-areas. Three scenarios of mining water requirements (high, base and low) were determined for the *Pre-feasibility study for the supply of industrial grade water between Hartbeespoort Dam and Lephalale*. It was agreed that those total mining water requirements also be used as the mining requirements for this study and are presented in **Table 5.4**.

Table 5.4: Mining water requirements (million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
High	92	129	145	152	152	151
Base	92	126	139	144	145	145
Low	92	124	136	142	142	142

There is still much uncertainty about the reliability of the projected future mining water requirements. This need to be further reviewed and verified.

The mining water requirements for the high, base and low scenarios per sub-area are presented in **Appendix D**.

5.5 POWER GENERATION WATER REQUIREMENTS

There are three power stations in the Crocodile River catchment: Kelvin in the Upper Crocodile sub-catchment and Pretoria-West and Rooiwal in the Apies-Pienaars sub-catchment. The water requirements of the Kelvin, Pretoria-West and Rooiwal power stations are 11 million m^3/a, 6 million m^3/a and 17 million m^3/a respectively.

5.6 WATER REQUIREMENTS FOR STOCK WATERING

Water requirements for stock watering was determined as part of the groundwater survey undertaken. The water requirements for stock watering occur throughout the catchment and the total water requirements are 22 million m^3/a. In the water balances the water requirements for stock watering were included together with the rural requirements.

5.7 TOTAL CROCODILE RIVER CATCHMENT WATER REQUIREMENTS

A summary of the total Crocodile River catchment water requirements for the four possible future scenarios are summarised in **Table 5.5**. Summary tables of the water use per user sector for the four scenarios being reported on are included in **Appendix E**.

Table 5.5: Total Crocodile River catchment water requirements (million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
High population growth, medium efficiency demand management	1 121	1 191	1 276	1 355	1 409	1 480
Base population growth, medium efficiency demand management	1 112	1 170	1 237	1 299	1 344	1 404
Low population growth, medium efficiency demand management	1 110	1 147	1 190	1 221	1 232	1 255
High population growth, high efficiency demand management	1 121	1 196	1 228	1 275	1 308	1 376

5.8 INTER-BASIN TRANSFERS OUT

Inter-basin transfers out refer to transfers out of the study area to neighbouring catchments (or water management areas). Existing users include water supply of 3.0 million m^3/a to Modimolle. This water is supplied from Roodeplaat Dam by Magalies Water.

Possible future developments in neighbouring Water Management Areas could influence the future water availability and water balances in the sub-areas of the Crocodile West River catchment. Future developments at Lephalale include expansions in the mining sector as well as possible new developments by Eskom and SASOL in the area. Eight scenarios of possible future water requirements to the Lephalale area in the Mokolo River catchment north-east of the Crocodile River catchment have been prepared. These eight development scenarios at Lephalale are:

- Scenario 1: Matimba power station (existing technology), Medupi power station (existing technology), Exxaro supply coal for two power stations, Lephalale town for two power stations
- Scenario 2: Matimba power station (existing technology), Medupi power station with flue gas desulphurisation (FGD), 1 additional new power station with FGD technology, coal supply to 3 power stations, Lephalale town for 3 power stations
- Scenario 3: Matimba power station (existing technology), Medupi power station with FGD technology, 1 additional new power station with FGD technology, 2 additional new power stations with fluidised bed combustion (FBC), coal supply to 5 power stations, Lephalale town for 5 power stations
- Scenario 4: Matimba power station (existing technology), Medupi power station with FGD technology, 3 additional new power stations with FGD, coal supply to 5 power stations, Lephalale town for 5 power stations
- Scenario 5: Scenario 1 + Mafutha + mine + SASOL township
- Scenario 6: Scenario 2 + Mafutha + mine + SASOL township
- Scenario 7: Scenario 3 + Mafutha + mine + SASOL township
- Scenario 8: Scenario 4 + Mafutha + mine + SASOL township

These scenarios are discussed in detail in a separate report entitled *Water requirements and availability for the Lephalale Area* (DWAF, 2007). The gross future water requirements are summarised in **Table 5.6** and include the irrigation water requirement of 10 million m^3/a downstream of Mokolo Dam.

Table 5.6: Gross future water requirements in the Lephalale area (million m^3/a)

Scenario	2007	2010	2015	2020	2025	2030
Scenario 1	20	25	41	54	54	54
Scenario 2	20	30	64	63	62	62
Scenario 3	20	32	76	83	84	84
Scenario 4	20	32	83	104	104	105
Scenario 5	20	25	81	134	134	134
Scenario 6	20	30	104	143	142	142
Scenario 7	20	32	116	163	164	164
Scenario 8	20	32	123	184	184	185

If the yield from Mokolo Dam of 39 million m^3/a is taken into account, and it is assumed that the net water requirements in the Lephalale area should be transferred from the Crocodile River catchment and the Vaal River system, the net volumes of water to be supplemented from the Crocodile River catchment and the Vaal River system to the Lephalale area are reflected in **Table 5.7**.

Table 5.7: Net future water requirements in the Lephalale area (million m^3/a)

Scenario	2007	2010	2015	2020	2025	2030
Scenario 1	0	0	2	14	14	15
Scenario 2	0	0	25	24	23	23
Scenario 3	0	0	36	44	45	45
Scenario 4	0	0	44	64	65	66
Scenario 5	0	0	42	94	95	95
Scenario 6	0	0	65	104	103	103
Scenario 7	0	0	76	124	125	125
Scenario 8	0	0	84	144	145	146

5.9 INTRA-BASIN TRANSFERS

Intra-basin transfers are water transfers from one sub-area to another sub-area as summarised in this report. The transfers are expected to grow according to the growth in intra-basin transfers into the study area from the Vaal River. These transfers are included in the different scenarios of the reconciliation.

6. WATER AVAILABILITY

The water availability has been determined from different sources and sectors which are discussed and summarised below.

6.1 LOCAL WATER RESOURCES

Local water resources include surface water and groundwater naturally occurring in the catchment as well as increased runoff from paved areas.

6.1.1 Surface water

Water availability from surface water is reported on a quaternary basis based on existing information from the *NWRS* at a 1:50 assurance of supply levels and are summarised per sub-catchment in **Table 6.1**. This information will be updated in the Final Reconciliation Strategy when the water resources yield analyses task of the *Modelling Study* has been completed.

6.1.2 Groundwater

A separate report on groundwater assessment was compiled as part of the *Modelling Study* (DWAF, 2007). Water availability from groundwater was determined on a quaternary basis and are summarised per sub-catchment and reflected in Table 6.1. This work was done on a high level of sophistication, however, uncertainties with respect to the quantification still remain due to the paucity of reliable field data.

6.1.3 Urban runoff

The increase in runoff from paved areas is also included per sub-catchment in Table 6.1. These volumes are incremental runoff on top of natural runoff and are based on the latest hydrological analysis under the *Modelling Study*, referenced to year 2005. The water availability from urban runoff is still subject to review.

Table 6.1: Local water resources (million m^3/a)

Sub-catchment	Surface water	Groundwater	Urban runoff
Upper Crocodile	89	33	24
Elands	22	11	0
Apies-Pienaars	19	20	16
Lower Crocodile	25	18	0
TOTAL	**155**	**82**	**40**

6.2 URBAN RETURN FLOWS

Urban return flows contribute significantly to the water availability in the Crocodile River catchment and already comprises over 30% of the water availability in the catchment. Commensurate with the growth in urban water requirements, the volume of return flows from this sector is also expected to increase significantly in future. Importantly, the implementation of water demand management scenarios for urban water users (discussed under Chapter 5.1 above) could have a major effect on the amount of water becoming available as return flows. Estimates of urban return flows for Scenarios B, C and D have therefore been determined, using the existing return flow model (DWAF, 2004). The urban return flows are based on modified population inputs as discussed under Chapter 3.1. The return flow figures refer to return flows to the rivers.

Yield calculations at Hartbeespoort Dam, also including projected future return flow figures, indicated that in excess of 97% of the growth in future return flows could be available as yield at the dam. It was therefore provisionally assumed that all growth in return flows will be available as additional yield. This will be replaced by the formal yield calculations from the *Modelling Study* when available.

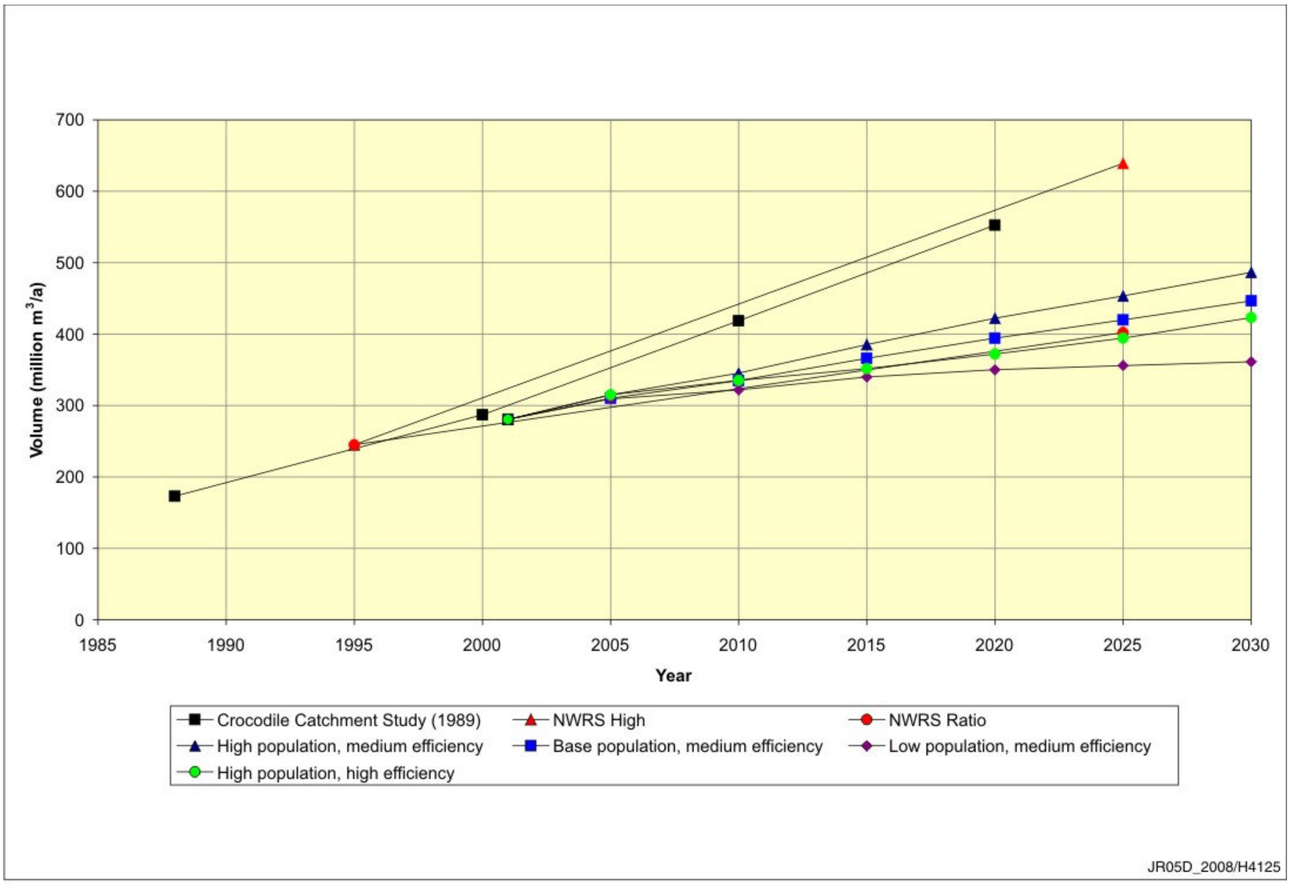
The total urban return flow projections for the study area for the high, base and low scenarios per sub-area are summarised in **Table 6.2**.

Table 6.2: Total urban return flows (million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
High population growth, medium efficiency demand management	315	345	385	422	453	486
Base population growth, medium efficiency demand management	310	335	366	394	420	447
Low population growth, medium efficiency demand management	309	322	340	350	356	361
High population growth, high efficiency demand management	315	335	352	372	394	423

The urban return flows for the high, base and low scenarios of population projections per sub-area are included in **Appendix C**.

A graph representing a comparison of the urban water return flows of this study with that of previous studies has been included in **Figure 5**.



CROCODILE (WEST) RECONCILIATION STUDY

Comparison of different estimates of urban water return flows **FIG 5**

6.3 INTER-BASIN TRANSFERS IN

Inter-basin transfers in are transfers into the study area from neighbouring catchments (or water management areas). These transfers are included in the different scenarios of the reconciliation.

All the water transfers into the Crocodile River catchment are from the Vaal River system by Rand Water to urban, industrial and mining water users. It was assumed that existing water users that are currently supplied by Rand Water will in future also be supplied with water from Rand Water. However, the options remain that the Rand Water supply area could be increased or decreased in future. It was further assumed that the supply area of Rand Water will not be extended to other areas, but that local water sources (including return flows) will be used to supply the growing water requirements in those areas. The transfer capacity of the Rand Water pipelines into the study area was assumed to be upgraded over time to make provision for the growing water requirements. The only exception being the Rand Water pipeline to Rustenburg, where it was assumed that Rand Water will supply water to the Rustenburg area to the maximum capacity of the existing Rand Water pipeline, and that water in excess of this capacity will be supplied from other sources. The total water transfers via the Rand Water system into the study area for the high, base and low scenarios per sub-area are summarised in **Table 6.3**.

Table 6.3: Total Rand Water inter-basin transfers into the Crocodile River catchment (million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
High population growth, medium efficiency demand management	554	558	624	691	741	805
Base population growth, medium efficiency demand management	546	540	593	643	684	738
Low population growth, medium efficiency demand management	545	521	551	573	582	600
High population growth, high efficiency demand management	554	564	577	611	640	702

Graphical presentations of the total water transfers into the Crocodile River system from the Vaal River system via Rand Water for the scenarios above are presented in **Figure 6**.

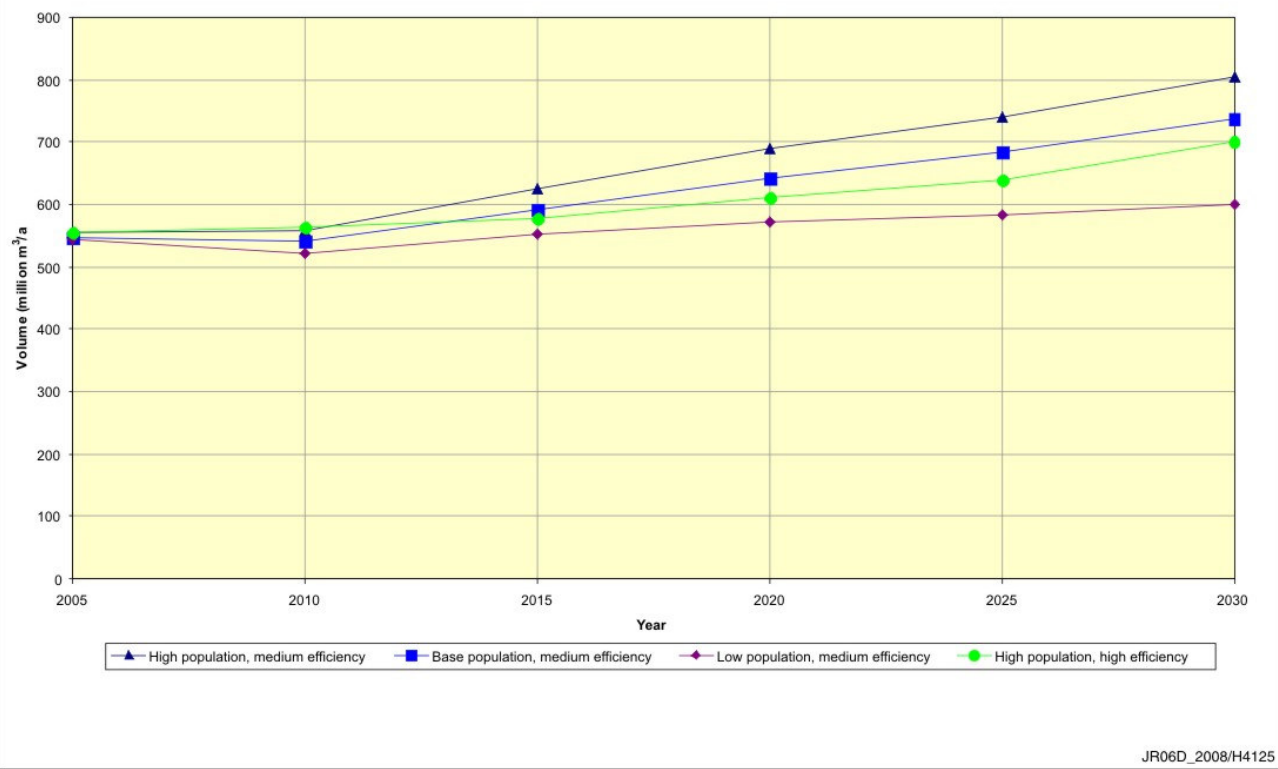
The total inter-basin transfers in for the scenarios above are included in **Appendix F**.

6.4 INTRA-BASIN TRANSFERS

Intra-basin transfers are water transfers from one sub-area to another sub-area within the Crocodile River basin. These transfers are expected to grow as a result to the growth in inter-basin transfers into the study area from the Vaal River. All transfers are accounted for in the different scenarios of the reconciliation.

6.5 IRRIGATION RETURN FLOWS

A separate agriculture assessment report was compiled as part of the *Modelling Study*. It was calculated that irrigation return flows are about 30 million m^3/a varying between 8% and 12% of the irrigation water requirements for different areas, with an average of 10%. About a third of the irrigation return flows occur in the areas downstream of Hartbeespoort and Roodekopjes Dams, another third in the Lower Crocodile downstream of the confluence of the Crocodile and Moretele Rivers and the other third downstream of the remainder of the irrigation areas throughout the catchment. The Moretele River is the reach of the river downstream of Klipvoor Dam to the confluence with the Crocodile River. Refer to Table 5.3 for more detail.



CROCODILE (WEST) RECONCILIATION STUDY

Water transfer via Rand Water into the Crocodile River catchment from the Vaal River sytem

FIG 6

7. WATER CONSERVATION AND DEMAND MANAGEMENT

Water use can be classified in to two main components: (i) water that is used consumptively and (ii) non-consumptive water use, which is the component giving rise to return flows. Most return flows originate from urban areas where, for the Crocodile River catchment, over 50% of the urban water requirements are discharged as effluent and returned to the rivers for possible re-use.

Savings on consumptive use would reduce the requirements for water, without impacting on the volume of return. It would, however, change the proportion of water requirements that ends up as return flows. Such savings would include the reduction of leakage (throughout the whole water distribution system), more efficient garden irrigation, etc.

Savings with respect to non-consumptive uses of water would influence both the requirements for water and the resultant return flows. Examples of non-consumptive use include most in-house uses of water, office buildings as well as certain components of industrial processes.

Water conservation and demand management in the Crocodile River catchment can therefore reduce the requirements for water from the Vaal River system and, depending on the measures implemented, may also reduce the volume of return flows becoming available for re-use.

High and medium efficiency water demand management scenarios for urban water users, similar as those determined for the Vaal River Reconciliation Strategy Study and described in Chapter 5.1 of this report, were considered.

The impacts on the return flows of the above scenarios are reflected in the projected return flows as reported on in Chapter 6.4.

8. WATER BALANCES

The water balances were calculated by subtracting the water requirements from the water availability. The water balances for the Crocodile River catchment are discussed under Chapter 8.2 of the report. Tables with summaries of the water balances per sub-area for the years 2005 to 2030 for the four scenarios reported on are included in **Appendix G**.

Detailed summaries of the water balances per sub-area for the years 2005 to 2030, including summaries of the water availability and requirements for the four scenarios reported on are included in **Appendix H**.

8.1 WATER BALANCE STATUS

Water balances were calculated for the four scenarios for the Crocodile River catchment on its own. As part of the strategy, future scenarios of water transfers from the Crocodile River catchment to Lephalale to supply the projected growing water requirements to the possible developments are addressed in **Chapter 8.3**. Water balances were calculated for the eight possible Lephalale development scenarios as reported on in Chapter 5.7.

8.2 WATER BALANCES FOR THE CROCODILE CATCHMENT

The water balances for the total Crocodile River catchment are summarised in **Table 8.1**.

Table 8.1: Total Crocodile River catchment water balances (million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
High population growth, medium efficiency demand management	58	22	43	68	95	121
Base population growth, medium efficiency demand management	54	15	32	48	70	91
Low population growth, medium efficiency demand management	53	6	10	11	15	16
High population growth, high efficiency demand management	58	12	10	18	36	58

From Table 8.1 it can be seen that the Crocodile River catchment should be able to supply the total water requirements in the catchment in future.

8.2.1 High population growth, medium efficiency water demand management

The water availability, water requirements and water balance for the high population projections and high mining water requirements with medium efficiency water demand management for the total Crocodile system is included in **Figure 7**.

8.2.2 Base population growth, medium efficiency water demand management

The water availability, water requirements and water balance for the base population projections and base mining water requirements with medium efficiency water demand management for the total Crocodile system is included in **Figure 8**.

8.2.3 Low population growth, medium efficiency water demand management

The water availability, water requirements and water balance for the low population projections and low mining water requirements with medium efficiency water demand management for the total Crocodile system is included in **Figure 9**.

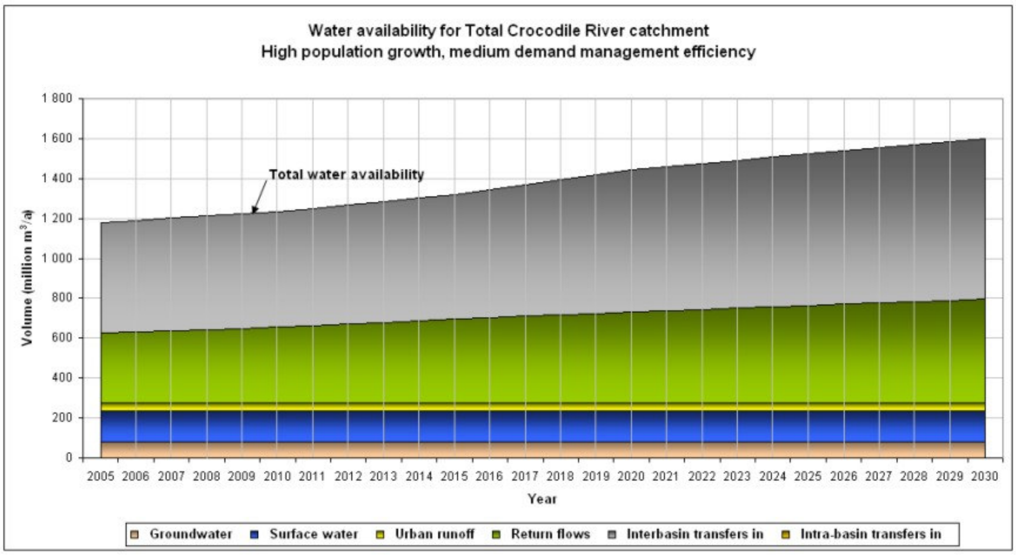
8.2.4 High population growth, high efficiency water demand management

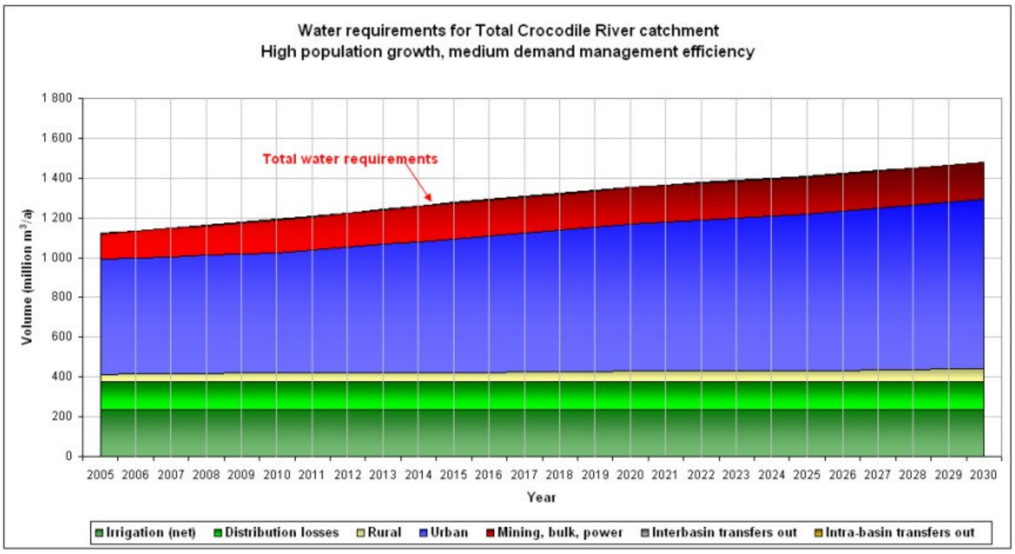
The water availability, water requirements and water balance for the the high population projections and high mining water requirements with high efficiency water demand management for the total Crocodile system is included in **Figure 10**.

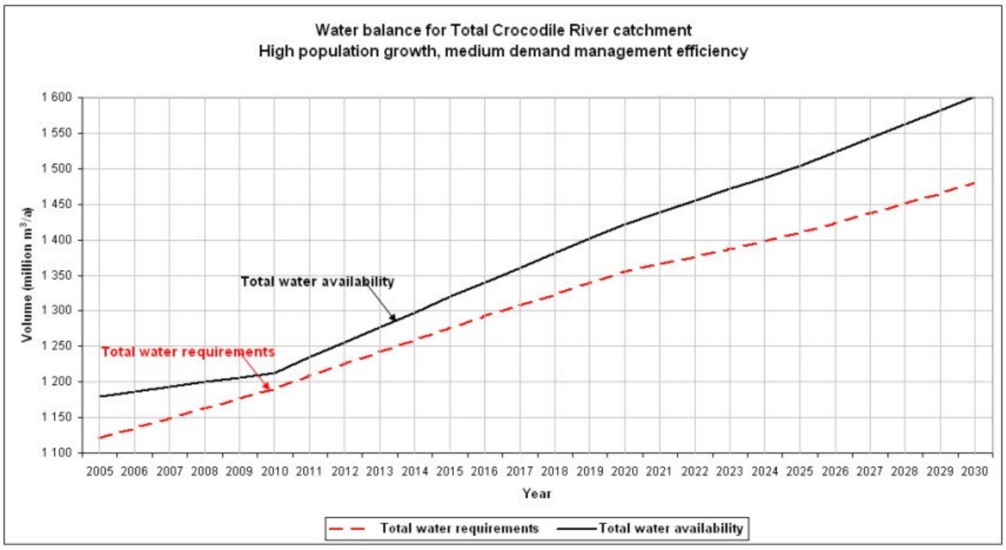
8.2.5 Resultant water balances

Evident from the water balances in Figures 7 to 10, is that there should be sufficient water available to meet the requirements for water within the Crocodile River basin under all of these scenarios. It also follows that greater surpluses can be expected to occur for the higher water use scenarios, where larger quantities of water will need to be transferred to the urban and industrial centres in the upper parts of the basin from the Vaal River System, with resultant larger volumes of return flow downstream. The scenario of low population growth with medium efficiency water demand management, the lowest water use scenario, shows a close balance between water requirements and availability. (The slight deficit after 2010 is regarded to be within the limits of accuracy.)

From the water balances for each of the eleven sub-areas, it also follows that most of return flows for re-use would accumulate at Hartbeespoort Dam, with the remainder entering the main stem of the Crocodile River between Hartbeespoort Dam and the confluence of the Moretele River (thus including flow in the Pienaars River).







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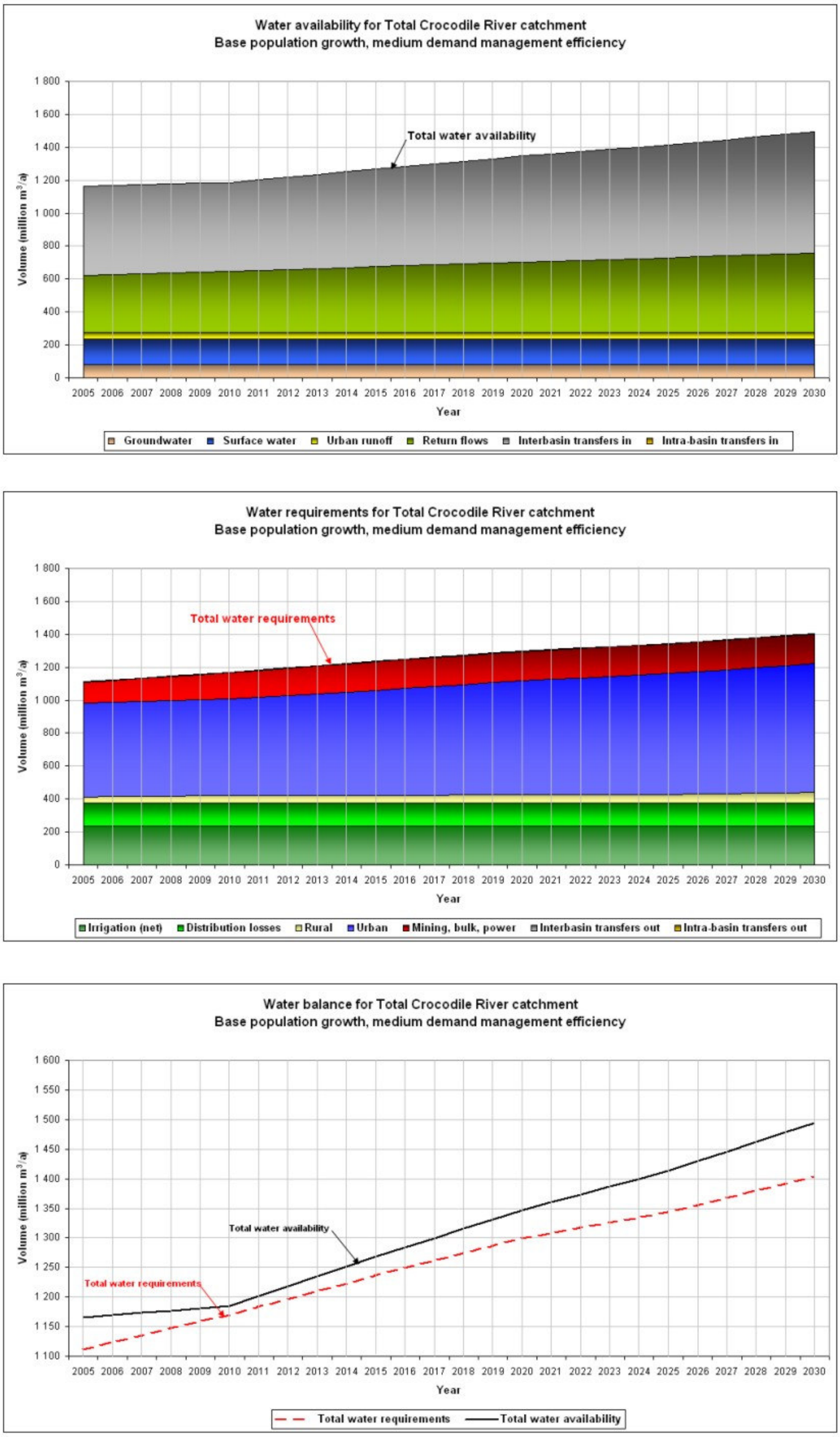
CROCODILE (WEST)
RECONCILIATION STUDY

Situation for total Crocodile River catchment: High population, medium efficiency

FIG 7



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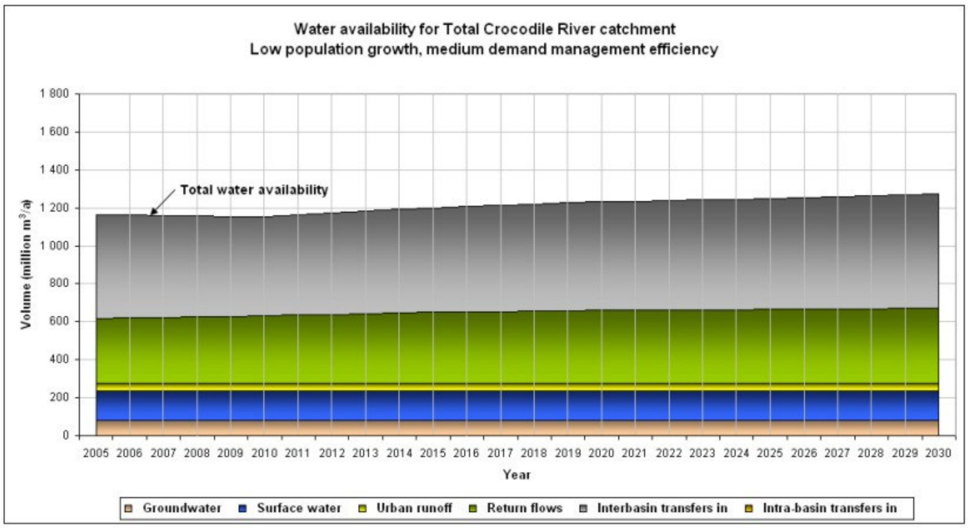
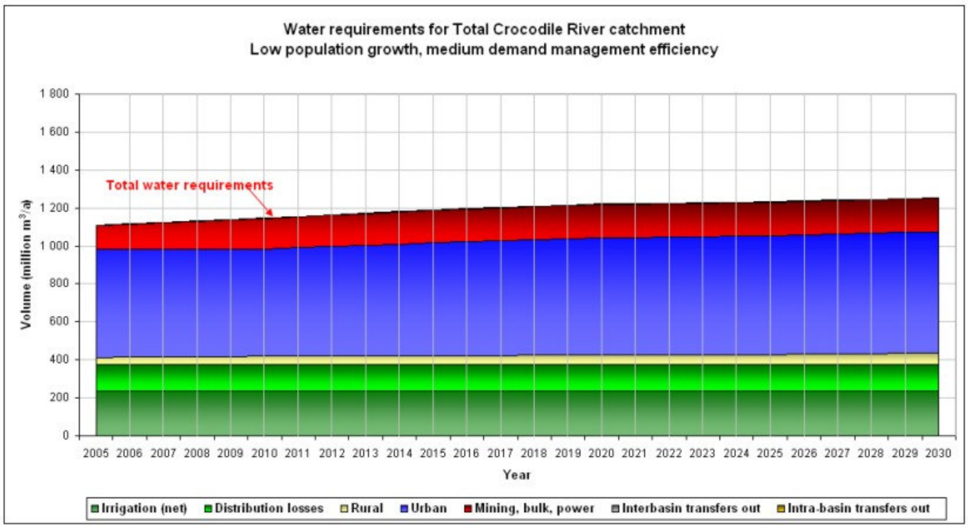
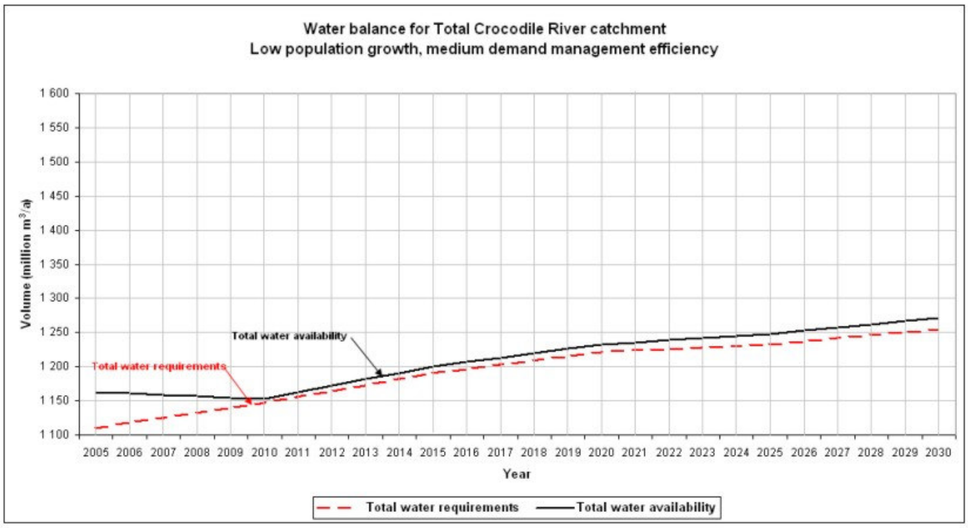
CROCODILE (WEST)
RECONCILIATION STUDY

Situation for total Crocodile River catchment: Base population, medium efficiency

FIG 8







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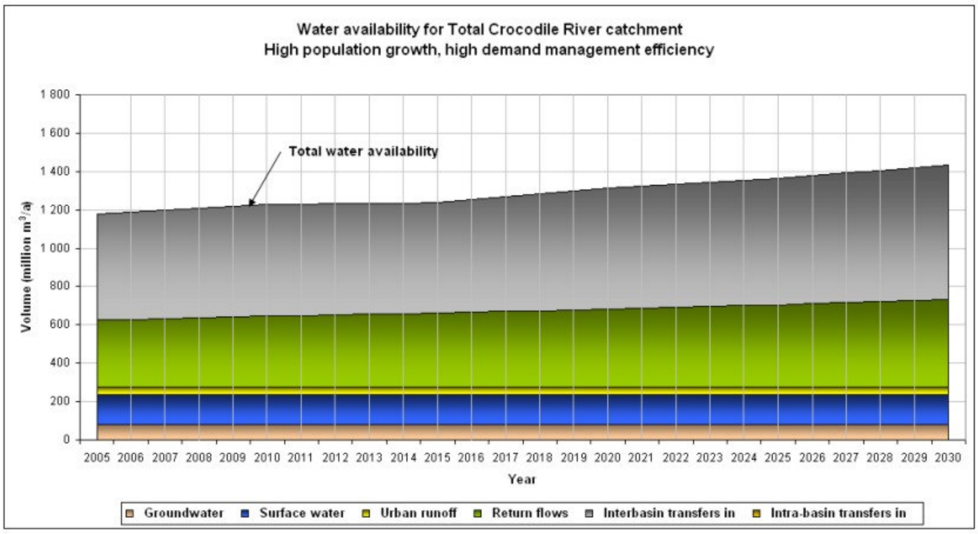
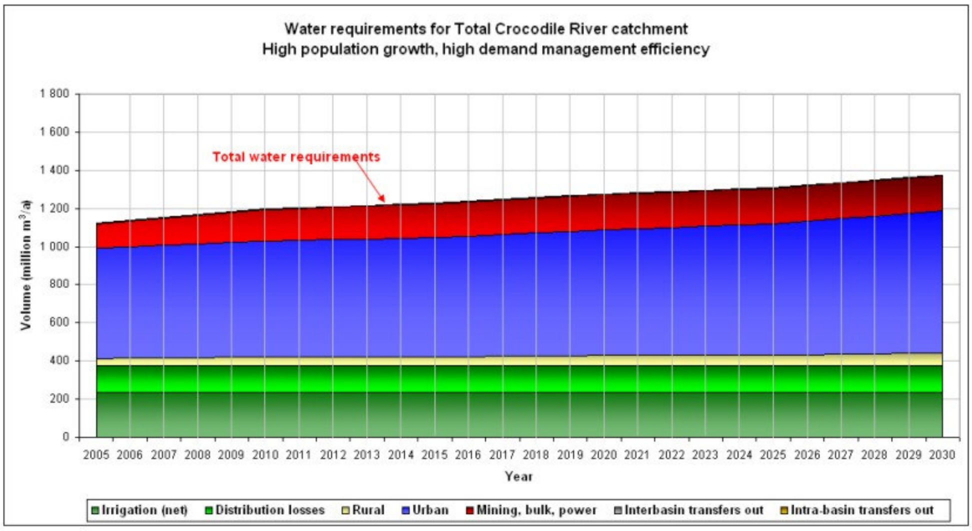
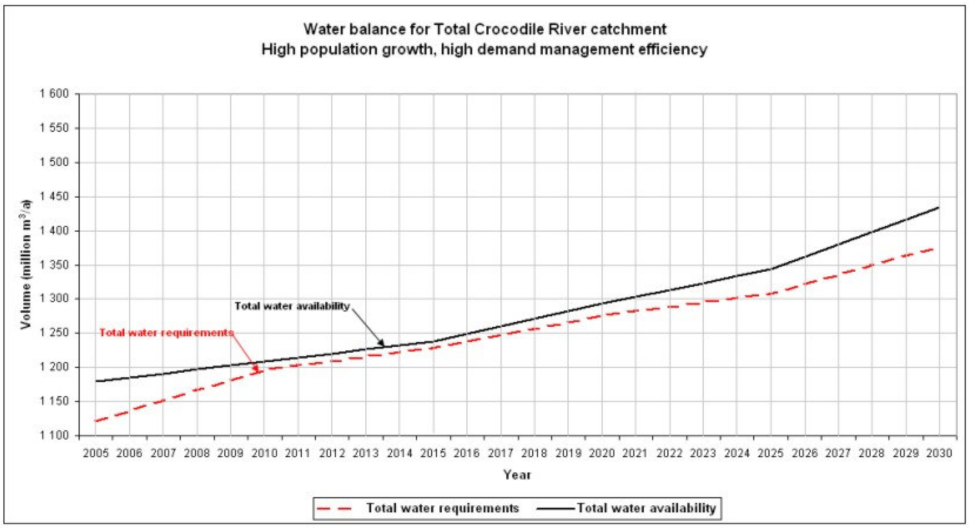
CROCODILE (WEST)
RECONCILIATION STUDY

Situation for total Crocodile River catchment: Low population, medium efficiency

FIG 9







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CROCODILE (WEST) RECONCILIATION STUDY

Situation for total Crocodile River catchment: High population, high efficiency

FIG 10

8.3 WATER BALANCES FOR THE CROCODILE/MOKOLO DAM SYSTEM

Chapter 5.7 of this report includes eight possible future development scenarios at Lephalale. The projected water requirements for these scenarios are summarised in **Appendix I**.

8.3.1 Development scenarios

The need for water transfers from the Crocodile River to the Lephalale area has been assessed for each of the eight Lephalale water requirements scenarios. The water balances for the Crocodile/Mokolo Dam system for these scenarios are presented in **Figures 11** to **14**. The Mokolo Dam yield is also shown on the figures to indicate when the requirements in the Lephalale area will exceed the water availability from Mokolo Dam.

The point on the above mentioned figures where the lines representing different scenarios of water requirement scenarios for the Lephalale area crosses the **Mokolo Dam yield** line shows when the requirements in the Lephalale area will exceed the water availability at Mokolo Dam. This will give an indication of when new infrastructure required to supplement the Lephalale area from the Crocodile River catchment needs to be in place.

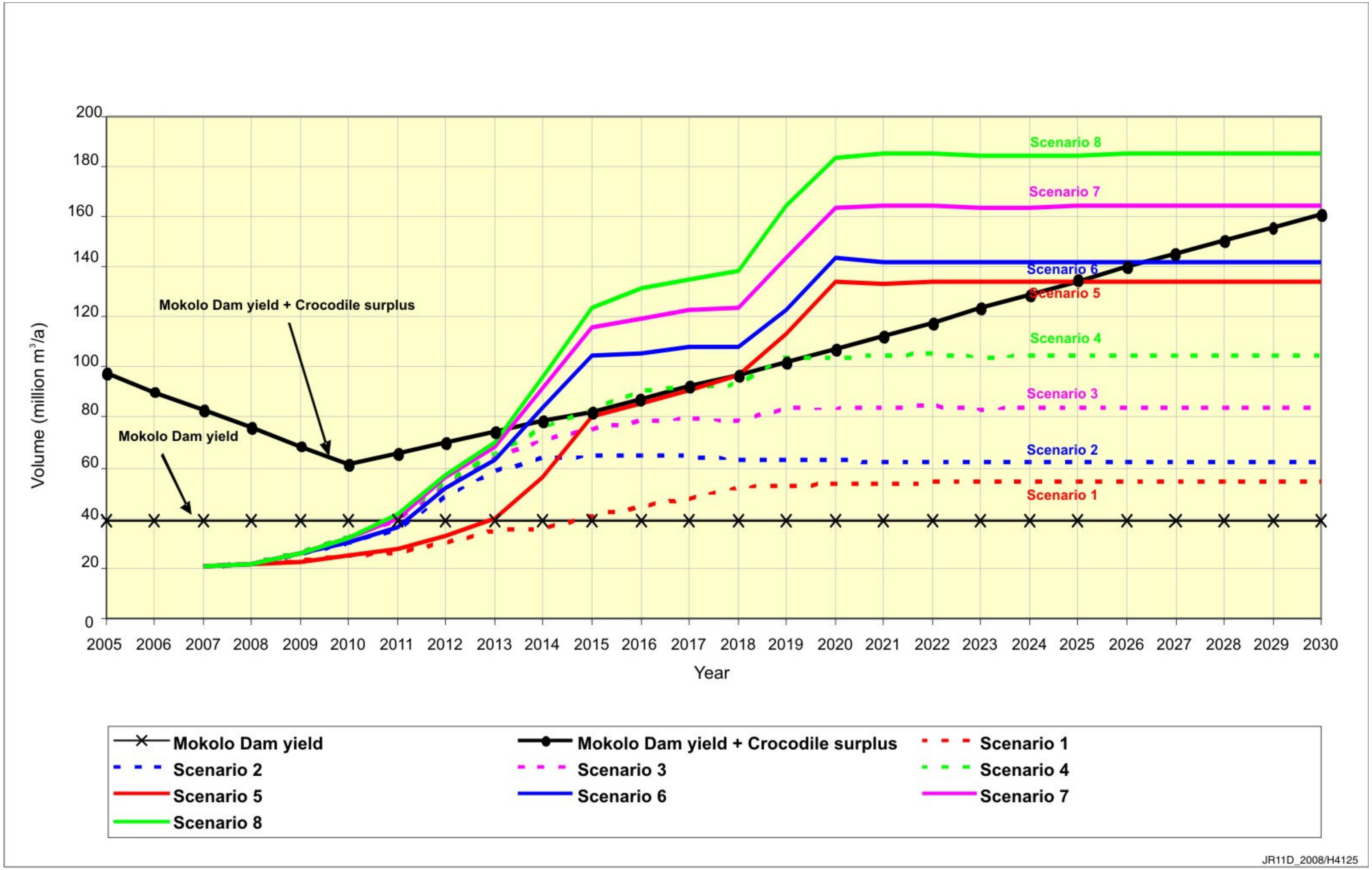
The point on the figures where the lines representing different scenarios of Lephalale water requirement crosses the **Mokolo Dam yield + Crocodile surplus** line gives an indication of when the requirements in the Lephalale area will exceed the Mokolo Dam yield plus the surplus from the Crocodile River catchment. This will require interventions within the Crocodile River catchment to free up more water for transfer to the Lephalale area and/or augmentation from the Vaal River system, either directly or through transfers from the Vaal River system via the Crocodile River catchment.

The tables showing the water balances in the Crocodile River catchment, with the transfers from the Crocodile River catchment and the Vaal River system to the Lephalale area to supplement the water requirements there, are presented in **Appendix J**.

8.3.2 Resultant water balances

From Figures 11 to 14 it is evident that the combined Mokolo Dam yield plus the Crocodile River surplus is not sufficient to supply the growing water requirements in the Lephalale area.

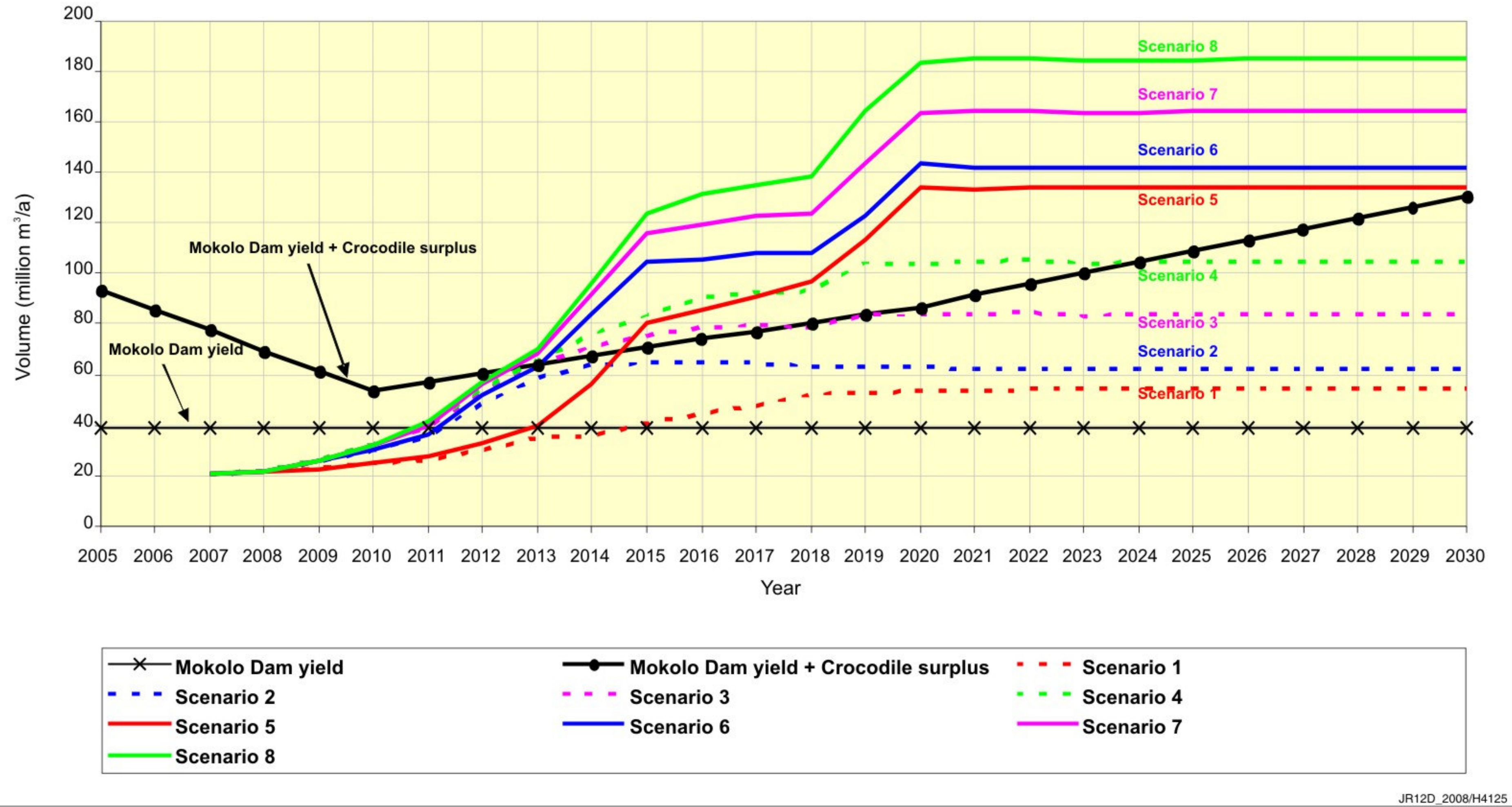
<u>Figure 11</u> (high population, medium efficiency in Crocodile catchment) shows that the yield from Mokolo Dam is sufficient to supply the water requirements of the Lephalale area until between 2011 and 2015, depending on the scenario being considered. Augmentation from the Crocodile River catchment can supply the growing water requirements of the Lephalale area for Scenarios 1 to 4 (with only a minor interim deficit in 2016 with respect to Scenario 4). Additional augmentation from the Vaal System will, however, be required from 2019 to 2024 for Scenario 5, and from 2014 onwards for Scenarios 6, 7 and 8.



CROCODILE (WEST) RECONCILIATION STUDY

Water balance at Lephalale
High population, medium efficiency

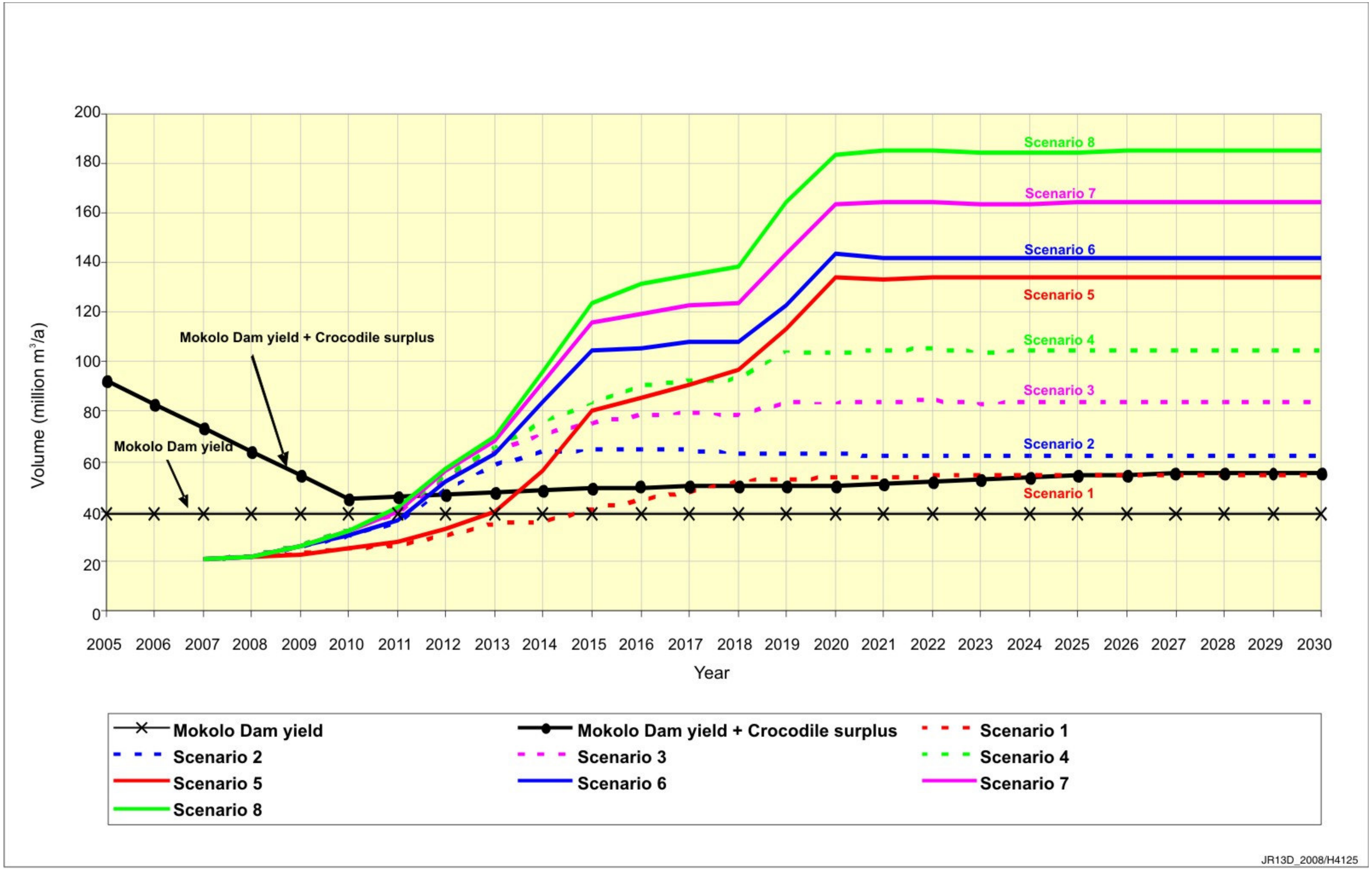
FIG 11



CROCODILE (WEST) RECONCILIATION STUDY

Water balance at Lephalale
Base population, medium efficiency

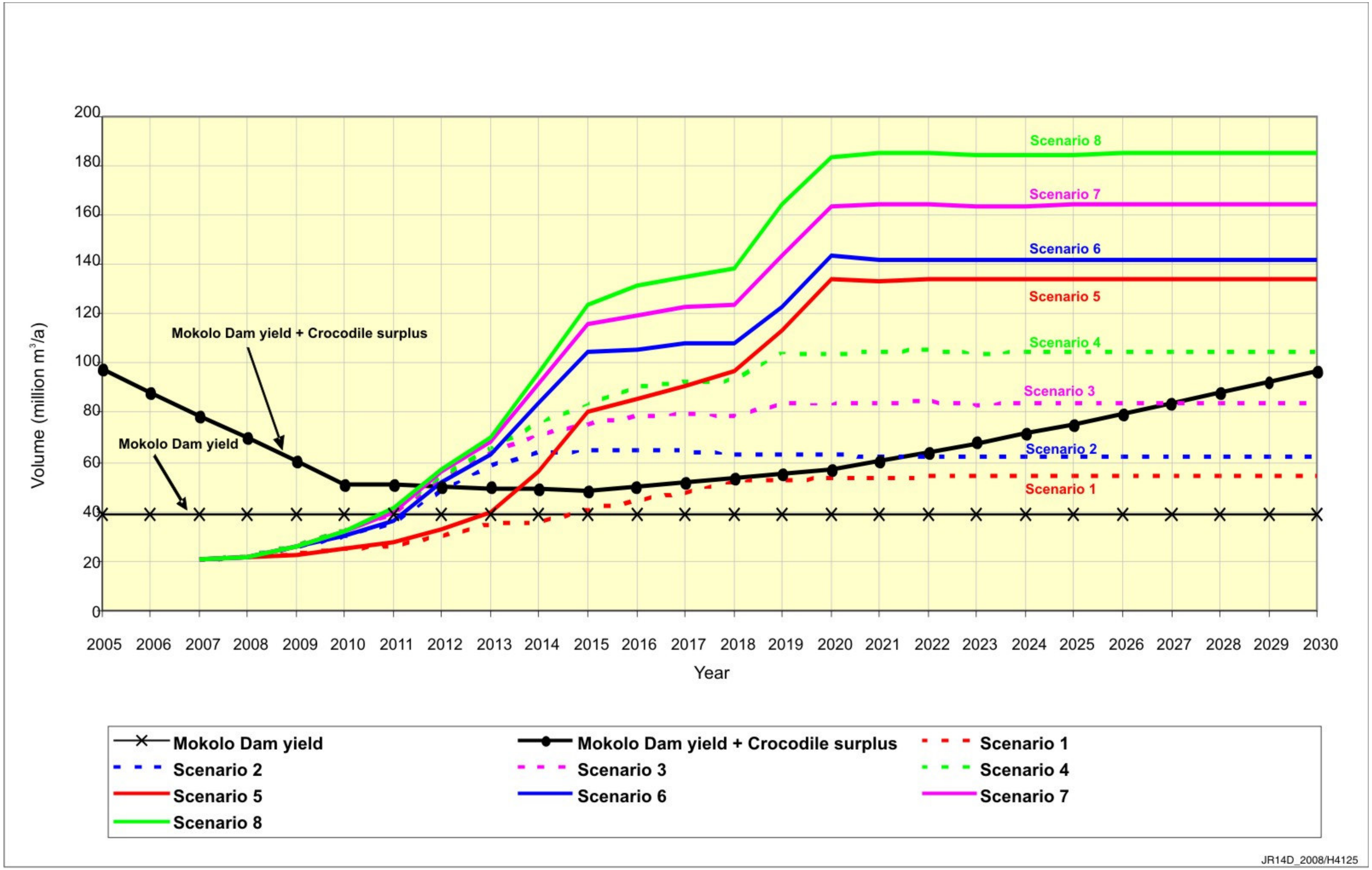
FIG 12



CROCODILE (WEST) RECONCILIATION STUDY

Water balance at Lephalale
Low population, medium efficiency

FIG 13



CROCODILE (WEST) RECONCILIATION STUDY

Water balance at Lephalale
High population, high efficiency

FIG 14

Figure 12 (base population, medium efficiency) shows the yield from Mokolo Dam remaining unchanged, and sufficient to supply the water requirements of the Lephalale area until between 2011 and 2015. (The same applies to Figures 13 and 14.) Supplementation from the Crocodile River catchment can supply the growing water requirements of the Lephalale area for Scenarios 1 and 2, whilst a small interim deficit is projected with respect to Scenario 3. Additional augmentation from the Vaal River system will be required from 2014 to 2023 for Scenario 4; from 2015 onwards for Scenario 5, and from 2013 onwards for Scenarios 6, 7 and 8.

Figure 13 (low population, medium efficiency) shows that augmentation from the Crocodile River catchment can supply the growing water requirements of the Lephalale area only for Scenario 1, subject to small deficits during 2018 to 2024. Additional augmentation will be required from 2012 onwards for Scenarios 2, 3, 4, 6, 7 and 8 from 2012, and from 2014 onwards for Scenario 5.

Figure 14 (high population, high efficiency) also shows the supplementation from the Crocodile River catchment as sufficient to only meet the water requirements of the Lephalale area for Scenario 1. Additional augmentation will be required from 2012 onwards for Scenario 2, 3, 4, 6, 7 and 8 and from 2014 for Scenario 5.

8.4 WATER TRANSFERS FROM THE VAAL RIVER SYSTEM

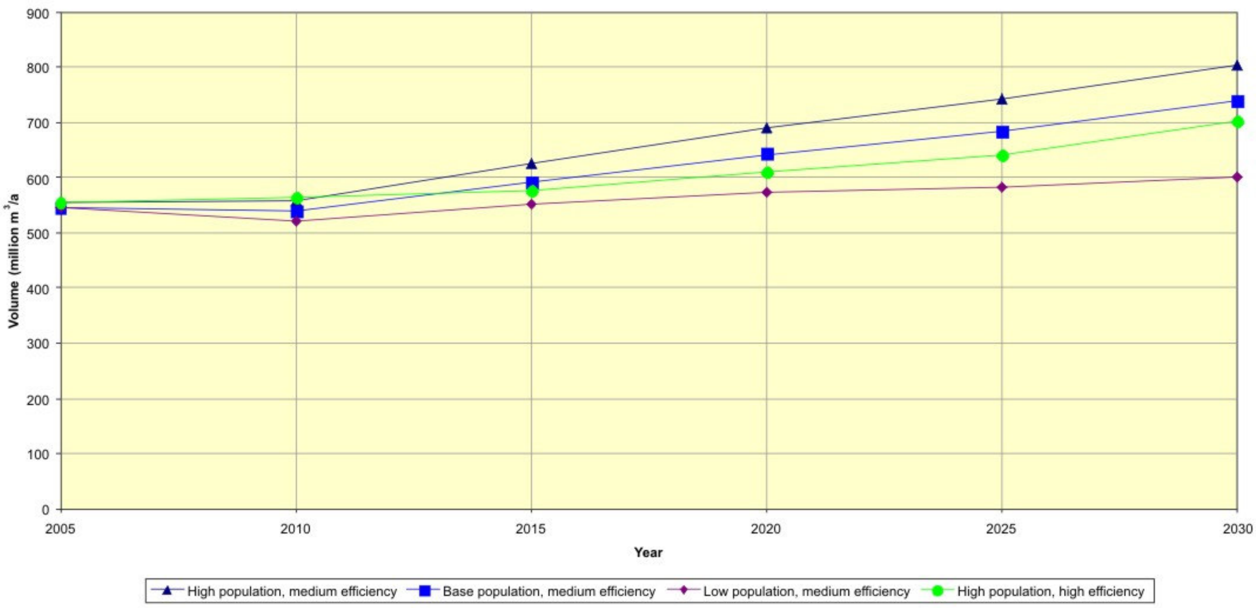
8.4.1 Vaal River system transfers to the Crocodile River catchment only

Table 8.2 represents the potable water transfers from the Vaal River through the Rand Water supply system to the Crocodile River catchment to supply urban and mining requirements in the Crocodile River catchment, for the relevant scenarios. Some of the urban and mining water requirements are supplied from own sources. Table 8.2 is the same as Table 6.3 earlier in the report.

Table 8.2: Total volumes of potable water to be transferred via Rand Water from the Vaal River system to the Crocodile River catchment (million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
High population growth, medium efficiency demand management	554	558	624	691	741	805
Base population growth, medium efficiency demand management	546	540	593	643	684	738
Low population growth, medium efficiency demand management	545	521	551	573	582	600
High population growth, high efficiency demand management	554	564	577	611	640	702

Figure 15 represents the figures listed in Table 8.2.



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CROCODILE (WEST) RECONCILIATION STUDY

Crocodile (West) River catchment - Transfers in of potable water via Rand Water from Vaal River system

FIG 15

8.4.2 Vaal River transfers to the Crocodile/Lephalale system

For some of the scenarios that were investigated the water surplus in the Crocodile River catchment is not enough to supply the total projected water requirements in the Lephalale area in future. Some additional water needs to be transferred to the Lephalale area, either directly or through the Crocodile River catchment. It was assumed that the additional water will be transferred from the Vaal River system. The volumes of water to be transferred from the Vaal River system to the Lephalale area (either directly or through transfers via the Crocodile River catchment) is presented in **Table 8.3**.

Table 8.3: Vaal River water transfers to the Lephalale area (million m^3/a)

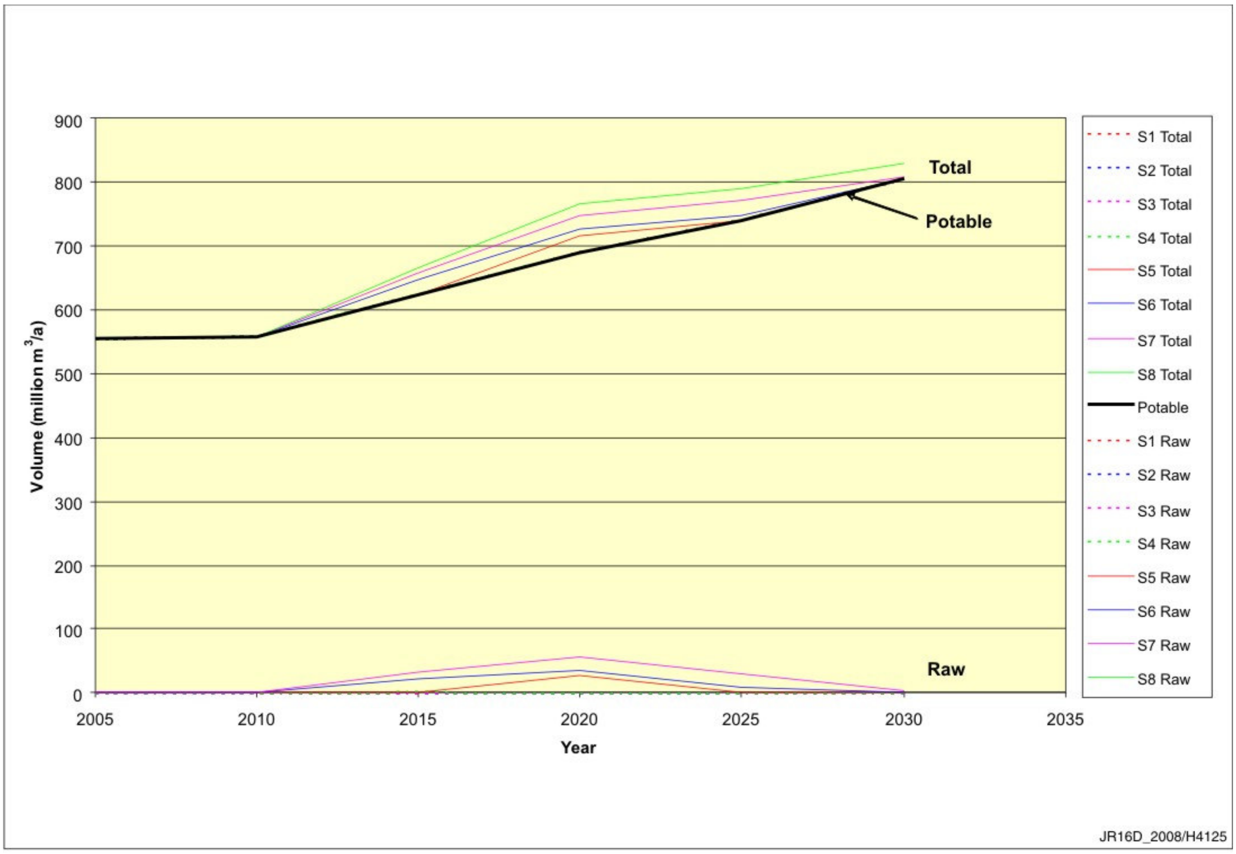
Scenario 1	2005	2010	2015	2020	2025	2030
High population, medium efficiency	0	0	0	0	0	0
Base population, medium efficiency	0	0	0	0	0	0
Low population, medium efficiency	0	0	0	3	0	0
High population, high efficiency	0	0	0	0	0	0
Scenario 2	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	0	0	0	0
Base population, medium efficiency	0	0	0	0	0	0
Low population, medium efficiency	0	0	15	13	8	7
High population, high efficiency	0	0	16	0	0	0
Scenario 3	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	0	0	0	0
Base population, medium efficiency	0	0	5	0	0	0
Low population, medium efficiency	0	0	26	33	29	29
High population, high efficiency	0	0	27	6	0	0
Scenario 4	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	1	0	0	0
Base population, medium efficiency	0	0	12	17	0	0
Low population, medium efficiency	0	0	34	53	50	49
High population, high efficiency	0	0	35	27	9	8
Scenario 5	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	0	7	0	0
Base population, medium efficiency	0	0	10	47	25	4
Low population, medium efficiency	0	0	31	83	80	79
High population, high efficiency	0	0	33	57	39	38
Scenario 6	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	23	16	0	0
Base population, medium efficiency	0	0	34	56	33	12
Low population, medium efficiency	0	0	55	93	88	87
High population, high efficiency	0	0	56	66	47	46
Scenario 7	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	34	36	9	4
Base population, medium efficiency	0	0	45	77	55	34
Low population, medium efficiency	0	0	66	113	109	109
High population, high efficiency	0	0	67	86	68	68
Scenario 8	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	41	57	30	25
Base population, medium efficiency	0	0	52	97	75	55
Low population, medium efficiency	0	0	74	133	130	129
High population, high efficiency	0	0	75	107	89	88

Table 8.4 represents the total water transfers from the Vaal River system to the Crocodile River catchment. These transfers include the potable urban and mining requirements in the Crocodile River catchment (supplied by Rand Water) plus the expected raw water shortfalls at Lephalale after supplementing it with surplus water (if available) from the Crocodile River catchment.

Table 8.4: Total Vaal River water transfers to the Crocodile/Lephalale system (million m^3/a)

Scenario 1	2005	2010	2015	2020	2025	2030
High population, medium efficiency	554	579	624	711	761	804
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	576	582	600
High population, high efficiency	554	584	576	632	660	701
Scenario 2	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	579	624	711	761	804
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	566	586	590	607
High population, high efficiency	554	584	593	632	660	701
Scenario 3	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	579	624	711	761	804
Base population, medium efficiency	546	540	597	643	684	738
Low population, medium efficiency	545	521	577	606	612	629
High population, high efficiency	554	584	604	638	660	701
Scenario 4	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	579	625	711	761	804
Base population, medium efficiency	546	540	605	659	684	738
Low population, medium efficiency	545	521	585	626	632	650
High population, high efficiency	554	584	611	658	669	709
Scenario 5	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	579	624	717	761	804
Base population, medium efficiency	546	540	602	689	709	742
Low population, medium efficiency	545	521	582	656	662	679
High population, high efficiency	554	584	609	688	699	738
Scenario 6	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	579	647	727	761	804
Base population, medium efficiency	546	540	626	699	717	750
Low population, medium efficiency	545	521	606	666	670	687
High population, high efficiency	554	584	633	698	707	747
Scenario 7	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	579	658	747	771	809
Base population, medium efficiency	546	540	637	719	739	772
Low population, medium efficiency	545	521	617	686	692	709
High population, high efficiency	554	584	644	718	729	769
Scenario 8	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	579	665	767	791	829
Base population, medium efficiency	546	540	645	739	759	793
Low population, medium efficiency	545	521	625	706	712	730
High population, high efficiency	554	584	651	738	749	789

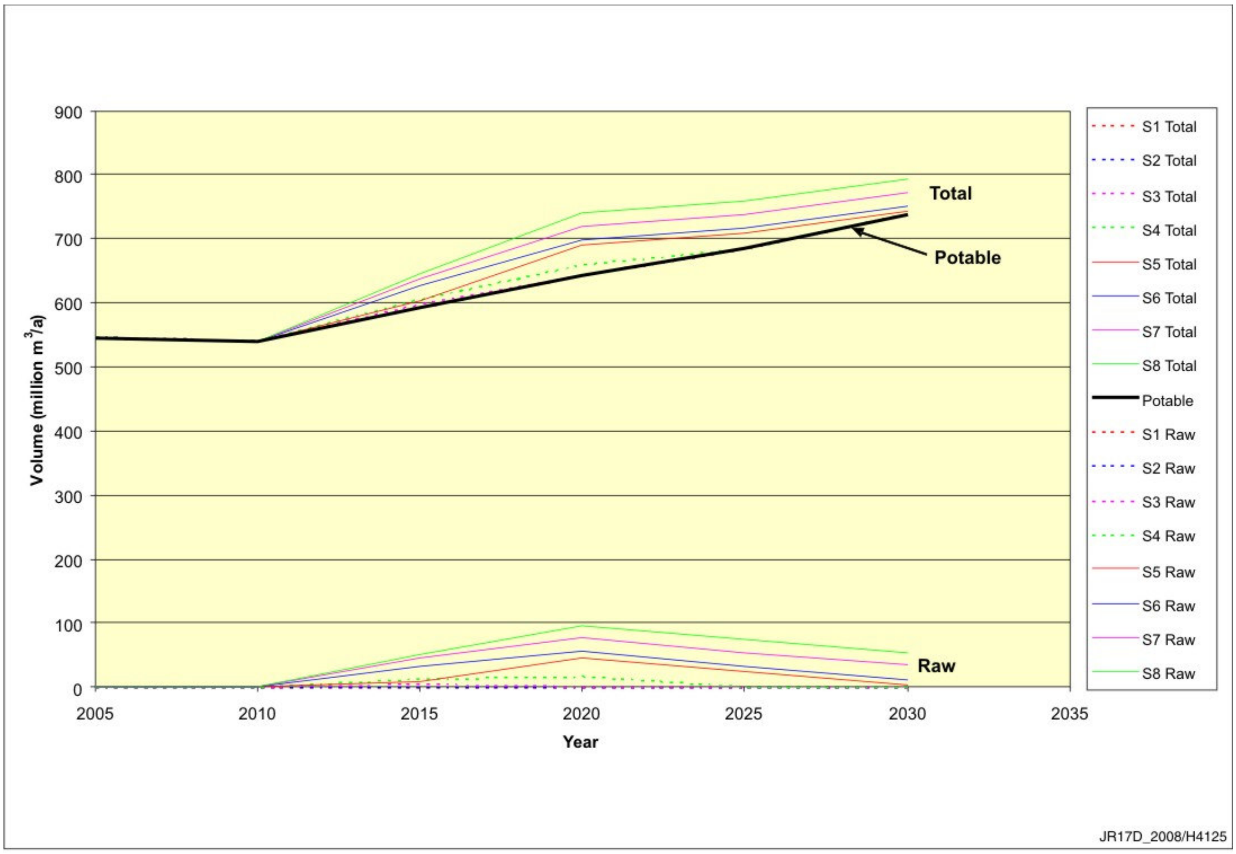
Figure 16 represents projected total water transfer from the Vaal River system for High population, medium efficiency for the figures listed in Table 8.3. Similarly **Figure 17** represents the projected transfers for the base population, medium efficiency, **Figure 18** the projected transfers for the low population, medium efficiency and **Figure 19** the projected water transfers for the high population, high efficiency.



CROCODILE (WEST) RECONCILIATION STUDY

Water transfer from the Vaal River to the Crocodile River and Lephalale: High population, medium efficiency

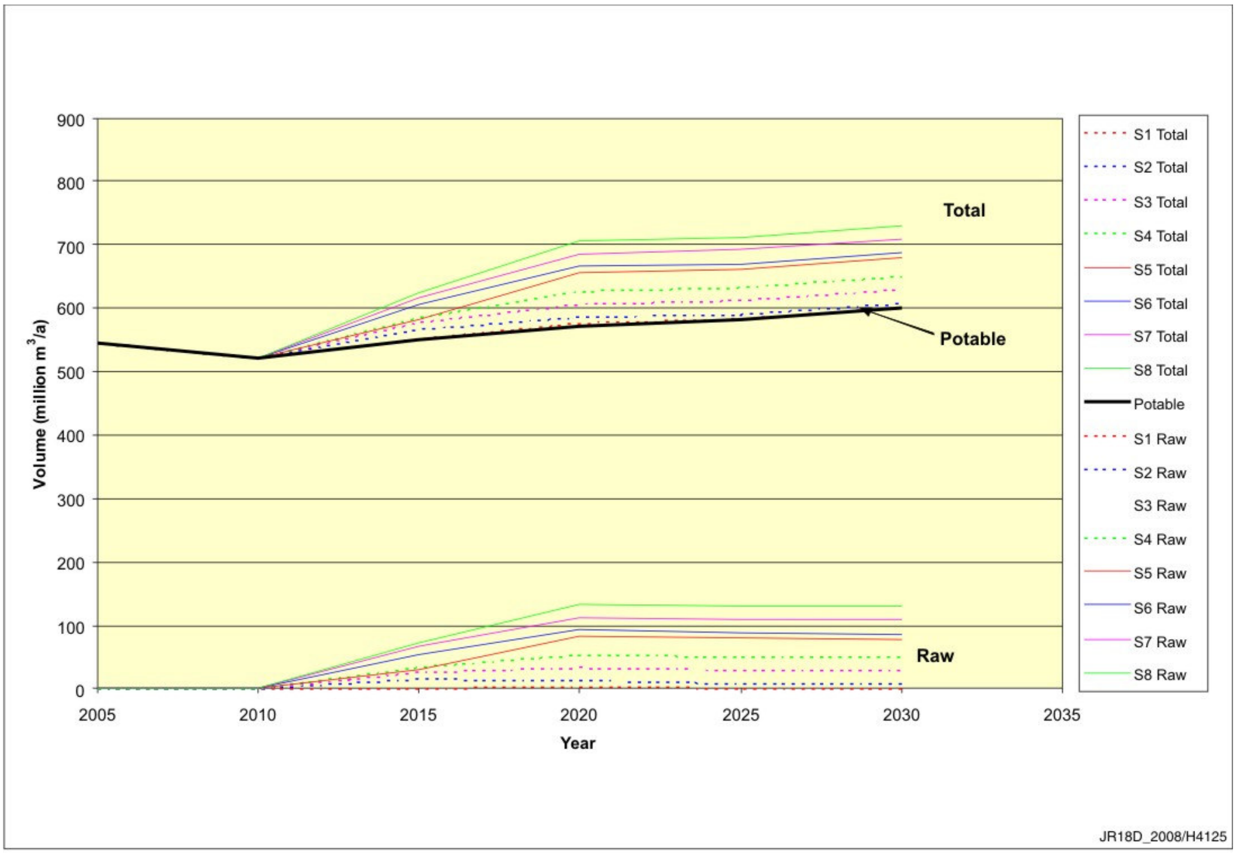
FIG 16



CROCODILE (WEST) RECONCILIATION STUDY

Water transfer from the Vaal River to the Crocodile River and Lephalale: Base population, medium efficiency

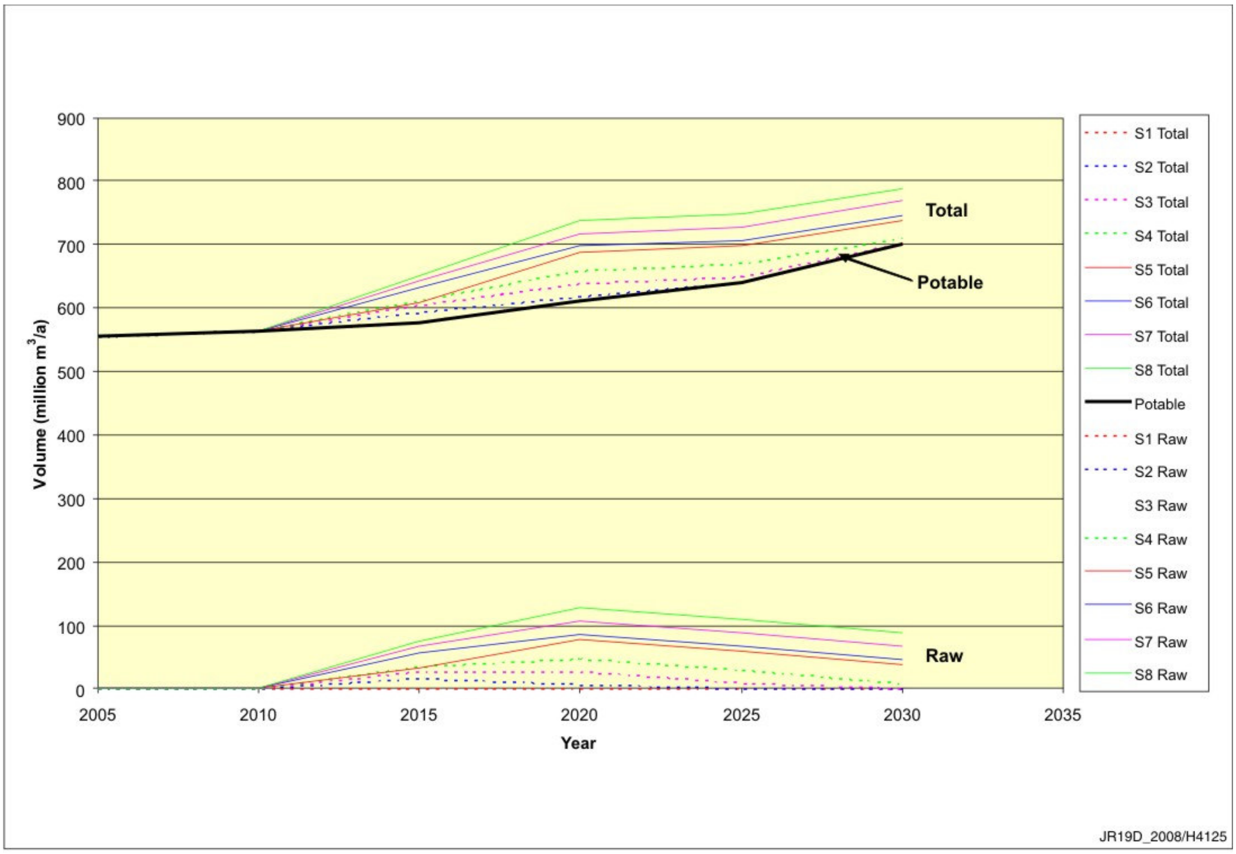
FIG 17



CROCODILE (WEST) RECONCILIATION STUDY

Water transfer from the Vaal River to the Crocodile River and Lephalale: Low population, medium efficiency

FIG 18



CROCODILE (WEST) RECONCILIATION STUDY

Water transfer from the Vaal River to the Crocodile River and Lephalale: High population, high effieincy

FIG 19

8.5 CORE OBSERVATIONS

Several core observations can be made from the preceding information, as concisely described below.

However, predicting the future is not an exact science and at least some variations should always be expected to occur. Therefore the use of scenario analyses as a means of assessing plausible alternatives.

It should also be noted that this Version 1 of the Strategy is partly based on information that is still in the process of being verified and finalised. Some of the larger items include confirmation of the yields of local water resources in the Crocodile catchment as well as for the Mokolo Dam near Lephalale, water use for agricultural irrigation, the timing at which planned developments will actually be implemented (if at all), and others.

8.5.1 Water balance for the Crocodile River catchment

Given that the growth in water requirements for the main urban centres (Johannesburg, Midrand, Pretoria, Rustenburg) will continue to be supplied from the Vaal River system via the Rand Water network, and the commensurate growth in urban return flows towards the Crocodile River and its tributaries, sufficient water should be available to meet all the requirements for water in the Crocodile River catchment until 2030 for all the scenarios analysed. Refer to the tables in Appendix J for more detail.

Return flows to the Crocodile River are discharged into various tributaries. These all converge upstream and at the confluence of the Moretele River with the Crocodile River, which offers the opportunity for large scale abstraction (such as for the Lephalale area) and possible regulation downstream of that point.

8.5.2 Transfers to Lephalale

The yield from Mokolo Dam is sufficient to supply the water requirements of the Lephalale area until between 2011 and 2015, depending on the development scenario in the Lephalale area being considered, and is not influenced by the situation in the Crocodile catchment.

For the high population, medium efficiency scenario there should be enough surplus in the Crocodile River catchment to supply the projected water requirements for Lephalale Scenarios 1 to 4. For Scenario 5 an interim deficit is projected, whilst Scenarios 6 to 8 need to be supplemented with water from elsewhere. Although some other interim measures may be taken, the long term solution would probably be that water be transferred from the Vaal River System.

For the base population, medium efficiency scenario there should be enough surplus in the Crocodile River Catchment to supply the projected water requirements for Lephalale Scenarios 1 and 2. Scenario 3 would experience a small interim deficit, whilst Scenarios 4 to 8 need to be supplemented with water (from the Vaal River system).

For the low population, medium efficiency scenario there would only be enough surplus in the Crocodile River catchment for Lephalale Scenario 1. The remainder need to be supplemented with water (from the Vaal River system).

For the high population, high efficiency scenario there should be enough surplus in the Crocodile River catchment for Lephalale Scenario 1. Scenarios 2 to 8 will need to be supplemented with water (from the Vaal River system).

At the time of the latest update of this report it was already evident that Scenario 2 is not applicable any longer, whilst it is doubtful whether the time scales of some of the other scenarios are still achievable.

8.5.3 Transfers from Vaal River system

The transfer of water from the Vaal River system to the Crocodile River catchment (potable water via Rand Water network) continues to grow for all the scenarios. Also refer to Table 8.2 and Figure 15.

Should the need for water transfer from the Crocodile River catchment to the Lephalale area be taken into account together with the Rand Water transfers to the Crocodile River catchment, the low water use scenarios in the Crocodile River catchment also result in the lowest total transfers from the Vaal River system, despite the need for additional augmentation (raw water) to meet the needs in the Lephalale area. The higher the requirements for water in the Crocodile River catchment, the larger the quantities of water to be transferred from the Vaal River system. Also refer to Table 8.3 and Figures 16 to 19.

A comparison of the volumes of water to be transferred from the Vaal River system by 2025 as currently estimated, with the projections in the National Water Resource Strategy (NWRS), is given in **Table 8.5**.

Table 8.5: Comparison of Vaal River system water transfers by 2025

Projection	2025 Transfer (million m^3/a)*		
	Low population growth	Base population growth	High population growth
NWRS	-	730	1 160
Crocodile only, medium demand management	580	685	740
Crocodile only, high demand management	-	-	640
Crocodile and Lephalale, medium demand management	580 to 710	685 to 760	740 for Scenario 1 to 790 for Scenario 8
Crocodile and Lephalale, high demand management	-	-	640 for Scenario 1 to 750 for for Scenario 8

* **Note:** Numbers rounded off for ease of comparison
Transfers given are to meet the combined needs in the Olifants catchment and Lephalale area

It is important to note that, although the water surplus in the Crocodile River catchment that can be transferred to the Lephalale area, is greater with medium water demand management efficiency than with high water demand management efficiency (see Figures 11 and 14), the high efficiency scenario results in a net saving in the total water that needs to be transferred from the Vaal River system to the Crocodile catchment and Lephalale area.

The differences in the transfer requirements between Scenarios 1 and 8 as shown in Table 8.5 are somewhat less than the difference in water requirements between the scenarios as shown on the graphs. This is due to the fact that in the event of Scenario1, the re-use of surplus return flows still needs to be optimised.

8.5.4 Water quality

It is evident that the quality of water in receiving streams will be further impacted upon by the growing quantities of return flows, or by the growing pollution load in the event of more concentrated effluent due to water conservation and demand management, unless appropriate remedial measures are taken to lessen the impact.

8.5.5 Irrigation distribution losses

Excessive water losses occur from the aged and unlined irrigation distribution canals. Approximately 45 million m^3 per year is estimated to be lost from the area between the Hartbeespoort Dam and Roodekopjes Dam alone, with substantial losses also further downstream.

Even partial curtailment of these losses can make a meaningful contribution to the availability of water. The actual losses need to be more reliably quantified, however, and the practicalities and costs of saving measures be determined.

8.5.6 Population and economic growths

The growth in urban water requirements is largely dependent on the future population and economic growth, where a relatively wide band of uncertainty prevails. This uncertainty is compounded by the impacts and efficiency of varying degrees of water conservation and demand management measures that may be implemented.

These will need to be closely monitored for timely adjustments where applicable.

8.5.7 Mining water requirements

Doubt exists about the reliability of the estimated future water requirements for mining in the Crocodile catchment. The projected future quantities appear to be high relative to other comparative areas, both for existing and future mining activities.

This can have a serious impact on the relevance and cost-efficiency of the Strategy to be developed.

8.5.8 Irrigation water requirements

The irrigation water requirements used in the projections and water balances are based on observed areas under irrigation. The legally valid water licenses as well as the actual volumes abstracted may differ substantially from this.

DWAF has started with a study on the validation and verification of existing lawful use of water in the Crocodile River catchment. The outcome of this study could have an effect on the water balances and resulting surpluses or deficits.

8.5.9 Provision for the Reserve

Due to the highly altered flow regime in the catchment where the volumes of return flows are well in excess of the natural runoff for the main stem of the Crocodile River and most of the main tributaries, provision for the Reserve has little impact on the yield from reservoirs and the availability of water.

A negative impact of the high proportion of return flows and the regulation of flow by control structures is that the natural variability of stream flow is smoothed out, also with resultant unnaturally high winter flows.

8.5.10 Water levels at Hartbeespoort Dam

Due to the current surplus availability of water at Hartbeespoort Dam, the operation of the dam resulted in relatively small fluctuations in water level during recent years. This, amongst others, led to substantial lakeside and marina-type developments along the shore.

Should the dam be operated to maximise the yield and the water availability from the Crocodile River system, much higher and more frequent fluctuations in the water level can be expected. Although no guarantees were given by the DWAF to developers regarding the management of water levels, there may be significant impacts from this.

9. POTENTIAL RECONCILIATION OPTIONS

Various reconciliation options and interventions have been identified and considered/investigated, to address the key influencing factors on the Strategy, in response to the realisation of the possible future scenarios.

A summary of the primary options and interventions only, is given below. Various secondary level actions are required in order to implement these:

- Water demand management
- Direct re-use or recycling of effluent
- Indirect re-use of effluent (various potential abstraction points)
- Monitoring, review and enforcement of water use licenses
- Improved water resources management, with negotiated assurance of supply requirements
- Management and allocation of water resources in order to meet user quality requirements
- Trading (re-allocation) of irrigation water
- Development of groundwater (localised small potential)
- Removal of alien vegetation
- Increase transfers from the Vaal River system
- Enforcement of effluent discharge standards (for quality)
- Land use planning, land management and agricultural practices (for quality)
- Treatment or blending of water (for quality)

A matrix on how these may relate to the key influencing factors is given in **Table 9.1**.

Table 9.1: Matrix on how actions and interventions may relate to key factors

Sector / locations	Options / interventions	Considerations	Potential impacts	Comments
Key factor 1: Growth in water requirements (1)				
Urban / industrial in total catchment	• Water demand management	• Current efficiencies, time, cost	• Reduces return flows • Reduces flexibility • Increased pollutants concentration • Lower municipal costs	• WCDM essential, can only partly address needs (if high growth)
Urban/industrial in Upper Crocodile	• Increase transfers from Vaal	• Water availability from Vaal system, cost	• Increase load on limited source (in Vaal)	• Probably best option for Johannesburg, Midrand, Centurion

Sector / locations	Options / interventions	Considerations	Potential impacts	Comments
Urban / industrial in Apies / Pienaars	• Increase transfer from Vaal • Re-use of effluent • Buy out / trading of irrigation water	• Water availability from Vaal, cost • Relative location of effluent demand centre • Quantity, quality of effluent • User quality requirements • Water available for urban / rural use	• Increase load on limited resource • Building up of salinity • Socio economics	• Need for minimum discharge from system • Indirect re-use from Hartbeespoort, Roodeplaat, Klipvoor main options • Bon Accord Dam
Urban / industrial in Elands	• Increase transfers from Vaal • Re-use of effluent	• Water availability from Vaal system, cost • As for Apies / Pienaars	• Increase load on limited resource • Building up of salinity	• Need for minimum discharge from system • Re-use of Rustenburg effluent and from Hartbeespoort Dam main options
Mining (Elands catchment and Garankuwa)	• Increase transfers from Vaal • Re-use effluent from Rustenburg, Brits • Abstract from Hartbeespoort, Roodekopjes	• Water availability from Vaal system, cost • Relative location of effluent to demand centre • Quantity, quality of effluent • User quality requirements • User quality requirements • Capacity of link canal	• Increase load on limited resource	• Potable water not needed for process requirements • Process water for mines largely consumptive
Mining (Lower Crocodile)	• Abstract from Crocodile River • Groundwater	• Availability	• Potential over-exploitation	• Small potential

Sector / locations	Options / interventions	Considerations	Potential impacts	Comments
Key factor 2: Natural water resources already fully developed and utilised				
All	• WCDM • Re-use of effluent • Transfers from Vaal	• See Key factor 1	• See Key factor 1	• To manage over-exploitation of groundwater
Key factor 3: Strong dependence on transfers from Vaal				
Urban / industrial / mining	• Resource optimisation: WCDM, re-use of effluent, minimise transfers from Vaal • Cost optimisation: WCDM, re-use of effluent, transfers from Vaal	• See Key Factor 1 • See Key Factor 1	• See Key Factor 1 • See Key Factor 1	• Optimal balance needed between resource and cost optimisation • Optimal balance needed between resource and cost optimisation
Key factor 4: Growing volumes of return flows				
Control illegal abstraction of return flows for irrigation	• Monitoring, review and enforcement of licenses • Location of discharge	• Human resources capacity	• Politically sensitive	
Impacts of WCDM	• Scenario analyses and assessment (models)	• Requirements for Reserve (quantity, quality)	• Increased concentration of pollutants	• Need to achieve optimal balance between options
Key factor 5: Implementation of Reserve				
Unregulated rivers (not impounded)	• Control of effluent discharges	• Requirements for flow variability	• Limitations on discharges and abstractions	
	• Control of abstractions	• Water quality requirements		
Regulated rivers	• Release of required flows	• Release capacity at dams • Flow regime and quality requirements	• Possible reduction of yield	

Sector / locations	Options / interventions	Considerations	Potential impacts	Comments
Key factor 6: Water quality				
Groundwater: Natural / poor quality	• Treatment, blending	• Intended use, quality requirements • Whether chemical and/or bacteriological contamination • Isolated boreholes or wellfield		• Proper operation and maintenance of treatment / blending
Deterioration due to urban / industrial return flows	• Enforcement of discharge standards • Location of effluent discharge • Direct re-use of effluent	• Assimilative capacity of stream (also seasonal) • Environmental requirements • Downstream user requirements	• Environmental damage • Water unfit for use • Pollution of groundwater • Recreational impacts	
Pollution from active mines	• Enforcement of statutory regulations • Recycling by mines	• Type of mining • Mining processes	• Pollution of groundwater • Pollution of surface water	
Mine closures	• Planning for mine closure	• Mines already closed, or still operational	• Pollution of groundwater • Pollution of surface water	
Agricultural impacts: point sources	• Enforcement of statutory regulations		• Mainly surface water pollution	
Agricultural impacts: diffuse sources	• Land use planning • Alternative agricultural practices	• Assimilative capacity • Downstream user requirements	• Mainly surface water pollution	• Probably little potential for change

Sector / locations	Options / interventions	Considerations	Potential impacts	Comments
Key factor 7: Linkages to neighboring WMAs and Limpopo River				
Limpopo River: Resultant flows and quality reaching Limpopo confluence	• Water management in Crocodile catchment	• Obligations in terms of Limpopo Watercourse Commission (quantity and quality)	• Political impacts if insufficient releases or quality • Excess load on Vaal inefficiently managed	• Crocodile River to be managed to fully meet LRBC obligations and environmental requirements, without excess flows to Limpopo
Needs for water in neighboring WMAs: ➢ Urban / rural, domestic	• Transfer from Roodeplaat to KwaMhlanga and Modimole	• Alternative resources (or lack of), cost optimisation	• Water balances in Crocodile catchment	
Needs for water in neighboring WMAs: ➢ Mining	• Transfer from Klipvoor or Lower Crocodile to Mokolo catchment	• Alternative sources (lack of) • Cost and risk optimisation (abstract at Klipvoor or Lower Crocodile)	• Water balances in Crocodile catchment	
Dependence and impacts on Vaal River system	• See Key Factor 3	• See Key Factor 3	• See Key Factor 3	• Close co-opertion needed re planning and operation of Vaal system and Crocodile system

10. RECONCILIATION AND MANAGEMENT STRATEGY

The objective of the Water Resource Reconciliation and Management Strategy is "to ensure the sufficient and reliable supply of water of appropriate quality to all existing and future users together with the best utilisation of resources in the catchment, at the lowest cost and in an environmentally sustainable manner". The Strategy is targeted at water related issues and addresses options, interventions and actions towards achieving the above. It is cognisant of the possible development scenarios and of the impacts and risks/uncertainties associated with the various options.

The Strategy is not intended to be a singular master plan with fixed sequencing and time scales, but should be both flexible and robust under changing conditions.

The Strategy comprises:

(1) certain general items and ongoing activities that need to be attended to as primary functions in support of the implementation of other components of the Strategy;

(2) strategies of general nature directed at key issues or components, and

(3) specific strategies, other than the above, for addressing of other key issues.

These are covered in the sections that follow.

10.1 GENERAL ITEMS AND ONGING ACTIVITIES

Certain elements of the Strategy are common to all scenarios and are of general application towards improved water resource management. These include:

- The validation and verification of water use licenses, and confirmation of actual abstraction and use. This has already been embarked upon and should receive high priority, with particular focus on irrigation water.
- Regular review as well as constant monitoring and enforcement of water use licenses. Without proper enforcement much of the water resource management strategies will be futile. (These activities appear to have been neglected in recent years.)
- Setting of assurance of supply requirements for different categories of water users, reflection of such in the water use licenses, and management of the water resources accordingly to ensure that the optimal utility is achieved.
- The allocation and management of water resources to meet user quality objectives.
- Management of the water resources in the Crocodile River catchment in order to minimise excess discharges to the Limpopo River as well as to minimise the overall transfers from the Vaal River System.

10.2 GENERAL STRATEGIES

Strategies of a general nature are covered below.

10.2.1 Increased water requirements

The growth in water requirements should be monitored on an ongoing basis. This should include the monitoring of actual developments with respect to population and economic growth, and the metering and assessment of water use. This should contribute towards reducing the band of uncertainty with respect to future growth, and ascertaining which the most likely development scenario to apply is.

The water requirements for the irrigation users should be determined with greater reliability after completion of the *Crocodile River Catchment Validation and Verification Study* currently being undertaken for DWAF.

The mining water requirements also need to be determined with more accuracy. Experience in other studies indicated that unless the mining sector enters into firm agreements for paying for specific projected water consumption figures, the mining requirements will tend to be inflated. DWAF should also ensure that mining houses meter water abstractions from different sources and submit water use figures onto a DWAF data base directly. This data base will support more realistic forecasts of projected future water requirements.

10.2.2 Water conservation and demand management

The primary focus in the urban/industrial sector should be on the minimisation of leaks, which is where most of the losses occur. Thereafter the focus should be on the reduction on consumptive use. The reduction of non-consumptive uses does not directly contribute to water savings, but impacts on infrastructure sizing and effluent concentrations.

Due to a current lack of resources at most municipalities (human resources and finances), the potential for successfully implementing water conservation and demand management measures over the short to medium term is uncertain.

With respect to the irrigation sector, the focus should be to minimise distribution losses (also addressed under 10.4).

10.2.3 Direct recycling of effluent

The direct recycling of effluent mainly occurs with respect to process water for mining and industries, where it is driven by economic considerations. This practice should be promoted.

Grey water recycling, such as for irrigation of golf courses, should be applied where economically feasible, and where the health risks are acceptable and it can be practiced on an environmentally sustainable basis.

10.2.4 Indirect re-use of effluent

Treated effluent discharged to rivers constitutes the largest source of water in the Crocodile catchment. Process water for mining and some industrial uses as well as much of the irrigation water, should be supplied through the re-use of effluent discharged to rivers

As a general norm, effluent should preferably be discharged at the most upstream location that is feasible and upstream of a regulation point, to facilitate the optimal opportunity for re-use. This is subject to water quality considerations, however, which in many cases would be the controlling factor. Specific proposals are given under Chapter 10.3.

10.2.5 Groundwater

Specific focus and management interventions through compulsory licensing are required where over-abstraction occurs, such as at Maloney's Eye. An active and reliable data base on groundwater use and aquifer performance should be developed for the identification of potential problem areas. Pumping from induced recharge from rivers should also be investigated and controlled.

Further groundwater development may be allowed in unstressed aquifers for small scale community water supply. Groundwater development for mining purposes may also be possible, subject to the proven sustainability thereof. Appropriate preventative or remedial measures need to be taken where the dewatering of mines could impact on existing users.

The risk of salinisation of groundwater as a result of high salinity irrigation return flows should be investigated.

10.2.6 Water quality

Water quality in the Crocodile River catchment is severely compromised as a result of the sprawling urban developments and large volumes of return flows.

Priority should first be given to the proper enforcement of effluent standards at all times. Water quality objectives should be established for all major streams and impoundments, and management options be investigated towards achieving these (such as the current initiatives with respect to improving the quality of water in the Hartbeespoort Dam).

Inadequate sanitation, as often occur in peri-urban and informal areas, is the cause of both surface water and groundwater pollution. The initiatives by the national and local governments towards improving sanitation infrastructure should be supported and prioritised.

10.2.7 Implementation of the Reserve

Implementation of the Reserve should be done in accordance with the provisions in the NWRS.

Due to the high degree of regulation of the Crocodile River catchment, and to the impacts of return flows on the flow regime and water quality, certain compromises will of necessity have to be made.

10.2.8 Alien vegetation

Invasive alien vegetation encroaching on streams should be removed as part of the "Working for Water" programme. Also in specific cases that may be identified and where it would be economical and sustainable to do so.

10.3 SPECIFIC STRATEGIES

10.3.1 Regulation of return flows

Of primary importance with respect to the efficient management of water resources in the Crocodile River catchment, is the efficient control and re-use of return flows.

Return flows to the Crocodile River System are dispersed over a wide geographic area. Similarly with respect to new urban and industrial developments that will contribute to return flows in future, and which locations are determined by many factors other than the point of return flow. This is partly compensated for by the fact that the return flows and new developments are mainly concentrated in the upper (southern) parts of the catchment, whilst the greatest potential for re-use of the return flows occur in the middle and downstream part of the catchment (below Hartbeespoort Dam and towards Thabazimbi).

To facilitate the efficient management of return flow re-use, it is proposed that a new regulation dam be investigated on the main stem of the Crocodile River at a location downstream of the last main tributary that contributes return flows.

A suitable location for such a dam has been identified on the farm Boschkop, immediately downstream of the confluence of the Moretele River with the Crocodile River. It is also located downstream of several major dams, that would enable the controlled releases from either or combinations of these dams for re-regulation at Boschkop. (The upstream dams being Hartbeespoort and Roodekopjes on the Crocodile River, Klipvoor Dam on the Pienaars River and downstream also of Roodeplaat Dam, and Vaalkop Dam on the Elands River.)

Abstractions and/or releases for downstream use, such as for transfer to the Lephalale area, can then be made from the dam at Boschkop.

10.3.2 Re-use below Hartbeespoort Dam

Most of the effluent return flows in the Crocodile catchment are discharged to the river system upstream of Hartbeespoort Dam. This has resulted in the surplus availability of water at that point, and which is shown to further increase in future under most scenarios. As a result of the dominant proportion of return flows entering the dam in relation to the natural runoff, there has also been a steady decline of the quality of water in the dam.

Given the extensive mining related developments along a band from Akasia to Rustenburg, below Hartbeespoort Dam, and northwards past the Pilanesberg and beyond, a proposal was made that these be supplied with water to be abstracted from the Hartbeespoort Dam. Water will be abstracted at or from the dam for treatment to industrial standards and then piped to the mines. This will also lessen the need for use of higher quality potable water from Rand Water, which could be allocated for urban use.

This strategy would facilitate the large scale re-use of effluent at that point, and should be supported and promoted. Sufficient water is projected to be available for implementation of this strategy under all the scenarios.

The possibility and feasibility of routing return flows around the Hartbeespoort Dam for water quality purposes, or abstraction upstream of the reservoir, need to be investigated.

10.3.3 Water supply to Madibeng and Rustenburg

Madibeng area

Madibeng currently abstracts raw water from the Crocodile River for own treatment and distribution, whilst water is also abstracted at different locations from the Hartbeespoort Dam for treatment and distribution to communities along the shores. Given the number of small treatment plants, it is difficult for these to be cost efficiently operated at the level of sophistication necessary to consistently produce high quality potable water from a poor and variable quality source. The abstraction of water from the same source to which effluent from the relevant communities are discharged, is also not an ideal situation.

Madibeng town and the communities around the dam should best be served with potable water directly from the Rand Water system.

The feasibility of routing effluent discharges from the local communities to a location downstream of the dam should also be investigated.

Rustenburg

The provision of water to the mines in the Rustenburg area with water from Hartbeespoort Dam (as discussed under 10.3.2), would free up some potable water currently used by the mines, for urban use in Rustenburg. The sufficiency of the existing pipeline capacity from Rand Water would thereby be extended by a number of years, whereafter expansion of the pipe network may again be required.

Water balances

Implementation of the strategies as under 10.3.2 and 10.3.3 above will not have a significant impact on the overall quantity of water supplied by Rand Water to the area. The main benefit is the more appropriate use of water of different quality as well as the better utilisation of existing pipeline capacity.

10.3.4 Water for transfer to the Lephalale area

Water for transfer to Lephalale could (probably best) be obtained from the proposed balancing dam at Boschkop. The water could be piped directly from the dam, or be released along the river for abstraction further downstream. DWAF has called for Tenders for a feasibility study to investigate the transfer of water from the Crocodile River to supplement the water supply to the Lephalale area.

However, sufficient water will not be available at Boschkop to meet all the needs with respect to the water requirement scenarios for the Lephalale area, and additional resources will be needed to meet the requirements for essentially all cases. Several options can be followed to augment the resources:

- A general outcome would be the transfer of water from the Vaal River System. Various options can again be considered and should be further investigated before a final decision is taken.
  - A secure but probably the most expensive option would be to pipe raw water directly from the Vaal Dam to the Lephalale area.
  - A lower cost option would probably be for the pumping of raw water from the Vaal River or Vaal Dam up to the divide, where it can be released for gravity flow to Hartbeespoort Dam and then to the new possible dam at Boschkop. Given the constant effluent returns already providing for base flows in several tributaries, the addition of raw water to such streams should not result in significant additional losses. Tight abstraction control will need to be exercised, however.
  - Another option would be for the diversion of effluent from waste water treatment plants in the Vaal River catchment but close to the divide with the Crocodile catchment, to be diverted towards the Crocodile River.
- Substantial savings that could significantly contribute to meeting the requirements in the Lephalale area could be achieved through improvements to the irrigation distribution systems. There is still much uncertainty about the quantification of these.
- The raising of the Mokolo Dam. This option has been investigated and the results are pending. Indications are that the yield of the dam, if raised by 12 m, could increase by about 17 million m^3/a at 1:200 assurance of supply. (Other indications from these investigations are that the yield from the existing Mokolo Dam may be higher than previously determined, due to less irrigation upstream.)
- As a further option, irrigation water could be re-allocated (through purchase) to the developments in Lephalale. Such irrigation areas could be located either upstream or downstream of the proposed dam at Boschkop, or be in the Mokolo River catchment.
- Irrigation water may also be acquired for an interim period only, whilst the permanent/long term measures are being implemented. Water from the Mokolo catchment would obviously offer the shortest time scales.

All of the infrastructure options will require substantial time to be implemented (investigations, approvals, design, construction) and it is most unlikely that the growth in water requirements in the Lephalale area as currently projected, can be met from such measures alone.

The eight possible development scenarios for the Lephalale area result in too wide a range of water requirements to allow for the proper planning of interventions (that is selection, sequencing, sizing, timing etc.). This needs to be narrowed down in liaison with Eskom and Sasol.

At the time of the latest update of this report it was already evident that Scenario 2 is not applicable any longer, whilst it is doubtful whether the time scales of some of the other scenarios are still achievable.

10.4 FURTHER INVESTIGATIONS

The following additional investigations are required:

10.4.1 Boschkop Dam

- A reconnaissance level investigation and costing, to be followed by a detail feasibility study.
- Yield analysis of the Crocodile River system with inclusion of the Boschkop Dam, to determine any possible increase in yield that may be achieved.

10.4.2 Mining water requirements

- A formal and rigorous review of the projected mining water requirements.

10.4.3 Irrigation canals

- Formal study for the determination of leakage from irrigation canals. Groundwater levels and flow paths for leakage water as well as evaporations and evapotranspiration to be considered.
- Estimation of the efficiencies that can be gained through the lining of canals, or replacements of canals by conduits. Also corresponding cost estimates. (All for selected areas.)

10.4.4 Water transfer from the Vaal

- Reconnaissance level investigation of the options and costs for the transfer of raw water from the Vaal River system for use at Lephalale.
- Similar investigations with respect to the diversion of return flows from the Vaal River catchment.

10.4.5 Operation of Hartbeespoort Dam

- Determination of the yields and water levels at Hartbeespoort Dam for different operating rules (lowest drawdown levels). Also assessment of how this may impact on the water quality in the dam.

10.4.6 Water tariffs

Water tariffs in the Crocodile catchment are low in comparison to some other parts of the country, which is partly attributable to the high proportion of return flows that may not properly be accounted for. The tariff structure need to be investigated and consideration should be given to bringing it in line with water tariffs in the Vaal River area.

11. IMPLEMENTATION OF THE STRATEGY

Guidelines and responsibilities with respect to the implementation of the Strategy still need to be developed.

The responsibility for the management and coordination of activities would normally reside with the Catchment Management Agency (CMA). During the interim, whilst the CMA is being established, these functions will be the responsibility of the DWAF. The CMA/DWAF shall assign responsibility for the execution of specific activities to other agencies or organisation as may be appropriate.

Activities that would need to be attended to, include:

- Development of a framework for the implementation of the Strategy.
- Implementation of specific projects and component strategies.
- Monitoring of progress and initiating remedial measures where necessary.
- Data gathering with respect to water resources, water supply, return flows, etc. Specific attention need to be given to implementing the recommendations as given in the hydrology report. (Report Nr. P WMA 03/000/00/2307)
- Monitoring and assessment of changes with respect to the key influencing factors.
- Regular review of the Strategy and adjustment of priorities as may be needed.

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APPENDICES

Appendix A	***:***	*Detail of the eleven sub-areas*
Appendix B	***:***	*Urban and rural population projections per sub-area*
Appendix C	***:***	*Urban and rural water requirements and return flows per sub-area*
Appendix D	***:***	*Mining water requirements per sub-area*
Appendix E	***:***	*Total Crocodile River catchment water requirements*
Appendix F	***:***	*Inter-basin transfers*
Appendix G	***:***	*Summary of water balances per sub-area for the years 2005 to 2030*
Appendix H	***:***	*Detailed summary of water balances for the years 2005 to 2030, including summaries of the water availability and requirements*
Appendix I	***:***	*Projected future water requirements scenarios in the Lephalale catchment*
Appendix J	***:***	*Water balances and water transfers for the different Lephalale scenarios*

Appendix A

Detail of the eleven sub-areas

For the purpose of reconciliation scenarios and the development of the Strategy, the Crocodile (West) River catchment was sub-divided into eleven representative sub-areas. These sub-areas are described in more detail below and are shown in **Figure 2** in the report:

1. Upper Crocodile sub-catchment down to Rietvlei Dam (quaternary catchment A21A)
2. Upper Crocodile sub-catchment between Rietvlei Dam and Hartbeespoort Dam (quaternary catchments A21B, A21C, A21D, A21E, A21F, A21G, A21H)
3. Upper Crocodile sub-catchment Between Hartbeespoort Dam and Roodekopjes Dam (quaternary catchments A21J, A21K)
4. Elands River in the Elands sub-catchment down to Bospoort Dam (quaternary catchments A22G, A22H)
5. Remainder of the Elands sub-catchment down to Vaalkop Dam (quaternary catchments A22A, A22B, A22C, A22D, A22E, A22F, A22J)
6. Pienaars River down to Roodeplaat Dam (quaternary catchments A23A)
7. Apies River upstream of Klipvoor Dam (quaternary catchments A23D, A23E and A23F)
8. Remainder of the Apies-Pienaars sub-catchment at Klipvoor Dam downstream of Roodeplaat Dam (quaternary catchments A23B, A23C, A23G, A23H, A23J)
9. Apies-Pienaars sub-catchment downstream of Klipvoor Dam, including the Tolwane River (quaternary catchments A23K, A23L)
10. Crocodile River downstream of Roodekopjes Dam and Vaalkop Dam to the confluence of the Crocodile and Pienaars Rivers (quaternary catchments A21L and A24A)
11. Lower Crocodile sub-catchment at the confluence with the Limpopo River (quaternary catchments A24B, A24C, A24D, A24E, A24F, A24G, A24H, A24J)

Appendix B

Urban and rural population projections per sub-area

Table B-1: Total urban population projections

Growth scenario	2005	2010	2015	2020	2025	2030
High	4 522 991	5 080 331	5 642 253	6 157 285	6 595 470	7 066 329
Base	4 454 641	4 933 355	5 372 455	5 770 617	6 131 279	6 515 899
Low	4 444 190	4 760 665	5 015 475	5 164 539	5 251 068	5 340 822

Table B-2: High urban population projections

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile at Rietvlei	90 890	102 569	113 370	122 802	131 582	140 990
Upper Crocodile at Hartbeespoort	2 076 453	2 317 856	2 565 240	2 790 384	2 970 805	3 163 031
Upper Crocodile at Roodekopjes	35 846	39 966	44 560	49 682	55 393	61 760
Elands at Bospoort	196 414	209 829	223 132	234 177	241 250	248 535
Elands at Vaalkop	170 240	182 473	194 834	205 766	214 019	222 708
Apies-Pienaars at Roodeplaat	515 613	590 888	665 796	734 850	795 754	861 706
Apies-Pienaars: Apies	724 968	827 450	929 351	1 023 708	1 109 113	1 201 644
Apies-Pienaars at Klipvoor	363 414	411 951	460 506	505 755	546 840	591 316
Apies-Pienaars: Rest	333 113	380 382	427 511	471 159	510 596	553 333
Crocodile d/s Roodekopjes to confluence with Pienaars	0	0	0	0	0	0
Rest of Lower Crocodile to Limpopo River	16 040	16 967	17 953	19 002	20 118	21 306
TOTAL	**4 522 991**	**5 080 331**	**5 642 253**	**6 157 285**	**6 595 470**	**7 066 329**

Table B-3: Base urban population projections

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile at Rietvlei	89 468	99 507	107 776	114 857	122 035	129 662
Upper Crocodile at Hartbeespoort	2 044 052	2 248 691	2 438 826	2 609 929	2 755 491	2 909 297
Upper Crocodile at Roodekopjes	35 846	39 966	44 560	49 682	55 393	61 760
Elands at Bospoort	193 345	203 572	212 143	219 037	223 769	228 602
Elands at Vaalkop	167 976	177 853	186 722	194 588	201 113	207 992
Apies-Pienaars at Roodeplaat	507 588	573 289	633 031	687 339	738 061	792 526
Apies-Pienaars: Apies	714 112	803 722	885 296	959 918	1 031 587	1 108 604
Apies-Pienaars at Klipvoor	358 286	400 737	439 675	475 568	510 138	547 248
Apies-Pienaars: Rest	327 928	369 051	406 473	440 697	473 574	508 902
Crocodile d/s Roodekopjes to confluence with Pienaars	0	0	0	0	0	0
Rest of Lower Crocodile to Limpopo River	16 040	16 967	17 953	19 002	20 118	21 306
TOTAL	**4 454 641**	**4 933 355**	**5 372 455**	**5 770 617**	**6 131 279**	**6 515 899**

Table B-4: Low urban population projections

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	89 256	95 941	100 450	102 500	104 078	105 681
Upper Crocodile: Hartbeespoort	2 039 156	2 168 103	2 272 848	2 329 006	2 349 797	2 370 878
Upper Crocodile: Roodekopjes	35 846	39 966	44 560	49 682	55 393	61 760
Elands: Bospoort	192 885	196 279	197 712	195 478	190 844	186 322
Elands: Vaalkop	167 636	172 469	176 068	177 194	176 803	176 776
Apies-Pienaars: Roodeplaat	506 357	552 691	589 897	613 333	629 413	645 915
Apies-Pienaars: Apies	712 380	774 844	824 968	856 555	879 732	903 534
Apies-Pienaars: Klipvoor	357 501	387 615	412 245	428 546	441 029	453 885
Apies-Pienaars: Rest	327 133	355 790	378 774	393 243	403 861	414 765
Crocodile d/s Roodekopjes to confluence with Pienaars	0	0	0	0	0	0
Rest of Lower Crocodile to Limpopo River	16 040	16 967	17 953	19 002	20 118	21 306
TOTAL	**4 444 190**	**4 760 665**	**5 015 475**	**5 164 539**	**5 251 068**	**5 340 822**

Table B-5: Total rural population projections

Growth scenario	2005	2010	2015	2020	2025	2030
High	1 029 640	1 062 190	1 068 341	1 092 439	1 121 118	1 215 986
Base	1 021 543	1 043 424	1 039 056	1 051 981	1 068 929	1 147 613
Low	1 013 493	1 024 953	1 010 518	1 012 943	1 019 073	1 082 959

Table B-6: High rural population projections

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	1 290	1 301	1 389	1 508	1 644	939
Upper Crocodile: Hartbeespoort	47 381	48 389	48 314	50 802	54 547	65 261
Upper Crocodile: Roodekopjes	160 393	166 352	169 588	172 428	174 262	175 565
Elands: Bospoort	35 953	34 891	32 294	30 780	30 216	28 690
Elands: Vaalkop	109 696	112 794	113 187	113 691	113 837	112 759
Apies-Pienaars: Roodeplaat	38 055	37 365	34 275	35 646	39 151	55 786
Apies-Pienaars: Apies	124 245	124 091	119 549	121 953	127 254	172 739
Apies-Pienaars: Klipvoor	149 547	157 619	161 499	167 221	173 111	174 220
Apies-Pienaars: Rest	166 804	171 246	171 996	174 910	177 963	196 476
Crocodile d/s Roodekopjes to confluence with Pienaars	20 325	21 273	21 906	22 472	22 899	23 234
Rest of Lower Crocodile to Limpopo River	175 951	186 868	194 343	201 027	206 234	210 316
TOTAL	**1 029 640**	**1 062 190**	**1 068 341**	**1 092 439**	**1 121 118**	**1 215 986**

Table B-7: Base rural population projections

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	1 280	1 278	1 351	1 452	1 567	886
Upper Crocodile: Hartbeespoort	47 008	47 534	46 990	48 920	52 008	61 592
Upper Crocodile: Roodekopjes	159 131	163 413	164 940	166 042	166 150	165 693
Elands: Bospoort	35 670	34 275	31 409	29 641	28 809	27 077
Elands: Vaalkop	108 834	110 801	110 084	109 481	108 537	106 419
Apies-Pienaars: Roodeplaat	37 756	36 705	33 336	34 326	37 329	52 650
Apies-Pienaars: Apies	123 268	121 899	116 272	117 437	121 330	163 026
Apies-Pienaars: Klipvoor	148 371	154 835	157 072	161 028	165 053	164 423
Apies-Pienaars: Rest	165 493	168 220	167 282	168 433	169 679	185 429
Crocodile d/s Roodekopjes to confluence with Pienaars	20 165	20 897	21 306	21 640	21 833	21 928
Rest of Lower Crocodile to Limpopo River	174 567	183 567	189 015	193 582	196 634	198 491
TOTAL	**1 021 543**	**1 043 424**	**1 039 056**	**1 051 981**	**1 068 929**	**1 147 613**

Table B-8: Low rural population projections

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	1 270	1 255	1 314	1 398	1 494	836
Upper Crocodile: Hartbeespoort	46 637	46 693	45 699	47 104	49 582	58 122
Upper Crocodile: Roodekopjes	157 877	160 520	160 410	159 881	158 401	156 359
Elands: Bospoort	35 389	33 668	30 546	28 541	27 466	25 552
Elands: Vaalkop	107 976	108 840	107 061	105 418	103 475	100 423
Apies-Pienaars: Roodeplaat	37 459	36 055	32 420	33 052	35 588	49 683
Apies-Pienaars: Apies	122 296	119 741	113 079	113 079	115 671	153 842
Apies-Pienaars: Klipvoor	147 202	152 093	152 758	155 053	157 355	155 160
Apies-Pienaars: Rest	164 188	165 243	162 687	162 182	161 764	174 982
Crocodile d/s Roodekopjes to confluence with Pienaars	20 006	20 527	20 721	20 837	20 815	20 692
Rest of Lower Crocodile to Limpopo River	173 192	180 317	183 825	186 398	187 463	187 308
TOTAL	**1 013 493**	**1 024 953**	**1 010 518**	**1 012 943**	**1 019 073**	**1 082 959**

Appendix C

Urban and rural water requirements and return flows per sub-area

Please note:

Scenario B: High	= no water demand management, high population growth
Scenario B: Base	= no water demand management, base population growth
Scenario B: Low	= no water demand management, low population growth
Scenario C: High	= high water demand management efficiency, high population growth
Scenario C: Base	= high water demand management efficiency, base population growth
Scenario C: Low	= high water demand management efficiency, low population growth
Scenario D: High	= medium water demand management efficiency, high population growth
Scenario D: Base	= medium water demand management efficiency, base population growth
Scenario D: Low	= medium water demand management efficiency, low population growth

Table C-1: Total urban water requirements (figures in million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
Scenario B: High	578.6	650.6	723.8	791.3	848.5	909.9
Scenario B: Base	569.6	631.3	688.3	740.4	787.2	837.2
Scenario B: Low	568.3	608.8	641.7	661.1	672.1	683.3
Scenario C: High	578.6	609.5	625.6	657.2	688.5	746.4
Scenario C: Base	569.6	591.4	595.0	615.0	638.8	686.8
Scenario C: Low	568.3	570.3	554.7	549.2	545.6	560.7
Scenario D: High	578.6	604.0	673.3	736.4	789.6	849.8
Scenario D: Base	569.6	586.1	640.2	689.1	732.6	781.9
Scenario D: Low	568.3	565.2	596.9	615.4	625.5	638.2

Table C-2: Scenario B: High urban water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	17.1	19.3	21.3	23.1	24.7	26.5
Upper Crocodile: Hartbeespoort	278.6	310.5	343.7	374.1	398.0	423.4
Upper Crocodile: Roodekopjes	5.9	6.7	7.6	8.6	9.6	10.8
Elands: Bospoort	17.6	18.8	20.0	21.0	21.7	22.3
Elands: Vaalkop	9.4	10.2	11.0	11.7	12.4	13.1
Apies-Pienaars: Roodeplaat	66.4	76.1	85.6	94.5	102.3	110.9
Apies-Pienaars: Apies	130.3	148.8	167.2	184.3	199.7	216.4
Apies-Pienaars: Klipvoor	27.4	31.0	34.6	38.0	41.0	44.3
Apies-Pienaars: Rest	23.5	26.9	30.2	33.3	36.0	39.1
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	2.4	2.5	2.7	2.8	3.0	3.1
TOTAL	**578.6**	**650.6**	**723.8**	**791.3**	**848.5**	**909.9**

Table C-3: Scenario B: Base urban water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	16.8	18.7	20.2	21.6	22.9	24.4
Upper Crocodile: Hartbeespoort	274.3	301.2	326.8	349.9	369.1	389.4
Upper Crocodile: Roodekopjes	5.8	6.5	7.2	8.0	8.9	10.0
Elands: Bospoort	17.4	18.3	19.1	19.7	20.1	20.6
Elands: Vaalkop	9.3	9.9	10.5	11.0	11.5	12.1
Apies-Pienaars: Roodeplaat	65.4	73.8	81.4	88.4	94.9	102.0
Apies-Pienaars: Apies	128.3	144.3	159.0	172.4	185.2	199.0
Apies-Pienaars: Klipvoor	27.0	30.0	32.9	35.5	38.1	40.8
Apies-Pienaars: Rest	23.1	26.0	28.7	31.1	33.4	35.9
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	2.4	2.5	2.7	2.8	3.0	3.1
TOTAL	**569.6**	**631.3**	**688.3**	**740.4**	**787.2**	**837.2**

Table C-4: Scenario B: Low urban water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	16.8	18.0	18.9	19.3	19.6	19.9
Upper Crocodile: Hartbeespoort	273.6	290.4	304.5	312.3	314.8	317.4
Upper Crocodile: Roodekopjes	5.8	6.2	6.7	7.2	7.6	8.1
Elands: Bospoort	17.3	17.6	17.7	17.6	17.2	16.8
Elands: Vaalkop	9.3	9.6	9.9	10.0	10.1	10.2
Apies-Pienaars: Roodeplaat	65.2	71.1	75.9	78.9	81.0	83.1
Apies-Pienaars: Apies	127.9	139.2	148.1	153.8	158.0	162.2
Apies-Pienaars: Klipvoor	26.9	29.0	30.7	31.7	32.5	33.2
Apies-Pienaars: Rest	23.1	25.1	26.7	27.8	28.5	29.3
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	2.4	2.5	2.7	2.8	3.0	3.1
TOTAL	**568.3**	**608.8**	**641.7**	**661.1**	**672.1**	**683.3**

Table C-5: Scenario C: High urban water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	17.1	17.6	17.7	17.3	16.8	18.4
Upper Crocodile: Hartbeespoort	278.6	284.4	295.9	307.2	321.3	345.7
Upper Crocodile: Roodekopjes	5.9	6.7	7.6	8.6	9.6	10.8
Elands: Bospoort	17.6	18.8	20.0	21.0	21.7	22.3
Elands: Vaalkop	9.4	10.2	11.0	11.7	12.4	13.1
Apies-Pienaars: Roodeplaat	66.4	71.3	67.6	70.9	73.5	81.2
Apies-Pienaars: Apies	130.3	143.3	145.1	154.9	163.2	178.9
Apies-Pienaars: Klipvoor	27.4	30.4	32.9	35.7	38.1	41.3
Apies-Pienaars: Rest	23.5	24.3	25.2	27.1	28.9	31.6
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	2.4	2.5	2.7	2.8	3.0	3.1
TOTAL	**578.6**	**609.5**	**625.6**	**657.2**	**688.5**	**746.4**

Table C-6: Scenario C: Base urban water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	16.8	17.0	16.9	16.2	15.6	16.9
Upper Crocodile: Hartbeespoort	274.3	275.9	281.3	287.3	298.1	317.9
Upper Crocodile: Roodekopjes	5.8	6.5	7.2	8.0	8.9	10.0
Elands: Bospoort	17.4	18.3	19.1	19.7	20.1	20.6
Elands: Vaalkop	9.3	9.9	10.5	11.0	11.5	12.1
Apies-Pienaars: Roodeplaat	65.4	69.2	64.3	66.3	68.2	74.7
Apies-Pienaars: Apies	128.3	139.1	138.0	144.9	151.4	164.5
Apies-Pienaars: Klipvoor	27.0	29.5	31.3	33.4	35.3	38.0
Apies-Pienaars: Rest	23.1	23.6	23.9	25.4	26.8	29.1
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	2.4	2.5	2.7	2.8	3.0	3.1
TOTAL	**569.6**	**591.4**	**595.0**	**615.0**	**638.8**	**686.8**

Table C-7: Scenario C: Low urban water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	16.8	16.4	15.7	14.4	13.3	13.8
Upper Crocodile: Hartbeespoort	273.6	266.0	262.2	256.4	254.2	259.1
Upper Crocodile: Roodekopjes	5.8	6.2	6.7	7.2	7.6	8.1
Elands: Bospoort	17.3	17.6	17.7	17.6	17.2	16.8
Elands: Vaalkop	9.3	9.6	9.9	10.0	10.1	10.2
Apies-Pienaars: Roodeplaat	65.2	66.7	59.9	59.2	58.2	60.9
Apies-Pienaars: Apies	127.9	134.1	128.6	129.3	129.1	134.1
Apies-Pienaars: Klipvoor	26.9	28.4	29.1	29.8	30.1	31.0
Apies-Pienaars: Rest	23.1	22.8	22.3	22.6	22.8	23.7
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	2.4	2.5	2.7	2.8	3.0	3.1
TOTAL	**568.3**	**570.3**	**554.7**	**549.2**	**545.6**	**560.7**

Table C-8: Scenario D: High urban water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	17.1	17.7	19.5	21.0	22.4	24.1
Upper Crocodile: Hartbeespoort	278.6	285.6	316.4	344.3	366.1	391.0
Upper Crocodile: Roodekopjes	5.9	6.7	7.6	8.6	9.6	10.8
Elands: Bospoort	17.6	18.8	20.0	21.0	21.7	22.3
Elands: Vaalkop	9.4	10.2	11.0	11.7	12.4	13.1
Apies-Pienaars: Roodeplaat	66.4	68.7	77.8	86.1	93.3	101.6
Apies-Pienaars: Apies	130.3	140.7	158.5	174.9	189.5	205.9
Apies-Pienaars: Klipvoor	27.4	30.1	33.6	36.9	40.0	43.2
Apies-Pienaars: Rest	23.5	23.1	26.2	29.1	31.7	34.6
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	2.4	2.5	2.7	2.8	3.0	3.1
TOTAL	**578.6**	**604.0**	**673.3**	**736.4**	**789.6**	**849.8**

Table C-9: Scenario D: Base urban water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	16.8	17.1	18.5	19.6	20.8	22.2
Upper Crocodile: Hartbeespoort	274.3	277.1	300.8	322.1	339.6	359.7
Upper Crocodile: Roodekopjes	5.8	6.5	7.2	8.0	8.9	10.0
Elands: Bospoort	17.4	18.3	19.1	19.7	20.1	20.6
Elands: Vaalkop	9.3	9.9	10.5	11.0	11.5	12.1
Apies-Pienaars: Roodeplaat	65.4	66.7	73.9	80.5	86.6	93.5
Apies-Pienaars: Apies	128.3	136.5	150.7	163.6	175.8	189.4
Apies-Pienaars: Klipvoor	27.0	29.2	32.0	34.6	37.1	39.8
Apies-Pienaars: Rest	23.1	22.4	24.9	27.2	29.4	31.8
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	2.4	2.5	2.7	2.8	3.0	3.1
TOTAL	**569.6**	**586.1**	**640.2**	**689.1**	**732.6**	**781.9**

Table C-10: Scenario D: Low urban water requirements (figures in million m^3/a)

Item	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	16.8	16.5	17.3	17.5	17.7	18.1
Upper Crocodile: Hartbeespoort	273.6	267.1	280.4	287.4	289.6	293.1
Upper Crocodile: Roodekopjes	5.8	6.2	6.7	7.2	7.6	8.1
Elands: Bospoort	17.3	17.6	17.7	17.6	17.2	16.8
Elands: Vaalkop	9.3	9.6	9.9	10.0	10.1	10.2
Apies-Pienaars: Roodeplaat	65.2	64.3	68.9	71.8	73.8	76.2
Apies-Pienaars: Apies	127.9	131.6	140.4	146.0	149.9	154.4
Apies-Pienaars: Klipvoor	26.9	28.1	29.8	30.8	31.6	32.4
Apies-Pienaars: Rest	23.1	21.6	23.2	24.3	25.1	25.9
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	2.4	2.5	2.7	2.8	3.0	3.1
TOTAL	**568.3**	**565.2**	**596.9**	**615.4**	**625.5**	**638.2**

Table C-11: Total rural water requirements

Scenario	2005	2010	2015	2020	2025	2030
High	15.0	23.3	23.4	31.9	32.7	44.4
Base	14.9	22.9	22.8	30.7	31.2	41.9
Low	14.8	22.4	22.1	29.6	29.8	39.5

Table C-12: High rural water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	0.0	0.0	0.0	0.0	0.0	0.0
Upper Crocodile: Hartbeespoort	0.7	1.1	1.1	1.5	1.6	2.4
Upper Crocodile: Roodekopjes	2.3	3.6	3.7	5.0	5.1	6.4
Elands: Bospoort	0.5	0.8	0.7	0.9	0.9	1.0
Elands: Vaalkop	1.6	2.5	2.5	3.3	3.3	4.1
Apies-Pienaars: Roodeplaat	0.6	0.8	0.8	1.0	1.1	2.0
Apies-Pienaars: Apies	1.8	2.7	2.6	3.6	3.7	6.3
Apies-Pienaars: Klipvoor	2.2	3.5	3.5	4.9	5.1	6.4
Apies-Pienaars: Rest	2.4	3.8	3.8	5.1	5.2	7.2
Crocodile d/s Roodekopjes to confluence with Pienaars	0.3	0.5	0.5	0.7	0.7	0.8
Rest of Lower Crocodile to Limpopo River	2.6	4.1	4.3	5.9	6.0	7.7
TOTAL	**15.0**	**23.3**	**23.4**	**31.9**	**32.7**	**44.4**

Table C-13: Base rural water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	0.0	0.0	0.0	0.0	0.0	0.0
Upper Crocodile: Hartbeespoort	0.7	1.0	1.0	1.4	1.5	2.2
Upper Crocodile: Roodekopjes	2.3	3.6	3.6	4.8	4.9	6.0
Elands: Bospoort	0.5	0.8	0.7	0.9	0.8	1.0
Elands: Vaalkop	1.6	2.4	2.4	3.2	3.2	3.9
Apies-Pienaars: Roodeplaat	0.6	0.8	0.7	1.0	1.1	1.9
Apies-Pienaars: Apies	1.8	2.7	2.5	3.4	3.5	6.0
Apies-Pienaars: Klipvoor	2.2	3.4	3.4	4.7	4.8	6.0
Apies-Pienaars: Rest	2.4	3.7	3.7	4.9	5.0	6.8
Crocodile d/s Roodekopjes to confluence with Pienaars	0.3	0.5	0.5	0.6	0.6	0.8
Rest of Lower Crocodile to Limpopo River	2.5	4.0	4.1	5.7	5.7	7.2
TOTAL	**14.9**	**22.9**	**22.8**	**30.7**	**31.2**	**41.9**

Table C-14: Low rural water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	0.0	0.0	0.0	0.0	0.0	0.0
Upper Crocodile: Hartbeespoort	0.7	1.0	1.0	1.4	1.4	2.1
Upper Crocodile: Roodekopjes	2.3	3.5	3.5	4.7	4.6	5.7
Elands: Bospoort	0.5	0.7	0.7	0.8	0.8	0.9
Elands: Vaalkop	1.6	2.4	2.3	3.1	3.0	3.7
Apies-Pienaars: Roodeplaat	0.5	0.8	0.7	1.0	1.0	1.8
Apies-Pienaars: Apies	1.8	2.6	2.5	3.3	3.4	5.6
Apies-Pienaars: Klipvoor	2.1	3.3	3.3	4.5	4.6	5.7
Apies-Pienaars: Rest	2.4	3.6	3.6	4.7	4.7	6.4
Crocodile d/s Roodekopjes to confluence with Pienaars	0.3	0.4	0.5	0.6	0.6	0.8
Rest of Lower Crocodile to Limpopo River	2.5	3.9	4.0	5.4	5.5	6.8
TOTAL	**14.8**	**22.4**	**22.1**	**29.6**	**29.8**	**39.5**

Table C-15: Scenario B: High urban return flows (all figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	10.0	11.3	12.5	13.5	14.5	15.5
Upper Crocodile: Hartbeespoort	150.8	169.2	188.4	206.0	219.6	234.3
Upper Crocodile: Roodekopjes	3.9	4.4	5.0	5.5	5.9	6.3
Elands: Bospoort	10.3	11.0	11.7	12.3	12.7	13.0
Elands: Vaalkop	0.9	1.0	1.1	1.2	1.4	1.5
Apies-Pienaars: Roodeplaat	42.9	49.1	55.3	61.0	66.1	71.6
Apies-Pienaars: Apies	70.7	81.5	92.3	102.3	111.3	121.1
Apies-Pienaars: Klipvoor	6.2	7.0	7.8	8.5	9.2	9.9
Apies-Pienaars: Rest	18.7	21.4	24.0	26.5	28.7	31.1
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.7	0.8	0.8	0.8	0.9	0.9
TOTAL	**315.1**	**356.6**	**398.9**	**437.6**	**470.2**	**505.2**

Table C-16: Scenario B: Base urban return flows (all figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	9.8	11.0	11.9	12.6	13.4	14.3
Upper Crocodile: Hartbeespoort	148.3	163.9	178.6	192.0	203.0	214.6
Upper Crocodile: Roodekopjes	3.8	4.3	4.7	5.1	5.4	5.8
Elands: Bospoort	10.4	10.9	11.4	11.8	12.0	12.3
Elands: Vaalkop	0.9	1.0	1.1	1.2	1.3	1.4
Apies-Pienaars: Roodeplaat	42.2	47.7	52.6	57.1	61.3	65.9
Apies-Pienaars: Apies	69.5	78.9	87.5	95.3	102.8	110.9
Apies-Pienaars: Klipvoor	6.1	6.8	7.4	8.0	8.5	9.1
Apies-Pienaars: Rest	18.4	20.7	22.9	24.8	26.6	28.6
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.7	0.8	0.8	0.9	0.9	1.0
TOTAL	**310.2**	**345.8**	**378.8**	**408.6**	**435.3**	**463.8**

Table C-17: Scenario B: Low urban return flows (all figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	9.8	10.6	11.1	11.3	11.5	11.6
Upper Crocodile: Hartbeespoort	147.9	157.6	165.8	170.2	171.6	173.0
Upper Crocodile: Roodekopjes	3.8	4.1	4.4	4.6	4.6	4.7
Elands: Bospoort	10.1	10.3	10.4	10.3	10.1	9.9
Elands: Vaalkop	0.9	1.0	1.0	1.1	1.1	1.2
Apies-Pienaars: Roodeplaat	42.1	45.9	49.0	50.9	52.3	53.7
Apies-Pienaars: Apies	69.3	75.9	81.1	84.4	86.9	89.4
Apies-Pienaars: Klipvoor	6.1	6.5	6.9	7.1	7.3	7.4
Apies-Pienaars: Rest	18.4	20.0	21.3	22.1	22.7	23.3
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.7	0.8	0.8	0.9	0.9	1.0
TOTAL	**309.2**	**332.6**	**351.7**	**362.8**	**368.9**	**375.1**

Table C-18: Scenario C: High urban return flows (all figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	10.0	10.3	10.1	9.6	9.1	9.2
Upper Crocodile: Hartbeespoort	150.8	155.0	160.2	165.8	175.5	187.9
Upper Crocodile: Roodekopjes	3.9	4.4	5.0	5.5	5.9	6.3
Elands: Bospoort	10.3	11.0	11.7	12.3	12.7	13.0
Elands: Vaalkop	0.9	1.0	1.1	1.2	1.4	1.5
Apies-Pienaars: Roodeplaat	42.9	46.6	48.4	52.2	55.4	60.2
Apies-Pienaars: Apies	70.7	79.3	85.5	93.4	100.0	108.0
Apies-Pienaars: Klipvoor	6.2	6.9	7.5	8.2	8.8	9.5
Apies-Pienaars: Rest	18.7	19.9	21.3	23.1	24.7	26.7
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.7	0.8	0.8	0.9	0.9	1.0
TOTAL	**315.1**	**335.1**	**351.5**	**372.1**	**394.3**	**423.1**

Table C-19: Scenario C: Base urban return flows (all figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	9.8	10.0	9.6	9.0	8.4	8.4
Upper Crocodile: Hartbeespoort	148.3	150.0	151.9	154.5	162.2	172.1
Upper Crocodile: Roodekopjes	3.8	4.3	4.7	5.1	5.4	5.8
Elands: Bospoort	10.4	10.9	11.4	11.8	12.0	12.3
Elands: Vaalkop	0.9	1.0	1.1	1.2	1.3	1.4
Apies-Pienaars: Roodeplaat	42.2	45.3	46.0	48.8	51.4	55.3
Apies-Pienaars: Apies	69.5	76.8	81.0	87.1	92.4	99.0
Apies-Pienaars: Klipvoor	6.1	6.7	7.2	7.7	8.2	8.8
Apies-Pienaars: Rest	18.4	19.3	20.3	21.6	22.9	24.5
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.7	0.8	0.8	0.9	0.9	1.0
TOTAL	**310.2**	**324.9**	**333.9**	**347.5**	**365.1**	**388.5**

Table C-20: Scenario C: Low urban return flows (all figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	9.8	9.6	8.9	8.0	7.2	6.9
Upper Crocodile: Hartbeespoort	147.9	144.3	141.0	137.0	137.2	138.8
Upper Crocodile: Roodekopjes	3.8	4.1	4.4	4.6	4.6	4.7
Elands: Bospoort	10.1	10.3	10.4	10.3	10.1	9.9
Elands: Vaalkop	0.9	1.0	1.0	1.1	1.1	1.2
Apies-Pienaars: Roodeplaat	42.1	43.6	42.9	43.5	43.9	45.1
Apies-Pienaars: Apies	69.3	73.8	75.2	77.2	78.1	79.8
Apies-Pienaars: Klipvoor	6.1	6.4	6.7	6.8	7.0	7.1
Apies-Pienaars: Rest	18.4	18.6	18.9	19.3	19.6	20.0
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.7	0.8	0.8	0.9	0.9	1.0
TOTAL	**309.2**	**312.6**	**310.1**	**308.6**	**309.6**	**314.4**

Table C-21: Scenario D: High urban return flows (all figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	10.0	10.3	11.3	12.1	12.9	13.7
Upper Crocodile: Hartbeespoort	150.8	164.5	182.3	198.7	211.9	225.6
Upper Crocodile: Roodekopjes	3.9	4.4	5.0	5.5	5.9	6.3
Elands: Bospoort	10.3	11.0	11.7	12.3	12.7	13.0
Elands: Vaalkop	0.9	1.0	1.1	1.2	1.4	1.5
Apies-Pienaars: Roodeplaat	42.9	46.9	52.9	58.4	63.3	68.6
Apies-Pienaars: Apies	70.7	79.5	90.1	99.9	108.6	118.0
Apies-Pienaars: Klipvoor	6.2	6.9	7.7	8.4	9.1	9.8
Apies-Pienaars: Rest	18.7	19.9	22.5	24.8	27.0	29.2
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.7	0.8	0.8	0.9	0.9	1.0
TOTAL	**315.1**	**345.2**	**385.3**	**422.1**	**453.5**	**486.5**

Table C-22: Scenario D: Base urban return flows (all figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	9.8	10.0	10.8	11.4	12.0	12.6
Upper Crocodile: Hartbeespoort	148.3	159.3	172.8	185.2	195.8	206.7
Upper Crocodile: Roodekopjes	3.8	4.3	4.7	5.1	5.4	5.8
Elands: Bospoort	10.4	10.9	11.4	11.8	12.0	12.3
Elands: Vaalkop	0.9	1.0	1.1	1.2	1.3	1.4
Apies-Pienaars: Roodeplaat	42.2	45.5	50.3	54.6	58.7	63.1
Apies-Pienaars: Apies	69.5	76.9	85.4	93.1	100.3	108.1
Apies-Pienaars: Klipvoor	6.1	6.7	7.3	7.9	8.4	9.0
Apies-Pienaars: Rest	18.4	19.4	21.4	23.2	25.0	26.8
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.7	0.8	0.8	0.9	0.9	1.0
TOTAL	**310.2**	**334.7**	**365.9**	**394.2**	**419.8**	**446.6**

Table C-23: Scenario D: Low urban return flows (all figures in million m^3/a)

Item	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	9.8	9.7	10.0	10.1	10.2	10.3
Upper Crocodile: Hartbeespoort	147.9	153.3	160.4	164.2	165.5	166.6
Upper Crocodile: Roodekopjes	3.8	4.1	4.4	4.6	4.6	4.7
Elands: Bospoort	10.1	10.3	10.4	10.3	10.1	9.9
Elands: Vaalkop	0.9	1.0	1.0	1.1	1.1	1.2
Apies-Pienaars: Roodeplaat	42.1	43.9	46.9	48.8	50.1	51.4
Apies-Pienaars: Apies	69.3	74.0	79.2	82.5	84.8	87.1
Apies-Pienaars: Klipvoor	6.1	6.4	6.8	7.0	7.2	7.3
Apies-Pienaars: Rest	18.4	18.7	19.9	20.7	21.3	21.9
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.7	0.8	0.8	0.9	0.9	1.0
TOTAL	**309.2**	**322.0**	**339.8**	**350.0**	**355.8**	**361.2**

Appendix D

Mining water requirements per sub-area

Table D-1: Total mining water requirements (figures in million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
High	92.3	128.8	144.6	151.5	151.7	150.6
Base	92.3	126.3	138.7	144.2	144.9	144.8
Low	92.3	124.4	136.3	141.6	142.3	142.3

Table D-2: High mining water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	0.4	0.4	0.4	0.4	0.4	0.4
Upper Crocodile: Hartbeespoort	5.0	5.0	5.0	5.0	5.0	5.0
Upper Crocodile: Roodekopjes	26.9	37.7	42.4	48.4	47.6	47.8
Elands: Bospoort	18.5	25.4	27.7	28.9	29.2	28.5
Elands: Vaalkop	20.7	28.8	34.2	33.8	34.1	33.4
Apies-Pienaars: Roodeplaat	0.6	0.6	0.6	0.6	0.6	0.6
Apies-Pienaars: Apies	0.2	0.2	0.2	0.2	0.2	0.2
Apies-Pienaars: Klipvoor	0.0	0.0	0.0	0.0	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0	0.0	0.0	0.0	0.0
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	19.9	30.7	34.0	34.3	34.5	34.8
TOTAL	**92.3**	**128.8**	**144.6**	**151.5**	**151.7**	**150.6**

Table D-3: Base mining water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	0.4	0.4	0.4	0.4	0.4	0.4
Upper Crocodile: Hartbeespoort	5.0	5.0	5.0	5.0	5.0	5.0
Upper Crocodile: Roodekopjes	26.9	37.5	41.9	47.5	47.6	47.7
Elands: Bospoort	18.5	23.2	23.4	23.5	23.4	23.4
Elands: Vaalkop	20.7	28.7	34.0	33.8	34.5	34.4
Apies-Pienaars: Roodeplaat	0.6	0.6	0.6	0.6	0.6	0.6
Apies-Pienaars: Apies	0.2	0.2	0.2	0.2	0.2	0.2
Apies-Pienaars: Klipvoor	0.0	0.0	0.0	0.0	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0	0.0	0.0	0.0	0.0
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	19.9	30.7	33.1	33.1	33.1	33.1
TOTAL	**92.3**	**126.3**	**138.7**	**144.2**	**144.9**	**144.8**

Table D-4: Low mining water requirements (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	0.4	0.4	0.4	0.4	0.4	0.4
Upper Crocodile: Hartbeespoort	5.0	5.0	5.0	5.0	5.0	5.0
Upper Crocodile: Roodekopjes	26.9	36.9	41.2	46.6	46.7	46.9
Elands: Bospoort	18.5	22.8	23.0	23.1	23.0	22.9
Elands: Vaalkop	20.7	28.1	33.4	33.2	33.9	33.7
Apies-Pienaars: Roodeplaat	0.6	0.6	0.6	0.6	0.6	0.6
Apies-Pienaars: Apies	0.2	0.2	0.2	0.2	0.2	0.2
Apies-Pienaars: Klipvoor	0.0	0.0	0.0	0.0	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0	0.0	0.0	0.0	0.0
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	19.9	30.4	32.5	32.5	32.5	32.5
TOTAL	**92.3**	**124.4**	**136.3**	**141.6**	**142.3**	**142.3**

Appendix E

Total Crocodile River catchment water requirements

Please note:

Scenario D: High = medium water demand management efficiency, high population growth

Scenario D: Base = medium water demand management efficiency, base population growth

Scenario D: Low = medium water demand management efficiency, low population growth

Scenario C: High = high water demand management efficiency, high population growth

Table E-1: Crocodile River catchment water requirements for Scenario D: High (volumes in million m^3/a)

User Sector	2005	2010	2015	2020	2025	2030
Urban	578.6	604.0	673.3	736.4	789.6	849.8
Rural	15.0	23.3	23.4	31.9	32.7	44.4
Irrigation	375.5	375.5	375.5	375.5	375.5	375.5
Mining	92.3	128.8	144.6	151.5	151.7	150.6
Power generation	34.5	34.5	34.5	34.5	34.5	34.5
Stock watering	21.9	21.9	21.9	21.9	21.9	21.9
Total	**1 117.8**	**1 188.0**	**1 273.2**	**1 351.7**	**1 405.9**	**1 476.7**

Table E-2: Crocodile River catchment water requirements for Scenario D: Base (volumes in million m^3/a)

User Sector	2005	2010	2015	2020	2025	2030
Urban	569.6	586.1	640.2	689.1	732.6	781.9
Rural	14.9	22.9	22.8	30.7	31.2	41.9
Irrigation	375.5	375.5	375.5	375.5	375.5	375.5
Mining	92.3	126.3	138.7	144.2	144.9	144.8
Power generation	34.5	34.5	34.5	34.5	34.5	34.5
Stock watering	21.9	21.9	21.9	21.9	21.9	21.9
Total	**1 108.7**	**1 167.2**	**1 233.6**	**1 295.9**	**1 340.6**	**1 400.5**

Table E-3: Crocodile River catchment water requirements for Scenario D: Low (volumes in million m^3/a)

User Sector	2005	2010	2015	2020	2025	2030
Urban	568.3	565.2	596.9	615.4	625.5	638.2
Rural	14.8	22.4	22.1	29.6	29.8	39.5
Irrigation	375.5	375.5	375.5	375.5	375.5	375.5
Mining	92.3	124.4	136.3	141.6	142.3	142.3
Power generation	34.5	34.5	34.5	34.5	34.5	34.5
Stock watering	21.9	21.9	21.9	21.9	21.9	21.9
Total	**1 107.3**	**1 143.9**	**1 187.2**	**1 218.5**	**1 229.5**	**1 251.9**

Table E-4: Crocodile River catchment water requirements for Scenario C: High (volumes in million m^3/a)

User Sector	2005	2010	2015	2020	2025	2030
Urban	578.6	609.5	625.6	657.2	688.5	746.4
Rural	15.0	23.3	23.4	31.9	32.7	44.4
Irrigation	375.5	375.5	375.5	375.5	375.5	375.5
Mining	92.3	128.8	144.6	151.5	151.7	150.6
Power generation	34.5	34.5	34.5	34.5	34.5	34.5
Stock watering	21.9	21.9	21.9	21.9	21.9	21.9
Total	**1 117.8**	**1 193.5**	**1 225.5**	**1 272.5**	**1 304.8**	**1 373.3**

Appendix F

Inter-basin transfers

Please note:

Scenario D: High = medium water demand management efficiency, high population growth

Scenario D: Base = medium water demand management efficiency, base population growth

Scenario D: Low = medium water demand management efficiency, low population growth

Scenario C: High = high water demand management efficiency, high population growth

Table F-1: Total inter-basin transfers into the Crocodile catchment

(figures in million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
Scenario D: High	554.4	558.4	624.5	690.5	741.0	804.9
Scenario D: Base	545.9	540.4	592.7	642.6	684.0	738.4
Scenario D: Low	544.5	521.1	551.2	572.8	582.4	600.4
Scenario C: High	554.4	563.9	576.8	611.3	640.0	701.5

Table F-2: Scenario D: High inter-basin transfers in (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	17.5	18.1	19.9	21.4	22.8	24.5
Upper Crocodile: Hartbeespoort	283.6	290.6	321.4	349.3	371.1	396.0
Upper Crocodile: Roodekopjes	14.4	16.3	17.2	18.2	18.1	18.1
Elands: Bospoort	16.6	17.7	17.7	18.8	18.6	18.4
Elands: Vaalkop	11.3	11.1	10.1	9.9	9.6	9.3
Apies-Pienaars: Roodeplaat	59.1	40.9	49.8	58.4	65.8	75.0
Apies-Pienaars: Apies	117.2	125.5	143.1	161.8	176.7	197.7
Apies-Pienaars: Klipvoor	11.2	15.2	18.9	23.5	26.7	31.3
Apies-Pienaars: Rest	23.5	23.1	26.2	29.1	31.7	34.6
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**554.4**	**558.4**	**624.5**	**690.5**	**741.0**	**804.9**

Table F-3: Scenario D: Base inter-basin transfers in (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	17.2	17.5	18.9	20.0	21.2	22.6
Upper Crocodile: Hartbeespoort	279.3	282.1	305.8	327.1	344.6	364.7
Upper Crocodile: Roodekopjes	14.4	16.2	16.9	17.7	17.7	17.7
Elands: Bospoort	16.6	17.7	17.7	17.7	17.5	17.5
Elands: Vaalkop	11.3	11.1	10.1	10.0	9.7	9.7
Apies-Pienaars: Roodeplaat	58.1	38.0	46.0	51.8	57.9	66.7
Apies-Pienaars: Apies	115.2	121.1	135.2	150.2	162.6	180.4
Apies-Pienaars: Klipvoor	10.8	14.3	17.1	21.0	23.6	27.4
Apies-Pienaars: Rest	23.1	22.4	24.9	27.2	29.4	31.8
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**545.9**	**540.4**	**592.7**	**642.6**	**684.0**	**738.4**

Table F-4: Scenario D: Low inter-basin transfers in (figures in million m^3/a)

Item	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	17.2	16.9	17.7	17.9	18.1	18.5
Upper Crocodile: Hartbeespoort	278.6	272.1	285.4	292.4	294.6	298.1
Upper Crocodile: Roodekopjes	14.4	15.9	16.7	17.3	17.3	17.3
Elands: Bospoort	16.6	17.7	17.7	17.6	17.4	17.4
Elands: Vaalkop	11.3	11.1	10.1	9.8	9.6	9.5
Apies-Pienaars: Roodeplaat	57.9	36.4	40.9	44.1	46.2	49.3
Apies-Pienaars: Apies	114.8	116.1	124.7	132.3	136.3	144.7
Apies-Pienaars: Klipvoor	10.7	13.2	14.8	17.1	17.9	19.8
Apies-Pienaars: Rest	23.1	21.6	23.2	24.3	25.1	25.9
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**544.5**	**521.1**	**551.2**	**572.8**	**582.4**	**600.4**

Table F-5: Scenario C: High inter-basin transfers in (figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	17.5	18.0	18.1	17.7	17.2	18.8
Upper Crocodile: Hartbeespoort	283.6	289.4	300.9	312.2	326.3	350.7
Upper Crocodile: Roodekopjes	14.4	16.3	17.2	18.2	18.1	18.1
Elands: Bospoort	16.6	17.7	17.7	18.8	18.6	18.4
Elands: Vaalkop	11.3	11.1	10.1	9.9	9.6	9.3
Apies-Pienaars: Roodeplaat	59.1	43.5	39.7	43.3	46.0	54.6
Apies-Pienaars: Apies	117.2	128.1	129.8	141.9	150.5	170.7
Apies-Pienaars: Klipvoor	11.2	15.5	18.1	22.3	24.8	29.4
Apies-Pienaars: Rest	23.5	24.3	25.2	27.1	28.9	31.6
Crocodile d/s Roodekopjes to confluence with Pienaars	0.0	0.0	0.0	0.0	0.0	0.0
Rest of Lower Crocodile to Limpopo River	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**554.4**	**563.9**	**576.8**	**611.3**	**640.0**	**701.5**

Appendix G

Summary of water balances per sub-area for the years 2005 to 2030

Please note:

Scenario D: High = medium water demand management efficiency, high population growth

Scenario D: Base = medium water demand management efficiency, base population growth

Scenario D: Low = medium water demand management efficiency, low population growth

Scenario C: High = high water demand management efficiency, high population growth

Table G-1: Total incremental water balances in the Crocodile catchment

(figures in million m^3/a)

Scenario	2005	2010	2015	2020	2025	2030
Scenario D: High	58.3	22.3	43.3	67.6	95.3	121.4
Scenario D: Base	54.0	14.7	31.8	47.6	69.9	91.1
Scenario D: Low	53.1	5.7	10.5	11.0	15.4	16.4
Scenario C: High	58.3	12.2	9.5	17.5	36.2	58.0

Table G-2: Scenario D: High incremental water balances in the Crocodile catchment

(figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	13.1	13.4	14.4	15.2	16.0	16.7
Upper Crocodile: Hartbeespoort	30.1	33.9	47.1	56.9	69.5	81.1
Upper Crocodile: Roodekopjes	-16.8	-17.6	-17.2	-17.8	-17.5	-18.5
Elands: Bospoort	-0.8	-4.2	-5.6	-3.3	-3.0	-0.3
Elands: Vaalkop	16.6	-9.8	-22.9	-27.9	-30.6	-34.0
Apies-Pienaars: Roodeplaat	35.2	17.5	23.5	32.7	38.0	49.1
Apies-Pienaars: Apies	37.5	43.2	53.9	65.0	73.8	85.2
Apies-Pienaars: Klipvoor	-105.6	-104.0	-103.3	-106.2	-105.9	-111.0
Apies-Pienaars: Rest	14.2	14.1	16.6	17.6	19.7	19.9
Crocodile d/s Roodekopjes to confluence with Pienaars	4.0	3.8	3.8	3.6	3.6	3.4
Rest of Lower Crocodile to Limpopo River	30.8	32.0	32.9	31.8	31.9	29.8
TOTAL	**58.3**	**22.3**	**43.3**	**67.6**	**95.3**	**121.4**

Table G-3: Scenario D: Base incremental water balances in the Crocodile catchment

(figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	12.9	13.1	13.8	14.4	15.0	15.6
Upper Crocodile: Hartbeespoort	27.7	29.0	38.1	44.3	53.8	62.8
Upper Crocodile: Roodekopjes	-16.8	-17.6	-17.2	-18.0	-17.7	-18.6
Elands: Bospoort	-0.6	-2.2	-1.7	0.2	0.7	2.7
Elands: Vaalkop	16.9	-7.5	-17.6	-21.3	-23.3	-26.6
Apies-Pienaars: Roodeplaat	34.5	15.2	20.7	27.4	31.6	42.5
Apies-Pienaars: Apies	36.3	40.6	49.1	58.0	65.3	74.9
Apies-Pienaars: Klipvoor	-105.7	-104.1	-103.4	-106.2	-105.9	-110.7
Apies-Pienaars: Rest	13.9	13.6	15.6	16.2	18.0	18.0
Crocodile d/s Roodekopjes to confluence with Pienaars	4.0	3.8	3.8	3.6	3.6	3.5
Rest of Lower Crocodile to Limpopo River	30.8	30.8	30.6	29.0	28.7	27.1
TOTAL	**54.0**	**14.7**	**31.8**	**47.6**	**69.9**	**91.1**

Table G-4: Scenario D: Low incremental water balances in the Crocodile catchment

(figures in million m^3/a)

Item	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	12.9	12.7	13.1	13.2	13.3	13.3
Upper Crocodile: Hartbeespoort	27.4	23.5	26.6	24.8	25.5	25.3
Upper Crocodile: Roodekopjes	-16.8	-17.7	-17.4	-18.4	-18.3	-19.3
Elands: Bospoort	-0.8	-2.5	-2.4	-1.1	-0.8	0.9
Elands: Vaalkop	16.9	-5.3	-14.1	-16.6	-17.6	-19.9
Apies-Pienaars: Roodeplaat	34.3	14.2	17.0	22.0	23.5	29.8
Apies-Pienaars: Apies	36.1	37.6	42.8	47.3	49.5	53.5
Apies-Pienaars: Klipvoor	-105.6	-104.1	-103.6	-106.6	-106.5	-111.3
Apies-Pienaars: Rest	13.9	13.0	14.3	13.9	14.5	13.4
Crocodile d/s Roodekopjes to confluence with Pienaars	4.0	3.8	3.8	3.6	3.6	3.5
Rest of Lower Crocodile to Limpopo River	30.9	30.6	30.5	28.9	28.8	27.3
TOTAL	**53.1**	**5.7**	**10.5**	**11.0**	**15.4**	**16.4**

Table G-5: Scenario C: High incremental water balances in the Crocodile catchment

(figures in million m^3/a)

Sub-area	2005	2010	2015	2020	2025	2030
Upper Crocodile: Rietvlei	13.1	13.3	13.1	12.6	12.1	12.2
Upper Crocodile: Hartbeespoort	30.1	24.3	24.9	24.0	33.1	43.4
Upper Crocodile: Roodekopjes	-16.8	-17.6	-17.2	-17.8	-17.5	-18.5
Elands: Bospoort	-0.8	-4.2	-5.6	-3.3	-3.0	-0.3
Elands: Vaalkop	16.6	-9.8	-22.9	-27.9	-30.6	-34.0
Apies-Pienaars: Roodeplaat	35.2	17.3	19.0	26.4	30.1	40.7
Apies-Pienaars: Apies	37.5	43.1	49.3	58.6	65.2	75.2
Apies-Pienaars: Klipvoor	-105.6	-104.0	-103.4	-106.3	-106.2	-111.3
Apies-Pienaars: Rest	14.2	14.0	15.4	15.9	17.4	17.4
Crocodile d/s Roodekopjes to confluence with Pienaars	4.0	3.8	3.8	3.6	3.6	3.4
Rest of Lower Crocodile to Limpopo River	30.8	32.0	32.9	31.8	31.9	29.8
TOTAL	**58.3**	**12.2**	**9.5**	**17.5**	**36.2**	**58.0**

Appendix H

Detailed summary of water balances for the years 2005 to 2030, including summaries of the water availability and requirements

High population growth, medium water demand management efficiency: Water balances for high water availability and requirements for 2005

2005: SUMMARY OF WATER AVAILABILITYAND REQUIREMENTS

Balance HBP	43.2
Balance rest	15.1
Balance total	58.3

Scenario D: High

2005 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Interbasin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.2	17.5	0.0	**47.3**	**13.1**	**13.1**	0.2	10.0	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	153.1	283.6	0.0	**518.5**	**30.1**	**43.2**	2.4	150.8	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	12.6	14.4	162.0	**233.9**	**-16.8**	**26.4**	8.5	3.9	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	11.3	16.6	5.6	**39.1**	**-0.8**	**-0.8**	0.3	10.3	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	1.6	11.3	52.2	**92.2**	**16.6**	**15.8**	0.6	0.9	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	43.2	59.1	7.4	**142.9**	**35.2**	**35.2**	0.3	42.9	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	72.1	117.2	7.6	**205.3**	**37.5**	**37.5**	1.4	70.7	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	7.5	11.2	34.1	**63.7**	**-105.6**	**-32.9**	1.3	6.2	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	19.1	23.5	0.0	**45.1**	**14.2**	**14.2**	0.4	18.7	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	**4.0**	**27.5**	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.7	0.0	154.8	**209.9**	**30.8**	**58.3**	10.6	0.7	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**347.8**	**554.4**	**0.0**	**1 179.1**	**58.3**	**58.3**	**29.5**	**315.1**	**3.2**	**-30.0**

2005 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.1	0.4	0.0	14.7	**34.2**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	3.4	278.6	16.0	0.0	162.0	**488.4**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	3.2	5.9	26.9	0.0	98.1	**250.6**	26.9	0.0
Elands: Bospoort	2.1	0.6	1.0	17.6	18.5	0.0	0.0	**39.9**	18.5	0.0
Elands: Vaalkop	4.2	1.3	4.0	9.4	20.7	0.0	36.0	**75.6**	20.7	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.0	66.4	0.6	3.0	34.4	**107.7**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	2.4	130.3	23.7	0.0	0.0	**167.8**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	5.3	27.4	0.0	0.0	124.3	**169.3**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	3.3	23.5	0.0	0.0	0.0	**30.9**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	0.9	0.0	0.0	0.0	0.0	**46.9**	0.0	0.0
Lower Crocodile	86.5	58.0	12.2	2.4	19.9	0.0	0.0	**179.0**	19.9	0.0
Total	**237.3**	**138.2**	**36.9**	**578.6**	**126.8**	**3.0**	**0.0**	**1 120.8**	**92.3**	**34.4**

High population growth, medium water demand management efficiency: Water balances for high water availability and requirements for 2010

2010: SUMMARY OF WATER AVAILABILITYAND REQUIREMENTS

Balance HBP	47.3
Balance rest	-25.0
Balance total	22.3

Scenario D: High

2010 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Interbasin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.5	18.1	0.0	**48.2**	13.4	13.4	0.2	10.3	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	166.9	290.6	0.0	**539.3**	33.9	47.3	2.4	164.5	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.2	16.3	171.6	**245.9**	-17.6	29.7	8.5	4.4	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	12.0	17.7	8.7	**44.0**	-4.2	-4.2	0.3	11.0	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	1.6	11.1	52.2	**92.2**	-9.8	-14.0	0.6	1.0	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	47.2	40.9	7.4	**128.7**	17.5	17.5	0.3	46.9	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	80.8	125.5	7.6	**222.3**	43.2	43.2	1.4	79.5	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	8.2	15.2	35.0	**69.3**	-104.0	-43.3	1.3	6.9	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	20.3	23.1	0.0	**45.9**	14.1	14.1	0.4	19.9	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.8	-9.6	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.8	0.0	168.3	**223.5**	32.0	22.3	10.6	0.8	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**378.0**	**558.4**	**0.0**	**1 213.3**	**22.3**	**22.3**	**29.5**	**345.2**	**3.2**	**-30.0**

2010 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.7	0.4	0.0	14.7	**34.8**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	3.7	285.6	16.0	0.0	171.6	**505.3**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	4.5	6.7	37.7	0.0	98.1	**263.5**	37.7	0.0
Elands: Bospoort	2.1	0.6	1.2	18.8	25.4	0.0	0.0	**48.2**	25.4	0.0
Elands: Vaalkop	4.2	1.3	4.9	10.2	28.8	0.0	52.7	**101.9**	28.8	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.3	68.7	0.6	3.0	35.3	**111.2**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	3.3	140.7	23.7	0.0	0.0	**179.1**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	6.6	30.1	0.0	0.0	124.3	**173.3**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	4.6	23.1	0.0	0.0	0.0	**31.8**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.1	0.0	0.0	0.0	0.0	**47.0**	0.0	0.0
Lower Crocodile	86.5	58.0	13.8	2.5	30.7	0.0	0.0	**191.5**	30.7	0.0
Total	**237.3**	**138.2**	**45.2**	**604.0**	**163.3**	**3.0**	**0.0**	**1 191.0**	**128.8**	**34.4**

High population growth, medium water demand management efficiency: Water balances for high water availability and requirements for 2015

2015: SUMMARY OF WATER AVAILABILITYAND REQUIREMENTS

Balance HBP	61.4
Balance rest	-18.1
Balance total	43.3

Scenario D: High

2015 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Interbasin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	11.5	19.9	0.0	**51.0**	14.4	14.4	0.2	11.3	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	184.7	321.4	0.0	**587.9**	47.1	61.4	2.4	182.3	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.7	17.2	176.3	**252.0**	-17.2	44.3	8.5	5.0	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	12.7	17.7	10.1	**46.1**	-5.6	-5.6	0.3	11.7	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	1.8	10.1	52.2	**91.3**	-22.9	-28.4	0.6	1.1	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	53.2	49.8	7.4	**143.7**	23.5	23.5	0.3	52.9	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	91.5	143.1	7.6	**250.7**	53.9	53.9	1.4	90.1	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	8.9	18.9	35.0	**73.7**	-103.3	-25.8	1.3	7.7	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	22.8	26.2	0.0	**51.6**	16.6	16.6	0.4	22.5	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.8	10.4	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.8	0.0	172.8	**228.0**	32.9	43.3	10.6	0.8	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**418.1**	**624.5**	**0.0**	**1 319.4**	43.3	43.3	**29.5**	**385.3**	**3.2**	**-30.0**

2015 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	19.5	0.4	0.0	14.7	**36.7**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	3.7	316.4	16.0	0.0	176.3	**540.8**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	4.6	7.6	42.4	0.0	98.1	**269.2**	42.4	0.0
Elands: Bospoort	2.1	0.6	1.2	20.0	27.7	0.0	0.0	**51.7**	27.7	0.0
Elands: Vaalkop	4.2	1.3	4.9	11.0	34.2	0.0	58.6	**114.1**	34.2	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.2	77.8	0.6	3.0	35.3	**120.2**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	3.2	158.5	23.7	0.0	0.0	**196.8**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	6.7	33.6	0.0	0.0	124.3	**176.9**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	4.7	26.2	0.0	0.0	0.0	**35.0**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.1	0.0	0.0	0.0	0.0	**47.1**	0.0	0.0
Lower Crocodile	86.5	58.0	13.9	2.7	34.0	0.0	0.0	**195.1**	34.0	0.0
Total	**237.3**	**138.2**	**45.3**	**673.3**	**179.0**	**3.0**	**0.0**	**1 276.1**	**144.6**	**34.4**

High population growth, medium water demand management efficiency: Water balances for high water availability and requirements for 2020

2020: SUMMARY OF WATER AVAILABILITYAND REQUIREMENTS

Balance HBP	72.0
Balance rest	-4.4
Balance total	67.6

Scenario D: High

2020 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Interbasin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	12.3	21.4	0.0	**53.3**	15.2	15.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	201.0	349.3	0.0	**632.1**	56.9	72.0
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	14.2	18.2	182.4	**259.7**	-17.8	54.2
Elands: Bospoort	4.7	0.9	0.0	13.3	18.8	13.1	**50.7**	-3.3	-3.3
Elands: Vaalkop	5.8	21.4	0.0	1.9	9.9	52.2	**91.2**	-27.9	-31.2
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	58.7	58.4	7.4	**157.8**	32.7	32.7
Apies-Pienaars: Apies	6.0	2.5	0.0	101.3	161.8	7.6	**279.1**	65.0	65.0
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	9.7	23.5	31.4	**75.4**	-106.2	-8.5
Apies-Pienaars: Rest	2.4	0.1	0.0	25.2	29.1	0.0	**56.8**	17.6	17.6
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.6	35.8
Lower Crocodile	16.7	24.6	0.0	13.9	0.0	173.7	**228.9**	31.8	67.6
Total	**82.0**	**154.5**	**40.4**	**454.9**	**690.5**	**0.0**	**1 422.3**	**67.6**	**67.6**

2020 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	12.1	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	198.7	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	5.5	0.2	12.2
Elands: Bospoort	0.3	12.3	0.7	-1.4
Elands: Vaalkop	0.6	1.2	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	58.4	0.0	-4.3
Apies-Pienaars: Apies	1.4	99.9	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	8.4	0.0	-8.9
Apies-Pienaars: Rest	0.4	24.8	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	0.9	2.4	4.6
Total	**29.5**	**422.1**	**3.2**	**-30.0**

2020 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	21.0	0.4	0.0	14.7	**38.2**
Upper Crocodile: Hartbeespoort	17.5	10.9	4.2	344.3	16.0	0.0	182.4	**575.3**
Upper Crocodile: Roodekopjes	70.8	45.7	5.9	8.6	48.4	0.0	98.1	**277.5**
Elands: Bospoort	2.1	0.6	1.4	21.0	28.9	0.0	0.0	**54.0**
Elands: Vaalkop	4.2	1.3	5.7	11.7	33.8	0.0	62.5	**119.1**
Apies-Pienaars: Roodeplaat	2.1	0.2	1.5	86.1	0.6	3.0	31.6	**125.1**
Apies-Pienaars: Apies	10.4	1.1	4.1	174.9	23.7	0.0	0.0	**214.1**
Apies-Pienaars: Klipvoor	11.1	1.2	8.0	36.9	0.0	0.0	124.3	**181.6**
Apies-Pienaars: Rest	3.6	0.4	6.0	29.1	0.0	0.0	0.0	**39.2**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.3	0.0	0.0	0.0	0.0	**47.2**
Lower Crocodile	86.5	58.0	15.5	2.8	34.3	0.0	0.0	**197.1**
Total	**237.3**	**138.2**	**53.8**	**736.4**	**186.0**	**3.0**	**0.0**	**1 354.7**

2020 Water requirements	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	48.4	0.0
Elands: Bospoort	28.9	0.0
Elands: Vaalkop	33.8	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	34.3	0.0
Total	**151.5**	**34.4**

High population growth, medium water demand management efficiency: Water balances for high water availability and requirements for 2025

2025: SUMMARY OF WATER AVAILABILITYAND REQUIREMENTS

Balance HBP	85.5
Balance rest	9.9
Balance total	95.3

Scenario D: High

2025 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Interbasin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	13.1	22.8	0.0	**55.5**	16.0	16.0	0.2	12.9	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	214.2	371.1	0.0	**667.1**	69.5	85.5	2.4	211.9	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	14.6	18.1	182.9	**260.3**	-17.5	67.9	8.5	5.9	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	13.6	18.6	14.0	**51.9**	-3.0	-3.0	0.3	12.7	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	2.0	9.6	52.2	**91.0**	-30.6	-33.7	0.6	1.4	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	63.6	65.8	7.4	**170.0**	38.0	38.0	0.3	63.3	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	110.0	176.7	7.6	**302.8**	73.8	73.8	1.4	108.6	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	10.3	26.7	31.0	**78.9**	-105.9	5.9	1.3	9.1	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	27.3	31.7	0.0	**61.5**	19.7	19.7	0.4	27.0	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.6	63.4	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.9	0.0	174.3	**229.5**	31.9	95.3	10.6	0.9	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**486.2**	**741.0**	**0.0**	**1 504.1**	**95.3**	**95.3**	**29.5**	**453.5**	**3.2**	**-30.0**

2025 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	22.4	0.4	0.0	14.7	**39.6**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	4.3	366.1	16.0	0.0	182.9	**597.6**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	6.0	9.6	47.6	0.0	98.1	**277.8**	47.6	0.0
Elands: Bospoort	2.1	0.6	1.4	21.7	29.2	0.0	0.0	**54.9**	29.2	0.0
Elands: Vaalkop	4.2	1.3	5.7	12.4	34.1	0.0	64.0	**121.6**	34.1	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.6	93.3	0.6	3.0	31.2	**132.1**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	4.3	189.5	23.7	0.0	0.0	**228.9**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	8.2	40.0	0.0	0.0	124.3	**184.8**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	6.1	31.7	0.0	0.0	0.0	**41.8**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.3	0.0	0.0	0.0	0.0	**47.2**	0.0	0.0
Lower Crocodile	86.5	58.0	15.7	3.0	34.5	0.0	0.0	**197.7**	34.5	0.0
Total	**237.3**	**138.2**	**54.6**	**789.6**	**186.1**	**3.0**	**0.0**	**1 408.8**	**151.7**	**34.4**

High population growth, medium water demand management efficiency: Water balances for high water availability and requirements for 2030

2030: SUMMARY OF WATER AVAILABILITYAND REQUIREMENTS

Balance HBP	97.9
Balance rest	23.5
Balance total	121.4

Scenario D: High

2030 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Interbasin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	13.8	24.5	0.0	**58.0**	16.7	16.7	0.2	13.7	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	228.0	396.0	0.0	**705.8**	81.1	97.9	2.4	225.6	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	15.0	18.1	184.2	**262.1**	-18.5	79.4	8.5	6.3	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	14.0	18.4	16.6	**54.7**	-0.3	-0.3	0.3	13.0	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	2.1	9.3	52.2	**90.8**	-34.0	-34.3	0.6	1.5	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	68.9	75.0	7.4	**184.5**	49.1	49.1	0.3	68.6	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	119.4	197.7	7.6	**333.1**	85.2	85.2	1.4	118.0	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	11.1	31.3	25.1	**78.3**	-111.0	23.2	1.3	9.8	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	29.5	34.6	0.0	**66.6**	19.9	19.9	0.4	29.2	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.4	91.6	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	14.0	0.0	174.2	**229.5**	29.8	121.4	10.6	1.0	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**519.3**	**804.9**	**0.0**	**1 601.0**	**121.4**	**121.4**	**29.5**	**486.5**	**3.2**	**-30.0**

2030 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	24.1	0.4	0.0	14.7	**41.3**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	5.1	391.0	16.0	0.0	184.2	**624.6**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	7.3	10.8	47.8	0.0	98.1	**280.5**	47.8	0.0
Elands: Bospoort	2.1	0.6	1.5	22.3	28.5	0.0	0.0	**55.0**	28.5	0.0
Elands: Vaalkop	4.2	1.3	6.5	13.1	33.4	0.0	66.5	**124.8**	33.4	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	2.5	101.6	0.6	3.0	25.3	**135.4**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	6.8	205.9	23.7	0.0	0.0	**248.0**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	9.5	43.2	0.0	0.0	124.3	**189.4**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	8.1	34.6	0.0	0.0	0.0	**46.7**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.5	0.0	0.0	0.0	0.0	**47.4**	0.0	0.0
Lower Crocodile	86.5	58.0	17.3	3.1	34.8	0.0	0.0	**199.7**	34.8	0.0
Total	**237.3**	**138.2**	**66.3**	**849.8**	**185.1**	**3.0**	**0.0**	**1 479.7**	**150.6**	**34.4**

Base population growth, medium water demand management efficiency: Water balances for base water availability and requirements for 2005

2005: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	40.6
Balance rest	13.4
Balance total	54.0

Scenario D: Base

2005 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.0	17.2	0.0	**46.9**	**12.9**	**12.9**	0.2	9.8	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	150.6	279.3	0.0	**511.6**	**27.7**	**40.6**	2.4	148.3	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	12.6	14.4	161.9	**233.7**	**-16.8**	**23.8**	8.5	3.8	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	11.4	16.6	5.5	**39.0**	**-0.6**	**-0.6**	0.3	10.4	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	1.5	11.3	52.2	**92.2**	**16.9**	**16.3**	0.6	0.9	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	42.5	58.1	7.4	**141.2**	**34.5**	**34.5**	0.3	42.2	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	70.9	115.2	7.6	**202.1**	**36.3**	**36.3**	1.4	69.5	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	7.4	10.8	34.2	**63.2**	**-105.7**	**-34.9**	1.3	6.1	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	18.8	23.1	0.0	**44.4**	**13.9**	**13.9**	0.4	18.4	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	**4.0**	**23.1**	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.7	0.0	154.8	**209.9**	**30.8**	**54.0**	10.6	0.7	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**342.9**	**545.9**	**0.0**	**1 165.7**	**54.0**	**54.0**	**29.5**	**310.2**	**3.2**	**-30.0**

2005 WATER REQUIREMENTS	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	16.8	0.4	0.0	14.7	**34.0**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	3.4	274.3	16.0	0.0	161.9	**483.9**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	3.2	5.8	26.9	0.0	98.1	**250.5**	26.9	0.0
Elands: Bospoort	2.1	0.6	1.0	17.4	18.5	0.0	0.0	**39.6**	18.5	0.0
Elands: Vaalkop	4.2	1.3	4.0	9.3	20.7	0.0	35.9	**75.3**	20.7	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.0	65.4	0.6	3.0	34.4	**106.8**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	2.3	128.3	23.7	0.0	0.0	**165.8**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	5.3	27.0	0.0	0.0	124.3	**168.9**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	3.3	23.1	0.0	0.0	0.0	**30.5**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	0.9	0.0	0.0	0.0	0.0	**46.9**	0.0	0.0
Lower Crocodile	86.5	58.0	12.2	2.4	19.9	0.0	0.0	**179.0**	19.9	0.0
Total	**237.3**	**138.2**	**36.8**	**569.6**	**126.8**	**3.0**	**0.0**	**1 111.7**	**92.3**	**34.4**

Base population growth, medium water demand management efficiency: Water balances for base water availability and requirements for 2010

2010: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	42.1
Balance rest	-27.4
Balance total	14.7

Scenario D: Base

2010 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.2	17.5	0.0	**47.4**	13.1	13.1	0.2	10.0	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	161.7	282.1	0.0	**525.5**	29.0	42.1	2.4	159.3	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.0	16.2	171.4	**245.4**	-17.6	24.5	8.5	4.3	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	11.9	17.7	8.1	**43.3**	-2.2	-2.2	0.3	10.9	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	1.6	11.1	52.2	**92.1**	-7.5	-9.7	0.6	1.0	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	45.8	38.0	7.4	**124.4**	15.2	15.2	0.3	45.5	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	78.3	121.1	7.6	**215.5**	40.6	40.6	1.4	76.9	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	7.9	14.3	35.2	**68.3**	-104.1	-48.3	1.3	6.7	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	19.7	22.4	0.0	**44.6**	13.6	13.6	0.4	19.4	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.8	-16.1	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.8	0.0	167.0	**222.2**	30.8	14.7	10.6	0.8	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**367.5**	**540.4**	**0.0**	**1 184.8**	**14.7**	**14.7**	**29.5**	**334.7**	**3.2**	**-30.0**

2010 WATER REQUIREMENTS	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.1	0.4	0.0	14.7	**34.3**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	3.7	277.1	16.0	0.0	171.4	**496.5**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	4.5	6.5	37.5	0.0	98.1	**263.0**	37.5	0.0
Elands: Bospoort	2.1	0.6	1.2	18.3	23.2	0.0	0.0	**45.5**	23.2	0.0
Elands: Vaalkop	4.2	1.3	4.8	9.9	28.7	0.0	50.8	**99.6**	28.7	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.2	66.7	0.6	3.0	35.4	**109.3**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	3.2	136.5	23.7	0.0	0.0	**174.9**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	6.5	29.2	0.0	0.0	124.3	**172.3**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	4.6	22.4	0.0	0.0	0.0	**31.1**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.1	0.0	0.0	0.0	0.0	**47.0**	0.0	0.0
Lower Crocodile	86.5	58.0	13.7	2.5	30.7	0.0	0.0	**191.4**	30.7	0.0
Total	**237.3**	**138.2**	**44.8**	**586.1**	**160.7**	**3.0**	**0.0**	**1 170.1**	**126.3**	**34.4**

Base population growth, medium water demand management efficiency: Water balances for base water availability and requirements for 2015

2015: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	51.9
Balance rest	-20.2
Balance total	31.8

Scenario D: Base

2015 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.9	18.9	0.0	**49.5**	13.8	13.8
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	175.2	305.8	0.0	**562.8**	38.1	51.9
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.5	16.9	175.8	**251.0**	-17.2	34.7
Elands: Bospoort	4.7	0.9	0.0	12.4	17.7	9.0	**44.7**	-1.7	-1.7
Elands: Vaalkop	5.8	21.4	0.0	1.7	10.1	52.2	**91.2**	-17.6	-19.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	50.6	46.0	7.4	**137.2**	20.7	20.7
Apies-Pienaars: Apies	6.0	2.5	0.0	86.8	135.2	7.6	**238.0**	49.1	49.1
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	8.6	17.1	35.3	**71.8**	-103.4	-33.6
Apies-Pienaars: Rest	2.4	0.1	0.0	21.7	24.9	0.0	**49.2**	15.6	15.6
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.8	1.2
Lower Crocodile	16.7	24.6	0.0	13.8	0.0	169.5	**224.6**	30.6	31.8
Total	**82.0**	**154.5**	**40.4**	**398.7**	**592.7**	**0.0**	**1 268.3**	**31.8**	**31.8**

2015 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	10.8	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	172.8	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	4.7	0.2	12.2
Elands: Bospoort	0.3	11.4	0.7	-1.4
Elands: Vaalkop	0.6	1.1	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	50.3	0.0	-4.3
Apies-Pienaars: Apies	1.4	85.4	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	7.3	0.0	-8.9
Apies-Pienaars: Rest	0.4	21.4	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	0.8	2.4	4.6
Total	**29.5**	**365.9**	**3.2**	**-30.0**

2015 WATER REQUIREMENTS	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	18.5	0.4	0.0	14.7	**35.7**
Upper Crocodile: Hartbeespoort	17.5	10.9	3.7	300.8	16.0	0.0	175.8	**524.7**
Upper Crocodile: Roodekopjes	70.8	45.7	4.5	7.2	41.9	0.0	98.1	**268.2**
Elands: Bospoort	2.1	0.6	1.2	19.1	23.4	0.0	0.0	**46.4**
Elands: Vaalkop	4.2	1.3	4.8	10.5	34.0	0.0	54.2	**108.9**
Apies-Pienaars: Roodeplaat	2.1	0.2	1.2	73.9	0.6	3.0	35.5	**116.6**
Apies-Pienaars: Apies	10.4	1.1	3.1	150.7	23.7	0.0	0.0	**188.9**
Apies-Pienaars: Klipvoor	11.1	1.2	6.6	32.0	0.0	0.0	124.3	**175.2**
Apies-Pienaars: Rest	3.6	0.4	4.6	24.9	0.0	0.0	0.0	**33.6**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.1	0.0	0.0	0.0	0.0	**47.0**
Lower Crocodile	86.5	58.0	13.8	2.7	33.1	0.0	0.0	**194.1**
Total	**237.3**	**138.2**	**44.7**	**640.2**	**173.1**	**3.0**	**0.0**	**1 236.5**

2015 WATER REQUIREMENTS	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	41.9	0.0
Elands: Bospoort	23.4	0.0
Elands: Vaalkop	34.0	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	33.1	0.0
Total	**138.7**	**34.4**

Base population growth, medium water demand management efficiency: Water balances for base water availability and requirements for 2020

2020: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	58.7
Balance rest	-11.1
Balance total	47.6

Scenario D: Base

2020 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	11.5	20.0	0.0	**51.2**	14.4	14.4
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	187.5	327.1	0.0	**596.3**	44.3	58.7
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.9	17.7	181.5	**257.8**	-18.0	40.7
Elands: Bospoort	4.7	0.9	0.0	12.8	17.7	11.5	**47.5**	0.2	0.2
Elands: Vaalkop	5.8	21.4	0.0	1.8	10.0	52.2	**91.1**	-21.3	-21.1
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	54.9	51.8	7.4	**147.4**	27.4	27.4
Apies-Pienaars: Apies	6.0	2.5	0.0	94.5	150.2	7.6	**260.7**	58.0	58.0
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	9.1	21.0	31.9	**72.9**	-106.2	-20.8
Apies-Pienaars: Rest	2.4	0.1	0.0	23.6	27.2	0.0	**53.3**	16.2	16.2
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.6	18.7
Lower Crocodile	16.7	24.6	0.0	13.9	0.0	169.5	**224.7**	29.0	47.6
Total	**82.0**	**154.5**	**40.4**	**427.0**	**642.6**	**0.0**	**1 346.5**	**47.6**	**47.6**

2020 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	11.4	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	185.2	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	5.1	0.2	12.2
Elands: Bospoort	0.3	11.8	0.7	-1.4
Elands: Vaalkop	0.6	1.2	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	54.6	0.0	-4.3
Apies-Pienaars: Apies	1.4	93.1	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	7.9	0.0	-8.9
Apies-Pienaars: Rest	0.4	23.2	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	0.9	2.4	4.6
Total	**29.5**	**394.2**	**3.2**	**-30.0**

2020 WATER REQUIREMENTS	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	19.6	0.4	0.0	14.7	**36.8**
Upper Crocodile: Hartbeespoort	17.5	10.9	4.1	322.1	16.0	0.0	181.5	**552.0**
Upper Crocodile: Roodekopjes	70.8	45.7	5.7	8.0	47.5	0.0	98.1	**275.8**
Elands: Bospoort	2.1	0.6	1.3	19.7	23.5	0.0	0.0	**47.3**
Elands: Vaalkop	4.2	1.3	5.6	11.0	33.8	0.0	56.7	**112.5**
Apies-Pienaars: Roodeplaat	2.1	0.2	1.4	80.5	0.6	3.0	32.1	**120.0**
Apies-Pienaars: Apies	10.4	1.1	4.0	163.6	23.7	0.0	0.0	**202.7**
Apies-Pienaars: Klipvoor	11.1	1.2	7.8	34.6	0.0	0.0	124.3	**179.1**
Apies-Pienaars: Rest	3.6	0.4	5.8	27.2	0.0	0.0	0.0	**37.1**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.3	0.0	0.0	0.0	0.0	**47.2**
Lower Crocodile	86.5	58.0	15.3	2.8	33.1	0.0	0.0	**195.7**
Total	**237.3**	**138.2**	**52.6**	**689.1**	**178.6**	**3.0**	**0.0**	**1 298.9**

2020 WATER REQUIREMENTS	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	47.5	0.0
Elands: Bospoort	23.5	0.0
Elands: Vaalkop	33.8	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	33.1	0.0
Total	**144.2**	**34.4**

Base population growth, medium water demand management efficiency: Water balances for base water availability and requirements for 2025

2025: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	68.8
Balance rest	1.1
Balance total	69.9

Scenario D: Base

2025 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	12.1	21.2	0.0	53.0	15.0	15.0
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	198.1	344.6	0.0	624.5	53.8	68.8
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	14.2	17.7	182.5	259.2	-17.7	51.1
Elands: Bospoort	4.7	0.9	0.0	13.0	17.5	12.1	48.3	0.7	0.7
Elands: Vaalkop	5.8	21.4	0.0	1.9	9.7	52.2	91.0	-23.3	-22.6
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	59.0	57.9	7.4	157.6	31.6	31.6
Apies-Pienaars: Apies	6.0	2.5	0.0	101.7	162.6	7.6	280.3	65.3	65.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	9.7	23.6	31.6	75.7	-105.9	-9.0
Apies-Pienaars: Rest	2.4	0.1	0.0	25.4	29.4	0.0	57.3	18.0	18.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	50.8	3.6	41.2
Lower Crocodile	16.7	24.6	0.0	13.9	0.0	169.5	224.7	28.7	69.9
Total	**82.0**	**154.5**	**40.4**	**452.6**	**684.0**	**0.0**	**1 413.5**	**69.9**	**69.9**

2025 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	12.0	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	195.8	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	5.4	0.2	12.2
Elands: Bospoort	0.3	12.0	0.7	-1.4
Elands: Vaalkop	0.6	1.3	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	58.7	0.0	-4.3
Apies-Pienaars: Apies	1.4	100.3	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	8.4	0.0	-8.9
Apies-Pienaars: Rest	0.4	25.0	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	0.9	2.4	4.6
Total	**29.5**	**419.8**	**3.2**	**-30.0**

2025 WATER REQUIREMENTS	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	20.8	0.4	0.0	14.7	37.9
Upper Crocodile: Hartbeespoort	17.5	10.9	4.2	339.6	16.0	0.0	182.5	570.6
Upper Crocodile: Roodekopjes	70.8	45.7	5.7	8.9	47.6	0.0	98.1	276.9
Elands: Bospoort	2.1	0.6	1.3	20.1	23.4	0.0	0.0	47.6
Elands: Vaalkop	4.2	1.3	5.6	11.5	34.5	0.0	57.3	114.3
Apies-Pienaars: Roodeplaat	2.1	0.2	1.5	86.6	0.6	3.0	31.9	125.9
Apies-Pienaars: Apies	10.4	1.1	4.1	175.8	23.7	0.0	0.0	215.0
Apies-Pienaars: Klipvoor	11.1	1.2	8.0	37.1	0.0	0.0	124.3	181.7
Apies-Pienaars: Rest	3.6	0.4	5.9	29.4	0.0	0.0	0.0	39.3
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.3	0.0	0.0	0.0	0.0	47.2
Lower Crocodile	86.5	58.0	15.4	3.0	33.1	0.0	0.0	196.0
Total	**237.3**	**138.2**	**53.1**	**732.6**	**179.3**	**3.0**	**0.0**	**1 343.6**

2025 WATER REQUIREMENTS	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	47.6	0.0
Elands: Bospoort	23.4	0.0
Elands: Vaalkop	34.5	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	33.1	0.0
Total	**144.9**	**34.4**

Base population growth, medium water demand management efficiency: Water balances for base water availability and requirements for 2030

2030: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	78.5
Balance rest	12.6
Balance total	91.1

Scenario D: Base

2030 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	12.7	22.6	0.0	**55.0**	**15.6**	**15.6**	0.2	12.6	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	209.1	364.7	0.0	**655.5**	**62.8**	**78.5**	2.4	206.7	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	14.5	17.7	183.7	**260.7**	**-18.6**	**59.9**	8.5	5.8	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	13.3	17.5	14.4	**50.8**	**2.7**	**2.7**	0.3	12.3	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	2.0	9.7	52.2	**91.1**	**-26.6**	**-24.0**	0.6	1.4	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	63.4	66.7	7.4	**170.7**	**42.5**	**42.5**	0.3	63.1	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	109.5	180.4	7.6	**305.9**	**74.9**	**74.9**	1.4	108.1	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	10.3	27.4	26.2	**74.8**	**-110.7**	**6.6**	1.3	9.0	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	27.2	31.8	0.0	**61.5**	**18.0**	**18.0**	0.4	26.8	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	**3.5**	**64.0**	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	14.0	0.0	169.5	**224.8**	**27.1**	**91.1**	10.6	1.0	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**479.4**	**738.4**	**0.0**	**1 494.7**	**91.1**	**91.1**	**29.5**	**446.6**	**3.2**	**-30.0**

2030 WATER REQUIREMENTS	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	22.2	0.4	0.0	14.7	**39.3**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	4.9	359.7	16.0	0.0	183.7	**592.7**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	6.9	10.0	47.7	0.0	98.1	**279.2**	47.7	0.0
Elands: Bospoort	2.1	0.6	1.5	20.6	23.4	0.0	0.0	**48.1**	23.4	0.0
Elands: Vaalkop	4.2	1.3	6.3	12.1	34.4	0.0	59.6	**117.7**	34.4	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	2.4	93.5	0.6	3.0	26.5	**128.2**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	6.5	189.4	23.7	0.0	0.0	**231.1**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	9.1	39.8	0.0	0.0	124.3	**185.5**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	7.7	31.8	0.0	0.0	0.0	**43.5**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.4	0.0	0.0	0.0	0.0	**47.4**	0.0	0.0
Lower Crocodile	86.5	58.0	16.9	3.1	33.1	0.0	0.0	**197.7**	33.1	0.0
Total	**237.3**	**138.2**	**63.8**	**781.9**	**179.3**	**3.0**	**0.0**	**1 403.5**	**144.8**	**34.4**

Low population growth, medium water demand management efficiency: Water balances for low water availability and requirements for 2005

2005: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	40.2
Balance rest	12.9
Balance total	53.1

Scenario D: Low

2005 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.0	17.2	0.0	**46.8**	**12.9**	**12.9**
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	150.2	278.6	0.0	**510.6**	**27.4**	**40.2**
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	12.6	14.4	161.9	**233.7**	**-16.8**	**23.5**
Elands: Bospoort	4.7	0.9	0.0	11.1	16.6	5.4	**38.7**	**-0.8**	**-0.8**
Elands: Vaalkop	5.8	21.4	0.0	1.5	11.3	52.2	**92.2**	**16.9**	**16.1**
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	42.4	57.9	7.4	**141.0**	**34.3**	**34.3**
Apies-Pienaars: Apies	6.0	2.5	0.0	70.7	114.8	7.6	**201.6**	**36.1**	**36.1**
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	7.4	10.7	34.2	**63.2**	**-105.6**	**-35.2**
Apies-Pienaars: Rest	2.4	0.1	0.0	18.7	23.1	0.0	**44.4**	**13.9**	**13.9**
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	**4.0**	**22.2**
Lower Crocodile	16.7	24.6	0.0	13.7	0.0	154.8	**209.9**	**30.9**	**53.1**
Total	**82.0**	**154.5**	**40.4**	**341.9**	**544.5**	**0.0**	**1 163.3**	**53.1**	**53.1**

2005 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	9.8	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	147.9	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	3.8	0.2	12.2
Elands: Bospoort	0.3	10.1	0.7	-1.4
Elands: Vaalkop	0.6	0.9	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	42.1	0.0	-4.3
Apies-Pienaars: Apies	1.4	69.3	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	6.1	0.0	-8.9
Apies-Pienaars: Rest	0.4	18.4	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	0.7	2.4	4.6
Total	**29.5**	**309.2**	**3.2**	**-30.0**

2005 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	16.8	0.4	0.0	14.7	**33.9**
Upper Crocodile: Hartbeespoort	17.5	10.9	3.4	273.6	16.0	0.0	161.9	**483.2**
Upper Crocodile: Roodekopjes	70.8	45.7	3.2	5.8	26.9	0.0	98.1	**250.5**
Elands: Bospoort	2.1	0.6	1.0	17.3	18.5	0.0	0.0	**39.6**
Elands: Vaalkop	4.2	1.3	4.0	9.3	20.7	0.0	35.9	**75.3**
Apies-Pienaars: Roodeplaat	2.1	0.2	1.0	65.2	0.6	3.0	34.5	**106.6**
Apies-Pienaars: Apies	10.4	1.1	2.3	127.9	23.7	0.0	0.0	**165.4**
Apies-Pienaars: Klipvoor	11.1	1.2	5.3	26.9	0.0	0.0	124.3	**168.8**
Apies-Pienaars: Rest	3.6	0.4	3.3	23.1	0.0	0.0	0.0	**30.5**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	0.9	0.0	0.0	0.0	0.0	**46.9**
Lower Crocodile	86.5	58.0	12.2	2.4	19.9	0.0	0.0	**179.0**
Total	**237.3**	**138.2**	**36.7**	**568.3**	**126.8**	**3.0**	**0.0**	**1 110.3**

2005 Water requirements	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	26.9	0.0
Elands: Bospoort	18.5	0.0
Elands: Vaalkop	20.7	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	19.9	0.0
Total	**92.3**	**34.4**

Low population growth, medium water demand management efficiency: Water balances for low water availability and requirements for 2010

2010: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	36.2
Balance rest	-30.5
Balance total	5.7

Scenario D: Low

2010 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	9.8	16.9	0.0	**46.4**	**12.7**	**12.7**
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	155.6	272.1	0.0	**509.5**	**23.5**	**36.2**
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	12.9	15.9	170.8	**244.4**	**-17.7**	**18.6**
Elands: Bospoort	4.7	0.9	0.0	11.3	17.7	7.3	**41.9**	**-2.5**	**-2.5**
Elands: Vaalkop	5.8	21.4	0.0	1.6	11.1	52.2	**92.1**	**-5.3**	**-7.8**
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	44.2	36.4	7.4	**121.2**	**14.2**	**14.2**
Apies-Pienaars: Apies	6.0	2.5	0.0	75.3	116.1	7.6	**207.5**	**37.6**	**37.6**
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	7.7	13.2	35.4	**67.1**	**-104.1**	**-52.4**
Apies-Pienaars: Rest	2.4	0.1	0.0	19.0	21.6	0.0	**43.1**	**13.0**	**13.0**
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	**3.8**	**-24.9**
Lower Crocodile	16.7	24.6	0.0	13.8	0.0	166.5	**221.6**	**30.6**	**5.7**
Total	**82.0**	**154.5**	**40.4**	**354.8**	**521.1**	**0.0**	**1 152.7**	**5.7**	**5.7**

2010 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	9.7	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	153.3	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	4.1	0.2	12.2
Elands: Bospoort	0.3	10.3	0.7	-1.4
Elands: Vaalkop	0.6	1.0	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	43.9	0.0	-4.3
Apies-Pienaars: Apies	1.4	74.0	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	6.4	0.0	-8.9
Apies-Pienaars: Rest	0.4	18.7	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	0.8	2.4	4.6
Total	**29.5**	**322.0**	**3.2**	**-30.0**

2010 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	16.5	0.4	0.0	14.7	**33.7**
Upper Crocodile: Hartbeespoort	17.5	10.9	3.7	267.1	16.0	0.0	170.8	**486.0**
Upper Crocodile: Roodekopjes	70.8	45.7	4.4	6.2	36.9	0.0	98.1	**262.1**
Elands: Bospoort	2.1	0.6	1.2	17.6	22.8	0.0	0.0	**44.4**
Elands: Vaalkop	4.2	1.3	4.8	9.6	28.1	0.0	49.5	**97.4**
Apies-Pienaars: Roodeplaat	2.1	0.2	1.2	64.3	0.6	3.0	35.6	**107.0**
Apies-Pienaars: Apies	10.4	1.1	3.2	131.6	23.7	0.0	0.0	**169.9**
Apies-Pienaars: Klipvoor	11.1	1.2	6.5	28.1	0.0	0.0	124.3	**171.2**
Apies-Pienaars: Rest	3.6	0.4	4.5	21.6	0.0	0.0	0.0	**30.2**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.1	0.0	0.0	0.0	0.0	**47.0**
Lower Crocodile	86.5	58.0	13.6	2.5	30.4	0.0	0.0	**191.0**
Total	**237.3**	**138.2**	**44.4**	**565.2**	**158.9**	**3.0**	**0.0**	**1 147.0**

2010 Water requirements	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	36.9	0.0
Elands: Bospoort	22.8	0.0
Elands: Vaalkop	28.1	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	30.4	0.0
Total	**124.4**	**34.4**

Low population growth, medium water demand management efficiency: Water balances for low water availability and requirements for 2015

2015: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	39.7
Balance rest	-29.2
Balance total	10.5

Scenario D: Low

2015 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.2	17.7	0.0	**47.5**	**13.1**	**13.1**	0.2	10.0	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	162.8	285.4	0.0	**529.9**	**26.6**	**39.7**	2.4	160.4	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.2	16.7	174.9	**249.5**	**-17.4**	**22.3**	8.5	4.4	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	11.4	17.7	7.6	**42.2**	**-2.4**	**-2.4**	0.3	10.4	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	1.7	10.1	52.2	**91.2**	**-14.1**	**-16.5**	0.6	1.0	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	47.2	40.9	7.4	**128.7**	**17.0**	**17.0**	0.3	46.9	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	80.6	124.7	7.6	**221.4**	**42.8**	**42.8**	1.4	79.2	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	8.1	14.8	35.6	**69.3**	**-103.6**	**-43.8**	1.3	6.8	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	20.3	23.2	0.0	**46.0**	**14.3**	**14.3**	0.4	19.9	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	**3.8**	**-20.0**	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.8	0.0	168.6	**223.8**	**30.5**	**10.5**	10.6	0.8	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**372.6**	**551.2**	**0.0**	**1 200.7**	**10.5**	**10.5**	**29.5**	**339.8**	**3.2**	**-30.0**

2015 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.3	0.4	0.0	14.7	**34.4**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	3.7	280.4	16.0	0.0	174.9	**503.3**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	4.4	6.7	41.2	0.0	98.1	**266.9**	41.2	0.0
Elands: Bospoort	2.1	0.6	1.1	17.7	23.0	0.0	0.0	**44.6**	23.0	0.0
Elands: Vaalkop	4.2	1.3	4.7	9.9	33.4	0.0	51.9	**105.3**	33.4	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.2	68.9	0.6	3.0	35.8	**111.8**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	3.0	140.4	23.7	0.0	0.0	**178.6**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	6.5	29.8	0.0	0.0	124.3	**172.9**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	4.5	23.2	0.0	0.0	0.0	**31.8**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.1	0.0	0.0	0.0	0.0	**47.0**	0.0	0.0
Lower Crocodile	86.5	58.0	13.7	2.7	32.5	0.0	0.0	**193.3**	32.5	0.0
Total	**237.3**	**138.2**	**44.0**	**596.9**	**170.7**	**3.0**	**0.0**	**1 190.2**	**136.3**	**34.4**

Low population growth, medium water demand management efficiency: Water balances for low water availability and requirements for 2020

2020: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	38.0
Balance rest	-27.0
Balance total	11.0

Scenario D: Low

2020 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.3	17.9	0.0	**47.9**	13.2	13.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	166.5	292.4	0.0	**540.7**	24.8	38.0
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.3	17.3	180.1	**255.5**	-18.4	19.6
Elands: Bospoort	4.7	0.9	0.0	11.3	17.6	9.1	**43.6**	-1.1	-1.1
Elands: Vaalkop	5.8	21.4	0.0	1.7	9.8	52.2	**90.9**	-16.6	-17.8
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	49.1	44.1	7.4	**133.8**	22.0	22.0
Apies-Pienaars: Apies	6.0	2.5	0.0	83.9	132.3	7.6	**232.2**	47.3	47.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	8.3	17.1	32.4	**68.6**	-106.6	-37.3
Apies-Pienaars: Rest	2.4	0.1	0.0	21.1	24.3	0.0	**47.9**	13.9	13.9
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.6	-17.9
Lower Crocodile	16.7	24.6	0.0	13.9	0.0	168.6	**223.9**	28.9	11.0
Total	**82.0**	**154.5**	**40.4**	**382.8**	**572.8**	**0.0**	**1 232.5**	**11.0**	**11.0**

2020 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	10.1	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	164.2	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	4.6	0.2	12.2
Elands: Bospoort	0.3	10.3	0.7	-1.4
Elands: Vaalkop	0.6	1.1	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	48.8	0.0	-4.3
Apies-Pienaars: Apies	1.4	82.5	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	7.0	0.0	-8.9
Apies-Pienaars: Rest	0.4	20.7	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	0.9	2.4	4.6
Total	**29.5**	**350.0**	**3.2**	**-30.0**

2020 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.5	0.4	0.0	14.7	**34.7**
Upper Crocodile: Hartbeespoort	17.5	10.9	4.1	287.4	16.0	0.0	180.1	**515.9**
Upper Crocodile: Roodekopjes	70.8	45.7	5.6	7.2	46.6	0.0	98.1	**273.9**
Elands: Bospoort	2.1	0.6	1.3	17.6	23.1	0.0	0.0	**44.7**
Elands: Vaalkop	4.2	1.3	5.5	10.0	33.2	0.0	53.4	**107.5**
Apies-Pienaars: Roodeplaat	2.1	0.2	1.4	71.8	0.6	3.0	32.6	**111.8**
Apies-Pienaars: Apies	10.4	1.1	3.8	146.0	23.7	0.0	0.0	**185.0**
Apies-Pienaars: Klipvoor	11.1	1.2	7.7	30.8	0.0	0.0	124.3	**175.1**
Apies-Pienaars: Rest	3.6	0.4	5.6	24.3	0.0	0.0	0.0	**34.0**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.2	0.0	0.0	0.0	0.0	**47.2**
Lower Crocodile	86.5	58.0	15.1	2.8	32.5	0.0	0.0	**194.9**
Total	**237.3**	**138.2**	**51.5**	**615.4**	**176.1**	**3.0**	**0.0**	**1 221.4**

2020 Water requirements	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	46.6	0.0
Elands: Bospoort	23.1	0.0
Elands: Vaalkop	33.2	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	32.5	0.0
Total	**141.6**	**34.4**

Low population growth, medium water demand management efficiency: Water balances for low water availability and requirements for 2025

2025: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	38.7
Balance rest	-23.3
Balance total	15.4

Scenario D: Low

2025 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.4	18.1	0.0	**48.2**	13.3	13.3
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	167.8	294.6	0.0	**544.2**	25.5	38.7
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.4	17.3	180.7	**256.2**	-18.3	20.5
Elands: Bospoort	4.7	0.9	0.0	11.0	17.4	9.3	**43.4**	-0.8	-0.8
Elands: Vaalkop	5.8	21.4	0.0	1.8	9.6	52.2	**90.7**	-17.6	-18.4
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	50.4	46.2	7.4	**137.2**	23.5	23.5
Apies-Pienaars: Apies	6.0	2.5	0.0	86.2	136.3	7.6	**238.5**	49.5	49.5
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	8.4	17.9	32.3	**69.4**	-106.5	-33.5
Apies-Pienaars: Rest	2.4	0.1	0.0	21.7	25.1	0.0	**49.3**	14.5	14.5
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.6	-13.3
Lower Crocodile	16.7	24.6	0.0	13.9	0.0	168.6	**223.9**	28.8	15.4
Total	**82.0**	**154.5**	**40.4**	**388.5**	**582.4**	**0.0**	**1 247.8**	**15.4**	**15.4**

2025 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	10.2	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	165.5	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	4.6	0.2	12.2
Elands: Bospoort	0.3	10.1	0.7	-1.4
Elands: Vaalkop	0.6	1.1	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	50.1	0.0	-4.3
Apies-Pienaars: Apies	1.4	84.8	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	7.2	0.0	-8.9
Apies-Pienaars: Rest	0.4	21.3	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	0.9	2.4	4.6
Total	**29.5**	**355.8**	**3.2**	**-30.0**

2025 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.7	0.4	0.0	14.7	**34.9**
Upper Crocodile: Hartbeespoort	17.5	10.9	4.1	289.6	16.0	0.0	180.7	**518.7**
Upper Crocodile: Roodekopjes	70.8	45.7	5.5	7.6	46.7	0.0	98.1	**274.5**
Elands: Bospoort	2.1	0.6	1.3	17.2	23.0	0.0	0.0	**44.2**
Elands: Vaalkop	4.2	1.3	5.4	10.1	33.9	0.0	53.6	**108.4**
Apies-Pienaars: Roodeplaat	2.1	0.2	1.5	73.8	0.6	3.0	32.5	**113.7**
Apies-Pienaars: Apies	10.4	1.1	3.9	149.9	23.7	0.0	0.0	**189.0**
Apies-Pienaars: Klipvoor	11.1	1.2	7.7	31.6	0.0	0.0	124.3	**176.0**
Apies-Pienaars: Rest	3.6	0.4	5.6	25.1	0.0	0.0	0.0	**34.7**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.2	0.0	0.0	0.0	0.0	**47.2**
Lower Crocodile	86.5	58.0	15.1	3.0	32.5	0.0	0.0	**195.1**
Total	**237.3**	**138.2**	**51.7**	**625.5**	**176.7**	**3.0**	**0.0**	**1 232.4**

2025 Water requirements	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	46.7	0.0
Elands: Bospoort	23.0	0.0
Elands: Vaalkop	33.9	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	32.5	0.0
Total	**142.3**	**34.4**

Low population growth, medium water demand management efficiency: Water balances for low water availability and requirements for 2030

2030: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	38.6
Balance rest	-22.2
Balance total	16.4

Scenario D: Low

2030 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.4	18.5	0.0	**48.5**	**13.3**	**13.3**
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	169.0	298.1	0.0	**548.8**	**25.3**	**38.6**
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.4	17.3	181.3	**256.9**	**-19.3**	**19.3**
Elands: Bospoort	4.7	0.9	0.0	10.8	17.4	10.9	**44.8**	**0.9**	**0.9**
Elands: Vaalkop	5.8	21.4	0.0	1.8	9.5	52.2	**90.7**	**-19.9**	**-19.0**
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	51.7	49.3	7.4	**141.6**	**29.8**	**29.8**
Apies-Pienaars: Apies	6.0	2.5	0.0	88.5	144.7	7.6	**249.2**	**53.5**	**53.5**
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	8.6	19.8	27.3	**66.5**	**-111.3**	**-28.1**
Apies-Pienaars: Rest	2.4	0.1	0.0	22.2	25.9	0.0	**50.6**	**13.4**	**13.4**
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	**3.5**	**-10.9**
Lower Crocodile	16.7	24.6	0.0	14.0	0.0	168.6	**224.0**	**27.3**	**16.4**
Total	**82.0**	**154.5**	**40.4**	**394.0**	**600.4**	**0.0**	**1 271.3**	**16.4**	**16.4**

Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
0.2	10.3	0.0	-2.2
2.4	166.6	0.0	-21.4
8.5	4.7	0.2	12.2
0.3	9.9	0.7	-1.4
0.6	1.2	0.0	-5.3
0.3	51.4	0.0	-4.3
1.4	87.1	0.0	-3.3
1.3	7.3	0.0	-8.9
0.4	21.9	0.0	0.0
3.6	0.0	0.0	0.0
10.6	1.0	2.4	4.6
29.5	**361.2**	**3.2**	**-30.0**

2030 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	18.1	0.4	0.0	14.7	**35.2**
Upper Crocodile: Hartbeespoort	17.5	10.9	4.8	293.1	16.0	0.0	181.3	**523.6**
Upper Crocodile: Roodekopjes	70.8	45.7	6.6	8.1	46.9	0.0	98.1	**276.2**
Elands: Bospoort	2.1	0.6	1.4	16.8	22.9	0.0	0.0	**43.9**
Elands: Vaalkop	4.2	1.3	6.1	10.2	33.7	0.0	55.2	**110.6**
Apies-Pienaars: Roodeplaat	2.1	0.2	2.3	76.2	0.6	3.0	27.5	**111.9**
Apies-Pienaars: Apies	10.4	1.1	6.2	154.4	23.7	0.0	0.0	**195.7**
Apies-Pienaars: Klipvoor	11.1	1.2	8.8	32.4	0.0	0.0	124.3	**177.8**
Apies-Pienaars: Rest	3.6	0.4	7.3	25.9	0.0	0.0	0.0	**37.3**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.4	0.0	0.0	0.0	0.0	**47.3**
Lower Crocodile	86.5	58.0	16.5	3.1	32.5	0.0	0.0	**196.6**
Total	**237.3**	**138.2**	**61.4**	**638.2**	**176.7**	**3.0**	**0.0**	**1 254.9**

Mining, bulk	Power generation
0.4	0.0
5.0	11.0
46.9	0.0
22.9	0.0
33.7	0.0
0.6	0.0
0.2	23.5
0.0	0.0
0.0	0.0
0.0	0.0
32.5	0.0
142.3	**34.4**

High population growth, high water demand management efficiency: Water balances for high water availability and requirements for 2005

2005: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	43.2
Balance rest	15.1
Balance total	58.3

Scenario C: High

2005 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.2	17.5	0.0	**47.3**	13.1	13.1	0.2	10.0	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	153.1	283.6	0.0	**518.5**	30.1	43.2	2.4	150.8	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	12.6	14.4	162.0	**233.9**	-16.8	26.4	8.5	3.9	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	11.3	16.6	5.6	**39.1**	-0.8	-0.8	0.3	10.3	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	1.6	11.3	52.2	**92.2**	16.6	15.8	0.6	0.9	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	43.2	59.1	7.4	**142.9**	35.2	35.2	0.3	42.9	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	72.1	117.2	7.6	**205.3**	37.5	37.5	1.4	70.7	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	7.5	11.2	34.1	**63.7**	-105.6	-32.9	1.3	6.2	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	19.1	23.5	0.0	**45.1**	14.2	14.2	0.4	18.7	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	4.0	27.5	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.7	0.0	154.8	**209.9**	30.8	58.3	10.6	0.7	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**347.8**	**554.4**	**0.0**	**1 179.1**	**58.3**	**58**	**29.5**	**315.1**	**3.2**	**-30.0**

2005 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.1	0.4	0.0	14.7	**34.2**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	3.4	278.6	16.0	0.0	162.0	**488.4**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	3.2	5.9	26.9	0.0	98.1	**250.6**	26.9	0.0
Elands: Bospoort	2.1	0.6	1.0	17.6	18.5	0.0	0.0	**39.9**	18.5	0.0
Elands: Vaalkop	4.2	1.3	4.0	9.4	20.7	0.0	36.0	**75.6**	20.7	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.0	66.4	0.6	3.0	34.4	**107.7**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	2.4	130.3	23.7	0.0	0.0	**167.8**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	5.3	27.4	0.0	0.0	124.3	**169.3**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	3.3	23.5	0.0	0.0	0.0	**30.9**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	0.9	0.0	0.0	0.0	0.0	**46.9**	0.0	0.0
Lower Crocodile	86.5	58.0	12.2	2.4	19.9	0.0	0.0	**179.0**	19.9	0.0
Total	**237.3**	**138.2**	**36.9**	**578.6**	**126.8**	**3.0**	**0.0**	**1 120.8**	**92.3**	**34.4**

High population growth, high water demand management efficiency: Water balances for high water availability and requirements for 2010

2010: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	37.7
Balance rest	-25.5
Balance total	12.2

Scenario C: High

2010 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.4	18.0	0.0	**48.1**	13.3	13.3	0.2	10.3	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	157.3	289.4	0.0	**528.4**	24.3	37.7	2.4	155.0	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.2	16.3	171.6	**245.9**	-17.6	20.1	8.5	4.4	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	12.0	17.7	8.7	**44.0**	-4.2	-4.2	0.3	11.0	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	1.6	11.1	52.2	**92.2**	-9.8	-14.0	0.6	1.0	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	46.9	43.5	7.4	**131.0**	17.3	17.3	0.3	46.6	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	80.7	128.1	7.6	**224.8**	43.1	43.1	1.4	79.3	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	8.2	15.5	35.0	**69.6**	-104.0	-43.7	1.3	6.9	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	20.2	24.3	0.0	**47.1**	14.0	14.0	0.4	19.9	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.8	-19.8	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.8	0.0	168.3	**223.5**	32.0	12.2	10.6	0.8	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**367.9**	**563.9**	**0.0**	**1 208.6**	**12.2**	**12**	**29.5**	**335.1**	**3.2**	**-30.0**

2010 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.6	0.4	0.0	14.7	**34.7**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	3.7	284.4	16.0	0.0	171.6	**504.1**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	4.5	6.7	37.7	0.0	98.1	**263.5**	37.7	0.0
Elands: Bospoort	2.1	0.6	1.2	18.8	25.4	0.0	0.0	**48.2**	25.4	0.0
Elands: Vaalkop	4.2	1.3	4.9	10.2	28.8	0.0	52.7	**101.9**	28.8	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.3	71.3	0.6	3.0	35.3	**113.8**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	3.3	143.3	23.7	0.0	0.0	**181.8**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	6.6	30.4	0.0	0.0	124.3	**173.6**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	4.6	24.3	0.0	0.0	0.0	**33.1**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.1	0.0	0.0	0.0	0.0	**47.0**	0.0	0.0
Lower Crocodile	86.5	58.0	13.8	2.5	30.7	0.0	0.0	**191.5**	30.7	0.0
Total	**237.3**	**138.2**	**45.2**	**609.5**	**163.3**	**3.0**	**0.0**	**1 196.4**	**128.8**	**34.4**

High population growth, high water demand management efficiency: Water balances for high water availability and requirements for 2015

2015: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	38.1
Balance rest	-28.6
Balance total	9.5

Scenario C: High

2015 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	10.2	18.1	0.0	**48.1**	13.1	13.1
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	162.5	300.9	0.0	**545.2**	24.9	38.1
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	13.7	17.2	176.3	**252.0**	-17.2	20.9
Elands: Bospoort	4.7	0.9	0.0	12.7	17.7	10.1	**46.1**	-5.6	-5.6
Elands: Vaalkop	5.8	21.4	0.0	1.8	10.1	52.2	**91.3**	-22.9	-28.4
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	48.7	39.7	7.4	**129.0**	19.0	19.0
Apies-Pienaars: Apies	6.0	2.5	0.0	86.9	129.8	7.6	**232.7**	49.3	49.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	8.8	18.1	35.0	**72.8**	-103.4	-35.1
Apies-Pienaars: Rest	2.4	0.1	0.0	21.7	25.2	0.0	**49.3**	15.4	15.4
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.8	-23.4
Lower Crocodile	16.7	24.6	0.0	13.8	0.0	172.8	**228.0**	32.9	9.5
Total	**82.0**	**154.5**	**40.4**	**384.3**	**576.8**	**0.0**	**1 238.0**	**9.5**	**10**

Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
0.2	10.1	0.0	-2.2
2.4	160.2	0.0	-21.4
8.5	5.0	0.2	12.2
0.3	11.7	0.7	-1.4
0.6	1.1	0.0	-5.3
0.3	48.4	0.0	-4.3
1.4	85.5	0.0	-3.3
1.3	7.5	0.0	-8.9
0.4	21.3	0.0	0.0
3.6	0.0	0.0	0.0
10.6	0.8	2.4	4.6
29.5	**351.5**	**3.2**	**-30.0**

2015 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.7	0.4	0.0	14.7	**34.9**
Upper Crocodile: Hartbeespoort	17.5	10.9	3.7	295.9	16.0	0.0	176.3	**520.3**
Upper Crocodile: Roodekopjes	70.8	45.7	4.6	7.6	42.4	0.0	98.1	**269.2**
Elands: Bospoort	2.1	0.6	1.2	20.0	27.7	0.0	0.0	**51.7**
Elands: Vaalkop	4.2	1.3	4.9	11.0	34.2	0.0	58.6	**114.1**
Apies-Pienaars: Roodeplaat	2.1	0.2	1.2	67.6	0.6	3.0	35.3	**110.0**
Apies-Pienaars: Apies	10.4	1.1	3.2	145.1	23.7	0.0	0.0	**183.5**
Apies-Pienaars: Klipvoor	11.1	1.2	6.7	32.9	0.0	0.0	124.3	**176.2**
Apies-Pienaars: Rest	3.6	0.4	4.7	25.2	0.0	0.0	0.0	**33.9**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.1	0.0	0.0	0.0	0.0	**47.1**
Lower Crocodile	86.5	58.0	13.9	2.7	34.0	0.0	0.0	**195.1**
Total	**237.3**	**138.2**	**45.3**	**625.6**	**179.0**	**3.0**	**0.0**	**1 228.5**

Mining, bulk	Power generation
0.4	0.0
5.0	11.0
42.4	0.0
27.7	0.0
34.2	0.0
0.6	0.0
0.2	23.5
0.0	0.0
0.0	0.0
0.0	0.0
34.0	0.0
144.6	**34.4**

High population growth, high water demand management efficiency: Water balances for high water availability and requirements for 2020

2020: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	36.6
Balance rest	-19.1
Balance total	17.5

Scenario C: High

2020 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	6.7	13.0	0.0	9.7	17.7	0.0	**47.1**	12.6	12.6	0.2	9.6	0.0	-2.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	168.1	312.2	0.0	**562.1**	24.0	36.6	2.4	165.8	0.0	-21.4
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	14.2	18.2	182.4	**259.7**	-17.8	18.7	8.5	5.5	0.2	12.2
Elands: Bospoort	4.7	0.9	0.0	13.3	18.8	13.1	**50.7**	-3.3	-3.3	0.3	12.3	0.7	-1.4
Elands: Vaalkop	5.8	21.4	0.0	1.9	9.9	52.2	**91.2**	-27.9	-31.2	0.6	1.2	0.0	-5.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	52.5	43.3	7.4	**136.4**	26.4	26.4	0.3	52.2	0.0	-4.3
Apies-Pienaars: Apies	6.0	2.5	0.0	94.8	141.9	7.6	**252.8**	58.6	58.6	1.4	93.4	0.0	-3.3
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	9.5	22.3	31.4	**74.0**	-106.3	-21.3	1.3	8.2	0.0	-8.9
Apies-Pienaars: Rest	2.4	0.1	0.0	23.4	27.1	0.0	**53.0**	15.9	15.9	0.4	23.1	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.6	-14.3	3.6	0.0	0.0	0.0
Lower Crocodile	16.7	24.6	0.0	13.9	0.0	173.7	**228.9**	31.8	17.5	10.6	0.9	2.4	4.6
Total	**82.0**	**154.5**	**40.4**	**404.8**	**611.3**	**0.0**	**1 293.0**	**17.5**	**18**	**29.5**	**372.1**	**3.2**	**-30.0**

2020 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	1.6	0.3	0.2	17.3	0.4	0.0	14.7	**34.5**	0.4	0.0
Upper Crocodile: Hartbeespoort	17.5	10.9	4.2	307.2	16.0	0.0	182.4	**538.1**	5.0	11.0
Upper Crocodile: Roodekopjes	70.8	45.7	5.9	8.6	48.4	0.0	98.1	**277.5**	48.4	0.0
Elands: Bospoort	2.1	0.6	1.4	21.0	28.9	0.0	0.0	**54.0**	28.9	0.0
Elands: Vaalkop	4.2	1.3	5.7	11.7	33.8	0.0	62.5	**119.1**	33.8	0.0
Apies-Pienaars: Roodeplaat	2.1	0.2	1.5	70.9	0.6	3.0	31.6	**109.9**	0.6	0.0
Apies-Pienaars: Apies	10.4	1.1	4.1	154.9	23.7	0.0	0.0	**194.2**	0.2	23.5
Apies-Pienaars: Klipvoor	11.1	1.2	8.0	35.7	0.0	0.0	124.3	**180.3**	0.0	0.0
Apies-Pienaars: Rest	3.6	0.4	6.0	27.1	0.0	0.0	0.0	**37.2**	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.3	0.0	0.0	0.0	0.0	**47.2**	0.0	0.0
Lower Crocodile	86.5	58.0	15.5	2.8	34.3	0.0	0.0	**197.1**	34.3	0.0
Total	**237.3**	**138.2**	**53.8**	**657.2**	**186.0**	**3.0**	**0.0**	**1 275.5**	**151.5**	**34.4**

High population growth, high water demand management efficiency: Water balances for high water availability and requirements for 2025

2025: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	45.2
Balance rest	-9.1
Balance total	36.2

Scenario C: High

2025 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	9.2	17.2	0.0	**46.1**	12.1	12.1
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	177.9	326.3	0.0	**586.0**	33.1	45.2
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	14.6	18.1	182.9	**260.3**	-17.5	27.7
Elands: Bospoort	4.7	0.9	0.0	13.6	18.6	14.0	**51.9**	-3.0	-3.0
Elands: Vaalkop	5.8	21.4	0.0	2.0	9.6	52.2	**91.0**	-30.6	-33.7
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	55.7	46.0	7.4	**142.4**	30.1	30.1
Apies-Pienaars: Apies	6.0	2.5	0.0	101.4	150.5	7.6	**267.9**	65.2	65.2
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	10.1	24.8	31.0	**76.8**	-106.2	-10.8
Apies-Pienaars: Rest	2.4	0.1	0.0	25.1	28.9	0.0	**56.5**	17.4	17.4
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.6	4.3
Lower Crocodile	16.7	24.6	0.0	13.9	0.0	174.3	**229.5**	31.9	36.2
Total	**82.0**	**154.5**	**40.4**	**427.1**	**640.0**	**0.0**	**1 343.9**	**36.2**	**36**

2025 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	9.1	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	175.5	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	5.9	0.2	12.2
Elands: Bospoort	0.3	12.7	0.7	-1.4
Elands: Vaalkop	0.6	1.4	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	55.4	0.0	-4.3
Apies-Pienaars: Apies	1.4	100.0	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	8.8	0.0	-8.9
Apies-Pienaars: Rest	0.4	24.7	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	0.9	2.4	4.6
Total	**29.5**	**394.3**	**3.2**	**-30.0**

2025 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	16.8	0.4	0.0	14.7	**34.0**
Upper Crocodile: Hartbeespoort	17.5	10.9	4.3	321.3	16.0	0.0	182.9	**552.8**
Upper Crocodile: Roodekopjes	70.8	45.7	6.0	9.6	47.6	0.0	98.1	**277.8**
Elands: Bospoort	2.1	0.6	1.4	21.7	29.2	0.0	0.0	**54.9**
Elands: Vaalkop	4.2	1.3	5.7	12.4	34.1	0.0	64.0	**121.6**
Apies-Pienaars: Roodeplaat	2.1	0.2	1.6	73.5	0.6	3.0	31.2	**112.3**
Apies-Pienaars: Apies	10.4	1.1	4.3	163.2	23.7	0.0	0.0	**202.7**
Apies-Pienaars: Klipvoor	11.1	1.2	8.2	38.1	0.0	0.0	124.3	**182.9**
Apies-Pienaars: Rest	3.6	0.4	6.1	28.9	0.0	0.0	0.0	**39.0**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.3	0.0	0.0	0.0	0.0	**47.2**
Lower Crocodile	86.5	58.0	15.7	3.0	34.5	0.0	0.0	**197.7**
Total	**237.3**	**138.2**	**54.6**	**688.5**	**186.1**	**3.0**	**0.0**	**1 307.7**

2025 Water requirements	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	47.6	0.0
Elands: Bospoort	29.2	0.0
Elands: Vaalkop	34.1	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	34.5	0.0
Total	**151.7**	**34.4**

High population growth, high water demand management efficiency: Water balances for high water availability and requirements for 2030

2030: SUMMARY OF WATER AVAILABILITY AND REQUIREMENTS

Balance HBP	55.6
Balance rest	2.4
Balance total	58.0

Scenario C: High

2030 Water availability	Ground-water	Surface water	Urban runoff	Return flows	Inter-basin transfers in	Intra-basin transfers in	Total availability	Inc Balance	Cum balance
Upper Crocodile: Rietvlei	6.7	13.0	0.0	9.3	18.8	0.0	**47.8**	12.2	12.2
Upper Crocodile: Hartbeespoort	19.8	37.7	24.2	190.2	350.7	0.0	**622.6**	43.4	55.6
Upper Crocodile: Roodekopjes	6.7	38.1	0.0	15.0	18.1	184.2	**262.1**	-18.5	37.2
Elands: Bospoort	4.7	0.9	0.0	14.0	18.4	16.6	**54.7**	-0.3	-0.3
Elands: Vaalkop	5.8	21.4	0.0	2.1	9.3	52.2	**90.8**	-34.0	-34.3
Apies-Pienaars: Roodeplaat	6.7	10.4	16.2	60.5	54.6	7.4	**155.7**	40.7	40.7
Apies-Pienaars: Apies	6.0	2.5	0.0	109.4	170.7	7.6	**296.1**	75.2	75.2
Apies-Pienaars: Klipvoor	5.0	5.8	0.0	10.8	29.4	25.1	**76.1**	-111.3	4.6
Apies-Pienaars: Rest	2.4	0.1	0.0	27.0	31.6	0.0	**61.2**	17.4	17.4
Crocodile d/s Roodekopjes to Pienaars	1.3	0.0	0.0	3.6	0.0	45.9	**50.8**	3.4	28.2
Lower Crocodile	16.7	24.6	0.0	14.0	0.0	174.2	**229.5**	29.8	58.0
Total	**82.0**	**154.5**	**40.4**	**455.9**	**701.5**	**0.0**	**1 434.2**	**58.0**	**58**

2030 Water availability	Irrigation return flows	Urban + rural return flows	Bulk return flows	EWR
Upper Crocodile: Rietvlei	0.2	9.2	0.0	-2.2
Upper Crocodile: Hartbeespoort	2.4	187.9	0.0	-21.4
Upper Crocodile: Roodekopjes	8.5	6.3	0.2	12.2
Elands: Bospoort	0.3	13.0	0.7	-1.4
Elands: Vaalkop	0.6	1.5	0.0	-5.3
Apies-Pienaars: Roodeplaat	0.3	60.2	0.0	-4.3
Apies-Pienaars: Apies	1.4	108.0	0.0	-3.3
Apies-Pienaars: Klipvoor	1.3	9.5	0.0	-8.9
Apies-Pienaars: Rest	0.4	26.7	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	3.6	0.0	0.0	0.0
Lower Crocodile	10.6	1.0	2.4	4.6
Total	**29.5**	**423.1**	**3.2**	**-30.0**

2030 Water requirements	Irrigation (net)	Distr. losses	Rural	Urban	Mining, bulk, power	Inter-basin transfers out	Intra-basin transfers out	Total require-ments
Upper Crocodile: Rietvlei	1.6	0.3	0.2	18.4	0.4	0.0	14.7	**35.6**
Upper Crocodile: Hartbeespoort	17.5	10.9	5.1	345.7	16.0	0.0	184.2	**579.3**
Upper Crocodile: Roodekopjes	70.8	45.7	7.3	10.8	47.8	0.0	98.1	**280.5**
Elands: Bospoort	2.1	0.6	1.5	22.3	28.5	0.0	0.0	**55.0**
Elands: Vaalkop	4.2	1.3	6.5	13.1	33.4	0.0	66.5	**124.8**
Apies-Pienaars: Roodeplaat	2.1	0.2	2.5	81.2	0.6	3.0	25.3	**115.0**
Apies-Pienaars: Apies	10.4	1.1	6.8	178.9	23.7	0.0	0.0	**220.9**
Apies-Pienaars: Klipvoor	11.1	1.2	9.5	41.3	0.0	0.0	124.3	**187.4**
Apies-Pienaars: Rest	3.6	0.4	8.1	31.6	0.0	0.0	0.0	**43.8**
Crocodile d/s Roodekopjes to Pienaars	27.5	18.5	1.5	0.0	0.0	0.0	0.0	**47.4**
Lower Crocodile	86.5	58.0	17.3	3.1	34.8	0.0	0.0	**199.7**
Total	**237.3**	**138.2**	**66.3**	**746.4**	**185.1**	**3.0**	**0.0**	**1 376.3**

2030 Water requirements	Mining, bulk	Power generation
Upper Crocodile: Rietvlei	0.4	0.0
Upper Crocodile: Hartbeespoort	5.0	11.0
Upper Crocodile: Roodekopjes	47.8	0.0
Elands: Bospoort	28.5	0.0
Elands: Vaalkop	33.4	0.0
Apies-Pienaars: Roodeplaat	0.6	0.0
Apies-Pienaars: Apies	0.2	23.5
Apies-Pienaars: Klipvoor	0.0	0.0
Apies-Pienaars: Rest	0.0	0.0
Crocodile d/s Roodekopjes to Pienaars	0.0	0.0
Lower Crocodile	34.8	0.0
Total	**150.6**	**34.4**

Appendix I

Projected future water requirements scenarios in the Lephalale catchment

Table I-1: Water requirements for Scenario 1: Matimba power station (existing technology), Medupi power station (existing technology), Exxaro supply coal for two power stations, Lephalale town for two power stations

USER	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ESKOM																								
Matimba Power Station	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Medupi Power Station		0.5	0.8	1.0	1.0	3.2	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Lephalale 3 Power Station																								
Lephalale 4 Power Station																								
Lephalale 5 Power Station																								
Total	**3.6**	**4.1**	**4.3**	**4.6**	**4.6**	**6.8**	**8.4**	**8.4**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**
MINES																								
Matimba - coal supplied by **Exxaro**	3.0	3.1	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Medupi - coal supplied by **Exxaro**				1.1	2.3	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other mining activities by **Exxaro** (local)							0.7	1.3	3.4	4.4	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Lephalale 3																								
Lephalale 4																								
Lephalale 5																								
Other: 1 000 MW power station							0.5	0.7	2.9	5.7	8.6	12.9	13.6	14.3	15.0	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
Total	**3.0**	**3.1**	**3.6**	**4.7**	**5.9**	**6.9**	**9.8**	**10.6**	**14.9**	**18.7**	**22.1**	**26.4**	**27.1**	**27.8**	**28.5**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**
SASOL																								
Construction																								
CTL Facility																								
Coal mining and beneficiation																								
Total																								
LEPHALALE MUNICIPALITY																								
Current	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Medupi		0.2	0.4	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 3																								
Lephalale 4																								
Lephalale 5																								
Construction		0.6	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0										
Sasol																								
Total	**3.4**	**4.2**	**4.5**	**5.0**	**5.4**	**5.9**	**6.3**	**6.5**	**6.8**	**6.8**	**6.8**	**6.8**	**6.8**	**6.8**	**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**5.8**	**5.8**
IRRIGATION	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**
TOTAL: SCENARIO 1	**20.4**	**21.8**	**22.8**	**24.7**	**26.3**	**30.1**	**34.9**	**35.9**	**40.6**	**44.4**	**47.8**	**52.1**	**52.8**	**53.5**	**53.2**	**54.0**	**54.0**	**54.0**	**54.0**	**54.0**	**54.0**	**54.0**	**54.0**	**54.0**
Water available from Mokolo Dam	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**
Water required from Crocodile/Vaal	**-18.7**	**-17.3**	**-16.3**	**-14.4**	**-12.8**	**-9.0**	**-4.2**	**-3.2**	**1.5**	**5.3**	**8.7**	**13.0**	**13.7**	**14.4**	**14.1**	**14.9**	**14.9**	**14.9**	**14.9**	**14.9**	**14.9**	**14.9**	**14.9**	**14.9**

Table I-2: Water requirements for Scenario 2: Matimba power station (existing technology), Medupi power station with flue gas desulphurisation (FGD), 1 additional new power station with FGD technology, coal supply to 3 power stations, no SASOL, Lephalale town for 3 power stations

USER	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ESKOM																								
Matimba Power Station	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Medupi Power Station		0.5	0.8	1.0	1.9	7.8	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Lephalale 3 Power Station				1.2	2.9	8.4	10.8	13.8	13.9	14.1	14.1	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Lephalale 4 Power Station																								
Lephalale 5 Power Station																								
Total	**3.6**	**4.1**	**4.3**	**5.8**	**8.5**	**19.7**	**26.0**	**29.0**	**29.3**	**29.4**	**29.4**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**
MINES																								
Matimba - coal supplied by **Exxaro**	3.0	3.1	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Medupi - coal supplied by **Exxaro**				1.1	2.3	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other mining activities by **Exxaro**			1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lephalale 3 - coal supplied by			1.1	2.3	2.8	2.8	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lephalale 4 - coal supplied by																								
Lephalale 5 - coal supplied by																								
Other: 1 000 MW power station																								
Total	**3.0**	**3.1**	**5.7**	**8.0**	**9.7**	**10.7**	**13.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**
SASOL																								
Construction																								
CTL Facility																								
Coal mining and beneficiation																								
Total																								
LEPHALALE MUNICIPALITY																								
Current	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Medupi		0.2	0.4	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 3		0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 4																								
Lephalale 5																								
Construction		0.6	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0										
Sasol																								
Total	**3.4**	**4.5**	**5.1**	**6.0**	**6.9**	**7.8**	**8.4**	**8.9**	**9.2**	**9.2**	**9.2**	**9.2**	**9.2**	**9.2**	**8.2**	**8.2**	**8.2**	**8.2**	**8.2**	**8.2**	**8.2**	**8.2**	**8.2**	**8.2**
IRRIGATION	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**
TOTAL: SCENARIO 2	**20.4**	**22.1**	**25.5**	**30.2**	**35.5**	**48.7**	**58.4**	**63.9**	**64.5**	**64.6**	**64.6**	**63.1**	**63.1**	**63.1**	**62.1**	**62.1**	**62.1**	**62.1**	**62.1**	**62.1**	**62.1**	**62.1**	**62.1**	**62.1**
Water available from Mokolo Dam	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**
Water required from Crocodile/Vaal	**-18.7**	**-17.0**	**-13.6**	**-8.9**	**-3.6**	**9.6**	**19.3**	**24.8**	**25.4**	**25.5**	**25.5**	**24.0**	**24.0**	**24.0**	**23.0**	**23.0**	**23.0**	**23.0**	**23.0**	**23.0**	**23.0**	**23.0**	**23.0**	**23.0**

Table I-3: Water requirements for Scenario 3: Matimba power station (existing technology), Medupi power station with FGD technology, 1 additional new power station with FGD technology, 2 additional new power stations with fluidised bed combustion (FBC), coal supply to 5 power stations, Lephalale town for 5 power stations

USER	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ESKOM																								
Matimba Power Station	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Medupi Power Station		0.5	0.8	1.0	1.9	7.8	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Lephalale 3 Power Station				1.2	2.9	8.4	10.8	13.8	13.9	14.1	14.1	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Lephalale 4 Power Station					0.5	0.8	1.0	2.7	4.6	6.7	7.0	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Lephalale 5 Power Station										0.5	0.8	2.3	6.4	5.9	6.4	6.5	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Total	**3.6**	**4.1**	**4.3**	**5.8**	**9.0**	**20.5**	**27.0**	**31.7**	**33.9**	**36.6**	**37.1**	**36.4**	**40.6**	**40.1**	**40.6**	**40.7**	**40.5**	**40.5**	**40.5**	**40.5**	**40.5**	**40.5**	**40.5**	**40.5**
MINES																								
Matimba - coal supplied by **Exxaro**	3.0	3.1	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Medupi - coal supplied by **Exxaro**				1.1	2.3	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other mining activities by **Exxaro**			1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lephalale 3			1.1	2.3	2.8	2.8	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lephalale 4				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lephalale 5									1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Other: 1 000 MW power station (Exxaro),																								
Total	**3.0**	**3.1**	**5.7**	**9.0**	**10.7**	**11.7**	**14.6**	**16.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**
SASOL																								
Construction																								
CTL Facility																								
Coal mining and beneficiation																								
Total																								
LEPHALALE MUNICIPALITY																								
Current	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Medupi		0.2	0.4	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 3		0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 4			0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4
Lephalale 5									0.3	0.6	1.0	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Construction		0.6	1.0	1.5	1.8	2.1	2.3	2.6	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Sasol																								
Total	**3.4**	**4.5**	**5.7**	**7.1**	**8.7**	**10.4**	**11.6**	**12.6**	**13.6**	**13.9**	**14.3**	**14.3**	**14.8**	**15.2**	**15.4**	**15.7**	**14.8**	**15.2**	**15.4**	**15.7**	**15.7**	**15.7**	**15.7**	**15.7**
IRRIGATION	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**
TOTAL: SCENARIO 3	**20.4**	**22.1**	**26.1**	**32.3**	**38.8**	**53.0**	**63.6**	**71.3**	**75.5**	**78.5**	**79.4**	**78.7**	**83.4**	**83.3**	**84.0**	**84.4**	**83.3**	**83.7**	**83.9**	**84.2**	**84.2**	**84.2**	**84.2**	**84.2**
Water available from Mokolo Dam	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**
Water required from Crocodile/Vaal	**-18.7**	**-17.0**	**-13.0**	**-6.8**	**-0.3**	**13.9**	**24.5**	**32.2**	**36.4**	**39.4**	**40.3**	**39.6**	**44.3**	**44.2**	**44.9**	**45.3**	**44.2**	**44.6**	**44.8**	**45.1**	**45.1**	**45.1**	**45.1**	**45.1**

Table I-4: Matimba power station (existing technology), Medupi power station with FGD technology, 3 additional new power stations with FGD, coal supply to 5 power stations, Lephalale town for 5 power stations

USER	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ESKOM																								
Matimba Power Station	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Medupi Power Station		0.5	0.8	1.0	1.9	7.8	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Lephalale 3 Power Station				1.2	2.9	8.4	10.8	13.8	13.9	14.1	14.1	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Lephalale 4 Power Station					0.5	0.8	1.0	5.3	9.3	13.4	13.9	12.4	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Lephalale 5 Power Station										0.5	0.8	4.6	12.8	11.8	12.8	13.0	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Total	**3.6**	**4.1**	**4.3**	**5.8**	**9.0**	**20.5**	**27.0**	**34.3**	**38.5**	**43.3**	**44.1**	**44.9**	**53.3**	**52.3**	**53.3**	**53.5**	**53.1**	**53.1**	**53.1**	**53.1**	**53.1**	**53.1**	**53.1**	**53.1**
MINES																								
Matimba - coal supplied by **Exxaro**	3.0	3.1	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Medupi - coal supplied by **Exxaro**				1.1	2.3	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other mining activities by **Exxaro**			1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lephalale 3			1.1	2.3	2.8	2.8	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lephalale 4				1.1	2.3	2.3	2.8	2.8	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lephalale 5									1.1	2.3	2.8	2.8	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other: 1 000 MW power station (Exxaro),																								
Total	**3.0**	**3.1**	**5.7**	**9.1**	**12.0**	**13.0**	**16.4**	**18.4**	**20.7**	**22.9**	**23.4**	**23.4**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**
SASOL																								
Construction																								
CTL Facility																								
Coal mining and beneficiation																								
Total																								
LEPHALALE MUNICIPALITY																								
Current	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Medupi		0.2	0.4	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 3		0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 4			0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4
Lephalale 5									0.3	0.6	1.0	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Construction		0.6	1.0	1.5	1.8	2.1	2.3	2.6	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Sasol																								
Total	**3.4**	**4.5**	**5.7**	**7.1**	**8.7**	**10.4**	**11.6**	**12.6**	**13.6**	**13.9**	**14.3**	**14.3**	**14.8**	**15.2**	**15.4**	**15.7**	**14.8**	**15.2**	**15.4**	**15.7**	**15.7**	**15.7**	**15.7**	**15.7**
IRRIGATION	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**
TOTAL: SCENARIO 4	**20.4**	**22.1**	**26.1**	**32.4**	**40.1**	**54.3**	**65.4**	**75.7**	**83.2**	**90.5**	**92.2**	**93.0**	**104.1**	**103.5**	**104.7**	**105.2**	**103.9**	**104.3**	**104.5**	**104.8**	**104.8**	**104.8**	**104.8**	**104.8**
Water avaiable from Mokolo Dam	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**
Water required from Crocodile/Vaal	**-18.7**	**-17.0**	**-13.0**	**-6.7**	**1.0**	**15.2**	**26.3**	**36.6**	**44.1**	**51.4**	**53.1**	**53.9**	**65.0**	**64.4**	**65.6**	**66.1**	**64.8**	**65.2**	**65.4**	**65.7**	**65.7**	**65.7**	**65.7**	**65.7**

Table I-5: Water requirements for Scenario 5: Scenario 1 + Mafutha + mine + SASOL township

USER	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ESKOM																								
Matimba Power Station using FBC	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Medupi Power Station using FBC		0.5	0.8	1.0	1.0	3.2	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Lephalale 3 Power Station																								
Lephalale 4 Power Station																								
Lephalale 5 Power Station																								
Total	**3.6**	**4.1**	**4.3**	**4.6**	**4.6**	**6.8**	**8.4**	**8.4**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**	**8.5**
MINES																								
Matimba - coal supplied by **Exxaro**	3.0	3.1	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Medupi - coal supplied by **Exxaro**				1.1	2.3	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other mining activities by **Exxaro**							0.7	1.3	3.4	4.4	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Lephalale 3																								
Lephalale 4																								
Lephalale 5																								
Other: 1 000 MW power station (Exxaro),							0.5	0.7	2.9	5.7	8.6	12.9	13.6	14.3	15.0	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
Total	**3.0**	**3.1**	**3.6**	**4.7**	**5.9**	**6.9**	**9.8**	**10.6**	**14.9**	**18.7**	**22.1**	**26.4**	**27.1**	**27.8**	**28.5**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**	**29.3**
SASOL																								
Construction					1.0	3.0	5.0			1.0	3.0	5.0												
CTL Facility								14.0	32.0	32.0	32.0	32.0	46.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0
Coal mining and beneficiation								1.0	3.0	3.0	3.0	3.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Total					**1.0**	**3.0**	**5.0**	**15.0**	**35.0**	**36.0**	**38.0**	**40.0**	**50.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**
LEPHALALE MUNICIPALITY																								
Current	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Medupi		0.2	0.4	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 3																								
Lephalale 4																								
Lephalale 5																								
Construction		0.6	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0										
Sasol								5.0	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Total	**3.4**	**4.2**	**4.5**	**5.0**	**5.4**	**5.9**	**6.3**	**11.5**	**11.8**	**11.8**	**11.8**	**11.8**	**16.8**	**16.8**	**15.8**	**15.8**	**15.8**	**15.8**	**15.8**	**15.8**	**15.8**	**15.8**	**15.8**	**15.8**
IRRIGATION	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**
TOTAL: SCENARIO 5	**20.4**	**21.8**	**22.8**	**24.7**	**27.3**	**33.1**	**39.9**	**55.9**	**80.6**	**85.4**	**90.8**	**97.1**	**112.8**	**133.5**	**133.2**	**134.0**	**134.0**	**134.0**	**134.0**	**134.0**	**134.0**	**134.0**	**134.0**	**134.0**
Water available from Mokolo Dam	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**
Water required from Crocodile/Vaal	**-18.7**	**-17.3**	**-16.3**	**-14.4**	**-11.8**	**-6.0**	**0.8**	**16.8**	**41.5**	**46.3**	**51.7**	**58.0**	**73.7**	**94.4**	**94.1**	**94.9**	**94.9**	**94.9**	**94.9**	**94.9**	**94.9**	**94.9**	**94.9**	**94.9**

Table I-6: Water requirements for Scenario 6: Scenario 2 + Mafutha + mine + SASOL township

USER	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ESKOM																								
Matimba Power Station	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Medupi Power Station		0.5	0.8	1.0	1.9	7.8	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Lephalale 3 Power Station				1.2	2.9	8.4	10.8	13.8	13.9	14.1	14.1	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Lephalale 4 Power Station																								
Lephalale 5 Power Station																								
Total	**3.6**	**4.1**	**4.3**	**5.8**	**8.5**	**19.7**	**26.0**	**29.0**	**29.3**	**29.4**	**29.4**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**	**27.9**
MINES																								
Matimba - coal supplied by **Exxaro**	3.0	3.1	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Medupi - coal supplied by **Exxaro**				1.1	2.3	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other mining activities by **Exxaro**			1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lephalale 3 - coal supplied by			1.1	2.3	2.8	2.8	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lephalale 4 - coal supplied by																								
Lephalale 5 - coal supplied by																								
Other: 1 000 MW power station (Exxaro),																								
Total	**3.0**	**3.1**	**5.7**	**8.0**	**9.7**	**10.7**	**13.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**
SASOL																								
Construction					1.0	3.0	5.0			1.0	3.0	5.0												
CTL Facility								14.0	32.0	32.0	32.0	32.0	46.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0
Coal mining and beneficiation								1.0	3.0	3.0	3.0	3.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Total					**1.0**	**3.0**	**5.0**	**15.0**	**35.0**	**36.0**	**38.0**	**40.0**	**50.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**
LEPHALALE MUNICIPALITY																								
Current	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Medupi		0.2	0.4	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 3		0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 4																								
Lephalale 5																								
Construction		0.6	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0										
Sasol								5.0	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Total	**3.4**	**4.5**	**5.1**	**6.0**	**6.9**	**7.8**	**8.4**	**13.9**	**14.2**	**14.2**	**14.2**	**14.2**	**19.2**	**19.2**	**18.2**	**18.2**	**18.2**	**18.2**	**18.2**	**18.2**	**18.2**	**18.2**	**18.2**	**18.2**
IRRIGATION	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**
TOTAL: SCENARIO 6	**20.4**	**22.1**	**25.5**	**30.2**	**36.5**	**51.7**	**63.4**	**83.9**	**104.5**	**105.6**	**107.6**	**108.1**	**123.1**	**143.1**	**142.1**	**142.1**	**142.1**	**142.1**	**142.1**	**142.1**	**142.1**	**142.1**	**142.1**	**142.1**
Water available from Mokolo Dam	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**
Water required from Crocodile/Vaal	**-18.7**	**-17.0**	**-13.6**	**-8.9**	**-2.6**	**12.6**	**24.3**	**44.8**	**65.4**	**66.5**	**68.5**	**69.0**	**84.0**	**104.0**	**103.0**	**103.0**	**103.0**	**103.0**	**103.0**	**103.0**	**103.0**	**103.0**	**103.0**	**103.0**

Table I-7: Water requirements for Scenario 7: Scenario 3 + Mafutha + mine + SASOL township

USER	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ESKOM																								
Matimba Power Station	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Medupi Power Station		0.5	0.8	1.0	1.9	7.8	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Lephalale 3 Power Station				1.2	2.9	8.4	10.8	13.8	13.9	14.1	14.1	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Lephalale 4 Power Station					0.5	0.8	1.0	2.7	4.6	6.7	7.0	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Lephalale 5 Power Station										0.5	0.8	2.3	6.4	5.9	6.4	6.5	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Total	**3.6**	**4.1**	**4.3**	**5.8**	**9.0**	**20.5**	**27.0**	**31.7**	**33.9**	**36.6**	**37.1**	**36.4**	**40.6**	**40.1**	**40.6**	**40.7**	**40.5**	**40.5**	**40.5**	**40.5**	**40.5**	**40.5**	**40.5**	**40.5**
MINES																								
Matimba - coal supplied by **Exxaro**	3.0	3.1	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Medupi - coal supplied by **Exxaro**				1.1	2.3	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other mining activities by **Exxaro**			1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lephalale 3			1.1	2.3	2.8	2.8	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lephalale 4				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lephalale 5									1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Other: 1 000 MW power station																								
Total	**3.0**	**3.1**	**5.7**	**9.0**	**10.7**	**11.7**	**14.6**	**16.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**	**17.6**
SASOL																								
Construction					1.0	3.0	5.0			1.0	3.0	5.0												
CTL Facility								14.0	32.0	32.0	32.0	32.0	46.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0
Coal mining and beneficiation								1.0	3.0	3.0	3.0	3.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Total					**1.0**	**3.0**	**5.0**	**15.0**	**35.0**	**36.0**	**38.0**	**40.0**	**50.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**
LEPHALALE MUNICIPALITY																								
Current	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Medupi		0.2	0.4	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 3		0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 4			0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4
Lephalale 5									0.3	0.6	1.0	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Construction		0.6	1.0	1.5	1.8	2.1	2.3	2.6	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Sasol								5.0	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Total	**3.4**	**4.5**	**5.7**	**7.1**	**8.7**	**10.4**	**11.6**	**17.6**	**18.6**	**18.9**	**19.3**	**19.3**	**24.8**	**25.2**	**25.4**	**25.7**	**24.8**	**25.2**	**25.4**	**25.7**	**25.7**	**25.7**	**25.7**	**25.7**
IRRIGATION	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**
TOTAL: SCENARIO 7	**20.4**	**22.1**	**26.1**	**32.3**	**39.8**	**56.0**	**68.6**	**91.3**	**115.5**	**119.5**	**122.4**	**123.7**	**143.4**	**163.3**	**164.0**	**164.4**	**163.3**	**163.7**	**163.9**	**164.2**	**164.2**	**164.2**	**164.2**	**164.2**
Water available from Mokolo Dam	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**
Water required from Crocodile/Vaal	**-18.7**	**-17.0**	**-13.0**	**-6.8**	**0.7**	**16.9**	**29.5**	**52.2**	**76.4**	**80.4**	**83.3**	**84.6**	**104.3**	**124.2**	**124.9**	**125.3**	**124.2**	**124.6**	**124.8**	**125.1**	**125.1**	**125.1**	**125.1**	**125.1**

Table I-8: Water requirements for Scenario 8: Scenario 4 + Mafutha + mine + SASOL township

USER	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ESKOM																								
Matimba Power Station	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Medupi Power Station		0.5	0.8	1.0	1.9	7.8	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Lephalale 3 Power Station				1.2	2.9	8.4	10.8	13.8	13.9	14.1	14.1	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Lephalale 4 Power Station					0.5	0.8	1.0	5.3	9.3	13.4	13.9	12.4	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Lephalale 5 Power Station										0.5	0.8	4.6	12.8	11.8	12.8	13.0	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Total	**3.6**	**4.1**	**4.3**	**5.8**	**9.0**	**20.5**	**27.0**	**34.3**	**38.5**	**43.3**	**44.1**	**44.9**	**53.3**	**52.3**	**53.3**	**53.5**	**53.1**	**53.1**	**53.1**	**53.1**	**53.1**	**53.1**	**53.1**	**53.1**
MINES																								
Matimba - coal supplied by **Exxaro**	3.0	3.1	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Medupi - coal supplied by **Exxaro**				1.1	2.3	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other mining activities by **Exxaro**			1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lephalale 3			1.1	2.3	2.8	2.8	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lephalale 4				1.1	2.3	2.3	2.8	2.8	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lephalale 5									1.1	2.3	2.8	2.8	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other: 1 000 MW power station																								
Total	**3.0**	**3.1**	**5.7**	**9.1**	**12.0**	**13.0**	**16.4**	**18.4**	**20.7**	**22.9**	**23.4**	**23.4**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**
SASOL																								
Construction					1.0	3.0	5.0			1.0	3.0	5.0												
CTL Facility								14.0	32.0	32.0	32.0	32.0	46.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0
Coal mining and beneficiation								1.0	3.0	3.0	3.0	3.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Total					**1.0**	**3.0**	**5.0**	**15.0**	**35.0**	**36.0**	**38.0**	**40.0**	**50.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**	**70.0**
LEPHALALE MUNICIPALITY																								
Current	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Medupi		0.2	0.4	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 3		0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lephalale 4			0.3	0.6	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4
Lephalale 5									0.3	0.6	1.0	1.0	1.5	1.9	2.1	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Construction		0.6	1.0	1.5	1.8	2.1	2.3	2.6	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Sasol								5.0	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Total	**3.4**	**4.5**	**5.7**	**7.1**	**8.7**	**10.4**	**11.6**	**17.6**	**18.6**	**18.9**	**19.3**	**19.3**	**24.8**	**25.2**	**25.4**	**25.7**	**24.8**	**25.2**	**25.4**	**25.7**	**25.7**	**25.7**	**25.7**	**25.7**
IRRIGATION	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**	**10.4**
TOTAL: SCENARIO 8	**20.4**	**22.1**	**26.1**	**32.4**	**41.1**	**57.3**	**70.4**	**95.7**	**123.2**	**131.5**	**135.2**	**138.0**	**164.1**	**183.5**	**184.7**	**185.2**	**183.9**	**184.3**	**184.5**	**184.8**	**184.8**	**184.8**	**184.8**	**184.8**
Water available from Mokolo	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**	**39.1**
Water required from	**-18.7**	**-17.0**	**-13.0**	**-6.7**	**2.0**	**18.2**	**31.3**	**56.6**	**84.1**	**92.4**	**96.1**	**98.9**	**125.0**	**144.4**	**145.6**	**146.1**	**144.8**	**145.2**	**145.4**	**145.7**	**145.7**	**145.7**	**145.7**	**145.7**

Table I-9: Summary of water requirements for the Lephalale area for different scenarios

Scenario	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Scenario 1	20	22	23	25	26	30	35	36	41	44	48	52	53	54	53	54	54	54	54	54	54	54	54	54
Scenario 2	20	22	26	30	35	49	58	64	64	65	65	63	63	63	62	62	62	62	62	62	62	62	62	62
Scenario 3	20	22	26	32	39	53	64	71	76	78	79	79	83	83	84	84	83	84	84	84	84	84	84	84
Scenario 4	20	22	26	32	40	54	65	76	83	90	92	93	104	104	105	105	104	104	104	105	105	105	105	105
Scenario 5	20	22	23	25	27	33	40	56	81	85	91	97	113	134	133	134	134	134	134	134	134	134	134	134
Scenario 6	20	22	26	30	36	52	63	84	104	106	108	108	123	143	142	142	142	142	142	142	142	142	142	142
Scenario 7	20	22	26	32	40	56	69	91	116	119	122	124	143	163	164	164	163	164	164	164	164	164	164	164
Scenario 8	20	22	26	32	41	57	70	96	123	131	135	138	164	184	185	185	184	184	184	185	185	185	185	185

Appendix J

Water balances and water transfers for the different Lephalale scenarios

Table J-1: Water balance and Vaal River transfers for Lephalale Scenario 1

Crocodile water balance	2005	2010	2015	2020	2025	2030
High population, medium efficiency	58	22	43	68	95	121
Base population, medium efficiency	54	15	32	48	70	91
Low population, medium efficiency	53	6	10	11	15	16
High population, high efficiency	58	12	10	18	36	58
Lephalale gross requirements	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	20	25	41	54	54	54
Base population, medium efficiency	20	25	41	54	54	54
Low population, medium efficiency	20	25	41	54	54	54
High population, high efficiency	20	25	41	54	54	54
Lephalale availability	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	39	39	39	39	39	39
Base population, medium efficiency	39	39	39	39	39	39
Low population, medium efficiency	39	39	39	39	39	39
High population, high efficiency	39	39	39	39	39	39
Crocodile/Lephalale balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	77	37	42	53	80	106
Base population, medium efficiency	73	29	30	33	55	76
Low population, medium efficiency	72	20	9	-3	0	1
High population, high efficiency	77	27	8	3	21	43
Transfers from Vaal to Lephalale	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	0	0	0	0
Base population, medium efficiency	0	0	0	0	0	0
Low population, medium efficiency	0	0	0	3	0	0
High population, high efficiency	0	0	0	0	0	0
Transfers from Rand Water to Crocodile	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	573	582	600
High population, high efficiency	554	564	577	611	640	702
Total transfers from Vaal (Crocodile + Lephalale)	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	576	582	600
High population, high efficiency	554	564	577	611	640	702

Table J-2: Water balance and Vaal River transfers for Lephalale Scenario 2

Crocodile water balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	58	22	43	68	95	121
Base population, medium efficiency	54	15	32	48	70	91
Low population, medium efficiency	53	6	10	11	15	16
High population, high efficiency	58	12	10	18	36	58
Lephalale net requirements	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	20	30	64	63	62	62
Base population, medium efficiency	20	30	64	63	62	62
Low population, medium efficiency	20	30	64	63	62	62
High population, high efficiency	20	30	64	63	62	62
Lephalale availability	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	39	39	39	39	39	39
Base population, medium efficiency	39	39	39	39	39	39
Low population, medium efficiency	39	39	39	39	39	39
High population, high efficiency	39	39	39	39	39	39
Crocodile/Lephalale balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	77	31	18	44	72	98
Base population, medium efficiency	73	24	6	24	47	68
Low population, medium efficiency	72	15	-15	-13	-8	-7
High population, high efficiency	77	21	-16	-7	13	35
Transfers from Vaal to Lephalale	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	0	0	0	0
Base population, medium efficiency	0	0	0	0	0	0
Low population, medium efficiency	0	0	15	13	8	7
High population, high efficiency	0	0	16	7	0	0
Transfers from Rand Water to Crocodile	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	573	582	600
High population, high efficiency	554	564	577	611	640	702
Total transfers from Vaal (Crocodile + Lephalale)	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	566	586	590	607
High population, high efficiency	554	564	593	618	640	702

Table J-3: Water balance and Vaal River transfers for Lephalale Scenario 3

Crocodile water balance	2005	2010	2015	2020	2025	2030
High population, medium efficiency	58	22	43	68	95	121
Base population, medium efficiency	54	15	32	48	70	91
Low population, medium efficiency	53	6	10	11	15	16
High population, high efficiency	58	12	10	18	36	58
Lephalale net requirements	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	20	32	76	83	84	84
Base population, medium efficiency	20	32	76	83	84	84
Low population, medium efficiency	20	32	76	83	84	84
High population, high efficiency	20	32	76	83	84	84
Lephalale availability	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	39	39	39	39	39	39
Base population, medium efficiency	39	39	39	39	39	39
Low population, medium efficiency	39	39	39	39	39	39
High population, high efficiency	39	39	39	39	39	39
Crocodile/Lephalale balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	77	29	7	23	51	76
Base population, medium efficiency	73	22	-5	3	25	46
Low population, medium efficiency	72	13	-26	-33	-29	-29
High population, high efficiency	77	19	-27	-27	-9	13
Transfers from Vaal to Lephalale	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	0	0	0	0
Base population, medium efficiency	0	0	5	0	0	0
Low population, medium efficiency	0	0	26	33	29	29
High population, high efficiency	0	0	27	27	9	0
Transfers from Rand Water to Crocodile	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	573	582	600
High population, high efficiency	554	564	577	611	640	702
Total transfers from Vaal (Crocodile + Lephalale)	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	597	643	684	738
Low population, medium efficiency	545	521	577	606	612	629
High population, high efficiency	554	564	604	638	649	702

Table J-4: Water balance and Vaal River transfers for Lephalale Scenario 4

Crocodile water balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	58	22	43	68	95	121
Base population, medium efficiency	54	15	32	48	70	91
Low population, medium efficiency	53	6	10	11	15	16
High population, high efficiency	58	12	10	18	36	58
Lephalale net requirements	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	20	32	83	104	104	105
Base population, medium efficiency	20	32	83	104	104	105
Low population, medium efficiency	20	32	83	104	104	105
High population, high efficiency	20	32	83	104	104	105
Lephalale availability	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	39	39	39	39	39	39
Base population, medium efficiency	39	39	39	39	39	39
Low population, medium efficiency	39	39	39	39	39	39
High population, high efficiency	39	39	39	39	39	39
Crocodile/Lephalale balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	77	29	-1	3	30	56
Base population, medium efficiency	73	21	-12	-17	5	25
Low population, medium efficiency	72	12	-34	-53	-50	-49
High population, high efficiency	77	19	-35	-47	-29	-8
Transfers from Vaal to Lephalale	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	1	0	0	0
Base population, medium efficiency	0	0	12	17	0	0
Low population, medium efficiency	0	0	34	53	50	49
High population, high efficiency	0	0	35	47	29	8
Transfers from Rand Water to Crocodile	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	573	582	600
High population, high efficiency	554	564	577	611	640	702
Total transfers from Vaal (Crocodile + Lephalale)	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	625	691	741	805
Base population, medium efficiency	546	540	605	659	684	738
Low population, medium efficiency	545	521	585	626	632	650
High population, high efficiency	554	564	611	658	669	709

Table J-5: Water balance and Vaal River transfers for Lephalale Scenario 5

Crocodile water balance	2005	2010	2015	2020	2025	2030
High population, medium efficiency	58	22	43	68	95	121
Base population, medium efficiency	54	15	32	48	70	91
Low population, medium efficiency	53	6	10	11	15	16
High population, high efficiency	58	12	10	18	36	58
Lephalale net requirements	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	20	25	81	134	134	134
Base population, medium efficiency	20	25	81	134	134	134
Low population, medium efficiency	20	25	81	134	134	134
High population, high efficiency	20	25	81	134	134	134
Lephalale availability	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	39	39	39	39	39	39
Base population, medium efficiency	39	39	39	39	39	39
Low population, medium efficiency	39	39	39	39	39	39
High population, high efficiency	39	39	39	39	39	39
Crocodile/Lephalale balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	77	37	2	-27	0	26
Base population, medium efficiency	73	29	-10	-47	-25	-4
Low population, medium efficiency	72	20	-31	-83	-80	-79
High population, high efficiency	77	27	-32	-77	-59	-37
Transfers from Vaal to Lephalale	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	0	27	0	0
Base population, medium efficiency	0	0	10	47	25	4
Low population, medium efficiency	0	0	31	83	80	79
High population, high efficiency	0	0	32	77	59	37
Transfers from Rand Water to Crocodile	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	573	582	600
High population, high efficiency	554	564	577	611	640	702
Total transfers from Vaal (Crocodile + Lephalale)	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	717	741	805
Base population, medium efficiency	546	540	602	689	709	742
Low population, medium efficiency	545	521	582	656	662	679
High population, high efficiency	554	564	609	688	699	738

Table J-6: Water balance and Vaal River transfers for Lephalale Scenario 6

Crocodile water balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	58	22	43	68	95	121
Base population, medium efficiency	54	15	32	48	70	91
Low population, medium efficiency	53	6	10	11	15	16
High population, high efficiency	58	12	10	18	36	58
Lephalale net requirements	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	20	30	104	143	142	142
Base population, medium efficiency	20	30	104	143	142	142
Low population, medium efficiency	20	30	104	143	142	142
High population, high efficiency	20	30	104	143	142	142
Lephalale availability	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	39	39	39	39	39	39
Base population, medium efficiency	39	39	39	39	39	39
Low population, medium efficiency	39	39	39	39	39	39
High population, high efficiency	39	39	39	39	39	39
Crocodile/Lephalale balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	77	31	-22	-36	-8	18
Base population, medium efficiency	73	24	-34	-56	-33	-12
Low population, medium efficiency	72	15	-55	-93	-88	-87
High population, high efficiency	77	21	-56	-87	-67	-45
Transfers from Vaal to Lephalale	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	22	36	8	0
Base population, medium efficiency	0	0	34	56	33	12
Low population, medium efficiency	0	0	55	93	88	87
High population, high efficiency	0	0	56	87	67	45
Transfers from Rand Water to Crocodile	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	573	582	600
High population, high efficiency	554	564	577	611	640	702
Total transfers from Vaal (Crocodile + Lephalale)	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	647	727	749	805
Base population, medium efficiency	546	540	626	699	717	750
Low population, medium efficiency	545	521	606	666	670	687
High population, high efficiency	554	564	633	698	707	747

Table J-7: Water balance and Vaal River transfers for Lephalale Scenario 7

Crocodile water balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	58	22	43	68	95	121
Base population, medium efficiency	54	15	32	48	70	91
Low population, medium efficiency	53	6	10	11	15	16
High population, high efficiency	58	12	10	18	36	58
Lephalale net requirements	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	20	32	116	163	164	164
Base population, medium efficiency	20	32	116	163	164	164
Low population, medium efficiency	20	32	116	163	164	164
High population, high efficiency	20	32	116	163	164	164
Lephalale availability	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	39	39	39	39	39	39
Base population, medium efficiency	39	39	39	39	39	39
Low population, medium efficiency	39	39	39	39	39	39
High population, high efficiency	39	39	39	39	39	39
Crocodile/Lephalale balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	77	29	-33	-57	-29	-4
Base population, medium efficiency	73	22	-45	-77	-55	-34
Low population, medium efficiency	72	13	-66	-113	-109	-109
High population, high efficiency	77	19	-67	-107	-89	-67
Transfers from Vaal to Lephalale	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	33	57	29	4
Base population, medium efficiency	0	0	45	77	55	34
Low population, medium efficiency	0	0	66	113	109	109
High population, high efficiency	0	0	67	107	89	67
Transfers from Rand Water to Crocodile	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	573	582	600
High population, high efficiency	554	564	577	611	640	702
Total transfers from Vaal (Crocodile + Lephalale)	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	658	747	771	809
Base population, medium efficiency	546	540	637	719	739	772
Low population, medium efficiency	545	521	617	686	692	709
High population, high efficiency	554	564	644	718	729	769

Table J-8: Water balance and Vaal River transfers for Lephalale Scenario 8

Crocodile water balance	2005	2010	2015	2020	2025	2030
High population, medium efficiency	58	22	43	68	95	121
Base population, medium efficiency	54	15	32	48	70	91
Low population, medium efficiency	53	6	10	11	15	16
High population, high efficiency	58	12	10	18	36	58
Lephalale net requirements	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	20	32	123	184	184	185
Base population, medium efficiency	20	32	123	184	184	185
Low population, medium efficiency	20	32	123	184	184	185
High population, high efficiency	20	32	123	184	184	185
Lephalale availability	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	39	39	39	39	39	39
Base population, medium efficiency	39	39	39	39	39	39
Low population, medium efficiency	39	39	39	39	39	39
High population, high efficiency	39	39	39	39	39	39
Crocodile/Lephalale balance	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	77	29	-41	-77	-50	-24
Base population, medium efficiency	73	21	-52	-97	-75	-55
Low population, medium efficiency	72	12	-74	-133	-130	-129
High population, high efficiency	77	19	-75	-127	-109	-88
Transfers from Vaal to Lephalale	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	0	0	41	77	50	24
Base population, medium efficiency	0	0	52	97	75	55
Low population, medium efficiency	0	0	74	133	130	129
High population, high efficiency	0	0	75	127	109	88
Transfers from Rand Water to Crocodile	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	624	691	741	805
Base population, medium efficiency	546	540	593	643	684	738
Low population, medium efficiency	545	521	551	573	582	600
High population, high efficiency	554	564	577	611	640	702
Total transfers from Vaal (Crocodile + Lephalale)	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
High population, medium efficiency	554	558	665	767	791	829
Base population, medium efficiency	546	540	645	739	759	793
Low population, medium efficiency	545	521	625	706	712	730
High population, high efficiency	554	564	651	738	749	789