water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Water Requirements and Availability Reconciliation Strategy for the Mbombela Municipal Area

CURRENT AND FUTURE WATER REQUIREMENTS AND WATER RESOURCES

FEBRUARY 2014

FINAL

APPROVAL

Report Title	Current and Future Water Requirements and Water Resources
Study Name	Water Requirements and Availability Reconciliation Strategy for the Mbombela Municipal Area
DWA Report No.	**PWMA 05/X22/00/2012/3**
Submitted by	IWR Water Resources in association with Aurecon South Africa (Pty) Ltd Kyamandi Development Services (Pty) Ltd.
Address	Postnet Suite 40 Private Bag X4 Menlo Park 0102
Authors	R Aird, D Koekemoer, D Timm and S Mallory
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Professional Service Provider: IWR Water Resources (Pty) Ltd.
Approved on behalf of the Professional Service Provider by:

.....
S Mallory
Director

DEPARTMENT OF WATER AFFAIRS
Directorate: National Water Resources Planning
Approved for Department of Water Affairs:

.....
NJ van Wyk
Project Manager

.....
T Nditwani
Acting Director

EXECUTIVE SUMMARY

National and Provincial Overview

Mbombela Local Municipality (MLM) is situated in the Mpumalanga Province and together with Thaba Chweu, Umjindi, Nkomazi and Bushbuckridge Local Municipalities forms part of the Ehlanzeni District Municipality (EDM). The southern part of the Kruger National Park being a District Management Area (DMA) also forms part of EDM.

The EDM is one of three district municipalities within the Mpumalanga Province and is bordered by the Limpopo Province to the north, the country of Mozambique to the east, the country of Swaziland to the south and the Nkangala and Gert Sibande District Municipalities to the west. ***Figure 1*** *shows the MLM within the national and provincial context.*

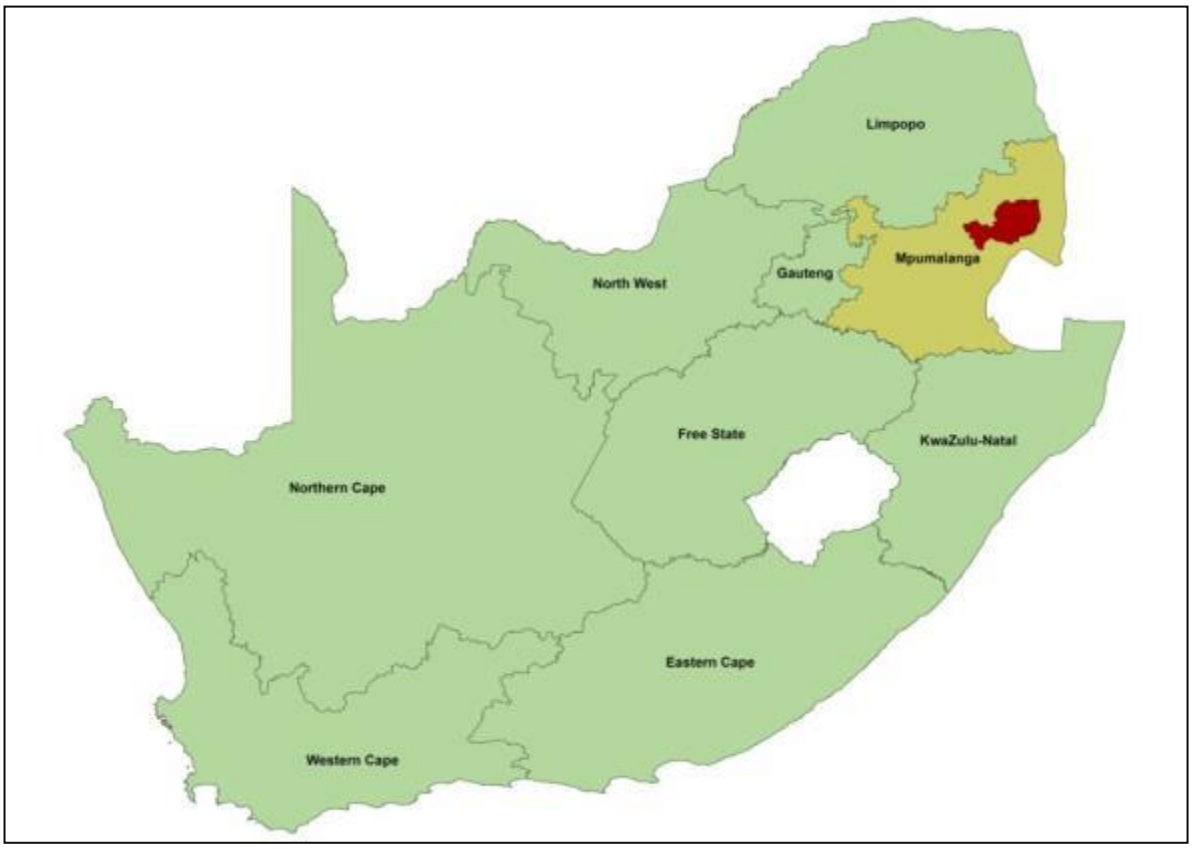


Figure 1: *Location of the Mbombela Local Municipality in relation to the province and the rest of South Africa*

The MLM area of jurisdiction includes the following areas and towns:

- *Nelspruit and White River (including Mataffin and the industrial area of Rocky Drift);*
- *Hazyview;*
- *Nsikazi North – towns and rural settlements;*
- *Nsikazi South – towns and rural settlements;*
- *Matsulu – mostly rural settlements*
- *Ngodwana paper mill and town;*
- *Kaapsehoop and Elandshoek, and*
- *The future Karino Plaston Corridor (KPC).*

***Figure 2** shows the MLM together with the Sabie and Crocodile (East) River catchments.*

Water Demand Centres

*As part of this study the towns were grouped into 9 different water demand centres (WDCs). The smaller demand centres like Ngodwana, Elandshoek and Kaapsehoop were grouped together in one demand centre. **Figure 3** shows the different WDCs.*

Base Population Estimate and Growth Scenarios

Low and high population growth scenarios were developed for each WDC over a 20 year period. The 2010 high population base figure for MLM is approximately 550 024 people with 33 000 people staying outside of WDCs. Approximately 70% of the total population reside in Nsikazi North and Nsikazi South. The base population figure was revised as part of this study and adjusted to 559 654 for the high growth scenario.

***Figure 4** shows the high population base per WDC and as can be seen the majority of the people in the MLM stay in the Nsikazi North and South WDCs. The population growth per WDC is summarised in **Table 1** below.*

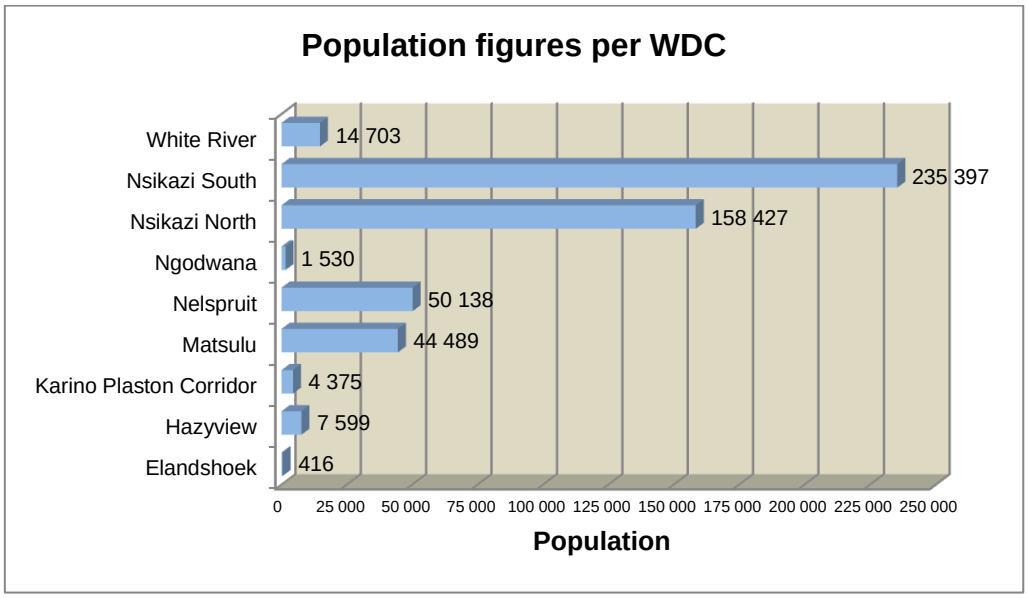


***Figure 4:** 2010 Population figures per WDC*

Population Growth Forecast

***Figure 5** indicates the population growth up to 2030 in the MLM based on modelling done as part of this study, and is compared to population growth scenarios from the Mbombela Bulk Water Strategy (MBWS) (MLM, 2011) and the MLM Water Services Development Plan (WSDP) (DWA, 2008).*

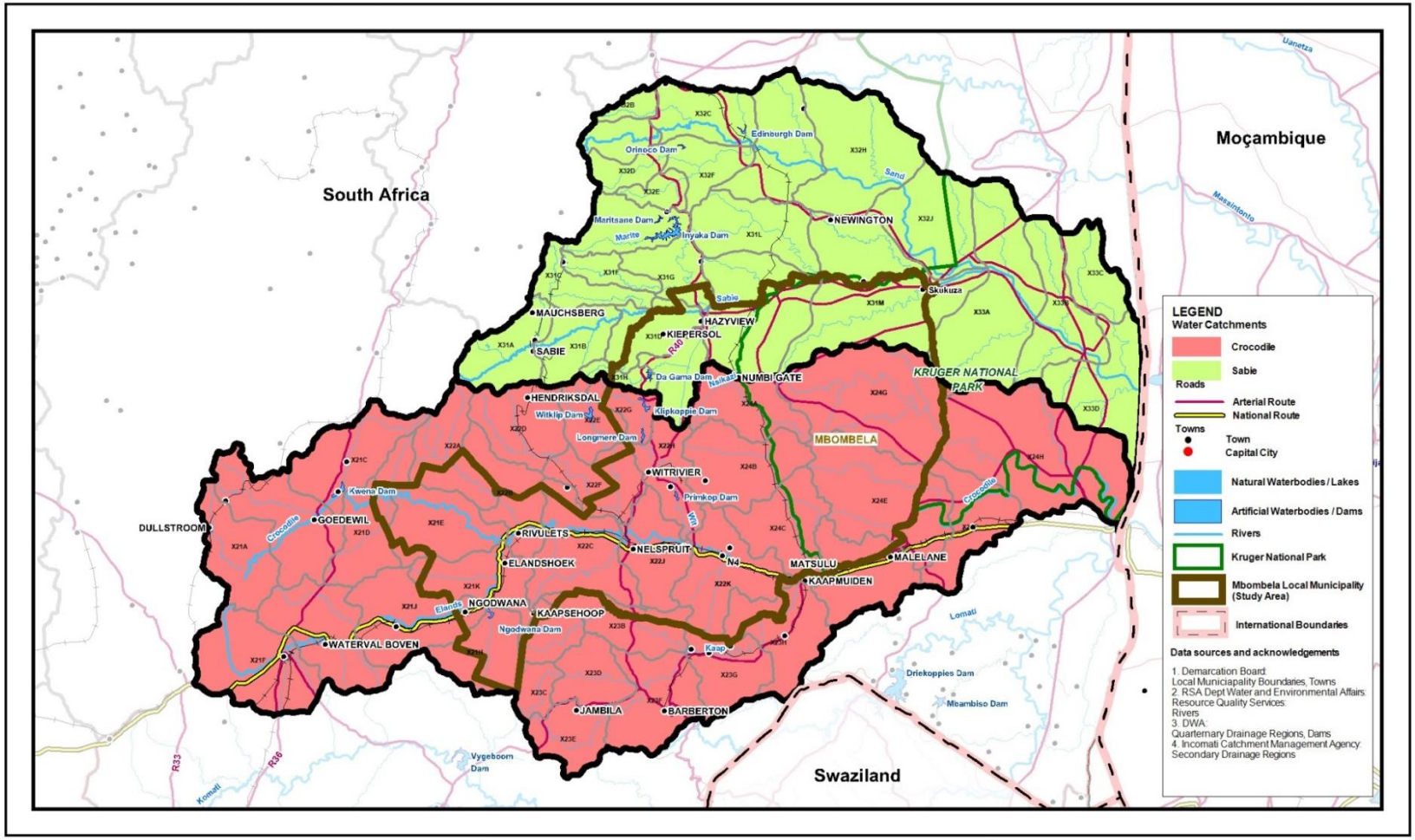


Figure 2: *Study Area together with Sabie and Crocodile River catchments*

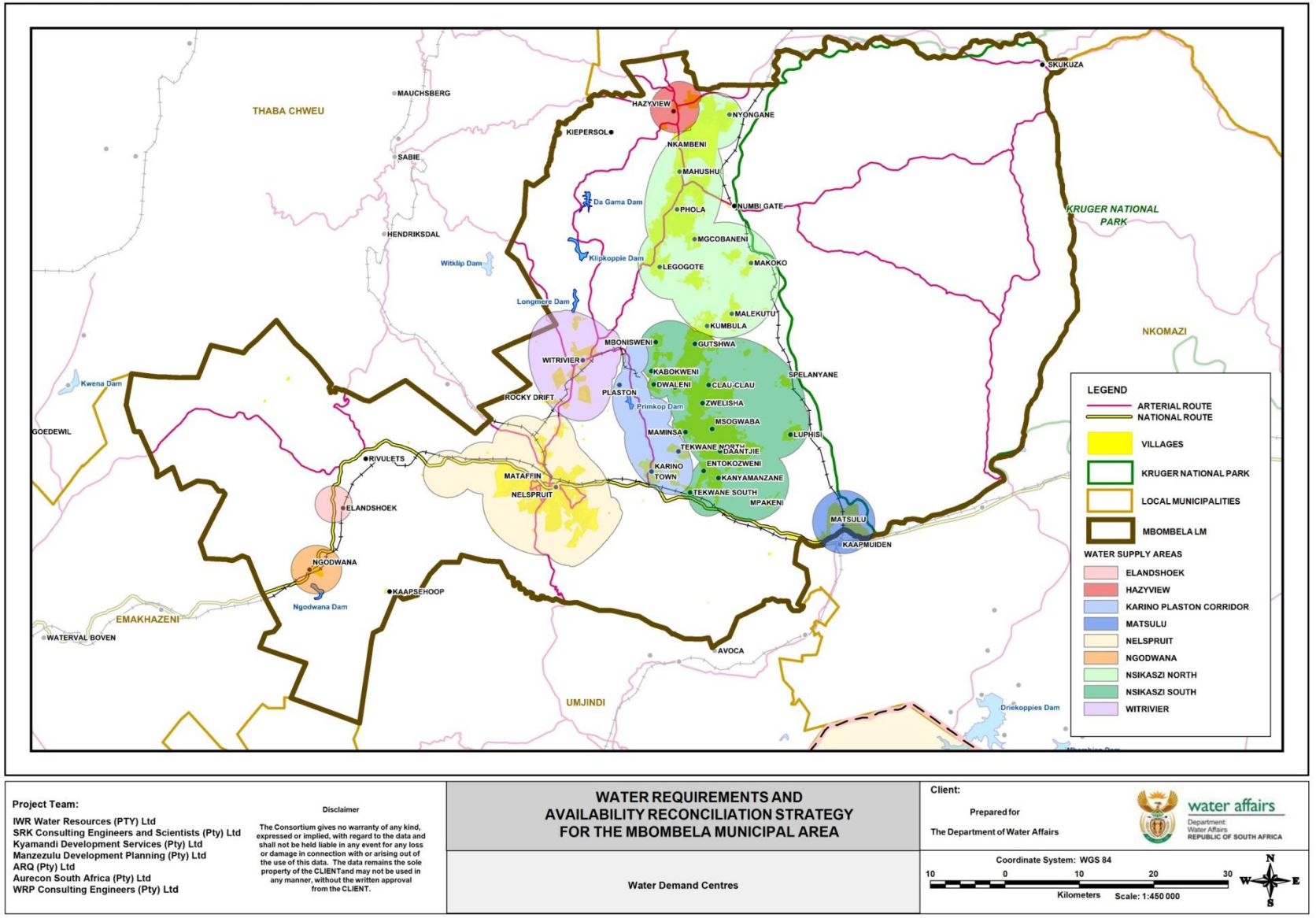
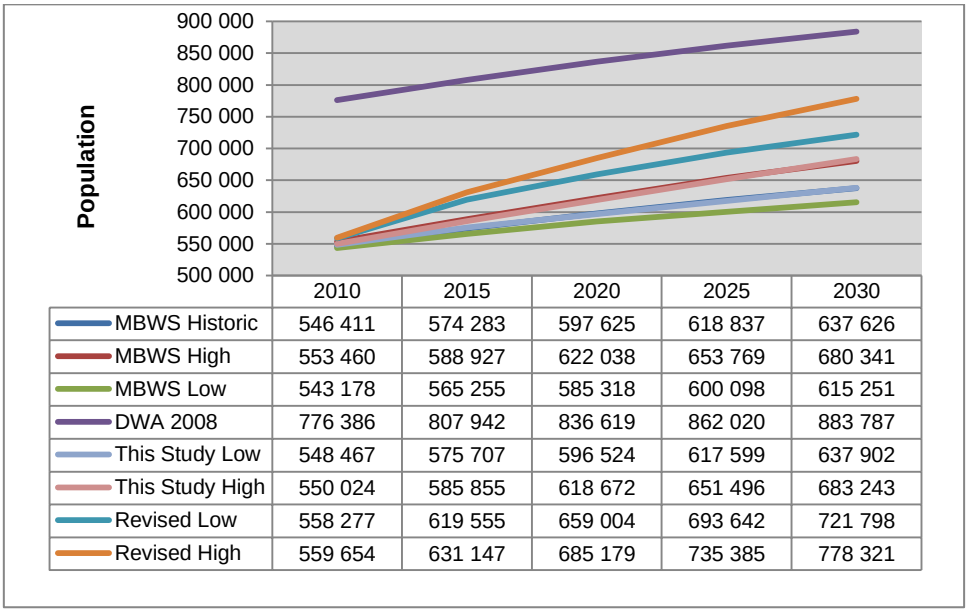


Figure 3: *Water Demand Centres in the Mbombela Local Municipality*

***Table 1** below shows the population growth per 5 year interval up to 2030 split according to WDC. The population growth has slowed down from 2010-2015 to 2025-2030.*

***Table 1:** Summary of population growth per WDC*

WDC	Growth scenario	2010-2015	2015-2020	2020-2025	2025-2030	2010-2030
Elandshoek	Low	2,4%	2,1%	1,8%	1,5%	**1,9%**
	High	2,4%	2,1%	1,8%	1,5%	**1,9%**
Hazyview	Low	1,0%	0,9%	0,8%	0,7%	**0,9%**
	High	1,2%	1,1%	1,0%	0,9%	**1,1%**
KPC	Low	8,1%	7,4%	3,8	1,6%	**5,4%**
	High	9,8%	8,0%	4,5	2,3%	**5,9%**
Matsulu	Low	0,5%	0,5%	0,4%	0,4%	**0,5%**
	High	0,8%	0,7%	0,6%	0,6%	**0,7%**
Nelspruit	Low	2,5%	2,2%	1,9%	1,7%	**2,1%**
	High	2,9%	2,7%	2,5%	2,3%	**2,6%**
Ngodwana	Low	0,0%	0,0%	0,0%	0,0%	**0,0%**
	High	0,0%	0,0%	0,0%	0,0%	**0,0%**
Nsikazi North	Low	1,0%	0,9%	0,8%	0,6%	**0,8%**
	High	1,3%	1,2%	1,1%	0,8%	**1,1%**
Nsikazi South	Low	0,7%	0,1%	0,2%	0,4%	**0,4%**
	High	0,9%	0,6%	0,7%	0,8%	**0,7%**
White River	Low	1,8%	1,6%	1,4%	1,2%	**1,5%**
	High	2,3%	2,1%	1,8%	1,6%	**2,0%**



	2010	2015	2020	2025	2030
MBWS Historic	546 411	574 283	597 625	618 837	637 626
MBWS High	553 460	588 927	622 038	653 769	680 341
MBWS Low	543 178	565 255	585 318	600 098	615 251
DWA 2008	776 386	807 942	836 619	862 020	883 787
This Study Low	548 467	575 707	596 524	617 599	637 902
This Study High	550 024	585 855	618 672	651 496	683 243
Revised Low	558 277	619 555	659 004	693 642	721 798
Revised High	559 654	631 147	685 179	735 385	778 321

***Figure 5:** Mbombela population growth comparisons*

Current and Future Urban and Industrial Water Demand Estimate

*The projected domestic and industrial future water requirements per WDC for the extra high, high and low growth scenarios are shown in **Table 2** below. **Table 2** also shows the water requirements per catchment.*

Nelspruit

For Nelspruit and surrounds an extra high growth scenario has been included to allow for the new university.

White River

It is anticipated that water use in the White River WDC will increase steadily up to 2030. The town council has recently approved the development of a number of developments that will require commercial water such as shopping centres, light industries etc. It is expected that this will result is very rapid growth in the domestic water requirements of White River over the next 15 years.

Karino Plaston Corridor (KPC)

The projected future domestic water requirements will follow the population growth in the area up to 2030.

There are a number of Industrial Development Zones (IDZs) planned around the Kruger Mpumalanga International Airport (KMIA). The MLM's intention is to supply these industries with water from Primkop Dam, although this will have to be done through trading with the irrigators to whom the water is currently allocated.

Nsikazi South

The domestic water use in Nsikazi South is expected to follow the same growth trend as the population growth up to 2030. Industrial water use is expected to remain constant.

Matsulu

It is anticipated that domestic use will increase up to 2030 in line with the population growth. There is no industrial use in Matsulu.

Nsikazi North

It is anticipated that domestic use will increase up to 2030 and follow the population growth. There is no industrial use in Nsikazi North.

Hazyview

The projected future water requirements are expected to follow the population growth and increase steadily up 2030. There are no significant industrial water users in Hazyview and this situation is not expected to change in future.

Ngodwana, Kaapsehoop and Elandshoek

The SAPPI paper mill at Ngodwana is the largest single industrial user in the municipal area, using approximately 14,0 million m^3/a. SAPPI have indicated that they would also need additional water in terms of their proposed expansion plans for the Ngodwana paper mill. However, at this stage they have not quantified their additional future water requirements and the industrial water use is expected to remain constant up to 2030 at this stage.

Table 2: *Projected domestic and industrial water requirements in million m^3/a*

Town	Sector	Scenario	2010	2015	2020	2025	2030
Nelspruit	Domestic	Low	8,98	10,15	11,30	12,41	13,48
		High	9,02	10,43	11,92	13,47	15,05
		Extra high	9,02	10,64	12,79	14,82	16,78
	Industrial	Low	4,20	4,74	5,28	5,80	6,30
		High	4,21	4,87	5,57	6,29	7,03
		Extra high	4,21	5,08	6,43	7,62	8,72
White River	Domestic	Low	2,58	2,83	3,06	3,27	3,47
		High	2,60	3,89	5,18	6,47	6,78
	Industrial	Low	0,64	0,71	0,76	0,81	0,86
		High	0,64	1,01	1,37	1,73	1,81
KPC	Domestic	Low	1,08	1,66	2,37	2,86	3,09
		High	1,09	1,74	2,56	3,18	3,57
	Industrial	Low	0,00	0,25	0,36	0,43	0,46
		High	0,00	0,25	0,37	0,46	0,52
Nsikazi South	Domestic	Low	19,01	19,65	19,77	20,01	20,46
		High	19,01	19,78	20,37	21,07	21,88
	Industrial	Low	0,29	0,29	0,29	0,29	0,29
		High	0,29	0,29	0,29	0,29	0,29
Matsulu	Domestic	Low	4,96	5,80	6,58	7,24	7,68
		High	4,96	5,84	6,72	7,46	7,99
	Industrial	Low	0,00	0,00	0,00	0,00	0,00
		High	0,00	0,00	0,00	0,00	0,00
Nsikazi North	Domestic	Low	10,66	11,18	11,68	12,16	12,52
		High	10,70	11,40	12,09	12,73	13,26
	Industrial	Low	0,00	0,00	0,00	0,00	0,00
		High	0,00	0,00	0,00	0,00	0,00
Hazyview	Domestic	Low	1,38	1,46	1,52	1,59	1,62
		High	1,39	1,47	1,56	1,64	1,71
	Industrial	Low	0,00	0,00	0,00	0,00	0,00
		High	0,00	0,00	0,00	0,00	0,00
Other	Domestic	Elandshoek	0,025	0,025	0,025	0,025	0,025
		Ngodwana	0,500	0,500	0,500	0,500	0,500
		Kaapsehoop	0,031	0,031	0,031	0,031	0,031
	Industrial	Elandshoek	0,00	0,00	0,00	0,00	0,00
		Ngodwana	14,00	14,00	14,00	14,00	14,00
		Kaapsehoop	0,00	0,00	0,00	0,00	0,00
Total	Domestic	Low	49,21	53,29	56,84	60,10	62,88
		High	49,33	55,11	60,96	66,58	70,80
	Industrial	Low	19,13	19,99	20,69	21,33	21,91
		High	19,14	20,42	21,60	22,77	23,65
Total		**Low**	**68,34**	**73,28**	**77,53**	**81,43**	**84,79**
		High	**68,47**	**75,53**	**82,56**	**89,35**	**94,45**
Crocodile		Low	56,30	60,64	64,33	67,68	70,65
		High	56,38	62,66	68,91	74,98	79,48
Sabie		Low	12,04	12,64	13,20	13,75	14,14
		High	12,09	12,87	13,65	14,37	14,97

Other Water Use

The biggest water user is irrigation with afforestation the second biggest in the Crocodile and Sabie River catchments.

Irrigation

An estimated 15 000 ha of irrigated agriculture, with a water requirement of 147 million m^3/a, falls within the Mbombela municipal area. Most of this irrigation is regulated through Irrigation Boards but there is also some limited diffuse irrigation along various tributaries, with regulation the direct responsibility of the Department of Water Affairs (DWA).

***Table 3** summarises the estimated water requirements within the Crocodile and Sabie River catchments and indicates the portion that lies within the Mbombela municipal area.*

***Table 3:** Irrigation within the Crocodile and Sabie River catchments*

Catchment	Irrigation requirement (million m^3/a)
Crocodile catchment	
Upstream of Mbombela	95
Within Mbombela	114
Downstream of Mbombela	209
Sabie catchment	
Upstream of Mbombela	7
Within Mbombela	33
Downstream of Mbombela	9

Streamflow Reduction

There are large areas of forestry within both the Crocodile and Sabie River catchments and it is a well-established fact that exotic plantations such as Pine, Eucalyptus and Wattle reduce the amount of water that would otherwise flow in the rivers in the catchments where the plantations are located.

*The streamflow reduction within the Crocodile and Sabie Rivers is indicated in **Table 4.***

It must be pointed out that there is not a clear relationship between streamflow reduction and yield. Water reallocation through a reduction in afforested area, which is an option, therefore needs to be carefully considered. For example, removing all the forestry from the Crocodile (excluding the Kaap River) and Sabie River (excluding the Sand River) catchments would increase the mean annual runoff (MAR) of these catchments by 122 and 81 million m^3/a respectively, but this water will mostly be in the form of increased floods.

Table 4: *Streamflow reduction due to afforestation within the Crocodile and Sabie River catchments*

Catchment	Streamflow reduction (million m3/a)
Crocodile catchment	
Upstream of Mbombela	70
Within Mbombela	52
Downstream of Mbombela	0
Sabie catchment	
Upstream of Mbombela	69
Within Mbombela	12
Downstream of Mbombela	0

Invasive Alien Plants

Invasive alien plants (IAPs) have an impact on water resources similar to that of exotic forests in that they reduce the runoff that would have flowed in the river under natural conditions. The difference between exotic forests and IAPs is that IAPs tend to invade riparian zones where water is more readily available and hence these trees can consume much more water than licenced forestry.

The estimated streamflow reduction due to IAPs is given in ***Table 5****. It is worth noting that while IAPs in riparian zones are the biggest concern for water resource managers, there appear to be very limited riparian IAPs remaining within the Crocodile and Sabie River catchments. The invaded areas are almost exclusively upland, that is, out of the riparian zone. This can be attributed to the efforts of Working for Water (WfW) who focused their IAP removal efforts on the riparian zones.*

Table 5: *Streamflow reduction due to IAPs within the Crocodile and Sabie River catchments*

Catchment	Streamflow reduction (million m^3/a)	Estimated yield increase due to removal of IAPs
Crocodile catchment		
Upstream of Mbombela	17	8
Within Mbombela	10	1
Downstream of Mbombela	~0	~0
Sabie catchment		
Upstream of Mbombela	~0	~
Within Mbombela	1,0	0,5
Downstream of Mbombela	~0	~0

Water Resources

MLM is situated in the Inkomati Water Management Area (WMA) and straddles the Crocodile (East) and Sabie River catchments. Much of the water flowing through the municipal area is derived from upstream catchments. MLM obtains all their water from these two catchments with a very small percentage obtained from groundwater. The water resources of these catchments have been studied in detail as part of several other projects and these analyses are reported on here.

Current Water Resources of the Crocodile River catchment

The water resources of the Crocodile River have two components; the yield available from dams (including farm dam) and the yield available from run-of-river. Assessing the yield of a large system with limited storage is complex since the total water resource availability is a combination of the run-of-river flows and the yields of the dam. The significant dams in the Crocodile River catchment are listed in ***Table 6****.*

Table 6: *Major dams in the Crocodile catchment*

Dam	Fully supply capacity (FSC)			Full supply area (FSA) (km^2)	Yield (million m^3/a)	
	million m^3	Natural MAR (million m^3/a)	FSC as %MAR		Historic	1 in 50
Kwena Dam	*158,9*	*119*	*134%*	*12,5*	*83,2*	*87,5*
Witklip Dam	*12,7*	*19,8*	*64%*	*1,88*	*8,1*	*8,5*
Klipkopje Dam	*11,9*	*188*	*63%*	*2,31*	*Operated as system with Longmere*	
Longmere Dam	*4,32*	*25,4*	*17%*	*0,96*	*10,3*	*10,6*
Primkop Dam	*1,97*	*39,4*	*5%*	*0,41*	*9,9*	*10,3*
Ngodwana Dam	*10,0*	*58,8*	*17%*	*1,00*	*21,0*	*22,4*
TOTAL	***199,8***	***450,4***	***44%***	***19,06***	***132,5***	***139,3***

The natural mean annual runoff of the Crocodile River catchment is 1 136 million m^3/a. It is clear from ***Table 6*** *that the dams in the catchment command and runoff of 450 million m^3/a, which is only about one third of the catchment. Expressing the total dam storage as a percentage of the runoff (199,8/1 136) results in a 17,6% storage relative to the MAR. By any standards, this is a very low dam development ratio. It would therefore be incorrect to ignore the remaining 82% of the catchment which is not commanded by dams. It is also immediately obvious that the water demands within the Crocodile River catchment (in excess of 500 million m^3/a) cannot be met from dams alone which have an estimated total yield of 139 million m^3/a.*

Current Water Resources of the Sabie River catchment

The water resources of the Sabie River catchment are similar to that of the Crocodile catchment in that there are a limited number of dams which offer support to users along the Sabie River during periods of low flow. By far the most significant dam is the Inyaka Dam which was completed in the year 2000. Due to the high rainfall and related high runoff from in the Sabie River, the Sabie River has relatively high baseflows which can support users for most of the year. Only during the winter months are releases from the Inyaka Dam required to supplement the water requirements of the users located on the middle and lower Sabie Rivers. The significant dams in the Sabie River are listed in ***Table 7****.*

Table 7: *Significant dams in the Sabie River catchment*

Dam	Fully supply capacity (FSC)			Full supply area (FSA) (km^2)	Yield (million m^3/a)	
	million m^3	Natural MAR (million m^3/a)	FSC as %MAR		Historic	1 in 50
Inyaka Dam	*125,0*	*79,9*	*156%*	*8,1*	*41,9*	*50,7*
Da Gama Dam	*13,6*	*20,3*	*67%*	*1,3*	*10,3*	*10,8*
Maritsane Dam	*2,1*	*24,9*	*8%*	*0,5*	*7,5*	*10,5*
TOTAL	***140,7***	***125,1***	***113%***	***9,9***	***59,7***	***72,0***

The natural MAR of the Sabie River catchment (excluding the Sand tributary) is 527 million m^3/a. The two major dams in the Sabie catchment command a runoff of 100 million m^3/a, which is less than one fifth of the catchment's MAR. Expressing the total dam storage as a percentage of the runoff (138,6/527) results in a 26% storage relative to the MAR. As with the Crocodile River catchment, this ratio is very low. The obvious conclusion is that run-of-river flows downstream of the dam form a very important part of the water resources of the Sabie River catchment and must be managed carefully in conjunction with the dams.

Possible Future Dams

Several possible new dams were evaluated as part of this Mbombela Reconciliation Strategy as well as the raising of existing dams. These dams are; Montrose Dam, Mountain View Dam, Boschjeskop Dam, Lupelule Dam, Strathmore Dam and the raising of Ngodwana, Longmere and Klipkopjes Dams. The yields of both dams and raised dams were evaluated over a range of possible full supply storages in order that an optimum storage can be determined. These results are presented in Chapter 11.

Groundwater Resources

The geology of the study area consists mostly of grey and white granites south of Nelspruit, and potassic gneiss to the north of the city. The occurrence of groundwater is mainly associated with the deeper weathered zones, whereas fault zones and dyke contacts represent other groundwater occurrences. The groundwater yield potential from the granite and gneiss is classified as "low", with potential yields between 0,1 to 0,5 ℓ/s in the granite

and 0,5 to 2,0 ℓ/s in the gneiss. According to Vegter (1995) the probability of drilling a successful borehole is below 40%. The possibility of drilling a borehole yielding more than 2 ℓ/s is only 20% to 30% in the granite, and 10% to 20% in the gneiss.

The western part of the Municipal area contains a dolomite aquifer which can yield as much as 5 ℓ/s per borehole. The probability of drilling a successful borehole in these dolomites lies between 40 and 60%. However, it is thought that there is a direct link between these dolomites and the surface flow and that the strong baseflows observed in the Elands River are due to the presence of the dolomite. Water sourced from the dolomites should not therefore been seen as additional water.

Conclusions and Recommendations

It is recommended that as part of future studies the growth rate in the Mbombela municipal area be monitored closely so that the gap between the very high and low growth can be narrowed and hence give more certainty as to when interventions to maintain a water balance will be required.

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List of Acronyms and Abbreviations

BLM	-	Bushbuckridge Local Municipality
BWB	-	Bushbuckridge Water Board
CBD	-	Central Business District
DMA	-	District Management Area
DWA	-	Department of Water Affairs (previously DWAF)
DWAF	-	Department of Water Affairs and Forestry
EDM	-	Ehlanzeni District Municipality
EWR	-	Ecological Water Requirements
FSA	-	Full Supply Area
FSC	-	Full Supply Capacity
FSL	-	Full Supply Level
HIV/AIDS	-	Human immunodeficiency virus / acquired immunodeficiency syndrome
IAP	-	Invasive Alien Plants
ICMA	-	Inkomati Catchment Management Agency
IDP	-	Integrated Development Plan
IDZ	-	Industrial Development Zone
IWAAS	-	Inkomati Water Availability Assessment Study
KMIA	-	Kruger Mpumalanga International Airport
KNP	-	Kruger National Park
KPC	-	Karino Plaston Corridor
LED	-	Local Economic Development
MAR	-	Mean Annual Runoff
MBCP	-	Mpumalanga Biodiversity Conservation Plan
MBWS	-	Mbombela Bulk Water Strategy
MIG	-	Municipal Infrastructure Grant
MLM	-	Mbombela Local Municipality
MoU	-	Memorandum of Understanding
NFEPA	-	National Freshwater Ecosystem Priority Areas
NNRWSS	-	Nsikazi North Regional Water Supply Scheme
NSRWSS	-	Nsikazi South Regional Water Supply Scheme
PES	-	Present Ecological Status
PMF	-	Probable Maximum Flood
RCC	-	Roller Compacted Concrete
RDP	-	Rural Development Program
SBC	-	Spot Building Count
SDF	-	Spatial Development Framework
TDS	-	Total Dissolved Solids
URV	-	Unit Reference Value
WDC	-	Water Demand Centre
WfW	-	Working for Water
WMA	-	Water Management Area
WSA	-	Water Service Authority
WSDP	-	Water Services Development Plan
WSP	-	Water Service Provider
WTW	-	Water Treatment Works

Units of Measurement

ha	hectare
km^2	square kilometre
Mℓ/day	Megalitres per day (1 Mℓ = 1 000 ℓ)
million m^3/a	Million cubic metres per annum
m^3/s	Cubic metres per second
ℓ/c/d	litres per capita per day

1 INTRODUCTION

1.1 BACKGROUND

The Department of Water Affairs (DWA) identified the need to develop strategies that will ensure adequate future reconciliation of water requirements and water availability in the main metropolitan areas, as well as in smaller municipal areas and towns.

The DWA identified the Mbombela Municipal Area, through a prioritisation process, as one of the municipalities that are most in need of a comprehensive strategy for reconciliation of water availability with future water requirements. The Mbombela Local Municipality (MLM) area of jurisdiction includes the following areas and towns:

- Nelspruit and White River (including Mataffin and the industrial area of Rocky Drift);
- Hazyview;
- Nsikazi North – towns and rural settlements;
- Nsikazi South – towns and rural settlements;
- Matsulu – mostly rural settlements
- Ngodwana paper mill and town;
- Kaapsehoop and Elandshoek, and
- The future Karino Plaston Corridor (KPC).

The water use within the MLM has increased rapidly over the last few years and the available resources will soon be insufficient to supply the users within the municipality at an acceptable level of assurance. A strategy is therefore required to ensure continued water supply to this region over the medium to long term.

The MLM does not occupy a single clearly defined catchment, but straddles the Crocodile (East) and Sabie River catchments. Much of the water flowing through the municipal area is derived from upstream catchments. It is therefore necessary to develop reconciliation strategies which consider the Crocodile and Sabie River catchments in their entirety.

There are a number of major dams in both catchments, but only one big dam in each catchment. The major dams in the Crocodile catchment are summarised in **Table 1.1** below:

Table 1.1: Major dams in the Crocodile catchment

Dam	Fully supply capacity (FSC)		Full supply area (FSA) (km^2)	Construction date
	10^6 m^3	%MAR		
Kwena Dam	158,9	134%	12,5	1984
Witklip Dam	12,69	64%	1,88	1969
Klipkopje Dam	11,87	63%	2,31	1959
Longmere Dam	4,32	17%	0,96	1942
Primkop Dam	1,97	5%	0,41	1970
Ngodwana Dam	10,00	17%	1,00	1983

Source: *RSA Department of Water Affairs and Forestry: Dam Safety Office, 2006*

The major dams in the Sabie catchment are summarised in **Table 1.2** below:

Table 1.2: Details of major dams in the Sabie River catchments

Dam	Fully supply capacity (FSC)		Full supply area (FSA) (km^2)	Construction date
	10^6 m^3	%MAR		
Inyaka Dam	123,7	156%	8,11	2000
Da Gama Dam	13,6	66,5%	1,29	1971

Source: *RSA Department of Water Affairs and Forestry: Dam Safety Office, 2006*

Water use sectors in the catchments include irrigation, commercial forestry, domestic and industrial. The biggest water user is irrigation with commercial forestry the second biggest.

MLM is the Water Service Authority (WSA) in the area and also the Bulk Water Service Provider (WSP) in most areas excluding Nelspruit, Nsikazi, Matsulu and Karino. Bushbuckridge Water Board (BWB) is the Bulk WSP in the Nsikazi area and a concessionaire Sembcorp Silulumanzi (Sembcorp) is the Bulk WSP in Karino, Nelspruit and Matsulu.

The Inkomati Water Availability Assessment Study (IWAAS) (DWAF, 2009) investigated the water requirements for the Inkomati Water Management Area (WMA). As part of the Greater Mbombela Bulk Water Strategy (MBWS) (MLM, 2011) the current actual domestic water use for Mbombela was used to do a yield balance within the municipal area. The outcome of the yield balance is that there is already a small deficit in the Mbombela municipal area and that new water resources need to be developed to ensure continued economic growth.

1.2 PURPOSE AND CONTEXT OF THIS REPORT

The purpose of this report is to present the findings relating to the determination of the current and future water requirements scenarios for the different Water Demand Centres (WDCs) forming part of the Mbombela municipal area.

The determination of the current and future water requirements is fundamental to the assessment of the availability of the water resources and infrastructure to meet the water demands.

1.3 STUDY AREA

The MLM is situated in the Mpumalanga Province and is part of the Ehlanzeni District Municipality. MLM is also situated in the Inkomati River Basin and forms part of the Inkomati WMA. The municipal area does not occupy a single clearly defined catchment as shown in **Figure 1.1** below.

The Mbombela municipal area includes various towns and villages including Elandshoek, Hazyview, Kaapsehoop, Karino, Mataffin, Matsulu, Nelspruit, Ngodwana, Nsikazi North and South, Plaston, Rocky Drift and White River. Nelspruit is also the Provincial capital of the province and also the gateway to the Kruger National park (KNP). The N4 Maputo corridor transverse the area from the east in Maputo Harbour (Mozambique) to Gauteng Province in the west and the R40 Maputo sub-corridor transverse the district from Barberton in the south linking Swaziland to Phalaborwa (Limpopo Province) in the north.

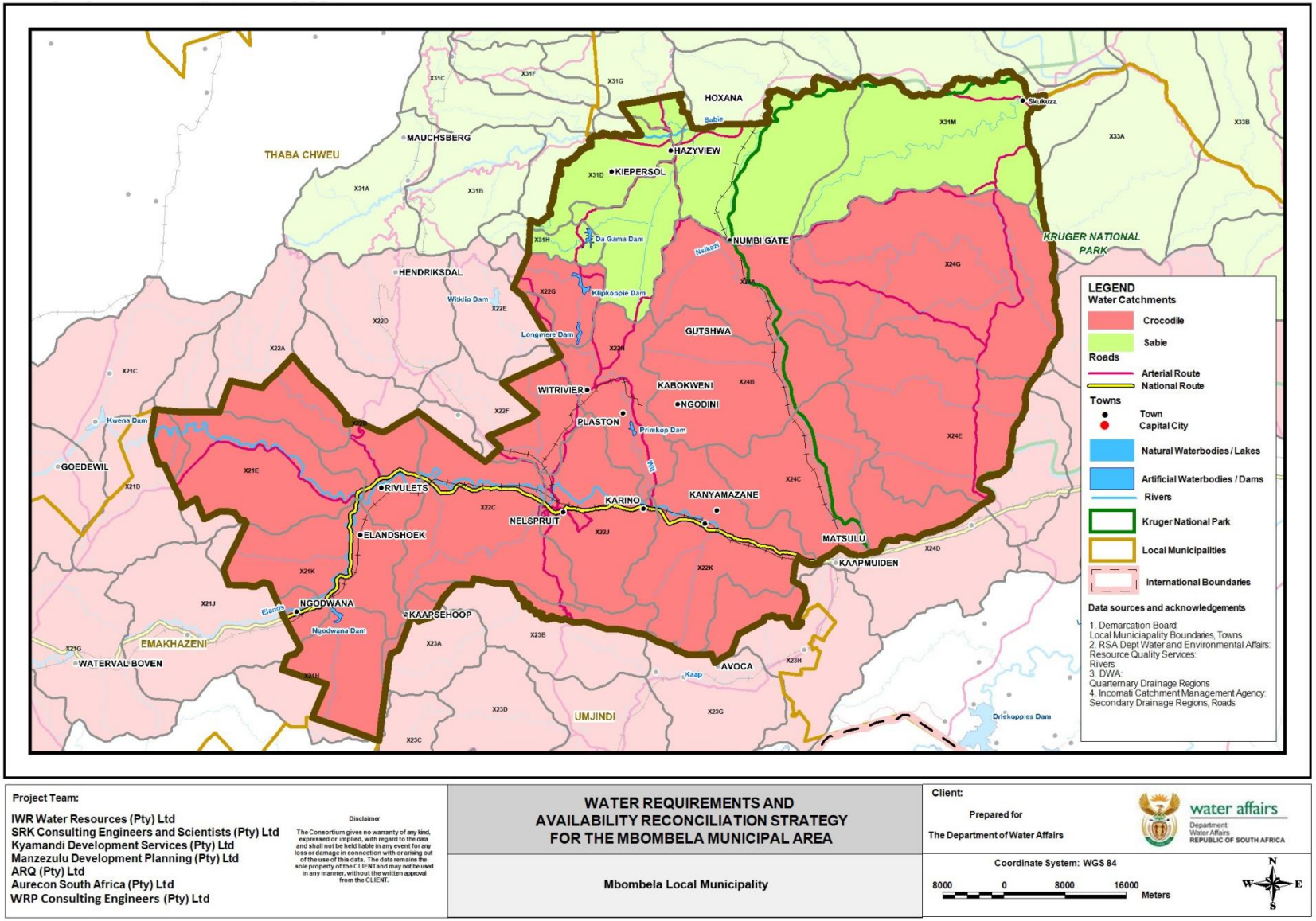


Figure 1.1: Study Area

2 STUDY OBJECTIVES

The main objective of this study is to develop a comprehensive water requirements and availability reconciliation strategy for the towns and grouping of towns and rural settlements of the Mbombela municipal area, up to year 2030. Information from existing studies will be reviewed, updated and integrated into in a reconciliation strategy that will meet the specific water services requirements of the MLM, whilst accommodating the broader aspirations and activities of the Inkomati Catchment Management Agency (ICMA) and promoting and supporting the sustainable development of the available water resources in the Crocodile and Sabie River catchments.

The primary objectives of this study are to:

- Address growing water demands as well as water quality problems experienced in the catchment;
- Assess current water availability and water deficit/surplus;
- Identify resource management and development options, and
- Recommend and sequence management and structural reconciliation interventions.

The main aim of this task is to estimate future urban and rural water requirements based on population projections formulated specifically for this study. Future water requirements are made using accepted per capita consumption estimates relative to the socio-economic standards of the communities served, and will be done for both a high and low growth scenario.

3 APPROACH AND METHODOLOGY

The MLM does not occupy a single clearly defined catchment, and much of the water flowing through the municipal area is derived from upstream catchments. It is therefore necessary to develop reconciliation strategies which consider the Crocodile (East) and Sabie River catchments in their entirety. **Figure 3.1** below shows the Mbombela municipal area as well as the Sabie and Crocodile catchments.

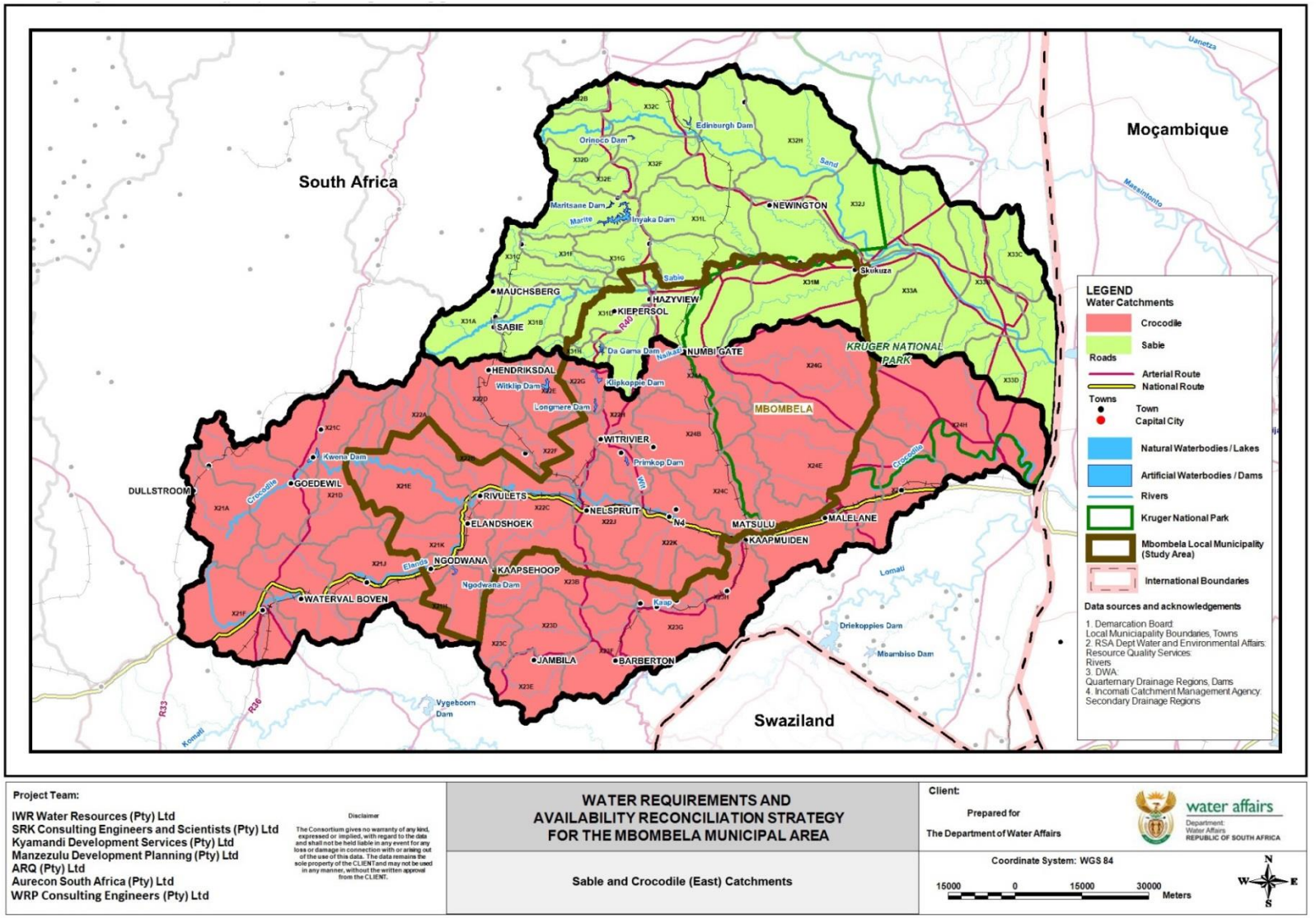


Figure 3.1: Sabie and Crocodile Catchments

3.1 WATER REQUIREMENTS

The process of determining the current and future water requirements is illustrated in **Figure 3.2** and indicates the various steps involved in the compilation, extraction and analysis of socio-economic data necessary to complete this task. The diagram below provides a depiction of all steps involved, whilst an in-depth discussion surrounding each step is given in the subsequent sections.

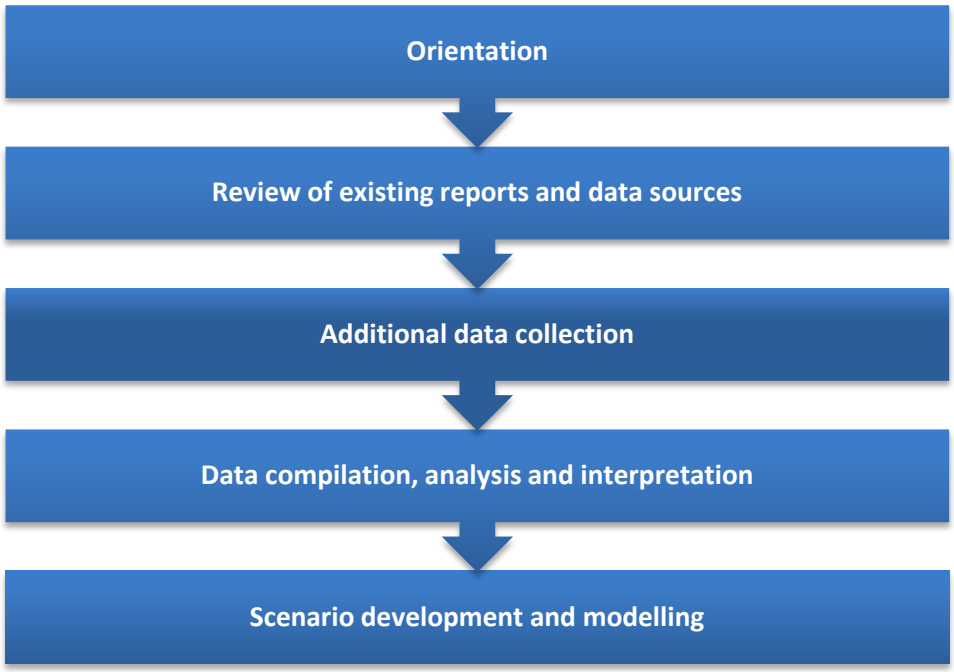


Figure 3.2: Water Requirements Methodology

The following sections provide a more in-depth discussion into the various steps incorporated in the water requirements process, and will provide more detail on what each step seeks to achieve.

3.1.1 Orientation

The purpose of this step was to become familiarised with the purpose and intended outcomes of the study, as well as with the study area. The study area lies along the boundaries of the MLM, and includes the towns of Mbombela (formerly known as Nelspruit), Hazyview, White River, Rocky Drift, Ngodwana, Matsulu, the Nsikazi area, Elandshoek and Kaapsehoop. The main water catchment and river systems within the study area boundary is the Crocodile River (East) catchment and the Sabie-Sand catchment area, which respectively run along the southern and northern edges of the MLM**. Figure 3.3** indicates the location of the study area and villages within the study area.

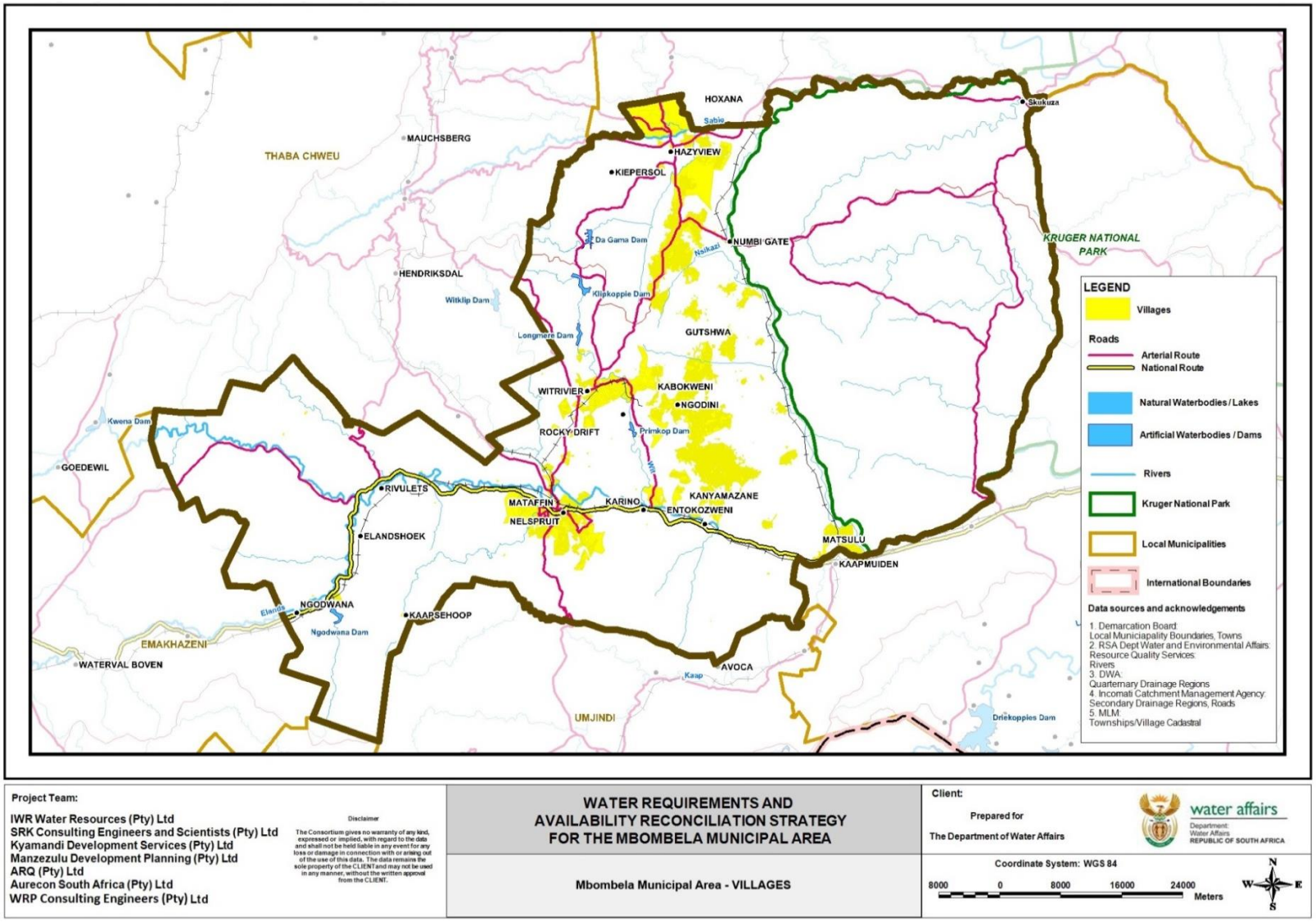


Figure 3.3: Study Area within the Ehlanzeni District Municipal Area

3.1.2 Review of Existing Reports and Data Sources

The first step in the process was to gather information relevant to the study area from previous studies that have been undertaken by DWA and other stakeholders. The intention was to extract all usable data from the reports and existing databases pertaining to especially demographic circumstances, forecasted growth patterns and water requirements.

3.1.3 Additional Data Collection

Additional data collection entails the application of desktop research in order to attain additional information crucial to determining the developmental and socio-economic growth potential and current reality status. The process is initiated by doing a simple desktop research study, as well as field work in order to attain background information on the relevant municipalities in the study area. This provides a good basis from which further information gathering and discussions can be facilitated.

Desktop research was done to gain insight into the current reality and to facilitate discussions with relevant stakeholders and role-players. The desktop research was done by obtaining documents and/or any other related information electronically from Local, District and Provincial Municipality websites. Major data sources that formed part of this research were:

- Spatial Development Framework (SDF);
- Integrated Development Plan (IDP);
- Local Economic Development (LED) strategy;
- Water Services Development Plan;
- Housing plan;
- Zoning schemes;
- Urbanisation or densification strategy;
- Urban edge strategy;
- Mbombela Bulk Water Strategy (2011), and
- Nsikazi Water Master Plan (2009).

The above-mentioned documents were reviewed to get insight into the municipality and its constraints and thus compose relevant questions and points for discussion.

Field research entailed visiting the MLM to consult relevant role-players regarding the dynamics and development patterns of the municipality. Discussions revolved around municipal plans, current commercial, industrial and residential developments in the municipal area, housing projects, future proposals for developments, etc.

3.1.4 Data Compilation, Analysis and Interpretation

The data collection phase allowed for the compilation of the status quo database which was then analysed and interpreted in order to gain insight into the strategic areas of development in the study area. This step involved determining the most appropriate data for the historical and future water requirements and return flows. The following subsections give insight into the aspects that have been dealt with.

3.1.5 Status Quo (baseline) Database

The most important objective of this step was to understand the study area in its current socio-economic context, and to compile a status quo (baseline) database based on information obtained from a variety of sources. The population base was compiled by making use of the following sources of information:

- Previous studies;
- Demographic information from provincial, district and local documents;
- 2009 Spot Building Counts (SBC), and
- Stats SA Census 2001, Community Survey 2007 and mid-year population estimates (2000-2011).

The above sources of information had to be used, as no official population figures exist for the study area for the required base year (2010). Population data for 2010 varies significantly between the Mbombela Bulk Water Strategy (MBWS) and the Mbombela Water Services Development Plan (WSDP), where the Bulk Water Strategy indicates a low scenario population of 543 178, as opposed to a population of 776 386 as indicated by the WSDP.

In addition to this, the base data could not be compared to the DWA settlements database for Mpumalanga as a different demographic grouping, namely settlements as opposed to sub-places, are used. Due to the discrepancies and the difficulties in comparing data on a lower level, own calculations have been made to determine the base population. The new base was created for the area by making use of StatisticsSA data and sub-place information from 2009 SBC, as well as by creating new sub-places where large concentrations of development and growth is evident. Average household size per sub-place was applied and the population per sub-place was summed to obtain the final population. The calculated based data was then compared to municipal figures and compared favourably, with less than 2% difference in total population.

3.1.6 Future Growth Expectations

The second stage of this activity was aimed at analysing the status quo database and interpreting the future growth of the MLM in socio-economic terms. With demographic statistics taken from Statistics SA, Quantec and the Eskom SBCs and through discussions with the municipality, it is possible to project future growth and development expectations for the municipal area. The model used produces results in terms of a low and high growth scenario in order to provide various perceptions of future outcomes.

3.1.7 Scenario development and Modelling

Once the base population data was been refined, growth scenarios up to 2030 were developed. The scenarios have been based on detailed local information relating to structural economic changes, policy changes, income groups, strategic development projects, social dynamics, proposed housing developments, infrastructure developments, urbanisation and migration trends, and historical growth patterns.

The objective was to develop scenarios (high growth and low growth in water requirements) which reflect the prevailing trends in a range of variables. Each scenario clearly sets out the basic assumptions made and indicates which of the driver variable/s selected should be monitored over time to indicate at some point in the future which scenario is actually being played out in the real world. This assists in identifying the most appropriate intervention required in the future to balance water requirement with water availability; being informed by actual trends in the market place.

Modelling has been done according to regions, which is each characterised by unique attributes and circumstances. The geographic region can be viewed as an area on its own which interrelates with the various other regions identified within the study area. Each region, based on information obtained from local municipalities, documents and discussions with role-players, has a specific growth forecast, which determines the pace and rate of population growth and the development of residential, commercial and industrial developments. The modelling process focuses on the growth of population or individuals and the distribution of these individuals within the study area.

3.2 WATER RESOURCES

The water resources of the Mbombela municipal area are already documented as part of the Mbombela Bulk Water Strategy (Mbombela Municipality, 2012). However, water resources cannot easily be determined or expressed in areas other than catchment areas. The MLM does not occupy a single clearly defined catchment, and much of the water flowing through the municipal area is derived from upstream catchments. It is therefore necessary to consider the water resources of both the Crocodile and Sabie River catchments in their entirety. **Figure 3.1** above shows the Mbombela municipal area as well as the Sabie and Crocodile catchments.

The water resources of the Sabie and Crocodile River catchment have been studied in detail as part of several other projects. The most comprehensive of these studies was the Inkomati Water Availability Assessment Study (IWAAS) (DWAF, 2010) which re-evaluated the hydrology and set up the Water Resources Yield Model (DWAF, 1998) for the whole Inkomati WMA. The IWAAS study concluded that the Crocodile River was stressed with the water demands exceeding the water availability even before implementation of the ecological Reserve. The Sabie River catchment, on the other hand, was found to have surplus water available even after implementation of the Reserve.

Three more recent studies have added to the knowledge base provided by the IWAAS study. These are:

- The determination of the ecological Reserve of the Crocodile and Sabie Rivers (DWAF, 2010d)
- The development of operating rules for the Crocodile River (DWAF, 2010e)
- The development of operating rules for the Sabie/Sand Rivers (DWAF, in progress)

The latter three studies took into account the actual operating rules of the Crocodile and Sabie River catchments in their water resources analyses. These operational models have been updated with the latest water use information and used to reassess the water resources situation. The results of these updated analyses are presented in Section 11.

As part of this Reconciliation Strategy, several dam development options were identified. This entails possible new dams at Montrose, Boschjeskop, Mountain View, Strathmore and Lupelule. These dam sites are shown in **Figure 3.4** below. In addition, the increased yield due to raising the existing dams was also evaluated. The operational models developed for the Crocodile and Sabie systems were used for this purpose since these take into account the actual operating rules of the system.

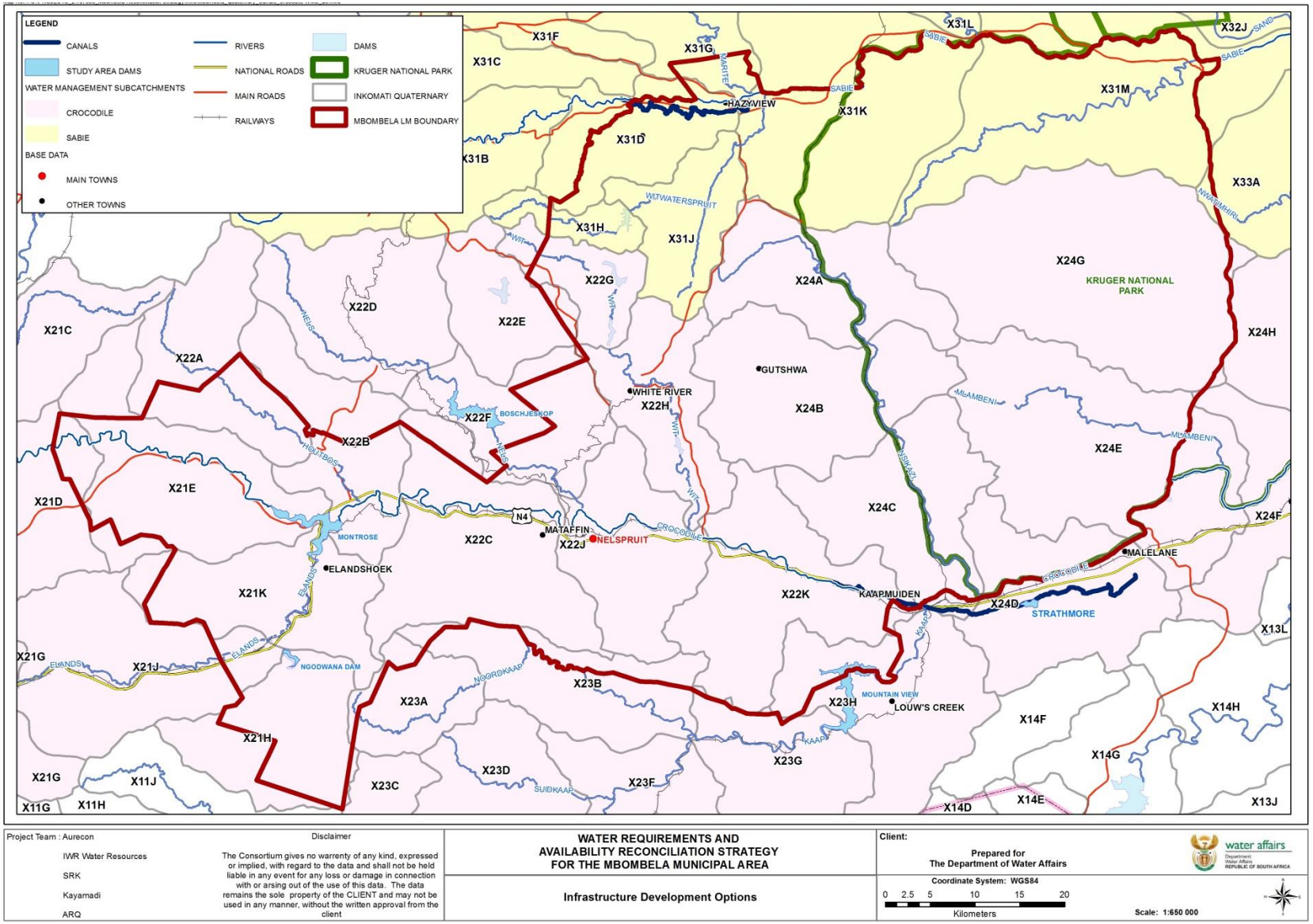


Figure 3.4: Location of possible new dams evaluated as part of this Reconciliation strategy

4 MUNICIPAL OVERVIEW

The section seeks to provide a contextual overview of the MLM within the broader spectrums within which the municipality functions. This includes a broad contextualisation of the locality of the municipality in relation to South Africa, the Mpumalanga province, and the Ehlanzeni District Municipality (EDM). The section will also seek to provide a broad overview of the various development nodes in the MLM. The discussions will concentrate on providing a picture of the current conditions and attributes of the municipality, the factors currently impacting on the municipality, the directives and objectives of various plans, and the future developmental potential for that municipality.

4.1 NATIONAL AND PROVINCIAL OVERVIEW

The MLM is located within the Mpumalanga Province, which is located within the north-eastern region of South Africa. The Mpumalanga Province is bordered by the Limpopo Province to the north, the countries of Mozambique and Swaziland to the east, the KwaZulu-Natal Province to the south and the Free State and Gauteng Provinces to the west. The MLM is located within the north-eastern part of the Mpumalanga Province. **Figure 4.1** below shows the MLM within the national and provincial contexts.

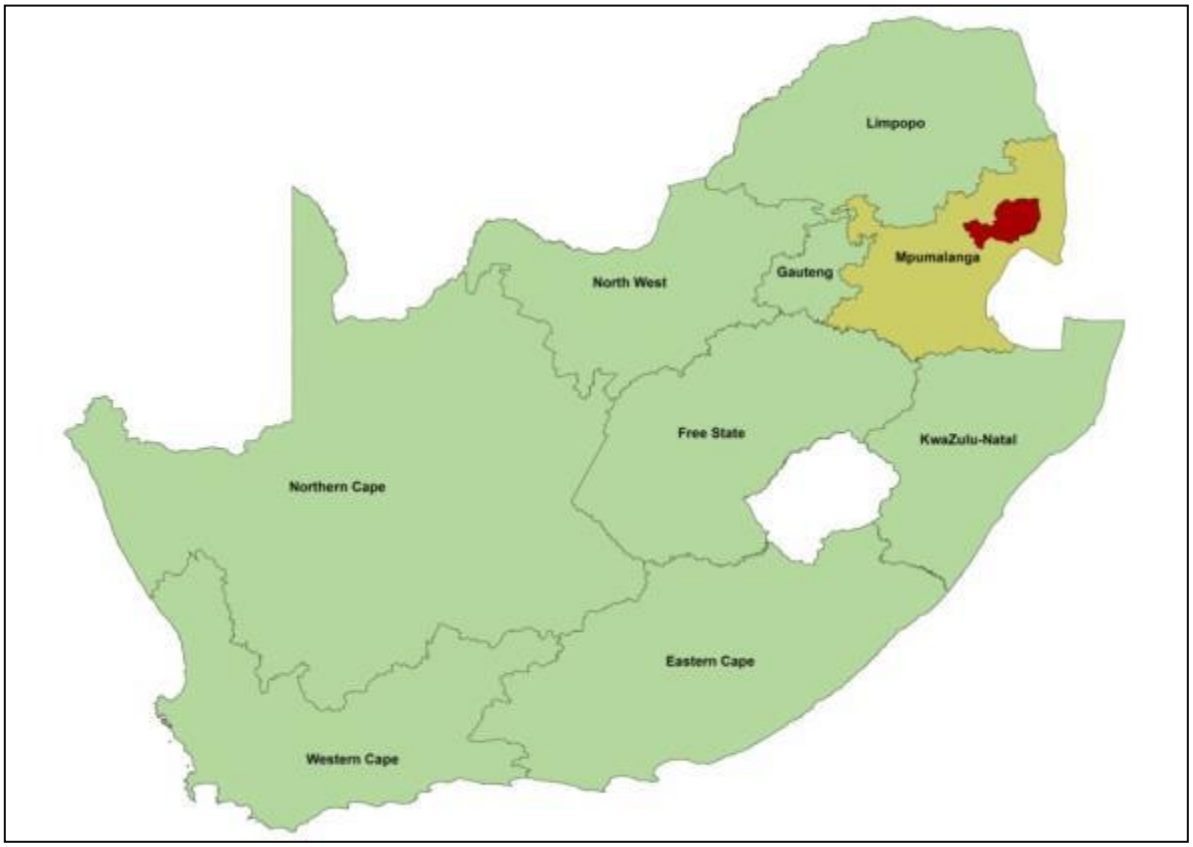


Figure 4.1: Location of the Mbombela Local Municipality in relation to the province and the rest of South Africa

4.2 DISTRICT OVERVIEW

The MLM is located within the Ehlanzeni District Municipality which is one of three district municipalities within the Mpumalanga Province. The EDM is bordered by the Mopani and Sekhukhune Districts of Limpopo Province to the north, the country of Mozambique to the east, the country of Swaziland to the south and the Nkangala and Gert Sibande District Municipalities to the west. **Figure 4.2** below shows the MLM (in red) within the EDM.

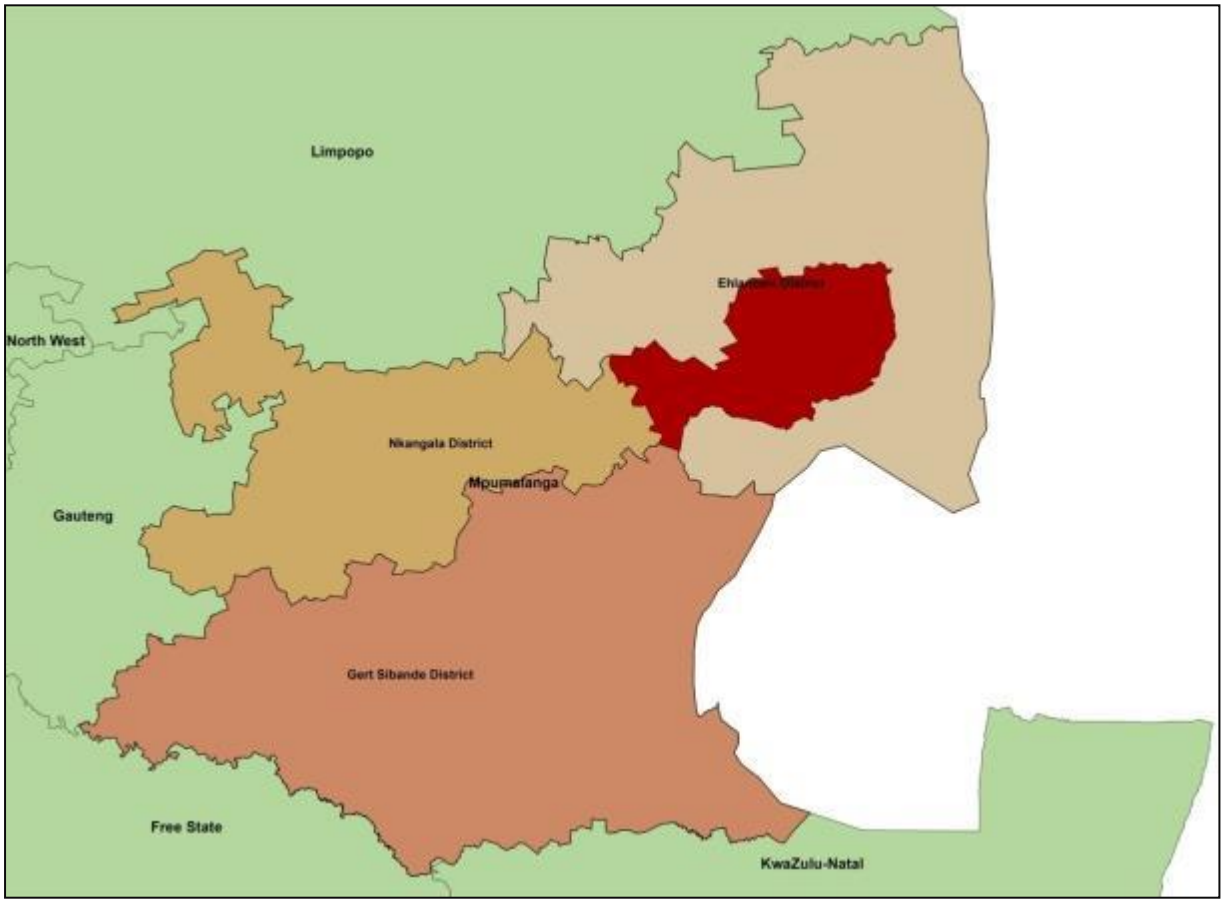


Figure 4.2: Location of the Mbombela Local Municipality in relation to the rest of the District Municipalities

4.3 MUNICIPAL OVERVIEW

The MLM is one of five local municipalities forming part of the bigger EDM. The other municipalities are Thaba Chweu, Umjindi, Nkomazi, Bushbuckridge and the southern part of the Kruger National Park being a District Management Area (DMA).

The MLM, as shown in **Figure 4.3**, is bordered by the Bushbuckridge Local Municipality to the north, the Nkomazi Local Municipality to the east, the Umjindi Local Municipality to the south and the Thaba Chweu Local Municipality, Nkangala and Gert Sibande District Municipalities to the west.

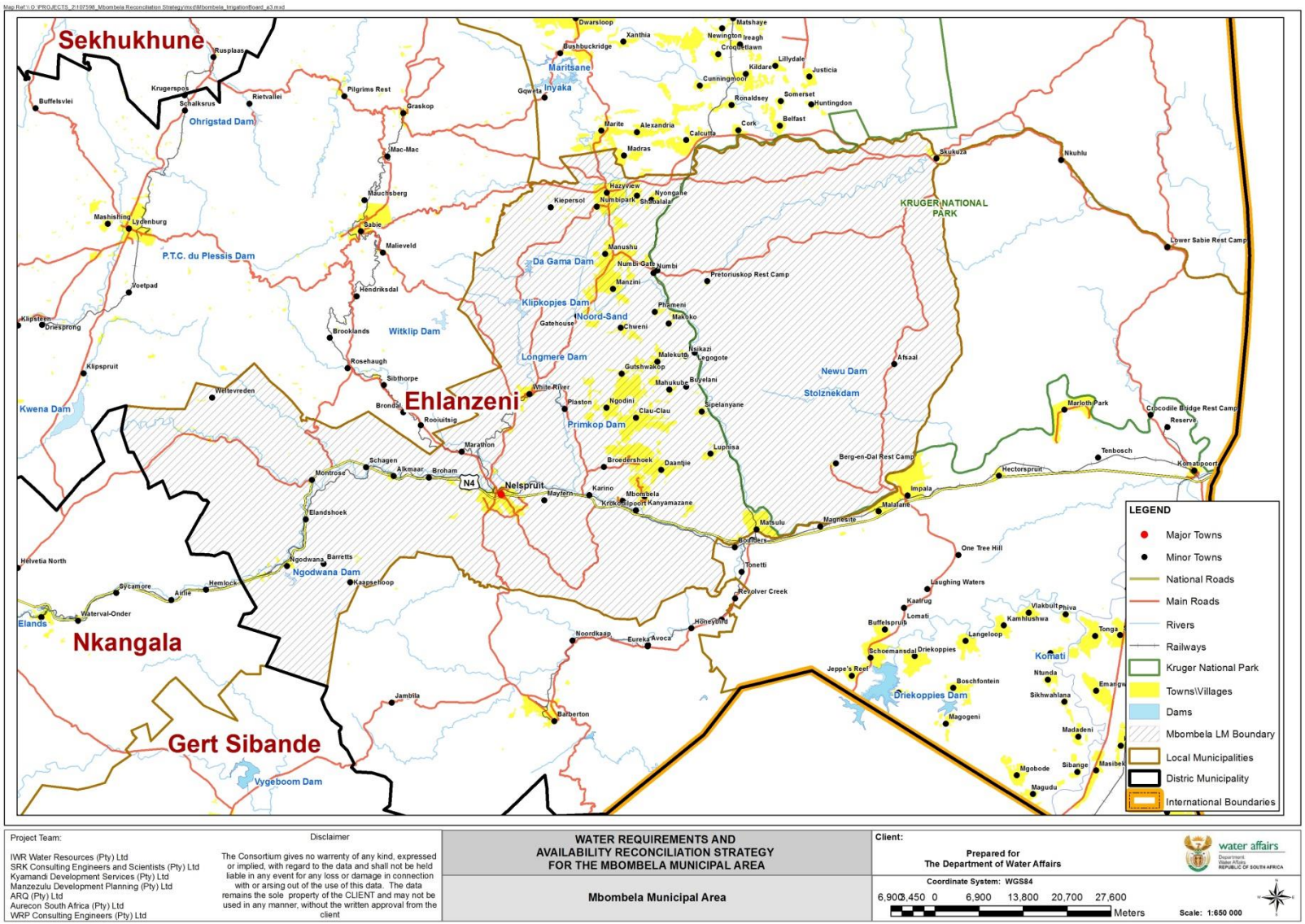


Figure 4.3: Location of the Mbombela Local Municipality in relation to the other local municipalities

The municipality forms part of the Drakensberg mountain range and can be divided in three physiographic regions namely, the highveld, the escarpment and the lowveld. The municipality extends from mountainous areas in the west to gently sloping areas in the central, northern and eastern parts.

The MLM is dissected by the N4 highway which runs from west to east, and the R40 which dissects the municipality from the north to south. The main town of the municipality is Nelspruit which functions as the main administrative and service delivery node within the municipality. Nelspruit is also the administrative capital of the Mpumalanga Province and houses various provincial departments within its borders. Other nodes of importance are White River, which functions as a secondary node to Nelspruit, Rocky Drift which functions as a regional industrial node and Hazyview, which is a local service delivery and tourism node within the municipality.

The municipality has 9 traditional authorities located along the eastern boundary of the municipality adjacent to the Kruger National Park. Various nodes such as Kanyamazane and Matsulu exist within this region, and the majority of the population of the municipality is located within the tribal regions. The majority of the eastern section of the municipality is part of the Kruger National Park and as such has various linkages to the tourism industry within the MLM.

The MLM has numerous infrastructure components of high quality which enables linkages to various parts of the country, as well the neighbouring countries of Zimbabwe, Mozambique and Swaziland. Important infrastructure components include the Kruger Mpumalanga International Airport (KMIA), railway linkages to parts of South Africa, Mozambique and Swaziland, and the N4 Maputo Corridor which links Gauteng and Mbombela to the deep sea port of Maputo.

The MLM has a wide variety of natural features such as diverse vegetation, varied topography and protected areas, which is in many cases linked to the tourism industry. Protected areas can be found across the MLM, and include the Kruger National Park and various conservation areas, natural heritage sites, and private and provincial nature reserves. Biodiversity within the MLM has been classified in accordance to the Mpumalanga Biodiversity Conservation Plan, which has indicated that:

- Irreplaceable areas are found within the Crocodile Gorge and the western escarpment;
- Highly significant areas are found within the western regions of the municipality;
- Important and necessary areas are located between Legogote and Numbi, areas surrounding Rocky Drift and Mataffin and along the southern boundary of the municipal area, and
- Areas of little concern are located within the eastern parts of the municipality.

In addition to tourism, agriculture is one of the major uses within the MLM. The region, as a result of its sub-tropical climate, is highly suitable for the production of sub-tropical fruits such as bananas, oranges, mangos and avocados. The region also has various attributes related to grazing and game reserves which make it suitable for cattle and wildlife farming. The municipal SDF indicates that arable land which supports cultivation, grazing and forestry can be found in the central and eastern regions of the municipality. Grazing land can be

found along the north-south strip stretching from Hazyview to the Crocodile River (East) and the western escarpment and highveld regions, while wilderness areas can be found in the Crocodile Gorge and southern regions of the municipality.

Furthermore, land in the municipality is categorised in terms of suitability and potential for agricultural related activities. The following areas of potential can be found in the municipal area:

- Very low potential: Found within the mountainous regions of the municipal area;
- Low potential: Found in the regions of the Kruger National Park, Schoemanskloof, Ngodwana, Pienaar, Daantjie and north-east of Legogote;
- Medium potential: The majority of the municipality is considered to be medium potential agricultural land, and
- High potential: Found within the Kiepersol region and along the Crocodile River and its tributary to the west.

Various mineral deposits can be found in the municipality, and reserves include gold, chrysotile (asbestos) and limestone which primarily occur along the escarpment within the western regions of the municipality. Within the central and eastern regions of the municipality no minerals exist that are worth exploitation. The municipal SDF identified some mineral deposits that may be considered as noteworthy and are listed below:

- Asbestos mining activities north of Kaapsehoop;
- Crusher quarries at Alkmaar, Karino, White River and Hazyview;
- Various localities in the western portion of the municipality where gold has been exploited, and
- Illegal small-scale sand mining is occurring along the Gutshwa River within the Nsikazi Area.

The MLM has two main identified corridors along which development occur. These corridors can be classified as:

- Nelspruit-White River Development Corridor, and
- Eastern Development Corridor.

The Nelspruit-White River Corridor is located along the R40 in a northerly direction from Nelspruit through Rocky Drift, White River and Hazyview. This corridor provides for structured urban growth at the towns through which it runs, while the mentioned nodes create an organised urban structure. Urban growth within the corridor has shown an expansion along the R40 from Nelspruit to White River, which will link the areas in the future as one continuous urban area.

The Eastern Development Corridor stretches from Hazyview in the north southwards towards Kanyamazane in the south to incorporate the Nsikazi area. This corridor includes both urban and semi-urban structures and settlements within the Nsikazi Region, and growth within these settlements is sprawled in nature as settlements are continuously expanding towards one another. Nodal development within this area is limited when considering employment and business and retail facilities, and the majority of such facilities are located within the western regions of the municipality. Uncontrolled growth places much strain on the provision of services to the area.

The MLM has seen significant growth as a result of its growing importance as provincial node and regional service provider. Development in the MLM is concentrated in a few key nodal areas, and vast areas exist where no or very little growth takes place. These areas have been classified to be:

1. Nelspruit (including Mataffin, the Agricultural College and Matumi Golf course ;
2. White River and Rocky Drift;
3. Hazyview;
4. Plaston and Karino;
5. Kanyamazane;
6. Matsulu;
7. Nsikazi South;
8. Nsikazi North, and
9. Kaapsehoop/Elandshoek/Ngodwana.

The following subsections will provide insight into prevailing development trends and patterns in each of the abovementioned areas, as well as future growth and expansion areas for residential, commercial and industrial development.

4.3.1 Nelspruit

The town of Nelspruit functions as the main node for the MLM, and is classified as a regional node servicing a broader area which extends to Mozambique, Swaziland and Limpopo. The majority of development activity in the municipality is concentrated in and around Nelspruit, with lesser concentrations around White River and Hazyview areas.

Development activity in Nelspruit is mostly concentrated in the north and northeast, and to the south and west of the town. Nelspruit has a large residential component, and residential expansion is evident in especially the northern parts of town in the Riverside area, to the east of town around the Kamagugu settlement, to the northeast of town around the Mbombela Stadium, and to the south of town in the Sonheuwel and Stonehenge areas.

Development pressure has been identified along the R40 to White River, and can be described as the demand for vacant developable land for continued growth and expansion, as well as the current and proposed development activity. Development pressure has been determined to be in line with commercial and retail activities, industrial expansion and residential opportunities, and are mostly to be found along the south of Nelspruit.

Commercial and industrial development is primarily located in the north and northeast of Nelspruit within the Riverside and Mataffin nodes which are located primarily along the major arterials of the N4 highway and the R40 to White River. The Riverside node specifically focuses on commercial and mixed use activities, and provides high quality retail and office components, as well as larger scale retailers and automotive industries. Commercial development in the Mataffin node is proposed along the N4 highway and around the stadium and allows for mixed use activity specifically focussed on retail and office developments.

4.3.2 Rocky Drift and White River

The Rocky Drift is approximately 13 km north of Nelspruit and 7 km south of White River, and is classified as a regional industrial node due to its location on the identified Nelspruit-White River Development Corridor and the Nelspruit-Phalaborwa sub-corridor. Various industrial activities exist within the area such as light industrial and warehousing to the east of the R40 and heavy noxious industries to the west of the R40.

Residential development is mainly focussed to the north, east and west of the existing Rocky Drift industrial area, and future residential growth areas are located to the west and north-west of Rocky Drift. The focus of development in the node is however industrial related, and future industrial development is directed along the R40 as well as to the west and south of the existing industrial activities. Commercial use activities are proposed to the south of the existing urban area of Rocky Drift.

The town of White River located approximately 20 km north of Nelspruit, 45 km south of Hazyview and 15 km west of the KMIA. The importance of White River as a residential node has grown considerably in the recent past, and has sparked the growth and development of residential development in and around the existing town.

Development activity is located surrounding the town in all directions. Future residential growth is seen to expand in all directions outward, and subsidised housing areas are proposed to specifically the east of town. Proposed growth areas coincide with arterials leaving and entering the node.

Commercial development in White River is focussed on central business district (CBD) revitalisation and densification, whilst new commercial development is proposed to the northwest and northeast of town towards Casterbridge. Development is proposed here to encourage nodal development and distribution of commercial mixed use activities. No industrial development is proposed within White River.

4.3.3 Hazyview

The town of Hazyview is located at the northernmost border of the MLM and is approximately 75 km from Nelspruit and 45 km from White River. The town functions as a sub-regional node servicing the local surrounding communities and the southern parts of the Bushbuckridge Local Municipality. The town is functionally a tourism related node as a result of its proximity to the Kruger National Park and various other tourism attractions.

Residential development in Hazyview is located along the R40 extending from the R40-R538 intersection to the R40-R536 intersection. Future residential growth areas are located to the east of the R40 extending towards the Tshabalala settlement and south of the R536 towards the Nkambeni settlement. Further areas have been identified, east of the CBD extending to the Hazyview vacation town, as well as north of the Hazyview vacation town, and south-west of the R40-R538 Intersection.

Commercial development is mainly concentrated surrounding the existing CBD of Hazyview, and future commercial development is proposed east of the existing CBD. Industrial

development is proposed along the R40 corridor and is mainly focussed on beneficiation practices of agricultural products.

4.3.4 Plaston and Karino

Plaston is located approximately 8 km south of White River and 3 km north of the KMIA, and contains limited commercial activities which provide basic services to the surrounding farming community. The KMIA is located 23 km from Nelspruit and 14 km from White River. Plaston and the KMIA have been identified as nodal points for the municipality.

As a result of the region being demarcated as a future node for the municipality, the developmental activity in the region is mostly based on future growth and the demarcation of these areas for residential purposes. Future residential growth was identified east of the R538 up to the Phatwa and Backdoor settlements and northward to the Boonsteloop River. South of the Plaston intersection land was also identified for future residential purposes.

Future commercial development is proposed west of the Backdoor settlement, continuing along the D2689 road westward to the R538. To the south of the Plaston intersection and north of the KMIA an Industrial Development Zone (IDZ) is proposed in order to exploit the strategic location of the municipality as well as to provide opportunities in relation to the KMIA. To the south of the KMIA land has been identified for airport related activities and expansion of the KMIA in the future.

Karino is located at the intersection of the N4 highway and R538, approximately 13 km east of Nelspruit, 9 km south of the KMIA and 8 km west from Kanyamazane. Karino has been identified as a future node of the municipality, but limited commercial and industrial activity is currently exists in the area.

Future growth regions for residential purposes have been identified for the area and are located north of Tekwane and east and west of the R538 north up to the D2966 Road. Subsidy housing projects are also proposed to the east and south-east of Tekwane.

Future growth areas for industrial development are promoted to the north of the N4 highway, along the D2296. Industrial growth areas have been proposed at this point in order to utilise the infrastructure linkages created by the N4. The location of agricultural land in the area also provides for the possibilities to establish agri-processing activities.

4.3.5 Kanyamazane

Kanyamazane is located within the southern sections of the Nsikazi area, and comprises a number of settlements which vary between urban and rural typologies. Kanyamazane can be classified as the main urban node within the Nsikazi region and is a continuous urban structure which extends from the N4 highway northwards to Msogwaba. The Mthethomusha Nature Reserve is located east of Kanyamazane, where development is restricted.

Residential development within the region is mainly located along the periphery of the existing settlements. Future residential growth areas are located to the north-east of the Daantjie settlement and east of the Phakane settlement. Another identified growth region

exists to the west of the Msogwaba settlement. Due to the typography, limited land for future expansion is identified within the region.

According to the municipal SDF, commercial development in the area should focus on the upgrading and densification of existing economic nodes in the area to sufficiently establish core economic centres. Commercial activity has been identified to the north of Luphisi, but no future commercial and industrial growth regions have been identified within the region.

4.3.6 Matsulu

Matsulu is located on the south-eastern boundary of the municipality, wedged between the Mthethomusha Nature Reserve in the north and west, the Kruger National Park in the east and the N4 highway to the south. The town is situated approximately 45 km east of Nelspruit. Matsulu primarily functions as a residential area with basic services and economic activities to accommodate the local community.

Future residential growth regions have been identified for Matsulu based on infill and densification properties as a result of limited land available for development. Future growth regions have been identified within Matsulu C and to the west and south of Matsulu B. Commercial development in Matsulu is focussed on intensification of economic activities within the existing commercial nodes.

4.3.7 Nsikazi South and North

The Nsikazi area is composed of a number of traditional authorities which are a mixture of rural, informal and semi-urban settlements. These tribal areas are located along the Nsikazi activity corridor which stretches from Hazyview in the north to Kanyamazane in the south. Nsikazi is located within the eastern portion of the municipality along the western border of the Kruger National Park.

Various portions of land have been identified in the Nsikazi area for future residential growth and expansion and are mostly distributed along the Nsikazi activity corridor at settlements determined to be future nodes. Portions identified for future residential development are located within Tshabalala, north of Nkambeni, within Mahushu, east of Phola, south of Manzini, east and west of Khumbula, and within Ngodini. Additional land for subsidy housing has also been identified in the area and is located in the settlements of Tshabalala, Nkambeni, Manzini A, Khumbula and Clau-Clau.

Commercial development is based on nodal development at strategic nodes to encourage commercial densification and intensification. No areas for future commercial growth have been identified in the area but small pockets of land for commercial development have been identified at the R538/ Numbi Road intersection at Bhekiswayo, along the R538 west of Lundi and at the D1411/D2970 intersection at Khumbula.

The municipal SDF has identified the development of tourism related activities which include hotels, lodges and recreational and educational tourism. These developments are to be established at the Kruger National Park Gates Phabeni and Numbi.

4.3.8 Kaapsehoop/Elandshoek/Ngodwana

Kaapsehoop is a residential settlement with approximately 255 proclaimed residential stands and is located approximately 35 km to the south-west from Nelspruit. The number of developed stands is rapidly increasing as the town has recently gained tremendously in popularity as a tourism destination and alternative accommodation to people working in either Nelspruit, Barberton and/or Ngodwana. The village has approximately 177 permanent residents and is mainly a weekend and holiday village with maximum overnight accommodation for another 390 visitors.

The settlements of Elandshoek and Ngodwana are located in the western farming region of the MLM, and form part of residential establishments for the employees of the SAPPI plant in the region. No expansion or development areas are proposed for the area except for subsidy housing in the form of formalisation within the Elandshoek informal areas.

4.4 WATER DEMAND CENTRES

The MLM is divided up into nine different Water Demand Centres (WDC), which refer to the respective areas within the municipal boundary of the MLM to which water services are provided. The different WDCs in the MLM are indicated on **Figure 4.4** below. Areas falling outside of the nine WDCs do not rely on bulk water supply, and rely on other sources such as boreholes for water supply. The WDCs are:

- Nelspruit and surrounds with Silulumanzi as the WSP;
- White River and Rocky Drift with MLM as the WSP;
- Karino Plaston Corridor;
- Nsikazi South with BWB as bulk WSP;
- Matsulu with Silulumanzi as WSP;
- Nsikazi North BWB as bulk WSP;
- Hazyview with MLM as the WSP, and
- Other centres including Ngodwana, Kaapsehoop and Elandshoek.

The various WDCs provide a good indication of where population concentrations exist in the municipal area. As can be seen on **Figure 4.4** below, the bulk of the eastern and western portions of the municipal area fall outside of the WDCs, and are mostly sparsely populated rural and farming areas.

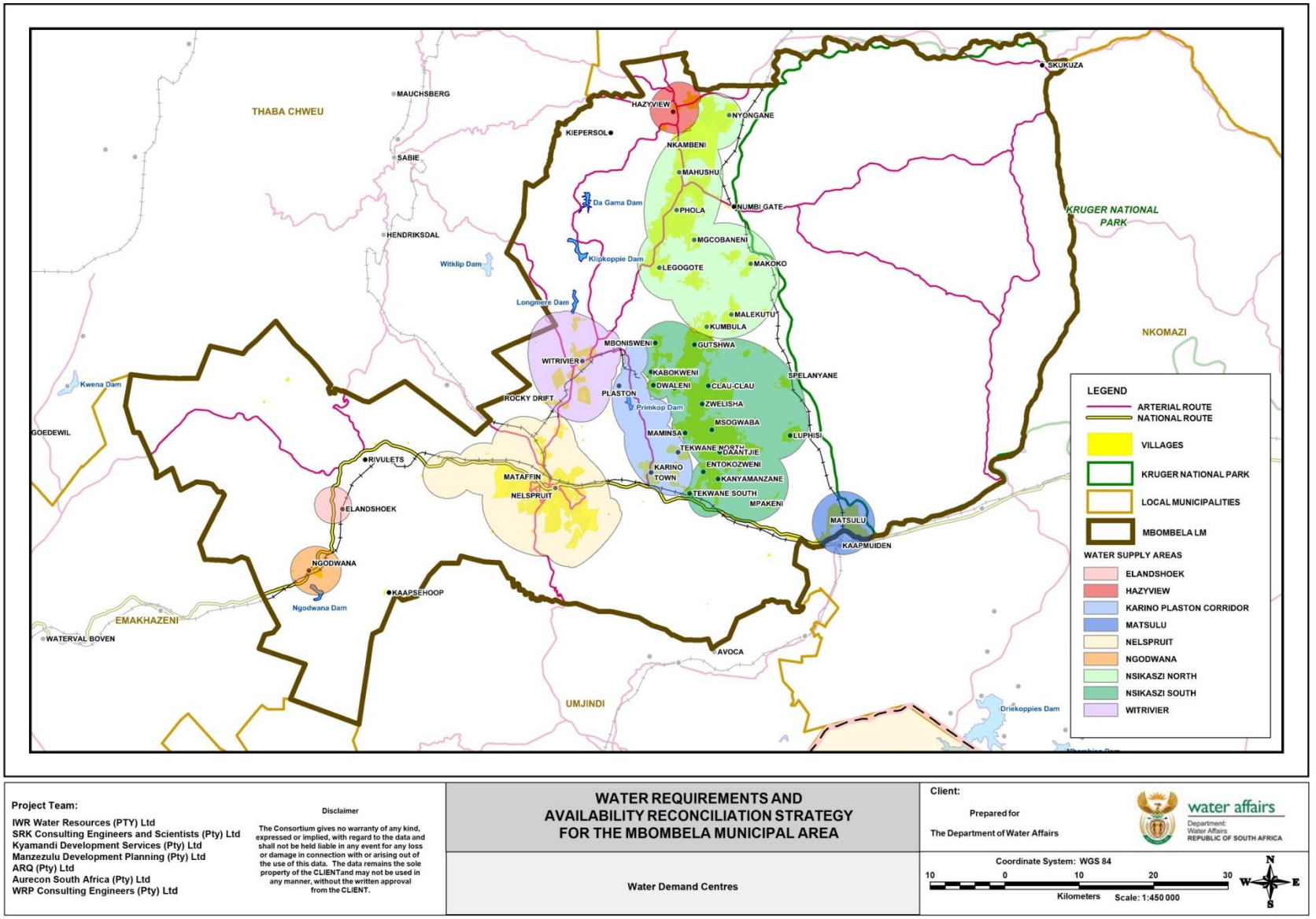


Figure 4.4: Water Demand Centres in the Mbombela Local Municipality

5 BASE POPULATION ESTIMATE AND GROWTH SCENARIOS

This section deals with the socio-economic components of the MLM. This section seeks to provide an overview of the social composition of the municipality and indicate historical growth to provide an indication of the past trends of population distribution. In addition to this, this section seeks to provide an indication of how the base population was determined, as well as how the base population was taken forward and applied into future growth scenarios for the area.

5.1 HISTORICAL PERSPECTIVE

To be able to understand MLM and all its components, reference must be made to factors which impact on the area from a historical perspective. This information would provide a picture of trends and impacts which would inform future population growth. For the purposes of this discussion, data from Statistics SA have been used.

5.1.1 Population size and growth

The size of population and the growth thereof plays a significant role in the impacts created by the population on the surrounding environment, as well as the need for residential options, commercial and industrial activities, employment and the impacts on service delivery and natural resources.

Table 5.1 below presents population values for 2001 and 2007 based on 2001 Census data and 2007 Community Survey data, and indicates the growth in population between the two years for the MLM.

Table 5.1: Population size and growth of the Mbombela Local Municipality

Mbombela Local Municipality	Population size		Population growth
	2001	2007	2001-2007
TOTAL	476 627	527 203	1,7%

As can be seen from the above table, the population of the MLM grew steadily, albeit at a slow rate, from 2001 to 2007. The population of the municipal area increased by approximately 50 600 individuals between 2001 and 2007, which translates into an annual growth rate of 1,7%. This growth rate in higher than the national and provincial growth rate for the same time period, which is calculated to be 1,3% on a national level, and 0,9% on a provincial level.

5.1.2 Number of households

Table 5.2 below provides an indication of the number of households within the study area based on 2001 and 2007 figures from StatisticsSA.

Table 5.2: Number of households in the Mbombela Local Municipality

Mbombela Local Municipality	Number of households		Household growth
	2001	2007	01-07
TOTAL	122 511	137 353	1,9%

From the above table, it is evident that the total number of households in the MLM grew from 2001 to 2007. The number of households in the municipal area increased from 2001 to 2007 by approximately 15 000 additional households, which translates into an annual average growth rate of 1,9%.

5.1.3 Household size

Table 5.3 below provides an indication of average household size for 2001 and 2007 in the MLM.

Table 5.3: Household size in the Mbombela Local Municipality

Mbombela Local Municipality	Household size	
	2001	2007
AVERAGE	3,9	3,8

From the above table it is evident that household size in the MLM stayed fairly constant.

5.1.4 Household income

Table 5.4 below provides an indication of the average annual household income of households within the MLM. The data reflects income differences between 2001 and 2007.

Table 5.4: Average annual household income in the Mbombela Local Municipality

Income	Income Category	2001	2007
No income	Low	18 694	6 929
R1 – R4 800		16 829	6 466
R4 801 – R9 600		27 755	16 846
R9 601 – R19 200		24 236	30 184
R19 201 – R38 400		15 990	29 709
R38 401 – R76 800	Middle	8 456	15 004
R76 801 – R153 600		5 633	10 200
R153 601 and more	High	4 919	22 014
TOTAL		**122 511**	**137 353**

From **Table 5.4** above it can be deduced that a clear shift exists in the average annual income of households between 2001 and 2007. A decrease in the number of households that earn an average annual income of between R0 and R9 600 can be seen whilst an increase has been experienced by households that fall within the latter income groups of R9 601 and higher. The shift in income levels may be attributed to greater affluence of households in the municipality as a result of job creation or increased wages.

5.2 BASE POPULATION CALCULATIONS

A 2010 base population figure is needed to form the starting point for the demographic modelling. Various municipal documents and previous studies have been consulted for demographic information. The various sources however each provide a different 2010 population figure, as highlighted in **Table 5.5** below.

Table 5.5: Base population comparison

Source	2010 Population
Municipal IDP	527 203
Municipal SDF	546 411
MBWS (low scenario)	543 178
MBWS (high scenario)	553 460
DWA 2008 (Mbombela WSDP)	776 386

Due to the discrepancies as highlighted in **Table 5.5** above, and the difficulty in comparing data prepared at different resolutions, base population was re-calculated as part of this study. The new base was created for the area by making use of StatisticsSA data and sub-place information from 2009 SBC, as well as by creating new sub-places where large concentrations of development and growth is evident.

Figure 5.1 below provides an indication of what SBC data typically looks like.

Figure 5.1: Example of 2009 SBC data

As can be seen from **Figure 5.1**, up-to-date aerial photographs are used and each dwelling unit is marked. Average household size per sub-place was subsequently applied and the population per sub-place was summed to obtain the final population. The calculated base data was then compared to municipal figures and compared favourably, with less than 2% difference in total population. The following table compares the new calculated base populations for the low and high scenarios to the various sources of demographic information.

Table 5.6: Base population comparison between calculated base and other sources

Source	2010 Population
Kayamandi calculated base (low scenario)	548 467
Kayamandi calculated base (high scenario)	550 024
Municipal IDP	527 203
Municipal SDF	546 411
MBWS (low scenario)	543 178
MBWS (high scenario)	553 460
DWA 2008 (Mbombela WSDP)	776 386

The base population for 2010 can be split between the various WDCs in the study area. For the purposes of **Figure 5.2** below, the high population base figure of 550 024 for 2010 have been used.

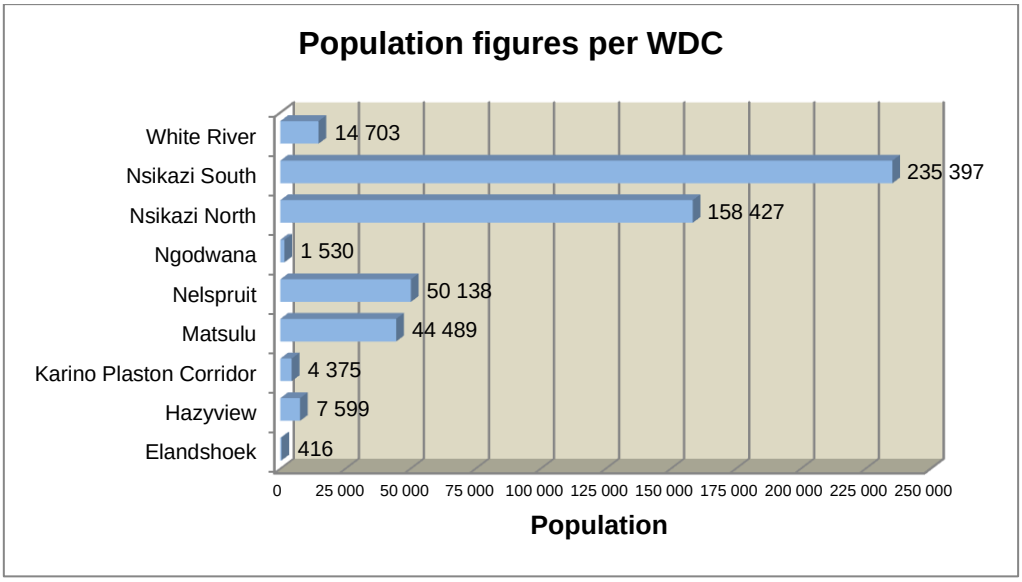


Figure 5.2: 2010 Population figures per WDC

As can be seen in **Figure 5.2**, the majority of people in the MLM are located in the Nsikazi North and South WDCs, with approximately 72% of the total population of the municipality residing in these two areas. The WDCs with the lowest population are Elandshoek and Ngodwana, which are located to the west of Nelspruit. Approximately 33 000 people stay outside of WDCs, and have not been indicated on the above graph.

After various consultations with MLM and Silulumanzi the base population figures were adjusted. The new township of Phumulani outside White River was added to the White River WDC. Villages in Nsikazi South like Emoyeni, Mamelodi and Tekwane North was added to the Karion Plaston Corridor as they get water from Primkop Dam and the Nsikazi South population was adjusted accordingly. A house count of Matsulu also resulted in a higher population estimate. The updated population figure per WDC is shown in **Figure 5.3** below.

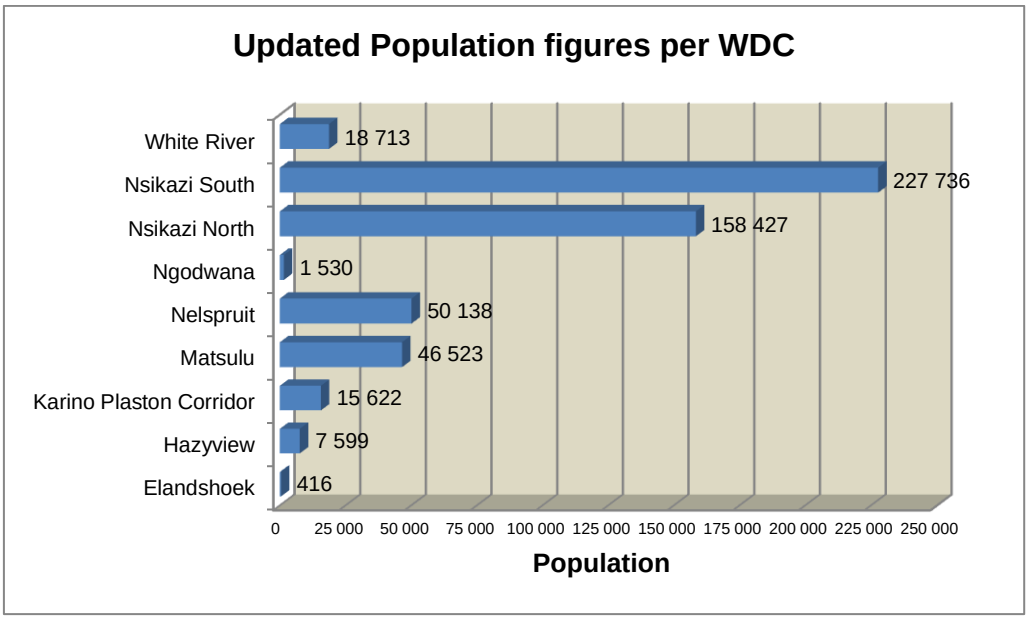


Figure 5.3: Revised 2010 Population figures per WDC

5.3 GROWTH SCENARIOS

It is necessary to develop different growth scenarios for development, as it is impossible for all the smaller settlements in MLM to grow at the same rate as larger nodes such as Hazyview, White River and Nelspruit as various factors affect each area according to their individual characteristics. Two scenarios have been developed (low and high growth) to take into account various development determinants or push and pull factors that could bring about alterations in the projected growth and resultant population size. The following demographic development determinants have been identified as likely factors to cause different water resource responses:

- Migration;
- Mortality;
- Fertility, and
- Human immunodeficiency virus / acquired immunodeficiency syndrome (HIV/AIDS), etc.

There are indications of large amounts of immigrants into South Africa who place enormous pressure on already over-extended and under-supplied social services (e.g. schools, clinics) and infrastructural services (e.g. water, electricity, etc.). Population predictions thus need to take into account in-migration and determine what it could mean for future population distribution and resource needs.

Future population projections, however, also need to account for internal movement, which will ultimately lead to differences in population figures between areas in a local municipality due to inherent internal movement dynamics of population. Very little information is available about migration patterns on a municipal level, but it is however a fact that a lack of sufficient job opportunities to accommodate economically active population, together with apartheid policies of influx control, has entrenched a migratory labour pattern in the country.

This pattern is very much evident from Census information, which indicates a discrepancy in the gender structure. Male absenteeism is higher in many rural areas. There are also females that form part of the migrant labour pattern, although substantially less than males.

Other demographic alterations could result from changes in perceived fertility, mortality and HIV/AIDS rates. According to data from StatisticsSA, the fertility rate has declined slightly from an average of 2,92 children per woman in 2001 to 2,35 children in 2011. While still high, the infant mortality rate has declined from an estimated 53 per 1 000 in 2001 to 38 per 1 000 in 2011.

Life expectancy at birth had declined between 2001 and 2005 but has since increased steadily from 2005 onwards to 2011, partly due to the roll-out of antiretrovirals. The increase in life expectancy at birth is expected to continue due to breakthroughs in medical technologies, improved education, improved living conditions, etc.

The total number of persons living with HIV in South Africa increased from an estimated 4,21 million in 2001 to 5,38 million by 2011. For 2011 an estimated 10,6% of the total population is HIV positive. Approximately one-fifth of South African women in their

reproductive ages are HIV positive. HIV prevalence is expected to increase going into the future.

The above demographic trends influencing population growth have been taken into account for both the growth scenarios designed for the MLM, which will be discussed in more detail in the following subsections.

5.3.1 Low growth scenario

For the low growth scenario, it is expected that natural population growth in the MLM will follow historical trends. Little development will take place within the municipal boundaries, due to fairly low economic growth and the lack of large industries establishing in the MLM. Due to low economic growth, in-migration into the area is expected to be low, as few additional employment opportunities will become available which normally attract large numbers of people. The prevalence of HIV is expected to increase steadily, putting further strain on population growth.

5.3.2 High growth scenario

In the high growth scenario, the local economy is expected to prosper, and new industries will establish in the MLM due to its strategic regional location in terms of especially the N4 Maputo Corridor. Due to increased development and new industries, employment opportunities are expected to increase, which in turn will attract more people from outside the municipal areas to the municipality. The major economic nodes in the municipality (Nelspruit, Hazyview and White River) will mostly be the preferred destination for jobseekers, not only from other the surrounding rural areas, other local municipalities and Provinces (especially Limpopo), but also from Mozambique.

Higher in-migration into the area will in turn require additional social (schools, hospitals, community centres, etc.) and infrastructure (water, electricity, sanitation, etc.) services, as well as housing development to accommodate the additional population moving into the area.

5.3.3 Very high growth scenario

The Low and High growth scenarios described in Sections 5.3.1 and 5.3.2 were based on baseline data from StatsSA. During the course of the study a factor previously not taken into account was incorporated into a ‘very high’ growth scenario. This is the proposed university in Nelspruit. The University will attract large numbers of people, which will increase the demand for housing and retail and commercial facilities which was not anticipated by StatsSA. This Very High growth scenario is dealt with in Section 8 as a very high water demand scenario.

5.4 POPULATION GROWTH FORECASTS

This subsection focuses on the modelling results obtained for the growth and distribution of population. Population growth depicts the estimated growth of the Mbombela municipal area, as well as in- and out-migration and internal migration within the area.

Before one can undertake future population estimations, an analysis of historic growth patterns is required. Mid-year population estimates by StatisticsSA are one of the information sources which have been used to inform future growth scenarios for the area. These estimates are however only provided on a national and provincial level, and have only been used as a reference to overall growth tendencies. **Figure 5.4** provides an indication of historical national and provincial population growth.

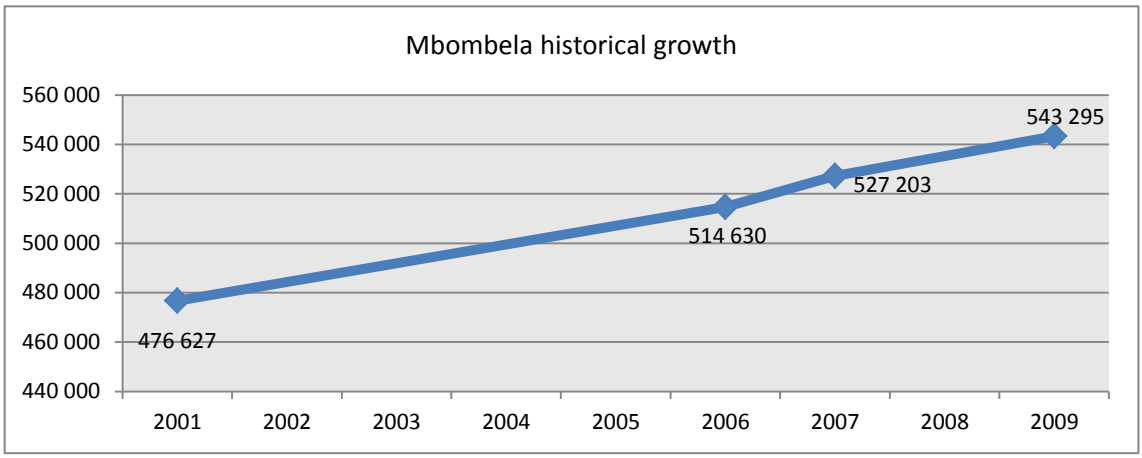


Figure 5.4: Historical population growth (Calculation based on StatsSA mid-year population estimates and provincial distributions)

As can be seen from **Figure 5.4,** the average annual population growth decreased on a national and provincial level, from 1,3% and 0,9% respectively to 1,1% and 0,8% respectively. SBC data for 2006 and 2009 for MLM can be used to provide a clearer picture of historical growth in the area. **Figure 5.5** illustrates the historical population growth for Mbombela, and is based on 2001 Census, 2006 SBC, 2007 Community Survey and 2009 SBC information.

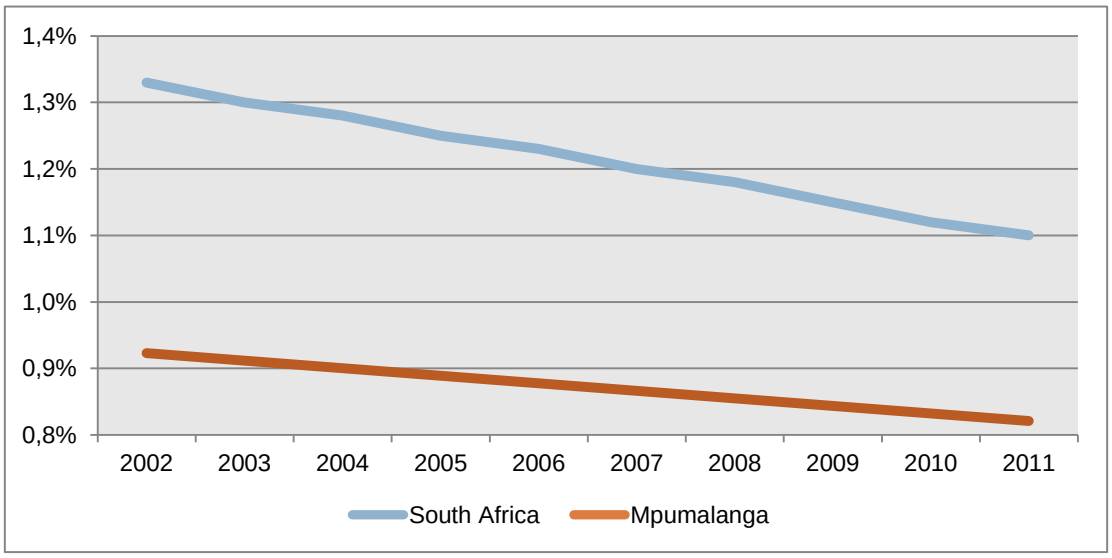


Figure 5.5: Mbombela historical growth

From **Figure 5.5** it is evident that the population of the MLM grew steadily between 2001 and 2009. The growth rate between 2001 and 2006 is 1,5%, after which the growth rate increases to 2,4% between 2006 and 2007. Between 2007 and 2009 growth however slows down to 1,8%. The total average annual growth rate over the entire time period between 2001 and 2009 in 1,6%, which is above both the national and provincial average growth rates. Building statistics can be used to give an indication of historical urban growth in a particular area, and **Figure 5.6** gives an illustration of historical urban growth in the MLM.

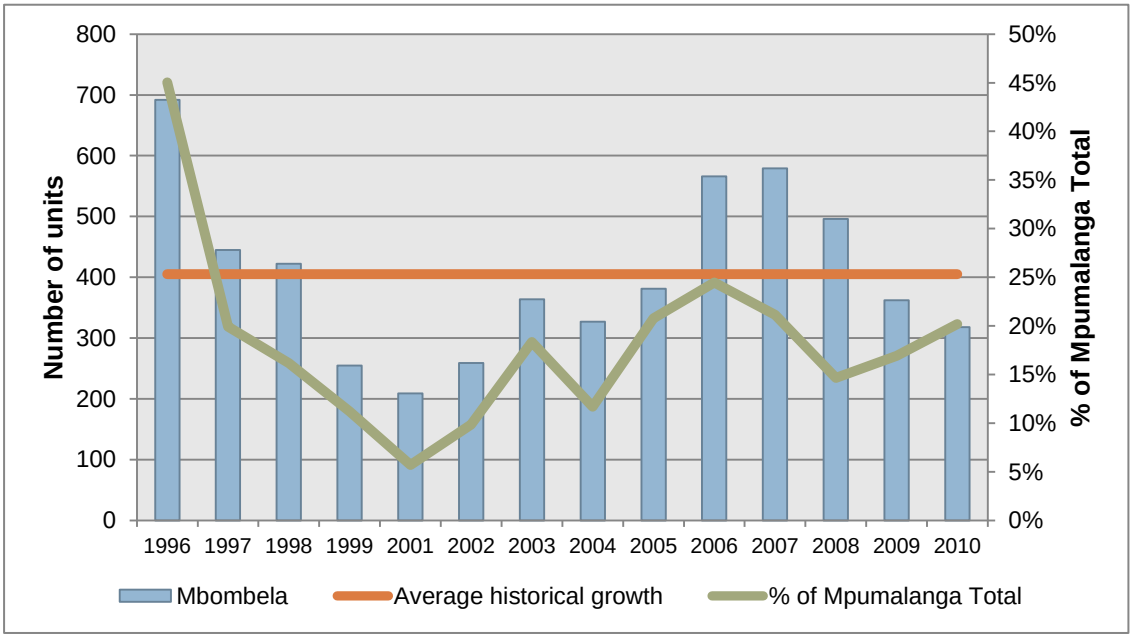


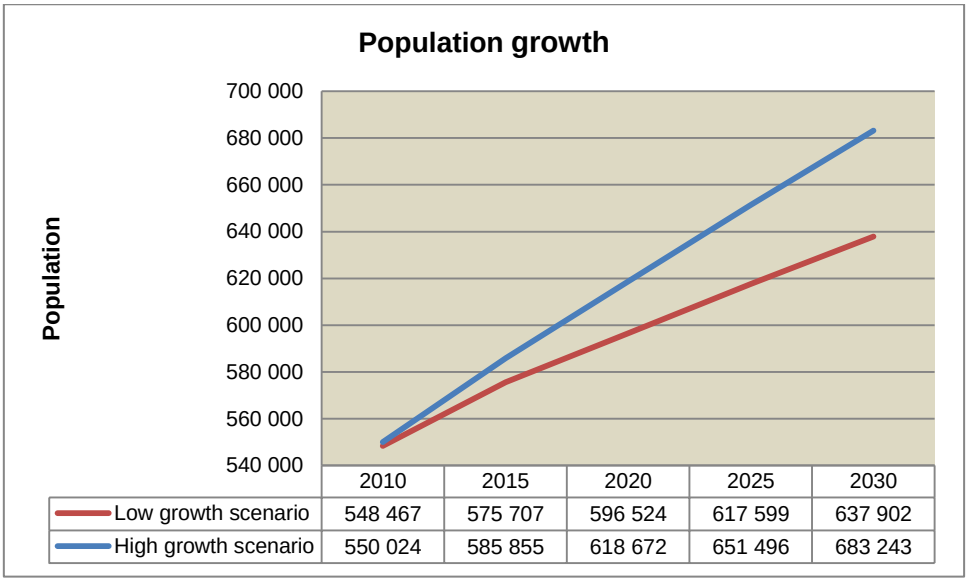
Figure 5.6: Historical urban growth (building statistics)

As can be seen in **Figure 5.6**, the number of units declined fairly sharply between 1996 and 2001, after which there was a noticeable increase. A slight decline is again evident in 2004,

as well as from 2008 onwards. It is important to note that on average, 18% of the buildings erected per year in the Mpumalanga province are located in the MLM.

5.4.1 Population growth

Figure 5.7 below shows the growth of population for the MLM over a 20 year period for the low and high growth scenarios.

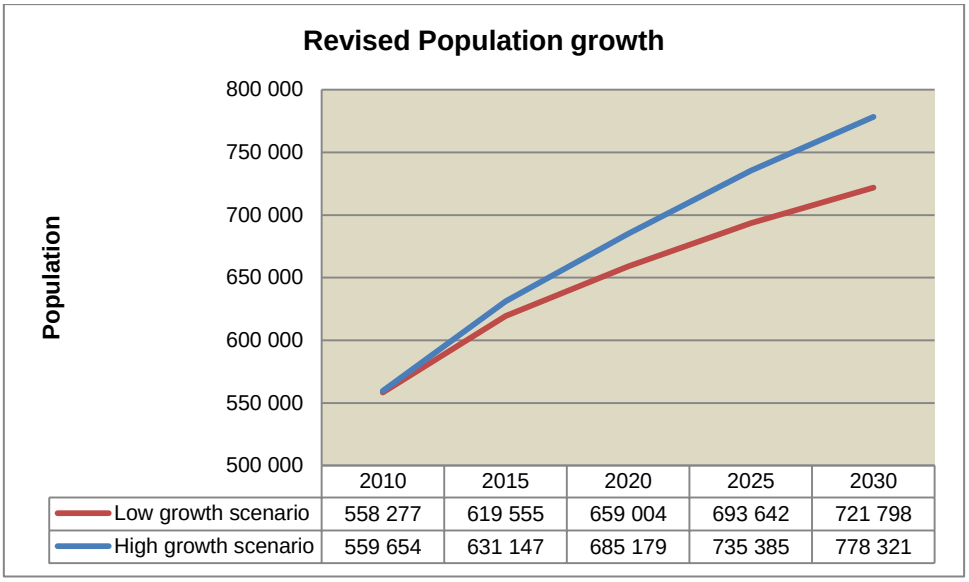


	2010	2015	2020	2025	2030
Low growth scenario	548 467	575 707	596 524	617 599	637 902
High growth scenario	550 024	585 855	618 672	651 496	683 243

Figure 5.7: Population growth in the Mbombela Local Municipality (2010 to 2030)

The population for the MLM for 2010 was determined to be 548 467 in the low scenario and 550 024 in the high scenario, which increased over a 20 year period by 89 435 people to 637 902 in the low growth scenario, and increased by 133 219 additional people to 683 243 in the high growth scenario. The average growth rate per 5 year interval over the 20 year period was 0,8% in the low growth scenario, and 1,1% for the high growth scenario, which means that an average of approximately 22 400 additional people have been added to the area per 5 year time-period in the low growth scenario, and approximately 33 300 people have been added to the area in the high growth scenario. The total difference in population as at 2030 between the low and high growth scenario is 45 341 people.

The revised population growth rates are shown in **Figure 5.8** below for MLM over a 20 year period for the low and high growth scenarios.

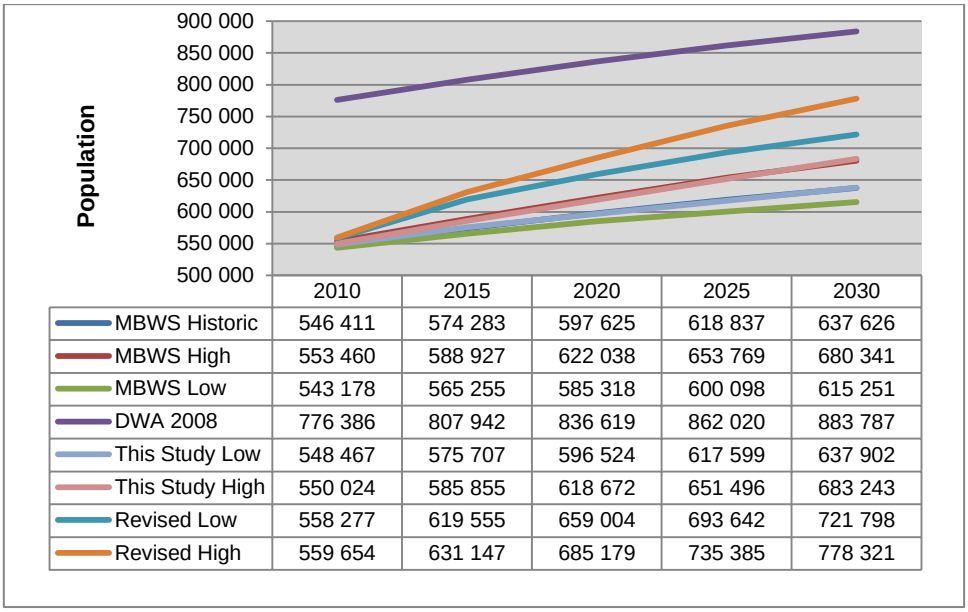


	2010	2015	2020	2025	2030
Low growth scenario	558 277	619 555	659 004	693 642	721 798
High growth scenario	559 654	631 147	685 179	735 385	778 321

Figure 5.8: Revised Population growth in the Mbombela Local Municipality (2010 to 2030)

The population for the MLM for 2010 was determined to be 558 277 in the low scenario and 559 654 in the high scenario, which increased over a 20 year period by 163 521 people to 721 798 in the low growth scenario, and increased by 218 667 additional people to 778 321 in the high growth scenario. The average growth rate per 5 year interval over the 20 year period was 1,3% in the low growth scenario, and 1,7% for the high growth scenario, which means that an average of approximately 39 180 additional people have been added to the area per 5 year time-period in the low growth scenario, and approximately 52 000 people have been added to the area in the high growth scenario. The total difference in population as at 2030 between the low and high growth scenario is 56 523 people.

Figure 5.7 indicating population growth up to 2030 in the MLM is based on modelling done by Kayamandi, and is compared to population growth scenarios from the MBWS and the WSDP (DWA 2008) in **Figure 5.9**.



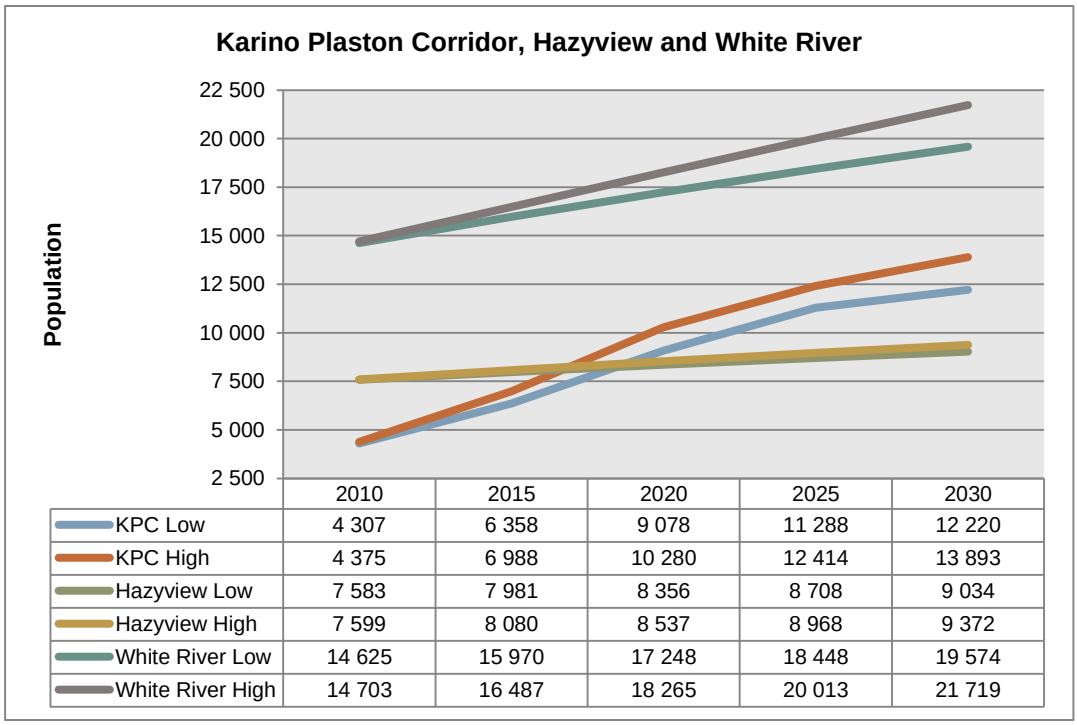
	2010	2015	2020	2025	2030
MBWS Historic	546 411	574 283	597 625	618 837	637 626
MBWS High	553 460	588 927	622 038	653 769	680 341
MBWS Low	543 178	565 255	585 318	600 098	615 251
DWA 2008	776 386	807 942	836 619	862 020	883 787
This Study Low	548 467	575 707	596 524	617 599	637 902
This Study High	550 024	585 855	618 672	651 496	683 243
Revised Low	558 277	619 555	659 004	693 642	721 798
Revised High	559 654	631 147	685 179	735 385	778 321

Figure 5.9: Mbombela population growth comparisons

As can be seen from **Figure 5.9**, the low growth scenario formulated as part of this study falls directly on top of the historic growth figure as highlighted in the MBWS. The average annual growth rates both for the Kayamandi low growth scenario and the MBWS historic growth scenario is 0,8%. The high growth scenario formulated by this study on the other hand falls directly on top of the high growth scenario as indicated in the MBWS. The average annual growth rate for the MBWS high growth scenario is 1%, while the average annual growth rate for the Kayamandi high growth scenario is 1,1%.

It is important to note how the population growth figure as indicated in the WSDP (DWA 2008) differs from all other base population figures. Despite this difference, the average annual growth rate for this growth scenario is 0,6%, which is in line with the average annual growth rate of 0,6% of the MBWS low growth scenario.

The total population for the Mbombela municipal area per 5-year interval up to 2030 have been split according to WDC, and is provided in the graphs below. **Figure 5.10** indicates low and high population growth in the KPC, Hazyview and White River WDCs, as estimated by Kayamandi as part of this study.



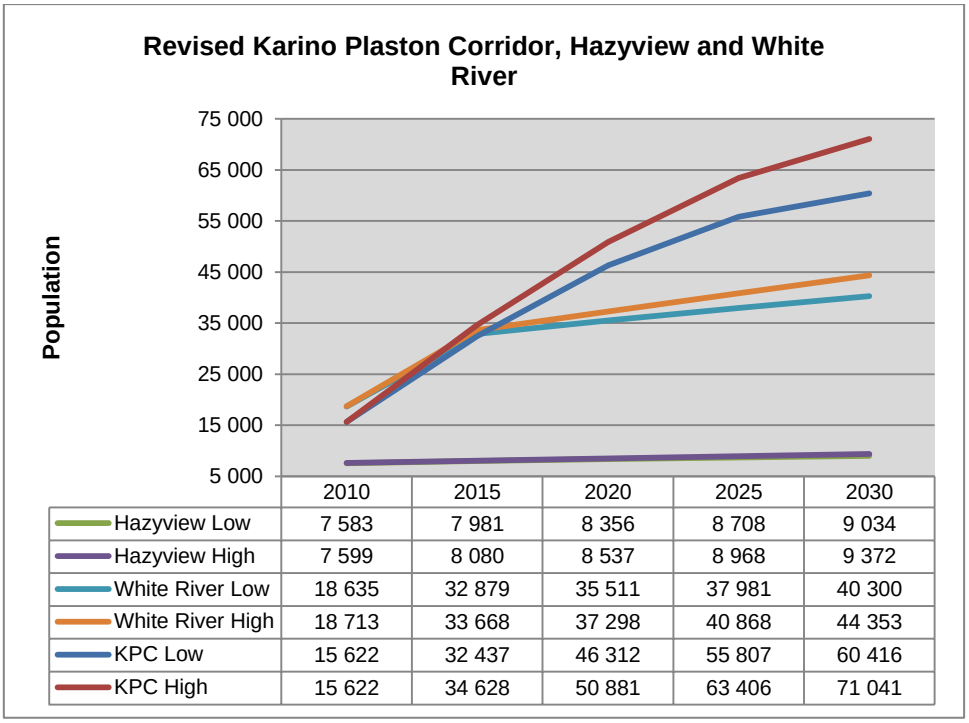
	2010	2015	2020	2025	2030
KPC Low	4 307	6 358	9 078	11 288	12 220
KPC High	4 375	6 988	10 280	12 414	13 893
Hazyview Low	7 583	7 981	8 356	8 708	9 034
Hazyview High	7 599	8 080	8 537	8 968	9 372
White River Low	14 625	15 970	17 248	18 448	19 574
White River High	14 703	16 487	18 265	20 013	21 719

Figure 5.10: Population growth in the Karino Plaston Corridor, Hazyview and White River WDCs

The population of the White River WDC is expected to grow steadily up to 2030, with an average growth rate of 1,5% in the low growth scenario, and 2,0% in the high growth scenario. The population of the Hazyview WDC is expected to increase slightly over the time period up to 2030, with an average growth rate of 0,9% in the low growth scenario, and 1,1% in the high growth scenario. The population growth rate of the KPC WDC is foreseen to be the highest, with an average growth rate of 5,4% in the low growth scenario, and 5,9% in the high growth scenario. Population growth in the KPC WDC is expected to be high between 2010 and 2015, after which it gradually slows down up to 2030.

Figure 5.11 indicates the revised low and high population growth in the KPC, Hazyview and White River WDCs.

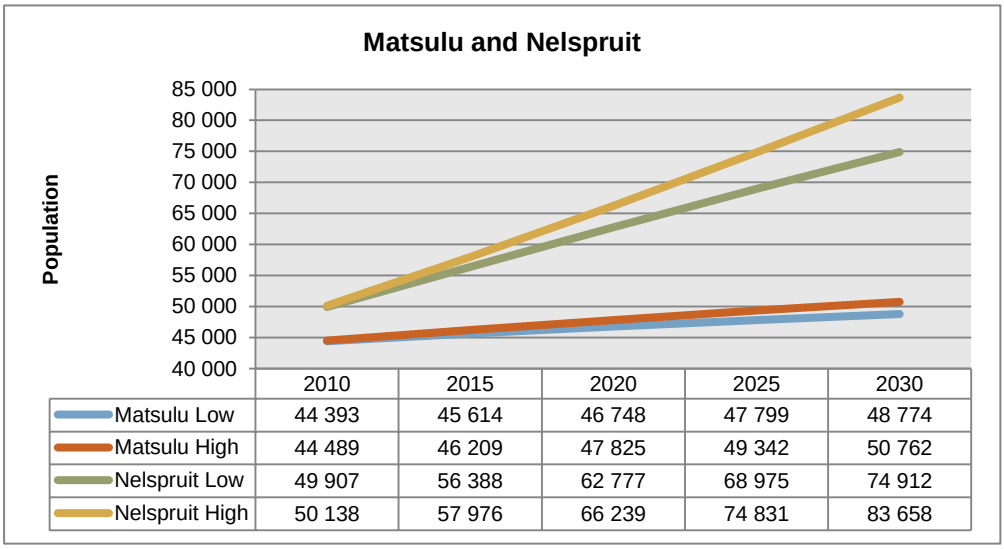
Based on the revised information the population of the White River WDC is expected to grow steadily up to 2030, with an average growth rate of 4,0% in the low growth scenario, and 4,4% in the high growth scenario. This is mainly due to the development at Phumulani since 2009. The population of the Hazyview WDC is expected to increase slightly over the time period up to 2030, with an average growth rate of 0,9% in the low growth scenario, and 1,1% in the high growth scenario. The population growth rate of the KPC WDC is foreseen to be the highest, with an average growth rate of 7,0% in the low growth scenario, and 7,9% in the high growth scenario mainly because of new developments around KMIA. Population growth in the KPC WDC is expected to be high between 2010 and 2015, after which it gradually slows down up to 2030.



	2010	2015	2020	2025	2030
Hazyview Low	7 583	7 981	8 356	8 708	9 034
Hazyview High	7 599	8 080	8 537	8 968	9 372
White River Low	18 635	32 879	35 511	37 981	40 300
White River High	18 713	33 668	37 298	40 868	44 353
KPC Low	15 622	32 437	46 312	55 807	60 416
KPC High	15 622	34 628	50 881	63 406	71 041

Figure 5.11: Revised population growth in the Karino Plaston Corridor, Hazyview and White River WDCs

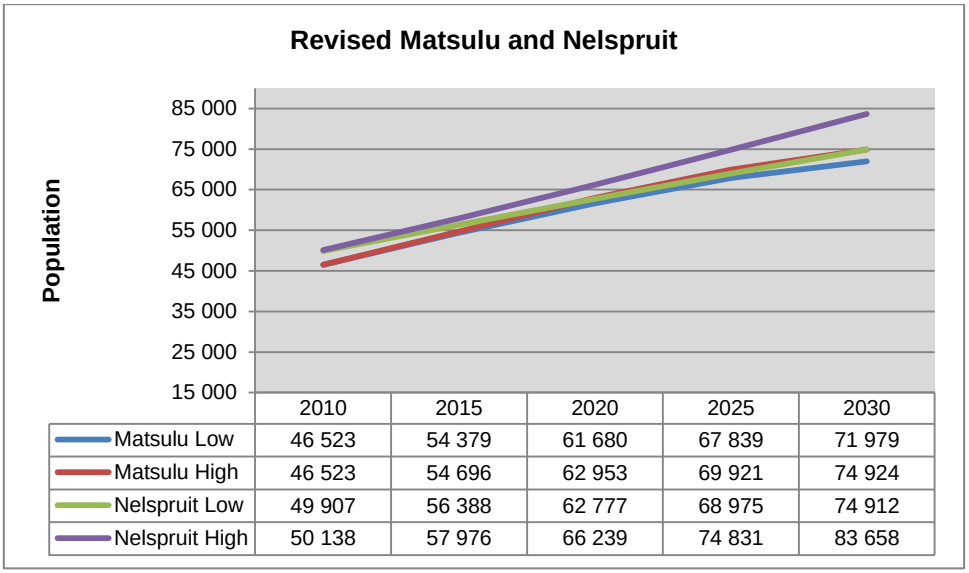
Figure 5.12 indicates population growth in the Matsulu and Nelspruit WDCs.



	2010	2015	2020	2025	2030
Matsulu Low	44 393	45 614	46 748	47 799	48 774
Matsulu High	44 489	46 209	47 825	49 342	50 762
Nelspruit Low	49 907	56 388	62 777	68 975	74 912
Nelspruit High	50 138	57 976	66 239	74 831	83 658

Figure 5.12: Population growth in the Matsulu and Nelspruit WDCs

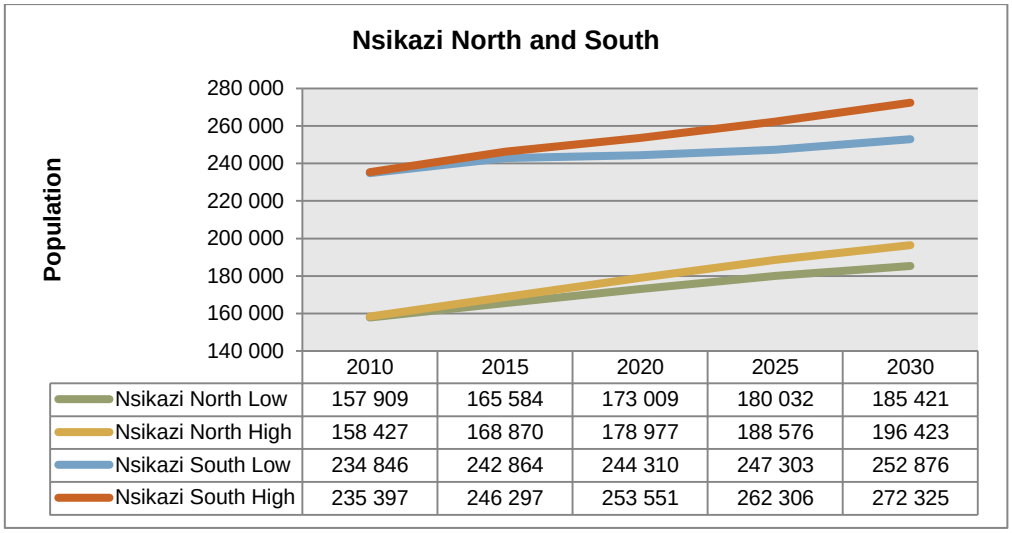
The population of the Nelspruit WDC is expected to grow steadily up to 2030, with an average growth rate of 2,1% in the low growth scenario, and 2,6% in the high growth scenario. The population of the Matsulu WDC increases slightly over the time period up to 2030, with an average growth rate of 0,5% in the low growth scenario, and 0,7% in the high growth scenario. **Figure 5.13** indicates the revised population growth in the Matsulu and Nelspruit WDCs.



	2010	2015	2020	2025	2030
Matsulu Low	46 523	54 379	61 680	67 839	71 979
Matsulu High	46 523	54 696	62 953	69 921	74 924
Nelspruit Low	49 907	56 388	62 777	68 975	74 912
Nelspruit High	50 138	57 976	66 239	74 831	83 658

Figure 5.13: Revised population growth in the Matsulu and Nelspruit WDCs

Figure 5.14 indicates population growth in the Nsikazi North and South WDCs.



	2010	2015	2020	2025	2030
Nsikazi North Low	157 909	165 584	173 009	180 032	185 421
Nsikazi North High	158 427	168 870	178 977	188 576	196 423
Nsikazi South Low	234 846	242 864	244 310	247 303	252 876
Nsikazi South High	235 397	246 297	253 551	262 306	272 325

Figure 5.14: Population growth in the Nsikazi North and South WDCs

An average growth rate of 0,4% in the low growth scenario and 0,7% in the high growth scenario is expected for the Nsikazi South WDC. A slight decline in growth is evident between 2015 and 2020 in both the low and high growth scenarios, after which the growth rate increases gradually up to 2030. The population of the Nsikazi North WDC increases steadily over the time period up to 2030, with an average growth rate of 0,8% in the low growth scenario, and 1,1% in the high growth scenario.

Figure 5.15 indicates the revised population growth in the Nsikazi North and South WDCs.

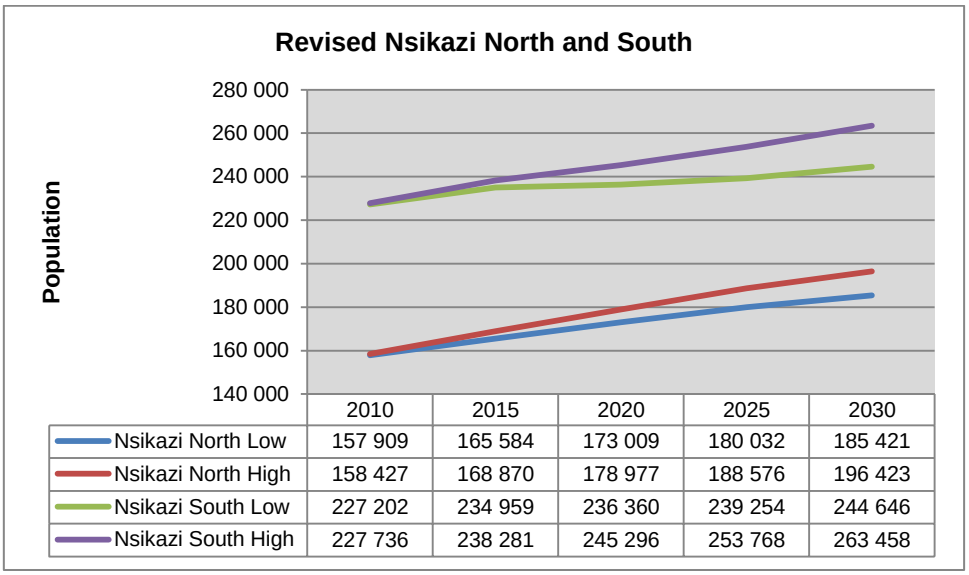


Figure 5.15: Revised population growth in the Nsikazi North and South WDCs

An average growth rate for the Nsikazi South WDC did not change only the base population changed. The population of the Nsikazi North WDC did not change.

It is important to note that in all WDCs, population growth have slowed down from 2010-2015 to 2025-2030. **Table 5.7** below provides a summary of population growth per WDC for the low and high growth scenarios.

Table 5.7: Summary of population growth per WDC

WDC	Growth scenario	2010-2015	2015-2020	2020-2025	2025-2030	2010-2030
Elandshoek	Low	2,4%	2,1%	1,8%	1,5%	**1,9%**
	High	2,4%	2,1%	1,8%	1,5%	**1,9%**
Hazyview	Low	1,0%	0,9%	0,8%	0,7%	**0,9%**
	High	1,2%	1,1%	1,0%	0,9%	**1,1%**
KPC	Low	8,1%	7,4%	3,8	1,6%	**5,4%**
	High	9,8%	8,0%	4,5	2,3%	**5,9%**
Matsulu	Low	0,5%	0,5%	0,4%	0,4%	**0,5%**
	High	0,8%	0,7%	0,6%	0,6%	**0,7%**
Nelspruit	Low	2,5%	2,2%	1,9%	1,7%	**2,1%**
	High	2,9%	2,7%	2,5%	2,3%	**2,6%**
Ngodwana	Low	0,0%	0,0%	0,0%	0,0%	**0,0%**
	High	0,0%	0,0%	0,0%	0,0%	**0,0%**
Nsikazi North	Low	1,0%	0,9%	0,8%	0,6%	**0,8%**
	High	1,3%	1,2%	1,1%	0,8%	**1,1%**
Nsikazi South	Low	0,7%	0,1%	0,2%	0,4%	**0,4%**
	High	0,9%	0,6%	0,7%	0,8%	**0,7%**
White River	Low	1,8%	1,6%	1,4%	1,2%	**1,5%**
	High	2,3%	2,1%	1,8%	1,6%	**2,0%**

Table 5.8 below provides a summary of the revised population growth per WDC for the low and high growth scenarios.

Table 5.8: Summary of revised population growth per WDC

WDC	Growth scenario	2010-2015	2015-2020	2020-2025	2025-2030	2010-2030
Elandshoek	Low	2,4%	2,1%	1,8%	1,5%	**1,9%**
	High	2,4%	2,1%	1,8%	1,5%	**1,9%**
Hazyview	Low	1,0%	0,9%	0,8%	0,7%	**0,9%**
	High	1,2%	1,1%	1,0%	0,9%	**1,1%**
KPC	Low	10,4%	6,0%	3,4	1,5%	**7,0%**
	High	11,0%	6,4%	4,0	2,1%	**7,9%**
Matsulu	Low	2,9%	2,4%	1,8%	1,2%	**2,2%**
	High	3,0%	2,6%	2,0%	1,3%	**2,4%**
Nelspruit	Low	2,3%	2,0%	1,8%	1,6%	**2,1%**
	High	2,7%	2,5%	2,3%	2,1%	**2,6%**
	Extra High	3,7%	4,8%	3,5%	2,7%	**3,7%**
Ngodwana	Low	0,0%	0,0%	0,0%	0,0%	**0,0%**
	High	0,0%	0,0%	0,0%	0,0%	**0,0%**
Nsikazi North	Low	1,0%	0,9%	0,8%	0,6%	**0,8%**
	High	1,3%	1,2%	1,1%	0,8%	**1,1%**
Nsikazi South	Low	0,7%	0,1%	0,2%	0,4%	**0,4%**
	High	0,9%	0,6%	0,7%	0,8%	**0,7%**
White River	Low	8,7%	1,5%	1,3%	1,2%	**3,9%**
	High	8,9%	1,9%	1,7%	1,6%	**4,4%**

5.4.2 Household growth

Figure 5.16 shows the growth in households over a 20 year period to 2030 for the MLM per the low and high growth scenarios.

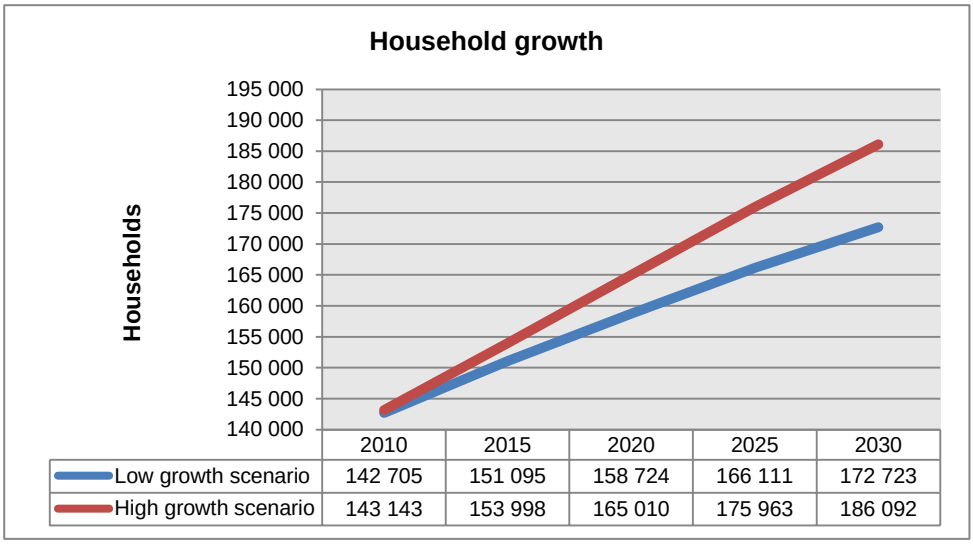


Figure 5.16: Household growth in the Mbombela Local Municipality (2010 to 2030)

The total number of households in the MLM for 2010 was determined to be 142 705 in the low scenario and 143 143 in the high scenario, which increased over a 20 year period by

30 018 additional households to 172 723 households in the low growth scenario, and increased by 42 949 additional households to 186 092 in the high growth scenario.

The average growth rate per 5 year interval over the 20 year period was 1,0% in the low growth scenario, and 1,3% for the high growth scenario, which means that an average of approximately 7 500 additional households have been added to the area per 5 year time-period in the low growth scenario, and approximately 10 700 households have been added to the area in the high growth scenario. The total difference in the number of households as at 2030 between the low and high growth scenario is 13 369 households.

The total number of households for the Mbombela municipal area per 5-year interval up to 2030 has been split according to WDC, and is provided in the **Table 5.9**.

Table 5.9: Number of households per WDC (2010-2030)

WDC	Growth scenario	2010	2015	2020	2025	2030
Elandshoek	Low	154	173	191	209	225
	High	154	173	191	209	225
Hazyview	Low	2 403	2 527	2 646	2 756	2 858
	High	2 408	2 559	2 702	2 834	2 961
KPC	Low	1 611	2 324	3 268	4 068	4 406
	High	1 637	2 557	3 722	4 500	5 044
Matsulu	Low	11 166	12 021	12 958	13 860	14 498
	High	11 203	12 259	13 389	14 477	15 293
Nelspruit	Low	14 391	16 462	18 379	20 309	22 179
	High	14 463	16 964	19 409	22 193	25 072
Ngodwana	Low	425	425	425	425	425
	High	425	425	425	425	425
Nsikazi North	Low	37 329	39 440	41 579	43 498	44 917
	High	37 455	40 246	43 082	45 657	47 742
Nsikazi South	Low	57 339	59 317	60 383	61 627	63 422
	High	57 482	60 211	62 801	65 703	68 703
White River	Low	5 252	5 770	6 259	6 723	7 157
	High	5 282	5 968	6 653	7 329	7 991

Aurecon did a count of structures and erven in the Nsikazi Area using 2007 aerial photography supplied by MLM as part of the 2009 Nsikazi Water Master Plan. Each structure and erf in each village was physically counted. The outcome of the count is shown in **Table 5.10**.

Table 5.10: Nsikazi Water Master Plan house count (MLM, 2007)

Area	Total Structures	Total Erven	Average Structures per Erven
Nsikazi North	40 436	35 440	1,14
Nsikazi South	69 653	59 239	1,18
TOTAL	**110 089**	**94 679**	

As part of this study house counts of Matsulu and KPC (the villages of Emoyeni, Mamelodi and Tekwane North) were done using the 2007 and 2011 aerial photographs supplied by MLM. The result of the house counts is shown in **Table 5.11** below.

Table 5.11: Matsulu and KPC house counts

Area	Total Structures 2007	Total Structures 2011	Growth Rate
Matsulu	10 528	11 983	3,3%
KPC	587	4 762	68,8%

The number of households in the Elandshoek WDC increase slightly over the time period up to 2030, with an average growth rate of 1,9% in the low and high growth scenarios. The number of households in the Hazyview WDC increase slightly over the time period up to 2030, with an average growth rate of 0,9% in the low growth scenario, and 1,0% in the high growth scenario.

The household growth rate of the KPC WDC is foreseen to be the highest, with an average growth rate of 5,2% in the low growth scenario, and 5,8% in the high growth scenario. Household growth in the KPC WDC is expected to be high between 2010 and 2015 after which it gradually slows down up to 2030. The number of households in the Matsulu WDC also increased over the time period up to 2030, with an average growth rate of 1,3% in the low growth scenario, and 1,6% in the high growth scenario.

The number of households in the Nelspruit WDC is expected to grow steadily up to 2030, with an average growth rate of 2,2% in the low growth scenario, and 2,8% in the high growth scenario. The number of households in the Ngodwana WDC is expected to grow stay stagnant up to 2030, with no average annual growth in the low or high growth scenarios.

An average growth rate of 0,5% in the low growth scenario and 0,9% in the high growth scenario is expected for the Nsikazi South WDC. A slight decline in growth is evident between 2015 and 2020 in both the low and high growth scenarios, after which the growth rate increases gradually up to 2030. The number of households of the Nsikazi North WDC increases steadily over the time period up to 2030, with an average growth rate of 0,9% in the low growth scenario, and 1,2% in the high growth scenario.

The number of households in the White River WDC is expected to grow steadily up to 2030, with an average growth rate of 1,6% in the low growth scenario, and 2,1% in the high growth scenario.

As is the case with population growth, it is important to note that in all WDCs, household growth have slowed down from 2010-2015 to 2025-2030. **Table 5.12** below provides a summary of household growth per WDC for the low and high growth scenarios.

Table 5.12: Summary of household growth per WDC

WDC	Growth scenario	2010-2015	2015-2020	2020-2025	2025-2030	2010-2030
Elandshoek	Low	2,4%	2,0%	1,8%	1,5%	**1,9%**
	High	2,4%	2,0%	1,8%	1,5%	**1,9%**
Hazyview	Low	1,0%	0,9%	0,8%	0,7%	**0,9%**
	High	1,2%	1,1%	1,0%	0,9%	**1,0%**
KPC	Low	7,6%	7,1%	4,5%	1,6%	**5,2%**
	High	9,3%	7,8%	3,9%	2,3%	**5,8%**
Matsulu	Low	1,5%	1,5%	1,4%	0,9%	**1,3%**
	High	1,8%	1,8%	1,6%	1,1%	**1,6%**
Nelspruit	Low	2,7%	2,2%	2,0%	1,8%	**2,2%**
	High	3,2%	2,7%	2,7%	2,5%	**2,8%**
Ngodwana	Low	0,0%	0,0%	0,0%	0,0%	**0,0%**
	High	0,0%	0,0%	0,0%	0,0%	**0,0%**
Nsikazi North	Low	1,1%	1,1%	0,9%	0,6%	**0,9%**
	High	1,4%	1,4%	1,2%	0,9%	**1,2%**
Nsikazi South	Low	0,7%	0,4%	0,4%	0,6%	**0,5%**
	High	0,9%	0,8%	0,9%	0,9%	**0,9%**
White River	Low	1,9%	1,6%	1,4%	1,3%	**1,6%**
	High	2,5%	2,2%	2,0%	1,7%	**2,1%**

The above information pertaining to household growth up to 2030 can be translated into a graph which indicates the estimated future growth of urban residential growth in the MLM. For the purposes of **Figure 5.17,** additional number of households in Nelspruit, White River and Hazyview have been plotted for the low and high scenario to provide an indication of estimated urban residential growth.

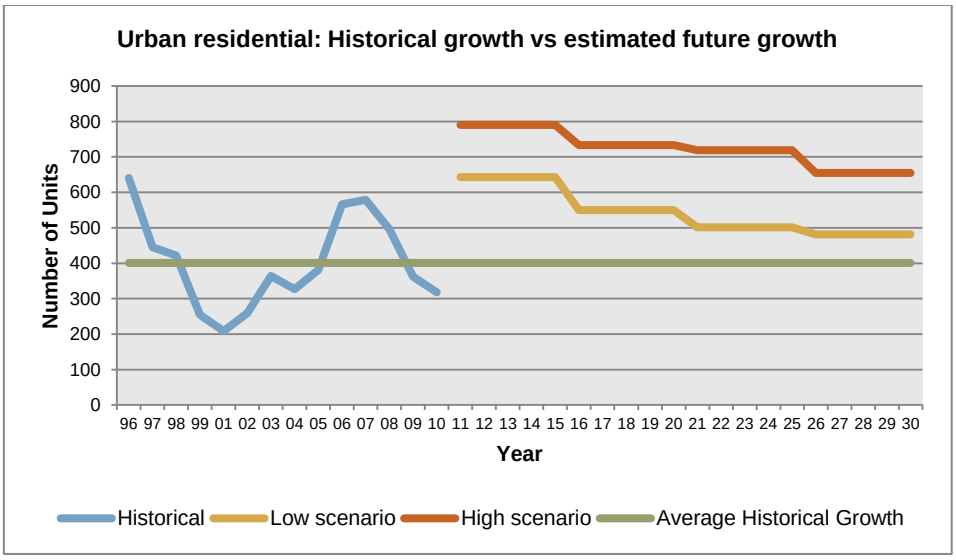


Figure 5.17: Urban residential growth

From the above graph, it is clear that there is a decrease in the additional number of households per 5-year period between 2010 and 2030. This trend is aligned to the declining household growth trend as discussed in the previous table, where growth rates decline per 5-year period up to 2030.

5.4.3 Household income

Household income can be closely linked to water demand, as water usage in higher income areas differ greatly to water usage in lower income areas. **Table 5.13** below provides an indication of the distribution of the various income categories per WDC. Low income refers to an annual household income of R0 to R38 400; middle income refers to an annual household income of R38 401 – R153 600; and high income refers to an annual household income of R153 601 and more.

Table 5.13: Household income distribution per WDC

WDC	Income category			TOTAL
	LOW	MIDDLE	HIGH	
Elandshoek	100%	0%	0%	100%
Hazyview	6%	44%	50%	100%
KPC	50%	43%	7%	100%
Matsulu	100%	0%	0%	100%
Nelspruit	15%	26%	59%	100%
Ngodwana, Kaapsehoop	100%	0%	0%	100%
Nsikazi North	100%	0%	0%	100%
Nsikazi South	66%	33%	1%	100%
White River	6%	61%	33%	100%

From **Table 5.13**, it is clear that the majority of WDCs in the MLM are comprised of low income households. The White River WDC is comprised of mainly middle income households, and Hazyview and Nelspruit are comprised of predominantly high income households.

6 ECONOMIC BASE DATA AND GROWTH SCENARIOS

This section deals with the economic components of the MLM, and seeks to provide a spectrum overview of the Gross Domestic Product (GDP) growth as well as the growth and distribution of employment and the sectoral share of economic functions. Together with the demographic overview of the municipal area as discussed in Section 5, this section will paint a holistic picture of the composition, strengths and future possibilities within the MLM.

In addition to this, this section seeks to provide an overview of economic growth scenarios specifically designed for the MLM. These growth scenarios have been taken forward and an economic growth forecast has been done whereby take-up of the commercial and industrial developments proposed is modelled to show growth in the local economy.

6.1 HISTORICAL PERSPECTIVE

In order to understand the MLM and all its components, reference must be made to GDP figures, sectoral GDP growth and distribution and employment statistics. This information would provide a picture of economic trends and impacts which could inform future growth and development in the MLM. For the purposes of this discussion, standardised industry data from 2001 onwards has been reviewed that has been captured per year. Data was analysed in two 5-year intervals (2001-2005 and 2006-2010) that correspond to the time periods used in the modelling.

6.1.1 Total GDP and GDP Growth

The total GDP per local municipality was extracted to indicate the contribution by the MLM to the national economy. **Table 6.1** indicates the GDP contribution (in R million) from 2001 to 2010.

Table 6.1: Total GDP (2001-2010) of the MLM (R millions at constant 2005 prices)

GDP (in R million) (Constant 2005 prices)									
2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
11 563	12 211	12 627	13 349	14 180	15 047	15 951	16 653	16 467	16 875

The information in **Table 6.2** below was calculated using the GDP figures per year as indicated in the above table.

Table 6.2: GDP growth of the Mbombela Local Municipality (2000 – 2010)

GDP Growth (Constant 2005 prices)										
00-01	**01-02**	**02-03**	**03-04**	**04-05**	**05-06**	**06-07**	**07-08**	**08-09**	**09-10**	**TOTAL**
5,6%	3,4%	5,7%	6,2%	6,1%	6,0%	4,4%	-1,1%	2,5%	5,6%	**4,3%**

The MLM experienced a positive growth trend over the time period, with a total growth over the time period of 4,3% per annum. A slight decline in growth is evident in the 2007-2008 time period, but the local economy recovered in the last two time periods.

The following information per local municipality will be discussed in the next subsections:

- Sectoral GDP and GDP growth;
- Sectoral contribution to GDP, and
- Employment per sector.

6.1.2 Sectoral GDP and GDP Growth

Table 6.3 below provides an indication of the GDP for the MLM and its economic sectors for the years 2001, 2005, 2006 and 2010. **Table 6.3** also provides an indication of the growth of the total economy as well as each sector between the time periods 2001-2005 and 2006-2010.

Table 6.3: Mbombela Local Municipality GDP and GDP growth per sector (R millions at constant 2005 prices)

Mbombela Local Municipality	GDP per sector				Growth per sector (%)	
	2001	2005	2006	2010	01-05	06-10
Agriculture, forestry and fishing	469	586	525	652	4,6	4,4
Mining and quarrying	315	453	495	325	7,5	-8,1
Manufacturing	2 232	2 752	2906	3226	4,3	2,1
Electricity, gas and water	235	298	310	300	4,8	-0,7
Construction	283	373	407	541	5,7	5,8
Wholesale and retail trade, catering and accommodation	1 949	2 112	2 219	2 265	1,6	0,4
Transport, storage and communication	1 309	1 575	1 615	1 713	3,8	1,2
Finance, insurance, real estate and business services	2 069	2 717	3 014	3 565	5,6	3,4
Community, social and personal services	975	1 209	1 320	1 559	4,4	3,4
General government	1 726	2 104	2 236	2 730	4,0	4,1
TOTAL	**11 563**	**14 180**	**15 047**	**16 875**	**4,2**	**2,3**

Between 2001 and 2005 the MLM showed an average annual growth rate of 4,2% which dropped to just above 2% between the years 2006 to 2010. Between 2001 and 2005 the municipality showed positive growth in all sectors of the economy of which mining and quarrying, construction and finance, insurance, real estate and business services sectors showed the highest growth, with annual growth rates of 7,5%, 5,7% and 5,6% respectively. The remaining sectors all showed growth between 4% and 5% except for the transport,

storage and communication sector, and the wholesale and retail trade, catering and accommodation sectors, which grew at 3,8% and 1,6% respectively.

The mining industry, which showed the highest growth between 2001 and 2005, showed a major decline in growth between 2006 and 2010, where declined by 8,1%. The electricity sector also incurred negative growth during this period by decreasing by 0,7%. The remaining sectors all showed a lower growth rate than in the first period, but maintained the positive growth previously experienced.

6.1.3 Sectoral Contribution to GDP

The contribution per sector to GDP for the MLM indicates which economic sector carries the largest weight and makes the largest contribution to the local economy. **Table 6.4** below highlights the contribution per sector to GDP.

Table 6.4: Mbombela Local Municipality economic sector contribution to total GDP

Mbombela Local Municipality	Contribution to GDP		
	2001	2005	2010
Agriculture, forestry and fishing	4%	4%	4%
Mining and quarrying	3%	3%	2%
Manufacturing	19%	19%	19%
Electricity, gas and water	2%	2%	2%
Construction	2%	3%	3%
Wholesale and retail trade, catering and accommodation	17%	15%	13%
Transport, storage and communication	11%	11%	10%
Finance, insurance, real estate and business services	18%	19%	21%
Community, social and personal services	8%	9%	9%
General government	15%	15%	16%
TOTAL	**100%**	**100%**	**100%**

In 2001 the highest contributing sector to the total GDP of the municipality was the manufacturing sector which contributed almost 20% of the total GDP. In conjunction, the finance, insurance, real estate and business services (18%), wholesale and retail trade, catering and accommodation (17%) and general government (15%) sectors were the dominant contributors to the total GDP of the municipality.

During 2005, the contributing roles that each sector played within the municipality's GDP continued with slight variations in contribution percentages. The manufacturing sector remained the highest contributing sector with a contribution of 19%, whilst the wholesale and retail trade, catering and accommodation sector showed a marginal decline to 15%, while the finance, insurance, real estate and business services sector increased its share contribution to 19%.

During 2010 the sectoral contribution to total GDP had once again changed and shifted marginally to the statistics from 2001 and 2005. The finance, insurance, real estate and business services sector increased its share contribution to 21%, whilst the general government sector increased its share to 16%. The contribution by the manufacturing sector remained unchanged, whilst smaller decreases were felt by the wholesale and retail trade, catering and accommodation and transport, storage and communication sectors.

6.1.4 Employment per sector

Table 6.5 below indicates the employment per sector for Mbombela Local Municipality, as well as the growth in employment over the two growth periods.

Table 6.5: Mbombela Local Municipality employment and employment growth per sector

Mbombela Local Municipality	Employment			Growth per sector	
	2001	2005	2010	01-05	06-10
Agriculture, forestry and fishing	21 029	17 752	9 798	-3,3%	-10,2%
Mining and quarrying	804	1 094	2 587	6,3%	14,9%
Manufacturing	15 728	15 203	9 931	-0,7%	-8,0%
Electricity, gas and water	1 103	777	798	-6,8%	0,4%
Construction	11 767	12 193	9 566	0,7%	-7,7%
Wholesale and retail trade, catering and accommodation	37 733	39 249	41 393	0,8%	0,0%
Transport, storage and communication	4 014	4 840	5 413	3,8%	1,3%
Finance, insurance, real estate and business services	14 547	18 411	23 551	4,8%	3,0%
Community, social and personal services	17 373	21 112	24 229	4,0%	1,5%
General government	14 009	17 733	25 211	4,8%	5,6%
TOTAL	**138 106**	**148 362**	**152 476**	**1,4%**	**-0,5%**

The average annual employment growth for the MLM during 2001 to 2005 was 1,4% per annum, which decreased to -0,5% in the 2006-2010 growth period. The highest growth within employment between 2001 and 2005 was within the mining and quarrying sector, which showed growth just above 6%, whilst other sectors such as transport, storage and communication, finance, insurance, real estate and business services, community, social and personal services and general government services showed growth between 3,8% and 4,8%. Negative growth was experienced by the electricity, gas and water sector (-6,8%) and the agriculture, forestry and fishing sector (-3,3%).

Between 2006 and 2010 the mining and quarrying sector continued its high growth in employment to almost 15%, whilst the general government sector also increased its growth

to just below 6%. The agriculture, forestry and fishing sector (-10,2%), the manufacturing sector (-8%) and the construction Sector (-7,7%) increased the negative growth that had been experienced in the first growth period. The electricity, gas and water sector which showed negative growth (-6,8%) between 2001 and 2005, showed improvements to 0,4%, whilst the remaining sectors all maintained positive growth, albeit at a slower rate than during the first growth period.

6.1.5 Historic Growth

Before the growth scenarios and estimated future commercial and industrial development can be discussed, it is necessary to provide a snapshot of historical economic growth. **Figure 6.1** provides an indication of historic commercial and industrial growth in the MLM.

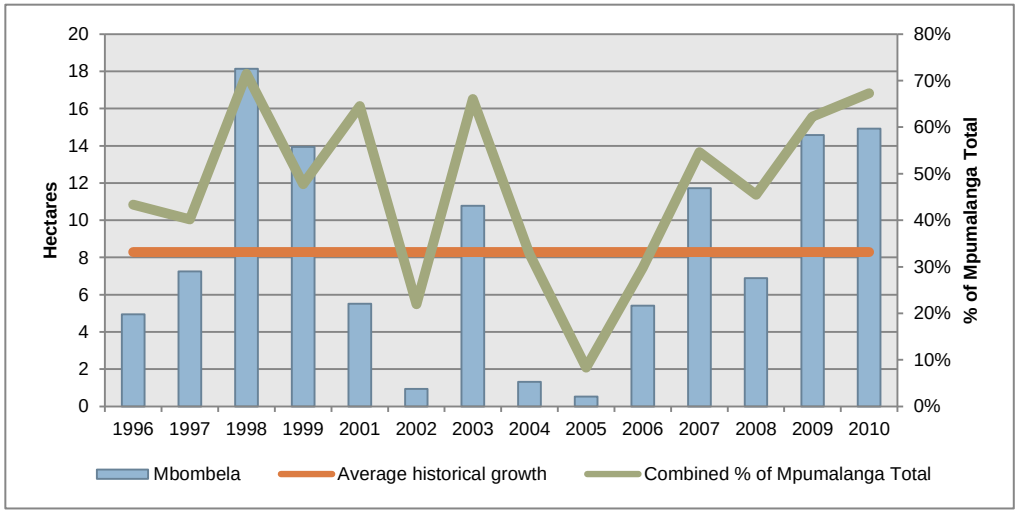


Figure 6.1: Historical economic growth (building statistics)

As can be seen from **Figure 6.1**, the area of land developed for commercial and industrial purposes rose fairly sharply between 1996 and 1998, after which a decline is evident up to 2002. In 2003, a massive spurt is evident followed by a decline. From 2005 onwards, a steady increase is visible, with a decline in 2008. It is important to note that on average, 47% of the commercial and industrial land developed per year in the Mpumalanga province is located in the MLM.

6.2 GROWTH SCENARIOS

It is necessary to develop different growth scenarios for economic development, as it is impossible for all the smaller settlements and service areas in the MLM to grow at the same rate as larger economic nodes such as Hazyview, White River and Nelspruit as various factors affect each area according to their individual characteristics. Two scenarios have been developed (low and high growth) to take into account various development determinants or push and pull factors that could bring about alterations in economic growth and development patterns. The following economic development determinants have been identified as likely factors to cause different water resource responses:

- Gross Domestic Growth (GDP) growth;
- Employment;

- Income, and
- Poverty levels, etc.

In addition to the above, strategic processes and forces such as political, administrative and spatial manifestations, anchor projects, etc. can influence water demand, and need to be taken into account.

It is important to describe what comprises economic determinants that will support the development of suitable scenario adjustments for water planning purposes, based on the economic determinants and projections that are known to be true today. Higher or lower economic growth (represented by GGP) directly results in higher or lower capital available for social services (e.g. schools, clinics) and infrastructural services (e.g. water, electricity, etc.) delivery. The economy could grow faster in line with government policies, economic interventions and major projects, or it could show slower growth rates if policy directives and major interventions are not put into action.

It is thus important to have a perspective on relevant factors that presently have an impact and those that may have an impact on the economic activities practised. This perspective is important for the purposes of this study as these economic activities together with their scale and the level of intensity determine the direction and the monetary value of the economy of areas. Economic factors determine (or influence) the economy in terms of its sectoral structure, monetary value and spatial locations.

South Africa is faced with the consequences of a 'living' case in point where policy factors such as the former government policy of segregated development have given form and structure to the current spatial development pattern. Therefore, it is clear that political and economic forces and processes, as in the past, could largely determine future settlement patterns. Decisions manifest in policies and for implementation and are enforced by means of legislation promulgated by national government. These development determinants could assist in identifying higher growth areas (with a resultant lower growth in other areas) than would have occurred naturally due to economic interventions in the form of growth points, nodes, corridors, etc.

The stimulation of fewer but larger growth points, nodes, corridors and population concentrations (in line with policy directives) would inevitably result in the concentration of consumer spending power, which could in turn stimulate economic development in these priority development nodes, corridor routes, strategic development areas and flagship projects with regards to tourism, mining, agriculture, industry, etc. In other words the premise of this determinant is that economic policy and interventions (at national, provincial, and local levels) could alter the flow of people.

6.2.1 Low Growth Scenario

For the low growth scenario, it is expected that little development will take place within the municipal boundaries, due to fairly low economic growth and the lack of large industries establishing in the MLM. Due to low economic growth and little movement in the local markets, investment into the area is expected to be fairly low. Due to low economic growth, in-migration into the area is expected to be low, as few additional employment opportunities

will become available which normally attract large numbers of people. In this scenario, unemployment and poverty is foreseen to stay fairly constant, ad will remain high in the rural areas.

6.2.2 High Growth Scenario

In the high growth scenario, the local economy is expected to prosper, and new industries will establish in the MLM due to its strategic regional location in terms of especially the N4 Maputo Corridor. Due to increased development and new industries, employment opportunities are expected to increase, which in turn will influence household income, and subsequently expenditure patterns. The major economic nodes in the municipality (Nelspruit, Hazyview and White River) will mostly be the preferred destination for investors, and will grow the fastest of all the nodes in the municipal area. Higher in-migration into the area due to additional employment opportunities will in turn stimulate commercial development.

6.3 ECONOMIC GROWTH FORECAST

This section will seek to provide information concerning the economic growth within the MLM based on results obtained from the modelling process. The economic growth results focuses on providing information and an overview of the proposed commercial and industrial land in the study area, as well as the determined take-up and utilisation of this land. This growth forecast provides an indication of the required future land for economic growth and the expected take-up rate and location of developments.

6.3.1 Take-up of Commercial Land

Figure 6.2 provides an indication of the expected take-up of commercial land in the MLM up to 2030.

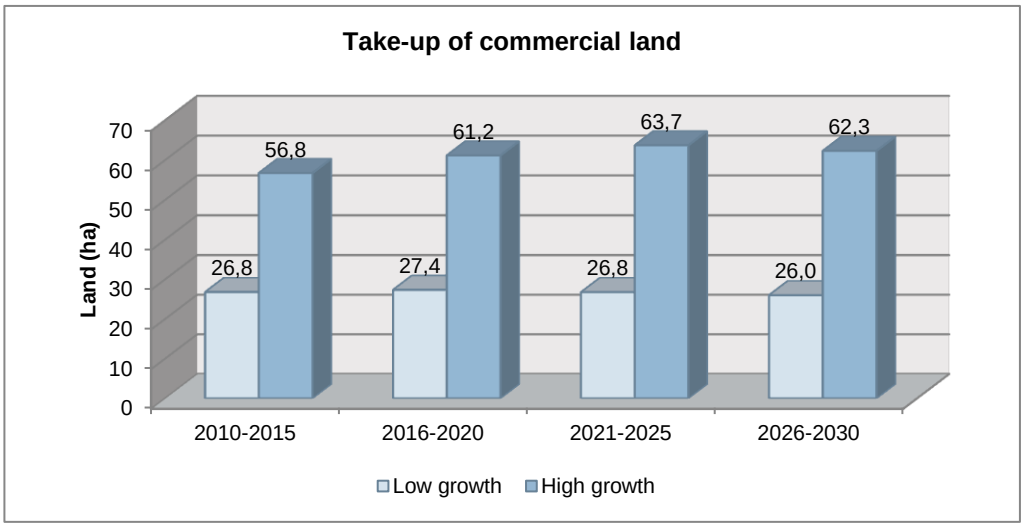


Figure 6.2: Take-up of commercial land in the Mbombela Local Municipality

Modelling results indicate that approximately 27 ha of commercial land will be developed up to 2015 in the low growth scenario, as opposed to nearly 57 ha in the high growth scenario.

Between 2016 and 2020, approximately 27 ha of commercial land will be developed in the low growth scenario, while approximately 61 ha of commercial land is foreseen to develop in the high growth scenario.

Approximately 27 ha of commercial land is expected to be developed in the 2021-2025 time period in the low growth scenario, while nearly 64 ha of land will be developed in the high growth scenario. In the last time period (2026-2030), 26 ha of commercial land will be developed in the low growth scenario, while just over 62 ha of land are expected to be developed in the high growth scenario.

The total foreseen commercial development in the Mbombela municipal area per 5-year interval up to 2030 has been split according to WSA. No commercial development is expected to take place in the Elandshoek, Matsulu or Ngodwana WDCs. The bulk of land for commercial development is located in the Nelspruit WDC, with an average of 75% of commercial land foreseen to develop being located in the Nelspruit WDC.

Figure 6.3 indicates the take-up of commercial land in the Nelspruit WDC.

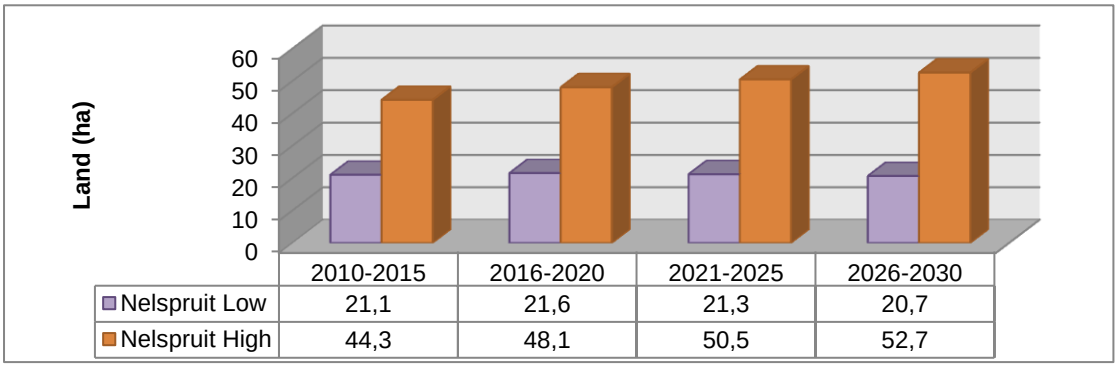
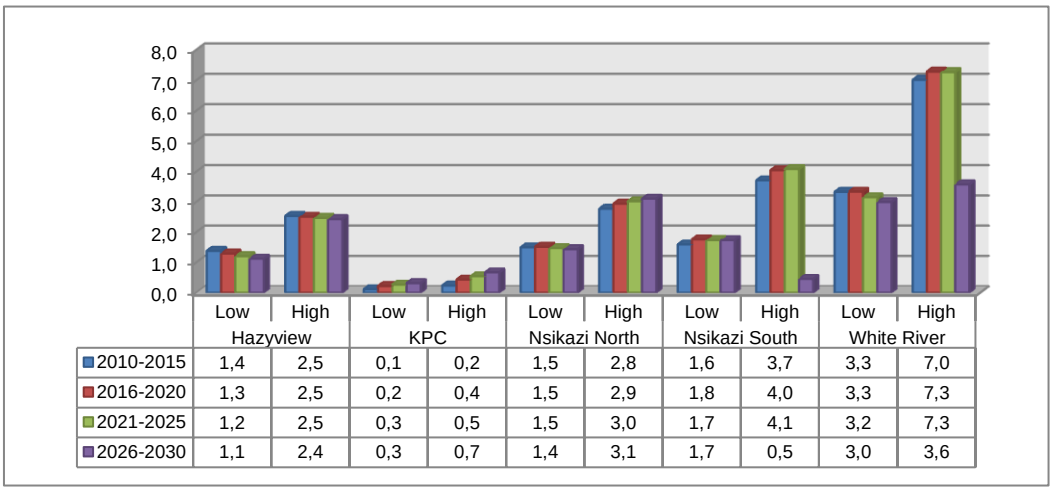


Figure 6.3: Take-up of commercial land in the Nelspruit WDC

In the low growth scenario, a total of approximately 85 ha of commercial land is foreseen to develop in the Nelspruit WDC, as opposed to nearly 196 ha of commercial land foreseen to develop in the high growth scenario. The bulk of commercial land is expected to develop between 2016 and 2020 in the low growth scenario (21,6 ha), and between 2026 and 2030 (52,7 ha) in the high growth scenario.

Figure 6.4 indicates the take-up of commercial land in the Hazyview, KPC, Nsikazi North and South and White River WDCs.



	Hazyview		KPC		Nsikazi North		Nsikazi South		White River	
	Low	High	Low	High	Low	High	Low	High	Low	High
2010-2015	1,4	2,5	0,1	0,2	1,5	2,8	1,6	3,7	3,3	7,0
2016-2020	1,3	2,5	0,2	0,4	1,5	2,9	1,8	4,0	3,3	7,3
2021-2025	1,2	2,5	0,3	0,5	1,5	3,0	1,7	4,1	3,2	7,3
2026-2030	1,1	2,4	0,3	0,7	1,4	3,1	1,7	0,5	3,0	3,6

Figure 6.4: Take-up of commercial land in remaining WDCs

A total of approximately 12,8 ha of commercial land is expected to be developed in the White River WDC in the low growth scenario, while a total of just more than 25 ha of land is expected to be developed in the high growth scenario. A total of nearly 7 ha of commercial land is expected to be developed in the Nsikazi South WDC in the low growth scenario, while a total of just over 12 ha is foreseen to develop in the high growth scenario. A total of approximately 5,9 ha of commercial land is expected to be developed in the Nsikazi North WDC in the low growth scenario, while a total of just under 12 ha of land is expected to be developed in the high growth scenario.

A total of 5 ha of commercial land is expected to be developed in the Hazyview WDC in the low growth scenario, while a total of 10 ha is foreseen to develop in the high growth scenario. Lastly, a total of nearly 1 ha of commercial land is expected to be developed in the KPC WDC in the low growth scenario, while a total of approximately 2 ha is foreseen to develop in the high growth scenario.

Therefore, a total of approximately 116 ha of commercial land is expected to develop up to 2030 in the low growth scenario, while nearly 257 ha of commercial land is expected to develop in the high growth scenario. In the low growth scenario, a total of 29,0 ha of commercial land is foreseen to develop between 2010 and 2015, 29,8 ha between 2016 and 2020, 29,1 ha between 2021 and 2025, and 28,3 ha between 2026 and 2030. In the high growth scenario, a total of 60,5 ha of commercial land is foreseen to develop between 2010 and 2015, 65,4 ha between 2016 and 2020, 67,9 ha between 2021 and 2025, and 62,9 ha between 2026 and 2030.

Figure 6.5 indicates the additional amount of developed commercial and industrial land in the MLM according to the low and high growth scenarios, and compares this to historical growth.

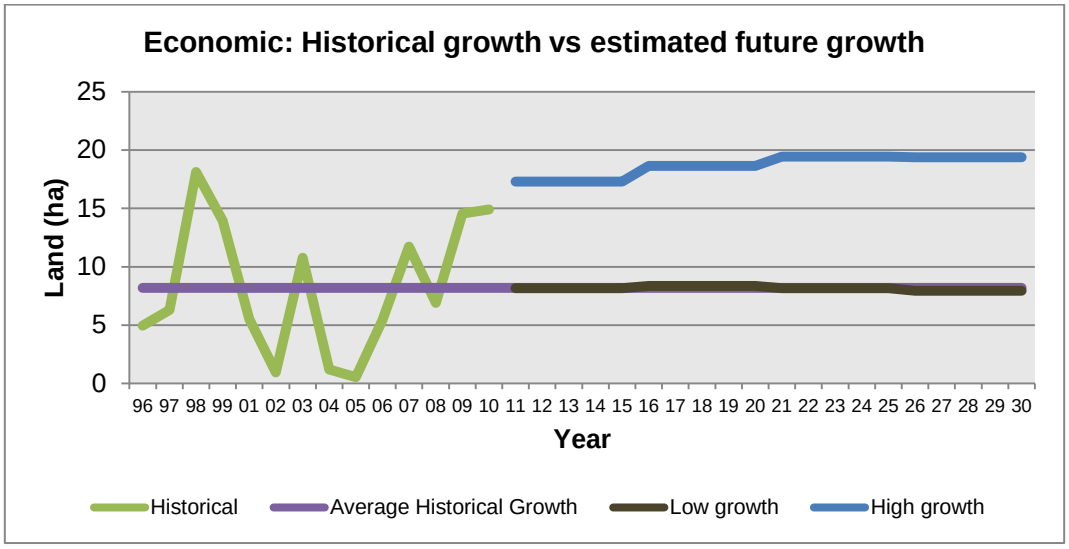


Figure 6.5: Commercial and industrial growth

From the above graph, it is clear that there is an increase in the amount of economic land per 5-year period up to 2020 in the high growth scenario. From 2021 to 2030, the amount of economic land stays constant. In the low growth scenario, the estimated future growth of economic land is aligned to average historical growth, with very slight variations. This trend confirms that the low growth scenario is based on historic development in the MLM.

7 SUMMARY AND INDICATION OF FUTURE LAND REQUIREMENTS

7.1 ECONOMIC SYNTHESIS

This section seeks to synthesise the low and high demographic and economic growth scenarios by providing insights into the future requirements for residential and economic land in the MLM. The availability of land as resource has become a pressing matter and the acquisition and utilisation thereof requires a lot of mitigation. This section will therefore provide an indication of future land requirements in order to provide some reference to the amount of land that would be required in order to fulfil the required development objectives.

Table 7.1 below gives an overview of the take-up of commercial and industrial land per 5-year interval for the various WSAs in the MLM.

Table 7.1: Take-up of commercial and industrial land per 5-year interval per WSA

WSA	Low growth scenario				High growth scenario			
	2015	2020	2025	2030	2015	2020	2025	2030
Elandshoek	0	0	0	0	0	0	0	0
Hazyview	2,0	1,8	1,7	1,6	3,6	3,5	3,5	3,4
KPC	2,2	2,8	3,1	3,3	4,5	5,8	6,4	6,9
Matsulu	0	1,0	2,0	3,0	5,0	6,0	7,0	8,0
Nelspruit	22,7	23,3	22,9	22,2	48,0	52,3	55,0	57,5
Ngodwana	0	0	0	0	0	0	0	0
None	0	0	0	0	0	0	0	0
Nsikazi North	1,5	1,5	1,5	1,4	2,8	2,9	3,0	3,1
Nsikazi South	1,6	1,8	1,7	1,7	3,7	4,0	4,1	0,5
White River	13,1	13,0	12,3	11,7	27,7	28,9	29,4	26,1
TOTAL	**43,1**	**45,1**	**45,2**	**45,0**	**95,3**	**103,4**	**108,4**	**105,5**

7.2 FUTURE LAND REQUIREMENTS

The total future land requirements are based on the high scenario modelling results, and have been divided into residential and economic land requirements per WDC. **Figure 7.1** illustrates the total future land requirements in the Mbombela Local Municipality.

The Nelspruit WSA has the greatest residential land requirements, followed by White River WSA and the Karino Plaston WDC. These areas are expected to experience the highest average annual population growth, as previously discussed. The Karino Plaston Corridor WDC and Nsikazi South WDCs have fairly similar residential land requirements, with Nsikazi South WSA having slightly lower land requirements.

The greatest economic land requirements exist in the Mbombela WDC where commercial and retail developments are concentrated, followed by White River WDC and Karino Plaston Corridor WDC. Hazyview WDC has slightly less economic land requirements than the Karino Plaston Corridor WDC, but more than Nsikazi North and South WDC (the only other WDCs with economic land requirements).

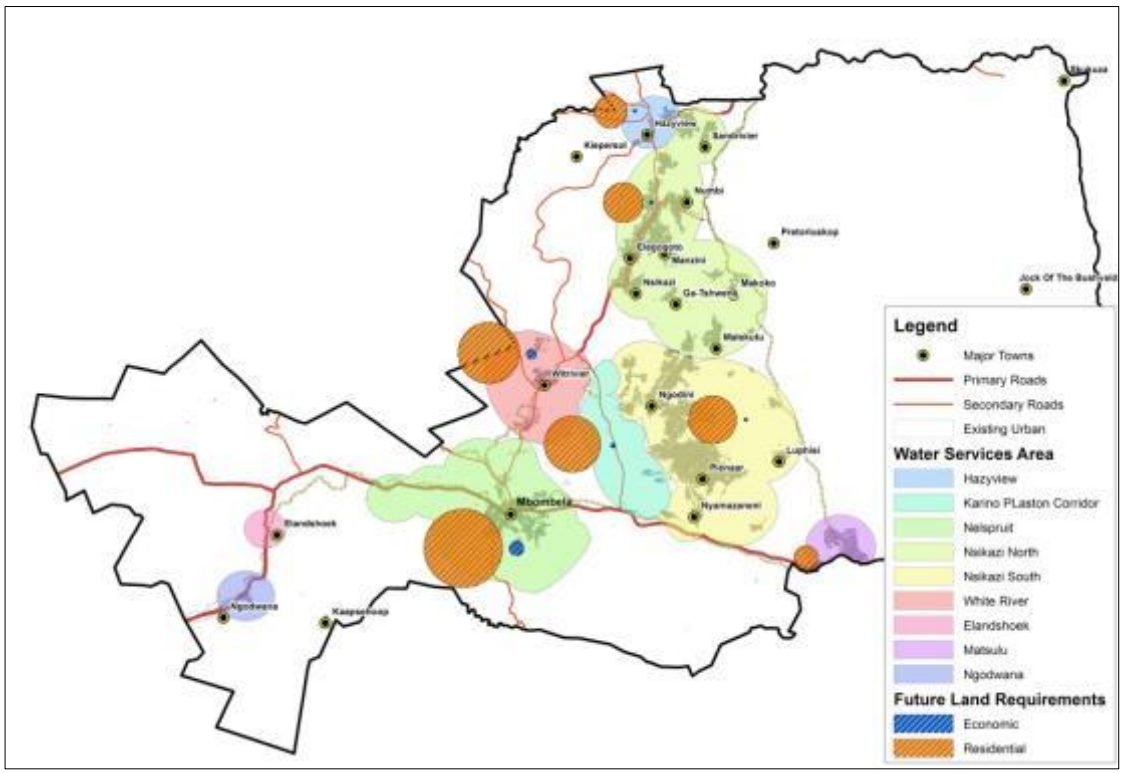


Figure 7.1: Future land requirements

7.3 FUTURE GROWTH AND DEVELOPMENT EXPECTATIONS

To conclude, future growth and development in the MLM is expected to be concentrated into various nodes and corridors in especially the Mbombela Golden Triangle, as illustrated in **Figure 7.2** below. In addition to this, there is a focus on development along major transport routes such as the N4 highway (Maputo Corridor/Southern Axis), the R40 (Nelspruit-White River Corridor / Western Axis) and the Eastern Development Corridor (Hazyview to Kanyamazane / Eastern Axis).

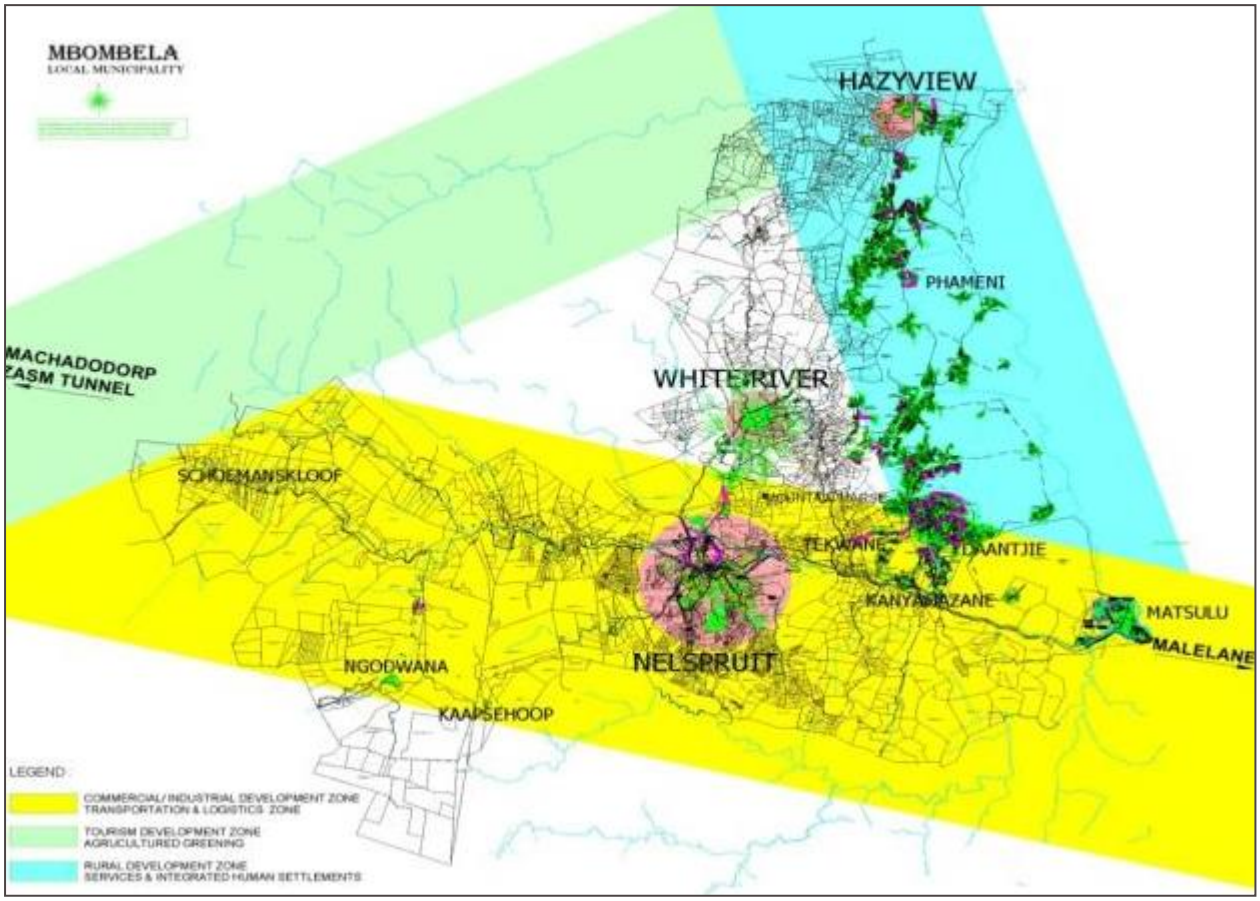


Figure 7.2: The Mbombela Golden Triangle

Focus is also placed on compacting the city and the provision of urban edges to stimulate densification and infill development in strategic areas, and to combat urban sprawl. Nodal development is focussed on primary activity nodes such as Nelspruit, White River and Hazyview, and community activity nodes such as Phola, Kabokweni, and Kanyamazane.

Development in the MLM is however hampered by varied topography, the location of protected areas and low service levels along the eastern boundary of the municipality.

8 CURRENT URBAN AND INDUSTRIAL WATER DEMAND ESTIMATES

8.1 BACKGROUND

This section deals with the current water requirements of each of the WDCs. The information box below gives an indication of excepted water supply design standards.

There are also the opinion that these standards are very high compared to the world average and actual usage in various metros and municipalities in South Africa.

The User Guidelines and Reference Manual for the Conceptual Planning and Costing of Community Water Supply Schemes (DWAF, 1998) specifies the following ranges for different levels of service for unit domestic water use.

Standard of Living	Level of Service	Range and average per capita daily water use (ℓ/capita/day)
Low	Standpipe	Range: 5 – 45 Average: 35
Medium	Yard connection	Range: 35 – 80 Average: 60
High	Kitchen connection	Range: 50 – 140 Average: 120
High	Fully reticulated	Range: 60 - > 350 Average: 250

The guideline also specify that water losses considerably add to the total volume of water required and therefore necessitate an incremental size increase in the various components of the water supply system. Guidelines suggested by DWAF (1997) are as follows:

- *Treatment works 10%*
- *Bulk water pipelines 10%*
- *Reticulation 10%*

Un-accounted for water generally exceeds 15%.

DWAF (1996) has provided guidelines for other water users and these are given below:

- *schools 15 ℓ/pupil/day, for pupils from outside the community*
- *bus and taxi ranks 15 ℓ/user/day, for people from outside the community*

Other water use not specifically addressed in the DWAF guidelines, but which may require considerable volumes of water are given below with an indication of the possible water needs:

- *Clinics and hospital 220 - 300 ℓ/bed/day*
- *Irrigated communal gardens $50m^3$/ha/day*
- *Police stations and administrative offices 100 -120 ℓ/office/day*
- *Sports fields $50m^3$/ha/day*
- *Industrial development (water needs are site specific. The user is cautioned that this water use may comprise a large percentage of the total water use of the community)*
- *Commercial*

Table 8.1: The Guidelines for Human Settlement Planning and Design, Volume 2, (Department of Housing, 2000)

Water Consumption in areas equipped with standpipes, yard connections and house connections (adapted from the DWAF 1999: Guidelines for the selection of design criteria)		
Domestic Water Consumption		
Type of water supply	*Typical Consumption (ℓ/c/d)*	*Range (ℓ/c/d)*
Standpipe (200 m walking distance)	*25**	*10 – 50*

Water Consumption in areas equipped with standpipes, yard connections and house connections (adapted from the DWAF 1999: Guidelines for the selection of design criteria)		
Domestic Water Consumption		
Yard connection	*55*	*50 – 100*
With dry sanitation		*30 – 60*
With LOFLOs		*45 – 75*
With full-flush sanitation		*60 – 100*
House connection (developed areas)#		*60– 475*
Development level: Moderate	*80*	*48 – 98*
Moderate to high	*130*	*80 – 145*
High	*250*	*130 – 280*
Very high	*450*	*260 – 480*

** This consumption of 25 ℓ/c/d is the minimum to be made available per person in terms of government policy.*

 # The water demand in this category, based on a different approach, is also given

Table 8.2: Non Domestic Water Demand

Non Domestic Water Demand	
Non-Domestic User	***Water Demand***
Schools: day	*15 – 20*
boarding	*90 – 140*
	litres/pupil/day
Hospitals	*220 – 300*
	litres/bed/day
Clinics	*5 – outpatients*
	40 – 60 in-patients
	litres/bed/day
Bus stations	*15 – for those persons outside the community*
	litres/user/day
Community halls/restaurants	*65 – 90*
	litres/seat/day

8.2 NELSPRUIT AND SURROUNDS

Water for Nelspruit is abstracted from the Crocodile River via a diversion weir and unlined canal. The water is treated at the Nelspruit water treatment plant and distributed. Water that is not treated continues to flow along the canal which feed the agricultural college, the golf course and irrigators located immediately east of Nelspruit.

8.2.1 Domestic water use

The current domestic use in Nelspruit is estimated at 9,07 million m^3/a (24,84 Mℓ/day). This was derived from Mbombela Municipality's metered water use.

A factor that needs to be taken into account is that this domestic water is not all used by the residents of Nelspruit. A high number of daily visitors to Nelspruit, tourists that pass Nelspruit on their way to the Kruger National Park and employees that work in Nelspruit but live somewhere else, also use Nelspruit's water. Based on the assumptions and calculations in the information box, it is estimated that 0,84 million m^3/a (2,3 Mℓ/day) is taken up by daily visitors/employees to Nelspruit and the rest 8,23 million m^3/a (22,5 Mℓ/d) by the residents themselves.

The assumptions and estimates in the information box need to be verified and it is recommended that the volume of water used by non-residents be investigated further during the course of the continuation study.

8.2.2 Industrial water use

An analysis of water use in the MLM area showed that commercial water use (e.g. water for schools, shops, hospitals, garden centres, municipal watering etc.), industrial and domestic water use can be broken up as follows:

- Domestic 67%;
- Commercial 28%, and
- Industrial 6%.

For the purpose of this strategy commercial and industrial water use had been grouped together and was regarded as industrial water use.

The current commercial and industrial water use in Nelspruit is estimated to be 4,91 million m^3/a (13,45 Mℓ/day). This was derived from Mbombela Municipality's metered water use. The larger industrial water users in the Nelspruit area include Mondipak, Manganese Metal Company, Delta EMD, Nelspruit Abattoir and Coke (ABI) with an average daily demand of 0,86 million m^3/a (2,35 Mℓ/day).

8.3 WHITE RIVER

For the purposes of this report, White River includes the White River Country Estate and the industrial area of Rocky Drift. White River receives water from three sources, namely Witklip Dam on the Sand River, Longmere Dam on the White River and the WTW in Nelspruit which takes water from the Crocodile River. The allocation from Witklip Dam is 0,75 million m^3/a (2,05 Mℓ/day) and from Longmere Dam is 1,25 million m^3/a (3,42 Mℓ/day). The White River Country Estate also receives water from the Longmere Dam, from a separate 0,37 million m^3/a (1 Mℓ/day) WTW which serves only the country estate. There is also a borehole in town supplying up to 0,15 million m^3/a (0,4 Mℓ/day). Water for Rocky Drift and Phumulani is supplied from the Crocodile River.

Rocky Drift is an industrial area and hence a significant component of the water use within this WDC is industrial use, estimated at 0,88 million m^3/a (2,4 Mℓ/day).

8.3.1 Domestic water use

During 2011/2012 the total volume of water supplied from the Crocodile River for domestic use was 0,26 million m^3/a (0,7 Mℓ/day). Total current domestic use is 2,77 million m^3/a (7,6 Mℓ/day).

8.3.2 Industrial water use

The industrial area of Rocky Drift is supplied from the Crocodile River. The current water use is 0,66 million m^3/a (1,8 Mℓ/day).

8.4 KARINO/PLASTON CORRIDOR

The Karino/Plaston Corridor obtains water from the Primkop Dam and direct abstraction from the Crocodile River via a recently constructed pump station and water treatment plant. The combined water use is 1,31 million m^3/a (3,6 Mℓ/day) and in future some of the areas receiving water from the Nsikazi South Regional Water Supply Scheme will be supplied from this WDC.

8.4.1 Current domestic water use

There are two WTWs supplying water to the Karino/Plaston Corridor: One receiving water from Primkop Dam and the other situated next to the Crocodile River. The combined water use is 1,31 million m^3/a (3,6 Mℓ/day).

8.4.2 Current industrial water use

There is currently no industrial water use in this WDC.

8.5 NSIKAZI SOUTH

Nsikazi South is supplied with water from the Nsikazi South Regional Water Supply Scheme, which is supplied directory from the Crocodile River. The raw water is pumped to the WTW works at Kanyamazane where it is treated before being distributed. The design capacity of the WTW has been upgraded to 54 Mℓ/day (19,71 million m^3/a), but it is operated at an average of 50 Mℓ/day (18,25 million m^3/a).

There is also a second pump station, known as the emergency pump station, which pumps water to the old WTW which has a capacity of approximately 1,8 Mℓ/d (0,66 million m^3/a).

Nsikazi South consists of formal villages which have yard connections and water borne sewage systems (Kanyamazane, Kabokweni, Tekwane South and Emoyeni) while the remainder of the villages within Nsikazi South are served by stand pipes.

There is also a package water treatment plant at Dwaleni which has a capacity of 0,6 Mℓ/day. A total groundwater supply of 0,34 Mℓ/day (0,12 million m³/a) is also provided from various boreholes .

There is an industrial area in Nsikazi South which and the water supplied to this industrial zone is estimated to be 0,8 Mℓ/day (0,29 million m³/a).

The total volume of water treated and supplied to Nsikazi South is therefore 19,3 million m³/a (52,7 Mℓ/d). This can be regarded as Nsikazi South's current water use.

8.6 MATSULU

Sembcorp is the WSP for Matsulu. Water is abstracted from the Crocodile River, treated and distributed to Matsulu. The current water use is 4,8 million m^3/a (14,5 Mℓ/day). According to Sembcorp an extension of the current WTW capacity of 12 Mℓ/d is planned to 24 Mℓ/d in two phases of 6 Mℓ/d each. These expansion plans do not appear to have considered the limited water resource available at the current abstraction point in the Crocodile River. The operators of the Matsulu works have indicated flows so low that they cannot abstract even their relatively small requirements. This problem was investigated as part of this Reconciliation study and it was found that water is being diverted for hydropower generation.

There is no industrial water use in Matsulu. There is some commercial use, but a breakdown between domestic and commercial use is not available.

8.6.1 Domestic water use

The domestic use is 4,8 million m^3/a (14,5 Mℓ/day).

8.6.2 Industrial water use

There is no industrial use in Matsulu. There is some commercial use, but a breakdown between domestic and commercial use is not available.

8.7 NSIKAZI NORTH

The main water supply for Nsikazi North is from the Sabie River. Water is abstracted at the Nsikazi North Regional Raw Water pump station and pumped to the Nyongane booster pump station where the water is chlorinated and distributed. The distribution of water to villages is according to a valve schedule with most villages getting water twice a week. There are also package plants supplying water to Majika, Msadza and Mnganduzweni. The mode of service in most of the area is via stand pipes.

There is a Memorandum of Understanding (MoU) between MLM and Bushbuckridge Local Municipality (BLM) to supply water from the Hoxane WTW to Nsikazi North if future. The WTW was constructed by DWA and consists of 4 x 9 Mℓ/day units. The mechanical and electrical works were, however, not completed and the intention is to commission the two

incomplete units and supply 18 Mℓ/day to Nsikazi North. Although there should be more than sufficient water to supply the population in this area with a generous per capita rate, the reality is that the service delivery is very poor. The reason for this is not entirely clear but is probably due to excessive losses and illegal connections.

Despite the MoU referred to above, MLM does not want to depend on BLM for treated water and plans to construct a 30 Mℓ/day WTW at Nyongane. MLM appointed a PSP to design the WTW and also to apply for Municipal Infrastructure Grant (MIG) funding. A water use licence for this additional abstraction has not been issued.

8.7.1 Domestic water use

The current water use in Nsikazi North is estimated to be 10,72 million m^3/a (29,4 Mℓ/day), of which 8,2 million m^3/a (22,4 Mℓ/day) is supplied from the Sabie River. 1,82 million m^3/a (5 Mℓ/day) is supplied from small tributaries of the Sabie River while the remaining 0,7 million m^3/a (2 Mℓ/day) is supplied from boreholes.

8.7.2 Industrial water use

There is no industrial water use in Nsikazi North.

8.8 HAZYVIEW

Hazyview gets water from the Sabie River, mostly via an irrigation canal which supplies the Sabie Irrigation Board. Water is diverted from the irrigation canal into the Hazyview WTW. When the canal is shut down for maintenance, water can also be supplied directly from the Sabie River.

8.8.1 Domestic water use

Current domestic use is approximately 1,39 million m^3/a (3,8 Mℓ/day).

8.8.2 Industrial water use

There is no industrial water use in Hazyview.

8.9 OTHER WATER SUPPLY CENTERS (NGODWANA, KAAPSEHOOP AND ELANDSHOEK)

8.9.1 Kaapsehoop

There is no surface water supply in the town. The water supply to Kaapsehoop consists of a number of boreholes (35) from which groundwater is abstracted. The boreholes are scattered through the village and some are located unacceptably close to existing septic tanks. It is reported that some of the boreholes in fact are as close as 2 to 5 m from existing septic tanks. This may lead to serious contamination and pollution of the water supply to residents with resultant health risks to the whole community and tourists visiting the area. Groundwater quality is also low due to high concentrations of iron. Groundwater is pumped

from the boreholes to elevated storage tanks which are scattered throughout the town. Current water use is 31 000 m^3/a (0,09 Mℓ/day).

8.9.2 Elandshoek

The Elandshoek Township gets water from a mountain stream which gravity feeds into a 1 Mℓ/day WTW. The current water use is 54 121 m^3/a (0,148 Mℓ/day). .

8.9.3 Ngodwana

Ngodwana, which consist of the Sappi's paper processing plant and well as the small town associated with this industry, obtain their water from the Ngodwana Dam. The current industrial water use is 14,0 million m^3/a while a further 0,5 million m^3/a (1,37 Mℓ/day) is used for domestic purposes.

9 OTHER WATER USE

9.1 IRRIGATION

The rural area surrounding Mbombela's urban centres is characterised by extensive irrigation. Most of this irrigation is regulated through Irrigation Boards but there is also some limited diffuse irrigation along various tributaries, with regulation the direct responsibility of the Department of Water Affairs. The areas of jurisdiction of the irrigation boards or water user associations in the Crocodile and Sabie River catchments are shown in **Figure 9.1**. Most prominent is the large Crocodile River Major Irrigation Board which stretches from Dullstroom in the West to Komatipoort in the East. A total of 28 271 ha of irrigation (225,7 million m^3/a) is supported by Kwena Dam, with a further 1 632 ha allocated above Kwena Dam, although not formally administered by the Crocodile River Irrigation Board.

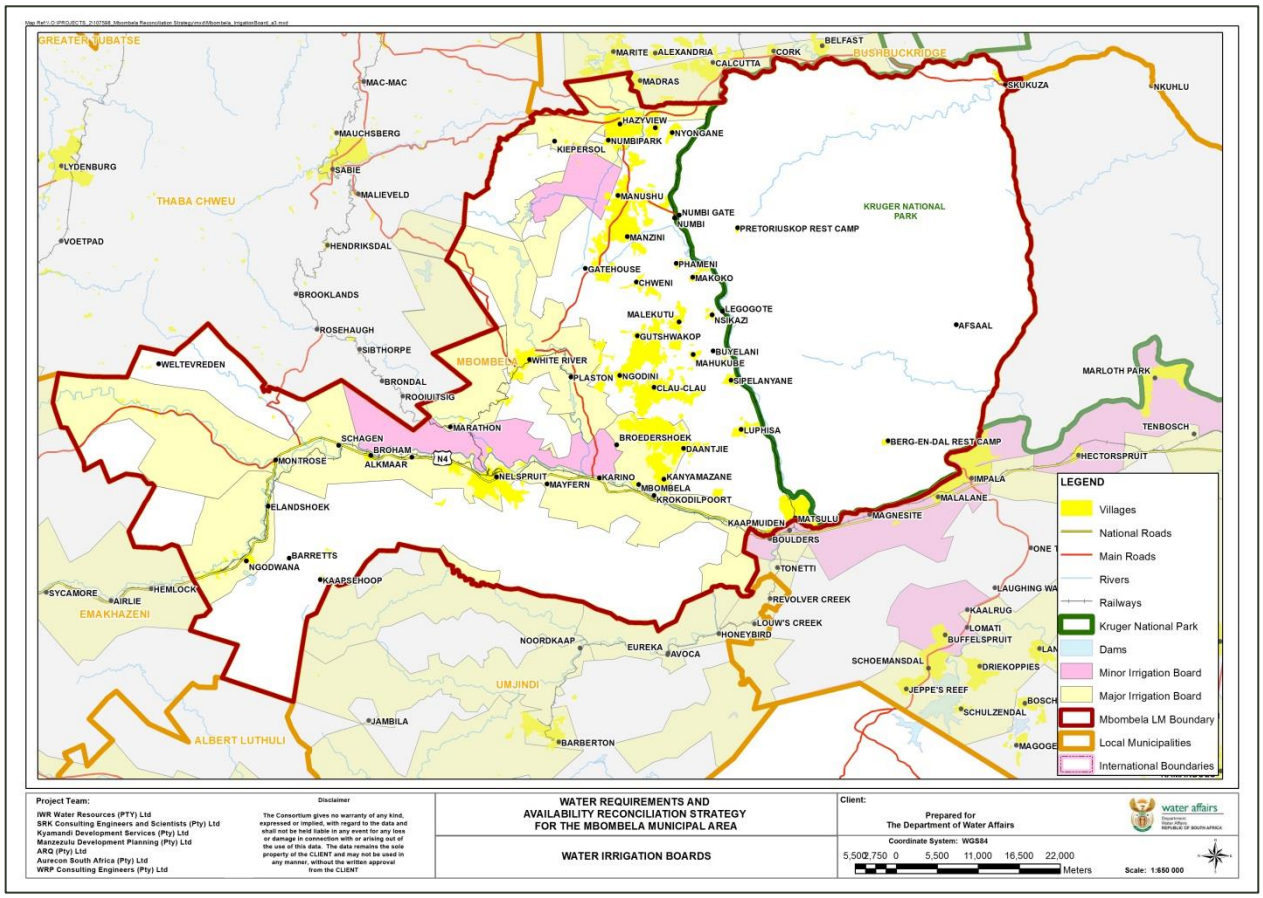


Figure 9.1: Irrigation Boards within and around the Mbombela LM area

An estimated 15 000 ha of irrigated agriculture, with a water requirement of 147 million m^3/a, falls within the Mbombela municipal area. It is, however, misleading to consider only the irrigation within the municipal area as upstream irrigators will already have had a major impact on river flows. Also, irrigators downstream of the municipal area have water use allocations and a legitimate expectation that enough water will be allowed to flow through the municipal area to meet their water demands at an acceptable level of assurance.

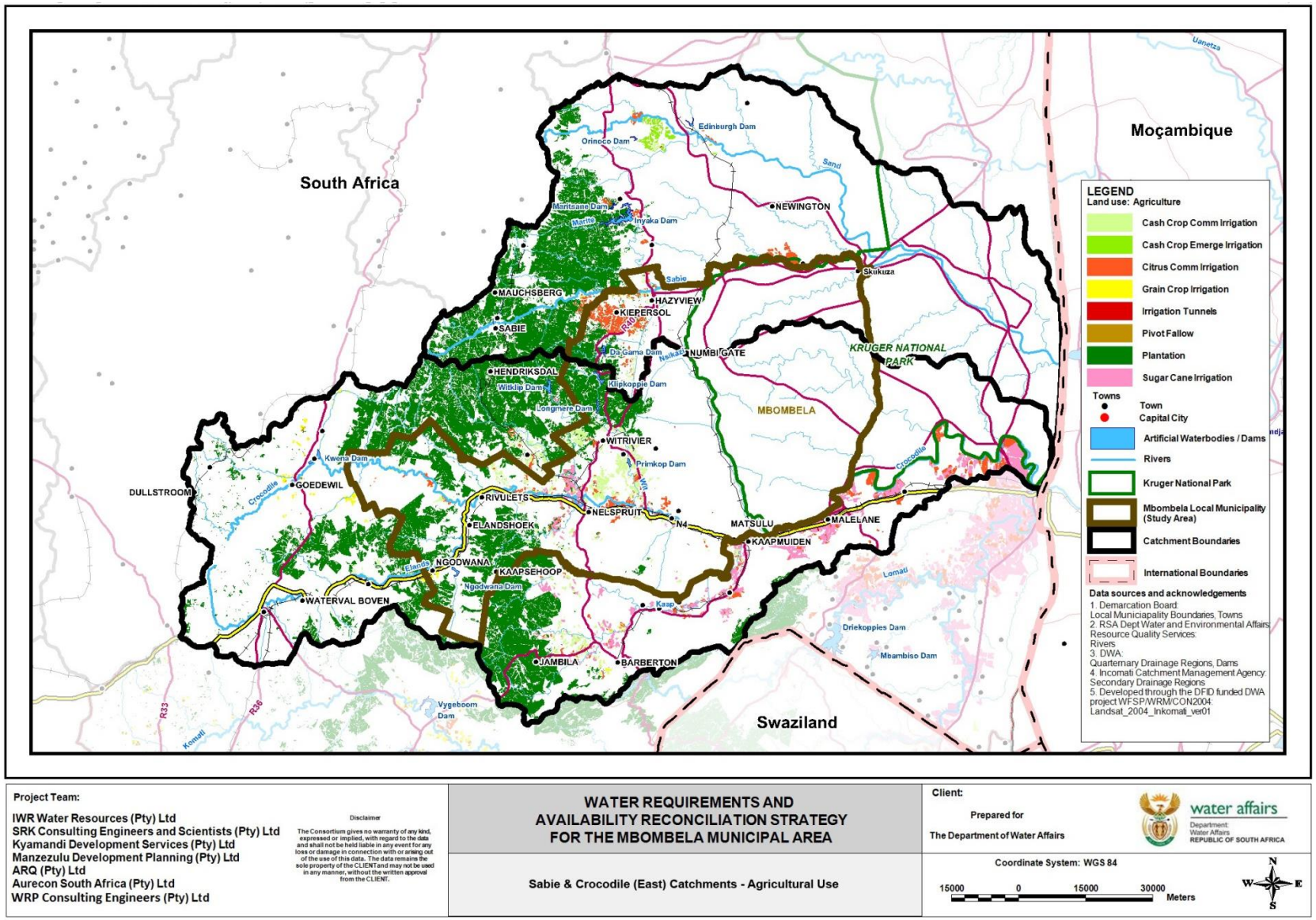


Figure 9.2: Afforestation and Irrigation in the catchments and municipal area

Table 9.1 summarises the estimated water requirements within the Crocodile and Sabie River catchments and indicates the portion that lies within the Mbombela Municipal area.

Note that this table excludes irrigation in the Kaap and Sand tributaries since they are not relevant to this study.

Table 9.1: Irrigation within the Crocodile and Sabie River catchments

Catchment	Irrigation requirement (million m^3/a)
Crocodile catchment	
Upstream of Mbombela	95
Within Mbombela	114
Downstream of Mbombela	209
Sabie catchment	
Upstream of Mbombela	7
Within Mbombela	33
Downstream of Mbombela	9

9.2 STREAM FLOW REDUCTION ACTIVITIES

There are large areas of forestry within both the Crocodile and Sabie River catchments and it is a well-established fact that exotic plantations such as Pine, Eucalyptus and Wattle reduce the amount of water that would otherwise flow in the rivers in the catchments where the plantations are located. As with irrigation, the afforested areas within the MLM area are not the only concern since forestry upstream of Mbombela reduces river flow that could otherwise conceivably be used for domestic or industrial use within the municipal area.

The streamflow reduction within the Crocodile and Sabie Rivers is indicated in **Table 9.2**.

It must be pointed out that there is not a clear relationship between streamflow reduction and yield. Water reallocation through a reduction in afforested area, which is an option, therefore needs to be carefully considered. For example, removing all the forestry from the Crocodile (excluding the Kaap River) and Sabie River (excluding the Sand River) catchments would increase the mean annual runoff (MAR) of these catchments by 122 and 81 million m^3/a respectively, but this water will mostly be in the form of increased floods. The yield made available by removing forestry is discussed further under reallocation options. As a rule of thumb for the Sabie and Crocodile catchments, between one third to one fifth of the streamflow reduction will become available as high assurance yield, should forestry plantations be removed.

Table 9.2: Streamflow reduction due to afforestation within the Crocodile and Sabie River catchments

Catchment	Streamflow reduction (million m^3/a)
Crocodile catchment	
Upstream of Mbombela	70
Within Mbombela	52
Downstream of Mbombela	0
Sabie catchment	
Upstream of Mbombela	69
Within Mbombela	12
Downstream of Mbombela	0

9.3 INVASIVE ALIEN PLANTS

Invasive alien plants (IAPs) have an impact on water resources similar to that of exotic forests in that they reduce the runoff that would have flowed in the river under natural conditions. The difference between exotic forests and IAPs is that IAPs tend to invade riparian zones where water is more readily available and hence these trees can consume much more water than licenced forestry. Also, unless controlled, IAPs will spread and result in increased reductions in runoff.

As part of the Inkomati Water Availability Assessment Study (IWAAS) (DWA, 2009), the areas of IAPs were quantified and the streamflow reduction was estimated. Working for Water (WfW) subsequently completed a national study (Kotze, 2010) and updated estimates of IAPs from the WfW study have therefore been used for this Mbombela Strategy. The estimated streamflow reduction due to IAPs is given in **Table 9.3**. It is worth noting that while IAPs in riparian zones are the biggest concern for water resource managers, there appear to be very limited riparian IAPs remaining within the Crocodile and Sabie River catchments. The invaded areas are almost exclusively upland, that is, out of the riparian zone. This can be attributed to the efforts of WfW who focused their IAP removal efforts on the riparian zones.

Table 9.3: Streamflow reduction due to IAPs within the Crocodile and Sabie River catchments

Catchment	Streamflow reduction (million m^3/a)	Estimated yield increase due to removal of IAPs
Crocodile catchment		
Upstream of Mbombela	17	8
Within Mbombela	10	1
Downstream of Mbombela	~0	~0
Sabie catchment		
Upstream of Mbombela	~0	~
Within Mbombela	1,0	0,5
Downstream of Mbombela	~0	~0

It has been established that the infested area in the Kwena Dam catchment is as much as 77 km^2. Removal of IAPs will not usually result in an increase in yield equivalent or even close to the increase in runoff. However, due to the location of the Kwena Dam and the operation of the Kwena Dam within a systems context, the removal of these IAPs from the Crocodile River upstream of the Kwena Dam will result in a significant increase in the system yield. This is because the Kwena Dam has the capacity to store much of the increased runoff.

The removal of IAPs in the Primkop Dam catchment could also improve the yield of Primkop Dam significantly. There are approximately 17,5 km^2 IAPs upstream of this dam.

10 FUTURE URBAN AND INDUSTRIAL WATER REQUIREMENTS

10.1 NELSPRUIT (INCLUDING MATAFFIN, THE AGRICULTURAL COLLEGE AND MATUMI GOLF COURSE)

10.1.1 Projected Domestic Water Requirements

It is anticipated that domestic water use will steadily increase up to 2030 and initial estimates of increasing water requirements were based on population projections provided in section 5.

During the course of this study it was learned that a new hospital and university are planned for Nelspruit and if this materialises will almost certainly result in an increase in the water requirements over and above the initial estimates. The impact of the university on the growth in water requirements was therefore evaluated.

The first phase of the university is planned to commence in 2014 with 271 staff and students and it is anticipated that the number of students will stabilize at 30 000 sometime in the future as new phases are implemented.

The following information in **Table 10.1**, up to 2030 has been obtained from SKC Masakhizwe Engineers (Pty) Ltd for the university.

Table 10.1: Projected population for the new University

Year Completed	Total Population (Educational Buildings)
2014	271
2016	4 515
2018	8 032
2020	10 115
2022	13 093
2025	15 685
2030	20 000

An extra high growth scenario has been included for Nelspruit to allow for the new university. The projected domestic future water requirements for the high and low scenarios are shown in **Table 10.2** and **Table 10.3** respectively below.

Table 10.2: Projected domestic water requirements in million m^3/a

Year	2010	2015	2020	2025	2030
Low	8,98	10,15	11,30	12,41	13,48
High	9,02	10,43	11,92	13,47	15,05
Extra high	9,02	10,64	12,79	14,82	16,78

Table 10.3: Projected domestic water requirements in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	24,59	27,78	30,93	33,98	36,91
High	24,70	28,56	32,64	36,87	41,22
Extra high	24,70	29,13	35,03	40,58	45,95

10.1.2 Projected Industrial Water Requirements

It is anticipated that industrial use will also steadily increase up to 2030 and are shown in **Table 10.4** and **Table 10.5** below.

Table 10.4: Projected industrial water requirements in million m^3/a

Year	2010	2015	2020	2025	2030
Low	4,20	4,74	5,28	5,80	6,30
High	4,21	4,87	5,57	6,29	7,03
Extra high	4,21	5,08	6,43	7,62	8,72

Table 10.5: Projected industrial water requirements in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	11,49	12,98	14,45	15,88	17,24
High	11,54	13,34	15,25	17,22	19,25
Extra high	11,54	13,91	17,59	20,85	23,88

10.2 WHITE RIVER TOWN (INCLUDING WHITE RIVER COUNTRY ESTATE AND ROCKY DRIFT)

10.2.1 Projected Domestic Water Requirements

It is anticipated that domestic water use in the White River WDC will increase steadily up to 2030. The town council has recently approved the development of a number of developments that will require commercial water such as shopping centres, light industries etc. (Greyling, 2012). It is expected that this will result is very rapid growth in the domestic water requirements of White River over the next 15 years.

The projected future water requirements are show in **Table 10.6** and **Table 10.7** below

Table 10.6: Project domestic water requirements in Mℓ/day for White River town

Year	2010	2015	2020	2025	2030
Low	5,26	5,75	6,21	6,64	7,04
High	5,29	5,93	6,57	7,20	7,81

Since 2008, a new area to the south-east of White River (referred to as Phumulani) was made available for housing development. Phumulani consist of a formal area with 465 Rural Development Program (RDP) level houses and an informal area with approximately 3 500 houses.

Table 10.7: Project domestic water requirements in Mℓ/day for Phumulani

Year	2010	2015	2020	2025	2030
Low	1,81	2,00	2,17	2,32	2,47
High	1,81	2,04	2,26	2,48	2,70

The White River WDC has an allocation of 5 million m^3/a (38,44 Mℓ/day) from the Crocodile River. A big portion of this water has been allocated to new residential developments but the allocation had not been taken up at the time of compiling this report. There is also a reserved allocation of 0,4 million m^3/a (1,117 Mℓ/day) for Phumulani included in **Table 10.8** which shows the water reserved for future domestic use in White River WDC.

Table 10.8: Reserved domestic water requirements in Mℓ/day for the White River WDC

Year	2010	2015	2020	2025	2030
High	0	2,68	5,36	8,02	8,02

The total projected domestic water requirements for the White River WDC are shown in **Table 10.9** and **Table 10.10** below.

Table 10.9: Projected total domestic water requirements in million m^3/a

Year	2010	2015	2020	2025	2030
Low	2,58	2,83	3,06	3,27	3,47
High	2,60	3,89	5,18	6,47	6,78

Table 10.10: Projected total domestic water requirements in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	7,08	7,75	8,37	8,96	9,51
High	7,11	10,64	14,19	17,72	18,55

10.2.2 Projected Industrial Water Requirements

The projected industrial water requirements excluding reserved industrial water are shown in **Table 10.11** below.

Table 10.11: Projected industrial water requirement in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	1,76	1,93	2,09	2,23	2,37
High	1,76	1,97	2,19	2,39	2,60

There is a reserved volume of 0,86 million m^3/a (2,4 Mℓ/day) allocation to Rocky Drift for future use as part of the 5 million m^3/a allocation from the Crocodile River. This reserved allocation has been included in the high growth scenario over a 15 year period as shown in **Table 10.12.**

Table 10.12: Projected reserved industrial water requirement in Mℓ/day

Year	2010	2015	2020	2025	2030
High	0	0,78	1,57	2,35	2,35

The total projected industrial water requirements are shown in **Table 10.13** and **Table 10.14.**

Table 10.13: Projected total industrial water requirements in million m^3/a

Year	2010	2015	2020	2025	2030
Low	0,64	0,71	0,76	0,81	0,86
High	0,64	1,01	1,37	1,73	1,81

Table 10.14: Projected total industrial water requirements in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	1,76	1,93	2,09	2,23	2,37
High	1,76	2,76	3,75	4,75	4,95

10.3 KARINO/PLASTON CORRIDOR (INCLUDING AREAS IN NSIKAZI SOUTH NOT GETTING WATER FROM KANYAMAZANE, E.G. MAMELODI, TEKWANE NORTH AND EMOYENI)

10.3.1 Projected Domestic Water Requirements

The projected future domestic water requirements will follow the population growth in the area up to 2030. The projected domestic use is shown in **Table 10.15** and **Table 10.16** in million m^3/a and in Mℓ/day, respectively.

Table 10.15: Projected water requirements in million m^3/a

Year	2010	2015	2020	2025	2030
Low	1,08	1,66	2,37	2,86	3,09
High	1,09	1,74	2,56	3,18	3,57

Table 10.16: Projected water requirements in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	2,97	4,55	6,49	7,82	8,47
High	2,99	4,77	7,00	8,73	9,78

10.3.2 Projected Industrial Water Requirements

There are a number of Industrial Development Zones planned around the KMIA. The MLMs intention is to supply these industries with water from Primkop Dam, although this will have to be done through trading with the irrigators to whom the water is currently allocated.

The projected industrial use is shown in **Table 10.17** and **Table 10.18** in million m^3/a and in Mℓ/day, respectively.

Table 10.17: Projected industrial use in million m^3/a

Year	2010	2015	2020	2025	2030
Low	0,00	0,25	0,36	0,43	0,46
High	0,00	0,25	0,37	0,46	0,52

Table 10.18: Projected industrial use in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	0,00	0,68	0,97	1,17	1,27
High	0,00	0,69	1,02	1,27	1,42

10.4 NSIKAZI SOUTH

10.4.1 Projected Domestic Water Requirements

The domestic water use in Nsikazi South is expected to follow the same growth trend as the population growth up to 2030. The projected domestic use is shown in **Table 10.19** and **Table 10.20** in million m^3/a and in Mℓ/day, respectively.

Table 10.19: Projected water requirements in million m^3/a

Year	2010	2015	2020	2025	2030
Low	19,01	19,65	19,77	20,01	20,46
High	19,01	19,78	20,37	21,07	21,88

Table 10.20: Projected water requirements in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	52,06	53,81	54,13	54,79	56,02
High	50,06	54,17	55,76	57,69	59,89

10.4.2 Projected Industrial Water Requirements

The industrial water use is expected to remain constant at 0,29 million m^3/a (0,8 Mℓ/day) in Nsikazi South. New industrial developments around the Kruger Mpumalanga Airport will be supplied with water from Primkop Dam forming part of the Karino Plaston Corridor WDC.

10.5 MATSULU

10.5.1 Projected Domestic Water Requirements

It is anticipated that domestic use will increase up to 2030 in line with the population growth. The projected domestic future water requirements are shown in **Table 10.21** and **Table 10.22**.

Table 10.21: Projected domestic water requirements in million m^3/a

Year	2010	2015	2020	2025	2030
Low	4,96	5,80	6,58	7,24	7,68
High	4,96	5,84	6,72	7,46	7,99

Table 10.22: Projected domestic water requirements in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	13,59	15,89	18,02	19,82	21,03
High	13,59	15,98	18,39	20,43	21,89

10.5.2 Projected Industrial Water Requirements

There are no industrial water users in Matsulu and this situation is not expected to change in future.

10.6 NSIKAZI NORTH

10.6.1 Projected Domestic Water Requirements

It is anticipated that domestic use will increase up to 2030 and follow the population growth. The projected domestic future water requirements are shown in **Table 10.23** and **Table 10.24** below.

Table 10.23: Projected water requirements in million m³/a

Year	2010	2015	2020	2025	2030
Low	10,66	11,18	11,68	12,16	12,52
High	10,70	11,40	12,09	12,73	13,26

Table 10.24: Projected water requirements in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	29,21	30,63	32,01	33,31	34,30
High	29,31	31,24	33,11	34,89	36,34

10.6.2 Projected Industrial Water Requirements

There are industrial water users in Nsikazi North and this situation is not expected to change in future.

10.7 HAZYVIEW

10.7.1 Projected Domestic Water Requirements

The projected future water requirements are expected to follow the population growth and increase steadily up 2030. **Table 10.25** and **Table 10.26** shows projected domestic water requirements.

Table 10.25: Projected water requirements in million m³/a

Year	2010	2015	2020	2025	2030
Low	1,38	1,46	1,52	1,59	1,65
High	1,39	1,47	1,56	1,64	1,71

Table 10.26: Projected water requirements in Mℓ/day

Year	2010	2015	2020	2025	2030
Low	3,79	3,99	4,18	4,35	4,52
High	3,80	4,04	4,27	4,48	4,69

10.7.2 Projected Industrial Water Requirements

There are no significant industrial water users in Hazyview and this situation is not expected to change in future.

10.8 OTHER WATER DEMAND CENTRES (NGODWANA, KAAPSEHOOP, ELANDSHOEK)

10.8.1 Projected Domestic Water Requirements

The projected domestic water requirements for each of the three towns are shown in **Table 10.27** and **Table 10.28** below.

Table 10.27: Domestic use for Elandshoek, Ngodwana and Kaapsehoop in million m^3/a

Year	2010	2015	2020	2025	2030
Elandshoek	0,025	0,028	0,032	0,034	0,037
Ngodwana	0,500	0,500	0,500	0,500	0,500
Kaapsehoop	0,031	0,031	0,031	0,031	0,031

Table 10.28: Domestic use for Elandshoek, Ngodwana and Kaapsehoop in Mℓ/day

Year	2010	2015	2020	2025	2030
Elandshoek	0,069	0,078	0,086	0,094	0,102
Ngodwana	1,370	1,370	1,370	1,370	1,370
Kaapsehoop	0,086	0,086	0,086	0,086	0,086

10.8.2 Projected Industrial Water Requirements

SAPPI at Ngodwana have indicated that as part of their proposed expansion plans they might require additional water in future. However, at this stage they have not quantified their additional future water requirements. It is expected that the industrial use will remain constant at 14 million m^3/a (38,33 Mℓ/day). There is no industrial use at Elandshoek or Kaapsehoop.

11 WATER RESOURCES

Mbombela Municipality obtains all their water from the Crocodile and Sabie Rivers with a very small percentage obtained from groundwater. The water resources of these catchments have been studied in detail as part of several other projects and these analyses are reported on here. The only new work that was carried out for this Reconciliation Strategy was to evaluate the yield of raised dams and to re-evaluate the yield of possible new dams.

11.1 CURRENT WATER RESOURCES OF THE CROCODILE RIVER

The water resources of the Crocodile River has two components; the yield available from dams (including farm dam) and the yield available from run-of-river. Assessing the yield of a large system with limited storage is complex since the total water resource availability is a combination of the run-of-river flows and the yields of the dam. These two components are linked through the system operating rule and cannot simply be assessed independently and the resulting yield added.

The significant dams in the Crocodile River catchment are listed in **Table 11.1.**

Table 11.1: Major dams in the Crocodile catchment

Dam	Fully supply capacity (FSC)			Full supply area (FSA) (km^2)	Yield (million m^3/a)	
	million m^3	Natural MAR (million m^3/a)	FSC as %MAR		Historic	1 in 50
Kwena Dam	158,9	119	134%	12,5	83,2	87,5
Witklip Dam	12,7	19,8	64%	1,88	8,1	8,5
Klipkopje Dam	11,9	188	63%	2,31	Operated as system with Longmere	
Longmere Dam	4,32	25,4	17%	0,96	10,3	10,6
Primkop Dam	1,97	39,4	5%	0,41	9,9	10,3
Ngodwana Dam	10,0	58,8	17%	1,00	21,0	22,4
TOTAL	**199,8**	**450,4**	**44%**	**19,06**	**132,5**	**139,3**

The natural MAR of the Crocodile River catchment is 1 136 million m^3/a. It is clear from **Table 11.1** that the dams in the catchment command and runoff of 450 million m^3/a, which is only about one third of the catchment. Expressing the total dam storage as a percentage of the runoff (199,8/1 136) results in a 17,6% storage relative to the MAR. By any standards, this is a very low dam development ratio. It would therefore be incorrect to ignore the remaining 82% of the catchment which is not commanded by dams. It is also immediately

obvious that the water demands within the Crocodile River catchment (in excess of 500 million m^3/a) cannot be met from dams alone which have an estimated total yield of 139 million m^3/a.

The operating rule maximises the yield of the system by only releasing water from dams when users require the water. Hence during summer when there is ample flow in the Elands River and other large tributaries such as the Houtbosloop and Nels Rivers, it is very often not necessary to release water at all. Through this careful management, water can be saved in dams for the low flow winter months when the water is needed. In addition, the operating rule allows for restrictions to be imposed timeously on water users to prevent failure of the water supply system. The restriction rule currently applied within the Crocodile River catchment is indicated in **Table 11.2** and **Table 11.3**.

Table 11.2: Restriction rule for irrigators

Storage in the Kwena Dam (% of full supply capacity)	Recommended Restriction to be imposed (% of allocation)
> 70%	0%
55 to 70%	35%
10 to 55%	60%
< 10%	0%

Table 11.3: Restriction rule for domestic use

Storage in the Kwena Dam (% of full supply capacity)	Recommended Restriction to be imposed (% of allocation)
> 50%	0%
20 to 50%	5%
10 to 20%	10%
< 10%	20%

In addition to simply preventing the system from failing, the operating rules strive to maintain a target assurance of supply, which in this case is 70% for irrigators and 98% for domestic users where assurance of supply is defined as the percentage of time that a user sectors obtains their full allocation.

11.2 CURRENT WATER RESOURCES OF THE SABIE RIVER

The water resources of the Sabie River catchment are similar to that of the Crocodile catchment in that there are a limited number of dams which offer support to users along the Sabie River during periods of low flow. By far the most significant dam is the Inyaka Dam which was completed in the year 2000. Due to the high rainfall and related high runoff from in the Sabie River, the Sabie River has relatively high baseflows which can support users for most of the year. Only during the winter months are releases from the Inyaka Dam required to supplement the water requirements of the users located on the middle and lower Sabie Rivers.

The significant dams in the Sabie River are listed in **Table 11.4**.

Table 11.4: Significant dams in the Sabie River catchment

Dam	Fully supply capacity (FSC)			Full supply area (FSA) (km^2)	Yield (million m^3/a)	
	million m^3	Natural MAR (million m^3/a)	FSC as %MAR		Historic	1 in 50
Inyaka Dam	125,0	79,9	156%	8,1	41,9	50,7
Da Gama Dam	13,6	20,3	67%	1,3	10,3	10,8
Maritsane Dam	2,1	24,9	8%	0,5	7,5	10,5
TOTAL	**140,7**	**125,1**	**113%**	**9,9**	**59,7**	**72,0**

The natural MAR of the Sabie River catchment is 450 million m^3/a. The situation in the Sabie River catchment is very similar to the Crocodile in that the dams in the catchment command only a small portion of the catchment runoff. In the case of Sabie River this portion is just over one quarter of the catchment's natural runoff. Hence the Sabie catchment is not well developed in terms of dams.

Unlike the Crocodile, however, the water demands of the Sabie could almost be from the dams were it not for the fact that the ecological Reserve in the Sabie River must also be supplemented by releases from the Inyaka Dam. In addition, an allocation of 25 million m^3/a has been made from this dam for transfer to the Sand River catchment. Taking these two water requirements into account, the Sabie catchment is in balance and there is not additional water available for allocation.

As with the Crocodile River catchment, operating rules have been developed to maximise the yield of the system by only releasing water from Inyaka Dam when required. These releases are not required often, only during low flow periods.

While water restrictions have never been required in the Sabie River catchment, once all the allocations have been taken up it will be necessary to apply restriction periodically in order to ensure a sustainable supply of water to all users The restriction rule recommended as part of the operating rules study are indicated in **Table 11.5** and **Table 11.6**.

Table 11.5: Restriction rule for irrigators

Storage in the Kwena Dam (% of full supply capacity)	Recommended Restriction to be imposed (% of allocation)
> 70%	0%
55 to 70%	35%
10 to 55%	60%
< 10%	0%

Table 11.6: Restriction rule for domestic use

Storage in the Kwena Dam (% of full supply capacity)	Recommended Restriction to be imposed (% of allocation)
> 50%	0%
20 to 50%	5%
10 to 20%	10%
< 10%	20%

The target assurance of supply for irrigators in the Sabie catchment 80% while for domestic use the target assurance is 98%.

11.3 POSSIBLE FUTURE DAMS

Several possible new dams were evaluated as part of this Mbombela Reconciliation Strategy as well as the raising of existing dams. These dams are shown in **Figure 11.1** below. The yields of both dams and raised dams were evaluated over a range of possible full supply storages in order that an optimum storage can be determined. These results are presented in the section below.

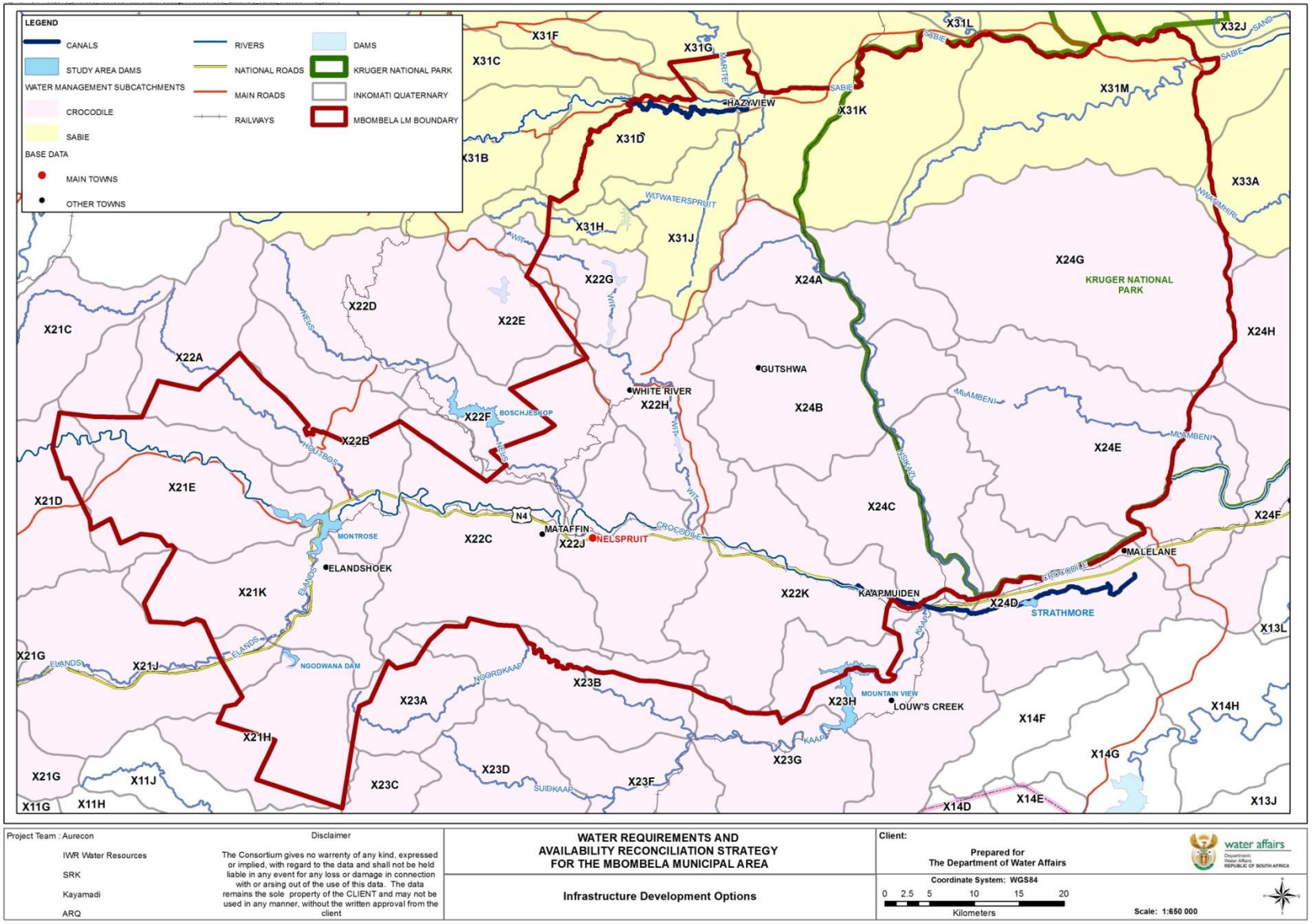


Figure 11.1: Possible Future Dams

11.3.1 Montrose Dam

The yield of the Montrose Dam is largely dependent on where the water is to be supplied to and whether or not the river is to be used as a conduit to supply users. The reason for this is that if the river is used as a conduit then incremental inflows can be used first before making releases from the dam, hence enhancing the system yield. Given this operational scenario, the further downstream a user is located the greater the system yield obtained from the construction of a dam in the upper reaches of a catchment.

In the case of the Montrose Dam, the assumption was made that water will firstly be supplied to domestic users in the Mbombela Municipal area and if there is surplus yield available then this could be supplied to irrigators. It is assumed that supply to all users will be via releases into the river. Water for Nelspruit and Rocky Drift will be abstracted at the existing Nelspruit off-take, water for Nsikazi South will be abstracted at the existing Kanyamazane off-take (Nsikazi South Regional raw water pump station), while water for Matsula will be abstracted at the existing off-take at Kaapmuiden. It is assumed that new irrigation development support from the Montrose Dam will occur in the lower Crocodile and the X24E quaternary catchment has been selected as a likely point for the abstraction of additional yield.

The operation of the Kwena Dam will also have a significant influence on the additional yield made available by the construction of Montrose Dam. In order to optimise the yield of the system, the Montrose Dam should be drawn down first before making releases from the Kwena Dam. It is uncertain if there will be ecological constraints placed on the flow in the Crocodile River downstream of Kwena Dam and it recommended that this be investigated in more detail during the feasibility study of the Montrose Dam should this dam be found to be the preferred option.

The ecological Reserve in the Crocodile River downstream of the proposed Montrose Dam also plays a significant role in the additional water that could become available from this source. The Reserve which has been approved by DWA is essentially the present day flow. The implication of this is that while no curtailment of water use is required to meet this Reserve, no additional water use can be allowed either since this will reduce the flow in the river to less than the present day flow. The ‘present day’ flow as a Reserve also excludes the construction of any new dam since this will also reduce the flow in the river. Since it was not the intention of decision makers to impose this situation on the catchment, the assumption has been made that the Reserve would be a combination of the minimum flows imposed by the present day flow regime and the flood regime imposed by the C class Reserve at EWR 6. This is explained in more detail in section 13 of this report.

The storage versus yield curve of the possible Montrose Dam is shown in **Figure 11.2** below.

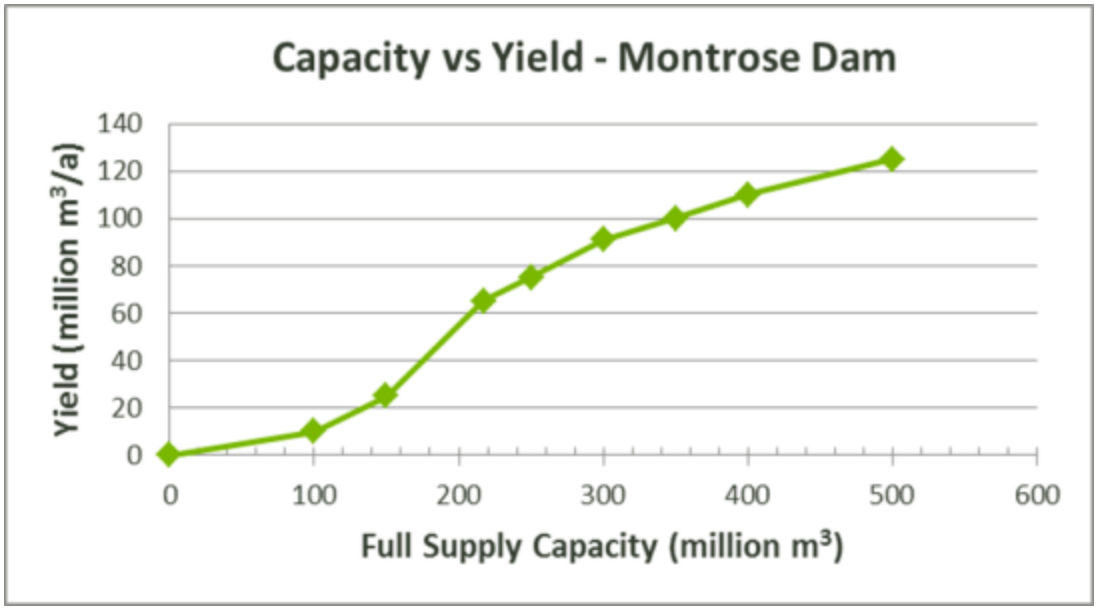


Figure 11.2: Yield versus capacity curve of the Montrose Dam option (after allowing for the EWR)

11.3.2 Mountain View Dam

Although the decision made with respect to the ecological Reserve is to maintain the present day flow in the Crocodile system this would imply that a dam at Mountain View would also have no yield (as for the Montrose Dam). It was therefore assumed that the C class Reserve at Mountain View, which represents the Present Ecological Status (PES), should be released from the dam. This will also ensure that the Kaap River makes its contribution to the EWR of the Crocodile River. The EWR that was modelled as a first priority release from the Mountain View Dam is attached as Appendix B-2.

The second important assumption made was that 15 million m^3/a from Mountain View Dam would be allocated to high assurance domestic use with any additional yield allocated to irrigators. In practice it is suggested that 10 million m^3/a of this 15 million m^3/a could be allocated to Matsula while the remaining 5 million m^3/a could be traded with irrigators downstream of the Matsula abstraction works. This will effectively free up 5 million m^3/a of high assurance use for Nelspruit South. Direct supply to Nsikazi South from Mountain View Dam is also a possibility that should be investigated.

It was assumed that if any new irrigation development takes place, supported from the Mountain View Dam, that these users be supplied directly from the dam by mean of a pipeline so as to save on pumping costs.

As with the Montrose Dam, assurance of supply also plays a major role in available yield of a dam. The assumption made was that 15 million m^3/a would be allocated to high assurance domestic use while any additional water would be allocated to irrigation at the same assurance at which they currently receive their water. In addition, it was assumed that irrigators upstream of the Mountain View Dam would be restricted according to the storage in the Mountain View Dam with the aim of achieving the same level of assurance of the irrigators located in the Crocodile River catchment, i.e. 70% assurance.

Based on all the above assumptions, the storage/yield curve for the Mountain View Dam is shown in **Figure 11.3**.

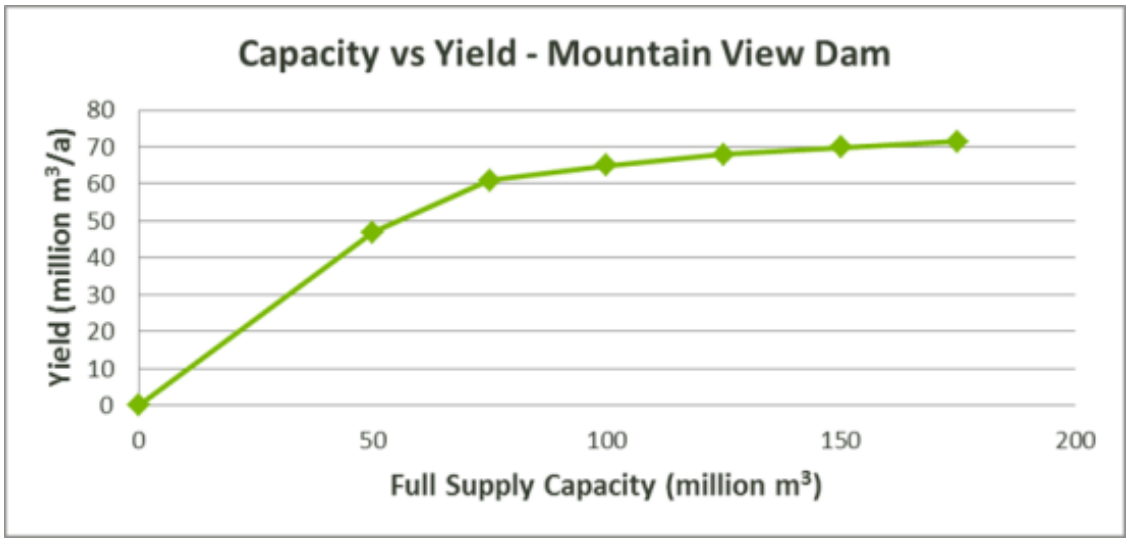


Figure 11.3: Capacity versus yield curve of the Mountain View Dam option (after meeting the EWR)

11.3.3 Boschjeskop Dam

The proposed Boschjeskop Dam is located on the Nels River in the X22F-1 quinary catchment. The runoff at the proposed site includes the runoff from the X22D catchment as shown in **Figure 11.4** below.

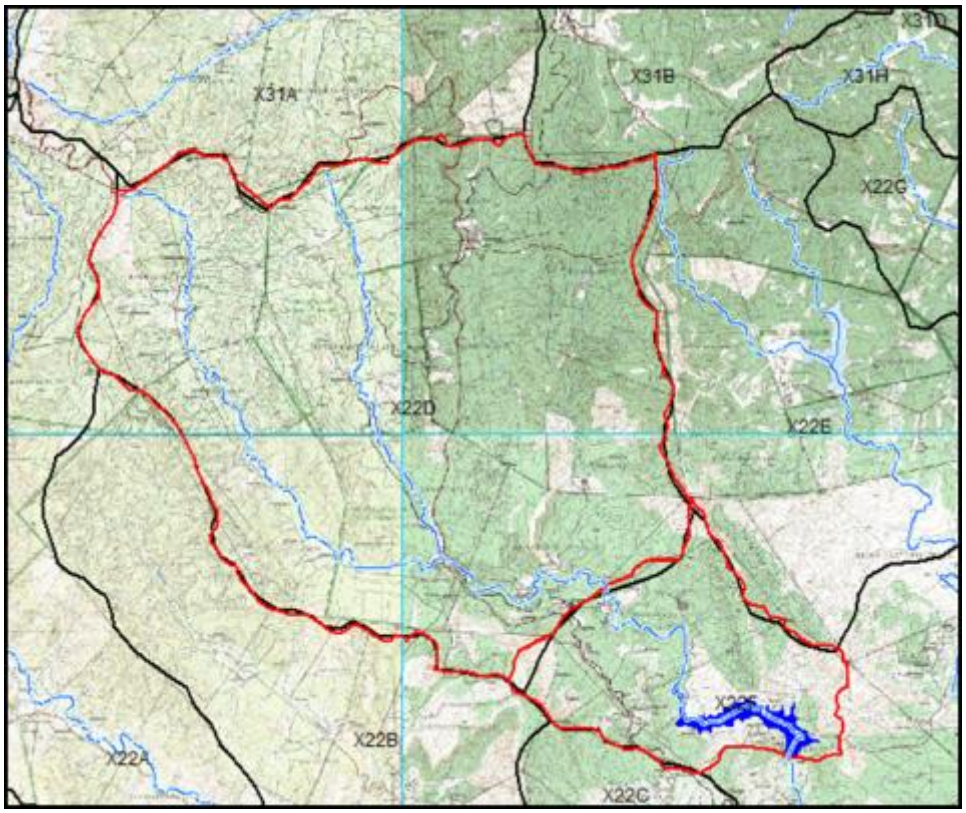


Figure 11.4: Location of the proposed Boschjeskop Dam

The catchment of the proposed Boschjeskop Dam has a high natural runoff but is heavily afforested. There is also a significant amount of irrigation upstream of the proposed dam site. **Table 11.7** summarises the hydrology of the catchment.

Table 11.7: Hydrology of the Boschjeskop Dam

Catchment	Catchment area (km^2)	Natural runoff (million m^3/a)	Present Day runoff (million m^3/a)
X22D	275,6	77,9	56,7
Portion of X22F-1	57,1	5,1	3,2
Total	**332,7**	**83,0**	**59,9**

The catchment upstream of the proposed Boschejskop Dam, which consist primarily of the X22D quaternary catchments, is one of the most heavily afforested catchments in South Africa. The estimated area of afforestation in the X22D catchment is 241 km^2 (DWAF, 2009c) which when compared with the catchment area of 275,6 km^2 implies 87% of the catchment is afforested. The area of forestry in the X21F-1 catchment upstream of the proposed Boscheskop Dam will need to be carefully surveyed but is estimated to be approximately 25 km^2. The total streamflow reduction due to afforestation upstream of the dam is estimated to be approximately 19 million m^3/a.

There is also a considerable amount of irrigation in the X22F-1 catchment. The IWAAS report estimates the irrigation use to be approximately 8 million m^3 /a. It is not certain how much of this irrigation lies upstream of the proposed dam site but it was assumed in these analyses that all this irrigation is located upstream of the dam. Taking into consideration the considerable upstream use, the yield of the Boschjeskop Dam is not large relative to the size of the dam. Nevertheless a 1 MAR dam will still deliver more than sufficient yield for Mbombela for many years into the future.

Historical yield analyses were carried out for a range of possible dam sizes at the Boschjeskop site. It was concluded that in order to provide a yield of approximately 15 million m^3/a (which would meet the growth in Mbombela's water demand for many years) a dam with a full supply capacity of approximately 60 million m^3 would be required. For the purpose of this analysis a C Class EWR was assumed to be released from the dam.

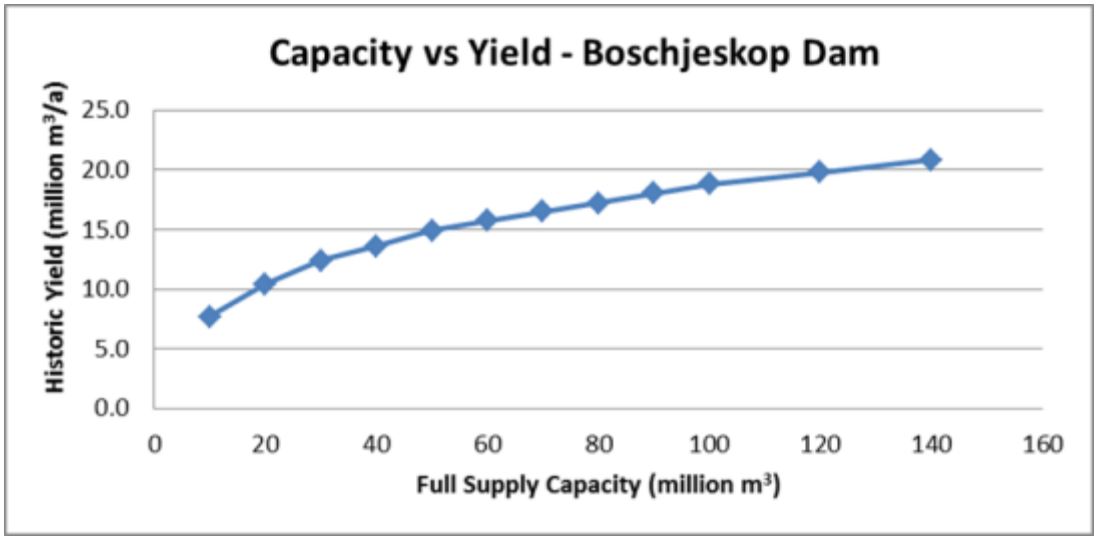


Figure 11.5: Capacity versus yield curve of Boschjeskop Dam (after allowing for the EWR)

11.3.4 Strathmore Dam

The Strathmore Dam was identified during DWA's reconnaissance study into possible dams in the Crocodile River catchment (DWAF, 2008). This is an off-channel dam and should be considered as a possible alternative to the Mountain View Dam since off-channel storage dams generally have a lower environmental impact than in-channel dams. The site's location, the basin, the proposed dam and the site geology are all described in the reconnaissance study report (DWAF 2008), from which the following is information has been sourced:

- The proposed dam site is located on the Jam Tin Creek (X24D), a tributary of the Crocodile River, 46 km east-south-east of Nelspruit. See **Figure 11.6.**
- Depending on the final wall height, the construction of this dam will require the construction of at least two separate dam walls.

The dam will be filled from the existing irrigation canal which abstracts water out of the Crocodile River at Krokodil Poort. It will be necessary to raise the canal to cater for the additional flow and install a pumpstation to pump water into the Strathmore Dam.

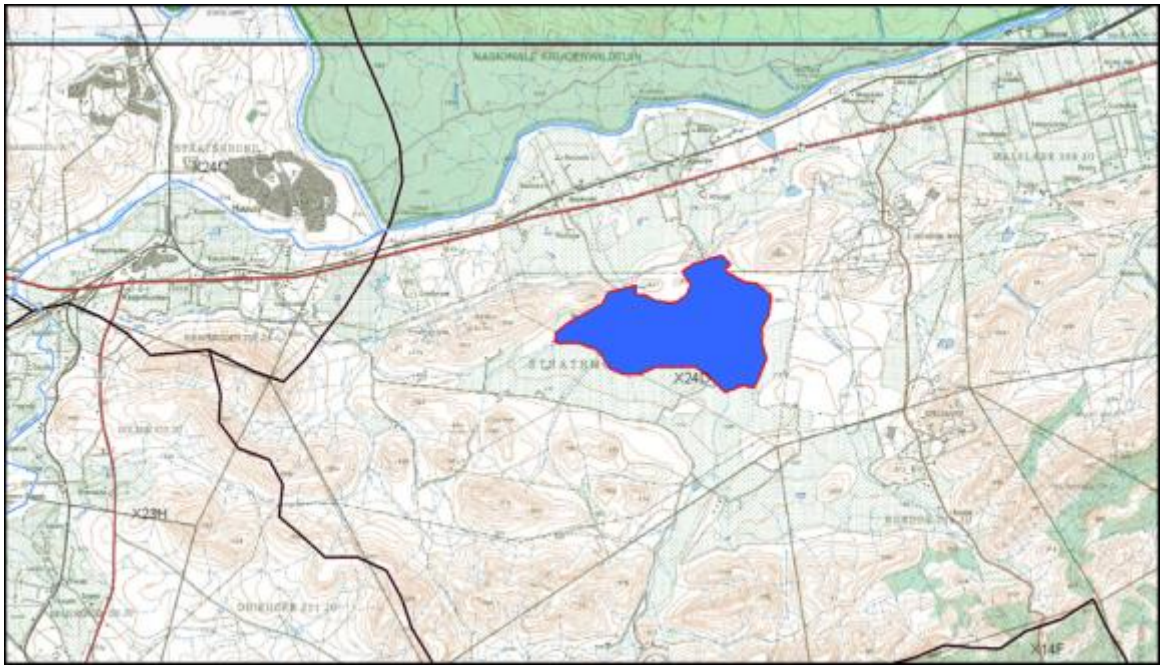


Figure 11.6: Location of the Strathmore Dam

The yield of the Strathmore Dam over a range of full supply capacities is shown in **Figure 11.7**. It was assumed that additional water will only be abstracted after the EWR requirements in the Crocodile River have been met.

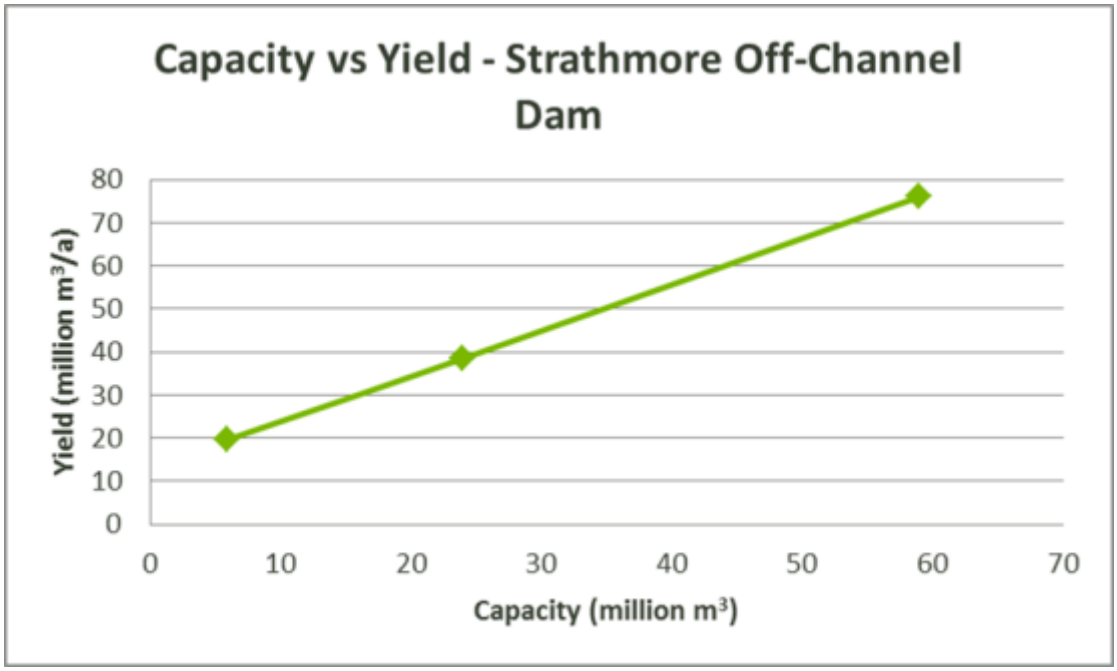


Figure 11.7: Capacity versus yield curve of the Strathmore off-channel Dam option

11.3.5 Lupelule Dam

The possibility of a small dam on one of the tributaries of the Elands River was raised at one the Stakeholder meetings. This was investigated and the largest of the tributaries (in terms of runoff) evaluated and a possible dam site identified. See **Figure 11.8**. A C Class EWR was assumed in determining the yield of the dam.

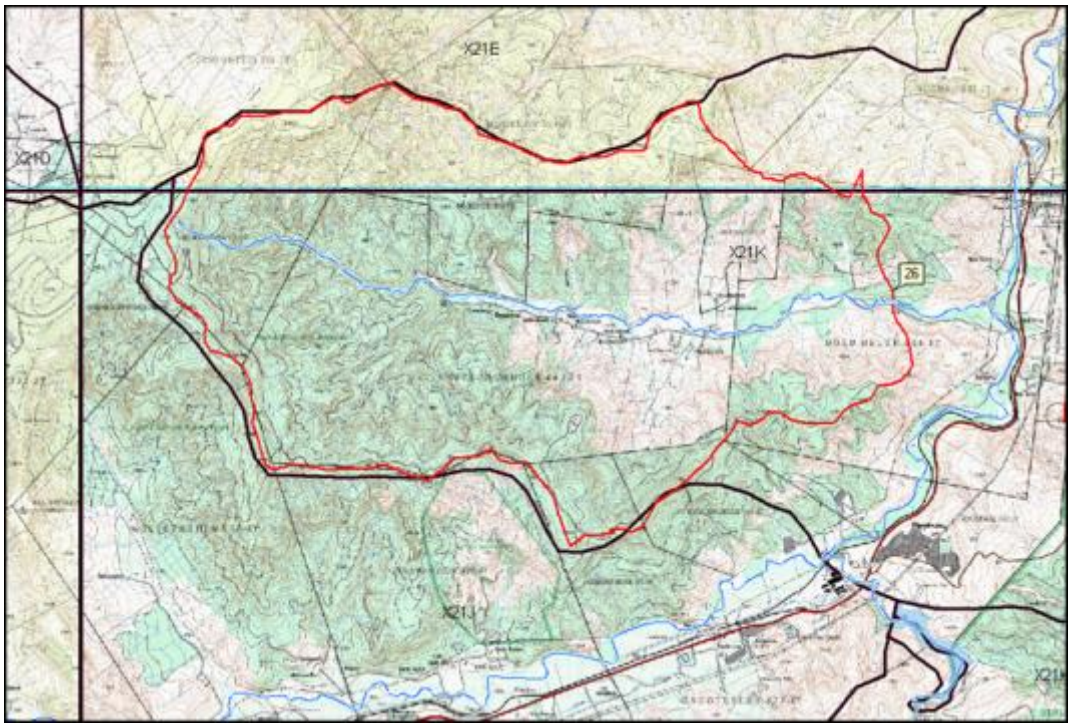


Figure 11.8: Lupelule Dam site

The yield of the dam was evaluated over a range of possible storages. See **Table 11.9**.

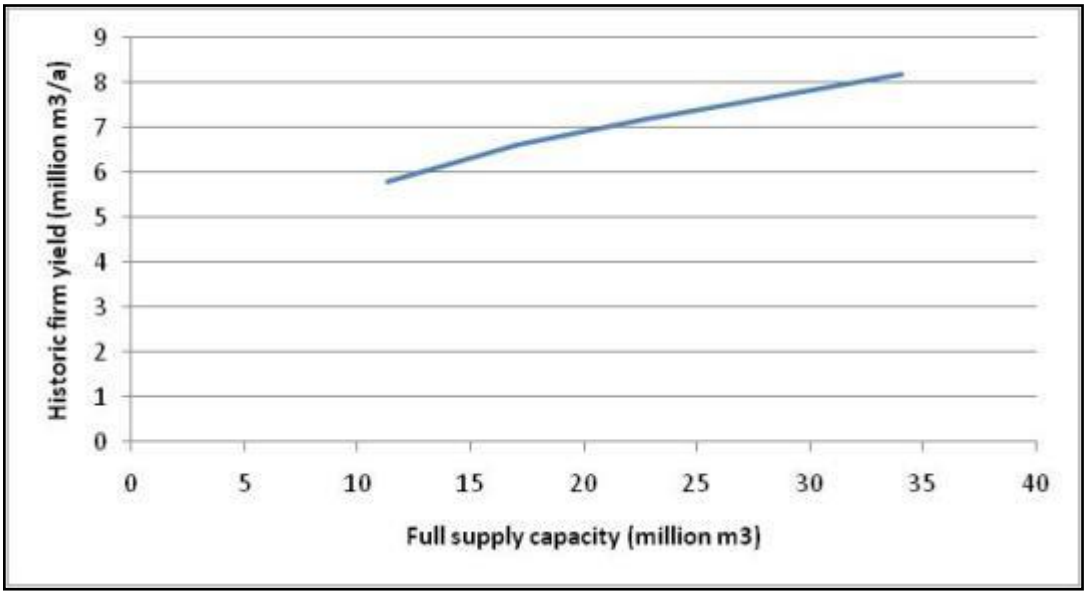


Figure 11.9: Yield versus storage of the possible Lupelule Dam (after supplying the EWR)

11.4 RAISING OF EXISTING DAMS

It is often more cost effective to raise existing dams that construct a new dam. Raising of existing dams generally also has a reduced environmental impact when compared to constructing a new dam. Several raising options were investigated are reported on in this section.

11.4.1 Ngodwana Dam

The Ngodwana Dam is an existing dam located in the X21H catchment on the Ngodwana River. The dam supplies water to the Sappi paper mill at Ngodwana as well as the small town which house Sappi staff. The hydrological statistics of the dam are given in **Table 11.8**.

Table 11.8: Hydrology of the Ngodwana Dam

Catchment	Catchment area (km^2)	Natural runoff (million m^3/a)	Present Day runoff (million m^3/a)
X21H	165,5	59,6	46,5

Considering that the existing full supply capacity of the Ngodwana Dam is only 10,4 million m^3 (17% of the natural MAR) there is potential to obtain large increases in yield from this dam through raising of the wall. The water use in this catchment, indicated as the difference between the natural and present day runoff in **Table 11.5**, is due to 77 km^2 of forestry upstream of the dam.

The yield of a raised Ngodwana Dam was evaluated for a range of possible full supply capacities. See **Figure 11.10**.

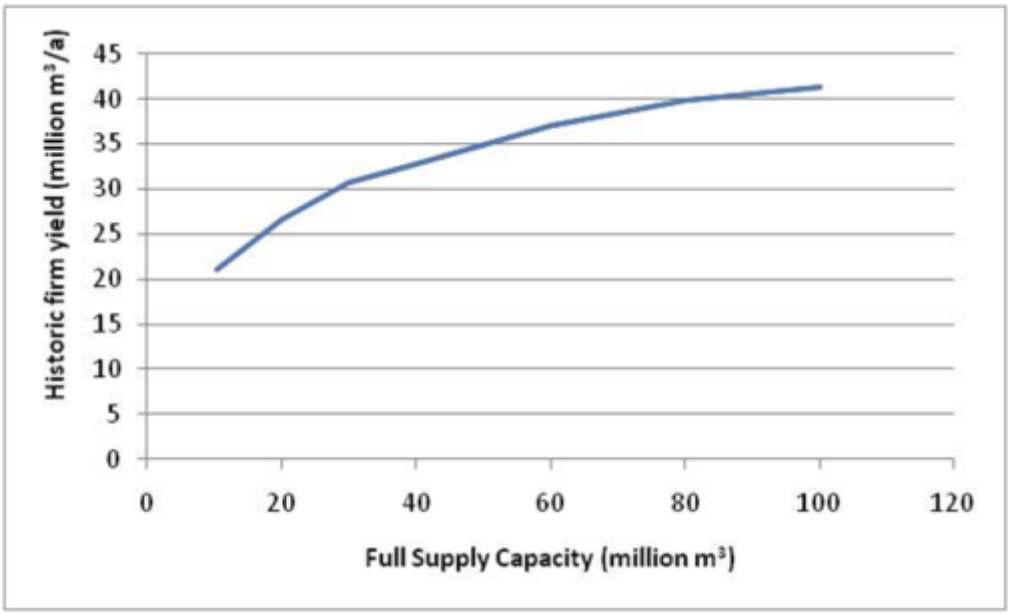


Figure 11.10: Yield of a raised Ngodwana Dam

It can be concluded from **Figure 11.12** that the yield of Ngodwana dam could conceivably be increased by as much as 20 million m^3/a. It was assumed that no release for the EWR would be required from this dam because it is located so close to the Elands River and there is current no release for the EWR.

11.4.2 Smaller dams in the White River area

The raising of the Witklip and Longmere Dams were evaluated and the increased yield is shown in **Figure 11.11**. Since the Longmere and Klipkopjes Dams are operated as a system, there is no merit in raising the Klipkopjes Dam. More yield will be made available by raising the downstream Longmere Dam.

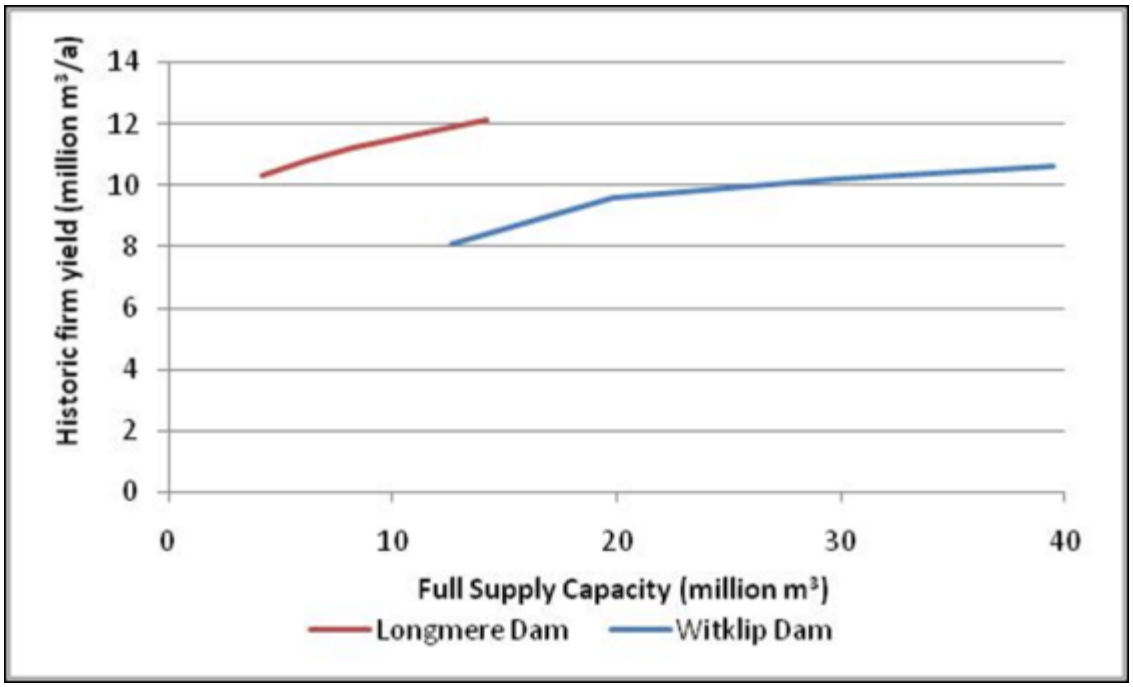


Figure 11.11: Yield of raised Witklip and Longmere Dams

11.5 CURRENT WATER RESOURCES OF THE SABIE RIVER CATCHMENT

The water resources of the Sabie, as with the Crocodile River, has two components; the yield available from dams (including farm dams) and the yield available from run-of-river. The significant dams in the Crocodile River catchment are listed in **Table 11.9**.

Table 11.9: Major dams in the Sabie River catchment

Dam	Fully supply capacity (FSC)			Full supply area (FSA) (km^2)	Yield (million m^3/a)	
	million m^3	Natural MAR (million m^3/a)	FSC as %MAR		Historic	1 in 50
Inyaka Dam	125,0	79,9	156%	8,1	41,9	50,7
Da Gama Dam	13,6	20,3	67%	1,3	10,3	10,8
TOTAL	**138,6**	**100,2**		**9,4**	**52,2**	**61,5**

The natural MAR of the Sabie River catchment (excluding the Sand tributary) 527 million m^3/a. The two major dams in the Sabie catchment command a runoff of 100 million m^3/a, which is less than one fifth of the catchment's MAR. Expressing the total dam storage as a percentage of the runoff (138,6/527) results in a 26% storage relative to the MAR. As with the Crocodile River catchment, this ratio is very low. The obvious conclusion is that run-of-river flows downstream of the dam form a very important part of the water resources of the Sabie River catchment and must be managed carefully in conjunction with the dams.

Detailed operating rules for the Sabie River have been developed (DWA, 2103). The operating rule maximises the yield of the system by only releasing water from dams when users require the water. Hence during summer when there is ample flow in the Elands River and other large tributaries such as the Houtbosloop and Nels Rivers, it is very often not necessary to release water at all. Through this careful management, water can be saved in dams for the low flow winter months when the water is needed. In addition, the operating rule allows for restrictions to be imposed timeously on water users to prevent failure of the water supply system. The restriction rule currently applied within the Crocodile River catchment is indicated in **Table 11.10** and **Table 11.11**.

Table 11.10: Restriction rule for irrigators

Storage in the Kwena Dam (% of full supply capacity)	Recommended Restriction to be imposed (% of allocation)
> 70%	0%
55 to 70%	35%
10 to 55%	60%
< 10%	0%

Table 11.11: Restriction rule for domestic use

Storage in the Kwena Dam (% of full supply capacity)	Recommended Restriction to be imposed (% of allocation)
> 50%	0%
20 to 50%	5%
10 to 20%	10%
< 10%	20%

In addition to simply preventing the system from failing, the operating rules strive to maintain a target assurance of supply, which in this case is 80% for irrigators and 98% for domestic users where assurance of supply is defined as the percentage of time that a user sectors obtains their full allocation.

11.5.1 Groundwater Resources

The geology of the study area consists mostly of grey and white granites south of Nelspruit, and potassic gneiss to the north of the city. The occurrence of groundwater is mainly associated with the deeper weathered zones, whereas fault zones and dyke contacts represent other groundwater occurrences. The groundwater yield potential from the granite and gneiss is classified as “low”, with potential yields between 0,1 to 0,5 ℓ/s in the granite and 0,5 to 2,0 ℓ/s in the gneiss. According to Vegter (1995) the probability of drilling a successful borehole is below 40%. The possibility of drilling a borehole yielding more than 2 ℓ/s is only 20% to 30% in the granite, and 10% to 20% in the gneiss.

The western part of the Municipal area contains a dolomite aquifer which can yield as much as 5 ℓ/s per borehole. The probability of drilling a successful borehole in these dolomites lies between 40 and 60%. However, it is thought that there is a direct link between these dolomites and the surface flow and that the strong baseflows observed in the Elands River are due to the presence of the dolomite. Water sourced from the dolomites should not therefore been seen as additional water.

As shown on the geological map of the MLM area several northwest southeast striking shear zones and intersecting dykes are present. High potential groundwater resources are normally associated with these structural features. However, high density airborne magnetic and radiometric surveys of the area are required to identify the exact locality of these structural features. Targets along these structures need to be selected for geophysical traversing. In addition the application of the radon emanation technique (Levin, 2000) is needed to select optimum drilling sites intersecting water bearing structures. It can be concluded that groundwater availability within the Mbombela Municipality is generally low and will require further detailed investigations for successful development.

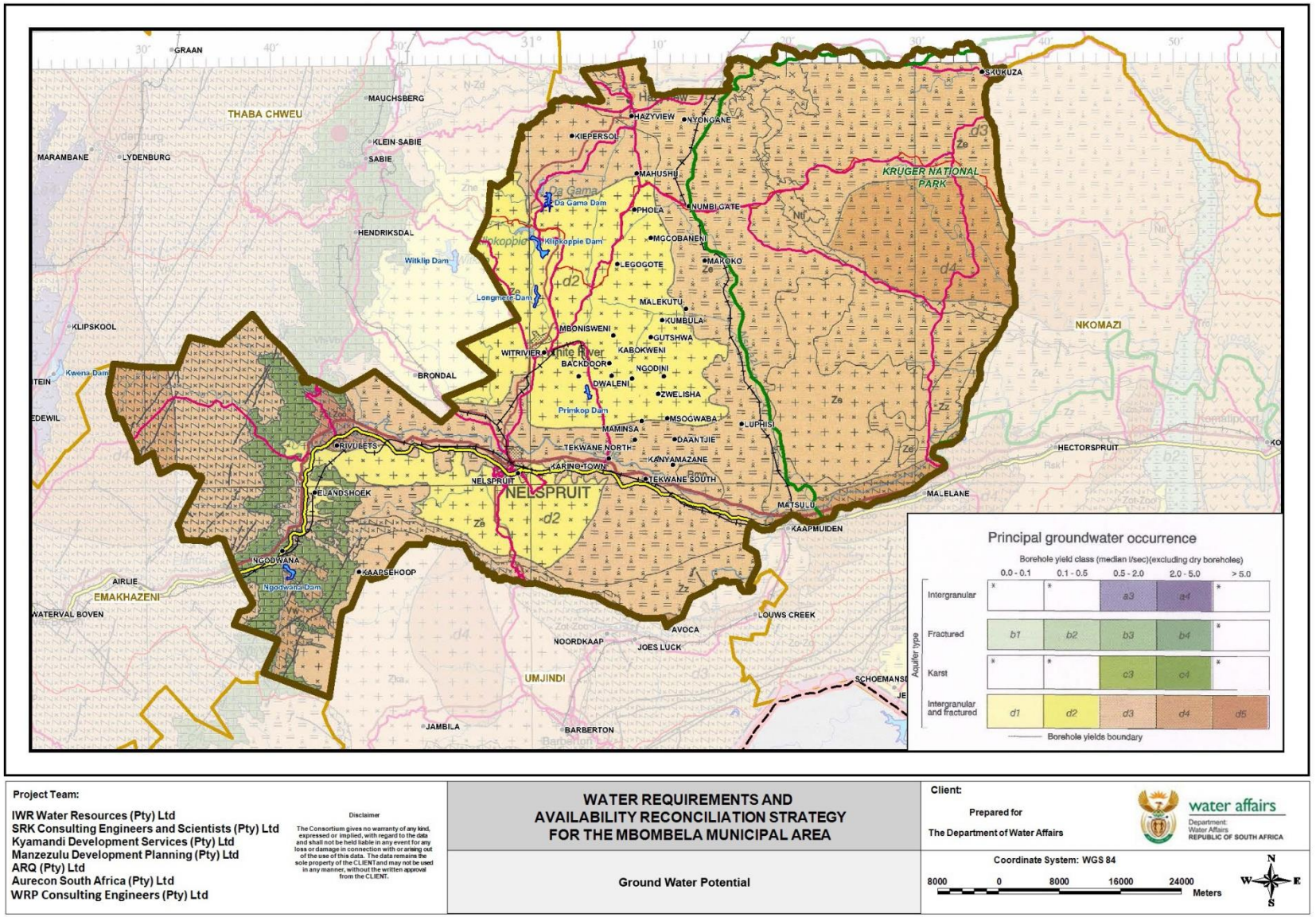


Figure 11.12: Groundwater availability in and around the Municipal area

12 CONCLUSIONS AND RECOMMENDATIONS

As part of the development of strategies to reconcile growing water requirements with the available water resource, a detailed assessment of the current and future water requirements and water availability was carried out. This included a detailed demographic analysis based on readily available information as well as an economic analysis to identify the drivers of development and hence increasing water requirements. The conclusion, based mostly on the StatsSA information, is that population growth within the Mbombela Municipality is predicted to be relatively slow, between 1 and 2%.

During the course of this study, information obtained from the Municipality suggested that in certain areas the growth rate could be considerably higher than suggested by the StatsSA data. Also, developments such as a new university in Nelspruit could also have a significant affects on the growth rate and hence future water requirements. These higher growths were addressed by developing a 'very high' growth scenario and estimating the future water requirements associated with this scenario. This 'very high' growth allowed for the university as well as housing in White River and Karino that is already in progress.

The water resources was re-evaluated as part of this study and reported on with a focus on the Municipal area while previous studies were catchment based. The conclusion is that the water resources in the Crocodile River catchment is fully allocated and full utilised. Hence new water resources will need to be developed in order to make additional yield available within the Municipal area. The yield from several development options was analysed as part of this study taking cognisance of the ecological water requirements. These options include the Montrose Dam on the main stem of the Crocodile and the Boshkopjes, Lupelele and Mountain View dams on tributaries of the Crocodile River. The Strathmore Dam, which is an off-channel option, was also evaluated. The yields of these options (after allowing for the ecological Reserve) varies from 20 to 60 million m^3/a and hence offer both medium and long-term solutions to reconciling water demands with the water resource within the Mbombela Municipal area. The raising of existing dams was also analyses. Only the raised Ngodwana Dam would provide sufficient additional yield to meet the increasing water demands for a reasonable period of time.

The analysis of the Sabie River concluded that while the available water resource of the Sabie River is not yet fully utilised, it has been fully allocated. Once the transfer of water from the Inyaka Dam to the Sand River has been fully implemented the water resource will be fully utilised. There are no development options on the Sabie River. The only option available in the Sabie River is to downgrade the ecological management class of the river. This will be evaluated as part of the Classification of the Water Resources.

It is recommended that as part of future studies the growth rate in the Mbombela municipal area be monitored closely so that the gap between the very high and low growth can be narrowed and hence give more certainty as to when interventions to maintain a water balance will be required.

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