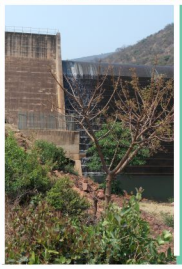
water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

REPORT NO: PWMA 01/000/00/02914/10/3



THE DEVELOPMENT OF THE LIMPOPO WATER MANAGEMENT AREA NORTH RECONCILIATION STRATEGY

WATER SUPPLY SCHEMES

Supporting Document 3:
Screening Workshop Starter Document

DRAFT

AUGUST 2015

W101_2014/J02173

Project Name:	***Limpopo Water Management Area North Reconciliation Strategy***
Report Title:	***Screening Workshop Starter Document***
Author(s):	***J Lombaard, HS Pieterse***
DWS Report No.:	***P WMA 01/000/00/02914/10/3***
DWS Contract No.	***WP 10768***
PSP Project Reference No.:	***J02173***
Status of Report:	***Draft***
First Issue:	***August 2015***
Final Issue:	***-***

CONSULTANTS: AECOM in association with Hydrosol, Jones & Wagener and VSA Rebotile Metsi Consulting.

*Approved for **AECOM**:*

HS Pieterse	***JR Rossouw***
Task Leader	*Study Leader*

DEPARTMENT OF WATER AND SANITATION (DWS): Directorate: National Water Resource Planning

*Approved for **DWS**:*

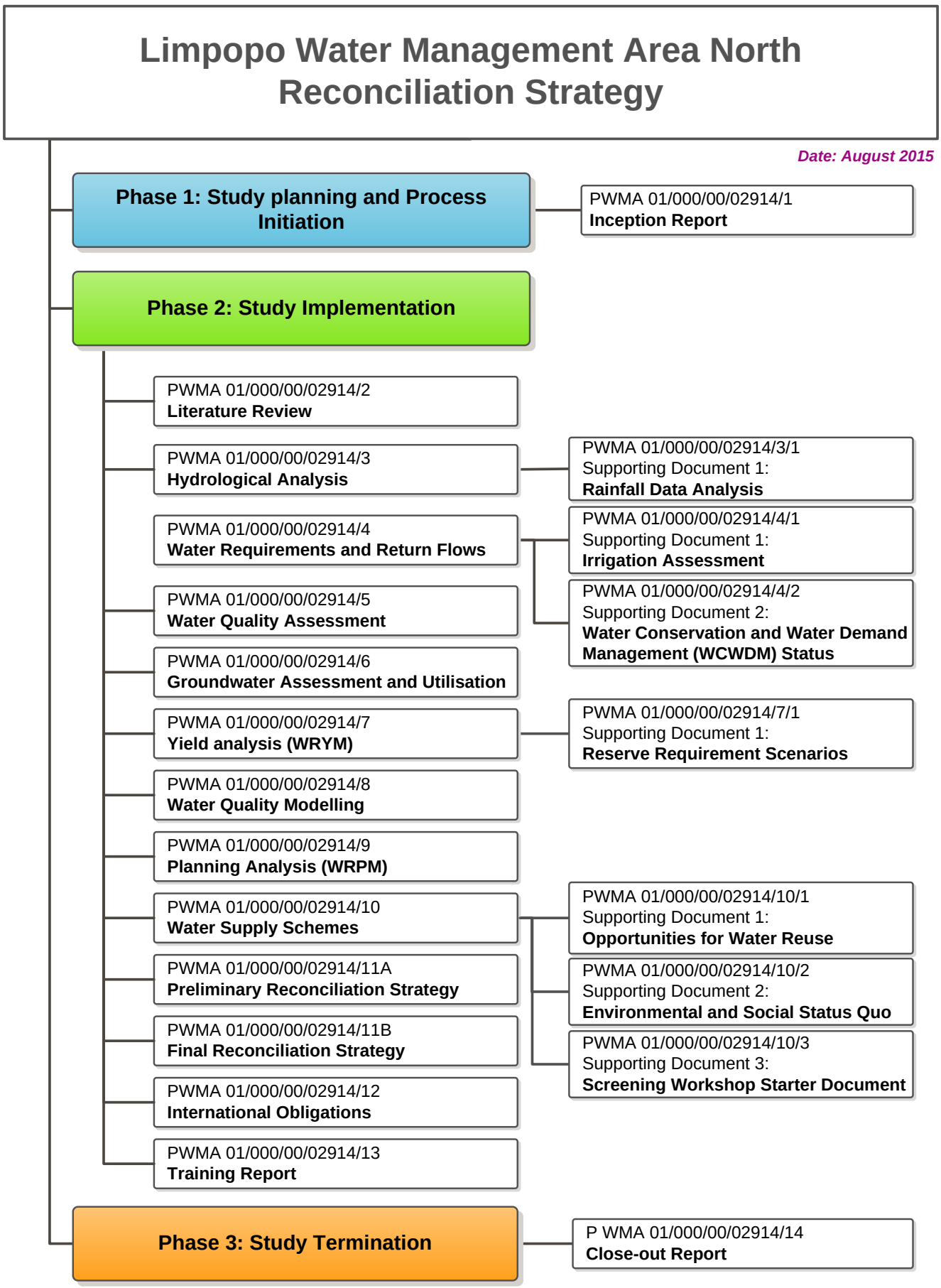
Reviewed: Dr B L Mwaka	***T Nditwani***
Director: Water Resources Planning Systems	*Acting Director: National Water Resource Planning*

Prepared by:

AECOM SA (Pty) Ltd
PO Box 3173
Pretoria
0001

In association with:

Hydrosol Consulting **Jones & Wagener** **VSA Rebotile Metsi Consulting**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LIST OF ABBREVIATIONS

AECOM	AECOM SA (Pty) Ltd
CoAL	Coal of Africa Limited
CTL	Coal-to-liquid
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
DM	District Municipality
GWS	Groundwater Scheme
IPPs	Independent Power Producers
IAP	Invasive Alien Plants
LEIP	Limpopo Eco-Industrial Park
LM	Local Municipality
MBET	Marapong-Boikarabelo Effluent Transfer
MAR	Mean Annual Runoff
MCWAP	Mokolo and Crocodile River Water Augmentation Project
NWRS-1	National Water Resource Strategy - First Edition (2004)
NWRS-2	National Water Resource Strategy - Second Edition (2012)
ORWRDP	Olifants River Water Resources Development Project
RDP	Reconstruction and Development Programme
RWSS	Regional Water Supply Scheme
RSA	Republic of South Africa
RWS	Rural Water Scheme
RWS	Rural Water Scheme
SAB	South African Breweries
SEZ	Special Economic Zone
V&V	Validation and Verification
WwTW	Wastewater Treatment Works
WCWDM	Water Conservation and Water Demand Management
WMA	Water Management Area
WRPM	Water Resources Planning Model
WRYM	Water Resources Yield Model
WTW	Water Treatment Works

LIST OF UNITS

a	annum
ha	hectare
kℓ	kilolitre
km	kilometer
km^2	square kilometre
ℓ/c/d	liter per capita per day
ℓ/s	litre per second
m	metre
m^3	cubic meter
m^3/a	cubic meter per annum
Mℓ/d	megalitre per day
mm	millimetre
$m^3/ha/a$	cubic meter per hectare per annum

1 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The DWS (then DWA) identified a need for the development of the *Limpopo Water Management Area (WMA) North Reconciliation Strategy* as part of a national initiative to ensure adequate and sustainable water supply for the future. The Limpopo WMA North refers to the Limpopo WMA described in the first edition of the *National Water Resource Strategy* (NWRS-1) published in 2004. The 19 initial WMAs were consolidated into nine WMAs during 2012 and acknowledged in the second edition of the *National Water Resource Strategy* (NWRS-2) of 2013. The newly defined Limpopo WMA also includes the original Crocodile (West) and Marico WMA as well as the Luvuvhu River catchment, previously part of the Luvuvhu and Letaba WMA. However, these additional areas will not be part of this Reconciliation Strategy.

1.2 OBJECTIVE OF THE STUDY

The main objective of the study is to formulate a water resource reconciliation strategy for the entire Limpopo WMA North up to 2040. The reconciliation strategy must (i) address growing water demands and water quality problems experienced in the catchment, (ii) identify resource development options and (iii) provide reconciliation interventions, both structural and administrative / regulatory.

1.3 STUDY AREA

The dry Limpopo WMA North is the most northern WMA and forms part of the internationally shared Limpopo River Basin. The study are comprises of six main river catchments namely the Matlabas, Mokolo, Lephalala, Mogalakwena, Sand and Nzhelele. The very small Nwanedi River catchment forms part of the Nzhelele River catchment. The Study Area is shown in **Figure 1.1**. The areas indicated in grey show the additional catchment and WMA areas included in the Limpopo WMA as per NWRS-2.

The main urban areas within the WMA include Mokopane, Polokwane, Mookgophong, Modimolle, Lephalale, Louis Trichardt and Musina. Approximately 760 rural communities are scattered throughout the WMA, mostly concentrated in the central region. The main economic activities are irrigation and livestock

farming as well as expanding mining operations due to the vast untapped mineral resources in the area. The water resources, especially surface water resources, are heavily stressed due to the present levels of development. It is crucial that water supply is secured and well managed.

The climate over the Study Area is temperate and semi-arid in the south to extremely arid in the north. Mean annual rainfall ranges from 300 mm to 700 mm with the potential evaporation well in excess of the rainfall. Rainfall is seasonal with most rainfall occurring in the summer. Runoff is low due to the prevalence of sandy soils in the most of the Study Area, however, loam and clay soils are also found.

The topography is generally flat to rolling, with the Waterberg on the south and the Soutpansberg in the north-east as the main topographic features. Grassland and sparse bushveld shrubbery and trees cover most of the terrain. Several wildlife and nature conservation areas have been proclaimed in the WMA, of which the Nylsvley Nature Reserve, Mapungubwe National Park and the Marekele National Park are probably the best known.

1.4 PURPOSE OF THIS DOCUMENT

The purpose of this *Starter Document* is to provide information on the intervention options that were identified to reconcile the current and future water requirements with the available water resources in the Study Area. This document also gives a brief background of the current resource situation in each catchment in the Study Area. The intervention options, both structural and management orientated, were sources from previous water resources related studies – refer to the *Literature Review Report (P WMA 01/000/00/02914/2)* for summaries of these studies. These intervention options will be presented at the second *Study Steering Committee* (SSC) Meeting to provide stakeholders with the opportunity to:

- Share their views on the identified intervention options;
- Identify the preferred intervention options that should be considered for further investigation as well as the level of investigation required; and
- Add additional options where applicable.

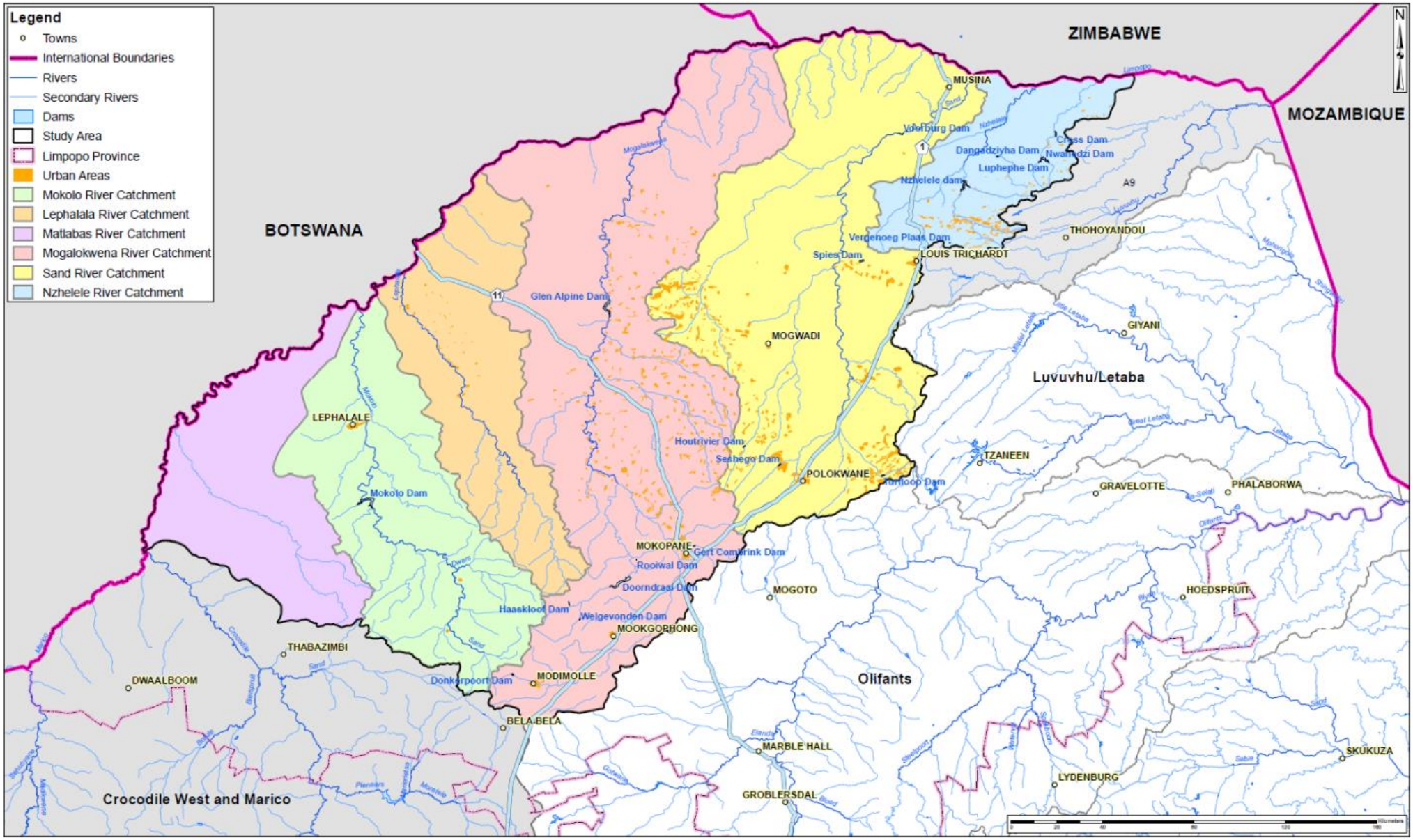

Figure 1.1: General layout of the Study Area

2 CATCHMENT STATUS AND INTERVENTION OPTIONS

2.1 MATLABAS RIVER CATCHMENT

The Matlabas River catchment is the smallest catchment in the Study Area, located in the most western area of the Limpopo WMA North which is predominantly flat. The catchment is very rural with limited and scattered settlements. The layout of the catchment is shown in Figure 2.1.

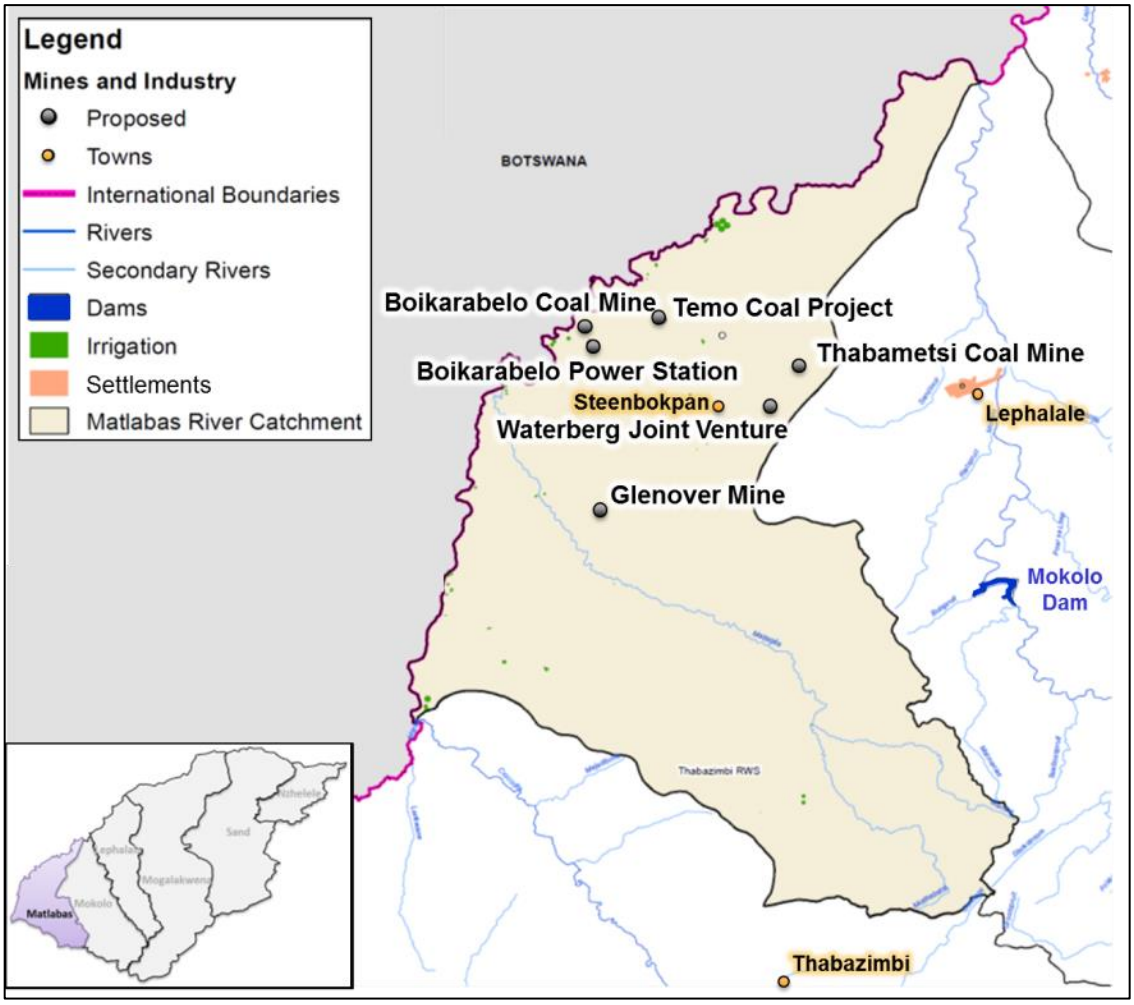

Figure 2.1: Matlabas River catchment

2.1.1 Overview of the current water availability and supply situation

The Matlabas River catchment is a dry catchment with non-perennial flow and hence no sustainable yield from surface water. Water related infrastructure is minimal - there are no large dams and no transfers in or out of the catchment. Some areas are still considered pristine. Although limited, the irrigation sector is the major water user and domestic supply is almost negligible. Water is supplied

approximately equally from surface water and groundwater via run-of-river abstractions and boreholes respectively. The total 2010-development level water requirement in the catchment is **7 million m^3/a**. The requirement per major user sector is illustrated in **Figure 2.2.** Distinction is made between the water requirements supplied by surface water (SW – darker colours) and groundwater (GW – lighter colours).

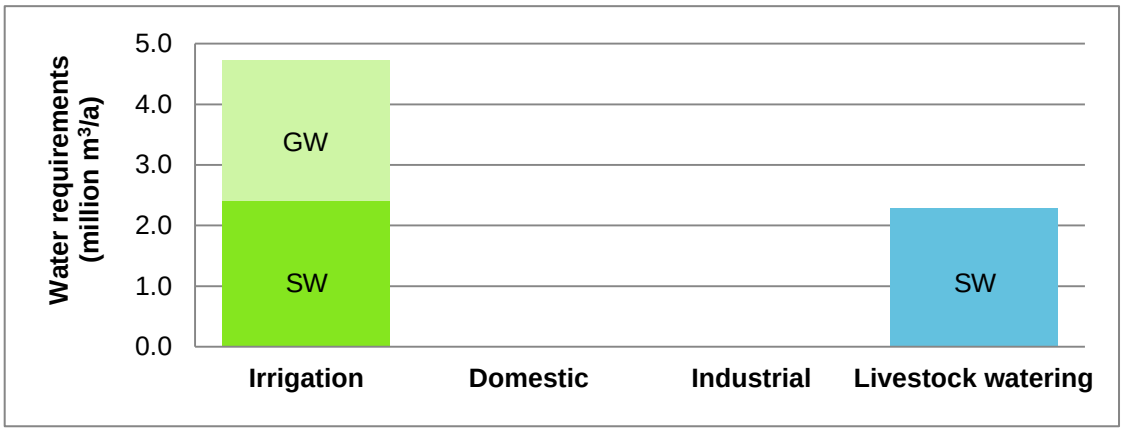

Figure 2.2: Matlabas River catchment 2010-development level water requirements

2.1.2 Future water requirements and intervention options

A number of potential mining and power generation developments exist in the catchment. Prospective developments include:

- Boikarabelo Coal Mine and Power Station
- Glenover Phosphate Mine;
- Temo Coal Project;
- Thabametsi Coal Mine; and
- Waterberg Joint Venture Coal Mine.

In terms of water supply to the Boikarabelo Coal Mine and Power Station, the *Marapong-Boikarabelo Effluent Transfer* (MBET) and groundwater development have been identified as possible supply sources. The Glenover Phosphate Mine is an existing platinum group metals mine currently not operating, however, it is projected that the mine will be reopened in future. Water resources for this mine have not yet been determined. The water requirements for the latter three developments are anticipated to be sourced from the *Mokolo and Crocodile River Water Augmentation Project* (MCWAP) Phase 2A. Other than these developments, the potential for land-use development and associated population growth is low and water requirement increases are limited.

The additional future domestic water requirements can be supplied from the under-exploited groundwater resources. Intervention options are given in Table A.1 in Appendix A. Distinction is made between intervention options that have already been approved by DWS, which will definitely be implemented and other possible intervention options that still require further investigation.

2.2 MOKOLO RIVER CATCHMENT

The Mokolo River catchment is located in the higher rainfall portion of the Study Area and has been the subject of intensive studies during recent years. The catchment is predominantly rural except for some larger towns namely Lephalale and Marapong. Other smaller settlements include Vaalwater and Mabaleng (previously Alma).

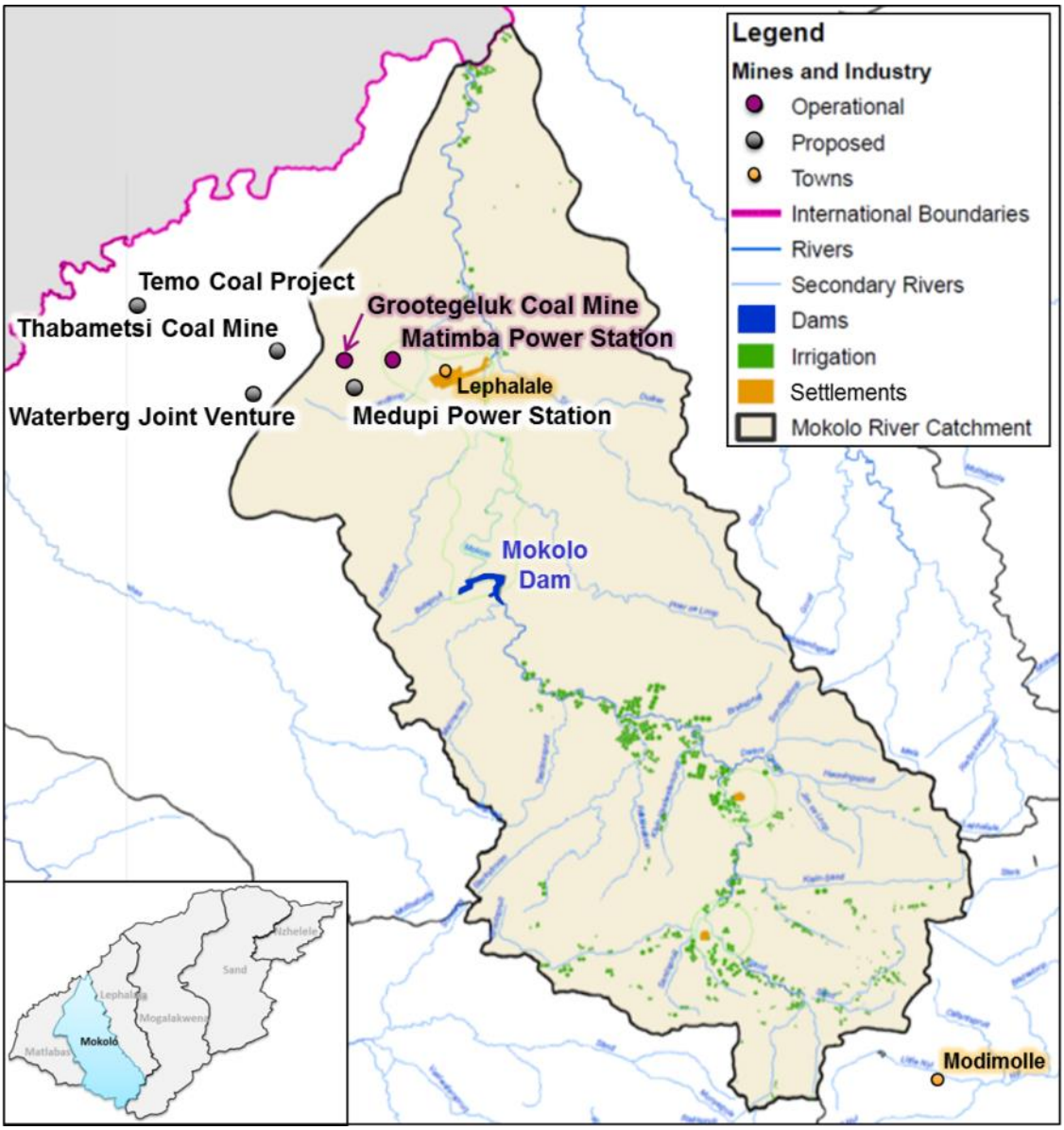

Figure 2.3: Mokolo River catchment

The Waterberg Coalfields in the vicinity of Lephalale are the economic focus of the area. The Matimba Power Station and the associated Grootegeluk Coal Mine, as well as the new Medupi Power Station, located in the lower regions of the catchment, are major water users. A number of other power stations, *coal-to-liquid* (CTL) fuel facilities by Sasol and mining activities by Exxaro are anticipated in the Lephalale as well as in the Steenbokpan area on the north eastern border of the Matlabas River catchment. These developments will increase the population and water requirements significantly for the area. The layout of the catchment is shown in **Figure 2.3**.

2.2.1 Overview of the current water availability and supply situation

The Mokolo River catchment is developed in terms of water resources. The Mokolo Dam is the largest dam in the Study Area. There are over 1 400 smaller water bodies in the catchment, including farm dams, weirs and gravel pits. Water to the Matimba Power Station, Medupi Power Station, Grootegeluk Coal Mine, and the Lephalale Local Municipality, including Lephalale town and Marapong, is supplied from the large Mokolo Dam. The water supply from Mokolo Dam can meet the current domestic and industrial requirements. However, it should be taken into account that the Mokolo Dam is over-allocated and the supply is limited by the distribution infrastructure. The small domestic requirements of Vaalwater and Mabaleng (Alma), situated in the upper reaches of the catchment, are supplied from local groundwater resources via the *Mabatlane Rural Water Scheme (RWS)* and the *Mabaleng RWS* respectively. However, boreholes tend to run dry, necessitating water to be supplied to the communities via water tankers. The irrigation sector is the major water user and is concentrated along the upper reaches of the Mokolo River and downstream of the Mokolo Dam.

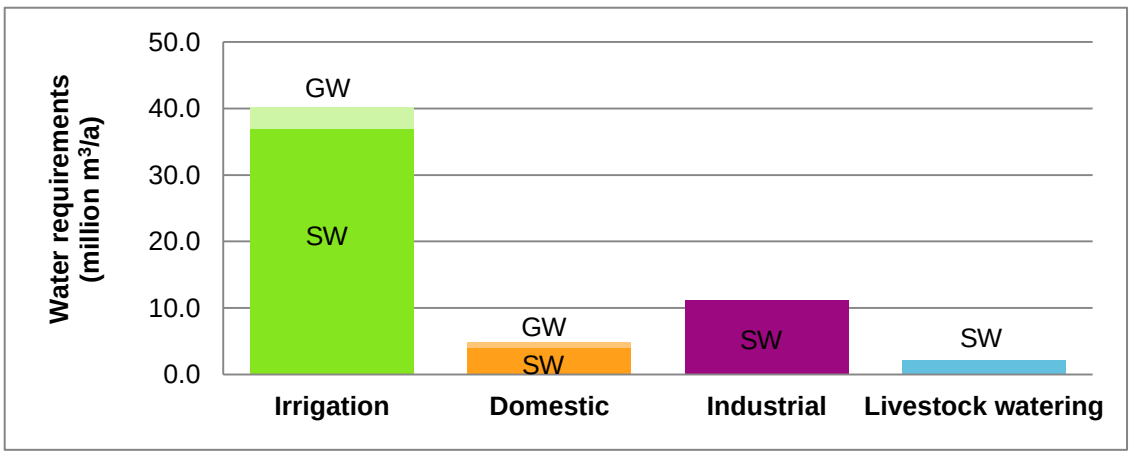

Figure 2.4: Mokolo River catchment 2010-development level water requirements

Almost the entire irrigation water requirement is supplied by surface water from run-of-river abstractions, small farm dams and the Mokolo Dam. The 2010-development level water requirement per user sector is illustrated in **Figure 2.4**. Distinction is made between the water requirements supplied by surface water (SW – darker colours) and groundwater (GW – lighter colours).

Water resources issues in the catchment include:

- The Mokolo Dam is over-allocated and some water users do not use their full allocation e.g. domestic users have an allocation of 5 million m^3/a but only uses approximately 1 million m^3/a;
- Poor groundwater and surface water quality in some regions due to coal mining activities and the rapid and uncontrolled growth of informal settlements around Vaalwater and Mabaleng.
- Overflowing oxidation ponds in Vaalwater, especially during the rainy season, which poses a threat to groundwater quality;
- Water shortages in the Vaalwater region to such an extent that water have to be provided by water carts;
- Large water losses due to aged infrastructure and lack of water loss accountability;
- A large volume (60%) of the water released from the Mokolo Dam is lost due the prevalence of sand aquifers downstream of the dam; and
- Unlawful water use, especially in the irrigation sector.

2.2.2 Future water requirements and intervention options

Extensive future development is planned for the Mokolo River catchment. Potential users and the associated development activities include:

- *Eskom* - Matimba Power Station, Medupi Power Station, a future third coal fired power station, a potential fourth coal fired power stations as well as two smaller sized *independent power producers* (IPPs), equivalent of one Eskom power station;
- *Exxaro* – Grootegeluk Coal Mine and associated new coal mines;
- *Other coal mining companies* – Allowance for additional coal mines to support power generation in Mphumalanga and coal exportation;
- *Sasol* – Potential CTL plant;
- *Lephalale and Steenbokpan* – Growth in households for construction and permanent workforce.

The total estimated 2040-development level water requirement for these developments are estimated at **121.7 million m^3/a**. Intervention options are listed in **Table A.2** in **Appendix A** and distinction has been made between intervention options that have already been approved by DWS, which will definitely be implemented or are currently being constructed and other possible intervention options that still require further investigation.

2.3 LEPHALALA RIVER CATCHMENT

The Lephalala River catchment is a small catchment with high rainfall in the upper Waterberg regions and reduces significantly towards the Limpopo River. The Wilderness area in the middle reaches of the catchment is of high conservation importance and is considered pristine. There are no major towns in the catchment and smaller settlements, such as Witpoort, are concentrated in the lower reaches, close to the Lephalala River. There are a number of nature reserves and tourist activities in the catchment as well as the Witpoort Hospital. The layout of the catchment is shown in **Figure 2.5**.

2.3.1 Overview of the current water availability and supply situation

The Lephalala River catchment is undeveloped in terms of water resources. No major dams exist in the catchment and the majority of water bodies, such as farm dams, are located in the upper, higher rainfall regions in the vicinity of the Waterberg Mountains. Irrigation is the major water user in the catchment, supplied mainly from farm dams in the upper reaches, storage weirs in the middle reaches and alluvial aquifers in the lower reaches. A large amount of irrigation (approximately 44%) is supplied by the Limpopo River alluvial aquifer. This alluvial aquifer is considered not to be fed by the runoff generated in the Lephalala River catchment but by the Limpopo River main stem.

Basic domestic and stock water needs of 38 villages are supplied by five local groundwater schemes (Ga-Phahladira Cluster, Ga-Seleka RWS, Mokuranyane RWS, Shongwane RWS and Witpoort RWS). In total these schemes consist of more than 120 boreholes. Small deficits in the water balances exist in some of the areas and need to be addressed. Remaining villages are supplied by individual borehole schemes, comprising of one or more boreholes, a short rising main, reservoir and rudimentary reticulation. The 2010-development level water requirement per user sector is illustrated in **Figure 2.6**. Distinction is made between the water requirements supplied by surface water (SW – darker colours) and groundwater (GW – lighter colours).

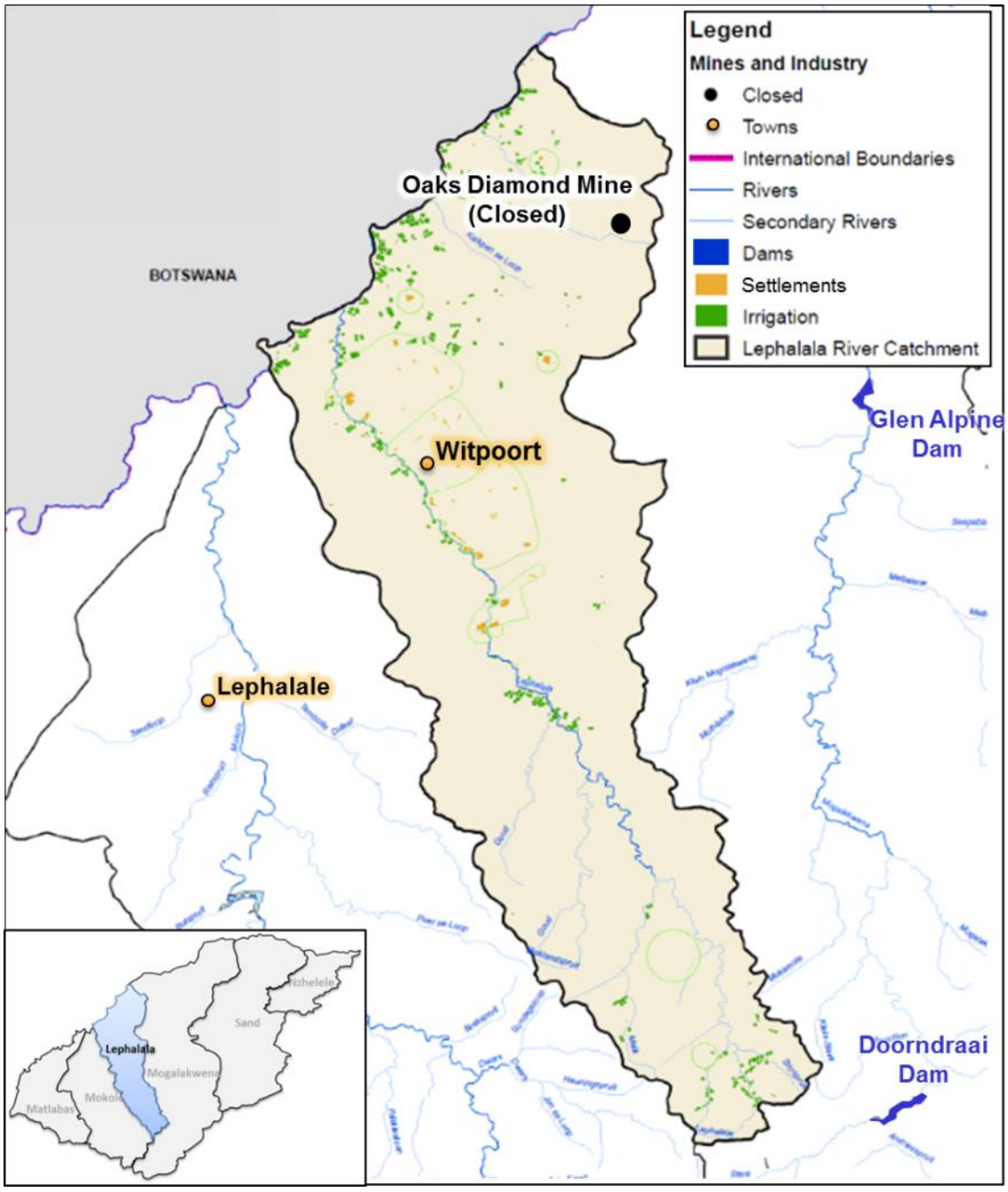

Figure 2.5: Lephalala River catchment

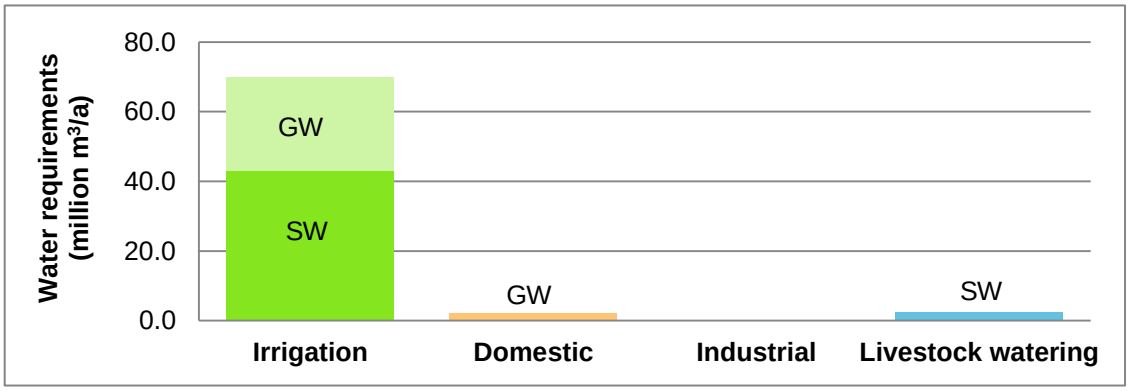

Figure 2.6: Lephalala River catchment 2010-development level water requirements

Water resources issues in the catchment include:

- The areas supplied by the Ga-Seleka RWS and Shongwane RWS is in deficit and needs to be addressed urgently;
- Current service levels are below RPD standards and increasing of service levels is complicated by the dispersed nature of rural settlements;
- Boreholes in some rural settlements are unprotected and can contaminate groundwater resources;
- Unlawful irrigation water use is estimated to be as high as 5.2 million m^3/a – especially the irrigation supplied from the unlawful Klipwerf Dam;
- The Reserve is not being implemented and may have a significant impact on water availability; and
- The Wilderness area is sensitive to any surface water developments.

2.3.2 Future water requirements and intervention options

There are no significant developments expected in the Lephalala River catchment due to the limited water resources available. Possible intervention options are listed in **Table A.3** in **Appendix A**. There are currently no definite intervention options in the catchment and hence options listed in **Table A.3** are only possible options that require further investigation as this Study progresses. Of note is that surface water development is limited due to the flat topography and the ecological sensitivity of the Wilderness area.

2.4 MOGALAKWENA RIVER CATCHMENT

The Mogalakwena River catchment is the largest catchment in the Study Area as well as the most densely populated and industrialised. Major towns include Modimolle, Mookgopong and Mokopane, all situated in the upper regions of the catchment where rainfall is relatively high. The central part of the catchment is densely populated with more than 80% of the population classified as rural. The Nylsvlei wetland between Modimolle and Mookgopong is the country's largest ephemeral floodplain and has been declared a RAMSAR wetland site because of its international conservation importance and birdlife. Numerous small mines as well as the large AMPLAT Mogalakwena Platinum Mine (previously the Potgietersrus Platinum Mine) are located in the catchment.

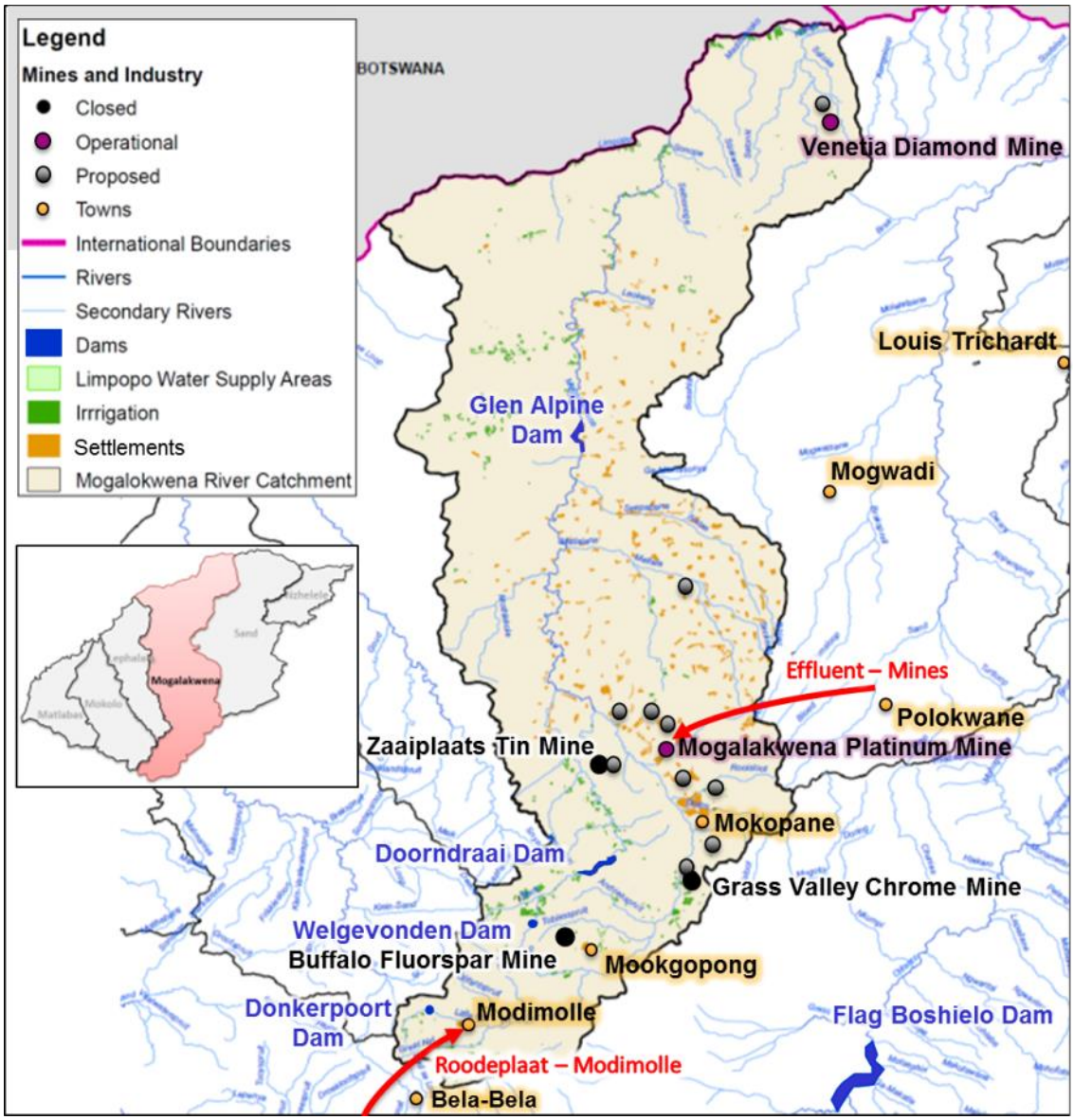

Figure 2.7: Mogalakwena River catchment

Future expansion of mining activities in the vicinity of Mokopane (Mogalakwena and Aganang local municipalities) is expected, which will increase the water requirements significantly. The layout of the catchment is shown in Figure 2.7.

2.4.1 Overview of the current water availability and supply situation

Surface water resources in the catchment are limited and have been fully developed. The major dams are the Doorndraai, Glen Alpine, Haaskloof, Rooiwal, Gert Combrink and Donkerpoort dams. These dams supply a variety of sectors. More than 700 farm dams have been constructed to improve the level of assurance for irrigation and more that 30 storage weirs are located downstream of Glen Alpine Dam on the Mogalakwena River. Large groundwater resources exist but have been extensively exploited by the dominant irrigation sector, especially in the upper region of the catchment.

Irrigation is concentrated in the Moorddrift area near Mokopane, Gillimburg area in the central parts of the catchment and in the Glen Alpine Dam area. Approximately 60% of irrigation in the catchment is supplied by groundwater. Surface water irrigation supply sources include the Doorndraai Dam, Glen Alpine Dam and storage weirs, especially downstream of Glen Alpine Dam.

Modimolle is mainly supplied by the *Modimolle Urban RWSS* via the Magalies Water pipeline from Roodeplaat Dam (Crocodile West River catchment) and additionally by the Donkerpoort Dam. Groundwater resources augment supply during peak demand periods. Water supply to Mookgopong is obtained from groundwater (mainly from the Nyl well-field) and Welgevonden Dam as part of the *Mookgopong RWSS*. The *Mokopane RWSS* provides water to Mokopane, Mahwelereng, AMPLAT Mogalakwena Platinum Mine and several denser settlements from the Doorndraai Dam and groundwater resources. Approximately 16 smaller schemes supply the settlements in the catchment Water for these schemes are mainly sourced from groundwater. The Mapela RWS, Bakenberg RWS and Rebone RWS are the largest in terms of water requirements. However, the Mapela RWS and Bakenberg RWS are in a severe deficit.

An additional 2 million m^3/a is transferred from the Roodeplaat Dam (Crocodile West River catchment). Anglo Platinum has been purchasing treated sewerage effluent (± 8 million m^3/a) from the Polokwane Local Municipality to supply the mining operations. However, due to the inadequate quality of the treated effluent, Anglo Platinum has stopped with the transfer. The Lonmin mining company has purchased a portion of the irrigation entitlements from Doorndraai Dam but is not using the water yet.

The 2010-development level water requirement per user sector is illustrated in **Figure 2.8**. Distinction is made between the water requirements supplied by surface water (SW – darker colours) and groundwater (GW – lighter colours) as well as by transfers in the case of domestic and industrial supply. The total 2010-development level water requirement in the catchment is **147.7 million m^3/a**.

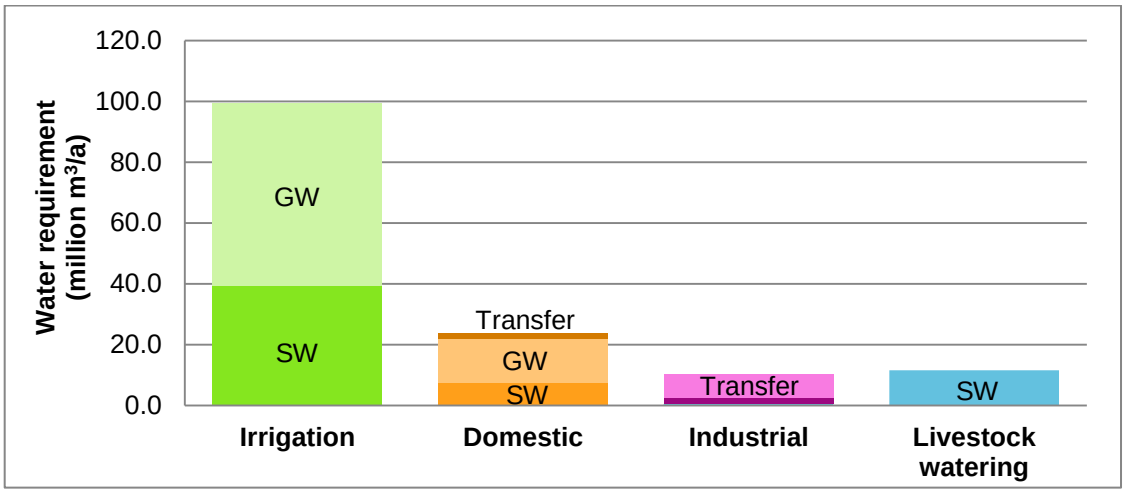

Figure 2.8: Mogalakwena River catchment 2010-development level water requirements

Water resources issues in the catchment include:

- Glen Alpine Dam is sensitive to releases - Water is released from the dam approximately three to four times a year, depending on the requirement from downstream irrigators. The released water is stored in more than 30 storage weirs downstream of the dam on the Mogalakwena River and if not used, the water is essentially lost into the Limpopo River. If releases are not adequately scheduled, transmission losses into the Limpopo River are in the order of 70% to 80%.
- Approximately 30% to 40% of releases made from the Doorndraai Dam are lost through the canal system;
- Unlawful irrigation water use is in the order of 6 million m^3/a;
- Water quality concerns induced by *waste water treatment works* (WwTW) operating above the design capacity and releasing below standard effluent;
- Aging infrastructure – increasing water losses;
- Groundwater reserves are over-exploited in some areas and contain high salinity levels; and
- Improper sanitation infrastructure poses a threat to water quality.

2.4.2 Future water requirements and intervention options

Developments in the catchment expected to increase water requirements include:

- *Platinum mining activities* – A number of possible new platinum mines were identified in the Mokopane area which is considered to be the platinum growth point of the Limpopo Province;

- *Other mining activities* – Possible new nickel, vanadium and iron ore mines north of Mokopane have been identified;
- *Increased domestic water requirements* – Domestic water requirements in the Mokopane area (including the Mogalakwena and Aganang local municipalities) will increase significantly due to possible future mining activities.

Possible new mines, expected operating start date and identified water supply source, where available are listed in **Table 2.1**. The majority of the new mines and additional water requirements will be supplied by the *Olifants River Water Resources Development Project* (ORWRDP) Phase 2B and 2G.

Table 2.1: New mines in the Mogalakwena River catchment

Mining operation	Expected start	Expected Water Source
Akanani Platinum Mine	2020	Not specified
Boikghantso Platinum Group Metals Project	Not specified	Not specified
Bushveld Iron Ore - Magnetite Project	Not specified	Not specified
Bushveld Vanadium project	Not specified	Not specified
Ironveld Project	2019	ORWRDP transfer
Krone-Endora Alluvial projec	Not specified	Not specified
Mokopane Bushveld mineral project	Not specified	Not specified
Platreef project	2020	ORWRDP transfers
Rooipoort Platinum and Nickel Project	Not specified	Not specified
Zebediela Nickel Project	Not specified	Not specified
Volspruit Platinum Group Metals Project	2018	Groundwater
War Springs Platinum Group Metals Project	Not specified	Not specified

The intervention options identified in previous studies as well as current studies are summarised in **Table A.4** in **Appendix A**. Distinction is made between intervention options that have already been approved by DWS, which will definitely be implemented and other possible intervention options that still require further investigation. Intervention options indicated in grey text are options that have been previously identified but are very unlikely to be implemented.

2.5 SAND RIVER CATCHMENT

The Sand River catchment is the driest catchment in the Study Area and has the largest water requirement. The main urban centres in the catchment include Polokwane, Louis Trichardt and Musina as well as smaller urban areas such as Mogwadi (previously Dendron) and Soekmekaar. Major industrial water users

include the *South African Breweries* (SAB) and thw Anglo Platinum smelter in Polokwane. Mining industries include the Vele Coal Mine (currently in a maintenance phase), Messina Copper Mine (closed) and the Artonvilla Copper Mine (closed). Major industrial developments, such as the Musina *Special Economic Zone* (SEZ) and the *Limpopo Eco-Industrial Park* (LEIP), as well as coal mining developments are expected in the north of the catchment. The layout of the catchment is shown in **Figure 2.9**.

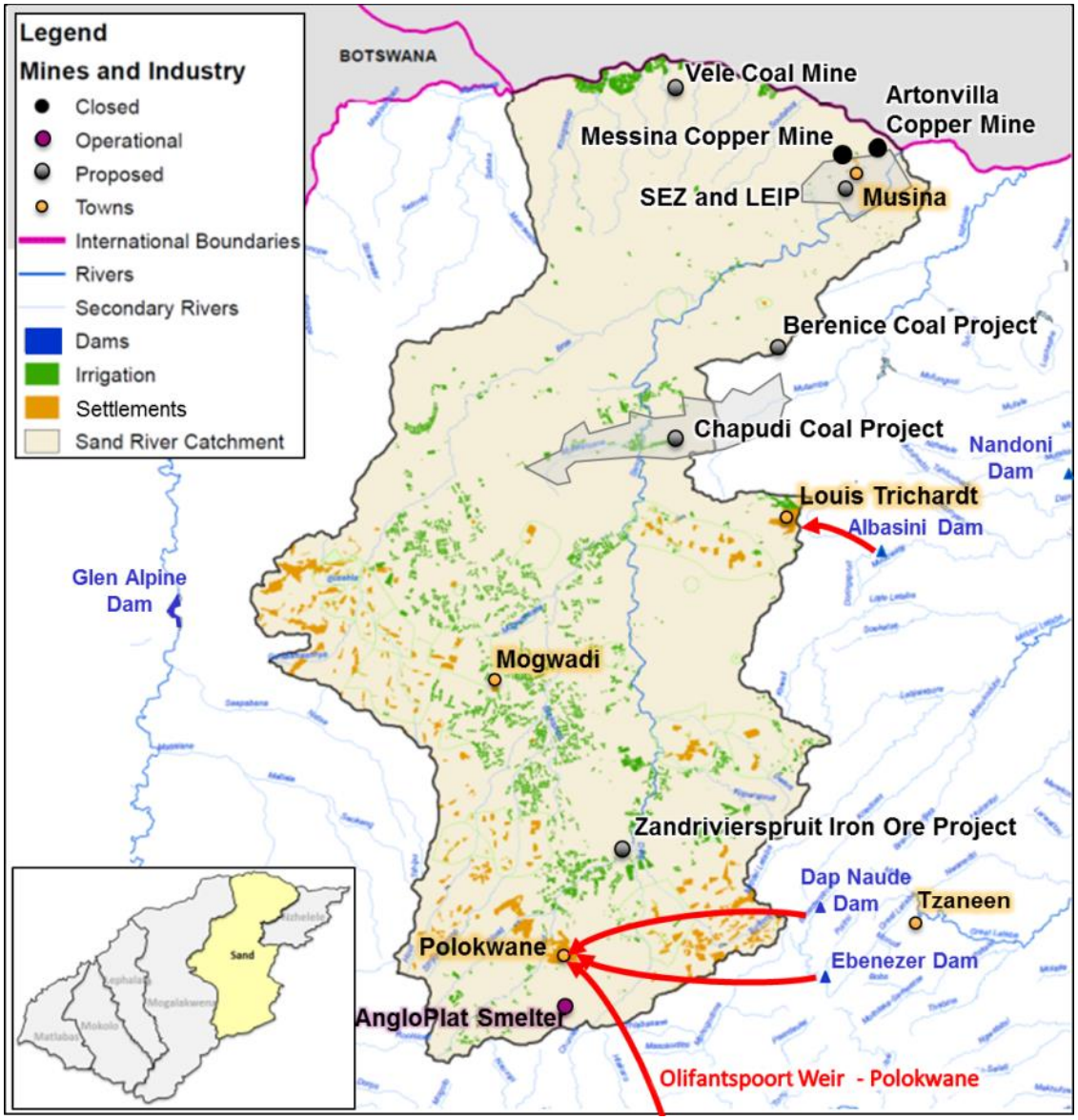

Figure 2.9: Sand River catchment

2.5.1 Overview of the current water availability and supply situation

Surface water resources in the catchment are limited to the small Seshego and Houtrivier dams and run-of-river abstractions – hence there are no major dams in the catchment. Groundwater is the only dependable water source for many rural settlements and villages. Large quantities of groundwater are abstracted for

irrigation, which is the main water user in the catchment. Although exceptional groundwater reserves exist, they have been fully and possibly over-exploited in some areas. The groundwater exploitable potential is **126 million m^3/a** compared to the current abstraction of **168 million m^3/a** (DWS, 2015).

Urban requirements are augmented from transfers from the other WMAs. The Polokwane urban area is supplied via the Olifants-Sand RWSS by transfers from the Ebenezer Dam (10.2 million m^3/a) and the Dap Naude Dam (6.5 million m^3/a) in the Luvuvhu and Letaba WMA as well as the Olifantspoort Weir (5.4 million m^3/a) in the Olifants WMA. Polokwane Local Municipality also recycled effluent water through an innovative artificial recharge scheme and provided it to the Anglo Platinum Mogalakwena Mine near Mokopane. The mine has, however, stopped to purchase the treated effluent due to water quality non-compliances. Additionally, 8 million m^3/a is supplied from the Ebenezer Dam to rural areas in the vicinity of Polokwane. Louis Trichardt initially received transferred water from Albasini Dam, which will be replaced by the Nandoni Dam (allocation of 11.6 million m^3/a). Both of these dams are in the Luvuvhu and Letaba WMA. Musina, situated in the northern part of the catchment, receives the majority of its water from alluvial aquifers next to the Limpopo River. This is considered as a surface water resource due to the shallow depth of the aquifer. Water to smaller settlements is supplied by one of the 28 regional/rural supply schemes of which the main resource is groundwater. The Houtrivier Dam supplies a small volume of water (0.58 million m^3/a) to the Houtrivier Rural Supply Scheme. The majority of these schemes are in deficit. The total estimated deficit as per previous studies for users supplied by these schemes is **14.5 million m^3/a** (DWA, 2011). Areas of high concern include areas supplied by the Mankweng RWSS, Mothapo RWSS, Olifants-Sand RWSS, Sebayeng-Dikgale RWSS and Sinthumule/Kutama RWS.

The 2010-development level water requirement per user sector is illustrated in **Figure 2.10**. Distinction is made between the water requirements supplied by surface water (SW – darker colours) and groundwater (GW – lighter colours) as well as by transfers in the case of domestic and industrial supply. The total 2010-development level water requirement in the catchment is **147.7 million m^3/a**.

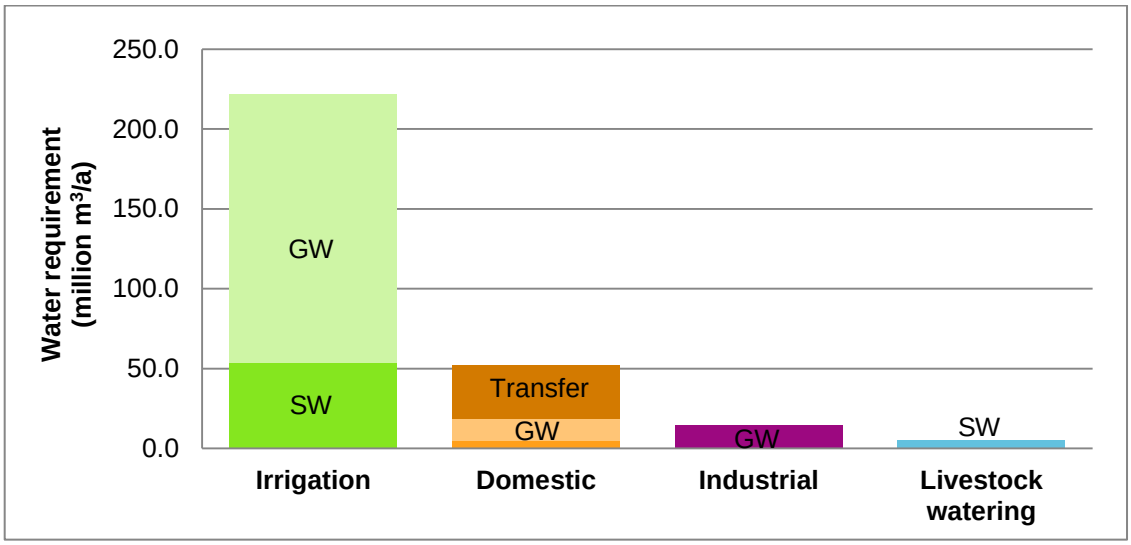

Figure 2.10: Sand River catchment 2010-development level water requirements

Water resources issues in the catchment include:

- Unreliable and unsustainable groundwater resources supplying smaller settlements.
- Major unlawful irrigation water use, especially from groundwater resources, estimated at **7 million m³/a**;
- 27% of the population in the Molemole LM receives water from tankers as there are no local water resources;
- Ageing infrastructure resulting in reticulation leaks and hence major water losses;
- Over-exploited groundwater resources, especially in the Mogwadi and Weipe areas;
- Groundwater quality in the Mogwadi and Vivo areas is severely affected by over-exploitation and uncontrolled use of fertilizers which results in high nitrate concentrates; and
- Poor sanitation infrastructure throughout the catchment also poses a threat to the groundwater quality.

2.5.2 Future water requirements and intervention options

The catchment has a high coal mining potential, which will significantly increase the water requirements of the catchment if developed. *Coal of Africa Limited* (CoAL) has identified a number of possible coal mining projects between Musina and Louis Trichardt. Some of these coal mines have already progressed beyond feasibility phase. The Makhado Coal Mine is anticipated to start with mining operations by 2018 and is considering water trading with the irrigation sector as the main source of supply. Major expected industrial development in the Musina

area include the Musina SEZ and LEIP, however, the water requirements and sources are yet to be confirmed. The industrial and mining water requirements are expected to grow from 15 million m^3/a in 2010 to 68 million m^3/a in 2040 – an estimated 29 million m^3/a of this is required by the SEZ and LEIP. Domestic water requirements are expected to increase from 52 million m^3/a in 2010 to 74 million m^3/a in 2040. Current water resources and approved future intervention options will not be sufficient to supply the high increase in water requirements, especially if the SEZ and LEIP realise.

The Sand River catchment is considered to be the most critical in terms of requiring intervention options. Possible intervention options are listed in **Table A.5** in **Appendix A**. Again distinction is made between intervention options that have already been approved by DWS, which will definitely be implemented and other possible intervention options that still require further investigation. Intervention options indicated in grey text are options that have been previously identified but are very unlikely to be implemented. It must be noted that effort has been made in much earlier studies to develop surface water resources in terms of dams. However, these options were discarded as runoff is not significant enough to sustain the possible dams.

2.6 NZHELELE RIVER CATCHMENT

The Nzhelele River catchment is a small rural catchment in the north-eastern corner of the Study Area. For the purpose of this Study the small Nwanedi River catchment is included as part of the Nzhelele River catchment. The rainfall distribution is variable across the catchment – ranging from high rainfall on the slopes of the Soutpansberg Mountains to the very dry Nzhelele Valley. There are no urban centres in the catchment except for a number of settlements in the high rainfall regions, including Makhado Town, Dzanani and Siloam. Small industries include a vegetable processing factory, bakery and furniture factory. Due to the high coal mining potential in the catchment, a number of coal mining projects along the Mutamba River have been identified by *Coal of Africa Limited* (CoAL).

The layout of the catchment is shown in **Figure 2.11.**

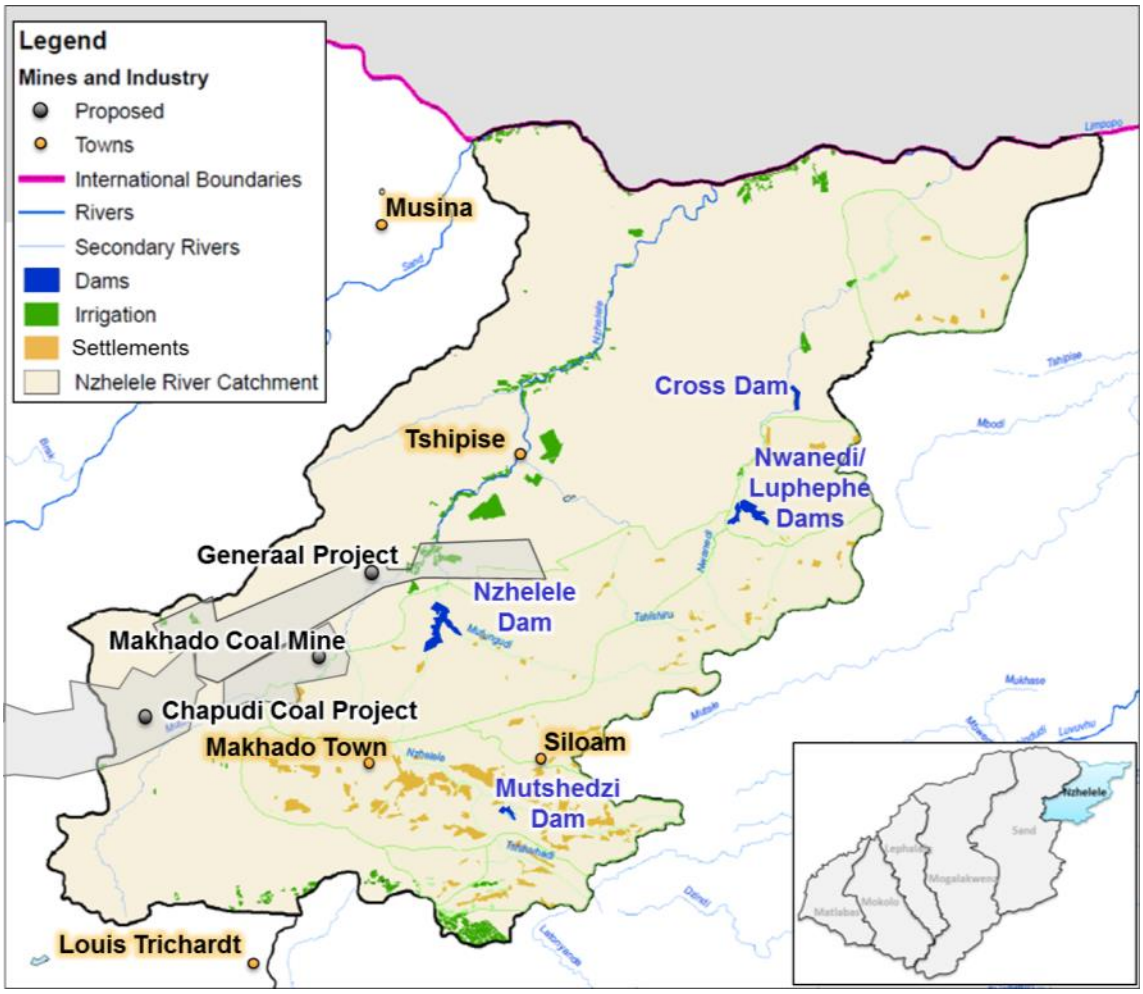

Figure 2.11: Nzhelele River catchment

2.6.1 Overview of the current water availability and supply situation

Surface water resources in the catchment are developed. Major dams in the catchment include the Nzhelele Dam (the second largest dam in the Study Area), Mutshedzi Dam and the connected Nwanedi and Luphephe dams. Cross Dam, downstream of the Nwanedi and Luphephe dams serve as a balancing dam. Domestic water requirements are supplied via the *Nzhelele RWSS* from Mutshedzi Dam, the Tshifiri and Murunwa weirs and from groundwater resources. The Nzhelele Dam supplies irrigation and the Tshipise Holiday Resort. The Nwanedi and Luphephe dams mainly supply irrigation by means of releases. The same river releases are scheduled to supply domestic water requirements through the *Nwanedi/Luphephe RWSS*. A small volume is abstracted to supply the Nwadeni Reserve camp site, directly downstream of the dam. In total eight water supply schemes fall within the catchment. The *Nzhelele RWS* and the *Nzhelele North RWS* is currently experiencing a severe deficit. The remainder of the schemes are in balance but additional water resources have to be identified to meet the growing future requirements.

The 2010-development level water requirement per user sector is illustrated in Figure 2.12. Distinction is made between the water requirements supplied by surface water (SW – darker colours) and groundwater (GW – lighter colours). The total 2010-development level water requirement in the catchment is **42.7 million m^3/a**, including water required by forestry and IAPs. Forestry and IAPs are associated with streamflow reduction.

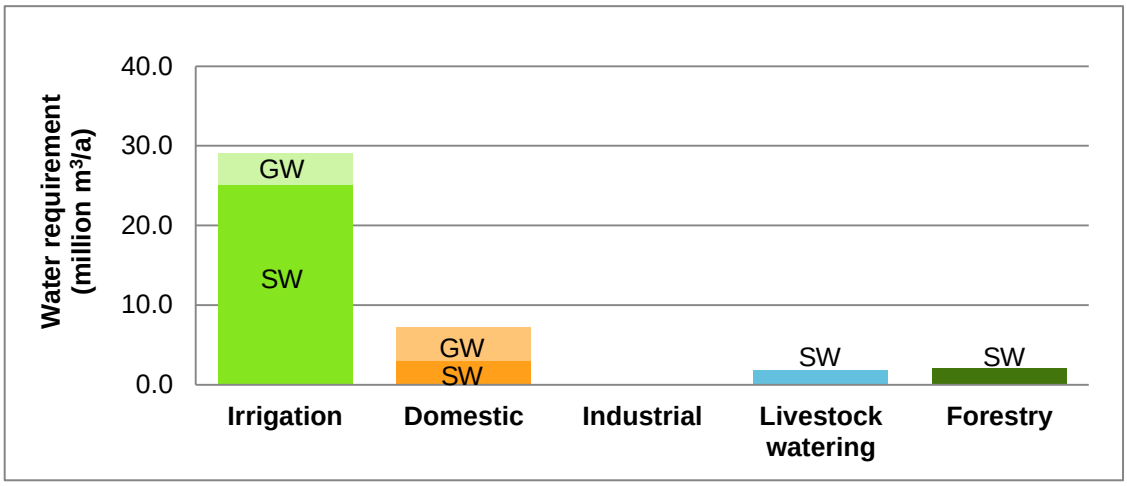

Figure 2.12: Nzhelele River catchment 2010-development level water requirements

Water resources issues in the catchment include:

- The inflows to the Mutshedzi and Nzhelele dams have been reduced as a result of afforestation upstream of these dams;
- Ageing infrastructure resulting in major water losses;
- Major losses, in the order of 60%, occur along the Nzhelele Canal;
- Unlawful irrigation water use in the order of 0.8 million m^3/a; and
- The water service level in many rural areas in the north-eastern region do not meet RDP standards and have no water supply for periods up to four days due to boreholes drying up.

2.6.2 Future water requirements and intervention options

CoAL has identified a number of possible coal mining projects along the Mutamba River – the Makhado Coal Mine, currently past feasibility stage, and the General Project, currently in an exploration phase. The Makhado Coal mine is expected to be operational from 2019 to end 2034 and the Generaal Project from 2030 until after 2040. Should water resources become available, citrus and tomato irrigation in the Nzhelele Valley is expected to expand significantly.

Possible intervention options are listed in **Table A.6** in **Appendix A**. Distinction is made between intervention options that have already been approved by DWS, which will definitely be implemented and other possible intervention options that still require further investigation. Intervention options indicated in grey text are options that have been previously identified but are very unlikely to be implemented. It must be noted that previous studies proposed that that surface water resources be developed in the upper reaches of the Nzhelele River catchment. However, little information on this is available and subsequent studies are limited. Nonetheless, the possibility of surface water development will be considered as part of this Study.

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Appendix A

Lists of intervention options

Table A.1: Matlabas intervention options

Matlabas intervention option	Additional yield or water saving @ 2040 (million $m^{3/}a$)	Level of assessment/ Project stage	Reference	Comments
Approved / definite intervention options				
Transfer from the Crocodile (West) River (MCWAP-2A)	± 37	Post feasibility bridging study	MCWAP (2013)	The MCWAP-2A includes a transfer pipeline, abstracting water from Vlieëpoort near Thabazimbi in the Crocodile (West) River to supply power generation and coal mining developments in the Lephalale and Steenbokpan areas. The preferred total transfer capacity, as indicated by National Treasury, is 80 million m^3/a, however the DWS Directorate: Options Analysis indicated that 100 million m^3/a should be used for the purpose of LNRS. Of this 100 million m^3/a, approximately 37 million m^3/a will be supplied to the mining developments in the Steenbokpan Area. Water supply is anticipated to commence in November 2020.
MBET	5.84	Feasibility (to be confirmed)	Boikarabelo Power Station Draft EIA Report and EMPr (2012)	The capacity of the Marapong Effluent Treatment Works, in the Mokolo River catchment, will be upgraded to 16 Ml/d. The reclaimed water will be transferred via a pump station and transfer pipeline to Boikarabelo Power Station and Coal Mine.
Other possible intervention options				
Groundwater development - industrial supply	0.2	Pre-feasibility (to be confirmed)	Boikarabelo Power Station Draft EIA Report and EMPr (2012)	Approximately 0.182 million m^3/a of water will be required during construction of the Biokarabelo Power Station and Coal Mine and 0.051 million m^3/a during operation. Water will be supplied from groundwater resources.
Groundwater development – domestic supply	To be determined	Identification	LNRS (2015)	Addition domestic requirements can be supplied by groundwater. The amount of groundwater required to be developed is still to be determined.
WCWDM - Irrigation, domestic and industrial	-	-	-	Not considered to have a significant effect. New mines and power stations in the catchment are assumed to consist of the latest water use efficiency technologies to reduce the operational water requirements.

Table A.2: Intervention options for the Mokolo River catchment

Mokolo Intervention option	Additional yield or water saving @ 2040 (million $m^{3/}a$)	Level of assessment/ Project stage	Reference	Comments
Approved / definite intervention options				
MCWAP Phase 1	13	Construction in progress – Supply from Oct 2015	MCWAP (2013)	New pipeline parallel to the existing Mokolo pipeline to supply Medupi and other developments from the Mokolo Dam. Water supply to commence by October 2015. The total supply from Mokolo Dam via both parallel pipelines will be 29.4 million m^3/a.
MCWAP Phase 2A	100	Post feasibility bridging study	MCWAP (2013)	Consist of atransfer pipeline, abstracting water from Vlieëpoort near Thabazimbi in the Crocodile (West) River to supply growing demands in Lephalale. Water supply to commence in November 2020. Preferred transfer capacity, as indicated by National Treasury, is 80 million m^3/a, however the DWS Directorate: Options Analysis indicated that 100 million m^3/a should be used for the purpose of LNRS. Note that some of the water will be supplied to coal mines in the Matlabas River catchment (± 37 million m^3/a)
Other possible intervention options				
WCWDM: Domestic (Urban and rural) - Assume a saving of 10% by 2020 - Assume a saving of 20% by 2020	20%	Reconnaissance	Lephalale Local Municipality IDP 2013-2016.	The percentage water saving (10-20%) seems too high and needs to be verified as part of this study. Implementation is phased in over a period of 5 to 10 years.
WCWDM: Irrigation - Reduce release losses from Mokolo Dam from 60% to 40% - Increase irrigation efficiency: Assume 5% water saving	5 %	Identification	Updating the Hydrology and Yield Analysis in the Mokolo River Catchment (2008)	Implementation time to minimise conveyance losses can be long and lining of canals or direct distribution to irrigators is expensive. The possibility of reducing release losses from the Mokolo Dam, as well as the associated water saving must be investigated. Water saved may possibly only be used to supply expanding irrigation by the relevant owner and will not necessary be made available for use by other sectors.
WCWDM: Mining and industrial	-	-	-	Mines and industries usually have their own water saving and reusing protocols, especially new mines. The validity of this option need to be confirmed as it may only be applicable to existing mines, which in the case of the Mokolo River Catchment is only the Grootegeluk Coal Mine.

Mokolo Intervention option	Additional yield or water saving @ 2040 (million m^3/a)	Level of assessment/ Project stage	Reference	Comments
Eliminating unlawful irrigation use including compulsory licencing.	± 2	Identification	V&V Study (2015)	Water saving still to be verified as part of the current parallel V&V study. Water saving assumed to be as much as 2 million m^3/a. The implementation time can take as long as 3-4 years. Compulsory licencing should only be considered as a last resort.
Transferring of water allocations (Section 25 of the Water Act)	Not specified	Identification	ISP (2004)	Mokolo Dam is over-allocated but irrigators do not use the full allocation and hence re-allocation should be considered. However, the Water Act does not allow for re-allocation and water can only be "transferred" to other users by willing parties. Water can only be transferred from irrigation to other sectors.
Raising of Mokolo Dam	17.3 (raised by 12 m) 21.6 (raised by 15 m)	Reconnaissance	Updating the Hydrology and Yield Analysis in the Mokolo River Catchment (2008)	Mokolo Dam is not likely to be raised due to technical complications and the associated costs which does not justify the small amount of yield to be obtained. Furthermore the dam falls within the internationally shared Limpopo River basin and hence raising of the dam should adhere to international obligations (SADC) and could be a lengthy process to get the necessary approval.
Development of groundwater schemes	Not specified	Identification	ISP (2004)	Groundwater may be required as a short term intervention in the Lephalale area until the implementation of the MCWAP. Groundwater can be additionally developed to supply areas around Vaalwater and Mabaleng. Current development potential to be determined based on outcome of LNRS Groundwater Utilisation Report.

Table A.3: Intervention options for the Lephalala River catchment

Lephalala intervention option	Yield/ Water saving (million m^3/a)	Level of assessment/ Project stage	Reference	Comments
WCWDM: Domestic (Rural) - Assume a saving of 1% by 2013 - Assume a saving of 2% by 2018	2%	Identification	All Towns Studies (2010)	Assumed water saving of 1% from 2010 to 2013 and 2% from 2013 to 2018. The low water saving is due to the dispersed and rural nature of settlements in the catchment. Implementation is phased in over a period of years.
WCWDM: Irrigation - Increase irrigation efficiency: Assume 5% water saving	5%	Identification	LNRS (2015)	Increase in irrigation efficiency will be the responsibility of the owners and hence it is difficult to provide a realistic saving. Water saved may possibly only be used to supply expanding irrigation by the relevant owner and will not necessary be made available for use by other sectors.
Eliminating unlawful irrigation use including compulsory licencing.	± 5.20	Identification	V&V Study (2015) ISP (2004)	Water saving still to be verified as part of the current parallel V&V study. Unlawful water use is considered to be as much as 5.2 million m^3/a. The implementation time can take as long as 3-4 years. Compulsory licencing will only be implemented if water balance cannot be restored through WCWDM and the elimination of unlawful irrigation water use.
Removal of *Invasive Alien Plants* (IAPs)	< 1.2	Identification	LNRS (2015)	Water saving very small - not considered a viable option. IAP causes stream flow reduction and if removed the increase in annual runoff may not directly translate into usable yield.
Development of groundwater schemes - Ga- Phahladira cluster area - Ga-Seleka area	 1.24 Not specified	Identification	All Towns Studies (2010)	Possibility of developing groundwater is only recommended by previous studies and further investigation is required. Development potential still to be verified and determined based on outcomes of LNRS Groundwater Utilisation Report as part of this Study.
Increased run-of-river abstraction in Ga- Phahladira cluster area	Not specified	Identification	All Towns Studies (2010)	Option only mentioned in previous studies and no indication of possible yield has been given. Hence further investigation of the option is required to determine the amount of water that can be sustainably abstracted.
Augment Lephalala supply from Mokopane (Surplus water from *Olifants River Water Resources Development Project* (ORWRDP) Phase 2B and 2G)	Not specified	Identification	All Towns Studies (2010)	Option only mentioned in previous studies – no further studies done. Currently there is no indication of surplus water from the ORWRDP and hence the option is considered not viable.

Table A.4: Intervention options for the Mogalakwena River catchment

Mogalakwena intervention option	Yield or water saving @ 2040 (million m^3/a)	Level of assessment/ Project Stage	Reference	Comments
Approved / definite intervention options				
Transfer from Olifants WMA (ORWRDP) - From Flag Boshielo Dam to Mokopane (2B) - Phase 2G	55.6	Detail design completed – construction initiated	Olifants Reconciliation Strategy (2010) Mogalakwena Bulk Water Supply Project (DWA, 2014) ORWRDP-2 BDS Technical Review Report (2015)	Phase 2B includes a pipeline from Flag Boshielo Dam to Pruisen, Mokopane (26.7 million m^3/a). Phase 2G is a possible second pipeline from Flag Boshielo Dam to Pruisen (13.3 million m^3/a). However, it was recommended that the first pipeline (Phase 2B) be sized to accommodate the requirements of Phase 2G as the construction of the second pipeline cannot be delayed for long after the first pipeline. The capacity of the pipeline will thus be able to deliver 56 million m^3/a. Additionally, the Mogalakwena Bulk Water Supply is a distribution system which will convey water from the end of the Flag Boshielo pipeline at Pruissen to the Mokopane users. Water delivery is for the first phases are expected to start by end 2015.
Transfer from the Crocodile (West) River - From Roodeplaat Dam or Klipvoor Dam to Modimolle and Mookgopong	8.5	Feasibility Study	Crocodile (West) River Reconciliation Strategy (2012)	Current study by Magalies Water to transfer water from either the Roodeplaat Dam or the Klipvoor Dam (Crocodile West River Catchment) to Modimolle and Mookgopong. Currently Klipvoor Dam seems to be preferred water resource option.
Aganang Bulk Water Supply Scheme	3.65	Implementation	RBIG Project List (2015)	Phase 1 of the scheme entails groundwater development and phase 2 the provision of a bulk water distribution system to supply bulk raw water from Flag Boshielo Dam to Sekhuruwe in Mogalakwena LM where it will be purified and pumped into Aganang East
Transferring of water allocations (Section 25 of the Water Act)	1.56	Reconnaissance	ISP (2004) Glen Alpine IRS: LPR008 (2014)	The Lonmin mining company has bought a portion of the irrigation allocations from Doorndraai Dam, but is not yet using the water. Approximately 280 ha of irrigation to be supplied by Glen Alpine Dam have never developed and hence that water allocation (1.56 million m^3/a) remains unclaimed. This allocation will be transferred to domestic users in the Mogwadi area (Sand River catchment) – refer to Table A.5.

Mogalakwena intervention option	Yield or water saving @ 2040 (million m^3/a)	Level of assessment/ Project Stage	Reference	Comments
Other possible intervention options				
Eliminating unlawful irrigation use and compulsory licensing	± 6	Identification	ISP (2004) V&V Study (2015)	Water saving still to be verified as part of the current parallel V&V study. Water saving can as much as 6 million m^3/a. Compulsory licencing should only be considered as a last resort. The implementation time can take as long as 3-4 years. Compulsory licencing should only be considered as a last resort.
WCWDM: Domestic (Urban and rural) - Assume a saving of 2% from 2035	2%	Identification	Mogalakwena Master Plan (2010) All Towns Studies (2010)	The 2% saving is only applicable to the Mogalakwena Local Municipality and only to be implemented from 2035. Additionally the All Town Studies indicated a water saving of 1% from 2010 to 2013 and 2% from 2013 to 2018. The overall catchment savings should be verified as part of this Study as it can be more and possibly be implemented earlier by phasing it in over a period of 5-10 years.
WCWDM: Irrigation - Reduce losses from Doorndraai and Glen Alpine dams - Increase irrigation efficiency: Assume 5% water saving	5%	Identification	Establishment of Operating Rules for the Glen Alpine System: Yield analysis (2011) Glen Alpine IRS: LPR008 (2014)	Losses from Doorndraai Dam are assumed in the order of 30-40% whereas losses from Glen Alpine Dam are assumed in the order of 70-80%. The combined water saving by reducing losses from these two dams need to be determined. Furthermore, the implementation practicality and time required to reduce losses need to be determined. Work has been done to determine the water savings if a lined canal is provided downstream of the Glen Alpine Dam. The water saving (0.62 million m^3/a) will be transferred to domestic users in the Mogwadi area (Sand River catchment) – refer to **Table A.5**. Increase in irrigation efficiency will be the responsibility of the owners and hence it is difficult to provide a realistic saving. Water saved may possibly only be used to supply expanding irrigation by the relevant owner and will not necessary be made available for use by other sectors.
WCWDM: Mining and industrial - Assume losses can be reduced by 1.5%	1.5%	Identification	Mogalakwena Master Plan (2010)	Mogalakwena Master Plan indicates that the current water loss in the mines and industry sector is 5% and can be reduced to 3.5%. New mines usually implement their own water saving and reusing protocols, hence water saving may only be applicable to existing mines and industries.

Mogalakwena intervention option	Yield or water saving @ 2040 (million m^3/a)	Level of assessment/ Project Stage	Reference	Comments
Development of groundwater schemes	Not specified	Identification	All Towns Studies (2010)	Additional groundwater development can be used to supply rural communities in the upper and lower reaches of the catchment as approximately only 40% of exploitable potential is currently used. The development potential is still to be determined based on outcomes of LNRS Groundwater Utilisation Report as part of this Study.
Transfer from the Crocodile (West) River - From Crocodile (West) River to Mokopane	25	Feasibility Study	Crocodile (West) River Reconciliation Strategy (2012)	The transfer to Mokopane is considered an alternative to the ORWRPD-2B. However, ORWRDP is the preferred supply option to Mokopane – the cost of the Crocodile River to Mokopane option is higher.
Removal of IAP	< 2.6	Identification	ISP (2004) LNRS (2015)	Water saving very small - not considered a viable option. IAP causes stream flow reduction and if removed the increase in annual runoff may not directly translate into usable yield.
Reuse – Polokwane effluent transfer to Mokopane Mines	10.7	Feasibility	Olifants Reconciliation Strategy (2011)	Mokopane and Polokwane domestic effluent to be reused by mines in Mokopane. 4 million m^3/a can be readily available and 10.7 million m^3/a by 2035. However, recently it has been decided to rather allocate the treated effluent from Polokwane Local Municipality for use in Polokwane itself. Additional re-use possibilities will be investigated as part of this Study.
Raising of Donkerpoort Dam	Not specified	Identification	Modimolle LM IDP 2015/2016	Raising of the dam seems unlikely due to safety concerns and high operational costs and aging infrastructure of the existing water treatment works (WTW).
Raising of Glen Alpine Dam	Not specified	Identification	Establishment of Operating Rules for the Glen Alpine System: Yield analysis (2011)	No specific information could be obtained at the time of writing this report. The feasibility and additional yield need to be determined.
Proposed Groenvley Dam - North west of Mokopnae	Need to obtain information		Overview of Water Resources Availability and Utilisation (2003)	Groenvley Dam only mentioned in previous studies but has been further investigated. Little information is currently available of these previous studies, however, the study team will continue to try and source the relevant documents and information.

Table A.5: Intervention options for the Sand River catchment

Sand intervention option	Yield or water saving @ 2040 (million $m^{3/}$a)	Level of assessment/ Project Stage	Reference	Comments
Approved / definite intervention options				
Transfer from Nandoni Dam to Louis Trichardt and Sinthimule/Kutama and Air Force Base)	11.6	Construction	RBIG Project List (2015)	This forms part of the Sinthumule Kutama Bulk Water Augmentation Project and the Makhado West Regional Bulk Water Supply. **Sinthumule Kutama Bulk Water Augmentation Project:** The water supply infrastructure from Nandoni Dam to Louis Trichardt as well as Sinthimule/Kutama and the Makhado Air Force Base has been completed in 2014 and is awaiting water supply (5.8 million m^3/a). **Makhado West Regional Bulk Water Supply:** Infrastructure for additional water supply from the Nandoni Dam to the area (5.8 million m^3/a) is currently being constructed. Water supply is expected by mid-2017.
Pipeline from Nandoni Dam to Matoks	5.5	Implementation ready – construction initiated	All towns studies (2011) RBIG Project List (2015)	The pipeline will supply Matoks as well as other areas along the length of the pipeline (a total supply of 8.6 million m^3/a). Water supply is anticipated by the end of 2020. The maximum allocation to Matoks will be 5.5 million m^3/a.
Transfer from Glen Alpine Dam to Molemole West supply area	2.0	Implementation ready	Glen Alpine IRS: LPR008 (2014)	This includes the transfer from the Glen Alpine Dam to the Molemole West supply area via a pipeline. Water will be sourced from the unused allocation (1.56 million m^3/a) for the former Lebowa irrigation and by the savings in losses (0.62 million m^3/a) obtained by providing a lined canal downstream of the Glen Alpine Dam. Water supply expected by 2020
Polokwane wastewater reclamation plant	12	Implementation ready	Polokwane Regional Wastewater Treatment Works Final Technical Feasibility Report (2014)	A phased 40 Ml/d wastewater reclamation plant (20Ml/d from 2015-2018 to 40Ml/d from 2018 to 2034), north of Polokwane near the confluence of the Sand, Diep and Turfloop rivers, is currently in the final design stages. The plant will treat wastewater from the Polokwane, Mankweng and Seshego areas. The possibility of supplying the treated effluent to mining developments downstream is being considered. The amount of effluent to be supplied is not yet finalised but for the purpose of this document, it is assumed that 80% of the treated effluent can be re-used. Water supply expected by 2015/2016.

Sand intervention option	Yield or water saving @ 2040 (million m^3/a)	Level of assessment/ Project Stage	Reference	Comments
Other possible intervention options				
WCWDM: Domestic (Urban and rural) - Assume a saving of 1% by 2013 - Assume a saving of 2% by 2016 - Assume a saving of 5% by 2040	5%	Identification	All Towns Studies (2010)	The City of Polokwane has a comprehensive WCWDM Strategy and also WCWDM awareness campaigns. Rural settlements are scattered, making water savings more than 2% difficult in these areas. Implementation of WCWDM will be phased in over a period of 5-10 years. The overall catchment savings should be verified as part of this Study.
WCWDM: Irrigation - Increase irrigation efficiency: Assume 5% water saving	5%	Identification	LNRS (2015)	The majority of irrigation is supplied by groundwater and hence associated conveyance losses are minimal. Water savings can be achieved by increasing the irrigation efficiencies which is the responsibility of the individual irrigators. Water saved may possibly only be used to supply expanding irrigation by the relevant owner and will not necessary be made available for use by other sectors.
WCWDM: Mining and industrial	-	-	-	Mines and industries usually have their own water saving and reusing protocols, especially new mines. The validity of this option need to be confirmed as it may only be applicable to existing mines.
Eliminating unlawful irrigation use including compulsory licencing.	± 7	Identification	ISP (2004) V&V Study (2015)	Water saving still to be verified as part of the current parallel V&V study. Water saving can as much as 7 million m^3/a. The implementation time can take as long as 3-4 years. Compulsory licencing should only be considered as a last resort if the deficit can't be rectified through WCWDM and other intervention options.
Transfer from Zhove Dam, Umzingwane River, Zimbabwe	30	Recon-naissance	Mutasshi Readiness Study (2013)	Dam is situated approximately 30km from the South Africa-Zimbabwe border. Currently, the majority of the yield is not allocated to any users. Water can be purchased from Zimbabwe National Water Authority (ZINWA) to supply Musina SEZ and LEIP. However, local resources must be considered first as there may be a number of international obligation constraints.
Development of groundwater schemes	Not specified	Identification	All towns studies (2011) LNRS (2015)	Currently, groundwater resources are over-abstracted in some areas (approximately 30% more than the exploitable potential is abstracted). Hence, at this stage further development of groundwater is not promoted but will have to be confirmed based on outcome of LNRS Groundwater Utilisation Report as part of this Study.
Removal of IAP and not allowing additional forestry	< 1.0	Identification	Overview of Water Resources Availability and Utilisation (2003) ISP (2004)	Water saving very small - not considered a viable option. IAP causes stream flow reduction and if removed the increase in annual runoff may not directly translate into usable yield.

Table A.6: Intervention options for the Nzhelele River catchment

Nzhelele intervention options	Yield or water saving @ 2040 (million $m^{3/}a$)	Level of assessment/ Project Stage	Reference	Comments
Approved / definite intervention options				
Nzhelele Valley Bulk Water Supply	**> 11.37**	Implementation ready	Technical Feasibility Study for Nzhelele Valley RWS (2014)	Construction expected to start in 2016 and supply by 2020
- Phase 1 - Groundwater development	> 0.94			Phase 1 includes the development of individual groundwater schemes in the Nzhelele Valley area. This includes equipping of > 23 existing boreholes and siting, drilling and testing of nine new boreholes, bulk supply pipelines and a command reservoir to supply the deficit of 0.94 million m^3/a
- Phase 2 – Augmenting supply to the Nzhelele Supply Area	> 0.53			Phase 2 has three possible options to supply the deficit of 0.53 million m^3/a: **Option 1: Supply from Nzhelele Dam** – includes new pipelines, pump stations and reservoirs as well as upgrading of existing pump stations, WTW and the raising of the Nzhelele Dam. No detail of the raising of the dam (height and yield has been specified. **Option 2: Supply from boreholes** - includes equipping of > 30 existing boreholes and 12 new boreholes, bulk conveyance pipelines and a command reservoir. **Option 3: Supply from Vondo Scheme –** includes pipeline from Vondo Dam to Mutshedzi Supply Area and then to Nzhelele Supply Area. The allocation from Vondo Dam has not been specified.
- Phase 3 - Augmenting supply to the Mutshedzi Supply Area	> 9.9			Phase 3 has three possible options to supply the deficit of 9.9 million m^3/a: **Option 1: Mutshedzi internal Upgrade** – includes upgrading of existing WTW and pipelines, new pump stations and reservoirs as well as raising of Mutshedzi Dam. No detail of the raising of the dam (height and yield has been specified. **Option 2: Supply from Vondo Scheme –** includes pipeline from Vondo Dam to Mutshedzi Supply Area. The allocation from Vondo Dam has not been specified.

Nzhelele intervention options	Yield or water saving @ 2040 (million m^3/a)	Level of assessment/ Project Stage	Reference	Comments
Luphephe Nwanedi Water Resources and Regional Bulk Water Supply	1.14	Implementation Ready	All Towns Studies (2010) RBIG Project List (2015)	Water for domestic supply will be abstracted directly from the Luphephe and Nwanedi twin dams and be treated at the recently constructed WTW, 2km downstream of the dams, before it is distributed to the domestic users. Water supply is expected to start by 2021.
Intervention options that can increase system yield				
WCWDM: Domestic (Urban and rural) - Assume a saving of 1% by 2013 - Assume a saving of 2% by 2018	2%	Identification	All Towns Studies (2010)	Assumed a water saving of 1% from 2010 to 2013 and 2% from 2013 to 2018. The low water saving is due to the dispersed and rural nature of settlements in the catchment. Implementation is phased in over a period of 5-10 years.
WCWDM: Irrigation - Reduce losses along the Nzhelele Canal. - Increase irrigation efficiency: Assume 5% water saving	2%	Identification	ISP (2004) LNRS (2015)	Current losses along the canal estimated to be 60%. Lining of canals can be expensive and implementation time can be long. However, the possibility of replacing the Nzhelele canal with a pipeline is being initiated. The associated feasibility and water saving have to be determined. Increase in irrigation efficiency will be the responsibility of the owners and hence it is difficult to provide a realistic saving. Water saved may possibly only be used to supply expanding irrigation by the relevant owner and will not necessary be made available for use by other sectors.
WCWDM: Mining and industrial	-	-	-	Mines and industries usually have their own water saving and reusing protocols, especially new mines. The validity of this option need to be confirmed as it may only be applicable to existing mines – of which, in the case of the Nzhelele River catchment, there are none.
Eliminating unlawful irrigation use and compulsory licensing	0.8	Identification	ISP (2004) V&V Study (2015)	Water saving still to be verified as part of the current parallel V&V study. Water saving can as much as 0.8 million m^3/a. Compulsory licencing should only be considered as a last resort. The implementation time can take as long as 3-4 years.
Transferring of water allocations (Section 25 of the Water Act)	2.5	Feasibility	CoAL (2014)	Makhado Coal Mine has negotiated water trading with the irrigation sector and is waiting for the outcome of the Water Use Licence Applications.

Nzhelele intervention options	Yield or water saving @ 2040 (million m^3/a)	Level of assessment/ Project Stage	Reference	Comments
Development of groundwater schemes	Not specified	Identification	All towns studies (2011) LNRS (2015)	Additional groundwater development potential (other than that part of the Nzhelele Valley Bulk Water Supply) still to be determined based on outcomes of LNRS Groundwater Utilisation Report. Approximately only 32% of exploitable potential is currently used.
Proposed dam on Mutamba River	Awaiting information	Feasibility	CoAL (2014)	Study team are in the process of obtaining the documentation from CoAL. However, CoAL has indicated that water trading is the preferred coal mining supply option.
Re-use of effluent from Louis Trichardt and Musina	Awaiting information	Identification	CoAL (2014)	This option is not supported by DWS as treated effluent from Louis Trichardt should rather be used by the town itself.
Removal of IAPs	< 2.1	Identification	ISP (2004) LNRS (2015)	Water saving very small - not considered a viable option. IAP causes stream flow reduction and if removed the increase in annual runoff may not directly translate into usable yield.
Proposed Wylliespoort Dam	Not specified	Identification	Water Resources Situation Assessment (2003)	Need to obtain information from old DWS archives.
Proposed Thipise Dam	Not specified	Identification	Water Resources Situation Assessment (2003)	Need to obtain information from old DWS archives.