PART B: STRATEGIES

INTRODUCTION TO STRATEGY TABLES

Through existing reports, interviews and workshops, the key issues of the Limpopo WMA were identified and strategies developed to resolve these issues with the overarching objective of giving effect to the NWA and the NWRS.

The strategies were divided into two broad categories; those which apply to the whole WMA (referred to as WMA Level Strategies) and those, which require more detail to resolve issues, that are specific to the catchments which make up the Limpopo WMA.

Specific strategies for each catchment were developed to deal with:

- Reconciliation of water requirements and the available resource
- Water Quality

Each strategy addresses the following aspects:

- **Broad Management Objective**

What the strategy must aim to achieve

- **Situation assessment**

Presents the background information and the relevant issues identified in each catchment. This provides a motivation for the strategy and actions.

a. Overall Strategy

The strategy states what needs to be done to resolve the issues and give effect to the NWA and NWRS.

a. **Management Action, priorities and responsibilities**

Specific actions to give effect to the strategies are listed, together with the responsible Directorate/Institution and a priority rating.

PART B1: CATCHMENT SPECIFIC STRATEGIES

Matlabas /Mokolo catchments

Strategy 1.1: Reconciliation of water requirements and available water resources

Strategy 1.2: Water quality

Lephalala catchment

Strategy 2.1: Reconciliation of water requirements and available water resources

Strategy 2.2: Water quality

Mogalakwena catchment

Strategy 3.1: Reconciliation of water requirements and available water resources

Strategy 3.3: Water quality

Sand catchment

Strategy 4.1: Reconciliation of water requirements and available water resources

Strategy 4.2: Water quality

Nzhelele/Nwanedi catchment

Strategy 5.1: Reconciliation of water requirements and available water resources

Strategy 5.2: Water quality

PART B2: GENERAL STRATEGIES APPLICABLE TO THE WHOLE WMA

Strategy G1: Water Balance and Reconcilation
- G1.1: Resource availability – surface waster
- G1.2: Resource availability – groundwater
- G1.3: Water requirements
- G1:4: Water reconciliation
- G1:5: Transfers and reservation of waster

Strategy G2: International Obligations
Strategy G3: Water Quality
Strategy G4: Water Use Management
Strategy G5: Water Conservation and Demand Management
Strategy G6: Co-operative Governance
Strategy G7: Waterworks Management
Strategy G8: Monitoring and Information
Strategy G9: Re-dressing Inequities
Strategy G10: Support to Local Authorities
Strategy G11: Implementation of the ISP

1.1	WATER BALANCE & RECONCILIATION – MATLABAS KEY AREA
Situation assessment	The Matlabas catchment is a laregly undveloped catchment with limited water resources and limited water use. There are no signifcant dams in this catchment and a significant portion of the water use is from groundwater due to the low assurance of the run-of-river yields. Due to the highly erratic surface water flow, the yield from surface water resources is negligible, while there are ample gourndwater resources which are underutilised. The largest water use in the Matlabas Key Areas is irirgation, but even this is very limited and estimated at only 4 million m^3/a, half of which is sourced from groundwater. There are limited rural requirements, estimated as 2 million m^3/a, which are supplied from groundwater. No significant increase in future water requirements is expected in the catchment.
Broad Management Objectives	To better understand current and potential future water requirements in the Matlabas and Mokolo catchments
Broad Strategic Approach	There are no major water-related issues in the Key Area requiring management intervention. Allocations for water use can be made from groundwater, but not from run-of-river yield. The construction of farm dams for irrigation or domestic rural is a possibility but careful evaluation will always be required due to unfavourable hydrological conditions.
Actions, Responsibility & Priority	No actions required at this time in this Key Area..

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1.2	WATER BALANCE & RECONCILIATION – MOKOLO KEY AREA
Situation assessment	Water requirements in the Mokolo Key Area consist of the follow: ▪ Irrigation: 77 million m^3/a ▪ Kumba Resources's Grootgeluk Colliery Mine: 4 million m^3/a ▪ ESKOM's Matimba Power Station: 7 million m^3/a ▪ Urban requirements for Lephalale town and the surrounding urban areas: 2 million m^3/a ▪ Scattered rural settlements: 2 million m^3/a The Ecological requirements have not been determined in any detail, but the NWRS estimates the impact of the Reserve on the currently available yield at 17 million m^3/a.. The surface water resources of the Mokolo Key Area are substantial while groundwater is also used. The large Mokolo Dam, togther with numerous dams in the upper reaches of the Key Area, as well as run-of-river, all contribute to a large surface warter resrouce estimated at 77 million m^3/a, aftter allowing for the Ecological Reserve. The current groundwater resource is estimated at 11 million m^3/a and this is used to supply irrihgation and domestic rural use. The Mokolo Key Area is approximately in balance. Potential future requirements of Mokolo Key Area are: ▪ Fast growing urban population in Lephalale and an explosion of informal settlements in and around the town of Vaalwater ▪ Water required for emerging farmers in the catchment ▪ Potential large scale methane gas field development around the coal reserves ▪ Ecological Reserve requirements ▪ Small-scale economic development for poverty eradication ▪ Water to meet basic needs of the rural communities
Broad Management Objectives	To better understand current and potential future water requirements in the Mokolo Key Area
Overall Strategic Approach	The overall strategy for the Mokolo Key Area is to maintain the catchment in at least its current state of balance. This can be achieved by not issuing any more water use licences for irrigation. Other user sectors will need to source their additional water requirements from gourndwater if possible, failing which the construction of farms dams is also as option. In the longer-term, if large new requirements materialise relating to development of the gas fields or the possible additional power station, additional surface water could be obtained from: • Transfers in from the Lower Crocodile • Raising of the Mokolo Dam • Trading with the irrigation sector

Actions, Responsibility & Priority	▪ Assemble better estimates of current water use, especially the irrigation sector ▪ Obtain reliable rural and urban population figures for the catchments and the corresponding growth rates. The information will assist in determining the trends ▪ Obtain projected future water demands from Kumba Resources and ESKOM ▪ Use the estimates to calculate accurate future water requirements ▪ Investigated groundwater as an additional option for meeting future water requirements ▪ Determine the needs of future coal/gas mining activities	DWAF RO (Priority 1)

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1.3	WATER QUALITY MANAGEMENT OF THE MOKOLO KEY AREA	
Situation Assessment	**Mokolo catchment:** Informal settlements have developed rapidly around Vaalwater (A42C) leading to increasing demands on the water supply and a serious potential for groundwater pollution. A similar situation is occurring at Alma, south of Vaalwater. Groundwater quality could be seriously impacted from the uncontrolled growth of informal settlements around the existing settlements. The quality of the water resource could also be affected by pollution from the Grootgeluk Coal Mine. Some of the water quality problems that could result from the coal mine are acid mine water, low PH, and a concentration of TDS. The extent of diffuse pollution from the mine and other industries in the area must be investigated and quantified. Adverse impacts from activities within these catchments outside of Vaalwater and small settlements are unlikely.	
Broad Management Objective	This strategy seeks to ensure that the extent of water resource pollution by Grootgeluk Colliery, agricultural activities, uncontrolled growth of informal settlements and other industries such as Matimba Power Station is understood and this understanding is applied in the development of strategies to improve the situation.	
Overall Strategic Approach	Sturies need to be initiated to understand the extent of potential pollution as a result of uncontrolled growth of informal settlements, mining activities in the Grootgeluk Mine, and agricultural activities. Water quality monitoring at selected key strategic points is required to understand the situation better and develop effective management strategies. These need to be developed and implemented in close co-operation with local Muncipalities and the Groorgeluk Colliery.	
Actions, Responsibility & Priority	Undertake a water quality situation assessment study to better understand pollution from Grootgeluk Coal Mine, agricultural activities upstream and downstream of the Mokolo Dam, and uncontrolled growth of informal settlements around Vaalwater.	DWAF RO Dir WQM (Priority 1)

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2.1	WATER BALANCE & RECONCILIATION – LEPHALALA KEY AREA	
Situation Assessment	Water requirements in the Lephalala Key Area are estimated to be as follows:- ▪ Irrigation: 39 million m^3/a. ▪ Rural use: 3 million m^3/a There are no mines or industry in this Key Area. The surface water resource, estimated at 15 million m^3/a, are derived from run-of-river and the yield from numerous farm dams in the upper reaches of the catchment. There are ample groundwater resources in the catchment, currently estimated at 12 million m^3/a. Rural water users rely almost exclusively on groundwater while irrigation water use from groundwater is estiamted at 9 million m^3/a. The Lephelala Key Area is stressed, with the requirements estimated to be 15 million m^3/a more than the evailable 1:50 yield from the catchment. Much of the irrigaiton is thought to be opportunistic, taking place at very low assuracne. This would explain the large deficit in this Key Area.	
Broad Management Objective	To better understand current and potential future water requirements in the Lephalala catchment	
Overall Strategic Approach	Groundwater will be the primary source of water for the scattered rural settlements. Optimization of the available resource to minimize the deficit will be achieved by implementing water saving measures, more especially in the agricultural sector. Emerging farmers will be given high priority whenever there is water available. Once all other water saving measures have been implemented and there is still a deficit, then compulsory licensing must be considered for this catchment.	
Actions, Responsibility & Priority	▪ DA together with DWAF must identify the needs and requirements of emerging farmers in the catchment and determine how much water is required to meet their requirements. ▪ Implement WC/WDM measures to minimize the deficit ▪ If the balance is not achieved by implementing WC/WDM, implement compulsory licensing	DWAF RO (Priority 1)

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STRATEGY 2.2

2	WATER QUALITY MANAGEMENT – LEPHALALA KEY AREA

Management Objective	This strategy seeks to ensure that the extent of diffuse pollution by agricultural activities is understood and that this understanding is applied in the development of strategies to improve the situation.	
Situation Assessment	Extensive agricultural activities are practiced in the upper reaches of the catchment. Both surface and groundwater quality could be impacted from agricultural activities, especially in areas where fertiliser application is poorly managed. There are also a growing number of tourist resourts in the upper reaches ofhte catchment and effluent from these developments, especially during periods of low flow, could become a problem. The middle reach is the Wilderness Area with no agricultural activity. This is pristine and ecologically sensitive. Any widespread or large-scale development will impact on the pristine nature of the resource. Isolated game management and water supply boreholes for tourist lodges are not considered a threat since their impact will be minimal. In the lower reaches, there are scattered rural settlements that rely on groundwater for domestic purposes. In most of these settlements, borehole heads are not protected from water spillage and damage from domestic animals. This could result in pollution of the source. Preventative measures must be taken.	
Strategic Approach	DWAF will do everything possible to protect the Wilderness Area, and will work with the local Department of Agriculture to ensure that farmers manage fertilizer applications better, and ensure that borehole heads are protected from spillage and damage from domestic animals. Stricter monitoring and control will have to be applied to the tourism industry in the area.	
Actions, Responsibility & Priority	Determine the extent and impact of fertilizer applications and encourage farmers to manage such applications Monitor correct siting of boreholes in rural settlements. Implement a programme for borehole protection to the existing boreholes. Establish a monitoring for all major tourist destinations in the Key Area.	DWAF RO (Priority 1)

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3.1	WATER BALANCE & RECONCILIATION – MOGALAKWENA KEY AREA	
Situation Assessment	This is the most densely populated and industrialized catchment in the Limpopo WMA. The economic activities in the catchment make a significant contribution to the Gross Geographic Product of various local municipalities and the province. The water is requirements of the Key Area are estimated as follows: ▪ Irrigation: 99 million m^3/a ▪ Mining/industrial :6 million m^3/a ▪ Urban: 9 million m^3/a ▪ Rural: 9 million m^3/a The surface water resources of the Mogolakwena Key Area are derived from two significant dams, the Doorndraai and the Glen Alpine, as well as run of river. There are not many farm dams in this Key Area. Groundwater use in the Key Area is large by any standards, with groundwater supplying 55 million m^3/a to mostly the irrigation sector, but also to the rural sector. The Key Area is approximately in balance. There is potential for the water requirements to increase due to: ▪ Fast growing urban population due to uncontrolled growth of informal settlements ▪ Mining and industrial development ▪ Economic development as a poverty relief initiative ▪ Emerging farmers ▪ Rural communities who are in dire need of basic water services	
Broad Management Objective	To better understand current and potential future water requirements of (mines, industries, urban, rural and irrigation).	
Overall Strategic Approach	Although the Mogalakwena Key Area appears to be approximately in balance, sourcing additional water for expanding water requirements will be problematical. The following options, in order of priority, are suggested: • Water conservation and demand management, including the clearing of invasive alien plants. • Groundwater • Additional transfers from other WMAs. • Only as a last resort should compulsory licencing be considered. In sourcing additional groundwater, care must be taken not to over-exploit the resource on a local scale.	
Actions, Responsibility & Priority	▪ Clearing of invasive aliens plants to maximize the available water must be prioritized. ▪ Explore the local groundwater resource ▪ Encourage mines and other industries to use recycled water and treated effluent ▪ DWAF together with the municipality must implement WC/WDM	DWAF RO (Priority 1)

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3.3	WATER QUALITY MANAGEMENT – MOGALAKWENA	
Situation Assessment	Extensive agricultural activities occur in the Sterk, Middle and Lower Mogalakwena catchments. If fertilizer applications in this areas are not properly managed, they will have a negative impact on the resource In the catchment mining activities take place near Mokopane. Some mines have been closed (e.g. Union Tin Mine) whilst others are still functional. Mining activities could pose serious pollution risks, more especially to groundwater. The possibilities of mine water decant from the old and abandoned mines in the catchment must be considered and any impacts identified and remediated. The extent of diffuse pollution from existing mines must also be understood. There are densely populated informal settlements in the catchment (especially near Mokopane) with poor sanitation levels. Pollution of the groundwater resource from pit latrines and increasing population in the informal settlements and some of the rural areas could result in elevated concentrations of TDS and NO_3. Most of the borehole heads servicing the informal settlements and rural communities in the catchment are not protected from water spillage, damage by cattle and donkey drinking, etc. The resources of the basalt in the Taaibosch Fault area are earmarked to supply over 20 communities. This aquifer must be protected against overexploitation and quality deterioration.	
Broad Management Objective	To gain a better understanding of the following water quality issues in the Mogalakwena catchment : ▪ Mine water decant, ▪ Diffuse pollution from existing mines, agricultural activities and uncontrolled growth of informal settlements around Mahwelereng ▪ Groundwater pollution due to high concentrations of pit latrines	
Overall Strategic Approach	To minimize the level of groundwater pollution, new boreholes servicing densely populated informal settlements will be positioned well away, and water piped to the settlements or rural areas. Given the importance of groundwater as the primary source of water to rural and informal settlements, initiatives must be undertaken to better understand the impact of mining activities on the groundwater resource.	
Actions, Responsibility & Priority	Determine the extent of pollution as a result of densely populated informal settlements with poor sanitation facilities and the closed mines in the catchment. Implement a programme for borehole protection to the existing boreholes in informal settlements and rural areas.	DWAF RO (Priority 1)

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4.1	WATER BALANCE & RECONCILIATION - SAND	
Situation Assessment	The water requirements in the Sand Key Area are as follows: Irrigation: 187 million m^3/a Mining/industrial: 4 million m^3/a Urban: 24million m^3/a Rural:9 million m^3/a The large irrigation requirement is supplied mostly from groundwater while the urban requirements are supplied mostly from transfers into the Key Area, with an estimated 15 million m^3/a being transferred into the Key Area from varisou sources.. The surface water resource of the Key Area is very limited, estimated at 10 million m^3/a, while the groundwater resource (or at least the current water use from groundwater) is estimated at 165 million m^3/a which clearly shows that the water resources of this Key Area is dominated by groundwater. Doubts as to the sustainability of the current groundwater use have been raised in this ISP. This is addressed in more detail in the groundwarter strategy (Strategy no. G1). The Sand Key Area appear to be in deficit but this is due to the relatively small irrigation requirement which is supplied from surface water. It is envisaged that increased water demands could result from : ▪ Potential mining development by Kumba Resources near the confluence of Sand and Diep Rivers ▪ Growing urban water demands ▪ Growing rural communities and the provision of basic water services to all ▪ Other industrial and mining developments	
Broad Management Objective	To better understand current and potential future water requirements (mines, industries, urban, rural and irrigation).	
Overall Strategic Approach	The state of the groundwater resource in this Key Area needs to investigated urgently before it becomes over-exploited – if it is not already over-exploited. Since irrigation has expanded way beyond previous estimates, no more irrigation licences should be issued and a process of verifying lawful use should be initiated as a matter of urgency. Growing urban demand in Polokwane can be met from the existing transfer schemes for some time to come, while water for rural water supply will have to be source from groundwater since in most cases there are no feasible alternatives. Should the proposed groundwater investigation proves that the groundwater resource is indeed over-exploited, then compulsory licencing may be the only alternative to rectify the situation. Re-use of treated effluent and recycled water, is also an option which needs to be considered before compulsory licencing.	
tions, Responsibility & Priority	▪ Investigate groundwater use and the sustainability thereof. ▪ Based on the outcome of the groundwater study, develop a long-term groundwater allocation plan for the Key Area. If this plan entails reductions in allocations, implement compulsory licencing. ▪ Obtain reliable rural and urban population figures and the corresponding growth rates. Estimate growth trends ▪ Estimate projected future water requirements to meet the needs of mining, industrial, emerging farmers and rural communities	DWAF RO (Priority 1)

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4.2	WATER QUALITY MANAGEMENT – SAND	
Situation Assessment	Agricultural activities occur in the Dendron area with groundwater being the main source of supply. Groundwater pollution in this area is widespread, with elevated Nitrates from fertilizer application frequently rendering the water DWAF Class 3. This aspect is a threat to the use of groundwater and must be managed. There is decant from mines at Musina and (possibly) elsewhere in the Key Area which may have an impact on the surface and groundwater quality. The scattered rural settlements in the catchment rely on groundwater for domestic purposes. Most of these rural communities have poor sanitation levels, while others rely on pit latrines. High concentration of pit latrines and increasing population pose risks of pollution of the groundwater resource, with elevated TDS and Nitrate concentrations. Borehole head areas are not protected from water spillage, damage by cattle drinking, donkeys etc.	
Broad Management Objective	This strategy seeks to ensure that the surface and groundwater quality situation in the Sand catchment is understood and preventative measures are taken to protect the water resource.	
Overall Strategic Approach	Given the importance of groundwater in the catchment, initiatives must be taken to protect the quality of the this crucial resource. In densely populated informal settlements with high concentrations of pit latrines, DWAF must support improvement of sanitation facilities to minimize potential negative impact on the groundwater resource. Appropriate steps must be taken to ensure that borehole heads for boreholes located in populated informal settlements and rural communities are protected. All new boreholes must be positioned well away from settlements, and water piped to settlements, where the groundwater resources are suitable to do this. A strategy relevant to local conditions is required to deal with mine water decant, especially from closed and abandoned mines	
Actions, Responsibility & Priority	▪ Develop and implement a groundwater quality monitoring programme. ▪ Implement strategies for dealing with decant and surface runoff from mines. The core strategy is to seal off abandoned mines at Musina and elsewhere in the catchment, covering them with soil and vegetation, the aim being to minimize water ingress into the workings. ▪ Protect borehole heads in informal areas and rural settlements ▪ Position new boreholes well away from settlements ▪ Make funds available to improve sanitation facilities in rural areas and informal settlements	DWAF RO (Priority 1)

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5.1	WATER BALANCE & RECONCILIATION – NZHELELE KEY AREA	
Situation Assessment	The water requirements in the Nzhelele Key Area are as follows: Irrigation: 42 million m^3/a Rural:4 million m^3/a Urban: There are not urban settlements in this Key Area, although the Tshipise Holiday Resort, situated downstream of the Nzhelele Dam, could be be classified as an urban use. There is however in the order of only 0,2 million m^3/a and does not have a significant impact in this Key Area. There is also a small area (31 km^2) of afforestation in the upper reaches of this Key Areas but the impact of this on the available yield is limited, estimated to be only 1 million m^3/a. The surface water resources of this catchment are derived mostly from the Nzhelele Dam, while the small Mutshedzi Dam, farm dams and run-of-river also contribute significantly to the yield. There is extensive use of groundwater but still potential for further use. The registered water use by the irrigation sector is much more than previously thought, and based on this the catchment is stressed. The Nzhele Basin Study (1993) did also indicate that the catchment was stressed. The stressed situation can be attriubuted to over-allocation and/or over-development of the irrigation sector. Possible increased water requirements relate to rural use and updgrading the water supply to this sector to, at least, RDP standards.	
Broad Management Objective	To better understand current and potential future water requirements in the Nzhelele catchments.	
Overall Strategic Approach	DWAF must support any activities that will assist in minimizing the current deficit. There is scope for WC&DM in this catchment which should be addressed as a priority. Due to the stressed nature of this Key Area, the implementation of the ecological Reserve may require compulsory licensing to deal with the over-allocation to the irrigation sector. There is however no great urgency for this. Increased rural requirements should be sourced from groundwater. No new allocations are possible to the irrigation.	
Action, Responsibility & Priority	DWAF together with the municipalities must implement WC/WDM measures, especially in the irrigation sector, to maximize the available water and meet the future water requirements	DWAF RO (Priority 1)

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STRATEGY 5.2

5.2	WATER QUALITY MANAGEMENT – NZHELELE KEY AREA	
Situation Assessment	Extensive agricultural activities occur upstream and downstream of the Nzhelele Dam. Groundwater quality might be impacted from agricultural activities in areas where application of fertilizers is poorly managed. Scattered rural settlements in the catchment rely on groundwater. In most of the villages, borehole head areas are not protected from water spillage, cattle drinking etc. Surface water quality could be affected by diffuse pollution from canning factories. The extent of pollution from these factories must be monitored and quantified.	
Broad Management Objective	This strategy seeks to ensure that surface and groundwater quality situation in the Nzhelele Key Area is understood and preventative measures are taken to protect the water resource.	
Overall Strategic Approach	DWAF will commission a study to understand the extent of diffuse pollution by canning factories, agricultural activities, risks of groundwater pollution by mining effluent and acid mine drainage and how must this be monitored. DWAF will ensure that the borehole head areas are protected and any new boreholes are be positioned away from settlements and water piped.	
Actions, Responsibility & Priority	▪ Undertake a study to determine the extent of pollution as a result of acid mine drainage, canning factories in the catchment and diffuse pollution from agricultural activities. ▪ Monitor installation of new boreholes to ensure that they are positioned away from informal settlements	DWAF RO (Priority 1)

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6.1	WATER BALANCE & RECONCILIATION – NWANEDI KEY AREA	
Situation Assessment	The water requirements in the Nwanedi Key Area are as follows: Irrigation: 17 million m^3/a Rural:1 million m^3/a Urban: There are no urban area in this Key Area.. Miniing: There is a small Magnesite Mine at Hafolovhodwe but the water requirements of this mine are negligible. The water resources of the Nwanedi are limited by its small size and the limited water resource development. There are twp small dams, the Nwanedzi Dam and the Luphulele Dam which are the source of most of the surface water resource in this Key Area. There is extensive use of groundwater but still potential for further use. As in the Nzhelele Key Area, the registered water use by the irrigation sector is much more than previously thought, and based on this the catchment is stressed. The stressed situation can be attriubuted to over-allocation and/or over-development of the irrigation sector. Possible increased water requirements relate to rural use and updgrading the water supply to this sector to, at least, RDP standards.	
Broad Management Objective	To better understand current and potential future water requirements in the Nwanedi Key Area.	
Overall Strategic Approach	Due to the stressed nature of this Key Area, the implementation of the ecological Reserve may require compulsory licensing to deal with the over-allocation to the irrigation sector. There is however no great urgency for this. Increased rural requirements should be sourced from groundwater. No new allocations are possible to the irrigation.	
Action, Responsibility & Priority	DWAF together with the municipalities must implement WC/WDM measures, especially in the irrigation sector, to maximize the available water and meet the future water requirements	DWAF RO (Priority 1)

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6.2	WATER QUALITY MANAGEMENT – NWANEDI KEY AREA	
Situation Assessment	Extensive agricultural activities occur upstream and downstream of the Nwanedi and Luphephe Dams. Groundwater quality might be impacted from agricultural activities, in areas where application of fertilizers is poorly managed. There is a magnesite mine operating at Hafolovhodwe. The risks of groundwater pollution by mining effluent and acid mine drainage must be understood. Prevention measures must be put in place, and monitoring programmes be established and maintained. In general there are no water quality problems in the catchment.	
Broad Management Objective	This strategy seeks to ensure that surface and groundwater quality situation in the Nwanedi Key Area is understood and preventative measures are taken to protect the water resource.	
Overall Strategic Approach	DWAF will commission a study to understand the extent of diffuse pollution by canning factories, agricultural activities, risks of groundwater pollution by mining effluent and acid mine drainage and how must this be monitored. DWAF will ensure that the borehole head areas are protected and any new boreholes are be positioned away from settlements and water piped.	
Actions, Responsibility & Priority	▪ Undertake a study to determine the extent of pollution as a result of acid mine drainage, canning factories in the catchment and diffuse pollution from agricultural activities. ▪ Monitor installation of new boreholes to ensure that they are positioned away from informal settlements	DWAF RO (Priority 2)

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7.1	WATER BALANCE & RECONCILIATION – LIMPOPO MAIN STEM	
Situation Assessment	The Water Resources Situation Assessment Report (DWAF, 2001b) and the NWRS both dealt with the Limpopo WMA as if it were independent of the Limpopo River, while the reality is that there are substantial but poorly quantified flows in the Limpopo River which are used, mostly by irrigators, in the Limpopo WMA. This ISP attempts to quantify the water use from the main stem of the Limpopo but the water resources (surface and groundwater) of the Limpopo has not yet been quantified. This would require a major study which is far beyond the scope of this ISP. The assumption is therefore made that development along the Limpopo River has expanded to the limit of sustainability and that the water resource balances out the water use. There is an estimated water requirements of 80 million m^3/a from the main stem of the Limpopo River. Other minor uses which have not been quantified are those of the Venetia diamond mine and the urban requirements of Musina. The registered water use indicates that 49 million m^3/a of the water abstractions from the Limpopo are from groundwater (ie from the alluvial aquifer) while the remining 31 million m^3/a are from surface flow, although the distinction between these two may not always be clear. It has been assumed in this ISP that the main stem of the Limpopo is in balance. Concerns have however been rasied that over-exploitation of the alluvial aqufier could long lasting negative impacts on the quality of the water.	
Broad Management Objective	To better understand current and potential future water requirements in the main stem of the Limpopo River within the Limpopo WMA.	
Overall Strategic Approach	The overall approach with the main stem of the Limpopo is to disallow any further water use licences from the river and from the alluvial aquifer, at least until the system is understood much better than is currently the case. A study aimed at gaining a better undertstanding of the water resource of the Limpopo - that is, the whole river at least up to the border with Mozambique and not just along the border of the Limpopo WMA, is required. This will allow better management of the river and prevent the over-utilisation of this important resource..	
Action, Responsibility & Priority	Initiate a study of the water resources study of the Limpopo Basin. This must include surface and groundwater and identify all existing users from the river and its alluvial aquifer. In the interim, the legal water use from the Limpopo should be verified and measures put in place to prevent unlawful abstractions	DWAF NWRP (Priority 2) DWAF RO (Priority 1)

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G1	RESOURCE AVAILABILITY – GROUNDWATER
Situation Assessment	The total groundwater use in the Limpopo WMA is given in the NWRS as 98 million m^3/a**.** However, new data which recently became available indicates much higher groundwater use. The registered water use gives a total groundwater use of 310 million m^3/a while estimates from the GRIP project (DWAF, 2004a) gives estimates of between 460 and 550 million m^3/a for the whole Limpopo Province. While there is a wide disparity in estimates of groundwater use, it is clear that the use is much larger than previously thought and the question that this now raises is whether or not this large use is sustainable. Based on estimates of the exploitable potential, it appears as if the Sand Key Area is already over-exploited. This justifies the urgent need for a comprehensive groundwater study in the Limpopo WMA, with the focus on the Sand Key Area.. The Groundwater Resources Information Project (GRIP) which is currently in progress should address this problem. The GRIP project envisages preparing 1:50 000 scale hydro-geological maps of the Limpopo Region, starting with the communal land areas bit this will be extended to cover all area. These maps will depict the groundwater resources, groundwater quality and development potential, based upon the needs of the end user. The GRIP project is commencing with a desk study of available information, and will then involve considerable field work to infill data gaps. The GRIP project is scheduled to run for 3 years and will provide the level of detailed information that will be useful to engineers and planners when considering groundwater resource development. Overall the available groundwater resources within the Limpopo WMA are under-utilised. Even weaker groundwater occurrence areas can provide more than the RDP level of 25 litres per head per day. Groundwater use in the various Key Areas is summarised in Chapter 3 of Part A of this ISP report. It is important to note that groundwater is the only remaining water resource int the WMA which is not fully utilised (with the exception of the Sand Key Area). In general, groundwater resources are available throughout the entire WMA, but in varying quantities depending upon the hydro-geological characteristics of the underlying aquifer. Parts of the Limpopo WMA are heavily populated and widespread rural communities are a feature of the area which includes the old Lebowa and part of the old Venda. The primary source of water to these scattered rural communities is groundwater which makes groundwater a resource of great strategic importance in the Limpopo WMA. Nevertheless, according to the registered water use in the WMA, more than 90% of groundwater is used for irrigation. There is extensive use of the groundwater from the deeply weathered and fractured granites north of Polokwane (catchments A71A) and in the area around Dendron, (catchments A72G and A72A) where large abstraction for irrigation and domestic supply occurs. Large abstractions of groundwater also occurs Wiepe (catchment A71L) from the aquifer associated with the Limpopo River. The mountainous area east of Mokopane are also of special interest as far groundwater is concerned as this area consists primarily of dolomite and has considerable groundwater resources. The aquifer is however is heavily exploited, both within the WMA (quaternary catchment A61F) and in the Olifants WMA (quaternary catchment B51E) where Zebedelia Estates abstract significant quantities in an uncontrolled manner. Abstraction along the Rooisloot valley for irrigation has caused a decline in groundwater levels, as has abstraction in the Dorps River valley. The Mokopane wellfield, with an abstraction of about 3 million m^3/a, is located in a small area in the west of the Dorps River valley, leading to stress on the aquifer in this area. Abstraction in these areas has resulted in a reduction of groundwater flow down the hydraulic gradient, leading to an impact on downstream users. In the past not enough resources have been put into sitting boreholes scientifically nor have abstractions been managed properly. This led to many boreholes running dry and creating the perception that groundwater is not a reliable resource.
Management Objective	To properly manage the groundwater resources of the Limpopo WMA and ensure that its use is sustainable in the long term.

Overall Strategic Approach	Groundwater should be used as a first priority resource to address the backlog in basic water services. However, given the high risk of over-exploitation in the Limpopo WMA, and especially the Sand Key Area, DWAF urgently need to develop and implement appropriate mechanisms to ensure that over-exploitation of the groundwater resource does not take place. One of the mechanisms to prevent over-exploitation is compulsory licensing. Groundwater can also be used for small-scale irrigation and community gardens in most areas of the WMA. The extent and importance of groundwater resources in the WMA should be recognized by both the regulatory authorities and users. Rural communities need to understand the safety and reliability of using groundwater (if managed correctly), and misconceptions about the reliability of groundwater need to be dispelled through a concerted information awareness campaign.. The Department also needs to ensure that there is an improved knowledge and understanding of the available quantities of groundwater. A groundwater monitoring programme needs to be established in the WMA, commencing with those areas where abstractions are large and possibly not sustainable. It is proposed that the dolomites east of Mokopane be managed as a single unit. This may required shifting the boundaries of the Olifants and Limpopo WMAs.	
Action, Responsibility & Priority	▪ The commissioning of a groundwater assessment study, aimed at quantifying the resource and its availability at different levels of exploitation, should be treated as a matter of urgency. The Sand Key area should be dealt with as matter of utmost priority. ▪ The groundwater use, especially in the Sand River catchment needs to be verified as a matter of urgency. ▪ The groundwater availability needs to be reconciled, starting with the Sand Key Area, with the verified use and a management plan developed and implemented in order to limit groundwater abstraction to within the expoitable potential. This will probably required compulsory licencing in the Sand Key Area. ▪ Large resources need to be made available to expedite these crucial actions. ▪ Implement a groundwater monitoring programme to monitor both the quantity and quality of groundwater abstracted needs throughout the WMA, commencing in areas of high abstraction, such as Wiepe. ▪ Investigate the possibility of changing the boundaries of WMAs to facilitate integrated management of groundwater in the dolomitic aquifers east of Mokopane.	Regional Office Priority:**Highest** Regional Office Priority: Medium Regional Office Priority: Medium

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G2	INTERNATIONAL OBLIGATIONS
Situation Assessment	The Limpopo River Basin is shared by Botswana, Zimbabwe, South Africa and Mozambique. When managing the catchments of the WMA, international agreements and the needs of these countries, must be adhered to. Use of water in the Limpopo Basin and provision for sufficient water to meet the needs of neighbouring countries, is governed by the SADC Protocol on Shared Watercourses. The overall objective of the Protocol is to foster closer co-operation for judicious, sustainable and co-ordinated management, protection and utilization of shared watercourses, and to advance the SADC's agenda of regional integration and poverty alleviation. Even though the Protocol applies to the whole region and not only Limpopo, catchment managers in the Limpopo WMA must fully understand its requirements. The Limpopo River Basin Commission was established in November 2003. The primary responsibility of this commission is, amongst others, to ensure conformity with the SADC Protocol principles at local levels and to report to the SADC Water Sector in Gaborone on the process being made in the implementation of the Protocol's provisions. There is also an existing Water Resources Technical Committee (WRTC) which provides technical support and advice to the SADC Water Sector on shared watercourses such as the Limpopo River Basin. The WRTC also considers and approves terms of references (TOR) for consultancies (i.e. consultancies related to water resources management) as well as their appointment in the shared watercourses. A comprehensive water resources study of the whole Limpopo Basin will be one of the first major tasks of the Limpopo River Basin Commission. Flood events in the Limpopo River have serious impact on the downstream users. A typical example is the 2000 flood event which cost lives, damage to agricultural activities, roads and water infrastructure and properties.Droughts are also a problem in the Limpopo Basin.
Broad Management Objective	To meet our international obligations including the SADC Protocol on Shared Watercourses, and best international practice.
Overall Strategic Approach	South Africa will stand by the SADC Protocol and any other water sharing accord in terms of ensuring that the water resource of the Limpopo Basin are utilised on a fair and equitable basis by all Basin States. At the same time, South Africa expects that these countries will not over–exploit their share of the systems resources to the detriment of the river ecology and the economy of this country. The current dependency of the people of the Limpopo WMA on their limited water resources must be taken into account in decision-making. South Africa has determined an ecological Reserve for all its rivers. This requires certain minimum releases to ensure flows allowing for the continued health of the river. It is expected that this will also be sufficient to meet our international obligations in terms of ecological requirements and that other nations will contribute to the flow of the Limpopo main-stem in similar fashion, based on the nature of the catchments. A strategy to minimise damage by floods is required. Damage due to flood could be minimized by installation of early flood warning devices in the main stem. Procurement, installation and maintenance of such warning systems should not be the responsibility of one member state, but all of them. The Protocol must therefore be unpacked to clearly spell-out how shared watercourses must deal with flood events.

	A joint drought management plan for the whole basin must be developed. The plan must provide a process: ▪ For an integrated approach to assessment of drought conditions, ▪ To agree on drought action levels, for appropriate actions that should be taken in the event of droughts in order to insure adequate water supply to different priority users. Cooperative governance, data sharing, knowledge and skills transfer, and any other common issues required for better management of the Limpopo River basin must be promoted by all member states.	
Action, Responsibility & Priority	The SADC protocol on shared watercourses should be unpacked for use by the DWAF Regional Office in the Limpopo Province. This should involve, *inter alia*: ▪ Flood warning systems and how to deal with floods, ▪ Reviewing the SADC protocol and setting South African principles on any future new dams in the Limpopo River tributaries, the impact of groundwater exploitation and over-abstraction on our neighbouring states ▪ Clear definition of policies on the management and utilization of surface and groundwater resources, infrastructure and water quality in the WMA. ▪ Management of releases in the tributaries to take care of downstream international users	Dir Int Liaison Dir NWRP & DWAF Regional Office (High Priority)
	Participate in the Limpopo River Basin Study. From this will flow: ▪ Installation of flood warning systems and how to deal with floods ▪ Development of a drought management plan, ▪ Knowledge and data sharing mechanisms ▪ Agreement on best institutional arrangements and water sharing mechanisms in the basin ▪ Management of releases in the tributaries etc.	Dir Int Liaison Dir NWRP (High Priority)

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G3	WATER QUALITY

Situation Assessment	Given that many of the rivers in the WMA are either dry or seasonal, about 35% of the water is drawn from the groundwater resource. It is important, therefore to consider water quality in terms of both surface and groundwater. The water quality in the Limpopo WMA is affected by: a. Pollution from urban areas and informal settlements surrounding urban centres b. Contamination of groundwater as a result of high concentration of pit latrines in many rural villages, c. Impact of mining and industrial activities d. Diffuse pollution as a result of agricultural activities Each of the abovementioned issues is discussed in brief below: ▪ There are few large urban centres, Polokwane being the only city of significance. Some of the water quality problems around the town and neighbouring urban areas are a consequence of inefficient management of solid waste disposal sites. Currently DWAF Regional Office is assisting Polokwane Municipality in addressing this issue. ▪ The Limpopo Province has long been considered one of the poorest in South Africa, with a large but widely scattered rural community, mostly settled into medium sized villages. These bring their own water quality management problems, particularly contamination of the very groundwater resources on which they are often dependent. Some of the generic problems related to rural areas are a high concentration of pit latrines and poor siting of boreholes. This calls for a very strong programme of planning and management of land use (settlement and stock watering) in relation to the water resource. ▪ As part of the thrust to move out of the poverty cycle, the Limpopo Province is fast expanding its mining interests. Major developments are in the Mogalakwena catchment. In addition there are old and closed mines which cause serious pollution, especially to the groundwater resource. The strategy needs to ensure that the integrity of the WMAs water quality is maintained, whilst at the same time not placing undue brakes on economic development. ▪ The impacts of irrigated agriculture on the water resource must be recognized. The leaching of fertilizers is a serious problem in the WMA, particularly given the limited surface water and the inability of the system to absorb and flush out these excess nutrients. This makes it particularly vulnerable. The Limpopo main-stem is the ultimate carrier of all pollutants out of the system. The nature of this river is highly seasonal with large annual floods. ▪ The detailed water quality situation in each of the catchments will be discussed separately in Catchment Specific Strategies in Part B1 of this report.
Broad Management Objective	The Water Quality Management Strategy in the Limpopo WMA seeks to ensure that the very rapid growth currently being experienced by the Province does not negatively impact on the quality of the water resource. Particular attention needs to be given to the fast-expanding mining sector. The opportunities for rural communities to make far more extensive use of groundwater has been identified in other strategies. The very communities it supports threaten this resource through pollution, and the objective is to ensure that settlements and land use management practices are planned and controlled so as to guarantee the quality of the resource for all future users. Finally the objective of this strategy is to ensure that people are made aware of the implications of their actions, and that managers are empowered through monitoring, staff, and supporting legislation to adequately control the water resource.

Overall Strategic Approach	DWAF will take a position to improve the water quality monitoring and early warning system. Whilst overall negative trends are evident, it is difficult to substantiate particular areas of decline due to a lack of consistent records. With the very limited water available in the WMA and given the ephermal nature of most catchments, little can be done to dilute surface waters. Waste discharges must be minimized. The dependency of so much of the population on groundwater definitely makes the protection of this resource a priority. A groundwater protection strategy, particularly in terms of sanitation systems, is critical and must receive maximum support. The Department of Water Affairs and Forestry will support any initiatives which promote education and awareness amongst communities, mines, farmers and industries about the impact of their actions on the surface and groundwater resources. DWAF will also ensure that Penalty structures for farmers, mines and industries that act irresponsibly in terms of polluting the water resource are developed and implemented. Some of these penalties may include, amongst others, fines or payment for being a diffuse source polluter.	
Actions, Responsibility & Priority	▪ Identify catchments that are sensitive to water quality problems ▪ Prioritize catchments which require urgent attention based on the severity of the problems ▪ Obtain copies of EMPRs, EIAs and Closure Plans for all the mines in the WMA and ensure that the content of these plans are well understood by catchment managers. ▪ Gather data on pesticides and herbicides used by farmers in the WMA. Information on the extent of fertilizer utilization should be assembled. ▪ Non-point source pollution needs to be assessed and primary offenders brought to book. This requires national, WMA and catchment level approaches to over-irrigation (water conservation and demand management will reduce irrigation return flows leaching salts into the river) and excessive fertilization. ▪ Develop a strategy to deal with decommissioning of mines and mine water decant ▪ Develop material for water quality awareness targeting various stakeholders	DWAF RO (High Priority)

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G4	RESERVE & RESOURCE QUALITY OBJECTIVES STRATEGY
Situation Assessment	None of the river systems in the Limpopo WMA have been classified nor have the resource quality objectives been determined. The methodology for classifying the river systems is in the process of being developed nationally. Rapid Reserve determinations have been done for some of the rivers based on the licence applications, but none have yet seen either intermediate or comprehensive determinations. A need for the Reserve in the river systems of the Limpopo WMA are discussed below: **Matlabas/Mokolo Rivers:** The *Matlabas River* system is semi-pristine and determination of the Reserve is not a priority. The *Mokolo River* system is perennial. The flow regime in the lower reaches downstream of the Mokolo Dam has been modified by releases from the dam. Irrigators also abstract water downstream of the Mokolo Dam. To ensure that there is a balance between the irrigators requirements and ecological environment, Reserve determination for the river reach downstream of the dam should be conducted at an Intermediate level. The Ecological requirements of the Mokolo Key Area have not been determined in any detail, but the NWRS estimates the impact of the Reserve on the currently available yield at 17 million m^3/a. This can theoretically be supplied from currently available water although this would require a re-allocation from the Mokolo Dam and/or the curtailment to irrigation upstream of the dam. **Lephalala River:** The middle reaches of the Lephalala River consist of a wilderness area, while the dry lower reaches support irrigation from an alluvial aquifer and small weirs which are fed by the Lephalala River. There is a significant amount of irrigation in the upper reaches of the Lephalala which is impacting on the ecological integrity of the Wilderness area. Compulsory licencing might be required in order to meet these requirements. The ecological Reserve, given in the WMA report as zero, was also re-assessed as part of this study and found to be in the order of 3 million m^3/a. **Mogalakwena River:** Some of the reaches and tributaries of the Mogalakwena River system have been developed (e.g. Sterk River) in terms of construction of dams, while others have little or no development. In developed reaches, diversity of species has been lost. The river system is important from the conservation perspective, because of: ▪ Flow dependent species that occur downstream of the Glen Alpine Dam ▪ The pools in the river reaches that offer refuge for various species ▪ The presence of the short fin barb which has been declared international red data species The impact of the ecological Reserve is estimated at only 5 million m^3/a in the NWRS which seems very low for such a large catchment. No comprehensive Reserve determinations have been carried out in this Key Area. **Sand River:** The *Sand River* system is relatively dry with seasonal flows only. With such unreliable surface water there are no flow dependent species found in the Sand River system. Ecological Reserve determination in the system is not of high priority.

Broad Management Objective	**Nzhelele/Nwanedi Rivers:** The *Upper Nwanedi River* is perennial, while the lower reaches have occasional flows. According to the latest study (DWAF, 1999), the physical and chemical quality of the water released from the Nwanedi/Luphephe Dams, abstractions of water from the river, and sedimentation of the river channel have had an adverse effect on the fish communities. It has been recommended that the whole Nwanedi River be regarded as an environmentally sensitive area (DWAF, 1999) due to the presence of the endangered species. The Ecological Reserve should be determined at an Intermediate Level to ensure sustainability of the aquatic species. Implementation of the Reserve may require compulsory licencing. The upper reaches of the *Nzhelele River* system are perennial and support numerous flow dependent species. There has been little development of water resources infrastructure. There are nevertheless considerable water abstractions by farmers in this area. The Nzhelele Regional Water Supply Scheme also abstracts water from the weirs on the Nzhelele and Tshifire Rivers. The flow regime in the lower reaches of the river system has been modified by releases from the Nzhelele Dam. An intermediate Ecological Reserve determination in the upper and lower reaches of the Nzhelele River system should be of high priority to ensure that abstractions do not have negative impact on the aquatic environment.	
	This strategy seeks to ensure that all the river systems, their tributaries and reaches in the Limpopo WMA are classified according to Chapter 3 (sections 12-15) of the NWA and that the class and resource quality objectives have been determined for all or part of the river systems that have been considered significant. In addition this strategy seeks to prioritise the various main river systems in the Limpopo WMA in terms of Reserve determination.	
Overall Strategic Approach	DWAF will do everything possible to set a stage for River Classification, determinations of the Resource Quality Objectives and Reserves. Once the river systems, reaches and tributaries have been classified and Resource Quality Objectives determined, the Department will determine the human & ecological Reserves in catchments where there is pressure to do so.	
Actions, Responsibility & Priority	▪ Prioritize the river systems with regard to Reserve determination. The following rivers should receive priority:- *Mokolo, Mogalakwena, Nzhelele and Nwanedi*. ▪ Assemble the data that would assist in the classification of the river systems. Typically this would include aquatic ecosystems in each river reach, socio-economic activities etc. ▪ Once appropriate data has been assembled, classify the river systems, reaches and tributaries. ▪ Once the methodology for classifying the river systems has been established, this should be applied to all systems. ▪ Develop management guidelines and procedures for each river system ▪ Liaise with all stakeholders to ensure that the concept of Reserve is well understood.	RDM Office DWAF Regional Office (Priority 1)

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G5	WATER CONSERVATION AND WATER DEMAND MANAGEMENT (WC/WDM)

5.1	URBAN/INDUSTRIAL/MINING SECTORS
Situation Assessment	Urbanization is one of the serious challenges in the Limpopo WMA. The main centers of Polokwane, Makhado, Mokopane, Modimolle, Musina and Mookgopong are facing the serious challenge of providing their increasing populations with adequate, reliable and sustainable water services. Urban centres should expect a further influx of people from the surrounding rural areas. The water needs of this additional population would have to be catered for depending on the local political sentiments. The problem is also compounded by the fact that Limpopo WMA is water stressed and most of these main centers such as Polokwane, Makhado and Modimolle receive water from neighbouring WMAs at high costs. Efficient utilization of water to meet growing urban population demands and get value for money, need to be encouraged. Seshego and Polokwane, situated in the Upper Sand River catchment, had a successful WC/WDM programme. Successful initiatives like this should be extended to other towns in the WMA. The Mokopane Municipality has commissioned a study for developing a business plan (BP) for WC/WDM. This study has been completed and fruitful recommendations were made. The municipality is looking for funding to implement these recommendations. The estimated cost is approximately R16million. It is uncertain what initiatives have been undertaken to optimize water utilization in towns such as Makhado, Mookgopong, Modimolle, Lephalale, Musina, Turfloop/Mankweng, and Polokwane. The growing mining sector near Mokopane is experiencing water shortages. That this is severe is indicated by the sector's consideration of alternative water supply options such as piping of treated effluent from Polokwane and increasing of the capacity of the pipeline from Doorndraai Dam to Mokopane. The quantity of treated effluent to be piped is not known. The mining sector and other industries in the WMA must be encouraged to implement WC/WDM practices.
Broad Management Objective	To promote efficient use of water in the urban and industrial sectors of the Limpopo WMA.
Strategic Approach	Given the situation in the WMA, DWAF will strongly encourage and advise all the towns and industries to give WC/WDM the highest priority.

Actions, Responsibility & Priority	▪ Promote water use education and awareness programmes ▪ Encourage urban centers to share success lessons about WC/WDM and also use latest technological equipments (e.g. domestic meters) ▪ Promote utilization of recycled water in the mines and industries ▪ Promotere-use of treated effluent in mines and ▪ Undertake WC/WDM situation assessment studies for all the towns (e.g. Makhado, Polokwane, Mookgopong, Modimolle, Lephalale, Musina, and Mankweng) in the WMA. ▪ Review recommendations from the WC/WDM business plan developed for Mokopane town ▪ In partnership with municipalities such as Polokwane, which have already implemented water conservation measures in Seshego, DWAF need to share lessons learned with other municipalities. Also to expand such measures in their area of jurisdiction. ▪ The feasibility of a joint WC/WDM education and awareness campaign need to be discussed by all the three District Municipalities of the WMA. This could minimize costs.	DWAF RO, Municipalities (High Priority)
	▪ DWAF in partnership with the municipalities must promote water saving methods and technologies in urban centers and the surrounding settlements. Incentives for water saving must be introduced. ▪ Municipalities in the Limpopo WMA, with the support of DWAF Regional Office, must encourage voluntary compliance with the principles and strategies expounded in the National WC/WDM Strategy.	
	Copies of a WC/WDM sector strategies developed by the Directorate:Water Use Efficiency should be provided to the municipalities in the WMA	DWAF: D: Water Use Efficiency (High Priority)

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G5	WATER CONSERVATION AND WATER DEMAND MANAGEMENT (WC/WDM)

G5.2	AGRICULTURAL SECTOR	
Situation Assessment	Irrigation is the largest water use sector with an estimated 73% of the total water requirements in the WMA. Significant losses occur in the canal systems from the Nzhelele and Doorndraai Dams. In the Nzhelele Irrigation Scheme, canal losses amount to approximately 70%. Some of the irrigators are still using non-conservative irrigation systems such as flood irrigation. There is a need for encouraging efficient irrigation systems to optimize water utilization. One of the other key areas of water use where inefficiencies can make a very big difference lies in Systems Operations. This refers to the releases both to meet downstream irrigation demands to meet the needs of the ecological Reserve. This applies to releases out of the Doorndraai, Nzhelele, Mokolo, Glen Alpine and Nwanedi/Luphephe Dams. Whilst releases for the Reserve are stated as fixed volumes within time series, the degree to which these fulfill the needs of the Reserve will depend primarily on the accuracy of the original requirement determination, as well as the timing of the release. Releases for irrigation depends on the demand, the timing, the distance from the site of release to the site of use and to the extent to which the volume of water released is eventually used.	
Broad Management Objective	To achieve more efficient utilization of the scarce water resource in the agricultural sector by: ▪ Minimizing canal losses in the Doorndraai and Nzhelele Dams ▪ Promote utilization of efficient irrigation systems ▪ Optimize systems operations – this refers to releases both to meet downstream irrigation demands and the ecological Reserve.	
Overall Strategic Approach	DWAF regards the implementation of WC/WDM in the agricultural sector as a matter of high priority. Minimizing losses in the canal systems and encouraging efficient irrigation systems will be given high priority. DWAF must ensure that the operation of the systems, and the systems operating rules are executed with the greatest consideration and care, recognizing the volumes of water that are at stake. Systems Operations will be continuously updated. A first step will be to review the risk and causes of possible losses between storage and use. Irrigators should pay for volumes that are released from dam for their use and according to their allocation. This will encourage them operate more efficiently.	
Actions, Responsibility & Priority	Conduct WC/WDM situation assessment study for agricultural sector. Typical data that would assist in the implementation of the strategy is irrigation systems in all the catchments, types of crops, water allocations, water use, benefit of replacing canal systems with pipelines, efficient management of releases etc.	DWAF RO (High Priority)
	Copies of a WC/WDM sector strategies developed by the Directorate: Water Use Efficiency should be provided to the municipalities in the WMA	DWAF D: Water Use Efficiency (High Priority)

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G6	COOPERATIVE GOVERNANCE	
Situation Assessment	In the Limpopo WMA there are quite a number of issues that require cooperative governance, viz ▪ Municipalities have developed Water Services Development Plans (WSDPs) and Water Sector Plans (WSPs). In these plans, water supply options within their area of jurisdiction have been outlined. However, some of the municipalities do not have technical capacity in implementing these plans. DWAF should provide technical guidance to both the District and Local Municipalities in the implementation of the WSDPs and WSPs, and also assist municipalities identifying reliable and sustainable sources of water. It is also important for DWAF to check the WSDPs and WSPs carefully and discuss current and future water supply options with the municipalities. ▪ There are several solid waste disposal sites in the WMA (e.g. Polokwane, Sebayeng, Vondeling, Bandelierskop, Senwabarwana, Dendron, Musina, Tshipise, Mogalakwena etc.). Some of these sites have permits, while others do not. Most of the solid waste disposal sites are not managed properly. Oxidation ponds previously owned by DWAF and Department of Public Works are not licensed. However, DWAF RO is currently attending to the matter. ▪ There are several mines in the Limpopo WMA. These have EMPRs (Environmental Management Plan Report) and Closure Plans. Implementation of the EMPRs should be monitored by municipalities with the support of DWAF Regional Office and Directorate WQP. A Memorandum of Understanding (MoU) has been signed between DWAF and Department of Minerals and Energy (DME) to ensure cooperation and co-ordination between the two departments on environmental issues related to mining. ▪ As part of the municipal Integrated Development Planning (IDP) process, the District and some of the Local Municipalities in the Limpopo WMA have developed Environmental Management Plans (EMPs). Most important is efficient and effective implementation. Municipalities require technical guidance from the Department of Environmental Affairs and Tourism (DEAT) to implement these plans. ▪ Emerging farmers in the WMA need water for irrigation purposes. However, they also need land and have to understand the agricultural component. To ensure that emerging farmers get full support, there should be a joint effort from the Department of Agriculture (DA), Department of Land Affairs (DLA), and DWAF.	
Broad Management Objective	Integrated Water Resources Management (IWRM) is an inter-governmental, inter-departmental, inter-sectoral process. This strategy seeks to ensure that there is cooperation and communication amongst all levels of government and private sector involved.	
Overall Strategic Approach	DWAF is committed to cooperative governance and also recognizes the importance of IWRM. Cooperative governance is best achieved through effective communication and DWAF must maximize its attendance and input into cooperative governance forums. Some of these forums are general/provincial whilst for others DWAF is the "lead agent". DWAF must also take cognisance of Act other than National Water Act when managing catchments, for example, the Mineral & Energy Act, the National Environmental Management Act, etc.	
Actions, Responsibility & Priority	A communication strategy and cooperation agreement amongst all the Departments involved in the issues affecting water resources in the Limpopo WMA should be developed	DWAF: Regional Office (High Priority)
	To ensure successful and all-inclusive environmental management in the WMA, integrated environmental management plan tailored to the Limpopo WMA situation should be developed and implemented.	DWAF Regional Office (High Priority)

Actions, Responsibility & Priority	▪ Communication between municipalities and DWAF's Regional Office Water Services Division should be improved. ▪ Department of Provincial and Local Government (DPLG) should also communicate their water services delivery expectations from municipalities to DWAF Regional Office. This would ensure that DWAF Regional Office provides support required by DPLG. ▪ DWAF and Department of Public Works (DPW) should ensure that licences are issued for all oxidation ponds. ▪ DWAF and Department of Environmental Affairs and Tourism (DEAT) should provide technical assistance to municipalities in managing solid waste disposal sites. Efficient management of the solid waste disposal sites would minimize potential impact on the water resources and the environment. ▪ A MoU between DWAF and DME should also include DEAT ▪ Municipalities with the support of DEAT, DME and DWAF should monitor the implementation of EMPRs and Closure Plans by mines	DWAF Regional Office, (High Priority)

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G7	WATERWORKS MANAGEMENT

G7.1	SYSTEM MANAGEMENT
Situation Assessment	In order to optimize the available water resource and maximize water supply, the existing water infrastructure must be managed efficiently. **MOKOLO CATCHMENT:** **Mokolo Dam**, located in the Mokolo River, is owned by DWAF. Minor operation and maintenance (O & M) are carried out by ISCOR/Kumba Resources. DWAF is responsible for major O & M. Dam releases are managed by ISCOR. **MOGALAKWENA CATCHMENT:** **Doorndraai Dam** supplies water for domestic and irrigation purposes. The dam has a gated spillway. It is owned and operated by DWAF. Releases from the dam are managed and monitored by DWAF. Irrigation releases are conveyed through the canal system. Downstream farmers submit their combined weekly request. If their request is less than 200 m^3/hour, then there won't be any releases. This latter operating rule does not foster water conservation. Every effort must be made to encourage that this water is piped instead of it reaching the farmers in the rivercourse where losses are high. Water for domestic and industrial use is piped from the dam to the raw water treatment works located a few meters downstream of the dam. The treatment works is operated by the Lepelle Northern Water. Treated water is then piped to supply Mokopane, PPL mines and surrounding communities. During floods the operator at the dam communicates with other users upstream and downstream of the dam before opening the gates. The information provided by upstream users and the water level at the dam guides the operator on the number of gates that should be opened. **Glen Apine Dam** supplies water for agricultural purposes. The dam is owned and operated by DWAF and the dam spillway is not gated. Just like Doondraai and Nzhelele Dams, releases from the Glen Alpine Dam are based on the farmers requests and DWAF manages the releases. These operating rules are demand driven and not according to maintaining the yield of the dam. Downstream farmers have diversion weirs for water storage. During floods the dam spills automatically because the spillway is not gated. **Donkerpoort Dam** supplies Modimolle town and is owned, operated and managed by Modimolle Municipality. DWAF are therefore not familiar with the operating rules of this dam. Releases from the dam are also monitored and managed by the municipality. **SAND CATCHMENT:** **The Seshego Dam** is owned, operated and managed by the municipality. DWAF are thereforenot familiar with the operating rules of this dam. Water is piped through 200mm diameter pipes to the nearby raw water treatment works. Treated water is then piped to Seshego and surrounding villages. Transfer schemes into the Sand catchment are Ebenezer, Dap Naude, Olifantspoort Weir, Albasini and possibly Nandoni Dam. Operation and management of each of the dams is discussed below:

	Ebenezer Dam is owned and operated by DWAF. Water is piped from the dam to the raw water treatment works located downstream. The treatment works is operated by the Lepelle Northern Water. Treated water is piped through 600mm diameter pipes to Polokwane (about 42km) through Mankweng/Turfloop. Water allocation from Ebenezer Dam to Polokwane and surrounding villages has been claimed as 18.53 million m^3/a. This needs to be confirmed. The impact on the Groot Letaba water users also needs to be reviewed. Only 10 million m^3/a of the total allocation is utilized due to capacity problems in the pipeline. **Dap Naude Dam** is owned, managed and operated by Polokwane municipality. Water is piped from the dam to the treatment works. Treated water is then conveyed by pipeline over a distance of approximately 60km to Polokwane. This pipeline needs to be refurbished. The firm yield of the dam is just under 4 x $10^6 m^3/a$ with the maximum draft around 7 x $10^6 m^3/a$. This supply is drawn at a significantly low assurance to supply. The low dam levels in 2003 may bear testimony of this operating rule. **Olifantspoort Weir** belongs to DWAF. Water is treated at the treatment works near the weir and piped to Polokwane. Lepelle Northern Water operates the treatment works. Releases from **Albasini Dam** are managed and monitored by DWAF. Water is conveyed by pipeline from the dam to treatment works. Treated water is conveyed to Makhado town by pipeline. **NZHELELE CATCHMENT:** **Nzhelele Dam**, located in the Nzhelele River system, is operated and maintained by DWAF. The dam spillway does not have gates. Releases from the dam are managed and monitored by DWAF. These releases are for irrigation and a small volume for urban use. There are approximately 25 farmers irrigating more than 3000ha of land. The common crops are mango, oranges, and maize. Flood and micro irrigation are the common methods of irrigation in the area. Irrigation releases are on a weekly basis. Downstream farmers submit a joint request on the quantity of water required. DWAF releases the water taking into account annual allocation for each farmer. Again this draft is demand driven and not necessarily in-line with the sustainable use of this resource. This operating rule needs to be developed and enforced especially if an ecological Reserve is to be implemented. The canal that conveys water to the irrigators is poorly maintained due to a lack of financial and human resources. Losses are high. Raw water is also released from the dam to supply Tshipise Holiday Resort located further downstream of the dam. The holiday resort has its own raw water treatment works. During floods the dam spills automatically, because the spillway is not gated. **NWANEDI CATCHMENT:** **Nwanedi & Luphephe Dams** are owned, operated and managed by DWAF. The two dams are operated on demand. Releases from the dams are for urban, rural and agricultural usage. There are no formal operating rules for Nwanedi & Luphephe Dams. **Cross Dam** located further downstream of the two dams, acts as a regulating dam facilitating release management to farmers downstream. During floods the dams spill automatically, because the spillways are not gated.	
Broad Management Objective	This strategy seeks to ensure that: ▪ Each dam/scheme in the Limpopo WMA has clear operating and maintenance rules. ▪ Improvements to existing operating rules are undertaken.	
Strategic Approach	DWAF must invest resources in improving efficiencies in dam and system operation. Particular attention must be given to releases into river from dams to supply downstream users.	
Actions, Responsibility, Priority	▪ Existing operating rules must be updated ▪ Compile existing information from various reports and new analyses into a clear set of rules ▪ Operators at the dams must be provided with system operating manuals ▪ Conveyance must be reviewed and water savings mechanisms put in place ▪ Actions to be taken by operators during flood events must be documented and distributed to all the dams ▪ A communication strategy for flood releases must be developed and implemented. ▪ Drought operating rules need to be developed.	DWAF RO (High Priority)

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STRATEGY G7.2

G7	WATERWORKS DEVELOPMENT & MANAGEMENT

G7.2	INFRASTRUCTURE DEVELOPMENT	
Situation Assessment	In the Limpopo WMA there are no further opportunities for large-scale surface water resources infrastructure. Suitable dam sites do not exist. The Mokolo Dam was however designed to be raised and this remains a feasibly option to make additional water resource available. Water for urban use is transferred into the WMA from the Letaba/Levuvhu WMA and these transfer schemes may have to be augmented. There is scope to augment the transfer from the Ebenezer Dam because Polokwane are not utilising their full allocation from this source. The possibility of increasing transfers to Makhado from the Levuvhu catchment, by utilisng some of the surplus yield in the Nandoni Dam is also a possibility.	
Broad Management Objective	To develop infrastructure for storing more water	
Overall Strategic Approach	DWAF will not consider any large –scale surface water resources infrastructure development in the WMA. Additional water will have be sourced from transfers from other WMAs.	
Actions, Responsibility & Priority	If necessary, consider raising the Mokolo Dam to catch more summer water	DWAF RO, Medium Priority

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G8	MONITORING & INFORMATION
Situation Assessment	The monitoring situation in the Limpopo WMA is discussed in the following sections:- ***Hydro-meteorological monitoring:*** There are 38 flow gauging stations and 9 main dams in the Limpopo WMA. Most of the flow gauging stations are located in the Mogalakwena catchment. The spatial distribution of rainfall stations in the Limpopo WMA need to be addressed, because their locations have an impact on the accuracy of rainfall-runoff hydrological modelling. ***Abstraction monitoring:*** Both surface and groundwater abstraction monitoring throughout the WMA is not sufficient. Over-abstraction of groundwater for irrigation and other uses is a problem in Dendron and Weipe. ***Groundwater monitoring & information:*** The groundwater situation in the WMA is exacerbated by a lack of good quality information. Planners need to know the volume of available groundwater resources, the distance a suitable source is from the intended use and the reliability of the source (assuming active good aquifer management). Information needs to be presented in a format understandable to planners and engineers and this information needs to be readily available. General background information is available on the published 1:2 500 000 Groundwater Resources of the Republic of South Africa prepared by J.R. Vegter (1995). Regional information is available from the published 1:500 000 hydrogeological map of Messina 2127 and also the 1995 Pietersburg 2326 map which is presently being revised. More detailed information for certain areas can be obtained from DWAF. As a minimum, hydrogeological maps need to be prepared for each Quaternary catchment or group of Quaternary catchments, preferably at a scale of 1:50 000, to provide planners and engineers with quantified and visual information. The difficulty of obtaining readily available area specific data in a quantified format is a major hindrance to the optimal development of groundwater resources. Currently there are no up-to-date data available for the aquifers within each Quaternary catchment, with the important exception of those rural areas served by community water supply schemes (ref: the Provincial Groundwater Data Base which is maintained and updated on behalf of DWAF by GPM Groundwater Project Managers, Polokwane. This company is also responsible for the co-ordination of the Groundwater Development Strategy in key development areas). This major shortcoming to development planning requires to be actively addressed by implementing a detailed mapping programme, starting in the most stressed and ecologically sensitive catchments. The Groundwater Resources Information Project (GRIP) envisages preparing 1:50 000 scale hydrogeological maps of the Limpopo WMA and adjacent areas, starting with the communal land areas. These maps will depict the groundwater resources, groundwater quality and development potential, based upon the needs of the end user. The GRIP project is commencing with a desk study of available information, and will then involve considerable field work to infill data gaps. The GRIP project is scheduled to run for 3 years and will provide the level of detailed information that will be useful to engineers and planners when considering water source development.
	There is limited or no monitoring of **drilling of new boreholes** in the Limpopo WMA. If drilling of new boreholes is left unmonitored and uncontrolled, it could have a negative impact on the available groundwater resource. DWAF Regional Office must be proactive in prioritizing monitoring of borehole drillers. ***Water quality monitoring:*** There is inadequate water quality monitoring throughout the Limpopo WMA. The DWAF Regional Office is in the process of identifying additional water quality monitoring points in the Mogalakwena catchment. It is envisaged that this process will be extended to other catchments in the WMA.

Broad Management Objective	The monitoring strategy in the Limpopo WMA seeks to: ▪ Improve monitoring networks so that the resource as well as its utilisation can be accurately quantified. ▪ Improve on efficiencies in the gathering of information, particularly through institutional cooperation in data capture and management ▪ Set and maintain standards for the capture, processing and management of information ▪ Ensure that data is accessible to stakeholders without compromising data security. The strategy applies to all aspects of water resources, viz : ▪ Hydro-meteorology - rainfall, climate, and streamflow ▪ Geo-hydrology – groundwater levels, monitoring drilling of new boreholes ▪ Inflows and outflows (transfers) ▪ Abstraction (water users, dam levels, operational releases, losses etc) ▪ Water quality (surface water, groundwater) ▪ Waste water outflows ▪ River Health (function and impact of the ecological Reserve) ▪ Sedimentation Monitoring networks, data capturing and information management systems are required for: a. Water resources planning and management b. Baseline information, regional and national databases c. Disaster management (e.g. flood and drought) d. Water use management and control e. Reserve related baseline and ongoing monitoring f. Water demand management g. Water balance estimations h. Water quality management and pollution control i. Environmental management j. Streamflow monitoring etc.	
Strategic Approach	DWAF will do everything possible to secure finances, human resources and approaches that will improve the status of monitoring networks in the Limpopo WMA. A good data is required to make better management decisions.	
Actions, Responsibility & Priority	▪ Assessment of information requirements (surface water, groundwater etc) at the scale of decisions (WMA and at catchment scale). ▪ DWAF must facilitate meetings and negotiations with cooperating partners. Assess what information is gathered, how it is processed, stored and disseminated. Develop a plan for the sharing of mutually useful information. ▪ Prepare a set of standards for data capture and the processing of information. ▪ Design a monitoring system to meet needs. This design should offer phased implementation, based on priorities. Priorities should be broken down to critical monitoring points within specific fields of concern, so that the most urgent areas can be attended to first. Apply the cost-benefit principle. ▪ Motivate and seek funding to meet requirements ▪ Review human, financial and material resources required for adequate monitoring in the WMA ▪ Develop and train staff required for effective monitoring ▪ Monitoring strategy must be reviewed and updated on a regular basis ▪ Mechanisms for controlling borehole drillers must be developed ▪ The status and accuracy of the flow gauging stations must be evaluated on a continuous basis.	DWAF RO (High Priority)

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G9	REDRESSING INEQUITIES

G9.1	WATER FOR EMERGING FARMERS AND ECONOMIC DEVELOPMENT	
Situation Assessment	Some of the catchments of the Limpopo WMA are water stressed. Despite this some water must be made available to emerging farmers. This can be achieved by: ▪ Re-allocation through compulsory licensing, ▪ Allowing trading of the existing water licences ▪ Implementing Water Conservation and Water Demand Management measures to maximize the available water Opportunities for implementing WC/WDM in the agricultural sector do exist in Mokolo, Mogalakwena, Lephalale, Nzhelele and Nwanedi catchments. If implemented successfully, more water can be brought back into the system to meet the requirements of emerging farmers. There are some agricultural schemes in the WMA which have been abandoned. A list of these schemes has been compiled by the DA. These schemes could be revitalized and running again. Previous water allocations to these schemes must be revised and re-allocated. As part of the IDP process, the Capricorn District Municipality has planned to revitalize irrigation schemes within their area of jurisdiction. DWAF has to assist them in getting water for the schemes. The municipalities which rely on **government grants as the primary** source of income must be targeted as the primary beneficiaries of water for economic development. Water should be made available to any interested investors in such municipalities. The Capricorn District Municipality has also planned to make municipal land available for commercial agriculture in the Molemole, Aganang and Blouberg Local Municipalities. The intention is to encourage economic development and create about 6000 jobs by 2007. This dream of creating jobs and boosting the economy for poor municipalities can be achieved if water is available. Recent discussions with the Co-ordinating Committee for Agricultural Water (CCAW), a special task group as formed to investigate the availability of water for revitalising irrigation schemes. The group consists of officials from DA, DWAF and ARC (Institute for Agricultural Engineering).	
Broad Management Objective	To make water available to emerging farmers	
Overall Strategic Approach	DWAF will try every possible means to maximize the available water in the Limpopo WMA and also offer support to initiatives from Department of Agriculture. DWAF will also take initiatives to quantify the amount of water required for economic development in the WMA.	
Actions, Responsibility & Priority	▪ Prioritize the catchments based on the emerging farmers needs ▪ Ensure that WC/WDM and compulsory licensing are implemented in an integrated manner ▪ Investigate groundwater as an alternative source of water for emerging farmers and economic development ▪ Prioritize revitalization programme ▪ Compile a list of municipalities which rely on **government grants** as the primary source of income. Target these municipalities as the primary beneficiaries of water for economic development. Any potential investors in these municipalities must be given priority when allocating licences	DWAF RO (High Priority)

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G9	REDRESSING INEQUITIES

G9.2	WATER FOR POVERTY ERADICATION	
Situation Assessment	It is quite evident that productive use of water and the water needs for the poor goes beyond basic water supply for domestic purposes. It is therefore recommended that water for poverty eradication strategy in the Limpopo WMA take into account the following steps: ▪ Make water available to meet basic human needs the top priority (provision of basic water services to comply with RDP standards) ▪ Make water available for small-scale gardens for fruit and vegetable production, brick making and building. It is also possible to start intensive agricultural schemes (e.g. hydroponics or high income/low space crops) that can be operated by co-operatives led by skilled agricultural managers. ▪ Educate communities on other ways of collecting water, for example, rainfall harvesting. Subsidies are available from DWAF for constructing rainfall harvesting tanks. Every South African citizen is entitled to basic water services. Communities who have basic water services, can divert their energy and time to thinking about productive use of water. Limpopo Province is one of the poorest provinces in the Republic of South Africa. A very high percentage of communities in the Limpopo WMA are still below 50% of RDP standards in terms of water supply. Between 86 to 97.5% of the rural population in the Mogalakwena, Lephalale, Molemole, Aganang and Blouberg Local Municipalities are below RDP level of water supply. In the Waterberg District Municipality, about 235 688 (i.e. 48 000 households) of people living in settlements do not have access to water at least 98% of the time. On the other hand about 130 000 people still have to walk more than 200m to fetch water from the nearby water sources. In order to address the abovementioned problems, DWAF must assist the municipalities in:- ▪ Identifying reliable and sustainable sources of domestic water supply ▪ Accessing funding mechanisms for new water infrastructures ▪ Managing existing water infrastructure to ensure sustainability Rainwater harvesting must also be encouraged in rural areas.	
Broad Management Objective	This strategy seeks to ensure that water for productive use at the household level is made available to the poor.	
Strategic Approach	DWAF must promote and support productive use of water for fruit and vegetable production, brick making and building. DWAF must encourage rain harvesting and also seek sustainable mechanisms for making water available to the poor.	
Actions, Responsibility & Priority	▪ Compile a list of all communities in the WMA with no access to basic water services ▪ Compile a list of all communities in the WMA with basic water services below RDP standards ▪ DWAF must assist the municipalities in identifying reliable sources of water supply ▪ DWAF should continue supporting municipalities technically (where necessary) and financially in delivering basic water supply services.	DWAF RO (High Priority)

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G10	INTEGRATED ENVIRONMENTAL STRATEGY

G10.1	INTEGRATED ENVIRONMENTAL MANAGEMENT
Situation Assessment:	Although discussions were held with the old DWAF Directorate: Social and Ecological Services, it was realised that not enough has been documented within DWAF regarding the environmental issues in the Limpopo WMA and their integration into the broader water resources planning picture. Numerous individual studies have been completed. Further collation work would be required to produce specific environmental strategies. A broad approach was therefore adopted in this version of the ISP. DWAF has been very proactive over the years regarding the institution of international best practice in the field of Integrated Environmental Management. The Department has recently published a Consolidated Environmental Implementation and Management Programme and is currently developing specific strategies, policies, and tools to implement processes that will take due consideration of all impacts that water resource and other water management activities will have on our broader environment in which we live. It must be noted that these environmental issues and strategies are cross-cutting through all aspects and approaches adopted in this ISP.
Broad Management Objective & Strategic Approach:	The ultimate aim is to ensure a balance between development in the Limpopo WMA (i.e. including all activities undertaken by DWAF) and the need to protect the natural and social environment for the benefit of all. There is a need to identify all environmental issues in the WMA and to address each of these according to priority. This attention should also take current and future water resources planning into account. Ensure that all linkages with NEMA (including the new NEMA currently being drafted) and other legislation (including co-operative governance initiatives) and the activities of DWAF are adhered to in the catchment, and that related implementation strategies are developed with the view of being audited by the Auditor-General in 2004. Planning of proper reporting procedures must be included in these strategies. DWAF must ensure environmental functioning in all activities it is related to in the Limpopo WMA. This includes the adoption of proper integrated environmental management processes, auditing and compliance monitoring in the planning, design, and construction phases of all projects. DWAF must also ensure environmental compliance of outside stakeholders in terms of its own legislation.

Strategy, Responsibility & Priority:	Water resources management calls for certain developments that have an impact on the environment (whether positive or negative). These environmental impacts need to be understood and addressed where necessary. Identification and a clear description of all the environmentally sensitive areas in the Crocodile River (West) Catchment needs to take place. This would help water resource managers when evaluating current and future developments in these areas. Guidelines and bylaws may need to be prepared to assist local authorities (refer to Water Quality Strategy).	Dir: SES Dir NWRP (N) (High Priority)
	Develop policies, guidelines and strategies in line with the CEIMP. Of particular importance will be the cross-cutting linkages between the strategies in this ISP, NEMA and other legislation. This was not specifically discussed within the workshops, and the Dir: SES will produce these strategies for the next version of the ISP.	Dir: SES (High Priority)
	Develop integrated Resource Directed Measures strategies.	Dir: RDM (Medium Priority)
	Wetlands need to be accorded more attention as they form a vital link in the sustenance of natural life and can act as water quality filters. Little information on the wetlands of the Limpopo WMA was available at the time of preparing this ISP. This needs to be investigated and a specific strategy prepared.	Dir: SES (Medium Priority)
	Tourism: Assist the Department of Environmental Affairs and Tourism with broad monitoring of water quality and quantity in certain conservation and tourism areas of the catchment. Appropriate water related actions might need to be taken to conserve these environments for the benefit of the local economies. Areas include the upper reaches of the Lephelala and Nylsvlei wetland..	Regional Office Dir: SES; Dir WQM (High Priority)
	Co-operative governance and institutional aspects: authorities should provide an enabling environment to promote economic growth as well as to protect the environment for the benefit of all life forms in the catchment.	Regional Office All Directorates (Priority 1)
	Land use impacts: arguably one of the most serious environmental impact consideration in this catchment. These include: solid and other types of waste seeping into the river system from urban areas; overgrazing and silting; effluent return flows and salination of water sources; groundwater pollution from rural settlements and industrial/agricultural activities; positive and negative aspects of poverty eradication efforts; *et cetera*. These have been referred to in other strategies, but need to be monitored and actions co-ordinated to ensure a sustainable environment.	
	Invasive alien vegetation: need to understand the extent of the infestation in this catchment, what is being done by Working for Water, and the development of a strategy (together with Working for Water) to annihilate these invasives where practically possible and where they have a threat of reconising in future.	Regional Office Working for Water (Medium Priority)
	Identify and implement strategies being developed in the CEIMP process.	Dir: SES Regional Office and all Directorates (Medium Priority)
Motivation:	An integrated approach to environmental management considerations needs to be adopted. This with a view to conserving and protecting our environment for the benefit of all life forms. DWAF has a mandate (via other government departments as well) to act as a custodian in our whole environment to ensure a healthy balance between development, social upliftment and protection, and preserving our biophysical environment and natural heritage.	

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G11	IMPLEMENTATION STRATEGY

Situation Assessment	Within the new dispensation of the National Water Law, the DWAF Regional Office is responsible for the practical hands-on management of the water resources of the Limpopo WMA. DWAF Head Office provides policy direction and any other support required by the Regional Offices. The Regional Offices are currently too under-staffed and under-funded to be able to completely fulfil the roles and responsibilities set out in this ISP. Restructuring within the Department is also proceeding, which creates uncertainty and a process of adjusting to new roles. It is therefore expected that the implementation of these water resource management functions will be gradually instituted with a view to handing over some of these functions to the CMA that will eventually be established.	
Management Objective	The strategies and approaches described in this ISP need to be implemented in future depending on priority. The work needs to be picked up by the responsible Regional Office or Directorate, specific people assigned and a budget and time scale connected to the task/strategy. There needs to be a well co-ordinated implementation plan to ensure that work is conducted and that shows water users that every effort is being made by the Regional Office to manage the water resources of the catchment, especially in the light of the levying of water resource management charges.	
Overall Strategic Approach	DWAF intends to hand over a number of water resource management functions to the Catchment Management Agency (CMA). The transitional process outlined in the CMA Business Plan needs to be discussed and a plan of implementation formally adopted. The structure of the Regional Offices is such that the responsibility for these functions is assigned to specific people, who usually have people assisting them. A co-ordinator, or champion, must be tasked to give effect to the implementation process as DWAF must show that it means business if it is already collecting water resource management levies. This co-ordinator must set up an activity list using the ISP as a starting point. These activities must be prioritised. The scope of work of each activity, or assignment, must be clearly spelt out and compared with the bigger picture to ensure its relevance before it is further developed or implemented. A detailed implementation plan can then be prepared. As these plans are being drafted and implemented, further input must be incorporated in the ISP so that a more detailed and up to date perspective can be provided. It is hoped that this document will then be used by the CMA as DWAF's input into the development of a Catchment Management Strategy.	
Action, Responsibility & Priority	• Assign a co-ordinator to champion the water resource management process in the Regional Office on a full-time basis. This person can be supported by other managers in the Regional Office and in Head Office. • Ensure that there is co-ordination of who is doing what between the two Regional Offices responsible for this catchment. • Set up comprehensive implementation plan linked to budgetary requirements.	DWAF RO (Highest Priority)

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APPENDICES

APPENDIX A: ECOLOGICAL MANAGEMENT CLASS PER QUATERNARY OF THE LIMPOPO WMA

APPENDIX B: DAMS IN THE LIMPOPO WMA

APPENDIX C: GROUNDWATER OVERVIEW OF THE LIMPOPO WMA

APPENDIX D: REGISTERED WATER USE IN THE LIMPOPO WMA

APPENDIX A: ECOLOGICAL MANAGEMENT CLASS PER QUATERNARY OF THE LIMPOPO WMA

	QUATERNARY CATCHMENT	ECOLOGICAL MANAGEMENT CLASS
Matlabas	A41A	B
	A41B	C
	A41C	C
	A41D	C
	A41E	C
Moholo	A42A	C
	A42B	C
	A42C	D
	A42D	B
	A42E	C
	A42F	C
	A42G	C
	A42H	D
	A42J	C
Lephalala	A50A	C
	A50B	C
	A50C	D
	A50D	B
	A50E	D
	A50F	D
	A50G	D
	A50H	D
	A50J	A
Mogalakwena	A61A	D
	A61B	D
	A61C	C
	A61D	B
	A61E	C
	A61F	C
	A61G	C
	A61H	D
	A61J	D
	A62A	B
	A62B	C
	A62C	C
	A62D	B
	A62E	B
	A62F	B
	A62G	C
	A62H	B
	A62J	C
	A63A	D
	A63B	D
	A63C	A
	A63D	C
	A63E	C
Sand	A71A	D
	A71B	B
	A71C	C
	A71D	C

	QUATERNARY CATCHMENT	ECOLOGICAL MANAGEMENT CLASS
	A71E	B
	A71F	B
	A71G	D
	A71H	B
	A71J	B
	A71K	B
	A71L	B
	A72A	D
	A72B	B
Nzhelele	A80A	C
	A80B	C
	A80C	D
	A80D	C
	A80E	C
	A80F	D
	A80G	D
Nwanedi	A80H	D
	A80J	D

APPENDIX B: DAMS IN THE LIMPOPO WMA

Quaternay catchment	Dam name	Use	Full supply capacity (million m3)	Full supply area (km2)
A41C	SCHOONWATER	Irrigation	0.096	0.06
A41D	MOTLOBO	Livestock	0.12	0.02
A42A	DOORNFONTEIN	Irrigation	0.06	0.02
A42A	DOORNFONTEIN	Irrigation	0.224	0.09
A42A	LEEUPOORT	Irrigation	0.35	0.18
A42A	RHENOSTERPOORT	Irrigation	0.627	0.33
A42B	ADRIAANSHOOP DAM NO.1	Irrigation	0.12	0.03
A42B	ADRIAANSHOOP DAM NO.2	Irrigation	0.12	0.02
A42B	KOPPIE ALLEEN DAM (OLKERSPRUIT)	Irrigation	0.04	0.02
A42B	KOPPIE ALLEEN DAM (RIETVLY)	Irrigation	0.28	0.12
A42B	RIETPOORT NO.2	Irrigation	0.126	0.08
A42C	DONKERHOEK NO.1	Irrigation	0.091	0.07
A42C	DONKERHOEK NO.2	Irrigation	0.127	0.05
A42C	GROOTSPRUIT NO.3	Irrigation	0.263	0.17
A42C	GROOTSPRUIT NO.4	Unknown	0.127	0.06
A42C	WATERVAL	Irrigation	0.058	0.01
A42E	HUFEISEN	Irrigation	0.402	0.18
A42E	OLIFANTSBEEN	Irrigation	0.75	0.3
A42E	WELTEVREDEN	Irrigation	0.078	0.04
A42F	MOKOLO DAM (HANS STRIJDOM)	Domestic Water Use	145.9	8.29
A42J	MATIMBA POWER STATION TERMINAL RESERVOIRS NO.	Pollution	0	0.08
A50A	ALIDA-SE-DAM	Irrigation	0.24	0.09
A50A	ALTA-SE-DAM	Irrigation	0.1	0.05
A50A	DE HOOP	Irrigation	0.02	0.01
A50A	DIE JACOBSPAN	Irrigation	0.24	0.07
A50A	ELANDSBOSCH 'D'	Irrigation	2.4	0.64
A50A	KAALFONTEIN	Irrigation	0.197	0.09
A50A	VLAKFONTEIN	Irrigation	0.208	0.05
A50A	VRISCHGEWAAGDT DAM NO. 2	Irrigation	0.05	0.01
A50B	BOSBOK	Irrigation	0.08	0.03

Quaternay catchment	Dam name	Use	Full supply capacity (million m3)	Full supply area (km2)
A50B	GOERGAP	Irrigation	0.15	0.03
A50B	RIETBOK	Irrigation	0.124	0.05
A50B	WILLIE VOS	Irrigation	1.5	0.52
A50B	ZAAGKUIL NO.1	Irrigation	0.089	0.04
A50C	COBUS BASSA	Irrigation	0.21	0.1
A50C	PALALA	Irrigation	0.242	0.13
A50C	THE POND	Irrigation	0.08	0.07
A50D	GELUKSFONTEIN-PLAAS	Irrigation	0.1	0.06
A50D	KAREL HAGER-SE-DAM	Irrigation	0.09	0.05
A50D	KWARRIEHOEK	Irrigation	0.1	0.06
A50E	DE KUIL	Irrigation	0.321	0.14
A50E	GANSKRAAL	Irrigation	0.192	0.03
A50E	KLIPWERF	Irrigation	1.3	0.44
A61A	DONKERPOORT	Domestic Water Use	3.429	0.55
A61C	BADSELOOP NO.1	Irrigation	0.1	0.04
A61C	BADSELOOP NO.2	Irrigation	0.3	0.08
A61D	BUFFELSFONTEIN-SANDSLOOT DAM NO. 2	Domestic Water Use	0.108	0.04
A61D	RIETFONTEIN DAM 1	Unknown	0.052	0.03
A61D	RIETFONTEIN DAM 2	Unknown	0.081	0.04
A61D	RIETFONTEIN DAM 3	Unknown	0.05	0.03
A61D	RIETFONTEIN DAM 4	Unknown	0.117	0.06
A61D	RIETFONTEIN DAM 5	Unknown	0.182	0.06
A61D	RIETFONTEIN DAM 6	Unknown	0.061	0.03
A61D	RIETFONTEIN DAM 7	Unknown	0.24	0.09
A61F	GERT COMBRINK	Leisure	0.8	0.21
A61G	RIETFONTEIN	Irrigation	0.58	0.21
A61G	SUID-BRABAND	Irrigation	0.13	0.04
A61G	VAALKOP NO. II	Irrigation	1	0.14
A61H	BOKPOORT NO.1	Irrigation	0.4	0.13
A61H	DOORNDRAAI	Domestic Water Use	44.2	5.61
A61H	GEMSBOKFONTEIN	Irrigation	0.3	0.05
A61H	HAASKLOOF	Irrigation	2.016	0.44
A61H	LEYLAND	Irrigation	0.16	0.06
A61H	OU HUIS	Irrigation	0.249	0.08
A61H	OU PERSKEBOORD	Irrigation	0.17	0.07

Quaternay catchment	Dam name	Use	Full supply capacity (million m3)	Full supply area (km2)
A61H	RIETBOKSPRUIT	Irrigation	0.3	0.1
A61H	ROODEPOORT	Irrigation	0.264	0.06
A61H	WELGEVONDEN	Domestic Water Use	0.93	0.26
A61J	ECKSTEIN	Irrigation	0.13	0.02
A61J	GROENVLEY	Irrigation	0.154	0.06
A61J	KLIPSPRUIT NO.1	Irrigation	0.226	0.1
A61J	KLIPSPRUIT NO.2	Irrigation	0.091	0.06
A61J	KLIPSPRUIT NO.3	Irrigation	0.15	0.1
A61J	LA DIQUE	Irrigation	0.25	0.08
A61J	RIETFONTEIN	Irrigation	0.1	0.06
A61J	RIVIER	Irrigation	0.059	0.02
A61J	SWARTKOP	Irrigation	0.2	0.13
A61J	WATERVAL	Irrigation	0.13	0.05
A61J	ZAAIPLAATS	Domestic Water Use	0.206	0.08
A62A	KLEIN STERK RIVIER	Irrigation	0.25	0.09
A62A	KRANSKLOOF	Irrigation	0.28	0.12
A62F	STEENBRAS NO. 1-	Irrigation	1.6	0.42
A62J	GLEN ALPINE	Irrigation	19.95	4.65
A63C	S'EMOER	Ground Covering	0.01	0.01
A63E	BULTPAN	Irrigation	0.16	0.04
A63E	LIZZULEA	Livestock	0.67	0.16
A63E	SCHRODA OFF-CHANNEL STORAGE	Industry	4.038	0.48
A71A	BOSCHFONTEIN	Irrigation	0.175	0.05
A71C	STEENBRAS NO. 2-	Irrigation	0.3	0.07
A71C	WILGEBOSCH	Irrigation	0.74	0.38
A71E	APPELFONTEIN A	Irrigation	0.75	0.32
A71E	APPELFONTEIN B	Irrigation	0.4	0.22
A71E	DIKGALE	Irrigation	3.6	0.75
A71E	KWAGGASBULT	Irrigation	1.64	0.58
A71E	MEANDERTHAL	Irrigation	0.59	0.34
A71E	ONVERWACHT	Irrigation	0.25	0.1
A71E	SOETDORINGS	Irrigation	0.45	0.26
A71F	KLIPKOPPIES-OPGAAR	Irrigation	0.2	0.06
A71F	WITKLIP	Irrigation	0.25	0.06

Quaternay catchment	Dam name	Use	Full supply capacity (million m3)	Full supply area (km2)
A71G	TURFLOOP		3.34	0.94
A71K	MESSINA-STUWAL (DAM)	Unknown	0.66	0.49
A71K	VOORBURGDAM	Unknown	1.324	0.5
A71L	MESSINA-PROEFPLAAS-TUINBOU	Irrigation	1	0.24
A72A	HOUTRIVIER		7.5	1.6
A72A	SESHEGO		2.36	0.74
A72A	SPIES		2.89	1.1
A80A	MUTSHEDZI		2.5	0.22
A80C	NZHELELE	Irrigation	55.3	5.9
A80F	PHANTOM	Irrigation	0.142	0.05
A80H	NWANEDI	Irrigation	5.562	0.59

APPENDIX C: GROUNDWATER OVERVIEW OF THE LIMPOPO WMA

1. INTRODUCTION

The Limpopo WMA incorporates 6 main catchments covering a total area of 60 689 km^2. The northern boundary comprises the Limpopo River into which all surface drainage flows.

From west to east the catchments forming the Limpopo WMA are:

- The Motlhatsi river catchment covering an area of 6 021 km^2. This catchment comprises 5 quaternary sub-catchments, A41A – A41E.
- The Mokolo river catchment covering an area of 8 416 km^2. This catchment comprises 9 quaternary sub-catchments, A42A – A42J.
- The Lephalala river catchment covering an area of 6 747 km^2. This catchment comprises 9 quaternary sub-catchments, A50A – A50J.
- The Mogalakwena river catchment covering an area of 19 400 km^2. This catchment comprises 23 quaternary sub-catchments, A61A – A61J, A62A – A62J and A63A – A63E.
- The Sand river catchment covering an area of 15 869 km^2. This catchment comprises 13 quaternary sub-catchments, A71A – A71L and A72A – A72B.
- The Nzhelele river catchment covering an area of 4 236 km^2. This catchment comprises 9 quaternary sub-catchments, A80A – A80J.

The distribution of these catchments is shown on Fig. 1. Fig. 1 also includes a part of B51E and B51G which lie in the Olifants River catchment, ref. sections 3.11 and 3.12.

2. GLOBAL ISSUES

Groundwater resources are available throughout the entire catchment, but in different quantities.

2.1. GUIDING PRINCIPLES

- The 1998 NWA gives equal weight to groundwater and surface water.
- Water demands must be matched to available resources. Only if groundwater is proved to be inadequate should surface water be considered as a source.
- Groundwater resources form an integral part of integrated water resources development planning.
- Conjunctive use of surface and groundwater where feasible

should be encouraged to maximise the optimal use of available resources.

2.2. AVAILABILITY OF INFORMATION

In the past groundwater has often been overlooked as a water source by planners and engineers in favour of surface water. This can be ascribed to a poor perception of groundwater, a lack of trust by users, failures in groundwater-based supply and the feeling that groundwater is unreliable. This is commonly due to a lack of understanding of the mechanism of groundwater occurrence and mismanagement of the available resources, e.g., overpumping of boreholes, absence of monitoring of abstraction schemes, etc.

The situation is exacerbated by a lack of good quality information. Planners need to know the volume of available groundwater resources, the distance a suitable source is from the intended use and the reliability of the source (assuming active good aquifer management).

Information needs to be presented in a format readily understandable to planners and engineers and this information needs to be readily available. General background information is available on the published 1:2 500 000 map,Groundwater Resources of the Republic of South Africa prepared by J.R. Vegter (1995). Regional information is available from the published 1:500 000 hydrogeological map of Messina 2127 and also the 1995 Pietersburg 2326 map which is presently being revised. More detailed information for certain areas can be obtained from DWAF. As a minimum hydrogeological maps need to be prepared for each Quaternary catchment or group of Quaternary catchments preferably at a scale of 1:50 000, to provide planners and engineers with quantified and visual information.

The difficulty of obtaining readily available area-specific data in a quantified format is a major hindrance to optimal development of groundwater resources. Currently there are no up-to-date area-specific data available for the aquifers within each Quaternary catchment, with the important exception of those rural areas served by community water supply schemes, (ref: the Provincial Groundwater Data Base which is maintained and updated on behalf of DWAF by GPM Groundwater Project Managers, Polokwane. This company is also responsible for the co-ordination of the Groundwater Development Strategy in key development areas).

This major shortcoming to development planning needs to be actively addressed by implementing a detailed mapping programme, starting in the most stressed and ecologically sensitive catchments. The Groundwater Resources Information Project (GRIP) envisages preparing 1:50 000 scale hydrogeological maps of the Limpopo WMA and adjacent areas, starting with the communal land areas. These maps will depict the groundwater resources, groundwater quality and development potential, based upon the needs of the end user. The GRIP project is commencing with a desk study of available information, and will then involve considerable field work to infill data gaps. The GRIP project is scheduled to run for 3 years and will provide the level of detailed information that will be useful to engineers and planners when considering water source development.

2.3 GROUNDWATER RESOURCES

As noted above groundwater resources are available throughout the entire catchment, but in varying quantities depending upon the hydrogeological characteristics of the underlying aquifer.

Parts of the Limpopo WMA are heavily populated and widespread rural communities are a feature of the area which includes the old Lebowa and part of the old Venda homeland areas. Groundwater is the main source of water supply to the rural communities in the west of the region, and is used together with surface water to supply many communities in the east of the region.

There is extensive use of the groundwater resources of the deeply weathered and fractured granite north of Polokwane (catchments A71A) and in the area around Dendron, (catchments A71G and A72A) where large abstraction for irrigation and domestic supply is practised. Groundwater is used to supply the platinum mines west of Mokopane.

Information concerning groundwater use in the region was obtained from Mr. W. du Toit, Assistant Director Geohydrology DWAF, responsible for the North Region.

Table 1 provides an overview of the use of groundwater in the Limpopo WMA and shows that total abstraction is of the order of 208 million m^3/a, 53% of which is used for irrigation and 34% for rural community supply.

TABLE 1: GROUNDWATER USE IN THE LIMPOPO WMA

Sector	**Use (million m^3 / annum)**	**% of Total Use**
Irrigation	131	63
Livestock	3	2
Rural Communities	53	25
Municipalities	12	6
Mining	9	4
Total	**208**	**100**

In comparison to the annual abstraction, overall recharge, assuming recharge is 2% of mean annual rainfall, amounts to 702 million m^3. Theoretically therefore, only 28% of the annual recharge to the region is currently used.

As shown in Table 1, irrigation is the biggest consumer of groundwater. Table 2 provides an overview of the distribution of irrigation use throughout the area.

TABLE 2: IRRIGATION FROM GROUNDWATER IN LIMPOPO

Geographic Area	Irrigation Area (ha)	Irrigation requirement (million m^3/annum)
Northern Springbok Flats	8 900	43
Sand river	8 700	42
Pontdrift / Weipe	5 600	55
Dendron	4 700	23
Altona	850	7
Louis Trichardt	420	2
Taaibosch	180	1
Beauty / Marnitz	180	1
Total	**29 530**	**174**

It is noted that these figures could be conservative. Estimates indicate that abstraction from the alluvial aquifer in the Pontdrift/Weipe area for irrigation could be as high as 120 million m^3/a.

Groundwater use can be categorised as follows:

Domestic: individual boreholes for primary water supply (village hand pumps), this is feasible within a reasonable distance of the user almost everywhere (except in rugged terrain).
small scale reticulation schemes for rural villages, schools, clinics, hospitals. This is feasible in most areas with a source available within a reasonable distance, (2 –5km).
larger schemes based on several boreholes, often feasible but depends on the hydrogeological conditions of the area.

Bulk water supply: wellfields comprising of several high yielding boreholes. Important bulk water supply is available in the deeply weathered and fractured granite aquifer north of Polokwane and around Dendron and the dolomites of A61F east of Mokopane.

Agricultural: individual boreholes (for stock watering, vegetable gardening), feasible virtually everywhere.

Irrigation: generally larger schemes requiring well-developed groundwater resources, e.g. the granite of catchment A72A and the alluvial aquifer of catchments A63E and A71L.

Industrial (and mining): medium to large-sized reticulation schemes based on several boreholes. Locally this is often feasible, depending upon available resources, demand and management practise, e.g., the Mokopane Platinum Mine wellfield in catchment A61F.

Overall the available groundwater resources within the catchment are under utilised although this clearly depends both on the groundwater occurrence and the demand. Even weaker groundwater occurrence areas can often provide more than the RDP level of 25 litres per person per day.

2.4. GROUNDWATER QUALITY

2.4.1. NATURAL

Regionally the natural groundwater quality is usually good, satisfies the DWAF water quality guidelines and is suitable for domestic and agricultural supply. The salt content of the groundwater is elevated in some of the drier western areas and, for example, conductivities above 150mS/m occur locally in Karoo strata to the W, NW, N and NE of Lephalala and in the basement rocks in the vicinity of Alldays. Fluoride values >1.5mg/l are locally present in the groundwater of the Limpopo Mobile Belt rocks and the Nebo granite SW and west of Mokopane.

2.4.2. POLLUTION

Groundwater pollution is an increasing threat. Pollution of groundwater can result from:

- domestic use
- agriculture
- mining
- waste disposal

The impact of groundwater pollution from mining and waste disposal can be controlled and remediated according to the requirements of DWAF. Mines and waste disposal sites must prepare EMPRs, EIAs and closure plans which will identify and put preventative and remediation measures, including monitoring, in place.

Pollution emanating from settlements, especially informal settlements, is more difficult to control. Elevated nitrate levels (NO_3 >10mg/l) in groundwater are frequently found in water supply boreholes in the traditionally settled areas of the catchment. In particular the following must be considered:

- Groundwater pollution occurs when latrine density is high. This results in a pollution plume of increased salinity and nitrate around the settlement.

- Abstraction from boreholes for water supply located within plumes has to be terminated, i.e., water quality monitoring must be implemented to determine when and if there is an unacceptable deterioration in groundwater quality.

- Groundwater must be abstracted from outside possible impacted areas, i.e., boreholes and wellfields have to be located well away from potential pollution sources.

- Education about the need for, and ways of, protecting the groundwater resources is required.

- Standards for borehole positioning, construction and protection, as specified by DWAF and the SABS, must be enforced.

Elevated NO_3 levels associated with poor agricultural practise are present in the Groblersbrug, Swartwater, Dendron and Bandelierskop areas.

Waste disposal sites offer a serious potential hazard throughout the region due to poor management and lack of operating controls. This pollution risk from the waste disposal throughout the region needs to be assessed and remediated.

2.5. MANAGEMENT AND MONITORING REQUIREMENTS

Effective groundwater management and monitoring is essential for long term sustainability of the supply and to protect the resource.

A monitoring programme needs to be implemented for each groundwater or conjunctive use scheme, involving regular measurements of:

- water levels,
- abstraction, and
- quality.

The DWAF operates a sparse monitoring network within the region, in particular at Nylsvlei (A61C), Mokopane (A61G) and along the Limpopo (A63C) in the Mogalakwena catchment, in A41E, Motlhasi catchment, A42J Mokolo catchments, north of Polokwane (A71A), near Louis Trichardt (A71H), Musina (A71K) and Venetia (A71L) in the Sand River catchment. Monitoring is also reported to be undertaken in the Dendron area (A71E & G and A72A) by the local Water Board.

Underdeveloped areas, i.e., areas with unutilised groundwater resources development potential can be identified and earmarked for future development. Likewise areas where the available resources are overdeveloped should be identified and alternative water sources considered to alleviate abstraction stress and to augment the groundwater.

Groundwater development projects should be undertaken by recognised professional hydrogeologists. All contracting works should be undertaken according to a proper technical specification and bill of rates to ensure:

- correct drilling technique,

- borehole construction meets the DWAF and SABS specifications for longevity and pollution protection,

- adequate testing procedures are followed,

- water quality is determined by analysis in an accredited

laboratory,

- management recommendations for the optimum long term sustainable use of the groundwater resource are prepared and implemented.

2.6. Poverty Alleviation

Groundwater has an important positive role in poverty alleviation. Development of the available resources leads to:

- an increase in water supply
- the provision of a clean water supply
- the time saved in collecting water is available for economic activity, such as
  - vegetable gardening
  - stock watering
  - chicken rearing
  - brick making.

The Department of Agriculture is implementing a project to encourage the development of 1 – 2 ha plots for food production as part of poverty alleviation. Abstractions for these projects will need to be licensed if the anticipated water use exceeds the general authorisation. This project must be integrated with other water use initiatives as part of overall integrated water resources planning and management within the catchment.

3. Overview of Groundwater Throughout the Catchments of the Region

The overview of the groundwater resources and associated issues is discussed according to groups of Quaternary Catchments sharing similar lithology and morphological characteristics.

Groundwater occurrence is controlled by the prevailing lithology of any given area. The entire region is underlain by hard rocks with aquifers developed in secondary features associated with weathering pockets and structure. Structural features are important and higher borehole yields are generally associated with these features. An exception is the localised occurrences of alluvial deposits along the Limpopo River, which are locally exploited. Considerable abstraction for irrigation is practised either directly from the Limpopo River, or from sand abstraction schemes constructed in the river bed sediments.

Abstraction from wellpoints installed in deposits of the river channels leading into the Limpopo is also common where these are suitably developed.

3.1. The South Western Region Underlain by Arenaceous Strata of Waterberg Age – Quaternary Catchments A41A – A41D of the Motlhatsi Catchment, A42A – A42J of the Mokolo Catchment, A50A – A50F of the Lephalala Catchment and A61A, A61B (southern part) A61H (northern part) A61J (western part) A62A – A62J of the Mogalakwena Catchment.

This is the area of the Waterberg Mountains underlain by a sequence of mainly coarse-grained sandstone and conglomerate. The area is structurally complex with numerous major faults and fracture zones and is characterised by a rugged and mountainous terrain with steep sided valleys.

This area is remote and comprises mostly game farms, with grazing and ranching practised elsewhere. Mokerong communal area is present in the Mogalakwena Key Area in parts of Quaternary catchments A62A – A62J and is reliant upon groundwater for domestic and stock watering water supply. The town of Vaalwater is in catchment A42C. Informal settlements have developed rapidly leading to increasing demands on the water supply and a serious potential for groundwater pollution. A similar situation is occurring at Alma, to the south of Vaalwater. The area lies within the jurisdiction of the Bushveld Water Board.

Within the game reserves groundwater is used for isolated game management boreholes and water supply to tourist lodges. Elsewhere the water is used for stock watering and for domestic supply for homesteads and is widely used as the water supply source for the rural population. Adverse impacts from activities within these catchments outside the communal area, Vaalwater and small settlements are unlikely.

Groundwater resources are generally limited with sustainable borehole yields usually in the 0.5 – 2 l/s range, although higher yields (>3l/s) are found along fault and fracture zones.

The resources are only suitable for development in valleys and areas of flat topography. Within the mountains the groundwater quality is mostly pristine; localised occurrences of elevated NO_3 levels are reported in Mokerong.

The Waterberg Mountains are an important recharge area and groundwater provides important baseflow to surface drainage.

Issues

In Mokerong (A62B – A62J):

- Availability of water during drought. Difficult to deal with in areas of low resources. Educate people on water conservation and implement water demand management where practical.

- Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3. Implement strategy of education and training to protect borehole head areas from water spillage, damage by cattle drinking, etc. Position new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.

In the Waterberg Mountain Area:

- Much of the area is pristine and ecologically sensitive. Any widespread or large scale development will impact on the pristine nature of the resources. Isolated game management and water

supply boreholes for tourist lodges are not considered a threat since any impact will be minimal.

- Groundwater quality could be impacted from agricultural activities, especially in those valley areas where irrigation is practised and fertiliser application is poorly managed.

- Groundwater quality could be seriously impacted from the uncontrolled growth of informal settlements around the existing settlements.

3.2. The North Western part of The Motlhatsi Catchment, (Northern Part of A41C, and A41E) underlain by Argillaceous Karoo Age Sediments.

This area is mostly agricultural. Some irrigation is practised along the Limpopo river from abstraction from the river or the alluvial sands within the river channel. The area is flat with a gentle gradient towards the Limpopo river.

This catchment is underlain by diamictite and shale. Groundwater occurrence is poor and sustainable borehole yields <0.5 l/s are the norm.

Groundwater quality is variable with DWAF Class 2 or 3 water frequently encountered due to naturally elevated TDS levels associated with the low permeability diamictite.

Issues

- Groundwater quality could be impacted from agricultural activities, especially along the Limpopo river where irrigation is practised and the application of fertiliser is poorly managed.

3.3. The North Western part of The Mokolo Catchment, (A42J), underlain by Arenaceous Karoo Age Sediments.

This includes the area to the west, north and north east of Lephalala. The Grootgeluk coal mine is in this area. Elsewhere the area comprises mostly agricultural land. The topography is flat with a gentle gradient towards the Limpopo river.

These areas are underlain by sandstone of the Upper Karoo sequence. Groundwater occurrence is widespread and sustainable borehole yields <0.5 – 2 l/s are often feasible.

Groundwater quality is generally good.

Issues

- Pollution of groundwater by mining effluent, acid mine drainage and agricultural activities in the Lephalala area.

- Impacts caused by mining need to identified and remediated if necessary. Prevention measures must be put in place. EMPR's need updating, closure plans required for mining to assess impacts of decant. Monitoring programmes to be established/maintained.

3.4. The North Western and Northern Portions of the Region, comprising the northern portion of A42J in the Mokolo Catchment, A50H and A50J in the Lephalala Catchment, A63C and parts of A63A, B D, and A63E in the Mogalakwena Catchment, the northern parts of A71J and A72B, A71K and A71L of the Sand river Catchment and the northern part of A80G and A80J of the Nzhelele catchment underlain by Metamorphosed Strata of the Limpopo Mobile Belt.

The NW and northern portion of the region from north of Lephalala to east of Musina is mostly underlain by the NE – SW trending metamorphic rock assemblage known as the Limpopo Mobile Belt. Much of the solid geology is covered by a thin cover of Recent deposits. The topography is varied with wide flat plains and rolling countryside interspersed with hills and areas of rugged terrain.

The area is mostly agricultural with arable land and stock farming. Irrigation is practised along the Limpopo River areas, especially on the old flood plain, e.g. in the Groblersbrug area. Game management areas are widespread, particularly in the Alldays area where many of the large cattle ranches are turning to game farming. The Lephalala Marapong communal land area lies in parts of catchments A50H and A50G and Bochum in A63B and D where the populations are reliant on groundwater for domestic supply and stock watering.

The Musina copper mine has closed down. The extent of groundwater pollution is unknown, the possibility of decant of contaminated groundwater exists.

Borehole yields are generally between 0.5 and 1 – 2l/s, but often <0.5l/s. Aquifers are areally limited and restricted to structural features and zones of deeper weathering. Impacts on groundwater quantity will be limited due to the restricted nature of the aquifers.

The groundwater quality is often naturally poor, with high salinity, e.g. around Groblersbrug and south of Alldays. Elevated NO_3 due to agricultural activities are locally serious, e.g. in the Groblersbrug area. Impacts in game management and ranching areas are unlikely. Isolated occurrences of NO_3 are present in the Lephalala Marapong area.

Issues:

- Groundwater quality could be impacted from agricultural activities, especially along the Limpopo river where irrigation is practised and the application of fertiliser is poorly managed.

- Pollution of groundwater by mining effluent and acid mine drainage. The possibility of decant from the old mine at Musina must be considered and any impacts identified and remediated. Prevention measures must be put in place. Monitoring programmes to be established/maintained.

- Availability of water during drought in areas reliant on groundwater for domestic supply and stock watering. Difficult to deal with in areas of low resources. Educate people on water conservation and implement water demand management where practical.

- Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3 levels. Implement a strategy of education and training to protect borehole head areas from water spillage, damage by cattle drinking, etc. Position new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.

3.5. The Northern part of Quaternary Catchment A63E and the NW part of A71L in the Mogalakwena and Sand River Catchments respectively underlain by Arenaceous Karoo Age Sediments with Alluvial Deposits along the Limpopo River.

This is a relatively small area bounding the Limpopo River in the vicinity of the confluence with the Shashe River and Pontdrift. The area is relatively flat and comprises agricultural land. The Vendu Nature Reserve is within catchment A71L.

Borehole yields are generally 0.5 – 2l/s in the sandstone but >5l/s in the alluvial deposits along the Limpopo. The Clarens Formation sandstone outcrops in Botswana and Zimbabwe. The area is sparsely populated.

The area is known to have groundwater dependent vegetation and is ecologically sensitive.

Venetia diamond mine is within this area. The mine obtains water from a wellfield(s) drawing on the alluvial deposits along the Limpopo river, abstraction is between 2 – 5 million m^3/annum. Large scale irrigation based on abstraction from the alluvial aquifer between Pontdrift and Weipe is reported to be between 60 and 120 million m^3/a.

Groundwater quality in the alluvial aquifer is good. The quality in the Clarens Sandstone is poor due to elevated salinity caused by inflow of high salinity groundwater from the metamorphic rocks of the Limpopo Mobile Belt.

Issues

- Uncontrolled abstraction from the alluvial aquifer and Clarens sandstone could have adverse impacts on the vegetation of area.

- The Clarens Sandstone crosses international boundaries. Is abstraction from the SA side impacting on the Botswana and Zimbabwe groundwater resources, and *visa versa?*

- The alluvial aquifer is adjacent to international boundaries. Is abstraction from the SA side impacting on the Botswana and Zimbabwe water resources, and *visa versa?*

- Is the very large abstraction from the alluvial aquifer affecting the flow of the Limpopo and international obligations?

- Groundwater quality could be impacted from agricultural activities, especially along the Limpopo river where irrigation is practised and the application of fertiliser is poorly managed.

- Pollution of groundwater by mining effluent and acid mine drainage needs

to be considered. Venetia mine is ecologically aware and undesirable impacts are unlikely. Nevertheless, the potential for impacts caused by mining needs to be recognised and prevention measures put in place. EMPRs need updating, closure plans required to assess impacts of decant. Monitoring programmes to be established/maintained.

3.6. The SW – NE trending strip of Arenaceous Karoo Age Sediments in the Sand River (part of A71J) and Nzhelele (part of A80F, G & J).

This area comprises a relatively narrow strip underlain by sandstone. The area is agricultural with scattered communal land settlements towards the west in the Nzhelele catchment (A80G & J) reliant on groundwater for domestic supply and cattle watering.

Borehole yields are variable but often <0.5 l/s.

Issues

- Availability of water during drought in areas reliant on groundwater for domestic supply and stock watering. Difficult to deal with in areas of low resources. Educate people on water conservation and implement water demand management where practical.

- Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3. Implement strategy of education and training to protect borehole head areas from water spillage, damage by cattle drinking, etc. Position new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.

3.7. Parts of A63B and A63D in the Mogalakwena Catchment, A72B and A71J in the Sandriver Catchment, A80G and J in the Nzhelele Catchment and The eastern parts of A61D and E in the southern boundary areas of the Mogalakwena Catchment underlain by Karoo age Basalt.

This comprises a NE – SW trending area between the metamorphosed rocks of the Limpopo Mobile Belt and the Soutpansberg Sandstone forming gently rolling to flat topography. The area is mostly agricultural with widespread use of groundwater. Scattered settlements in the west in Nzhelele catchment (A80G & J) are reliant on groundwater for domestic supply and cattle watering.

Yields tend to be 0.5 - 2l/s. Aquifers within the basalt are generally of limited areal extent. Yields >5l/s are locally present in major structural features, e.g. the boundary between the metamorphic rocks and the Karoo basalts in catchment A63D in the Taaibosch fault area, where high yields are present in the basalt aquifer. These yields are associated with deep weathering (40 – 50m) of the basalt, and local faults sub-paralleling the main Taaibosch Fault. Overexploitation could become a problem in these areas, elsewhere impacts on quantity will be limited due to the restricted nature of the aquifers.

Research into the Clarens sandstone below the basalt in the Taaibosch Fault area indicates very high yields (>40 l/s) could be available from deep

boreholes (>200m) tapping primary permeability in this sandstone.

The groundwater quality is primarily good and either Class 1 or 2. Isolated occurrences of elevated NO_3 occur in settlements.

Issues

- Availability of water during drought in areas reliant on groundwater for domestic supply and stock watering. Difficult to deal with in areas of low resources. Educate people on water conservation and implement water demand management where practical.

- Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3. Implement strategy of education and training to protect borehole head areas from water spillage, damage by cattle drinking, etc. Position new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.

- The resources of the basalt in the Taaibosch Fault area are earmarked to supply over 20 communities. This aquifer must be protected against overexploitation and quality deterioration.

- Research into the resources of the underlying sandstone aquifer must be continued. This could be an important as yet untapped aquifer and an aquifer management plan must be in place before any abstraction occurs.

3.8. The North eastern Areas Principally underlain by Arenaceous Strata of Waterberg Age forming the Soutspansberg Mountains, (Quaternary Catchments A71H in the Sand River Catchment and A80A – E, southern part of A80F & G and A80H in the Nzhelele Catchment).

This comprises the east - west trending Soutpansberg Mountains underlain by a sequence of mainly coarse-grained sandstone and conglomerate. Louis Trichardt is situated immediately south of the eastern edge of this area. The area is structurally complex with numerous major faults and fracture zones and is characterised by a rugged and mountainous terrain with steep sided valleys.

In the west this area comprises mostly agricultural land and game farms, while in the eastern outcrop the area comprises communal lands. Here, Quaternary catchments A80A, B, C, E, F & H the in Nzhelele Key Area are heavily settled. There is widespread use of groundwater but many of the communities are supplied with conjunctive schemes using surface water together with groundwater as the source.

Groundwater resources are generally limited with sustainable borehole yields often <0.5l/s, although higher yields (>3l/s) are found along fault and fracture zones. Springs are an important source of water supply for rural communities.

The groundwater quality is mostly good; localised occurrences of elevated

NO_3 levels are reported in the communal land areas.

The Soutpansberg Mountains are an important recharge area and groundwater provides important baseflow to surface drainage.

Issues

- Availability of water during drought. Difficult to deal with in areas of low resources. Educate people on water conservation and implement water demand management where practical.
- Springs must be protected, especially where these are used for water supply to rural communities.
- The impact of development on spring flow must be considered when implementing groundwater abstraction schemes.
- Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3. Implement strategy of education and training to protect borehole head areas from water spillage, damage by cattle drinking, etc. Position new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.
- Groundwater quality could be impacted from agricultural activities, especially in those valley areas where irrigation is practised and fertiliser application is poorly managed.

3.9. The Central and eastern Areas Principally underlain by Granite and Gneiss of the Basement Complex (Parts of A61D, E & J, A62B, F, H of the Mogalakwena Catchment and A71A – H and A72A of the Sand River Catchment, A91B & C)

This granitic area underlies approximately 30% of the region. It covers the area from Polokwane in the South, Dendron in the NW, and Louis Trichardt in the NW. The granite forms a generally flat to rolling landscape with isolated kopjes, becoming more hilly to the east towards the escarpment which lies within the Letaba Catchment.

The area between Polokwane and Louis Trichardt, and west to Dendron, is mostly agricultural with extensive irrigation, (Table 2). The Dendron area was declared the Houdenbrak Subterranean Water Government Controlled Area under the previous Water Act. The granitic rocks are deeply weathered and high borehole yields, >5 l/s, are commonly found.

An artificial recharge scheme of the granite aquifer immediately north of Polokwane is in place where purified effluent from the sewage works is recycled by pumping onto the sands along the Sand River and allowed to infiltrate into the underlying deeply weathered granite aquifer. It is planned to pipe future increases in the volume of treated sewage to Potgietersrus Platinum Mine, but the current volume of effluent will continue to be recharged into the Sand River aquifer and the scheme will therefore not be impacted by this plan to supply the mine.

Groundwater abstraction is increasing with an increasing area being irrigated. Although groundwater levels are relatively stable at present, overexploitation could become a problem. Groundwater pollution is widespread, with elevated NO_3 from fertilizer application frequently rendering the water DWAF Class 3.

Much of the area comprises communal lands. There is heavy dependence on groundwater in Bochum (Quaternary catchment A72A), Seshego (A62E, F & H, A71E & F), Kutama (A71G & H) and Mankweng (A71A, B & C).

With the exception of the agricultural pollution mentioned above, groundwater quality is generally good. Isolated occurrences of elevated NO_3 are reported for the settlements.

Issues

- Availability of water during drought. Difficult to deal with in areas of low resources. Educate people on water conservation and implement water demand management where practical.

- Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3 levels. Implement a strategy of education and training to protect borehole head areas from water spillage, damage by cattle drinking, etc. Position new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.

- The Houdenbrak subterranean water control area needs to be extended to the west to incorporate the communal lands of the old Lebowa homeland(catchment A72A).

- Groundwater quality is impacted by agricultural activities where irrigation is practised and fertiliser application is poorly managed. This aspect is a threat to the use of groundwater and must be managed.

- The potential for over exploitation of the granite aquifers by agricultural due to increasing irrigation demands, especially in the Dendron area and along the Sand River north of Polokwane, needs to be investigated, assessed and managed.

- The impact of the plan by Potgietersrus Platinum Mines to pipe treated sewage from Polokwane needs to be assessed even though the current level of artificial recharge is to be maintained. It is understood Polokwane intends to consider the current wellfield as a standby source in the future.

- Groundwater abstraction must be licensed as soon as possible. Licences should only be issued once the groundwater resources are thoroughly understood and quantified.

3.10. The Northern parts of A61E, Central A61F & G and A62F & H, western parts of A62E and eastern part of A62G in the Mogalakwena Catchment and the central part of A50G in the Lephalala Catchment, underlain by Norite and Gabbro of the Bushveld Igneous Complex.

These are valley and flat areas with widespread groundwater resources. Borehole yields of 0.5 – 2 l/s are common, with >5 l/s locally available. The settlements of Mokerong (catchments A61G and A62F & G) and Lephalala Marapong (A50G) are reliant on groundwater for domestic supply and stock watering.

The mining activities taking place west of Mokopane are a potential source of conflict between the local inhabitants and the mine infrastructural requirements. Potgietersrus Platinum Mines (PPL) have a permit to abstract up to 1 500 m^3/d from an abandoned chrome mine S of Mokopane in A61E. The impact of this abstraction on surrounding users needs to be determined. Expansion plans at PPL which include extending the open pit by 5km will impact the groundwater resources and potentially existing users. PPL also plan to pipe treated sewage water from Polokwane (see Section 3.9).

Groundwater quality is generally good. Isolated NO_3 pollution is present in the settlements and the potential for pollution due to mining activities must be recognised.

Issues

- Conflicts between the demands of the local population, and dewatering and quality impacts can be anticipated. The mines will need to undertake sympathetic and responsible development to minimise impacts on the groundwater resources.

- Groundwater pollution from the mining activities can be anticipated. Ensure compliance with EMPRs and mine closure plans.

- The impact of abstraction of up to 1500 m^3/d from the abandoned chrome mine South of Mokopane needs to be determined.

- The impact of mine expansion plans (PPL plan to extend the pit by 5 km x 0.5 km), and associated dewatering on groundwater resources and existing abstraction must be quantified.

- The impact of any expansion of the PPL wellfield (comprising several scattered boreholes and the Kommando Drift wellfield) on available groundwater resources would need to be evaluated.

- Availability of water during drought. Difficult to deal with in areas of low resources. Educate people on water conservation and implement water demand management where practical.

- Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3 levels. Implement strategy of education and training to protect borehole head areas from water spillage, damage by cattle drinking, etc. Position new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.

3.11. The eastern parts of A61C, A61D and A61E in the Source areas of the Mogalakwena Catchment underlain by Arenaceous Karoo Age Sediments A61C & A61D and Karoo Age Basalt (A61D and A61E). Part of Catchments B51E & G which lie within the Olifants Catchment are also Included

This encompasses the agricultural areas forming the source catchments of the Mogalakwena SW and NE of Naboomspruit SE of the Waterberg Mountain Range. The area is flat and forms the NW edge of the Springbok flats. Nylsvlei wetland is within this area, the area is ecologically sensitive.

The area was a subterranean water control area under the old Water Act and groundwater usage was controlled. The allocations are reported to be too high and a severe decline in groundwater levels has occurred.

This area is characterised by a reversal in the groundwater gradient due to over abstraction of groundwater in A61C, D & E for irrigation, i.e. the groundwater gradient is contrary to the surface water gradient. The groundwater divide to the east does not coincide with the surface water divide between the Mogalakwena and Olifants catchments and the impact of abstraction on the groundwater resources in the Olifants catchment, and *visa versa* is not known.

Borehole yields in this area are generally 0.5 – 2 l/s in the sandstone and often >5 l/s in the basalt.

Groundwater quality is generally good.

Issues

- The impact of over abstraction for irrigation needs to understood, particularly in relation to the reversal of the groundwater gradient.
- The review of the current abstraction allocation and re-licensing of groundwater use must be a priority.
- The area is ecologically sensitive, impacts on Nylsvlei of groundwater use need to investigated.
- The impact of agricultural practice on groundwater quality must be assessed.
- The groundwater catchment does not coincide with the surface water catchment. The impact of the over-abstraction in the Mogalakwena catchment on the resources of the Olifants catchment is not known.

3.12. Catchment A61F of the Mogalakwena Catchment underlain by Shales and Sandstone of Pretoria Age and Malmani Dolomite, and the Northern Part of Catchment B51E and western edge of B51G of the Olifants River Catchment.

This area lies mainly to the east, north and NE of Mokopane. It comprises mountainous and hilly areas formed by the dolomite and sandstone with valleys and flat areas underlain by shale.

The dolomite aquifer has considerable groundwater resources and is heavily exploited, both within A61F and in B51E where Zebedelia Estates abstract significant quantities in an uncontrolled manner. Abstraction along the Rooisloot valley for irrigation has caused a decline in groundwater levels, as has abstraction in the Dorps River valley. The Mokopane wellfield, with an abstraction of ±3 million m^3/a, is located in a small area in the west of the Dorps River valley, leading to stress on the aquifer in this area. Abstraction in these areas has resulted in a reduction of groundwater flow down the hydraulic gradient, leading to an impact on downstream users.

Borehole yields are generally between 0.5 – 2 l/s. Higher yields, >5 l/s, are present in the dolomite.

Groundwater quality is generally good. The impact of agriculture must be considered.

Issues

- The Dorps River and Rooisloot valleys are heavily over-exploited. The available resources of the entire area need to be quantified.
- Water use need to be licensed as a matter of urgency.
- The impact of abstraction of groundwater flow to downstream users needs to determined.
- The Mokopane wellfield needs to be spread over a larger area to reduce the stress on the aquifer.
- The dolomites extend across the surface catchment boundary into the Olifants Catchment. The impact of abstraction in one area on the adjacent area needs to be assessed.
- The dolomites are an important and currently poorly managed resource. It is proposed that the dolomite aquifer is managed as one unit, even though it crosses the surface water catchment boundary.

Additional Issues

- Quaternary catchments A61C, D, E, and F appear to be critically -over utilized at present.
- Waste management throughout the region is poor and many waste disposal sites are potential sources of groundwater pollution.

3.13. River Bed Sand Aquifers

The sand deposits of drainage channels are often used to obtain water, either directly from the surface flow of the river, or from sand-abstraction schemes constructed in the river bed sediments.

Wellpoints offer a means of abstracting water from rivers from the subsurface flow and storage within the sand aquifers after the visible flow has ceased. Usually these schemes operate until the subsurface flow has diminished and the water level has declined to such an extent that the volume of water

delivered is no longer viable for the intended use.

Numerous wellpoint schemes are installed along the Limpopo River. The town of Musina obtains much of it's supply from a wellpoint system installed in the Limpopo River. Here the sand deposits have been raised by the construction of a weir across the Limpopo River which has formed an artificial sand trap and thus increased storage for use during times of reduced river flow. Weirs have been constructed across the Limpopo River in many places from the confluence with the Crocodile River downstream.

Abstraction from wellpoints installed in deposits of the river channels leading into the Limpopo River is also common where these are suitably developed. It is considered that sand abstraction schemes are over-utilising the available resources and licences for new schemes are not being issued at present.

4. GROUND WATER/SURFACE WATER LINKAGE

Groundwater contributes to base flow throughout the catchment via sub surface seepage and springs. The Waterberg and Soutspansberg Ranges are important areas for groundwater recharge and drainage base flow.

The relationship between groundwater, base flow, and river flow is reasonably well understood where hydrographs are available. However, the impact of groundwater abstraction on surface water resources is less well understood and this is an aspect that warrants study.

Recharge of the groundwater system from river flow, especially during flood events, is important.

APPENDIX D: REGISTERED WATER USE IN THE LIMPOPO WMA