P WMA 03/000/00/0404

DEPARTMENT OF WATER AFFAIRS AND FORESTRY

DIRECTORATE NATIONAL WATER RESOURCE PLANNING

CROCODILE (WEST) MARICO WATER MANAGEMENT AREA

INTERNAL STRATEGIC PERSPECTIVE

FOR

MARICO, UPPER MOLOPO AND UPPER NGOTWANE CATCHMENTS

VERSION 1

February 2004

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
DIRECTORATE NATIONAL WATER RESOURCE PLANNING

DEVELOPMENT OF INTERNAL STRATEGIC PERSPECTIVE

FOR THE

CROCODILE (WEST) AND MARICO WATER MANAGEMENT AREA (WMA 3)

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INVITATION TO COMMENT

This report will be updated on a regular basis until the Catchment Management Strategy of Crocodile (West) and Marico Water Management Area eventually supersedes it. Water users and other stakeholders in the Marico, Upper Molopo & Upper Ngotwane catchments and other areas of the WMA are encouraged to study this report and to submit any comments they may have to the Version Controller (see box overleaf).

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The CD contains the following reports (all available on DWAF website)

- Marico, Upper Molopo & Upper Ngotwane catchments Internal Strategic Perspective (*This Report*) (Report No: P WMA 03/000/00/0404)
- Crocodile (West) Internal Strategic Perspective (Report No. P WMA 03/000/00/0303)
- The National Water Resource Strategy, First Edition
- Crocodile (West) and Marico WMA: Overview of the Water Resources Availability and Utilisation (Report No: P WMA 03/000/00/0203)
- Crocodile (West) and Marico WMA: Water Resources Situation Assessment (Report No: P WMA 03/000/00/0301)

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EXECUTIVE SUMMARY

The National Water Act (Act No. 36 of 1998) (NWA) is the principal legal instrument relating to water resource management in South Africa. It is now being incrementally implemented. The NWA introduces far-reaching concepts such as the National Water Resource Strategy (NWRS), the first Edition of which will be published in the first quarter of 2004. This NWRS is being progressively developed to set out policies, strategies, objectives, plans, guidelines, procedures and institutional arrangements for the protection, development, conservation, management and control of the country's water resources.

The NWA requires that Catchment Management Agencies (CMAs) are established for each Water Management Area (WMA). These CMAs must each prepare a catchment management strategy (CMS) which will guide the management of the water resources of the WMA. This strategy must set out the objectives, plans, guidelines and procedures of the CMA for the sustainable management of the water resources of its WMA to achieve the social and economic benefit of the users without environmental degradation. The strategy prepared by each CMA must not be in conflict with the Department of Water Affairs and Forestry (DWAF) national water resources strategy (NWRS).

Until CMAs are established, the Regional DWAF has the legal mandate to be the agency for the sustainable water resource management of a WMA. This raises the need for an interim strategy for the management of the water resources of a WMA. The purpose of this report is to document how the Regional DWAF Office is and will undertake the "protection, use, development, conservation, management and control" of the water resources of the Marico, Upper Molopo and Upper Ngotwane catchments.

The Marico, Upper Molopo and Upper Ngotwane catchments are part of the Crocodile (West) and Marico WMA. The development of the internal strategic perspective for Crocodile (West) and Marico WMA was done in two parts. The first part was the Crocodile (West) catchments. This was separated from the other catchments of the WMA, i.e. Marico, Upper Molopo and Upper Ngotwane because of the different catchment characteristics and dynamics of the two parts of the WMA as well as the socio-economic structure of the two areas.

The Marico, Upper Molopo and Upper Ngotwane catchments are situated to the west of the Crocodile (West) catchment and form the boundary with Botswana. The Marico and Upper Ngotwane Rivers are tributaries of the Limpopo River, a major international shared watercourse between Botswana, Mozambique, South Africa and Zimbabwe, while the Molopo River flows into Botswana before joining the Orange River, which forms an international shared watercourse with Namibia (see **Figure 1**).

The climate of the catchments of Marico, Upper Molopo and Upper Ngotwane is generally semi-arid and varies from the Marico catchment in the east to the Upper Molopo and Ngotwane in the west. The distribution of the Mean Annual Precipitation (MAP) ranges between 600 and 800mm in the Marico catchment to between 400 and 600mm in the Upper Molopo catchments. The temporal and spatial variability of the rainfall in these catchments are very high. The topography is generally flat with undulating areas in the lower Marico catchment.

Economically the Marico, Upper Molopo and Upper Ngotwane catchments are the poorest in the Crocodile (West) and Marico WMA. The economy is mainly the primary sectors of agriculture on the dolomites of the Upper Molopo and the Marico catchment as well as mining around Zeerust, with some secondary industries such as cement manufacturing at the Slurry. The tourism sector is growing particularly in the lower Marico in the game reserves of Madikwe.

These catchments do not contribute significantly to the GGP of the North West Province because of lack of beneficiation in the mining sector within the catchments. Commercial agriculture is practised in the Upper Molopo and Marico contributing particularly to income distribution and to some extent to the GGP of the WMA. Unemployment is estimated to be higher than the national average. This is mainly due to cyclical unemployment due to layoffs in the mines resulting in migration from the mines to the rural areas. The overall population in the Marico, Upper Molopo and Upper Ngotwane catchments is estimated to be 539 100 at 1995 level. This is expected to remain stagnant and later decline, although it is forecasted that there will be a population increase in the towns such as Mafikeng and Madikwe due to the push-pull effect.

The main water user sectors in the three catchments are (i) commercial irrigation farming in all three catchments (ii) urban water use in the main towns of Mafikeng, Zeerust, Groot Marico and Itsoseng and (iii) rural domestic water use. The major water user in the Marico is irrigation (at **32 million m^3/a**) along the Groot Marico River and the Klein Marico as well as downstream of Marico Bosveld and Klein Maricopoort. This is followed by rural water use of **12 million m^3/a**. In the Upper Molopo sub-area irrigation and urban water use is the major water user utilising **24 million m^3 per annum** and **13 million m^3 per annum** respectively. The sources of supply are the dolomitic aquifers of the Grootfontein compartment and Molopo springs. Irrigated agriculture is the dominant water user in the Upper Ngotwane sub-area (**5 million m^3/a**) followed by rural water use of approximately **3 million m^3/a**.

LOCALITY MAP

LEGEND

- WMA Boundaries
- Dams
- City/Town
- Provincial Boundary
- Rivers
- Primary Drainage Region
- Secondary Drainage Region
- Quaternary Drainage Region
- Crocodile West Catchment
- Marico Catchment

Botswana

Limpopo Province

LIMPOPO WMA

OLIFANTS WMA

CROCODILE WEST AND MARICO WMA

MIDDLE VAAL WMA

LOWER VAAL WMA

UPPER VAAL WMA

North West

Gauteng

Mpumalanga

Gaborone

Thabazimbi

Mokwaseng

Madikwe

Zeerust

Mafikeng

Lichtenburg

Itsoseng

Rustenburg

Koster

Brits

Mabopane

Ga-Rankuwa

Pretoria

Hammanskraal

Bela Bela

Mookgophong

Cullinan

Bronkhorstspruit

Krugersdorp

Johannesburg

Soweto

Gaborone Dam

Molatedi Dam

Marico Bosveld Dam

Madikwe Dam

Mankwe Dam

Vaalkop Dam

Roode-kopjes Dam

Bospoort Dam

Koster Dam

Olifantsnek Dam

Buffelspoort Dam

Hartbeespoort Dam

Ben Accord Dam

Roodeplaat Dam

Rietvlei Dam

Klipvoor Dam

Modimola Dam

Disaneng Dam

Ngotwane Dam

Kromellenboom Dam

Lindleyspoort Dam

Scale 1 : 1 500 000

20 0 20 40 Kilometers

N

25° 26° 27° 28°

MAP REFERENCE: d:\lisa\mxd\Fig2_locality.mxd

Figure 1

It is expected that there will be an increase in water requirements for the domestic sector, particularly the urban centres of Mafikeng and Madikwe as the population in these areas is expected to increase by an average annual growth of 1,27% and 2,6% respectively. There will also be an increase in water use by the domestic sector as the levels of service increase. Growth in irrigated agriculture is not likely. Land restitution and redistribution will however bring considerable change in the agricultural sector. This will require a re-allocation of some water from existing commercial irrigators into the resource poor farmers. A summary of the sectoral water requirements in each of the sub-areas is presented in **Table 1**. Please note that the water requirement figures for the Upper Ngotwane have been separated from the Marico catchment as reflected in the National Water Resources Strategy. The sum of the Marico and Upper Ngotwane are comparable with the NWRS figures.

Table 1: Water Requirements for 2000 development (million m^3/a)

Sub-area	Total sub-area requirements				Total sub-area require-ments	Transfers out	Grand Total
	Irrigation	Urban	Rural	Mining & Bulk Industry			
Marico*	32	9	12	5	58	7	65
Upper Molopo	24	13	6	5	48	0	48
Upper* Ngotwane	5	2	3	0	10	0	10

* The NWRS combined Marico and Upper Ngotwane catchments. However, because of the different catchment characteristics, each was made a sub-area in the ISP.

The available water resources of the Marico, Upper Molopo and Upper Ngotwane catchments do not meet the current level of water requirements at the appropriate levels of assurance of supply. All three sub-areas of Marico, Upper Molopo and Upper Ngotwane are in deficit as indicated in the water balance tables below. Because of the semi-arid nature of the catchments and the low mean annual precipitation, there is very little or no potential for surface water resource development to meet future water requirements in the domestic sector or to provide for equity considerations in the agricultural sectors. The available water resources of the catchments are however not well understood. This applies particularly to the impact of return flows on the yield of existing dams, as well as the long-term sustainable amount of groundwater that can be abstracted from the dolomites that traverse the catchments.

Table 2: Available water in year 2000 (million m³/a)

Sub-area	Total sub-area requirements		Usable Return Flow			Total local yield	Transfers in	Grand Total
	Surface water	Ground -water	Irriga-tion	Urban	Mining & bulk			
Marico*	30	23	2	3	1	59	0	59
Upper Molopo	9	9	0	5	2	25	0	25
Upper Ngotwane	1	5	0	0	0	6	0	6

A balancing of the water requirements against the available water resources for the year 2000 is presented in **Table 3**.

Table 3: Reconciliation of requirements and available water for year 2000 (million m³/a)

Sub-area	Available water			Water Requirements			Balance
	Local yield	Transfers in	Total	Local requirements	Transfers out	Total	
Marico*	59	0	59	58	7	65	(6)
Upper Molopo	25	0	25	48	0	48	(23)
Upper Ngotwane	6	0	6	10	0	10	(4)

All three sub-areas indicate a water deficit at the year 2000 level of development. The large deficit in the Upper Molopo sub-area is due to over abstraction of the groundwater.

The challenges the Regional DWAF Office faces in the water resources management of the Marico, Upper Molopo and Upper Ngotwane and the strategic positions developed within the context of the NWRS that would address these issues can be summarised as follows:

- **Water Balance and Reconciliation Strategies** – All three sub-areas are in deficit. The main source of water supply is groundwater. From the available information the deficit can be attributed to over-abstraction of groundwater. The amount of groundwater that can be abstracted in each of the three sub-areas depends on the character of the underlying dolomitic aquifers and frequency of recharge. The amount of abstraction is exceeding the recharge based on the current level of information. The other reason for the deficit is the water requirements, which cannot be met at the required level of assurance of supply from the surface water particularly in the Marico sub-area. However, increasing return flow may be increasing the available yield of the systems. The strategic position taken by DWAF for each of the sub-areas is to ensure that data and information on the **water**

resources availability of the catchments is up to date and accurate. This strategy includes understanding of areas and sectors for **effluent re-use** as well as the **groundwater resources strategies** for the dolomites. A good database that includes hydrology update, land resources of the catchment, demand projections and inventories of potential development (particularly of groundwater) and environmental conditions is essential for Integrated Water Resources Management (IWRM).

- **Water Resources Protection Strategies** – One of the key challenges facing the Regional DWAF Office is the protection of the water resources from pollution and ensuring that there is no environmental degradation of the sensitive ecosystems dependent on the water resources. The increasing water quality problems of the receiving streams particularly in the Upper Molopo River because of poor wastewater treatment of the municipal effluent are increasing the water scarcity in the sub-area. As part of the strategy, DWAF will establish water quality objectives for the receiving streams taking into account the water quality standards of downstream users. There should be delineation of groundwater protection zones during the siting of boreholes in order to avoid pollution of groundwater from inadequate sanitation. Point and non-point source pollution need to be identified and effluent discharge permits enforced. **Resource Quality Objectives** and **water quality management strategies** are recommended including the plan of action to address the specific issues in each sub-area.

- **Water Conservation and Water Demand Management Strategies** – The increasing demand for water in the domestic sector and the North West Provincial government policy of employment creation through land reforms for small-scale irrigation development will increase the water scarcity in all three sub-areas of Marico, Upper Molopo and Upper Ngotwane catchments. The NWRS makes clear reference to the incorporation of Water Conservation/Demand Management (WC/DM) in order to ensure efficient water utilisation of this scarce resource, which is an important factor of production that contributes to poverty eradication. The WC/DM strategy that is addressed in this ISP report is (i) situation assessment – provides an evaluation of the status of water demand management in the main water user sectors (irrigation and domestic) to identify whether water is being utilised effectively and economically in each sub-area. The current status indicates significant inefficiencies in all the sectors; (ii) establishment of water demand management strategies by each of these sectors using DWAF guidelines.

There are general water resources management issues common to Marico, Upper Molopo and Upper Ngotwane sub-areas. These include the following:

- **Water Use Management Strategies** – The pricing of waste discharge charges, which is very important in these catchments, has not been developed far enough for it to be implemented. This strategy is important in the Marico, Upper Molopo and Upper Ngotwane because of the increasing importance of meeting water quality objectives to ensure the achievement of social equity, ecological and financial sustainability through effective cost recovery. A **water use allocation plan** will be required once the verification of existing users and their lawfulness has been established.

- **Cooperative Governance** – This is an essential strategy for the sustainable management of the water resources of the Marico, Upper Molopo and Upper Ngotwane catchments. Although the development of the ISP has been done by

DWAF without the participation of other areas of government in the region, it is recognised that the genuine inter-sectoral, multidisciplinary approach that can be implemented successfully depends on co-operative governance.

- **Social and Institutional Development Strategies** – The Act provides for the establishment of statutory bodies for ensuring sustainability, equity and beneficial use of water resources in the catchments. The institutional framework for any catchment including Marico, Upper Molopo and Upper Ngotwane sub-areas to ensure sustainable management and stakeholder commitment to implementation of the strategies are shown below.

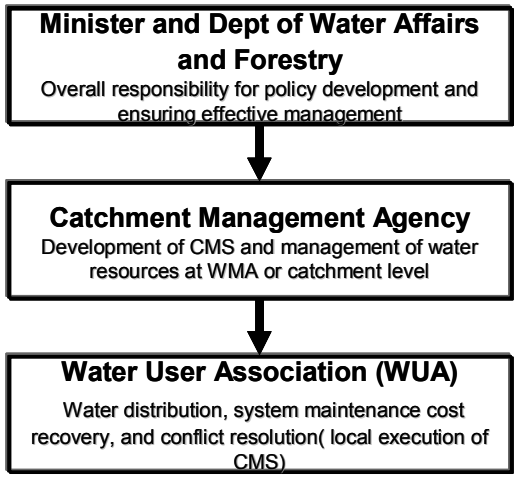

Figure 2: Institutional arrangements in the context of Integrated Water Resources Management

- **International Obligations** – Water does not respect borders. The existing agreement (**TSWASA Agreement**) on the water resources of Molatedi Dam between Botswana and South Africa (including the former homeland of Bophuthatswana) needs to be reviewed to account for the over-allocation from the dam. There is a distinct need for frequent exchange of information between the basin states and to measure the allocations to each state so that adjustments to the TSWASA Agreement can be made. On the Upper Molopo River, there are concerns from Botswana that increasing water use in the upper catchments are impacting on the available of water from the sand wells on which the local Botswana communities are dependent on. The strategic option is to ensure that the catchments are managed as one unit. The organisational and administrative structures for the TSWASA Agreement has since changed and needs to be restructured in the light that the former area of Bophuthatswana was reincorporated into South Africa.

- **Stakeholder Participation** – In order to ensure acceptance of the strategies formulated for the Marico, Upper Molopo and Upper Ngotwane ISP stakeholder participation and consultation is critical in order to legitimise decisions made and to ease the implementation of the strategies identified for the catchment and their sub-areas.

It is concluded in this ISP that an implementation plan be developed for the plans of actions that are identified in the strategy tables. The formulation of the ISP has not considered the

organisational capabilities and capacity of the Directorates identified as being responsible for implementation of the activities.

The Marico, Upper Molopo and Upper Ngotwane ISP establishes the direction for the sustainable water resources management by DWAF but has not analysed the resources and capabilities, structures and systems for the implementation of the ISP. The document recommends the establishment of an **oversight body** that not only reviews and ensures the implementation of the Marico, Upper Molopo and Upper Ngotwane catchments but also integrates these strategies into the Crocodile West and Marico WMA. This oversight body should consist of other areas of government in the Marico, Upper Molopo and Upper Marico catchments and must act as a steering committee during the development of the implementation programme for the ISP, review progress and approve the course of work.

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LIST OF ABREVIATIONS

DWAF	Department of Water Affairs and Forestry
WMA	Water Management Area's
CMA	Catchment Management Agencies
NWA	National Water Act
NWRS	National Water Resources Strategy
RQO	Resource Quality Objective
ISP	Internal Strategic Perspectives
MAR	Mean Annual Runoff
IWRM	Integrated Water Resource Management
CMS	Catchment Management Strategy
IDP	Integrated Development Plan
WSDP	Water Services Development Plan
NWWSA	North West Water Supply Authority
WTW	Water Treatment Works
WwTW	Wastewater Treatment Works
WMI	Water Management Institution
RDM	Resource Directed Measures
MC	Management Class
SWCA	Subterranean Water Control Area
WC/DM	Water Conservation/Demand Management

GLOSSARY OF TERMS

Aquifer	A Stratum or Zone below the surface of the earth capable of producing water
Assessment (Water Resources Assessment)	An examination of the aspects of the supply and demand for water and of the factors affecting the management of water
Assurance of Supply	The reliability of which a specified quantity of water can be provided, usually expressed either as a percentage or as a risk. For example "98% reliability" means that over a long period of time, the specified quantity of water can be supplied for 98% of the time, and less for the remaining 2%. Alternatively, this situation may be described as a "1 in 50 year risk of failure" meaning that, on average, the specified quantity of water will fail to be provided in 1 year in 50 years, or 2% of the time.
Basin	The area of land that is drained by a large river, or river system.
Biota	A collective term for all the organisms (plants, animals, fungi, bacteria) in an ecosystem
Catchment	The area of land drained by a river. The term can be applied to a stream, a tributary of a larger river or a whole river system.
Comprehensive water resources	Water Resources planning, development, and control that Management incorporates physical, social, economic and environmental interdependencies
Cost Recovery	Fee structures that cover the cost of providing the service or investment
Condensed Area	The equivalent area of alien vegetation with a maximum concentration / density that represents the more sparsely distributed alien vegetation that occurs over a large area.
Ecological Category	Ecological Category (A-D). A class indicating the ecological importance and sensitivity of an area, as it is likely to have been under natural (undeveloped) conditions and the risks of disturbance that should be tolerated. Values range from Category A (highly sensitive, no risks allowed) to category D (resilient systems, large risk allowed)
Water Demand	The use of price, quantitative restrictions, and other devices

Management	to limit the demand for water
Drainage Region	The drainage regions referred to in this document are either single large river basins, or groups of contiguous catchments or smaller catchments with similar hydrological characteristics. They follow the division of the country into drainage regions as used by the Department of Water Affairs and Forestry.
Ecosystem	A complex system formed by the interaction of a community of organisms with its environment
Ecosystem health	An ecosystem is considered healthy if it is active and maintains its organisations and autonomy over time, and is resilient to stress. Ecosystem health is closely related to the idea of sustainability.
Ecological importance	A measure of the extent to which a particular species, population or process contributes towards the healthy functioning of an ecosystem. Important aspects include habitat diversity, biodiversity, the presence of unique, rare or endangered biota or landscapes, connectivity, sensitivity and resilience. The functioning of the ecosystem refers to the natural processes.
Edaphic	Pertaining to the influence of soil on organisms, or Resulting from or influenced by factors inherent in soil rather than by climatic factors.
Endemic	Occurring within a specified locality; not introduced.
Endoreic	Portion of a hydrological catchment that does not contribute towards river flow in its own catchment (local) or to a river flow in downstream catchments (global). In such catchments the water generally drains to pans where much of the water is lost through evaporation.
Ephemeral Rivers	Rivers where no flow occurs for long periods.
Historical Flow Sequence	A record of river flow over a defined period and under a defined condition of catchment development in the past, calculated from a record of observed flow corrected for inaccuracies, or from records of observed rainfall, or a combination of the two.
Hydrological Year	The Twelve-month period from the beginning of October in one year to the end of September in the following Year.
Irrigation Quota	The quantity of water, usually expressed as m3/ha per year, or mm per year, allocated to land scheduled under the scheme. This is the quantity to which the owner of the land is entitled at the point at which he or she takes delivery of the

	water and does not include conveyance losses to that point.
Mean Annual Runoff	Frequently abbreviated to MAR, this is the long -term mean annual flow calculated for a specified period of time, at a particular point along a river and for a particular catchment and catchment development condition. In this report, the MARs are based on the 70-year period October 1920 to September 1990 inclusive.
Opportunity cost	The value of goods or services foregone, including environmental goods and services, when a scarce resource is used for one purpose instead of for its next best alternative use
Opportunistic Irrigation	Irrigation from run-of-river flow, farm dams, or compensation flows released from major dams. As storage is not provided to compensate for reduced water availability in dry years, areas irrigated generally have to be reduced in dry years.
Present Ecological Status Class	A Class indicating the degree to which present conditions of an area have been modified from natural (undeveloped) conditions. Factors that are considered in the classification include the extent of flow modification, inundation, water quality, streambed condition, riparian condition and proportion of exotic biota. Values range from Class A (largely natural) to Class F (critically modified)
Quaternary Catchment	The basic unit of area resolution used in the WR90 series of reports published by the Water Research Commission and also in this report. The primary drainage regions are divided into secondary, tertiary and quaternary catchments. The quaternary catchments have been created to have similar mean annual runoffs: the greater the runoff volume the smaller the catchment area and vice versa. The quaternary catchments are numbered alphanumerically in downstream order. A quaternary catchment number: for example D41A, may be interpreted as follows: the letter D denotes Primary Drainage Region D, the number 4 denotes secondary catchment 4 of Primary Drainage Region D, the number 1 shows that the secondary catchment has, in this case, been sub-divided into tertiary catchments, and the letter A shows that the quaternary catchment is the first in sequence downstream from the head of secondary catchment D41.
River basin	A geographical area determined by the watershed limits of a system of water, including surface and underground water, flowing into a common terminus
Reserve	The quantity and quality of water required (a) to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act, 1997 (Act No.108 of 1997) for people, who are now or who will, in the

	reasonably near future, be (iii) being supplied from, the relevant water resource; and (b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource as indicated in the National Water Act (Act No.36 of 1998)
Resilience	The ability of an ecosystem to maintain structure and patterns of behaviour in the face of disturbance or the ability to recover following disturbance.
Resource Quality	The quality of all the aspects of a water resource including: the quantity, pattern, timing, water level and assurance of instream flow; (b) the water quality, including the physical, chemical and biological characteristics of the water; (c) the character and condition of the instream and riparian habitat; and (d) the characteristics, condition and distribution of the aquatic biota.
Resource Quality Objective	Quantitative and variable statements about water quantity, water quality, habitat integrity and biotic integrity that specify the requirements (goals) needed to ensure a particular level of resource protection.
River System	A Network of rivers ranging from streams to major rivers and, in some cases, including rivers draining naturally separate basins that have been inter-connected by man - made transfer schemes
Scheduled Land	Irrigable land to which a water quota has been allocated.
Sensitivity analysis	Assessment of the response of some factors as a result of changes in others
Sewage	Liquid refuse or waste matter carried off by sewers
Sewerage	The removal and disposal of sewerage and surface water by sewer systems
Subsistence Farming	Small-scale farming where almost all produce is consumed by the farmer's household or within the local community.
Suggested Ecological Management Class	A class of water resource indicating the suggested management objectives of an area which could possibly be attained within Five years. Values range from Class A (largely natural) to Class D (largely modified)
Stakeholder	Organization or individual that is concerned with or has an interest in water resources and that would be affected by decisions about water resources management

Strategy (Water resources Strategy)	A set of medium to long-term action programs to achievement of development goals and to implement water related policies.
Water Imports	Water imported to one drainage basin or secondary sub catchment from another.
Water Transfers	Water transferred from one drainage basin or secondary sub-catchment to another. Transfers in are synonymous with water imports.
Watercourse	A system of surface and underground waters that constitute, by virtue of their physical relationship, a unitary whole and that flow into a common terminus
Watershed	An area by a river or stream system; also referred to as a catchment area
Wetlands	Areas of marsh, fen, peat land, or water that include natural, artificial, permanent, and temporary areas with static or flowing water that is fresh,
Yield	The maximum quantity of water obtainable on a sustainable basis from a dam in any hydrological year in a sequence of years and under specified conditions of catchment development and dam operation.

PART 1 – INTRODUCTION AND OVERVIEW

1 BACKGROUND TO THE INTERNAL STRATEGIC PERSPECTIVE OF THE MARICO, UPPER MOLOPO AND UPPER NGOTWANE CATCHMENTS OF THE CROCODILE RIVER (WEST) AND MARICO WMA

1.1 INTRODUCTION

The Department of Water Affairs and Forestry (DWAF), as the custodian of the South Africa's water resources, wishes to make optimal use of these resources in promoting economic growth and wealth for all its citizens. On the other hand, armed with the National Water Act (NWA) and other legislation, it has the difficult responsibility of ensuring that such water utilisation is sustainable, and especially ensuring the sustainability of our natural environment.

The following document presents DWAF's strategic perspective on how it wishes to protect, allocate use, develop, conserve, manage and control the water resources within the Marico, Upper Molopo and Upper Ngotwane catchments of the Crocodile West Marico WMA until the regional responsible authority (to be known as the Catchment Management Agency or CMA) has been established and is in a position to take over most or all of these functions. The ISP for the Crocodile River (West) catchment part of the WMA is given a separate report (Reference number: P WMA 03/000/00/0303).

In keeping with sound business practice, the RO of the Department, assisted by the Directorate: National Water Resource Planning together with the other relevant DWAF Head Office Directorates has focussed on the following in preparing this document:

- Understanding what their core business is in conducting their interim water resource management functions (these must be in line with DWAF's Vision, Mission, Policy Objectives, the NWA, the recently drafted National Water Resource Strategy, and all NWA implementation processes);

- Clear management objectives and the setting of desired deliverables;

- Obtaining a thorough understanding of the natural, social, economic, political and other environments in the Crocodile (West) River catchment in which they have to perform their strategically important responsibilities. This is crucial to ensuring that the service they deliver optimises benefits for all water users by integrating all planning, implementation and management activities;

- A clear understanding of the water resources availability and how it is intended that this water be used. Reconciliation of water requirements and availability, as well as optimisation of river and water system operations, in the best interest of the country and the regional economy, is fundamental to the success of this management role.

- Providing a concise overview of the way in which DWAF will manage its business. This includes strategies and actions regarding all aspects of water resources management in the WMA. Where no clear policy or approach exists, a strategy to obtain better decision support information is proposed.

- Business infrastructure and human resources that need to be assigned to each task or function. This includes prioritisation of these tasks and functions, including work scheduling.

The structure of this Internal (DWAF) Strategic Perspective (ISP), or interim management strategy, has been prepared in such a way that the reader is provided with the necessary background along with the management approach to be adopted by the Department. This includes motivations as to how these approaches are intended to benefit all by ensuring equity of access to water, sustainability in maintaining the balance of utilisation by natural ecosystems and water users, and efficient and effective water use.

1.2 LOCATION OF CROCODILE (WEST) AND MARICO WATER MANAGEMENT AREA

The Marico, Upper Molopo and Upper Ngotwane catchments form a major part of the Crocodile West and Marico WMA, the locality of which is shown in **Figure 1.1.**

Figure 1.1: Location of the Crocodile (West) and Marico WMA

1.3 WATER LEGISLATION AND MANAGEMENT

Water is one of the most fundamental and indispensable of all natural resources. It is fundamental to life and the quality of life, to the environment, food production, hygiene, industry, and power generation. The availability of affordable water can be a limiting factor for economic growth and social development, especially in South Africa where water is a relatively scarce resource that is distributed unevenly, geographically and through time, as well as socio-politically.

Prosperity for South Africa depends upon sound management and utilisation of our many natural and other resources, with water playing a pivotal role. South Africa needs to manage its water resources optimally in order to further the aims and aspirations of its people. Current

government objectives for managing water resources in South Africa are set out in the National Water Resources Strategy (NWRS) as follows:

- **To achieve equitable access to water.** That is, equity of access to water services, to the use of water resources, and to the benefits from the use of water resources.

- **To achieve sustainable use of water**, by making progressive adjustments to water use to achieve a balance between water availability and legitimate water requirements, and by implementing measures to protect water resources and the natural environment.

- **To achieve efficient and effective water use** for optimum social and economic benefit.

The NWRS also lists the following important proposals to facilitate achievement of these policy objectives:

- Water will be regarded as an indivisible national asset. The Government will act as the custodian of the nation's water resources, and its powers in this regard will be exercised as a public trust.

- Water required to meet basic human needs and to maintain environmental sustainability will be guaranteed as a right, whilst water use for all other purposes will be subject to a system of administrative authorisations.

- The responsibility and authority for water resource management will be progressively decentralised by the establishment of suitable regional and local institutions, with appropriate community, racial and gender representation, to enable all interested persons to participate.

1.3.1 The National Water Act (NWA)

The NWA of 1998 is the principal legal instrument relating to water resource management in South Africa. The Act is now being implemented incrementally. Other recent legislation, which supports the NWA, includes the Water Services Act (Act 108 of 1997) and the National Environmental Management Act (Act 107 of 1998).

1.3.2 The National Water Resource Strategy (NWRS)

The NWRS is the implementation strategy for the NWA and provides the framework within which the water resources of South Africa will be managed in the future. All authorities and institutions exercising powers or performing duties under the NWA must give effect to the NWRS. This strategy sets out policies, strategies, objectives, plans, guidelines, procedures and institutional arrangements for the protection, use, development, conservation, management and control of the country's water resources. The purpose of the NWRS is to provide the following:

- The National framework for managing water resources;

- The framework for preparation of catchment management strategies in a nationally consistent way;

- Information, in line with current legislation, regarding transparent and accountable public administration; and

- The identification of development opportunities and constraints with respect to water availability (quantity and quality).

1.3.3 Catchment Management Strategies (CMS)

The country has been divided into 19 Water Management Areas (WMAs). The delegation of water resource management from central government to catchment level will be achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA will progressively develop a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA.

The Department's eventual aim is to hand over certain water resource management functions to CMAs. Until the CMAs are established and are operational, the Regional Offices (ROs) of DWAF will have to continue managing the water resources in their areas of jurisdiction.

1.4 INTERNAL STRATEGIC PERSPECTIVES (ISP)

1.4.1 The Objectives of the ISP Process

The objective of the ISP will be to provide a framework for DWAF's management of the water resources in each Water Management Area, until the Regional Offices can hand over the management functions to the established CMA. This will ensure consistency when answering requests for new water licences and informing existing water users (including authorities) on how the Department will manage the water resource within the area of concern. Stakeholders must be made aware of the bigger picture as well as the management detail associated with each specific water resource management unit.

1.4.2 Approach Adopted in Developing the ISP

The ISP for the Marico, Upper Molopo & Upper Ngotwane catchments was developed in five stages as follows:

(i). Determining the status of water resource management and relevant water resource management issues and concerns in the Marico-Upper Molopo & Upper Ngotwane ISP area. This was achieved through interviews with individual members of DWAF's RO and by collating information from the NWRS, WMA reports, Water Resource Situation Assessment (WRSA) reports and other catchment study reports. The following topics were discussed with Regional Office staff and their issues and concerns documented:

- Water Situation
- Resource Protection
- Water Use
- Water Reconciliation
- Water Infrastructure

- Monitoring and Information
- Water Management Institutions
- Co-operative Governance
- Planning Responsibilities.

A starter document of the identified issues and concerns was produced as a discussion document for the first workshop.

(ii). The first workshop was held with attendees from the Regional Office, the Integrated Water Resource Planning (IWRP) Chief Directorate of the Department as well as the consulting team. The workshop focussed on the lists of general issues in the WMA as well as area-specific issues. The issues were clarified and refined during the workshop. Strategies were discussed and developed to address the issues.

(iii). The third stage involved the preparation of the second workshop document to be used for refining strategies to address the various issues and concerns, during the second workshop.

(iv). The fourth stage was the second workshop. During this workshop, the overall management of the water resources in the catchment was discussed along with the ISP management strategies and the relevant issues and concerns. The priorities and responsibilities for carrying out the strategies were identified. First workshop attendees were again involved, as were representatives of several DWAF Head Office directorates.

(v). The fifth stage was the finalisation of the ISP document.

As can be deduced from the above this Marico, Upper Molopo & Upper Ngotwane ISP was prepared internally within the Department, and captures the Department's perspectives. Once approved by DWAF Management, it is intended that the Regional Office will make the ISP available to Water User Associations (WUAs), Water Service Providers (WSPs), Water Service Authorities (WSAs) and other forums for discussion and comment. These comments will be considered and worked into later versions of the ISP. By adopting this procedure this ISP becomes a working document, which will be progressively updated and revised by DWAF. Public participation forms part of the CMS process, for which the ISP serves as a foundation (see Paragraph 1.5).

The ISP does not formulate all the details pertaining to every strategy but provides a suggested framework for each strategy around which the details will be developed by the responsible authority. Where relevant and readily available, certain details have been included in the strategies. The responsible authority for the further development of each strategy is indicated. This is predominantly the Regional Office, which remains responsible for involving the relevant DWAF directorates.

1.4.3 The ISP formulation process

The process that has been used to develop the ISP for the Marico, Upper Molopo and Upper Ngotwane catchments is illustrated in **Figure 1.2.** An important step in the strategic planning cycle is the implementation of the strategy. This has not been developed in detail as part of the ISP. The ISP has specified the organisation or institution responsible for monitoring or following up the implementation of the ISP. However, whether the responsible organisation

has the capacity and the resources to oversee the implementation has not been part of the ISP formulation.

Figure 1.2: The ISP Planning Cycle

1.4.4 Specific objectives for Marico, Upper Molopo & Upper Ngotwane ISP Area

The available water resources of Marico, Upper Molopo and Upper Ngotwane catchments indicate that they cannot meet the current water requirements (at 2000 development level) at the acceptable level of assurance of supply if the allocations in the catchments are taken up.(See **Chapter 4** for more details)

In view of this, the primary objectives of this ISP are for the decision makers in the regional DWAF offices to make informed decisions on the following:

- Provide a reconciliation strategy for the current and future water requirements with the available resources based on a desktop level of information.
- Identify, on the basis of the desktop level information, where future water resources to meet any growing water needs, will come from;
- Determine whether compulsory licensing are necessary in these catchments:

- Provide strategies that address the various issues identified as influencing the sustainable utilisation and management of the available water resources.

1.4.5 Limitations

Some of the difficulties encountered in the development of the ISP of the Marico, Upper Molopo and Upper Ngotwane River catchments were the following:

- The watershed boundaries of the surface water resources do not correspond with the extent of the dolomitic groundwater aquifers, which straddle two other water management areas.

All three rivers are shared watercourses with Botswana and some of the issues are at a national scale rather than regional level.

1.4.6 Updating of the ISP Report

The ISP strategies should not lag behind national developments, become outdated or differ from related ISPs regarding trans-boundary management. There is therefore a need to have a standard process for updating strategies, and to prevent strategies becoming outdated by ensuring adequate feedback from national developments. Furthermore, the proposal and introduction of new strategies needs to be accommodated. It is suggested that each strategy has a version-control system. The following is necessary:

- Keep abreast of changes in national legislation and policy changes or refinements by keeping a list of all relevant legislation and supporting documents relevant to the ISP;
- Ensure consistency between the ISP strategies and national strategies through a regular review-and-update procedure;
- Annually review and ensure consistency and agreement regarding trans-boundary ISP management issues by liaising with the responsible managers of other areas and updating relevant ISP strategies if necessary;
- Annually review the priorities of required management actions and align budgets accordingly;
- Monitor the implementation of the ISP (review actions, progress, implementation and stumbling blocks);
- Incorporate feedback from stakeholders;
- Rigorously apply ISP version control.

Updating and Version Control

The actual frequency of ISP revision will be determined by the number and extent of revisions to management approaches as reflected in strategy amendments. All updates to this report, particularly with respect to amendment to the strategies, need to be passed on to and vetted by the Catchment Manager for the Marico, Upper Molopo & Upper Ngotwane

catchment. The current incumbent is Mr R Botha, who has been delegated the task of managing version control.

1.4.7 The Authority of Information Contained in the ISP

The NWRS is a statutory document, subject to a high level of public scrutiny and input, and signed off by the Minister. The information contained in the NWRS is the best information and knowledge available at the time. The information in Chapter 2 and Appendix D of the NWRS strategy on water requirements, availability and reconciliation was updated with comments received from the public participation process in the second half of 2002. To enable the finalisation of the NWRS, these figures were "closed" for changes in February 2003.

Underlying the figures in Chapter 2 and Appendix D is a set of 19 reports "Overview of Water Resources Availability and Utilisation", one for each WMA. These reports contain more detailed information on each WMA than was summarised for the NWRS and are referred to, in short, as "WMA Reports". The WMA reports were also finalised with the February 2003 information.

Still deeper in the background lies another set of reports (one per WMA), the so-called Water Resource Situation Assessment Reports. These reports contain a wealth of information on each WMA, but the figures on requirements, availability and reconciliation have been superseded by the WMA report and the NWRS.

The ISPs for all WMAs used the information contained in the NWRS and WMA reports as the point of departure. However, an inevitable result of the ISP process has been that better information has emerged in some cases. The reason is that the level of study is more detailed and intense for the ISP. This included very close scrutiny of the numbers used in the NWRS, and in some cases a reworking of base data and some re-modelling. Where the ISPs contain yield balance data, which differs from the NWRS, these discrepancies are carefully explained. Where other differences from the NWRS are necessary these are also detailed in the ISP, with accompanying explanations.

It is required that the Department work with the best possible data so that the best possible decisions can be taken. Where the ISPs have improved upon the NWRS then this is the data that should be used. The new data contained in the ISP will also be open to public scrutiny as the ISP reports will be published on the Internet and in hardcopy, and will be presented and discussed at WMA forums. Comments received will be considered and worked into subsequent versions of the ISP on a regular (yearly) basis. The NWRS will be updated to reflect the latest understanding in each new edition.

1.5 INTEGRATED WATER RESOURCE MANAGEMENT (IWRM)

It is imperative that the natural, social, economic, political and other environments and their various components are adequately considered when conducting water resources planning and management. Water as a strategic component also interacts with other components in all environments. For example, human activities such as the use of land, the disposal of waste, and air pollution can have major impacts on the quantity and quality of water, which is available for human use and for proper life support to natural biota.

Taking an even broader view, water must also be managed in full understanding of its importance for social and economic development. It is important to ensure that there is conformity between the water-related plans and programmes of the CMAs, and the plans and programmes of all other role players in their management areas. The CMAs must

therefore establish co-operative relationships with a wide range of stakeholders, including other water management institutions, water services institutions, provincial and local government authorities, communities, water users ranging from large industries to individual irrigators, and other interested persons.

This integrated planning and management approach is intended, through co-operative governance and public participation, to enable water managers to meet the needs of all people for water, employment, and economic growth in a manner that also allows protection and, where necessary, rehabilitation of aquatic ecosystems. Above all, Integrated Water Resource Management (IWRM) will enable water managers to use our precious water resources to assist us in poverty eradication and removal of inequity.

One of the big opportunities to formally integrate a large number of actions in water resource management presents itself during the compulsory licensing process.

Compulsory licensing is identified in the NWRS as a very important action for implementing the NWA. However, it is not a simple action of issuing licences but a complex process of closely related and interdependent activities that will in itself formalise IWRM to a great extent. The process of IWRM is diagrammatically depicted in **Figure 1.3**.

Before an allocation schedule can be determined and the legal steps followed to finalise compulsory licensing (through the issuing of licences to all users), many other aspects must be addressed.

Existing use and the lawfulness of that use must be verified, all users (existing and new) must apply for licences, a good understanding of future use scenarios must be developed and water required for equity purposes and rural development must be clearly understood.

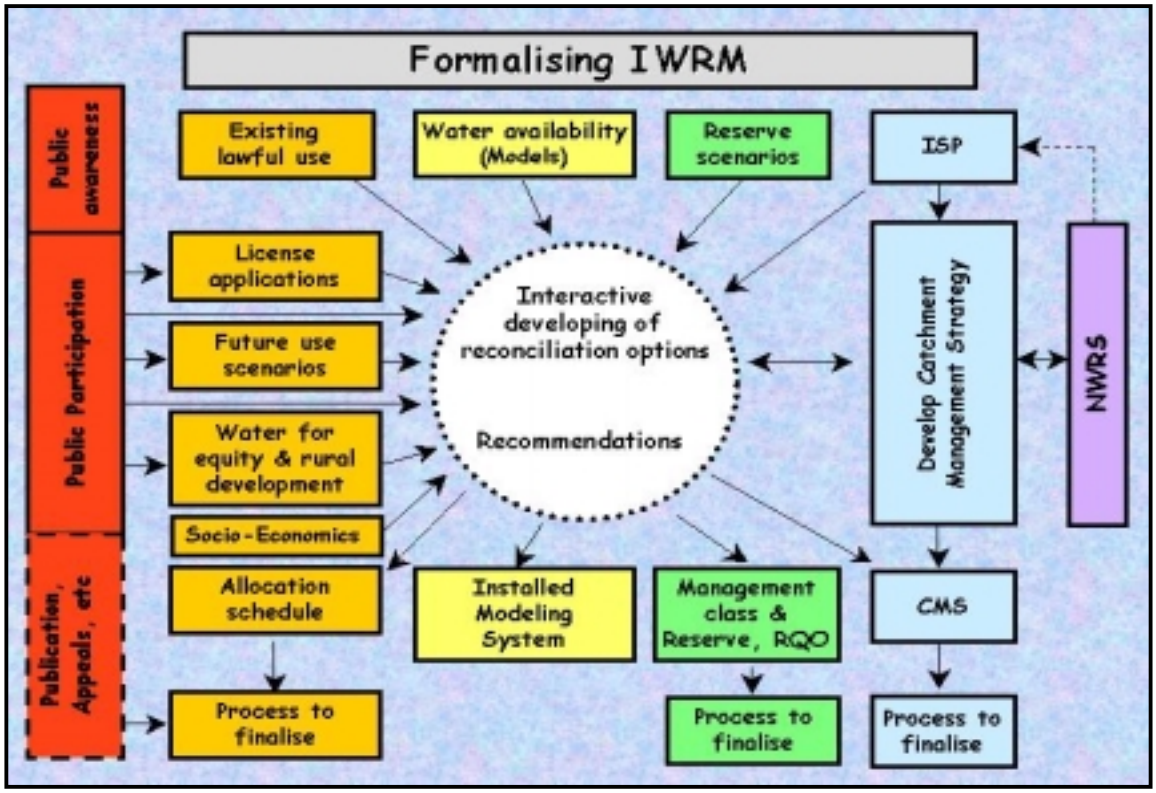


Figure 1.3: Diagram showing DWAF Integrated Water Resource Management (IWRM) Approach

- Water availability must be understood as thoroughly as possible with "best available" existing information used to model all possible reconciliation options.

- Reserve scenarios must be developed for all significant resources in the catchment, for instance, the river flow requirements for all possible classes that may be considered.

- The development of strategies for implementing the licensing (abstraction controls, for example), the Reserve and Resource Quality Objectives (i.e. incrementally over time) must go hand in hand with the rest of the processes to ensure that practical, workable solutions are found.

The processes will then enter a very intensive, interactive phase of developing realistic reconciliation options. This would entail, for example, the selection of a specific management class to be scrutinised for its impact on the number of licences that could be issued for use, with its concomitant impacts on the social and economic structure of the catchment.

The active participation of stakeholders in this process will then hopefully crystallise clear recommendations on an allocation schedule, management classes for the various reaches of the rivers and the resultant ecological Reserve and Resource Quality Objectives, as well as strategies for the implementation.

Although the Department will play a very strong role in guiding this process, it is extremely important to have the CMA actively involved. Preferably, at least the Board of the CMA must be in place to drive the public participation for the process.

1.6 CARING FOR THE ENVIRONMENT

DWAF is responsible for water resource development and management in terms of the NWA, and within the broader framework of other environmental legislation. The Department also strongly reflects the will to make sound decisions which ensure the development of society and the economy whilst maintaining, and where possible enhancing, ecological integrity. The concept of management of the environment has evolved from the exclusivity of protection of plants and animals to balancing the complex interaction of society, the economy, and ecology. "Environmental management is the integration of social, economic and ecological factors into planning, implementation and decision-making so as to ensure that development serves present and future generations" (NEMA).

The key legislative Acts to which DWAF is required to refer are the National Environmental Management Act (NEMA, Act 107 of 1998) and the Environment Conservation Act (ECA, Act 73 of 1989). DWAF has prepared a Consolidated Environmental Implementation and Management Plan (CEIMP) as a requirement of NEMA. This describes the Department's functions, policies, plans and programmes, and states how these comply with environmental legislation. Through the CEIMP the Department has committed itself to developing and implementing an integrated Environmental Management Framework (EMF) to ensure that its approach is aligned with the principles prescribed in NEMA and the ECA. The EMF will inform the Department at a strategic decision-making level, bring about environmental legal compliance, and help in achieving environmental sustainability through the promotion of sound environmental management practices. Integrated Environmental Management is a co-operative governance effort with DWAF as a full partner in the process.

This ISP has the responsibility of raising and maintaining the environmental consciousness of the Department's water resource planners and managers. The control over water has a very broad range of influence and impact for which strategies and planning need to account. Impacts come from many different angles.

Some of these angles of impact, which are considered through this ISP, are noted below:

- The direct impact of physical structures (environmental constraints to construction e.g. of weirs or dams)
- The implications of allocating and licensing water for use. Forestry and irrigation are examples of users where development based on water can mean the transformation of extensive areas of otherwise 'natural' environments.
- The allocation of water for equity. Here we can include approaches towards the application of Schedule 1 Use, General Authorisations, the revitalisation of irrigation schemes, etc.
- Failure to support equity, or appropriate development – noting the consequential impacts of poverty.
- Sanitation systems and the impacts on groundwater quality.
- The implementation of the Reserve.

- The ability to monitor and manage compliance, thus protecting the resource and with it the environment.

All decisions regarding water are critical to the environment. Decisions must be made on a balance of social, economic and ecological costs and benefits, considering both the immediate and the long-term, and always with an eye out for the unintended consequence. It is the intention of the ISP to provide the basis for integrated decision-making. The principles of environmental management underpin every strategy developed in this document.

There are a number of strategic areas with a particularly strong biophysical/ ecological emphasis. These include:

- The Reserve (groundwater, rivers, wetlands and estuaries)
- Water quality - surface and groundwater
- The approach towards the clearing of Invasive Alien Plants
- The management of wetlands
- Land degradation. Erosion and sedimentation (land care)
- Land use and especially how this is impacted by land reform and the re-allocation of water.

The roles of Co-operative Governance and the need for awareness raising and capacity building are key strategic elements of many strategies.

In reality, all strategies and all aspects of management have a strong interaction with the biophysical environment. This ISP endeavours to capture all of these concerns in discussion and through a strategic approach, which emphasises the will of the Department to manage the environment to the best benefit of the country and its people.

The approach set out above applies to all Water Management Areas and associated ISPs, and is not repeated within the Strategy Tables (Part 2 of this ISP). It reflects the way the Department views Integrated Water Resource Management and the importance of the biophysical aspects of decision-making. There may nevertheless be specific ecological and biophysical aspects of management, which require specific attention and which may not be captured in the above-mentioned or other strategies. The ISP therefore still includes an Environmental Strategy, which serves to make pertinent those issues of the environment, which might not otherwise be covered.

1.7 THE SOCIAL ENVIRONMENT

The utilisation of water resources is aimed at the benefit of society, and at society through the economy. As noted in Section 1.5 this should not be at undue cost to ecological integrity.

Impacts on society are a core element of this ISP, and decisions are often complicated by the risk of unintended consequence. As a typical example, the over-zealous implementation of the ecological Reserve may benefit the river, to the intended benefit of society, but the cost of lack of use of that water to employment and to livelihoods may lead to other strains on natural resources that undo the benefits.

The implementation of the NWA requires that society be kept at the forefront of all decision-making. This principle is now deep-seated within the Department and is integral to all strategies. Water resource allocation and use has critical social impact, as does water quality management. However, pivotal to the social component is the question of equity. What can be done and what is being done to redress past inequities? Within this, strategies have been developed to consider the provision of water to Resource Poor Farmers, the use of water under Schedule 1, Licensing and General Authorisations, etc. Whilst water supply and sanitation are not part of the brief of the ISP, the provision of water to meet these needs most certainly is. The urban poor, and the poor in rural villages, are as important in the consideration of the distribution and use of water resources as are the rural subsistence poor, and this should not be forgotten in the urgencies of land reform and the enthusiasm to establish a substantial class of farmers from amongst the previously disadvantaged.

This ISP aims to see water contributing to benefiting society. This can be through access to water in livelihood strategies, through small-farmer development programmes, through water supply and sanitation and especially the provision of good quality drinking water, and through the maintenance and growth of income-producing, job creating, and tax paying agricultural, commercial and industrial strategies.

Consultation and public participation are cornerstones of the social component of any strategic document. These requirements are repeatedly stressed throughout the National Water Act. This ISP has been prepared as DWAF's position statement with respect to the management of water resources and, although strategies and plans have been captured without consultation with the stakeholders, it remains an open and transparent document where the understanding of the Department, its visions and its principles are made clear for all to see and to interact with. This is amplified in the Implementation Strategy (**Strategy 9.1**) of this ISP.

1.8 WATER QUALITY MANAGEMENT

Much of the emphasis in water resource management has revolved around ensuring that users have sufficient quantities of water. However, as more water gets used and re-used, as quantities get scarce and feedback loops get even tighter, it is quality that begins to take on a dominant role.

Water availability is only as good as the quality of that water. Both quantity and quality need to be considered at the correct level of detail, and this can mean that at times they should be considered with similar emphasis and with similar expenditure of resources. Too often we have failed to integrate the issues of quantity and quality – both with regard to surface water and groundwater. The concept of Available Assimilative Capacity, the ability of the water resource to absorb a level of pollution and remain 'serviceable', is as important in water resource management as is the concept of Systems Yield.

Quantity and quality can no longer be managed in isolation of each other. Not that this isolation has ever been total. The consequences of irrigation, the leaching of fertilisers, and more importantly the leaching of salts from deeper soil horizons can render both the lands themselves and the receiving rivers unsuitable for use. Diffuse agricultural 'effluent' may be less visible than direct discharges of sewage or industrial effluent, but are no less pernicious.

Direct discharges to rivers are licensed and managed on the basis of assimilative capacities of those rivers, and on Receiving Water Quality. Where these limits are exceeded, often through the cumulative impact of diffuse discharges, water becomes unavailable to some, or even all, users downstream. DWAF will licence users to take water, and again to discharge it

in recognition that there is generally a cost to the resource in terms of a reduction in quality and a reduction in its further assimilative capacity. It is for this reason, and in order to bring about additional management and a strong incentive, that the Waste Discharge Charge System is being developed. Discharge users will be obliged to pay, depending on the quantity and quality of their discharge.

Surface water quality is affected by many things including sediment and erosion, the diffuse discharges from irrigated farmland (both fertilisers and salinity through leaching), domestic and urban runoff, industrial waste, and sewage discharges. Of these, industrial waste and sewage discharges are the easiest to licence and control, but this does not mean that this is problem-free. The Department has found that the situation with regard to sewage discharges often far exceeds the standards and conditions demanded by licences. There is a problem of compliance with regard to Local Authorities and private operators responsible for waste management systems. Diffuse discharges only compound the problem by reducing the assimilative capacity until the water becomes unfit for use, very expensive to purify, and a danger to human health.

Groundwater quality requires equal attention, and more so as we recognise the importance of groundwater in supplementing our meagre resources, and providing water to remote communities. Although our groundwater resources are for the most part to be found at a relatively deep level (50-100m is quite typical) this water can easily be polluted by surface activity. The leaching of fertilisers is one such problem but of greater concern is the influx of nitrates, primarily a consequence of human habitation and sanitation. Pit latrines are on the one hand so necessary, and have the huge advantage of not requiring volumes of water, but disposal is 'on-site', and often responsible for the longer-term pollution of the underlying aquifers which feed and water the communities above.

Water quality is a very important aspect of strategy within this ISP – considered primarily within the Water Quality Strategy and Groundwater. Industrial wastewater discharge, diffuse agricultural discharges, wastewater treatment works, the location and management of solid waste disposal sites, the siting of new developments, informal settlements and the impacts of sanitation systems, are all elements considered with great concern in this and other ISPs. Despite this attention, it may be that Water Quality has still not taken its rightful place in the integrated management of the water resource. However, the Department is moving towards IWRM and the integration of quantity and quality issues. Managers have now been given crosscutting responsibilities that will ensure a far more integrated approach in future.

Actions recommended within the Department include:

- The need to actively workshop the integration process. Resource Management, Planning and Allocations of Groundwater and Surface Water Quantity and Quality.
- The review and incorporation of knowledge from recent Water Research Commission Studies on both radioactivity and nitrates (groundwater quality issues).
- A review of all water quality literature reflecting situational knowledge and understanding within this WMA (and each and every WMA).
- Ensure that Water Quality monitoring is fully integrated into WMA water resources monitoring.

1.9 GROUNDWATER

The ISP process in all of the Water Management Areas of South Africa has highlighted the role and importance of groundwater as part of the total water resource. Although groundwater has always been important in some areas, this overall vision is a significant advance on our previous understanding of the potential for groundwater use. With the surface water resources in many WMAs now fully utilised, almost the only opportunity left for further development lies in the exploitation of groundwater. More particularly it is recognised that many of the more remote towns and villages, far from surface supplies, can in fact supply or supplement existing sources through groundwater, and that this must become a priority option. Therefore, too many small communities and subsistence farmers can avail themselves of groundwater when it would otherwise be impossible or impractical to lay on piped supplies. This can also reduce the pressure on existing users and perhaps even circumvent the need for Compulsory Licensing. The Department will be developing its capacity to explore and encourage the use of groundwater.

Of obvious concern is the likelihood of an interaction between groundwater and surface water. If the interaction is strong then additional use of groundwater may simply be reducing the surface water resource already allocated to someone else. In some instances (such as in the case of dolomitic aquifers) this interaction can indeed be very strong, whilst across many areas of the country it is so weak as to be negligible. In these circumstances groundwater comprises a huge pool of available water which is only of benefit if it is utilised. Care must always be taken with the issuing of licenses to ensure that both the Groundwater Reserve and other downstream users do not end up being the losers.

The realisation in this and other ISPs is that groundwater offers a huge resource of water which can be tapped, and that this can be a very significant supplement to the national water resource. The dolomitic aquifer, which underlies much of the Marico, Upper Molopo & Upper Ngotwane) area is being specifically researched for its utilisation potential.

1.10 PUBLIC RECREATION – THE USE OF DAMS AND RIVERS

The use of water for recreational purposes is one of the 11 water uses regulated in terms of the NWA (Section 21 j). The Department is developing a national policy towards 'Recreation on Dams and Rivers' and this should, in the first instance, be adhered to. Recreational use can take many forms and only occasionally has any direct impact on the water resource. Most obvious are activities such as power-boating, sailing and swimming which can have quality / pollution impacts. These activities can bring very significant economic benefits to the WMAs concerned, and where water releases can be accommodated, particularly through alignment with the needs of the ecological Reserve or other downstream users, then so much the better.

It is noted in this ISP that water resources offer a recreational outlet and that recreation is an important public and social asset necessary for national health and productivity. A central philosophy is that recreational opportunity should not be unreasonably and unnecessarily denied to users, and that the implementation of policy should ensure that disadvantaged and poor people should also be able to avail themselves of opportunities.

The Department has already transferred responsibility for the management of many public waters to Local Authorities and will continue with this process. Responsibility will therefore devolve upon these Authorities, but within the broad principles as laid down by the Department.

1.11 CO-OPERATIVE GOVERNANCE – THE PLACE OF THE ISP

The ISP is DWAF's approach to the management of water resources within the WMA. This will, in the longer term, be replaced by a fully consultative Catchment Management Agency. What is most important, in the medium term is that the ISP has a good fit with the Provincial Growth and Development Plan, with regional and other Environmental Management Plans, with plans and expectations of the Departments of Agriculture, Land Affairs, the Environment and others. It must also be aligned with the Integrated Development Plans and Water Services Development Plans now required for each District Municipality. Water is very often a constraining feature in development and co-operative governance planning and implementation is essential in matching what is wanted with what is possible.

2 CROCODILE (WEST) AND MARICO WMA: OVERVIEW OF MARICO, UPPER MOLOPO AND UPPER NGOTWANE ISP AREA

2.1 LOCATION

The Marico, Upper Molopo and Upper Ngotwane River catchments make up the western part of the Crocodile West and Marico Water Management Area (see **Figure 2.1** below). These catchments border on Botswana to the northwest, the Crocodile West catchment in the east, the Lower Vaal WMA and the Middle Vaal WMA in the south.

For a more detailed overview of the Marico, Upper Molopo & Upper Ngotwane ISP area, the reader is referred to the NWRS and the "Overview of Water Resources Availability and Utilisation" for the Crocodile (West) and Marico Water Management Area.

The sections below summarise the physical characteristics of the ISP area and the socio-economic activities of the area.

2.2 PHYSICAL CHARACTERISTICS

2.2.1 Topography and Rivers

The topography of the area is generally very flat with undulating hills in the lower reaches of the Marico River. A detail of the topography of the ISP area is shown below in **Figure 2.2**.

The Marico and Crocodile Rivers form the headwaters of the Limpopo at their confluence. The flow in the Marico River is highly variable and intermittent. There are two major storage reservoirs that regulate the flow in the Marico River, namely the Marico Bosveld Dam in the upper catchment and the Molatedi Dam further down-stream. There are several other dams, such as the Klein Maricopoort and Sehujwane Dams, from which water is mainly used for irrigation along the Marico River, particularly downstream of Marico Bosveld Dam, are present.

The Ngotwane River is a tributary of Limpopo River. It flows into Botswana before turning and joining the Limpopo River.

The Molopo River is a tributary of the Orange River. It ceases as a surface flow and discharges into pans in Botswana before turning south and emerging as surface flow just before it reaches the Orange River.

2.2.2 Geology and Groundwater

The western portion of Upper Molopo catchment is underlain by Basement granite. This is covered with an increasing thickness of Kalahari sand to the west. A mostly intrusive volcanic rock assemblage (Allanridge lava) lies to the east of Mafikeng. Significant aquifers are present locally north of Slurry. The aquifers tend to be relatively shallow. Groundwater is the only source of water supply for the rural population.

In the Upper catchment of the Groot Marico as well as the Upper Ngotwane catchment, the landscape is generally flat to gently rolling due to the Malmani dolomites. The dolomite is intruded by numerous dolerite dykes that have effectively sub-divided the dolomite into a

series of compartments, which may or may not be hydraulically linked. Groundwater is widespread, especially in chert rich horizons and karst zones where borehole yields greater than 5l/s are common, and yields of 20l/s are feasible.

The NE portions of catchments of A10A, A31A, and A31D, A10B, A31F, G, H, J, A32A, B, and C (see **Figure 2.3** below) are underlain by sandstone, quartzite, shale, diabase and andesite of the Pretoria Group.

Reference should be made to section 2.6.2: Groundwater Resources, for additional insight into the relationship between geology and groundwater in the ISP area.

Figure 2.4 shows a generalised soils map of the catchments using the broad soil groupings. The following soils types occur in the Marico, Upper Molopo and Upper Ngotwane catchments:

- Moderate to deep clay loam soils occur in most of the Upper Molopo catchment with moderate to deep sandy soils in the lower reaches of the D41A catchment. The moderate to deep clay loam soils are not the ideal soils for irrigation farming because although they have a reasonably high water holding capacity they are not readily penetrable by water.

- Moderate to deep clay loam soils with undulating topography occurs in the Marico (with the exception of the lower Marico) and Upper Ngotwane catchments. These soils are also not very suitable for irrigation farming, also due to their low permeability. Overgrazing in some portions of the catchment results is excessive soil erosion and loss of land cover. This has an impact on groundwater recharge. Irrigation farming is generally practised along the Groot Marico and its tributaries.

- Moderate to deep sandy loam soils in general flat terrain occur in the lower Marico. These soils are ideal for irrigation farming because they provide a good balance between the ability to convey water and ability to retain water. This is the area where most of the irrigation is taking place(see land use map **Figure 2.7** below)

2.3 CLIMATE AND RAINFALL

The climate of the catchments of Marico, Upper Molopo and Upper Ngotwane is generally semi-arid in the east and dry in the west. **Figure 2.5** provides the distribution of the Mean Annual Precipitation (MAP) ranging between 600 and 800 in the Marico catchment to between 400 and 600 in the Upper Molopo catchments. The rainfall is strongly seasonal with rainfall occurring as thunderstorms in summer. The variation in annual rainfall from the long term mean is especially pronounced in the Marico, Upper Molopo and Upper Ngotwane river catchments (DWAF: 1997).

The average potential Mean Annual Evaporation (MAE) (as measured by A-pan) for the western parts of the Marico catchment and the Upper Molopo and Ngotwane is very high. It is estimated to be as high as 2800mm, with the highest levels occurring in December (DWAF: 2001).

LOCALITY MAP

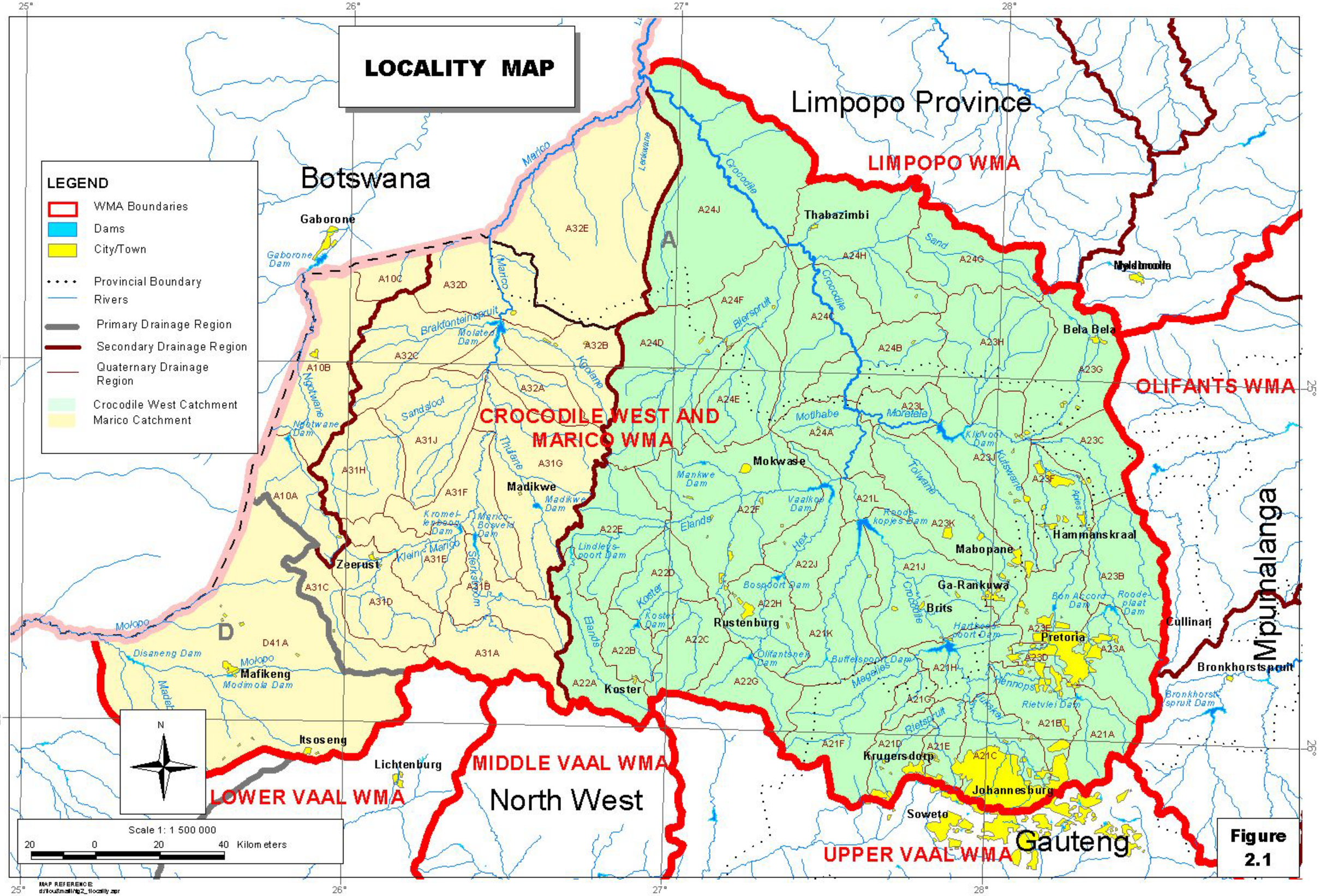


Figure 2.1

TOPOGRAPHY

LEGEND

- WMA Boundaries
- Dams
- City/Town
- Catchment Boundaries
- Provincial Boundary
- Rivers

Topography

- 800 - 1199
- 1200 - 1599
- 1600 - 1999

BOTSWANA

NORTH WEST

LIMPOPO

Lower Marico

Ngotwana Outlet

Molatedi Dam

Ngotwana Dam

Kromellenboog Dam

Upper Molopo

Marico Bosveld Dam

CROCODILE WEST & MARICO WMA

MIDDLE VAAL WMA

LOWER VAAL WMA

GABORONE

ZEERUST

MAFIKENG

ITSOSENG

LICHTENBURG

Gaborone Dam

Marico

Lenkwane

Braklfontein Spruit

Bierspruit Dam

Sandelaar

Groot - Marico

Thulane

Mankwe Dam

Sehujwane Dam

Madikwe Dam

Kromellenboog Dam

Klein-Maricopoort Dam

Klein Marico

Marico-Bosveld Dam

Lindleyspoort Dam

Ramabatama

Molopo

Disaneng Dam

Setumo Dam

Marebie

Wilgaboomspruit

Swartruggens Dam

Koster Dam

Sterkstroom

Coligny Dam

Klerkskraal

N

Scale 1: 1 250 000

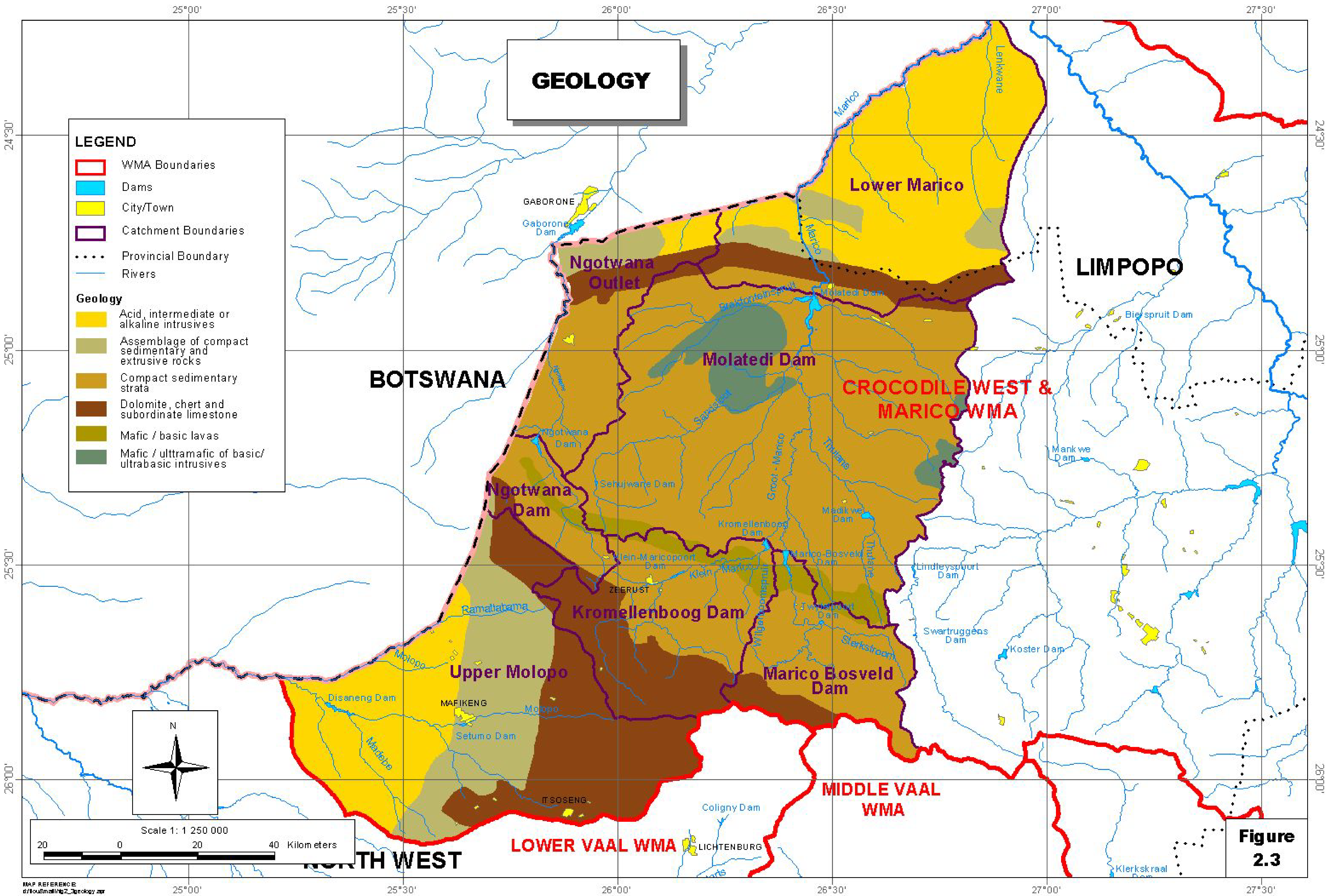
20 0 20 40 Kilometers

25°00' 25°30' 26°00' 26°30' 27°00' 27°30'

24°30' 25°00' 25°30' 26°00'

MAP REFERENCE:
d:\locus\mailing\2_2\topography.apr

Figure 2.2


GEOLOGY
LEGEND
WMA Boundaries
Dams
City/Town
Catchment Boundaries
Provincial Boundary
Rivers
Geology
Acid, intermediate or alkaline intrusives
Assemblage of compact sedimentary and extrusive rocks
Compact sedimentary strata
Dolomite, chert and subordinate limestone
Mafic / basic lavas
Mafic / ulttramafic of basic/ ultrabasic intrusives
BOTSWANA
LIMPOPO
CROCODILE WEST & MARICO WMA
MIDDLE VAAL WMA
LOWER VAAL WMA
NORTH WEST
Lower Marico
Ngotwana Outlet
Molatedi Dam
Ngotwana Dam
Kromellenboog Dam
Upper Molopo
Marico Bosveld Dam
GABORONE
Gaborone Dam
ZEERUST
MAFIKENG
ITSOSENG
LICHTENBURG
Bierspruit Dam
Mankwe Dam
Lindleyspoort Dam
Swartruggens Dam
Koster Dam
Coligny Dam
Klerkskraal Dam
Sehujwane Dam
Kromellenboog Dam
Madikwe Dam
Klein-Maricopoort Dam
Marico-Bosveld Dam
Disaneng Dam
Setumo Dam
Marico
Lenkwane
Molopo
Ramatlabama
Thulane
Groot - Marico
Klein - Marico
Sterkstroom
Scale 1: 1 250 000
20 0 20 40 Kilometers
N
25°00' 25°30' 26°00' 26°30' 27°00' 27°30'
24°30' 25°00' 25°30' 26°00'
MAP REFERENCE:
Figure 2.3

SOIL TYPES

LEGEND

- WMA Boundaries
- Dams
- City/Town
- Catchment Boundaries
- Provincial Boundary
- Rivers

Soils

Depth	Texture	Relief
Moderate to Deep	Clay Loam	Flat
Moderate to Deep	Sandy Soil	Flat
Moderate to Deep	Clay Loam	Undulating
Moderate to Deep	Sandy Loam	Flat
Moderate to Deep	Sandy Loam	Undulating

BOTSWANA

Ngotwana Outlet

Lower Marico

Molatedi Dam

Ngotwana Dam

Kromellenboog Dam

Upper Molopo

Marico Bosveld Dam

LIMPOPO

CROCODILE WEST & MARICO WMA

MIDDLE VAAL WMA

LOWER VAAL WMA

NORTH WEST

GABORONE

MAFIKENG

ITSOSENG

LICHTENBURG

ZEERUST

Gaborone Dam

Disaneng Dam

Setumo Dam

Sehujwane Dam

Klein-Maricopoort Dam

Kromellenboog Dam

Madikwe Dam

Marico-Bosveld Dam

Lindleyspoort Dam

Swartruggens Dam

Koster Dam

Mankwe Dam

Coligny Dam

Molatedi Dam

Bierspruit Dam

Jwaneng

Ramatlabama

Molopo

Marico

Lenkwane

Braklfontein Spruit

Sandaloot

Groot - Marico

Thulane

Klein Marico

Wilgenboomspruit

Sterkstroom

Marlebe

N

Scale 1: 1 250 000

20 0 20 40 Kilometers

Figure 2.4

MAP REFERENCE
d:\locus\small\fig2_4soils.apr

25°00' 25°30' 26°00' 26°30' 27°00' 27°30'

24°30' 25°00' 25°30' 26°00'

RAINFALL

LEGEND

- WMA Boundaries
- Dams
- City/Town
- Catchment Boundaries
- Provincial Boundary
- Rivers

Mean Annual Precipitation

- 400 - 500 mm
- 500 - 600 mm
- 600 - 700 mm

BOTSWANA

NORTH WEST

LIMPOPO

Lower Marico

Ngotwana Outlet

Molatedi Dam

Ngotwana Dam

Kromellenboog Dam

Upper Molopo

Marico Bosveld Dam

CROCODILE WEST & MARICO WMA

MIDDLE VAAL WMA

LOWER VAAL WMA

GABORONE

MAFIKENG

ITSOSENG

LICHTENBURG

ZEERUST

Gaborone Dam

Disaneng Dam

Setumo Dam

Ngotwana Dam

Sehujwane Dam

Klein-Maricopoort Dam

Kromellenboog Dam

Madikwe Dam

Marico-Bosveld Dam

Coligny Dam

Mankwe Dam

Lindleyspoort Dam

Swartruggens Dam

Koster Dam

Klerkskraal Dam

Bierspruit Dam

Marico

Lenkwane

Molopo

Ramatlabama

Braklfontein Spruit

Sandaloot

Groot - Marico

Thulane

Klein - Marico

Wilgeboomspruit

Sterkstroom

Matlebe

N

Scale 1: 1 250 000

20 0 20 40 Kilometers

Figure 2.5

MAP REFERENCE
d:\lous\mail\fig2_5precipitation.apr

25°00' 25°30' 26°00' 26°30' 27°00' 27°30'

24°30' 25°00' 25°30' 26°00'

2.3.1 Vegetation

Grassland and sparse bushveld shrubbery and trees cover most of the terrain. **Figure 2.6** indicates the vegetation type of the Marico, Upper Molopo & Upper Ngotwane ISP area. The vegetation type is susceptible to erosion. Forest and woodland is located in the upper catchments of Marico and Upper Ngotwane where the dolomitic aquifers are located.

2.3.2 Land Use

Figure 2.7 below provide a schematic representation of the land use pattern of the catchments of Marico, Upper Molopo & Upper Ngotwane ISP area. Land use activities comprise the following:

- The land use characteristics of the **Marico** catchment comprise rural economic activities consisting of subsistence dryland agriculture and cattle grazing with some commercial irrigation in the upper catchment and along the Marico River downstream of the Marico Bosveld Dam and Molatedi Dam. There are no major towns in the catchment but smaller settlements are scattered throughout.

- In the **Upper Molopo** catchment the land use pattern is mainly grazing and dryland subsistence agriculture, with Mafikeng the major urban and industrial town in the catchment. Commercial irrigated agriculture occurs in the northern and western portions of the catchment where the dolomites traverse the Upper Molopo catchment. The majority of the population in the catchment lives in the rural areas. There is an internal migration within the catchment from the rural areas into the urban and peri-urban areas of Mafikeng, which is putting pressure on the available resources such as water supply to the town. The other urban area is Itsoseng situated 30 km northwest of Lichtenburg.

- In the **Upper Ngotwane** catchment, there is cattle grazing and subsistence agriculture.

Overgrazing in some portions of the catchment, particularly the Upper Molopo and Upper Ngotwane, results in excessive soil erosion and loss of land cover. This has an impact on groundwater recharge

There is very little urbanisation in the catchments of the Marico, Upper Molopo and Upper Ngotwane. The only significant urban areas in these catchments are:

- Mafikeng, the capital of the North West Province. This is situated in the Upper Molopo catchment.

- Zeerust, a mining and agricultural town situated in the Marico catchments.

VEGETATION

LEGEND

- WMA Boundaries
- Dams
- City/Town
- Catchment Boundaries
- Provincial Boundary
- Rivers

Vegetation

- Tropical Bush & Savanna
- False Bushveld
- False Grassveld

Soil Erosion

- Degraded: Unimproved Grassland
- Dongas & Sheet Erosion
- Forest & Woodland
- Wetlands

BOTSWANA

GABORONE

Gaborone Dam

Ngotwana Outlet

Lower Marico

LIMPOPO

Molatedi Dam

CROCODILE WEST & MARICO WMA

Ngotwana Dam

Kromellenboog Dam

ZEERUST

Upper Molopo

Marico Bosveld Dam

MAFIKENG

Setumo Dam

Disaneng Dam

ITSOSENG

Coligny Dam

LICHTENBURG

MIDDLE VAAL WMA

LOWER VAAL WMA

Marico

Molopo

Ramatlabama

Groot - Marico

Thuliane

Sandaloot

Braklfontein Spruit

Kromellenbood Dam

Madikwe Dam

Marico-Bosveld Dam

Lindleyspoort Dam

Swartruggens Dam

Hartbeespoort Dam

Klein-Maricopoort Dam

Sterkstroom

Wilgeboomspruit

Bierspruit Dam

Mankwe Dam

Klipvalspruit

N

Scale 1: 1 250 000

20 0 20 40 Kilometers

Figure 2.6

MAP REFERENCE:
d:\lou\small\fig2_6Vegetation.apr

25°00' 25°30' 26°00' 26°30' 27°00' 27°30'

24°30' 25°00' 25°30' 26°00'

LAND USE

LEGEND

- WMA Boundaries
- Dams
- City/Town
- Catchment Boundaries
- Provincial Boundary
- Rivers
- Mines

Landuse

- Cultivated Land: Irrigated
- Cultivated Land: Dryland
- Afforestation
- Commercial Areas
- Industrial Areas
- Residential Areas
- Waterbodies
- Other

BOTSWANA

GABORONE

Gaborone Dam

Ngotwana Outlet

Lower Marico

LIMPOPO

Molatedi Dam

CROCODILE WEST & MARICO WMA

Ngotwana Dam

Sehujwane Dam

Kromellenboog Dam

Klein-Maricopoort Dam

ZEERUST

Kromellenberg Dam

Madikwe Dam

Marico-Bosveld Dam

Lindleyspoort Dam

Swartruggens Dam

Roster Dam

Bierspruit Dam

Mankwe Dam

Ramatlabama

Upper Molopo

Marico Bosveld Dam

Sterkstroom

Twyfelfontein Dam

Wilgeboomspruit

Klein Marico

Marico

Lenkwane

Tlhabane

Sandaloot

Molopo

Setumo Dam

MAFIKENG

Disaneng Dam

Madikwe

WEST

MIDDLE VAAL WMA

LOWER VAAL WMA

Coligny Dam

LICHTENBURG

Klerkskraal Dam

N

Scale 1: 1 250 000

20 0 20 40 Kilometers

Figure 2.7

MAP REFERENCE:
d:\locus\mailing\2_7landuse.apr

25°00' 25°30' 26°00' 26°30' 27°00' 27°30'

24°30' 25°00' 25°30' 26°00'

2.3.3 Demography

The National Demographic Study undertaken for DWAF provides a model for demographic change that provides input into scenarios of future water use. The study provides population scenarios for 1995 to 2025 in 5-year intervals according to province, magisterial districts and urban and rural areas**. Figure 2.8** below shows the map of settlements and ownership in the catchments.

The total population of the Marico, Upper Molopo & Upper Ngotwane ISP area in 1995 was estimated to be 539 100 with 199 600 (DWAF: 2003) located in Marico and Upper Ngotwane catchments. Approximately 62% of the population or 340 000 are located in the Upper Molopo catchment.

The Upper Molopo river catchment covers an area of 4 300 km^2. This catchment is densely populated with a population density of 79 people per km^2 compared to the Marico and Upper Ngotwane with a population density of only 14 people per km^2. The Marico river catchment covers an area of 12 030 km^2. The Ngotwane river catchment covers an area of 1842 km^2. These two catchments are sparsely populated in the rural areas with the population concentrated in the urban areas indicated.

Table 2.1 presents the population and expected growth in the urban/rural towns of the Marico-Upper Molopo & Upper Ngotwane ISP. The projected population estimates up to 2025 are expected to remain stagnant with the exception of Mafikeng and Madikwe (DWAF: 2003)

The population of Mafikeng is expected to grow at an average annual growth of 1,27% until 2025 while that of Madikwe is expected to grow at 2,6% per/annum. The rest of the urban centres are expected to have a decline in population because of the lack of economic stimulus to attract growth. The socio-economic factors influencing the growth in population for Mafikeng are the pull factors of potential employment opportunities and access to services such as water, electricity, health services, etc. These factors have to be considered in estimating future water requirements of the various demand centres of the catchment and the impact of increasing population in the towns of Mafikeng and Madikwe on the existing services such as water.

The decline in population in the other urban centres as well as potential depopulation of the rural areas is also attributed to the impact of HIV/AIDS as people move into urban centres with health services (DWAF: 2003).

SETTLEMENT & OWNERSHIP

LEGEND

- WMA Boundaries
- Dams
- City/Town
- Catchment Boundaries
- Provincial Boundary
- Rivers

- COMMERCIAL / INDUSTRIAL
- CONSERVATION
- CULTIVATED LAND
- FORESTRY
- MINING
- RESIDENTIAL
- SUBSISTANCE FARMING
- COMMUNAL LAND

25°00' 25°30' 26°00' 26°30' 27°00' 27°30'

24°30' 25°00' 25°30' 26°00'

BOTSWANA

GABORONE

Gaborone Dam

Lower Marico

Ngotwana Outlet

LIMPOPO

Molatedi Dam

Bierspruit Dam

CROCODILE WEST & MARICO WMA

Ngotwana Dam

Kromellenboog Dam

Upper Molopo

Marico Bosveld Dam

MIDDLE VAAL WMA

LOWER VAAL WMA

ZEERUST

MAFIKENG

LICHTENBURG

ITSOSENG

Lenkwane

Marico

Groot - Marico

Klein Marico

Molopo

Setumo Dam

Disaneng Dam

Mankwe Dam

Lindleyspoort Dam

Swartruggens Dam

Koster Dam

Coligny Dam

Klerkskraal Dam

N

Scale 1: 1 250 000

20 0 20 40 Kilometers

Figure 2.8

MAP REFERENCE:
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Table 2.1: Population of the urban areas in the catchment

Grouped Consumption Centre	1995	2005	2015	2025	QUAT
Ottoshoop	300	312	302	286	A31C
Zeerust / Ikageleng	15 100	15 728	15 192	14 378	A31D
Groot Marico	1 000	1 042	1 006	952	A31E
Madikwe	5 650	7 097	8 283	9 474	A31G
Debrak / Ditaung	915	1 009	1 033	1 036	A32A
Mmabatho / Mafikeng	95 450	109 870	117 402	122 934	D41A
Lehurutshe	5 500	5 729	5 534	5 237	D41A

2.4 LAND TENURE

Land tenure in the area is characterised by the different systems found in the former South Africa and the former Bophuthatswana. Within what was previously Bophuthatswana there are five categories of land tenure:

- Tribal land, sometimes coupled with the quitrent system. This constitutes over 80% of the area in these former homelands areas
- Freehold land
- State land
- Municipal land
- Institutional land (churches etc)

Within what was the "South African" portion of the area, either individuals or farming syndicates hold the majority of land under freehold title. The remaining areas are state, municipal and institutional lands.

Problems associated with the tribal land tenure system include overgrazing on communal lands etc, Very little progress has been made to date to change the tenure system to improve land use practices.

2.5 CATCHMENT ECONOMY

The economic activity in the Crocodile River (West) and Marico WMA as determined in the economic study undertaken by Urban-Econ (2000), contributes approximately 25% of the Gross Domestic Product (GDP) of South Africa (DWAF: 2003). This is the largest single contribution to the value added to the country from any of the water management areas.

Unfortunately, the socio-economic activities in the Marico, Upper Molopo & Upper Ngotwane ISP area have not been assessed separately from the Crocodile (West) ISP (Urban-Econ: 2000). No detailed information at the level of Marico, Upper Molopo and Upper Ngotwane catchments is therefore available on the level of socio-economic activity. The contribution to the GGP of these catchments is included in the whole Crocodile (West) and Marico WMA. Only a broad overview of the catchment economy is discussed below.

The main economic activities are irrigated agriculture, particularly in the dolomites, which traverse the Upper Ngotwane in the north down to the southern parts of the Upper Molopo catchments and along the Marico River. Commercial agriculture also occurs in the Marico including ranching (see **Figure 2.7**). The soil potential of the Marico, Upper Molopo and Upper Ngotwane catchments is very limited for agricultural expansion to take place in the ISP area (see **Figure 2.9**).

There are a number of small mines in the Marico catchments. These include chrome in the upper catchments of Marico and slate around Groot Marico.

There are very few secondary or tertiary economic activities taking place in the catchments with the exception of some industrial areas in Mafikeng and manufacturing in Zeerust. There are mining activities taking place around Zeerust as well as cement factories in the lower catchment of Marico (Dwaalboom) and the Upper Molopo catchment. Government contributes significantly to the GGP of the catchments, including transfer payments.

2.6 INSTITUTIONAL ARRANGEMENTS

Water resources and water supply fall under the jurisdiction of DWAF, the District Municipalities as the Water Service Authorities (Bojanala and Central) and the Water Service Provider, Botshelo Water. Mafikeng and Zeerust Local Municipalities have been authorised to act as Water Service Authorities (see **Figure 2.10**). Realignment of roles according to the Water Act is ongoing but is constrained by the lack of financial resources and skilled labour.

SOIL POTENTIAL

LEGEND

- WMA Boundaries
- Dams
- City/Town
- Catchment Boundaries
- Provincial Boundary
- Rivers

Soil Potential

- No dominant class
- Not suitable for agrculture or commercial forestry; suitable for conservation, recreation or water catchments
- Soils highly suited to arable agriculture where climate permits
- Soils not suitable for arable agriculture; suitable for forestry or grazing where climate permits
- Soils of intermediate suitability for arable agriculture where climate permits
- Soils of poor suitability for arable agriculture where climate permits
- Waterbodies

BOTSWANA

GABORONE

Gaborone Dam

Ngotwana Outlet

Lower Marico

LIMPOPO

Molatedi Dam

CROCODILE WEST & MARICO WMA

Ngotwana Dam

Kromellenboog Dam

ZEERUST

Upper Molopo

Marico Bosveld Dam

MAFIKENG

MIDDLE VAAL WMA

LOWER VAAL WMA

LICHTENBURG

ITSOSENG

Marico

Lenkwane

Braklfontein spruit

Biespruit Dam

Sandeloot

Thulane

Mankwe Dam

Sehujwane Dam

Groot - Marico

Madikwe Dam

Kromellenboog Dam

Klein-Maricopoort Dam

Klein Marico

Marico-Bosveld Dam

Lindleyspoort Dam

Wilgaboomspruit

Jwaneng Dam

Sterkstroom

Swartruggens Dam

Koster Dam

Ramatlatama

Molopo

Disaneng Dam

Setumo Dam

Matlebe

Coligny Dam

Klerkskraal

N

Scale 1: 1 250 000

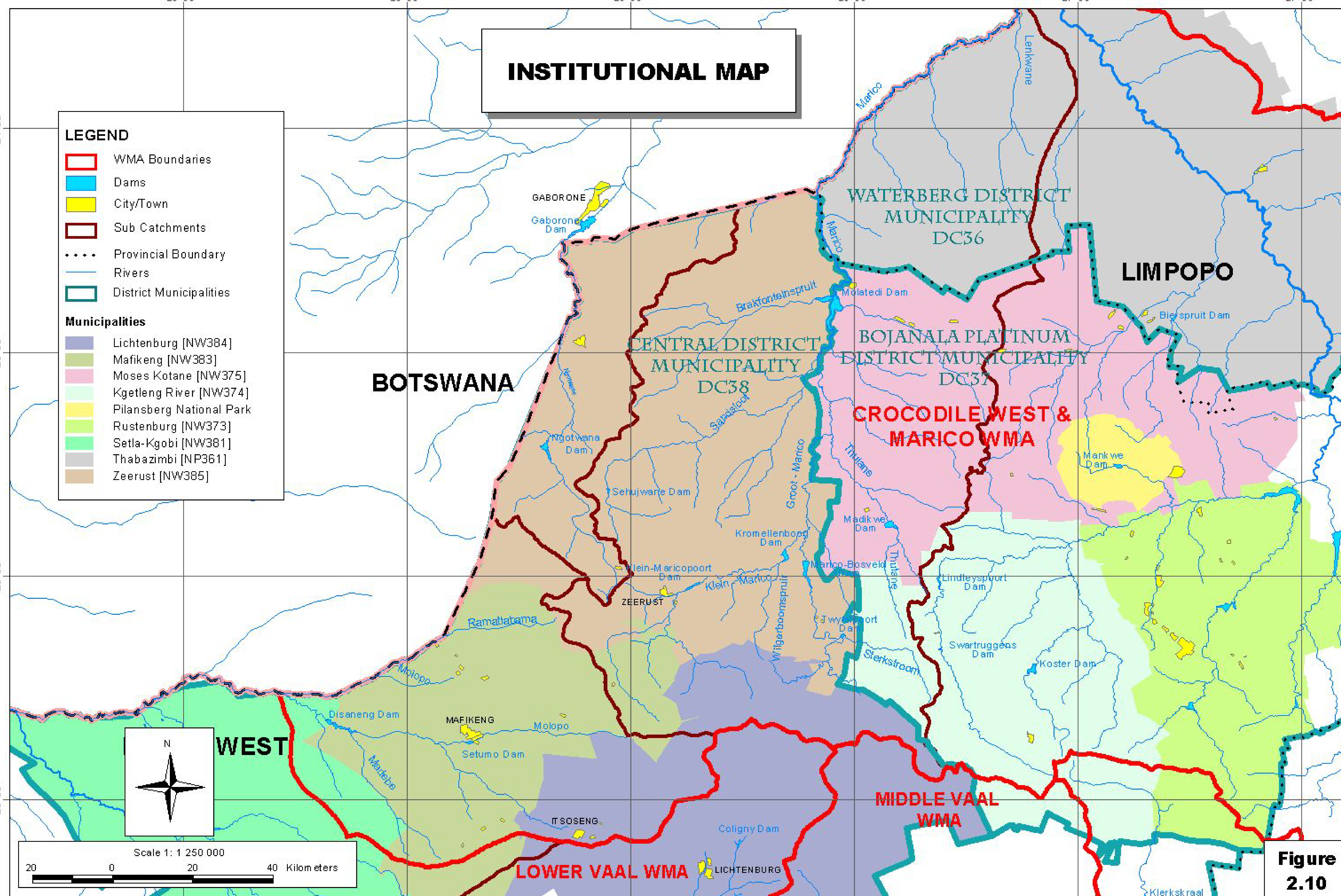
20 0 20 40 Kilometers

Figure 2.9

MAP REFERENCE
d:\ilou\Smalling\2_Soilpot.apr

25°00' 25°30' 26°00' 26°30' 27°00' 27°30'

24°30' 25°00' 25°30' 26°00'


INSTITUTIONAL MAP
LEGEND
WMA Boundaries
Dams
City/Town
Sub Catchments
Provincial Boundary
Rivers
District Municipalities
Municipalities
Lichtenburg [NW384]
Mafikeng [NW383]
Moses Kotane [NW375]
Kgetleng River [NW374]
Pilansberg National Park
Rustenburg [NW373]
Setla-Kgobi [NW381]
Thabazimbi [NP361]
Zeerust [NW385]
BOTSWANA
LIMPOPO
WEST
WATERBERG DISTRICT MUNICIPALITY DC36
CENTRAL DISTRICT MUNICIPALITY DC38
BOJANALA PLATINUM DISTRICT MUNICIPALITY DC37
CROCODILE WEST & MARICO WMA
MIDDLE VAAL WMA
LOWER VAAL WMA
GABORONE
Gaborone Dam
Molatedi Dam
Bierspruit Dam
Mankwe Dam
Madikwe Dam
Ngotwana Dam
Sehujwane Dam
Kromellenboog Dam
Klein-Maricopoort Dam
Marico-Bosveld
Lindleyspoort Dam
Swartruggens Dam
Koster Dam
Disaneng Dam
Setumo Dam
Coligny Dam
Klerkskraal Dam
ZEERUST
MAFIKENG
ITSOSENG
LICHTENBURG
Marico
Lenkwane
Brakfonteinspruit
Sandsloot
Groot - Marico
Klein - Marico
Thulane
Sterkstroom
Ramatlabama
Molopo
Maelebe
Scale 1: 1 250 000
20 0 20 40 Kilometers
N
25°00'
25°30'
26°00'
26°30'
27°00'
27°30'
24°30'
25°00'
25°30'
26°00'
Figure 2.10

2.7 WATER RESOURCES OVERVIEW

The surface water runoff is highly variable and the available surface water resource has been fully developed. There is very limited potential for further surface water resources development of the ISP area.

Groundwater in Marico, Upper Molopo & Upper Ngotwane ISP area is an abundant source of water because of the geology. Groundwater is important at two levels:

- There are high yielding dolomitic aquifers as discussed in more detail in chapter 4.
- Local groundwater sources are available for rural water supplies

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. Groundwater is the main source for rural water supplies.

The Marico, Upper Molopo & Upper Ngotwane ISP area is currently under stress even without implementation of the reserve. Therefore, no new licences can be considered from surface water resources with the exception of licences to abstract from groundwater outside of the dolomites.

Interbasin transfers from the Vaal River for instance will be hugely expensive and this must be seen in context with the low level of economic activity and the socio-economy of the area. The area should rely on groundwater for its future water requirements. This can be achieved by improving the groundwater management and understanding the dolomitic aquifers traversing the ISP area better.

Trading of water licences between user sectors and within user sectors is another option available to the Marico, Upper Molopo & Upper Ngotwane ISP area. There is also potential for re-use of effluent in such catchments as the Upper Molopo where a lot of return flow is being generated and is currently not being fully utilised.

Groundwater occurrence is controlled by the prevailing lithology of any given area. The distribution of the lithologies of the region with respect to hydrogeology is illustrated on the simplified lithostratigraphical map of **Figure. 2.3.** All three catchments of Marico, Upper Molopo and Upper Ngotwane are underlain by hard rocks with aquifers developed in secondary features associated with weathering pockets, structure and, in dolomite areas, karst features.

Structural and karst features are important and higher borehole yields are generally associated with these features. The biggest groundwater resources are associated with the dolomite aquifer.

Groundwater is available throughout the three catchments in varying quantities depending upon the hydrogeological characteristics of the prevailing lithology. The catchments are characterised by a different geology and lithology, each with distinctive groundwater occurrence.

The dolomite aquifer in the south of the region is a major aquifer suitable for bulk water supplies and currently supports abstraction of approximately 82 million m^3 per annum. This aquifer is thought to be suitable for further development assuming appropriate management and studies are currently being undertaken to properly quantify the available resources and potential for additional abstraction.

2.8 SURFACE WATER RESOURCES AND SOURCES OF SUPPLY

The following tables contain information on the updated available water, water requirements and water balance information in each sub-area of the Marico, Upper Molopo and Upper Ngotwane catchments. During the ISP assessment of water availability and water requirements, differences were identified in the water requirements and availability. The differences between the NWRS figures and ISP are explained in the chapter dealing with each sub-area of the Marico, Upper Molopo and Upper Ngotwane ISP.

These figures are provided in **Table 2.2 - Table 2.5** below.

Table 2.2: Natural Mean Annual Runoff and Ecological Reserve (million m^3/a)

Catchment	Natural MAR (1)	Ecological Reserve (1, 2)
Marico	126	29
Upper Molopo	37	5
Upper Ngotwane	14	0
TOTAL	**177**	**35**

1 Quantities given are incremental, and refer to the sub-area under consideration only.
2 Total volume given, based on preliminary estimates. Impact on yield being a portion of this
(Source: Midgely, 1994)

The Marico catchment has the highest natural MAR of the three sub-areas, estimated at **126 million m^3 per annum**. There are two major dams developed in the Marico sub-area, namely the Marico-Bosveld and Molatedi Dams and a number of small dams.

The Upper Molopo River catchment has very low rainfall-runoff characteristics. Its estimated natural Mean Annual Runoff (MAR) is only **37 million m^3 per annum**. The total yield from the catchment is so small that any applications for bulk water supplies cannot be supplied from surface water resources.

The Upper Ngotwane is the area with the smallest unit runoff with a MAR of **14,4 million m^3 per annum**.

Table 2.3 indicates that available water (i.e. yield) in each sub-area of the Marico, Upper Molopo and Upper Ngotwane catchments. The available water is the volume of water available for abstraction over a given period of time from a reservoir or any other water resource system. This is the **yield** from either a reservoir or any water resource system over a given period of time.

Table 2.3: Available yield in year 2000 (million m³/a)

Sub-area	Total sub-area requirements		Usable Return Flow			Total local yield	Transfers in	Grand Total
	Surface water (1)	Ground -water	Irrigation	Urban	Mining & bulk			
Marico*	30	23	2	3	1	59	0	59
Upper Molopo	9	9	0	5	2	25	0	25
Upper* Ngotwane	1	5	0	0	0	6	0	6

* Upper Ngotwane has been separated from Marico in the ISP

([1]) After allowance for the impacts on yield of: ecological component of Reserve, river losses, alien vegetation, dry land agriculture and urban runoff.

The above information provides the background of the sources of supply for the water users in the ISP area.

2.9 WATER REQUIREMENTS

Table 2.4 below presents the water requirements for the year 2000 at 1:50 year assurance of supply. The main water user sectors are Irrigation in the Marico sub-area and urban water in the Upper Molopo sub-area where the population density is very high.

Table 2.4: Year 2000 water requirements (million m³/a)

Sub-area	Irrigation	Urban[1]	Rural[1]	Mining & bulk[2]	Total local requirements	Transfers out	Grand Total
Marico	32	9	12	4	58	7	65
Upper Molopo	24	13	6	5	48	0	48
Upper Ngotwane[3]	5	2	3	0	10	0	10
TOTAL	**61**	**24**	**21**	**9**	**116**	**7**	**123**

[1] includes component of Reserve for basic human needs at 25 l/c/d

[2] mining and industrial water uses which are not part of urban systems

The water requirements are given at 1:50 year assurance of supply.

2.10 RECONCILIATION OF AVAILABLE YIELD WITH WATER REQUIREMENTS

The reconciliation of the available water and total requirements for the year 2000, including transfers, to Botswana is presented in **Table 2.5**.

As can be seen from **Table 2.5,** Marico, Upper Molopo and Upper Ngotwane sub-areas are currently in deficit. The deficit takes into account the impact of the ecological Reserve on the local yield of the catchments. Reconciliation for future water requirements (year 2025) indicates that the deficit increases because there is no potential for further surface water resource development. The potential for further groundwater development is discussed in chapter 5.

Table 2.5: Reconciliation of water requirements and available yield for year 2000 (million m³/a)

Sub-area	Available water			Water requirements			Balance
	Local yield	Transfers in	Total	Local requirements	Transfers out	Total	
Marico*	**59**	**0**	59	**58**	**7**	**65**	**(6)**
Upper Molopo	**25**	**0**	25	**48**	**0**	**48**	**(23)**
Upper* Ngotwane[3]	**6**	**0**	**6**	**10**	**0**	**10**	**(4)**
TOTAL	**90**	**0**	**90**	**116**	**7**	**123**	**(33)**

* Marico and Upper Ngotwane catchments separated in the ISP

2.11 IDENTIFICATION OF SUB-AREAS FOR THE MARICO, UPPER MOLOPO AND UPPER NGOTWANE CATCHMENTS

The ISP area was divided into the following three sub-areas based on the distribution of the surface water resources;

- Marico sub-area, which comprises the A31 and A32 secondary catchments.
- Upper Molopo sub-area, which comprises only the D41A quaternary catchment.
- Upper Ngotwane sub-area, which comprises the A10 secondary catchment.

The NWRS combined Marico with the Upper Ngotwane catchments into one sub-area. In this ISP these two catchments have been split and this ISP therefore deals with three sub-areas instead of two as per the NWRS. The reason for splitting the ISP into three sub-areas is because of the distinct nature of the Marico, Upper Molopo and Upper Ngotwane catchments. This is described in the following sections below. The sub-areas are shown in **Figure 2.11**.

The groundwater sub-areas do not however correspond with the surface sub-areas. This is discussed in chapter 3 on groundwater overview.

2.11.1 Marico Sub-area

The main rivers in the sub-area are the Groot Marico River, Thulane and Sandsloot.

The primary motivation for this sub-area is the fact that the Marico River and its tributaries supply water to Gaborone based on the TSWASA agreement signed in 1988 between Botswana, South Africa and the former homeland of Bophuthatswana. The area has commercial agriculture along the banks of Marico River. There are therefore more commercial farms and eco-tourism developments than rural towns in this sub-area, and as such it represents a different economic activity to the other sub-areas. An additional reason for the sub-area division is that the Marico sub-area has significant surface water resources, compared to the very limited surface water resource of other sub-areas.

2.11.2 Upper Molopo Sub-area

The main river in the sub-area is the Molopo River, which flows through the main urban area of Mafikeng. The run-off in the river is mainly from the return flows of the Mafikeng urban area.

There are significant dolomitic aquifers in the Upper Molopo, which traverse the Middle Vaal Water Management Area. Besides Mafikeng and the small urban area of Itsoseng, rural towns and settlements with mainly subsistence farming and community grazing practised characterize the sub-area. The sub-area has the highest population density compared to the other sub-areas.

2.11.3 Upper Ngotwane Sub-area

Ngotwane River is the only river in this sub-area. The main feature of the sub-area is that it is deeply rural dominated by subsistence farming. There are no industries or major urban centres.

SUB AREA MAP

LEGEND

- WMA Boundaries
- Dams
- City/Town
- Catchment Boundaries
- Provincial Boundary
- Rivers
- Primary Drainage Region
- Secondary Drainage Region
- Quaternary Drainage Region
- Nature Reserve Boundaries

Sub Areas

- Upper Ngotwana
- Marico
- Upper Molopo

BOTSWANA

LIMPOPO

NORTH WEST

CROCODILE WEST & MARICO WMA

MIDDLE VAAL WMA

LOWER VAAL WMA

GABORONE

Gaborone Dam

ATHERSTONE

Lenkwane

Marico

Molatedi Dam

Brakfontein spruit

Ngotwana Dam

Sehujwane Dam

PIENAAR

Kromellenboom Dam

Madikwe Dam

Klein-Maricopoort Dam

Klein Marico

Marico-Bosveld Dam

MARICO BOSVELD

Twyfelfontein Dam

Wilgetboomspruit

Sterkstroom

Thulane

Groot - Marico

Sandspruit

ZEERUST

BOTSALANO

Ramatlabama

Molopo

Disaneng Dam

MAFIKENG

Setumo Dam

Madebe

MALMANIES-OOG

ITSOSENG

Coligny Dam

LICHTENBURG

Mankwe Dam

PILANESBERG

Hundleyspoort Dam

Swartruggens Dam

Koster Dam

Bierspruit Dam

Klerkskraal

A10A A10B A10C A10D

A22A A22B A22C A22D A22E A22F A22G A22H A22J A22K

A24A A24B A24C A24D A24E A24F A24G A24H

A31A A31B A31C A31D A31E A31F A31G A31H A31J

A32A A32B A32C A32D A32E

A41A

C23F C24C C24F C31A

A21F A21K

25°00' 25°30' 26°00' 26°30' 27°00' 27°30' 24°30' 25°30' 26°00'

N

Scale 1: 1 250 000

20 0 20 40 Kilometers

MAP REFERENCE:

Figure 2.11

3 GROUNDWATER RESOURCES OVERVIEW

3.1 GROUNDWATER OCCURRENCE AND RESOURCE OVERVIEW

The overview of the groundwater resources is discussed according to groups of Quaternary Catchments sharing similar lithology and morphological characteristics. The distribution of the lithologies of the region with respect to hydrogeology is illustrated on the simplified lithostratigraphical map of **Fig. 2.3**.

Groundwater occurrence is controlled by the prevailing lithology of any given area. All three catchments are underlain by hard rocks with aquifers developed in secondary features associated with weathering pockets, structure and, in dolomite areas, karst features. Structural and karst features are important and higher borehole yields are generally associated with these features. The highest groundwater resources are associated with the dolomite aquifer.

3.2 THE CENTRAL AND WESTERN PART OF CATCHMENT D41A

This comprises the catchment of the Upper Molopo west of the dolomite outcrop. Mafikeng is a significant urban centre within this area. The quaternary catchment comprises generally flat to rolling countryside. Land use is grazing and dry land agriculture with some small irrigation. South, west and north of Mafikeng the area is communal land.

The western portion of D41A is underlain by Basement granite. This is covered with an increasing thickness of Kalahari sand to the west. Groundwater occurrence within the granite is widespread but very variable with borehole yields ranging from 0.1 l/s to 2 l/s. Higher yields of 5 l/s or more are found, especially north of Mafikeng towards Ramatlabama in a small area of Kraaipan Formation. Borehole depths vary from 30 – 100m and water levels are mostly between 15 and 30m, with the deeper levels towards the west and north.

A mostly intrusive volcanic rock assemblage (Allanridge lava) lies to the east of Mafikeng. Significant aquifers are present locally north of Slurry and irrigation using centre pivots is feasible from borehole yields greater than 5l/s. Elsewhere groundwater is limited but is usually sufficient for motorised pumps, yields 0.5 – 2 l/s. The aquifers tend to be relatively shallow, ranging between 30m – 50m. Borehole depths average 30 – 80m with water levels 10 – 30m below surface.

3.2.1 Groundwater Quality

The groundwater quality is characterised by conductivities generally between 70mS/m and 150mS/m (Class 1) but locally Class 2 with conductivities between 150mS/m and 300mS/m. The pH is between 6.5 – 7.5. Overall, the quality is generally acceptable for potable use, although elevated NO_3 are reported in some rural localities.

3.3 THE EASTERN PART OF CATCHMENT A41C, CATCHMENT A31C AND SW PORTIONS OF A31A, AND D AND A10A UNDERLAIN BY MALMANI DOLOMITE.

The Malmani dolomite forms a generally flat to gently rolling plateau landscape and covers approximately 3500km^2 in the southern part of the region. The elevation of the plateau varies from around 1600mamsl in the east to 1430 mamsl east of Mafikeng and 1410mamsl at

Dinokana. NW of Dinokana the dolomite outcrop narrows rapidly and there is a steep drop to the Botswana border at 1230mamsl.

The area is almost entirely agricultural with Itsoseng and Ottoshoop the only towns on the outcrop. There is extensive irrigation based on groundwater abstraction in the southern part of the dolomite centred along the Lichtenburg – Mafikeng road. The northern part of the dolomite in catchment D41A and the southern area around Itsoseng comprises communal land.

The dolomite is intruded by numerous dolerite dykes, which have effectively sub-divided the dolomite into a series of compartments, which may or may not be hydraulically linked. Aquifers are shallow to deep (10 – 70m) depending upon the presence or absence of chert horizons, karst features and topography. Groundwater is widespread, especially in the chert rich horizons in the Monte Christo and Eccles Formations, and karst zones are common where borehole yields greater than 5l/s occur and yields of 20l/s are often feasible. Elsewhere sustainable yields can be less than0.5l/s.

Boreholes can be up to 150m deep, but are mostly 50 – 70m. Water levels are generally between 0m at the springs increasing to 30 – 40m below surface in the centre of the outcrop.

The dolomite feeds many springs and contributes base flow to the Marico, Ngotwane and Molopo catchments.

As noted above this is an important regional groundwater resource suitable for development for bulk water supply. The bulk water supply for Mafikeng is mostly obtained from the Grootfontein and Molopo springs and there is significant abstraction to supply Zeerust, and Itsoseng. Additional bulk water supply schemes are presently being assessed.

3.3.1 Groundwater Quality

Groundwater quality is good and is mostly pristine, Class 0. There is little evidence of pollution. Quality concerns relate to informal settlements, concentrations of people near springs and the impact of irrigation.

There are no constraints to use for potable or agricultural purposes.

3.4 GROUNDWATER USE

Several bulk abstraction schemes have their source of water supply from the dolomite aquifer:

- Mafikeng is supplied by approximately **5 million m³/a** from Grootfontein spring and **6 million m³/a** from Molopo spring.
- Approximately **1,3 million m³/a** are abstracted from the Polfontein compartment to supply Itsoseng.
- Zeerust draws **3 million m³/a** from the Doornfontein wellfield and **3 million m³/a** from Rietpoort wellfields. Both these wellfields are in A31D.

- Uitvalgrond (also in A31D) to the SW of Zeerust is designed to deliver **1 million m³ /a**, also for Zeerust.

- The Dinokana wellfield supplies **1,5 million m³ /a** for Lehurutshe.

The total bulk abstraction for urban supply is thus some **21 million m³/a**.

Irrigation abstraction within this region is substantial and estimated at some **61million m³ /a**, (ref. Augmentation of Primary Water Supply to Zeerust, Mafikeng and Swartruggens. Feasibility Study Phase 1, Vol. 1, Main Report, Bigen Africa, January 2001.)

The relationship between this abstraction of some **82 million m³/a** and the overall groundwater resources of the dolomite in this area and the ability of the aquifer to sustain exploitation at this level is currently being investigated, (ref. the North West Province Dolomitic Water Area Resources Management project, A detailed understanding of the magnitude of the resources is critical to the long-term management and sustainability of the dolomite aquifer.

3.5 THE NE PORTIONS OF CATCHMENTS A10A, A31A, AND A31A, A10B, A31F, G, H, J, A32A, B, AND C.

These catchments are underlain by sandstone, quartzite, shale, diabase and andesite of the Pretoria Group. The topography comprises a series of dips and escarpments formed by the Pretoria Series quartzite ridges and shale valleys, with andesite and diabase forming wide valleys and plains.

Aquifers are associated with weathering and fracturing of the bedrock. Groundwater resources are widespread but aerially limited and borehole yields are generally less than 0.5 l/s to 2.0 l/s. Borehole depths are variable and controlled by the depth of the weathering and fracturing forming the water bearing horizons and vary from 30m to greater than100m. Water levels tend to be shallow between 20 – 30m below surface.

The aquifers represent important sources for stream base flow for the Groot Marico and its tributaries. Protection of the aquifers from over exploitation is important.

3.5.1 Groundwater Quality

The groundwater quality is characterised by conductivities generally between 70mSm and 150mS/m (Class 1) but locally Class 2 with conductivities between 150mS/m and 300mS/m. PH is generally 6.5 – 7.5.

Overall, the quality is generally acceptable for potable use, although elevated NO_3 are reported in some localities within the communal land areas of Lehurutshe District.

3.6 THE NORTHERN PORTION OF A10B, AND CATCHMENTS A10C, A32D AND A32E.

These are rural catchments, with communal areas in the SW and SE. Madikwe Game Reserve covers a large area in the north in A10C and A32D. Most of A32E is cattle ranching with limited water requirements although some irrigation may be practised along the Marico River using water released from Molatedi Dam. Groundwater represents the only source for water supply away from the Groot Marico River and Molatedi Dam.

A narrow east west trending outcrop of Malmani dolomite forms rugged terrain in the northern part of A10B and southern parts of A10C and A32D. The topography becomes more subdued to the east in the southern part of A32E. The groundwater resources of these dolomites are mostly limited and underdeveloped and the area could be ecologically sensitive. In the undeveloped areas, the groundwater quality is pristine and some contribution to base flow can be anticipated. Karst development is either absent or localised and borehole yields usually less than 2l/s from boreholes with average depths between 40 and 100m. Water levels are dependent upon the topography, varying from less than 10m to greater than 40m.

The dolomite crosses the international boundary into Botswana at Ramotswe. However, there is limited interaction across the border. The dolomite aquifer at Ramotswe has been developed but has become heavily polluted from the growth of the town. The impact of the uncontrolled development at Ramotswe on the groundwater resources of the dolomite within the catchment in the far west of A10B needs to be determined.

North of the dolomite the area is underlain by basement granite and some sedimentary strata. Aquifers within these rocks are confined to weathering and fracturing zones. The area is characterised by poor to marginal groundwater resources, with yields <0.5l/s. Groundwater in Madikwe Game Reserve is only used for isolated game management boreholes and water supply to the lodges.

Groundwater is more widespread in secondary aquifers developed in weathering and fracturing of the granite of A32E and is used for stock watering. The aquifers tend to be 20 – 50m deep, and borehole yields 0.5l/s or less. Water levels in this area are between 20 – 30m below surface. Adverse impacts from activities within these northern catchments outside the communal area are unlikely.

3.6.1 Groundwater Quality

The groundwater in the Malmani dolomite is pristine to the east of the area adjacent to the border at Ramotswe.

Elsewhere, the groundwater quality is characterised by conductivities generally between 70mS/m and 150mS/m (Class 1) but locally Class 2 with conductivities between 150mS/m and 300mS/m. PH is generally 6.5 – 7.5. Overall, the quality is generally acceptable for potable use, although elevated NO_3 are reported in some rural localities in the far north of Lehurutshe District.

3.7 GROUNDWATER RECHARGE

An assessment of aquifer recharge provides an indication of the sustainable groundwater resources.

The mean annual rainfall in the Molopo and Marico catchments varies between 400 and 600mm, with the lower precipitation west of Mafikeng and in the far north of the Marico catchment (A10C, A32D and A32E). Although the annual rainfall is accordingly quite similar over the entire catchment annual recharge is estimated to vary significantly, with recharge conservatively estimated to be over 40mm in the dolomite plateau in the southern areas (greater than 7% of rainfall) to less than 5mm in the western and far northern areas, (1% of rainfall).

Using these figures, groundwater recharge over the entire region is estimated to be approximately **350 million m³ /a**, with over 42% of the recharge (150Mm³) occurring on the dolomites which cover 3500km², (19%) of the catchment. On this basis the dolomite aquifer, for example, should be able to sustain the current abstraction of **82 million m³ /a**. Estimates of recharge to the dolomite vary widely. Recharge is known to increase rapidly with increase in rainfall. The 150Mm³ per annum recharge to the dolomite is thus likely to at the lower end of recharge estimates. This aspect is being investigated as part of the NWDWARM project.

The recharge estimates for the catchments of the WMA indicate that overall, the available groundwater resources are under utilised. It should be stressed that the exploitation potential depends upon both the mode of groundwater occurrence and the water demand to be satisfied. Even weaker groundwater occurrence areas can usually provide more than the RDP level of 25 litres per head per day within a reasonable distance of the user, conversely, bulk abstractions for urban supply in any aquifer other than the dolomite is not feasible.

3.8 SPECIFIC ISSUES AFFECTING GROUNDWATER SUB-AREAS

3.8.1 Catchments Underlain by Dolomite (The eastern part of catchment A41C, catchment A31C and SW portions of A31A, and D and A10A).

- *The dolomite aquifer crosses the international boundary into Botswana close to Lobatse.*

The dolomite does not represent a significant aquifer close to the border due to a narrowing of its outcrop and steep topography. Nevertheless, the groundwater gradient is towards Botswana and regional groundwater flow will therefore cross the international boundary. The extent of flow and the impact of abstraction within the catchment and flow towards Lobatse need to be assessed in terms of international obligations.

- *The dolomite aquifer crosses the catchment boundary into the Lower Vaal WMA.*

The dolomite strike trends to the south and SE into the Lower Vaal WMA. Abstraction from the dolomite aquifer within the catchment could affect the resources available within the WMA, and visa versa. Whether or not this is an issue is unclear at this stage.

An investigation is underway (NWDWARM) to determine regional groundwater flow directions, distribution of aquifers within the Malmani dolomite, compartmentalisation due to dolerite dyke intrusions and impact of abstraction.

- *Abstraction for irrigation is important. Knowledge of the volumes abstracted, particularly in D41A, is not properly quantified.*

- *Abstraction from dolomite aquifer can cause sinkholes to develop.*

It is a known fact that pumping of groundwater from dolomite can cause sinkholes to develop, especially in areas where the ground is already unstable and water levels are allowed to fluctuate regularly. Sinkholes are not currently reported to be a problem but cognizance of this potential problem must be made.

- *Dolomite aquifers are particularly vulnerable to pollution, in particular:*

(i). Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3. The strategy discussed in section 4.4 must be implemented.

(ii). The impacts of agricultural practise on groundwater quality must be assessed, especially with regard to use of fertilisers in the irrigated areas, and surface runoff of nitrate and phosphate rich water entering drainages and the groundwater resources, which then provide base flow.

- *The dolomite aquifer is an important strategic water resource and requires sound management.*

Knowledge of the volume of the groundwater resources available and the impact of existing use, contribution to spring/surface water flow and the reserve requirements is essential before decisions concerning further abstraction can be made. This is being undertaken as part of the broad dolomite groundwater resources assessment study mentioned above, (NWDWARM).

- *Management control of the Malmani Dolomite Aquifer.*

The dolomite represents a strategic water resource. As presently envisaged the outcrop falls into several CMA even though the boundaries of the dolomite aquifers and compartments do not coincide with the surface catchment boundaries. A study to determine the most suitable institutional framework for the management of dolomite aquifers is being undertaken by the IUCN under the umbrella of the NWDWARM project.

- *Springs must be protected, particularly where these are used for water supply to urban and rural communities.*

- *The impact of development on spring flow must be considered when implementing groundwater abstraction schemes.*

3.8.2 The northern portion of A10B, and Catchments A10C, A32D and A32E.

- *Parts of the dolomite area are ecologically sensitive. Any development will impact on the pristine nature of the resources.*

- *The dolomite aquifer crosses the international boundary into Botswana at Ramotswe.*

The pollution of the dolomite at Ramotswe is noted.

4 GROUNDWATER STRATEGIES

Management objectives in relation to sustainable and equitable utilisation of the available resources can be broadly summarised as follows:

4.1 BROAD MANAGEMENT OBJECTIVES

- Groundwater resources form an integral part of integrated water resources development planning.
- Conjunctive use of surface and groundwater, where feasible, is to be encouraged to maximise the optimal use of available resources.
- Equitable availability of (ground) water resources to all users.
- Management of available resources shall be aimed at ensuring the long-term sustainability.

4.2 OVERALL STRATEGIC APPROACH

At this stage, the magnitude of the groundwater resources within the region is not well documented and the development of an increased understanding of the availability and distribution of the groundwater resources is therefore a priority. This requires the preparation of a catchment wide assessment of the groundwater resources and the continual updating of this assessment.

The overall strategic approach to the development and management of the groundwater resources of the region must include:

- Optimal development of the available groundwater resources using a proper scientific approach, i.e.,
  - (i). suitable assessment of the aquifers and available resource,
  - (ii). application of photogeological and geophysical methods for correct selection of drilling sites,
  - (iii). construction of boreholes according to DWAF and SABS standards to ensure longevity and protection of the aquifer from pollution,
  - (iv). controlled testing of boreholes and selection of correct pumps and operational recommendations.
  - (v). groundwater quality assessments
- Long-term aquifer, wellfield and borehole management to avoid over-exploitation and long-term sustainability.

- The protection of the available groundwater resources (quantity and quality) to ensure long-term sustainability. This requires:

  (i). the application of optimal development procedures as noted above

  (ii). the implementation of a programme to promote awareness amongst users, educate users on water conservation and demand management,

  (iii). delineation of wellhead protection zones,

  (iv). protection of wellhead zones from water spillage, damage by cattle drinking, etc.

  (v). Positioning of new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.

- Equitable availability to all users

- Groundwater quality objectives and management strategies

- Implement study of interrelationship between surface and groundwater. This will incorporate the study of the relationship between groundwater abstraction and stream flow in drainage source areas.

Equitable availability of water to all users forms the cornerstone of the entire water management strategy. This requires that the water resources, including groundwater, are available to all users and utilised for the benefit of all. In particular, management decisions will/may be needed in the future to re-allocate water from some existing users to new users, e.g., from existing irrigation users to emerging farmers or community water supply in areas of shortage via compulsory licensing.

As noted elsewhere, groundwater resources are usually sufficient to meet the RDP level of supply within a reasonable distance of all users.

4.3 GROUNDWATER AVAILABILITY

This involves issues such as groundwater abundance, over exploitation, shortages during drought, licensing, etc.

The availability of groundwater for abstraction is controlled by the aquifer characteristics of permeability and storage. These parameters are variable and hence areas with differing lithology, and even within the same lithology, will have differing groundwater resources and thus differing groundwater development potential. As noted in Section 2, borehole yields vary widely across the region.

In areas of heavy demand in relation to the resources, groundwater availability becomes a management issue, and accordingly if over exploited, even dolomite aquifers can eventually fail. The licensing of groundwater use combined with the assessment of the overall available resources is thus an important component of active aquifer management.

Of particular concern, especially since this affects the rural population disproportionally, are shortages of water during drought. This is particularly the case in areas of low resources and low capacity, (i.e., limited number of boreholes) and/or where boreholes have been poorly sited (intersecting shallow water horizons vulnerable to drought and contamination. To cope with these eventualities the following strategy is required:

- Suitable siting of boreholes
- Correct drilling procedures and borehole design and construction
- Testing of boreholes to confirm the long term sustainable yield
- Collection of samples and analyses for potability
- Equipping of boreholes with the correct capacity pump set at the correct depth
- Implement policy to educate users on water conservation
- Implement water conservation and demand management practices.

4.4 GROUNDWATER QUALITY

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

- domestic use
- agriculture
- mining
- waste disposal

Pollution emanating from settlements, especially informal settlements, is 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 actions 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 concerning the need for, and ways of, protecting the groundwater resources is required.

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

- Impacts of agricultural practise on groundwater quality must be assessed, especially with regard to over use of fertilisers, and surface runoff of nitrate and phosphate rich water entering drainages and the groundwater resources, which then provide base flow.

- Establish wellhead protection areas in accordance with DWAF guidelines.

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, EIA and closure plans which will identify and put preventative and remediation measures, including monitoring, in place.

- A census of operational and abandoned mines is required to assess any potential groundwater pollution threat and determine the need for remediation.

- Pollution of groundwater by mining effluent and acid mine drainage. The possibility of decant from abandoned mines must be considered and any impacts identified and remediated. Prevention and remediation measures may be needed. Monitoring programmes may need to be established/maintained.

Waste disposal sites offer a potentially serious hazard due to poor management and lack of operating controls. The pollution risk from waste disposal needs to be assessed and remediated.

It is important that mines, industry and waste dumps have valid licenses and approved EMPR's/EIA's where necessary.

4.5 DEVELOPMENT APPROACH

This requires a thorough assessment of the groundwater resources be undertaken before confirming the water source.

- Develop groundwater as first priority for any scheme.

- Ensure conjunctive use where groundwater resources alone are inadequate to satisfy the demand.

- This requires a thorough assessment of the groundwater resources be undertaken before confirming the water source.

Ensure development is undertaken following sound scientific principles. Selection of borehole sites, borehole design and construction, testing, equipping and management operations must adhere to DWAF and SABS standards, as a minimum.

4.6 GROUNDWATER DEVELOPMENT PROCEDURES

Groundwater development projects should be undertaken by recognised professional hydrogeologists. All contracting works must 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.

The adoption of correct development procedures is a pre-requisite for the sustainable utilization of the groundwater resources.

4.7 INFORMATION

Availability of up to date information is important for development and management. Information is available from a number of sources, including:

- 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 maps of Johannesburg 2526, Vryburg 2522 and the 1995 Pietersburg 2326 map.
- More detailed information, especially for communal land areas, can be obtained from the National Groundwater Data Base (NGDB) of DWAF. Recent hydro-census data is available for the dolomite areas, also from DWAF.

5 MARICO SUB-AREA – WATER RESOURCES OVERVIEW, ISSUES AND STRATEGIES

5.1 WATER RESOURCES OF MARICO SUB-AREA

The rainfall pattern of Marico catchments is highly variable and unevenly distributed within the catchments. The intermittence of the rainfall results in frequent floods and local droughts.

The natural MAR of the Marico River is approximately **126 million m³ /a.** The available surface water resource is mainly from the Marico Bosveld and the Molatedi dams. The total transfer out of Marico sub-area to Gaborone in Botswana from the Molatedi Dam is estimated to be **7 million m³/a**. This is in line with the TSWASA agreement.

Table 5.1 indicates the main surface water resources of Marico sub-area. The purpose of these reservoirs is also indicated in the table. There are no more economical sites available for the construction of dams in this sub-area.

Table 5.1: Surface water resource yield from the main River and Dams in the Marico sub-area

Catchments	Rivers	Dams	Owner	Yield (million m³/a)	Purpose
A31B	Groot Marico	Marico –Bosveld	DWAF	9,6	Irrigation
A31D	Klein Marico	Klein Maricopoort	DWAF	1,4	Irrigation
A31E	Klein Marico	Kromellenboog	DWAF	1,8	Irrigation
A31G	Thulane	Madikwe	DWAF	1,2	Domestic
A31H	Sandsloot	Sehujwane	DWAF	0,52	Domestic
A32A,B,C	Groot Marico	Molatedi Dam	DWAF	21	Irrigation/domestic
A31G	Thulane	Pella	DWAF	0,74	Domestic
TOTAL SURFACE YIELD				**36,26**	

(Source: Crocodile (West) and Marico situation assessment report)

The Marico Bosveld Dam situated in the upper catchment of the Groot Marico River (A31B) supplies irrigators downstream in A31.

The TSWASA scheme, which consists of the Molatedi Dam and associated infrastructure, was constructed to supply water to the former homeland of Bophuthatswana, the Republic of South Africa and the Government of Botswana. An agreement known as the TSWASA agreement was signed in 1988. Its purpose was to supply water to the parties as follows:

- 7,1 million m³ /a to Gaborone for primary purposes,

- 5,0 million m^3 /a for irrigation purposes in the former Homeland of Bophuthatswana
- 10,6 million m^3 /a for irrigation purposes in the then Republic of South Africa.

The above target drafts are slightly higher than the firm yield of Molatedi Dam of **21 million m^3 /a**. However, the dam is operated at a higher risk target draft, which is acceptable for irrigation purposes and hence there is potential for the Molatedi Dam to fail.

5.2 AVAILABLE YIELD OF MARICO SUB-AREA

The water resource available from the rivers in the Marico sub-area, before allowing for the Ecological Reserve, is approximately **36 million m^3/a**. This includes the yield of the Molatedi Dam. The impact of the Ecological Reserve on the firm yield was estimated for the NWRS at **6 million m^3/a**. At present, the dams are not being operated to allow for environmental reserve releases. It is also not known if the outlets are capable of accommodating the required environmental releases. Once the ecological reserve is implemented, there will be a reduction in the available water resources. These figures have been factored into the water balance for the Marico sub-area.

Groundwater resource availability from the wellfields that are in the Marico sub-area has been estimated at 23 million m^3 per annum.

Return flows from sewage treatment works in Zeerust and return flows from the mines around Zeerust as well as irrigation in the Marico catchments is estimated at approximately **6 million m^3/a**. The available water in the Marico sub-area is presented in **Table 5.2** below

Table 5.2: Available yield for Marico ISP sub-area

Resource	Quantity (million m3 per annum)
Surface water resource yield:	36
Subtract	
• Ecological Reserve	6
• Alien vegetation	0
Net surface water yield available for use	**30**
Available groundwater resource	23
Usable return flows	6
GRAND TOTAL	**59**

The ecological reserve is currently not affecting users in the catchment because it has not yet been implemented.

5.3 WATER REQUIREMENTS IN MARICO SUB-AREA

The source of supply for each water user sector was identified for water requirements at the year 2000 level of development. There are a number of important rural settlements and irrigation developments in the sub-area, with Zeerust, Groot Marico and Madikwe the main centres. This sub-area borders on Botswana in the north and water is transferred from this sub-area to Gaborone. There is commercial agriculture downstream of the Marico Bosveld Dam and downstream of the Molatedi Dam.

The major water users for the year 2000, including their sources of supply, are shown in **Table 5.3**

Table 5.3 Water Use/Requirements (2000 development) for the Marico sub-area (million m^3/a)

Sector	Groundwater	Farm Dams	Surface water	Imp/Exp	Total
Rural	11	-	1	-	12
Urban	5,4	-	3,6	-	9
Irrigation	6	-	26	-	32
Industrial		-	-	1	1
Mining	2	-	2	-	4
Total	**24,4**	**-**	**30,6**	**1**	**58**

Zeerust, the main urban centre in the Marico sub-area, obtains most of its water supply from groundwater although Klein Maricopoort supplements its water supply. The rural towns of Madikwe and surrounding villages obtain their water requirements from the Madikwe Dam on the Thulane River. Some of the rural villages further down-stream obtain their water from the Pella Dam. These water resources are fully utilised. There is potential for groundwater development to meet additional rural water supplies.

The rural villages in the western portion of Marico sub-area obtain their water from the Sehujwane Dam.

The water requirements table indicates that the major water users in the Marico sub-area are irrigation and domestic supply for the rural population. Stockwatering is included in the rural water requirements. The urban water requirements are for the main towns of Zeerust, Groot Marico and Madikwe. Return flow is not being directly utilised but it contributes to the yields of the dams in the sub-area.

The Marico sub-area has no commercial afforestation. There is no water used for strategic use.

5.4 RECONCILIATION OF MARICO SUB-AREA (A31, A32)

Table 5.4 presents the current water balance in the Marico sub-area.

Table 5.4: Reconciliation of Marico sub-area for year 2000 (million m³/a)

Sub-area	Available water			Water requirements			Balance
	Total Local yield	Transfers in	Total	Local requirements	Transfers out	Total	
Marico	**59**	**0**	**59**	**58**	**7**	**65**	**(6)**

The current deficit of the Marico sub-area, if the impact of the water requirement for the Ecological Reserve is taken into account, is **6 million m³ per annum**. The Ecological Reserve is currently not being implemented and is not reducing the available yield from the dams in the sub-area, therefore making the sub-area to be in balance. The recommended strategy is not to implement the Ecological Reserve before compulsory licensing is done.

5.5 COMPARISON OF THE NWRS WITH UPDATED ISP WATER BALANCE

It was important to compare the available yield and water requirements figures of this ISP and the NWRS figures. The following points are important when analysing the water resources of each sub-area to ensure consistent use of the same figures or to justify changes to the figures in the NWRS. This has been done in the ISP with respect to balancing water resources yield availability and water requirements for each area. The following approach was used in the ISP:

- The water requirements for the year 2000 level of development have been updated based on the latest available information from various sources. These are presented in a table that indicates the current sources of water for the various water user sectors in the various catchments. These sources have been grouped into four main categories, namely, groundwater resources, surface water resources, transfers into the area and return flows.

- The balancing of the available water resources yield with the water requirements is also given in a similar tabular format to that of the NWRS.

The water balance figures for the ISP sub-areas were aggregated to reflect the sub-areas given in the NWRS. A comparison has been done between the NWRS and the ISP water balance and is presented in tables in each chapter of the sub-area. Where inconsistencies have been identified and there is justification for using ISP figures, motivations are given as to which figures have been used in the balancing of water resource availability with water requirements for the sub-area in the following chapters.

The water resource availability and use in the Marico sub-area as determined in the ISP were compared with the figures of the NWRS. **Table 5.5** below presents a comparison of the water availability in the Marico sub-area system between NWRS and the ISP figures. Because the

figures for the Upper Ngotwane sub-area are included in the Marico sub-area in the NWRS, these had to be substracted in order to compare with the ISP figures.

Table 5.5: Comparison of the available yield in the Marico Sub-area (year 2000) between NWRS and ISP

Resource category	Available/impact (million m³/a)	
	ISP	**NWRS**
Surface water resource yield:	36	20
Subtract:		
- Ecological Reserve	6	6
- Alien vegetation	0	0
Net Surface water resource	***30***	***14***
Ground water	23	7
Return flows	6	5
Total local yield	***59***	***26***

The net surface water resources determined by the ISP for the Marico sub-area are higher than the NWRS figures. This ISP yield given in **Table 5.5** was obtained from firm yields of various dams (see **Table 5.1** above) the sum of which is much higher than the **14 million m³ /a** stated in the NWRS.

The groundwater resource was re-assessed as part of the ISP and is estimated to be much higher in the Marico sub-area than given in the NWRS. This higher estimate of the available groundwater resource was verified by consulting DWAF's Geohydrology database.

The impact of the ecological reserve on the available resource, as given in the NWRS, is accepted as the best estimate available.

Return flows are derived mostly from irrigation in the Marico catchment.

The figures used for the reconciliation strategy of Marico sub-area are therefore those determined by this ISP.

Table 5.6 presents a comparison of the water requirements between the NWRS and the ISP for the year 2000.

Table 5.6: Comparison of water requirements (year 2000) between NWRS and ISP

User Sector	Requirement/impact on yield (million m³/a)	
	ISP	NWRS
Irrigation	32	23
Urban	9	5
Rural*	12	6
Industrial and mining	5	2
Afforestation	0	0
Total requirement	**58**	**36**

* Includes rural domestic and stockwatering

The large difference between the NWRS and ISP water requirements lies in the irrigation user sector as well as use, in both the urban and rural sectors. The ISP has obtained updated water requirements for the urban and rural sectors based on the information in the Water Services Development Plans of the area, which indicate that more water is being utilised than previously estimated. Stockwatering is significant in the Marico sub-area and was underestimated in the NWRS. Irrigation from groundwater was not included in the NWRS.

The ISP figures for water requirements at 2000 development have been used in the water balance and the reconciliation strategy for Marico sub-area.

5.6 RECONCILIATION ISSUES OF MARICO SUB-AREA

The Marico sub-area is not expected to develop significantly. However, any future water requirements for the Marico sub-area have to come from further development of the groundwater. Water supply to Madikwe rural town is expected to increase because of increasing population, as highlighted in the section on demography. Other water requirements are not expected to increase because the forecast population growth is expected to remain stagnant or even decrease.

The rural development initiatives in Marico sub-area will have to take cognisance of the lack of water availability. There are deficits in the upper catchments of A31A and A31H. This is mainly due to opportunistic irrigation taking place in these quaternary catchments. Monitoring in A31D catchment indicates that there is over pumping of the Malmani dolomites, which could well affect the sensitive ecosystem dependent on the springs in the catchment.

The A32A quaternary catchment has a current deficit of **10,7 million m³/a**. If the estimated ecological Reserve is implemented, the deficit reduces to approximately **4,7 million m³/a**.

There is no potential for further surface water resource development in the Marico catchment. The strategy table for the water resources issues of Marico sub-area are presented in **strategy 1.1**. There is potential for development of local groundwater resources to meet domestic water supplies but not bulk water requirements for purposes such as

irrigated agriculture. Use of return flows from the A31C and A31D catchments for downstream potable water supplies should be considered if the quality standards for re-use are met.

The upper catchments of the Marico River system are under stress and there are deficits in the catchments A31C and A31B. Irrigators in these catchments have lower levels of assurance of supply and use water when it is available.

The Government of Botswana, South Africa and the former homeland of Bophuthatswana signed a water sharing agreement in 1987. The agreement allowed the development of Molatedi Dam from which allocations for the three parties were made. This agreement is called the TSWASA agreement.

It will not be possible to meet the allocations scheduled from the Molatedi Dam in accordance with the TSWASA agreement once the environmental Reserve is implemented. However, the impact can be minimised if the catchments above the Molatedi Dam make their contributions to the reserve. The allocation for irrigation to the former Bophuthatswana was not taken up and is currently supporting irrigation downstream.

There is a growing demand for domestic water supplies in the Central District Municipality while the North West Government has identified development of resource poor farmers as a strategy for poverty eradication and rural development. If the Reserve is to be implemented and the North West Provincial government requires water currently supporting irrigation downstream, then reallocation of water will be required. This can be done without renegotiating the TSWASA agreement. However, Botswana will need to be informed because the water released for farmers downstream also support users along the banks of the Limpopo River on the Botswana side of the border.

Where the Provincial Government has identified suitable land for resettling farmers, only re-allocation of water from commercial farmers in the catchment should be considered. This is already happening such as at the Marico-Bosveld Government Water Supply Scheme.

Other strategies such as water conservation and water demand management, effluent re-use and reallocation of water use based on the value of water and the most beneficial use of the water resources should be initiated.

5.7 WATER RESOURCES PROTECTION STRATEGIES

5.7.1 Water Quality Management and Pollution Control Strategy

The objective of this strategy is to ensure that the health of the human, physical and biological sub-systems is improved through the sustainable management of the Marico River system and its interaction with groundwater in the upper catchment. A comprehensive water quality management programme and pollution control of the groundwater resources is essential.

There is increasing siltation of the Marico Bosveld Dam due to the land use practices such as overgrazing in the upper catchment. Subsistence farming practices are also reducing the storage capacity of the dam.

There are also increasing salinity problems downstream of the Marico Bosveld Dam due to irrigation practices.

There is increasing return flow from irrigation taking place in catchment A31D and from the mines around Zeerust. However, the increased nutrient and salt content of the return flow has limited its re-use for domestic supplies without costly treatment.

DWAF should ensure that co-operative governance with the responsible authorities takes place in the catchment. Irrigation practices should be taken into consideration in the reviewing of the licence application. However, no new licences are likely to be issued due to a lack of available water resources.

DWAF should ensure that the resource quality objectives of the Marico River in the upper catchment and the river reach below the Marico Bosveld Dam are set in order to maintain and improve the overall quality of the water resources. Once set, a monitoring programme should be developed to ensure compliance by the various water users in the catchment.

The management actions for the sub-area of the Marico catchment required for the above stated objective are discussed in **Strategy 2.2**.

5.8 WATER CONSERVATION AND WATER DEMAND MANAGEMENT

The objective of this strategy is to ensure efficient utilisation of the existing water resources before considering development of new water resources. This maximises the return on the capital invested on existing water resource infrastructure.

There are high unaccounted for water losses in the communities and urban areas of the Marico catchment. This is causing increasing cost of water to consumers due to new capital investments required to augment existing water supplies.

The on-field practices of the irrigators in the Marico catchment and the water losses have not been assessed to determine if water is being efficiently utilised by the irrigation sector.

DWAF should ensure that all water user sectors develop business plans or water management plans for implementation of water conservation and water demand management strategies before new sources of water can be considered for existing lawful water users. DWAF should provide benchmarks for water use efficiencies for the different water user sectors and empower the agencies involved in water services provision to ensure these benchmarks are met.

5.9 OPERATIONAL ISSUES AND STRATEGIES FOR THE EXISTING WATER RESOURCE INFRASTRUCTURE

There are potential risks of supply failure from dams such as Sehujwane, Marico Bosveld, Madikwe and Molatedi because the demands on the dams are much higher than the available yield. The Kromellenboog Dam is also being operated in combination with Marico-Bosveld Dam and is therefore also over-utilised.

The current operating rules for all the dams in the catchment, which supply the irrigation scheme in the downstream catchment A31F, need to be reviewed.

6 UPPER MOLOPO SUB-AREA – WATER RESOURCES OVERVIEW, ISSUES AND STRATEGIES

6.1 WATER RESOURCES OF UPPER MOLOPO SUB-AREA

The Upper Molopo comprises one single quaternary catchment. The rainfall pattern of Upper Molopo sub-area is highly variable and unevenly distributed within the catchment. The intermittence of the rainfall results in frequent floods and local droughts.

The natural MAR of the Upper Molopo River is approximately **37 million m³ per annum.** The available surface water resource is mainly from the Setumo and Disaneng Dams. **Table 6.1** presents the main rivers and dams in Upper Molopo sub-area

Table 6.1: Surface water resource yield from the main rivers and dams in the Upper Molopo sub-area

Catchments	Rivers	Dams	Owner	Yield (Million m³/a)	Purpose
D41A	Molopo	Setumo	DWAF	13,2	Domestic
D41A	Molopo	Disaneng	DWAF	1,0	Irrigation
D41A	Molopo	Lotlamoreng	DWAF	0,1	Recreation
TOTAL				**14,3**	

The most significant resource in the Upper Molopo catchment is the groundwater from the dolomitic aquifers of the Grootfontein and Lichtenburg compartments. This is discussed in more detail in chapter 5.

The development in Upper Molopo sub-area is concentrated around Mafikeng, the capital city of North West Province. Mafikeng obtains most of its water supply from two sources of supply, namely, groundwater from the Molopo springs and from the Setumo Dam. There is return flow from the urban and industrial areas of Mafikeng and Itsoseng. The urban/industrial water use is the most significant in the catchment constituting 53% of the total water requirements. There is however also growing demand for water in the rural areas of the catchment, particularly in the western areas.

According to the Water Management Area report(DWAF:2003), the surface water resource available from the rivers in the Upper Molopo sub-area, before impact of Ecological Reserve on the yield is estimated at approximately at **14 million m³/a**. The Setumo Dam and Disaneng Dams are the main dams in the sub-area. The impact of the ecological Reserve is likely to be small but difficult to estimate because the Upper Molopo River is an ephemeral river.

Return flows from the sewage treatment works in Mafikeng is estimated at approximately **7 million m³/a**.

6.2 AVAILABLE YIELD IN UPPER MOLOPO SUB-AREA

Based on the comparison between the NWRS and the ISP and the recommended figures to use in the ISP, **Table 6.2** presents the water resource available in the Upper Molopo sub-area.

Table 6.2: Available water resource yield in the Upper Molopo ISP sub-area

Type of water Resource	Amount million m^3/a
Total surface water resource yield:	14
Subtract:	
- Ecological Reserve	5
- Alien vegetation	0
Net surface water resource yield available for use	9
Available groundwater resource	9
Usable return flows	7
Total Local Yield	**25**

The available surface water is mainly for urban use in Mafikeng (supplied from the Setumo Dam) and some irrigated agriculture downstream of Disaneng Dam.

6.3 WATER REQUIREMENTS IN UPPER MOLOPO SUB-AREA

The major water users for the year 2000 are shown in **Table 6.3.** The major water users in the Upper Molopo sub-area are the irrigators from the dolomitic aquifers of the Grootfontein and the Lichtenburg compartments. These farmers are dependent on groundwater from the dolomites. They are currently pumping approximately **22,4 million m^3 /a** from the dolomitic aquifers. This is unsustainable in the long term. The main irrigated crop is maize. There is also approximately **2,4 million m^3 /a** of irrigation from Disaneng Dam.

The second major water user in the sub-area is the urban use of Mafikeng which has two sources of supply, namely, groundwater and surface water from Setumo Dam. Mafikeng Municipality is currently abstracting **11 million m^3 /a** from the dolomitic aquifers. Their water allocation is approximately **8 million m^3 /a** from the government Subterranean Water Control Area (SWCA). This means the municipality is over-abstracting by **3 million m^3 /a** in terms of their allocation. Mafikeng Municipality is not currently utilising the Setumo Dam Water Supply Scheme except for emergency purposes. The scheme was designed such that its treated water would be blended with the good quality groundwater at the service reservoirs.

The rural domestic water requirement is quite small but has been increasing because most of the rural communities to the west of the sub-area have had no access to potable water supplies in the past and are now at least beginning to get some basic level of service.

As can be seen from the **Table 6.3** all the water users in the Upper Molopo sub-area are dependant on groundwater. The municipality of Mafikeng is also dependant on surface water from Setumo Dam but they are currently not utilising this source.

Table 6.3: Water Use/Requirements (2000 development) for the Upper Molopo sub-area (million m³/a)

Sector	Groundwater	Farm Dams	Surface water	Imp/Exp	Total
Rural	6	-		-	6
Urban	13	-		-	13
Irrigation	22	-	2	-	24
Industrial	5	-	-		5
Mining					
Total	**46**	**-**	**2**	**-**	**48**

The water requirements table indicates that the major water users in the Marico sub-area are irrigation and domestic supply for the rural population. Stock watering is included in the rural water requirements. The urban water requirements are for the main towns of Zeerust, Groot Marico and Madikwe. Return flow is not being directly utilised although it contributes to the yields of the dams in the sub-area.

The Marico sub-area has no commercial afforestation. There is no water used for strategic use.

6.4 RECONCILIATION OF UPPER MOLOPO SUB-AREA (D41)

Table 6.4 presents the current water balance in the Upper Molopo sub-area.

Table 6.4: Reconciliation of Upper Molopo sub-area for year 2000 (million m³/a)

Sub-area	Available water			Water requirements			Balance
	Total Local yield	Transfers in	Total	Local requirements	Transfers out	Total	
Upper Molopo	**25**	**0**	**25**	**48**	**0**	**48**	**(23)**

The current deficit in Upper Molopo sub-area is estimated at **23 million m³ /a** after taking into account that Mafikeng is over-abstracting from the dolomites but is not utilising its allocation from the Setumo Dam. The deficit will increase once methods to determine Reserves for ephemeral rivers are known.

This deficit is not that apparent as the irrigators and the municipality are abstracting more than the sustainable level of the dolomite aquifers as currently understood. The over pumping occurs mainly in the Grootfontein compartment by the irrigation users as well as the Mafikeng Municipality. It is noted that the increasing return flows estimated to be **7 million m³/a** from

Mafikeng and Itsoseng is not being fully utilised although it is contributing to the yield of the Setumo Dam, which is intended to meet the growing water requirements of Mafikeng.

6.5 COMPARISON OF THE NWRS WITH UPDATED ISP WATER BALANCE

A comparison of the NWRS figures with the information obtained for the ISP on the water resource availability and use was done for the Upper Molopo sub-area. The basis of the comparison is as discussed under the Marico sub-area comparison in section 5.5.

Table 6.5 below presents a comparison of the water availability in the Upper Molopo sub-area between NWRS and the ISP figures.

Table 6.5: Comparison of the water availability in the Upper Molopo sub-area (year 2000) between NWRS and ISP

Resource category	Available/impact (million m³/annum	
	ISP	**NWRS**
Surface water resource yield:	14	3
Subtract:		
- Ecological Reserve	5	0
- Alien vegetation	0	0
Net Surface water resource	**9**	**3**
Ground water	9	9
Return flows	7	7
Total local yield	**25**	**19**

The net surface water resources determined by the ISP for the Upper Molopo sub-area are higher than the NWRS figures. This ISP yield given in **Table 6.1** was obtained from firm yields of various dams (Setumo Dam, Cooke's Lake, Lotlamoreng and Disaneng Dams) (BKS, 2002), the sum of which is much higher than the **3 million m³ /a** stated in the NWRS.

The groundwater resource was re-assessed as part of the ISP and is also estimated to be much higher in the Upper Molopo sub-area than given in the NWRS. However, the groundwater resource availability based on the ability of the aquifers to sustain exploitation has not yet been determined. The NWRS figures have therefore been used although the groundwater resource is expected to be higher as can be seen from the abstraction.

The NWRS has estimated that there is no impact of the ecological reserve. However, the ISP has estimated that the impact of the ecological reserve on the available resource is **5 million m³ /a**.

Return flows are derived mostly from irrigation in the Marico catchment, while in the Molopo catchment the return flows are from the urban use in Mafikeng. It is assumed that there is no surface return flow from irrigation in the Molopo catchment.

Table 6.6 below presents a comparison of the water requirements between the NWRS and the ISP for the year 2000.

Table 6.6: Comparison of water requirements (year 2000) between NWRS and ISP

User sector	Requirement/impact on yield (million m³/annum)	
	ISP	NWRS
Irrigation	24	3
Urban	13	13
Rural*	6	3
Industrial and mining	5	5
Afforestation	0	0
Total requirement	**48**	**24**

* Includes rural domestic and stockwatering

The large difference between the NWRS and ISP water requirements lies in the irrigation user sector as well as the rural sector. The ISP has obtained updated water requirements for the urban and rural sectors based on the information in the Water Services Development Plans of the area, which indicate that more water is being utilised than previously estimated.

The NWRS figures for irrigation are much less than the recorded groundwater abstraction, which is taking place, especially in the Molopo sub-area, for this purpose. The ISP information on water requirements for the irrigation sector was obtained from the Directorate: Geohydrology who have recent and reliable data on groundwater use in the Bo-Molopo Subterranean Government Water Control Area.

6.6 RECONCILIATION ISSUES OF UPPER MOLOPO SUB-AREA

The issues affecting the management of the water resources of the Upper Molopo catchment identified during the workshops are discussed below. As discussed above, the catchment is in deficit, although the current surface yield is not utilised to its full capacity. The deficit is in the groundwater abstraction, which is more than the available groundwater as currently understood. The yield from groundwater may be much higher than currently understood.

There is no potential for further surface water resource development. There are insufficient surface water resources in the Upper Molopo catchment to meet the growing domestic water requirements in the western rural areas of the catchment.

There is a licence application for an additional 60 hectares of irrigation. There is an existing lawful use for irrigating 75 hectares from Disaneng Dam, which was built to meet irrigation requirements. The licence application is for Resource Poor Farmers and can still be met from Disaneng Dam. This is assuming the Reserve is not implemented in the short to medium term.

The groundwater resources as well as return flows are not fully utilised. If the Reserve requirements are taken into account for the groundwater ecosystem dependent species, the water resources scarcity for use by other water user sectors will be exacerbated.

The detailed water resources issues, causes, objectives and strategic perspectives to achieve sustainable and effective integrated water resources management of the Upper Molopo River catchment are provided in Appendix B **strategy 1.1**.

The objective of DWAF is to ensure that the agencies responsible for water service provision have adequate access to sources of potable water supplies that are affordable to all water users.

The water requirements are mainly from the increasing demand and higher levels of service in the rural communities in the western part of the catchment and growth in Mafikeng. It is recommended that the local groundwater resources of the Upper Molopo catchment are first fully developed to meet water requirements of the rural communities in the western part of the catchment before transfers into the catchments are considered. The full cost of any additional water requirements above the basic human needs from either local groundwater sources or transfer from other resource rich catchments should be borne by the users

Use of the return flows from Mafikeng for the rural communities in the western parts of the catchment should be considered if it meets the quality objectives for re-use by the downstream communities.

It is essential that an integrated and updated groundwater management information system for the dolomites of the Upper Molopo and surrounding WMAs and catchment such as Upper Ngotwane is developed to ensure conjunctive use of the surface and groundwater resources. The Regional Office is already considering developing such a system for the whole area.

The volume of the groundwater resources available for use at different levels of assurance from the dolomites of the Upper Molopo catchment is reasonably well understood. The dolomites, because of their characteristics, function as underground storage reservoirs where in periods of good rains and recharge the water table rises while in periods of drought the water table is drawn down.

Use of the dolomite aquifer storage in this way has the advantage that the underground storage is not subject to evaporation losses and contamination as surface water resources are. (NB. Proper sanitation infrastructure is required).

The existing groundwater monitoring system should be reviewed by DWAF to confirm whether it achieves the above objective.

6.7 WATER RESOURCES PROTECTION STRATEGY

6.7.1 Water quality management and pollution control strategies

The quality of the return flow from the urban and industrial areas of Mafikeng does not meet the effluent standard for discharge containing waste. This is increasing the cost of treatment. As a result, the Municipality does not utilise water from the Setumo Dam because of the high treatment costs and abstract from the Grootfontein compartment beyond their allocation for Mafikeng water supply. Mafikeng Municipality should be pressured to meet quality requirements before additional resources are allocated to it. They should also be restricted to their allocation from the Grootfontein compartment.

There is also increasing eutrophication of the Setumo Dam due to the high nutrient enriched return flow into the dam. In the presence of sunlight, this stimulates growth of algae and other aquatic plants, which have undesirable effects such as taste and odour of the treated water. For this reason, Mafikeng is reluctant to use the Setumo Dam for potable water supplies.

DWAF must ensure that effluent discharge into the Molopo River meets its discharge permit requirements in terms of the quantity and quality. Various operational instruments must be considered and applied where necessary to enhance the quality of the receiving waters of the Molopo River. It is therefore essential to manage the in-stream water quality standards of the Upper Molopo River for the use of the river as a source of water for municipal purposes.

The groundwater resources, especially those associated with shallow aquifers such as in the Itsoseng area, and in the populated western parts of the catchment are increasingly at risk of contamination locally from the surrounding communities who are served with on-site sanitation facilities in the form of pit latrines.

6.7.2 Solid Waste Management Strategy

Solid waste, particularly municipal solid waste has been identified as a potential problem in this dolomitic aquifer system. The Itsoseng area was identified as the area whose groundwater, its only source of water supply, may be adversely impacted.

The objective is therefore to minimise the adverse environmental effects that may be caused by the indiscriminate disposal of solid wastes, particularly hazardous materials.

The strategy to address pollution problems of the groundwater resources of the catchment is to ensure that proper and adequate sanitation infrastructure is constructed for the communities situated on the dolomites.

To facilitate the management of solid wastes it is important for DWAF to ensure that in the application of landfill sites from the local authorities the following are considered:

- Site selection
- Land filling methods and operations
- Occurrence of gases and leachate in landfills and

- Movement and control of landfill gases and leachate in the dolomites that dominate the geology of Upper Molopo and Upper Ngotwane catchments, whose communities are dependant on groundwater as the major source of supply

DWAF must ensure that the IDPs address solid waste management both regionally to achieve economies of scale and locally where the impacts are localised such as Itsoseng.

7 UPPER NGOTWANE SUB-AREA – WATER RESOURCES OVERVIEW, ISSUES AND STRATEGIES

7.1 WATER RESOURCES OVERVIEW

The Upper Ngotwane is the catchment bordering on Botswana to the north, the Upper Molopo to the southwest, and the Groot Marico to the east. The main sources of water supply are the Ngotwane dam and groundwater from the dolomites. The Dinokana springs are a major source of water supply for the urban area of Lehurutse and surrounding villages.

No comparison was made between the NWRS and the ISP because the Upper Ngotwane sub-area was not treated separately in the NWRS. The ISP figures have been used to determine the water balance and reconciliation strategy for the sub-area.

7.2 AVAILABLE WATER RESOURCES OF UPPER NGOTWANE SUB-AREA

The surface water resource available from the rivers in the Upper Ngotwane sub-area is very limited. Ngotwane Dam has a historical firm yield of **1 million m³/a**. The impact of the ecological Reserve is likely to be small but difficult to estimate because the Ngotwane River is an ephemeral river.

The available water in the Upper Ngotwane sub-area is presented in **Table 7.1**.

Table 7.1: Water availability in the Upper Ngotwane sub-area

Type of Resource	Available/impact on yield million m³/a
Total surface water resource yield:	1
Subtract:	
- Ecological Reserve	0
- Alien vegetation	0
Net surface water resource yield available for use	***1***
Available groundwater resource	5
Usable return flows	0
Total Local Yield	**6**

7.3 WATER REQUIREMENTS IN UPPER NGOTWANE SUB-AREA

The major water users for the year 2000 are shown in **Table 7.2.** There are several rural settlements in this sub-area with Lehurutse and Dinokana being supplied from the Dinokana

springs. Irrigation from groundwater is the largest user requiring **5,4 million m³/a** at 98% assurance of supply.

Table 7.2: Water Use/Requirements (2000 development) for the Ngotwane sub-area (million m³/a)

Sector	Groundwater	Farm Dams	Surface water	Imp/Exp	Total
Irrigation	4	-	1	-	5
Urban	2	-		-	2
Rural	3	-		-	3
Total	**9**	**-**	**1**	**-**	**10**

7.4 RECONCILIATION OF UPPER NGOTWANE SUB-AREA (D41)

Table 7.3 presents the current water balance in the Upper Molopo sub-area.

Table 7.3: Reconciliation of Upper Molopo sub-area for year 2000 (million m³/a)

Sub-area	Available water			Water requirements			Balance
	Total Local yield	Transfers in	Total	Local requirements	Transfers out	Total	
Upper Ngotwane	**6**	**0**	6	**10**	**0**	**10**	**(4)**

An analysis of the quaternary catchments of the Upper Ngotwane sub-area (see Appendix A) shows that the A10A catchment is in deficit of approximately **4 million m³/a**. This is mainly because the level of assurance of supply for the users supplied from the Ngotwane Dam is much lower than the norm. These are the irrigators who may be irrigating annual crops and do not require higher levels of assurance of supply.

The population in the sub-area is expected to remain stagnant or even decrease due to pull factors of the surrounding urban centres such as Zeerust. The growth in water requirements is expected from communities who have in the past had no access to water as well as the increase in the level of service from public stand-pipes to yard/house connections.

No growth in irrigation farming is expected due to the lack of available water resources. It is not possible to allocate more water for irrigation use from surface water.

7.5 RECONCILIATION ISSUES OF UPPER NGOTWANE SUB-AREA

There are insufficient surface water resources in the Upper Ngotwane sub-area to meet current requirement and reliance is placed on the groundwater resources from Malmani dolomites, and Dinokana springs.

The strategy that DWAF can and has already taken is to investigate the groundwater resources in order to understand the availability of this resource for use in the catchment. It is important that a monitoring programme of recharge and abstraction from the dolomitic aquifers and springs in the catchment is established. This will help determine the extent of the groundwater resources and the sustainable abstraction that can be done from the dolomites without significantly impacting on any ecological systems dependent on the springs.

7.6 WATER QUALITY MANAGEMENT STRATEGY

The land use practises and overgrazing taking place in the Upper Ngotwane catchment are causing water quality problems to the limited surface water resources, thus reducing the available resources in the catchment.

The growth of Ramotswe town has impacted on the quality of the dolomitic aquifer crossing into Botswana. It is essential to understand the vulnerability of groundwater sources to pollution.

In order to address the water quality issues in the Upper Ngotwane sub-area, DWAF must ensure pollution protection measures are in place for areas where groundwater is vulnerable from pollution. Protection zones must be delineated for the dolomitic aquifers.

Through co-operative governance with other governmental agencies and public awareness campaigns, DWAF can ensure that proper land use management programmes are put in place.

7.7 WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGY

High unaccounted for water losses in the towns of Lehurutse and Dinokana have been identified. The inefficient utilisation of the scarce water resources is putting stress on the resources and costing the local authorities in terms of reduced revenue for sustainable continuous supply to consumers.

The strategy is to manage water use through engineering (i.e. water loss control methods), legal (bye-laws) and economic instruments (proper tariff structures). These direct and non-direct methods of demand management such as community awareness need to be considered and DWAF must ensure these are considered in the WSDPs.

DWAF must ensure that there are effective communication and social awareness programmes in place.

8 GENERAL ISSUES AND STRATEGIES FOR MARICO, UPPER MOLOPO & UPPER NGOTWANE ISP AREA

8.1 GENERAL

There are a number of ISP area wide issues and the significant importance of groundwater in the Marico, Upper Molopo and Upper Ngotwane sub-area. The groundwater resource utilisation has not reached its full exploitable potential in the catchment as a whole. However, surface water resources are being fully utilised except for the increasing return flows of lower quality. Groundwater can assist in alleviating water supply stresses and meeting future water requirements in the catchments. Groundwater resources need to be better quantified in terms of specific sources, size of the resource, sustainability of use and frequency of recharge. There is a need to maintain the groundwater Reserve.

These issues are important to integrated water resource management (IWRM), which the DWAF is striving to achieve through the development of the ISP. These general issues are discussed in this chapter below.

8.2 INSTITUTIONAL ARRANGEMENTS FOR GROUNDWATER RESOURCE MANAGEMENT

The Marico, Upper Molopo and Upper Ngotwane catchments share two significant dolomitic groundwater aquifer systems with neighbouring WMAs. These are the Lichtenburg compartment in the southwest and the Marico/Schoonspruit compartments in the south with Lower Vaal and Middle Vaal respectively.

In order to facilitate IWRM an institutional arrangement is required for the sustainable management of the dolomitic groundwater aquifer systems. The institutional framework must take into account the future of the CMAs of the various WMAs. The organisational structure of the Grootfontein WUA must take this consideration to facilitate IWRM.

Two options that are available are to keep the CMA borders as is and determine joint management procedures or to change the CMA borders to coincide with those of the dolomitic compartments and jointly manage surface water (which is insignificant in these border areas)

8.3 CO-OPERATIVE GOVERNANCE

The apparent separate focus and jurisdictions of different Provincial (and National) departments such as the DWAF and the Department of Agriculture Conservation Environment and Land Affairs is an area of potential conflict. Clear guidelines are required where protection of groundwater resources, which are strategic sources of supply for the three sub-areas, are given greater prominence than any other land use practice. There is a need for co-operative governance between the Regional DWAF and the various provincial government departments involved in the water resource utilisation.

Water resource protection, particularly groundwater resource protection, and sustainable development will benefit from an alignment of local authority and regional planning with catchment management. This is particularly relevant to the dolomites, which are an important source of water supply in the area.

There is significant soil erosion happening in the catchments due to overgrazing of the land and the agricultural practices. This is increasing the quantities of sediment reaching the rivers of the Upper Molopo, Upper Ngotwane and Marico, leading to loss of storage capacity of the reservoirs and quality of the water resources.

It is essential that marginal land is not used for agriculture, correct irrigation practices are encouraged and the rural economic development is sustainable through community participation and awareness creation.

Through co-operative governance the DWAF should ensure that all IDPs include soil-conservation measures. These measures could include contour ploughing, terraces, strip cropping and other techniques that retard overland flow and reduce erosion where dryland agriculture is practiced. Use of irrigated pastures for grazing should be considered to reduce overgrazing which is reducing the vegetation cover in the catchment.

DWAF should embark on awareness campaigns on the impact of soil erosion on the quantity and availability of the water resources of the catchment.

8.4 STAKEHOLDER PARTICIPATION

Water users, water providers and those with an interest in water-related issues such as non-government organisations all have a stake in the decisions that are made in the formulation of water management strategy and the implementation of the identified strategies. Therefore, their participation in the process of designing and implementing strategies and plans of action is very important. The involvement of stakeholders in the formulation and implementation of the water resources management strategies identified for the sub-area to address the specific and generic issues, helps in gathering information that will assist in the strategy formulation. Their involvement also creates a sense of commitment or "ownership" that can help to implement the plans of actions and therefore lower the risk of the strategies and plans of actions being unsustainable.

Although the ISP development for the Marico, Upper Molopo and Upper Ngotwane has been done without the involvement of the other external stakeholders to the DWAF, the institutional stakeholders should now become an integral part of the process of further developing the strategy and the implementation strategy mainly because it would:

- alternatives serving a broad range of interests are considered
- help to gather data or information, identify gaps in data or information and identify sources of data or information in the future
- provide transparency and accountability regarding both decisions taken and the process by which decisions were taken in the development of the ISP
- build a broad base of commitment to options by creating an environment that rewards the realistic discussion of benefits, risks, and costs of options and that provides a meaningful basis for informed consent to recommendations
- Lower the risk of implementation of recommendations made for the management of the water resources of the Groot Marico, Upper Molopo and Upper Ngotwane catchments and increase the return on investment for sustainable water resources management strategy.

In order to achieve the above aims of stakeholder participation, the plan of action should include at least two activities:

(i) identifying stakeholders (i.e. people and institutions concerned with or have interest in water management that influence or are influenced by decisions on water management of the Groot Marico, Upper Molopo and Upper Ngotwane; and

(ii) securing their participation in the work of developing and implementing a water resources strategy. There is the substantial risk that involving stakeholders can turn into political conflicts, but if the process is well managed, this risk can be avoided. **Strategy 6.1** outlines the situation and the strategic option required to achieve stakeholder participation in the catchments of the Groot Marico, Upper Molopo and Upper Ngotwane catchments.

8.5 MONITORING AND INFORMATION SYSTEM

The availability of reliable data and information on all aspects of water resources management is fundamental to the success of strategies to implement the NWA. No proper decision on any matter can be made with confidence unless it is supported by reliable, relevant, up-to-date information, which complies with certain standards.

A strategy will need to be developed to collate and develop these systems (see **Monitoring and Information Management Strategy**). Please refer to **Chapter 3: Part 6 of the NWRS** for guidance in this regard.

A comprehensive information system is required for the Groot Marico Upper Molopo and Upper Ngotwane catchments, which not only covers the collection and analysis of data, but how it is disseminated. The need for an information system for these catchments has arisen because of the following:

- There is an increasing scarcity of water, which will result in potentially unacceptable completion and conflict.

- There are significant dolomitic aquifers, which are and will contribute significantly to meeting the current and future water requirements. These need to be well understood and how the compartments are interlinked.

- The economic values of stream flows are increasing. The springs contribute significantly to the base flows of the rivers in the three catchments. These need to be well understood.

- Environmental and health concerns are increasing in all three catchments. A database of the health and water quality information is essential for effective management of the resource.

Effective groundwater management and monitoring is essential for long-term sustainability of the supply and to protect the resource. The NWA requires the Minister to establish national monitoring systems for water resources to collect appropriate data and information necessary to assess:

- The quantity, quality and use of water in water resources

- The rehabilitation of water resources
- Compliance with resource quality objectives
- The health of the aquatic ecosystems
- Atmospheric conditions which may influence water resources, and,
- Other data and information, which may be necessary.

Resources currently available for monitoring are generally inadequate throughout all existing systems.

DWAF have a regional monitoring network covering part of the dolomite outcrop area. Regular monitoring of the Dinokana, Rietpoort and Doornfontein wellfields is carried out. Water levels and flows are recorded in several of the large springs such a Wonderfontein, Molopo, Grootfontein, etc. Maintaining the monitoring network is fundamental to the management of the dolomite (and other aquifers) and will be a significant responsibility of the CMA.

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.

The monitoring programme needs to be maintained and improved following a suitable implementation strategy, which will include:

- Undertake a census of all current groundwater monitoring.
- Implement a groundwater monitoring programme at selected key localities, including abandoned mines and important wellfields/boreholes. This will involve water level measurements and water quality sampling.
- Implement strategy of routine abstraction monitoring in areas of heavy groundwater use, i.e., water supply boreholes and well fields.
- Establish a monitoring protocol to include frequency of water abstraction and water level measurements and groundwater sampling, and the range of constituents to be analysed for, (as a minimum, this must incorporate pH, TDS, conductivity, macro anions, macro cations, Fe, F, and NO_3. Samples collected near working and abandoned mines will need to be analysed for parameters relevant to the mining operation, e.g. CN at old gold mines.
- Integrate any current local monitoring with the catchment wide monitoring programme.

The information will then be used to develop a regional monitoring strategy incorporating both surface and groundwater monitoring to meet the specific situation within the Region.

- Establish status of existing monitoring programmes

- Integrate all monitoring information within the catchment
- Update relevant data base (NGDB)
- Establish system of data management and responsibility
- Implement groundwater abstraction, groundwater level and groundwater quality monitoring in strategic localities throughout the WMA.
- Determine resources needed to undertake the groundwater-monitoring programme.

A database needs to be established/maintained by the responsible management authority, (the CMA). This database will record all monitoring data collected in the region and will be the NGDB or compatible with the NGDB. A custodian of the information database is required.

8.6 PUBLIC HEALTH AND SAFETY

The Department's current commitments are associated with the following:

- Managing floods and drought disasters by direct intervention on the ground.
- Reducing pollution and preventing serious or hazardous pollution events, and
- promoting dam safety.

DWAF's (and the CMAs in some cases) commitments under the National Disaster Management Act, which was promulgated in 2002, are:

- DWAF/CMA will be required to support and enforce disaster management planning by all relevant authorities.
- Drafting a National Flood Management Policy (DWAF).
- Dam safety policy (DWAF).
- Co-operating with the Department of Agriculture on drought relief strategies and policy formulation.
- Pollution of water resources (i.e. limiting health hazards such as water borne diseases including cholera).

8.7 WATER PRICING STRATEGY

Chapter 5 of the NWRS outlines the background to the **Water Pricing Strategy** that DWAF gazetted and is in force nationally. DWAF Gauteng Regional Office has already levied water resource charges on bulk water users in the catchment in these catchments.

The Pricing Strategy is intent on achieving the following:

- To achieve social equity by setting differential water use charges. This financial assistance (e.g. also to emerging farmers) has a sunset clause of five years.
- Finding the direct and related costs of water resources management.
- To achieve compliance with prescribed standards and water management practices according to the "user pays" and "polluter pays" principles.
- Water charges will be used as a means to encourage reduction in the wastage of water.
- Provision is made for incentives for effective and efficient water use.
- Non-payment of water use charges will attract penalties, including the possible restriction or suspension of water supply from a waterworks or of an authorisation to use water.

The pricing strategy for the Marico, Upper Molopo and Upper Ngotwane catchments in Appendix B4 illustrates the need for development of wastewater discharge charges because of the importance of this in these catchments if the catchments are to be economically sustainable and viable. Waste discharge strategy is currently under development.

8.8 INTERNATIONAL ISSUES

The fact that the Groot Marico, Upper Molopo and Upper Ngotwane catchments are part of shared watercourses (Groot Marico in the North and Molopo in the Southwest) with Botswana, particularly careful consideration needs to be taken in the management of the water resources of these three catchments. There are international obligations that South Africa has to honour with respect to the quantity and quality of these shared watercourses. In the Marico River there are commitments in accordance with the TSWASA agreement to transfer **7 million m^3/a** at 98% level of assurance to Gaborone.

The impact of water use in the Upper Molopo catchment on the shallow wells along the endoreic Molopo River in Botswana needs to be addressed at national level.

The issue of international implications of water resources management of the Marico, Upper Molopo and Upper Ngotwane catchment can only be addressed at DWAF national level.

9 STRATEGY FOR IMPLEMENTATION OF THE MARICO, UPPER MOLOPO & UPPER NGOTWANE ISP

9.1 GENERAL

This ISP document recognises that without effective implementation, the best-laid strategies are of little use. Critical to the effective implementation of any strategy is the mobilisation of resources and capabilities within the organisation and/or division assigned the responsibility for implementation of the strategy. This document sees this as part of the development and resourcing of the Regional Office of DWAF. **Strategy 11** below presents the strategy for implementation of the action plans discussed in this ISP document.

The approach to the development of the Marico-Upper Molopo & Upper Ngotwane ISP area has been based on the understanding that the water resources strategy formulation is primarily concerned with water requirements and availability rather than the organisation of the institutions involved in water resources management. Hence, the focus has been on understanding the water resources issues and the characteristics of the water user sectors (both consumptive and non-consumptive) in the catchments and how the water resources infrastructure is being managed.

The various sections within DWAF identified as responsible for implementing the strategy need to build the strategies into their business plans.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 GENERAL

Key considerations with respect to the sub-areas of Marico, Upper Molopo & Upper Ngotwane ISP are the already full utilisation of local surface water resources and the increasing importance of return flows in the reconciliation interventions. Potential for further local groundwater resources is realised. Return flows are also becoming a realistic source of supply to meet future water requirements.

All three catchments are currently in deficit, with no or very limited potential for additional development of the surface water resources. Because of the deficits and lack of water supply side management options available in all three catchments, the strategies available to the Marico, Upper Molopo and Upper Ngotwane catchments are mainly the **water demand management options**. These demand side management options include:

- Adoption of water demand constraint measures in order to improve water use efficiency in all water use sectors within the catchments. Emphasis could be placed on extending the metering of domestic supplies to other water user sectors particularly irrigated agriculture. Guidelines for 'conservation planning', i.e. measures to induce economy in the use of water should be considered. Three sequential levels of approach can be considered. The first comprises of universal metering, water loss control (i.e. leakage and wastage reduction in conveyance systems), and public education. DWAF must ensure that all WSDPs and IDPs provide detailed water conservation and water demand management measures by each water user sector.

- Once the water demand management constraints are implemented by the various user sectors, consideration should be made to re-allocate water based on the most beneficial use of water within each sector (water trading within a regulatory framework set by the DWAF). Cognisance should be taken for re-allocation of water from commercial farmers to resource poor farmers where the Provincial Government has identified irrigated agriculture as contributing to equity and poverty eradication. Compulsory licensing may be required at this stage.

- One increasingly important source of water is the use of **properly treated** wastewater from the sewage systems to supplement the finite good quality water resources. The return flow can be used for domestic and industrial use as well as for appropriate agricultural use. However, there are water quality problems in the catchment due to the increasing return flow.

- Much of the requirement for the ecological component of the Reserve can also volumetrically be supplied from return flows in some catchments, although intervention may be required to ensure the appropriate temporal distribution of flows. However groundwater Reserve requirements for the sustainable management of the ecological systems dependent on the aquifer fed springs in the catchment (Molopo spring, Malmani spring, Marico springs etc.) should be determined before any additional abstractions from the dolomitic aquifers are allowed.

- Groundwater for rural supplies and community gardens

- Broad scale groundwater recharge figures indicate that yield from dolomitic aquifers may be larger than currently calculated. It is important that more detailed assessments of this resource be made.

10.2 USE OF THE ISP

The ISP should form the basis for implementing effective water resources management of Marico, Upper Molopo and Upper Ngotwane sub-areas.

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12 FORMAT OF THE STRATEGY TABLES

Broad strategies consistent with the National Water Resources Strategy have been identified. These form the basis on which the strategies for the sub-areas of the Upper Molopo, Marico and Upper Ngotwane, as well as catchment wide strategies have been developed.

Strategies formulated specifically for each sub-area of the Marico, Upper Molopo and Ngotwane sub-areas are discussed first. These are:

1. Resources Availability and Reconciliation Strategies

1.1 ***Resource availability strategy***: This addresses both the amount of water available and the uncertainties in the information regarding the water resources in each of the sub-areas.

1.2 ***Effluent Re-use strategy:*** The catchments are all under stress. There is a need to use all possible sources of water including effluent.

1.3 ***Groundwater availability strategy:*** Dolomitic aquifers are the major source of water supplies to the different sectors. There are uncertainties with regard to inter-linkages of the various compartments and the safe yield that can be abstracted.

1.4 ***Balancing available water resources with demands***: Currently all three sub-areas are in deficit. This strategy reviews how the deficits can be addressed.

2. Water Resources Protection Strategies

2.1 ***Reserve and Resource Quality Objectives strategy***: This strategy considers the need for and nature of the protection of the resource.

2.2 ***Water Quality Management and Pollution Control strategy***: With the rapid urbanisation taking place in the catchments and the limited water resources available, it is essential that water quality management is given special attention as this may affect other potential sources of water supply such as effluent re-use and even the scarce water resources from groundwater if they are polluted.

2.3 ***Solid waste disposal strategy***: The impact of leachate on the dolomitic aquifers if proper solid waste management programme is not in place can affect the water resources of the catchments.

3 Water Conservation and Water Demand Management Strategies

3.1 ***Water Conservation and Water Demand Management in the Urban and Rural sector***: This sector is a significant water user in the area. Efficient utilisation of the water resources in stress catchments in critical.

3.2 ***Water Conservation and Water Demand Management in the Irrigation sector*:** The irrigation sector is mainly dependent on groundwater in the dolomitic areas but in catchments such as Marico there is commercial irrigation. Irrigation practices need to be efficient, particularly in these stressed catchments because irrigation water is a high volume and low-value use compared to other sectors.

The above strategies for each of the sub-areas of Marico, Upper Molopo and Upper Ngotwane catchments are discussed in Appendices A -C.

The following strategies are considered to be broad enough to include all the three sub-areas and therefore discuss the issues that are generic to the Upper Molopo, Marico and Upper Ngotwane catchments:

4 Water Use Management Strategies

5 Social Strategies

6 Co-operative Governance and Socio-Economic Development Strategies

7 Monitoring and Information Management Strategy

8 Implementation Strategy

12.1 ASPECTS ADDRESSED UNDER EACH STRATEGY

The following layout is reflected in each strategy table:

- **Management Objective**: An understanding of where we want to be after strategy formulation and implementation.

- **Assessment and Analysis of issue**s: The management objective of each strategy provides the platform from which to launch an assessment and analysis of issues. This involves identifying, analysing and ranking major water resource issues affecting the key area under discussion. This also examines the physical aspects and wide variety of factors that influence the management of the water resources. This forms the basic platform upon which strategies are formulated.

- **Strategy and recommendations**: The intention of this section in the table is to strike a balance between the ideal and practical choices available to address the issues, which have arisen. This includes developing options and analysing them as far as possible. Full analysis requires that options are compared on technical, sociological, environmental and economic grounds before arriving at recommendations. The recommendation is the strategy seen to best address the issue, is then motivated.

- **Plan of Action:** In this section of the strategy table, the required activities or work packages to achieve the objective, and the responsible authority, are identified and discussed.

The other sections of the strategy tables provide supporting information on related strategies and relevant issues raised at the workshops.

APPENDIX A: MARICO SUB-AREA – STRATEGY TABLES

Strategy No.:	1.1

RECONCILIATION STRATEGIES

SURFACE WATER RESOURCE AVAILABILITY

MANAGEMENT OBJECTIVE:

The objective of the water resource availability strategy is to determine the temporal and spatial availability of the water resources that comprise surface water (rivers, and dams), at a high level of confidence in order to ensure decisions made on water allocation planning are based on the most up to date information.

ASSESSMENT & ANALYSIS OF ISSUES:

The natural MAR of the Marico River is approximately **126 million m³ per annum.** Surface water resource is mainly from the Marico Bosveld and the Molatedi Dams. There are other smaller dams such as Klein Maricopoort and Kromellenboog Dams. Approximately 7 million m³ per/a is transferred out of Marico sub-area to Gaborone in Botswana from the Molatedi Dam.

There has been no update of the hydrological information of the Marico River catchment, since the TSWASA agreement between Botswana, South Africa and the former Bophuthatswana was signed in 1988. The recent floods and droughts of 1992 have not been taken into account in the water resources availability for the Marico. The surface water hydrology of the Marico River catchment has not been updated and the ecological Reserve is not incorporated in the agreement. The level of confidence on the hydrological information is very low and the risk of managing the resources of the sub-area of the Marico Catchment with the level of information is very high.

The dams in the Marico catchment, Marico-Bosveld, Klein Maricopoort, and Kromellenboog were built a very long time back. The yield of the Molatedi dam is less than the target draft that is in the TSWASA agreement. The yield of the overall system is based on hydrology, which dates back to 1988 when the TSWASA agreement came into effect between Botswana, South Africa and the former Bophuthatswana. No systems analysis has been done for the Marico sub-area.

Future water requirements are not expected to increase because the population growth is likely to decline or remain stagnant. However, there are several smaller dams, which supply the rural communities. The level of assurance of supply is lower than 98% for dams such as Madikwe, which needs to be confirmed. The rural communities in Madikwe do not have adequate water supplies from the available water resources to meet the basic human needs and water for sustainable livelihood. These supplied from local groundwater as described in chapter 5.

SURFACE WATER RESOURCE AVAILABILITY		
Marico river base flow is dependent on the recharge from the Marico spring and the Malmani springs. The implications of abstraction of groundwater in the upper catchment of Marico for use by the Middle Vaal irrigators needs to be investigated and analysed to assess its impact on the base flow of the Marico River and its impact on the yield of the Marico Dam.		
PROPOSED STRATEGY In order to address the high degree of uncertainty in the water resources availability of the Marico sub-area, various options were identified. The following options shall be considered: (i) Updating the hydrology with the best information available and undertake a system analysis for both the surface water and groundwater. (ii) Undertake a comprehensive basin study of the Marico catchment.		
PRIORITY	**Medium** – Implementation of this strategy is not critical because there are no licences being received for the sub-area. In the medium term however a basin study will be required to understand water use and available water resources.	
	ACTIONS	**RESPONSIBLE ORGANISATION**
PLAN OF ACTION	The following management actions are necessary to address the uncertainty in the water resources availability figures. It is important that the DWAF **Regional Office** takes responsibility for coordinating and integrating these activities	
	(i) Undertake monitoring of water use, the hydrological, hydrogeological and water quality-monitoring information of the Marico River and its tributaries.	Directorate: Information Programmes
	(ii) Set up the water resources systems model for the Marico catchment and assess the yield of Molatedi Dam, Marico Bosveld Dam, Kromellenboog Sehujwane, Pella and Madikwe Dams.	Directorate: National Water Resource Planning
	(iii) Model the surface water and groundwater interactions of the sub-area of the Marico River catchment and assess the contribution of dolomite aquifers to the base flow of the Upper catchments of the Marico River.	Dir.: WRPS in collaboration with NWRP & Information Programmes

SURFACE WATER RESOURCE AVAILABILITY		
	(iv) Model the water quality impact of the return flows on the total available water resources of the sub-area. Assess the nature and quality of the effluent for reuse in the sub-area. DWAF should investigate the feasibility of utilising the available return flow for irrigation purposes depending on the type of crops to be irrigated. This license should be for a limited period of time.	Directorate: WRPS, NWRP and RO: Water Resources Management

RELATED STRATEGIES:

Strategies that should be read in conjunction with Resource Availability Strategy are as follows:

1.2 Effluent re-use strategy

1.3 Groundwater resource availability strategy

1.4 Verification of existing lawful use

2.2 Water Quality Management

5.1 Monitoring and Information System

10 International obligations

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RECONCILIATION STRATEGIES

EFFLUENT RE-USE

MANAGEMENT OBJECTIVE:

- The primary management objectives of this strategy is t**o ensure optimal utilisation** of the effluent generated in the sub-area to compliment the good quality water in the Marico catchment without contributing to environmental degradation.

ASSESSMENT & ANALYSIS OF ISSUES:

The growth in water demand in the urban areas of Zeerust, Marico and Lehurutse as well as the water requirements for irrigated agriculture is increasing the return flow in Marico River catchment. The return flow generated from urban as well as irrigation is currently being discharged into the Klein Marico River. It is therefore available for downstream use. It could be meeting ecological water requirements of the tributaries of Marico. The problem with meeting the ecological water requirement is the lack of variability in the effluent discharge and the quality of the effluent. Effluent discharges from urban areas are more nearly constant throughout the year than in irrigation return flows.

Approximately **5,4 million m³ /a** of effluent is being discharged into the Marico River and its tributaries contributing to the available water resource of the catchment. Municipal (mainly from Zeerust) and wastewater from irrigation constitute the most significant amount of effluent that is currently not being directly re-used. If return flows is to be re-used before discharging into streams, then the treatment of wastewater must be of a higher standard. The quality of the effluent discharged into the Marico River and its tributaries is not known whether it meets the water quality objectives of the Marico River and its major tributaries. The water quality objectives for the Marico River and its tributaries have not been set as yet.

The total water resources development in the Marico may have reached the limit of its ultimate utilisable potential for a high return on investment. Further resource development is also constrained by environmental (ecological) concerns that the reuse of effluent is becoming a viable option besides inter-basin transfer, which is expensive and not an option. It is essential to maximise wastewater reclamation and reuse strategy to utilise this available water resource before considering transfer from other catchments.

The potential for direct effluent reuse in the Marico has not been quantified to know where and when effluent can be reused. Guidelines for effluent reuse either at national level or in the Marico catchment specifically have not been fully developed. Because of the very nature of effluent water quality, it generally meets the requirements of certain type of water use, such as agriculture or certain types of industries, but these options can be increased through treatment and reliable quality control.

<table>
<tr><th colspan="3">EFFLUENT RE-USE</th></tr>
<tr><td colspan="3">PROPOSED STRATEGY

The proposed strategy is for direct effluent re-use before discharging into streams. This will have an impact on downstream users who are currently dependent on the return flow flows.</td></tr>
<tr><td>PRIORITY</td><td colspan="2">High –short to medium term development and implementation of the strategy is required</td></tr>
<tr><td></td><td>ACTIONS</td><td>RESPONSIBLE ORGANISATIONS/INSTITUTIONS</td></tr>
<tr><td rowspan="4">PLAN OF ACTION:</td><td>(i) Determine the wastewater treatment methods needed and the degree of reliability required for the treatment processes and operations for implementation of wastewater reclamation and reuse.</td><td>Directorate: Waste Discharge and Disposal in collaboration with NW Regional Office Water Quality Section</td></tr>
<tr><td>(ii) Investigate and determine methods for accounting the effluent into the water resource availability action plan. Identify water quality monitoring stations for effluent reuse and establish the required monitoring protocol and standards for effluent reuse.</td><td>Directorate: Options Analysis</td></tr>
<tr><td>(iii) Develop water quality objectives for the Marico River and its tributaries. Identify options available for effluent re-use in the catchment.</td><td>Directorate: Waste Discharge and Disposal in collaboration with the RO Water Quality Section</td></tr>
<tr><td>(iv) Engage with stakeholders on the potential reuse of effluent before discharge into the rivers in order to gauge acceptability for effluent reuse.</td><td>As above</td></tr>
<tr><td colspan="3">RELATED STRATEGIES:

The above strategy needs to be read in conjunction with the following related strategies:
♦ Resource availability strategy
♦ Water resources protection strategy
♦ Water Quality Management strategy
♦ Water Use Management strategies
♦ Co-operative Governance strategy</td></tr>
</table>

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RECONCILIATION STRATEGIES

GROUNDWATER RESOURCES AVAILABILITY

MANAGEMENT OBJECTIVE:

The objective of this strategy is to **maximise the conjunctive use** of the significant groundwater resources in the Upper catchments of the Marico sub-area and the surface water resources of the catchments to meet the current and growing water needs.

ASSESSMENT & ANALYSIS OF ISSUES:

Dolomitic aquifers are very important source of water in this area. Groundwater resources are potentially the only source of supply for the future water requirements that the generally poor communities that dominate the catchment can afford on a sustainable basis. There is potential for abstracting more out of the aquifers but the yield from these aquifers is not well understood.

The dolomite aquifer of Marico sub-area catchment crosses the catchment boundary into the Lower Vaal WMA. It also extends into the Upper Ngotwane sub-area (A10A, A10B and A10C). The aquifers represent important sources for stream base flow for the Groot Marico and its tributaries. All the tributaries of the Groot Marico river rise in the dolomite and the catchment is heavily dependent upon the dolomites for base flow. Chapter 4 of the ISP report provides the specific groundwater issues in the whole ISP area including Marico catchment.

Abstraction from the dolomite aquifer within the Lower Vaal could impact on the resources available within the Marico sub-area and visa versa. Whether or not this is an issue is unclear at this stage. An investigation is required to determine regional groundwater flow directions, distribution of aquifers within the Malmani dolomite, compartmentalisation due to dolerite dyke intrusions and impact of abstraction. As noted for the Upper Molopo sub-area such an investigation is underway and is being planned for the entire dolomite aquifer. This investigation will provide definitive answers

In terms of section 39(1), read together with section 21 of the National Water Act, 75m^3/ha/a may be abstracted from the quaternary catchments of the Marico River in terms of the latest general Authorisation. The figures have been increased from the original 60 m^3/ha/a, which was allowed in the 1999 Gazette. These figures apply to the Malmani dolomites and if not managed will negatively affect availability of groundwater in the long term.

There are ecological systems in the Upper catchments of Groot Marico that are dependent on the groundwater from the springs. The extent of their dependence on the groundwater from the springs needs to be investigated and understood as this will be required in the

GROUNDWATER RESOURCES AVAILABILITY		
determination of the groundwater reserve for ecosystem protection. During the workshop proceedings, it was resolved that where dolomitic aquifers are already supporting abstractions and feed rivers and streams flowing through environmentally sensitive areas (e.g. Marico springs,), **no new abstractions** should be allowed before full hydrogeological investigations mentioned in the main actions to determine the vulnerability of the aquifer from failure. It should also be noted that although the groundwater resource availability has been dealt with separately, there is a need for an Integrated Water Resources Management (IWRM) approach. The IWRM approach is already reflected at the institutional changes made within the DWAF and the administrative arrangements required for the whole water sector in the Regional DWAF Office. There is over exploitation of the groundwater resources which may cause subsidence of the ground (sinkholes) since the geology of the area is dolomitic There are sensitive environmental areas, which are dependent on the springs fed by the dolomitic aquifers. Knowledge of the volumes abstracted from the dolomite aquifers in the Marico catchment is not properly quantified. Overgrazing in the sub-area is impacting on and reducing the groundwater recharge capacity of the area because of removal of vegetation cover that decreases percolation and increases run-off. The rural communities are mainly dependent on groundwater as the source of water for both domestic and stock watering.		
PROPOSED STRATEGY It is important to understand the groundwater potential of the dolomitic aquifers and their interaction within the dolomitic compartments and with the surface water resources in order to reconcile current and future water requirements of the Marico		
PRIORITY	**Very High –**Understanding the groundwater resources availability in the Marico sub-area is critical to IWRM. The sub-area is almost entirely dependent on groundwater.	
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION	The dolomites traverse three WMAs and cross the international boundary with Botswana. Responsibility is therefore at national level with the **Directorate: Hydrological Information** and the involvement of **3 Regional Offices** and support by the **Directorate: National Water Resources Planning**	

GROUNDWATER RESOURCES AVAILABILITY			
	(i)	Develop tools to quantify surface-groundwater interaction in order to better quantify the contribution of groundwater to base flow and the recharge of groundwater systems from river flow especially during flood events.	Directorate: Water Resource Planning Systems
	(ii)	Develop groundwater management guidelines to manage groundwater and guide groundwater allocation planning	Directorate: Water Allocation, WRPS, Information Programmes
	(iii)	Determine the impact of groundwater abstraction on surface water resources in the tributaries of the Groot Marico River underlain by the dolomites	Directorate: WRPS, Water Allocation
	(iv)	Investigate the institutional arrangements required for the effective and sustainable management of the groundwater resources of the Marico and other catchments of the Lower Vaal and Middle Vaal WMA, which are interlinked to it.	Directorate: Water Allocation
	(v)	Review the General Authorisation (refer to **strategy 3.1**) on groundwater based on the potential yield of the dolomites. Determine new limits for the groundwater abstraction zones for the Marico catchment	Directorate: WRPS and RO
	(vi)	Develop more detailed knowledge of the groundwater resources.	Directorate: WRPS
	(vii)	Promote awareness of groundwater conservation.	RO
	(viii)	Promote use of local groundwater resources in preference to piping surface water long distances.	RO
RELATED STRATEGIES:	The above strategy needs to be read in conjunction with the following related strategies: ♦ **Protection of groundwater resources** ♦ **Water resource availability strategy** ♦ **Licensing** ♦ **Water Quality Management**		

GROUNDWATER RESOURCES AVAILABILITY	
	♦ **General Authorisation** ♦ **Co-operative Governance strategy** ♦ **Monitoring and Information System**

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RECONCILIATION STRATEGIES

BALANCING WATER DEMANDS WITH AVAILABLE WATER SUPPLIES

MANAGEMENT OBJECTIVE:

The objective of this strategy is to ensure that the available water supplies are optimally utilised by the water users of the Marico sub-area in order to achieve equity while maintaining social and economic development in a sustainable manner.

ASSESSMENT & ANALYSIS OF ISSUES:

Chapter 6 of this document illustrates that the sub-area of the Marico catchment is currently in deficit at 1:50 year assurance of supply for the year 2000 development by approximately **6 million m³ per annum,** if the requirements of the Reserve is taken into account. This deficit also excludes the **20.4 million m³ per annum** (at 80 per cent assurance of supply) allocated to the former Bophuthatswana.

The upper catchments of Marico, A31A, A31D and A31E, show that they are in deficit. The main water requirements for groundwater include irrigation and stockwatering. There are uncertainties about the existing water use figures particularly from groundwater. The lack of understanding of the total groundwater resource from the dolomites that is being abstracted and that can be utilised influence the reconciliation of the water requirements with available supplies.

Over-abstraction of the groundwater from the dolomites will impact on the long-term sustainability of water resources and dry up the Marico springs which are ecologically sensitive areas if not properly managed.

Where dolomitic aquifers are already supporting abstractions and feed rivers and streams flowing through environmentally sensitive areas (e.g. Marico springs), **no new licenses** in the stressed quaternary catchments mentioned above should be allowed before the main actions to determine the water resources availability as well as the groundwater resource availability strategies have been implemented.

There is an over-allocation of the water resources of the Molatedi dam. The downstream irrigators are presently utilising water that will in future be required to meet the ecological water requirements for the stretch of river downstream of Molatedi Dam. The status of the water allocations of the former Bophuthatswana farmers who did not take up their allocations in terms of the TSWASA Agreement may have significant impact on the reconciliation of the water resources. In terms of the agreement, former Bophuthatswana was entitled 20.4 million m³ per annum but that water is not available as indicated in the water balance.

BALANCING WATER DEMANDS WITH AVAILABLE WATER SUPPLIES

PROPOSED STRATEGY

The proposed strategy for reconciling the available water resources with the current water requirements is manage the water demands based on benchmarks of water use for each water use category. This can only be done once the confidence in the existing water use figures is high.

DWAF needs to engage with the water user sectors so that they can implement efficient utilisation of the water resources using the instruments at their disposal. Reallocation of water from high volume low value use to low volume high value in the catchment should be encouraged through water trading.

The recommended strategy is to prepare an audit of who are the water users and where in the Marico sub-area they are getting their raw water supplies for the present and future requirements. This will include balancing the current water and future water requirements with available water supplies. The reallocation of water use within sectors and among sectors to maximise the welfare of communities based on the value of water (i.e. economic value, use cost and opportunity costs) should be considered as part of this strategy taking into account equity considerations to improve rural livelihoods.

PRIORITY	**Medium High –** It is important that water users (or water user associations) know where their sources of supply are.	
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION	(i). Verify existing water use from the different sources in the Marico sub-area. Establish their lawfulness. (Surface as well as groundwater)	RO
	(ii). From the water resources availability strategy determine the quantity and quality of the various sources of water supply in the sub-area.	Directorate: National Water Resource Planning
	(iii). Undertake a study of the economic analysis of three critical factors: - the value of water, the use cost of water and the opportunity cost of the resource for the different user sectors in the sub-area of Marico catchment.	Directorate: WR Planning Systems
	(iv). Identify the future sources of water supplies for the local authorities and Resource Poor Farmers as well as for rural livelihoods and provide this input into the IDPs and WSDPs	Directorate: Option Analysis

BALANCING WATER DEMANDS WITH AVAILABLE WATER SUPPLIES		
	(v). Determine the status of the water rights of the former Bophuthatswana farmers who did not take up their allocations in terms of the TSWASA agreement.	Directorate: National WR Planning
RELATED STRATEGIES:	The above strategy needs to be read in conjunction with the following related strategies: ♦ **Groundwater resource availability** ♦ **Water resource availability** ♦ **Verification of existing lawful water use** ♦ **Licensing** ♦ **Water Quality Management** ♦ **General Authorisation**	

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Strategy No.:	2.1

WATER RESOURCE PROTECTION STRATEGIES

RESERVE AND RESOURCE QUALITY OBJECTIVES

MANAGEMENT OBJECTIVE:

The objective of this strategy is to provide the quantitative and qualitative characteristics of the surface water and groundwater resources in order to ensure sustainable management of the water resources for both the social and economic development and the natural environment.

ASSESSMENT & ANALYSIS OF SUB-AREA ISSUES:

The Marico River sub-area has received very few applications for licenses. In terms of the Act all preliminary reserve and resource quality objectives need to be determined before a license application can be considered.

Although considerations need to be given to the Reserve requirements (both ecological and basic human needs) of the Groot Marico River and the groundwater in order to ensure sustainable management and functioning of the ecosystem, if the Reserve is determined and implemented, there will be much bigger shortages which will result in negative social and economic implications

There are no areas presently in the Marico sub-area where the Reserve implementation is urgently required. However it is important if baseline monitoring of the biotic and abiotic components for future determination of comprehensive reserve determinations when compulsory licence is necessary.

The key factor in reserve determinations and setting resource quality objectives is if compulsory licensing is required for the following :

- The farmers in the former Bophuthatswana (assuming they exist) take up their allocations in terms of the TSWASA agreement. There will be an over-allocation of water from Molatedi Dam, which will require licensing of all water users However in terms of the definition of existing lawful use (**Clause 32 of the Act**.) the farmers may no longer be declared existing lawful water users.

Not many license applications have been received in this sub-area. The environmental department has not expressed major concerns with regard to the environmental degradation due to over-utilisation of the dolomites or of the Upper Molopo River. The farmers of former Bophuthatswana have not raised the need to up their water allocations.

RESERVE AND RESOURCE QUALITY OBJECTIVES

PROPOSED STRATEGY:

The strategic options evaluated during the ISP development to address the above sub-area issues of the Marico catchments on the Reserve and Resource Quality Objectives include the following:

(i) Undertake a reserve determination of the sub-area and determine the RQOs of the Marico River and the dolomites. This will require developing baseline information for future monitoring. The constraint with this strategy is that with the limited resources and capacity for reserve determinations nationally. The sub-area is therefore not of high priority.

(ii) Leave the status quo as it currently is but continue to monitor use of the water resources and their impact on the natural environment. This may not be sufficient because of the need for reallocation of the available water resources.

The recommended strategy is not to undertake the reserve determination and determine the Resource Quality Objectives because the above issues do not rank very high when compared with other strategies. DWAF does not have the capacity to implement Reserve determination in low priority catchments. It is recommended that baseline monitoring commences.

PRIORITY	**Low** – Reserve Determination. This sub-area does warrant requirement for the reserve because the catchments are generally in deficit. **High** – Monitoring is important.		
	ACTIONS		**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION:	(i)	Engage with the Provincial Department of Agriculture and Environment Affairs concerning identification of environmentally sensitive areas in the sub-area and establish how this concern if any can be addressed.	The RO is responsible for the plan of action
	(ii)	Undertake a scoping study on the water resources issues and indicators, which drive the sustainability of the natural environment.	As above
	(iii)	Set up a baseline monitoring programme of the key indicator species in the water management area such as at springs. The objective is to ensure updating of management information with regard to the ecosystem functioning in the sub-area.	As above
	(iv)	Engage, in a monitoring program, as the ecology in this sub-area is not well known.	As above

RESERVE AND RESOURCE QUALITY OBJECTIVES	
RELATED STRATEGIES:	The above strategy needs to be read in conjunction with the following related strategies: ♦ **Water Resource availability** ♦ **Reconciliation of the available water resources with demands** ♦ **Water Quality Management**

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Strategy No.:	2.2

WATER RESOURCES PROTECTION STRATEGIES

WATER QUALITY MANAGEMENT

MANAGEMENT OBJECTIVE:

The objective of this strategy is to ensure the protection of the water resources for sustainable use while taking into account the need for social and economic development in a sustainable manner

ASSESSMENT & ANALYSIS OF ISSUES:

The central parts of the Groot Marico catchment have a large rural population, which has no adequate sanitation infrastructure in place. There is potential for pollution of the resources from latrines and increasing population, with elevated TDS and NO_3. It is currently no known whether the pollution problem is significant.

There are varying water quality impactors in the Marico catchments. Both point and non-point source pollution. Downstream of Marico Bosveld Dam there is significant irrigation taking place, which is a potential area for diffuse source pollution because of the intensive use of fertilisers. The important issue to consider in dealing with the water quality problems of irrigated agriculture is the spatial and temporal variation of the impact from irrigation on the water resources downstream of the Marico Bosveld Government Irrigation Scheme. Impacts of agricultural practise on groundwater quality must be assessed, especially with regard to over use of fertilizers, and surface runoff of nitrate and phosphate rich water entering drainages and the groundwater resources, which then provide for base flow.

Impacts of overgrazing on groundwater recharge, soil erosion and surface runoff are major problems that are prevalent in the Marico sub-area particularly in the dense settlements around Madikwe.

The dolomite aquifer at Ramotswe has been developed but has become heavily polluted from the increasing population in the town.

WATER QUALITY MANAGEMENT		
PROPOSED STRATEGY The proposed strategy if that DWAF must ensure pollution control at the source and water quality objectives for all users in the Marico sub-area which is essential for meeting international obligations from Molatedi dam. The strategy of prevention at source is very important for the sustainable utilisation of the water resources. The dolomite aquifers, a strategic source of supply to the area for the rural communities needs to be protected from pollution due to lack of adequate sanitation infrastructure.		
PRIORITY	**Medium - High**	
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION:	(i) Validation of all the existing wastewater dischargers, identification and prioritisation of areas requiring special attention such as the Marico River	DWAF RO **water quality management**
	(ii) Determining the water quality objectives for rivers such as the Marico as effluent–limited rivers because of the potential re-use of water for municipal purposes.	Dir.: WRPS
	(iii) 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.	RO
	(iv) Impacts of agricultural practise on groundwater quality must be assessed, especially with regard to over use of fertilizers, and surface runoff of nitrate and phosphate rich water entering drainages and the groundwater resources, which then provide base flow.	Dir.: WRPS and RO
	(v) Address the impacts of overgrazing on groundwater recharge, soil erosion and surface runoff through co-operative governance and a public awareness campaign	As above
	(vi) Determine the extent of pollution of the dolomite aquifer due to the uncontrolled development of Ramotswe	As above
	(vii) Identify where groundwater pollution is taking place in the sub-area and determine the sources of groundwater pollution.	As above

WATER QUALITY MANAGEMENT		
	(viii) DWAF must regulate regional solid waste management for the Marico sub-area at Zeerust with transfer stations from other areas such as Madikwe, Pella , etc.	RO and Waste Discharge and Disposal
RELATED STRATEGIES:	The above strategy needs to be read in conjunction with the following related strategies: ♦ **Groundwater resources availability** ♦ **Water resource availability** ♦ **Water Conservation and Water Demand Management**	

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Strategy No.:	4.1

WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGIES

MANAGING DEMAND IN WATER SERVICES INSTITUTIONS

MANAGEMENT OBJECTIVE:

- To make **more efficient use** of the existing available water resources to the domestic and industrial sectors before consideration is given to expensive alternative sources of supply

ASSESSMENT & ANALYSIS OF ISSUES:

Inefficient use of existing sources of water supplies due to unaccounted for water losses through leakage and wastage continues to be a matter of great concern in the Marico catchments.

There have been plans to increase the number and capacity of WTWs in the catchments when there are limited water resources to supply these treatment works. The WSDPs of the local municipalities do not provide detailed strategies of how the demand side management will be implemented. There are no business plans developed for the implementation of water conservation and water demand management for the towns in the sub-area.

Most of the regional WTW are operating at their design capacity. These include the 2Ml/d Madikwe Regional Water Supply which currently receives its supply from Madikwe dam (estimated yield at 98% assurance is 0,657Mm3 per/a) Botshabelo Water has indicated the desire to utilise the Marico Bosveld Dam as a source of supply to the area. However, the yield of the Marico Bosveld Dam is fully allocated and the water is fully utilised mainly by the irrigators downstream.

Although reallocation is an option, it will have socio-economic consequences for the area. There is an urgent need to manage demand side before considerations are made about the supply side. The lack of cost recovery in most of the communities in the catchment is increasing the consumer wastage and leakage in the distribution system.

Use of public standpipes is influencing the water use because of lack of accountability in communities.

There is very small recovery of the operation and maintenance cost in the water services sector.

Increasing soil erosion in the catchment is reducing water resource availability

MANAGING DEMAND IN WATER SERVICES INSTITUTIONS

PROPOSED STRATEGY

The proposed strategy is the implementation of water conservation and water demand management strategy measures throughout the entire sub-area. This strategy has the benefit of increasing the local municipality's revenue (through appropriate rising block tariff). The resource of the local authorities can be efficiently allocated for priority projects rather than augmenting wastewater treatment plants, which cannot be operated efficiently because of capacity problems.

This strategy is critical because the limited groundwater and surface water resources of the catchments cannot meet the existing demand at a high level of assurance.

PRIORITY:	**Very High** – This sub-area is water stressed and only demand side management measures are feasible. The options for increasing water supplies are diminishing because the costs of water development projects for the area are rising dramatically.	
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION	(i) DWAF must publicise their guidelines on the development and implementation of Water Conservation and Water Demand Management for Water Services Institutions.	The RO is responsible for initiating the awareness campaign with assistance from the Directorate: Water Use Efficiency
	(ii) DWAF must ensure that water is distributed efficiently by encouraging the water services institutions to initiate a metering programme	
	(iii) DWAF should initiate an awareness campaign with institutional stakeholders to educate on the benefits of water conservation and demand management (such as maximising the return on existing capital investment).	
	(iv) Support to water services institutions to develop and implement WC/WDM measures, specific to their circumstances, should be given by DWAF.	As above
	(v) DWAF should encourage any current initiatives in water conservation and water demand management that are taking place in the sub-area.	As above
	(vi) DWAF should encourage the local authorities to implement rising block tariffs where this is not being implemented as an economic instrument for reducing water use to sustainable levels.	As above

MANAGING DEMAND IN WATER SERVICES INSTITUTIONS		
	(vii) Local authority bye-laws should be reviewed to include water saving devices in development	As above
	(viii) Ensure that consumer use reduction activities are undertaken and incorporated in the WSDPs for all municipalities	As above

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Strategy No.:	4.2

WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGIES

MANAGING DEMAND IN THE IRRIGATION SECTOR

MANAGEMENT OBJECTIVE:

The objective of this strategy is to ensure that the on-field and off-field water use by the irrigation sector is being efficiently managed for the sustainable use of the water resources.

ASSESSMENT & ANALYSIS OF ISSUES:

Irrigated agriculture in the sub-area of the Marico catchment is quite significant. It uses approximately 31.7 million m^3 per annum of the available resources, which translates to about 56% of the resource utilisation.

The efficiency of water use in the irrigation sector is however not well understood in the area. The crops under irrigation on the Marico Bosveld irrigation scheme are tobacco, chillies and wheat. The most efficient irrigation methods for the types of crops irrigated have not been determined to establish whether on-field irrigation methods are efficient.

The irrigation systems and structures include canal system for conveyance of water to the edge of the fields. There are system losses in these canals because of the age of the canal system. With no proper measurements, it is difficult to quantify the conveyance losses.

PROPOSED STRATEGY:

The Marico Sub-area is water stressed therefore all water user sectors should be practicing water conservation and water demand management. The proposed strategy is to encourage the Irrigators develop water management plans, which illustrates the cropping patterns, on-field irrigation, practices, measuring systems of water loss to field edge.

PRIORITY:	**High** – this is the biggest user of water	
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION:	(i) Engage with water users in the catchment and publicise the generic guidelines for water conservation and water demand management in the irrigation sector	RO and Water Use Efficiency

MANAGING DEMAND IN THE IRRIGATION SECTOR			
	(ii)	Establish Water User Associations and transform existing Irrigation Boards into Water User Associations	Directorate: WMI Oversight
	(iii)	Encourage metering in the irrigation sector Water User Associations are encouraged to develop their water management plans because of the benefit it has on the return on investment to farmers.	The RO is responsible for implementing this strategy
	(iv)	Encourage trading of water with the irrigation sector. This will provide incentives for improve irrigation efficiencies. Alternative cropping systems with less dependence on irrigation will be investigated by the WUA in order to free up water, which can be traded. Other options to be investigated include improvement of existing systems, salt-water utilisation for growing crops, wastewater utilisation for agriculture and adoption of new irrigation technologies. The increasing return flow in the upper catchments of Klein Marico should be further explored to supplement the water requirements of the Marico Bosveld government irrigation scheme.	Directorate: Water Use Efficiency
	(v)	Improve cost recovery and system maintenance through the establishment of WUAs based on the source of supply for all users and the promotion of active WUAs.	RO
RELATED STRATEGIES	The above strategy needs to be read in conjunction with the following related strategies: • **Water resource availability** • **Groundwater resource availability**		

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APPENDIX B: UPPER MOLOPO SUB-AREA – SPECIFIC STRATEGIES

Strategy No.:	1.1

RECONCILIATION STRATEGIES

WATER RESOURCE AVAILABILITY

MANAGEMENT OBJECTIVE:

The objective of this strategy is to improve the information on the available water resources of the sub-area of the Upper Molopo River catchment by identifying and analysing the water supply sources (location, quantity, and quality).

ASSESSMENT & ANALYSIS OF ISSUES:

The Upper Molopo River Catchment is in deficit if the resource availability of both the surface water resources and groundwater resources is compared with the current water requirements, taken at the appropriate level of assurance of water supply, based on the limited hydrological information that is available. The level of confidence on the hydrological information is very low and the risk of managing the resources with this information is very high. No water allocation plan can be developed without a good understanding of the available water resources.

In the Upper Molopo sub-area there is increasing return flow, from the Mafikeng Town and this resource is not being fully utilised. Although this key area appears to have this resource, there are water quality problems for the intended use (urban water use), which is affecting treatment and operating costs of the water.

The Local Municipality of Mafikeng is over-abstracting from the dolomitic compartments of the Grootfontein and Molopo and this may not be sustainable if the recharge capacity is exceeded by the abstraction during the wet periods. The problem is to know how much water can be abstracted from the dolomites before it becomes unsustainable. The effect of the over-abstractions on the surface and groundwater ecological reserves has not been determined. The surface water groundwater interaction is not well understood. This is very important in this sub-area because the Molopo River is dependent on the spring flow from Molopo springs. There may be double counting of the available water resources of the sub-area.

There has been application for additional water from Disaneng for irrigation purposes to support Resource Poor Farmers.

The rural communities do not have adequate water from the available surface water resources to meet the basic human needs and water for rural livelihoods. The surface water resources of the Upper Molopo catchment are not adequate and reliance is placed on the groundwater potential of the dolomites

<table>
<tr><th colspan="3">WATER RESOURCE AVAILABILITY</th></tr>
<tr><td colspan="3">The availability of the groundwater and surface water resources have not been quantified-with a high degree of confidence. Local groundwater resources have not been fully developed to supply the rural communities

The costs of transferring water from Middle Vaal as proposed in some studies for the rural communities are very high and is probably not sustainable. There is need to first develop local water resource (groundwater and surface water resources) to their full potential before looking at importing from other catchments.

The springs, which are dependent on the Grootfontein dolomitic compartments, have been known to dry up. This may be an indication of groundwater overdraft from these compartments, which may in the long term be unsustainable.

It was highlighted that there was a need for continuous monitoring of the Grootfontein Compartment. The large events are not picked up on monthly monitoring.</td></tr>
<tr><td colspan="3">PROPOSED STRATEGY

The proposed strategy is to understand how much can be abstracted from the dolomitic aquifers on a long-term sustainable basis. The surface water resource is not significant for upper Molopo sub-area. In the long term, it is important to understand the groundwater-surface water interaction in this sub-area.</td></tr>
<tr><td>PRIORITY</td><td colspan="2">High – Groundwater surface water interaction should be done in the short term to determine available water resources.</td></tr>
<tr><td></td><td>ACTIONS</td><td>RESPONSIBLE ORGANISATION</td></tr>
<tr><td rowspan="3">PLAN OF ACTION</td><td>Initiate a study to determine the groundwater resource including the surface water interaction. A study is underway in this regards. This study must feed into understanding the water resources availability of Upper Molopo sub-area</td><td>DWAF Regional Office takes responsibility for coordinating and integrating these activities</td></tr>
<tr><td>(i) Assess the yield of Setumo Dam with the increasing return flows and urban runoff from Mafikeng. Use the model that was set up during the construction of Setumo Dam to determine the surface water resources of the Upper Molopo catchment.</td><td>Directorate: National Water Resource Planning</td></tr>
<tr><td>(ii) Develop an integrated water resources system model for the Upper Molopo catchment (for both surface and groundwater)</td><td>Directorates: NWRP and WRPS</td></tr>
</table>

WATER RESOURCE AVAILABILITY		
	(iii) Model the surface water and groundwater interactions in the catchment including the contribution of dolomite aquifers to the base flow of the Upper Molopo River.	Ditto
	(iv) Model the water quality impact of the return flows on the total available water resources of the catchment. Assess the nature and quality of the effluent for reuse in the catchment. DWAF should investigate the feasibility of utilising the available return flow for irrigation purposes depending on the type of crops to be irrigated. This license should be for a limited period of time.	Directorate: WRPS, NWRP and RO: Water Resources Management
	(v) Improve the monitoring of hydrological, hydrogeological systems and water quality-monitoring stations of the Molopo River and its tributaries.	RO: Water Resources Management
	(vi) Determine the sustainable quantities of surface and groundwater resources that can be utilised without negatively impacting on the ecology. A preliminary reserve should be determined.	Directorate: Water Use
	(vii) Identify the future sources of water supplies for the local authorities and the Resource Poor Farmers as well as for rural livelihoods based on the IDPs and WSDPs	Directorate: Options Analysis
RELATED STRATEGIES:	Strategies that should be read in conjunction with Resource Availability Strategy are as follows: **1.2 Effluent re-use strategy** **1.3 Groundwater resource availability strategy** **1.4 Verification of existing lawful use** **2.1 Water Quality Management** **5.1 Monitoring and Information System**	

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Strategy No.:	1.2

RECONCILIATION STRATEGIES

EFFLUENT RE-USE

MANAGEMENT OBJECTIVE:

- The primary management objectives of this strategy is **to ensure optimal utilisation** of the effluent generated in the sub-area to compliment the limited good quality water in the Upper Molopo catchment without contributing to environmental degradation.

ASSESSMENT & ANALYSIS OF ISSUES:

Due to very limited resource in Upper Molopo sub-area, the use of wastewater effluent, currently being discharged into the environment from the municipal wastewater treatment plants, needs to receive more attention as an alternative source of water.

The Mafikeng Local Municipality has been increasingly utilising the water resources from the dolomitic aquifers of the Grootfontein and Molopo springs. This source of water supply is limited and the Local Municipality is exceeding their water allocation from the dolomites.

There is underutilisation of the water resources from Setumo Dam, whose yield is increasing due to the return flows from the urban and industrial areas of Mafikeng. The reason for this is the increasing cost of treating the water from Setumo Dam affecting the operating and maintenance cost of the WTW at Setumo Dam.

Approximately **5 million m^3 /a** of effluent is being discharged into the Molopo River and contributes to the yield of Setumo Dam.

The Local Municipality of Mafikeng does not have the capacity nor the resources to operate the wastewater treatment works to produce domestic wastewater discharge to the wastewater limit values set in table 3.2 of the general authorisation gazetted on 8 November1999.

The wastewater limit values for orthophosphate as phosphorous of 10 mg/l are being exceeded. Effluent reuse has to be licensed if irrigation with waste is allowed because of the potential water quality problems that can affect the groundwater from the dolomite aquifers.

PROPOSED STRATEGY

Surface water resources development in the Upper Molopo has reached the limit of its ultimate utilisable potential. Further resource development is also constrained by environmental (ecological) concerns so the reuse of effluent is becoming a viable option besides inter-basin transfer, which is expensive. It is important to develop wastewater reclamation and reuse strategy to utilise this available water resource before considering transfer from other catchments.

EFFLUENT RE-USE		
PRIORITY	**High** –short to medium term development and implementation of the strategy is required	
PLAN OF ACTION	**ACTIONS**	**RESPONSIBLE ORGANISATIONS/ INSTITUTIONS**
	(i) Identify the categories of water use sector for municipal wastewater reuse in the Upper Molopo catchment and identify the potential constraints for reuse of the increasing municipal wastewater supplies	Directorate: Waste Discharge and Disposal in conjunction with Regional Office Quality Section
	(ii) Determine the wastewater treatment methods needed and the degree of reliability required for the treatment processes and operations for implementation of wastewater reclamation and reuse.	
	(iii) Identify water quality monitoring stations for monitoring effluent reuse.	RO Water Quality Section
	(iv) Develop water quality objectives for the Molopo River and its tributaries.	Directorate: Waste Discharge and Disposal and RO
	(v) Engage with stakeholders discharging waste into the Upper Molopo River to build capacity in reuse of effluent	As above
	(vi) Establish incentives for dischargers to meet the water quality objectives of the Upper Molopo River and the effluent standards	As above
RELATED STRATEGIES:	The above strategy needs to be read in conjunction with the following related strategies: • **Resource availability strategy** • **Water resources protection strategy** • **Water Quality Management strategy** • **Water Use Management strategies** • **Co-operative Governance strategy**	

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Strategy No.:	1.3

RECONCILIATION STRATEGIES

GROUNDWATER RESOURCES AVAILABILITY

MANAGEMENT OBJECTIVE:

The management objective of achieving the groundwater resources availability strategy is to **maximise the conjunctive use** of the significant groundwater resources and the surface water resources of the catchment to meet the current and growing water needs of the catchment in order to promote equity and socio-economic development of the communities.

ASSESSMENT & ANALYSIS OF ISSUES:

Groundwater is available throughout this key area but it is found in different quantities. Overall the available groundwater resources within the catchment are under utilised although this clearly depends both on the groundwater occurrence and the demand. Even smaller groundwater sources can often provide more than the RDP level of service of 25 litres per person per day.

There are significant dolomitic aquifers traversing the Upper Molopo catchment but the extent of groundwater withdrawal from the compartments of Grootfontein and Molopo springs in not known with a high degree of confidence. The sustainable yield from these compartments has not been determined.

A number of studies have been completed in the past on the groundwater recharge potential of the dolomites, but the relationship of the compartments has not been well understood. A study is currently underway which is focusing only on the Polfontein compartments. The management of the groundwater is further complicated by the WMA boundaries, which are based on the watershed boundaries. These do not apply to the dolomites. The dolomite aquifer crosses the catchment boundary into the Lower Vaal WMA

The extent to which the abstractions from the dolomitic compartments affects the water users drawing from the same compartment or using surface water fed from the spring discharges from the aquifer has been known to affect the yield of the groundwater resources from the dolomites.

The Upper Molopo catchment (D41A) is classified in the Groundwater abstraction Zone A It would appear that the groundwater abstractions above those set out in Schedule 1 of the National Water Act are being exceeded without authorisation (or license). This might mean that groundwater mining is taking place in some of the compartments of the catchments. Grootfontein compartment seems to be over-abstracted although spring flows in some of the compartments such as Molopo indicate no mining is apparent.

GROUNDWATER RESOURCES AVAILABILITY

There are monitoring networks in the Grootfontein compartment, which can be extended to other compartments. Continuous monitoring of groundwater levels is not being done in all the dolomite aquifers.

The depth of boreholes and whether pumps are sited low enough to average out percolation fluctuations has not been determined in most of the dolomitic compartments and other groundwater bearing geology in the catchment.

Where dolomitic aquifers are already supporting abstractions and feed rivers and streams flowing through environmentally sensitive areas (e.g. Dinokana springs, Molopo springs), **no new licenses** should be considered before full hydrogeological investigations mentioned in the main actions to determine the vulnerability of the aquifer from failure.

DWAF must ensure that NWWSA does not abstract more than the **8,8 million m³** per annum for the Grootfontein compartment and the Molopo spring

The Grootfontein compartment can be treated as a large underground reservoir that can be drawn down to supply water needs during periods of low recharge. Lowering of the water table during periods of low recharge does not mean the yield of the compartment has been exceeded if it recovers during rainy periods. This approach has not been established for all the compartments of the Upper Molopo catchment.

Availability, and reliability of water supply to Mafikeng, most of which is obtained from the Malmani dolomites to the east of the town is being affected by the continued overdraft of the Grootfontein Compartments by the Municipality.

Knowledge of the volumes abstracted from the dolomite aquifers in the Upper Molopo catchment is not properly quantified.

Over-abstraction from the dolomites of the Grootfontein can cause sinkholes. Over-abstraction from the Molopo springs may cause depletion of streamflow in the Upper Molopo River, which is dependent on recharge from the spring. The streamflow is important for dilution of the increasing return flows from the urban and industrial wastewater flows from Mafikeng. The streamflow dilution is important in the reuse of the return flows.

Overgrazing in the sub-area is impacting on and reducing the groundwater recharge capacity of the area. This is mainly in the rural communities who are mainly dependent on groundwater as the source of water for both domestic and stock watering.

Botshabelo Water wants to increase the Mafikeng WTW from its present 45Ml/d to 60Ml/d. The current sources of supply for the WTW are the Grootfontein and Molopo spring and supplemented by Setumo Dam, which is hardly utilised. If the allocation to the NWWSA from the dolomites is increased this may negatively impact on the base flow of the Molopo River, which is fed from the dolomite aquifer spring.

The water requirements of the ecosystems dependent on aquifer spring flows of the Molopo spring have not been established and its significance to ecosystem functioning are not known. This needs to be established even at preliminary level.

<table>
<tr><th colspan="3">GROUNDWATER RESOURCES AVAILABILITY</th></tr>
<tr><td colspan="3">PROPOSED STRATEGY:

To understand the groundwater potential of the dolomitic aquifers and their interaction within the dolomitic compartments and with the surface water resources in order to reconcile current and future water requirements of the Marico, Upper Molopo and Upper Ngotwane.

Groundwater resources are potentially the only source of supply for the future water requirements that the general poor communities that dominate the catchment can afford on a sustainable basis. It is critical that the DWAF understands the optimal utilisation of the groundwater without negatively impacting on the ecology dependent on the dolomitic aquifer fed springs that are prevalent in the catchment.</td></tr>
<tr><td>PRIORITY</td><td colspan="2">Very High –Understanding the groundwater resources availability in the Upper Molopo sub-area is critical to IWRM. The sub-area is entirely dependent on groundwater.</td></tr>
<tr><td></td><td>ACTIONS</td><td>RESPONSIBLE ORGANISATION/ INSTITUTION</td></tr>
<tr><td rowspan="5">PLAN OF ACTION</td><td>(i) Extend the current investigation of the Polfontein compartment to the Upper Molopo sub-area and determine the linkages of the compartments within this area and other catchments</td><td rowspan="4">The dolomites are a traversing three WMAs and cross the Botswana therefore responsibility should be at national level with the Directorate: WR Planning Systems and the involvement of 3 Regional Offices and support by the Directorate: Hydrological Information</td></tr>
<tr><td>(ii) Determine the abstractions (spatial and temporal distribution) from the dolomitic aquifers within the sub-area of the Upper Molopo.</td></tr>
<tr><td>(iii) Undertake an investigation to quantify the limiting yield of the dolomitic aquifers as the source of water supply and recharge (a key parameter for determining the groundwater component of the Reserve)</td></tr>
<tr><td>(iv) Develop tools to model surface-groundwater interaction in order to increase the contribution of groundwater to base flow and the recharge of groundwater systems from river flow especially during flood events.</td></tr>
<tr><td>(v) Develop generic groundwater management guidelines to manage groundwater and guide allocations in the Upper Molopo sub-area</td><td>Directorate: WRPS and Water Allocation</td></tr>
</table>

GROUNDWATER RESOURCES AVAILABILITY			
	(vi)	Determine the impact of groundwater abstraction on surface water resources in the parts of Upper Molopo sub-area underlain by the dolomites	Directorate: WRPS and Water Allocation
	(vii)	Investigate the institutional arrangements required for the effective and sustainable management of the groundwater resources of the Upper Molopo and other catchments, which are interlinked to it.	Directorate: Water Allocation
	(viii)	Undertake verification of existing lawful use in the Upper Molopo catchment particularly use from the SGWCA and update the WARMS database.	RO and Information Programmes
	(ix)	Review the General Authorisation (refer to catchment wide **strategy 3.1**) on groundwater use based on the potential yield of the dolomites. Determine new limits for the groundwater abstraction zones for the Upper Molopo catchment	Directorate: WRPS and RO

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Strategy No.:	1.4

RECONCILIATION STRATEGIES

BALANCING WATER DEMANDS WITH AVAILABLE WATER SUPPLIES

MANAGEMENT OBJECTIVE:

The objective of this strategy is to ensure that the available water supplies are optimally utilised by the water users of the Upper Molopo sub-area in order to achieve equity while maintaining social and economic development in a sustainable manner.

ASSESSMENT & ANALYSIS OF ISSUES:

The Upper Molopo River catchment is currently in deficit which is between **12** and **19 million m³/a**. The huge deficit is attributed mainly to the overdraft of the groundwater by both the irrigators and the local municipalities.

The allocation of water for the Mafikeng Local Municipality from the Grootfontein compartment is approximately **8,8 million m³/a**. It is however understood that the Local Municipality is drawing approximately **11 million m³/a** from the dolomites, which is 2.2 million m³/a more than their allocation.

The rural villages west of Mafikeng town do not have access to treated water. A study recently undertaken proposed to supply the area with water supply from the Middle Vaal WMA. The cost of bringing this water will exceed any possible cost recovery as the communities are generally poor and will not be able to meet the operation and maintenance costs of the scheme. Considering that most of the communities will be using free basic water, the equity share that the local authority will receive will not be able to meet the O&M costs.

A groundwater census investigation, which was recently undertaken on all the boreholes in Setla-Kgobi, which is west of Mafikeng, could give an indication of the groundwater potential in the area. This area is outside the dolomite aquifers that pervade the Upper Molopo sub-area. The interpretation of the survey has not been done.

Where dolomitic aquifers are already supporting abstractions and feed rivers and streams flowing through environmentally sensitive areas (e.g. Molopo springs), **no new licenses** should be considered before full hydrogeological investigations mentioned in the main actions to determine the vulnerability of the aquifer from failure

The NW province has expressed interest in developing up to 200 hectares of irrigation from Disaneng Dam. The yield of Disaneng dam will not be able to support the intended 200 hectares of irrigation.

<table>
<tr><th colspan="3">BALANCING WATER DEMANDS WITH AVAILABLE WATER SUPPLIES</th></tr>
<tr><td colspan="3">PROPOSED STRATEGY

The proposed strategy is to develop an audit of where the water users in the Upper Molopo River sub-area should get their raw water supplies for the present and future requirements. This should be included in the WSDPs.</td></tr>
<tr><td>PRIORITY</td><td colspan="2">High – It is important that water users (or water user associations) know were their sources of supply are.</td></tr>
<tr><td></td><td>ACTIONS</td><td>RESPONSIBLE ORGANISATION/ INSTITUTION</td></tr>
<tr><td rowspan="5">PLAN OF ACTION</td><td>(I) Verify existing water use from the different sources in the Upper Molopo River sub-area. Establish their lawfulness.</td><td>RO: Water Resource Management</td></tr>
<tr><td>(ii) From the resources availability strategy determine the quantity and quality of the various sources of water supply in the sub-area.</td><td>Directorate: National Water Resource Planning</td></tr>
<tr><td>(iii) The Local Municipality of Mafikeng, which is the largest water user in the catchment, should be informed of the limit it can draw from the Grootfontein compartment. Its additional water requirements should come from Setumo Dam.</td><td>RO Water Resources Management</td></tr>
<tr><td>(iv) The rural communities west of Mafikeng should be supplied from local groundwater resources once their sustainable yield has been established and is known according to strategy 1.1 above.</td><td>RO Water Resources Management</td></tr>
<tr><td></td></tr>
<tr><td></td><td>(v) The Itsoseng area should continue to be supplied from the Lichtenburg dolomitic compartment once the. The yield of the compartment should be accurately assessed.</td><td>RO Water Resources Management and WRPS</td></tr>
<tr><td></td><td>(vi) The rural communities to the north of Mafikeng should also be supplied from Setumo Dam, once the yield of the dam and its operating rules have been established as part of the resource availability strategy</td><td>RO Water Resources Management

NWRP and WRPS</td></tr>
<tr><td>RELATED STRATEGIES:</td><td colspan="2">The above strategy needs to be read in conjunction with the following related strategies:

♦ Groundwater resource availability</td></tr>
</table>

BALANCING WATER DEMANDS WITH AVAILABLE WATER SUPPLIES	
	♦ **Water resource availability** ♦ **Verification of existing water use** ♦ **Licensing** ♦ **Water Quality Management** ♦ **General authorisation** ♦ **Co-operative Governance strategy** ♦ **Monitoring and Information Syste**m

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WATER RESOURCE PROTECTION STRATEGIES

RESERVE AND RESOURCE QUALITY OBJECTIVES

MANAGEMENT OBJECTIVE:

The objective of this strategy is to provide the quantitative and qualitative characteristics of the surface water and groundwater resources in order to ensure sustainable management of the water resources for both the social and economic development and the natural environment.

ASSESSMENT & ANALYSIS OF ISSUES:

At present there are not many license applications being received for the Upper Molopo River sub-area. The only application likely to be received is for irrigating of an additional 125 hectares from the Disaneng Dam. The local authorities have been investigating water supply augmentation options to provide water to the rural communities to the west of the Mafikeng.

With the increasing scarcity of the water resources of the Upper Molopo sub-area, it is becoming essential to assess the ecological water requirements for the Upper Molopo River and the groundwater reserve to maintain the ecology dependent on these two resources. It should be noted that although not quantified, there is significant interaction between groundwater and surface water particularly in the headwaters of Upper Molopo River where there are springs feeding the river.

The increasing water quality concerns in the sub-area also warrant the development of resource quality objectives to protect the water resources in order to ensure sustainable management of the water resources.

PROPOSED STRATEGY

The proposed strategy is not to initiate baseline monitoring for future reserve determination and determination of the Resource Quality Objectives because the above issues do not rank very high when compared with other objectives.

PRIORITY	**Medium** – The situation in this sub-area do not warrant immediate requirement for the reserve.

RESERVE AND RESOURCE QUALITY OBJECTIVES		
	ACTIONS	**RESPONSIBLE ORGANISATION/INSTITUTION**
	(i) Engage with the Provincial Department of Agriculture and Environment Affairs concerning environmental sensitive areas in the water management and establish how these concerns if any can be tackled.	The RO is responsible for the plan of action
	(ii) Undertake a situation assessment study on the water resources issues and indicators, which drive the sustainability of the natural environment.	Directorate: RDM
	(iii) Set up a baseline monitoring programme of the key indicator species in the water management area such as at springs. The objective is to ensure updating of management information with regard to the ecosystem functioning in the sub-area.	Directorate: Resource Quality Information
RELATED STRATEGIES:	The above strategy needs to be read in conjunction with the following related strategies: ♦ **Resource availability** ♦ **Reconciliation of the available water resources with demands** ♦ **Water Quality Management**	

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Strategy No.:	2.2

WATER RESOURCES PROTECTION STRATEGIES

WATER QUALITY MANAGEMENT

MANAGEMENT OBJECTIVE:

The objective of this strategy to manage the water quality of the water resources of the Upper Molopo is to ensure the protection of the scarce water resources for sustainable use while taking into account the need for social and economic development in a sustainable manner

ASSESSMENT & ANALYSIS OF ISSUES:

In the Upper Molopo sub-area, a significant volume of return flow is being generated from the urban and peri-urban areas of Mafikeng. However, the quality of the effluent contains high concentrations of nutrient, which is causing eutrophication in Cooke's Lake and the downstream Setumo Dam as well as Lotlamoreng Dam, which is used for recreational purposes. It is understood that some of the wastewater treatment plants in the sub-area were not designed for nitrate and phosphate removal, which is causing eutrophication in the water bodies.

The urban population in the Upper Molopo River sub-area continues to grow rapidly (internal migration within the catchment due to the push and pull effects) and the sanitation needs are also increasing. There are increasing health risks if the downstream communities without potable water are abstracting directly from the Upper Molopo River, which may result in diarrhoea, cholera or other waterborne diseases.

There is increasing pollution of the groundwater in areas such as Itsoseng due to lack of proper sanitation facilities. The landfill sites for solid waste in the Itsoseng area are situated on the dolomite aquifers. Itsoseng bulk water supply scheme gets its water from the dolomites. If the dolomites are not managed properly, they will be affected by the pollution. Remediating groundwater contamination is generally more difficult and therefore more expensive than treating surface water pollution because the properties of aquifer materials and their transport mechanisms are more difficult to understand and define.

The salts, fertilizers and pesticides used in agriculture may dissolve in water and leach into groundwater.

The Government Gazette No. 20526, on general authorisation, does list the Upper Molopo River as a listed water resource, which warrants that wastewater discharge complies with special limit values set in table 3.2 of the general authorisation for discharges (up to 2000 m^3/day). Given the importance of the return flows, in future the Upper Molopo River should be a listed water resource.

WATER QUALITY MANAGEMENT			
The water quality of the Upper Molopo River is increasingly deteriorating because the water institutions are not properly operating and maintaining the wastewater treatment plants to meet the effluent standards. The wastewater treatment plant upstream of Cooke's Lake does not meet the phosphate limits as prescribed in the general authorisation			
PROPOSED STRATEGY The proposed strategy is that DWAF must ensure pollution control at the source and develop source directed measures for the Molopo River, which is critical as a future source of supply for the Local Municipality of Mafikeng. The strategy of prevention at source is very important for the sustainable utilisation of the return flow in the Upper Molopo sub-area, as there are limited freshwater resources. The improvement of in-stream quality should result in better raw water for municipal purposes. The dolomite aquifers, a strategic source of supply to the area for the rural communities, needs to be protected from pollution due to lack of adequate sanitation infrastructure.			
PRIORITY	**Very high** – water quality is as important as the quantity		
	ACTIONS		**RESPONSIBLE ORGANISATION/INSTITUTION**
PLAN OF ACTION:	(i)	Validation of all the existing wastewater dischargers and identifications and prioritisation of dischargers to be targeted in Upper Molopo sub-area	RO Water Quality Management
	(ii)	Determining the water quality objectives for rivers such as the Molopo because of potential direct re-use of effluent for municipal purposes.	Directorate: WRPS
	(iii)	DWAF should consider remediation and Legal measures where the responsible authority has not met the required standards for effluent discharges.	RO
	(iv)	Identify where groundwater pollution is taking place in the sub-area and determine the sources of groundwater pollution.	RO and WRPS
	(v)	Assess the impact on groundwater from return flows in the areas around Itsoseng where commercial agriculture is being practiced.	RO
	(vi)	Develop guidelines to meet resource quality objectives of the Upper Molopo River	RO and WRPS

WATER QUALITY MANAGEMENT		
	(vii) Identify the constraints in the local authorities and irrigators and through co-operative governance assist in capacity building of the institutions discharging waste into the Upper Molopo River to ensure proper operation and maintenance of the existing wastewater treatment plants	RO
	(viii) 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.	RO
	(ix) DWAF must encourage regional solid waste management for the Upper Molopo catchment with transfer stations from other areas such as Itsoseng , etc.	RO and Waste Discharge and Disposal
	(x) Motivate the Upper Molopo River to be a listed water resource in the general authorisation for discharge to comply with special limit values.	RO
RELATED STRATEGIES:	The above strategy needs to be read in conjunction with the following related strategies: ♦ **Groundwater resources availability** ♦ **Water resource availability** ♦ **Water Conservation and Water Demand Management**	

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Strategy No.:	2.3

WATER RESOURCES PROTECTION STRATEGIES

SOLID WASTE MANAGEMENT STRATEGY

MANAGEMENT OBJECTIVE:

The objective is to ensure that the main sources of water supply of the Upper Molopo catchment are protected from landfill leachate pollution in order to protect the dolomitic aquifers, which are the main sources of water supply.

ASSESSMENT & ANALYSIS OF ISSUES:

The catchments of the Marico, Upper Molopo and Upper Ngotwane are dominated by significant dolomites, which are the main source of water supply for both irrigated agriculture and urban and industrial water supply. They contribute significantly to the base flows of the three rivers of Molopo, Groot Marico and Upper Ngotwane. There are dangers of groundwater contamination from solid waste generated from agriculture and urbanisation in the catchments.

In Itsoseng it has been identified that the solid waste sites are situated close to the dolomite aquifer supplying this urban centre. Other areas in the Upper Ngotwane catchment and the upper catchment of Marico River are vulnerable to groundwater pollution from solid waste, which may result in the aquifer becoming completely unusable in the long term.

It should be noted that the situation has not deteriorated significantly. However if no proper land use management takes place, there is a potential for losing the main resource of the catchment.

There are illegal solid waste sites in the Upper Molopo catchment.

The day-to-day solid waste management by the local municipalities is very important. Resources are required to achieve proper solid waste management programme. DWAF is responsible for licensing, approving solid waste sites and monitoring of the solid waste sites.

PROPOSED STRATEGY

The proposed strategy is that DWAF must ensure that proper land use planning is done when new developments are envisaged in these catchments. Cooperative governance in the planning development is essential. The catchments should be delineated so that groundwater protection zones are established to protect them from potential leachate into the groundwater. Regional solid waste sites with transfer stations should be considered and compared with local solid waste sites for each development in the catchment. This strategy

SOLID WASTE MANAGEMENT STRATEGY		
is important because groundwater is the most important water resource supplying both farmers and domestic sectors and this is easily contaminated.		
PRIORITY:	**Medium High** – The dolomites of the catchments are the main sources of water supply and need to be protected.	
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION:	(i) Evaluate the vulnerability of groundwater sources to pollution from location of solid waste sites based on consideration of the lithology and thickness of the strata above the aquifer and the surface soil leaching properties.	The RO is the responsible authority
	(ii) Determine the size of the protection zones required for groundwater sources. Categories of these protection zones could be included in the general authorisation for solid waste site	As above
	(iii) Liaise with local authorities as part of land use planning for the Upper Molopo and Upper Ngotwane catchment to determine the areas where landfill sites should be situated.	As above
	(iv) Investigate the impact of existing landfill sites on groundwater.	As above
RELATED STRATEGIES	The above strategy needs to be read in conjunction with the following related strategies: • **Water Quality Management and Pollution Control strategy** • **Verification of Existing Lawful use**	

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Strategy No.:	4.1

WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGIES

MANAGING DEMAND IN WATER SERVICES INSTITUTIONS

MANAGEMENT OBJECTIVE:

The management objective of demand side management strategy is to make **more efficient use** of the existing available water resources to the domestic and industrial sectors before consideration is given to expensive alternative sources of supply

ASSESSMENT & ANALYSIS OF ISSUES:

Inefficient use of existing sources of water supplies due to unaccounted for water losses through leakage, high usage and wastage continues to be a matter of great concern in the Upper Molopo sub-area.

Cost recovery is still below 50% although there have been significant improvements in revenue collection.

There have been plans to increase the WTW in the catchments when there are limited water resources to supply these treatment works. The WSDPs of the local municipalities do not provide detailed strategies of how the demand side management will be implemented. There are no business plans developed for the implementation of water conservation and water demand management for the towns in the sub-area.

It is understood that Mafikeng is not efficiently utilising the available water supplies because of water losses in the bulk and distribution networks. The infrastructure leakage index is estimated to be very high due to lack of maintanance. The lack of cost recovery in most of the communities in the catchment is increasing the consumer wastage and leakage in the distribution system. High real and apparent losses in the towns of Dinokana and Lehurutse

Mafikeng town has a high per capita consumption indicating the available water resources are not being efficiently utilised.

The amount of wastewater entering the treatment works of Mafikeng is increasing significantly. This may be due to water losses in the system. The effect of inefficiency of water use and high water losses on the water resources will lead to augment the source earlier than would be absolutely necessary. This will divert financial resources from other activities. Additional water resources allocated to one sector might impact on the water resource availability to other water user sectors. The negative impact on the consumers is a potential increase in the tariffs, which will reduce the already meagre disposable income of the community.

MANAGING DEMAND IN WATER SERVICES INSTITUTIONS

PROPOSED STRATEGY

The proposed strategy is that DWAF must ensure identification and implementation of water conservation and water demand management measures. This strategy has the benefit of increasing the local municipality's revenue (through appropriate rising block tariff). The resource of the local authorities can be efficiently allocated for priority projects rather than augmenting wastewater treatment plants, which cannot be operated efficiently because of capacity problems.

This strategy is critical because the limited groundwater and surface water resources of the catchments cannot meet the existing demand at a high level of assurance.

PRIORITY:	**Very High** – This sub-area is water stressed and only demand side management measures are feasible as the options for increasing water supplies are diminishing because the costs of water development projects for the area are rising dramatically.	
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION	(i) DWAF must urgently engage with Mafikeng Municipality to ensure that the municipality start implementing water conservation and water demand management measures immediately	Regional Office
	(ii) DWAF must publicise their guidelines on the development and implementation of Water Conservation and Water Demand Management for Water Services Institutions	The RO is responsible for initiating the awareness campaign with assistance from the Directorate: Water Use Efficiency
	(iii) DWAF must ensure that water is distributed efficiently by encouraging the water services institutions to initiate a metering programme, by fixing leaks and managing pressures.	
	(iv) DWAF initiates an awareness campaign with institutional stakeholders to educate on the benefits of water conservation and demand management such as maximising the return on existing capital investment.	
	(v) Provision of support to water services institutions to develop and implement WC/WDM measures specific to their circumstances should be given by DWAF.	

MANAGING DEMAND IN WATER SERVICES INSTITUTIONS		
	(vi) Focus should be given to the water services sector as it has the highest expected growth in demand in the Upper Molopo sub-area. DWAF must ensure that all WSDPs should spell out the targets to reduce wastage and the procedures to be followed to achieve these targets.	
	(vii) DWAF should encourage the current initiatives in water conservation and water demand management that are taking place in the water management.	
	(viii) DWAF should encourage the local authorities to implement rising block tariffs where this is not being implemented as an economic instrument for reducing water use to sustainable levels.	
	(ix) Local authority bye-laws should be reviewed to include water saving devices in development	
	(x) Ensure that consumer use reduction activities are undertaken and incorporated in the WSDPs for all municipalities	

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Strategy No.:	4.2

WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGIES

MANAGING DEMAND IN THE IRRIGATION SECTOR

MANAGEMENT OBJECTIVE:

The objective of this strategy is to ensure that the on-field and off-field water use by the irrigation sector is being efficiently utilised for the sustainable management of the water resources.

ASSESSMENT & ANALYSIS OF ISSUES:

The irrigation sector utilises approximately 22 million m3/a in the Upper Molopo River sub-area. This accounts for just over 50% of the water use in the area. The main source of water supply is from the Upper Molopo Subterranean Government Water Control Area (SGWCA).

The efficiency of water use in the irrigation sector is however unknown for the area. The irrigation methods for the types of crops irrigated have not been determined to establish whether on-field irrigation methods are efficient.

However, because almost all the irrigators use groundwater for irrigation, which involves paying for their own pumps, wells and energy and making their own pumping decisions, the marginal cost of water in the Upper Molopo sub-area is generally higher than irrigators supplied from surface water resources.

PROPOSED STRATEGY

The proposed strategy is to encourage trading of water within and across sectors.

PRIORITY:	**Very High**	
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION:	(i) Engage with water user associations in the catchment and publicise the generic guidelines for water conservation and water demand management in the irrigation sector	The RO is responsible for this plan of action.
	(ii) Encourage metering in the irrigation sector. Review pricing of irrigation water taking into account efficiency and equity considerations	

MANAGING DEMAND IN THE IRRIGATION SECTOR		
	(iii) Identify areas under irrigation using satellite images in the WMU	
	(iv) Assist WUAs in the development of water management plans and implementation strategy by each Water User Association in the sub-area of the Upper Molopo catchment.	
RELATED STRATEGIES	(i) Resource availability (ii) Groundwater resource availability	

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APPENDIX C: UPPER NGOTWANE SUB-AREA – SPECIFIC STRATEGIES

Strategy No.:	1.1

RECONCILIATION STRATEGIES

WATER RESOURCE AVAILABILITY

MANAGEMENT OBJECTIVE:

The objective of this strategy is to confirm and identify the water supply sources (location, quantity, and quality) for the urban and agricultural water user sectors in the Upper Ngotwane catchment.

ASSESSMENT & ANALYSIS OF ISSUES:

There are no significant surface water resources in the Upper Ngotwane catchment The water infrastructure is the Ngotwane dam which has an estimated yield of 1.3 million m^3/a.

The Upper Ngotwane River is not a significant water resource for the sub-area. Groundwater is the major source of water supply for both irrigation and potable water supplies for the rural communities.

PROPOSED STRATEGY

The proposed strategy is to develop the local water resources (mainly groundwater) up to its full potential and sustainable limits by understanding the distribution, quantity and quality of the local water resources.

This strategic approach is very important because it is the key for determining how much water can be allocated in this catchment and where each water user can get their water. This strategy of developing local water resources first is also important given the actual socio-economic level of the catchment. The catchment is generally very poor with limited economic development, mostly is in the service industry. The poor cost recovery rates in the Upper Ngotwane catchment particularly in the rural communities risks the efficient maintenance of costly water transfer infrastructure. Hence there is a need to develop resources to their maximum potential.

WATER RESOURCE AVAILABILITY		
PRIORITY	**Very high** – Implementation should be done in the short term to drive other strategies.	
	ACTIONS	**RESPONSIBLE ORGANISATION**
PLAN OF ACTION	(i) Determine the potential yield of the dolomitic aquifers in the catchment by extending the current study, which is investigating the yield of the Polfontein compartment.	Regional Office supported by WRPS and Hydrological Information
	(ii) Assess the availability of the groundwater in the dolomitic aquifers of the catchment and determine the sustainable yield from the aquifer	
	(iii) Model the surface water and groundwater interactions in the catchment including the contribution of dolomite aquifers to the base flow of the Upper Ngotwane River.	Directorate: National WR Planning and WRPS
	(iv) Improve the hydrological, (both surface and ground) and water quality-monitoring stations of the Upper Ngotwane River and its tributaries.	Directorate: Hydrological Information and RO
	(v) Determine the sustainable quantities of surface and groundwater resources that can be utilised without negatively impacting on the ecology. A preliminary reserve should be determined.	Directorate: Water Use
	(vi) Identify the future sources of water supplies for the local authorities and Resource Poor Farmers as well as for rural livelihoods based on the IDPs and WSDPs	Directorate: Options Analysis
RELATED STRATEGIES:	Strategies that should be read in conjunction with Resource Availability Strategy are as follows: **1.2 Effluent re-use strategy** **1.3 Groundwater resource availability strategy** **1.4 Verification of existing lawful use** **2.1 Water Quality Management** **5.1 Monitoring and Information System**	

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Strategy No.:	1.3

RECONCILIATION STRATEGIES

GROUNDWATER RESOURCES AVAILABILITY

MANAGEMENT OBJECTIVE:

- The objective of this strategy is to **maximise the conjunctive use** of the significant groundwater resources and the surface water resources of the catchment to meet the current and growing water needs of the catchment in order to promote equity and socio-economic development of the rural communities.

ASSESSMENT & ANALYSIS OF ISSUES:

The area is mainly comprised of communal land with widespread dependence on groundwater for water supply, vegetable gardening and stock watering. The sub-area is sparsely populated although there is significant development in the headwaters of the Upper Ngotwane catchment.

Of the known available water resources in the Upper Ngotwane sub-area, surface water contributes only 1.1 million m^3/a while groundwater resources are 5 times more at 5 million m^3/a. There is a need to understand the groundwater resources at higher level of confidence because the sub-area is mostly dependent on it.

Availability of water during drought in the communal land areas is difficult to deal with in areas of low resources.

The groundwater resources of dolomites are mostly limited and underdeveloped and the area could be ecologically sensitive. There is therefore a need to understand how much groundwater is available for water use including maintaining the ecological sensitive areas in A10B and A10C catchments of the sub-area.

Where dolomitic aquifers are already supporting abstractions and feed rivers and streams flowing through environmentally sensitive areas (e.g. Dinokana springs,), **no new abstractions** should be allowed before completion full hydrogeological investigations mentioned in the main actions to determine the vulnerability of the aquifer from failure.

The dolomites should be treated as groundwater reservoirs, which can be drawn down during low flow periods, but should be allowed to replenish during wet periods.

PROPOSED STRATEGY:

To understand the groundwater potential of the dolomitic aquifers and their interaction within the dolomitic compartments and with the surface water resources in order to reconcile current and future water requirements of the Upper Ngotwane.

<table>
<tr><th colspan="3">GROUNDWATER RESOURCES AVAILABILITY</th></tr>
<tr><td colspan="3">Groundwater is the only source of supply for the future water requirements that the generally poor communities that dominate the catchment can afford on a sustainable basis. It is critical that the DWAF understands the optimal utilisation of the groundwater without negatively impacting on the ecology dependent on the dolomitic aquifer fed springs that are prevalent in the catchment.</td></tr>
<tr><td>PRIORITY</td><td colspan="2">Very High –Understanding the groundwater resources availability in the Upper Ngotwane sub-area is critical to IWRM. The sub-area is almost entirely dependent on groundwater.</td></tr>
<tr><td></td><td>ACTIONS</td><td>RESPONSIBLE ORGANISATION/ INSTITUTION</td></tr>
<tr><td rowspan="4">PLAN OF ACTION</td><td>(i) Determine the abstractions (spatial and temporal distribution) from the dolomitic aquifers within the sub-area of the Upper Ngotwane</td><td rowspan="4">The dolomites are traversing three WMAs and cross to Botswana therefore responsibility should be at national level with the Directorate: Hydrological Information and the involvement of 3 Regional Offices and supported by the Directorate: National Water Resource Planning and WRPS</td></tr>
<tr><td>(ii) Undertake an investigation to quantify the limiting yield of the dolomitic aquifers as the source of water supply and recharge study (a key parameter for determining the groundwater component of the Reserve)</td></tr>
<tr><td>(iii) Develop tools to quantify surface-groundwater interaction in order to better quantify the contribution of groundwater to base flow and the recharge of groundwater system from river flow especially during flood events.</td></tr>
<tr><td>(iv) Develop generic groundwater management guidelines to manage groundwater and guide allocations in the Upper Ngotwane sub-area</td></tr>
<tr><td>RELATED STRATEGIES:</td><td colspan="2">The above strategy needs to be read in conjunction with the following related strategies:
♦ Protection of groundwater resources
♦ Water resource availability strategy
♦ Licensing
♦ Water Quality Management
♦ General Authorisation</td></tr>
</table>

GROUNDWATER RESOURCES AVAILABILITY	
	♦ **Co-operative Governance strategy** ♦ **Monitoring and Information System**

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Strategy No.:	1.4

RECONCILIATION STRATEGIES

BALANCING WATER DEMANDS WITH AVAILABLE WATER SUPPLIES

MANAGEMENT OBJECTIVE:

The objective of this strategy is to ensure that the available water supplies are optimally utilised by the water users of the Upper Ngotwane sub-area in order to achieve equity while maintaining social and economic development in a sustainable manner.

ASSESSMENT & ANALYSIS OF ISSUES:

The Upper Ngotwane catchment is in deficit because of apparent over-utilisation of the existing groundwater supplies.

The local groundwater deficit has been estimated at 3 million m3/a. It is understood that there are problems between the community of Dinokana and Lehurutse because Lehurutse is getting its water supply from the Dinokana springs whilst Dinokana does not have a water supply system.

The RO has identified additional groundwater resources and these will supply rural communities of Dinokana.

PROPOSED STRATEGY

The strategy is to develop an audit of how much water is available, where the water users in the Upper Ngotwane sub-area are getting their water and where they should get their raw water supplies for the present and future requirements.

PRIORITY	**High –** It is important that water users (or water user associations) know were their sources of supply are.	
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION	(i) Verify existing water use from the different sources in the Upper Ngotwane sub-area. Establish their lawfulness.	RO

BALANCING WATER DEMANDS WITH AVAILABLE WATER SUPPLIES		
	(ii) From the resources availability strategy determine the quantity and quality of the various sources of water supply in the sub-area.	Directorate: National Water Resource Planning
	(iii) The rural communities of Upper Ngotwane should be supplied from local groundwater resources once the sustainable yield from local groundwater in the area has been established and is known according to strategy 1.1 above.	RO
RELATED STRATEGIES:	The above strategy needs to be read in conjunction with the following related strategies: ♦ **Groundwater resource availability** ♦ **Water resource availability** ♦ **Verification of existing water use** ♦ **Water Quality Management** ♦ **General authorisation** ♦ **Monitoring and Information System**	

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Strategy No.:	4.1

WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGIES

MANAGING DEMAND IN WATER SERVICES INSTITUTIONS

MANAGEMENT OBJECTIVE:

- To make **more efficient use** of the existing available water resources to the domestic and industrial sectors before consideration is made to expensive alternative sources of supply

ASSESSMENT & ANALYSIS OF ISSUES:

Inefficient use of existing sources of water supplies due to unaccounted for water losses through leakage and wastage continues to be a matter of great concern in the urban and rural area of Upper Ngotwane sub-area. The condition of the infrastructure based on the infrastructure index leakage is understood to be significantly high in some of the centres. This is an indication of system losses.

There have been some improvements in Lehurutse. Cost recovery is still below 50% although there have been significant improvements in revenue collection.

The WSDPs of the local municipalities do not provide detailed strategies of how the demand side management will be implemented. There are no business plans developed for the implementation of water conservation and water demand management for the towns in the sub-area.

Use of public standpipes is impacting on the water use because of lack of accountability in communities. High water losses in the towns of Dinokana and Lehurutse

PROPOSED STRATEGY:

(i) The strategy is that DWAF must ensure implementation of water conservation and water demand management measures. This strategy has the benefit of increasing the local municipality's revenue (through appropriate rising block tariff). The resource of the local authorities can be efficiently allocated for priority projects rather than augmenting wastewater treatment plants, which cannot be operated efficiently because of capacity problems.

PRIORITY:	**Very High** – This sub-area is water stressed and only demand side management measures are feasible as the options for increasing water supplies are diminishing because the costs of water development projects for the area are rising dramatically.

MANAGING DEMAND IN WATER SERVICES INSTITUTIONS		
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION	(i) DWAF must publicise their guidelines on the development and implementation of Water Conservation and Water Demand Management for Water Services Institutions	The RO is responsible for initiating the awareness campaign with assistance from the Directorate: Water Use Efficiency
	(ii) DWAF must ensure that water is distributed efficiently by encouraging the water services institutions to initiate a metering programme and fixing of leaks as well as undertaking pressure management.	
	(iii) DWAF initiates an awareness campaign with institutional stakeholders to educate on the benefits of water conservation and demand management such as maximising the return on existing capital investment.	
	(iv) Provision of support to water services institutions to develop and implement WC/WDM measures specific to their circumstances should be given by DWAF.	
	(v) DWAF should encourage the current initiatives in water conservation and water demand management that are taking place in the water management.	
	(vi) DWAF should encourage the local authorities to implement rising block tariffs where this is not being implemented as an economic instrument for reducing water use to sustainable levels.	
	(vii) Local authority bye-laws should be reviewed to include water saving devices in development	
	(viii) Ensure that consumer use reduction activities are undertaken and incorporated in the WSDPs for all municipalities	

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APPENDIX D: GENERAL STRATEGIES OF MARICO, UPPER MOLOPO & UPPER NGOTWANE ISP AREA

Strategy No.:	3.1

WATER USE MANAGEMENT STRATEGIES

GENERAL AUTHORISATIONS

MANAGEMENT OBJECTIVE:

The objective of this strategy is to ensure that General Authorisations are applied to the best benefit of IWRM in the ISP area.

ASSESSMENT & ANALYSIS OF ISSUES:

There are no changes specific to the ISP in the new gazette. The gazette sets out the areas excluded from General Authorisation in the Marico-Upper Molopo & Upper Ngotwane ISP area for both surface and groundwater. The areas have remained the same.

The areas excluded from general authorisation for surface water abstraction include Marico and Upper Ngotwane catchments. Upper Molopo catchment (D41A) has not been excluded from general authorisation for surface water abstraction. This should be reviewed in light of the fact that the surface water resources are very limited.

The subterranean government water control areas in the ISP have been excluded from general authorisation (i.e. A30 and D41).

The conditions for General Authorisation as set out in section 29 of the National Act are understood not to have been updated to reflect the spirit and intentions of the Act. They still reflect conditions of 1966.

The Upper Molopo catchment has been designated as a Groundwater Abstraction Zone C, which limits abstraction to 300m^3 per hectare per annum. It is understood that some of the water users may be abstracting more than the limit set for abstraction under the General Authorisation. Without proper/and accurate information on the sustainable yield from groundwater it is difficult to know whether the limit set for this catchment will not lead to overdraft of the dolomite aquifers.

It is likely that the General Authorisation abstraction limit of 300m^3/ha/a is more likely to be exceeded in this sub-area because of the limited availability of surface water resources in the area.

There is no practical General Authorisation for surface water abstractions, which puts pressure on the limited resources to undertake Reserve determinations if there are license applications made in the Upper Molopo sub-area.

GENERAL AUTHORISATIONS

Discharging of domestic and industrial wastewater into the Upper Molopo River by the Local authorities (Mafikeng Local Municipality) and the irrigators is known to exceed the wastewater limit values set for in the General Authorisation. Orthophosphates is understood to exceed the general limit of 10mg/l. Considering that Setumo Dam's yield includes the return flow and can be reused these limit values should not be exceeded. The Upper Molopo sub-area is not one of the areas excluded from General Authorisation for discharges to water resources.

Given the fact that the sub-area has very limited water resources and may in the near future rely on use of marginal water quality to meet its water requirements it may be necessary to consider whether the Upper Molopo sub-area should not be excluded from General Authorisation for discharges into the Upper Molopo River without a license.

The wastewater limit values applicable to discharge into the Upper Molopo River are being exceeded particularly in Cooke's Lake and Lotlamoreng Dam.

Itsoseng town has pollution problems, which may be affecting the water resources of the Upper Molopo River. No general authorisation should be allowed for discharge into the Upper Molopo River.

PROPOSED STRATEGY:

The limited availability of water resources makes it imperative that practical ranges for abstractions using General Authorisation are determined to allow the Regional Office to effectively manage the water resources of the catchment in a sustainable manner.

PRIORITY:	**Medium – High** – This strategy can only be implemented once the Resource Availability is well understood and the information has been updated.	
	ACTIONS	**RESPONSIBLE ORGANISATION/INSTITUTION**
PLAN OF ACTION:	(i) Develop a monitoring protocol to determine whether General Authorisation abstraction limits associated with Zone C, which applies to this sub-area, are being exceeded	Regional Office Water Resources Management
	(ii) Determine whether there is merit in putting a range for General Authorisation from surface water resources for this sub-area	Regional DWAF Office

GENERAL AUTHORISATIONS		
	(iii) Motivate whether there is merit of including the Upper Molopo River as a listed water resource where wastewater discharges of up to 2 000 m^3 is not allowed under general authorisation and will require a license.	Regional DWAF Office
RELATED STRATEGIES	The following strategies need to be read in read in conjunction with this strategy: (i) Groundwater Resources availability (ii) Water Resources Protection (iii) Licensing Strategy	

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Strategy No.:	3.2

WATER USE MANAGEMENT STRATEGIES

VERIFICATION OF EXISTING LAWFUL USE

MANAGEMENT OBJECTIVE:

The primary objective is to ensure that all water users are registered and their water user is lawful in order to achieve a sustainable management of the water resources of the catchment. All unlawful use needs to be stopped so that this water is kept available for use by those to whom it has been allocated.

ASSESSMENT & ANALYSIS OF CATCHMENT ISSUES:

The catchments of Marico, Upper Molopo & Upper Ngotwane ISP area are under stress. There is uncertainty about the actual use and the lawfulness of existing water use. The status of the allocation to the farmers in the former Bophuthatswana is unknown.

Section 32 (1) of the National Water Act defines existing lawful use as water use

(a) "which has taken place at any time during a period of two years immediately before the date of commencement of this Act or,

(b) "which has been declared an existing lawful water use under section 33."

The WARMS database has been registering all existing water users. These existing water users have not been verified. The regional office has not yet commenced with the verification of existing lawful use in the catchments of Marico, Upper Molopo and Upper Ngotwane.

It is not known whether the water users are using currently allocated water or whether they are exceeding their allocations illegally.

The source of supply for these centre pivots, is the dolomite aquifers, which are easily over-exploited. It is important that the water use for this intended irrigation system is lawful if sustainability is to be achieved. The information of actual use is very important for understanding of groundwater yields.

PROPOSED STRATEGY:

The strategy is to determine actual use in the Marico, Upper Molopo & Upper Ngotwane ISP area and to get rid of unlawful use.

PRIORITY:	**High**

VERIFICATION OF EXISTING LAWFUL USE		
	ACTIONS	**RESPONSIBLE ORGANISATION/INSTITUTION**
PLAN OF ACTION:	Undertake verification according to DWAF guidelines.	The RO Water Resources Management is the responsible organisation to undertake this plan of action
RELATED STRATEGIES	The following strategies need to be read in read in conjunction with this strategy: • **Groundwater Resources availability** • **Water Resources Protection** • **Licensing Strategy**	

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Strategy No.:	3.3

WATER USE MANAGEMENT STRATEGIES

LICENSING OF WATER USE

MANAGEMENT OBJECTIVE:

There is very little available water in these catchments and what little there is must be sensibility and equitably allocated. This strategy aims to indicate what resources might be available and to provide the Region for a basis for its allocation.

ASSESSMENT & ANALYSIS OF ISSUES:

Water use exceeds water availability in most of the quaternary catchments of the Marico, Upper Molopo & Upper Ngotwane ISP area at 98% assurance of supply. This means that no new licences for water storage and abstraction will be issued in the near future until additional water is available. New requirements, such as new irrigation development in the Upper Molopo River to meet the provincial government's land reform programme, will have to be met either through the purchase of existing water use licenses or through compulsory licensing.

PROPOSED STRATEGY

There is no more water to issue licences. If there is pressure for new licences, it is recommended that compulsory licensing be implemented. Any further allocation without proving the resource will only increase the risk of failure of supply to all users.

PRIORITY:	**Medium** – There are not many licence applications being received by the Regional DWAF Office.	
	ACTIONS	**RESPONSIBLE ORGANISATION/INSTITUTION**
PLAN OF ACTION	(i) Monitor the license applications in the ISP area and determine when compulsory licensing will be required.	Regional Office
RELATED STRATEGIES	(i) Water Pricing Strategy (ii) Water Use Management Strategies (iii) Water Conservation and Water Demand Management strategies	

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Strategy No.:	3.4

WATER USE MANAGEMENT STRATEGIES

RECREATION ON STATE OWNED DAMS

MANAGEMENT OBJECTIVE:

The objective of this strategy is to ensure the sustainability of an industry utilising water for recreational purposes by protecting the water resource and also that the utilisation thereof be based on sound management, while ensuring equitable benefits to the affected communities.

ASSESSMENT & ANALYSIS OF ISSUES:

To date recreation on dams, whether state owned or private, which is a water-based industry has, however, largely been neglected in policy and legislation development, as well as in implementation.

With the promulgation of the National Water Act, No. 36 of 1998 (NWA) this situation changed. Section 21(k) of the NWA introduces and identifies 'using water for recreational purposes' as a water use.

In the Upper Molopo River sub-area, there are two dams whose purpose is solely for recreational purpose. These are Lotlamoreng Dam and Cooke's Lake all near Mafikeng the capital city of the North West Province.

In Marico sub-area, there are a number of dams on which recreation could improve the utility of the dams such as Molatedi and Marico Bosveld.

One of the major problems identified on these water bodies has been the quality of the water. In most instances, there are wastewater treatment plants upstream of these recreational facilities. The quality of the effluent is known not to be up to standard for the dams to serve their objectives of providing recreational facilities to the surrounding communities and thereby contributing to the "*social and economic development*" of the sub-area.

The policy on using water for recreational purposes require that the quality of the water comply with public and if applicable, industry health and safety norms, standards and regulations. This is not the case with Lotlamoreng Dam and Cooke's Lake. There is increasing eutrophication in these dams, which is an indication of the increasing nutrient levels. This is due to poor quality of the treated wastewater from the town and the surrounding land use practises, particularly agriculture and solid waste management.

It is noted that recreational activities on state owned dams are usually incidental to the other functions of the dam. The ideal recreational reservoir is one, which remains nearly full

RECREATION ON STATE OWNED DAMS		
during the recreation season to permit boating, fishing, and swimming and other water sports. However all the dams in the catchments of Marico, Upper Molopo and Upper Ngotwane are subject to large drawdown, which create problems in maintaining some of the recreational activities, (boat moorings, etc.) in usable conditions.		
STRATEGIC OPTIONS The strategy options and choices available include the following: (i) The development of guidelines and policies on the procedures for use of dams for recreational purposes. (ii) Maintaining the status quo on the state owned dams.		
PRIORITY:	**Medium to Low** – there is scope for recreational activities on state dams in the study area	
	ACTIONS	**RESPONSIBLE ORGANISATION/INSTITUTION**
PLAN OF ACTION:	(i) Develop zoning plans for all dams in the Marico, Upper Molopo and Upper Ngotwane catchments that have no zoning plans.	Directorate: WRPS
	(ii) Identify recreational activities that can be implemented on dams in the catchment.	RO
	(iii) Update the operating rules (reservoir levels required for recreational activities) of the dams to include the recreational activities based on socio-economic benefit to the communities.	Directorate: NWRP WRPS

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Strategy No.:	3.5

WATER USE MANAGEMENT STRATEGIES

WATER PRICING

MANAGEMENT OBJECTIVE:

The objective of the water pricing strategy is to ensure the achievement of the following:

(i) Social equity

(ii) Ecological sustainability

(iii) Financial sustainability through effective cost recovery

(iv) Efficient allocation of the scarce water resources and maintaining sustainable economic development

ASSESSMENT & ANALYSIS OF CATCHMENT WIDE ISSUES:

The National Water Act provides the broad policy framework for the implementation of a pricing strategy to finance of water resource management services.

The Act identifies water as both an economic good as much as a social good and a need to balance these aspects. Therefore effective water resources management includes the management of water not only to achieve social equity but also as an economic resource. The raw water pricing strategy developed by DWAF provides for this.

Section 56 of the Act provides for charging of any water use described in section 21. However, the current pricing strategy has not been developed for all water uses described in Section 21. The following water uses are excluded from water pricing:

- Discharging of waster or water containing waste into a water resource
- Disposing of water which contains waste from any industrial or power generation process;
- Disposing of waste in a manner which may detrimentally impact on a water resource.

DWAF's long-term objective is to charge for the above water uses.

However, in the Upper Molopo sub-area there is increasing reliance on the use of marginal water quality. If the quality of the return flows is only depended on the compliance of the

<table>
<tr><th colspan="3">WATER PRICING</th></tr>
<tr><td colspan="3">users discharging into the water resource such as the Upper Molopo River, effluent re-use may not be achievable in the short to medium term. The quality of wastewater discharge into the Upper Molopo River does not to meet the wastewater limit values set in the general authorisation. Although DWAF has adopted the “polluter pays principle” most of the polluters (both point and non-point sources of pollution) are not paying for the environment damage caused by discharging waste above the standards set for wastewater limit values. These externalities, which are not being internalised by the polluters, are and will eventually be borne by the communities in the sub-area through health impacts, cost of treating water, etc.

Other strategy options need to be considered if the quality of the return flows is to be maintained.

The Directorate: Water Quality Management has developed the national water quality management framework policy.

The Act provides for trading in water use entitlements, but this will be subject to regulation to take account of the external costs on the local economy.

There is no groundwater use charge. Users of groundwater are charged the water resource management charge

The only government waterworks are Setumo Dam and Disaneng, which supply urban and irrigators respectively. The raw water charge needs to be implemented for these waterworks.</td></tr>
<tr><td colspan="3">STRATEGIC OPTION

The strategy is that DWAF must implement raw water pricing according to the Government Gazette 20615 of 12 November 1999 for the water use sectors. DWAF must urgently complete water charges for discharging waste or water containing waste into water resource.

Implementation of this strategy is very important because of the need for sustainable management of the water resources of the sub-area.</td></tr>
<tr><td>PRIORITY:</td><td colspan="2">High – Waste discharge charges is essential for the financial sustainability of the CMA that are being established to manage these catchments.</td></tr>
<tr><td></td><td>ACTIONS</td><td>RESPONSIBLE ORGANISATION/INSTITUTION</td></tr>
<tr><td>PLAN OF ACTION:</td><td>(i) Assist the Directorate: Water Use with the determination of the water resources development and use of waterworks charges of the Upper Molopo sub-area.</td><td>DWAF: RO</td></tr>
</table>

WATER PRICING		
	(ii) Identify water users from the WARMS database who qualify for subsidies (i.e. Resource Poor Farmers).	Regional DWAF
	(iii) Promote trading of water within and between sectors on the basis of a regulatory framework that protect the socio-economy of the catchments	Directorate: Waste Use
	(iv) Initially recover administrative costs of users discharging waste or water containing waste after discharge charge system has been promulgated.	The RO is responsible assisted by the Directorate: Water Use
	(v) Ensure that free basic water is provided for in the tariff calculation of the raw water charge for the domestic sector.	Regional DWAF
RELATED STRATEGIES	(i) Water Quality & Pollution Management (ii) Verification of existing lawful use. (iii) Effluent reuse	

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Strategy No.:	5.1

SOCIAL AND INSTITUTIONAL DEVELOPMENT STRATEGIES

CATCHMENT MANAGEMENT AGENCY

MANAGEMENT OBJECTIVE:

The objective of establishment of a CMA to oversee these catchments is to delegate water resource management to regional or catchment level and to involve local communities in water resource management in order to ensure sustainability, equity and beneficial use of the resource.

ASSESSMENT & ANALYSIS OF ISSUES:

The National Water Act aims to reorient and strengthen existing water administrations, it also calls for the creation of new structures like basin entities called Catchment Management Agencies (CMA), within which existing water distribution agencies like irrigation boards, water boards and District Municipalities (as water services authorities responsible for domestic and industrial water supply) will participate as stakeholders along with farmer groups.

The Crocodile (West) and Marico WMA has begun the process of establishing a CMA by establishing catchment forums. These forums are in place and the process is far advanced. A proposal for the establishment of a CMA has been submitted to the Directorate: Catchment Management for review.

The economic viability of the CMA is based on the Johannesburg/Pretoria industrial node. However, the economic viability of the western portion of the WMA is not sustainable if cost recovery is not improved and waste discharge charges mechanisms are not developed. This disparate situation in the Crocodile (West) and Marico WMA could affect the effective functioning of the CMA.

There will be a need to build technical and information capacity within the water management area if the CMA is to be economically sustainable and financially self-sufficient.

STRATEGIC OPTION

The decentralisation of functions and the separation of regulatory functions and operations functions through the establishment of a CMA will improve operational efficiency because of stakeholder involvement.

PRIORITY:	Low

CATCHMENT MANAGEMENT AGENCY		
	ACTIONS	**RESPONSIBLE ORGANISATION/INSTITUTION**
PLAN OF ACTION:	The process of establishment of a CMA has already been initiated. The RO together with the Directorate: Catchment Management have established catchment forums which represent various stakeholders involved and using the water resources of Crocodile (West) and Marico WMA. As part of the CMA establishment process the financial viability, administrative feasibility and human resource capacity of establishing the CMA was investigated. On face value, the CMA will be viable because of the strong revenue base it will have.	The RO is responsible for establishment of the CMA.
RELATED STRATEGIES	(i) Co-operative Governance strategy (ii) Stakeholder Participation strategy	

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Strategy No.:	5.2

SOCIAL AND INSTITUTIONAL DEVELOPMENT STRATEGIES

WATER USER ASSOCIATIONS

MANAGEMENT OBJECTIVE:

The objective of this strategy is to decentralise responsibility to local water users for the management and maintenance of the systems that serves them.

ASSESSMENT & ANALYSIS OF ISSUES:

The Free State Regional Office has been investigating the institutional arrangements for the management of the part of the dolomitic system under their responsibility. It was highlighted that WRC/DWAF were doing the same investigation.

The establishment of WUA is part of DWAF's policy to devolve some of the responsibility for the management and maintenance of irrigation (or domestic water and wastewater) services from central/regional government onto users.

The WUA establishment is motivated by the search for efficiency and cost savings, with DWAF or another body such as a CMA adopting the role of regulator rather than operator.

The Free State was investigating the establishment of the WUA for the Schoonspruit and Grootpan compartment for the farmers abstracting from the dolomites.

Proposals for the Grootfontein WUA, and Itsoseng/Lichtenburg had been submitted to the Directorate: Catchment Management. There was no activity in the establishment of the Zeerust WUA.

The dolomites represent a strategic water resource. As presently envisaged the outcrop falls into several WMAs even though the boundaries of the dolomite aquifers and compartments do not coincide with the surface catchment boundaries. The organisational structure of the WUA should take this into account.

Water User Associations can be seen as a means of community participation and community ownership of services, which can lead to sustainability.

STRATEGIC OPTION

It is essential that DWAF establishes WUA because their establishment should lead to greater user commitment which is important for sustainable utilisation of the water resources

WATER USER ASSOCIATIONS		
PRIORITY:	**Medium- High**	
	ACTIONS	**RESPONSIBLE ORGANISATION/INSTITUTION**
PLAN OF ACTION:	(i) Review the guidelines for the establishment of WUAs to be based on all users grouped around a particular canal or a common groundwater aquifer resource	The RO is responsible for establishment WUA.
	(ii) Continue with the process of converting irrigation boards in the area to WUA but also including other users dependent on the source of supply.	As above

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Strategy No.:	6.1

SOCIAL STRATEGY

STAKEHOLDER PARTICIPATION STRATEGY

MANAGEMENT OBJECTIVE:

The objective of this strategy is to create a sense of commitment or "ownership" among the communities that can help in the implementation of the strategies identified for the ISP of the Marico, Upper Molopo and Upper Ngotwane.

ASSESSMENT & ANALYSIS OF ISSUES:

Stakeholder involvement is essential and critical to the process of developing and implementation of a strategy. Although the ISP has been developed internally by DWAF, this strategy will need to be sold to the stakeholders of the Marico, Upper Molopo and Ngotwane catchments in order for them to buy-in to the implementation.

In order for DWAF to implement the ISP two activities are required in stakeholder participation: identifying stakeholders (both institutional and community based stakeholders), and securing stakeholder participation

The ISP cannot be implemented by the DWAF alone without the commitment and ownership of the stakeholders in the catchment. Building commitment to and ownership of the ISP will depend on satisfying interested parties in several ways: substantive, procedural and psychological.

Stakeholder participation programmes are currently focused at service delivery. It is difficult to convince communities to participate in water resources management because they do not see the results as tangible as they would in the case of a water supply scheme. However the decisions made in water resources management affect the communities in the long term and therefore their involvement

Stakeholder participation is therefore a long-term commitment of DWAF to change the mindset in how to manage the water resources for their present and future requirements in a sustainable manner.

The Act requires that stakeholder participation be from planning right through to implementation.

STRATEGIC OPTION

To gain a full understanding of the level of poverty, the poverty gap that exists and the social dynamics of the catchments in order to better understand equity needs and the role

STAKEHOLDER PARTICIPATION STRATEGY		
played by water.		
PRIORITY:	**High** – It is essential that with the development of an implementation plan for the ISP, stakeholder participation should be done to ensure commitment and "ownership" of the process.	
	ACTIONS	**RESPONSIBLE ORGANISATION/INST-ITUTION**
PLAN OF ACTION:	(i) Identify stakeholders who have influences in the catchments. (Who are the stakeholders in the Marico, Upper Molopo and Upper Ngotwane catchments)	The RO is responsible for implementation of this strategy.
	(ii) Prepare an inventory of information on the major issues in the water sector of the catchments. This should include the assessment of the interests and positions of the various stakeholders as well as their perception of the issues described in the Marico, Upper Molopo and Upper Ngotwane ISP. Based on this prepare a grid or chart with the identified stakeholders, listed in one column and four other columns outlining each stakeholder issues, positions, interests and options	Regional DWAF
	(iii) Hold a series of evaluation workshops to determine whether all the water related catchment issues are captured and to gauge early indications of whether the proposed strategic actions are acceptable to the stakeholders.	Regional DWAF
	(iv) Develop awareness creation programmes specific for the Marico, Upper Molopo and Upper Ngotwane catchments modelled on the approach being followed for the NWRS.	The RO is responsible for implementation of this strategy
	(v) Develop programmes that ensures visibility of the ISP implementation at the appropriate level of publicity without over-saturation and ensure public access to data or information regarding the management of the water resources of the Marico, Upper Molopo and Upper Ngotwane catchments	The RO is responsible for implementation of this strategy
	(vi) Undertake surveys such as KAP surveys to determine the communities' **knowledge, attitudes and perception** of water resources management in the three catchments	The RO is responsible for implementation of this strategy

STAKEHOLDER PARTICIPATION STRATEGY		
	(vii) Develop communication strategy for continuous interaction with stakeholders.	The RO is responsible for implementation of this strategy
SUPPORTING INSTITUTIONS:	Provincial Departments involved in water management such as Department of Local Government and Housing and the Department of Agriculture.	

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CO-OPERATIVE GOVERNANCE AND SOCIO-ECONOMIC DEVELOPMENT STRATEGY

POVERTY ERADICATION STRATEGY

MANAGEMENT OBJECTIVE:

To ensure that water plays its rightful role in providing for jobs and/or sustainable livelihoods for the very poor within this ISP area.

ASSESSMENT & ANALYSIS OF ISP AREA:

The catchments of the Marico, Upper Molopo and Upper Ngotwane catchments are some of the poorest catchments in the Crocodile West and Marico WMA. There is high unemployment, high illiteracy rates in the catchments with strong income inequality and widespread poverty.

The majority of the population in these catchments live in rural areas and their incomes are mostly directly linked to the agricultural sector. The trickle-down development has failed to improve the livelihoods of the rural population to any appreciable extent.

The agricultural sector, which is the main link to the rural livelihoods of the communities, has not been able to assist in improving the income levels because most of the communities are farming in marginal land which is not productive and also there is lack of water for irrigation farming to take place in the rural areas. There are many reasons why the rural development in the Marico, Upper Molopo and Upper Ngotwane catchments has not been successful:

- Lack of education and training which means that the rural poor are often unable to make use of their meagre assets more effectively and efficiently.
- Weak links to the organised market economy i.e. lack of access to credit, essential inputs and improved but appropriate technology problems with marketing of products, etc.
- Use of resources such as water and the environment, for sheer survival in ways which are unsustainable over the longer term.

The presence of widespread poverty in the catchments is one of the causes of serious environmental degradation in the Marico, Upper Molopo and Upper Ngotwane catchments.

The NW provincial government has commenced looking at land reform programmes that are aimed at benefiting the rural poor that are landless or have very small holdings in marginal land.

POVERTY ERADICATION STRATEGY		
PROPOSED STRATEGY The water resources are very limited to promoted water intensive development in the ISP. The proposed strategy is to encourage economic activities in the ISP area that can generate more jobs per m^3 of water and whose economic value is high per m^3 of water.		
PRIORITY:	**Very high**	
	ACTIONS	**RESPONSIBLE ORGANISATION/INSTITUTION**
PLAN OF ACTION:	(i) Identify area in the rural areas where groundwater can be used in small quantities for growing of vegetables that will improve living conditions.	Regional DWAF
	(ii) Identify viable sectors with high economic value that can generate jobs for less water, e.g. ecotourism.	Regional DWAF

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CO-OPERATIVE GOVERNANCE AND SOCIO-ECONOMIC DEVELOPMENT STRATEGIES

ENVIRONMENTAL MANAGEMENT STRATEGY

MANAGEMENT OBJECTIVE:

Economic development can only be sustained if the country's renewable resources (including its population) are protected and maintained. The objective of this strategy is to ensure the inherent worth of its natural ecosystems is protected to ensure the availability of resources in the future and avoid serious damage to the environment in the present.

ASSESSMENT & ANALYSIS OF ISSUES:

Over the years the approaches used in water resources management have been mainly sectoral with very little integration of the activities in the sectors depended on water. The cumulative impact of water resources management at sectoral level rather on inter-sectoral basis has been environmental degradation with significant negative externalities, which has been borne by the society at large. This approach cannot be sustainable in the long term.

The presence of widespread poverty in the Marico, Upper Molopo and Upper Ngotwane catchments has often been the cause of serious environmental degradation through continuous erosion of resources and the environment which people are dependent on their livelihood. To meet their desperate immediate basic needs the rural communities have had to cultivate marginal land which is prone to heavy soil erosion, graze the livestock on land that is becoming barren from overuse, cut shrubs and trees for fuel wood thereby reducing the stability of soil and water regimes in the catchment.

The water sector of the Marico, Upper Molopo and Upper Ngotwane catchments face emerging threats that include, over abstraction of surface water (i.e. in the Marico catchments) and groundwater and water pollution from point and non-point sources.

DWAF has been very proactive over the years regarding the institution of international best practice in the field of Integrated Environmental Management. The Directorate: Social and Environmental Services has recently published the Department's Environmental Implementation and Management Programme[10] and is currently developing specific strategies to implement processes that will take due consideration of all impacts that water resource and other water management activities will have on the broader environment in which we live.

It must be noted that these environmental issues and strategies are crosscutting through all aspects and approaches adopted in this ISP.

STRATEGIC OPTIONS

ENVIRONMENTAL MANAGEMENT STRATEGY		
A strategic framework for action that calls for strengthening the environmental management capacity through the adoption of environmental criteria in water resources planning, development, and management decision making is essential. The integration of the ecological Reserve process (recognition of ecological uses as required by the Act) into broader environmental management should be considered in the strategy formulation. Tourism development in the catchments with community participation will improve the management of the environment		
PRIORITY:	**Very High** – It is essential that mainstreaming of environmental management practices is adopted into the water resources planning process and integrated water resources management.	
	ACTIONS	**RESPONSIBLE ORGANISATION/INSTITUTION**
PLAN OF ACTION:	(i) Promotion of a comprehensive approach to water resources management. Treating water as unitary resource that needs to be addressed in a comprehensive manner.	Dir: WRPS
	(ii) Adoption of clear criteria for environmentally sustainable water resources management for mainstreaming integration of environmental quality objectives based on RQOs for the catchment.	Dir: WRPS
	(iii) A concerted attack on socio-economic roots of extreme poverty, one that provides people with the opportunity to earn a decent livelihood in a non-destructive manner, will permit protection of the catchments' natural environment.	Dir: Communication Services
	(iv) Develop an Integrated water resources development and management programme for the catchment, based on intersectoral approaches.	Dir: NWRP, WRPS
	(v) Promoting a sound institutional environment, improving economic analysis of natural resource management options (e.g. spring ecosystem dependent species). An assessment of the economy of the natural environment should be considered in environmental management.	Dir: WRPS

ENVIRONMENTAL MANAGEMENT STRATEGY		
	(vi) Integration of water quality management by supporting actions to more fully integrate water quality concerns into water resources management strategies of the Marico, Upper Molopo and Upper Ngotwane catchments through preventive and curative actions to address control of point and non-point source pollution should be undertaken.	Dir.: NWRP, WRPS
SUPPORTING INSTITUTIONS:	Provincial Department of Environment Affairs and Tourism	
RELATED STRATEGIES	The above strategy needs to be read in conjunction with the following related strategies: ♦ **Poverty Eradication Strategy** ♦ **Co-operative Governance** ♦ **Water Quality Management strategy**	

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WATERWORKS MANAGEMENT STRATEGY

PUBLIC HEALTH, DISASTER AMANAGEMENT AND DAM SAFETY STRATEGY

MANAGEMENT OBJECTIVE:

The objective of this strategy is to ensure that users in the Marico, Upper Molopo and Upper Ngotwane Catchment are safe from the effects of poor water quality that can create health problems (e.g. cholera), and to ensure that strategies are in place to deal with floods and droughts

ASSESSMENT & ANALYSIS OF ISSUES:

The Department's current commitments are associated with:

- Managing floods and drought disasters by direct intervention on the ground.
- Reducing pollution and preventing serious or hazardous pollution events.
- Promoting dam safety.

DWAFs (and the CMAs in some cases) future commitments under the National Disaster Management Act which has been promulgated in 2002 are:

- DWAF/CMA will be required to become involved in supporting and enforcing disaster management planning by all relevant authorities.
- Drafting a National Flood Management Policy (DWAF).
- Dam safety policy (DWAF).
- Co-operating with the Department of Agriculture on drought relief strategies and policy formulation.
- Handling pollution of water resources (i.e. limiting health hazards such as cholera) and ensuring water is suitable for recreational use.

On the dam safety aspects, it has been identified that the spillway of Klein Maricopoort is a major risk. The dam does not have an Operation and Maintenance manual or Emergency Preparedness Plan has been developed.

There is erosion downstream of the spillways of Marico Bosveld Dam. The Dam also does not have an O&MM or an EPP.

PUBLIC HEALTH, DISASTER AMANAGEMENT AND DAM SAFETY STRATEGY		
The spillway capacity of Krommellenboog Dam has been identified as a major risk factor		
STRATEGIC OPTION: The Department accepts responsibilities in terms of the National Disaster Management Act and will work with its co-operative governance partners in managing the health and safety of the catchments.		
PRIORITY:	Medium	
	ACTIONS	**RESPONSIBLE ORGANISATION /INSTITUTION**
PLAN OF ACTION:	(i) Improve the spillway capacity of Klein Maricopoort and Krommellenboog Dams (ii) Prepare operation and maintenance manuals for all the dams in the Marico, Upper Molopo and Upper Ngotwane catchments. (iii) Investigate the erosion downstream of Marico Bosveld Dam and assess the risk factor to dam safety.	Dam Safety Office.

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MONITORING AND MANAGEMENT INFORMATION SYSTEM STRATEGY

MONITORING STRATEGY

MANAGEMENT OBJECTIVE:

The objective is to ensure availability of reliable data and information on all aspects of integrated water resources management and potential development in the catchment

ASSESSMENT & ANALYSIS OF ISSUES:

The Act requires the establishment of a national monitoring system to collect appropriate data for water resources in order to assess:

- The quantity and quality and use of water in the water resources
- The rehabilitation of water resources
- Compliance with resource quality objectives
- The health of aquatic ecosystems

The National Groundwater Database (NGDB) and the Water Quality Database (WQDB) represent the main repository of Geohydrological information and data for the catchment. However in the three catchments, monitoring and management of groundwater resource utilisation and quality is biased towards the more productive dolomite aquifers at the expense of local groundwater resources from the minor hard-rock (secondary) aquifers, which fulfil an important potable water supply function. This approach has resulted in portions of the catchments without much data (e.g. the Lower Marico)

Rainfall monitoring stations are limited in the catchment (mainly in the Upper Marico catchments). There is no information on the conjunctive use of groundwater and surface water resources, which are significantly dependent on the dolomite aquifer springs found in the catchment.

The Water Use Authorisation and Registration Management System (WARMS) do not handle water use queries at sub-area level.

There is no sharing of the information and databases available in the catchment in order to effectively manage the conjunctive use of groundwater and surface water.

There are not adequate monitoring stations for groundwater in the Lower Marico catchment and there are limited hydrological monitoring stations in the whole of the Marico catchment

STRATEGIC OPTION

The strategic option is to establish a monitoring system that integrates the groundwater data with the surface water resources and water quality management information systems.

It is important for DWAF to establish a monitoring system that fully includes surface resources, water quality and minor secondary aquifers in the catchment which are important sources of water supply to the rural communities as well as for stockwatering.

PRIORITY	Very High – An information system plays an important role in integrated water resources management.	
	ACTIONS	**RESPONSIBLE ORGNISATION/ INSTITUTION**
PLAN OF ACTION:	(i) Identify which data is being collected in the catchments, how it is collected analysed and shared and where the gaps in data are.	Regional Office
	(ii) Develop a good database that includes hydrology, land uses, demand projections. Also an inventory of potential development projects and environmental conditions of the Marico Upper Molopo and Upper Ngotwane catchments.	Dir.: Hydrological Information
	(iii) Identify and analyse existing hydrometeriologic networks for measuring factors such as quantity, quality, rainfall, evaporation, humidity in the catchments and identify the gaps in the data requirements.	Dir.: Hydrological Information
	(iv) Increase gauging stations downstream of the Marico Bosveld Dam up to the border with Botswana.	Dir.: Hydrological Information
	(v) Ensure that Eutrophication monitoring is effectively implemented in the Setumo Dam, Cooke's Lake, Disaneng and Marico Bosveld.	Regional Office
	(vi) Extend the groundwater monitoring to include the minor secondary aquifers in the catchment.	Regional Office

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INTERNATIONAL OBLIGATIONS

INTERNATIONAL OBLIGATIONS

MANAGEMENT OBJECTIVE:

The objective is to manage the water resources of the Marico, Upper Molopo and Upper Ngotwane catchments for the mutual benefit of the co-basin states and ensure that DWAF complies with international commitments on shared watercourses in accordance with the revised SADC Protocol on Shared Watercourses.

ASSESSMENT & ANALYSIS OF ISSUES:

The watercourses of Marico, Upper Molopo and Upper Ngotwane are shared with Botswana to the north and Namibia to the west. The Upper Ngotwane and Marico are part of the Limpopo drainage basin while the Upper Molopo is part of Orange River drainage basin, which is shared with Namibia.

There is an existing agreement between South Africa, Botswana and the former homeland of Bophuthatswana (called the TSWASA agreement) that was signed in 1988. This agreement took account of water requirements in the former Bophuthatswana (now North West Province of RSA). Most of the allocation was not taken up by the Bophuthatswana farmers. No revision of the agreement has been made since the re-incorporation of Bophuthatswana into South Africa and the promulgation of the NWA in 1998 which places a very high status on environmental water requirements and is guaranteed together with Basic Human Needs Reserve.

There have been concerns from Botswana that the infrastructure developments in the upper catchments of Molopo River have impacted on the subsurface flows on which communities in the catchment on the Botswana side were dependent on.

Groundwater is also an area which was not considered in the TSWASA agreement which could be significant in terms of regional cooperation.

STRATEGIC OPTIONS

It is recommended that a review of the TSWASA agreement in terms of the current National Water Act be considered to determine whether there are merits in revising the agreement with Botswana. It is also important to update the hydrology of the Marico in order to determine the yield of Molatedi Dam to take into account recent droughts of 1992 and 1995/6.

PRIORITY:	High -.

INTERNATIONAL OBLIGATIONS		
	ACTIONS	**RESPONSIBLE ORGANISATION/ INSTITUTION**
PLAN OF ACTION:	(i) Assess the merits of revising the TSWASA agreement based on the fact that Bophuthatswana no longer exists and the farmers did not take up their allocation	Directorate: National WRP.
	(ii) Investigate the impact of Setumo and Disaneng Dams on the water use by Botswana which have been relying on shallow wells, which are drying up.	Directorate: National WRP
	(iii) Engage in discussions with Botswana at JPC level on the issues and initiatives that will be taken on the shared water courses of Marico, and Upper Molopo River.	Directorate: National WRP
	(iv) Assess whether there is a need for the joint groundwater investigations on the dolomites traversing the two countries.	Directorate: National WRP
	(v) Investigate and analyse whether the water infrastructures developed in the Upper Molopo River have negative impacts on the reach that traverse Botswana	Directorate: National WRP

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IMPLEMENTATION STRATEGY OF THE ISP

IMPLEMENTATION

MANAGEMENT OBJECTIVE:

The objective of this strategy is to develop the ISP implementation programme for Marico, Upper Molopo and Upper Ngotwane catchments.

ASSESSMENT & ANALYSIS OF ISSUES:

The approach to the development of the ISP for Marico, Upper Molopo and Upper Ngotwane catchments has been based on the understanding that the water resources strategy formulation is primarily concerned with water requirements and availability rather than the organisation of the institutions involved in water resources management. Hence the focus has been on understanding the water resources issues and the characteristics of the water user sectors (both consumptive and non-consumptive) in the Catchments, and how the external environment influence how water resources are managed.

It should be noted, however, that the separation of strategy formulation, which is the main focus of this report, and strategy implementation, is less apparent. A well-formulated strategy must take account of the process through which it will be implemented and it is through implementation that strategies are formulated and reformulated. Therefore this ISP for the management of the Marico, Upper Molopo and Upper Ngotwane catchments should be seen as only the beginning of the process, which will be refined as the resources, structures and systems for strategy implementation are developed, and experience is gained from the initial implementation of the strategy.

Critical to the effective implementation of any strategy is the mobilisation of resources and capabilities within the organisation and/or institutions assigned for implementation of the strategy. This implementation strategy sees this as a part of the development and resourcing of the Regional Office, which plays a central role in the implementation of the ISP.

STRATEGIC OPTION

The analysis of the gap between what structures and systems are available for the implementation of the ISP and what is required for implementation is critical to this strategy.

It is recommended that an implementation strategy be developed that align resources with the requisite actions described in the ISP.

PRIORITY:	Reflected in each strategy

IMPLEMENTATION		
	ACTIONS	**RESPONSIBLE ORGANISATION /INSTITUTION**
PLAN OF ACTION:	The work packages or activities needed for implementation of the ISP are as follows: (i). Development of a business plan that will include operational plans and budgets of the various Directorates and institutions which are aligned to the priorities of this ISP	**Oversight Body (lead by the RO)**
	(ii). Establishment or appointment of an Oversight Body (i.e. intra and interdepartmental committee) or some other existing committee within the region that will act as a steering committee during the implementation, reviewing progress and approving the course of work. It is important that the body tasked reflects the inter-sectoral, multidisciplinary approach required for successful implementation of the ISP.	
	(iii). Review the strategies for the Marico, Upper Molopo and Upper Ngotwane to assess the resource and capacity requirements both internally and externally.	
	(iv). Align financial and human resources with the required actions to achieve the implementation of the ISP. This will involve consideration of options and evaluations to determine the best fit between the ISP activities and the resources.	
	(v). Alignment of current initiatives that serve to achieve the objectives of the ISP.	
	(vi). The RO must gain consensus and commitment at individual and institutional level for the implementation of the ISP.	
	(vii). Political dimension – gaining buy-in within power structures within the DWAF and key stakeholders.	
	(viii). Facilitation of knowledge sharing, improving and strengthening strategic partnerships within the catchment.	

IMPLEMENTATION	
RELATED STRATEGIES	All the specific and general strategies for the Marico, Upper Molopo and Upper Ngotwane catchments.

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