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DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE OLIFANTS RIVER WATER SUPPLY SYSTEM

WP10197

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SUMMARY REPORT: DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE OLIFANTS RIVER WATER SUPPLY SYSTEM (WP10197)

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Glossary of Terms

Allocatable Water
Water which is available to allocate for consumptive use.

Database
Accessible and internally consistent sets of data, either electronic or hard copy with spatial attributes wherever possible.

Environmental Water Requirement
The quantity, quality and seasonal patterns of water needed to maintain aquatic ecosystems within a particular ecological condition (management category), excluding operational and management considerations.

IWRM Objectives
The objectives and priorities for water resource management, for a given time frame, which have been agreed by the parties as those which will best support the agreed socio economic development plans for the basin.

IWRM Plans
A set of agreed activities with expected outcomes, time frames, responsibilities and resource requirements that underpin the objectives of IWRM.

Management Information System
Systems such as GIS which provide a user friendly interface between databases and information users.

Resource Classification
A process of determining the management class of resources by achieving a balance between the Reserve needs and the beneficial use of the resources.

Acid Mine Drainage
Decanting water from defunct mines which have become polluted and acidic and that reach the resource.

Level of Assurance
The probability that water will be supplied without any curtailments. The opposite of Level of Assurance is the risk of failure.

Internal Strategic Perspective
A DWA status quo report of the catchment outlining the current situation and how the catchment will be managed in the interim until a Catchment Management Strategy of a CMA is established.

List of Abbreviations & Acronyms

CMA	Catchment Management Agency
CMC	Catchment Management Committee
CME	Compliance Monitoring and Enforcement
DPLG	Department of Provincial and Local Government
DWA	Department of Water Affairs
DWAF	Former Department of Water Affairs and Forestry
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EWR	Ecological Water Requirements (Ecological Component of the Reserve)
GDP	Gross Domestic Product
GIS	Geographical information System
IB	Irrigation Board
IDP	Integrated Development Plan
IAP	Invasive Alien Plants
ISP	Internal Strategic Perspective
IWRM	Integrated Water Resources Management
IWRMP	Integrated Water Resources Management Plan
LNW	Lepelle Northern Water Board
MAR	Mean Annual Runoff
MINWAC	Mining & Industry Water Action Committee
MY	Million Years
NWA	National Water Act (Act 36 of 1998)
NWRS	National Water Resource Strategy
OWAAS	Olifants Water Availability Study
RO	Regional Office
ROD	Record of Decisions
RWQO	Resource Water Quality Objectives
SALGA	South African Local Government Association
SDF	Strategic Development Framework
ToR	Terms of Reference
URV	Unit Reference Value
VAC	Visual Absorption Capacity
VAPS	Vaal Augmentation Planning Study
WAAS	Water Availability Assessment Study
WCDM	Water Conservation /Demand Management
WFGDS	Water for Growth & Development Strategy
WMA	Water Management Area
WMP	Water Management Plan
WQMP	Water Quality Management Plan
WQT	Water Quality Time Series Model
WRC	Water Research Commission
WRPM	Water Resources Planning Model
WRSM	Water Resource Simulation Model
WRYM	Water Resource Yield Model
WSDP	Water Services Development Plan
WUA	Water User Association
WWTP	Waste Water Treatment Plant
WWTW	Waste Water Treatment Works

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1. Introduction

1.1 Background

The Olifants River Water Management Area is made up of portions of three provinces, namely, Limpopo, Mpumalanga and Gauteng. A portion of the Kruger National Park (KNP) also falls within the area. The catchment is currently one of South Africa's most stressed catchments as far as water quantity and quality is concerned. When the First Edition of the National Water Resource Strategy (NWRS) was approved by Cabinet in 2004, the Olifants Water Management Area was already described as one of the eleven WMAs in the country where the water requirements exceeded the water availability.

Various studies on the catchment's ability to satisfy the water requirements both in terms of water quantity and water quality have been carried out or are currently running. There is a need to review and verify the information coming from these studies and to assemble all this information with the purpose of developing a reconciliation strategy for the Olifants River System. The strategy must cover both management and infrastructure options as well as their sequence of implementation.

It is foreseen that an interim strategy will have to be developed in order to alleviate stress on water users over the short term and that a more comprehensive strategy for the longer term will be completed towards the end of the project.

Since water is currently being transferred out of the catchment to Polokwane and will shortly be transferred to Mokopane, it was decided that these two towns and their surrounding area will be part of the study area.

The first deliverable of Phase 2 (Study Implementation) of this study is a Summary Report which provides a brief summary of each previous report which is regarded as relevant for the purpose of the study and which will synthesize all this information into a single status quo description of the study area.

1.2 Purpose of the Report

The Summary Report lists and briefly describes past reports that were reviewed with the aim of capturing relevant information that can be used in the current study which has the objective to prepare a strategy with appropriate management measures and planned bulk infrastructure options that were investigated in the past. The aim with the information review task was to collate information from previous studies and assessments that are relevant for the development of the preliminary and final reconciliation strategies for the Olifants River Water Supply System.

This Summary Report will be used for the Preliminary Screening Meeting where the reconciliation options will be evaluated in order to determine which options should be investigated further.

This report will also be used to prepare a slide presentation which will be used for the screening meeting.

1.3 Information Sources

Many water related reports have been written on the Olifants River System of which most of them were done by and for the Department of Water Affairs. A few water related reports which were prepared for other departments were also found. An example is the Environmental Management Framework which was recently completed for the Department of Environmental Affairs.

Since many previous reports have become outdated, it was decided to summarise only reports of the last decade which superseded older reports. In the case where no new studies on a certain subject were done in the last decade, and the older reports were the only source of information, these older reports were also summarised.

Approximately 40 reports have been summarised and have been used to sketch the status quo of the study area.

The list of reports which were included in this Summary Report is as per Bibliography List at the end of this report.

1.4 Report Layout

An independent summary of each selected previous report is provided in Section 2. It will therefore be possible for the reader to easily identify the topic of a specific report. For each summary, the following information is given:

- Report Title,
- Purpose,
- Major Findings,
- Recommendations,
- Relevance to this study.

Section 4 describes the status quo of the study area where all relevant information in Section 2 was assembled to portray a holistic picture of the study area.

Information gaps were also identified and these are listed in Section 5 where Section 6 lists the recommendations on how to fill these information gaps.

The report is concluded with a list of conclusions in Section 7.

2. Summary of Pertinent Information from the Reports

2.1 Studies on New Infrastructure

2.1.1 Olifants River: Raising of the Flag Boshielo Dam: Main Report

Report Title: Report No P WMA 04/B51/00/0904, Olifants River: Raising of Flag Boshielo Dam: Main Report. Department of Water Affairs and Forestry. Prepared by Ninham Shand.

Purpose

After completion of a feasibility study, this report addressed certain additional work required before implementation of the raising of the Flag Boshielo Dam, in particular regarding environmental and social work.

Major Findings

The study prepared operating rules, updated cost estimates and prepared an Environmental Management Plan.

Relevance to the study

This project has been fully implemented with the dam wall having been raised by 5 m. The raised dam has been incorporated in subsequent hydrological analyses, making this report redundant to this study.

2.1.2 Olifants River Water Resources Development Project: Environmental Impact Assessment: Resource Economics

Report Title: Report No P WMA 04/B50/00/3204, ORWRDP: Environmental Impact Assessment: Resource Economics. Department of Water Affairs and Forestry. Prepared by Urban-Econ.

Purpose

The objective of this study was to determine the economic value of the (then) current use of the water resource and the impacts that could be expected as a result of the De Hoop dam.

The results of the study is summarised in the **Table 2.1**.

Major Findings

Table 2.1: Findings

	Irrigation	Mining	Other	Total
Economic Price of Water 2010 (R/m^3)	0.05	9.78	5.83	3.55
Economic Price of Water 2025 (R/m^3)	0.11	19.22	7.65	6.42
Economic Value of Water 2010 (R/m^3)	0.03	3.27	2.05	1.23
Economic Value of Water 2025 (R/m^3)	0.04	5.09	2.46	1.81
Jobs / (R m per annum)	9.48	2.05	5.36	5.38
Total Value of a job (R)	105 476	487 805	186 741	185 759
Current Investment per job (R)	36 798	376 000	176 400	164 724
Price Elasticity	0.00	0.39	0.65	0.11

Relevance to the study

The results from the report will be useful when comparing the advantages and disadvantages of different reconciliation options.

2.2 Resource Directed Measures and Environmental Studies

2.2.1 Olifants River Water Resources Development Project: Environmental Authorisation Study Phase 1: Screening Investigation

Report Title: Olifants River Water Resources Development Project: Environmental Authorisation Study Phase 1: Screening Investigation (Draft 2). Department of Water Affairs and Forestry. Prepared by ACER (Africa) Environmental Management Consultants. May 2004.

Purpose

The purpose of this report is to compare the best dam development options previously identified, namely the De Hoop and Rooipoort sites; to consider the groundwater supplies and options for water leasing and trading, as well as other possible alternatives, and to recommend the best development configuration for further investigation. The study identifies, at an early stage, any potential red flag issues that may render any of the options or components non-feasible. The different components are evaluated in terms of the significance of their expected environmental impacts.

Major Findings

Rooipoort dam is an unsuitable dam site from a number of perspectives. However, of over-riding importance is the fact that the dam has an extremely high social cost. This is measured in terms of the number of people (and associated physical and social infrastructure) that would need to be resettled. The human and financial cost of resettlement has been estimated to be extremely high, and it is likely that DWAF would need to make a long-term commitment to the redevelopment of affected people to enable them, at some point in the future, to re-establish their livelihoods and their livelihood strategies in a sustainable manner. Given the harsh realities of the landscape, combined with the fact that the proposed dam would inundate most of the locally-available arable soils, this option is considered risky, with a positive outcome achievable in decades, rather than years.

The site at Rooipoort is not known to contain any endemic species of special significance, or vulnerable or endangered species of aquatic or terrestrial organisms. The riparian vegetation at this site has also been significantly reduced both in extent and quality by livestock grazing and by the community for subsistence purposes. The development proponent should not underestimate the short-term negative consequences on affected communities to be resettled or the long-term commitment to the re-development of sustainable livelihoods of those affected by resettlement.

Recommendations

The Environmental Team do not recommend a dam at the Rooipoort site. Managing the social and resettlement impacts is considered a serious red flag issue. The magnitude of the resettlement required coupled to the loss of valuable arable land in a region that already has few natural resources to sustain the population, cannot be considered to be sustainable and in the long-term interests of the affected communities.

ACER/CSIR recommends that the focus of the current project is changed significantly from the current focus which is based primarily on regional supply-side solutions, to a conjunctive approach that focuses on regional demand-side management with additional water from national supply alternatives. This configuration balances the current economic benefits with social and environmental factors and will hold the best chance of balancing long-term sustainability and development over the entire catchment area, which also includes the Kruger National Park and Mozambique.

Relevance to the Study

The ORWRDP Screening report indicates that the Olifants-Sand Transfer Study was undertaken primarily for the purpose of supplying Polokwane and Mokopane with water from the Olifants River. During this investigation, four possible dam sites on the Olifants River were identified, viz. the Rooipoort, Olifantspoort, Tongwane and Gwaragwara sites.

The site at Olifantspoort was disregarded due to its significant social impact. Gwaragwara, an off-channel site, had the least biophysical and social impacts. However, technical concerns surrounding an off-channel dam resulted in this option being discarded. Tongwane, another off-channel site, was also discarded due to high biophysical impacts and similar off-channel technical difficulties.

A possible dam at the Rooipoort site was rated on a scale of 1 (least acceptable) to 10 (most acceptable) to have a biophysical impact of 2 and a social impact of 3. Despite the social red-flagging, the study accepted that this was the preferred option for development on condition that: i) The Mafefe, 'Downs' Road, which would be inundated, should be re-routed adjacent to the full supply level and not through the pristine mountains to the north, and ii) The significant social impacts of the Rooipoort site should be carefully managed with full community participation to ensure that no one is left worse off after dam construction. The De Hoop dam is currently under construction.

Figure 2.1: Olifants River at the Rooipoort Site (Source: ORWRDP Screening Report)

Figure 2.2: Homes within a possible dam basin at the Rooipoort site (Source: ORWRDP Screening Report)

2.2.2 Olifants River Water Resources Development Project: Environmental Impact Assessment: Infrastructure Development Environmental Impact Report

Report title: Environmental Impact Assessment: Infrastructure Development Environmental Impact Report. Report no. P WMA 04/B50/00/3004. Department of Water Affairs and Forestry. Prepared by ACER (Africa) Environmental Management Consultants/CSIR Environmentek. October 2005.

Purpose

To investigate whether the construction of a large storage dam on the Steelpoort River plus associated national bulk water distribution infrastructure (pipelines, pump stations, balancing dams, off-takes and reservoirs) in Mpumalanga and Limpopo Provinces of South Africa would be environmentally feasible.

Major Findings

The following key issues and associated impacts were identified:

The proposed dam will reduce the annual flows in the Steelpoort River by approximately 63%, yet will have little significant impact on the quantity of river flows in the Lower Olifants River. The Department has made the commitment that the full Reserve requirements of the Steelpoort River will be released from the proposed De Hoop Dam once inundation commences. The release of the Reserve from the proposed De Hoop Dam will have a net positive impact on the downstream aquatic ecology, by improving base flow conditions. This positive impact is further enhanced by the option of releasing water into the Steelpoort River, thereby using the river as a natural conveyance, up to a proposed abstraction weir at Steelpoort town (this option is an alternative to piping the water from the proposed dam to Steelpoort). Possible cumulative impacts of increased mining on the long-term quality of the stressed water resources of the Olifants River System are outside the scope of this assessment. However, although these impacts are covered by existing legislation, they have been raised as a potential concern that requires enforcement of the legislation and monitoring by the Authorities.

The significance of loss of flora inundated by the dam depends on the scale at which it is considered. In terms of the loss of Sekhukhuneland vegetation habitat, the impact is low. However, considering the formally recognised plant associations within this portion of Sekhukhuneland vegetation, i.e. the biodiversity richness, and that new species are being found in this vegetation type and that during the vegetation surveys at least five undescribed plant taxa (not new to science but awaiting description) were recorded, the impact on biodiversity is considered of high significance. Various range-restricted, vulnerable and Red Data species occur within these vegetation communities and, by implication, conservation of the entire habitat is important (along with the conservation of individual species).

Currently, the most suitable mitigation measure is considered to be an off-site option that ensures a similar vegetation habitat is formally set aside for conservation and protection. Given that conservation is not the mandate of the Department of Water Affairs and Forestry, in the spirit and practise of co-operative governance, it is suggested that a feasibility study for off-site mitigation be undertaken in partnership with national and provincial conservation agencies to formally secure, protect and conserve an area of this valuable habitat for future generations.

Responsibility to ensure that the investigation is undertaken is vested with the Project Strategy Committee, the highest order planning body for the ORWRDP. Aquatic impacts, although of some significance, may be improved and negative impacts could potentially be mitigated within the same off-site mitigation site as for terrestrial ecology.

With its water resources already over-committed, the ability of the Olifants River System to sustain and meet human and ecological needs into the future, needs to be considered carefully. Supply-side approaches to meeting the new demands cannot continue indefinitely. A demand-side approach to meeting water resource requirements is not only one of the key principles arising from the World Commission on Dams, but is also a key requirement of South Africa's National Water Resources Strategy.

Importantly, there appears to be potential to improve the efficiency of all water users within the Middle Olifants River Catchment. Therefore, arising from this assessment, it is proposed that the Department of Water Affairs and Forestry should develop a demand management strategy within the Middle Olifants Catchment, in parallel to the proposed infrastructure development (a process that spans eleven years, with immediate possible actions and a longer period that should enable the completion of water use verification, validation and compulsory licensing that are key components of such a strategy). This should facilitate positive long-term benefits, taking due cognisance that the high water tariff, associated with this proposed development, will, in any event, result in improved water use efficiencies.

The project area is relatively poorly serviced in terms of health facilities, domestic water supplies, sanitation systems and other essential services. The potential influx of people during the dam construction period could have a medium impact on the available services, as will the anticipated influx of people due to associated mining developments. Therefore, it is recommended that National and Provincial Government must continue to give attention to upgrading facilities and services in the area to ensure that the anticipated widespread benefits, due to the boost in the regional economy from mining, are realised. Importantly, the net result of this economic boom on the health of the population, particularly over the short- to medium-term, could potentially be negative and of high significance. In order to mitigate this impact it is important that health facilities and services are upgraded and that construction practises are planned in order to minimise the negative impacts of family separation and social disruptions.

Another important service that is needed in the project area is improved domestic water supplies for the many communities that currently lack adequate services. This holds significant positive social and health impacts for the area. The Department of Water Affairs and Forestry is currently supporting and assisting, where required, that acceptable plans and programmes are developed that will ensure domestic water supply allocations within the proposed De Hoop Dam can be distributed once available.

Furthermore, given the existing inadequacy of health-care services in the project area, it will be necessary for the Department of Water Affairs and Forestry to provide on-site health-care facilities and services (currently planned to be a medical room with local doctors on standby where patients can be stabilised prior to transfer to existing hospitals) that can deal with emergency situations and any accidents that may occur. In this regard, it is important to recognise that, as development proponent, the Department of Water Affairs and Forestry should play a catalytic and facilitative role, to bring on board Government Departments (at all levels) who carry responsibility for the different elements that comprise integrated development and service provision.

Construction activities result in a range of impacts. Potential impacts include dust and noise, increased traffic, the influx of people, social ills, crime, and the development of informal trading areas, unnecessary destruction of valuable flora and pollution of the soil and water resources. Careful planning of construction camps and activities in relation to the surrounding environment, as well the implementation and monitoring of the Environmental Management Plan can lead to the adequate mitigation of these impacts.

The proposed De Hoop Dam basin will affect 15 private landowners, of which two are Communal Property Associations and the balance, individual commercial farmers. The mitigation of this impact is complicated due to the fact that the farms will all be divided by the dam and road realignment into two or more segments. The economic viability of these remaining portions needs to be determined by a valuator in terms of statutes. This could be influenced by the existing legal water uses still available on the properties as well as the neighbouring landowners' willingness to sell so that portions can be consolidated.

The realigned R555 is also a factor as the potential noise impact on existing game and eco-tourism enterprises, particularly at the tail end of the dam, will potentially be significant. Mitigation through the construction of a noise attenuation berm has been proposed. However, if this does not prove adequate, alternative solutions will need to be investigated.

A number of other issues were raised by stakeholders, including catchment land care, the spread of alien plant species, the relationship between ground and surface water resources and the negotiation of mineral and land claim rights in the dam basin. Also raised, and possibly one of the more important aspects, is that a large number of cultural heritage and archaeological sites have been identified within the dam basin. A number of these sites have been identified as requiring further excavation and mapping in accordance with the National Heritage Resources Act. Approximately ninety graves have been identified in the dam basin and it is likely that more will be located during construction. This will require an appropriate programme of exhumation and reburial in terms of current legislation and cultural practices. The other issues have medium to low significance and mitigation mostly relies on the Department of Water Affairs and Forestry taking the lead in the coordination required between responsible the Government Departments.

There can be little doubt that positive impacts of the proposed project are the employment opportunities (for dam construction, operation of the bulk infrastructure and employment on current and future mines) that will bring great benefit to the region and its people. These opportunities need to be optimised by the development proponent and enhanced through formalised training and development programmes. Similarly, it should be recognised that the expenditure envisaged for the construction of the proposed project, plus ancillary mine developments, will constitute a major economic benefit to the project area and region.

Recommendations and conclusions

The key negative environmental implications of the proposed ORWRDP relate to the loss of terrestrial habitat and associated flora and fauna of environmental significance. While there are also negative impacts on the aquatic ecology of the Steelpoort River, these are more easily managed and, indeed, positive outcomes for the aquatic ecology are also projected. It is the opinion of the EIA Team that the most meaningful manner in which habitat loss can be mitigated is through off-site mitigation. Options do exist for the off-site mitigation of the loss of Sekhukhuneland Centre of Plant Endemism habitats, vegetation types, and individual floral and faunal species but these options need to be explored further.

It is probable that this type of off-site mitigation will require the development proponent to make a long-term commitment and to enter into partnership with national and provincial conservation agencies to investigate the feasibility of formally securing, protecting and conserving an area of this valuable habitat for future generations.

The social implications of the proposed development are of a positive and negative nature. On the positive side, the creation of additional employment opportunities, directly on the construction of water resource infrastructure and, indirectly, on new mines that are established when the water resource is secure, will have a significant impact on the wealth base of the population of the region and nationally. This impact is, however, offset by the same jobs attracting external jobseekers into the area. The implications of an induced labour force may be to create competition for social and environmental resources in the area. Additional noise and traffic, although causing a nuisance in terms of disturbance and increased travel times, are unlikely to cause significant risk to surrounding communities.

However, conversely, the capacity of the receiving environment to accommodate the proposed ORWRDP as well as ancillary new mine developments is questionable. In this regard, the Department of Water Affairs and Forestry needs to facilitate the spirit and practice of co-operative governance to ensure that sufficient attention and resources are directed at planning for and providing the necessary social services within the receiving environment by those primarily responsible for such services, viz. other National Government Departments, and Provincial and Local Government. Negative impacts relate primarily to directly affected people who would lose land and, in some cases, their homes. However, numbers are not large and the impacts are relatively easily managed.

Economic benefits are likely to be realised through increased upstream and downstream spending in the local, regional and national economy, primarily from the mining sector. In addition, further revenues gained through increased tax earnings and rates will be of benefit to the local, provincial and national economies.

Relevance to the Study

The ORWRDP EIA report provides a useful indication of the environmental issues that can be expected in some parts of the catchment.

2.2.3 Olifants River Water Resources Development Project: Environmental Management Plan for the Construction of the De Hoop Dam

Report Title: Environmental Management Plan For The Construction of the De Hoop Dam. Report no. P WMA 04/B50/00/4504. Department of Water Affairs and Forestry. Prepared by Iliso.

Purpose

To ensure that the environment is properly considered during the construction of the De Hoop Dam, and that negative impacts are avoided or minimised and positive impacts enhanced. The EMP provides a logical extension of the Environmental Impact Assessment (EIA) and ensures that recommendations contained in the EIA are implemented and that the requirements of the Record of Decision (RoD) are met.

Relevance to the Study

The EMP addresses the footprint of the De Hoop Dam only and is not directly relevant or useful to the remainder of the study area.

2.2.4 Olifants River Water Resources Development Project: Environmental Impact Assessment – Public Health Impact Assessment

Report Title: Olifants River Water Resources Development Project: Environmental Impact Assessment – Public Health Impact Assessment. Report no. P WMA 04/B50/00/3204. Department of Water Affairs and Forestry. Prepared by MEDUNSA Department of Community Health. January 2005.

Purpose

The study examined public health impacts that may be caused or aggravated by the proposed ORWRD project and its operation. These could be direct effects associated with water supply and quality, or indirect effects such as those of immigration and employment, in the context of existing human population and health services. The project examines the impacts of the project infrastructure and any alternatives, and recommends how health gains could be maximized and negative health impacts mitigated.

Major Findings

Population size, structure and health status in the area are changing rapidly due to the massive increase in AIDS related disease infections and deaths, falling fertility, and economic growth, driven by large existing mines. Vital registration of births, deaths, and in particular notification of cause of death, is poor. The health infrastructure in the project area needs to expand. This is to keep the pace with an increasing burden of disease, and the service demands created by the construction project and subsequent mining and economic development. Currently, the status of public health facilities is changing as new clinics and hospitals are built and old ones are decommissioned or downgraded.

Communities (and their health) may benefit from infrastructure primarily intended for industry. Upgraded roads, electricity, water supply and communication in the area reduce costs to the whole community. The important proviso is that these benefits are not automatic. Unless the bulk water from the pipelines is purified and reticulated to households, the potential benefit is lost. Unless services such as electricity and transport are affordable, they will not significantly improve the health status of the poor majority of the population. This is a particular concern where such basic services are privatised or run by parastatal monopolies.

The affected regions have among the worst health status and lowest per capita health expenditure in the country. There is no specific strategic plan for public health services to meet the additional demands resulting from the project. The overall planning framework for the province is outdated and probably seriously underestimates future needs, particularly for the project area. While health facilities in the project area are being upgraded to meet their targets, the limiting factors for the health system are inefficient and poor quality care, resulting from an evolving staffing crisis.

Recommendations

- The strategic planning framework for health services in Limpopo needs to be revised and updated.
- Develop specific projections for health services needs, in the light of the project and mining developments.
- Expansion of environmental health services and health promotion expertise should be implemented to support improvements in water supply, sanitation and hygiene.
- DWAF support should be formally linked with the approval of the project to water reticulation

Relevance to this Study

This report is specific to the de Hoop Dam and associated bulk water supply infrastructure only and is not directly relevant or useful to the remainder of the study area.

2.2.5 Olifants River Water Resources Development Project: Environmental Impact Assessment – Cultural Heritage Assessment

Report Title: Olifants River Water Resources Development Project: Environmental Impact Assessment – Cultural Heritage Assessment. Report no. P WMA 04/B50/00/3404. Department of Water Affairs and Forestry. Prepared by Nzumbululo Heritage Solutions/ Institute for Cultural Resources Management. April 2005.

Purpose

Identify and describe impacts on archaeological, cultural heritage, religious resources and practices associated with the proposed ORWRDP project area, including identifying grave sites. Make recommendations on mitigation measures and identify and describe management measures.

Major Findings

The survey of the dam basin yielded a large volume of archaeological and cultural sites. A total of 109 cultural heritage sites, including burial grounds and graves, were recorded in the dam basin study area. The sites are categorised into archaeological (Stone Age and Iron Age sites) and Historic periods. Thirty of these cultural heritage sites are either cemeteries or individual graves burial sites. Only two sites are recorded as ritual. Sites recorded along the water pipe line and the bulk water infrastructure sites routes are presented and assessed separately. Preliminary assessments of the identified sites indicate that human communities occupied the Steelpoort River Valley area at least as far back as the Middle Stone Age, between 250,000 and 25,000 years ago. All the evidence at hand suggests that this area is archaeologically important and has the potential to contribute towards understanding the history of African farmers in the area.

The proposed dam would inundate several identified sites; the quarrying would dig up at least three concentrations of archaeological sites). The proposed road realignment route appears to transect two visible kraals in the Early Iron Age complex and is close to other Iron Age sites.

Recommendations

All archaeological cultural heritage baseline studies such as, surface collection, test excavations and excavations herein recommended may be utilized under the guidelines and permits issued by the South African Heritage Agency (SAHRA). The relocation of affected burial grounds and graves is subject to agreements between the developer and the local communities whose graves are affected. However, under section 36 of the National Heritage Resources Act, Act 25 of 1999, heritage permits are also required to effect the relocation of particular graves. Generally, most burials would be relocated in line with the applicable Ordinances and the Human Tissue Act of 1983 as amended.

Before archaeological excavations are sanctioned, usually the SAHRA excavation permits carry with them minimum requirements of heritage material handling. First artefacts resulting from pre-development excavations should be catalogued and packaged properly according to minimum set standards. Secondly, a permanent repository should be identified before the materials are removed from site.

Relevance to Study

The ORWRDP Cultural Heritage Assessment addresses the footprint of the De Hoop Dam only and is not directly relevant or useful to the remainder of the study area.

2.2.6 Olifants River Water Resources Development Project: Environmental Impact Assessment – Visual Impact Assessment

Report Title: Olifants River Water Resources Development Project: Environmental Impact Assessment – Visual Impact Assessment. Report no. P WMA 04/B50/00/3404. Department of Water Affairs and Forestry. Prepared by Cave Klapwijk and Associates. March 2005.

Purpose

The purpose of the project is to provide the physical infrastructure (storage dam and associated bulk transfer pipelines and pump stations) that will provide water to meet the current and future water demands of all sectors within the middle part of the Olifants River catchment and parts of the Mogalakwena / Sand catchments.

Major Findings

The De Hoop Dam is located within a closed sided valley that will contain the scenic views that will be possible from the re-aligned R555. The dam basin is in an area with a high Visual Absorption Capacity (VAC) that will help reduce visual intrusion. The dam wall remains highly intrusive and the visual quality of the area is high. The De Hoop Dam exerts a negative influence on the visual environment. This is largely due to:

- relatively largely impoundment area that replace the scenic valley;
- the high but limited visibility from the relocated R555;
- the unsightly drawdown zone during periods of low water level;
- the intense construction period;
- the view of the dam wall that is visually incompatible with the surrounding landscape.

The significance of the negative impact is regarded as low due to the fact that viewers have an affinity for water bodies and find them attractive and that the implementation of the mitigation measures will reduce the impact of the disturbed areas.

The road traverses an area with a medium VAC that helps reduce the visual intrusion. The visual impact is generally contained within a 2.5 km zone either side. The visual quality is regarded as moderate. Views from the road of the dam will be scenic, especially when the dam is full. The road cut and fill areas will be highly visible from within the dam basin area when viewed from the full supply level and the eastern mountains.

The dam construction camp site is located close to the dam wall and will be visible from the realigned R555, especially when viewed when travelling south. The VAC is high and will reduce the visual intrusion. The visual quality is regarded as high.

The reservoirs are large concrete structures. These are difficult to mitigate due to their size and form.

Recommendations

It is recommended to rehabilitate all disturbed areas as soon as possible to reduce visual scarring. This rehabilitation can be progressive during the construction period and does not necessarily have to begin once construction has ceased. It is essential that the road cut and fill areas are fully vegetated to reduce the visible scaring. Night lighting during construction and operation needs to be contained and limited. Mitigation of the reservoirs is proposed in the form of screening and possibly the use of pigments in or the staining of the concrete to change the colour from a reflective light grey to a warm tan colour. Screening the viewer from the reservoir by placing screening plants and earth berming will help to lessen the impact. It will not be necessary to relocate the structures if the recommended mitigation measures are implemented.

Relevance to this Study

The ORWRDP Visual Impact Assessment addresses the de Hoop Dam site and associated bulk water supply infrastructure only and is not directly relevant or useful to the remainder of the study area.

2.2.7 Olifants River Water Resources Development Project: Environmental Impact Assessment – Vegetation / Terrestrial Ecology

Report Title: Olifants River Water Resources Development Plan Study: Environmental Impact Assessment, Infrastructure Development – Vegetation / Terrestrial Ecology. Report No. P WMA 04/B50/00/3204. Department of Water Affairs and Forestry and Acer (Africa) Environmental Management. Prepared by Ecorex Consultancy. March 2005.

Purpose

This study describes the current status of the project area with particular reference to vegetation and terrestrial ecology. Mitigation measures to reduce the impact of De Hoop Dam construction and inundation are made.

Major Findings

This report was reviewed mainly for information on Alien Invasive Plants (AIPs). While the threat of Alien Plant invasion is noted as high and mitigation measures to resist the threat are described, there is no information on the extent or type of AIP's in the study area.

Relevance to the study

This report is of limited value to the current study.

2.2.8 Olifants River Water Resources Development Project: Environmental Impact Assessment – Aquatic Ecology

Report Title: Olifants River Water Resources Development Project: Environmental Impact Assessment – Aquatic Ecology. Report no. P WMA 04/B50/00/3104. Department of Water Affairs and Forestry. Prepared by Nepid Consultants. April 2005.

Purpose

- To describe the aquatic environment in the vicinity of the proposed development against which the likely impacts of the proposed developments can be evaluated and future changes can be compared (i.e. to collect baseline data);
- To assess the likely implications of the proposed developments on aquatic ecosystem processes in terms of their extent, duration, severity and overall significance;
- To suggest measures for mitigating negative implications and enhancing positive impacts where appropriate, and;
- To reassess the overall significance with the mitigation measures applied.

Major Findings

The Present Ecological State of the Steelpoort River was considered, for most part, to be Moderately Impaired (Category C), but there is a tendency for the river to become Largely Impaired (Category D) during low flow periods. The most important impacts contributing towards the low Present Ecological State in the Steelpoort River are:

- Excessive sedimentation, particularly of chromite, due to erosion and overgrazing and possibly mining, leading to reduced depth of pools and reduced habitat for larger fish species;
- Water abstraction for agriculture and associated reduced flow depth, especially during the dry season, and;
- Abundant thick mats of filamentous algae indicate eutrophication in the system. The mats create physical barriers to the movement of fish, especially in some badly affected riffle areas. Elevated nutrients are possibly related to the influx of fertilizers from agricultural return flows, the use of soaps and washing powders in and adjacent to the river, livestock using the river as a source of drinking water, and inadequate sanitation in the area as a whole. Elevated nutrients are likely to induce significant daily changes in dissolved oxygen and pH and this is likely to impact negatively on aquatic biota.

A comparison between the expected and observed fish diversity in the Steelpoort River shows that there has been a loss in most habitat preference categories. This indicated that the quality of all available habitat types has been reduced. A large proportion of fish species not collected have a preference for pools, as most of the pools are too shallow to provide sufficient cover for larger pool-dwelling species. There has also been a loss of fish species that are intolerant of poor quality water, intolerant of no flow conditions and species with a preference for stones-in-current and marginal vegetation.

Recommendations

The following recommendations concern the catchment upstream of the dam and although they are not directly related to minimising the impacts of the proposed dam, they have indirect implications for conditions in the impoundment and are therefore considered important.

- Reduce Soil Erosion in the Catchment. It is suggested that the Catchment Management Agency should consider a comprehensive plan to reduce soil erosion in the catchment and in doing so, reduce turbidity levels in the impoundment. Interventions should include protection of suitable buffer zones on either side of all perennial streams in the catchment, and rehabilitation of road crossings and their stormwater drainage systems.
- Clear Alien Vegetation in Riparian Zone. Clearing alien vegetation in the riparian zone of the Steelpoort River and its perennial tributaries upstream of the proposed impoundment is recommended, partly to improve water yield, but also to improve biodiversity.

Relevance of the study

This study focussed specifically on the De Hoop Dam area.

2.2.9 Environmental Management Framework for the Olifants and Letaba Rivers Catchment Area: Status Quo, Opportunities, Constraints and Desired State

Report Title: Environmental Management Framework for the Olifants and Letaba Rivers Catchment Area: Status Quo, Opportunities, Constraints and Desired State. Prepared by Environomics Environmental Consultants. July 2009.

Purpose

The initial purpose of this document was to serve as a basis of interaction with stakeholders, including members of the Project Steering Committee, the district municipalities as well as stakeholders from the private sector when compiling the EMF. It was also used as background information for the completion of the EMF.

Major Findings

- The water resource in the EMF area is already over allocated and any further significant allocation of water must come from the redistribution of existing water allocations;
- Impoundment of rivers (especially in the mountainous areas) may cause irreversible damage to the hydrological regime as well as the ecosystems and human enterprises that depend on it;
- Excessive pollution of water bodies and rivers has a negative impact on the user value of the water in the system and in some instances even have potentially disastrous effects on ecological and economic processes that depend on the quality of the water;
- Erosion, turbidity and sediment deposition in hydrological systems that result from practices that remove vegetation cover in the catchment areas significantly diminish the potential of the hydrological system;
- Mining activities (often inadequately rehabilitated) occurs in scenic areas and impacts unnecessarily on the value that such areas has for tourism, because the impacts have not been internalised to the extent where rehabilitation is adequate to retain or replace the original value of the site and area for tourism;
- Extreme levels of air pollution, especially on the Highveld originating from heavy industry, electricity generation and the domestic burning of coal for heating and cooking pose health risks to the people who stay in the affected areas, and has a devastating effect on the scenic qualities of the affected areas, especially during winter months;

  Poverty and its associated impacts occur over extensive parts of the EMF area;
- Inadequate services and infrastructure remains a significant problem in certain areas;
- The extensive use of indigenous trees for firewood is not sustainable;
- The unsustainable harvesting of medicinal plants especially in indigenous forests is causing severe damage to the vegetation in certain parts of the area; and
- The uncertainty about the potential future impacts of climate change makes it difficult to plan for contingencies.

Based on the Status Quo information the area has been divided into preliminary environmental management zones. The reason for this is that the areas have distinct environmental features and it was also clear that each area have very specific opportunities and constraints as well as expectations of stakeholders (desired state). Each of these areas also requires a different set of management interventions. The environmental management zones' boundaries have since been slightly adjusted, and the updated maps and information can be found in the final EMF Report.

Relevance to the Study

This study provides useful environmental information for the study area.

2.2.10 Olifants River Ecological Water Requirement Assessment: Social Utilisation of the Olifants River

Report Title: Olifants River Ecological Water Requirement Assessment: Social Utilisation of the Olifants River. Report no. PB-000-00-6099. Department of Water Affairs and Forestry. Prepared by Naledi Development. August 2001.

Purpose

To determine how and to what extent communities rely on a healthy riverine ecosystem in the Olifants River catchment. In essence, this involves an understanding of the extent of peoples' reliance on the water in the river and the use of aquatic and riparian plants and animals for food, thatching, medicinal and other purposes, as well as the use of pools and floodplains.

Major Findings

The main use of the water in the upper catchment of the Olifants River is commerce and industry: the social consequences of a change to the ecological status of the Olifants River are minimal. From an utilisation point of view, the upper Olifants River can be divided into two zones, i.e. crop production, and mountain and undetermined land use.

For crop production, the farmers, as a rule, do not use water from the river for irrigation purposes. Communities that live on farms do not rely on the river for drinking water but would use the land next to the river for cattle grazing. It is concluded that the social use of the river is incidental, and the cultural use can be accommodated, irrespective of the quality or flow characteristics of the river.

The mountain and undetermined land use areas, are inaccessible with a very low capacity to house communities. The project team were not able to identify user groups with the exception of the Mpumalanga Parks Board. In conclusion, this zone is inaccessible and social consequences of a change to the ecological status of the river will not influence stakeholders.

In the middle catchment area, the main users of the water in this section of the Olifants River are commercial farmers. Although the rural communities are not major users of water, they do rely heavily on the river. From an utilisation point of view, the Middle Olifants River can be divided into two zones, that of crop production, and subsistence farming.

In crop production, the farmers, as a rule, pump water from the river for irrigation of crops. In most cases there are no alternative sources of water and the on-going survival of this interest group depends on the perennial flow of water in the river. Communities that live on farms do not rely on the river for drinking water but use the land next to the river for cattle grazing. It is concluded that the social use of the river is incidental, and the cultural use can be accommodated, irrespective of the quality or flow characteristics of the river.

For subsistence farming the social use of the river is significant at a number of levels:

- As a source of potable water where there are no alternatives;
- As a source of water for cattle where there are no alternatives;
- As a place for bathing and washing of clothes;
- As a supplementary source of food in the form of fish and wild fruits;

Communities rely more heavily on certain sections of the river. While in most cases there are alternatives for the social uses mentioned above, the most significant is the absence of purified drinking water, which causes the communities to rely very heavily on the river. The cultural use can be accommodated, irrespective of the quality or flow characteristics of the river.

In the lower catchment, the main users of the water in this section of the Olifants River are commercial farmers and the mine at Phalaborwa. Although the rural communities are not major users of water, they do rely heavily on the river. Conservation and eco-tourism on the Olifants River is also not a major user of water. However, they are major earners of foreign currency and one of the largest employers in the area. From a utilisation point of view, the Lower Olifants River can be divided into three zones, those of subsistence farming, irrigation farming, and tourism.

The subsistence farming consists of the section of the Olifants and Steelpoort Rivers where they pass through the mountains. The social use of the river is significant at a number of levels. Although the social use of the river is incidental, and the cultural use can be accommodated, irrespective of the quality or flow characteristics of the river, this group relies on the river for their livelihood in terms of it being the source of irrigation water.

The irrigation farmers pump water from the river (and citrus farmers on the Selati River) or obtain water from the canal system in the case of the Blyde Poort Irrigation Scheme. In most cases, there is no alternative source of water and the on-going survival of this interest group depends on the perennial flow of water in the river.

Tourism plays a leading role in the economy of the region. In the case of the Kruger National Park, the social use is critical as the Olifants River is the sole source of potable water for tourists and staff of the two large camps in the central portion of the reserve (Olifants and Satara camps) as well as the two smaller camps at Balule and the walking-trails camp.

Relevance to the Study

This report provides useful information regarding the social use of water in the catchment, although becoming somewhat outdated.

2.3 Reconciling Water Requirements with Water Availability

There are two recent reports which document the water requirements and water availability of the Olifants catchment. These reports are ‘The Development of an Integrated Water Resources Management Plan for the Upper and Middle Olifants catchment’ (referred to further as the IWRMP report) which deals with the upper reaches of the Olifants catchment, and the

'Olifants Water Availability Assessment' (refer to further as the OWAAS report) which deals with the lower reaches of the catchment. The report on the Upper and Middle Olifants catchment presents comprehensive reconciliations for each major town while similar information is not available in the Lower Olifants. A First-Order reconciliation has been attempted for the whole Olifants catchment based on the afore-mentioned reports and is presented in **Table 2.2** below. Note that Ecological Reserve is an estimate based on the Ecological Reserve Requirements (EWR) at the downstream end of the Olifants catchment and a lot more work is required to verify this estimate and extrapolate to the upstream parts of the catchment.

Table 2.2: First Order Reconciliation of Water Resources and Water Requirements (98% Assurance of Supply)

Catchment	Water Requirements (million m^3/a)	Water Resource (million m^3/a)	Ecological Reserve (million m^3/a)	Balance (million m^3/a)
Upper Olifants	381	342		-39
Middle Olifants	77	131		54
Steelpoort	71	60		-11
Lower Olifants	188	205		17
			~200	
Total	717	738		-179

2.3.1 Overview of Water Resources Availability and Utilisation

Report Title: Olifants Water Management Area: Overview of Water Resources Availability and Utilisation. Report no. P WMA 04/000/00/0203. Department of Water Affairs and Forestry in association with Water Resource Planning. Prepared by BKS. September 2003.

Purpose

This report serves to provide an overview of the current and expected future water resources situation in the Olifants Water Management Area and to highlight the key issues of relevance. The report provides broad strategies for the management of water resources in the Water Management Area. The detailed study of the population distribution in the country and of the expected future demographic and economic changes were to serve as background to the estimation of future water requirements.

Major Findings

Mirroring the predominantly rural character of the water management area is the population distribution, with 67% of the people classified as living in rural areas. Furthermore, close to 60% of the total population in the water management area live in the Middle Olifants sub-catchment, mostly in scattered informal villages with limited services and commerce. The total population of the water management area represents about 7% of the national population, which closely corresponds to the proportionate contribution to the GDP from the Olifants Water Management Area.

The requirements for and availability of water are in balance in the Upper Olifants, as only the exact quantities required are transferred into the water management area for use at the power stations, while any surpluses from local resources accumulate at Loskop Dam for release (transfer) to the Middle Olifants. The deficits given with respect to the Middle and Lower Olifants are mainly attributable to the provision for the ecological component of the Reserve, which is still to be implemented. Key issues with respect to the Olifants water management area are:

- The already full utilisation, and over commitment in certain areas, of the water resources as currently developed and available.
- Substantial deficits which will result from implementation of the ecological component of the Reserve.
- Strong growth expected in the mining sector along the Bushveld Igneous Complex, together with continued urban and industrial growth at Witbank, Middelburg and Phalaborwa.
- The need for increased transfer of water into the water management area for power generation.
- Water quality management in the Upper Olifants sub-catchment in particular, as well as related to mining activities elsewhere in the water management area.
- Ensuring the adequate availability of water of appropriate quality with respect to the ecological requirements in the Kruger National Park.

Recommendations

Upper Olifants

With respect to urban and industrial use, water demand management should first be successfully implemented and the re-use of effluent be investigated, before resorting to the further transfer of water into the area. Little change is expected with respect to rural requirements for water as well as water use by the mining sector. The proper management of acidic mine discharges being blended into the natural stream flow remains of critical importance. It may in future also become economically feasible for mine effluent to be treated for industrial or urban use.

Middle Olifants

Although sufficient resources are available for this purpose, the main issue is the most cost efficient provision of water supply infrastructure. Groundwater could offer the most cost-effective solution for water supply to the Nebo Plateau area, with construction of a new dam on the Steelpoort River as an alternative.

Water for mining developments can provisionally be obtained through the raising of Flag Boshielo Dam and from the re-allocation of irrigation water. Larger developments and increased transfers to Polokwane (Pietersburg) and possibly Mokopane (Potgietersrus) in the Limpopo Water Management Area will probably require construction of the proposed Rooipoort Dam. Further water resource development through the construction of new infrastructure will be very expensive, and unlikely to be affordable for irrigation. Water for irrigation as a means of rural development and poverty relief will therefore have to be sourced largely through reallocation from existing users.

Steelpoort sub-catchment

The main requirements for water in this sub-catchment area for basic human needs in rural areas, and with respect to new mining developments. Rural water supplies can probably best be sourced from groundwater, or alternatively through construction of a dam on the Steelpoort River. Water for mining developments could probably be supplied from the Olifants River, through the re-allocation of irrigation water, and a possible new dam on the Steelpoort River.

Lower Olifants

Discharge of mine effluent into the Selati River near Phalaborwa poses water quality problems downstream in the Kruger National Park, which need to be addressed.

Relevance to the Study

Although somewhat outdated, the main findings of the report are still valid. The recommendations mentioned in the report provide a foundation for the identification of potential sources of water to balance the economic and social requirements in the WMA. It is anticipated that the work that will be done as part of this study will build on this foundation and add substantially to the value of the previous assessments.

2.3.2 Ecological Reserve Report

Report Title: Olifants River Ecological Water Requirement Assessment: Ecological Reserve. Report no. PB-000-00-5299. Department of Water Affairs and Forestry.

Purpose

To provide water resource managers with a concise document of aquatic ecosystem conditions in the catchment and to highlight what needs to be achieved in the short and long-term to protect the aquatic ecosystem in order to provide ecologically sustainable development and use of the resource in the future. The report also looks at whether the ecological requirements can be met and the effect of the Ecological Reserve on the water supply to the current water users.

Major Findings

The social assessment of the Olifants River did not have any influence on the setting of the Ecological Class. It was recommended, however, that a special project be established to formally integrate the link between human uses and values of river resources, and the quantification of environmental flow requirements, into the IFR process.

The process followed to determine the ecological water requirements of the Olifants River followed that prescribed by DWAF (DWAF, 1999 – Volume 3). The geographical boundaries of the study area were delineated and IFR sites selected. The selection of the sites was based on aerial video footage of the study area, an assessment of the instream and riparian habitat integrity for each 5 km segment of the river and a field visit by IFR specialists. Sites were selected on the basis of ease of access, distance from impoundment, suitability for hydraulic modelling, suitability of biological cues, the structure and condition of the riparian vegetation, and river zonation.

The Present Ecological State (PES) was then derived from, or described as a change for the worse from a described reference condition. The degree of change is described by one of a range of classes (Class A to Class F), where Class A to D is considered to be ecologically sustainable, and classes E to F indicate a current state that is ecologically unsustainable. In the OREWRA project the PES was expressed in the components: habitat (habitat integrity), biophysical (fish, riparian vegetation, aquatic invertebrates and geomorphology) and water quality (chemistry) integrity.

The trajectory of change, which describes the current trend of changes in the river in present conditions, was then described for each component for which the PES was determined. Both short term (less than 5 years) and long term (more than 10 years) changes were described. It was therefore possible to derive whether the PES evaluation reflects a stable state, or whether it was still changing under present conditions.

It shall be noted, however, that the yield analysis was done for each incremental catchment on its own. For instance, the possibility of the Blyderiverspoort Dam supporting the flow requirements in the Lower Olifants River was not investigated. It is believed that most of the shortages can be overcome, although this will have to be determined by means of a more comprehensive study.

Recommendations

Water Quality

It is recommended that water quality management in the Upper Olifants River catchment focus on the following problems:

- Increasing levels of TDS in the Wilge River
- High TDS and nutrients in the Klein Olifants River
- Low pH and high TDS in the Klip River, and
- All point sources of pollution in the catchment.

Water quality management in the Middle Olifants catchment should focus on:

- Addressing the impacts of elevated salinity, as a result of irrigation return flows from the Loskop Irrigation Scheme, on water quality in the Olifants, lower Moses and lower Elands Rivers
- Investigating the potential impact of very low winter flows downstream of Flag Boshielo and Mokgomo Dam and elevated salinities resulting from evaporation.
- Improving land use management in the catchment downstream of Mokgomo Dam to reduce the impact of soil erosion and high suspended sediment concentrations during high rainfall months.
- Assessing the importance of agricultural toxic substances (e.g. pesticides) in irrigation return flows.

Water quality management in the lower Olifants River catchment should focus on:

- High silt levels released from the Phalaborwa Barrage
- High fluoride, TDS and sulphate levels in the Selati River
- High levels of particulate chromite in the Steelpoort River
- The distribution and concentration of chromium VI in the Steelpoort River Basin. In the lower Selati River, poor water quality should be addressed by management of point and diffuse sources, and not by dilution

Flow

Upper Olifants catchment

It is recommended:

- That flows within the upper 1 to 4% flow duration percentiles should be maintained. Larger floods in the catchment should be released in order to mobilise the entire bed, maintain the floodplains and the channel structure.
- That for the IFR recommendations to be met, the operation of all regulatory structures along the river must be co-ordinated. In particular, the management of

Premier Mine and Bronkhorstspruit Dams should be co-ordinated with that of Doringpoort and Middleburg Dams.

- That direct social dependence on the river be taken into consideration during drought periods when the boreholes are likely to dry up and people and livestock become reliant on the river.

Middle Olifants catchment

It is recommended:

- That flows within the middle 1 to 4% flow duration percentiles should be maintained in order to mobilise the entire bed from time to time, maintain the floodplains and channel structure.
- That a high protection status should be given to the Mohlapitse River when planning developments in the catchment, due to the beneficial impact of this healthy river as a refuge area for aquatic biota.
- That the results of the Desktop analysis for the upper and middle Elands River should be upgraded to a Rapid determination of the Reserve.

Lower Olifants catchment

It is recommended:

- That flows within the lower 1 to 4% flow duration percentiles should be maintained in order to mobilise the entire river bed from time to time, maintain the channel structure and riparian floodplains.
- That an Integrated Land Care Programme be established in the lower Olifants River as the erosion and the associated high levels of sediment cannot be addressed through flow manipulation alone.

Relevance to the Study

Although the social utilisation study for the Olifants River was conducted in 2001, the information still remains relevant in terms of providing an indication of the basic human needs requirements in the water management area. This information will provide the required information for the Reserve which will need to be considered in water use reconciliation, allocation and licensing.

2.3.3 Olifants River Water Resources Development Project: Surface Water Resources

Report Title: Olifants River Water Resources Development Project: Surface Water Resources. Report No. P WMA 04/B50/00/1704. Department of Water Affairs and Forestry. Prepared by KP-SSI Joint Venture. June 2007.

Purpose

The objective of this Surface Water Resources Report was to assess the increase in water availability of various water resource augmentation options.

Major Findings

The study involved firstly revising and extending the hydrology within the catchment, setting up a water resources model, and then determining the yields for a range of dam sizes at both the De Hoop and Rooipoort Dam sites. The increased yield due to the raising of the Flag Boshielo Dam was also investigated. In addition to these augmentation analyses, the impact of the proposed developments on the Massingir Dam (located on the lower Olifants River in Mozambique) was also assessed.

The main findings emanating from the study are the Full Supply Level versus Yield relationship of dams at De Hoop and Rooipoort. Probabilistic yields using the revised Steelpoort hydrology for the proposed De Hoop Dam for a range of assurance levels are shown in the **Table 2.3.** The yield of the De Hoop Dam varies from 46 to 82 million m^3/annum at 98% assurance. The yield of the Rooipoort Dam ranged from 21 to 51 million m^3/annum. Raising the Flag Boshielo Dam makes an additional 16 million m^3/annum available at 98% assurance.

Table 2.3: Probabilistic Yield from a Dam at De Hoop

FSL (m)	Storage (million m^3)	Stochastic yield for assurance level (million m^3/a)			
		95%	98%	99%	99.5%
892	86.788	54	46	45	43
896	115.878	60	54	50	47
900	150.350	70	62	56	52
903	181.650	75	66	61	58
905	203.990	79	67	62	60
907	229.143	81	70	66	63
909	255.797	84	73	68	65
911	283.950	86	76	70	67
915	347.440	90	80	75	71
917	382.360	93	82	77	73

Relevance to the study

The report has limited relevance, as the De Hoop Dam is currently under construction. The yield values however can be used in system calculations.

2.3.4 Olifants River Water Resources Development Project: Mogalakwena / Sand: Comparison of Water Supply Augmentation Options

Report Title: Olifants River Water Resources Development Plan Study: Mogalakwena / Sand: Comparison of water supply augmentation options for Aganang, Polokwane and Mogalakwena Municipalities. Report No. P WMA 04/B50/00/2304. Department of Water Affairs and Forestry. Prepared by ECH Sellick. August 2006.

Purpose

The objective of this Augmentation Report was to estimate future water requirements and water availability for the following municipalities outside and adjacent to the Olifants River catchment:

- Aganeng Municipality,
- Polokwane and Lebowkgomo Municipalities and
- Mogolakwena Municipality

Major Findings

The study provides estimated water requirements for both present (2005) and the future (up to 2020), as well as identifying possible augmentation options.

Recommendations

The options include the construction of dams at Groenvlei on the Mogolakwena River, Doornkop on the Lephelale River, the further development of groundwater resources, as well as increasing the transfer of water from the Olifants River Catchment to the towns of Polokwane and Mokopane.

The conclusion reached in this study was that the water demands of the Mogalakwena and Sand River catchments are growing rapidly and there will be severe water shortages by 2010 unless water resources are augmented. The water demands can be met through a number of measures but the report does not make a specific recommendation.

Relevance to the study

This report has limited relevance as augmentation from the middle Olifants River catchment is limited by the water requirements of the middle Olifants system which itself requires augmentation of water resources.

2.3.5 Olifants River Water Resources Development Plan: Water Requirements Assessment study for future economic development in the Dikolong Corridor

Report Title: Olifants River Water Resources Development Plan Study: Water Requirements assessment study for future economic development in the Dikolong Corridor. Report No. P WMA 04/B50/00/5004. Department of Water Affairs and Forestry. Prepared by Kayamandi.

This report has NOT been located but if report number is correct it does belong to the ORWRDP study. The Dikolong corridor is in the Olifants catchments and appears to relate to the Platinum mining industry in the Eastern Limb of the Bushveld Complex. Mining in this area is constrained by water resources and is directly linked to the raising of Flag Boshielo Dam and the construction of the De Hoop Dam in the middle Olifants catchment.

2.3.6 Assessment of water availability in the Olifants WMA by means of Water Resource related Models: Hydrological Analysis

Report Tile: Assessment of Water Availability in the Olifants WMA by means of Water Resources related Models: Hydrological Analysis. Report No. P WMA 04/000/00/5307. Department of Water Affairs and Forestry. Prepared by SSI, KP, AGES and Umfilo Wempile. January 2009.

Purpose

The report is one of a suite of reports for this WAAS study. This report covers the hydrological analysis of the catchment downstream of Loskop Dam. The hydrological analysis was carried out using the WRSM2000 rainfall-runoff model and runoff modules were established for every quaternary catchment.

Major Findings

The study involved an extensive data collection exercise that included the selection and patching of rainfall, flow and reservoir records. Landuse information was also obtained for forestry, alien vegetation, irrigation, mining, reservoirs, groundwater and for industrial and domestic users.

The WRSM model was calibrated and used to simulated flows for the period 1920 to 2004. The results of the calibration are provided in **Error! Reference source not found..**

The simulated flows at the most reliable streamflow gauge, B7H015 at Mamba in the Kruger National Park, are 3 % higher than the observed flows, which is well within the acceptable range for gauging accuracy. Naturalised flows were produced for all quaternary catchments and were used in further phases of this study.

Table 2.4: Olifants WAAS: WRSM calibration results

Sub-catchment	Gauge	Record Period	Observed MAR	Simulated MAR
			($10^6m^3/a$)	($10^6m^3/a$)
Loskop spill	Inflow from Upper Olifants	1920-2004	253.27	Spill / releases
		1920-2004	98.31	Irrigation canal
Olifants River flow gauges				
B32	B3H001	1966-2004	343.22	345.13
B51	B5R002 (Flag Boshielo infl)	1987-2004	447.92	496.08
B52	B5H002	1948-1976	720.25	406.04
B71	B7H009	1960-1997	799.06	805.64
B72	B7R002	1966-2004	1411.26	1170.42
B71	B7H015	1987-2004	1205.25	1244.72
Tributary flow gauges				
B31	B3H021 - Elands	1991-2004	25.58	31.65
B41	B4H003 - Steelpoort	1957-2004	95.19	94.28
B42	B4H021 - Waterval	1972-2004	22.76	20.29
B42	B4H007 - Klein Spekboom	1968-2004	25.92	26.61
B42	B4H010 - Spekboom	1979-2004	62.54	56.45
B60	B6R003 - (Blydepoort infl)	1977-2004	304.64	280.05
B72	B7H019 - Selati	1988-2004	73.28	61.42
B72	B7R001 - Klaserie	1961-1999	30.25	29.22

Relevance to the study

The report provides an indication of water availability within the catchment area.

2.3.7 Assessment of Water Availability in the Olifants WMA by means of Water Resource related Models: WRPM Analysis

Report Tile: Assessment of Water Availability in the Olifants WMA by means of Water Resources related Models: WRPM Analysis. Report No. P WMA 04/000/00/5807. Department of Water Affairs and Forestry. Prepared by SSI, 2009.

The WRPM Analysis Report is one of a suite of reports for the Olifants Water Availability study. The report is currently not available and cannot be reviewed. According to the project consultant the report has not been completed (pers comm., Allan Bailey, SSI, February 2010).

Relevance to the study

The report is relevant to the current study and will be obtained when it has been approved.

2.3.8 Lepelle Northern Water Board

Report Title: Lepelle Northern Water Business Plan for 2009/10 Report Summary

Purpose

The report focuses on the defining water requirements from 2008/09 to 2013/14 for of the schemes it owns and or operates. Water resources are described and short comings in water resources are highlighted. The potential for water conservation/demand management (WCDM) in the various schemes are summarised.

Major Findings

The Lepelle North Water Board (LNW) was established on 1st April 1997, in terms of Chapter Six of the Water Services Act, No 108 of 1997.

The Lepelle North Water Board's primary business activity is to provide bulk water services to other water services institutions and industries in its service area. The area of supply of LNW covers approximately 80 000 square kilometres or 72% of the surface area of the Limpopo Province.

The Board has positioned itself to be able to receive and/or operate across Municipal boundary schemes. These include: -

- Middle Letaba, which serves both Vhembe and Mopani District Municipalities;

- Olifants-Sand transfer scheme which serves Polokwane municipality, Greater Sekhukhune District and Capricorn District Municipalities; and
- Flag Boshielo scheme, which serves Capricorn and Sekhukhune District Municipalities.
- Nandoni Scheme which will serve Vhembe, Mopani and Capricorn DM's.

LNW also supplies industrial water to the mining and heavy industries in the Ba-Phalaborwa municipality. The systems used for distribution are designed in such a way that any possible contamination of the different classes of water is eliminated.

In addition to the primary activity, the Board also assists the Water Services Institutions in the following areas:

- Internal reticulation services, cost recovery and revenue management.
- A cost recovery system that caters for the provision of Free Basic Water (FBW).
- The finalization and the implementation of FBW policies, etc.

LNW is also involved with internal reticulation in partnership with municipalities requiring this support. This will assist the municipalities to better realise their constitutional mandate. LNW is in discussion with Capricorn District Municipality (CDM) to extend the existing reticulation services agreement. An implementation agreement of the bulk supply agreement with the Greater Sekhukhune District Municipality (GSDM) will be implemented in this financial year. Negotiations with GSDM are at an advanced stage to undertake reticulation in some villages within the district.

LNW also takes cognisance of the needs of the environment and ensures that all its project implementation is undertaken within the guidelines of the Environmental Impact Assessments Framework. To this end, the following steps are taken:

- Conversion from chlorine gas to sodium hypochlorite for water disinfection at the water treatment plants where suitable.
- The proper use of settling ponds to improve the quality of water used in backwashing filters before it is returned to rivers.
- Recycling of settled water from the sludge ponds on the water treatment plants.
- Financing of a comprehensive silt management study in order to determine and minimise the impact of silt releases from the Phalaborwa Barrage into the Kruger National Park.
- Removal of alien plant species through the Working for Water Program.
- Continued monitoring of raw water quality in the rivers.

In addition the LNW subscribes to the principle of Water Conservation and Demand Management (WCDM). To this end a water demand management programme is being developed for all Schemes operated by LNW. Part of the management entails determining the extent of Unaccounted for Water (UFW). The LNW will embark on a program to investigate and reduce such UFW over a two-year period. Whereas the operations team will first and foremost deal with reducing the physical losses, it will in close cooperation with its customers also address the sources of commercial losses.

The water requirements for the next 5 years are summarised for all schemes operated by LNW and that occur within or are linked to water resources in the Olifants WMA.

The Board currently operates one inter-basin transfer scheme in the Olifants WMA. The Olifantspoort IBT, pumps water from the Olifants River in the Olifants WMA to Polokwane and other DM's in the Limpopo WMA.

Table 2.5 depicts the consolidated forecast for the next 5 years for the Polokwane Municipality, the capacity of its own sources and the requirements from the Olifantspoort Plant. The amount required from Olifantspoort is not available as yet and is above the current allocation.

Table 2.5: Polokwane Municipality water requirements

Year	Demand	Dap Naude	Boreholes	Ebenezer	Olifantspoort	Olifantspoort	Allocation
	(Ml/d)	(Ml/d)	(Ml/d)	(Ml/d)	(Ml/d)	million m^3	million m3/a
2008/09	88.2	16.8	15.4	28.0	28.0	10.2	5.4
2009/10	94.0	16.8	15.4	28.0	33.8	12.3	5.4
2010/11	99.8	16.8	15.4	28.0	39.6	14.5	5.4
2011/12	106.1	16.8	15.4	28.0	45.9	16.8	5.4
2012/13	109.7	16.8	15.4	28.0	49.5	18.1	5.4
2013/14	111.0	16.8	15.4	28.0	52.6	19.2	5.4

LNW operates a total of 11 schemes within its supply area of which seven as shown in **Table 2.6** are located within or are linked to the water resources of the Olifants WMA.

Table 2.6: Water supply schemes in the Olifants WMA

Name of Scheme	District Municipality	Owned by	Scheme Cap (Ml/d)
Olifantspoort	Capricorn DM	DWEA & LNW	30.0
Flag Boshielo	Sekhukhune DM	Sekhukhune DM	12.0
Burgersfort	Sekhukhune DM	Sekhukhune DM	3.0
Steelpoort	Sekhukhune DM	Sekhukhune DM	1.5
Ohrigstad	Sekhukhune DM	Sekhukhune DM	0.3
Phalaborwa	Mopani DM	LNW	175.0
Doorndraai	Waterberg	LNW	12.0

The Doorndraai (Mokopane) system is described and while it is currently not linked to the Olifants WMA it will be in the future as the DWA is developing a pipeline that will link the system to Flag Boshielo Dam in the Olifants to augment water resources in the Mokopane area.

Relevance to this study

The report provides comprehensive information on all Schemes operated by LNW and directly affecting the Olifants River Catchment.

2.4 Groundwater Studies

2.4.1 Groundwater quality deterioration in the Olifants River Catchment: Witbank dam sub-catchment

Report Title: Investigation into Groundwater Quality Deterioration in the Olifants River Catchment above the Loskop Dam with Special Investigation in the Witbank Dam Sub-Catchment. Water Research Commission (WRC). Prepared by FDI Hodgson and RM Krantz. WRC Report 291/1/98.

Purpose:

The purpose of the investigation was to:

- Quantify the contribution of various activities which may result in a deterioration of the groundwater resources in the catchment above the Loskop Dam, with special emphasis on the Witbank Dam Sub-catchment.
- Predict future salt loads in groundwater, based on projections of potable development in the area. Extrapolate information to other catchments that supply water to the Olifants Catchment.
- Investigate and research improved management and precautionary measures that could be utilized to minimize groundwater quality deterioration.

- Integrate groundwater information with other investigations in the area, including the water management programme of the DWA. with the purpose of deriving a catchment management programme.

Major Findings:

Groundwater in the area investigated occurs in the near- surface weathered strata, fractures in the un-weathered Karoo sediments and to a lesser extent, in the rock underneath the Karoo Formations. Borehole yield is low, less than 1 l/s and only sufficient for domestic use or stock farming. Groundwater quality is generally good in undisturbed areas as result of the short residence time in this zone and most leachable minerals have been removed over time. Water quality is mainly calcium/magnesium type with electrical conductivity in the order of 30 – 70 mS/m.

The study shows that surface water quality has deteriorated during the 20 years pre 1998. There is also a direct link between surface water quality and developments in the catchment. Sulphate and Manganese levels are a direct link to acid mine drainage. Trace quantities of other constituents, specially found in urban, metal industry, mining and agriculture are present in specific localities.

According to the study opencast mining has the greatest impact on groundwater quality. Coal discards in unsaturated zone constitutes one of the main problems because of the vast volumes of material dealt with. Underground mining has the problem to dispose of groundwater in the underground mining works. The quality of this water is inadequate for disposal into public streams. Disposal in evaporation ponds is possible but at present the coal mines are implementing underground storage.

The study investigated the effect of power generation on groundwater quality. The possible sources identified are mainly that of the fly ash disposal, coal stockpiling and dirty water dams. Eight power stations are located in the Olifants River Catchment. The power stations use saline effluents from demineralization plants with the ashing system distribution for dust control. Only one power station utilises dry ash disposal. A well managed dry ash dump does not pose any threat to groundwater pollution. Wet ash disposal if not managed well does impact on the groundwater and a pollution plume is established downstream from the ash dam. It was concluded that the disposal facilities at Eskom power stations are well managed and groundwater pollution is minimal. Mass transport modelling is used to predict future trends.

The disposal of general waste in the Olifants Catchment is mostly done within environments that are already polluted by mining. It was concluded that although general waste disposal may pose a threat to groundwater pollution, the threat is much localized. The impact of Sewage works do not significantly impact on groundwater quality. Treated sewage effluent, which is discharged into streams, has ameliorating effects on the acid-rock drainage.

Several metal industries are located in the catchment and comprise mainly steel, stainless steel, ferrosilicate and vanadium producing plants. Locally, problems are experienced in the disposal of saline liquids, slimes, slags, phenol and in the case of the stainless steel industry, chromium and nickel. Groundwater pollution is localized but intense in nature.

Agricultural pollution of groundwater is local and isolated. Nitrate and phosphate levels is generally less than 2 mg/l. Groundwater pollution at feed lots is localized and site-specific. The report stated that pesticide and herbicide levels are low in surface and groundwater.

The overall assessment concluded that regional groundwater pollution from point pollution sources in the catchment is not possible because of the layered nature of the aquifers and dynamic shallow through flow in the upper aquifer. Pollution that enters into the ground mainly affects the top, weathered aquifer. This pollution moves with the natural groundwater gradient towards streams, where it discharges. It is therefore only in areas between the sources of pollution and the streams that groundwater pollution is present. This pollution ranges from severe for certain industries to negligible for others, based on the composition of the leachate.

Recommendations

The recommendations were mainly made for future work. The important ones are:

- The acid-base accounting methodologies developed during the investigation should be refined, verified and published as a set of guidelines, supported by case histories, to be used by consultants and DWAF.
- The water management options at current opencast mining operations are very limited. As part of acid-base accounting, the three options, namely selective spoil handling, flushing or containment should be evaluated and recommendations should be made for procedures to decide upon the merit of a specific management option.
- Coal discard disposal poses one of the long-term environmental threats. While certain proposals have been made in this report, based on hydraulic and chemical considerations, these suggestions will have to be evaluated under actual field conditions, followed by the development of a set of guidelines.

- Control of groundwater pollution is well in hand at the power stations. Qualitative monitoring has been ongoing for many years. It is suggested that the qualitative data should be supported by quantitative modelling, generating generic and expert systems that can be used by the power stations for performance evaluation with respect to groundwater pollution control.

Relevance to the study

The study was done in 1998 and gives a past baseline against which the present status can be compared to see if any progress in water management was made. The area investigated certainly represents one of the most impacted mining and industrial areas within the catchment. The findings of the investigations can be extended to the other coal mining areas in the catchment. To alleviate the long term threat of salination within the mines certain options such as flushing or containment are proposed. The proper management and control of the water and salt balance in the catchment can lead to better quality water that can be made available for irrigation. The report deals mainly with water quality and not quantity, however, the quality management aspect is important if treatment and reuse need to be considered. The report created a general awareness of water pollution in the area, which plays an important role in the future water management of the catchment.

2.4.2 Assessment of water availability in the Olifants WMA by means of water resource related models.

Report Title: The assessment of water availability in the Olifants WMA by means of water resource related models (Volume 4 of 12): Groundwater and groundwater quality analysis. Department of Water Affairs and Forestry. Prepared by SATAC Joint Venture. 20 May 2009.

Purpose:

The specific purpose of this study was to contribute to the formulation of a detailed strategy for water resource management in the Olifants River Catchment in terms of groundwater quantity and quality. Specific emphasis was to determine the future groundwater allocations for application in the water use licensing process.

The main objectives of this study are summarised as follows:

- a regional assessment and review of existing information on the Olifants River WMA aquifers;
- evaluation of the groundwater component of the Olifants River WMA in terms of water flow balances during variable recharge conditions;

- integration of the groundwater flow component with the surface water components at quaternary sub-catchment level in terms of base flow volumes;
- determine stressed aquifers as well as aquifers with potential for further groundwater development;
- development of detailed numerical groundwater flow balance models for selected stressed catchments;
- evaluate the groundwater quality component of the Olifants River Catchment;
- evaluation of the available data and recommend further studies required to optimise groundwater management in the catchment.

Major findings

The groundwater recharge across the whole Olifants River Catchment covering an area of 54 550 km^2 is in the order of 860 million m^3/a. The recharge in the Middle and Lower Olifants Catchments is in the order of 700 million m^3/a.

The groundwater component of the base flow was calculated to be in the order of 45 million m^3/a for the whole Olifants River WMA and 35 million m^3/a in the Middle and Lower Olifants Catchments.

The Groundwater Yield Model results showed that, 70% to 80% (500 million m^3/a) of the groundwater that is recharged is lost due to groundwater evapo-transpiration losses. On a regional scale, the potential evapo-transpiration is more than 50 times higher than the recharge, which means that the entire groundwater recharge volume can be evaporated on 2% to 5% of the catchment areas. More groundwater may be available than was expected, given that it can be economically utilized before it is lost to groundwater evapo-transpiration.

Apart from groundwater evapo-transpiration losses, which account for up to 70% of the recharge, the biggest water users are community water supply at 93 million m^3/a (10% of recharge) and irrigation 72 million m^3/a (8% of recharge). The inflow from dam seepage could be as high as 47million m^3/a, which is more than the groundwater component of base flow.

The groundwater component of the Olifants River WMA is considered as unstressed on a regional scale given that only 25% of the quaternary catchments are in stressed state. At least 70 million m^3/a of additional groundwater resources can be developed in the quaternary catchments that are not stressed. A water balance model developed for the relatively-unexploited dolomite in the north escarpment area of the Olifants River WMA, indicates that the groundwater balance in the dolomite aquifers is positive and can be used for future development as a regional groundwater resource.

There are 6 stressed aquifers (hot spots) that need immediate intervention:

- The Delmas Dolomite Aquifer (B20A and B20B) where irrigation in the order of 6 million m^3/a is abstracted from a spatial limited aquifer. The risk of sinkhole formation is an important aspect that should be managed.
- Similar to Delmas is the Zebediela Dolomite Aquifer (B51E and B51G) where 3 million m^3/a is abstracted also from a spatially limited aquifer.
- The Springbok Flats Karoo Aquifer (B51E) where 10 – 12 million m^3/a, is abstracted for irrigation.
- Highveld coal mining area at Witbank-Middelburg-Kriel Karoo Coal Aquifers (B11K, B11J, B11H and B12D) where water quality is more affected than quantity.
- Steelpoort mining and community water supply aquifer areas (B41J and B41K) where groundwater quantity and quality is affected.
- Kruger National Park and Bushbuckridge Catchments (B73J, B73H and B73F) where groundwater sustains community water and riparian vegetation.

In terms of groundwater quality:

- The distribution of the National Groundwater Data Base (NGDB) of Department of Water Affairs did not cover the total Olifants Catchment to evaluate the impacts of the mining areas.
- The water quality data is less than 20% of the boreholes registered on the NGDB database.
- The NGDB water quality data cover the Springbok Flats, rural villages and the Bapsfontein area.
- The biggest contributors to poor water quality water are Nitrate, Fluoride, EC, Sodium, Magnesium, Calcium and Sulphate.
- The minor contributors to poor water quality apart from the above are Arsenic and Iron.
- Nitrate is the biggest human initiated pollutant in the database.
- Fluoride is the biggest natural pollutant in the database.
- The available data showed no impact from water use in the Delmas area, but in the springbok Flats and Gravelotte areas water usage such as mining and sanitation does impact on groundwater quality.
- There was not enough data to evaluate the surface groundwater interaction.

Recommendations

The following groundwater regulation and management actions are recommended:

- Shorten the time that it takes to evaluate and authorize or decline a Water Use License Application. Due to long time frames, water users continue or are forced to continue to use water resources illegally and without a management framework as would be set out in the license conditions.
- Implement a groundwater accounting system so that the regulatory authority can keep track of the groundwater allocations and surplus or deficits in each quaternary catchment.
- Control Water drilling in the catchment. All drilling contractors are required to register with the DWAF or a regulatory body and all boreholes drilled are required to be reported by the drilling contractor.
- Implement a groundwater information project similar to GRIP in the Limpopo Province across the whole Olifants River WMA. This is vital as only 20% of the NGDB boreholes have associated water quality data.
- A groundwater management plan should be developed for the stressed quaternary catchments. Water users will have to cut back on groundwater volumes used to ensure sustainability of the resources. The groundwater management plan should be developed in co-operation with the local water users associations.
- The listed stressed catchments should be reviewed and more detailed numerical models developed that should be used to determine management options.
- Validation of groundwater use: The groundwater use distribution is complete. Although a large data set is available, the reliability and accuracy of the NGDB dataset is limited. The information is not validated before it is entered and errors are promulgated in the co-ordinates, position and status of the borehole. GRIP type programme should be implemented to address this aspect.
- Artificial recharge investigation: The use of artificial recharge where surplus water during wet seasons and treated effluent water are pumped into the aquifer is successfully employed at Atlantis in South Africa and in Windhoek, Namibia. This leads the way for groundwater banking, storage as well as groundwater “mining” during the drought periods. Further consideration can be made of this method if warranted and research initiated.
- Compulsory licensing: This initiative would run concurrently with the validation exercise and regulation of drilling. All catchments which are currently considered sensitive or stressed should undergo compulsory licensing. All uses validated, licensed and monitored for compliance. A system of licensing is ineffective and meaningless without monitoring for compliance.

- Monitoring: At least 5 regionally representative aquifers should be selected and equipped with automatic monitoring systems to verify groundwater recharge volumes. This information can then be used throughout the catchment.
- The groundwater management of sanitation systems in villages and rural areas must receive attention. Similarly waste water released from waste facilities, mining and industries must also be validated and monitored for compliance.
- Research: Additional research is required to verify and validate the groundwater base flow loss component and regional recharge.

Relevance to this study

This report gives us a good perspective of the status of groundwater management in the Olifants River WMA. The report specifically addresses the shortcomings in groundwater data accumulation and management of groundwater resources. There seems to be a number of serious shortcomings that needs to be considered and the reconciliation of the groundwater resources can be implemented. Validation of data is an issue that must be addressed. Certainly the under-used areas should receive attention in terms of potential supply to stressed areas. The management of groundwater in the stressed areas should also receive attention in terms of re-use of water. Artificial recharge is one of the aspects that should be considered to cater for drought periods.

2.5 Studies on Water Use Efficiency

Although a study was commissioned in 2006 to investigate water use and efficiency within the District Municipalities located within the Olifants catchment, of the eight reports that should have been completed as part of this study, only one complete report and one partial report could be obtained. The report on the Emalahleni District Municipality indicates that out of the 33 million m^3/annum currently being abstracted for the towns of Witbank and Middelburg 11 million m^3/annum is unaccounted for. This represents a loss of 33% which is unacceptably high.

The Western Highveld area (formerly Kwandabele) is well known for its very high losses but a recent report on this problem has not been forthcoming. The Development of an Integrated Water Resources Management Plan does however allude to this area of high loss in that the future projected water use in this area assumes that the raw water abstraction will reduce from 28 million m^3/annum in 2005 to only 15 million m^3/annum in 2010 as a result of Water Conservation measures. This study will need to confirm that the WCDM have indeed been successful.

2.5.1 Water Conservation and Demand Management Strategy and Business Plan: Emalahleni Local Municipality.

Report Title: Olifants Water Management Area: The development of a comprehensive water conservation and water demand management strategy and business plans. Emalahleni Local Municipality / Upper Olifants. Department of Water Affairs and Forestry. Prepared by Water for Africa, November 2008.

Purpose

The report relate to the domestic sector water use and water delivery.

The primary objective of the situation assessment reports is to respond to the following key questions:

1. How much water is available and where is it being used? The approach is to capture for every sector, what their sources of supply is, where is the water being used in the production process, what is the value placed on the water, what institutional arrangements are in place to manage its use, what is the level of water use efficiency.
2. How much water is being lost? This is done by conducting a water audit by checking production and consumption, conducting a water balance, and reviewing records, operating procedures and skills for operation and maintenance.
3. Where is the water being lost? The methods used include quantifying the total losses, identifying where the losses are occurring in the water supply chain (i.e. bulk mains, distribution mains, reservoirs, consumer end, technology used, etc.).
4. Why is there water loss? The approach is to investigate historical reasons, any local influences such as financial, social and political factors.

A financial benefit cost analysis will also be conducted in order to prioritise implementation of WCDM options.

Major Findings

In the Emalahleni study, the total system losses was estimated at 30.3ML/day (or 11.1 million m^3/a) and the apparent losses were estimated at 6.4ML/day (2.3 million m^3/a) assuming a 10% metering error for Witbank and 5% for the other towns.

Recommendations

The reports focus on the documenting of the findings of situation assessments and make recommendations towards WCDM measures for the studied Municipalities.

Relevance to the study

By identifying volume of losses and where losses are occurring, one can target these areas in order to reduce demands and increase water availability in the system.

2.5.2 Water Conservation and Demand Management Strategy and Business Plan: Lebowakgomo Local Municipality.

Report Title: Olifants Water Management Area: The development of a comprehensive water conservation and water demand management strategy and business plans. Lebowakgomo Local Municipality / Middle Olifants. Department of Water Affairs and Forestry. Prepared by Water for Africa, October 2007.

Purpose

The report relate to the domestic sector water use and water delivery.

The primary objective of the situation assessment reports is to respond to the following key questions:

1. How much water is available and where is it being used? The approach is to capture for every sector, what their sources of supply is, where is the water being used in the production process, what is the value placed on the water, what institutional arrangements are in place to manage its use, what is the level of water use efficiency.
2. How much water is being lost? This is done by conducting a water audit by checking production and consumption, conducting a water balance, and reviewing records, operating procedures and skills for operation and maintenance.
3. Where is the water being lost? The methods used include quantifying the total losses, identifying where the losses are occurring in the water supply chain (i.e. bulk mains, distribution mains, reservoirs, consumer end, technology used, etc.).
4. Why is there water loss? The approach is to investigate historical reasons, any local influences such as financial, social and political factors.

A financial benefit cost analysis will also be conducted in order to prioritise implementation of WCDM options.

Major Findings

In the Lebowakgomo study, the total system losses for the towns studies was estimated at 13.5 ML/day (or 4.9 million m^3/a) of which 1.3ML/d was estimated to be apparent losses (metering inaccuracy; unauthorised billed and unbilled water consumption; and theft of water).

Recommendations

The reports focus on the documenting of the findings of situation assessments and make recommendations towards WCDM measures for the studied Municipalities.

Relevance to the study

By identifying volume of losses and where losses are occurring, one can target these areas in order to reduce demands and increase water availability in the system.

2.5.3 Water Conservation and Demand Management Strategy and Business Plan: Irrigation sector

Report Title: The Development of a Comprehensive Water Conservation and Water Demand Management Strategy and Business Plan for the Olifants and Inkomati WMAs: Irrigation Sector. Project Number 2006-084.

Purpose

The report focuses on the potential for water conservation/demand management (WCDM) in the irrigation agriculture sector in the Olifants and Inkomati Water Management Areas (WMAs). This summary however, only covers the Olifants WMA. The goal of this study was to collect data from WUAs and IBs in the catchments, in order to develop a WMP that would identify the ways and means that WUE can be achieved in the Olifants and Inkomati WMAs, and thus quantify the water savings that could potentially be achieved.

Major Findings

Loskop Irrigation Scheme

In Mpumalanga Province, with a total of 16 117 scheduled hectares of irrigation land, full quota of the scheme is 7 700 m^3 per hectare per year.

The main source of water provision is Loskop Dam with a catchment area in the Highveld. The Scheme consists of a network of concrete lined canals and seven balancing dams. Irrigation systems include centre pivot, drag lines, micro, drip, and travelling gun. Water losses are added as a percentage of the flow and lag times are based on previous experience.

Existing water management problems include algae and water grass. Years of historical data available of water releases into their canal network are available. Water orders from farmers are the main data input which is captured in the WAS database and used to calculate water releases from the Loskop dam. Weather data is also published on their website for use by farmers or consultants that run an irrigation scheduling service.

Lower Blyde River WUA

The main crops cultivated in the area are export citrus and mangoes. All inflows and outflows are measured with accurate meters, and data is collected via telemetry. Existing lawful water use entitlements for 8978.1ha at 9900 m3/ha are registered.

Most of the irrigation systems are micro or drip irrigation with only the sweetcorn being grown under centre pivot and sprinkler irrigation. The scheme is well organised and managed, data collected monthly, fitted with telemetry for remote control and monitoring.

Great Dwars River Irrigation board

An increase in mining activity in the area has lead to essentially no irrigation longer taking place there. In 1936 the IB had 1202 ha of water rights allocated at a quota of 6700 m^3/ha, but most have been converted to mining water. A water bailiff at the dam is paid by the IB to release water, but no clear operating rules for management exist.

The Lower Spekboom River Irrigation Board

No control over the amount of water being diverted into the canal, the flow to the scheme depends on the level of the river. IB never receives any feedback information regarding their water use from DWAF. Farmers perform the annual maintenance on the canal themselves.

The actual irrigated area is estimated at 750 ha, centre pivot irrigation, cropping patterns has changed to maize, soya and wheat. No water control staff working on the scheme. Each farmer controls his own water abstraction through a sluice gate, on-farm storage dams as no direct pumping from the canal is allowed.

Irrigation applied was largely supplemental to the rainfall; farmers did not know what their current water use entitlements were, or what their allocations were in the past. The quality of the water is reported to be very good.

They would like to have access to the data collected by DWAF with the depth sensor. Inflation and higher input costs are also forcing the farmers to improve their farming practices,

Ohrigstad Irrigation Scheme

Irrigation quota for the area are 7000 m3/ha/year, 3000ha are irrigated. There is very strong groundwater. Water is managed to ensure supply to the bottom end of the scheme.

DWAF funded the installation of electromagnetic flow meters at all the pump stations, but farmers would like the scheme to be put under their own control. The area under citrus is currently 500 ha, with drip irrigation and some micro sprinklers. Cash crops include lucern, wheat, and vegetables. Water quality is good.

Central Steelpoort Irrigation scheme

Most of the irrigation land has been bought out by mines for the water rights. There are only two active farmers left, who together irrigate approximately 350 ha. The system consists of earth canals being filled from weirs in the river, but at many places the farmers are now pumping directly from the river. Annual rainfall - 400mm average per year, with high evaporation levels and seepage losses.

Only expense to operate the systems is maintenance and there is no yearly levy. No metering takes place. There are some problems in terms of silt and algae as a result of mining activities. Most of the farmers would prefer to sell their water allocation to the mines and stop farming.

In terms of overall water management issues, there is a lack of control and measuring infrastructure on river distribution systems. Unlined canals which are not well controlled or monitored are also common. No DWAF water control staff is appointed in this WMA. Many IBs have not yet converted to WUAs. Some IBs have stopped paying water resource management (WRM) charges over to DWAF as they have not seen any funds being spent on WRM.

In addition to those issues already mentioned above, there is the issue of water management at the revitalised emerging farmer schemes (the RESIS project). Capacity building will need to be undertaken to ensure the managers of these schemes are adequately skilled to operate within the requirements of the WMA's rules and to implement WCDM measures.

Recommendations

The envisaged outcome of this project is the development of a standard approach to improving WCDM, Steps to be taken to accomplish this are:

- To inform / educate DWAF, CMAs, WUAs and water users on what is the ideal situation at their level that can be achieved
- To illustrate the benefits of improved management to all levels of stakeholders
- To provide information on how improved practices can be implemented.

The top five outputs for the catchment have been selected as:

- Ensure that water allocations promote equitable and optimal utilization of water - Water allocations should be fair, known, clear and secure
- Ensure that sufficient irrigation information is generated and is accessible to all stakeholders - management information must be available so that informed decisions can be made
- Ensure that water is accurately measured and service providers implement audits from the water source to end users and beyond - measurement methods should be standardised as far as possible across the catchment
- Ensure that appropriate measures to influence the reduction in water wastage are implemented - requirement of international obligations that must be met.
- Ensure that the concepts of environmental awareness and protection are promoted and accepted by all stakeholders - reducing the non-beneficial component of water use.

These outputs are to be achieved by the implementation of best management practices (BMPs). The strategy proposes that the following goals must be set to achieve the strategic outputs:

- Improve distribution efficiency
- Improve on farm efficiency
- Promote environmental awareness
- Develop good institutional practices

Relevance to the study

The irrigation sector is the largest water user within the water management area. Therefore, any improvements in efficiency of use within this sector will benefit the whole catchment area.

2.5.4 Water Conservation and Demand Management Strategy and Business Plan: Power Generation

Report Title: The Development of a Comprehensive Water Conservation and Water Demand Management Strategy and Business Plan for the Olifants and Inkomati WMAs: Industrial Component: Power Generation. Situation Assessment. Department of Water Affairs and Forestry. Prepared by VWG Consulting, October 2007.

Purpose

The report is a detailed review of the drivers of water use efficiency in power generation and benchmarking between power stations with respect to these drivers.

Major Findings

Within the Olifants WMA, Eskom operates 8 coal-fired power stations, 6 of which were included in this report. The 6 stations reviewed collectively consume approximately 200 million m^3 of water per annum. Approximately half of this water is transferred into the Olifants from the Inkomati WMA, and the balance is supplied by the Vaal and Usutu water systems.

Kendal, the only dry-cooled power station in the Olifants WMA, consumes approximately 15 times less water per unit sent out than Matla (the best performing wet-cooled station). Water saving initiatives should therefore focus on Eskom's wet-cooled stations: Arnot, Hendrina, Duvha, Kriel and Matla.

Eskom sets water use targets for each power station in the WMA based on historical performance and a detailed analytical model. Only Matla has met/exceeded its target more than once in the past 6 financial years. If each power station on the Olifants WMA had met its target in the 2006/2007 financial year, approximately 25 ML/day of raw water would have been saved.

Recommendations

Report looks at process efficiency of each of the identified power stations and makes recommendations towards improvements.

Relevance to the study

Power generation has very large water requirements, most of which are met via interbasin transfers. This impacts on the yield and requirements within the catchment.

2.5.5 National Invasive Alien Plants Survey Study

Report Title: National Invasive Alien Plant Survey. Project No.: GW/A/2009/76 and GW51/050. Agricultural Research Council. Prepared by the Institute for Soil, Climate and Water.

Purpose

The main objectives of the study are the following:

- To update the CSIR map on Invasive Alien Plant (IAP) range and abundance,
- Review methodologies used to map IAP species.

The study is for the Working for Water Programme within the DWA. Results from the study are only expected at the end of March 2010.

Relevance to the study

The study outputs are of interest as information on AIP area is out dated in the Olifants. The progress of the study will be tracked as information should become available within the time frames for this project.

2.6 Studies on System Operating Rules

There are two operating rule studies in the Olifants catchment which have been conducted by the Directorate of Water Resource Planning Systems of the DWA. They are the Western Highveld Region Water Augmentation Prefeasibility Study and the Blyde River Systems: Development of Operating Rules Study. The latter study is currently being updated with an Integrated Model that will be utilised for the Blyde River System and also later for the remaining Olifants River System.

The study to develop operating rules on the Blyde River resulted in the setting up of the Water Resources Planning Model (WRPM) which is a decision support system to advise system operators when to impose restrictions, based on the state of storage in the dam. The intention is to run the WRPM model once a year in May from which a decision can be made as to the level of restriction to be imposed on the various user sectors supplied from the dam.

There is only one recently completed study on System Operating Rules, and this relates only to the Blyde River catchment. It is understood that a study into the operating rules of the remainder of the Olifants River System is in progress but no reports are available from this study as yet.

The updated study with an integrated model for both the Blyde River System and the Remaining Olifants River system will initially only cover and focus on the Blyde System operating rule and it is the intention to later expand the scope of the study to include other sub systems and dam operating rules as well. The modelling tool will then assist with the efficient operation of the major dams in the system, namely, the Bronkhorstspruit, Witbank, Middelburg, Loskop and Flag Boshielo Dams.

The intention of the completed Blyde River study was to develop operating rules for Blyderivierspoort and Ohrigstad Dams. The updated study will update those operating rules based on a further investigation into the losses in the Blyde River as well as the impact that the Olifants incremental runoff has on the Blyde demands. The Operating Rules for the Olifants River system and Integration of the Operating Rules to determine the optimal configuration of water resources developments within the Olifants River catchment will then follow as a further phase.

2.6.1 Development of Operating Rules for the Blyde River System

Report Title: Development of Operating Rules for the Blyde River System: Development of Operating Rules. Report No. P NMA 02/000/00/0305. Department of Water Affairs and Forestry. Prepared by WRP. May 2006.

Purpose

The main objective of this study was to develop the annual systems operating rules, which will be applied to regulate the systems' water availability so that their distribution can be reconciled with the water demand patterns for the Blyderivierpoort and Ohrigstad Dams on the system.

Major Findings

The yield results from the historic firm yield runs and stochastic firm yield runs undertaken using the WRYM are summarised in **Table 2.7.**

Table 2.7: Sub-system summary of yield characteristics

Sub-system	2005 Demand (million m^3/a)	Historic Firm Yield recurrence interval (1:200 year)	Long-term Stochastic firm Yield at indicated recurrence intervals (million m^3/a)				
			1:10 year	1:20 year	1:50 year	1:100 year	1:20 0
Ohrigstad	24.7	19.8	22.0	21.8	20.7	20.0	19.8
Blyderivierpoort	150.3	142.8	157.3	157.0	150.0	146.5	143.5

The result of the yield analyses are summarised as follows:

- The Ohrigstad sub-system is overallocated.
- The yield from the Blyderivierpoort Dam shows that there is available yield at 90 % (1:10) assurance of supply.
- The HFY from Blyderivierpoort Dam drops to 60 million m^3/a when the IFR from the Olifants River Environmental Water Requirements Assessment Study is placed on the Blyde system. The IFR was not used, instead a constant ecological release of 10 million m^3/a was placed on the Blydepoort Dam.

Recommendations

Using the yield characteristics obtained from the WRYM, the WRPM was used to develop the operating rules for the system at the required level of assurance. The user category and priority classifications were determined and agreed upon for the Blyde system are provided in **Table 2.8.**

Table 2.8: User category and priority classification used in the Blyde System

System and User Category	Priority Classification (%)			
	Low (90% assurance) (1:10 year)	Medium Low (95% assurance) (1:20 year)	Medium High (98% assurance) (1:50 year)	High (99.5% assurance) (1:200 Year)
Ecological Release	0	0	0	100
Irrigation	30	30	30	10
Losses	0	0	0	100
Domestic	5	15	30	50
Mining / Industrial	5	5	10	80

There are two main recommendations from the Operating Rules Study for the Blyde system:

1) To supply the Ohrigstad sub-system users at their required assurance the total demand allocated needs to be reduced. This will require a re-assessment of the irrigation quota in the Ohrigstad scheme or the acceptance by irrigators of reduced assurance of supply.
2) Recommended that the total Olifants River System including the Blyde River System be integrated and simulated as one combined system in order to better determine the various contributions to the Phalaborwa demands.

Relevance to the study

The operating rules are applicable to the catchment area.

2.6.2 Development of Operating Rules for the Blyde and Olifants River Systems Study: Hydrodynamic model: Activity 1: Conceptual Model

Report Title: Development of Operating Rules for the Integration of the Blyde River and Olifants River systems: Task 7: Hydrodynamic model: Activity 1: Conceptual Model. Report No. WRP2006-090. Department of Water Affairs and Forestry. Prepared by WRP. February 2007.

Purpose

The objective of this activity is to propose a conceptual framework to determine loss dependant variables for use within the WRPM using Hydrodynamic modelling.

Recommendations

The following recommendations have been proposed:

- River loss variables can be determined through a combination of water balancing, hydrodynamic modelling and monitoring.

- To do this the Blyde River system must be divided into 3 distinct sections.
- Provide relevant flow logging equipment at flow gauges and perform temporary gauging to add to and supplement flow records.
- Calibrate the hydrodynamic model at high flows to reduce and overcome the effects of river losses.

Relevance to the study

Subsequent stages of this activity and the Operating Rules study should be tracked as the results are likely to provide useful information to the reconciliation study.

2.7 Studies on Water Quality

2.7.1 Olifants River Water Resources Development Project: Environmental Impact Assessment – Water Quality Assessment

Report Title: Olifants River Water Resources Development Project: Environmental Impact Assessment –Water Quality Assessment. Report no. P WMA 04/B50/00/3104. Department of Water Affairs and Forestry. Prepared by CSIR Environmentek. March 2005

Purpose

This specialist report deals with the anticipated water quality impacts of the De Hoop Dam and the evaluation of impacts related to the construction, maintenance and decommissioning of the dam, associated pipelines and realignment of a section of the R555 national road.

Major Findings

Water resources in the Olifants River are stressed, with water requirements for mining, agricultural and domestic supplies exceeding the current supply. Mean annual evaporation ranges from 1300 mm in the east (Lydenburg) to 1700 mm at the De Hoop Dam site in the west (Janse van Vuuren, et al., 2003). The ecological Reserve study indicates that the Steelpoort River is considered to be in a fair state for water quality. There are significant increases in total dissolved salts in the downstream areas of the river, which can be attributed to mining activities, irrigation and land use practices. There are concerns about heavy metal contamination from chromium and vanadium high mining in the catchment. The existing mines use mainly public and borehole water. Vast expansion of mining activity is expected in this area.

During low flow months, high TDS concentrations were recorded in the downstream end of the Steelpoort River. Nutrients were slightly elevated, probably as a result of treated domestic effluent from Burgersfort. Erosion and sedimentation have led to a reduction of available habitat, thereby reducing abundance, diversity and size class of fish. Turbidity and sedimentation also have affected invertebrates.

Recommendations

It is important that monitoring starts as soon as possible to establish baseline data. A dual monitoring programme should be established before construction of the dam starts. The programme should include physical attributes (Na, Mg, Ca, Cl, SO_4, NO_2, NO_3, NH_4, PO_4 and suspended solids). A permanent monitoring programme should be established as part of DWA's routine programme.

Relevance to this Study

The water quality component provides essential information in terms of understanding the water uses and users and their specific requirements and impacts on the water resources of the Olifants Water Management Area. The status of the water quality will be critical when determining fitness for use and in the assessment and development of a reconciliation strategy since it will be used for the substantiation of RWQO and will influence water supply aspects.

2.7.2 Assessment of Water Availability in the Olifants WMA by means of Water Resource Related Models: Water Quality Situation Assessment Analysis

Report Title: Assessment of Water Availability in the Olifants WMA by means of Water Resource Related Models: Water Quality Situation Assessment Analysis. Report no. P WMA 04/B50/00/5607. Department of Water Affairs and Forestry. Prepared by SSI and Africon (now Áurecon) in association with Knight Piesold, Sigodi Marah Martin and Umfula Wempilo. September 2008

Purpose

To provide general modelling and water resource evaluation services for allocable water quantification and to support integrated water resource planning for the Olifants Water Management Area (WMA). The report aims to characterise the water quality of the Lower Olifants WMA, by graphically representing key monitoring stations with their 50th percentile (P50) of certain problematic chemicals over space and over time.

Major Findings

Saline input: The water entering the main stem of the Olifants River via Flag Boshielo Dam is already salinised, with the exceedance of the Target Water Quality Range for TDS for more than 50% of the time.

Rooipoort Dam: The Total Water Quality Requirement for salinity is exceeded more than three-fold for 50% of the time at Zeekoegat, the site of the planned Rooipoort Dam, with even higher peak concentrations. This is a particular concern for the intended irrigation use.

Ga-Selati River: Extremely high salinity in the lower Ga-Selati River renders the water unfit for domestic and irrigation use. This threatens the sensitive environment of the Kruger National Park and the associated tourism industry.

Catchment development: Upstream and local mining, industrial, irrigation, urban and infrastructure development is expected to continue to degrade water quality of the lower Olifants River.

De Hoop Dam: is expected to have acceptable water quality. But it will reduce the diluting effect of runoff to the downstream Steelpoort and Olifants River system.

Transboundary flows: Development and water allocation in the Olifants catchment will affect the salinity of the runoff into Mozambique, especially at Massingir Dam.

Monitoring deficiencies: The cessation of critical water quality monitoring at Zeekoegat from 1989 has left a very serious gap in the data, given the high salinity at this point and the plans to build Rooipoort Dam.

Recommendations

- Water quality modelling: System based hydro-salinity modelling is required to address the issues discussed above. As a first step the WQT model needs to be calibrated for the Olifants River system. The second step is use of the WRYM to evaluate options. This should be followed by analysis of the implications for individual problem ions and combinations thereof, such as sodium, calcium, magnesium, chloride, and the SAR.
- Monitoring improvements: It is essential to restore monitoring at lapsed stations to fill critical information gaps. The lack of key data is particularly evident at the Rooipoort Dam site. The entire monitoring programme should be reviewed; including identification of sites where concurrent flow gauging and water quality sampling is required. The Mozambique authorities Lower Olifants Water Quality Study should be encouraged to sample water quality in Massingir Dam and at key downstream points to support joint modelling studies.
- Erosion control and sediment management: Immediate steps are required to curb the erosion of valuable land. Particular care is required in the design of river structures and operating procedures to exclude and pass silt.

Relevance to this study

The report provides an excellent overview of water quality in the catchment. However, the approach to assessing the fitness for use of the water with respect to water quality has recently changed. As long as the data can be obtained (preferably as an Excel spreadsheet) this can be used to determine the water quality of the catchment in terms of the revised water quality resource objectives.

2.7.3 Integrated Water Resource Management Plan for the Upper and Middle Olifants Catchment

Report Title: Integrated Water Resource Management Plan for the Upper and Middle Olifants Catchment. Report no. P WMA 04/000/00/7007. Department of Water Affairs and Forestry in association with Water Resource Planning. Prepared by Golder Associates . July 2009.

Purpose

To present the Integrated Water Resource Management Plan for the study area. The report is regarded as an interim report, until the modelling of the Middle Olifants area is completed and the model of the study area.

Major findings

The current water quality situation is that there are acid conditions in the Klipspruit and Kromdraaispruit catchments due to failed neutralisation plants. The sulphate concentrations exceed the Resource Water Quality Objectives (RWQO) in a number of catchments. The TDS and sulphate concentrations in the Witbank, Middelburg and Loskop Dams have been increasing since 1970. Sulphate load will have to be removed from the system to arrest the increase. This will involve the management of the sources of pollution which include decants and seepages from defunct mines, seepages from waste facilities located next to streams and spills from polluted water management systems.

The sources are not only mines but power stations and industries. The trophic status of the rivers and dams are mesotrophic. Four of the 5 major WWTP discharge into streams which report directly into the upper end of the Loskop Dam. This has resulted in eutrophic conditions in the dam with periodic blue green algae blooms.

Many of the mines are filling with water and have reached a stage where they are generating excess water that needs to be managed. This excess mine water is in excess of the contribution that would be made naturally by the mined catchment area. Mine water treatment and reclamation is being pursued by a number of mines using desalination technologies to treat mine water to potable standards. The Emalahleni Mine Water Reclamation Plant (MWRP) is operational and the Optimum MWRP is under construction.

The reconciliation situation assessment showed that the water supply from Witbank and Middelburg Dams to Emalahleni and Steve Tshwete Local Municipality (LM) requires immediate augmentation. The water requirements of Steve Tshwete LM will exceed the 50 year yield of the dam by 2012. In the case of Emalahleni LM, the current water requirements exceed the 50 year yield of Witbank Dam and the supply from the Emalahleni MWRP. The water reconciliation situation in the Western Highveld Region is in balance due to the supply from Rand Water. However to maintain the balance, the water supply infrastructure constraints and the reduction in water requirements due to water conservation and demand management (WCDM) will have to be realised. The Loskop Dam is able to meet the requirements of the irrigators and the small towns at an adequate assurance of supply.

Water Quality Management Strategy

The key elements of the water quality management strategy are the setting of the RWQO; source based salinity and nutrient management as well as bolstering of management resources and information systems. The RWQO were determined based on the current set of RWQO in the Witbank, Klipspruit and Middelburg Dam catchments modified to account for the available water quality component of the ecological Reserve. The current ecological Reserve for salinity water quality variables was developed using outdated methodology. Where RWQO were not set, the South African Water Quality Guidelines together with the present water quality status were used to determine RWQO.

The set of RWQO determined in the study are interim RWQO that will be reviewed in 5 years time once the water quality component of the ecological Reserve has been updated. The management of salinity involves the reduction of loads into the system. The strategy has been divided into the management of the defunct and operational mines. The defunct mine strategy involves refurbishing the Brugspruit neutralisation plant and collection system which will address the acidity issue. A committee needs to be set up to develop a defunct mine strategy which prioritises and looks for synergies with operating mines to manage the decants.

The required reductions in load from the operational mines, power stations and industries will be achieved by source management through audits, Integrated Waste and Water Management Plans, Water Use Licensing, compliance monitoring and reporting. The waste discharge charge will also be implemented to ensure that the source reductions are achieved and that money is raised to fund an appropriate institutional structure to manage water quality. The nutrient management strategy involves the upgrading of the 5 major WWTP and sanitation systems as well as revising the phosphate discharge standard to 1 mg/L for the major works. The smaller WWTP must be audited to ensure that the plant performance is aligned with the technology installed.

Reconciliation Strategy

The application of the yield model to investigate the further development of surface water resources showed that the construction of additional dams did not increase the yield of the system of dams in the study area. The yield was merely transferred from the downstream dams to the upstream dams. This highlights the need for the development of an integrated reconciliation strategy for the entire catchment. The immediate concerns are the augmentation of the water supply to Steve Tshwete and Emalahleni LM.

The use of excess mine water was investigated. The available volumes of mine water were determined over time and compared to the water requirement projections. The findings are that there is sufficient mine water available however the water will require treatment and the process of allocating the water will need management. The other actions that will be implemented to assist with reaching reconciliation are the elimination of the unlawful water use, ongoing application of the catchment modelling systems, trading of water rights and the development of groundwater for supply to rural areas.

Recommendations

The Department’s Regional Office is currently responsible for the management of the water resource. The office is under stress with a high staff turnover. The study area needs strong, proactive management by a well staffed institution. Staffing requirements for such an institution were proposed with an estimate of the budget requirements. Further to the management institution, an institutional structure was proposed which includes the establishment of a Catchment Management Committee (CMC) which will oversee and co-ordinate the activities in the catchment. One of the major roles of the CMC will be to implement the strategy.

The CMC will be supported by the management/regulatory authority which could be the Regional Office of DWA or the Catchment Management Agency (CMA). There are a number of committees which are focused on specific management actions. The Mining and Industry Water Action Committee (MINWAC) will address licensing, controlled release, status of mine water, defunct mine strategy, compliance and implementation of commitments. The Municipal Managers Forum will deal with matters related to the municipalities which includes water requirement projections and WWTP and sanitation system upgrades. The mine water companies set up to treat the mine water will be represented as they play an important role in the co-ordination of the use of the mine water. The DWA is currently busy with an initiative to set up Water User Associations (WUA) across the catchment to represent the interests of the water users at the local catchment level.

The process of setting up the Olifants River CMA has stalled since the public participation process and proposal was prepared in 2001. The original proposal prepared by the Department divided the Olifants WMA into five areas, each with a Catchment Management Committee (CMC) to manage the water resources in that area. The study area falls into two of the original areas proposed viz the Upper and the Upper Middle areas. An institutional structure is therefore proposed for this area which fits in with the CMA proposal and the current initiatives in the catchment.

The institutional framework is the key to the success of the strategy. An institutional structure incorporates the WUA that are currently being set up in the Olifants WMA and provides committees to manage the immediate issues facing the study area. The functions of the committees are discussed below. A CMC must be established for the study area. The mandate of the CMC will be to assist the Department in managing the water resources in the study area according to the strategy set out in this report and to ensure that the strategy is implemented and updated.

The CMC has the Municipal Managers Forum, MINWAC, WUA and the mine water companies represented on the CMC. The WUA will be responsible for co-ordination of activities in the different ports of the study area. The constitutions or charters for the WUA will define their functions and responsibilities which will vary between the different WUAs. The WUAs will be represented on the Catchment Management Committee (CMC). The Mining and Industrial Water Action Committee (MINWAC) should be established based on the existing controlled release committee.

Relevance to the Study

Any strategy which is developed will need to be implemented by an existing or planned institution. In the long term the intent of the NWA and the NWRS is that CMA's will have the delegated powers to implement strategies and ensure regulatory compliance. In the absence of a CMA, the information in this report provides a good indication of the types of institutional arrangements which need to be taken into account when developing the strategy as part of this project.

2.8 Existing Strategies and Plans

2.8.1 The development of an Integrated Water Resources Management Plan for the Upper and Middle Olifants Catchment: Hydrology Report

Report Title: The Development of an Integrated Water Resources Management Plan for the Upper and Middle Olifants catchment: Hydrology Report. Report No. P WMA 04/000/00/6407. Department of Water Affairs and Forestry. Prepared by WRP. November 2008.

Purpose

The Hydrology Report is one of a suite of reports for this study. The hydrology task involved the re-calibration of the WRSM2000 model for the Loskop Dam catchment. This was done by extending the hydrology and recalibrating the WRSM2000 model, to extend the calibration period a further 8 years.

Major Findings

The updated hydrology covers the period 1920 to 2004 and is an improvement on previous hydrology in that activities such as groundwater abstractions and mining were taken into account which became possible due to improvements in the WRSM2000 hydrology model. Improved algorithms relating to stream flow reduction due to afforestation and alien vegetation also improved the hydrology of the study area.

Naturalised incremental hydrology was produced for so-called Management Units which are catchments consisting of quaternary or sub-quaternary catchments.

The study produced extended and improved hydrology for the Upper and Middle Olifants River catchment. The natural MAR for the study area as a whole increased by about 7% but the main change is in the distribution of flow. This latest study obtained much higher natural runoff in the upper reaches of the catchment with reduced incremental runoff in the lower reaches. **Table 2.9** summarises the Hydrology statistics of the IWRMP study with previous studies.

Relevance to the study

The importance of this Hydrology study to the development of a reconciliation strategy is that it provided the building blocks upon which the yield assessment was carried out. It should be necessary to reference this work directly as its output is encapsulated in the yield models (WRYM and WRPM).

2.8.2 The development of an Integrated Water Resources Management Plan for the Upper and Middle Olifants Catchment: Systems Analysis

Report Title: The Development of an Integrated Water Resources Management Plan for the Upper and Middle Olifants catchment: Systems Analysis Draft Report. Report No. P WMA 04/000/00/6907. Department of Water Affairs and Forestry. Prepared by WRP. 2008.

Purpose

The Systems Analysis Report is one of a suite of reports for this study. The report describes the processes of setting up the WRYM and determining the System yield and the generation of short term yield curves for the Loskop Dam catchment. Information from WRYM will be used to update the Water Resources Planning Model (WRPM). The WRPM is the main component of the modelling system that will be used to manage and integrate the water resources of the Olifants WMA. This part of the Systems Analysis Task is not complete (pers. comm., WRP, 2010) which means a final version of this report is outstanding.

Table 2.9: Updated Hydrology Statistics Compared with Previous Studies

Gauge	Location	Record Period	Mean annual Runoff (million m^3/a)		% Difference
			This study	Other Studies	
B1R001	Olifants River at Witbank Dam	1920-1991+	157.36	124.20	26.70
		1920-1989*	158.12	124.90	26.60
		1920-1995#	160.44	126.80	26.53
		1920-2004	164.05		
B1H005	Olifants River at Wolwekrans	1920-1989*	142.42	111.70	27.50
		1920-1995#	144.52	115.42	25.21
		1920-2004	147.94		
B1H018	Olifants River at Middelkraal	1920-1989*	44.23	36.80	20.19
		1920-1995#	44.79		
		1920-2004	45.73		
B1H017	Steenkoolspruit at Aangewys	1920-1989	19.12	12.80	49.38
		1920-1995#	19.40		
		1920-2004	19.85		
B1H019	Noupoortspruit at Nauwpoort	1920-1989	4.24		
		1920-1995#	4.32	2.98	44.97
		1920-2004	4.28		
B1H002	Spookspruit at Elandspruit	1920-1989*	10.96	8.90	23.15
		1920-1995#	11.21	8.30	35.06
		1920-2004	11.35		
B1H004	Klipspruit at Zaaihoek	1920-1989*	20.28	17.40	16.55
		1920-1995#	21.28	21.00	1.33
		1920-2004	22.25		
B1R002	Klein Olifants River at Middelburg Dam	1920-1991+	49.65	41.90	18.50
		1920-1989*	50.03	44.90	11.43
		1920-1995#	50.94	41.20	23.64
		1920-2004	53.52		
B2R001	Bronkhorstspruit at Bronkhorstspruit Dam	1920-1991+	51.84	49.20	5.37
		1920-1989*	52.48	47.40	10.72
		1920-1995#	54.06	55.30	-2.24
		1920-2004	56.40		
B2H014	Wilge River at Onverwacht	1920-1989*	39.75	37.80	5.16
		1920-1995#	42.87	48.21	-11.08
		1920-2004#	45.78		
B3R002	Olifants River at Loskop Dam (incremental catchment)	1920-1991+	207.80	245.80	-15.46
		1920-1989*	208.94	222.30	-6.01
		1920-1995#	226.18	237.30	-4.69
		1920-2004	224.92		
Total	**Total Olifants River catchment u/s of Loskop Dam**	**1920-1991+**	**498.00**	**461.00**	**8.03**
		1920-1989*	**500.80**	**466.00**	**7.47**
		1920-1995#	**524.11**	**490.00**	**6.96**
		1920-2004	**532.50**		

Notes: # - 'Development of an Integrated Water Resources Model for the Upper Olifants River Catchment' Study
+ - DWAF Report B500/00/1595 – Olifants-Sand Transfer Scheme
* - Surface Water Resources of South Africa, 1990 (Volume 1)

Major Findings

Yield results in the report are based on two types of analyses. Historic yield analyses were undertaken by analyzing the WRYM system based on the time-series of monthly historical natural incremental runoff volumes. These analyses provide the historical firm yields (HFY) for the system for the various scenarios considered. The HFY is the highest annual target draft that can be supplied by the system without causing a failure. **Table 2.10** presents the HFY analyses results for various scenarios.

Table 2.10: Historic Firm Yield Results for Various Scenarios (all in million m^3/a)

Dam	Previous study yield	1.A.1 (Base 1)	1.A.2 (EWR)	1.B.1 (Part court order)	2A (no AIPs)	2B (no unlawful irr)	3.B (raised Loskop)
Witbank	35.2	37.6	23	29.5	22.3	23.9	21.9
Middelburg	18.8	14.2	9.2	12.6	12.7	13.8	12.6
Bronkhorstspruit[1]	16.4	16.9	8.8	16.9	17.2	18.7	16.9
Premier mine	6.4	6.7	0.003	6.7	6.7	9.3	6.7
Loskop	138.1	136.9	100.9	153.6	162.7	167.4	176.6
	214.9	**212.3**	**141.903**	**219.3**	**221.6**	**233.1**	**234.7**

Notes:
1. **A.1 : Base Scenarios:** Current day conditions
2. **A.2 : EWR:** Includes the ecological flow requirements met as the highest priority user.
3. **B.1 : Part Court Order:** Include Court Orders which require releases from some of the dams
4. **2A : No AIPs:** Remove Alien Vegetation
5. **2B : No unlawful Irrigation:** Remove unlawful irrigation
6. **3B : Raised Loskop Dam**

The HFY analyses are supported by a long-term stochastic yield analyses. The results of the long-term stochastic yield results for selected scenarios are presented in **Table 2.11.**

Table 2.11: Long Term Stochastic Yield Results (all in million m^3/a)

	1.B.1 Part court order no EWR				3.B Raised Loskop			
Dam	**1:200**	**1:100**	**1:50**	**1:20**	**1:200**	**1:100**	**1:50**	**1:20**
Witbank	26.36	28.1	33	39.75	26.36	28.1	33	39.75
Middelburg	11.38	12.57	13.98	16.06	11.38	12.57	13.98	16.06
Bronkhorstspruit [1]	20.71	22.01	23.52	26.62	20.71	22.01	23.52	26.62
Loskop	142.3	153.1	167.6	193.0	154.9	165.3	183.3	200.9

Note: (1) Yield channel downstream of dam

Short term yield-reliability characteristic curves (YRC's) were developed for the WRPM for the Witbank, Middelburg, Bronkhorstspruit and Loskop Dams using the WRYM. This was undertaken based on 501 5-year stochastically generated streamflow sequences. A summary of the characteristics of short term yield-reliability curves are shown for the various dams in **Table 2.12.** The short term yield-reliability characteristics will be incorporated into the WRPM system configuration for the Upper and Middle Olifants catchments.

Table 2.12: Short Term Characteristics for Reservoirs in the Upper Olifants

		Yield million m³/annual at indicated RI (3)				
Starting storage (as % of live FSC(1))	**Selected period length (years) (2)**	**1:200**	**1:100**	**1:50**	**1:20**	**1:10**
Witbank Dam						
100%	5	30.35	33.25	37.25	45.5	54.8
80%	4	25.6	28.75	33	42	50.5
60%	4	23.45	26.95	31.25	39	48
40%	4	18.35	21.1	24.25	31.5	42
20%	3	13.1	13.7	15.75	19.5	26.25
10%	2	7.44	7.85	8.4	10.5	14.5
Long term yield (4)		**26.36**	**28.1**	**33**	**39.75**	
Middelburg Dam						
100%	5	14.55	15.2	16.75	19.5	22.5
80%	5	12.55	13.4	14.75	17.7	20.8
60%	4	10.95	11.85	12.85	15.5	18.8
40%	4	8.63	9.55	10.25	12.5	15.5
20%	3	6.23	6.55	7.2	8.25	9.85
10%	2	4.58	4.75	5.15	5.7	6.75
Long term yield		**11.38**	**12.57**	**13.98**	**16.06**	
Bronkhorstspruit Dam						
100%	5	23.5	25.25	27.00	31.5	35.00
80%	5	21.75	23.25	25.25	31.2	33.50
60%	5	19.65	20.45	22.75	27.00	31.00
40%	4	16.70	17.60	19.6	22.5	26.50
20%	2	12.10	12.90	14.25	16.5	19.50
10%	2	8.85	9.55	10.7	12.25	14.50
Long term yield		**20.71**	**22.01**	**23.52**	**26.62**	
Loskop Dam						
100%	5	169.08	181.11	195.82	220.54	260.64
80%	5	156.4	164.4	180.5	210.52	243.27
60%	5	134.33	145.02	157.7	187.1	220.54
40%	4	114.28	121.63	135	157.7	182.45
20%	3	84.21	91.5	100	118.96	135.6
10%	2	65.50	71.51	78.19	90.89	101.58
Long term yield		**142.26**	**153.13**	**167.61**	**192.96**	

Note: (1) Live full supply capacity (FSC) of Dam.
(2) Selected period length, from 1 to 5 years, that provides most conservative result.
(3) Recurrence interval of failure, in years
(4) From WRYM analysis, based on Scenario 1.B.1.

Relevance to the study

The results from the draft report provide yield information for the upper catchment area.

2.8.3 Western Highveld Region Water Augmentation Pre-feasibility Study: Water Resources

Report Title: Western Highveld Region Water Augmentation Pre-feasibility Study: Water Resources. Report No. PB B310/00/1803. Department of Water Affairs and Forestry. Prepared by Kwezi V3, Bigen & PDNA. September, 2005.

Purpose

This study was initiated due to the low storage conditions experienced in the Bronkhorstspruit and Wilge Dams in the summer of 2003. Many of the goals of the study were overtaken as an emergency scheme was implemented by Randwater to extend the water supply infrastructure from Mamelodi to Cullinan and Ekandustria. Thus detailed investigation of augmentation options were no longer required. The focus changed to a water resource assessment.

Major Findings

The Western Highveld Region consists of two catchments namely the Wilge (B20) and Elands River (B32) catchments. The water resources assessment of these catchments is based on hydrology for the period 1920 to 1996.

Relevance to the study

The results of the assessment has been overtaken by more recent studies such as the Development of an Integrated Water Resources Management Plan for the Upper and Middle Olifants Catchment and Assessment of Water Availability in the Olifants WMA by means of Water Resources related Models. Both studies updated the hydrology for the Olifants WMA to 2004 (September 2005), and have been discussed in this report.

2.8.4 Olifants Water Management Area: Internal Strategic Perspective (ISP)

Report Title: Olifants Water Management Area: Internal Strategic Perspective. Report no. P WMA 04/000/00/0304. Department of Water Affairs and Forestry. Prepared by GMKS, Tlou and Matji and WMB. February 2004

Purpose

The purpose of the ISP is to document the DWAF's corporate perspectives on how the water resources should be managed and to offer sound motivation to demonstrate proper and reasonable governance. The ISP presents a common and consistent Departmental approach to guide officials when addressing water management related queries and evaluating water licence applications and represents DWAF' s view on how Integrated Water Resource Management (IWRM) should be practised in this WMA.

Major Findings

The water requirements in the Upper Olifants Sub-area are projected to grow in the urban areas of Witbank and Middelburg. Substantial growth has been projected for the Witbank area. The basis for these projections needs to be reviewed as the projections have a significant impact on the timing and planning of augmentation for the sub-area.

The growth in the water requirements in the Middle Olifants Sub-area is largely due to the new mining operations being established in the Dilokong Corridor. The extent of the mining operations and the projected growth in water requirements as regards the influx of people to the area is not fully known. There are a number of irrigation schemes in this area that have fallen in to disuse. The schemes are being revived as poverty eradication initiatives and the use of water on the schemes will grow steadily back to their water allocations as the schemes come back on line.

The water requirements in the Burgersfort area of the Steelpoort Sub-area are growing due to the influx of people being housed in the town. The extent of the growth is being determined as part of a water requirement study which covers the Middle Olifants and Steelpoort Sub-areas. Like the Middle Olifants Sub-area, there are irrigation schemes that have fallen into disuse. Plans are being implemented to revive these schemes as part of poverty eradication initiatives.

The water requirements in the Lower Olifants Sub-area are not foreseen to grow significantly. The water requirements in the Phalaborwa area are likely to drop with the implementation of treatment and the recycling of water by Foskor and the advent of underground mining by Phalaborwa Mining Company. The water requirements in this area need to be confirmed.

Recommendations

With water playing a pivotal, role the DWA is striving to ensure that Integrated Water Resource Management becomes an entrenched approach in management options. 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.

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.
- 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.

Relevance to the Study

The ISP is intended to provide a strategic framework specific to the WMA and provides the fundamental management philosophy for effective water resource management. This background will be critical in providing a comprehensive overview and a point of departure. This study will update the information in the report and also go into more detail.

2.8.5 Environmental Management Framework for the Olifants and Letaba Rivers Catchment Area: Environmental Management Framework

Report Title: Environmental Management Framework for the Olifants and Letaba Rivers Catchment Area: Environmental Management Framework. Prepared by Environmonics Environmental Consultants. December 2009.

Purpose

The purpose of this EMF is to develop a framework that will integrate policies and frameworks, and align different government mandates in a way that will streamline decision-making to improve cooperative governance and guide future development in an environmentally responsible manner.

Major Findings

The issues related to the geology and topography include:

- the lack of faults on the Highveld area around Middelburg and Witbank means the formation of smaller rivers which form the headwaters of the Olifants River and related wetlands. For this same reason, the higher quality coal deposits are found in this area;
- the geological formations created protected areas, which affected certain vegetation types or isolated them, forming the basis for centres of endemism;

- erosion is more likely to be a problem in areas containing more clay based soils such as the Sekhukhune area, than areas that have sand based soils; and
  - land formations may form the basis of areas with scenic value, such as areas in the escarpment, which may contribute to the ecotourism sector.

Issues related to water quality of the EMF area are listed as follows:

- the impact of climate change is uncertain and it is likely that the seasonal variations as well as variations between wet and dry periods may also become more pronounced and severe;
- most rural communities in the area, more than two million people, depend on groundwater resources for their basic water needs;
- on the Springbok Flats, ground water resources are also used for irrigation farming;
- surface water is relatively unusable in rivers and streams, it has to be dammed to make it useful;
- dams do not increase the volume of water in the system but allows for the storage and the distribution management of water as well as the evening out of supply between seasons and to a certain extent also between wet and dry periods;
- the ecological Reserve requirements of the EMF area as a whole and of most rivers and streams that constitute it are not being met and any further allocation of water must come from the redistribution of existing water allocations;
- one method of increasing the volume of available water is to import water from external sources, but this will prove very costly and will have to be taken into account fully in the valuation of projected future economic contributions of the various sectors as well as in the determination of the viability of proposed activities in the area;

Biological issues relating to Olifants River Catchment Area include:

- The Steelpoort River is in a fair to unacceptable ecological state;
- overgrazing, and dryland cultivation throughout the area surrounding the Spekboom, Steelpoort, Beetgekraal, and Waterval Rivers including within the riparian zone, leads to erosion, which causes high silt levels in the rivers;

- high silt levels in the aforementioned rivers, increases the risk of flooding and leads to the smothering of in-stream habitats and fish gills resulting in loss of invertebrate and fish species;
- runoff from mines and other activities lowers the water quality in the Steelpoort River;
- on the Olifants River the riparian vegetation is overgrazed and over utilised. As a result, riverbanks are collapsing due to erosion and sedimentation occurs in the riverbed;
- downstream of the Rust de Winter Dam, on the Elands River, flow is extremely regulated with very infrequent releases which has a severe impact on in-stream biota because the river is often dry;
- artificial flow regimes in the Elands River caused by ecologically insensitive releases of water from the Rhenosterkop Dam change the riverbed, causes erosion and results in undesirable habitat conditions for in-stream biological communities;
- the Olifants River, upstream of the Flag Boshielo Dam, is impacted by agricultural activities, runoff from commercial agricultural areas contains agro-chemicals, which cause eutrophication or contamination of water, either of which can impair the health of invertebrates and fish;
- riparian vegetation on both the Elands River and the Olifants River is in a very degraded state due to overgrazing and over utilization and as a result, riverbanks are collapsing due to erosion, and sedimentation occurs in the riverbed;
- mining, predominantly for coal, and other industrial activities around the Wilge, Bronkhorstspruit, Klein Olifants and Olifants Rivers are the main contributors to poor in-stream and riparian habitat conditions where acid leachate from mines is a primary contributor to poor water quality and instream conditions;
- in some parts around the above mentioned rivers, access roads, mostly related to mining and industrial activities, have resulted in severe disturbance of riparian habitats, and increased erosion of both land and riverbed;
- the riparian vegetation around the Wilge, Bronkhorstspruit, Klein Olifants and Olifants Rivers is under pressure from overgrazing in some parts, and alien plants such as wattles that occur within the riparian zone, competing with indigenous vegetation and reducing available water;
- water quality in the Olifants River is negatively impacted by the high acidity and high concentrations of dissolved salts in some of the tributaries, especially the Klip River;

Recommendations

Water allocation in this zone may not have a further negative impact on the ecological Reserve of any part of the river system in the EMF area. Additional water allocations must come from savings from existing allocations that are reallocated. The methods of achieving the savings and facilitating the transfers must be negotiated until DWA develops a policy in this regard. Illegal use of water must be investigated, followed up and the perpetrators should be prosecuted.

Water users must ensure that water that is released back into the system from their activities and comply with the relevant quality standards. It is their responsibility to find out what standards are applicable to them. Water release quality standards must be applied strictly and transgressors should be prosecuted. Municipalities should be capacitated (personnel and funding) to upgrade and manage sewage works to acceptable standards. Municipalities that fail to manage waste water treatment works effectively should be prosecuted.

Conservation and associated tourism is the preferred land-use in the area and any other land-use that is allowed should not have significant detrimental long term impact on the conservation land-use focus.

Relevance to the Study

The EMF identifies environmentally sensitive zones in which the development of infrastructure would potentially have significant impacts.

It further suggests that water allocation in the catchment may not have a further negative impact on the ecological Reserve of any part of the river system, and that additional water allocations must come from savings from existing allocations that are reallocated. Illegal use and/or contamination of water must be investigated, followed up and the perpetrators should be prosecuted.

2.9 Other Studies

2.9.1 Opportunities, Constraints and Development Priorities in the Spatial Development

Report Title: Opportunities, Constraints and Developments in the Spatial Development. Prepared by Environomics.

Purpose

To highlights the difficulties experienced within each municipality as well as potential opportunities.

Major Findings

GERT SIBANDE DISTRICT MUNICIPALITY

The Govan Bheki and the Musukaligwa Local Municipalities are the two local municipalities in the EMF area. Some of the towns falling within the EMF area in these Municipal areas include Evander, Kinross, Secunda, Bethal and Trichardt for Govan Mbeki and Davel for Musukaligwa. The major urban centres in the district municipality include Evander, Secunda and Bethal, with Secunda being the most important development node. Outside these nodes, the district is predominately rural in character with agriculture, mining, nature reserves and forestry being the major economic sectors. Economical activities are concentrated within the major urban nodes; the sectors include business, retail, social services and industry (petroleum, chemical and rubber production) sectors.

The opportunities for sustainable development in the municipal area include:

- Both local municipalities have a good transport network;
- the district features a strong agricultural sector with Bethal as one of it's strong centres;
- Gert Sibande also has a strong mining sector and industrial base (mining of gold and coal), especially in Secunda;
- there is growth in the tourism sector, though the area like Secunda is dominated by heavy industry and mining activities these features are now open to the public as a tourist attraction; and
- areas like Secunda and Evander are strategically located and this has added to their advantage.

The main constraints in this municipal area include:

- Environmental impacts due to the mining and industrial activities;
- a serious lack of land by the government for low cost development in the urban areas;
- a lack of road maintenance;
- the decline of Davel as an economic node due to the closure of the coal mine in Ermelo has added to the social and economical impacts; and
- Musukaligwa municipality faces a lot of security and safety issues.

Planning and development priorities in the SDF for the whole district include:

- To manage the natural environment resource of the municipality;
- to capitalise on the district's five economic strips;
- to link all settlements with the economic nodes;
- to promote forestry within and along the tourism corridor;
- to promote intensive farming throughout the district and facilitate and concentrate subsistence farming activities in the rural areas;
- to ensure all communities have at least minimal basic services; and
- to facilitate and accommodate mining in the district in a sustainable manner.

NKANGALA DISTRICT MUNICIPALITY

The Nkangala District Municipality is located within Mpumalanga Province. There are six local municipalities within the District Municipality. The Nkangala District Municipality is predominately rural in character, comprising of extensive farming, forestry, nature reserves and mining activities. There are approximately 165 towns and villages spread throughout the area. Witbank and Middelburg are the two main towns in the district, both in terms of location and function. Delmas and Belfast are secondary service centres serving as central places to the surrounding farming areas. The tourism potential of the region has resulted in the regeneration and growth of towns such as Dullstroom and Waterval-Boven.

The opportunities for sustainable development in the municipal area include:

- A strong industrial, mining and agricultural base. The region has rich deposits of coal and chrome;

- Eskom power stations;
- Nkangala has an extensive road and rail network;
- the main towns, Witbank and Middelburg, are strategically located along the Maputo Development Corridor;
- Nkangala is located close to Gauteng which is an added advantage; and
- the region has tourism potential due to its natural beauty.

The main constraints in the municipal area include:

- The environmental effects of coal mining such as land and surface water degradation, ground water and air pollution;
- the municipality lacks land for low income residential development, which has contributed to rapid mushrooming of informal settlements around the urban areas;
- Nkangala has high levels of unemployment due to a shortage of appropriate skills; and
- the roads are poorly maintained and are dilapidated, due to the mines heavy coal haulage.

Planning and development priorities in the SDF for this municipal area include:

- To develop and classify the N12 freeway as a development corridor as it links Nkangala with the Ekhurhuleni Metropolitan area and promote development activities in areas such as Belfast and Machadodorp;
- to transform the R555 route as a “Local Development Corridor” with emphasis on agri-processing, service industry for the agriculture sector, manufacturing, warehousing as well as improving the railway network to encourage export to Maputo;
- to promote a “Tourism Belt” in the region which will incorporate sensitive wetlands and nature reserves in the area;
- to enhance mining activities in the southern region to contribute to job creation;
- formalise and upgrade the informal settlements to ensure that the community has access to basic services; and
- to promote industrial areas in the district as well as upgrading services in priority areas.

GREATER SEKHUKHUNE DISTRICT MUNICIPALITY

The District Municipality consists of five local municipalities. The District is rural in character with an exception of Groblersdal, Marble Hall, Burgersfort, Jane Furse, Ohrigstad, Steelpoort and Driekop, which are urban centres. The economic activities are predominately concentrated in the Greater Marble Hall, Greater Tubatse and Elias Motsoaledi local municipalities, with intensive commercial agriculture and platinum mining being the dominant economic activities, as well as tourism which is mostly related to nature, game farming and hunting.

The opportunities for sustainable development in the municipal area include:

- great agriculture potential with agriculture products such as citrus fruits, grapes, cotton, vegetables, corns being cultivated and exported;
- livestock farming is also practiced which includes the rearing of cattle, goats and game;
- the Greater Tubatse local municipality region offers great opportunities for mining, with rich deposits of platinum, chrome, vanadium, andalusite, silica and magnetite; and
- the location of the Loskop Dam in the area serves as a water source for irrigation and as a potential for tourism (water sports and fishing).

The main constraints in the area include:

- Lack of water availability in the area is one of the major constraints. This has led to conflicts between the farming communities, tourism conservation groups and the mining companies;
- the district has poor road networks and roads are dilapidated. The main roads only service the urban areas and the rest of the district is accessible via gravel roads; and
- despite having mines in the area, the district has high levels of unemployment due to lack of skills and low levels of education.

Planning and development priorities in the SDF for the District include:

- To actively protect, manage and enhance the natural environment in order to reduce conflicts between the mining, agriculture and tourism sector in the area;
- to promote mining activities in the area to ensure job creation and development of the Dilokong Corridor;

- to promote tourism through natural environment and historic culture in the district;
- to promote farming, industry and food production (agri-processing) with the help of the proposed De Hoop Dam;
- to speed up development by focusing on education and skills development; and
- to implement the proposed LED anchor projects for the district.

Recommendations

It is intended that the various opportunities and constraints identified for the District areas, are used as a planning aid in implementing development programmes in the area. It is evident that the area has rich natural recourses which can successfully support various economic sectors if proper assessment of what is in-place and what is lacking is carried out. This process can also help with the implementation of appropriate development programmes for the various Municipalities in the EMF area which have different economic needs. Developmental resources will also add value to the area's economy if strategically directed to where it is mostly needed. It lies with the decision-makers to make good use of the information gathered in order to initiate better development and economic decisions for the Municipalities. This report serves as the reference document for the OLEMF report, it is with hope that the report will contribute towards sustainable implementation of economic projects and programmes in the EMF area.

Relevance to the study

The report provides strategic development planning objectives and background information for some of the District municipalities within the catchment area.

2.9.2 Hydrology

In support of the water availability assessment there was a comprehensive review and update of the hydrology of the entire Olifants River catchment. The updated hydrology covers the period 1920 to 2004 and is an improvement on previous hydrology in that activities such as groundwater abstractions and mining were taken into account which became possible due to improvements in the WRSM2000 hydrology model. Improved algorithms relating to stream flow reduction due to afforestation and alien vegetation also improved the hydrology of the study area. The importance of this Hydrology study to the development of a reconciliation strategy is that it provided the building blocks upon which the yield assessment was carried out.

The IWRMP study produced extended and improved hydrology for the Upper and Middle Olifants River catchments. The natural MAR of the Upper and Middle Olifants catchment increased by about 7% but the main change is in the distribution of flow. This latest study obtained much high natural runoff in the upper reaches of the catchment with reduced incremental runoff in the lower reaches.

The OWAAS study does not make a comparison between the updated and previous hydrology and it is recommended that this be done as part of this study.

3. Approach to Synthesizing the Available Information

Section 2 of this report summarises the existing reports within the catchment area. Important findings and recommendations from these summaries have been gathered. The information from the previous reports has been used to describe the status quo of the catchment as it exists today. The important findings and recommendations have been used to highlight key aspects to be addressed in the reconciliation strategy.

The characterisation of the study area starts with inter alia a description of the study area boundaries, the land use in the area, the water supply infrastructure, water transfers in and out and the water management institutions.

The current water availability is thereafter described and both surface and groundwater resources are assessed. Information on water quality is also provided.

The water requirements by the different water use sectors and by other WMAs and Moçambique (international obligations) are then described. Future water requirements in 20 year’s time are also dealt with.

Water requirements and water availability are then weighed up against each other and water surpluses and shortfalls in the different sub-catchments are provided.

Possible generic structural and management interventions are listed without going into any specific detail.

Any gaps in information have been identified through the report summaries, e.g. there is little information regarding mine water. These gaps will be identified and addressed in Sections 5 and 6 respectively.

4. Summary of the Available Information

Using information from the reports summarised above, together with supplementary information, this chapter outlines the current status quo of the Olifants WMA which, together with the Polokwane and Mokopane areas form the study area.

4.1 Description of the Study Area as it Today Exists

4.1.1 Study Area Delineation

The Olifants WMA originates in Gauteng province, before flowing north-easterly through Mpumalanga and Limpopo provinces and into Mozambique. The Water Management Area is approximately 54 570km^2 and according to the ISP, is divided into four sub-catchments, i.e. The Upper Olifants catchment (includes the Wilge River), the Middle Olifants catchment (including the Elands river), the Steelpoort catchment and the Lower Olifants catchment (including the Blyde River), as illustrated in **Figure 4.1**.

The towns Polokwane and Mokopane and their surrounding areas, which both fall in the Limpopo WMA, have been added to the study area as water from the Olifants WMA is already being pumped to Polokwane and will also soon be transferred to Mokopane. The additional area which will form part of the study area is also shown on **Figure 4.1.**

The Study Area transbound 8 District, and 25 Local Municipalities. The District and Local Municipality boundaries are both shown on **Figures 4.2 and 4.3** respectively. Urban centres within the study area include Emalahleni (formerly Witbank), Steve Tshwete (formerly Middelburg) Cullinan, Delmas, Kriel, Hendrina, Arnot, Marble Hall, Polokwane, Mokopane, Belfast, Steelpoort, Ohrigstad, Lydenburg, Hoedspruit, Gravelotte and Phalaborwa.

The study area also includes Traditional Authority areas. These are concentrated mainly in the Middle and Lower catchments of the Olifants WMA, as illustrated in **Figure 4.4.**

4.1.2 Study Area Characteristics

Geology

The geology of the study area is widely varied. The area contains exposed rocks from the early Precambrian Era 4600 million years ago (MY) all the way through to the Cenozoic Era 1.65 MY. It contains the three basic rock types, namely sedimentary, igneous and metamorphic.

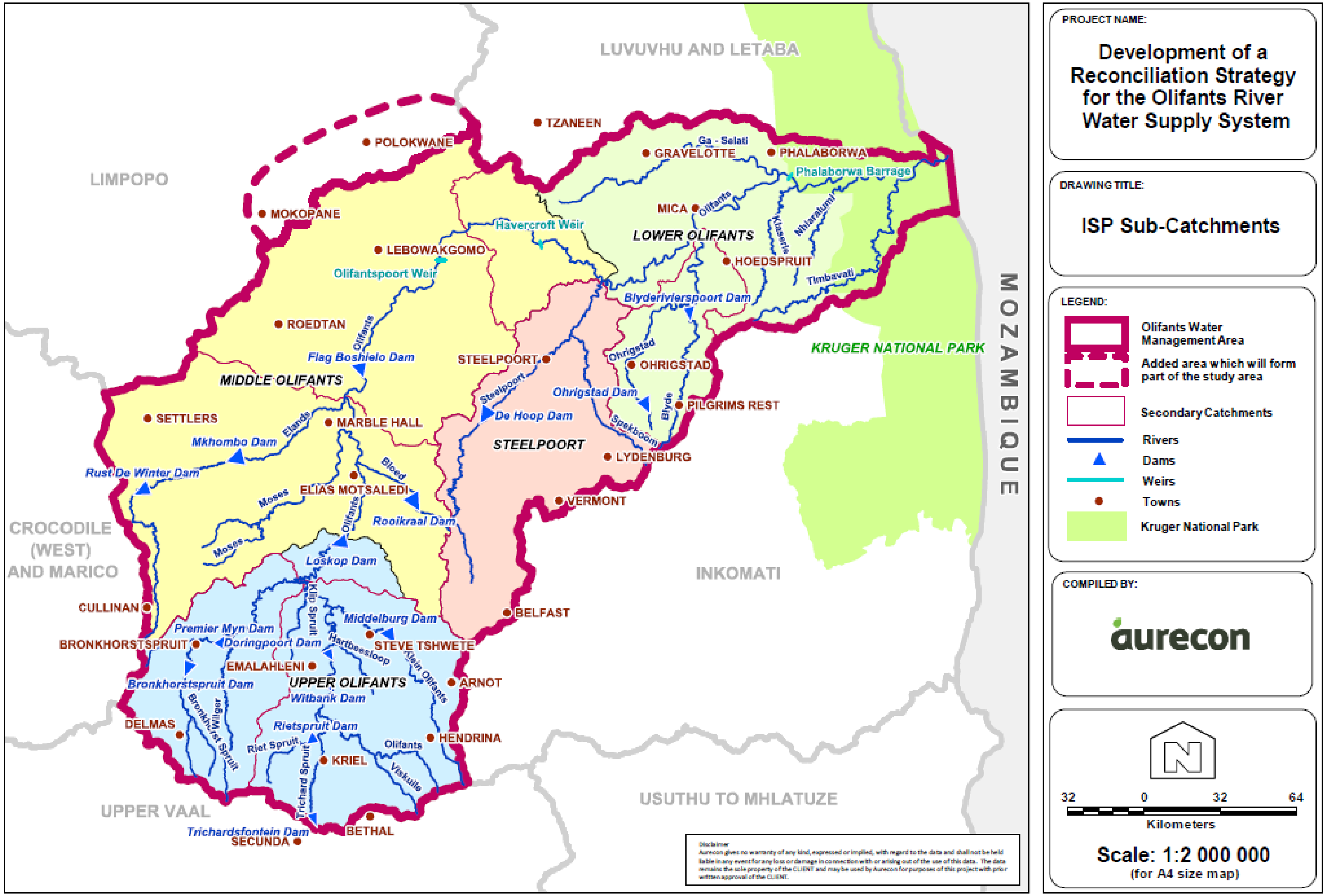

Figure 4.1: Olifants Catchment ISP Sub-Catchment Map

Figure 4.2: District Municipalities Transbounded by the Olifants River Catchment

Figure 4.3: Local Municipalities Transbounded by the Olifants River Catchment

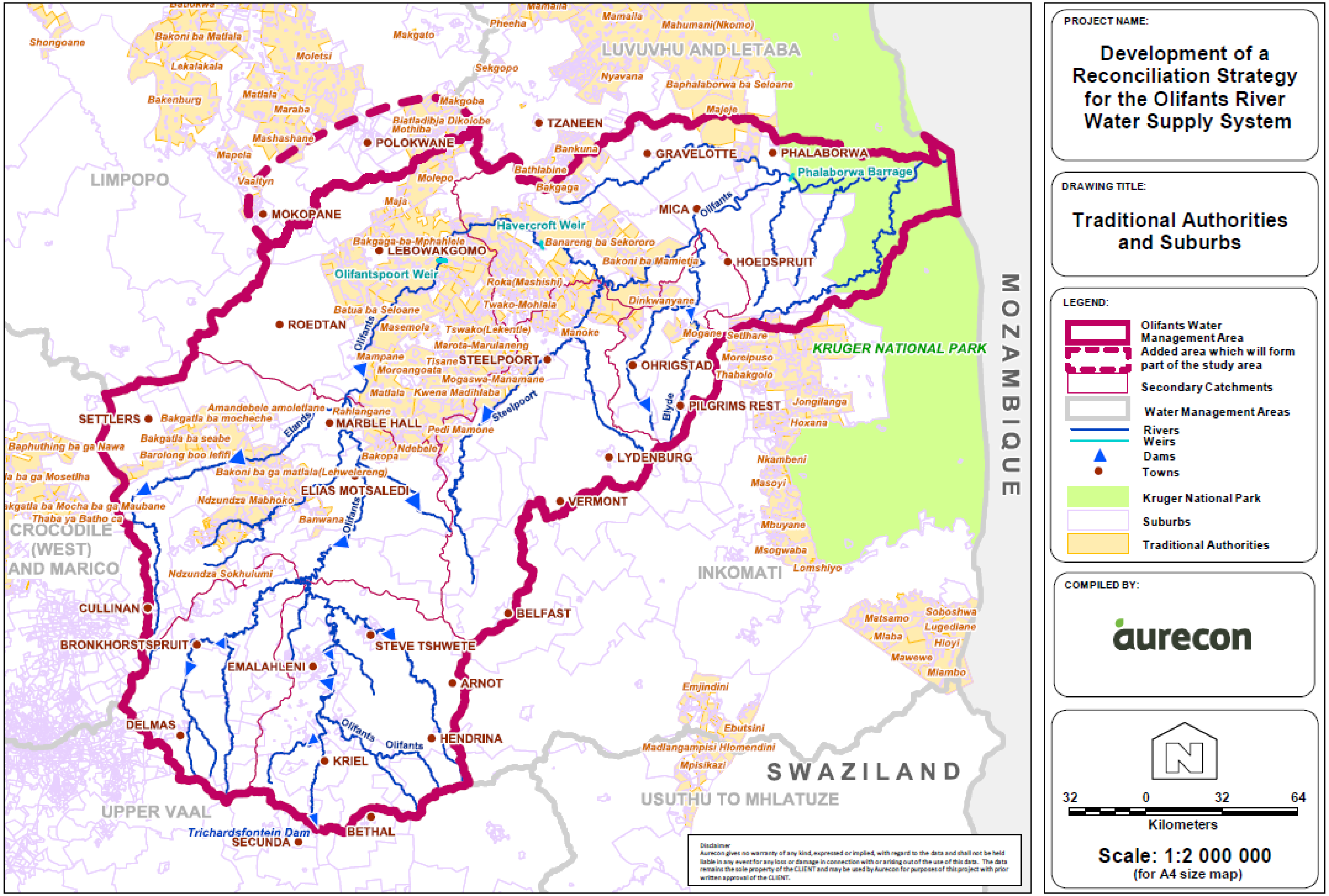

Figure 4.4: Traditional Authorities within the Olifants River Catchment.

Landscape, Climate and Rainfall

The WMA is large and the topography across the area is very varied. The topographical information correlates closely with the geological information. The area contains Highveld, which is composed of undulating plains and pans, and a large open flat area, referred to as the Springbok Flats. These areas are divided from the Lowveld by the escarpment, which consists of various hills and mountain terrain. The Lowveld consists mainly of plains and undulating plains.

The study area falls across four climatic regions, which include:

- The Highveld, with moderate maximum temperatures and cold winter nights, with severe frost occurring regularly;
- the Bushveld, with high maximum temperatures and cool winter nights without severe frost occurring;
- the escarpment, which partly lies in the mist belt, with moderate maximum temperatures and cool winter nights; and
- the eastern Lowveld with a hot sub-tropical climate.

The whole study area falls within the summer rainfall region. The mean annual precipitation within the study area varies greatly:

- Dry areas with 325 mm/annum to 550 mm/annum occur in parts of Sekhukhune and the northern parts of the eastern Lowveld;
- In the Highveld region and the southern part of the eastern Lowveld the rainfall varies between 550 mm/annum to 750 mm/annum;
- The escarpment receives a higher rainfall of between 750 mm/annum to 1000 mm/annum; and
- The Wolkberg area receives an annual rainfall exceeding 1000mm.

The Mean Annual Evaporation for the catchment ranges from 1300mm in the west to 1700mm in the east.

Conservation areas

There are a number of ecologically important areas within the Olifants WMA and various conservation areas have been proclaimed in the WMA (DWAF, 2004a):

- Blyde River Canyon Reserve

- Klaserie Game Reserve
- Thorny Bush Game Reserve
- Umbabat Nature Reserve
- Timbavati Nature Reserve
- Wolkberg Wilderness Area
- The Dawns Nature Reserve
- Selati Game Reserve
- Mount Sheba Game Reserve
- Sterkspruit Nature Reserve
- Lydenburg Nature Reserve
- Gustav Klingbiel Nature Reserve
- Ohrigstad Dam Nature Reserve
- Loskop Dam Nature Reserve

The most well known conservation area is the Kruger National Park (KNP) located in the Lower Olifants WMA. There are other ecologically important areas in the WMA, which have not been proclaimed as conservancy areas. These include the Mohlapitse River, which was identified during the ecological Reserve determination study as an ecologically important area due to the numerous cool mountain streams that join the Olifants River. The mix of hot and cold waters provides habitat for numerous red data and endemic fish species and frogs that occur in these environments. The Mohlapitse River also has several wetlands. It is important to maintain the status quo as far as flow and water quality regimes are concerned in this area of the WMA.

Ecology and Ecosystems

There are numerous pans and wetlands located in the Upper Olifants WMA. The wetlands play an important role in storing water in the environment, as well as providing habitat to many common and threatened species. Many of these pans and wetlands are under threat by mining. This is due to undermining and mining through or the use of the pans for the storage and evaporation of saline mine water.

There are also numerous gorges. The more important gorges are located upstream of the Mozambique border in the Kruger National Park; in the transition from the Highveld to the Lowveld; and upstream of Loskop Dam.

There are two centres of endemism within the Olifants WMA: namely the Sekhukhuneland, and Wolkberg Centres of Endemism. The Sekhukhuneland Centre of Endemism is entirely within the catchment while approximately half of the Wolkberg Centre of Endemism is within the catchment. These Centres of Endemism contain high levels of biodiversity with many species restricted entirely to these areas. As such they are of high priority in terms of conservation. The high biodiversity and the many unique plant species restricted to these areas means that they are particularly vulnerable.

The **Wolkberg Centre** is extremely rich floristically. More than 40 species endemic/near endemic to the dolomites and more than 90 to the quartz- and shale-derived substrates occur in the area. These figures are conservative, with more taxa likely to be added as knowledge of the flora improves.

The three families with the largest number of endemics on the quartzitic and related rock types are the Asteraceae, Iridaceae and Liliaceae. The asteraceous genus Helichrysum, with 10 species being the most prolific in producing endemics. Gladiolus has more than ten species endemic to the region as a whole. The Liliaceae is the family with the largest number of dolomite endemics to the region as a whole, followed by the Euphorbiaceae, Lamiaceae and Acanthaceae. For mosses, the Wolkberg Centre is one of the main southern African centres of diversity and a secondary centre of endemism.

Significantly, nearly all the endemics (notably the quartzitic ones) are grassland species. Most of the taxa endemic to the Wolkberg Centre appear to be palaeoendemics. The Wolkberg Centre, especially the arid dolomite areas, shares many species with the adjacent Sekhukhuneland Centre, several of which are endemic to the combined region.

The vegetation of the **Sekhukhuneland Centre** has never been studied in detail. It is usually mapped as Mixed Bushveld. However, floristically the bushveld of Sekhukhuneland Centre is quite unique and certainly deserves recognition as a separate type. The Kirkia wilmsii, a species that is relatively rare in other parts of the Mixed Bushveld is a characteristic tree of this area. Vegetation differences between the north- and south-facing aspects of the mountains are often striking. Intriguing vegetation anomalies associated with heavily eroded soils are present throughout the region.

The flora of the Sekhukhuneland Centre is still poorly known, with many apparently endemic species awaiting formal description. Families particularly rich in Sekhukhuneland Centre endemics include the Anacardiaceae, Euphorbiaceae, Liliaceae, Lamiaceae and Vitaceae. A still-to-be-described monoptypic genus of the Alliaceae is endemic also. The area around Burgersfort is reputed to have the highest concentration of Aloe species in the world. The Leolo Mountains harbour relic patches of Afromontane Forest, Fynbos-type vegetation and several Sekhukhuneland Centre endemics. There are also some rare wetlands in the summit area.

The Kruger to Canyons Biosphere Reserve also falls within the catchment area.

Alien and Invasive Vegetation

It has been noted in various reports, that alien and invasive plants (AIP) are present in the catchment, in particular eucalyptus and wattle trees. The detailed coverage of AIPs is still to be determined. Removal of the AIPs will contribute to eliminating water losses from the system, but won't necessarily contribute significantly.

Heritage

The heritage report for the De Hoop Dam, stated that the area is archaeologically important. During the EIA study for De Hoop Dam a large volume of archaeological and cultural sites were discovered. Preliminary assessments of the identified sites indicated that human communities occupied the Steelpoort River Valley area as far back as the Middle Stone Age, between 250 000 and 25 000 years ago. Although the findings of the report are localised, further sites may be encountered within the catchment.

Riparian Status

The following section was adapted from extractions from the State of the Rivers Reports for the Olifants and Letaba River Systems.

The Upper catchment of the Olifants River is characterised mainly by mining, agricultural and conservation activities. Over-grazing and highly erodable soils result in such severe erosion, in parts of the Middle catchment that, after heavy rains the Olifants River has a red-brown colour from all the suspended sediments.

Downstream of the Rust de Winter Dam, on the Elands River, flow is extremely regulated with very infrequent releases, which has a severe impact on in-stream biota because the river often runs dry. The artificial flow regimes in the Elands River caused by is ecologically insensitive releases of water from the Mkhombo Dam have altered the riverbed, caused erosion and results in undesirable habitat conditions for in-stream biological communities.

The Olifants River, upstream of the Flag Boshielo Dam, is impacted by agricultural activities, runoff from commercial agricultural areas contains agro-chemicals, which cause eutrophication or contamination of water, both of which can impair the health of invertebrates and fish.

Riparian vegetation on both the Elands River and the Olifants River is in a very degraded state due to overgrazing and over utilization and as a result, riverbanks are collapsing due to erosion, and sedimentation occurs in the riverbed. Alien vegetation along the banks of the Olifants and Elands River include Eucalypts (Eucalyptus spp.) Sesbania (Sesbania punicea) and Seringa (Melia azedarach).

Mining, predominantly for coal, and other industrial activities around the Wilge, Bronkhorstspruit, Klein Olifants and Olifants Rivers are the main contributors to poor in-stream and riparian habitat conditions where acid leachate from mines is a primary contributor to poor water quality and instream conditions. In the same areas, access roads, mostly related to mining and industrial activities, have resulted in severe disturbance of riparian habitats, and increased erosion of both land and riverbed. On **Figure 4.5** the high concentration of coal mines in the Upper Olifants sub-catchment can be seen. Similarly in these areas, the riparian vegetation is under pressure from overgrazing in some parts, and alien plants such as wattles that occur within the riparian zone, compete with indigenous vegetation and reduce available water.

Water quality in the Olifants River is negatively impacted by the high acidity and high concentrations of dissolved salts in some of the tributaries, especially the Klip River. The Klipspruit receives mine effluent and a long term management plan will be required to cope with the problem, because contaminant loads inherited from mining activities are likely to persist for many years.

Intensive irrigation of crops (including fruit trees) extends from the Loskop Dam to Marble Hall. Heavy abstraction of water in this area may reduce the water available for ecological functioning downstream. Commercial agricultural activities extend to the edge of the riverbanks of the Olifants River downstream of the Loskop Dam and the clearing of ground cover associated with these activities increases the potential for erosion as well as sedimentation in the river channel. Seasonal and ecologically insensitive releases from, or retention in, the Loskop Dam have an adverse impact on in-stream biological communities and cause erosion of the riverbed, through scouring.

The quality of the water in the Witbank Dam is poor, and the outflow from the dam is having a negative impact on the rivers downstream.

The Steelpoort River is in a fair to unacceptable ecological state. Overgrazing, and dryland cultivation throughout the area surrounding the Spekboom, Steelpoort, Beetgekraal, and Waterval Rivers including within the riparian zone, leads to erosion, which causes high silt levels in the rivers. The high silt levels in the aforementioned rivers, increases the risk of flooding and leads to the smothering of in-stream habitats and fish gills resulting in loss of invertebrate and fish species. Runoff from mines and other activities in the sub-catchment also contribute to the low water quality in the Steelpoort River.

Demographics

According the 2000 DWA ISP Report, the total population is approximately nearly 3 million people. Two thirds and the majority of the population are classified as rural, which are located in the Middle catchment, as shown in **Table 4.1.** The concentration of rural population correlates to the concentration of Traditional Authority Areas. This is important to note for domestic water supply.

Table 4.1: Urban – Rural population distribution in the Olifants River Catchment

	Urban	*Rural*	*Total*
Upper Olifants	597 882	125 126	723 008
Middle Olifants	231 226	1 353 223	1 584 449
Steelpoort	28 354	184 547	212 899
Lower Olifants	54 691	208 074	262 765
Total	**912 151**	**1 870 970**	**2 783 121**

The population figures in **Table 4.1** are outdated but provide the reader nevertheless with an order of magnitude. An effort will be made to obtain more up-to-date population figures during the course of the study.

According to the 2007 population data, the concentration (60%) of population in the Greater Sekhukhune District (Middle catchment) fall under the age of 24 years.

The majority of the study area has a high poverty rating, with the majority of the economically active people earning an annual income of not more than R 19 200 annually or R 1 600 per month. According to the 2001 and 2007 economic data, the majority of the populations in the Nkangala District (Upper catchment), Greater Sekhukhune (Middle catchment) and Capricorn and Mopani Districts, earn less than R1 600 per month. Populations in these areas also have limited or no schooling.

4.1.3 Land Use

The main economic sectors in the study area are mining, agricultural activities, forestry and tourism. Detailed land use information is presented in **Table 4.2**.

Table 4.2: Use of land / Land cover (source: DEA, 2009)

	Surface Area in (km2)	Percentage %
Indigenous Forest	374,157	0.51
Woodland	14 643.211	19.89
Thicket and Bushland (incl. Herbland)	21 656.643	29.41
Grassland	11 066.547	15.03
Planted Grass	17.389	0.02
Forest Plantation	1 231.863	1.67
Water Body/Wetland	580.843	0.79
Bare Rock and Soil (Natural)	180.490	0.25
Degraded Land	7 229.180	9.82
Irrigated Agriculture	1 941.989	2.64
Dryland Agriculture	11 886.193	16.14
Urban/Built-up (Residential)	2 236.441	3.04
Urban/Built-up (Smallholdings)	84.268	0.11
Mining/Industrial	495.973	0.67
Total Area	**76 630.049**	**100.00**

Mining and Industry

The Upper catchment and Steelpoort catchment are characterised predominantly by mining and industrial activities. The main mining activities include coal. Several metal industries are located in the catchment, including steel, stainless steel, ferrosilicate and vanadium producing plants. Other industrial activities in the catchment area include Eskom's 8 power stations. **Figure 4.5** illustrates the concentration of coal mines in the Upper catchment, and the concentration of platinum group metals and other metals in the Middle and Steelpoort catchments. **Figure 4.6** highlights the concentration of power stations in the Upper catchment, corresponding to the location of coal mines.

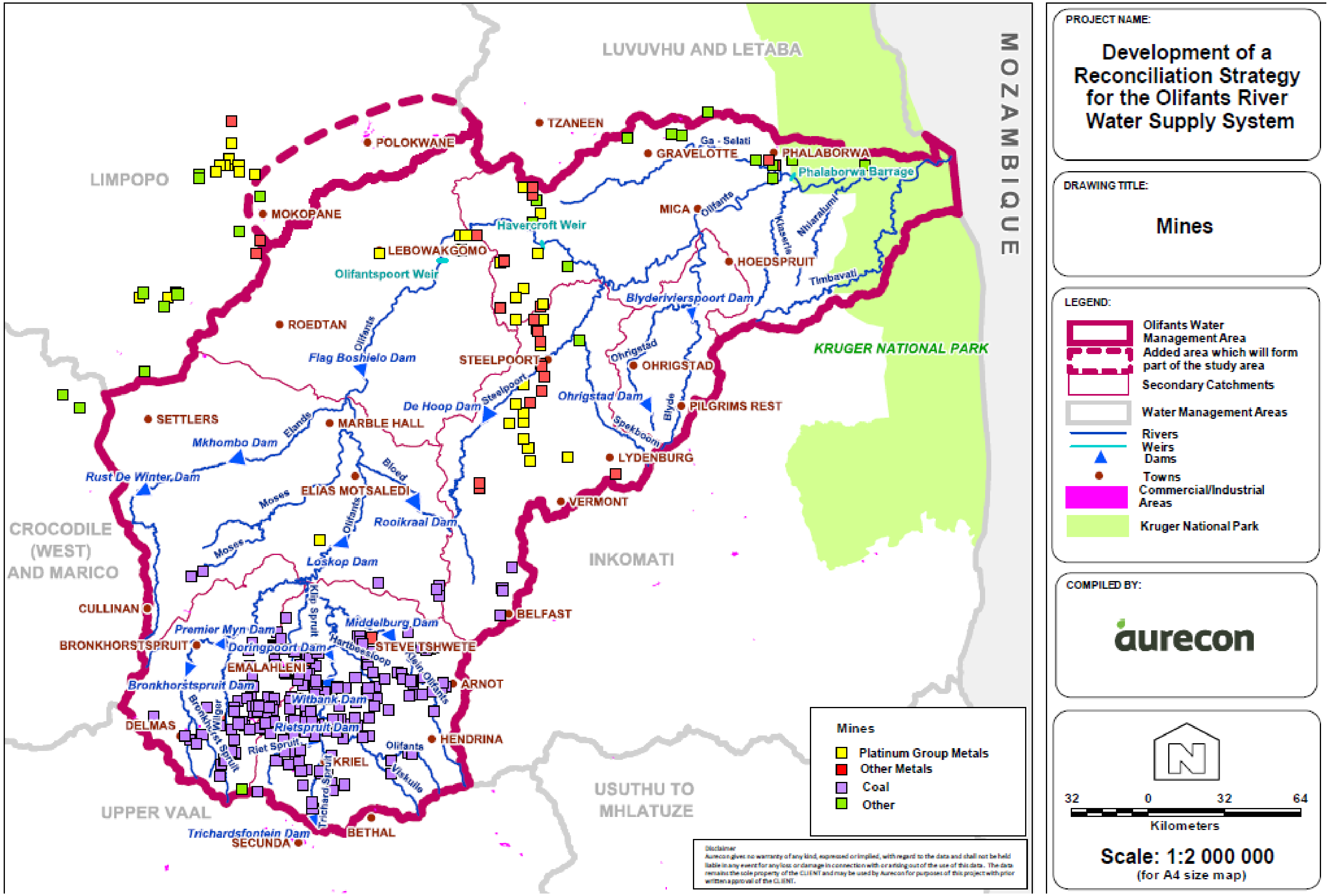

Figure 4.5: Location of Mines in the Olifants River Catchment

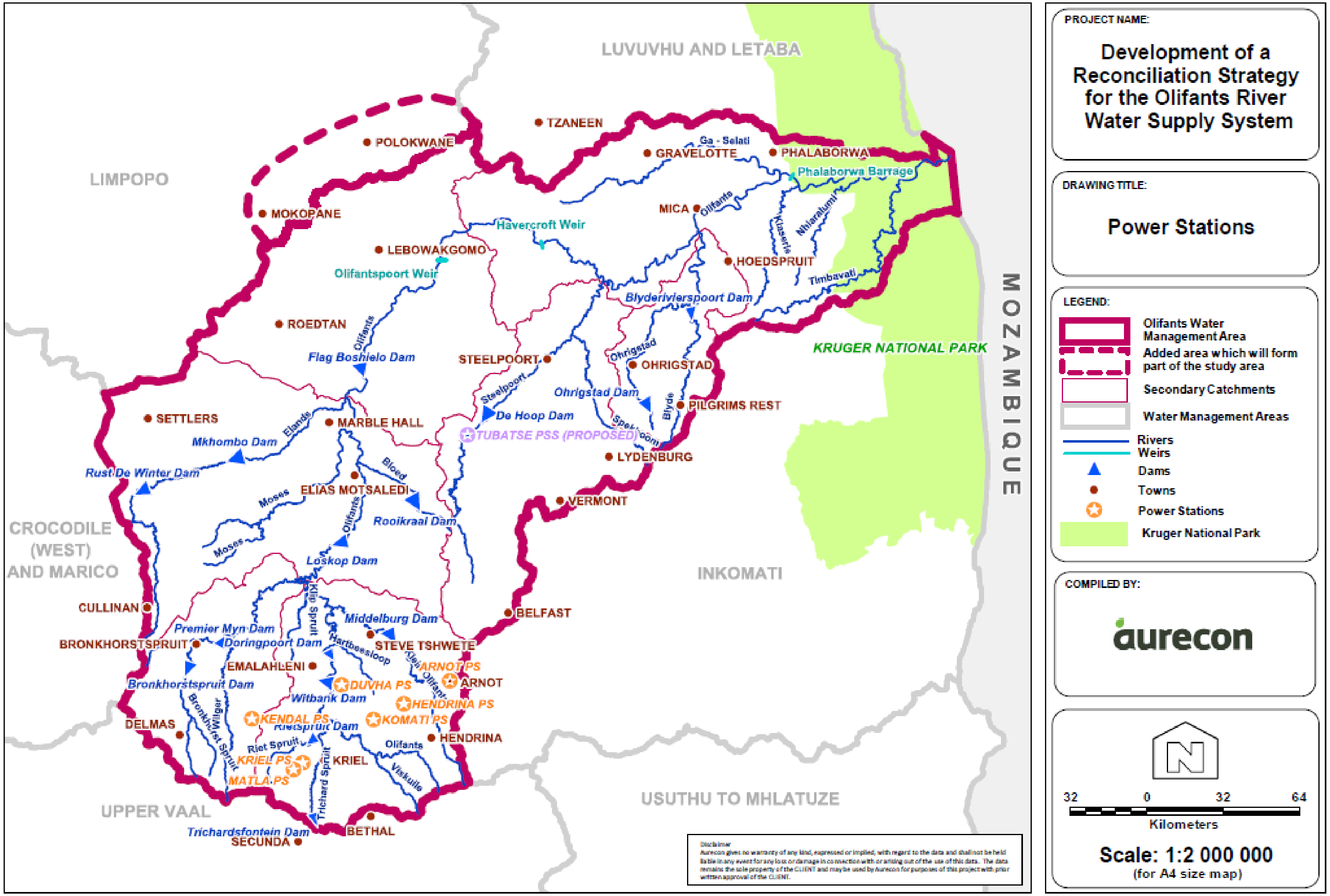

Figure 4.6: Location of Power Stations and Other Mines in the Olifants River Catchment

Agriculture

Agricultural activities are located predominantly in the Upper and Middle catchments. The total registered irrigation area in the Olifants WMA is recorded as 129 010ha. The main form of irrigation is centre pivot (76 567ha) and 9478ha still utilise flood irrigation. Sprinkler irrigation is the second most common system (31 568ha). The most common crops include maize and green mealies (52 357ha), potatoes (9210ha), wheat (8439ha) and a variety of vegetables (approximately 10 000ha) and citrus fruits.

Forestry

Forestry is a small land use within the catchment, with land cover of only 1.67% of the catchment. Pine forest afforestation occurs mainly on the eastern side of the catchment, in the Belfast to Lydenburg area.

Tourism

The tourism sector has been identified as one of the growing sectors in the catchment area. The Kruger National Park (KNP) is the major economic driver of this sector. The Kruger National Park is situated along the easternmost edge of the WMA. The park includes the Sabie Sabie Game Reserves, Timbavatie and Manyeleti Reserve, Thornybush Game Reserve and the Klaserie Reserve which have been integrated with the KNP as private concessions enabling animals to move freely without the fencing. Measures are being put in place to safe-guard the KNP which is facing threats of encroachment from mining and agricultural activities as well as the formal and informal housing schemes around the area.

The Blyde River Canyon has also been identified has a potential tourism destination. It is a majestic area which forms part of the Transvaal-Drakensberg Escarpment with breathtaking views of the Blyde River Canyon and gorge, Blyde Dam, the three Rondawels, Bourkes Luck Potholes, Gods Window and Pinnacle. Past investigations review that the Blyde Canyon and Mariepskop (state forest) are to be proclaimed as one National Park, as well as to acquire National Heritage status due to their ecological diversity and unique geology. This initiative will also help conserve the over-stressed Olifants River Catchment. Other opportunities in this regard include the generation of income and employment linked to eco-tourism; and the initiation of programmes of forestation at Mariepskop where commercial timber is produced.

The Loskop Dam also has great potential as a tourist destination. This however, has not been capitalised on. To realise its full potential the main focus must be on tourism marketing and awareness; and development of future tourism plans that focus on agri- and eco-tourism attraction that safeguard cultural and natural heritage of the area whilst creating employment opportunities and developing skills.

There is a need to fully exploit other sectors in the catchment area besides mining, agriculture and tourism. The aforementioned economic sectors must capitalise on promoting labour intensive secondary sectors such as manufacturing and agri-processing, construction, transport and communication sectors. These sectors will help maximise the development potential in the area and stimulate growth, which will eventually lead to an improvement in basic provision, roads and infrastructure as well as housing and dwelling. This will in turn benefit the development of the retail and commercial sectors and contribute towards skills development within the area.

Economic Activities

According to the ISP Report, economic activities within the Olifants River Catchment contribute approximately 5% of the GDP of South Africa. The Report omits the contributions of tourism and forestry within the catchment, but does identify the contributions of other sectors as being Mining 22%, Manufacturing 18%, Electricity 16%, Government 16% and Agriculture 7%. As part of this Reconciliation project, these figure will be updated and include the contributions of tourism and forestry.

4.1.4 Water Supply Infrastructure

The Upper Olifants has well developed dams and infrastructure supplying various municipalities, irrigation areas and mines. Some of the dams include the Trichardsfontein Dam, Rietspruit Dam, Witbank Dam, Bronkhorstspruit Dam, Doringpoort Dam, Premier Myn Dam, Middelburg Dam and the Loskop Dam.

The Middle Olifants has some dams, and limited infrastructure to deliver domestic water supply. The dams include the Rooikraal Dam, Rust de Winter Dam, Mkhombo Dam, and the Flag Boshielo Dam. This catchment also has the Olifantspoort Weir and the Havercroft Weir.

The Steelpoort catchment includes the De Hoop Dam (under construction), and good infrastructure supplying various mines with water.

The Lower Olifants is characterised by significant infrastructure distributing water from the Phalaborwa Barrage to various municipalities and mines. The Ohrigstad Dam is located in the Lower catchment, as well as the Blydepoort Irrigation canal distributing water for irrigation.

Of particular importance to this study are the Middle Olifants and Steelpoort Rivers where significant new infrastructure is currently being developed or is planned as part of the Olifants River Water Resources Development project (ORWRDP). This includes:

i) Phase 1: The raising of Flag Boshielo dam which was completed a few years ago
ii) Phase 2A: The new De Hoop Dam, which is currently under construction on the Steelpoort River.
iii) Phase 2B: A pipeline from Flag Boshielo Dam to Mokopane to supply domestic and mining users. It should be noted that water will only become available from the dam when other demands are supplied from De Hoop via the Phases below.
iv) Phase 2C is a planned new gravity pipeline from De Hoop Dam to Steelpoort
v) Phase 2D is a planned new pump main which will pump water from Steelpoort to Mooihoek, on the watershed between the Steelpoort and Middle Olifants catchments. This section of the scheme is to be integrated with the existing Lebalelo scheme.
vi) Phases 2E and 2F are planned gravity mains from Mooihoek to the existing Olifantspoort WTW, which supplies local domestic users as well as the larger centres such as Lebowakgomo and Polokwane.

The major dams in the study area can be seen on **Figure 4.7** and the new pipelines from De hoop and Flag Boshielo Dams on **Figure 4.8.**

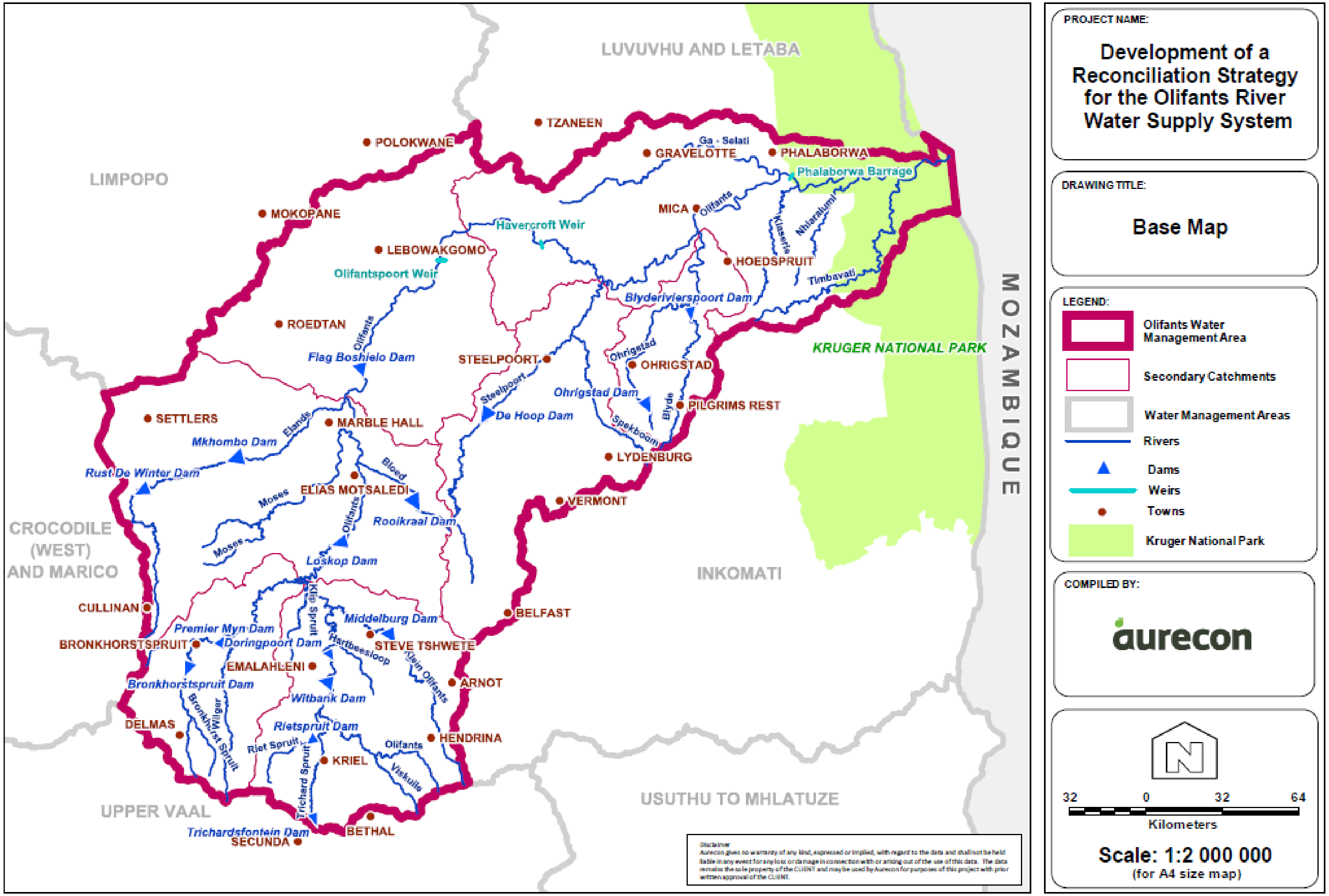

Figure 4.7: Major Dams in the Study Area

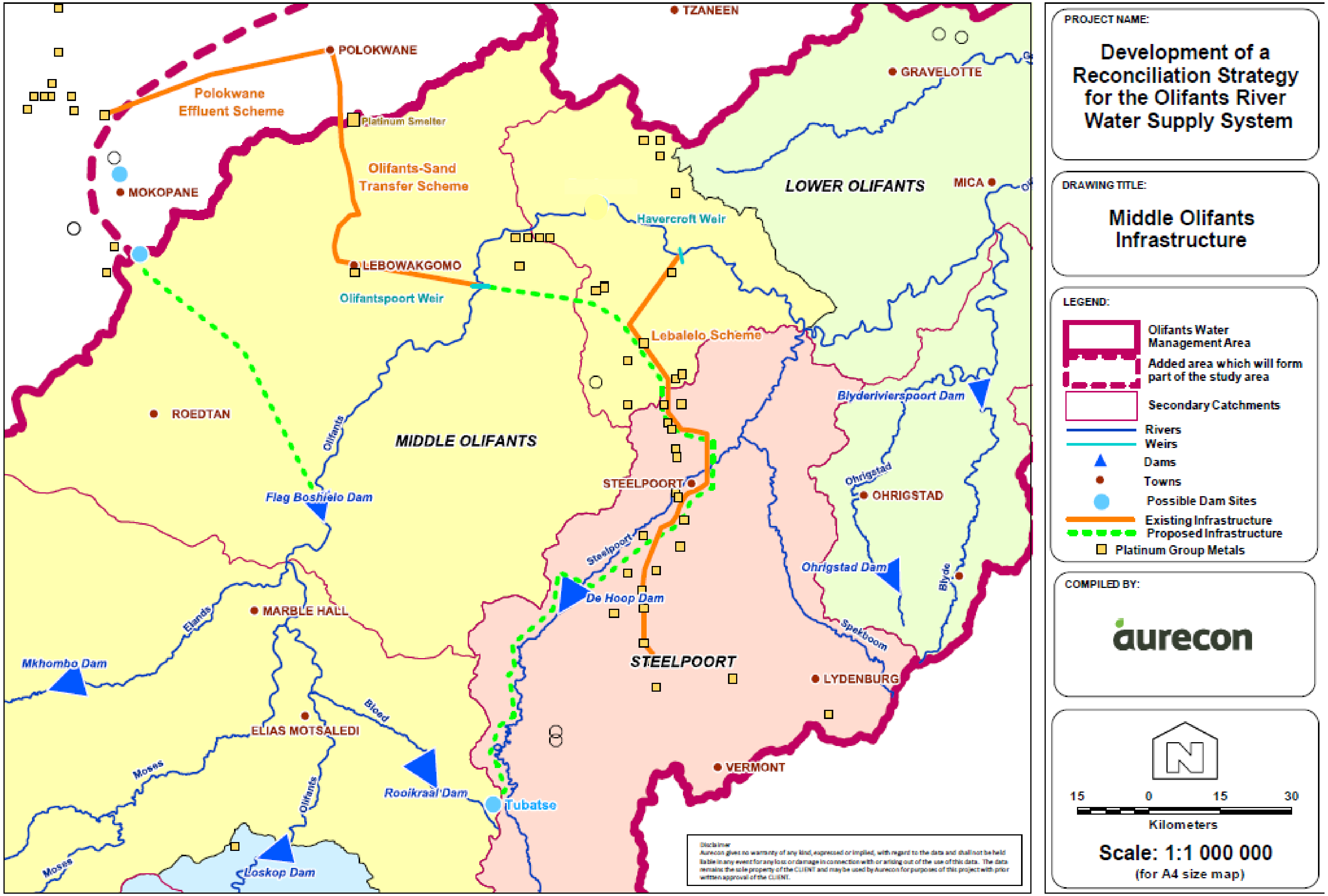

Figure 4.8: New Pipelines from De Hoop and Flag Boshielo Dams

4.1.5 Water Transfers in and out of the Catchment

There are several water transfer schemes in and out of the Olifants River Catchment. These have been presented in **Table 4.3** below.

Table 4.3: Current water transfers into and out of the Olifants River Catchment

	In	Out
Metsweding		5 million m^3/a
Vaal	36 million m^3/a	
Usutu	51 million m^3/a	
Komati	85 million m^3/a	
Polokwane		3 million m^3/a
Total	**172 million m^3/a**	**8 million m^3/a**

All the transfers into the catchment occur in the Upper Olifants, and are mainly utilised for cooling water for power generation by the Eskom power stations. The transfer out to Metsweding occurs from the Upper catchment, whereas the transfer to Polokwane occurs from the Middle Olifants.

4.1.6 Institutional Set-Up

Currently the establishment of the Catchment Management Agencies (CMAs) has been put on hold by the Minister of Water Affairs. The powers of the CMA in terms of managing the water management area are held by the Regional and National offices of the Department of Water Affairs.

There are several Irrigation Boards (IBs) operating within the catchment area, however many of the IBs have not yet converted themselves into a Water User Authority. The Municipalities (District, and Local where appropriate) are the Water Service Providers, in particular for domestic consumption.

Rand Water Board supplies bulk water to the municipalities in the Upper catchment, and water users. The Lepelle Northern Water Board provides water to the municipalities in the Middle and parts of the Lower catchment. Magalies Water supplies water to a small area within the Upper/Middle Olifants Catchment in the vicinity of Cullinan.

4.1.7 Existing Public Participation in the Water Sector

Key roleplayers who are involved in the study area and who can be considered for participating in this study, can be representatives of:

- Mines (Chamber of mines and mining houses)
- Industry
- Power generation (Eskom)
- Chamber of Commerce
- Agriculture (Irrigation Boards, Water User Associations)
- Tourism (SANParks, Conservation organisations)
- Forestry (Komatiland Forests, Sappi, Mondi)

Administrative representation can include:

- Catchment Management Committees
- CMA / Proto-CMA
- Traditional Authorities
- Municipalities (District and Local)
- Water Boards (Rand Water, Lepelle Northern Water Board)
- Provincial Government Departments (Agriculture, Environment, Local Government, Housing)
- National Departments (Water, Mining, Forestry, Tourism)

4.2 Current Water Availability

4.2.1 Hydrological Information and Concerns

Hydrological information is summarised in **Tables 4.4** and **4.5**.

There are two concerns regarding the hydrology. The first is that the OWAAS hydrology report does not indicate the extent to which the new hydrology deviates from the previous hydrology. Hence it is not possible to comment on how this updated hydrology is likely to influence the water balance of the catchment. The second concern is that, according to the OWAAS report, the hydrology of the Steelpoort catchment has changed significantly since the feasibility study into the De Hoop Dam but no explanation for this change is given in the OWAAS report. It is recommended that this be investigated.

Table 4.4: Updated hydrology statistics compared with previous studies: Upper and Middle Olifants catchment

Gauge	Location	Record Period	Mean annual Runoff (million m^3/a)		% Difference
			Latest study (DWAF, 2008)	Other Studies	
B1R001	Olifants River at Witbank Dam	1920-1991⁺	157.36	124.20	26.70
		1920-1989*	158.12	124.90	26.60
		1920-1995#	160.44	126.80	26.53
		1920-2004#	164.05		
B1H005	Olifants River at Wolwekrans	1920-1989*	142.42	111.70	27.50
		1920-1995#	144.52	115.42	25.21
		1920-2004#	147.94		
B1H018	Olifants River at Middelkraal	1920-1989*	44.23	36.80	20.19
		1920-1995#	44.79		
		1920-2004#	45.73		
B1H017	Steenkoolspruit at Aangewys	1920-1989	19.12	12.80	49.38
		1920-1995#	19.40		
		1920-2004#	19.85		
B1H019	Noupoortspruit at Nauwpoort	1920-1989	4.24		
		1920-1995#	4.32	2.98	44.97
		1920-2004#	4.28		
B1H002	Spookspruit at Elandspruit	1920-1989*	10.96	8.90	23.15
		1920-1995#	11.21	8.30	35.06
		1920-2004#	11.35		
B1H004	Klipspruit at Zaaihoek	1920-1989*	20.28	17.40	16.55
		1920-1995#	21.28	21.00	1.33

Gauge	Location	Record Period	Mean annual Runoff (million m^3/a)		% Difference
			Latest study (DWAF, 2008)	Other Studies	
		1920-2004#	22.25		
B1R002	Klein Olifants River at Middelburg Dam	1920-1991+	49.65	41.90	18.50
		1920-1989*	50.03	44.90	11.43
		1920-1995#	50.94	41.20	23.64
		1920-2004#	53.52		
B2R001	Bronkhorstspruit at Bronkhorstspruit Dam	1920-1991+	51.84	49.20	5.37
		1920-1989*	52.48	47.40	10.72
		1920-1995#	54.06	55.30	-2.24
		1920-2004#	56.40		
B2H014	Wilge River at Onverwacht	1920-1989*	39.75	37.80	5.16
		1920-1995#	42.87	48.21	-11.08
		1920-2004#	45.78		
B3R002	Olifants River at Loskop Dam (incremental catchment)	1920-1991+	207.80	245.80	-15.46
		1920-1989*	208.94	222.30	-6.01
		1920-1995#	226.18	237.30	-4.69
		1920-2004#	224.92		
Total	**Total Olifants River catchment u/s of Loskop Dam**	**1920-1991+**	**498.00**	**461.00**	**8.03**
		1920-1989*	**500.80**	**466.00**	**7.47**
		1920-1995#	**524.11**	**490.00**	**6.96**
		1920-2004#	**532.50**		

Notes: # - 'Development of an Integrated Water Resources Model for the Upper Olifants River Catchment' Study**,** DWAF: 2008
+ - DWAF Report B500/00/1595 – Olifants-Sand Transfer Scheme
* - Surface Water Resources of South Africa, 1990 (Volume 1)

Table 4.5: WRSM2000 calibration results: OWAAS Study

Sub-catchment	Gauge	Record Period	Observed MAR ($10^6m^3/a$)	Simulated MAR ($10^6m^3/a$)
Loskop spill	Inflow from Upper Olifants	1920-2004	253.27	Spill / releases
		1920-2004	98.31	Irrigation canal
Olifants River flow gauges				
B32	B3H001	1966-2004	343.22	345.13
B51	B5R002 (Flag Boshielo infl)	1987-2004	447.92	496.08
B52	B5H002	1948-1976	720.25	406.04
B71	B7H009	1960-1997	799.06	805.64
B72	B7R002	1966-2004	1411.26	1170.42
B71	B7H015	1987-2004	1205.25	1244.72
Tributary flow gauges				
B31	B3H021 - Elands	1991-2004	25.58	31.65
B41	B4H003 - Steelpoort	1957-2004	95.19	94.28
B42	B4H021 - Waterval	1972-2004	22.76	20.29
B42	B4H007 - Klein Spekboom	1968-2004	25.92	26.61
B42	B4H010 - Skekboom	1979-2004	62.54	56.45
B60	B6R003 - (Blydepoort infl)	1977-2004	304.64	280.05
B72	B7H019 - Selati	1988-2004	73.28	61.42
B72	B7R001 - Klaserie	1961-1999	30.25	29.22

4.2.2 Hydrogeological Information about Various Aquifers

The groundwater recharge across the whole Olifants WMA covering an area of 54 550 km^2 is in the order of 860 million m^3/a. The recharge in the Middle and Lower Olifants Catchments is in the order of 700 million m^3/a.

The groundwater component of the base flow was calculated to be in the order of 45 million m^3/a for the whole Olifants River WMA and 35 million m^3/a in the Middle and Lower Olifants Catchments.

The Groundwater Yield Model results showed that, 70% to 80% (500 million m^3/a) of the groundwater that is recharged is lost due to groundwater evapo-transpiration losses. On a regional scale, the potential evapo-transpiration is more than 50 times higher than the recharge, which means that the entire groundwater recharge volume can be evaporated on 2% to 5% of the catchment areas. More groundwater may be available than was expected, given that it can be economically utilized before it is lost to groundwater evapo-transpiration.

Apart from groundwater evapo-transpiration losses, which account for up to 70% of the recharge, the biggest water users are community water supply at 93 million m^3/a (10% of recharge) and irrigation 72 million m^3/a (8% of recharge). The inflow from dam seepage could be as high as 47 million m^3/a, which is more than the groundwater component of base flow.

The groundwater component of the Olifants River WMA is considered as unstressed on a regional scale given that only 25% of the quaternary catchments are in stressed state. At least 70 million m^3/a of additional groundwater resources can be developed in the quaternary catchments that are not stressed. A water balance model developed for the relatively-unexploited dolomite in the north escarpment area of the Olifants River WMA, indicates that the groundwater balance in the dolomite aquifers is positive and can be used for future development as a regional groundwater resource.

There are 6 stressed aquifers (hot spots) that need immediate intervention:

- The Delmas Dolomite Aquifer (B20A and B20B) where irrigation in the order of 6 million m^3/a is abstracted from a spatial limited aquifer. The risk of sinkhole formation is an important aspect that should be managed.
- Similar to Delmas is the Zebediela Dolomite Aquifer (B51E and B51G) where 3 million m^3/a is abstracted also from a spatially limited aquifer.
- The Springbok Flats Karoo Aquifer (B51E) where 10 – 12 million m^3/a, is abstracted for irrigation.
- Highveld coal mining area at Witbank-Middelburg-Kriel Karoo Coal Aquifers (B11K, B11J, B11H and B12D) where water quality is more affected than quantity.
- Steelpoort mining and community water supply aquifer areas (B41J and B41K) where groundwater quantity and quality is affected.
- Kruger National Park and Bushbuckridge Catchments (B73J, B73H and B73F) where groundwater sustains community water and riparian vegetation.

The biggest contributors to poor groundwater quality are Nitrate, Fluoride, EC, Sodium, Magnesium, Calcium and Sulphate. Minor contributors include Arsenic and Iron. Human initiated pollution includes Nitrate. Natural pollutant includes Fluoride. In the Springbok Flats and Gravelotte areas, water usage such as mining and sanitation has impacted on groundwater quality.

4.2.3 Water Quality Information and Concerns

The water quality of the catchment is problematic. There is an increase in dissolved salts in a downstream direction through the catchment as a result of mining activities, irrigation and agricultural runoff, erosion and landuse practices. There is heavy metal contamination from Chromium and Vanadium in catchment. The Total Dissolved Solids and Sulphate concentrations in the Loskop, Witbank and Middelburg dams as been increasing since 1970. Sulphate concentrations exceed Resource Water Quality Objectives (RWQO) in many of the tertiary catchments. Acid conditions exist in the Klipspruit and Kromdraai tertiary catchments due to decanting from old mines and non performance of the neutralisation plants at Brugspruit. There is excessive sedimentation throughout the catchment due to erosion, overgrazing, mining and land use. Four of the five major waste water treatment works (WWTW) in the Upper catchment discharge into the upper end of Loskop dam leading to eutrophic conditions and periodic blooms of blue-green algae.

In the Upper catchment, the Klein Olifants tributary is of medium class (D), the Olifants is Medium to Poor (D – E) and the Wilge tributary is Good (B). Downstream of Loskop dam the Olifants river is in a Fair state (class C).

In the Middle catchment, the Elands tributary digresses from Fair (C) to Poor (E). The Olifants also digresses from Fair (C) to Poor (E) due to the high TDS.

The Steelpoort sub-catchment is of a Medium state (D). The Lower catchment improves from Poor (E) to Fair (C) due to the Good state (B) of the Blyde river providing a diluting effect to the Olifants.

The general poor water quality is a threat to the environment and to human health. Negative impacts accumulate downstream in the catchment. The Olifants flows across the border into the Massingir Dam which supplies drinking water in Mozambique.

In the Upper catchment in particular, there is an increase in Acid Mine Drainage discharging into the rivers. The Middle catchment is characterised by dolomitic rock and the aquifers are a key supply for rural drinking water and agricultural irrigation. Contamination of this sub-catchment by the AMD poses a threat to human life in terms of contaminated drinking water and contaminated irrigation water, but also the threat of sinkhole formation.

Another concern is the reduced diluting effect of runoff in the Steelpoort catchment, due to the construction of the De Hoop Dam. Dilution of the lower Olifants will be limited to the Blyde river.

4.2.4 Historic and Long Term Yields of Dams

The IWRMP and OWAAS report both provide updated assessments of the available yield from the various dams in the Olifants River catchment. These are summarised in **Table 4.6.** It should be noted that dam yields from Witbank Dam down to Loskop Dam were sourced from the IWRMP study and the rest from the OWAAS study.

Table 4.6: Summary of Yields of Dams within the Olifants River Catchment

Dam	Historical yield (million m^3/a)		1:50 Yield (without EWR) (million m^3/a)
	Without EWR	With EWR	
Witbank	29.5	23.0	33.0
Middelburg	12.6	9.2	14.0
Bronkhorstspruit [1]	16.9	8.8	23.5
Premier Mine	6.7	0.003	
Loskop	153.6	100.6	167.6
Mkombo System	11.7	10.4	13.3
Rust de Winter	9.8	4.5	11.7
Flag Boshielo	36.5	66.2	81.0
Ohrigstad	18.9	11.4	19.0
Blyde	110	14.7	130.0
De Hoop	75.3	55.9	78.0

[1]Yield Channel at this dam for previous study comparison, channel moved d/s for stochastic analyses.
Units are million m^3/a

There are a couple of points to note from the modelled information of the two reports:

- The long term yield of the dams is calculated without applying the EWR.
- The yield of the Flag Boshielo Dam increases when the EWR is applied.
- The yield of the Blydepoort Dam decrease significantly with the application of the EWR.
- The yield of the Mkombo Dam varies between the OWAAS (8.1 million m^3/a) and the IWRMP (11.7 million m^3/a) reports.
- The yield of the De Hoop Dam in the OWAAS report quotes as 56 million m^3/a after meeting the Reserve, while the planning for the dam was based on yield of 80 million m^3/a.

The application of the yield model to investigate the further development of surface water resources showed that the construction of additional dams did not increase the yield of the system of dams in the study area. The yield was merely transferred from the downstream dams to the upstream dams.

4.3 Water Requirements

4.3.1 Water Requirements by Different Water Use Sectors

Current and future water requirements were obtained from the IWRMP and OWAAS reports and are summarised in **Table 4.7** and **Table 4.8**. The growth in water demands can be attributed mostly to increasing urban and mining demands which include transfers to Mokopane and Polokwane.

Table 4.7: Current water requirements

Sub-area	Power Generation million m^3/a	Urban/ Industrial million m^3/a	Irrigation million m^3/a		Mining million m^3/a	Losses million m^3/a	Total million m^3/a
			Schemes	Diffuse sources			
Transfers In	172						**172**
Loskop		77	153	104	17	31	**382**
Steelpoort		4	5	53	8	0	**70**
Blydes		23	103	10	18	21	**175**
Elands		19	2	3	1	0	**25**
Middle Olifants		6	13	9	14	0	**42**
Lower Olifants		0		20	4	0	**24**
TOTAL	**172**	**129**	**276**	**199**	**62**	**52**	**890**

Table 4.8: Future water requirements (20 Y Planning Horizon)

Sub-area	Power Generation million m^3/a	Urban/ Industrial	Irrigation million m^3/a		Mining million m^3/a	Losses million m^3/a	Total million m^3/a
			Schemes	Diffuse sources			
Transfers In	172						**172**
Loskop		129	153	104	17	31	**434**
Steelpoort		8	5	35	65	0	**113**
Blydes		23	103	10	18	21	**175**
Elands		14	2	3	1	0	**20**
Middle Olifants		61	13	9	0	0	**83**
Lower Olifants		0		20	4	0	**24**
TOTAL	**172**	**235**	**276**	**181**	**105**	**52**	**1021**

It is important to note that water requirements for the forestry and tourism sectors have not been included in these water requirement tables, neither the Environmental Water Requirements.

The industrial sector usually includes power generation facilities. The ESKOM power stations in the Upper Olifants Catchment is one of the largest users of water (172 million m^3/a). The majority of supply for power generation is via inter basin transfers from the Vaal, Usuthu and Komati basins. Industry and urban requirements have been grouped together and provide a distorted view of user requirements, especially when one compares the relationship across sectors between water requirements to land cover area and contribution to GDP of the catchment.

The majority of the population of the catchment, as shown in the demographics section, is rural in nature, and located in the Middle Olifants catchment. However, in presenting the water requirements, there is no distinction between rural and urban needs.

4.3.2 Reserve Requirements

According to the DWAF Report PB000-00-5899, Olifants River Ecological Water Requirements (EWR) Assessment: Lower Olifants Comprehensive Ecological Reserve. April 2001, the average ecological reserve requirement is 301 Million m^3/a. The EWR requirements vary as a function of the natural flow of the river. The current estimates are that the EWR requirements will reduce the water availability in the system by about 200 Million m^3/a, this will be confirmed as part of this reconciliation study.

The environmental water requirements (EWR) are not included in summary Tables **4.7** and **4.8**. The breakdown of the EWR per sub-catchment must still be modelled. The overall EWR is included in the water balancing tables in the following section.

4.3.3 International Water Requirements

Downstream of the Kruger National Park, the Olifants River flows in Mozambique where it is a tributary of the Limpopo River. On 24 November 1971, South Africa signed a Treaty with Portugal (of which Mozambique was a colony at the time), in regards to rivers of mutual interest, 1964 Massingir Dam (Treaty 5/1971). Section 5 of the Treaty states that “No restriction is placed on the Government of the Republic of South Africa in regard to its use of the water of the Olifants River in its territory, notwithstanding the provisions of the Agreement between the Governments of the Republic of South Africa and the Government of the Republic of Portugal in regard to Rivers of Mutual Interest. "It is understood that no flow requirements were placed on the border flow of the Olifants due to the construction of the Massingir Dam, which would regulate flow into Mozambique.

Section 6 of the Treaty states that "The Government of the Republic of South Africa shall not be held responsible for any pollution of the water of the Massingir Dam that may occur, unless such pollution is caused wilfully or without reasonable precautionary measures having been taken place." The strategy will need to address the water quality issues raised in order to show reasonable precautionary measures are being taken.

Subsequent to this Treaty, South Africa and Mozambique were signatory to the Revised Protocol on Shared Water Courses in the SADC Region. The current status of the Treaty, in light of the SADC Protocol and Mozambique's independence from Portugal, will be investigated in this study.

4.4 Current and Future Water Balances

4.4.1 Current

The current water requirements are captured in **Table 4.9**.

Table 4.9: Current Water Balance

Sub-area	Requirement million m^3a	Water availability (at 1:50 year assurance) million m^3/a	Water Balance million m^3/a
Loskop	382	342	-40
Steelpoort	70	60	-10
Blyde	175	175	0
Elands	25	29	4
Middle Olifants	42	91	49
Lower Olifants	24	24	0
Transfer in for Power Generation	172	172	0
Ecological	200		-200
TOTAL	**1 090**	**893**	**-197**

There is a total shortfall of 197 million m^3/a as a result of the total Ecological Water Requirements of 200 million m^3/a. This total EWR has not been broken down per sub-catchment and therefore it may appear as if some sub-catchments are in balance or that there are even surpluses in some. However, once the breakdown of the total EWR per sub-catchment has been determined, it is doubtful if even one single sub-catchment will be in balance. The rapidly increasing domestic and mining water requirements will result in further growing deficits into the future unless addressed through various interventions.

The entire WMA is therefore under stress in so far that water requirements exceed the water availability.

4.4.2 Future

The future water balances are captured in **Table 4.10.**

Table 4.10: Future (2030) water balance (Million m^3/a)

Sub-area	Requirement million m^3/a	Water availability (at 1:50 year assurance) million m^3/a	Water Balance million m^3/a
Loskop	434	342	-92
Steelpoort	113	138	25
Blyde	175	175	0
Elands	20	29	9
Middle Olifants	83	91	8
Lower Olifants	24	24	0
Transfers in for Power Generation	172	172	0
Ecological	200		
TOTAL	**1221**	**971**	**-250**

The total deficit will grow from 197 million m^3/a to 250 million m^3/a in 20 year's time if no intervention measures are implemented. Once again, the surpluses in the sub-catchment are not real surpluses because the total EWRs have not been broken down to the individual sub-catchments.

- Surpluses

  The only expected surplus is in the Steelpoort catchment, based on the commissioning of the De Hoop Dam.

4.5 Possible Structural and Management Interventions

Interventions to improve water availability and water quality in the Olifants WMA will require both physical (structural) interventions and management or (policy type) interventions.

The intervention possibilities are discussed below without going into specific detail.

4.5.1 Structural Interventions

Structural interventions can be divided into two groups, i.e.

A – Interventions that could increase the yield of the system,

B – Interventions that could optimise the use of the available resource.

A - Interventions that could increase the yield of the system

- Potential water surface schemes
  A number of dam sites are available on the Lower Steelpoort, Blyde, Middle and Lower Olifants rivers, from which significant volumes of water could theoretically be supplied. However, as abstractions further upstream already result in the EWRs being significantly undersupplied, any new dam would exacerbate this situation unless the dam is built specifically to improve supply of the EWRs.

- Potential groundwater schemes
  Groundwater already is a main water supply in the Middle Olifants catchment. The hydrogeological studies suggest there is further potential to expand the use of groundwater in the area and in the catchment.

- Water transfer schemes
  There are already well developed plans to transfer water out of the catchment via Phase 2B of the ORWRDP described in 4.1.4 above. Increased demand in the Limpopo WMA in particular at Polokwane and Mokopane will require larger transfers from the Olifants catchment.

  Water is already imported into the Upper Olifants from the Vaal River catchment, from Grootdraai Dam and also from the Komati and Usuthu Catchments. This water is fully committed to Eskom. A further scheme from Vaal Dam could bring additional water for other users, but it must be borne in mind that the Vaal River system is already supplemented from the Lesotho Highlands Water Project, making the further transfer of this water to the Olifants an expensive option.

B – Structural Interventions that could optimise the use of the available resource

- Re-using/Reclaiming/Recycling of Water

A possible new scheme which should be investigated is the import of treated sewage effluent from a number of waste water treatment plants on the East Rand (outside of the catchment). This would require additional treatment of the water if it is not to exacerbate the existing water quality problems in the Upper Olifants.

- Potential desalination schemes

  The Middle catchment experiences high concentrations of dissolved salts from mining, irrigation and agricultural runoff. Water from the river needs to be treated before it can be used, in order to reduce the salt levels. Implementation of desalination schemes could assist with the treating of the high saline water.

- Water purification, especially for the use of contaminated groundwater, AMD.

The eMalahleni Mine Water Reclamation Plant (MWRP) is a multi-stage reverse osmosis treatment process, located in the Upper catchment. The plant is a joint initiative of Anglo Coal (a subsidiary of Anglo American) and Ingwe Collieries (owned by BHP Billiton). The eMalahleni reclamation plant has a water recovery rate of more than 97%, and produces 25Ml/d. The process produces Gypsum (metal rich and $Mg(OH)_2$ rich Gypsum) as "solid waste". This is being further investigated for re-use in the construction of pre-cast housing. The potable water produced for the system is used to augment the potable water supply of Emalahleni Municipality. Some water is also discharged in order to meet ecological flow requirements within the sub-catchment.

The eMalahleni MWRP has successfully demonstrated the benefits of reclaiming contaminated water, both for improving water quality, and by augmenting the rapidly growing demands of the municipal water supply. Further MWR plants should be investigated and implemented for the catchment, and for treating contaminated groundwater.

- Grey water for irrigation and processing

  Partially treated grey water could be used for the irrigation of suitable agricultural crops, used for process water in industrial processes and the watering of sports fields and parks.

- Saline water for stock drinking, salt tolerant crop irrigation

Water quality problems in the Middle catchment have been identified as too saline water. Saline water can be used for stock watering. Salt resistant crop types could also be irrigated using the saline water.

- Dual reticulation

  Dual reticulation is not a source but rather an infrastructure design. Dual reticulation is a system whereby housing areas and industrial areas are serviced by two water reticulation systems. The first system provides potable water for drinking. The second system provides treated grey water for non-drinking purposes such as flushing toilets, watering gardens etc. The second system is clearly marked as not for consumptive use. There are several examples of this system throughout the world.

- Maintenance – irrigation canals

  Irrigation canals in the catchment are in need of maintenance and upgrading. Several of the canals have been identified as being unlined, e.g. lower Spekboom canal. Improved status f the irrigation canals will potentially help reduce losses in the system.

- Rain water harvesting

  The mean annual rainfall across most of the catchment varies between 500mm and 800mm. Rainwater harvesting, especially in the densely populated rural areas of the Middle catchment could contribute towards water supply for domestic consumption, subsistence farming irrigation and other domestic uses, e.g. washing, cooking, toilet flushing, etc.

4.5.2 Management Interventions

Management interventions can be divided into three groups, i.e.

A – Interventions that could reduce the demand,

B – Interventions that could increase the yield, and

C – Interventions that could promote equity.

A – Interventions that could reduce the water demand

- Water Conservation and Water Demand Management (WCDM)

  Water Conservation is the minimisation of loss or waste, care and protection of water resources, the improvement or maintenance of water quality, and the efficient and effective use of water. Demand Management on the other hand is a management approach to increase the availability of water cost-effectively, through more equitable, efficient and eco-friendly allocation and usage, through sound policy and selective incentives. WCDM can be applied across all users and sectors.

Implementation of improved irrigation techniques can reduce loss through evaporation and runoff. Irrigation according to the growth cycle of the crops also reduces water wastage and improves absorption.

The Emalahleni and Labowakgomo Municipalities have estimated their water losses as 11.05 million m^3/a and 4.9 million m^3/a respectively. Repairing leaks in taps and pipelines, reducing waste and promoting water conservation and water reuse/recycling can reduce these losses and help reduce the deficit in the overall system.

The Western Highveld (Kwandebele), which is known to be a high loss area, has reported that it will decrease its water requirements from 28 million m^3/a to only 15 million m^3/a by implementing WCDM measures.

In the industrial sector, ESKOM's WCDM report made suggestions towards site specific improvements for each of its plants. Savings would range from 2.78 million m^3/a at Arnot to 7.6 million m^3/a at Matla plant.

The combined savings across users and sectors has the potential to have a significant reduction in overall demand on water requirements throughout the Olifants catchment.

There is almost certainly scope for reducing overall water use by reducing losses, in both the urban and irrigation sector. The options need to be quantified.

- Adjusting the assurance of supply

  Water users could accept a reduced assurance of supply, e.g. the irrigation quotas for irrigation schemes could be re-assessed.

- Operating rules – Dwars river, and irrigation canal blyde irrigation system

  The lack of formal operating rules on the Dwars river for irrigation purposes by the Great Dwars River Irrigation Board is leading to inefficient water releases in the system. Improved or formal operating rules could contribute to the more efficient management of the Dwars system. Similarly, there is no control of water being diverted in the lower Spekboom river into the irrigation canal. The implementation of formal control measures will contribute to the more efficient management of that section of the system. This should be included in the System Operating Rules project – separate to this study.

B – Interventions that could increase the yield

- Removal of Invasive Alien Plants (IAP)

  Consensus on the methodologies to determine the increase in yield resulting from the removal of alien vegetation needs to be obtained with key stakeholders.

  Invasive Alien Plants use more water than the original indigenous plants and by removing IAP and allowing the re-growth of indigenous plants, significant quantities of additional water can be made available.

- Rainfall Enhancement

  Experiments with rainfall enhancement (cloud seeding with aircrafts) have stopped but has been resumed in the Eastern Cape.

- Optimising operating rules

  The operation of the system as a whole can be improved through the timely introduction of water restrictions, the available resources can be augmented. This option is however not included in the ToR of the project since it falls within the scope of the System Operating Rules study which is currently in progress. Also of importance to note, but within the realm of the System Operating Rules project, is the need to operate the catchment as an integrated system, and not operating the Blyde system and Olifants system separately.

C – Management Interventions that could promote equity

- Prevention of illegal water use
- Compulsory Licensing

  The NWA of 1998 makes provision for a process whereby all existing water users with their existing lawful use are forced to apply for new licences. New allocations can then be made and aims such as promoting equity in water use could simultaneously be strived for. Compulsory licensing could form part of the Water Allocation Reform initiative of DWA.

- Water Trading

  The Olifants catchment has no further scope for new allocations. Existing allocations need to be reviewed and trading of water allocations could be allowed to ensure the best beneficial use of the water.

5. Information Gaps and Recommendations

5.1 Gaps in available information

5.1.1 Rural Water Use

It does not appear as if rural water use was separately identified in previous studies. This could be important for future demand projections, particularly if DWA decide to improve water services to rural areas through supply from any of the large dams rather than rely on local resources such as farm dams and groundwater.

The majority of the population within the catchment are located in rural areas. The water requirements between urban and rural areas need to be separated and determined in this study.

5.1.2 Alien and Invasive Vegetation

No spatial data was available to determine the extent of coverage of alien and invasive plants (AIPs) within the catchment. AIPs contribute to losses in the system. The removal of AIPs is important both to biodiversity and to reduce losses from the system. The removal of AIPs won't necessarily significantly reduce losses, but it will contribute to the systems efficiency.

5.1.3 Mining Sector

- WCDM Report for Mining

  As part of the project for the Development of a comprehensive water conservation and water demand management strategy and business plans, a report for various sectors (Irrigation and Power Generation) as well as for Emalahleni and Lebowakgomo Municipalities was reviewed. Mining has been identified in the status quo as a key user of water, a major economic contributor and the major polluter of water resources in the catchment. However, no water conservation and demand management report has been reviewed. A report referring to the mining sector has not been identified in the other reports.

- Water requirements report for mining and future mining activities
  Although mining sector water requirements are included in the water balances, there is limited detailed breakdown of this water use. There are increased mining activities in the Dilokong Corridor, however the growth in water requirements for this area is unknown.

5.1.4 Forestry Sector

Little reference has been made to the water requirements of the forestry sector within the catchment. Similarly, the forestry sector has been omitted from the economic contributions within the catchment.

5.1.5 Tourism Sector

Little or no reference has been made to the water requirements tourism within the catchment. Water quality is of significant important to tourism, due to the direct impact to the environment of poor water quality. There is a high concentration of game and nature reserves and conservation areas in the Lower catchment. Although the water requirements may be low, the importance of water quality is very high. Similarly, tourism has been omitted from the economic contributions within the catchment.

5.1.6 Non-conventional sources of water

Very little reference is made to the use of non-conventional sources of water. The catchment includes a leading example of acid mine water reclamation for domestic potable use, however no other examples are included. While non-conventional sources of water don’t necessarily contribute additional yield to the overall system, it does reduce demand for potable water and improves water quality discharges.

5.1.7 International Requirements

The Treaty between the Governments of the Republics of South Africa and Portugal was signed in 1971. No further information, Agreements, or updates relating to the SADC Protocol or Moçambique’s independence were available for review for this report. This will be addressed further for inclusion into the study.

5.2 Recommendations on how to address the information gaps

5.2.1 Rural Water Use

The intention is to obtain data on Rural Water Use from the All Towns Study, failing which the water requirements will be estimated using population estimates obtained from DWA's Water Services database and per capita water use estimates.

5.2.2 Alien and Invasive Vegetation

The Agricultural Research Council (ARC) will be consulted for updated spatial coverage of alien and invasive vegetation within the catchment. The Working for Water Programme operating in the catchment will also be consulted.

5.2.3 Mining Sector

A WCDM report for the mining sector will be searched both within the scope of the Water Conservation and Water Demand Management Strategy and Business Plans project of the Department of Water Affairs, but also within the Chamber of Mines.

5.2.4 Forestry Sector

The Department of Forestry, and the forestry companies will be approached with regard to current and future water requirements within the catchment. Similarly information regarding WCDM and the economic contribution to GDP in the catchment will also be requested.

5.2.5 Tourism

The Department of Tourism, and SANParks will be approached with regard to current and future water requirements within the catchment. Similarly information regarding the economic contribution to GDP in the catchment will also be requested.

5.2.6 Non-conventional sources of water

A questionnaire will be submitted to Water User Associations and leading water users, municipalities etc. The questionnaire will investigate the use of non-conventional sources of water across users and sectors.

5.2.7 International Water Requirements

The Joint Water Commission between the Republic of South Africa and Mozambique will be approached for further updates regarding the 1971 Treaty on Massingir Dam. SADC will also be approached with regards to the Protocol, the SADC Strategy and Policy with regards to water quality requirements for cross-border flows.

6. Conclusions

Based on the information presented in this report, the catchment is water stressed. The water requirements of its users currently far exceed the water availability within the catchment. For future scenarios, radical changes to water resources management, water use efficiency and water allocations need to take place in order to ensure optimal use of the water available within the catchment. This reconciliation study needs to address these issues. Some key areas for further investigation include:

- Improved monitoring of water quality and quantity is required in order to provide a more realistic understanding of the system. Validating the current hydrological information. These will assist in improving the operating rules for the catchment.
- Verification and validation of water use.
- More and stricter enforcement is required for compliance to discharge and abstraction permits, in order to reduce water contamination, as well as unlawful and illegal water use.
- Reduce system losses (including removal of alien and invasive vegetation, maintenance of unlined irrigation canals).
- Implementing water conservation and water demand management measures, in order to improve water use efficiency across all users and sectors within the catchment.
- Investigate and implement suitable non-conventional sources of water within the catchment.
- Addressing the gaps in available information, and the differences in the model outputs, e.g. for the Flag Boshielo dam and the Mkombo system, and difference between planned and modelled yield of the De Hoop Dam.

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