CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE OLIFANTS WATER MANAGEMENT AREA: (WMA 4) - WP 10383

INFORMATION ANALYSIS REPORT

FINAL

REPORT NO.: **RDM/WMA04/00/CON/CLA/0211**

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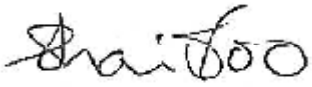

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Shane Naidoo

Director: Water Resource Classification

EXECUTIVE SUMMARY

In order for the Department to effectively classify the significant water resources of the Olifants WMA, a thorough understanding of the status quo and information availability of the WMA is needed to the determine existing situation. The information analysis task was designed, as part of the study, to provide a high level analysis of the available water resource related data and information for the Olifants WMA in terms water resource quality, ecological water requirements, hydrology, water quality and socio-economics. This task has been undertaken in compliance with the requirements of the study terms of reference that specify that the classification process is required to build from existing and current initiatives undertaken in support of integrated water resource management. As this study is solely reliant on existing and parallel studies for its information requirements, it is critical to determine if all the data components of the classification process are met, and if not, what are the gaps that are present.

It is critical at the outset to determine if any key information is outstanding or absent for successful implementation of the WRCS in the Olifants WMA. An information review has been initiated and undertaken during the inception phase and the outcomes of this are captured in this report. All previous studies undertaken for the Olifants River and its tributaries have been sourced and reviewed. For parallel studies ongoing liaison has been established with other study teams and will be maintained to ensure that the transfer of information, data and reports takes place. This task has also included the assessing of the models that are to be used for the classification of the water resources in the Olifants WMA.

At this stage the information analysis is not considered to be exhaustive and the review will continue as new information and data come to light.

The above have been used to identify any gaps and outstanding information. Specific recommendations have been made as to the collection of additional data and/or the extrapolation of existing data. These have been discussed with client and will be confirmed in finalisation of this task 2.

The information analysis has been undertaken as follows and is detailed in the sub-sections of this report:

- Previous Studies
- Parallel Studies
- Data Sources
- Models
- Other.

DOCUMENT INDEX

Reports as part of this study:

Bold type indicates this report.

Report Index	Report number	Report title
1	RDM/WMA04/00/CON/CLA/0111	Inception Report
2	**RDM/WMA04/00/CON/CLA/0211**	**Information Analysis Report**

LIST OF ABBREVIATIONS AND ACRONYMS

AMD	Acid Mine Drainage
CD: RDM	Chief Directorate: Resource Directed Measures
DAFF	Department of Agriculture, Forestry and Fisheries
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DBSA	Development Bank of South Africa
EC	Electrical Conductivity
EIS	Ecological importance and sensitivity
EMC	Ecological Management Class
EMF	Environmental Management Framework
ESBC	Ecologically Sustainable Base Configuration
EWR	Ecological Water Requirements
IUA	Integrated Unit of analysis
IWRM	Integrated Water Resource Management
IWRMP	Integrated Water Resources Management Plan
KNP	Kruger National Park
MC	Management Class
NFEPA	National Freshwater Ecosystem priority areas
NWA	National Water Act
PES	Presentation Ecological State
RDM	Resource Directed Measures
RHP	River Health Programme
RO	Regional Office
RQOs	Resource Quality Objectives
RQS	Resource Quality Services
RWQOs	Resource Water Quality Objectives
SAM	Social Accounting Matrix
STATS SA	Statistics South Africa
TDS	Total Dissolved Salts
UORC	Upper Olifants River Catchment
WMA	Water Management Area

WRC	Water Research Commission
WRCS	Water Resource Classification System
WRYM	Water Resources Yield model
WRPM	Water Resources Planning Model

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1 INTRODUCTION

The Olifants River originates at Trichardt to the east of Johannesburg and initially flows northwards before gently curving in a generally eastward direction through the Kruger National Park and into Mozambique, where it joins the Limpopo River before discharging into the Indian Ocean. The Olifants water management area (WMA) corresponds with the South African portion of the Olifants River catchment (excluding the Letaba River catchment). It falls within three provinces, *viz*. a small part to the west within Gauteng, with the southern part mainly in Mpumalanga and the northern part in Limpopo Province. The main tributaries are the Wilge, Elands and Ga-Selati Rivers on the left bank and the Steelpoort, Blyde, Klaserie and Timbavati Rivers on the right bank (Figure 1).

Distinct differences in climate occur; from cool Highveld in the south to subtropical, east of the escarpment. Mean annual rainfall is in the range of 500 mm to 800 mm over most of the WMA.

The main economic activity in the WMA is related to coal, platinum, vanadium, chrome, copper and phosphate mining. The coal mining is located in the upper reaches of the catchment around Witbank, Middelburg and Delmas. There are large thermal coal fired power stations associated with the coal mining. The platinum, chrome and vanadium mines are located in the Steelpoort and lower Olifants areas of the water management area while the copper and phosphate mining occurs in the lower Olifants around Phalaborwa. There are also large steel foundries located in Middelburg and Witbank.

Extensive irrigation occurs in the vicinity of the Loskop Dam, along the middle reaches of the Olifants River, near the confluence of the Blyde and Olifants Rivers, as well as in the Steelpoort valley and upper Selati catchment. Much of the central and north western areas of the water management area are largely undeveloped, with scattered rural villages where the people are mainly dependent on income from migrant workers in the Gauteng area, Witbank, Middelburg and Phalaborwa are the largest urban centres. Land use in the water management area is characterised by rain-fed cultivation in the southern and north-western parts, with grain and cotton as main products. While most of the water management area remains under natural vegetation for livestock and game farming as well as conservation, severe overgrazing is prevalent in many areas. Afforestation is found in some of the higher rainfall areas, with notable plantations in the upper Blyde River valley.

With the Olifants River flowing through the Kruger National Park, which is located at the downstream extremity of the water management area, the provision of water to meet ecological requirements is one of the controlling factors in the management of water resources throughout the water management area (2004).

Most surface runoff originates from the higher rainfall southern and mountainous areas. There are 9 major dams constructed in the Olifants River and the major tributaries which regulate the flow in the river system.

Large quantities of groundwater are abstracted for irrigation in the north-west of the water management area, as well as for rural water supplies throughout most of the area. Potential for increased groundwater utilisation has been identified on the Nebo Plateau north-east of Groblersdal. Substantial amounts of water are transferred into the water management area as cooling water for power generation, while smaller transfers are made to neighbouring water management areas.

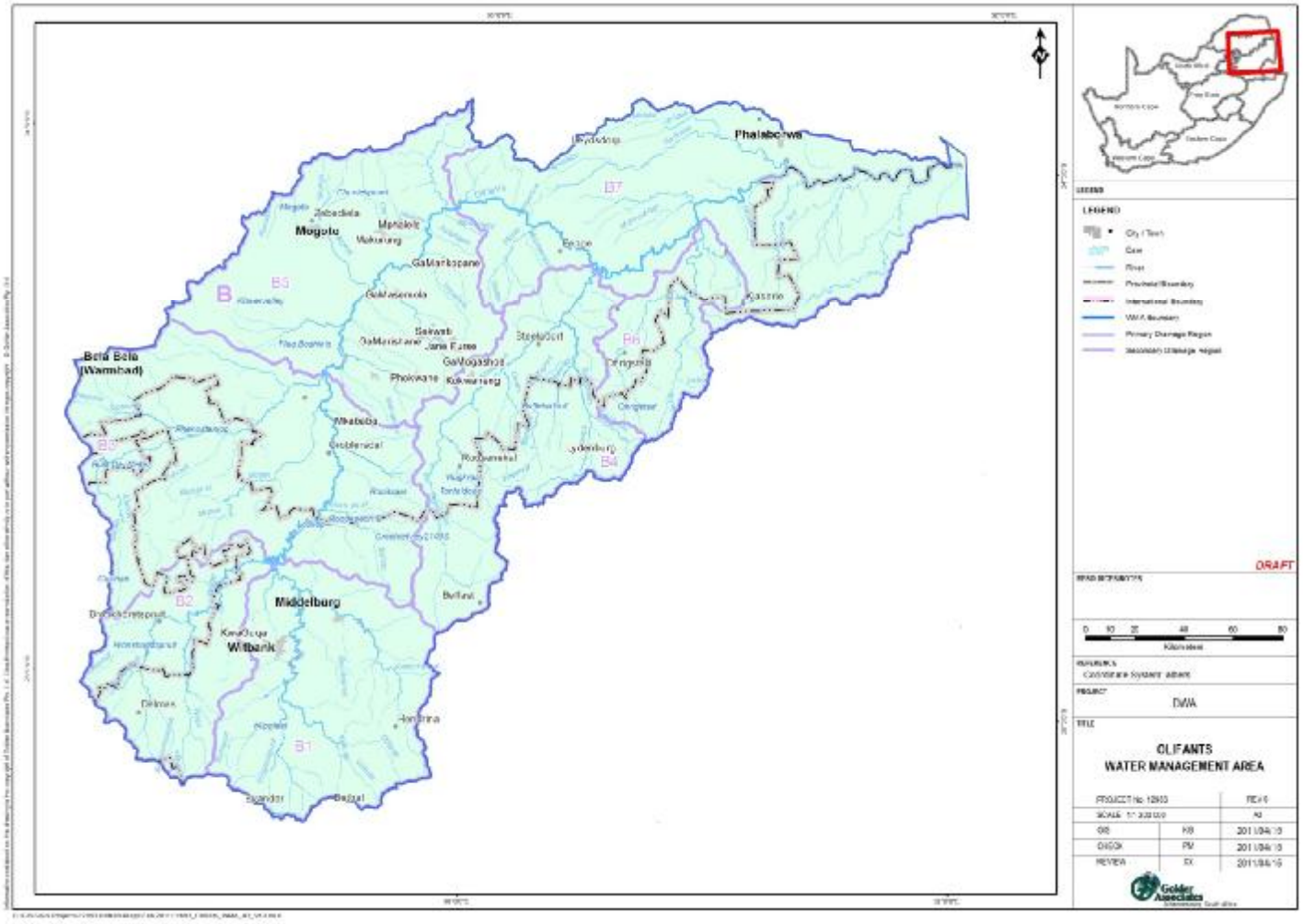

Figure 1: The Olifants WMA

The Olifants WMA is a highly utilised and regulated catchment and like many other WMAs in South Africa its water resources are becoming more stressed due to an accelerated rate of development and changing weather patterns resulting in the scarcity of water resources. There is an urgency to ensure that water resources in the Olifants River catchment area are able to sustain their level of uses and be maintained at their desired states. The determination of the Management Classes (MC) of the significant water resources in Olifants River System will ensure that the desired condition of the water resources, and conversely, the degree to which they can be utilised is maintained and adequately managed within the economic, social and ecological goals of the water users. The MC of the water resource will therefore set the boundaries for the volume, distribution and quality of the Reserve and RQOs, and thus the potential allocable portion of a water resource for use.

2 CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE OLIFANTS WMA

The National Water Act (Act No. 36 of 1998) (NWA) is founded on the principle that National Government has overall responsibility for, and authority over, water resource management for the benefit of the public without, seriously affecting the functioning of the water resource systems. In order to achieve this objective, Chapter 3 of the NWA provides for the protection of water resources through the implementation of resource directed measures (RDM). As part of the RDM, a management class (MC) has to be determined for a significant water resource, as the means to ensure a desired level of protection. The purpose of the MC is to establish clear goals relating to the quantity and quality of the relevant water resource.

The classification system, the Reserve and RQOs together are intended to ensure comprehensive protection of all water resources. An important consideration in the determination of RDM is that they should be technically sound, scientifically credible, practical and affordable.

The Chief Directorate: Resource Directed Measures (CD:RDM) of the Department of Water Affairs (DWA) is tasked with the responsibility of ensuring that the water resources are classified in terms of the Water Resource Classification System (WRCS) to ensure that a balance is sought between the need to protect and sustain water resources on one hand and the need to develop and use them on the other. The CD: RDM has identified the need to undertake the classification of significant water resources (rivers, wetlands, groundwater and lakes) in the Olifants WMA in accordance with the WRCS.

The MC and associated resource quality objectives (RQOs) will assist the DWA make more informed decisions regarding the authorisation of future water uses, operation and management of the system and the evaluation of the magnitude of the impacts of the present and proposed developments.

The purpose of this study is to coordinate the implementation of the 7 step process of the WRCS to classify all significant water resources the Olifants WMA in order to determine a suitable MC for the relevant water resources and in so doing deliver the IWRM template with recommendations for presentation to the delegated authority.

The determination of the MC is necessary to facilitate a balance between protection and use of water resources. In determining the class, it is important to recognise that different water resources will require different levels of protection. In addition to achieving ecological sustainability of the

significant water resources through classification, the process will allow consideration of the social and economic needs of competing interests by all who rely on the water resources. The WRCS will be applied taking account of the local conditions, socio-economic imperatives and system dynamics within the context of the South African situation. The process will also require a wide range of complex trade-offs to be assessed and evaluated at a number of scales.

There study approach for the determination of the MC includes:

- An assessment of the Olifants WMA to understand the status quo with regard to water resource quality, water resource issues, existing monitoring programmes, infrastructure, institutional environment, socio-economics, sectoral water uses and users, etc.
- The delineation of the WMA into integrated units of analysis (IUAs) based on identified criteria and system understanding and characteristics;
- The application of the WRCS within each IUA, *i.e.* establishing the MC by integration of the economic, social and ecological goals through a suitable analytical decision-making system (trade-offs).
- Population of the classification templates.

The study approach is defined by 6 tasks depicted in Figure 2.

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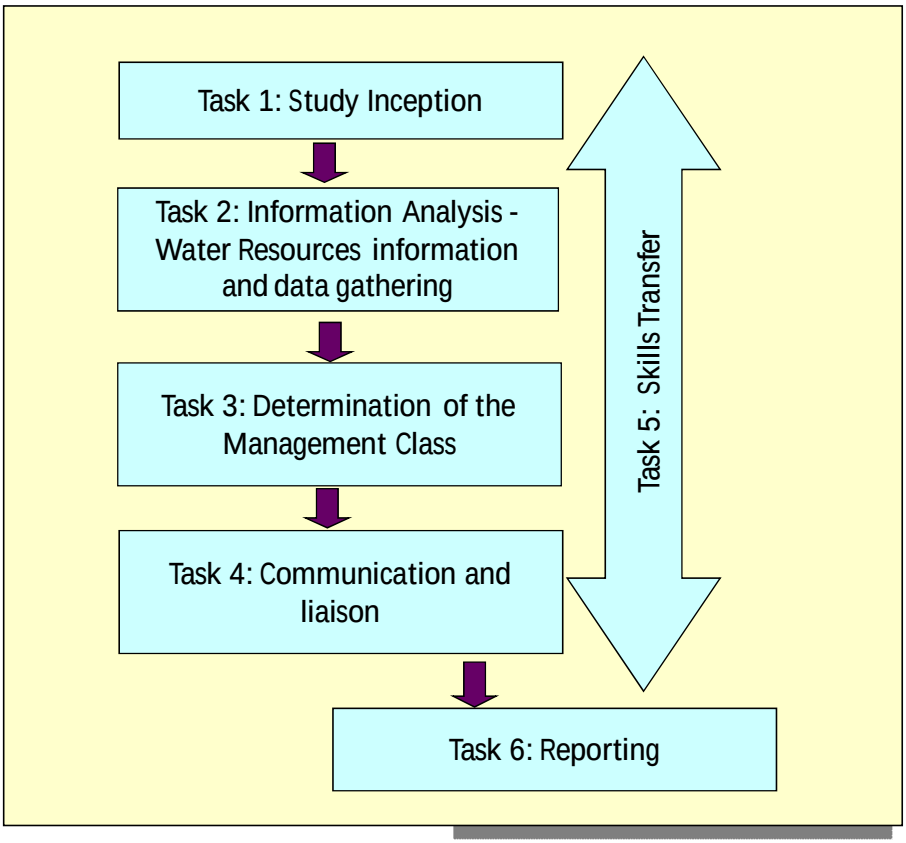

Figure 2: The study tasks

2.1 THE INFORMATION ANALYSIS TASK

In order for the Department to effectively classify the significant water resources of the Olifants WMA, a thorough understanding of the status quo and information availability of the WMA is needed to the determine existing situation. This task has been undertaken in compliance with the requirements of the study terms of reference that specify that the classification process is required to build from existing and current initiatives undertaken in support of integrated water resource management. The determination of the MC and application of the WRCS task is preceded by an information and data gathering component which supports the state of knowledge that is needed for the implementation of the classification process steps. The state of knowledge required involves the review and assessment of existing and parallel studies, data, information, reports, models, etc., that will form the departure point from where further analysis can proceed.

2.2 SPATIAL EXTENT OF STUDY

The spatial extent for the classification study includes secondary drainage regions B1 to B7, the catchment area of the Olifants WMA. This includes the Upper, Middle and Lower Olifants and Steelpoort river sub-catchment areas within the Olifants WMA (see Figure 3). The Letaba River catchment area is not included in the study area.

2.3 OBJECTIVES OF THE INFORMATION ANALYSIS TASK

The information analysis task was designed as part of the study to provide a high level analysis of the available water resource related data and information for the Olifants WMA in terms water resource quality, ecological water requirements, hydrology, water quality and socio-economics.

The specific objectives of the task are:

- To review previous studies and related reports and assess information availability and applicability;
- To assess available data and data sources (e.g. water quality, hydrology, hydraulics, economics data, water use information, etc.);
- To assess the status of parallel studies to determine the information availability and timing as it relates to the Olifants study classification process;
- To review set-up of the models to be applied;
- To assess the relevant gaps and how they may be addressed, and
- To confirm that the information available is applicable, adequate and reliable to undertake the classification of significant water resources in the Olifants WMA.

Figure 3: Olifants WMA indicating four sub-catchment areas

2.4 PURPOSE OF THE REPORT

This report focuses on the information analysis component which comprises task 2 of the study. The purpose of the report is to assess and review whether the information requirements of the study are met based on the information and data that is currently available through previous and parallel studies and to identify gaps that may be present which could influence the study process and progress.

3 INFORMATION ANALYSIS

This study is almost entirely reliant on existing results and information from previous studies or soon to be made available information and results from parallel studies. Information analysis was therefore focussed on understanding the availability, accessibility and usefulness of the information and data sources applicable to the Olifants WMA that are required for the implementation of the WRCS. It is critical to determine if any key information is outstanding or absent.

The information review has been initiated and undertaken during the inception phase and the outcomes of this are captured in the sections below. Previous studies undertaken for the Olifants River and its tributaries, including water resource planning, Reserve determination, water quality, socio-economic, augmentation and reconciliation strategies and specific detailed studies for WMA sub-areas have been sourced and reviewed. For parallel studies ongoing liaison has been established with other study teams and will be maintained to ensure transfer of information, data and reports takes place. This task has also included the assessing of the models that are to be used for the classification of the water resources in the Olifants

The above have been used to identify any gaps and outstanding information. Specific recommendations have been made as to the collection of additional data and/or the extrapolation of existing data. These have been discussed with client and will be confirmed in finalisation of this task 2.

At this stage the information analysis is not considered to be exhaustive and review will continue as new information and data come to light.

3.1 THE APPROACH ADOPTED TO CONDUCT THE INFORMATION ANALYSIS TASK

To achieve the objective of the information analysis, the following was considered in the assessment and evaluation of the related data and information for the Olifants WMA:

- Identification and review of key studies
- Information requirements from parallel studies
- Determination of the applicability and usefulness of the information/data
- Gap analysis to identify information/data that is not available and how the gaps will be addressed.
- Grouping of relevant information sources
- Mitigation measures in terms of identified risks.

In terms of the analysis, the assessment criteria applied to the study/information/data review compromised of:

- The *information requirements* of each of the seven steps of the WRCS (as per the classification Guidelines);

as applicable/relevant to the Olifants WMA (study area), which are summarised in Table 1.

Table 1: Information requirements of each of the seven steps of the WRCS

Information Requirements	WRCS Component Supported	WRCS Step
Water quality, water quantity, ecological status, resource quality baseline information. Water use allocation data. Status of infrastructure. Spatial data. Ecological Water Requirement (EWR) sites	• Status of the catchment significant water resources; • Delineation of IUAs; • Establishment of the network of significant water resources	Step 1
Socio –economic data for the WMA (per IUA defined): Macro-economic data; micro-economic data; population information; land use information; social data	• Socio-economic status/socio-economic framework; • Social well-being; • Decision analysis framework; • Linking of the value and condition of the water resources.	Steps 1, 2 and 5
Information/ data on ecological condition of water resources	• Significant water resource network establishment; • Establishment of nodes;	Step 1, 2 and 3
Ecosystem Goods, Services and Attributes (EGSAs) information/data; social data; water use data per sector per socio economic zone.	• Valuation of the use of the water; • Social well-being; • Linking of the value and condition of the water resources	Step 2, 3 and 5
Biological and eco-regional information; hydrology data; water quality data; Ecological Importance and Sensitivity (EIS); Present Ecological Status (PES); Resource Directed Measures data; Ecological Water Requirements; Conservation	• Status of the catchment significant water resources • Delineation of IUAs; • Establishment of the network of significant water resources • Quantification of the EWR changes in non-water quality EGSAs	Steps 1 to 5

Information Requirements	WRCS Component Supported	WRCS Step
data and information	• Establishment of nodes; • Establishment of the Ecologically Sustainable Base Configuration Scenario (ESBC) • Establishment of RDM configuration scenarios • Evaluation of scenarios	
Planning information (water requirements/needs)	• Establishment of the Ecologically Sustainable Base Configuration Scenario (ESBC)	Step 4
Water Resource Yield Model (water yield data)	• Quantification of the EWR changes in non-water quality EGSAs • Establishment of the Ecologically Sustainable Base Configuration Scenario (ESBC) • Evaluation of scenarios	Step 3, 4 and 5

The information analysis has been undertaken in terms of the above and is detailed in the sub-sections 3.2 to 3.6:

3.2 IDENTIFICATION AND REVIEW OF KEY STUDIES

Table 2 lists the relevant key studies that have been identified and reviewed as part of the previous studies undertaken in the Olifants WMA. Where identified the details of the reports/studies are to be consulted and used during the course of the study to support the information needs.

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Table 2: Review of identified key studies undertaken in the Olifants WMA of relevance to the Classification study

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
1	Olifants WMA Water Resources Situation Assessment	DWAF, Directorate National Water Resource Planning. 2004	This report is a desktop assessment of the available water resources and quality in the WMA. It also addresses patterns of water requirements that existed during 1995. The report highlights the principal water related issues, identifies water shortages and most importantly provides information that is necessary to formulate future strategies to ensure best sustainable water utilization.	The study provides good baseline and background information on the WMA.	The report does not address water requirements beyond 1995 but provide estimates of utilizable potential of water resources after their full development. More recent water use and water requirement information is required for the Classification study.
2	The Internal Strategic Perspective for the Olifants WMA	DWAF, Directorate National Water Resource Planning. 2004. Report No. P WMA 04/000/00/0304.	The ISP for the Olifants WMA provides a framework for DWA's management of water resources. The ISP details the strategies for water resource management and related water resource issues and concerns in the WMA.	The report provides good perspective of the water resources situation and the key water resource management issues facing the WMA. It includes good background and water resource related information on the WMA for the status quo assessment. The strategies highlight the focus areas that need to be considered.	The report is primarily a DWA internal perspective.
3	Olifants WMA: Overview of Water Resources and Utilisation.	DWAF, Directorate National Water Resource Planning. 2003. Report No. P WMA	The report provides an overview of the current and expected future water resources situation in the	The study provides good baseline and background information on the WMA for the status quo assessment and	The report is primarily a DWA internal perspective. Updated water availability and

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
		04/000/00/0203.	Olifants WMA as was the situation in 2002. It also highlights the key issues of relevance and provides broad strategies with regards to the management of water resources in the WMA. The report was compiled in support of the development of the National Water Resource Strategy.	understanding the WMA.	water utilisation information is required for the classification study.
4	The Olifants River Ecological Water Requirements Assessment: Technical input into the Ecological Management Class (EMC)	DWAF, Chief Directorate Resource Directed Measures. March 2001. Report No. PB 000-00-5499.	This report documents the specialist recommendations for the EMC, records the basis of these specialist recommendations, and provides information which contributes to the evaluation of stakeholder recommendations. Recommendations are based on the present ecological state, the ecological and social importance, and an assessment of the current processes affecting ecological status.	These results from the Comprehensive Reserve Determination study form the basis of the ecological information and data to be used during the classification process.	The data has been collected more than 10 years ago and in some areas the system has changed due to anthropogenic activities.
5	Development of an Integrated Water Resource Management Plan (IWRMP)	DWAF, Directorate National Water Resource Planning. July 2009. P WMA 04/000/00/7007	This study was a large scale study which has culminated in an IWRMP for the Upper and		

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
	for the Upper and Middle Olifants Catchment. IWRMP includes the following supporting reports: • Hydrology Report • Resource Water Quality Objectives Report • Water Quality Situation Assessment Report • Water quality model calibration report • Economic Model • Yield/WRPM report		Middle Olifants catchment areas. The plan incorporates the following outcomes of the study: • A set of integrated RWQOs for the study area and strategy to achieve them as required at selected river reaches / points. • A strategy to reconcile the available water resources with the water requirements. • A proposed institutional framework which can be used to manage the water resources in the study area, until the CMA is established. • An installed water resources modelling system which can be applied to manage the water resources of the study area. • A monitoring system to check on the progress with the implementation of the IWRMP and the state of water resources of the study area.	The study provides good baseline information which will be used in understanding the catchment situation and in the assessment and analysis of scenarios.	The IWRMP does not include the Lower Olifants and the Steelpoort catchment areas.

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
6	Upper Olifants River Catchment Wetland Inventory, Mpumalanga and Gauteng Provinces	Coaltech 2020. Exigent Engineering Consultants. December 2006.	This study focused on collating available literature on wetlands in the Upper Olifants River Catchment, and the compilation of a digital map for the area with an associated database.	The report defines wetlands as per DWA definition and includes wetland mapping of the area. A description of wetlands, their different types and their functions is clearly outlined. The database compiled forms a good reference of baseline information on wetlands. The wetlands delineated in the area will also be used in the assessment of goods and services.	Only the Upper Olifants area was included in the study, thus information on the Middle and Lower Olifants areas are lacking. The database is still to be sourced. The scale of mapping of the wetlands may not be suited to the scale required for the classification study. Other gaps noted: • Lack of data on specific wetlands attributes and status of wetlands • Water quality data of very few wetlands is known • There was limited field verification, thus attributes included in the database were based on aerial photographs. • The status of the wetlands was the most inaccurate attribute, since it was also based on aerial photographs.
7	State of the Rivers Report. Crocodile, Sabie-Sand and Olifants River Systems.	Water Research Commission. March 2001. Report No. TT 147/01	The report provides specific indices to indicate aquatic ecosystem health of the Crocodile, Sabie-Sand and	The report serves as a good reference guide for the state of aquatic health of the Olifants River system. It provides an overview of the study area (such as	The results of the assessment although serve as a useful guide may be outdated as the study was undertaken in 2001 (based

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
			Olifants River Systems.	land cover and land use, climate, population, terrain, economic profile and developmental priorities). It also provides the indices for: • Ecoregions and river characteristics. • The present ecological state for each ecoregion. • Drivers of ecological change (land use activities). • The desired ecological state and response by resource managers.	on 1998 and 1999 data), and habitats have been altered since then due to anthropogenic activities and system changes.
8	The nature, distribution and value of aquatic ecosystem services of the Olifants, Inkomati and Usutu to Mhlatuze Water Management Areas.	DWA, Chief Directorate Resource Directed Measures. 2010	The study attempted to provide a spatially explicit description of aquatic ecosystem goods, services and attributes and their estimated value for every significant water resource in the Olifants, Inkomati and Usutu to Mhlatuze WMAs. A simple modelling approach was taken in the study.	The study gives a good overview of the Olifants WMA describing the socio-economic components, topography, geology, ecology and water resources in detail, which will be of use to the socio-economic component of the study.	While the study provides a valuation of the ecosystem services in the Olifants WMA, these may not be applicable once the scenarios have been set for the current study.

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
9	Olifants River Catchment Site Visit and Scoping meeting report	DWAF, Chief Directorate Resource Directed Measures and IUCN. June 2007.	The report provides the details of a site visit and scoping meeting attended in June 2007 by representatives from the DWA Head Office and Regional Office (RO), IUCN and Kruger National Park (KNP). The site visit was to the Blyde River catchment. In terms of the scoping meeting representatives identified the main issues/concerns for the Olifants River catchment.	The report provides useful information for the ecological component of the classification study (site information, issues of concern, etc.)	Limited detail.
10	Water Quality overview and literature review of ecology of the Olifants River.	Water Research Commission. March 2010.	This report gives an overview of the water quality status and further synthesis the literature on the aquatic ecology with possible linkages to water quality.	A good description of the study area, its major tributaries and impoundments. It outlines the major activities/land uses taking place in the area. A useful map on land use is provided. Water quality analysis and trends identified will be useful in the classification process.	Largely an overview perspective, with limited detail in terms of water quality.
11	Ecological and Economic evaluation of wetlands in the Upper Olifants River Catchment.	Water Research Commission. November 2002.	The report provides a preliminary assessment of the ecological and economic values of wetlands in the Upper Olifants River Catchment (UORC). The wetlands were classified on the basis of hydro-geomorphic determinants. A detailed digital map,	Good desktop discussion on the biodiversity of wetlands in the Olifants catchment which could be useful in interpreting water quality data. (discussion is on a desktop level only and needs field verification). A brief discussion on land use patterns and land ownership is included which could be useful in interpreting water	Only the Upper Olifants area was included in the study, thus value of the wetlands for downstream users is not considered. The statements, conclusions and recommendations made in this report may be invalid at this time as more updated information may be available at this stage. In

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
			captured at a scale of 1:50 000 and reproduced at a scale of 1:160 000, showing the distribution of various wetland types in the Upper Olifants River catchment, accompanies the report.	quality data.	addition the wetland condition and health may have changed. The scale of mapping of the wetlands may not be suited to the scale required for the classification study.
12	Framework and Manual for the evaluation of aquatic ecosystems services.	Water Research Commission. 2010.	This document provides a framework and manual to guide practitioners conducting the evaluation of aquatic ecosystem services required in establishing resource directed measures for the protection of water resources in any Water Management Area (WMA).	This framework will be used in the assessment of scenarios and in the evaluation of trade-offs.	The lack of data in terms of application.
13	Environmental Management Framework for the Olifants and Letaba Rivers Catchment Areas (OLEMF).	Environomics Environmental Consultants. December 2009	The EMF provides a framework to 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. It provides guidance to meet regulatory requirements and a decision support system for	The EMF provides very baseline, status quo information on the Olifants catchment area. The spatial representation of the key environmental elements and human activities is very useful. The GIS component will be extremely useful for this study.	Information is primarily at a spatial scale. More detailed information is required for the socio-economic model and assessment of scenarios.

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
			development in the area to ensure that environmental attributes, issues and priorities are taken into account.		
14	Olifants River Water Resources Development Project (ORWDP): Phase 1 and 2	DWAF, Directorate National Water Resource Planning. 2009.	The Project included two phases – the main phase, phase 1 included the raising of Flag Boshielo Dam and phase 2 the consisting of the building of De Hoop Dam and other infrastructure such as pipelines, specifically in the Middle Olifants region. The project included a number of specialist environmental and engineering reports.	Some of the study reports provide good baseline information on the Olifants River catchment and the associated impacts of water resources development. The information does prove useful for understanding the issues in the catchment.	The information/reports are focused on and specifically related to the ORWDP (and catchment area).
15	Smallholder irrigation and agricultural development in the Olifants River Basin of Limpopo Province: Management Transfer, Productivity, Profitability and Food Security Issues.	Water Research Commission. December 2004.	The specific aims of the study were to assess productivity and profitability of smallholder irrigation and the potential for achievement of food security; to identify cropping and irrigation management practices; to determine the effects of irrigation practices on soil salinity; and to examine the institutional and organizational arrangements affecting smallholder irrigation. The report outlines a number	The information will be of use to the socio-economic component of the study.	Information is limited to six irrigation schemes in the basin (in the Limpopo Province).

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
			of findings and recommendations of the above in the Olifants River Basin of the Limpopo Province.		
16	Inventory of River Health Programme Monitoring sites on the Olifants, Sabie and Crocodile Rivers.	Water Research Commission. May 2001.	The report is an inventory that contains information on each of the 201 sites monitored during pilot River Health surveys undertaken in the Mpumalanga Province during 1996 to 1999 as well as summaries of the three primary biological indicators that are used in the River Health Programme.	The report provides good information on RHP sites in the Olifants, Sabie and Crocodile Rivers.	Survey data may no longer be applicable due to system changes and anthropogenic activities. Sites may no longer be accessible.
17	Collection of reports/studies completed on water related aspects in support to WQP piloted in the Oilfants Water Management Area.	Directorate Water Resource Planning Systems. Water Quality Planning. August 2010.	This report is a collection of information with respect to water quality issues identified in Olifants WMA. The report discusses the identified different sources of information and reports collected from each source are summarized per report.	Provides a reference for possible sources of information and data related to water quality.	List of information is limited to water quality related reports.
18	Ecological Water Requirement sites: Evaluation and recommendations for the Olifants River, Mpumalanga,	The World Conservation Union (IUCN), 2008. Report produced by R Stassen, Dr C Brown, A Jordanova, C Todd & Dr J Engelbrecht.	The main objective of this study was to re-visit the existing EWR sites as identified during the 2001 comprehensive Reserve study	The information in emanating from this study will be utilized to identify the final set of rivers where additional field work need to be undertaken if estimation and/or extrapolations can't be undertaken using existing EWR site	Other significant tributaries may be identified during the classification process which have not been evaluated.

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
	2008		and evaluate the current (2007) state of the sites in terms of accessibility and further use for monitoring purposes. The second objective was to identify additional EWR sites where Reserve determination needs to be undertaken to ensure a better coverage of EWR sites. This was specifically to address the shortcoming of the 2001 study that only concentrated on the main stem Olifants and major tributaries.	information.	
19	Management of Environmental impacts from coal mining in the Upper Olifants River Catchment as a function of age and scale	P. Hobbs, S.H.H Oelofse and J. Rascher. Water Resources Development, Vol. 24, No: 3, p417-431, 2008.	This paper provides an overview of coal mining, water resources and AMD in the upper Olifants River catchment. The formulation of water legislation in relation to AMD is discussed and three examples of AMD related water management is explored.	Some information on the impacts of coal mining (acid mine drainage) are described for the Witbank Dam catchment area. This may be of value during the socio economic assessment of water quality impacts.	Limited detail is provided.
20	Mid-Olifants Integrated Water resources Management Plan: Agricultural Sector Report	DWAF, Directorate National Water Resource Planning. March 2007. Prepared by Golder Associates Africa (Pty) Ltd. Report number	The study looked at quantifying present irrigation water use, the types of crops being irrigated, the future trends in cropping patterns	The study provides useful information on the agricultural activities of the Mid-Olifants catchment that will be incorporated into the socio-economic component of the study.	The study did not address the entire Olifants WMA.

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
		6894/9401/5/B	and water requirements and the minimum water quality requirements for these enterprises, in order to prepare a meaningful and effective IWMP for the catchment and in turn the setting of appropriate WQO for Loskop Dam. An economic model was developed to show the effect of salinity on the value of agricultural production.	The economic model, which shows the effect of salinity on the value of agricultural production, will be utilized if such analysis is required once the scenarios are set.	
21	Risk assessment of pollution in surface waters of the Upper Olifants River system: implications for aquatic ecosystem health and health of human users of water.	J. M. Dabrowski *et al.* CSIR Report to the Olifants River Forum, April 2010. CSIR/NRE/WR/ER/2010/0025/B	This was a baseline study that looked at water quality and aquatic health indicators to assess health of the ecosystem in the Upper Olifants catchment area. The study makes an attempt to link specific pollutants in the upper Olifants catchment to specific land uses or stressors, identify important priority pollutants in the catchment in terms of their potential to negatively impact on human and ecological health, and lastly to identify hotspot areas for specific pollutants.	The report does provide a source of water quality related information for the Upper Olifants catchment (impacts, stressors, possible land bases sources). This information will be useful in understanding water quality characteristics.	Report is intended for use by the Olifants River Forum. Permission to use the information needs to be obtained. Assessment is limited to the Upper Olifants catchment area.

No	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Olifants River Classification Study	Possible Limitations
22	Blydepoort River Systems; Development of operating rules.	DWAF. Directorate National Water Resource Planning. 2009.	Still to be sourced		
23	Ecological Reserve determination Study (Rapid III) for the Treur River, tributary of the Blyde River, in Mpumalanga.	DWAF, Chief Directorate Resource Directed Measures. 2008.	This report provides the results of the preliminary determination of the quantity requirements of the Reserve on a rapid level III for the Treur River in quaternary catchment B60C. The results were obtained with the Desktop Reserve Model (SPATSIM, version 2.7) and accepted by the various specialists for a recommended ecological category of A/B.	The results of the study will form the basis of the ecological information and data to be used during the classification process for the Treur River catchment area.	The Treur River has a very high ecological importance and sensitivity (Ecostatus is a A/B category). The overall confidence in the results is however low. Thus there may be limitations in the use of the data.
24	Assessment of Water Availability in the Olifants WMA by means of Water Resource Related models		Still to be sourced		

3.3 INFORMATION REQUIRED FROM PARALLEL STUDIES

Table 3 lists the relevant information and reports from parallel studies that will support the information needs of the Olifants WMA classification study.

Table 3: Parallel studies underway in the Olifants WMA that support the information needs of the Classification study

No	Study underway	Information Source	Information needs supported	Status of information	Possible risk
1	Development of a Reconciliation Strategy for the Olifants River Water Supply System	DWA, Directorate National Water Resource Planning	Water supply and use information, water demands and requirements, projections and water infrastructure information. Updated hydrology Water Resources Planning Model (WRPM)	At various stages of collation.	Information gaps in water use, supply, demand and requirement information may require additional data collection. If necessary WRPM may need to re-calibrated.
2	PES/EIS 2010 Database Update	DWA Chief Directorate: Resource Directed Measures and the Water Research Commission	Updated PES/EIS for all sub-quaternary catchments in the Olifants WMA. Identification of priority tributaries and sub-nodes.	Still to be obtained	Any delay beyond June 2011 could impact on Classification study programme
3	National Freshwater Ecosystems Priority Areas (NFEPA) Project	(CSIR, DWA, Department of Environment Affairs, south African National Biodiversity Institute, World Wildlife Fund, 2010)	Identification of National Freshwater Ecosystems Priority Areas - to support delineation of sub-nodes/priority tributary sub-catchments	Draft maps are in the process of being sourced. Meeting still to be set up with the study technical manager to compare NFEPAs in the Olifants WMA with ground truthing and existing information.	Discrepancy between NFEPAs and priority sub-catchments identified
4	Situation assessment of the ecology and water quality of the Upper Olifants	CSIR and Coaltech	Water quality and ecological related information (related to the coal mining impacts) – to support information needs for assessment of risks	In the process of being collated	Spatial scale of information maybe limiting

No	Study underway	Information Source	Information needs supported	Status of information	Possible risk
5	Water Supply Reconciliation strategies for towns in the Northern Region	DWA, Directorate National Water Resource Planning	Water requirements and demand information for all the small towns in the Olifants WMA Population Data information	At various stages of completion. To date the only strategy obtained is that for the Emalahleni and Springvalley clusters.	Delays in information on water requirements for small towns could influence on Classification study programme.
6	Controlled release scheme in the Middleburg and Witbank Catchments	DWA	Water quality and flow information	Ongoing	
7	Development of operating rules for stand-alone dams/schemes typical for small municipal set-ups.	DWA, Directorate National Water Resource Planning	System operation information	Still to be confirmed	Could influence scenario analysis of sub-nodes

3.4 RELEVANT/INFORMATION DATA SOURCES

Data and information available from various sources is required to undertake the classification of significant water resources in the Olifants WMA Classification Study. These sources will form data inputs or base information to various steps in the classification process. The data/information required is at various stages of collation. Table 4 outlines the data and information sources, the status of collation and their applicability to the classification process. Sections 3.4.1 to 3.4.5 describe the requirements further.

Table 4: Data sources supporting information needs of study

Information/Data required	Status of Collation	Applicability to process
Key previous studies applicable to the Olifants WMA	Obtained (see Table 1)	Status quo description; IUA delineation; Establishment of network of significant water resources
NFEPA maps	Obtained (see Table 1)	Status quo description; IUA delineation; Establishment of network of significant water resources
Updated hydrology for the Olifants WMA	Obtained	Required for node establishment. Required for the WRPM/WRYM - to be used in determining flows at the node, for the EBSC and the scenario assessment (socio-economic)
Yield Model	Obtained	Required for the quantification of the EWR changes in non-water quality EGSAs; establishment of the ESBC and evaluation of scenarios
Water Resources Planning Model (which includes water demands, future requirements)	Still to be sourced	Required for the WRPM/WRYM - to be used in determining flows at the node, for the EBSC and the scenario assessment (socio-economic)
Updated water quality data and information from the Water Management System of the Department.	Some information in hand. Additional data in the process of being obtained from the Directorate Resource Quality Services.	Required for the EBSC and scenario assessment

Information/Data required	Status of Collation	Applicability to process
Ecological Water Requirements (Information, data, models, indices)	Data and models to be sourced.	Required for ecological water requirements determination, for the ESBC and the assessment of scenarios
PES/EIS 2010 Update – Excel database for the Olifants WMA	Data and models to be sourced (currently being populated)	Required for delineating IUAs and significant water resources and determination of nodes and sub-nodes
The nature, distribution and value of aquatic ecosystem services of the Olifants, Inkomati and Usutu to Mhlatuze Water Management Areas.	Obtained	To be used in socio-economic decision-analysis framework development and in assessment; and in the linking of the value and condition of the water resource
Land use, population data, socio-economic data; macro and micro economic data and related information from Stats SA; water users; Governments Departments; Chamber of Mines, etc.	Various stages of collation	To be used in socio-economic decision-analysis framework development and in the scenario assessment
Statistics SA's Water Resource Accounts	Obtained	To be used in socio-economic decision-analysis framework development and in assessment;
The Millennium Ecosystems Assessment framework of ecosystem services	Obtained	To be used in determining/identification of ecosystem system services of value
Best practice resource economics	Obtained	To support socio-economic decision-analysis framework and methodology development and in assessment of scenarios
Social accounting analyses	Obtained	To be used in socio-economic decision-analysis framework and methodology development
The Social Accounting Matrix (SAM) models of the Development Bank of South Africa (DBSA)	Obtained	To be used in socio-economic decision-analysis framework and methodology development
River Health Programme Studies: Olifants River	Information collation ongoing	To enhance data collected for the Reserve determination and PES/EIS

The study team will liaise with the responsible persons/organisations to obtain the required data sources. However if necessary, the assistance of the Department may be required to facilitate the acquisition of some of the above data sources, specifically with obtaining some of the ecological-related data sources and some economic information.

3.4.1 Hydrology

A comprehensive study to update the surface water hydrology of the Olifants River catchment was recently completed in 2009. The updated hydrology is available and will be used for the Olifants WMA classification study.

As the latest hydrology is significantly different to the previous hydrology used for the Reserve Determination study of 2001, the updated hydrology was used for the hydrological extrapolation of existing EWR results to the identified management units in the Upper and Middle Olifants and to the outlet of quaternary catchments for the Lower Olifants. This information, together with the hydraulic profiles and biotic information and models will be used during the evaluation of the various ESBC scenarios.

3.4.2 Water Quality

The Department of Water Affairs Resource Quality Services (RQS) water quality database will be used as the source of the water quality data for this analysis. A substantial amount of data has been collected and analysed and some further assessment will be done. However a number of previous studies have analysed water quality to a fine resolution, thus data analysis will not be extensive.

Some further data sources will be investigated to obtain additional water quality monitoring data such as those of the local municipalities and mines in the WMA. This data will be useful in understanding local sub-catchment water quality status and related impacts.

The WMS database of DWA (RQS) includes water quality variables that are analysed for: Electrical Conductivity (EC), Total Dissolved Salts (TDS), pH, Sodium, Magnesium, Calcium, Potassium, Fluoride, Chloride, Sulphate, Phosphate as P, Total Alkalinity as $CaCO_3$, Ammonium as N, Nitrate + Nitrite as N. No trace metal or organic analysis is performed as part of this routine monitoring (Pers. Comm. DWA Regional Office – Mpumalanga). For the purposes of this study, the certain indicator variables will be used to assess current status.

The monitoring points of the DWA National Chemical Monitoring Programme (NCMP) (WMS data) within the Olifants WMA are primarily located on the main stem Olifants River and the major tributaries (Trichardspruit, Klipspruit, Wilge River, Elands River, Steelpoort River, Blyde River and Ga-Selati River) (Figure 4). A challenge posed for the classification study is the determination of the water quality status at more remote sites where no monitoring is currently undertaken – specifically if a sub-node is identified in a smaller tributary catchment with a high PES/EIS. An attempt will be made to use neural network analysis to address this information gap.

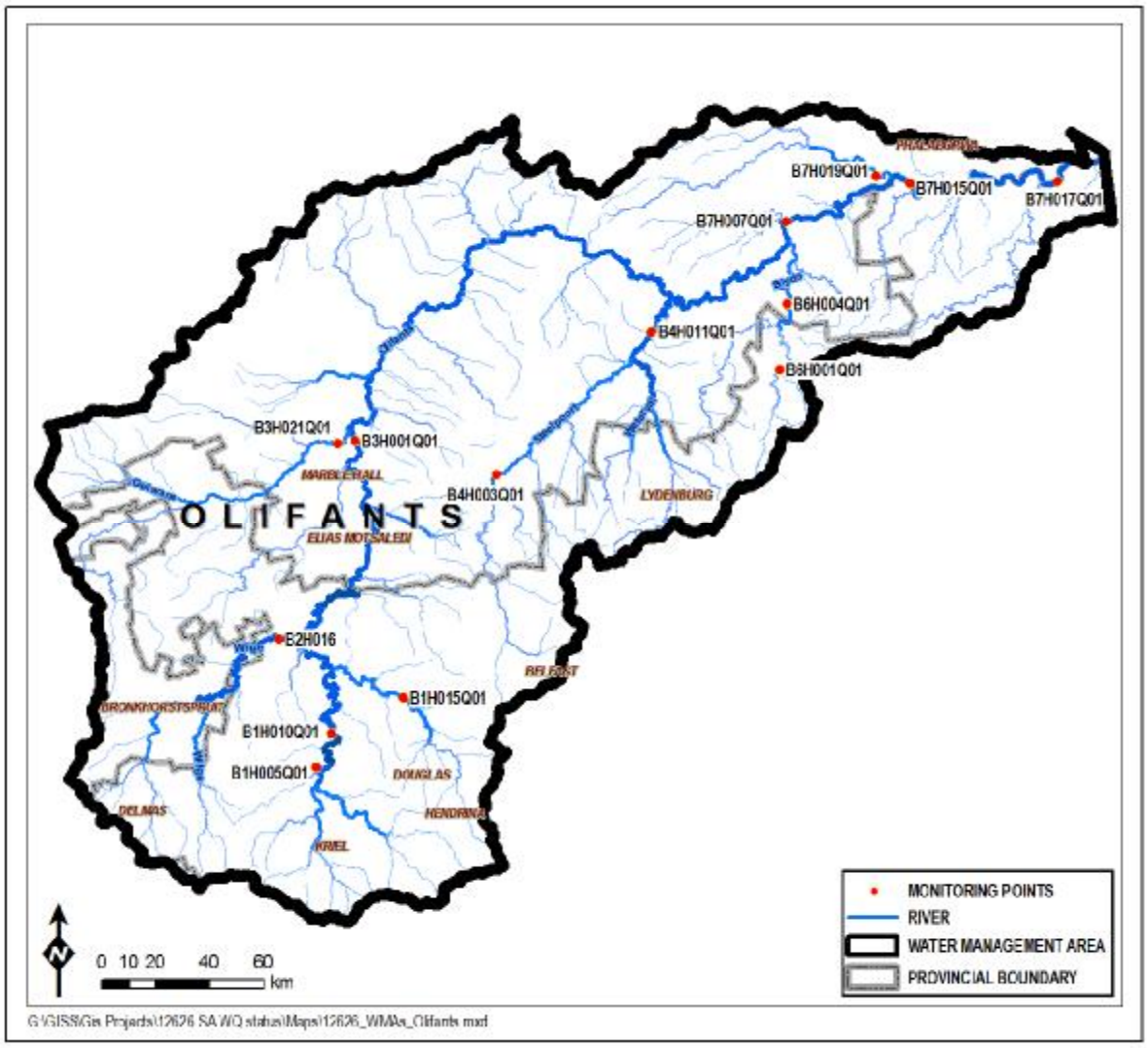

Figure 4: Location of selected DWA water quality monitoring points across the Olifants WMA

3.4.3 Ecological

The following sources were considered to determine the availability of data and/or information for the ecological component of the classification of the water resources of the Olifants River in Mpumalanga. This information together with other data to be gathered will form the basis of the ecological assessment.

(a) Comprehensive Reserve determination study

The results from this study will form the basis of the ecological information and data to be used during the classification process. However, this data has been collected more than 10 years ago and in some areas the system has changed due to anthropogenic activities. This was confirmed during a site visit to a number of the existing site as part of an IUCN study undertaken in 2008.

The main results from the study are summarised in Table 5 and Table 6 below.

The rules as determined during the comprehensive study to obtain the ecological requirements will be used during this study for the existing EWR sites and where applicable for estimation and/or extrapolation to other areas.

The existing hydraulic profiles will be utilized during the proposed specialist workshop to confirm the flows and for the interpretation (to determine possible ecological consequences) of the various flow scenarios at the EWR sites during the determination of the ESBC.

Table 5: **Summary of PES, EIS and REC per resource unit**

REACH	PES	EIS	REC
Upper Olifants River : Segment 1 - 8	D	Moderate	D
Upper Olifants River : Segment 9 - 13 (Witbank Dam)	E	Moderate	D
Upper Olifants River : Segment 14 (Doringpoort Dam) - 27 (At & excluding Klipspruit confluence)	D	Moderate	C
Upper Olifants River : Segment 29 (Wilge confluence) - 37 (upper end of Loskop Dam)	C	High	B
Klein Olifants River : Segment 1 - 4 (Middelburg Dam)	D	Moderate	D
Klein Olifants River : Segment 5 (Middelburg Dam) - 12 (Olifants confluence)	D	Moderate	D
Wilge River : Segment 1 (Bronkhorstspruit Dam) 7 (Premier Mine Dam) (Bronkhorstspruit River)	C	Moderate	C
Wilge River : Segment 7 (Premier Mine Dam) - 20 (Olifants confluence)	B	High	B
Middle Olifants River : Segment 39 (Loskop Dam Wall) - 45	C	High	B
Middle Olifants River : Segment 46 - 57 (Arabie Dam)	D	Moderate	D
Middle Olifants River : Segment 58 (Arabie Dam Wall) - 84	E	Moderate	D
Elands River : Segment 1 - 7 (Rust de Winter Dam)	C	Moderate	B
Elands River : Segment 8 (Rust de Winter Dam) - 15 (Renosterkop Dam)	E	Moderate	C
Elands River : Segment 16 (Renosterkop Dam) - 27 (Arabie Dam - Olifants confluence)	E	Moderate	D
Lower Olifants River : Segment 85 - 99 (Blyde confluence)	E	High	D
Lower Olifants River : Segment 100 (Blyde confluence) - 110 (Selati confluence)	C	High	B
Lower Olifants River : Segment 111 (Selati confluence) - 132 (Mozambique border)	C	High	B
Selati River : Segment 1 - 9	C	Moderate	C

REACH	PES	EIS	REC
Selati River : Segment 10 - 18	E	Moderate	D
Blyde River : Segment 1 (Blydepoort Dam) - 8 (Olifants River confluence)	B	High	B
Steelpoort River : Segment 1 - 8	D	High	D

Table 6: Summary of EWR site information

EWR site	River	Quaternary	PES	EC	EIS	%EWR	EWR (MCM)
1	Olifants	B11J	E	C	Moderate	18.6	27.59
2	Olifants	B32A	C	B	High	23.8	116.38
3	Klein Olifants	B12E	D	C	Moderate	27	19.9
4	Wilge	B20J	B	B	High	29.9	57.74
5	Olifants	B32D	C	B	High	19.09	95.52
6	Elands	B31G	E	D	Moderate	17.9	11.33
7	Olifants	B51G	E	D	Moderate	12.7	89.39
8	Olifants	B71B	E	D	Moderate	15.2	127.05
9	Steelpoort	B41J	D	D	High	15.2	26.03
10	Steelpoort	B41K	D	D	High	12.1	49.17
11	Olifants	B71J	E	D	High	13.7	189.8
12	Blyde	B60J	B	B	High	34.5	132.33
13	Olifants	B72D	C	B	Moderate	23.6	434.86
14a	Selati	B72K	C	C	Moderate	31.2	17.13
14b	Selati	B72K	E	D	Moderate	24.8	16.12
16	Olifants	B73H	C	B	Very high	21.6	425.73

(b) State of the aquatic ecosystems in the Olifants WMA (2007)

The purpose of this study was to undertake a desktop assessment of the water resources to update the 1999 spreadsheet of present state and ecological importance and sensitivity per quaternary catchment utilizing all additional information available since the completion of the comprehensive Reserve determination study in 2001.

Matrices were developed to determine the overall ecological importance per quaternary catchment

of the resource by integrating the PES and EIS information (see Figure 5) and to determine the proposed level of Reserve determination to be undertaken by incorporating an estimate of water resource stress based on water availability (see Figure 6).

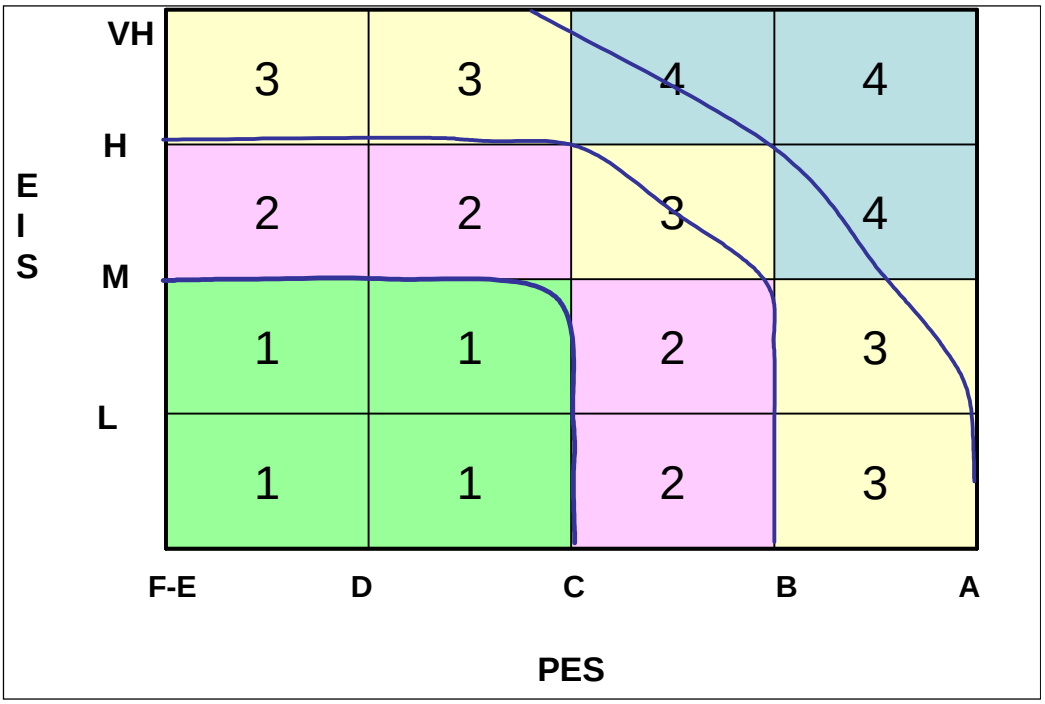

Figure 5: Ecological importance using PES and EIS

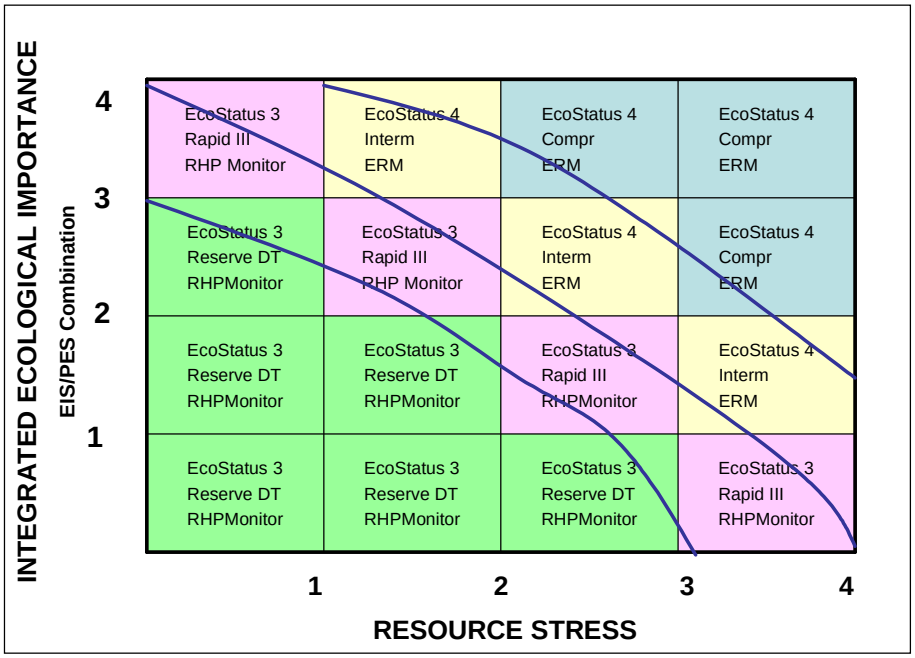

Figure 6: Matrix indicating the level of Reserve required

The desktop results of the evaluation of PES and EIS per quaternary catchment are attached as Appendix A.

(c) Ecological Water Requirement sites: Evaluation and recommendations for the Olifants River, Mpumalanga

The main objective of this study was to re-visit the existing EWR sites as identified during the 2001 comprehensive Reserve study and evaluate the current (2007) state of the sites in terms of accessibility and further use for monitoring purposes. The purpose of the study was not to re-evaluate the PES or EIS of the sites.

The second objective was to identify additional EWR sites where Reserve determination need to be undertaken to ensure a better coverage of EWR sites. This was specifically to address the shortcoming of the 2001 study that only concentrated on the main stem Olifants and major tributaries. These additional sites could also be used for extrapolation purposes in future.

A summary of the sites visited and comments on the state of these sites are provided in Table 7 and Table 8 list the new sites that were identified.

Table 7: Summary of evaluation of EWR sites revisited during October 2007

Existing EWR site	River	Quaternary catchment	Visited/not	Comments
IFR1	Olifants	B11J	Yes	Existing site inundated due to the construction of a weir downstream. Possible site higher upstream.
IFR2	Olifants	B32A	Yes	Site still intact and can be used for future surveys and monitoring.
IFR3	Klein Olifants	B12E	No	Not accessible due to the development of a resort. New site to be found for future surveys.
IFR4	Wilge	B20J	Yes	Access to be arranged prior to surveys. The site is still intact, but situated in a fenced-off area.
IFR5	Olifants	B32D	Yes	Existing site inundated due to the construction of a weir.
IFR6	Elands	B31G	No	Not visited due to time constraints.
IFR7	Olifants	B51G	No	Not visited due to safety reasons.
IFR8	Olifants	B71B	Yes	Existing site changes after the floods. New site to be found.
IFR9	Steelpoort	B41J	Yes	Site still available for surveys and monitoring.

Existing EWR site	River	Quaternary catchment	Visited/not	Comments
IFR10	Steelpoort	B41K	Yes	Not visited due to time constraints.
IFR11	Olifants	B71J	Yes	Site still available for future surveys and monitoring. Access to be arranged prior to visit.
IFR12	Blyde	B60J	Yes	Site still intact for future surveys and monitoring
IFR13	Olifants	B72D	Yes	Existing site changed due to recent floods. Not suitable for hydraulic of macro-invertebrate surveys
IFR14A	Ga-Selati	B72K	Yes	Existing site has changed. Most of the time the river is dry and won't be suitable for surveying or monitoring.
IFR14B	Ga-Selati	B72K	Yes	Not visited due to access control by the mine.
IFR16	Olifants	B73H	No	Not visited due to time constraints.
Bronkhorstspruit	Bronkhorstspruit	B20C	No	Not visited due to time constraints
Treur EWR1	Treur	B60C	Yes	Fairly good site for future surveys and monitoring.
Dwars EWR1	Dwars	B41H	Yes	Fairly good site for future surveys and monitoring.

Table 8: Possible new sites identified for higher confidence Reserve determination studies

River	Catchment	Comment
Zaalklap	B20G	Desktop assessment indicated only a desktop level Reserve is required for this river.
Spekboom	B42E	Desktop assessment indicated a comprehensive level Reserve is required for this river. A potential EWR site after the confluence with the Waterfalls River was selected.
Mohlapitse	B71C	Desktop assessment indicated a comprehensive level Reserve is required for this river. A potential EWR site just upstream of the confluence with the Olifants River was selected.
Blyde/Treur	B60A, B, C	Desktop assessment indicated a rapid level Reserve is required for this river. A rapid III study was undertaken in 2007 as part of the IUCN study.
Brug/Klip	B11K	Desktop assessment indicated a rapid level Reserve is required for this river. No EWR site was selected due to time constraints.

River	Catchment	Comment
Bronkhorstspruit	B20C, D	Desktop assessment indicated a desktop/rapid level Reserve is required for this river. CD: RDM undertook a rapid III study during 2005 in this area.
Orighstad	B60F, G, H	Desktop assessment indicated an intermediate level Reserve is required for this river. A potential EWR site upstream of Blyderivierspoort Dam, but is only accessible by boat.
Dwars	B41G, H	Desktop assessment indicated an intermediate level Reserve is required for this river. An intermediate Reserve determination study was undertaken by BKS for Anglo Mines during 2007/8.
Elands	B31D, F	Desktop assessment indicated only a desktop level Reserve is required for this river.
Upper Olifants	B11A-G	Desktop assessment indicated a rapid level Reserve is required for this river. No EWR site was selected due to unsuitable characteristics for EWR sites.
Upper Klein Olifants	B12A-C	Desktop assessment indicated a rapid level Reserve is required for this river. An EWR site at the N4 road crossing just upstream of Middelburg Dam was selected.
Klip River	B41F	Desktop assessment indicated a comprehensive level Reserve is required for this river. No EWR site was selected due to time constraints.
Waterfalls	B42F	Desktop assessment indicated an intermediate level Reserve is required for this river. No EWR site was selected due to time constraints.
Makutsi	B72A	Desktop assessment indicated a comprehensive level Reserve is required for this river. No EWR site was selected due to time constraints.

This information will be utilized to identify the final set of rivers where additional field work needs to be undertaken if estimation and/or extrapolations can't be undertaken using existing EWR site information.

3.4.4 Socio-economics

In terms of the socio-economic information for the Olifants WMA, social data comes primarily from the StatsSA 2001 Ward Census Data. While this data may be fairly outdated, the next Census is due to take place this year (2011) and the results will only be available in a few years after that.

Information to be used from this database will include the following:

- Household income;
- Household sanitation;
- Household water services;

- Person by labour employment;
- Person by labour industry; and
- Person by labour occupation.

The underlying data from the DWA (2009) report entitled: “Development of Water Reconciliation Strategies for All Towns in the Central Region: Demographic Scenario Report” will also be utilised.

Further to this the study undertaken by DWA viz. “The nature, distribution and value of aquatic ecosystem services of the Olifants, Inkomati and Usutu to Mhlatuze Water Management Areas” will be relied upon to a large extent to for the selection of the ecosystem values to be considered based on ecological and economic data and for the description of the relationships that determine how economic value and social wellbeing are influenced by the ecosystem characteristics and the sectoral use of water.

(a) Mining Data

Data has been collected from the Chamber of Mines, The Department of Mineral Resources (DMR), Statistics SA and the Council for Geoscience. The Olifants River Forum is currently conducting a study on the impacts of coal mining on the Olifants River and will be contacted in due course.

Data Gaps

Data for mining production is aggregated on a National and Provincial level, so it is difficult to make assumptions on a WMA scale. The Council of Geosciences has spatial data that may be of use to the study, but there is a cost associated with the data, which may be prohibitive. A quote is available on request.

(b) Agricultural Data

The Department of Agriculture, Forestry and Fisheries (DAFF) has been contacted with regards to our data requirements and have expressed their willingness to assist.

To date, some data has been received from Provincial Department of Agriculture.

3.4.5 Supporting information

Other supporting information such as water user sector information, water users in the catchment (and water quality requirements), land use, water infrastructure and water allocation information, environmental information, biodiversity and conversation data are in the process of being sourced from various previous and parallel studies (discussed in the previous sections) and from DWA. As primary data collection is not part of this study a synthesis of available will be prepared for use in this study. Where data is not available conservative assumptions will be made.

3.5 MODELS

The Water Resource Planning Model (WRPM) and the Water Resources Yield Model (WRYM) for the Olifants WMA of the DWA, Directorate National Water Resource Planning will be relied upon to determine and ESBC.

The WRYM has been calibrated for the Reconciliation study that is currently underway, has been sourced for use in this study. The model does include the updated hydrology.

3.6 OTHER

Data available from the River Health Programme (RHP), the NFEPA project, WMS, water quality assessments and the updated PES, EI and ES (current study) will be used to populate the models during the specialist workshop to evaluate the ESBC scenarios.

This information will enhance the data collected for the comprehensive Reserve determination study and will assist the specialist to make recommendations on more current data.

4 IDENTIFICATION OF POTENTIAL INFORMATION GAPS

In terms of the information analysis undertaken key information gaps that have been identified for the study relate to three aspects*, viz*:

- The ecological water requirements component,
- The socio-economic component, and
- To some extent to the water quality information.

The gaps in information that are present are detailed below.

4.1 Ecological Water Requirements:

- The approach followed during the 2001 Comprehensive Reserve study was to identify Ecological Water Requirement (EWR) sites (formally IFR sites) on the main stem and major tributaries. Small, more sensitive and un-impacted tributaries were not part of the focus of this study.
- Scenario analysis were undertaken but impact on yield was analysed and not the ecological consequences of these scenarios.
- The water quality component of the study was undertaken using a method that has subsequently been updated and need to be re-visited.
- Linking of EWR sites (existing, new and extrapolation) to nodes. This was partly undertaken when the management units were defined for the Upper Olifants (up to Flag Boshielo Dam). This needs to be defined for the Middle and Lower Olifants and the major tributaries (Steelpoort, Blyde and Selati) as well as the smaller tributaries.

In terms of addressing the gaps identified the team will able to fill these based on running of the Reserve models, specialist workshops, supporting information from studies such as River Health, the PES/EIS 2010 update, the NFEPA project and Rapid III Reserve assessments.

4.2 Socio-Economic:

Two key gaps exist with regard to the socio-economic and resource economics components:

- *Data gaps*: Data gaps may be manifold, and can only be fully identified once the exact valuation problems, associated with the management scenarios for each IUA, are defined. Gaps in information related to the mining data available for the mines in the WMA are evident.

  Data gaps are common to economic valuation of this nature, and will be addressed, in the case of the classification of the water resources in the Olifants WMA, through accessing all available literature, published and unpublished databases, and expert involvement. The parallel study, the Development of the Reconciliation Strategy for the Olifants WMA will be relied upon to deduce approximate water usages and expected growth patterns. Specific assumptions will be made where data is absent however these will be clearly defined and explained.

  The previous DWA study on ‘the nature, distribution and value of aquatic ecosystem services of the Olifants, Inkomati and Usutu to Mhlatuze Water Management Areas’ will be relied on to

address data gaps and the outputs used in the assessments.

- *Knowledge of causal effect gaps:* These gaps relate to defining evidence-based cause-and-effect linkages between a particular management class and the economic and ecosystem goods and services that are affected by a change in management class. This gap is common in the field of resource economics.

  The team will address it through a comparative risk assessment (CRA), wherein domain experts will take part. (CRA is both an analytical process and a methodology for prioritizing complex problems. CRA is a systematic way of clearly describing the effects of ecological change on human well-being that is transparent, clearly recorded and repeatable. The CRA provides an objective process for prioritizing risks, and therefore the nature and extent of ecosystem effects resulting from development, captured in a risk description for each asset. A risk assessment provides a deeper understanding of meaning and context of associated risk).

4.3 Water quality:

In terms of water quality data assessment the WQ monitoring stations and related information are mainly concentrated on main stem rivers and tributaries. Data gaps could potentially exist for the sub-nodes (still to be identified) in smaller tributary catchments which are identified as high PES and ecological importance and sensitivity.

The option available to address this potential gap is to use water quality neural networks. Dr S Jooste from the DWA, Directorate RQS has indicated that he is willing to assist the team in this regard.

5 MITIGATION MEASURES FOR RISKS IDENTIFIED

Potential risks/limitations identified are listed in Table 9.

Table 9: List of possible identified risks and limitations with proposed mitigation measures

Risk/Limitation	Mitigation Measure
Existing ecological/EWR and economic data available may be found to be inadequate to support all modelling processes	Best available information will be used and where possible modelling, extrapolation, estimations will be used. Every effort will be taken to ensure that the end results and outputs are technically sound, scientifically supported and defendable. Where possible meetings/liaison will be undertaken with the water use sector (e.g. mining data – Chamber of Mines). Assumptions made will be documented in detail.
Parallel studies may not deliver the required outputs (planning data; updated PES/EIS) as per the Olifants Study schedule. (e.g Recon study; PES/EIS study).	Information available at the time will be used. As new information becomes available it will be included should it be within the study budget and timeframes (e.g. the PES/EIS information; water requirements information).
Water quality data may not be available for smaller tributary catchments	Potential to be addressed by neural network analysis (support from Dr S Jooste).
Discrepancy between NFEPAs and priority sub-catchments (significant water resources) may be identified	A meeting/workshop with the SANBI and the CSIR is proposed to come to a consensus.

6 CONCLUSIONS ON INFORMATION APPLICABILITY AND ADEQUACY FOR CLASSIFICATION STUDY

From the information analysis that has been undertaken on understanding the availability, accessibility and usefulness of the information and data sources applicable to the Olifants WMA that is required for the implementation of the WRCS, it is evident that sufficient data does exist for the significant water resources within the Olifants WMA to enable an evaluation of changes in their ecological condition in response to changes in water

It can be concluded that the Olifants system is fortunately, well studied and a wide range of experts, with firsthand knowledge of the system, are available both in the project team and within the networks of the project team. In this manner, best available and reasonable evidence will be used in all valuations and in the classification of the water resources within the WMA.

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APPENDIX A

DESKTOP RESULTS OF THE EVALUATION OF PES AND EIS PER QUATERNARY CATCHMENT IN THE OLIFANTS WMA (2007)

Catchment	River	PES	EIS	EC	Integrated PES/EIS	WU score	Integrated Ecological/ Water Use	Comments
Upper Olifants								
B11A-G								Upstream Witbank Dam, water use and quality impacts
B11A	Olifants	E	Low	D	1	4	Rapid	Water quality due to mining discharges
B11B	Olifants	D/E	Low	D	1	4	Rapid	Water quality due to mining discharges
B11C	Steenkoolspruit	D/E	Low	D	1	4	Rapid	Water quality due to mining discharges
B11D	Trichardtspruit	E	Low	D	1	4	Rapid	Water quality due to mining discharges
B11E	Rietspruit	E	Low	D	1	4	Rapid	Water quality due to mining discharges
B11F		E	Low	D	1	3	Desktop	Ogies area, mines
B11G	Olifants	E	Low	D	1	4	Rapid	Water quality due to mining discharges
B11H	Spookspruit	D	Low	D	1	3	Desktop	Downstream Witbank Dam
B11J	Olifants	C	High	C	3	3	Intermediate	Mainstem - releases from dam, abstraction, dams
B11K	Klipspruit	E	Low	D	1	4	Rapid	Klipspruit, mining, urban return flows
B11L	Olifants	C	High	C	3	3	Intermediate	Main stem - releases from dam, abstraction
Klein Olifants								
B12A-E								Upstream Middelburg Dam, mining & new mines
B12A	Klien Olifants	C/D	Low	C/D	1	4	Rapid	Water quality due to mining discharges
B12B	Klien Olifants	D	Low	C	1	4	Rapid	Water quality due to mining discharges
B12C	Klien Olifants	D	Low	D	1	4	Rapid	Water quality due to mining discharges
B12D	Klein Olifants	D	Moderate	D	1	2	Desktop	Water quality due to mining discharges
B12E	Klein Olifants	C	High	C	3	3	Intermediate	Downstream Middelburg Dam, irrigation, nature reserves
Wilge								
B20A-C								Upstream Bronkhorstspruit Dam, irrigation from dolomites & return flows
B20A	Bronkhorstspruit	C	Moderate	C	2	3	Rapid	Irrigation from dolomites, return flows
B20B	Koffiespruit	B/C	Moderate	B/C	2	3	Rapid	Irrigation from dolomites, return flows
B20C	Bronkhorstspruit	C	Low	C	1	3	Desktop	Irrigation from dolomites, return flows
B20D-F								Upstream Wilge (Premier mine Dam), mining (quality)
B20D	Bronkhorstspruit	C	Moderate	C	2	3	Rapid	Bronkhorstspruit Town (irrigation, urban return flows)
B20E	Upper Wilge	C	Moderate	C	2	2	Desktop	Irrigation, mining

Catchment	River	PES	EIS	EC	Integrated PES/EIS	WU score	Integrated Ecological/ Water Use	Comments
B20F	Upper Wilge	C	Moderate	C	2	2	Desktop	Irrigation, mining
B20G	Saalklapspruit	D	Moderate	D	1	3	Desktop	Mining
B20H	Wilge	B	Moderate	B/C	3	3	Intermediate	Downstream Wilge (Premier mine Dam), irrigation, small dams
B20J	Wilge	B	High	B	4	3	Comprehensive	Downstream Wilge (Premier mine Dam), irrigation, other dams
B32								
B32A	Olifants	B	High	B	4	4	Comprehensive	Upstream Loskop, impacts of Wilge, Klein Olifants and Olifants water use and quality
B32B	Selons	B/C	Moderate	B/C	3	2	Rapid	Tributary, irrigation
B32C	Olifants	C	Moderate	C	2	2	Desktop	Tributary, irrigation
B32D	Olifants	C	Moderate	C	2	4	Intermediate	Irrigation, releases to downstream from Loskop Dam
B32E	Bloed	C	Low	C	1	2	Desktop	Tributary, irrigation
B32F	Bloed	C	Low	C	1	2	Desktop	Tributary, irrigation
B32G,H	Moses	C	Moderate	C	2	3	Rapid	Mosesspruit, irrigation
B32J	Olifants	D	Moderate	D	1	4	Rapid	Irrigation, releases to downstream from Loskop Dam
Elands								
B31A-C								Upstream Rust de Winter Dam, irrigation
B31A	Elands	B/C	Moderate	B/C	3	2	Rapid	Upstream Rust de Winter Dam, irrigation
B31B	Elands	A/B	Moderate	A/B	3	2	Rapid	Upstream Rust de Winter Dam, irrigation
B31C	Elands	B/C	Moderate	B/C	3	2	Rapid	Upstream Rust de Winter Dam, irrigation
B31D-F								Between Rust de Winter and Rhenosterkop (Mkhombo)
B31D	Elands	D	Moderate	D	1	2	Desktop	Below Rust de Winter, irrigation
B31E	Gotwane	C	Low	C	1	2	Desktop	Farms dams, irrigation
B31F	Elands	D	Moderate	D	1	2	Desktop	Below Rust de Winter, irrigation
B31G, H								Downstream Rhenosterkop
B31G	Elands	E	Moderate	D	1	3	Desktop	Irrigation, alien vegetation
B31H	Elands	E	Moderate	D	1	3	Desktop	Farm dams, irrigation
B31J	Elands	E	Moderate	D	1	2	Desktop	Irrigation
B51								

Catchment	River	PES	EIS	EC	Integrated PES/EIS	WU score	Integrated Ecological/ Water Use	Comments
B51 (tributaries)								Small tributaries to Olifants main
B51A	Mossephiri	C	Moderate	C	2	2	Desktop	Rural, mining, sediment
B51E	Endorheic	E	Low	D	1	2	Desktop	No stream, Klavervalley Dam
B51F	Nkumpi	C	Low	C	1	2	Desktop	Rural, mining, sediment
B51H	Ngwaritse	D	Low	D	1	2	Desktop	Rural, mining, sediment
B51 (main stem)								Olifants up- and downstream of Flag Boshielo
B51B	Olifants	E	Moderate	D	1	3	Desktop	Olifants upstream Flag Boshielo
B51C	Olifants	D	Moderate	D	1	4	Rapid	Releases downstream Flag Boshielo
B51G	Olifants	D	Moderate	D	1	4	Rapid	Releases downstream Flag Boshielo
B52								
B52 (tributaries)								Mining, rural
B52B	Lepellane	D	Low	D	1	2	Desktop	Rural, Lepellane dam
B52C	Chunies	E	Low	D	1	2	Desktop	Rural, irrigation
B52D	Chunies	E	Low	D	1	2	Desktop	Rural, irrigation
B52F		D	Low	D	1	2	Desktop	Rural
B52H	Klipspruit	D	Low	D	1	2	Desktop	Rural
B52 (mainstem)								Releases for downstream users (irrigation, rural, mining)
B52A	Olifants	D	Moderate	D	1	4	Rapid	Releases for downstream users (irrigation, rural, mining)
B52E	Olifants	D	Moderate	D	1	4	Rapid	Releases for downstream users (irrigation, rural, dam)
B52G	Olifants	D	Moderate	D	1	4	Rapid	Releases for downstream users (irrigation, rural)
B52J	Olifants	D	Moderate	D	1	4	Rapid	Releases for downstream users (irrigation, rural, mining)
Steelpoort								
B41A-E								Upstream proposed De Hoop, Belfast, Tonteldoos Dam, irrigation
B41A	Grootspruit	C	Moderate	C	2	2	Desktop	Irrigation
B41B	Steelpoort	C	Moderate	C	2	2	Desktop	Irrigation
B41C	?	C	Moderate	C	2	2	Desktop	Vlugkraal Dam, irrigation
B41D	Steelpoort	C	Moderate	C	2	2	Desktop	Mapochs Dam, irrigation
B41E	Steelpoort	C	Moderate	C	2	2	Desktop	Irrigation, rural
B41F-K								Downstream proposed De Hoop Dam

Catchment	River	PES	EIS	EC	Integrated PES/EIS	WU score	Integrated Ecological/ Water Use	Comments
B41F	Klip	B	Very high	B	4	2	Comprehensive	Dams, irrigation
B41G	Dwars	B/C	High	B/C	3	3	Intermediate	Dams, mining
B41H	Dwars	B/C	High	B/C	3	3	Intermediate	Mining
B41H	Steelpoort	D	High	D	3	4	Comprehensive	Rural, irrigation
B41J	Steelpoort	D	Moderate	D	1	4	Rapid	Rural, irrigation
B41K	Steelpoort	D	High	D	3	4	Comprehensive	Rural, irrigation
B42								
B42A	Dorps	C	Moderate	C	2	2	Desktop	Upstream Lydenburg, irrigation
B42B	Dorps	C/D	Low	C/D	1	2	Desktop	Upstream Lydenburg, irrigation
B42C	Dorps	C/D	Moderate	C/D	1	3	Desktop	Lydenburg, return flows
B42D	Spekboom	C	Moderate	C	2	3	Rapid	Abstractions for irrigation
B42E	Spekboom	B	High	B	4	3	Comprehensive	Abstractions for irrigation
B42F	Waterfalls	A/B	Moderate	A/B	3	3	Intermediate	Abstractions for irrigation
B42G	Waterfalls	B	High	B	4	3	Comprehensive	Abstractions for irrigation
B42H	Spekboom	C	High	C	3	3	Intermediate	Abstractions for irrigation
Blyde								
B60A-C								Upstream Blyderivierspoort Dam
B60A	Blyde	A/B	Very high	A/B	4	1	Desktop	Rural, afforestation
B60B	Blyde	B/C	Moderate	B/C	3	1	Desktop	Rural, afforestation
B60C	Treur	A/B	Very high	A/B	4	1	Rapid	Rural, afforestation
B60D	Blyde	A	High	A	4	1	Desktop	Rural
B60E, F,G, H								Upstream Blyderivierspoort Dam, Orighstad, irrigation, dams
B60E	Orighstad	B	High	B	3	1	Desktop	Orighstad Dam, afforestation
B60F	Orighstad	C	Moderate	C	2	2	Desktop	Downstream of Orighstad Dam, irrigation
B60G	Orighstad	C/D	Moderate	C/D	1	2	Desktop	Orighstad, irrigation
B60H	Orighstad	B/C	High	B/C	3	3	Intermediate	Irrigation, rural
B60J	Blyde	B	High	B	3	4	Comprehensive	Blyderivierspoort Dam releases, irrigation
B71								
B71 (mainstem)								Main stem Olifants

Catchment	River	PES	EIS	EC	Integrated PES/EIS	WU score	Integrated Ecological/ Water Use	Comments
B71A	Olifants	D	Moderate	D	1	4	Rapid	Domestic, abstractions, downstream dams (Loskop, Flag Boshielo)
B71B	Olifants	D	Moderate	D	1	4	Comprehensive	Domestic, abstractions, downstream dams (Loskop, Flag Boshielo)
B71D	Olifants	C	High	B	3	4	Comprehensive	Domestic, abstractions, downstream dams (Loskop, Flag Boshielo)
B71F	Olifants	D	High	C	3	4	Comprehensive	Domestic, abstractions, downstream dams (Loskop, Flag Boshielo)
B71G	Olifants	D	High	C	3	4	Comprehensive	Domestic, abstractions, downstream dams (Loskop, Flag Boshielo)
B71H	Olifants	C	High	B	3	4	Comprehensive	Domestic, abstractions, downstream dams (Loskop, Flag Boshielo)
B71J	Olifants	D	High	C	3	4	Comprehensive	Domestic, abstractions, downstream dams (Loskop, Flag Boshielo)
B71 (tributaries)								
B71C	Mohlapitse	B	Very high	A	4	2	Comprehensive	Rural, domestic, water quality
B71E	Motse	C	Low	C	1	1	Desktop	Rural
B72								
B72A, B (tributaries)								Tributaries of Olifants
B72A	Makutsi	A/B	Very high	A/B	4	2	Comprehensive	Irrigation, run-of-river abstractions
B72B	Makutsi	C/D	Low	C/D	1	2	Desktop	Irrigation, run-of-river abstractions
B72C, D (mainstem)								Mainstem Olifants
B72C	Olifants	C	High	B	3	2	Rapid	Irrigation
B72D	Olifants	C	High	B	3	4	Comprehensive	Phalaborwa Barrage on main stem, sedimentation
B72E-K								Selati River system
B72E	Ngwabatse	D	Moderate	D	1	2	Desktop	Tours Dam, irrigation
B72F	Selati	A/B	Very high	A/B	4	1	Rapid	Nature Reserve
B72G	Selati	C/D	High	C/D	3	1	Desktop	Irrigation
B72H	Selati	D	Low	D	1	1	Comprehensive	Irrigation
B72J	Molatle	D	Low	D	1	1	Desktop	Irrigation

Catchment	River	PES	EIS	EC	Integrated PES/EIS	WU score	Integrated Ecological/ Water Use	Comments
B72K	Selati	D	Moderate	D	1	4	Comprehensive	Foskor mining, Phalaborwa, water quality, return flows
B73								
B73 (tributaries)								
B73A	Klaserie	B/C	Moderate	B/C	3	2	Rapid	Klaserie Dam, irrigation
B73B	Klaserie	B/C	High	B/C	3	2	Rapid	Dams, irrigation
B73D	Nhlaralumi	A	Moderate	A	3	2	Rapid	Irrigation
B73E	Timbavati	A	Moderate	A	3	2	Rapid	Irrigation
B73F	Timbavati	A	Moderate	A	3	2	Rapid	Irrigation
B73 (mainstem)								
B73C	Olifants	C	Very high	B	4	2	Intermediate	Main stem to KNP, irrigation
B73G	Olifants	C	Very high	B	4	2	Intermediate	Main stem to KNP, irrigation
B73H	Olifants	C	Very high	B	4	2	Comprehensive	Main stem to KNP, irrigation