CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE MOKOLO CATCHMENT: LIMPOPO WATER MANAGEMENT AREA (WMA) AND CROCODILE (WEST) AND MARICO WMA: WP 10506

INFORMATION ANALYSIS REPORT: CROCODILE (WEST) AND MARICO WMA

FINAL

REPORT NO: RDM/WMA1,3/00/CON/CLA/0112A

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EXECUTIVE SUMMARY

Thorough preparatory work, understanding of the status quo and information availability of the Crocodile West-Marico WMA is needed to effectively classify the significant water resources of the study area. The information analysis task was designed, as part of the study, to provide an analysis of the available water resource related data and information for the Crocodile West-Marico WMA in terms of water resource quality, ecological water requirements, hydrology, water quality and socio-economics. This information analysis 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 (IWRM). 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 the gaps are.

For successful implementation of the Water Resource Classification System (WRCS) in the Crocodile West-Marico WMA it is critical at the outset of the project to determine whether there is any key information that is outstanding. An information review has been undertaken and the outcomes of this are captured in this report. Previous studies undertaken for the Crocodile West-Marico WMA have been sourced and reviewed. For parallel studies communication mechanisms will be established with other study teams to ensure ongoing liaison. These will be maintained to ensure that the transfer of information, data and reports takes place.

At this stage the information analysis is not considered exhaustive and the review will continue as new information and data come to light. The information analysis task was 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/WMA1,3/00/CON/CLA/0111	Inception Report
2	**RDM/WMA1,3/00/CON/CLA/0112A**	**Information Analysis Report : Crocodile (West) Marico WMA**
3	RDM/WMA1,3/00/CON/CLA/0112B	Information Analysis Report : Mokolo and Matlabas catchments: Limpopo WMA

LIST OF ABBREVIATIONS AND ACRONYMS

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

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

The Crocodile (West) and Marico Water Management Area (WMA) is defined by the following Catchments: Crocodile River, Marico River, South African portion of Ngotwane River and the Upper Molopo River. The area forms part of the Limpopo River basin, which spans the four countries of Botswana, Zimbabwe, South Africa and Mozambique. The area covers approximately 48 000 km^2 with the largest being the Crocodile River catchment (29 349 km^2) followed by the Marico River catchment (12 049 km^2). The remainder is covered by the Ngotwane River and Upper Molopo River catchments at approximately 5 000 km^2 and 1 800 km^2 respectively. The WMA includes the tertiary drainage regions: A10, A21 to A24, A31, A32 and quaternary drainage region D41A.

The Crocodile West and Marico WMA is one of the many water stressed catchments in South Africa. Surface water resources are used extensively, particularly in the Crocodile River catchment, with the main water users being agriculture, industry, mining and urban. Agriculture accounts for about 33.5% of total use and largely utilises privately owned dams and Government water schemes. Rand Water, Magalies Water and the North West Water Authority supply most of the mining, industrial and domestic sectors with water from sources within the catchment as well as from transfers from the Upper Vaal River system, which receives a significant amount of return flow from Tshwane. Approximately 70% of the population within the WMA lives in urban areas. The main economic activities revolve around mining, agriculture and light industry.

As the water resources in the Crocodile West & Marico Water Management Area 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 are able to sustain their level of use and be maintained at their desired states. The determination of the Management Classes (MC) of the significant water resources in the study area 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.

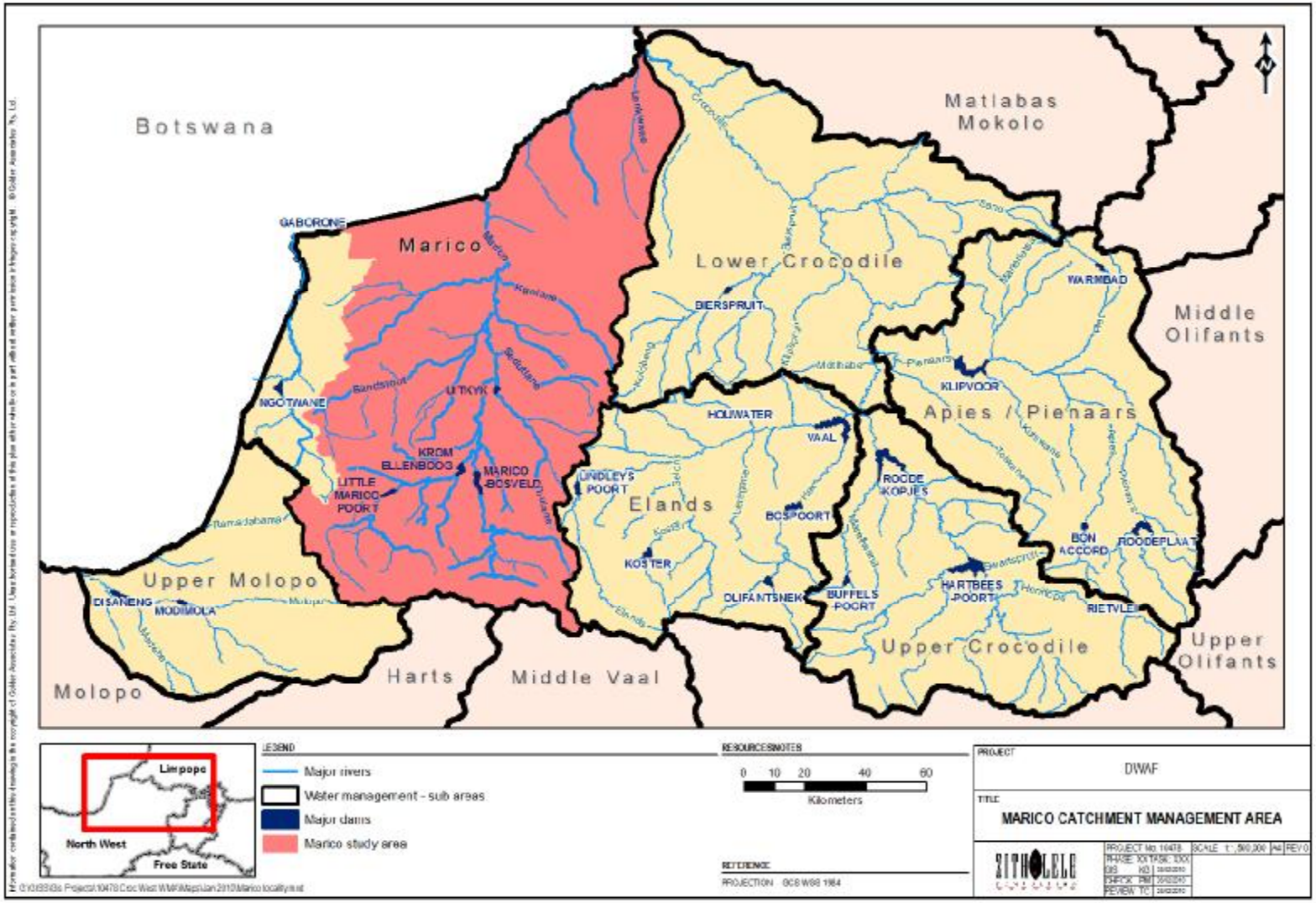

Figure 1: Map showing Crocodile (West) and Marico WMA (Intermediate Reserve Determination Study, June 2010)

2 CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE CROCODILE (WEST) AND MARICO 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 Crocodile (West) and Marico 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 in the Crocodile (West) and Marico 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 Crocodile (West) and Marico WMA to understand the status quo in regard to water resource issues such as water resource quality, existing monitoring programmes, infrastructure, institutional environment, socio-economics and sectoral water uses and users.

- The delineation of the WMA into integrated units of analysis (IUAs) is 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); and
- Population of the classification templates.

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

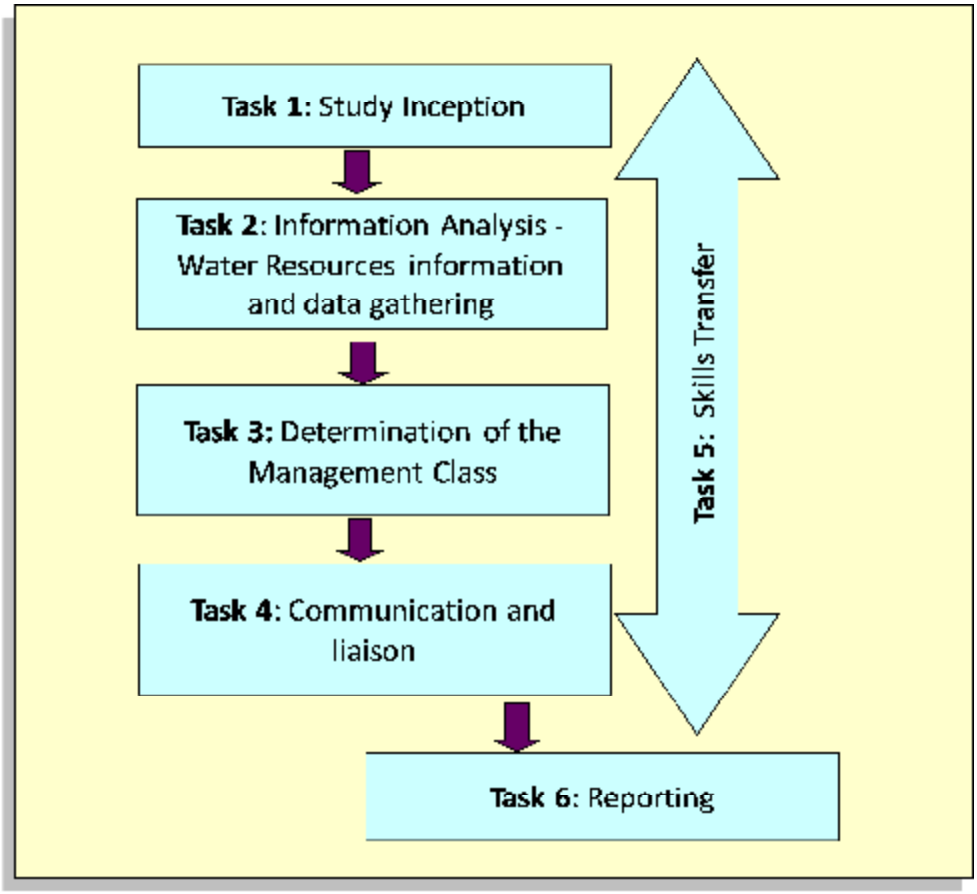

Figure 2: The study tasks

2.1 THE INFORMATION ANALYSIS TASK

In order for the Department to effectively classify the significant water resources of the Crocodile (West) and Marico WMA, a thorough understanding of the status quo and information availability of the study area is needed to effectively classify the significant water resources of the Crocodile (West) Marico WMA. The information analysis 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 and models that

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 A1, A2, A3, quaternary drainage region D41A of the Crocodile West-Marico WMA as well as tertiary drainage regions A41 and A42 of the Matlabas and Mokolo catchments, respectively, however, this report concentrates only on the Crocodile (West) Marico WMA and the Matlabas and Mokolo catchments are covered in a separate report. This report therefore includes the Crocodile River, Marico River, South African portion of Ngotwane River and the Upper Molopo River (Figure 3).

2.3 OBJECTIVES OF THE INFORMATION ANALYSIS TASK

The information analysis task was designed as part of the study to provide an analysis of the available water resource related data and information for the Crocodile (West) and Marico WMA in terms of 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 such as water quality, hydrology, hydraulics, economics data and water use information;
- To assess the status of parallel studies to determine the information availability and timing as it relates to the Crocodile (West) and Marico study classification process;
- 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 Crocodile (West) and Marico WMA.

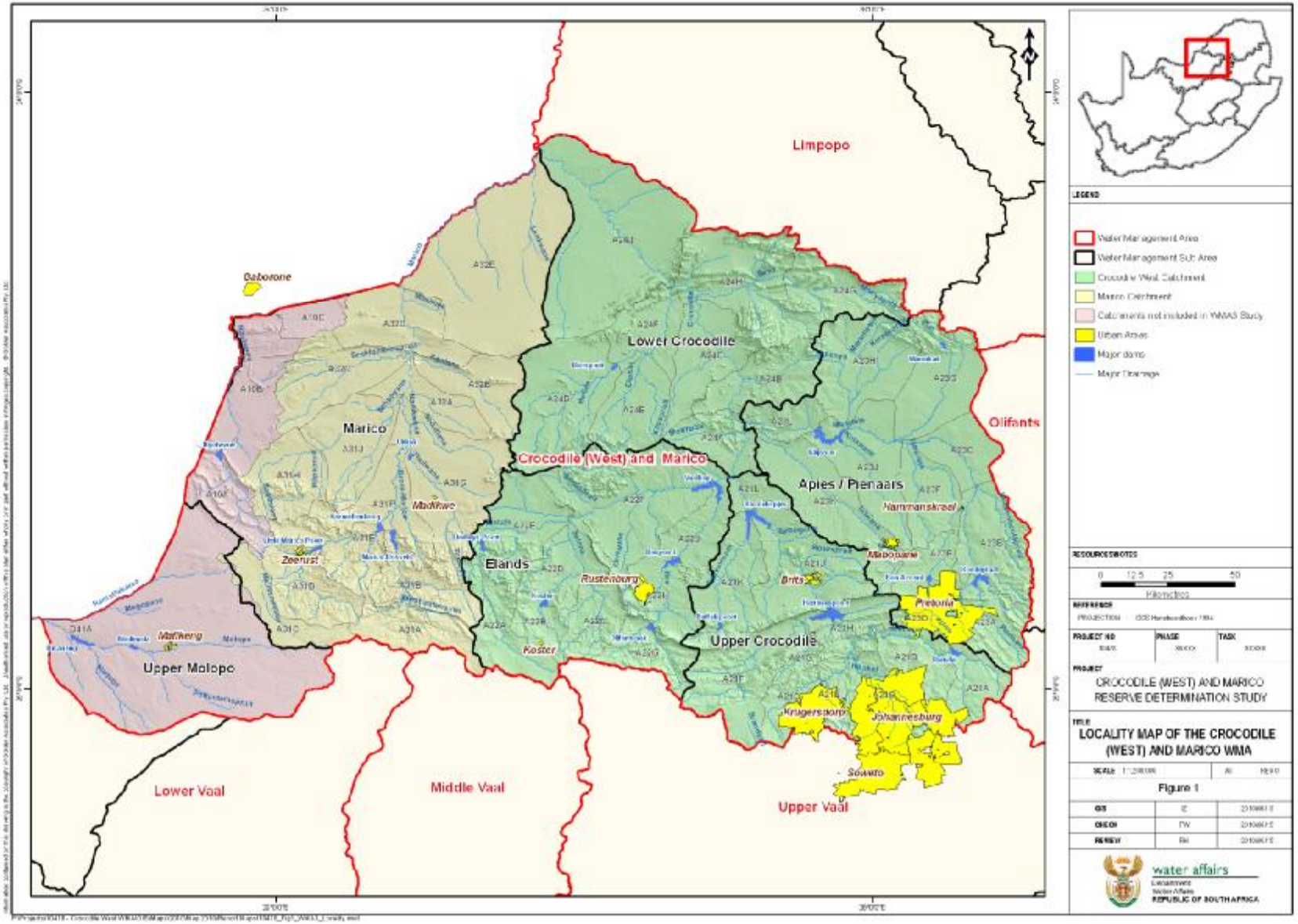

Figure 3: Spatial extent of the Crocodile (West) and Marico WMA

2.4 PURPOSE OF THE REPORT

The purpose of this 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

The classification of water resources in the study area 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 focused on understanding the availability, accessibility and usefulness of the information and data sources applicable to the Crocodile (West) and Marico that are required for the implementation of the WRCS. It is critical to determine if any key information is outstanding or absent.

Previous studies undertaken for the Crocodile (West) and Marico, including water resource planning, Reserve determination, water quality, socio-economic, augmentation and reconciliation strategies and other relevant studies for the study area have been sourced and reviewed. The above have been used to identify any gaps and outstanding information. The analysis of information 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 Crocodile (West) and Marico 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 comprised of the *information requirements* of each of the seven steps of the WRCS (as per the classification Guidelines); as applicable/relevant to the Crocodile (West) and Marico WMA, summarised in **Table 1**.

Table 1: Information requirements of each of the 7 steps of 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; microeconomic data; population information; land use information; social data	• Socio-economic status/socioeconomic 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 data and information	• 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; • Establishment of nodes; • Establishment of the Ecologically Sustainable Base Configuration Scenario (ESBC); • Establishment of RDM configuration scenarios; • Evaluation of scenarios	Steps 1 to 5
Planning information (water requirements/needs)	Establishment of the Ecologically Sustainable Base Configuration Scenario (ESBC)	Step 4

Information Requirements	**WRCS Component**	**Supported WRCS Step**
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

3.2 IDENTIFICATION AND REVIEW OF KEY STUDIES

Table 2 lists the relevant key studies that have been identified and reviewed as part of various previous studies undertaken in the Crocodile (West) and Marico 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.

Table 2: Review of identified key studies undertaken in the Crocodile West-Marico WMA of relevance to the Classification study

No.	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Classification Study	Possible Limitations
1	Internal Strategic Perspective: Crocodile West Marico Water Management Area	DWAF, Directorate National Water Resource Planning. 2004	The ISP for the Crocodile River (West) Catchment provides a framework for management of water resources. It details the strategies for water resource management and related water resource issues and concerns.	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 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
2	Institutional Roles and Linkages. Situational Assessment: WMA3: Crocodile West and Marico	IWRM Strategies, Guidelines and Pilot implementation in Three Water Management Areas, South Africa. March 2004	This report reflects, characteristics of available institutions in the Crocodile West & Marico WMA, their geographic locations, policies governing them, and their functions and relationships with other institutions. Information on land use and demographics is also covered.	Description of the water management area. Information on institutions will assist with the identification of stakeholders.	Information might be outdated
3	State-of-Rivers Report: Monitoring and Managing the	River Health Programme. March 2005	Provides information on habitat integrity and the biological response	Provides an overview of the study area including the physical characteristics, land use as well as social and economic characteristics;	No bio-monitoring took place in the Upper Molopo sub-management area in

No.	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Classification Study	Possible Limitations
	Ecological State of Rivers in the Crocodile (West) Marico WMA		indicators	Information on eco-status and the state of rivers.	this 2004 survey. The information presented in the report for Upper Molopo is based on previous, unrelated surveys.
4	The development of the Reconciliation Strategy for the Crocodile West water supply system	DWAF, Directorate National Water Resource Planning. July 2008. P WMA 03/000/00/3608	Strategy for reconciling the requirements for water in the Crocodile River catchment with the availability thereof; projections and water infrastructure information; Updated hydrology; Water Resources Planning Model	Information emanating from this study will be utilized during the incorporation of planning scenarios as a requirement when establishing ESBC and starter scenarios	At the time of the latest update of this report it was already evident that Scenario 2 is not applicable any longer, whilst it is doubtful whether the time scales of some of the other scenarios are still achievable.
5	North West Province, Environment Outlook	A Report on the State of the Environment. 2008. http://www.nwpg.gov.za/Agriculture/NW_ENVIRONMENTAL_OUTLOOK/chapter.asp?CHAPTER=11&PAGE=3&TITLE=Part%203	Overview of the people, economy, culture and sustainable development in the North West Province	Provides information on land use, state of water resources and aquatic ecosystems, demand for water resources in the North West Province.	An overall assessment of the water resources quality in accordance with the selected outlook indicators was not possible due to the lack of or limited data of the following indicators: • Surface water toxicity; • Faecal coliforms; • Surface water;

No.	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Classification Study	Possible Limitations
					• radioactivity; • Groundwater toxicity, and • Groundwater radioactivity.
6	Adopt-A- River Programme Phase II: Development of an Implementation Plan	Water Resource Quality Situation Assessment, DWA RQS, 2009	A brief description of the Crocodile West River catchment, summary tables of water resource quality issues and concerns summarised for water resources issues, water quality issues and aquatic ecosystem health issues.	Information on water balance in the catchment. Concerns about salinity, nutrient enrichment, bacteriological quality, trace metals, pH, and other concerns. Ecosystem health issues (related to overall eco-status, instream and riparian zone habitat, fish, macro-invertebrates, and ecosystem water quality.	Only published information that was readily available was used for the assessment.
7	Framework and Manual for the evaluation of aquatic ecosystems services.	Water Research Commission. 2010.	This document provides a framework and manual to guide socio-economic practitioners on evaluation of aquatic ecosystem services 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.
8	Investigating the behavioural drivers of Stakeholder Engagement and	WRC Report No KV 264/10, March 2011	The study investigated several possible factors that influence an individual or community's	The classification process is a consultative process therefore one needs to understand the reasons behind low levels of stakeholder engagement in the study area.	The study is limited to the Hartebeespoort community.

No.	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Classification Study	Possible Limitations
	Volunteerism in the South African Water Arena		drive towards engagement and volunteerism in the Crocodile (West) Marico catchment around the Hartbeespoort dam. The study has also compiled a list of key issues for consideration should a community facing an IWRM challenge wishes to increase engagement and volunteerism levels.		
9	A comparison of the response of diversity and aut-ecological diatom indices to water quality variables in the Marico-Molopo River catchment	On the use of diatom-based biological monitoring Part 1. Available on website http://www.wrc.org.za ISSN 0378-4738 = Water SA Vol. 34 No. 1 January 2008	The study compared diversity indices and aut-ecological indices as measures of aquatic ecosystem health by comparing their response to water quality variables. The study also compared the performance of diatom-based indices with that of a macro-invertebrate index (SASS 5) in terms of their ability to indicate changes in water quality	Due to the highly significant relationship of aut-ecological diatom indices with water quality, these indices are deemed more relevant and reliable for use in rivers and streams to inform decision making in integrated water resource management.	It has not been investigated whether diatoms such as these are in fact true endemics or if their distribution is simply gov-erned by the factors such as local geology and climate, which may not be found elsewhere.

No.	Report Title	Report Details/Reference	Brief Summary	Usefulness/Applicability to Classification Study	Possible Limitations
			variables.		
10	A Systematic Conservation Plan for the Freshwater Biodiversity of the Crocodile West Marico WMA	Conservation planning in the Crocodile (West) and Marico WMA.	The report presents a systematic conservation plan for the freshwater ecosystems of the Crocodile (West) and Marico WMA. Provides systematic and strategic guidance regarding the trade-offs between conservation and development, and provides a strategic perspective to decision makers at the scale of a WMA.	Conservation targets need to be taken into account when assigning IUA class for catchment configuration.	The setting and adoption of biodiversity targets reflects scientific best judgement only and, hence, should be subject to review over time.
11	Development of an automated desktop procedure for defining macro-reaches for river longitudinal profiles	Available on website http://www.wrc.org.za ISSN 0378-4738 = Water SA Vol. 32 No. 3 July 2006	The paper presents an automated desktop procedure for delineating river longitudinal profiles into macro-reaches for use in EWR assessments and to aid freshwater ecosystem conservation planning.	The paper provides an alternative approach that can be used with a reasonable degree of certainty where there are insufficient data and/or where a regional assessment is required that is repeatable and statistically defensible.	Desktop methods provide low confidence results and do not obviate the need for primary data collection, field work and a detailed expert-driven approach.

3.3 INFORMATION REQUIRED FROM PARALLEL STUDIES

Table 3 lists the relevant information and reports from parallel studies that will support the information needs for the classification study in the Crocodile West-Marico WMA.

Table 3: Parallel studies underway in the Crocodile West-Marico WMA that support the information needs of the Classification study

No.	Study underway	Information Source	Information needs supported	Information Status	Possible Risk
1	Review and update of the 1999 EIS and PES of South African Rivers including expansion to priority tributaries and wetlands according to quaternary catchments	DWA Chief Directorate: RDM	Updated PES/EIS for all sub-quaternary catchments in Croc West Marico. Identification of nodes.	Report still under review and is due in May 2012	Delay in the WRC study.
2	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	2011 Report available	Discrepancy between NFEPAs and priority sub-catchments may occur
3	Crocodile West and Marico Intermediate Reserve Determination study	DWA Chief Directorate: RDM	Ecological Water Requirements determined during this study will be used in step 3 of the classification process i.e quantification of EWRs	Report still under review	The Apies Pienaars River together with the Pienaars River wetland were not adequately represented with just two EWR sites one on the Pienaars River below Klipvoor/Borakala Dam and the other site below Roodeplaat Dam.
4	Support to the Implementation and Maintenance of the Reconciliation Strategy of the Crocodile West Water Supply System	DWA: National Water Resource Planning	Revised Strategy Information will be utilized during the incorporation of planning scenarios as a requirement when establishing ESBC and starter scenarios	The first draft of the revised and updated Strategy will be available in September 2011	Delay in the WRC study

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 study area. 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 0 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 Crocodile (West) and Marico WMA	Obtained (see Table 1)	Status quo description; IUA delineation; Establishment of network of significant water resources
NFEPA maps , shapefiles and metadata	Obtained	Status quo description; IUA delineation; Establishment of network of significant water resources
Updated hydrology for the Crocodile (West) and Marico WMA	Obtained by PSP during Reserve determination	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	Obtainable from PSP who undertook the Reserve studies (BKS, Arcus Gibb and WRP)	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)	Obtainable from PSP who undertook the Reserve studies (BKS, Arcus Gibb and WRP)	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.	Obtainable from WMS	Required for the EBSC and scenario assessment
Ecological Water Requirements (Information, data, models, indices)	Obtained by PSP during Reserve determination	Required for ecological water requirements determination, for the ESBC and the assessment

Information/Data required	Status of Collation	Applicability to process
		of scenarios
PES/EIS 2010 Update – Excel database for the Crocodile West Marico WMA	Obtainable from D: RR (still under review)	Required for delineating IUAs and significant water resources and determination of nodes and sub-nodes
Land use, population data, socioeconomic data; macro and micro economic data and related information from Stats SA; water users; Governments Departments; Chamber of Mines, etc.	Land use data obtained	To be used in socio-economic decision-analysis framework development and in the scenario assessment
Statistics SA's Water Resource Accounts	To be sourced	To be used in socio-economic decision-analysis framework development and in scenario assessment
The Millennium Ecosystems Assessment framework of ecosystem services	Obtained (national framework)	To be used in determination/identification of ecosystem system services of value
Best practice resource economics	To be sourced	To support socio-economic decision-analysis framework and methodology development and in assessment of scenarios
Social accounting analyses	Available for the provinces	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)	Available for the provinces	To be used in socio-economic decision-analysis framework and methodology development
River Health Programme Studies: Crocodile West and Marico Rivers	Obtained by PSP during Reserve determination	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.

3.4.1 Hydrology

The simulated flow data for the Crocodile (West) River Catchment (A2-region) was obtained during the Reserve determination from the 2007 DWA study executed by BKS and Arcus Gibb, namely "The assessment of water availability in the Crocodile (West) River Catchment by means of water resource related models in support of the planned future licensing process". The simulated flow data, for the Crocodile (West) River Catchment, covers the hydrological years 1920 to 2003. The

updated hydrology (WRP-Nov 2009) for Marico was finalised in November 2009.

3.4.2 Water Quality

The Department of Water Affairs conducts an ongoing water quality monitoring programme on the Crocodile River however not all sites are currently being monitored, but there are long term monitoring sites for the preliminary resource units and ecological water requirements (EWR) sites identified during the Reserve determination. The monitoring sites are listed in Table 5 below.

All the DWA long term monitoring sites include the monitoring of electrical conductivity (EC), pH, the major ions (Mg^+, Na^+, Ca^+, K^+, $SO4^-$ and Cl^-), total alkalinity and nutrients (PO_4-P, NH_3, NO_2, NO_3).

Table 5: **DWA water quality sites related to the Crocodile (West) and Marico EWR sites**

	WQ SITE	QUARTENARY CATCHMENT	OTHER INFO
CROCODILE WEST	**A2H012** – Crocodile River at Kalkheuwel	A21H	Downstream of the confluences of the Jukskei, Hennops and Rietspruit Rivers with the Crocodile River, and upstream of Hartebeespoort Dam.
	A2H023 – Jukskei River at Nietgedacht	A21C	Situated at the confluence of the Jukskei River with the Upper Crocodile River, and upstream of Hartebeespoort Dam.
	A2H083 – Hartebeespoort Dam: downstream weir	A21J	Crocodile River immediately downstream of Hartebeespoort Dam
	A2H006 – Pienaars River at Klipdrift	A23B	Weir is downstream of EWR site
	A2H021 – Pienaars River at Buffelspoort	A23L	Weir is 21 km downstream of EWR site
	A2H094 – Bospoort Dam: downstream weir	A22J	Weir is situated at Tweedepoort, 4 km downstream of EWR site
	A2H060 - Crocodile River at Nooitgedacht	A24C	WQ site is 23 km upstream of the EWR
	A2H116 – Paul Hugo Dam: downstream weir	A24F/H/J	Weir is situated at Haakdoorndrift
MARICO	**A3KAAL-**Riets Rietspruit at Bridge on Kaaloog Se Loop	A31A	There are no weirs in the vicinity. This is a River Health Programme site situated at Rietspruit bridge.
	A3GMAR-Koedo Koedoesfontein on Groot-Marico River	A31B	There are no weirs in the vicinity. This is a River Health Programme site situated at Koedoesfontein.
	A3H028 – canal d/s Marico-Bosveld Dam	A31F	This is a River Health Programme site situated downstream of Marico-Bosveld Dam.
	A3H040 – Mooiplaats/ Tswasa Weir	A32D	Weir is downstream of EWR site

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 Crocodile (West) Marico WMA. This information together with other data to be gathered will form the basis of the ecological assessment.

(a) 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. Table 6 shows the PES, EIS and REC associated with each EWR site. Table 7 and 8 show the EIS ratings for Priority Wetlands identified and the present status categories of Groundwater Resource Units in the Crocodile (West) River Catchment, respectively.

Table 6: **Summary of PES, EIS and REC per resource unit**

	EWR Site number	EWR site name	River	RU	Quaternary catchment	PES	REC	EIS
CROCODILE WEST	EWR 1	Upstream of the Hartbeespoor t Dam	Crocodile	MRU Crocodile 3	A21H	**D**	**D**	Moderate
	EWR 2	Heron Bridge School	Juskei	MRU Crocodile 1	A21C	**E**	**D**	Moderate
	EWR 3	Downstream of Hartbeespoor t Dam in Mount Amanzi	Crocodile	MRU Crocodile 5	A21J	**C/D**	**C/D**	High
	EWR 4	Downstream of Roodeplaat Dam	Pienaars	MRU Pienaars 5	A23B	**C**	**C**	High
	EWR 5	Downstream of the Klipvoor Dam in Borakalalo National Park	Pienaars	MRU Pienaars 8	A23J	**D**	**D**	High
	EWR 6	Upstream of Vaalkop Dam	Hex	MRU Hex 5	A22J	**D**	**D**	Moderate
	EWR 7	Upstream of the confluence with the Bierspruit	Crocodile	MRU Crocodile 10	A24C	**D**	**D**	Moderate

	EWR Site number	EWR site name	River	RU	Quaternary catchment	PES	REC	EIS
	EWR 8	Downstream of the confluence with the Bierspruit in Ben Alberts Nature Reserve	Crocodile	MRU Crocodile 11	A24H	**C**	**C**	Moderate
	Rapid EWR	Upstream of Malony's Eye	Magalies	MRU Magalies 1	A21F			
	Rapid EWR	Highveld	Elands	MRU Elands 1	A22A			
	Rapid EWR	Upstream Buffelspoort Dam	Sterkstroom	MRU Sterkstroom 1	A21K			
MARICO	EWR 1	Site below the gorge area (before confluence with Marico)	Kaaloog se loop	Kaaloog se loop	A31A	**B**	**B**	Very high
	EWR 2	Upstream confluence of the Sterkstroom	Groot Marico	Groot Marico 1	A31B	**B**	**B**	Very high
	EWR 3	Downstream of Marico Bosveld dam	Groot Marico	Groot Marico 3	A31F	**C/D**	**C/D**	High
	EWR 4	Downstream of the Tswasa Weir, in the Madikwe Game Reserve.	Groot Marico	Groot Marico 6	A32D	**C**	**C**	High
	Rapid EWR	Downstream Klein Maricopoort Dam	Klein Marico	Klein Marico 3	A31E			

Table 7: Summary of EWR site information

Catchment Area	Priority Wetlands	EIS Category	Eco Class
GROOT MARICO	Marico Dolomitic Eye	High	B
	Molemane Dolomitic Eye	High	B
	Malmane's Loop	Moderate	C
	Bokkraal Wetland (Upstream of tufa	Moderate	C
	Rietspruit Eye	Moderate	C
	Ngotwane River Dinokana Eye.	High	B
CROCODILE WEST	Moretele Floodplain (Pienaar's River)	High	C
	Waterval Valley Mire (Kgaswane NR)	High	B
	Apies River Floodplain	Moderate	C
	Tswaing Crator Valley Bottom Wetland	High	C
	Skeerpoort River Drainage Area	High	B
	Rietvlei Mire (Rietvlei Nature Reserve)	Moderate	C
UPPER MOLOPO	Molopo Eye	High	B
	Mafeking Game Reserve Wetland	Moderate	C

Table 8: **Categorisation of Groundwater Resource Units (2010) in the Crocodile (West) River Catchment**

Catchment area	Resource Unit: Quaternary Catchments	Categorisation	
		Present Status Category	Water Resource Category
CROCODILE WEST	A21A	E	Poor
	A21B	C	Fair
	A21C	B	Good
	A21D	E	Poor
	A21E	B	Good
	A21F	E	Poor
	A21G	B	Good
	A21H	B	Good
	A21J	D	Fair
	A21K	D	Fair
	A21L	B	Good
	A22A	B	Good
	A22B	B	Good
	A22C	B	Good
	A22D	C	Good
	A22E	B	Good
	A22F	B	Good

Catchment area	Resource Unit: Quaternary Catchments	Categorisation	
		Present Status Category	Water Resource Category
	A22G	B	Good
	A22H	C	**Fair**
	A22J	C	Good
	A23A	B	Good
	A23B	B	Good
	A23C	B	Good
	A23D Pretoria Fountains Incl.	E	Poor
	A23E	D	**Fair**
	A23F	C	Good
	A23G	D	**Fair**
	A23H	B	Good
	A23J	B	Good
	A23K	A	Natural
	A23L	B	Good
	A24A	D	**Fair**
	A24B	C	Good
	A24C	D	**Fair**
	A24D	B	Good
	A24E	A	Natural
	A24F	D	**Fair**
	A24G	A	Natural
	A24H	B	Good
	A24J	F	**Poor**
MARICO	A31A	C	Good
	A31B	B	Good
	A31C	C	Good
	A31D	B	Good
	A31E	A	Good
	A31F	B	Natural
	A31G	A	Natural
	A31H	A	Natural
	A31J	A	Natural
	A32A	A	Natural
	A32B	A	Natural
	A32C	A	Natural
	A32D	A	Natural
	A32E	A	Good

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.

The existing EWR information can be used to extrapolate to most of the selected hydronodes for the Crocodile West and Groot Marico catchments. However, in some cases the Desktop Reserve Model (DRM) will be used to generate desktop EWR results where the existing EWR sites were not adequate to be used for extrapolation. Extrapolation consists of:

- determining which hydronodes are sufficiently similar to the EWR sites in terms of biophysical similarity as well as indicator guilds used for setting EWRs at those sites; and
- deriving the EWRs for these nodes using the specific EWR site characteristics and the DRM to provide the flow requirements.

Tables 9 and 10 provide the recommendations for extrapolations that can be undertaken to provide EWR information at the various hydronodes for the Crocodile West and Groot Marico catchments.

A gap exists in quaternary catchment D41A, Upper Molopo and the Ngotwane River, quaternary catchment A10A and A10B.

Table 9: Extrapolation recommendations for Crocodile West catchment

Quaternary catchment/ Modeling zone	**Contribution per quaternary catchment**	**River/Description**	**Notes/Comments**
Upper Crocodile			
A21A	A21A	Source to Rietvlei Dam	Rietspruit - urban, dolomitic at the top. Swartspruit - urban, Kempton Park, Erwat STW. **Use DRM**
A21B	A21A, A21B	Outlet of quaternary catchment (Hennops River)	Sesmylspruit- urban, seasonal up to Kaalspruit. Kaalspruit - urban, channelised, Thembisa. Rietspruit from Midrand - urban. Hennops - better to confluence with Jukskei. **Use available biological data and DRM**
A21C (EWR2)	A21C	Outlet of quaternary catchment (Jukskei River)	**Use EWR 2 for Jukskei River**. **Use DRM** for Modderfonteinspruit - urban/industrial
A21D	A21D	Tweelopies	Tweelopies, Riet and Bloubankspruit - acid mine drainage, dolomitic area. Bloubankspruit - Botanical Gardens (fish) **Use DRM**
A21E	A21D, A21E	Outlet of quaternary catchment	**Use DRM**
A21F (EWR9)	A21F	Outlet of quaternary catchment (Magalies River)	**Use EWR 9**, dolomitic

Quaternary catchment/ Modeling zone	**Contribution per quaternary catchment**	**River/Description**	**Notes/Comments**
A21G	A21G	Outlet of quaternary catchment (Skeerpoort River)	**Use EWR 9**, dolomitic
A21H1 (EWR1)	A21A-E, A21H1	Jukskei River from EWR 2 to Hartbeespoort Dam	**Use EWR 1**
A21H_1	A21F, A21G	Tributaries to Hartbeespoort Dam	Swartspruit, Mogarwe - wetland areas in bottom. Leeuspruit - low flowing river **Use DRM**
A21H (EWR3)	A21A-H	Hartbeespoort Dam	**Use EWR 3**
A21J	A21A-J	Crocodile River to Roodekopjes Dam	**Use EWR3** for main stem. Rosespruit, Kareespruit – **Use DRM**
A21K2 (EWR11)	A21K1, A21K2	Source to Buffelspoort Dam (Sterkstroom)	Unique system, upstream of dam. **Use EWR 11**
A21K3	A21K1, A21K2, A21K3	Sterkstroom to Roodekoppies Dam	Potential developments - housing. **Use EWR 11**
A21K	A21A-K	Outlet of Roodekopjes Dam	**Use EWR 3** for main stem
A21L	A21A-L	Crocodile River to Elands confluence	**Use EWR 3** for main stem
Elands River			
A22A1 (EWR10)	A22A1	Elands to Swartruggens Dam	**Use EWR 10**
A22A	A22A	Elands to Lindleyspoort Dam	**Use EWR 10**
A22B	A22B	Outlet of Kosterrivier Dam	**Use EWR 10**, biological data give similar results as Upper Elands
A22C	A22C	Outlet of quaternary catchment (Selons River)	**Use EWR 10**
A22D	A22B, A22C, A22D	Koster/Selonsspruit	**Use EWR 10**
A22E	A22A, A22E	Outlet of quaternary catchment	Biological data available **Use DRM**
A22F	A22A-F	Elands River to Vaalkop Dam	**Use EWR 6**, biological data available - Elands characterised by pools. Tributaries- Leragane, Mankwe - **Use DRM**

Quaternary catchment/ Modeling zone	Contribution per quaternary catchment	River/Description	Notes/Comments
			with available biological data
A22G	A22G	Hex to Olifantsnek Dam	**Use EWR 11** in Sterkstroom. Biological data available.
A22H	A22G, A22H	Hex to Bospoort Dam	**Use EWR 6**
A22H2	A22H2	Waterkloofspruit	Special case - nature reserve. If any applications, need to consider at least a rapid depending of impacts
A22J1 (EWR6)	A22G, A22H, A22J1	Hex River to Vaalkop Dam	**Use EWR 6**
A22J	A22A-J	Elands River to Upper Crocodile confluence	**Use EWR 6**
Apies/Pienaars			
A23A	A23A	Source to Roodeplaat Dam	Urban, storm water, WWTWs, canalised. **Use the PES with DRM**. Maintain riparian vegetation
A23B4	A23B4	Boekenhoutspruit	Main constraint sand mining, **use rapid results from previous Tolwane River** with updated hydrology
A23B (EWR4)	A23A, A23B	Outlet of quaternary catchment	**Use EWR 4** for main stem from Roodeplaat Dam to Boekenhoutspruit confluence
A23C	A23A-C	Pienaars River to confluence with Tshwanespruit	Floodplain (valley bottom)
A23D	A23D	Outlet of quaternary catchment	Urban, storm water, WWTWs, canalised. **Use the PES with DRM**. Maintain riparian vegetation
A23E1	A23D, A23E1	Source to Bon Accord Dam	Urban, storm water, WWTWs, canalised**. Use the PES with DRM**. Maintain riparian vegetation
A23E	A23D, A23E	Main stem to outlet of quaternary catchment	Semi-urban, storm water, WWWTs, canalised. **Use the PES with DRM.** Maintain riparian vegetation
A23F2	A23F2	Tshwanespruit	Small wetlands
A23F	A23D, A23E, A23F	Apies River to confluence with Pienaars River	Floodplain (valley bottom)
A23G	A23G	Platspruit	**Use results from previous rapid** study

Quaternary catchment/ Modeling zone	Contribution per quaternary catchment	River/Description	Notes/Comments
			with updated hydrology for the upper reaches.
A23H	A23H	Karee/Rietspruit/Toitspruit	**Use DRM**
A23J1	A23J1	Kutswane	Urban up to Tswaing Crater. Below Crater very sandy - **use previous Tolwane rapid results** with updated hydrology
A23J	A23A-J	Pienaars and Apies Rivers to Klipvoor Dam	Floodplain (valley bottom)
A23K	A23K	Tolwane River	**Use previous Tolwane rapid results** with updated hydrology
A23L (EWR5)	A23A-L	Pienaars River to Crocodile confluence	**Use EWR 5** for main stem
Lower Crocodile			
A24A	A21, A22, A23, A24A	Outlet of quaternary catchment	**Use DRM** with biological data available from Atlanta
A24B	A21, A22, A23, A24A-B	Outlet of quaternary catchment	**Use EWR 7** for main stem Tributaries – seasonal, **use DRM**
A24C (EWR7)	A21, A22, A23, A24A-C	Vaalkop, Roodekoppies & Klipvoor Dams to confluence with Sand River	**Use EWR 7** for main stem Tributaries - Sand River seasonal, use biological data available **with DRM**
A24D	A24D	Source to Bierspruit Dam	Mostly wetland systems, groundwater
A24E	A24E	Outlet of quaternary catchment	Tributaries - seasonal. Groundwater system in upper reaches. **Use DRM**
A24F	A24D-F	Bierspruit to confluence to Crocodile River	**Use DRM** with biological data available
A24G	A24G	Outlet of quaternary catchment (Sand River)	Sand and Vingerkraal-se-Loop. Biological data available. **Use with DRM**
A24H (EWR8)	A21,A22, A23, A24A-C, A24G, A24H	Crocodile River to confluence with Bierspruit	**Use EWR 8**
A24J	A21, A22, A23, A24A-J	Crocodile River	**Use EWR 8**, rest mainly groundwater

Table 10: Extrapolation recommendations for Groot Marico catchment

Quaternary catchment	EWR sites	River/Description	Notes/Comments
A31A	EWR 1	Kaaloog-se-Loop	**Use EWR 1** for extrapolation to Bokkraal-se-Loop, Rietspruit and Ngotwane
A31B	EWR 2	Groot Marico	**Use EWR 2** For tributaries (Sterkstroom) – use biological data and updated hydrology with **DRM**
A31C		Klein Marico	Dolomitic area and peatland system (Molomane-se-Loop). No surface water
A31D		Klein Marico	**Use EWR 5** for main stem and Kareespruit
A31E	EWR 5	Klein Marico	**Use EWR 5**
A31F	EWR 3	Groot Marico	**Use EWR 3**
A31G		Groot Marico	**Use EWR 3** for main stem Tributaries are ephemeral
A31H		Sandsloot	Tributaries are ephemeral
A31J		Sandsloot	Tributaries are ephemeral
A32A		Groot Marico	**Use EWR 3** for main stem Tributaries are ephemeral
A32B		Kgolane	Tributaries are ephemeral
A32C		Brakfonteinspruit	Tributaries are ephemeral
A32D	EWR 4	Groot Marico	**Use EWR 4** for main stem
A32E		Groot Marico	**Use EWR 4** for main stem

3.4.4 Socio-economics

Building on Prime Africa's work on the socio-economic component of the Olifants WRCS, most of the information required for the socio-economic analysis is gathered from sources other than the reports published by DWA. This section provides a detailed list of the information categories generally required in a study of this nature.

Social data comes primarily from the StatsSA 2001 Ward Census Data. While this data may be fairly out-dated, results from the recently conducted 2011 Census are not yet available. 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.

Water quality data

A large component of the socio-economic study would be to quantify the water quality impacts on the economic sectors directly dependent on water resources in the WMA. The main activities within the WMA and the Molopo Catchment are mining, agriculture, light industries, urban development, rural settlements and tourism. These activities will impact on the water quality of receiving water bodies as point and non-point sources of pollution.

In order to estimate the cost of the decline in water quality due to these activities the following data and information is required:

- Physical data: the flow (expressed as MAR) of the river system at EWR sites;
- Physical data: the loading of specifically identified water quality indicators at EWR sites;
- Spatial data: in order to identify specific activities downstream of EWR sites;
- Other data: volumes of effluents and concentrations of water quality indicators in effluents of waste water treatment works within the study area;
- Economic data: using the load model and the marginal cost of abatement model as developed for the Olifants WMA.

Mining Data

Data will be collected from the Chamber of Mines, The Department of Mineral Resources (DMR), Statistics SA and the Council for Geoscience. Published annual reports of mining companies in the WMA will be sourced. Information on mining will be sourced from various DWA published reports, including:

- Scoping level assessment of how water quality and quantity will be affected by mining method and mining of the shallow Waterberg coal reserves west of the Daarby Fault. 2011. WRC.

A meeting will be held with the Chamber of Mines in order to gather information regarding possible mining expansions and trajectories.

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.

Agricultural Data

Output for the agricultural sector will be calculated from several sources:

- Total area of dryland, irrigated and subsistence for each integrated unit of analysis (IUA) will be calculated using the Land Cover Database developed by the CSIR (2001). Although the database is a decade old, it is reliable source of data and has been used as a baseline for several studies;
- Further area estimates will be calculated from the Stats SA Agricultural Census of 2002. Results from the Stats SA Agricultural Census of 2010 will be utilised if completed by Stats SA; and
- Discussions with Department of Agriculture, Forestry and Fisheries (DAFF).

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 Crocodile (West) and Marico catchments of the DWA, Directorate National Water Resource Planning will be relied upon to determine an ESBC.

A gap exists in quaternary catchment D41A, Upper Molopo and the Ngotwane River, quaternary catchment A10A and A10B where no yield models exist.

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 Intermediate Reserve study was to identify Ecological Water Requirement (EWR) sites on the main stem and major tributaries;
- Only eight sites were assessed on an intermediate level and three on the rapid level for the Crocodile West Catchment; gaps identified are:
    - Rietspruit, quaternary catchment A21A;
    - Waterkloofspruit, sub-quaternary catchment A22H2; and
    - Bierspruit, quaternary catchments A24D, A24E and A24F.
- The Apies Pienaars River together with the Pienaars River wetland were not adequately represented with just two EWR sites one on the Pienaars River below Klipvoor/Borakala Dam and the other site below Roodeplaat Dam;

- There are no EWR sites in quaternary catchment D41A, Upper Molopo and the Ngotwane River, quaternary catchment A10A and A10B;
- Rapid site on the Lower Elands;
- Rapid site on one of the tributaries in the Bela Bela area; and
- Confidence in the hydrology of the lower Groot Marco is low and while this was used during the Intermediate Reserve study, it was with very low confidence in the actual EWRs. Guidance from DWA will therefore be needed on how to proceed.

In terms of addressing the gaps identified the team will be 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 several Rapid III Reserve assessments.

4.2 Socio-Economic

- Gaps in information related to the mining and power station data available for the mines in the WMA may exist. Gaps identified need to be addressed, through accessing all available literature, published and unpublished databases, and expert involvement:
- The study, “The Development of a Reconciliation Strategy for the Crocodile (West) Water Supply System” may be used to deduce approximate water usages and expected growth patterns; and
- Specific assumptions will need to be made where data is absent however these will be clearly defined and explained.

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. Water quality specialists within the Department need to be approached to assist the classification team in this regard.

5 MITIGATION MEASURES FOR RISKS IDENTIFIED

Potential risks/limitations identified are set out in Table 11.

Table 11: List of possible identified risks and limitations with proposed mitigation

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 needs to be used and where possible modelling, extrapolation, estimations be used. Every effort needs to be taken to ensure that the end results and outputs are technically sound, scientifically supported and defendable. Where possible meetings/liaison must be undertaken with the water use sector (e.g. mining data – Chamber of Mines). Rapid III Reserve studies to be undertaken if possible, where necessary.
Water quality data may not be available for smaller tributary catchments	Potential gap to be addressed by water quality neural network analysis
Gaps in information related to future mining and power station development	Gaps identified need to be addressed, through accessing all available literature, published and unpublished databases, and expert involvement: The study, "The Development of a Reconciliation Strategy for the Crocodile (West) Water Supply System" may be used to deduce approximate water usages and expected growth patterns; and Specific assumptions will need to be made where data is absent however these will be clearly defined and explained.

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 Crocodile (West) and Marico WMA required for the implementation of the WRCS, it is evident that considerable data exists for the significant water resources within the Crocodile (West) and Marico WMA to enable an evaluation of changes in their ecological condition in response to changes in water related issues.

The Crocodile (West) and Marico WMA is well studied, thorough preparations have been made and it can be concluded that adequate, useful information as well as experts, with firsthand knowledge of the system for the implementation of the WRCS in the WMA, are available.

7 REFERENCES

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