CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE INTHE MOKOLO AND MATLABAS CATCHMENTS: LIMPOPO WATER MANAGEMENT AREA (WMA) AND CROCODILE (WEST) AND MARICO WMA

WP 10506

INCEPTION REPORT

FINAL

Directorate: Water Resource Classification

MARCH 2012

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

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REFERENCE

This report is to be referred to in bibliographies as:

Directorate Water Resource Classification. Department of Water Affairs, South Africa, March 2012. **CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE MOKOLO AND MATLABAS CATCHMENTS: LIMPOPO WATER MANAGEMENT AREA (WMA) AND CROCODILE (WEST) AND MARICO WMA** Inception Report. Report No: RDM/WMA1,3/00/CON/CLA/0111

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Title:	*Inception Report*
Authors:	*Study Team*
Project Name:	*Classification of significant water resources in the Mokolo and Matlabas catchments: Limpopo Water Management Area (WMA) and Crocodile (West) and Marico WMA: WP 10506*
DWA Report No:	*RDM/WMA1,3/00/CON/CLA/0111*
Status of Report:	*Final*
First Issue:	*January 2012*
Final Issue:	*March 2012*

Professional Service Providers: **Golder Associates Africa/ Zitholele Consulting/ Wetland Consulting Services and Prime Africa**

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List of Abbreviations

BID	Background Information Document
CD: WES	Chief Directorate: Water Ecosystems
DWA	Department of Water Affairs
DBSA	Development Bank of South Africa
EIS	Ecological importance and sensitivity
EWR	Ecological Water Requirements
IUA	Integrated Unit of analysis
MC	Management Class
NFEPA	National Freshwater Ecosystem priority areas
NWA	National Water Act
PES	Presentation Ecological State
PMC	Project Management Committee
PSC	Project Steering Committee
RDM	Resource Directed Measures
RQOs	Resource Quality Objectives
RWQOs	Resource Water Quality Objectives
SAM	Social Accounting Matrix
STATS SA	Statistics South Africa
TTG	Technical Task Group
WMA	Water Management Area
WRC	Water Research Commission
WRCS	Water Resource Classification System
WRYM	Water Resources Yield model
WRPM	Water Resources Planning Model

Classification of significant water resources in the Mokolo and Matlabas catchments: Limpopo Water Management Area (WMA) and Crocodile (West) and Marico WMA

Inception Report

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1.0 INTRODUCTION

1.1 OVERVIEW

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 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 Reserve has to be determined for a significant water resource, as a means to ensure a desired level of protection.

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 Mokolo and Matlabas catchments: Limpopo Water Management Area (WMA) and Crocodile (West) and Marico WMA in accordance with the WRCS.

Golder Associates (Africa) in association with Prime Africa Consultants, Zitholele Consulting and Groundwater Consulting Services have been appointed to undertake the study, 'Classification of significant water resources (rivers, wetlands, groundwater and lakes) in the Mokolo catchment: Limpopo Water Management Area (WMA) and Crocodile (West) and Marico WMA''. It must also be noted that in parallel and as part of a capacity building programme, DWA will undertake the classification of the Matlabas catchment situated in the Limpopo WMA, in-house.

The purpose of the management class (MC) is to establish clear goals relating to the quantity and quality of the relevant water resource.

As South Africa's water resources are becoming more stressed due to an accelerated rate of development and the 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 uses and be maintained at their desired states specifically in the Mokolo and Matlabas catchments of the Limpopo Water Management Area (WMA) and Crocodile (West) and Marico WMA area. The determination of the MC of the significant water resources in Mokolo and Matlabas catchments: Limpopo Water Management Area (WMA) and Crocodile (West) and Marico WMA will essentially describe the desired condition of the resource, and conversely, the degree to which it can be utilised by incorporating the economic, social and ecological goals of the users and stakeholders.

1.2 PURPOSE OF THE STUDY

The purpose of this project is to coordinate the implementation of the seven step process of the WRCS to classify all significant water resources (as so defined) in the Mokolo and Matlabas catchments: Limpopo Water Management Area (WMA) and Crocodile (West) and Marico WMA in order to determine a suitable MC for each of the relevant water resources and in so doing deliver the IWRM template with recommendations for presentation to the Minister.

It is understood that this project is not aimed at determining the Resource Quality Objectives or the Reserve for the water resources. Where the preliminary Reserve is available, the data for the ecological water requirements will be used to extrapolate to the nodes, when possible and

appropriate.

The specific objectives of the study include:

- Study Inception;
- Status quo on water resources within the Mokolo and Matlabas catchments: Limpopo Water Management Area (WMA) and Crocodile (West) and Marico WMA;
- Information and data sourcing;
- Implementation of the WRCS;
- Communication and liaison; and
- Skills development and transfer.

1.3 PURPOSE OF THE REPORT

The inception report has been produced to better define the scope of work for the study, document any changes to the scope of work from the proposal, and highlight related considerations that could influence the study, confirm the study programme and indicate any revised cost estimates resulting from the initial assessments and reviews undertaken during the inception phase of the project.

1.4 STUDY AREA

1.4.1 Overview

The study area is the Mokolo and Matlabas catchments which form part of the Limpopo WMA and the Crocodile (West) and Marico WMA (

Table 1 and Figure 2).

The Mokolo and Matlabas catchments: Limpopo WMA

The Mokolo catchment stretches from the Waterberg Mountains through the upper reaches of the Sand River, and includes the Mokolo Dam and a number of small tributaries that join the main Mokolo River up to its confluence with the Limpopo River, including the Tambotie, Poer-se- Loop, and Rietspruit rivers. The catchment covers an area of 8 387 km^2.

The Matlabas catchment is situated in a predominantly flat area of the Limpopo WMA. Matlabas River originates in the Waterberg mountain range and the altitude varies from 1 400 m to approximately 840 m at the confluence with the Limpopo River. The catchment is largely undeveloped with limited water resources and limited water use. The area covers approximately 6 014 km^2.

Crocodile (West) and Marico WMA

The Crocodile (West) Marico WMA (WMA 3) borders on Botswana (north-west) and includes two major river systems the Crocodile West and Marico, which give rise to the Limpopo River at their confluence.

The two major rivers in the Crocodile (West) Marico WMA are the Crocodile (West) River and the Groot Marico River, which form the south-western part of the Limpopo River basin (Drainage Region A), eventually draining into the Indian Ocean in Mozambique. The WMA also includes the headwaters of the Molopo River, a tributary of the Orange River which drains westwards to the Atlantic Ocean. The WMA includes the tertiary drainage regions A10, A21 to A24, A31, A32 and quaternary drainage region D41A.

The WMA covers a total catchment area of 47 565 km^2. The Pienaars, Apies, Moretele, Hennops, Jukskei, Magalies and Elands rivers are the major tributaries of the Crocodile River which together make up the A20 tertiary drainage catchment, with 39 quaternary catchments. The Crocodile River contributes to the flow of the Limpopo River, which has an international river basin shared with Botswana, Zimbabwe and Mozambique.

Table 1: The sub-catchment areas within the study area

Sub-catchment	**Catchment Area (km^2)**	**Quaternary catchments**
Upper Crocodile (A21)	6 336	A21 A – L
Elands (A22)	6 221	A22 A – J
Apies/Pienaars (A23)	7 588	A23 A – L
Lower Crocodile (A24)	9 204	A24 A – J;
Marico (A31 and A 32)	12 030	A32 A – E; A31 A – J
Ngotwane (A10)	1 842	A10 A – C
Upper Molopo (D41))	4 300	D41 A
Matlabas (A41)	6 014	A41A – E
Mokolo (A42))	8 387	A42 A – J

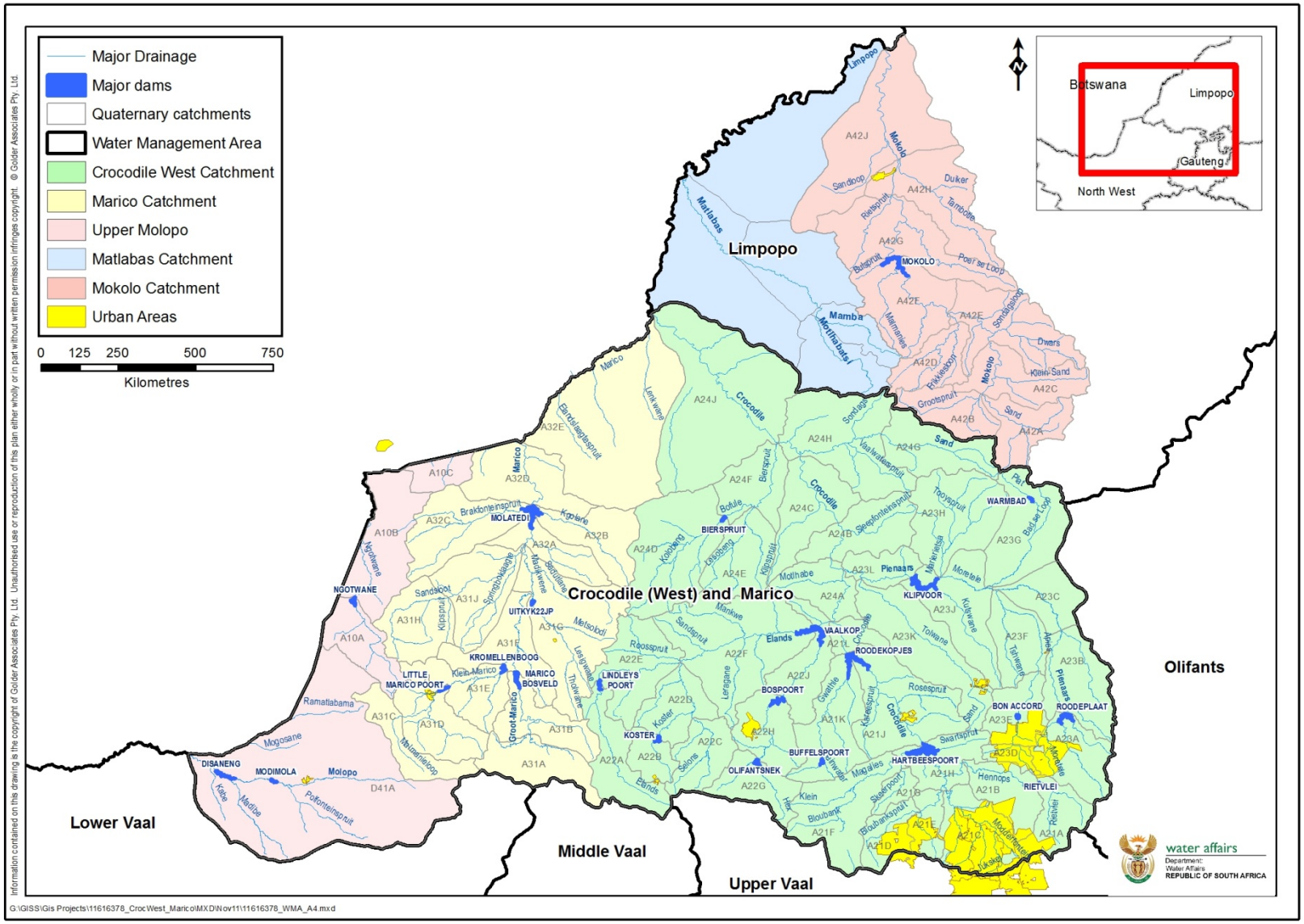

Figure 1: Mokolo and Matlabas catchments: Limpopo WMA and Crocodile (West) and Marico WMA indicating the sub-catchment areas

1.4.2 Socio-economic situation

Mokolo and Matlabas catchments

The Mokolo catchment falls within the south western portion of the Limpopo WMA and Limpopo Province. Exxaro's Grootegeluk Colliery is currently the only commercial coal mining operation in the Waterberg Basin. At present the annual production of Grootegeluk coal mine is 15.3 Mt/a. It is the largest open cast coal mine of its kind in the world. The mine is now being expanded to supply the new Medupi Power Station with coal. Additional to Matimba and Medupi three new Eskom power stations CF3, CF4 and CF5 are envisaged for the future.

The Lephalale area has been selected by Sasol to access the vast coal reserves in the Waterberg coal fields for its Maphuta coal to liquid fuel projects (Mafutha) however this is currently on the backburner.

The Steenbokpan area, quaternary catchment A41E in the Matlabas catchment, is part of the Lephalale coalfield and numerous mining developments are foreseen for this region. Current and future developments around the available coal reserves in the Steenbokpan area will require adequate planning for future water needs.

Crocodile West Marico

The Crocodile (West) Marico WMA stretches across three provinces: Gauteng, Northwest and Limpopo and comprises the Crocodile and Groot Marico Rivers. Economic activity across the WMA is diverse. The Upper Crocodile sub-catchment (A21) and the urban areas of the Pienaars sub-catchment (A23) comprise a well-developed manufacturing and general commercial urban economy. Rustenburg in the Elands River sub-catchment (A22) is well known for its extensive platinum mining activities. The rural parts of the Pienaars River sub-catchment (A23); the Lower Crocodile River (A24); and the Groot Marico (A3) economies are dominated by agriculture and eco-tourism activities.

Mining operations in the Crocodile (West) Marico WMA is dominated by platinum and the platinum group metals, gold, chrome, manganese, iron ore, diamonds, dimension stone and mineral sands, as well as smaller quantities of vanadium, limestone and andalusite (an aluminium nesosilicate mineral). The entire western section of the mineral-rich Bushveld Igneous Complex is situated here, resulting in intense mining activity in that region

Irrigation occurs mostly in the Crocodile catchment, immediately downstream of the Hartbeespoort Dam and also further downstream towards the south of Thabazimbi. Irrigation is done at Lichtenberg with water sourced from the Grootfontein dolomitic compartments. Dry land crops, mostly maize, are grown in the higher rainfall south and south-eastern parts of the WMA. Stock and game farming dominate land-use in the drier northern and western regions.

There are several heavy industries in the WMA. These include Pelindaba and Valindaba (direct abstractions from the Crocodile River upstream of Hartbeespoort Dam), and the Dwaalboom cement factory at Thabazimbi (supplied by Magalies Water from the Vaalkop Dam). Three relatively small power stations, Rooiwal, Pretoria West and Kelvin, are present in the WMA.

Although the Crocodile (West) Marico WMA is not as renowned for its tourism activities as other provinces (e.g. Mpumalanga, KwaZulu-Natal, Eastern Cape and Western Cape), tourism nevertheless plays an important role in stimulating accommodation, transport and retail sectors. Of

special interest is the Hartbeespoort Dam, a significant hub for various forms of recreation and tourism.

The Regional Gross Domestic Product (GDPR) of the Crocodile (West) Marico WMA was estimated by DWA to be R130,1 billion in 1997 with the following contributions from various municipal areas:

Tshwane = 34,1%;

Johannesburg = 32,0%;

Ekurhuleni = 10,0%; and

Other 22,9%.

The key economic sectors contributing to GDPR were:

- Manufacturing = 22,7%;
- Government sector 18,7%;
- Finance 17,7%;
- Transport 15,7%; and
- Other 25,2%.

The University of Pretoria estimated a GDPR of R137.6 billion for the Crocodile (West) Marico WMA for 2002 (Hassan *et al.* 2008).

Macro-economic data is generally available at a provincial level and therefore analysis of economic activity within the Crocodile (West) Marico WMA is complicated by its partial coverage of three provinces.

1.4.3 Socio-economic zones

The objective of dividing the catchment into socio-economic zones (SEZ) is to predict and report the implications of different catchment configuration scenarios on social well-being, economic prosperity and ecosystem health at an appropriate scale. For the Crocodile (West) Marico WMA we propose the following preliminary SEZs:

Table 2: Preliminary socio-economic zones (SEZs) for the Crocodile (West) Marico Water Management Area (WMA)

Name	Description	Location (Quaternary Catchment)
Urban SEZ	The Urban SEZ includes the major metropolitan municipalities of Johannesburg, Tshwane and the other municipalities in-between. The SEZ includes a large portion of Gauteng conurbation, which includes: Johannesburg, Ekurhuleni (East Rand), and Tshwane (greater Pretoria). The conurbation comprises a population of approximately 14.6 million people.	A21A-E and A21G and H; A23A,B,D and E.
Conservation	The areas of particular importance to conservation	Magaliesburg PA:

Name	Description	Location (Quaternary Catchment)
SEZ	efforts include the Cradle of Humankind and the Magaliesburg Protected Area as well as the upper catchment of the Marico River. The dolomitic headwaters of the Marico River contain unique biodiversity and it has been recognised as an important fish sanctuary. There is an active tufa waterfall and seasonal tufa cascades and MCCA efforts for protection status for various farms in the upper Marico and striving for Biosphere Reserve status. Other possible areas include the Madikwe Protected Area located in the lower Marico Catchment. Landowners around Molopo eye have applied for Nature Reserve status. It is currently a conservancy (Molopo Oog Conservancy). Molemane Nature Reserve is a provincial reserve managed by NWP&TB.	A21F, A21G, Upper Marico headwaters: A31A,B,C,D,E Madikwe: Lower portion of A32E
Mining SEZ	The Mining SEZ comprises of the platinum mining area surrounding the town of Rustenburg. The CWM WMA contains a large portion of the Bushveld Igneous Complex, the largest platinum group metals (PGM) deposit worldwide.	A21J, A21K, A21L, A23K, A23L
Agricultural SEZ	A large proportion of the CWM WMA falls within this category. The Upper Crocodile River area below the Hartbeespoort Dam is largely of a commercial agricultural nature. The area encompassing the Moretele River is largely temporary commercial dryland agriculture in nature and includes the agricultural district of Bela Bela. The lower Crocodile River Catchment down to the Limpopo River is characterised by some commercial agricultural activities, some subsistence farming and cattle/game farming. Upper Molopo Catchment consists mainly of dryland and some subsistence agriculture. The Marico Catchment below the Marico Bosveld Dam comprises commercial and small-scale agriculture. The Mokolo Catchment comprises some commercial and small-scale agriculture. The Matlabas catchment comprises mostly natural veld which is used for stock or game farming.	Essentially the rest of the WMA.

1.4.4 Surface Water

Mokolo and Matlabas catchments

The surface water resources of the Mokolo catchment are substantial while groundwater is also used. The Mokolo Dam, together with numerous dams in the upper reaches of the catchment, as well as run-of-river, all contribute to a large surface water resource estimated at 77 million m^3/a, after allowing for the Ecological Reserve. The Mokolo Key Area is approximately in balance.

The Matlabas catchment is dry with non-perennial flow and hence no sustainable yield from surface water. The limited water use in this catchment is mostly from groundwater, which is under-exploited. Despite the significant MAR of the catchment (49 million m^3/a), the surface water flow is very erratic, the river flow is ephemeral, and the 1:50 year yield is effectively zero.

Crocodile (West) Marico

The Marico and Crocodile Rivers form the headwaters of the Limpopo at their confluence. The flow in the Marico River is highly variable and intermittent in the lower reaches (upper reaches constant baseflow from various dolomitic eyes). There are two major storage reservoirs that regulate the flow in the Marico River: the Marico Bosveld Dam in the middle catchment and the Molatedi Dam in the lower part of the catchment. There are several other dams including the Klein Maricopoort, Kromellenboog and, from which water is mainly used for irrigation along the Marico River. Sehujwane Dams used for mainly domestic water supply to village. The Ngotwane River is a tributary of the Limpopo River. It flows into Botswana before turning and joining the Limpopo River.

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

The topography of the area is generally very flat with undulating hills in the lower reaches of the Marico. Gradient of Marico river fairly steep below eyes- flowing through maountaineous area- dolomitic areas fairly flat yes and area below Marico Bosveld Dam fairly flat yes. The Marico River flows through a variety of geomorphological features from source to the confluence with the Limpopo River. The river has a total length of 250 km and an altitudinal variation of 700 m descending at an average slope of 1: 357 (Grobler *et al*., 2007). The upper tributaries flow in deeply incised gorges that are relatively unimpacted and sheltered from anthropogenic disturbances such as intensive agricultural activities (Grobler *et al*., 2007). The lower catchment area, downstream from Marico Bosveld Dam, is characterised by limited flow contribution to the Marico River (Ashton *et al*., 2001).

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

The Marico, Upper Molopo and Upper Ngotwane area is currently under stress and therefore, no new water uses can be considered from surface water resources with the exception of abstraction of groundwater outside of the dolomites. The area should rely on groundwater for its future water requirements.

The naturalised mean annual runoff in the Crocodile (West) catchment area is about 646 million m^3 per annum, with an exploitable groundwater resource of about 125 million m^3 per annum.

1.4.5 Groundwater

Mokolo and Matlabas catchments

The current groundwater resource of the Mokolo catchment is estimated at 11 million m^3/a and is used to supply irrigation and domestic rural use.

A significant portion of the water use in the Matlabas catchment is from groundwater due to the non-perennial flow of the Matlabas River.

Crocodile (West) Marico

Groundwater in the Marico area is an abundant source of water because of the geology. Groundwater is important at two levels, as there are high yielding dolomitic aquifers and local groundwater sources are available for rural water supplies.

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

In the Upper catchment of the Groot Marico as well as the Upper Ngotwane catchment, the landscape is generally flat to gently rolling due to the Malmani dolomites. The dolomite is intruded by numerous dolerite dykes that have effectively sub-divided the dolomite into a series of compartments, which may or may not be hydraulically linked. Groundwater is widespread, especially in chert rich horizons and karst zones where borehole yields greater than 5l/s are common, and yields of 20l/s are feasible.

1.4.6 Water supply infrastructure

Mokolo and Matlabas catchments

There are several small irrigation dams in the Mokolo catchment, upstream of the Mokolo Dam, the main storage dam in the catchment used for domestic supply.

The Mokolo Dam is by far the largest dam in the WMA with a full supply capacity of about 146 million m^3 and the natural MAR at the dam site estimated at 240 million m^3/a (Midgely, et al). The dam was constructed in the late 1970s primarily to supply water to the Matimba power station but the dam also supplies water to the town of Lephalale as well as for irrigation downstream of the dam.

There are no significant dams in the Matlabas catchment and a significant portion of the water use is from groundwater due to the low assurance of the run-of-river yields.

Crocodile (West) Marico

The Crocodile (West) Marico WMA receives water from the Upper Vaal and Olifants WMAs, of which the most significant transfer is by Rand Water from the Upper Vaal WMA to supply the urban and industrial demands of Johannesburg, Midrand, Tshwane and Rustenburg, as well as the larger mines in the WMA. Water is transferred from the Crocodile (West) Marico WMA to Botswana (Gaborone) and the Limpopo WMA (Modimolle).

Several large dams have been constructed on the rivers and their tributaries, and the surface water resources are already highly developed. The main storage dams on the Crocodile River system are:

- Rietvlei, Hartbeespoort and Roodekopjes in the Upper Crocodile catchment;
- Roodeplaat and Klipvoor dams in the Apies/Pienaars catchment, and
- Olifantshoek, Bospoort, Lindleyspoort and Vaalkop in the Elands River catchment.
- No major dams occur in the Lower Crocodile catchment area.

A key factor in terms of water supply in the Crocodile West and Marico catchment is that about 90% of all municipal and bulk industrial use and 50% of mining use is supplied from the Upper Vaal WMA. The catchment is therefore heavily reliant on the Upper Vaal WMA for its water. This water produces about 87% of the urban, industrial and mining return flow in the WMA (which may be used as a proxy for the water quality impact on the WMA). While the return flows offer considerable potential for re-use, effluent is causing major pollution of the rivers in the WMA. Municipal water use was assumed to grow at 1% per year, industry, mining and power at 2.5% per year, and irrigated agriculture and forestry at 0% per year.

1.4.7 Water Quality

Mokolo and Matlabas catchments

Groundwater quality in much of the Mokolo catchment is poor due to the coal and gas fields. This poor quality groundwater could still be used for industrial purposes or irrigation, however, is unsuitable for domestic use. Coal mining activities are also impacting on the surface water quality of the Mokolo catchment.

The rapid and uncontrolled growth of informal settlements around Vaalwater and Alma (south of Vaalwater) is a source of concern with regard to the surface and groundwater quality in this area.

The quality of the water resource could also be affected by pollution from the Grootgeluk coal mine. Some of the water quality problems that could result from the coal mine are acid mine water, low pH and high TDS. The extent of diffuse pollution from the mine and other industries in the area is unknown and must be investigated and quantified. Adverse impacts from activities within these catchments outside of Vaalwater and small settlements are unlikely.

There are no reported water quality problems in the Matlabas catchment, either surface or groundwater. Due to the low levels of development in this catchment, no water quality problems are anticipated.

Crocodile (West) Marico WMA

The water resources of the WMA are already fully utilised, and the importance of the transfers and return flows in the water balance cannot be overemphasised especially in light of the continued strong growth expectations in the Tshwane-Johannesburg and the Platinum Belt regions. These factors will impact on flows and water quality along the Crocodile River and also on South Africa's international obligations. An estimated 549 million m^3/a of the natural mean annual runoff of 855 m^3/a that originates in the WMA, flows out, 96% of this to the Limpopo River.

Water quality assessments of the different sub catchments in the Crocodile West and Marico/Marico WMA have been done previously. The biggest impactors on water quality in the

area are the large scale water and land users. The urban areas in the south-east of the catchment, with their undersized water systems and large waste problems impact substantially on the Hartbeespoort and Roodeplaat dams. Other contributors to the poor water quality include industries and old abandoned mines. The return flows from sewage works are also a major contributing factor and local authorities struggle to comply to discharge standards. Fertilizers and pesticides from agricultural activities are likely to have a negative impact however this has not yet been quantified.

Groundwater quality is generally good, apart from specific rural areas where the groundwater is polluted by poor sanitation facilities.

Treated wastewater return flows from the Upper Vaal WMA play an important role downstream where the water is used in the Crocodile West and Marico catchment area (makes up approximately 27% of available water, in excess of 356 million m^3/a). The quantities are increasing and while serving as a potential source of water for future development in the catchment, the cumulative impact on the water quality needs to be determined.

The Department of Water Affairs conducts an ongoing monitoring programme in the Crocodile River catchment area.

1.4.8 Ecological Important Areas

Mokolo catchment

Between Bela-Bela and Lephalale in the north eastern section of the study area, is the Waterberg. This comprises the watershed and upper catchment of the Mokolo catchment area. This area is characterized by steep mountain slopes with sandy nutrient poor soils, rocky plateaus and mixed broad leaved savanna bushveld. The wetland systems typically found in the Waterberg include hillslope seeps, sheetrock wetlands and channeled and unchanneled valley-bottom systems. Water quality is typically good, and the streams are flanked by narrow riparian zones with the larger dominant tree typically being the Waterberry (*Syzygium cordatum*) and water pear (*Syzygium guineense)*. Valley-bottom wetlands typically comprise a mixture of tall emergent plants such as the common reed *Phragmites australis* and the grass *Miscanthus junceus* and shorter grass-sedge meadows dominated by *Leersia hexandra* and Red vlei grass (*Ischaemum fasciculatum*). The main ecosystem services supplied by these systems include flood attenuation, water quality enhancement, streamflow augmentation and biodiversity maintenance.

Extensive wetland systems occur in the Sand River catchment (southern most watershed of the Mokolo River). They form important habitat for Blue cranes and are thus of high importance from a conservation and biodiversity perspective. Land use in the area is mostly agricultural and as a result many of the wetland systems have been degraded. WfWetlands targeted the area for wetland rehabilitation and to date a number of projects have been implemented. In addition to these wetlands, the riparian and instream habitats of the Sterkstroom, Taaibosspruit and Rietspruit are also considered important ecologically. These are also some of the remaining rivers in the catchment that still support flow dependent fish species (River Health Programme, 2006).

Downstream of the Mokolo Dam the Mokolo River enters the Limpopo plain. Here colluvial processes dominate and the river and associated riparian and wetland habitats are controlled by the deposition, transport and erosion of sediment. Here the alluvial (river process driven) aquifer supports an extensive riparian forest fringe and instream biota. The riparian zone in particular,

which includes large specimens of the Nyala berry (*Xanthocercis zambesiaca*), Waterberry (*Syzygium cordatum*) and the Tamboti (*Spirostachys africana*), is dependent on this shallow alluvial aquifer system. The lower reaches also support Leadwood trees (*Combretum imberbe*). In the vicinity of Lephalale, the river is extensively used for sand mining. This together with the regulated flows from the Mokolo Dam upstream has affected the structure of the river along this reach with resulting alterations to the flow regime and pattern. There is also evidence suggesting that the resulting changes have not only affected the distribution and abundance of reedbeds in the system, but also the alluvial aquifer which in turn is impacting on the instream and riparian ecosystem.

The Tambotie River which flows through D'Nyala Nature Reserve and joins the Mokolo River near to Lephalale, is also regarded as an important system. The floodplain of the Tambotie River supports an extensive population of Tamboti (*Spirostachys Africana*) and Leadwood trees (*Combretum imberbe*). Water abstraction and the droughts experienced in the 1980's and early 1990's impacted on the system and with the drying out of the alluvial aquifer during this time, many of the Leadwood trees died. This floodplain system is nevertheless considered to have high ecological importance and sensitivity and is a key wetland in the region.

Matlabas catchment

The Matlabas River flows through the Marakele Nature Reserve. The park is characterized by the Waterberg Moist Bushveld vegetation type (veld type 12),mixed Bushveld (veld type 18) and the Sweet Bushveld (veld type 17). The Sweet Bushveld is mostly found along the banks of the Matlabas River and forms an important winter refuge area for game particularly during limiting periods at the end of the dry season. The planned western expansion of the park will include more of this vegetation type, which is crucial to sustain adequate numbers of prey species for large predators such as lion and spotted hyena. One of the rare and threatened plant species of Marakele is the Waterberg cycad (Waterbergbroodboom) *Encephalartos eugene-maraisii*. This cycad is endemic to the Waterberg region and grows to 5 m tall among low shrubs at an altitude of 1 450 m.

Crocodile (West) Marico WMA

Dolomite forms the main watershed of the Molopo, Marico and Malmani Rivers to the southwest of the study area as well the upper reaches of the Apies, Pienaars and tributaries of the Crocodile River to the southeast of the study area. The actual source of the Molopo Ngotwane, Marico and Malmani rivers are known as dolomitic eyes, which are wetlands fed by groundwater originating from fractures in the underlying dolomite. The water from these dolomitic eyes is typically alkaline (pH range from 7.5 to 9.3) having picked up magnesium and calcium carbonates through solution from the parent dolomite. Associated with this is the active tufa waterfall in Bokkraal se loop (fed by dolomitic eye, on tributary of Marico River) and the associated active- seasonal tufa cascade on Kuilfontein; a tributary of Marico River. Being perennial, all the wetland systems associated with, and downstream of, the eyes form peat wetlands or peatlands. Peatlands are defined as peat-accumulating fresh water wetlands which develop in areas where there is a net surplus of water with an accreting substrate comprising a high percentage of undecomposed organic plant material (usually with more than 20 - 35% organic matter on a dry weight basis - Mitsch and Gosselink, 1986).

Three Peat Wetland Eco-regions are represented in the study area, being the Highveld, Central Highlands and Bushveld Basin (Marneweck, Grundling and Muller, 2001). The peat wetlands within the former two regions in particular have developed over long periods ranging between 7000 to 15000 years (depending on peat depth) with peat accumulation rates of between 0.3 to 0.6mm/year (Grundling and Marneweck, 1999; Marneweck *et. al.*, 2001). Peatlands in general, and more specifically those associated with the dolomitic eyes, are rare in South Africa and southern Africa in general. Those associated with the dolomites in the Molopo, Malmani and Marico Rivers in particular comprise unique ecosystems characterised by a high degree of endemicity (species which are found only there). The results from both the morphological and genetic studies of the fish species showed that the indigenous cichlid populations inhabiting these dolomitic wetlands are unique, with a number of populations having differentiated to the extent where they may be considered as separate species (DEA&T, 1995). One cyprinid species in particular, *Barbus cf. brevipinnis* (a type of ghieliemientjie) is endemic to the Molopo and is currently under high risk of extinction due to loss of habitat as a result of reduced flows to the wetland area. Also *Barbus motabensis* type locality and NFEPA Fish species.

Studies on the aquatic invertebrates of these dolomitic wetlands have also produced several new distribution records for South Africa and also 21 new species to science (DEA&T, 1995). Similarly, the ostracod diversity from the Molopo system showed that of all the species found in the area at the time of the survey, 30% were new to southern Africa and one species was new to science (DEA&T, 1995). For this reason, dolomitic eyes and their associated peatlands are regarded as sensitive systems. Most of these systems are also important water supply sources and thus the associated ecosystems have been impacted by water abstraction. They are also threatened by groundwater contamination from agriculture, industry and mining, habitat transformation and invasions by alien species (particularly exotic plants e.g. poplars and fish species e.g. black bass) and some have been mined for peat. Working for Wetlands (WfWetlands) started doing rehabilitation work in the Molopo catchment in 2001 including in the headwaters. It has long been recognized that an integrated management strategy is required for conserving or maintaining these unique wetland systems.

The wetlands within the Borakalalo National Park are also considered of high conservation value, despite being heavily degraded. They have also been the focus of WfWetlands work over the past few years. Borakalalo forms the western end of the Moretele floodplain. This is the second largest floodplain in the Bushveld Ecoregion and represents the southern-most natural distribution of Wild Rice (*Oryza longistaminata*) in Africa. The floodplain is used extensively by the surrounding communities for fishing and grazing and is also regarded as an important birding area, with the floodplain and surrounding area supporting 362 of the 461 species recorded in the North West Province. The wetland also includes traditionally sacred sites which have high cultural significance.

The Mareetsane wetland near Mafeking also provides important ecosystem services for people, livestock and wildlife, including water supply and livelihoods support. It is on the Mareetsane River, which flows into the Molopo River. WfWetalnds has been undertaking wetland rehabilitation work on this system. Other rehabilitation projects within the study area targeted by WfWetlands include a wetland system within the Rustenburg Nature Reserve and on the Hex River. These projects were undertaken in partnership with the Local Municipality and Tribal Authority.

A wetland type not well represented in the study area is pans. Pan complexes (groups of pans) occur in three main areas in the study area, namely: south and northwest of Koster (a complex of approximately 24 pans); northeast of Derby (7 pans); and in Johannesburg (approximately 24 pans between Midrand and Kempton Park). Despite impacts from agriculture, an extensive complex of hillslope seepage and valley-bottom wetlands remains associated with the pans near Koster and Derby. Pans are recognized as being important for biodiversity support and more recently their links to other wetland systems in relation to landscape hydrology have also been highlighted. Pans are also unique in terms of their individual biogeochemical attributes. This combination of an extensive network of pans, hillslope seepages and valley-bottom systems, and also that they are unaffected by urbanization and not found elsewhere in the catchments under consideration, renders this an important water resource in the study area. The pans in the Midrand and Kempton Park area are also considered important, but mainly from a biodiversity perspective as they support related bird and amphibian populations. Those that still have some of their catchments intact or that still have associated hillslope seepage wetlands also support some of the last remaining populations of the endangered Giant bullfrog (*Pyxicephalus adspersus*) on the Highveld. The remaining pans and wetlands are thus regarded as critical habitat for these populations. The wetlands including the pans in this area are all threatened by impacts from urbanization. Wetland habitat loss continues as urbanization expands and the hydrology of the related systems and catchments change due largely to storm water management or lack thereof. It is likely that populations of the Giant bullfrog may occur or be found in the pans in the Koster and Derby areas.

1.4.9 Shared Watercourse

The Crocodile (West)/ Marico WMA as well as the Mokolo and Matlabas catchments fall within the Limpopo River Basin, shared by South Africa, Botswana, Zimbabwe and Mozambique. As the Ngotwane, Marico, Crocodile and Mokolo rivers flow directly from South Africa into Botswana, joining the Limpopo River, developments in South Africa can directly impact upon its' neighbours. Issues related to the management of these aforementioned catchments therefore can have bearing on all the basin states of the Limpopo River.

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

International co-operation with respect to the use and management of the watercourses in the Limpopo River Basin was overseen by the Limpopo Basin Permanent Technical Committee (LBPTC) with membership by South Africa, Botswana, Zimbabwe and Mozambique. The commitment of the riparian states managing their water resources together dates back to 1986, when the "Limpopo Basin Permanent Technical Committee" was jointly established. In 2003 this cooperation was fostered through the multilateral agreement to establish the Limpopo Water Course Commission (LIMCOM).

2 BACKGROUND

2.1 OVERVIEW

The NWA was promulgated to provide for fundamental reform of the law relating to water resources, recognising that water is a scarce and unevenly distributed national resource that belongs to all people. The NWA provides the Department of Water Affairs (the Department) with a mandate to protect, use, develop, conserve, manage and control South Africa's water resources in a manner that is integrated, equitable, efficient and sustainable. This mandate is based on the following key principles:

- The ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users;
- The protection of the quality of water resources is necessary to ensure sustainability of the nation's water resources in the interests of all water users; and
- The need for integrated management of all aspects of water resources and, where appropriate, the delegation of management functions to a regional or catchment level so as to enable everyone to participate.

These principles are based on the National Water Policy for South Africa, 1998. The National Water Resource Strategy (NWRS) describes how the water resources of South Africa will be protected, used, developed, conserved, managed and controlled in accordance with the requirements of the National Water Act and the National Water Policy for South Africa. The central objective of managing water resources is to ensure that water is used to support equitable and sustainable social and economic transformation and development.

With the promulgation of the NWA, water resources management in South Africa underwent a paradigm shift. South Africa's water resources are now managed to ensure equitable access and achieve sustainable and efficient use. The Department as custodian of the nation's water resources is mandated to protect, use, develop, conserve, manage and control the nation's water resources in a sustainable and equitable manner for the benefit of all South Africans. Sustainability encompasses both the long- and short-term protection of water resources to ensure that they can be developed and used effectively into the future.

To give effect to the interrelated objectives of sustainability and equity, an approach to managing water resources has been adopted that introduces measures to protect water resources by setting objectives for the desired condition of resources and putting measures in place to control water use to limit impacts to acceptable levels. Resource Directed Measures, together with Source Directed Controls are the key strategic approaches designed under the National Water Act (NWA) (Act No. 36 of 1998) to achieve equity, sustainability and efficiency in Integrated Water Resources Management in South Africa

The WRCS, Reserve and RQOs are protection-based measures that together form the Resource Directed Measures (RDM). These form the protection principles which are contained in Chapter 3 of South Africa's NWA. 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 WRCS which is required by the NWA, is a set of guidelines and procedures for determining

the desired characteristics of a water resource, and is represented by a MC. The MC outlines those attributes that the Department and society require of different water resources. The WRCS prescribes a consultative process to classify water resources (Classification Process) to help facilitate a balance between protection and use of the nation's water resources. The outcome of the Classification Process will be the approval of the MC by the Minister or her delegated authority for every significant water resource (river, estuary, wetland and aquifer) which will be binding on all authorities or institutions when exercising any power, or performing any duty under the NWA. Only three MC are acceptable, Class I: Minimally Used, Class II: Moderately Used, or Class III: Heavily Used. The MC essentially describes the desired condition of the resource, and conversely, the degree to which it can be utilised. In other words, the MC of a resource sets 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.

Classification therefore affects both ecosystem health and the economic activities that rely on water supply and therefore has considerable socio-economic implications. It is also inherently political, as past inequities necessitate redress in terms of access to, use of, and benefit from water resources for previously disadvantaged communities.

The WRCS has been designed to deliver on the outcome of the Classification Process – information for the Minister or delegated authority to set the MC of a resource. The process will require a wide range of complex trade-offs that will need to be assessed and evaluated at a number of scales. The aim of this study is to implement the WRCS in the Mokolo catchment, a portion of the Limpopo WMA and the Crocodile (West)/Marico WMA determining the MC of the significant resources in these areas for presentation to the Minister.

The key phases associated with the determination of the MCs for the water resources and the delivery of the IWRM template for the Mokolo catchment: Limpopo WMA and the Crocodile (West)/Marico WMA will therefore include the following:

- Scope definition;
- Water Resource assessment and information gathering;
- Implementation of the WRCS to determine the management class;
- Communication and liaison; and
- Capacity building.

It is recognised that the process of classification of water resources requires a strongly driven stakeholder engagement and communication component supported and guided by the necessary technical and institutional components. Stakeholder engagement is a key consideration; however the outcome in terms of this process is essentially technically driven and supported by the appropriate institutional structures. Thus the classification of the significant water resources in the study area will not be successful if these components are not able to complement each other.

2.2 PREVIOUS AND PARALLEL STUDIES

The following previous and parallel studies have been identified for the WMA and will be consulted and used to every extent to support the information needs of this study:

2.2.1 Previous studies

The following studies have been undertaken in relation to the Mokolo and Matlabas catchments (Limpopo WMA):

- Limpopo Water Management Area: Overview of water resources availability and utilization (Department of Water Affairs, Pretoria, South Africa. 2003);
- Limpopo Water Management Area: Water Resources Situation Analysis (Department of Water Affairs, Directorate: Water Resources Planning. 2003);
- River Health Programme. State-of-Rivers Report: The Mokolo River System (Department of Environmental Affairs and Tourism, Pretoria, 2006);
- Internal Strategic Perspective: Limpopo Water Management Area (Department of Water Affairs: Directorate: National Water Resource Planning, 2004);
- Economic Boom Strains Waterberg Resource (The Water Wheel November/December 2006);
- The Mokolo River Catchment: Validation of the Existing Lawful Use of Water (Department Of Water Affairs and Forestry, Directorate: National Water Resource Planning, 2007);
- Status on monitoring and Surface water level trends (Department of Water Affairs, Water Resource Information, and Limpopo Province, South Africa. 2009);
- Adopt-a-River Programme Phase II: Development of an Implementation Plan. Water Resource Quality Situation Assessment (Department of Water Affairs, Pretoria, South Africa. 2009);
- Intermediate Reserve Determination Study for the Surface and Groundwater Resources in the Mokolo Catchment, Limpopo Province: Main Report. (Department of Water Affairs, South Africa, 2010)
- Mokolo and Crocodile River (West) Water Augmentation Project (MCWAP) - Phase 1: Augment Supply from Mokolo Dam -Amended Plan of Study for Environmental Impact Assessment – MCWAP Phase 1 (Department of Water Affairs, Directorate: Integrated Water Resources Planning. 2010);
- MCWAP PHASE 1: Wetlands & Watercourse Survey (Compiled by Matthew and Tahla Ross Henning of Nemai Consulting. 2010);
- MCWAP PHASE 1: Draft Social Impact Assessment Draft Report (Prepared by Dr. Neville Bews & Associate and submitted to Nemai Consulting.DEA Reference Number: 12/12/20/1465. 2010);
- Economic Impact Assessment of the Proposed Mokolo River Water Augmentation Project-Draft 1 (Conningarth Economists, in association with In Association with Naledi Development Restructured (Pty) Ltd and Tlou Consulting (Pty) Ltd on behalf of the Directorate: Option Analysis. 2010);
- MCWAP PHASE 1: COMMENTS & RESPONSE REPORT (Nemai Consulting.2010);
- Investigation of potential water quality and quantity impacts associated with mining of the shallow Waterberg coal reserves, west of the Daarby Fault, Limpopo Province, South Africa (M Bester and P. D. Vermeulen. 2010. Water SA Vol. 36 No. 5);
- 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 (PD Vermeulen, M Bester, L-M Cruywagen and GJ van Tonder, WRC Report No. 1830/1/10, 2011);
- An overview of the impact of mining and Mineral processing operations on Water resources and water quality In the Zambezi, Limpopo and Olifants catchments in Southern Africa (Ashton, P.J., D. Love, H. Mahachi, P.H.G.M. Dirks, 2001);

- Environmental Management Framework for the Waterberg District: DRAFT Desired State Report (Environomics Environmental Consultants and NRM Consulting. Report number: 2010/014/PC019. July 2010); and
- Determination of the Groundwater component of the Reserve: Limpopo Water Management Area , RDM/WMA1/02/CON/COMP/0111

The following studies have been undertaken in relation to the Crocodile (West)/Marico WMA:

- Internal Strategic Perspective: Crocodile West Marico Water Management Area (DWAF, Directorate National Water Resource Planning. 2004)
- Institutional Roles and Linkages. Situational Assessment: WMA3: Crocodile West and Marico IWRM Strategies, Guidelines and Pilot implementation in Three Water Management Areas (March 2004);
- State-of-Rivers Report: Monitoring and Managing the Ecological State of Rivers in the Crocodile (West) Marico WMA River Health Programme (March 2005);
- The development of the Reconciliation Strategy for the Crocodile West water supply system (DWAF, Directorate National Water Resource Planning. July 2008);
- North West Province, Report on the State of the Environment. (2008);
- Adopt-A- River Programme Phase II: Development of an Implementation Plan Water Resource Quality Situation Assessment (DWA RQS, 2009);
- Framework and Manual for the evaluation of aquatic ecosystems services. Water Research Commission, 2010)
- Investigating the behavioural drivers of Stakeholder Engagement and Volunteerism in the South African Water Arena (WRC, March 2011)
- 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 (January 2008);
- A Systematic Conservation Plan for the Freshwater Biodiversity of the Crocodile West Marico WMA;
- Development of an automated desktop procedure for defining macro-reaches for river longitudinal profiles (July 2006); and
- National Freshwater Ecosystems Priority Areas (NFEPA) Project (CSIR, DWA, Department of Environment Affairs, south African National Biodiversity Institute, World Wildlife Fund, 2011);

2.2.2 Parallel studies

The following studies in relation to the Mokolo catchment are being finalised:

- Economic Impact Assessment of the Proposed Mokolo River Water Augmentation Project DWA, Directorate: Option Analysis;
- Draft Social Impact Assessment Proposed Mokolo River Water Augmentation Project DWA, Directorate: Option Analysis; and
- Mokolo and Crocodile River (West) Water Augmentation Project (MCWAP) Phase 1: Augment Supply from Mokolo Dam Environmental Impact Assessment - MCWAP Phase 1 DWA, Directorate: Integrated Water Resources Planning.

- The study "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)", in relation to the Matlabas catchment is being finalised.

The following studies in relation to the Crocodile (West)/Marico are being finalised:

- 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);
- Crocodile West and Marico Intermediate Reserve Determination study (DWA Chief Directorate: RDM); and
- Support to the Implementation and Maintenance of the Reconciliation Strategy of the Crocodile West Water Supply System (DWA: National Water Resource Planning).

A delay in finalisation of these reports may impact on the timelines for the classification study.

3 INFORMATION REVIEW

Existing study results and information will be relied upon to a large extent for this study. Information review has been initiated and will be completed during the inception phase. For parallel studies that may not yet have been finalised, ongoing liaison will be maintained with other study teams to ensure that transfer of information, data and reports occurs.

3.1 RELEVANT PREVIOUS REPORTS

The following reports as well as others that may be identified during the course of the project have been or are being assessed during the inception phase of this study:

- Limpopo Water Management Area: Overview of water resources availability and utilization (Department of Water Affairs, Pretoria, South Africa. 2003);
- Limpopo Water Management Area: Water Resources Situation Analysis (Department of Water Affairs, Directorate: Water Resources Planning. 2003);
- River Health Programme. State-of-Rivers Report: The Mokolo River System (Department of Environmental Affairs and Tourism, Pretoria, 2006);
- Internal Strategic Perspective: Limpopo Water Management Area (Department of Water Affairs: Directorate: National Water Resource Planning, 2004);
- Economic Boom Strains Waterberg Resource (The Water Wheel November/December 2006);
- The Mokolo River Catchment: Validation of the Existing Lawful Use of Water (Department Of Water Affairs and Forestry, Directorate: National Water Resource Planning, 2007);
- Status on monitoring and Surface water level trends (Department of Water Affairs, Water Resource Information, and Limpopo Province, South Africa. 2009);
- Adopt-a-River Programme Phase II: Development of an Implementation Plan. Water Resource Quality Situation Assessment (Department of Water Affairs, Pretoria, South Africa. 2009);

- Intermediate Reserve Determination Study for the Surface and Groundwater Resources in the Mokolo Catchment, Limpopo Province: Main Report. (Department of Water Affairs, South Africa, 2010)
- Mokolo and Crocodile River (West) Water Augmentation Project (MCWAP) - Phase 1: Augment Supply from Mokolo Dam -Amended Plan of Study for Environmental Impact Assessment – MCWAP Phase 1 (Department of Water Affairs, Directorate: Integrated Water Resources Planning. 2010);
- MCWAP PHASE 1: Wetlands & Watercourse Survey (Compiled by Matthew and Tahla Ross Henning of Nemai Consulting. 2010);
- MCWAP PHASE 1: Draft Social Impact Assessment Draft Report (Prepared by Dr. Neville Bews & Associate and submitted to Nemai Consulting.DEA Reference Number: 12/12/20/1465. 2010);
- Economic Impact Assessment of the Proposed Mokolo River Water Augmentation Project-Draft 1 (Conningarth Economists, in association with In Association with Naledi Development Restructured (Pty) Ltd and Tlou Consulting (Pty) Ltd on behalf of the Directorate: Option Analysis. 2010);
- MCWAP PHASE 1: COMMENTS & RESPONSE REPORT (Nemai Consulting.2010);
- Investigation of potential water quality and quantity impacts associated with mining of the shallow Waterberg coal reserves, west of the Daarby Fault, Limpopo Province, South Africa (M Bester and P. D. Vermeulen. 2010. Water SA Vol. 36 No. 5);
- 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 (PD Vermeulen, M Bester, L-M Cruywagen and GJ van Tonder, WRC Report No. 1830/1/10, 2011);
- An overview of the impact of mining and Mineral processing operations on Water resources and water quality In the Zambezi, Limpopo and Olifants catchments in Southern Africa (Ashton, P.J., D. Love, H. Mahachi, P.H.G.M. Dirks, 2001); and
- Environmental Management Framework for the Waterberg District: DRAFT Desired State Report (Environomics Environmental Consultants and NRM Consulting. Report number: 2010/014/PC019. July 2010).
- Internal Strategic Perspective: Crocodile West Marico Water Management Area (DWAF, Directorate National Water Resource Planning. 2004)
- Institutional Roles and Linkages. Situational Assessment: WMA3: Crocodile West and Marico IWRM Strategies, Guidelines and Pilot implementation in Three Water Management Areas (March 2004);
- State-of-Rivers Report: Monitoring and Managing the Ecological State of Rivers in the Crocodile (West) Marico WMA River Health Programme (March 2005);
- The development of the Reconciliation Strategy for the Crocodile West water supply system (DWAF, Directorate National Water Resource Planning. July 2008);
- North West Province, Report on the State of the Environment. (2008);
- Adopt-A- River Programme Phase II: Development of an Implementation Plan Water Resource Quality Situation Assessment (DWA RQS, 2009);
- Framework and Manual for the evaluation of aquatic ecosystems services. Water Research Commission, 2010)

- Investigating the behavioural drivers of Stakeholder Engagement and Volunteerism in the South African Water Arena (WRC, March 2011)
- 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 (January 2008);
- A Systematic Conservation Plan for the Freshwater Biodiversity of the Crocodile West Marico WMA;
- Development of an automated desktop procedure for defining macro-reaches for river longitudinal profiles (July 2006); and
- National Freshwater Ecosystems Priority Areas (NFEPA) Project (CSIR, DWA, Department of Environment Affairs, south African National Biodiversity Institute, World Wildlife Fund, 2011);
- Economic Impact Assessment of the Proposed Mokolo River Water Augmentation Project DWA, Directorate: Option Analysis;
- Draft Social Impact Assessment Proposed Mokolo River Water Augmentation Project DWA, Directorate: Option Analysis; and
- Mokolo and Crocodile River (West) Water Augmentation Project (MCWAP) Phase 1: Augment Supply from Mokolo Dam Environmental Impact Assessment - MCWAP Phase 1 DWA, Directorate: Integrated Water Resources Planning.
- 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);
- Crocodile West and Marico Intermediate Reserve Determination study (DWA Chief Directorate: RDM); and
- Support to the Implementation and Maintenance of the Reconciliation Strategy of the Crocodile West Water Supply System (DWA: National Water Resource Planning).

3.2 DATA SOURCES

Data sources to be used will include amongst others the following:

- Updated hydrology for Mokolo catchment (Limpopo WMA) and Crocodile (West)/Marico WMA (DWA, Directorate National Water Resource Planning);
- Updated PES/EIS data (DWA: Directorate RDM);
- The Water Resource Planning Model (WRPM) and the Water Resources Yield Model (WRYM) for the WMA (DWA, DWA, Directorate National Water Resource Planning);
- Water demand and requirement projections from parallel studies (Reconciliation strategy studies of DWA, Directorate National Water Resource Planning);
- Updated water quality data and information from the Water Management System of the Department. (DWA, Directorate Resource Quality Services);
- Ecological Water Requirements (Information, data, models, indices) (DWA, Directorate: Reserve Requirements);
- Land use, population data, socio-economic data and related information from Stats SA;
- Statistics SA's Water Resource Accounts;
- The Millennium Ecosystems Assessment framework of ecosystem services;

- Best practise resource economics;
- Social accounting analyses; and
- The Social Accounting Matrix (SAM) models of the Development Bank of South Africa (DBSA).

The assistance of the Department may be required to facilitate the acquisition of some of the above data sources. This may include the necessary correspondence written by the client to the relevant organisations in question. Unforeseen delays in sourcing information/data could impact on the study programme.

3.3 INFORMATION GAPS

Key information gaps identified for the study relate to the Upper Molopo (quaternary D41 A) and Ngotwane (quaternary A10A-C) catchments of the Crocodile (West) and Marico WMA. These catchments were not included in the Reserve determination studies for the Crocodile (West) and Marico WMA.

However, the Molopo catchment was assessed as part of the ORASECOM study in 2010, but due to the almost episodic nature of the river, only the Molopo wetland in quaternary catchment D41A was assessed. This catchment is mainly groundwater driven and should therefore be assessed from a groundwater perspective during the WRCS.

Another information gap identified relate to the Matlabas catchment. Relatively, very few studies were conducted and no surface water Reserve determination study was conducted in the Matlabas catchment. The Limpopo WMA groundwater Reserve determination study completed in 2011 will provide invaluable input towards the classification project since the significant portion of the water use in the catchment is from groundwater due to the low assurance of the run-of-river yields.

4 STUDY PARAMETERS

4.1 TERMS AND DEFINITIONS

A list of terms and definitions relevant to study are included in Appendix A.

4.2 WATER RESOURCE COMPONENTS

This study focuses on the classification of significant water resources (rivers, wetlands, groundwater and lakes) in the Mokolo catchment: Limpopo WMA and the Crocodile (West)/Marico WMA. The selected rivers in the study area will be classified. The available information will be used to prioritise their significance in the WMA and importance to associated river systems. If the available information is insufficient for the high priority wetlands then field work by the wetland specialists in the project team will be undertaken to collect sufficient information to classify the wetlands.

Groundwater is the main source of water supply to many of the rural communities in the study area. There is extensive use of groundwater resources of the dolomite aquifer north east of Johannesburg (A21A), south of Pretoria (A21B), north west of Krugersdorp (A21F and A21D), and southwest and south of Zeerust (A31C and A31A). Large abstraction for irrigation, domestic, industrial and municipal supply is practiced. Overall the groundwater resources within the WMA3 are under-utilised although this does depend on groundwater occurrence and demand requirements.

The diverse geology in the WMA has some of the richest mineral deposits in the world. North of the Magaliesberg the geology is largely dominated by the Bushveld Complex – a massive layered igneous complex. The lower portion of the intrusive complex comprises of ultramafic rocks known as the Rustenburg Layered Suite, which is overlain by acidic rocks that form the Rashoop Granophyre Suite and Leboa Granite. The Rustenburg Layered Suite is rich in minerals and a number of mines have been developed. Platinum, chrome and vanadium mining in particular are taking place at a large scale. The Rashoop Granophyres and Leboa Granite represent weathered and fractured aquifers which often contain excessive fluoride in groundwater from geological origin, rendering the water unsuitable for human consumption.

In the Upper Crocodile sub-catchment, dolomite formations of the Malmanie Subgroup are found in the Rietvlei Dam catchment and to the north and west of Krugersdorp (Tarlton area). These dolomite formations also occur in the south-western parts of the Marico catchment. The dolomite formations are compartmentalised by intrusive dykes and represent productive karst aquifers. Dolomite formations are also found at the confluence of the Tolwane and Pienaars rivers as well as the origin of the Apies River (Pretoria Fountains) in the Apies/Pienaars sub-catchment.

The water rich dolomite compartments are used extensively for domestic (Pretoria, Centurion and Zeerust areas) and irrigation water supplies. Spring flows from dolomite compartments have largely been secured for bulk municipal supply purposes. These flows have been diverted into pipelines, thereby limiting or curtailing their contribution to the original receiving surface water catchments.

The Lower Crocodile River in catchment A24J traverses and is incised into an alluvial flood plain underlain by mainly basement complex granites, termed the Makoppa Granite Dome. The total reach of the river is some 92 km. Hobbs (1986) reports that the alluvial aquifer is in hydraulic

connection with the river, which recharges the aquifer during flow events. The alluvial aquifer is partially underlain by highly productive secondary aquifers, associated with highly fractured granite bedrock.

The valley of the Crocodile River, upstream of Thabazimbi in catchments A24H, A24C and A24B, contains extensive alluvial deposits for approximate 80 km in length - termed the Crocodile River Valley Aquifer. The area is known for intensive irrigation which relies heavily on both surface and groundwater resources.

- **Significant rivers**: The significant rivers to be classified within defined integrated units of analysis (IUA) will be identified and confirmed through the inception phase. It is accepted that certain identified rivers of importance may require special mention in the IWRM template with specific conditions should they not be included in the group of "significant". For the purpose of this study significant is defined as per the WRCS definition (Volume 2: February 2007) (refer to Appendix A). A preliminary list of significant water resources identified within the Mokolo catchment: Limpopo WMA and the Crocodile (West)/Marico WMA include:

Mokolo and Matlabas catchments:

- Sand
- Renosterbosspruit
- Frikkie-se-Loop
- Sterk
- Klein Vaalrivierspruit
- Jim-se-Loop
- Upper Dwars
- Lower Dwars
- Taaibos
- Tambotie
- Matlabas

Groot Marico West catchment:

- Kaaloog-se-Loop
- Groot Marico
- Klein Marico
- Sandsloot
- Kgolane
- Brakfonteinspruit

Crocodile West catchment:

- Crocodile River
- Jukskei River

- Tolwane River;
- Kulwane River;
- Pienaars River;
- Moretele River;
- Hex River;
- Bierspruit ;
- Magalies River;
- Elands River;
- Sterkstroom;

- **Wetlands**: All the wetlands in the study area will be assessed in terms of their abundance, health, function, importance, sensitivity and present state. A priority list of the most important wetlands will be compiled; and
- **Groundwater**: Identification of priority areas where over-utilisation of groundwater resources has been identified and where there is significant contribution of groundwater to base flows.

The updated hydrology from the studies undertaken by the Directorate National Water Resources Planning will be utilised during the classification study. Major changes to the hydrology could have specific ecological impacts/consequences. This will be highlighted and addressed during the study if so identified.

4.3 METHODOLOGY FOR EXTRAPOLATING EWRS FOR ADDITIONAL SITES

Intermediate Reserve determination studies were undertaken for all of the major catchments during 2008 to 2011. These results are available for the Mokolo main stem, Crocodile West and its main tributaries (Pienaars, Elands, Jukskei) and the Groot Marico and Klein Marico. These results were enhanced by additional rapid level 3 studies and extrapolations undertaken to those areas that were not covered by an intermediate assessment.

The Molopo catchment was assessed as part of the ORASECOM study in 2010, but due to the almost episodic nature of the river, only the Molopo wetland in quaternary catchment D41A was assessed. This catchment is mainly groundwater driven and should be assessed from a groundwater perspective during the WRCS.

Groundwater Reserve determination study was completed in 2011 for the Limpopo WMA and information from this study will be useful for the Matlabas catchment. Where necessary, Rapid III Reserve studies will be conducted at identified EWR sites.

Table 3 provides the details of all of the sites that were assessed as part of the intermediate Reserve studies that were undertaken for the Resource Directed Measures chief directorate. The results from these studies will be used in this classification study. Table 4 provides the details of the sites assessed as part of the groundwater Reserve for the Matlabas catchment. All available EWR data and supporting models have been made available by DWA to the study team for use in this study.

Table 3: Details of EWR sites from intermediate Reserve studies

EWR site	River: Site name	Quaternary catchment	PES	Coordinates	Level of determination
Mokolo River system					
1a	Mokolo: Vaalwater	A42C	C/D	S24 17.362 E28 05.544	Intermediate
1b	Mokolo: Tobacco	A42E	B/C	S24 10.697 E27 58.661	Intermediate
2	Mokolo: Ka'ingo	A42F	B/C	S24 03.897 E27 47.230	Intermediate
3	Mokolo: Gorge	A42G	B/C	S23 58.080 E27 43.614	Intermediate
4	Mokolo: Malalatau	A42G	C	S23 46.272 E27 45.315	Intermediate
5	Mokolo: Tambotie floodplain	A42G	D	N/A	-
Crocodile West River system					
EWR 1	Crocodile: Upstream of the Hartbeespoort Dam	A21H	D	E 27.896 S 25.8004	Intermediate
EWR 2	Jukskei: Heron Bridge School	A21C	E	E 27.9621 S 25.9539	Intermediate
EWR 3	Crocodile: Downstream of Hartbeespoort Dam in Mount Amanzi	A21J	C/D	E 27.8431 S 25.7168	Intermediate
EWR 4	Pienaars: Downstream of Roodeplaat Dam	A23B	C	E 28.312 S 25.4155	Intermediate
EWR 5	Pienaars/Moretele: Downstream of the Klipvoor Dam in Borakalalo National Park	A23J	D	E 27.80457 S 25.12657	Intermediate
EWR 6	Hex: Upstream of Vaalkop Dam	A22J	D	E 27.3749 S 25.5214	Intermediate

EWR site	River: Site name	Quaternary catchment	PES	Coordinates	Level of determination
EWR 7	Crocodile: Upstream of the confluence with the Bierspruit	A24C	D	E 27.51743 S 24.88661	Intermediate
EWR 8	Crocodile: Downstream of the confluence with the Bierspruit in Ben Alberts Nature Reserve	A24H	C	E 27.32569 S 24.64476	Intermediate
Rapid EWR 9	Magalies: Downstream of Malony's Eye	A21F	B	E 27.56581 S 26.01689	Rapid 3
Rapid EWR 10	Elands: Upstream Swartruggens Dam	A22A	C	E 26.72044 S 25.72655	Rapid 3
Rapid EWR 11	Sterkstroom: Upstream Buffelspoort Dam	A21K	C	E 27.47848 S 25.80739	Rapid 3
Groot Marico River system					
EWR 1	Kaaloog-se-Loop: Below gorge	A31A	B	E 26.433 S 25.777	Intermediate
EWR 2	Groot Marico: Upstream confluence with Sterkstroom	A31B	B	E 26.435 S 25.669	Intermediate
EWR 3	Groot Marico: Downstream Marico Bosveld Dam	A31F	C/D	E 26.392 S 25.461	Intermediate
EWR 4	Groot Marico: Downstream Tswasa Weir	A32D	C	E 26.424 S 24.706	Intermediate
EWR 5	Klein MaricoDownstream Klein Maricopoort Dam	A31E	C	E 26.159 S 25.516	Rapid 3
Molopo River system					
EFR M8	Molopo: Wetland	D41A	C	-25.8812	

Table 4: Groundwater Reserve and categorisation for the Matlabas Catchment

Description	Groundwater Resource Unit (GRU)	Quaternary catchment	Area (Km^2)	Recharge Mm^3	GW to Baseflow Mm^3	Reserve as % of Recharge	Final Present Category
Upper Matlabas	A41-1	A41A-B	1050	25.53	6.33	**25%**	I
Lower Matlabas	A41-2	A41C-D	3024	29.95	1.16	**4%**	III
Steenbokpan	A41-3	A41E	1940	12.41	0.35	**3%**	II

Hydronodes and extrapolation

Hydronodes have been selected for the development of reconciliation strategies for the Crocodile West and Mokolo catchments and during the updating of the hydrology of the Groot Marico catchment as part of the National Water Resource Planning directorate projects.

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 5 and 6 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.

Table 5: Extrapolation recommendations for Crocodile West catchment

Quaternary catchment / Modelling zone	Contribution per quaternary catchment	River/Description	Notes/Comments
Upper Crocodile			
A21A	A21A	Source to Rietvlei Dam	Rietsvlei - urban, dolomitic at the top. Swartspruit - urban, Kempton Park, Erwat STW. **Use DRM**

Quaternary catchment / Modelling zone	Contribution per quaternary catchment	River/Description	Notes/Comments
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
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	A21K1,	Source to Buffelspoort	Unique system, upstream of dam.

Quaternary catchment / Modelling zone	Contribution per quaternary catchment	River/Description	Notes/Comments
(EWR11)	A21K2	Dam (Sterkstroom)	**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** 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	A22G, A22H,	Hex River to Vaalkop	**Use EWR 6**

Quaternary catchment / Modelling zone	Contribution per quaternary catchment	River/Description	Notes/Comments
(EWR6)	A22J1	Dam	
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, stormwater, WWTWs, canalised. **Use the PES with DRM**. Maintain riparian vegetation
A23E1	A23D, A23E1	Source to Bon Accord Dam	Urban, stormwater, WWTWs, canalised**. Use the PES with DRM**. Maintain riparian vegetation
A23E	A23D, A23E	Main stem to outlet of quaternary catchment	Semi-urban, stormwater, 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 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**

Quaternary catchment / Modelling zone	Contribution per quaternary catchment	River/Description	Notes/Comments
			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 6: Extrapolation recommendations for Groot Marico West 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

Estimation was used to determine the EWRs at the various hydronodes identified for the Mokolo catchment, using the existing EWR sites from the intermediate Reserve determination study. Table 7 provides the details of the sites that were used for each of the quaternaries to estimate the EWRs at the selected hydronodes for the various tributaries of the Mokolo River. The information for these hydronodes is available as rule and summary tables to be used during the classification process.

Table 7: Estimation undertaken for the Mokolo catchment

Quaternary catchment	Site nr	River	Coordinates
A42A	1	Sand	-24.65283; 28.231
A42B	2XSA/2XSB	Renosterbosspruit	-24.50804; 27.86574
A42D	9	Frikkie-se-Loop	-24.31397; 27.95724
A42D	10	Sterk	-24.30554; 27.89699
A42E	11	Klein Vaalrivierspruit	-24.21941; 28.05363
A42E	6	Jim-se-Loop	-24.27184; 28.20002
A42E	4	Upper Dwars	-24.26661; 28.21718
A42E	5XSA/5XSB	Lower Dwars	-24.26736; 28.21873
A42F	8	Taaibos	-24 11.128; 27 51.673
A42H	7XSB	Tambotie	-23.81291; 27.94885

The Present Ecological State (PES) as determined during the Reserve studies will be compared to the updated desktop PES categories for all of the catchments if available.

Specific considerations

The recommendations as included in the available State of the Rivers Reports, NFEPA maps, systematic conservation plans for the freshwater biodiversity and the Reserve determination reports will be used as a guide throughout the classification of the water resources of the Crocodile West, Groot Marico, Molopo and Mokolo systems. Some of the specific considerations for these catchments are provided below.

Crocodile West catchment

The adequacy of desktop extrapolations for those rivers identified in Table 2 needs to be confirmed with the Client. Where desktop requirements are not adequate it is recommended that rapid level 3 Reserve assessments are undertaken. It is currently recommended that rapid level 3 studies be undertaken for the following tributaries:

- Rietspruit, quaternary catchment A21A;
- Waterkloofspruit, sub-quaternary catchment A22H2; and
- Bierspruit, quaternary catchments A24D, A24E and A24F.

Important features to be considered during the classification include the Bafokeng Tribal Area, the Pilanesberg Nature Reserve,the Wonderboom Nature Reserve in the northern part of Tshwane, the Cradle of Humankind Heritage site, the Magaliesberg Protected Natural Environment area, Dinokeng Conservation Area and numerous other nature reserves and conservation areas

Maloney's Eye, the source of the Magalies River, a tributary of the Skeerpoort River upstream of Hartebeespoort Dam is a unique dolomitic eye in the upper Crocodile West system and needs special attention during the study.

The wetlands of the Crocodile West system occur in a variety of biomes contributing to a rich diversity of types, biodiversity and extent. Some of these wetlands include the extensive Moretele floodplain wetlands and the pristine Waterval valley bottom mire in the mountains of Kgaswane Nature Reserve in Rustenburg.

The systematic conservation plan for the freshwater biodiversity will be considered to ensure that the targets set during that process are incorporated into the classification of the water resources of the Crocodile West catchment.

Groot Marico and Molopo catchments

The updated hydrology, especially the very high base flows, as supplied during the intermediate Reserve study for the lower Groot Marco River, downstream the confluence of the Groot Marico and Kromellenboog Rivers need to be re-assessed.

Numerous nature reserves and conservation areas, including the Madikwe Game Reserve that is one of the largest game reserves in South Africa is situated in the Marico catchment.

The dolomitic wetlands or "eyes" found at the source of the Klein Marico (Molemane), Marico and Molopo Rivers need special attention as well as the conservation challenges for the burning Bodibe peatland located between the towns of Mafikeng and Lichtenburg.

The arid kalahari plains thorn bushveld area hosts unique wetlands such as the Molopo wetland complex on the border with Botswana.

The systematic conservation plan for the freshwater biodiversity will be considered to ensure that the targets set during that process are incorporated into the classification of the water resources of the Groot Marico catchment.

Mokolo and Matlabas catchments

The recommendations from the recently completed intermediate Reserve determination as provided in the reports and specifically in the Reserve template will be included as part of the classification process.

4.4 SELECTION OF ADDITIONAL SITES

Additional EWR sites should be selected, after approval from the Client, where rapid III studies can be undertaken to determine the EWRs. This is necessary as no data is available for the smaller tributaries from the previous comprehensive Reserve study. A planning session where all existing data will be used, together with the various resource units as determined during the previous Reserve study to consider all other options (extrapolation and/or estimation) before additional field work will be undertaken. The information as generated during the update of the PES/EIS (current RDM study) will be used where possible and applicable. The newly developed methodology for estimation will also be utilised where possible.

In terms of the IUAs defined and still to be refined and preliminary assessment undertaken as part of the inception phase of this study, additional sites may still be identified at this stage for a Rapid Reserve determination. This will be finalised during January 2012.

4.5 INTEGRATED UNIT OF ANALYSIS

Seventeen (17) preliminary IUAs have been defined for the Mokolo and Matlabas catchments: Limpopo WMA and the Crocodile (West)/Marico WMA during this inception phase. These have been based on socio-economics of the areas, water uses and users, envisaged level of protection required and significance of the resource. The availability of representative EWR sites within each IUA and catchment boundaries and catchment modelling schematics were also considered. The WRCS Guideline, Volume 2, Ecological, hydrological and water quality guidelines for the 7-step classification procedure (February 2007) was also followed in terms of IUA delineation.

The 17 IUAs proposed will be presented by the project team members at the first PSC meeting on the 8th March 2012 and then finalised. Sub-nodes will be added within the IUAs at ecologically important sensitive areas within the IUAs.

The study team considers the 17 preliminary IUAs as a manageable number and practical to work with in terms of the implementation of the WRCS process within the time and budget constraints of the study. This is considered cost –effective in terms of the study for classification of the water resources of the Mokolo and Matlabas catchments: Limpopo WMA and the Crocodile (West)/Marico WMA.

4.6 DEFINITION OF SCENARIOS

A baseline scenario and three alternative scenarios will be defined. The scenarios will be discussed and proposed to the PSC. The additional scenarios will be analysed and the results taken back to the PSC and the broader stakeholders for discussion. All scenarios will be based on current available information. No additional assessments will be undertaken.

For those water resources that are categorised as a high ecological sensitivity and importance (identified through the current PES/EIS 2010 database update study) an assessment will be included in the scenario modelling with a view to setting a class level that will ensure these areas get protected. This may not be same for the class set for the IUA. These resources will be listed as specials conditions in the IWRM template.

4.7 STAKEHOLDER ENGAGEMENT

A robust and focused stakeholder engagement process will be undertaken that is aligned to the technical steps of the study. The process will not be a public participation exercise. Every effort will be made to link and align to existing structures and forums in an effort to eliminate stakeholder fatigue. A wide and extensive stakeholder database will be set up which will be updated at regular intervals.

Stakeholders representing specific sectors of society (e.g. agriculture, mines, conservation) will be identified and asked to serve on a Project Steering Committee (PSC) for the duration (two years) of this project. Appendix C includes the proposed PSC members for this Mokolo Catchment (Limpopo WMA) and Crocodile (West)/Marico WMA classification study. It is the intention that these representatives communicate the key outcomes and decisions of the study back to their organisations. It is envisaged that four PSC meetings will be held during the course of the study. A background information document will be sent to PSC members before each meeting to provide guidance for that specific meeting.

Technical Task Group meetings will be held with PSC members to discuss specific issues should

there be a need to further interrogate a specific topic during the study.

Geographical focus group or sector focus group meetings will be held, should the need arise, to further discuss and evaluate scenarios specific to an area or sector.

Stakeholders will be updated every six months on the status of the project. This will be done by a letter to all stakeholders, including the media to announce the study; as well as sending out newsletters.

There will be a stakeholder meeting at the end of the study at an appropriately identified point (proposed during Step 6 of the process) in the WRCS process to present the scenarios.

An Issues and Responses Report will be compiled and updated throughout the two-year period of the implementation of the project and submitted to the Department on a monthly basis, unless no new responses or issues have been received.

4.8 RESOURCE QUALITY OBJECTIVES

Resource Quality Objectives are outside the scope of this study and will not be determined through this process. However, where identified specific recommendations will be made in the IWRM summary template.

4.9 CAPACITY BUILDING

One DWA personnel member, Ms Mohlapa Sekoele, is directly included and involved in the Mokolo Catchment (Limpopo WMA) and Crocodile (West)/Marico WMA classification study as part of the capacity building framework provided. Ms Sekoele will run the classification for the Matlabas catchment of the Limpopo WMA in parallel with this study with review of the work undertaken by the project team. A mentorship programme for Ms Sekoele is attached as Appendix B.

Table 8: Proposed capacity building programme

Capacity building activity	Level of training	Timeframe	Key performance area	Knowledge area gap	Learning area addressed
Assessment of data, models and information	Discussion, demonstration and application	22 hours	Water Resource information and data sourcing	Data interpretation	Understanding biophysical processes: - water quantity and quality - hydrology - ecology - economics Understanding basin systems and modelling
IUA delineation	Discussion and demonstration	6 hours	Implementation of the WRCS process	Delineating IUAs	Use of GIS and mapping of IUAs
Rapid Reserve assessments and EWR	Discussion, demonstration and application	16 hours	Implementation of the WRCS process	Extrapolation of data from EWR sites to	Running of Desktop RDM model Understanding of

Capacity building activity	Level of training	Timeframe	Key performance area	Knowledge area gap	Learning area addressed
extrapolation				nodes	EWR sites and nodes and related biophysical processes
Scenario development and analyses	Discussion, demonstration and application	32 hours	Implementation of the WRCS process	Understanding the relationship between social, economic and ecological trade-offs	Scenario generation and understanding of trade-offs within larger IWRM process Running of yield models and determination of implications of alternate scenarios
Economic modelling	Application	24 hours	Implementation of the WRCS process	Understanding the relationship between social, economic and ecological trade-offs	Socio-economic issues - running of economic models and determination of implications of scenarios

In addition workshops relating to the topics set listed below will be presented in a participatory manner to Department of Water Affairs Officials.

- Assessment of data, models and information;
- IUA delineation;
- Rapid Reserve assessments* and EWR extrapolation;
- Scenario development and analyses; and
- Economic modelling.

*Capacity building on the Rapid Reserve assessments will be undertaken on site in the field.

4.10 METHODOLOGY

Regulation number 810 (Government Gazette 33541), dated 17 September 2010 gives effect to the WRCS and will be followed during the execution of this project. The process that will be implemented is new, having only been implemented in a few cases. In this respect the methodology to be followed will be iterative using the 7-step process of WRCS as close as possible. Any suggested changes to this process will be made under guidance from the client. As this is a detailed approach, efforts will be made to streamline the process where possible after discussions with the client. Efforts will be made to co-ordinate and align with the other study teams undertaking the classification process in other WMAs. However any proposed changes to the

methodology by the client that impacts significantly on the Mokolo Catchment (Limpopo WMA) and Crocodile (West)/Marico WMA classification process and study budget will require a scope change and approval by the Department.

4.11 FORMAT OF THE INTEGRATED WATER RESOURCE MANAGEMENT SUMMARY TEMPLATE

The standard summary template as prescribed in the WRCS 7 step procedure will be used and populated with the DWA recommendations to Minister of Water and Environmental Affairs. As the study progresses the template may be modified as required.

5 STUDY PROCEDURE

5.1 OVERVIEW

This study is primarily of a technical nature supported by stakeholder participation and engagement and legal processes. The study team will ensure that in addition to putting a mechanism in place (water resource classification) to achieve ecological sustainability of the significant water resources, due consideration of the social and economic needs of competing interests by all who rely on the water resources will be given. The team will apply the WRCS taking account of the local conditions, socio-economic imperatives and system dynamics within the context of the South African situation.

There are six main areas that will be addressed through the study approach:

- Status quo assessment of the WMA such as water resource quality, water resource issues, existing monitoring programmes, infrastructure, institutional environment, socio-economics, and sectoral water uses and users;
- Definition of the IUAs;
- The application of the WRCS, i.e. establishing the MC by integration of the economic, social and ecological goals through a suitable analytical decision-making system (trade-offs);
- Stakeholder engagement, co-operative governance and consultation processes;
- Population of the classification templates; and
- Capacity building.

In addition the following aspects are fundamental to the process, and it is important that DWA and the PSP share a common view in this regard.

5.1.1 Compliance with Legal Requirements

Certain legal considerations have to inform the determination of the management classes. The process has to be aligned to the principles and requirements of the NWA and needs to be consistent with the WRCS that exists for the classification of water resources. The stakeholder involvement process that is proposed will comply with the WRCS guidelines and the requirements of DWA.

It is therefore important that the stakeholder engagement process, described more fully below, not only fulfils the requirements for proper Integrated Water Resource Management, but also of the new WRCS. This will ensure conformity with the principles of best practice.

The study team has included a legal expert in the group. Where the team's legal advisor cannot address any legal issues encountered, these will be referred to DWA legal section. The IWRM summary template will be drawn up based on guidance and direction from the legal specialist.

5.1.2 Stakeholder involvement programme

Based on the principles of transparency, devolution of water resource management, co-operation and inclusiveness it is important that relevant stakeholders are involved in the classification process. This is essential to ensure buy-in, consensus and acceptance of the MC as well as successful implementation.

Stakeholder engagement throughout the process is thus fundamental, not only in support of the requirement for consultation, but for the stakeholders to understand and accept the ecological and

economic goals and the MC, and become worthy custodians of the country's water resources.

Stakeholder involvement or participation is a process that should lead to a joint effort by stakeholders. Stakeholders should represent all relevant interests and sectors of society, technical specialists and the various relevant organs of state who work together to produce better decisions than had they acted independently, and better implementation of decisions through stakeholder ownership of the process. The main aim of the stakeholder engagement/participation process is to jointly find solutions for the catchments in the study area.

Ideally, stakeholder involvement or participation involves a process resulting in improved decision-making because of a better understanding of the study being undertaken and the reason for implementing a certain MC. The details of the stakeholder process are presented in Section 6.5.

5.1.3 Integration of stakeholder issues and technical aspects

Study teams that cannot achieve integration of stakeholder participation and technical aspects fail to meet the core purpose of their work - providing decision-makers with the information to help them understand the consequences, risks and alternatives.

True integration can only be achieved when project teams are committed to a common, well-defined purpose. In this regard the PSP team mutually understands that the roles of integrated water resource management, institutional governance and stakeholder engagement are equally important, and these should be aligned and integrated in a single approach. Considerable joint, up-front planning and ongoing interaction within the framework of a joint vision will be undertaken to ensure the desired outcomes of the classification process.

An overview of the proposed study process is illustrated in Figure 2.

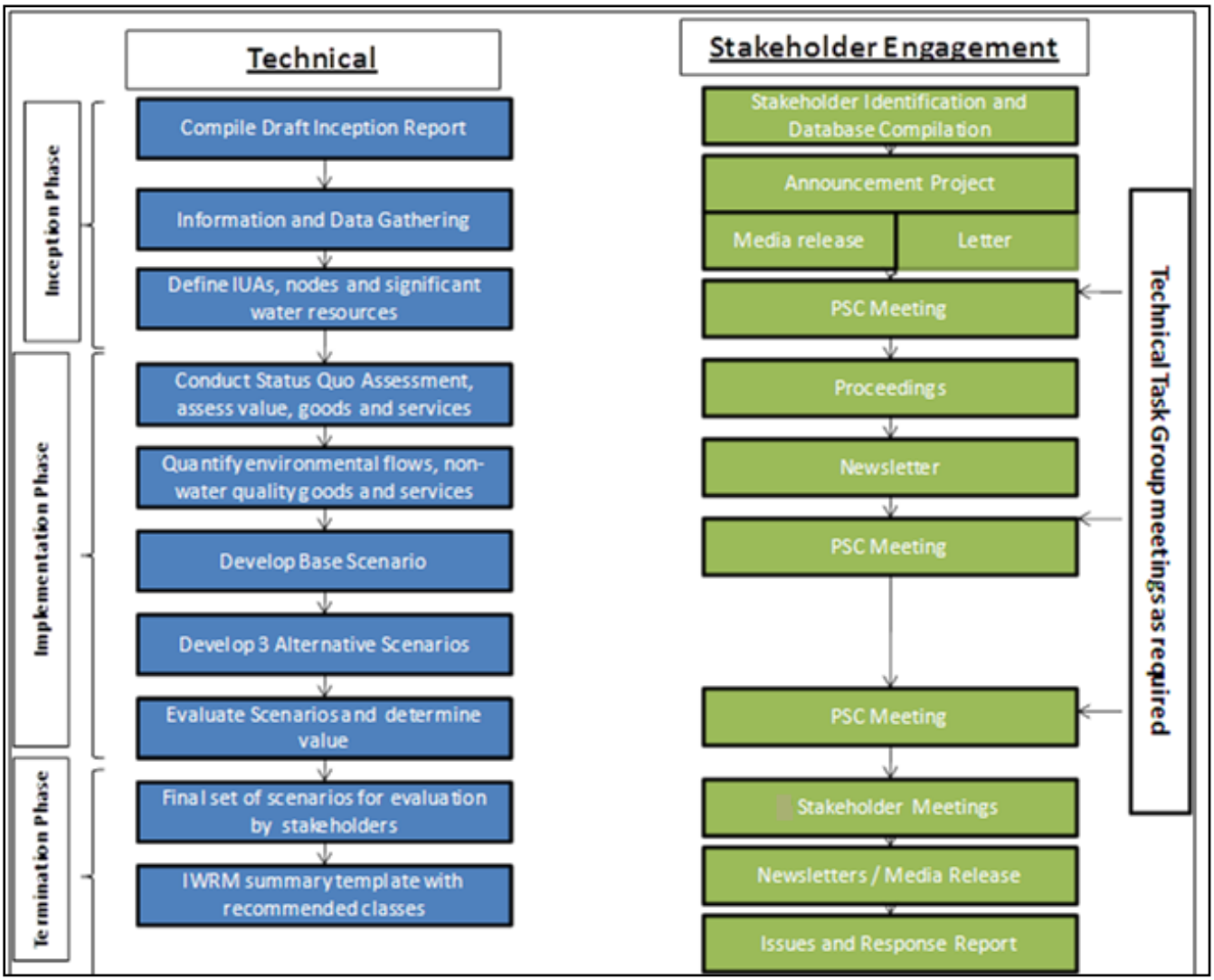

Figure 2: Overview of technical and stakeholder engagement processes for the study

6 SCOPE OF WORK

6.1 TASK 1: STUDY INCEPTION

Task 1 entails the inception phase of the study and is currently underway. The study team views the inception phase as critical as it provides a platform for assessing and understanding the nature of the scope of the project consequently ensuring alignment between DWA's expectations for the study and the actual product delivered by the study team.

The purpose of this component is to clearly define the specific project scope to ensure that DWA and the team agree on the process to be undertaken, what is expected and the final outcomes. In addition this task must clearly indicate what will not be done. These aspects have been outlined in section 4 under study parameters.

All relevant information that is currently available on the study area is being sourced and documented. A gap analysis is being undertaken and results and recommendations thereof documented. Some initial gaps identified have been listed in section 3.3.

To date an inception meeting (28 September 2011), one project management committee meeting (14 November 2011) have been held with the study manager, officials from the Resource Directed Measures Chief Directorate (CD: RDM), the DWA North West and Limpopo Regional Offices and other relevant DWA Directorates responsible for water resource management to discuss the approach to be followed, the significant water resources, the various study tasks and activities and the envisaged process. These meeting were held in October and November 2011. The proposed IUAs will be refined by the project team on the 17th January 2012 and will then be presented for review at a workshop to be held at DWA Offices in Pretoria during the later stages of January/February 2012, the date to be confirmed by DWA.

Proposals on the necessary study committees and proposed stakeholder engagement process were also discussed. There was a general acceptance of the technical approach (ecological and socio-economic approaches).

An important activity that was undertaken during the inception task is the identification of preliminary IUAs in the Mokolo and Matlabas catchments (Limpopo WMA) and Crocodile (West)/Marico WMA. These will however be refined at technical team meeting scheduled for the 17th January 2012. These have been delineated as per the criteria listed below which is in accordance with the process described in the WRCS Guideline, Volume 2:

- Catchment areas (drainage regions and water resource systems);
- Similar land use characteristics/land based activities;
- Ecological Water Requirement sites;
- Ecological Importance and sensitivity (EIS) of the water resources;
- Similar socio-economic zones (SEZs); and
- Present status of water resources (flow and quality).

Seventeen preliminary IUAs have been defined. They are listed in Table 9, described in Table 10 and illustrated in Figure 3. The EWRs from Interim Reserve studies and lower confidence rapid Reserves conducted on some tributaries will be used to extrapolate to the nodes identified for these IUAs.

Table 9: Preliminary IUAs delineated in the Mokolo and Matlabas catchments (Limpopo WMA) and Crocodile (West)/Marico WMA

IUA ID No.	Quaternary catchments
1	A21A; A23A; A23B; A23E; A23D; A21H; A21B; A21C; A21E; A21D
2	A21F; A21G
3	A21J
4	A21F; A22J; A22H; A21K; A22G
5	A22E; A22D; A22C; A22B; A22A; A22E
6	A31B; A31E; A31D
7	A31A
8	A31C
9	D41A
10	A41A
11a	A10C; A32D; A32E
11b	A31H; A31F; A31G; A31J; A10B; A32C; A32A; A32B
12	A24D; A24E; A24F
13	A24J; A24H; A24C; A24G; A24B; A24A; A21L
14	A23K; A23J; A23F; A23C; A23G; A23L; A23H
15	A42B; A42A; A42C; A42D; A42E; A42F;
16	A42G; A42H; A42J
17	A41A-E

The inception task also includes the definition of the role-players, project scope, interfacing with other initiatives and the study budget. This report forms the draft inception report to serve as a roadmap for the study roll out.

Task 1 Deliverables –

- **Study Inception Report; and**
- **Capacity Building programme and schedule**

Table 10: Descriptions of preliminary Integrated Units of Analysis defined in the Mokolo catchment (Limpopo WMA) and Crocodile (West)/Marico WMA

IUA ID No.	Quaternary catchment	EWR sites			Rationale for the IUA	Preliminary Socio-economic Assessment
		EWR Site ID	EWR Site Name	River System		
1	A21A-E; A21H; A23A; A23B; A23D and A23E	EWR 1 (A21H)	Crocodile: Upstream of the Hartbeespoort Dam	Crocodile West	Water resources presently in a D category due to urbanization, return flows (increased flows) and poor water quality. However *Barbus Mattozi* is still present in the system. Rietvlei Dam is situated in the upper reaches of the Hennops River. Rivers: Bloubankspruit, Hennops, Crocodile	IUA 1 contains the Metropolitan Municipalities of Tshwane (full), Johannesburg (part) and Ekurhuleni (part) and the town of Krugersdorp. The IUA constitutes a large portion of South Africa's commercial, financial, industrial and manufacturing sectors and is an important contributor to National GDP.
		EWR 2 (A21C)	Jukskei: Heron Bridge School	Crocodile West	Water resources presently in an E category due to urbanization, industrialization, return flows (increased flows) and poor water quality Rivers: Modderfontein, Sandspruit, Jukskei	
		EWR 4 (A23B)	Pienaars: Downstream of Roodeplaat Dam	Crocodile West	The upper parts of the catchment are impacted by urbanization, irrigation in some areas; water treatment works releases and increased flows. Roodeplaat Dam on the Pienaars and Bon Accord Dam on the Apies contribute to changes in the flow regime. The present state of the Pienaars River downstream of Roodeplaat Dam is in a C category and the EIS is high. This reach of the river provides for the colonization of several fish species no longer found in other tributaries and the system is important for fish movement, especially with Roodeplaat Dam upstream and Klipvoor Dam downstream. No EWR site is situated on the Apies River. Rivers: Apies, Pienaars, Moreletta, Bloubankspruit	
2	A21F and A21G	Rapid EWR 9	Magalies: Downstream of Malony's Eye	Crocodile West	The present state of the Magalies River is in a B category, especially with Maloney's Eye situated in the upper reaches. The EIS is very high due to the presence of the rare *Barbus motebensis* in the system. The Magalies River is an important provincial conservation area and has been identified as a sensitive catchment in the Gauteng conservation plan. The lower reaches of the Magalies and Skeerpoort Rivers are impacted by water abstraction for irrigation. Rivers: Magalies, Skeerpoort	The IUA contains the Magaliesburg conservation area as well as the Cradle of Humankind World Heritage Site. Both important for tourism and conservation activities. There is also some agricultural activities in the IUA.
3	A21J	EWR 3	Crocodile: Downstream of Hartbeespoort Dam in Mount Amanzi	Crocodile West	The water resources are in a degraded state (C/D to E category) due to changes in the flow regime as a result of Hartbeespoort Dam just upstream of this IUA and the poor water quality from IUA1. Roodekopjes Dam is situated at the outlet of this IUA. Rivers: Crocodile and smaller tributaries (Rosespruit, Kareespruit)	The area downstream from Hartbeespoort Dam is an important agricultural area and considerable tourism activities exist on the Crocodile River.
4	A21K; A22G; A22H; A22J	EWR 6	Hex: Upstream of Vaalkop Dam	Crocodile West	The water resources of the Hex River have been degraded due to the Olifantsnek, Bospoort and Vaalkop Dams situated on the river. Rustenburg and extensive mining in the middle reaches of the catchment further impacts on the water resources, both quantity and quality. The Waterkloofspruit (mostly wetland) is still in a very good condition and forms part of a conservation area. Vaalkop Dam is situated at the outlet of this IUA. Rivers: Hex, Waterkloofspruit	Rustenburg is the main town found in this IUA. The western limb of the Bushveld Igneous Complex (BIC), the largest platinum group metals (PGM) deposit worldwide, is found in this IUA. There is also substantial granite mining in the area.
		Rapid EWR 11	Sterkstroom: Upstream Buffelspoort Dam	Crocodile West	The present state of the water resources is in a C category. Some irrigation is present in the upper reaches of the system. Buffelskloof Dam and part of Roodekopjes Dam is situated in the catchment. The EIS is high due to the presence of the vulnerable *Barbus motebensis and the h*igh abundance of the unique *Amphilius uranoscopus* and *Barbus motebensis* upstream in catchment. Rivers: Sterkstroom	
5	A22A -F	Rapid EWR 10	Elands: Upstream Swartruggens Dam	Crocodile West	The water resources in the upper catchment of the Elands River are in a C category. This deteriorates further downstream with the presence of Swartruggens and Lindley'spoort Dams, mining, irrigation and return flows from water treatment works. The presence of the vulnerable *Barbus motebensis* contributes to a high EIS for the upper reaches. This reach also serves a refugia as the downstream catchment and river has been degraded. The unique Pilanesberg area is situated in the middle reaches of the IUA. Klipvoor Dam is situated at the outlet of this IUA. Rivers: Koster, Selons, Elands and some smaller tributaries in the lower reaches of the IUA	The IUA contains the towns of Koster and Swartruggens. Major socio-economic activities include agriculture, private owned conservation areas and some tourism activities.
6	A31B; A31D and A31E	EWR 2	Groot Marico: Upstream confluence with Sterkstroom	Groot Marico	The water resources are in a B category with some impacts due to irrigation and degraded riparian zone and alien invasive plants. The EIS is very high mainly due to the unique Blepharoceridae, locality of aquatic lampyridae as well as a large number of inverts and fish sensitive to water quality changes. The Marico Bosveld Dam is situated at the outlet of this IUA. Rivers: Polkadraaispruit, Groot Marico	The IUA contains the town of Zeerust and Groot Marico. Major socio-economic activities include agriculture, light manufacturing, conservation and tourism. There have been rumours of nickel

IUA ID No.	Quaternary catchment	EWR sites			Rationale for the IUA	Preliminary Socio-economic Assessment
		EWR Site ID	EWR Site Name	River System		
		EWR 5	Klein MaricoDownstream Klein Maricopoort Dam	Groot Marico	The water resources are in a C category due to the impacts of Zeerust and the Klein Maricopoort Dam (irrigation) in the upper reaches of the catchment. Kromellenboog Dam, mainly being used for irrigation is situated in the lower Klein Marico River just before the confluence with the Groot Marico. Rivers: Rhenosterfontein, Malmaniesloop, Klein Marico, Karee	mining prospecting rights granted in the area.
7	A31A	EWR 1	Kaaloog-se-Loop: Below gorge	Groot Marico	The water resource is in a B category and is situated close to the source of the Marico River. The EIS is very high with the presence of the rare and endangered *B motebensis and B waterburg* and the very high taxon richness of inverts (>45). The area has been identified a a national priority area for protection/conservation due to the dolomitic eyes and associated fauna and flora. Rivers: Kaaloog-se-Loop, Vanstraatenvlei	The IUA is largely rural in nature with game farms and commercial agriculture present. The area is an important tourism area due to the dolomitic eyes found there.
8	A31C	None		Malmaniesloop	Mainly groundwater – Malmanie's Eye	The IUA is largely rural in nature with game farms and commercial agriculture present. The area is an important tourism area due to the dolomitic eyes found there.
9	D41A	EFR M8	Molopo: Wetland	Molopo	Mainly groundwater – Molopo Eye. Water from the eye is diverted for use and only a small volume is released into the Molopo River.	The IUA contains the town of Mafikeng, which is the capital of the North West Province and is an important regional hub. Socio-economic activities include some commercial agriculture, dry-land and subsistence farming and limited tourism activities.
10	A10A	None	-		Mainly groundwater – Dinokeng Eye. The water from the eye flows to the Ngotwane Dam at the border of Botswana and is mainly used for domestic purposes.	The IUA is largely rural in nature and contains dry land and subsistence agriculture.
11a	A10C; A32D; A32E	EWR 4	Groot Marico: Downstream Tswasa Weir	Groot Marico	The present state is a C category mainly due to the impact of the Molatedi Dam upstream and the release pattern from the Tswasa Weir for irrigation purposes just upstream of the site. The EIS is high as this reach forms a natural refugia with a number of perennial pools and is adjacent to the Madikwe Provincial Nature Reserve. Water is currently transferred from Molatedi Dam to Botswana. Rivers: Groot Marico and a number of seasonal tributaries.	This large IUA is largely rural in nature and contains a portion of the former Bophutatswana Homeland. Major socio-economic activities in the IUA include, commercial agriculture, dry-land agriculture and subsistence farming. Local communities in the area highly dependent on the ecosystem services delivered by the Groot Marico River.
11b	A31F-J; A32A-C and A10B	EWR 3	Groot Marico: Downstream Marico Bosveld Dam	Groot Marico	The presence of Kromellemboog Dam (Klein Marico) and specifically the Marico Bosveld Dam just upstream of this IUA has severely impacted on the flow of the Marico River. Only small volumes of seepage from the dams are available instream. This resulted in a degraded system with a PES of a C/D. The EIS is high due to the species/taxon richness of the system and the presence of a number of inverts sensitive to water quality changes. Rivers: Groot Marico and a number of seasonal streams	
12	A24D-F	None	-	Bierspruit	The water resources are degraded due to mining activities, town development and irrigation in the catchment. The Bierspruit Dam is situated in the upper reaches of the Bierspruit. No EWR site is present in this IUA. Rivers: Wilgespruit, Bierspruit and some seasonal tributaries	The IUA contains the town of Thabazimbi. Mining is an important sector in this IUA, with iron ore and andalusite significant examples. The IUA is also important as a hunting area and the Marakele National Park is found here.
13	A21L: A24A-C and A24G-J	EWR 7	Crocodile: Upstream of the confluence with the Bierspruit	Crocodile West	The water resources of the Crocodile River in this reach have been degraded due to increased flows (irrigation return flows, releases from upstream dams for irrigation) and water quality impacts. The PES is a D category. Rivers: Crocodile and a number of seasonal tributaries	This large IUA is primarily agricultural in nature and contains commercial agriculture, dry-land and subsistence agriculture. In addition, the area has large hunting and private conservation areas.
		EWR 8	Crocodile: Downstream of the confluence with the Bierspruit in Ben Alberts Nature Reserve	Crocodile West	The water resources of the Crocodile River in this reach have been degraded due to increased flows (irrigation return flows, releases from upstream dams for irrigation) and water quality impacts (mining and towns). The PES is a C category as the site is situated in the Ben Alberts Nature Reserve with improved riparian vegetation. Rivers: Crocodile	
14	A23C; A23F-L	EWR 5	Pienaars/Moretele: Downstream of the Klipvoor Dam in Borakalalo National Park	Crocodile West	The lower reach of the Pienaars/Moretele River flows through the extensive Moretele Floodplain and the Borakalalo National Park. Klipvoor Dam is situated in this reach. The present state is in a D category mainly due to the changes in flow as a result of the releases from the dams and water quality impacts from upsteam urbanization.	This IUA contains the peri-urban areas of Mabopane and a portion of Hammanskraal, which have large populations. The IUA

IUA ID No.	Quaternary catchment	EWR sites			Rationale for the IUA	Preliminary Socio-economic Assessment
		EWR Site ID	EWR Site Name	River System		
					The EIS is high due to the presence of the unique *Barbus Mattozi* and a number of fish species (*Chiloglanis pretoriae, Labeobarbus marequensis, Labeo cylindricus, Labeo molybdinus*) and inverts intolerant to water quality and flow changes. The downstream reach is important for fish movement, especially with Roodeplaat and Klipvoor Dams upstream of the site. Rivers: Pienaar/Moretele, Plat, Riet, Tolwane, Kutswane, Tshwane	contains commercial agriculture, dry-land and subsistence agriculture. The Moretele flood plain is important from an ecosystems services point of view as it supports grazing in the dry season. The floodplain is also an important birding area. The IUA also contains the Borakalalo Game Reserve.
15	A42A-F	1A	Mokolo: Vaalwater	Mokolo	The PES is a C/D category mainly due to the abstractions for irrigation purposes and general farming activities. The EIS is high due to the presence of rare and endangered mammals, reptiles and unique fish species. Rivers: Mokolo, Sand, Klein Sand, Grootspruit and a number of smaller tributaries	The IUA is largely comprised of a mix between conservation and game farming. The IUA contains some commercial agriculture. Tourism, in the form of hunting and game viewing, is an important sector in this IUA. At present, a pipeline is being built from the Mokolo Dam to supply the Grootgeluk Coal Mine in IUA 16.
		1B	Mokolo: Tobacco	Mokolo	The present state is in a B/C category with farming activities the main impact on the water resources. The EIS is high due to the presence of rare and endangered mammals, reptiles and unique fish species and the taxon and species richness of the system. Rivers: Frikkie-se-Loop, Sterkstroom, Dwars, Mokolo	
		2	Mokolo: Ka'ingo	Mokolo	The present state is in a B/C category with farming activities and abstraction weirs the main impacts on the water resources. The EIS is very high due to the presence of rare and endangered mammals, reptiles and unique fish and invert species and the taxon and species richness of the system. Rivers: Taaibosspruit, Mokolo	
16	A42G-J	3	Mokolo: Gorge	Mokolo	The present state is in a B/C category with farming activities and the Mokolo Dam the main impacts on the water resources. The EIS is very high due to the presence of rare and endangered biota and fish species intolerant to water quality changes. Rivers: Mokolo, Malmanies, Bulspruit	The IUA contains the town of Lephalale. The area is an important future energy hub and contains the Matimba power station as well as the Medupi power station, which is under construction. The Grootgeluk Coal Mine is in the IUA and several new coalmines have been earmarked for the future. The IUA is also important from a game farming and conservation perspective and contains the D'Nyala Nature Reserve.
		4	Mokolo: Malalatau	Mokolo	The present state is in a C category with farming activities and the Mokolo Dam the main impacts on the water resources. The EIS is very high due to the presence of rare and endangered biota and fish species intolerant to water quality changes. Rivers: Mokolo, Rietpruit	
		5	Mokolo: Tambotie Floodplain	Mokolo	This reach of the river was assessed as a floodplain. The IHI for the floodplain was determined as a D category due to decreased flows, farming activities and sand mining that changed the groundwater characteristics of the system. Rivers: Mokolo, Tambotie, Sandloop	
17	A41A-E	-	-	Matlabas	The Matlabas River flows through the Marakele Nature Reserve. There are no EWR sites in the catchment. The groundwater Reserve has been undertaken for the catchment. Rivers: Matlabas; Motlhabatsi	The major economic activities in this IUA are stock or game farming.

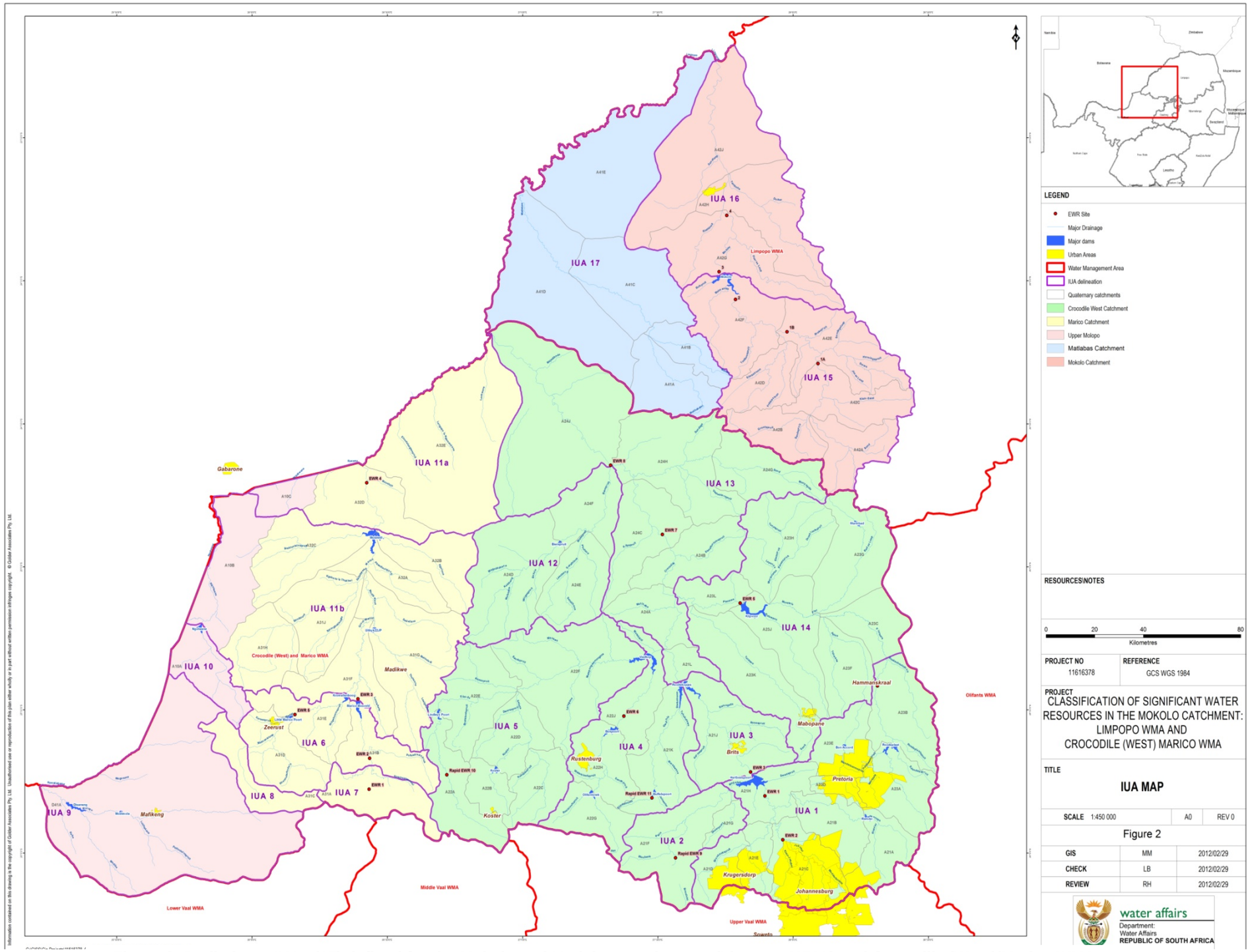

Figure 3: Preliminary IUAs (17) defined for the Mokolo and Matlabas catchments (Limpopo WMA) and Crocodile (West)/Marico WMA

6.2 TASK 2: WATER RESOURCE INFORMATION AND DATA GATHERING

The purpose of this task is to review existing literature, reports, maps and any other relevant information on the study area that is supportive to the classification process. Documents on studies such as the Overview of water resources availability in Crocodile (West) and Marico catchment areas, and Limpopo WMA (completed in 2003); Determination of the Intermediate Reserves for the Mokolo catchment and Crocodile (West) and Marico (WMA); and the Reconciliation Strategy for the Crocodile (West) Water Supply System. Information from River Health Programme studies, Groundwater related studies, the Internal Strategic Perspectives and other related studies will be critical in performing a gap analysis to determine if there is any other additional work required.

All previous studies undertaken for the Mokolo, Matlabas, Crocodile (West) and Marico River catchments including planning, water quality, socio-economic, augmentation and reconciliation strategies and specific detailed studies for sub-areas will be listed and the information or data will be sourced.

A number of priority wetlands/pans have been identified in the area in the Reserve Determination study for the Crocodile (West) and Marico WMA, some of which are under threat. Through this study, these water resources will be re-assessed and any other wetlands or group of wetlands that of significance will be included in the WRC process.

This task will also include the sourcing of the models that are currently been used for water quantity and quality modelling. This will be setup and test runs will be undertaken to ensure that the models are running and that all input data has been obtained.

All the above will be used to identify any gaps that will require additional data collection. This will be included during the development of a detail project plan. Specific recommendations will be made as to the collection of additional data and/or the extrapolation of existing data. The detail plan will be discussed with the client before finalization.

Task 2 Deliverables –

- **Report on, water resources information gap analysis and recommendations,**
- **Inventory of current water resources models and their applicability.**

6.3 TASK 3: DETERMINATION OF THE MANAGEMENT CLASS

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.

The classification of the significant water resources in the Mokolo, Matlabas, Crocodile (West) and Marico River catchments will require a wide range of complex trade-offs to be assessed and evaluated at a number of scales. These trade-offs will include those between use and protection (which may or may not be conflicting), between downstream impacts and upstream uses and vice versa, between possible use of resources within a catchment and between catchments, and between possible resource use between different parts of the country. Decisions on these trade-offs will have different implications for different stakeholders at local, regional and national levels. In the Crocodile (West) and Mokolo River catchments these will have to be considered at an integrated system level due to the inter-dependence of these catchments. There are also

international considerations due to the agreement between the South Africa and Botswana in relation to the Marico River catchment. In addition due to the economic demands and high level of development within the Crocodile (West) and Mokolo River catchments the valuation of the water resources, its condition, use and ecosystem characteristics are crucial to the evaluation of scenarios.

The classification process has bearing on a range of broader processes, given the wider socio-economic, political and ecological implications of the class. Accordingly, cooperation with all three spheres of Government, participation of stakeholders and engagement with civil society is required to ensure appropriateness and acceptability of the proposed class. The classification process will need to be aimed at ensuring consensus seeking, participation and cooperative governance to ensure that the socio-economic balance and sustainability are achieved.

The 7 step process of WRCS will be implemented in the Mokolo, Matlabas, Crocodile (West) and Marico River catchments to classify all significant water resources in order determine a suitable Management Class for the relevant water resources (

Figure **4**).

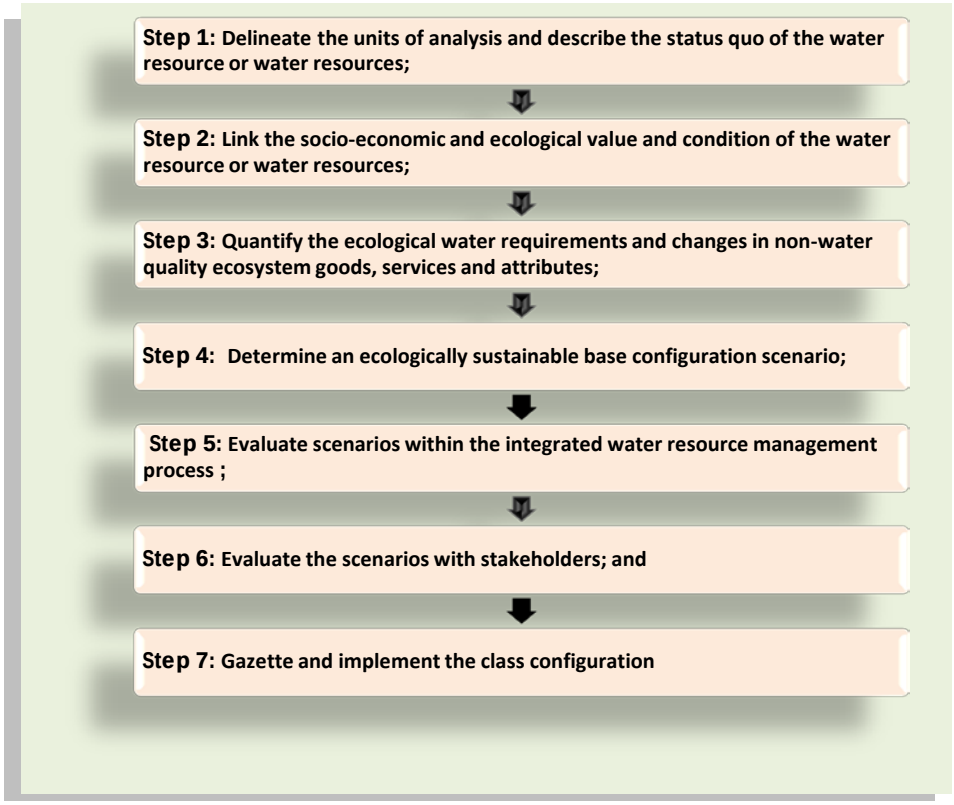

Figure 4: Steps to determine the Management Class

As the WRCS implementation is still in its infancy, the application of the approach and process and will require intensive collaboration between the client and the PSP. Accordingly, this will be an interactive process and may have to be adapted according to the study learning's and circumstances. The team will also strive to ensure that as much of the existing information will be used and the steps kept as simple as possible. As the process unfolds, the dynamics of the study area, local conditions and stakeholder drivers may also influence the outcome.

The process to be followed for the determination of the MC of the various water resource components will be defined during the first step of the classification process once the significant water resources are identified and a network is defined. However the general approaches to classification of the rivers, wetlands, groundwater and lakes will be described during the study inception phase.

A sound, integrated and analytical decision making system will be required for the classification process implementation in the study area. The decision-analysis framework provided by the WRCS guideline may have to be adapted to suit the circumstances. Multi-Criteria Decision Making analysis supported by the necessary Cost Benefit Analysis will be applied to ensure a robust, defendable socio-economic analysis process that allows weighing up the advantages and disadvantages of all alternatives, resulting in a desired outcome. The Water Resources Yield and Planning models will be used to evaluate the scenarios within the IWRM process to determine practicality.

The process that will be followed as best suited to circumstances and conditions is described below as outlined the WRCS guidelines (DWA, 2007).

6.3.1 Proposed Approach

The proposed approach for the determination of the management class is outlined in Figure 5.

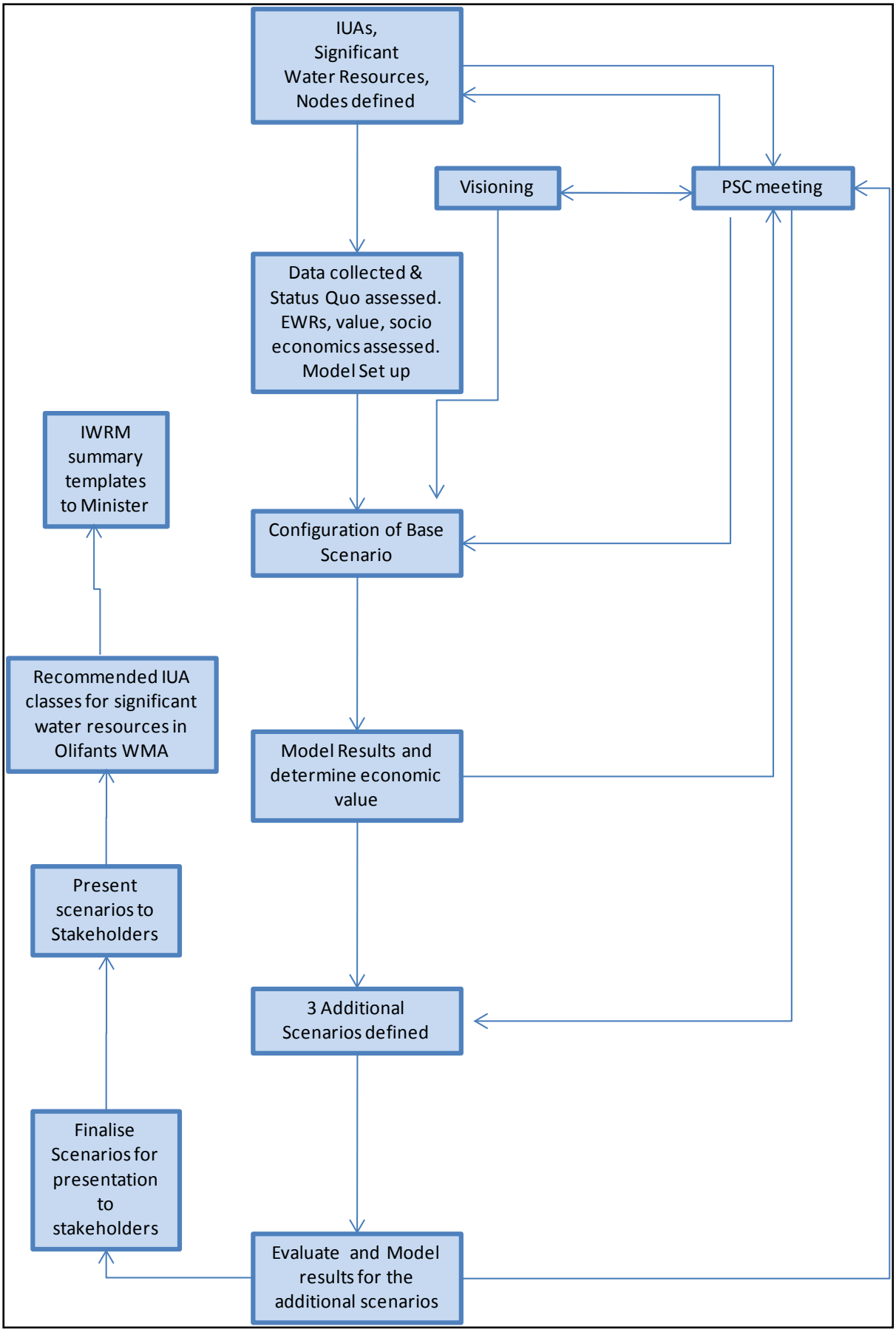

Figure 5: Proposed approach for determination of the management class

6.3.2 Task 3a: Delineation of the units of analysis

- Description of the present-day socio-economic status of the catchment;
- Division of the catchment into socio-economic zones;
- Identification of a network of significant resources, description of the water resource infrastructure and identification of the water user allocations;
- Definition of a network of significant resources and establishment of the biophysical and allocation nodes.
- Description of the communities and their wellbeing;
- Description and valuation of the use of water;
- Description and valuation of the use of aquatic ecosystems;
- Definition of the Integrated Units of Analysis (IUA);
- Development and/or adjustment of the socio-economic framework and the decision-analysis framework; and
- Description of the present-day community wellbeing within each Integrated Unit of Analysis.

6.3.3 Task 3b: Link the value and conditions of the water resources

- Selection of the ecosystem values to be considered based on ecological and economic data;
- Description of the relationships that determine how economic value and social wellbeing are influenced by the ecosystem characteristics and the sectoral use of water; and
- Definition of the scoring system for evaluating scenarios.

6.3.4 Task 3c: Quantifying the ecological water requirements and changes in non water quality Ecosystem goods, services and attributes

- Identification of the nodes to which Resource Directed Measures data can be extrapolated and making the extrapolation;
- Development of the rule curves, summary tables and modified time series for all nodes for all ecological categories; and
- Quantification of the changes in relevant ecosystem components functions and attributes for each ecological category for each node.

6.3.5 Task 3d: Determine an Ecologically Sustainable Base Configuration scenario and establish starter configuration scenarios

- Determination of an Ecologically Sustainable Base Configuration (ESBC) scenario that meets feasibility criteria for water quantity, water quality and ecological needs;
- Incorporation of the planning scenarios (future use, equity considerations and existing lawful use); and
- Establishment of the Resource Directed Measures configuration scenarios.

6.3.6 Task 3e: Evaluate the scenarios within the Integrated Water Resource Management Process

- Running of a yield model for the Ecologically Sustainable Base Configuration scenario and other scenarios and adjust the scenarios if necessary;
- Assessment of the water quality implications (fitness for use) for all users;
- Reporting on the IUA-scale ecological condition and aggregate impacts for each preliminary scenario;
- Valuation of the changes in aquatic ecosystems and water yield;
- Description of the macro-economic and social implications of different catchment configuration scenarios;
- Evaluation of the overall implications at an Integrated Unit of Analysis-level and a regional-level; and
- Selection of a subset of scenarios for stakeholder evaluation.

The above evaluation will be undertaken in the broader context of IWRM in the WMAs where the ecological, economic and social trade-offs will be made.

6.3.7 Task 3f: Evaluate scenarios with stakeholders

- Stakeholders evaluation of scenarios and agree on a short-list; and
- Recommendation of classes for the Integrated Units of Analysis.

6.3.8 Task 3g: Gazette the class configuration

Population of the Integrated Water Resource Management summary template and presentation to the Minister or his/her delegated authority for consideration and approval if accepted;

Task 3 Deliverables –

- **IUA report (process and principles);**
- **Report on the socio-economic evaluation framework and decision analysis system and summary of indices and scoring system;**
- **Ecological Water Requirements Report;**
- **Socio-economic Report;**
- **Definition of scenarios and description of ESBC scenarios;**
- **Preliminary consequences report;**
- **Yield Model configurations of scenarios;**
- **Presentations and documents for stakeholder engagement;**
- **Minutes and record of decisions;**
- **Recommended MC;**
- **IWRM summary templates;**
- **Recommendations to achieve management class;**
- **Implementation plan.**

6.4 TASK 4: COMMUNICATION AND LIAISON

The stakeholder engagement process complements the technical activities which are taking place within the study. It is designed to ensure that stakeholder inputs feed into the technical process and simultaneously, the technical process has to empower stakeholders to assist with their inputs to ensure the efficient classification of water resources. The graphic below (

Figure ***6***) provides an overview of the proposed stakeholder engagement process.

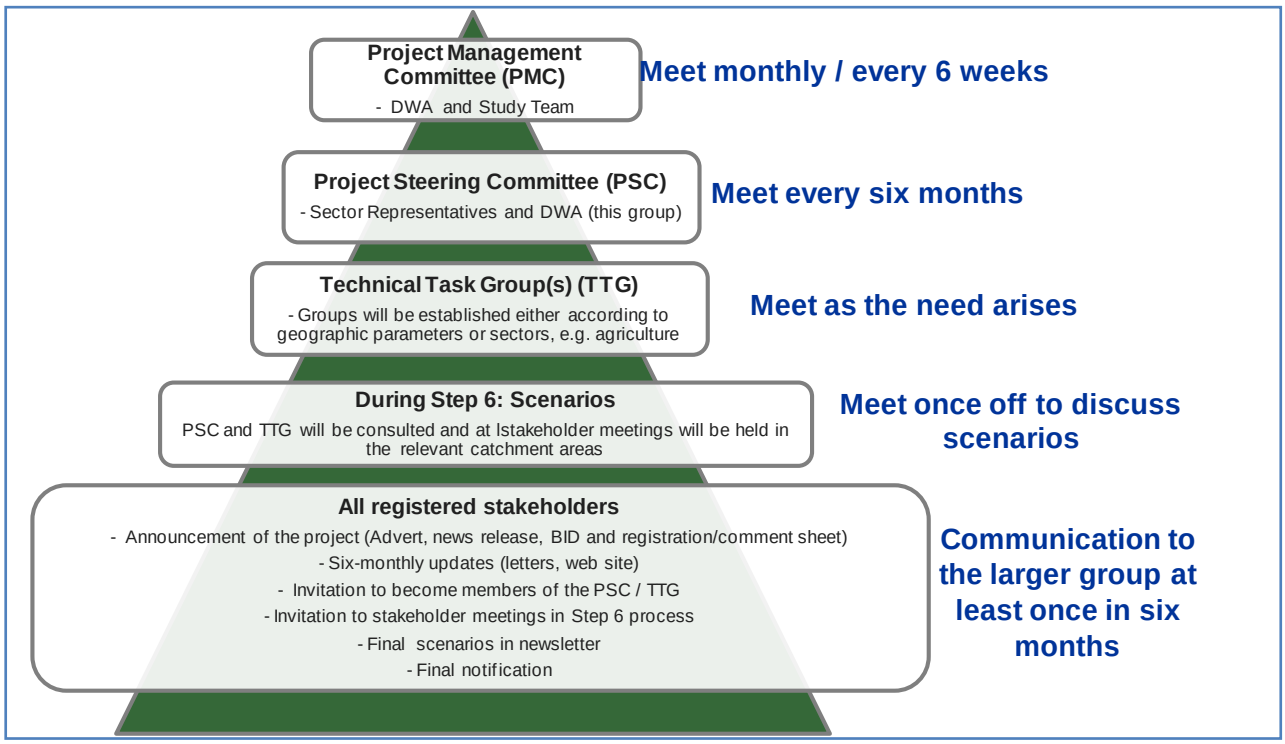

Figure 6: Summary of stakeholder engagement process to be undertaken in the Mokolo catchment (Limpopo WMA) and the Crocodile West Marico WMA classification study

6.4.1 Stakeholder identification and database

Representatives from the following sectors have been identified in the study area to become involved in the project:

- Relevant government departments on national and provincial level such as the Department of Environmental Affairs, the Department of Mineral Resources and the Department of Agriculture, Forestry and Fisheries;
- Metropolitan, District and Local Municipalities;
- Agriculture (Irrigation Boards, National and Local Agricultural Unions);
- Mining and industry;
- Conservation organisations;
- Relevant parastatals (e.g. Eskom);
- Community representatives; and
- Civil society.

Details of the representative stakeholders will be captured electronically for record keeping purposes. The draft database will be compiled during the first few weeks of the project

implementation period; however a database is dynamic and will be constantly updated as more information becomes available and as stakeholder information change.

6.4.2 Announce the project

After the Inception Report is approved a newsletter will be compiled for distribution to all stakeholders on the database. The purpose of this document will be to announce that the DWA is undertaking the classification process of significant water resources in the Crocodile (West) Marico WMA and Mokolo and Matlabas catchments, the process to be followed, anticipated activities, proposed time lines as well as how stakeholders can become involved in the project. The same information will also be sent to the media and should be combined with a media release as well.

This document will be accompanied by an announcement letter and a comment/reply sheet to provide people the opportunity to comment on the classification study and to register as a stakeholder or provide names of other possible stakeholders.

This document will also aim to explain the necessity of the project and the context of the study. Information such as where more information can be obtained, the website, etc will also be shared. At this early stage in the project stakeholders will be requested to provide their comments and inputs. Responses will be captured in an Issues and Responses Report.

6.4.3 Issues and Responses Report

An Issues and Responses Report will be compiled and updated throughout the two-year period of the study. This report will list all the comments from stakeholders (to be received from comment sheets, at meetings, via telephone calls, etc) and responses from the study team.

6.4.4 Evaluation of scenarios with stakeholders – Step 6 of NWRCS process

Stakeholders have to evaluate the scenarios presented by the DWA and its study team. The following approach and steps are anticipated:

- All stakeholders and not just the SSC members will be invited to a workshop at the end of the study where the scenarios are to be presented.
- A background information document explaining the various scenarios will be distributed to all stakeholders prior to the workshop.
- Minutes of this workshop will be sent to all stakeholders on the database.
- The various scenarios will be discussed at PSC meetings prior to the final workshop.
- The various scenarios will also be discussed in the newsletter that will be sent to stakeholders at regular intervals.

Should the scenarios which were presented have changed significantly with the consideration of stakeholder comments, the process to invite stakeholder inputs on the revised scenarios will have to be repeated to reach an acceptable level of agreement with stakeholders.

Once the scenarios have been agreed upon, stakeholders have to be informed of the “short-listed” scenarios which will be submitted for final sign-off.

6.4.5 Establishing a Project Steering Committee

Stakeholders representing specific sectors of society (e.g. agriculture, mines, conservation) will be

identified and asked to serve on a Project Steering Committee (PSC) for the duration (two years) of this project. The PSC should be a relatively small group of people of key representative bodies that will ensure strategy implementation and provide strategic advice and guidance.

The PSC will be invited to a meeting only when the study team has new information to discuss with the stakeholders. Invitation letters and a proposed agenda will be distributed to the PSC members providing them with sufficient information about the status of the project, the purpose of the meeting and what will be expected of them (e.g. read through documents prior to the meeting and provide inputs and comments). It is anticipated that the PSC will not meet more than four times over the two-year period.

A Terms of Reference will be drawn up to assist members of the PSC.

6.4.6 Technical Task Group meetings

A technical task group, which will be a sub-group of the SSC, for the study will be set up. It is anticipated that these meetings will be held on an ad-hoc basis when the need arises. Prior to these meetings the necessary documentation will be compiled and distributed. The nature and composition of these meetings will vary. This will be determined by the study team.

6.4.7 Meetings

The study team will assist with all the arrangements of these meetings. Our proposed methodology for arranging any type of meeting is as follows:

- There must be a clear purpose for a meeting and the objectives of what needs to be achieved by the meeting is clearly defined.
- Stakeholders must receive notification of the meeting date and its objectives at least three weeks in advance.
- A formal advance registration process was allowed.
- Stakeholders must receive documentation such as a draft agenda and a background information document for the meeting at least five working days before the meeting.
- A dry run meeting for project team members must be conducted in advance to agree on the content of the meeting, the comprehension levels of presentations and to strategise for discussion sessions.

6.4.8 Continuous feedback to stakeholders

Stakeholders need to be taken by the hand from the beginning to the end of a project. It is recommended that stakeholders be updated every six months on the status of the project. This will be done by the distribution of a) the announcement background information document b) a letter to all stakeholders on the database, including the media informing them of progress made c) invitations to stakeholders to attend a geographic focus group meeting and lastly towards the end of the project it is anticipated to compile and distribute a newsletter that will provide information on the classification of important water resources in the Crocodile (West) Marico WMA and Mokolo Catchment.

The DWA website will be utilised for the publishing of all public information (announcement documentation, minutes of meeting, etc) to enable stakeholders with access to electronic media to

stay updated in this fashion.

6.4.9 Collaborating with existing projects / structures in the Crocodile (West) Marico WMA and Mokolo and Matlabas catchments

Existing projects of the DWA in the Crocodile (West) Marico WMA and Mokolo and Matlabas catchments will also be used to market and promote this project.

Task 4 Deliverables –

- **Stakeholder database**
- **Newsletters/BIDs/Media releases**
- **Notes and minutes of the meetings**
- **Register of stakeholders and their comments and responses**

6.5 TASK 5: CAPACITY BUILDING

The study team is cognisant of the DWA's and specifically the CD: RDM's imperative to build capacity and transfer skills in water resource management and protection. This is acknowledged as a high priority and the study will aim to build expertise in HDIs and create an enabling environment for them to participate in the processes and aspects relating to the study and the classification process.

Ms Mohlapa Sekoele is the project co-ordinator from the Department and in order to build her capacity will be used in the execution of specific tasks on the project and in the general running of the study. This will be a start to broadening of the RDM skills base. Ms Sekoele will spend time at the offices of Golder Associates, Zitholele Consulting in Midrand as well as Prime Africa and Wetland Consulting Services in Pretoria, depending on the phase of the project, working with the project team on various tasks. In addition Ms Sekoele will attend the proposed site visits and participate in workshops and stakeholder participation.

In addition the team will ensure that the study structure will provide a platform for young black professionals to build their expertise, master their skills and become suitably qualified in various areas of technical and professional fields, ensuring a core capacity of scientists and engineers for the future. The project tasks will also be structured to ensure that junior HDI team members will be under the guidance of team leaders who will ensure that adequate transfer of skills and capacity during the performance of the tasks. This will ensure their active participation and contribution to the project.

As the WRCS implementation is still in its infancy there may have to be training and exposure for DWA personnel and management. This will have to be identified through the study, and may require the holding of possible training workshops. This will have to be defined in the study inception phase.

Another component of the skills transfer and capacity may be required is that of the stakeholders. As the WRCS is unfamiliar to most stakeholders, building their capacity on the process, decision-making and outcomes maybe required. The study team through the process implementation will ensure that stakeholders are informed and understand their participation in the process, as well as build their understanding of water resource protection, integrated water resource management and

sustainability principles. These concepts and relevant approaches will have to be understood before any trade-offs are made and a desired class is selected.

Task 5 Deliverables –

- **Capacity Building programme; and**
- **Progress Reports during study execution.**

6.6 TASK 6: STUDY MANAGEMENT AND CO-ORDINATION

Mr Trevor Coleman will be responsible for overall project direction and management while Ms Lee Boyd for coordination of the study. In order to ensure effective management of this study with the appropriate guidance from various levels of DWA the following management structures will be used for both guidance and review:

6.6.1 Client liaison

Liaison with the DWA Study Manager will include the following activities:

- Arrange Project Management Committee (PMC) meetings regularly over the course of the Study as required;
- Establishing interim communication (between meetings) to advise the Study Manager of, inter alia, important events or problem situations, possible changes to the scope of work, appointment of sub-consultants, etc;
- Motivating the appointment of proposed new members of the consultant team to the Study Manager, as and when required;
- Motivating the appointment of sub-consultants and/or co-consultants and specialists to the Study Manager; and
- Implementing the appointment of the sub-consultants and/or co-consultants and specialists after approval by the Client.

6.6.2 Coordination of Study Team

The Project manager will be responsible for overall coordination of the Study Team and activities will include:

- Serving as link between DWA Study Manager and Consultant Team;
- Ensuring that the sub-consultants and/or co-consultants and specialists are properly briefed by the Task Leaders prior to commencing with work;
- Convening regular meetings with the Task Leaders as dictated by programme and progress;
- Rendering guidance and assistance to the Task Leaders; and
- Monitoring and control of performance, programming and cost of study, including revision of the Study Plan, if and when necessary.

6.6.3 Performance monitoring

A performance monitoring system will be instituted whereby all key activities under each main Task will be assigned milestone dates against which progress will be monitored. The monitoring system will basically be presented in bar chart format for ease of reference. The system will allow for

detecting potential problem areas at an early stage to enable remedial measures to be instituted to ensure that the Study remains on course.

Regular progress reports will be submitted to the Client and the study management committee at the study meetings to advise of progress and status.

6.6.4 Financial control

A financial control system, comprising an interactive spreadsheet model, will be used to monitor and control costs. The spreadsheet will be submitted to the client on continuous basis or on request. Budgets will be assigned to the key activities for each main Task. Actual costs incurred will be correlated with completion targets to ensure compliance with progress. Should deviations from the allocated costs for the key activities become evident, the Study Leader shall assess the reason/s and impact of such deviations and institute corrective action as required.

Where additional work may be required, the Study Leader shall obtain a detailed motivation and budget (both time and costs) from the relevant Task Leader for such additional activities for assessment and submission to the Study Manager for consideration and approval. No additional expenses outside the approved budget will be allowed without the prior written approval of the Client.

6.6.5 Study administration

Study administration duties to be performed will include:

- Compiling, certifying and submitting monthly invoices to the Client based on input received from the Task Leaders. The Client will be presented with only one invoice monthly from the Consultant Study Team. The Study Leader will arrange payment to the other members of the Study Team after receiving the same from the Client;
- Keeping minutes of meetings with the Client and other stakeholder bodies and distribution thereof to the interested parties, as required;
- Ensuring that all project files are kept up to date and accessible to the Client if and when required; and
- The Study Leader will provide a secretariat to perform the required duties for the Study Management Committee.

6.6.6 Peer review

Experts in the field will be approached to peer review the content and suitability of the deliverables. These reviews will be identified through the project management team.

6.6.7 Reporting and Reviewing System

The Project Management Committee will give overall guidance to the Study Team. Progress meetings will take place in accordance with the project plan. The findings of the study will be written up in the IWRM summary template in accordance with appropriate reporting guidelines and requirements.

Task 6 Deliverables –

- **Progress reports documenting work progress against programme and actual expenditure against cash flow estimates.**
- **Minutes of the meetings**
- **Presentations as required**
- **Financial and administration information as required**

6.7 SUMMARY OF DELIVERABLES

The summary of deliverables for the study as outlined per task will include the following (**Error! Reference source not found.**):

Table 11: Summary of study deliverables

DELIVERABLE
Task 1: Study Inception
• Study Inception Report
• Capacity Building Programme and schedule
Task 2: Water Resource Information and Data gathering
• Information Analysis Report
• Inventory of water resource models and their capabilities
Task 3: Determination of the Management Class
• Integrated Units of Analysis report
• Socio-economic reports (Evaluation and the decision-analysis framework and Method Summary report, Analysis system)
• Ecological Water Requirements Report
• Base Scenario Configuration Report
• Final Scenario report (including assessment of consequences)
• IWRM template – Class configuration
Task 4: Communication and Liaison
• Stakeholder database
• Two Newsletters, Background Information Document, Media releases and Advertisements
• Notes and minutes/proceedings of PSC and stakeholder meetings held
• Registers of stakeholders of all meetings
• Issues and response report
Task 5: Capacity Building
• Quarterly capacity building reports

Task 6: Study Management
• Progress reports on study progress
• Minutes of meetings
• Presentations as required
• Financial and administration information as required

7 STUDY PROGRAMME

The study programme of the study tasks is provided as a bar chart programme of the tasks in Appendix D. In terms of the programme the study is expected to terminate in September 2013.

8 STUDY TEAM

8.1 GENERAL

The study team consists of Golder Associates Africa supported by Zitholele Consulting, Prime Africa Consultants (Pty) Ltd and Groundwater Consulting Services.

The Study Leader for the study will be Trevor Coleman who has worked extensively on water resource projects over the years. He was involved in the development of the IWRM Plan for the Upper and Middle Olifants catchment, project manager for the Olifants WRCS and is extensively involved in the Management of the Controlled Released scheme for the Witbank and Middelburg Catchments. Trevor Coleman will be supported by Ralph Heath as study technical advisor and Lee Boyd as study co-ordinator. Task leaders include Trevor Coleman, Jackie Crafford, Anelle Lötter, Retha Stassen and Frans Wiegmans, both experienced in working on large integrated projects will provide an experienced support base to the study leadership.

The Study Leader will be responsible for the liaison with the Client and the general supervision of the Study.

8.2 TEAM MEMBERS

Details of team members that will be involved in the study are listed in Table .

Table 12: Team members involved in the study

Team Member	Company Name	Responsibility Level	Study Position /Role
Trevor Coleman	Golder Associates	Project Manager	Study Leader/Senior hydrologist
Lee Boyd	Golder Associates	Study co-ordinator/Senior Scientist	Water quality and IWRM
Didi Masoabi	Golder Associates	Scientist	Water quality and IWRM
Oliver Malete	Golder Associates	Scientist	Water quality and IWRM
Ralph Heath	Golder Associates	Study Director	Technical advisor and environmental flows
Frans Wiegmans	Golder Associates	Divisional Leader: Senior Geohydrologist	Hydrogeology
Collen Monokofala	Golder Associates	Senior Engineer	Groundwater – support
Kate Goosen	Golder Associates	GIS specialist	GIS mapping
Retha Stassen	Golder Associates	Senior hydrologist	Hydrology, water resources, 63odeling and environmental flows
Gary Marnewick	Wetland consulting Services	Ecologist	Ecology/wetlands

Team Member	Company Name	Responsibility Level	Study Position /Role
Bhuti Dlamini	Wetland consulting Services	Wetland Specialist	Wetlands
Jackie Crafford	Prime Africa	Water resource Economist	Socio-economic
Kyle Harris	Prime Africa	Ecologist	Ecology (Economy)
Melanie Wilkinson	Prime Africa	Development specialist	Socio-economic
Amelia Burger	Prime Africa	Water quality specialist	Water quality
Andre Joubert	Zitholele Consulting	Stakeholder engagement Practitioner	Stakeholder Engagement/ Communication – task leader
Patiswa Mnoqokoyi	Zitholele Consulting	Project Assistant	Communication – support
Mohlapa Sekoele	Department of Water Affairs	Project Manager running the Matlabas study in parallel to the Mokolo/Crocodile (West) Marico study	DWA project manager

The following changes to the team have been made since the proposal was developed and contract signed:

- Ms Lee Boyd has replaced Ms Priya Moodley as Project co-ordinator.

Approval has been received from the client however changes to the contract are still being made. Details of any changes to HDI participation will be provided in the submission.

In addition, Ms Mohlapa Sekoele from DWA will be running the classification of the Matlabas catchment in parallel to the Mokolo/Crocodile (West) Marico study and therefore indirectly forms part of the study team.

8.3 ORGANISATIONAL STRUCTURE

The organisational structure related to task components is presented in Figure 7.

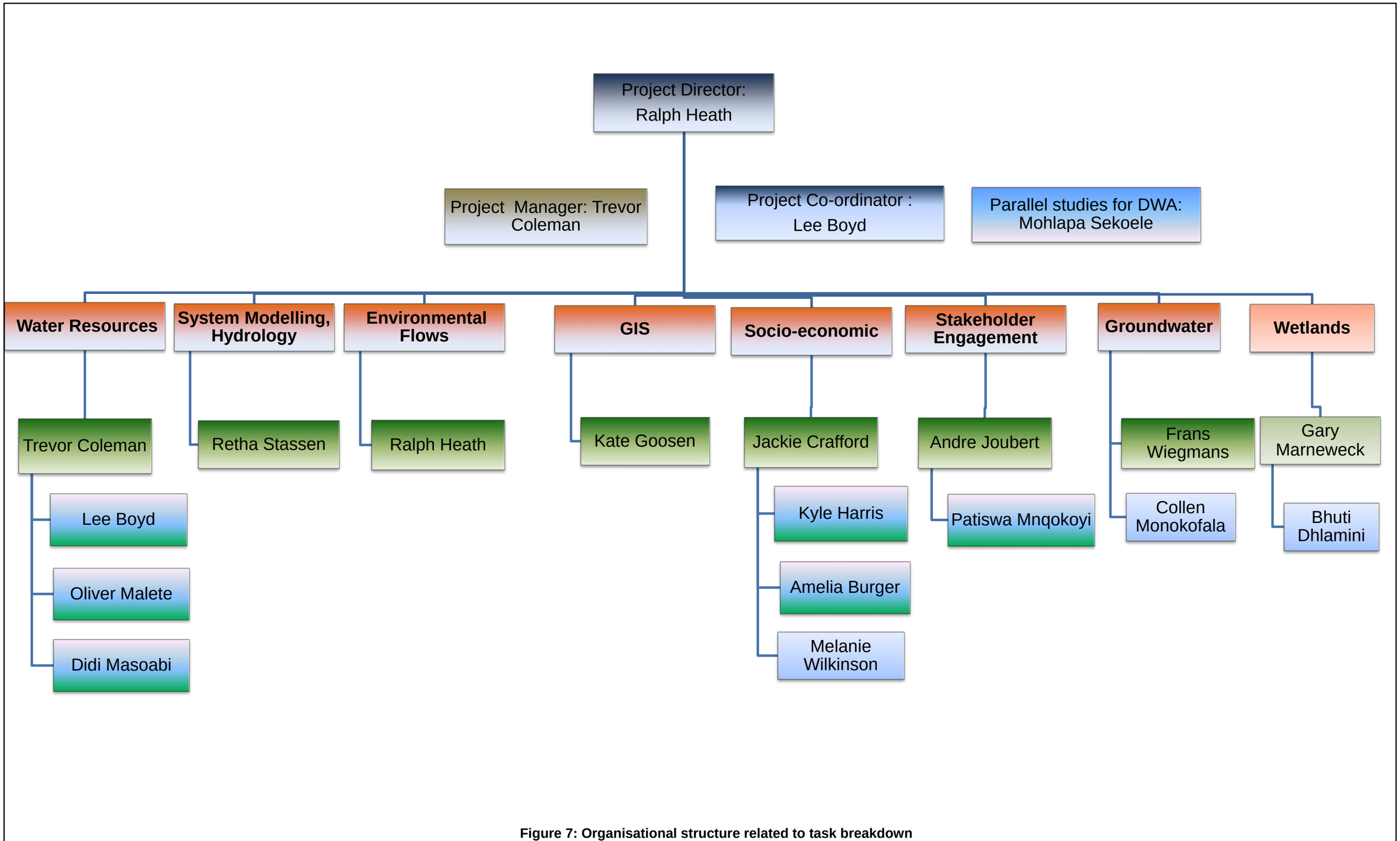

Figure 7: Organisational structure related to task breakdown

9 STUDY RISKS AND UNCERTAINTIES

The identified risks in the study are listed in Table 15.

Table 15: List of possible identified risks and uncertainties

Risk category	Risk description	Cause	Mitigation Action
Low	Lack of understanding of the WRC process and WRCS by stakeholders and the implications thereof. Risk of increased objections to the "unknown".	Classification of water resources is a new concept for stakeholders. The WRCS process is a new process being implemented for the first time. There is no previous experience or knowledge on what to expect.	Sufficient and accessible information about the WRC process, its objectives and aims should be communicated at every interaction with stakeholders (in writing, at meetings, through news releases, posters, power point presentations, etc). Do not be scared to repeat the same messages every time – do that until stakeholders have internalized the necessary information, definitions and processes. After the initial announcement of the process stakeholders can be requested to write down in 100 words their understanding of WRC and its objectives – review the written information to monitor their understanding.
	The constituted PSC may not be seen as sufficiently representative of the broader stakeholder community. This may also have time and budget implications for the study if there is a requirement to go back to stakeholders.	Lack of guidelines/criteria on the PSC composition. Who constitutes "key" stakeholder in terms of WRC process. Failure to adequately identify all key stakeholders at study inception could result in an objection being lodged by a stakeholder later on in the process as to their "exclusion".	A stakeholder consultation process is never closed - thus if suggestions for further members are made it should be considered. The PSC membership should be reviewed annually to ensure that members are representing all relevant sectors of society for the WRC process. The broader stakeholder community is represented through municipal structures – ensure that local and district municipal structures are represented.
Medium	Existing data available may be found to be inadequate to support all modelling processes	Overestimation of availability of data. Classification process requires more detailed data requirements that is not readily available (e.g. for	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

Risk category	Risk description	Cause	Mitigation Action
		water quality) or no longer applicable (e.g. some EWRs).	supported and defendable.
	Parallel studies may not deliver the required outputs as per the Mokolo/Crocodile (West) Marico Study schedule. (e.g Recon study; PES/EIS study).	Classification study schedule not aligned to parallel study delivery dates. Delays in progress of parallel studies and extent of information provided is less than expected.	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).
	Legal challenge on the network of significant water resources	Stakeholders do not accept significant water resources selected	Provision will be made for including additional sub-nodes in the models should it be practical and achievable.
High	The study programme is delayed. Study cannot conclude by September 2013.	Stakeholders need extended consultation on processes, methodology, models. Etc. Stakeholder objections/queries only received at Step 6 of the process during the scenario workshops. Delays in information from other parallel studies.	Technical Task group meeting are planned to take stakeholders through the modelling and the economic approach. Stakeholders will be also informed of progress and findings throughout the duration of the study. This will avoid receiving stakeholder concerns and queries only at the end of the process.
	Scenarios proposed are not accepted by stakeholders during the consultation stage (step 6 of the WRCS process). This could have time and budget implications for the study.	Stakeholders do not accept scenarios as presented. Process is not understood. Seen not to be part of it. Implications on water use are realized – not happy with outcome. Trade-offs cannot be agreed upon (highly used areas versus highly protected areas).	The process to develop scenarios will be explained to stakeholders from the inception. Stakeholders will be required to provide their inputs in the development of the scenarios. Once the process of developing scenarios is completed, stakeholders were part of it and would be less inclined to only comment negatively. The team will always, at each possible event explain the WRC process, it s aims and objectives to ensure that stakeholders internalize the process.

The risks listed above will be monitored through the project and the client will be informed should a risk pose a serious threat to the study progress.

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APPENDIX A

TERMS AND DEFINITIONS

Terms and definitions

Some key terms and definitions as understood and interpreted by the study team for application in the study.

- *Integrated unit of analysis (IUAs)*: The basic unit of assessment for the classification of water resources. The IUAs incorporates socio-economic zones and is defined by catchment area boundaries. Ten preliminary IUAs have been defined for the Mokolo catchment (Limpopo WMA) and Crocodile (West)/Marico WMA.
- *Water Resource Planning Model (WRPM):* The WRPM setup for the WMA will be used to assess the scenarios. The outputs from the model will be shortfalls in supply to the various users which will be used for input to the economic analysis.
- *Resource Water Quality Objectives (RWQOs):* RWQOs are numeric or descriptive in-stream water quality objectives set to provide detail upon which to base the management of water quality. RWQOs integrate ecological water quality requirements that and user fitness for use requirements. The RWQO, if set in the Mokolo catchment (Limpopo WMA) and Crocodile (West)/Marico WMA, will be used as an input into the water quality component of the assessment.
- *Resource Quality Objectives (RQOs:* Numeric or descriptive (narrative) goals for resource quality (includes all aspects of water quantity, water quality and aquatic ecosystem quality, the latter including the quality of in-stream and riparian habitats and aquatic biota) within which a water resource must be managed. These are given legal status by being published in a Government Gazette.
- *Scenario:* consists of a set of classes set up for the IUAs and sub areas of the IUAs where applicable. There will be a base case scenario which is an initial scenario setup for the WMA by the project team. This scenario will be analysed and the results presented to the Project Steering Committee (PSC). Further scenarios will be developed based on the findings of the base scenario with inputs from the PSC. The additional scenarios will be analysed and the results taken back to the PSC and the broader stakeholders for discussion
- *Node:* These are modelling point's representative of an upstream reach or area of an aquatic eco-system (rivers, wetlands, estuaries and groundwater) for which a suite of relationships apply. A node is set at the outlet of an IUA where the flow and water quality requirements required to be met for a particular scenario are set. The flows set are based on the different categories set at the EWR sites.
- *Sub-nodes:* are nodes set within a particular IUA at which flows and water qualities will be set to protect a particular ecological subarea or user that is identified as important and sensitive. The sub-nodes will be setup in the model with specified flows that have to be met. This may change the behaviour of the system in terms of supply to the users and to meet the ecology.
- *Ecological Water Requirements:* The flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition. This term is used to refer to both the quantity and quality components. The EWRs as determined by the Comprehensive Reserve study of 2001 will be applied in this study.
- *Ecological Water Requirement Sites:* Ecological Water Requirement sites are set at specific points on the river. These sites provide sufficient indicators for the specialists to assess environmental flows and information about the variety of conditions in a river reach. An EWR

- site consists of a length of river which may consist of various cross-sections for both hydraulic and ecological purposes. EWR sites (6 sites in the Mokolo; 8 in the Crocodile (West) and 4 in the Marico catchments) were assessed as part of the intermediate Reserve studies. 4 rapid EWR sites are also included in the study and one wetland site in the Molopo catchment.
- *Sub-quaternary catchments:* A finer subdivision of the quaternary catchments (the catchment areas of tributaries of main stem rivers in quaternary catchments). The update of the PES and EIS (2010) status is being determined per sub-quaternary.
- *Present Ecological State (PES):* The degree to which ecological conditions of an area have been modified from natural (reference) conditions. The measure is based on water quality variables, biotic indicators and habitat information. The PES at each existing EWR site will be assessed as part of this study.
- *Ecological Importance and Sensitivity (EIS):* Key indicators in the ecological classification of water resources. Ecological importance relates to the presence, representativeness and diversity of species of biota and habitat. Ecological sensitivity relates to the vulnerability of the habitat and biota to modifications that may occur in flows, water levels and physico-chemical conditions. A current study to update the PES and the EIS of all sub quaternary catchments is currently underway by the DWA and the Water Research Commission. Once the results of this update become available, it will be used as an additional consideration in assessing value and significance of water resources in the WMA.
- *Significant Water Resources:* Water resources that are deemed to be significant from a water resource use perspective, and/or for which sufficient data exist to enable an evaluation of changes in their ecological condition in response to changes in their quality and quantity of water. Water resources are deemed to be significant based on factors such as, but not limited to, aquatic importance, aquatic ecosystems to protect and socio-economic value.
- *Trade-offs*: Balancing of all factors in relation to the water resource and/or and IUA(s) that are not necessarily attainable at the same which may involve a giving up of one benefit, advantage, etc. in order to gain another regarded as more desirable. This may include balancing of those factors between use and protection (which may or may not be conflicting), between downstream impacts and upstream uses and vice versa, between possible use of resources within a catchment and between catchments, and between possible resource use between different parts of the country. Decisions on these trade-offs will have different implications for different stakeholders at local, regional and national levels.
- *Management Class (MC)*: The MC is representative of those attributes that the DWA (as the custodian) and society require of different water resources (consultative process). The process requires a wide range of trade-offs to assessed and evaluated at a number of scales. Final outcome of the process is a set of desired characteristics for use and ecological condition each of the water resources in a given catchment. The WRCS defines three management classes, Class I, II, and three based on extent of use and alteration of ecological condition from the predevelopment condition.

APPENDIX B

MENTORSHIP PROGRAMME

DRAFT MENTORSHIP PROGRAMME

CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE MOKOLO AND MATLABAS CATCHMENTS AND CROCODILE (WEST) AND MARICO WMA: WP10506

The WRC Directorate has agreed that Matlabas catchment will be done in-house as an area of application after being capacitated. The PSP team is expected to supervise and ensure that the work done for Matlabas meets the requirements of the WRCS. The PSP team will be responsible for quality check and control.

LEARNING AREA	TASK DESCRIPTION	MENTEE PARTICIPATION/INVOLVEMENT	PERFORMANCE INDICATOR	DELIVERABLE
Ecology, Hydrology, Water Quality, Socio-economics, GIS	Scoping	Review literature and prepare scoping report	Scoping report including information analysis	Information analysis report
Ecology, Hydrology, Water Quality, Socio-economics, GIS **(Classification step 1)**	Establishment of a network of nodes to be used as the basis of the Classification Process	Identification of significant water resources (Google earth, site visits) Data sourcing, analysis and interpretation: population, economic, hydrological, current allocation schedules, supply-demand balance, infrastructure etc.	A "node network diagram" of the significant water resource units within the catchment	IUA delineation report
	Delineation of IUAs		A set of IUA polygons	
	Determination of the present-day status of the catchment (ecological, economic, social)		Summary of the present-day status of the catchment	
Socio-economics **(Classification step 2)**	Determination of the relationship between the value and the condition of the water resource	Development of a list of ecosystem indicators and definition of a scoring system	Socio-economic evaluation and decision-analysis framework	Socio-economic report

LEARNING AREA	TASK DESCRIPTION	MENTEE PARTICIPATION/INVOLVEMENT	PERFORMANCE INDICATOR	DELIVERABLE
Ecology, Hydrology, Water Quality **(Classification step 3**	Extrapolation and estimation processes	Identification of the nodes to which RDM data can be extrapolated	List of EWR sites and corresponding nodes	EWR report
	Rapid Reserve assessments	Site visit including invertebrate, fish and hydraulic assessments; Determination of IHI, EIS, REC; Interrogation of data using FRAI and MIRAI models; Participate in specialist workshops	EWR rule curves, summary tables and modified time series for each node for all ecological categories	
Ecology, Hydrology, Water Quality **(Classification step 4)**	Establishment of scenarios taking into account the relationship among social, economic and ecological trade-offs	Determine the ESBC configuration and ensure that it satisfies a basic set of ecological and hydrological constraints	ESBC configuration scenario RDM configuration scenarios	Scenarios report
Ecology, Hydrology, Water Quality, socio-economics **(Classification step 5)**	Assessment of water quantity and quality implications for water users	Running of relevant models and determination of implications of scenarios	A set of tables specifying the ecological category configuration for each of the preliminary scenarios, the associated water availability and water quality for all the major water-use sectors	

LEARNING AREA	TASK DESCRIPTION	MENTEE PARTICIPATION/INVOLVEMENT	PERFORMANCE INDICATOR	DELIVERABLE
Communication, public participation, stakeholder engagement	Stakeholder consultation	Arrange PMC Meetings (Logistics & minute-taking); Compilation of initial PSC list; Drafting of invitations to PSC and Public meetings; BID, Newsletters; DWA presentations at PSC, public meetings & other stakeholder engagements	Presentations, meetings and workshops	Stakeholder consultation report

APPENDIX C

PROPOSED PROJECT STEERING COMMITTEE MEMBERSHIP FOR THE CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE MOKOLO AND MATLABAS CATCHMENTS (LIMPOPO WMA) AND CROCODILE (WEST)/MARICO WMA CLASSIFICATION STUDY

Classification of significant water resources in the Mokolo and Matlabas catchments: Limpopo Water Management Area (WMA) and Crocodile (West) and Marico WMA - Members of the Project Steering Committee				
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APPENDIX D

STUDY PROGRAMME

STUDY PROGAMME: CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE MOKOLO CATCHMENT AND CROCODILE (WEST) AND MARICO WMA A (WP10506)

TASK		YEAR																								
		2011				2012													2013								
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Task 1	**Project Inception**																									
	Documentation of all relevant information on previous studies conducted																									
	Identification of potential IUAs																									
	Development of a capacity building programme																									
	Draft Inception Report																									
	Final Inception Report																									
Task 2	**Water resources information and data gathering**																									
	Literature review																									
	Information gap analysis																									
	Identification of additional work to be done and recommendations																									
	Inventory of currently available water reources models																									
	Report																									
Task 3	**Determination of the management class**																									
Step 1	Delineation of units of analysis and describe status quo of the water resources																									
Step 2	Link the value and condition of the water resource																									
Step 3	Quantify the Ecological Water Requirements (EWRs) and changes in non-water quality Ecosystem Goods, Services and Attributes (EGSAs)																									
Step 4	Determine an Ecological Sustainable Base Configuration (ESBC) scenario and establish starter configuration scenarios																									
Step 5	Evaluate the scenarios within the Integrated Water Resource Management (IWRM) process																									
Step 6	Evaluate the scenarios with stakeholders																									
Step 7	Gazette the class configuration																									
Task 4	**Communication and liaison**																									
	Stakeholder identification and database development																									
	Compile an announcement document and BID																									
	PSC meetings																									
	Stakeholder workshops/meeting arrangements																									
	Continuous communication																									
	Newsletter development																									
	Gather comments/issues on study																									
	Capacity Building																									
Task 5	**Reporting**																									
	Technical progress reports (milestone based)																									
	Finalization of all deliverables																									
	Compilation of IWRM summary																									

STUDY PROGAMME: CLASSIFICATION OF SIGNIFICANT WATER RESOURCES IN THE MOKOLO CATCHMENT AND CROCODILE (WEST) AND MARICO WMA A (WP10506)

TASK		YEAR																								
		2011				2012												2013								
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Presentation of recommended class to DWA																									
	Final IWRM template																									
	Implementation plan																									
Task 6	**Study Management and Co-ordination**																									
	Project management team meetings																									
	Invoicing and progress reports																									

APPENDIX E

STUDY PROJECTED CASH FLOW

APPENDIX F

COMMENTS RECEIVED FROM I AND AP'S AFTER 1ST PSC MEETING

Name	Reference	Correction/comment
Hermien Roux	Deleted Hermien Roux 08/03/2012 09:01:00 AM/ Page 5: Inserted Hermien Roux 08/03/2012 09:01:00 AM	Mmbatho/ Lichtenburg
	Page 7: Inserted Hermien Roux 08/03/2012 09:17:00 AM	There is an active tufa waterfall and seasonal tufa cascades and
	Page 7: Inserted Hermien Roux 08/03/2012 09:04:00 A M	MCCA efforts for protection status for various farms in the upper Marico and striving for Biosphere Reserve status
	Page 7: Inserted Hermien Roux 08/03/2012 09:04:00 AM	Landowners around Molopo eye also applied for Nature Reserve status and is currently a conservancy (Molopo Oog Conservancy). Molemane Nature Reserve- Provincial managed by NWP&TB
	Page 8: Inserted Hermien Roux 08/03/2012 09:18:00 AM	in the lower reaches (upper reaches constant baseflow from various dolomitic eyes)
	Page 8: Deleted Hermien Roux 08/03/2012 09:20:00 AM/Page 8: Inserted Hermien Roux 08/03/2012 09:20:00 AM	Upper/middle
	Page 8: Deleted Hermien Roux 08/03/2012 09:20:00 AM/ Page 8: Inserted Hermien Roux 08/03/2012 09:20:00 AM	Sehujwane Dams/ Sehujwane Dams used for mainly domestic water supply to village.
	Page 8: Inserted Hermien Roux 08/03/2012 09:29:00 AM	Gradient of Marico river fairly steep below eyes- flowing through maountaineous area- dolomitic areas fairly flat yes and area below Marico Bosveld Dam fairly flat yes. The Marico River flows through a variety of geomorphological features from source to the confluence with the Limpopo River. The river has a total length of 250 km and an altitudinal variation of 700 m descending at an average slope of 1: 357 (Grobler *et al*., 2007). The upper tributaries flow in deeply incised gorges that are relatively unimpacted and sheltered from anthropogenic disturbances such as intensive agricultural activities (Grobler *et al*., 2007). The lower catchment area, downstream from Marico Bosveld Dam, is characterised by limited flow contribution to the Marico River (Ashton *et al*., 2001).
	Page 9: Inserted Hermien Roux 08/03/2012 09:34:00 AM	Also direct abstraction from the Molopo eye for water supply to Mahikeng- Mafikeng
	Page 12: Inserted Hermien Roux 08/03/2012 10:17:00 AM	Ngotwane,

Name	**Reference**	**Correction/comment**
	Page 12: Inserted Hermien Roux 08/03/2012 10:21:00 AM	Associated active tufa waterfall in Bokkraal se loop (fed by dolomitic eye, on tributary of Marico River) associated active- seasonal tufa cascade on Kuilfontein- tributary of Marico River.
	Page 12: Inserted Hermien Roux 08/03/2012 10:24:00 AM	Also Barbus motabensis type locality and NFEPA Fish species….
Philip J. van der Walt	Table 5: Extrapolation recommendations for the Crocodile (West) catchment.	I think you want to refer to Rietvlei, the stream discharging into the Rietvlei Dam. The Rietspruit is 15km further downstream and discgharges into the Hennops