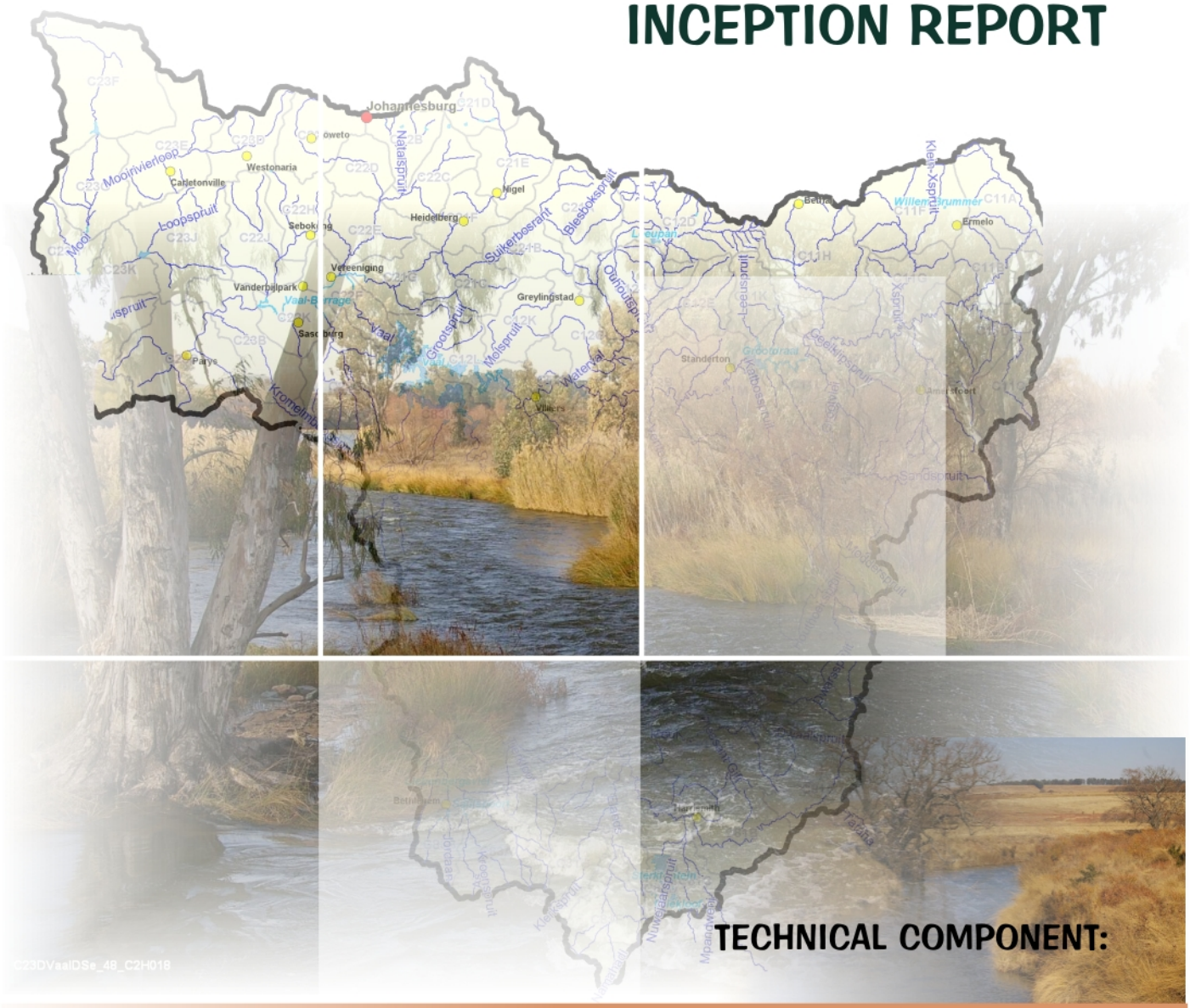
COMPREHENSIVE RESERVE DETERMINATION
INTEGRATED VAAL RIVER SYSTEM
SURFACE WATER

INCEPTION REPORT



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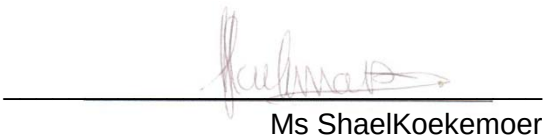

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ACRONYMS

BBM	Building Block Methodology
BHNR	Basic Human Needs Reserve
CD: RDM	Chief Directorate: Resource Directed Measures
CMA	Catchment Management Agency
D:NWRP	Directorate: National Water Resource Planning
D: RQS	Directorate: Resource Quality Services
DRIFT	Downstream Response to Imposed Flow Transformation
DTM	Digital Terrain Model
DWAF	Department of Water Affairs and Forestry
EC	Ecological Category
EcoSpecs	Ecological Specifications
EFR	Ecological Flow Requirement
EIS	Ecological Importance and Sensitivity
EPA	Environmental Protection Agency
EWR	Ecological Water Requirements
FMP	Flow Management Plan
FRAI	Fish Response Assessment Index
GAI	Geomorphological Driver Assessment Index
GDP	Gross Domestic Product
GIS	Geographic Information System
GGP	Gross Geographic Product
HAI	Hydrological Assessment Index
HFSR	Habitat Flow Stressor Response
HGM	Hydro-Geomorphic
IHI	Index of Habitat Integrity
LHWP	Lesotho Highlands Water Project
MAP	Mean Annual Precipitation
MIRAI	Macro Invertebrate Response Assessment Index
NGO	Non Governmental Organization
NWA	National Water Act
NWRS	National Water Resource Strategy
PAI	Physico Chemical Driver Assessment Index
PES	Present Ecological State
PMT	Project Management Team
PSP	Professional Service Provider
REC	Recommended Ecological Category
RHP	River Health Programme
RQO	Resource Quality Objective
RU	Resource Unit
RWQO	Resource Water Quality Objective
SANBI	South African National Biodiversity Institute
SARS	South African Revenue Service
SCI	Socio Cultural Importance
SPATSIM	Spatial and Time Series Information Modelling
SSF	Sasol Synthetic Fuels
ToR	Terms of Reference
TPC	Threshold of Potential Concern
VEGRAI	Vegetation Response Assessment Index

VMP	Value Marginal Product
WHI	Wetland Health Index
WMA	Water Management Area
WRC	Water Research Commission
WRYP	Water Resource Yield Planning

PSP ACRONYMS

Golder	Golder Associates Africa
BRS	BioRiver Solutions
CS	Clean Stream
KAS	Koekemoer Aquatic Services
NC	Nepid Consultants
SS	Streamflow Solutions
WCS	Wetland Consulting Services
WFA	Water for Africa
CE	Conningarth Economists
WRP	Water Resources Planning Consulting Engineers
IS	Innovative Solutions
CES	Coastal and Environmental Services
LVA	Loxton Venn and Associates

1 INTRODUCTION

1.1 BACKGROUND

The National Water Act (NWA, Act No. 36 of 1998, Section 3) requires that the Reserve be determined for rivers, i.e. the quantity, quality and reliability of water needed to sustain both human use and aquatic ecosystems, so as to meet the requirements for economic development without seriously impacting on the long-term integrity of ecosystems. It is therefore imperative that the Reserve be determined and requirements met before other economic activities can be satisfied. As the Department of Water Affairs and Forestry (DWAF) is the custodian of the nation's water resources, it is their responsibility to ensure the adequate protection and effective management of these resources. The Chief Directorate: Resources Directed Measures (CD: RDM) of DWAF is tasked with the responsibility of ensuring that Reserve assessments take place before licensing can proceed.

The CD: RDM identified the Integrated Vaal River System, with the focus of this study, the Upper Vaal Water Management Area (WMA) as requiring a comprehensive Reserve assessment as to provide input to the Reconciliation studies and the integrated water quality management plan for the Vaal River studies undertaken by the National Water Resources Planning Directorate (D: NWRP) of the DWAF. These studies require higher levels of confidence in the Reserve determination results as is currently available. This will assist the DWAF to make informed decisions regarding the authorisation of future water use and the magnitude of the impacts of the present and proposed developments.

1.2 STUDY AREA

The study area for the Reserve determination is the Upper Vaal system as represented by WMA 8. WMA 8 is part of a larger water supply system, which includes adjacent WMAs, and Lesotho. The Upper Vaal WMA is one of three WMAs in the Vaal River catchment, which is the drainage area of the Vaal River from its headwaters to the confluence of the Vaal and Orange Rivers (DWAF, 2004).

The Upper Vaal WMA includes the Vaal, Klip, Wilge, Liebenbergsvlei, Waterval, Suikerbosrant and Mooi Rivers and extends to the confluence of the Mooi and Vaal Rivers. It covers a catchment area of 55 565 km^2. This WMA includes the very important Vaal, Grootdraai and Sterkfontein dams. The southern half of the WMA extends over the Free State, the north-east mainly falls within Mpumalanga and the northern and western parts in Gauteng and North West provinces respectively (DWAF, 2004).

The Upper Vaal is the uppermost WMA in the Vaal River catchment and one of five WMAs in the Orange River Basin. It is surrounded by the Crocodile (West) and Marico, Olifants, Inkomati, Usutu to Mhlathuze, Thukela, Upper Orange and Middle Vaal WMAs and adjoins Lesotho in the southern extreme. The National Water Resource Strategy (NWRS) describes and discusses the Upper Vaal WMA in three sub-areas *viz* the Vaal upstream of Vaal Dam, Wilge and the Vaal downstream of the Vaal Dam (DWAF, 2004). A study area map is provided in Figure 1.1.

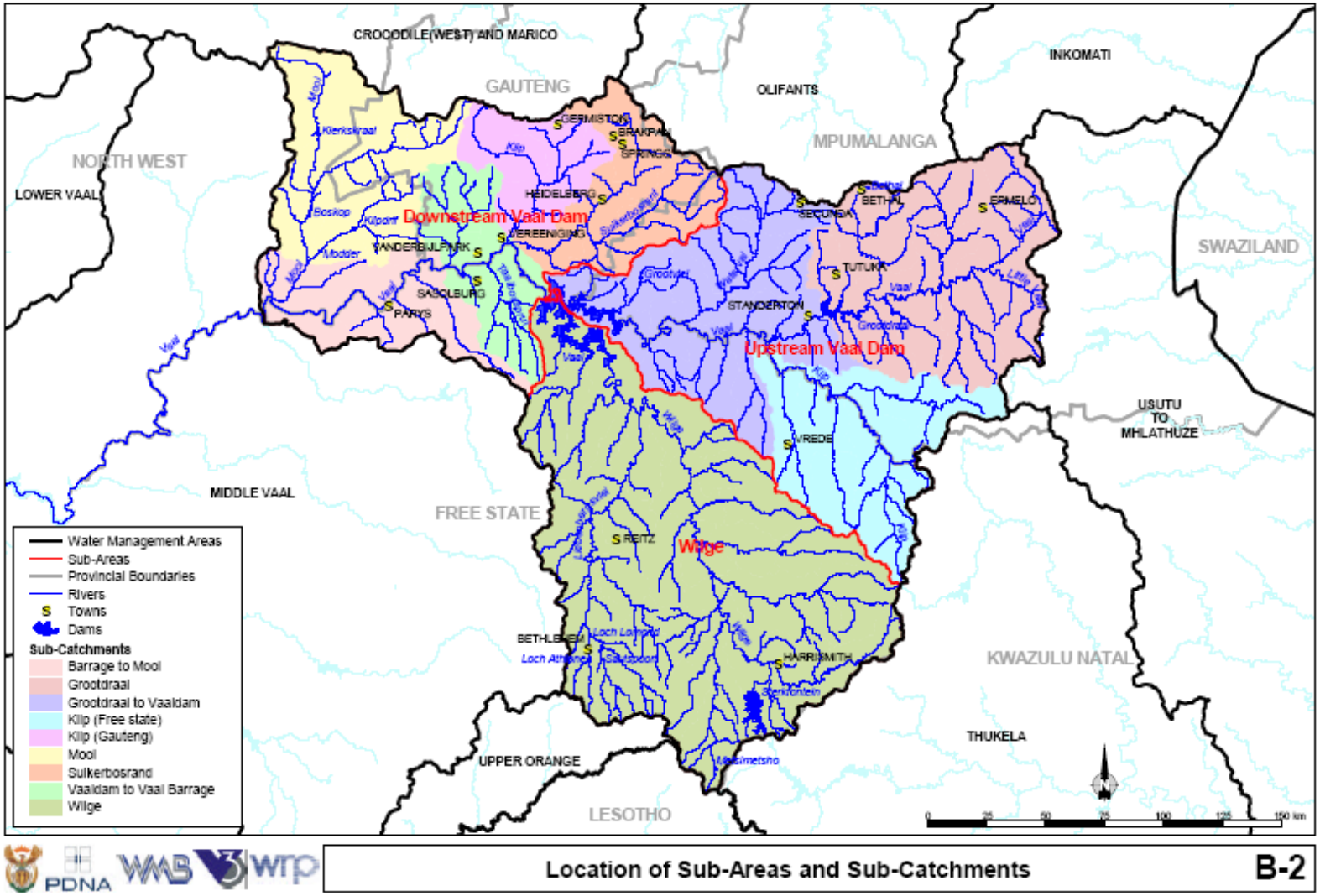

Figure 1.1 Layout and location of the Upper Vaal WMA (DWAF, 2003)

1.2.1 Climatic conditions

The mean annual temperature ranges between 16°C in the west to 12°C in the east, with an average of about 15°C for the catchment as a whole. Maximum temperatures are experienced in January and minimum temperatures usually occur in July.

Rainfall is strongly seasonal with most rain occurring in the summer period (October to April). The peak rainfall months are December and January. Rainfall occurs generally as convective thunderstorms and is sometimes accompanied by hail. Frost occurs in winter and there is occasional light snow on high lying areas (DWAF, 2004).

The climatic conditions vary across the WMA, with the Mean Annual Precipitation (MAP) reducing from 800mm in the headwaters to 500mm at the Middle Vaal WMA boundary. This tendency is reversed when considering potential annual evaporation, which increases from 1300mm in the Upper Vaal to 2800mm in the West.

1.2.2 Topography

The Vaal catchment slopes gently from about 1 800m in the east to 1 450m in the west in the vicinity of the Vaal Barrage, with some steep areas in the headwaters of the Wilge tributary on the south-eastern border with the Orange River. The water from the Upper Vaal WMA flows across the Middle Vaal, Lower Vaal and Lower Orange WMAs before reaching the Atlantic Ocean near the town of Alexander Bay in the western corner of the country. This cascading characteristic illustrates the interdependence of the indicated WMAs and emphasises the need for water resource management to take place across the WMA boundaries (DWAF, 2004).

1.2.3 Vegetation

In this WMA the predominant veld type is pure grassveld. In the upper Wilge catchment and along the escarpment where the rainfall increases from about 700mm to up to 1 000mm there are areas of temperate and transitional forest and scrub while false grassveld predominates to the north of the Vaal River in its central reaches, particularly in the Mooi catchment (DWAF, 2004).

1.2.4 Environmentally sensitive areas

Ecologically sensitive areas identified in the Upper Vaal WMA include wetlands in the catchment of Suikerbosrand River, Klip (Free State) River and in the Wakkerstroom area of the WMA. The Blesbokspruit wetland in the Suikerbosrand catchment has been identified as a wetland of international importance as defined in the RAMSAR Convention. The Golden Gate National Park is located in the southern extreme of the WMA, while other conservation areas are scattered through the WMA (DWAF, 2004).

1.2.5 Geology

The area to the south of the Vaal River is underlain by fine sedimentary rocks of the Karoo system, as is the area to the north of the Vaal River, situated east of longitude 28° E. The Karoo system covers about 80 % of the Upper Vaal WMA. To the north of the Vaal River, west of longitude 28° E, igneous and metamorphic rocks predominate but there are extensive dolomitic exposures in the central areas which are mainly in the catchment of the Mooi tributary.

The predominant minerals are gold, uranium, base metals, semi-precious stones and industrial minerals. Gold mining is of particular economic importance. Also of importance is uranium and coal mining. The mining of these minerals have implications in terms of water quality (DWAF, 2004).

Soil depths are generally moderate to deep with an undulating relief over the entire Upper Vaal WMA. There are three main soil types that predominate and these are distributed across the catchment as follows:

- Sandy Loam: In upper reaches of the Vaal and Wilge catchments and to north of the Vaal River along its central reaches.
- Clay Loam: In the Klip (Gauteng) and Suikerbosrand catchments and to the south of the Vaal River along its central reaches.
- Clay Soil: In the middle and lower catchments of the Wilge and Vaal catchments upstream of Vaal Dam. It also occurs to the west of the Vaal.

1.2.6 Economic characteristics

This WMA is economically one of the most important in the country and nearly 20% of the Gross Domestic Product (GDP) of South Africa originates from the Upper Vaal WMA. Only the adjacent Crocodile (West) and Marico WMA, with about 24%, contributes more to the GDP. The contribution of the different sectors to the Gross Geographic Product (GGP) in the Upper Vaal WMA reflects a diversified economy with a strong industrial and financial base. Despite the large areas under cultivation, agriculture only contributes about 2% of the GGP. Agriculture, however, has important linkages to other sectors and provides livelihood to a large proportion of the rural population (DWAF, 2004).

The potential for future growth in this WMA remains strong. Growth will largely be attracted to the already strong urban and industrial areas in the Johannesburg - Vereeniging-Vanderbijlpark complex. New mining developments will mainly replace worked out mines with a long term decline expected in this sector. There is however potential for further development of coal mining on the Eastern Highveld and in the Vereeniging area downstream of Vaal Dam (DWAF, 2004).

1.2.7 Mining

Products of the mining industry in the Upper Vaal WMA include coal, precious metals (gold, uranium, etc.), base metals, semi-precious stones and industrial minerals. The major impact of the mines on the water resource is the water pumped from the mines to dewater the underground workings mainly of the gold mines. The salinity loads associated with these mine discharges together with the sewage return flows contribute significantly to the salinity problems that are experienced in the Vaal Barrage and downstream river system. The mine dewatering and the diffuse salinity contributions from the highly developed urban and industrial areas in the Vaal Barrage catchment has resulted in the need for the currently applied blending and/or dilution operating rules applied downstream of Vaal Dam (DWAF, 2004).

1.2.8 Industry

Major industries in this WMA include Sasol I (Sasolburg), Mittal Steel, Sappi, the Sasol Midlands Plant and Sasol Synthetic Fuels (SSF) (Secunda). Sasol I is located in the Free State province near Sasolburg and abstracts water from the Vaal Barrage. The production of petro-chemicals is the main activity. Mittal Steel is located near Vanderbijlpark and is supplied with water from the

Vaal Barrage. The production of iron and steel products is the main activity. SSF are located in Mpumalanga Province near the Secunda urban area. Water for SSF is supplied by pipeline from Grootdraai Dam. The production of petro-chemicals products is the main activity. Other important industries such as Sappi and Sasol Midlands Plant receive water from the urban centres where they are located. All these industries are economically important and provide significant employment. There are three operational coal fired power stations located in the WMA. The power stations are the Lethabo, Tutuka and Majuba Power Stations (DWAF, 2004).

1.2.9 Irrigated areas

The irrigation areas were estimated by Loxton Venn and Associates (LVA) in the report entitled: Report for the Vaal River Irrigation Study (DWAF, 1999a). Since the completion of the irrigation study, the registration of water use has been completed. Comparisons between the registered water use and the irrigation figures given in the report highlighted the uncertainties in the irrigation areas and water use, with the registered water use exceeding the LVA information. The verification process, which has been started in the WMA, will provide more certainty on the irrigation numbers. Regional DWAF personnel have indicated that the two major conveyance rivers are the Wilge and Liebenbergsvlei and that major illegal irrigation occur along these rivers. Preliminary results from the Upper Vaal Water Management Area Validation Study indicated that as much as 236 million m^3/annum of the year 2005 irrigation water use could be unlawful (DWAF, 2006).

About 75% of the irrigation is upstream of major storage dams and are supplied from run-of-river or farm dams. These areas will be supplied at a lower assurance of supply than the irrigation areas located in the Mooi sub-catchment (Mooi Government Water Scheme, Klipdrift and Vyfhoek Schemes) and Barrage to Mooi sub-catchment (Rietpoort and Koppieskraal Irrigation Boards) which are supported by major dams and conveyance infrastructure (DWAF, 2004).

1.2.10 Land use

The land use in the Upper Vaal WMA is characterised by the sprawling urban and industrial areas in the northern and western parts of the WMA. There are also extensive coal and gold mining activities located in the Upper Vaal WMA. These activities generate substantial return flow volumes in the form of treated effluent from the urban areas and mine de-watering that are discharged into the river system. These discharges have significant impacts on the water quality in the main stem of the Vaal River (DWAF, 2004).

Land use is dominated by cultivated dry land, which occurs throughout the catchment with high density areas in the Wilge and Vaal Dam to Vaal Barrage sub areas with the main crops being maize and wheat.

1.2.11 The Social Environment

The Upper Vaal WMA is the most populous WMA in South Africa. The total population is estimated at 5.6 million people in the year 1995. More than 80% of the population in the WMA reside in the area downstream of the Vaal Dam with nearly 97% living in an urban environment (DWAF, 2004).

The demography of the WMA will be influenced by economic opportunities and potential. Projections are therefore for continued strong growth in urban population in the sub-area

downstream of Vaal Dam where most of the economic activity is centred. A decline in population is projected for the Wilge sub-area due to the movement of people out of Phuthaditjaba and the former QwaQwa area (DWAF, 2004).

1.2.12 Equity issues

The poor in urban areas and rural villages are as important, in the consideration of the distribution and use of water resource, as the small (poor) rural subsistence farmer. This should not be forgotten in the urgencies of land reform and the enthusiasm to establish a substantial class of farmers from amongst the previously disadvantaged (DWAF, 2004).

Equity can be achieved through access to water in livelihood strategies, through small-farmer development programmes, through water supply and sanitation and especially the provision of good quality drinking water, and through the maintenance and growth of income-producing, job creating, and tax paying agricultural, commercial and industrial strategies (DWAF, 2004).

1.2.13 Recreational Water Use

The use of water for recreational purposes is one of the 11 water uses regulated in terms of the NWA. Recreational use can take many forms and only occasionally has any direct impact on the water resource. Most obvious are activities such as power-boating, sailing and swimming which can have quality / pollution impacts. Far more significant in terms of both quantity and quality is the release of water to allow for canoeing and other water sports downstream (The Upper Vaal, Dusi and Fish River canoe marathons being prime examples). These activities can bring very significant economic benefits to the WMAs concerned, and where water releases can be accommodated, particularly through alignment with the needs of the ecological Reserve or other downstream users, then so much the better (DWAF, 2004).

Water resources offer a very significant recreational outlet and that recreation is an important public and social asset necessary for national health and productivity. A central philosophy is that recreational opportunity should not be unreasonably and unnecessarily denied to users, and that the implementation of policy should ensure that disadvantaged and poor people should also be able to avail themselves of opportunities (DWAF, 2004).

1.2.14 Water Availability

Due to the extensive development in the Vaal River System and in the Upper Vaal and Crocodile (West) WMA, which are supplied from the Upper Vaal WMA, the local surface water resources in all three of the Vaal WMAs had been fully exploited for more than 30 years. It was therefore necessary to augment the supply by developing various transfer schemes importing water from the Thukela and Usutu to Mhlathuze WMAs, as well as from the Kingdom of Lesotho through the Lesotho Highlands Water Project (LHWP) (DWAF, 2004).

The surface water availability in the Vaal River System is estimated through a set of water resource models, each fulfilling a particular function in the management of the water resources. Combined, these models serve as a decision support tool that contains a large and comprehensive database of hydrological and physical system characteristics, required to simulate the water resource systems as realistically as possible. Due to the interdependencies, the management and planning of the Vaal River System is undertaken at the national level and not by the Upper Vaal

water managers (Catchment Management Agency (CMA) when it is established, until then the DWAF Regional Office) (DWAF, 2004).

The Upper Vaal water managers are, however, responsible for the assessment of the availability of the local groundwater and surface water resources used to supply local authorities and district councils without access to the Vaal River System water supply infrastructure (DWAF, 2004).

1.2.15 Water Requirements

The water requirement projections that are currently used for planning originate from the development of the NWRS. The total water requirement in the Upper Vaal WMA is 2424 million m^3/annum. The total water requirements for the Upper Vaal are projected to reach 3071 million m^3/annum by the year 2025 based on the August 2006 DWAF population scenario (DWAF, 2006).

With the commissioning of Phase 1b of the LHWP (Mohale Dam and transfer tunnel) during the later part of 2003, an additional 320 million m^3/annum is available. This surplus is expected to be gradually depleted over time (to supply the growing water requirements) until a deficit of about 56 million m^3/annum is projected for the year 2019 using the base requirement scenarios (DWAF 2006).

What is important to recognise is that this estimated excess in supply is qualified as “conditional” since it is only available if all the transfers are fully operational. In practice the volume of water conveyed through the Thukela-Vaal Transfer scheme will be determined annually, effectively operating the system such that the water demands are in balance with the supply. The quantity transferred will thus increase over time in line with the growth in the water requirements.

A further important perspective is that, although the system as a whole will experience surplus conditions over the medium to long term, this surplus is not available in Grootdraai Dam and supporting systems (also referred to as the Eastern Sub-system) due to the physical location of some of the transfer schemes. A pre-feasibility study into the need for augmentation of the Eastern Sub-system showed that further augmentation of this sub-system will be required by the year 2010. A number of options have been assessed as possible schemes to augment the supply and the latest recommendation is that a pipeline should be constructed to convey water from Vaal Dam to support the water requirements of the Eastern Sub-system.

2 APPROACH TO THE RESERVE DETERMINATION STUDY

2.1 INTRODUCTION

The approach to the Reserve study will be within context of the eight-step Reserve procedure according to Louw and Hughes (2002). A diagrammatic presentation of the eight-step procedure is provided in Figure 2.1 and has been adapted from DWAF 2006.

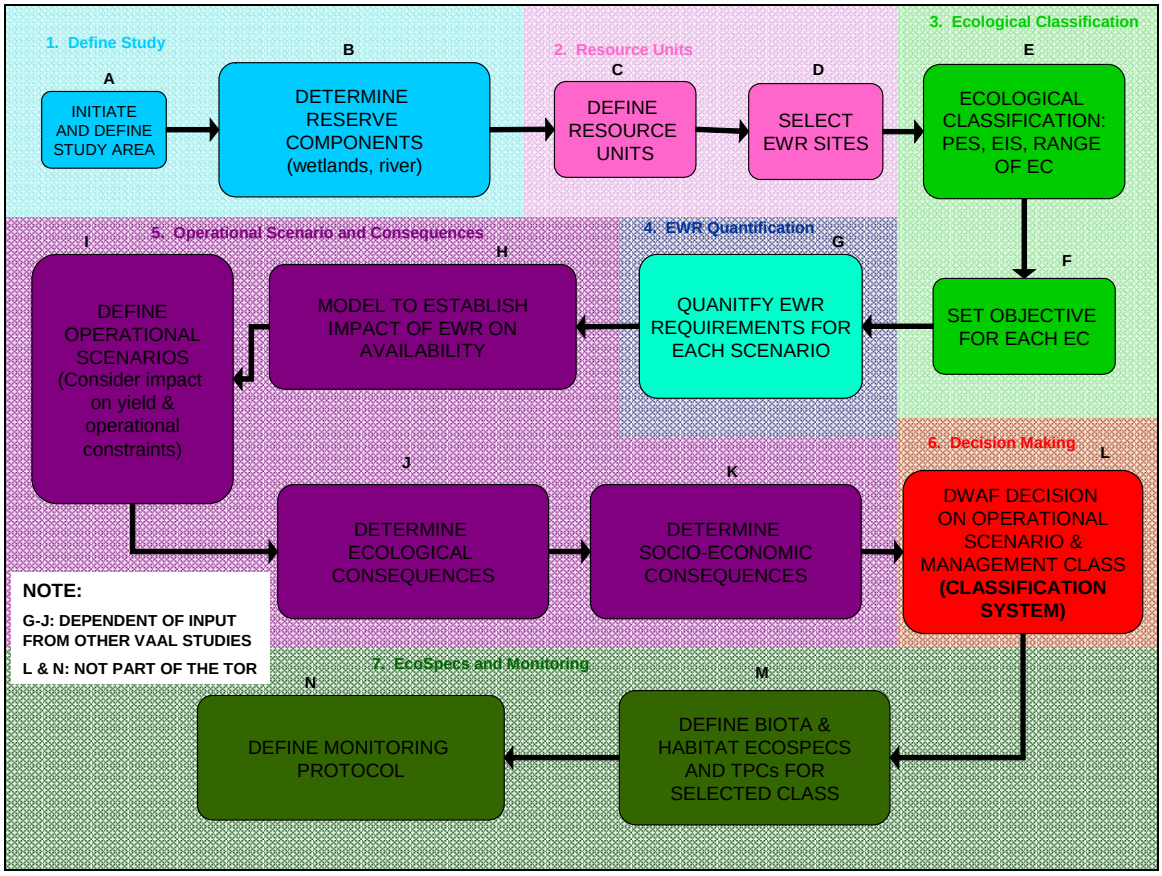

Figure 2.1 Diagram illustrating the process to be followed for the Upper Vaal Comprehensive Reserve study (adapted from DWAF, 2006)

2.2 AIMS, OBJECTIVES AND OUTCOMES OF THE STUDY

The Reserve process is a scenario-based approach. The team will therefore generate a series of likely scenarios that will be determined by an interactive series of discussions between key specialists of the technical, the yield planning consultants (WRP) and management teams. This approach enables the DWAF to make management decisions using scenarios, based on a number of alternatives with anticipated consequences.

The overall aim of the project as described in the Terms of Reference (ToR) is to provide EcoClassification results and Comprehensive Reserves for WMA 8. The detailed aims, objectives and proposed outcomes of the study are as follows:

- Provide the typing, importance and habitat integrity for wetlands and make recommendations regarding Reserve assessments.
- Provide a Desktop assessment per quaternary catchment of the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and Socio-cultural Importance (SCI) as part of the EcoClassification process.

- Provide a Level 4 EcoStatus assessment for the Resource Units (RUs) represented by comprehensive Ecological Water Requirements (EWRs) sites as part of the EcoClassification process.
- Identify other Ecological Categories (ECs) and provide implications / consequences of these categories.
- Determine EWRs for each of these ECs.
- Determine the impact of EWRs on the allocatable yield and, based on the impacts, devise additional scenarios to optimise the allocatable yield.
- Determine the ecological and resource-economic consequences of each of these additional scenarios.
- Provide the Ecological Specifications (EcoSpecs), as input to the Resource Quality Objectives (RQOs), associated with the Management Class provided to the Provisional Service Provider (PSP) by DWAF. If the Management Class is not available, then the EcoSpecs will be provided for the most realistic scenario as a surrogate for the Management Class. The Project Management Team will select the scenario. Note that this will only be possible if economic consequences to the required standard are provided as part of this project.
- Train selected specialist trainees in specific tasks relating to Reserve determinations. Opportunity for training, according to a capacity building structure to be developed, for DWAF officials to be trained. This will potentially be managed and coordinated by the Management Consultant.

The output of the study will be EWR rules for every site and quaternary catchment for an Ecological Category as well as the EcoSpecs.

Note that catchment activities are incorporated at a number of stages during the assessment, e.g. the socio-cultural importance of sites is taken into consideration when the EC is set, operational constraints and catchment requirements are incorporated into yield scenario modelling, and catchment activities impacting on ecology are considered when determining Resource Units. However, the focus of the Upper Vaal study is to determine the Ecological Reserve and to provide sufficient information regarding the consequences of the various operational scenarios to allow for decision-making. The Reserve specification is therefore a management decision based on ecological and other catchment-based information.

2.3 ASSUMPTIONS AND PROVISIONS

2.3.1 Methodology

This sub-section is based primarily on constraints of the river and wetland/pan systems being studied, as well as method development being a continuous process. This is particularly relevant to wetlands and extrapolation methods, which are currently being updated and reassessed.

The study will strive to use the best available methods at all stages of the project, provided budget and time constraints can be met. The procedure for rivers to be followed is according to the revised methods for rivers as outlined in Louw and Hughes (2002), HFSR manual (IWR Source-to-Sea, 2004) and the EcoClassification manual version 2 (in production and based on version 1, Kleynhans *et al*., 2005).

Whilst the methods for the determination of Reserves for riverine systems are well developed, those for wetlands systems are poorly developed. DWAF has issued some guidelines for

procedures for Reserve determination (DWAF 1999b), but these guidelines do not detail any methods for the actual determination of scores or water volumes. Due to the absence of any rigorous methods, a procedure (adapted partially from the river and estuary Reserve procedures) is to be adopted within this study. Methods to be used are currently in development by the wetland PSP on other projects for DWAF.

To provide the final results of the study, it is assumed that the Management Class will be provided to the PSP during the final stages of the study as a Classification system is now available. The budget does not include the process previously associated with Comprehensive studies in the absence of a Classification system to provide a Management Class. If the Management Class is not available, then the EcoSpecs will be provided for the most realistic scenario as a surrogate for the Management Class. The Project Management Team will select the most optimised scenario based on the ecological, yield, socio-economic and goods and services consequences. Note that this will only be possible if economic consequences to the required standard are provided as part of this project.

It is assumed that physico chemical input into the EcoClassification process is provided based on Kleynhans *et al*., 2005 presently being updated for version 2. The most updated and applicable Jooste model must also be used (*Pers. Comm*., Dr. P Scherman - water quality advisor to the CD: RDM).

Cognisance will be taken of the associated catchments with reference to transfers. However, as clearly stated in the ToR: “This terms of reference concerns the technical component of the comprehensive Reserve determination study for the integrated Vaal River system, specifically focused on the water quantity requirements of the rivers and wetlands/pans of the Upper Vaal WMA”. Previous Reserve information for associated catchments should be incorporated in the yield modelling if of reasonable confidence. The possibility of selecting EWR sites in these areas will depend on whether there are sufficient motivations to place any of the 10 Upper Vaal site in these systems. It is of the opinion that existing Desktop information should rather be used for the yield modelling, rather than utilising the Upper Vaal resources on this. Desktop Reserve information as well as the Desktop EcoClassification is available for the Usuthu system. All hydrological analysis will include all transfers. To understand the operation of the system, it is important that a clear understanding of the transfers is formed. Previous studies that will be used for this assessment is:

- The Thukela Water Project Decision Support Phase: Reserve Determination Model.
- The Joint Maputu River Basin Water Resources Study.

The stressed areas in the Vaal River system will be identified. The Integrated Water Quality Management Plan study has identified RWQO sites and the RHP monitoring sites could also be utilized. Urgent water use license applications with major impacts will also be included.

The focus for selection of EWR sites and RUs will be on the Vaal River and significant tributaries.

2.3.2 Study programme

The proposal is based on the study being initiated 1 February 2007. The site selection and first survey must therefore take place during the 2007 dry season (June – August). To allow for a full spectrum of flows to be experienced for hydraulic calibration purposes, the collection of data will be undertaken until at least May 2008.

2.3.3 Number of EWR sites

The number of river reaches recommended for the EWR sites in the ToR cannot practically be accommodated at a comprehensive scale. An agreement has been reached that 10 EWR sites will be selected and that data at Rapid sites will be selected for future use possibly for extrapolation or for Rapid EWR assessment.

2.3.4 Integration between the sub-studies

Although the study title refers to the Reserve determination, this study will not address the Reserve as the physico-chemical (water quality) component forms part of another sub-study. Integration of these sub-studies, to ensure that the end product reflects the Ecological and Basic Human Needs Reserve, is crucial. The provision of the system hydrology in the required format and continuous close liaison is also essential. Furthermore, the Vaal Reserve study is divided into Upper, Middle and Lower sub-studies. These sections cannot be addressed independently as any of the flow scenarios designed and evaluation affects the adjacent areas. Integration and similarity of approaches and combined design of scenarios are essential.

2.3.5 Level of assessment

The ToR indicates a Comprehensive level of assessment at numerous EWR sites. It is however possible that the assessment process can be streamlined during the Inception Phase of this project with regard to selecting different assessment levels for a variety of sites. However, if necessary a more streamlined approach can be suggested based on the results of the Task 3 Reconnaissance Survey.

2.3.6 Extrapolation

As minuted during the Technical initiation meeting, 20 February 2007 the following approach was agreed on:

''Extrapolation was taken out of the Upper Vaal Proposal as the methods will not be completed due to the lack of the approval of the WRC study to further develop this and the indication from the Directorate Resource Quality Services (D: RQS) that they cannot at this stage support the process without the methods and manuals being properly in place. Any use of the methods and modules without their input and support are strongly advised against. Due to the concern of the few EWR sites in the system, the agreement was reached that the budget will include the surveys at a Rapid III level at 10 additional sites for the Upper Vaal. Pending the success of a new proposal to the WRC and whether the method has been further developed through other smaller pilot studies, this information can then be used for extrapolation. As a last resort, the 10 Rapid sites can be analysed and results produced in the standard manner. A hydrological process based only on ecological similarity (process is available) can then be followed. The Rapid survey of 10 sites is included in the budget; once we know where we stand during 2008, a VO will be requested for either analysis or extrapolation. A similar approach will be followed for the Middle and Lower Vaal."

2.3.7 Capacity building

Strong emphasis is made on capacity building in the ToR. However, all previous capacity building exercises as applied on the Thukela, Komati, Letaba and Kromme Comprehensive Reserve studies have had limited success due to the lack of suitable trainees in a specialist field such as

Reserve determination. Another major factor limiting training is the length of projects. During the course of a 2 - 3 year project dedicated trainees usually accept other or new job offers that does not allow for the training to be completed. The Upper Vaal and Crocodile West Reserve training programmes will be integrated and linked to the PMT training framework and therefore will allow for a more detailed approach. A detailed training programme for mentors and trainees (DWAF trainees included) will be supplied as soon as the integrated programme has been finalised in late June 2007. It is planned that training will be structured in a range of set tasks according to a training strategy and a dedicated training task leader (Dr Patsy Scherman). The interim training project plan is described in Chapter 5.

2.3.8 Flow Management Plan and Capping Flows

The ToR recommends that for the highly modified Vaal River, a Flow Management Plan (FMP) be applied. The Flow Management Plan is a modification from the Building Block Methodology (BBM) and designed for use on the Sundays and Fish Rivers (Eastern Cape). The FMP approach is used specifically where a river has undergone structural changes due to a high degree of management and where the constraints or demands are such that reversal of these conditions is impractical. The Flow Management Plan has since then only been applied on the Vaal River during the late 1990s. Since this application, the BBM was modified into the Habitat Flow Stressor Response (HFSR) to accommodate the scenario approach and in effect therefore, the FMP.

2.3.9 Requirements of a Comprehensive Study

The scope of work follows where budget allows the requirements for a comprehensive Reserve assessment in terms of number of surveys, number of hydraulic calibrations and the level of EcoClassification. There are requirements however that cannot be accommodated due to cost constraints of the study. Key issues are listed below:

- Habitat Modelling at every suitable site.
- Sediment transport modelling at every suitable site.
- Riparian vegetation specialist present at site selection and at an additional survey.
- Fish and aquatic macroinvertebrate surveys at various points in the RU and not only at the EWR site.
- Sufficient liaison between the ecologists and the Goods and Services component.

2.3.10 Identification of EcoSpecs (Ecological RQOs), the monitoring programme and implementation strategy

Ecological RQOs: Objective the approach

The objective of this task (Task 13) is to determine the EcoSpecs (the ecological component of RQOs) for the recommended EC and link the ECs to TPCs (Thresholds of Probable Concern). EcoSpecs will be set for flow, quality, habitat and biota. The quality and flow EcoSpecs are dependent on a decision regarding an acceptable operational scenario as the Ecological Reserve. The habitat and biota EcoSpecs must be linked to the relevant category and will be quantified as far as possible.

Monitoring Programme

Draft documentation (Kleynhans & Louw, 2006) is available which describes the process of using the suite of EcoStatus models to generate the EcoSpecs and TPCs. These EcoSpecs and TPCs are then used for design of a monitoring programme. The Ecological Reserve Monitoring programme is described in Kleynhans & Louw, 2006 and is being refined as part of another RDM

funded study. It is therefore recommended that the Vaal EcoSpecs be used within the generic monitoring programme which will be finalised prior to the end of the Vaal study. The assessment undertaken as part of the Vaal study will also include an assessment regarding the adequacy of existing data for a baseline for monitoring and make recommendations of the additional data required to set a baseline. The criteria for assessing the adequacy of data are also described in Kleynhans & Louw, 2006.

Implementation Strategy

The implementation of the Ecological Reserve consists of both the physical implementation of the flow requirements, as well as the monitoring and management actions required if ecological objectives are not met. A present RDM study being undertaken by WFA is piloting the implementation of flows on four catchments as well as addressing the monitoring. Setting up the models for implementation should be a separate study as the cost would not fit into the existing available budgets without detracting seriously from all the other Reserve steps. The design of an implementation strategy regarding what the requirement is to ensure implementation of both the flows and the monitoring and the identification of all actions that would be required will be included in this task.

3 PROJECT PLAN

3.1 PROJECT PLAN

The project plan has been designed specific to the Upper Vaal Reserve Study (Figure 3.1). The blocks in blue in the figure indicate where input is required from other current Vaal studies and where it needs to link it to the Upper Vaal Reserve study.

The project plan consists of a range of tasks and subtasks listed below and detailed in Chapter 4.

TASK 1 - PROJECT MANAGEMENT
1.1 Internal technical team management and coordination
1.2 PMT Meetings (Progress meetings)
1.3 Liaison with other studies
1.4 Financial management
PHASE I: STUDY INITIATION AND DESIGN
TASK 2 - PROJECT PLANNING AND PROCESS INTEGRATION
2.1 Design of project plan and available current data collection
Inception Report
2.2 Mobilisation of study team
PHASE II: STUDY IMPLEMENTATION
TASK 3 - PES, EIS and SCI: QUATERNARY BASIS
3.1 Preparation
3.2 Reconnaissance assessment (includes prelim site selection)
3.3 Application of EcoStatus models (PES, EIS and SCI)
3.4 Database and Reporting
TASK 4 - LIMITED PUBLIC AWARENESS: ASSESSMENT
TASK 5 - BASIC HUMAN NEEDS RESERVE
TASK 6 - RESOURCE UNITS
6.1 Geomorphological zones
6.2 EcoRegions
6.3 System operation
6.4 Water quality sub-units
6.5 Groundwater sub-units
6.6 Identification of Resource Units
6.7 EWR site selection and dry season survey (10 sites)
A Prelim ID of sites
B Dry season survey Week 1
B Dry season survey Week 2
C Habitat modelling survey
6.8 RU Report
TASK 7 - WETLAND TYPING AND ECOCLASSIFICATION
7.1 Wetland inventory
7.2 Wetland classification
7.3 Determination of Reference conditions
7.4 General current ecological conditions
7.5 Identification of priority wetlands
7.6 Ecological Importance and Sensitivity
7.7 WHI assessment
7.8 Reporting

TASK 8 – COMPREHENSIVE RIVER ECOCLASSIFICATION
8.1 Suite of EcoStatus models
8.2 Index of Habitat Integrity
8.3 EcoStatus assessment
8.4 EcoClassification specialist meeting: Workshop
8.5 Reporting
TASK 9 - EWR SCENARIO ASSESSMENT
9.1 Hydraulic calibration and wet season site visit (10 sites)
A High flow calibration
B Hydraulic calibration
C Hydraulic calibration & field surveys
9.2 EcoHydraulic modelling and Sediment Transport Modelling
9.3 EcoHydrology analysis
9.4 Specialist meeting preparation
9.5 EWR scenario determination
A Workshop 1
B Workshop 2
9.6 Reporting
TASK 10 -SOCIO ECONOMIC PRESENT STATE EVALUATION
10.1 Identification of the sectors directly and indirectly using water from the Vaal River System
10.2 Determination of economic zones and current water allocation to each category of use
10.3 Determination of the appropriate valuation technique for each use category
10.4 Economic value of water use by each category
TASK 11: RAPID III - EXTRAPOLATION
Rapid data collation
TASK 12 - DETERMINING OPERATIONAL SCENARIOS AND CONSEQUENCES
12.1 Liaison: Yield modelling
12.2 Determining ecological consequences
12.3 Determining consequences on socio economics & Ecosystem services
A Change in value of the socio-economic activities for different EWR scenarios
Ecological input
B Changes in value of ecosystem services for different EWR scenarios
C Optimisation of the overall benefits from water re-allocation scenarios
12.4 Reporting
TASK 13 – IDENTIFICATION OF ECOSPECS (Ecological RQO's)
13.1 Identification of EcoSpecs
13.2 Reporting
PHASE III: STUDY TERMINATION
TASK 14 - STUDY TERMINATION
14.1 Preparation of final Reserve results
14.2 Training audit and report
14.3 Compilation of main report
TASK 15 CAPACITY BUILDING: TRAINING PROGRAMME
15.1 Design and application of training programme
15.2 Introductory EWR workshop
15.3 Individual training: Task 1 - Management
15.4 Individual training: Task 5 - BHNR
15.5 Task 6 - Field Survey: Resource Units
15.6 Individual training: Task 7 - Wetland
15.7 Individual training: Task 8
15.7.1 Hydrology + Hydraulics

15.7.2 Geomorphology
15.7.3 Macro Invertebrates
15.8 EcoClassification specialist workshop: Task 8
15.9 Field survey: Task 9
15.10 Technical EWR training workshop
15.11 EWR specialist workshop: Task 9
15.12 Individual training: Task 10 - Socio-economic study
15.13 Individual training: Task 12.1 - Operational scenarios
Task 12.2 - Socio-economic consequences
15.14 Training evaluation and reporting

The project plan is shown below in Figure 3.1.

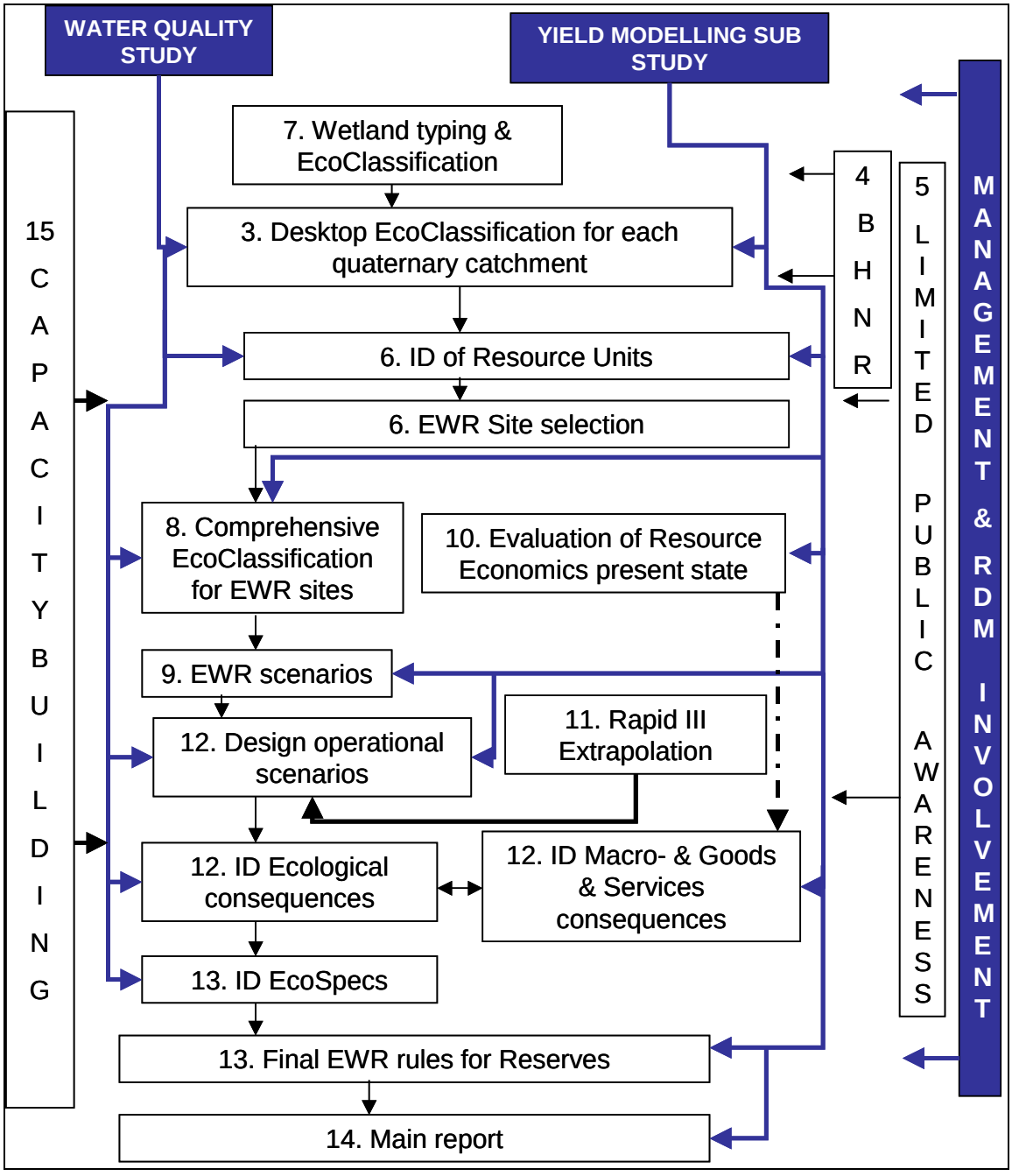

Figure 3.1 Project Plan for the Upper Vaal Reserve study

4 TASK STRUCTURE

This section of the Inception Report consists of detailed information per task. Task numbers in the text are aligned with those in the project scheduling (Chapter 7) and budget / cash flow (Appendix A and B). Tasks 1 and 2 present the management tasks to be undertaken during the study, with Tasks 3 - 14 presenting the technical and reporting tasks. Task 15 represents the training component which takes place during most of the tasks of the study. The following information is provided for each of the technical tasks and/or sub-tasks:

- Description.
- Task responsibility (i.e. consultant(s) undertaking the task).
- Information required (where relevant).
- Actions.
- Deliverables and milestones.
- Responsibility of the Consultant.

Note that the scope of work follows the requirements for a comprehensive Reserve assessment in terms of number of surveys, hydraulic calibrations, number of survey sites, etc. for 10 EWR sites.

4.1 TASK 1 PROJECT MANAGEMENT

Objective and approach

The objective of this task is to ensure effective, efficient and pro-active management. The aim is to ensure that a comprehensive technical document that details the results of a successful study process, be delivered on time, on budget and as per brief by ensuring general project management and administration, monitoring of progress, internal liaison within the team, liaison with the DWAF Study Manager, Ms Retha Stassen – who represents the CD: RDM, as well as report editing and review. This task includes all internal liaison required by the project including time spent on e-mail, the phone or at specific meetings with task leaders, specialists and the DWAF Study Manager.

This task requires a three-person team and the management structure required has been designed accordingly.

4.1.1 Task 1.1 Internal technical team management and co-ordination

Project administration will take place at two tiers. These are:

Overall project management

- D Louw – Technical management: Water for Africa (WFA)
- S Koekemoer – Administrative management: Koekemoer Aquatic Services (KAS)
- S Louw – Project administrator and general assistance: Water for Africa (WFA)

Task management

- Administrative manager – S Koekemoer
- Water Quantity team leader – D Louw
- Wetland team leader - M Rountree
- Basic Human Needs team leader – G Huggins
- Socio-economic team leader - T Tlou
- Training team leader – P-A Scherman

Task responsibility

Koekemoer S, Louw D

Trainee: Louw S

Actions

- Meetings between the project management and specialists to discuss the programme and integration between the tasks.
- Meetings with the client and programme managers to clarify scope and process.
- General administration.

Deliverables and milestones

- N/A.

Responsibility of the Consultant

- Sound administration and reporting.
- Reviewing all reports and ensuring milestones and deliverable dates are met.
- Providing the necessary training as outlined in Chapter 5.

4.1.2 Task 1.2 PMT Meetings (Progress meetings)

The proposal caters for 10 Project Management Team (PMT) meetings to be held every third month in Pretoria for the duration of the project. This allows for general liaison and meetings with CD: RDM (hereafter referred to as the Client). Formal reports, as per the format prescribed by the Client, will be submitted. Regular PMT meetings will allow for direct report-back and trouble-shooting with the project managers. Information included in the progress report will consist of:

- Activities undertaken during the period under review.
- Progress against that anticipated in the project plan and milestones.
- Expenditure against budget.
- Progress of capacity building trainees.
- Anticipated problems/savings.

The consultant would in most cases send one of two representatives to the meeting. These would either be Ms MD Louw or Ms S Koekemoer or both. The minutes of the meeting will be recorded and distributed to the Client by the consultant.

Task responsibility
Koekemoer S, Louw D
Trainee: Louw S

Information required

- Information on how the combined progress meetings with the Middle and Lower Vaal will function and the responsibilities regarding agenda, minutes and coordination.

Actions

- Preparation of progress report.
- Attendance and participation of 10 PMT meetings.
- Producing minutes of the meeting and distribution thereof.

Deliverables and milestones

- Progress report.
- PMT meetings are shown in the project scheduling (Chapter 7).

Responsibility of the Consultant

- Ensuring attendance of appropriate technical team members at PMT meetings.
- Production and circulation of the minutes.
- Providing the necessary training as outlined in Chapter 5.

The budget does not allow for:

- The attendance of more than ten PMT meetings.

4.1.3 Task 1.3 Liaison with other sub-studies

The successful outcome of this project is dependent on close liaison with the Middle and Lower Vaal, water quality, groundwater, and yield planning PSPs to ensure effective interaction and integration of information between key components of the different studies.

Task responsibility
Koekemoer S

Information required

- Project timing and scheduling of other studies (Water quality, Groundwater and Yield planning).
- Programme and timing of information needed by KAS and WFA, to be provided to other PSPs regarding the Upper Vaal Reserve study.

Actions

- Liaison between the Client and project management teams and specialists of other related studies to discuss the programme and integration of information needed to complete tasks.
- General administration.

Deliverables and milestones

- Incorporated in progress reporting and on-going liaison and communication with Project Management PSP and CD: RDM.

Responsibility of the Consultant

- Liaising and obtaining relevant information from the Client or relevant PSPs with regard to water quality, groundwater and yield planning.
- Reporting progress and identifying problems at PMT meetings.
- Forwarding of information that may be needed by relevant PSPs.

The budget does not allow for:

- Adjusting the Upper Vaal Reserve project plan and rescheduling if any problems occur with information to be provided by Golder and WRP.

4.1.4 Task 1.4 Financial management

Financial management consists of the management of the technical project budget so as to ensure that the budget is not exceeded and that cash flow predictions are met. Financial management will include:

- Monthly invoicing.
- Invoices will be submitted on a monthly basis. Invoices will be detailed to outline expenditure by person and per task and by disbursement per task.

- Budget management.
- Budget management is critical to ensure that the specialists remain within specified limits. This will consist of monitoring budgets against briefs submitted to specialists.
- Cash flow projections.
- Cash flow projections will be allied to the budget management process and will be set against expenditure, expected expenditure and the budget. The cash flow (projected and actual) will be supplied in the progress reports.

Task responsibility
Koekemoer S, Louw D
Trainee: Louw S

Actions
- General financial management.

Deliverables and milestones
- Production of invoice and appropriate financial reporting for the progress report.

Responsibility of the Consultant
- Ensuring the appropriate high standard of financial accountability and that the invoice format is according to the criteria laid down by the SARS.
- Providing the necessary training as outlined in Chapter 5.

PHASE 1: STUDY INITIATION AND DESIGN

4.2 TASK 2 PROJECT PLANNING AND PROCESS INTEGRATION

Objective and approach
The objective of the project planning and process integration task is to produce a concise, clear and unambiguous Inception Report. This is required to ensure the Client, programme manager and consultants are clear as to the deliverables, timing and budget of the programme.

4.2.1 Task 2.1 Design of project plan and available current data collection

Meetings will be held between the task leaders to discuss the programme and integration between the tasks as well as with the Client and programme managers to clarify scope and process. The project plan incorporates aspects relating to the sourcing of additional information, data in gap areas and assessments of previous studies (Task 2.3 in proposal) during the implementation phase.

Task responsibility
Louw D, Birkhead, Huggins, Hughes, Koekemoer S, Rountree, Scherman, Tlou
Trainee: Louw S

Information required
- ToR, proposals and all subsequent agreements.

Actions

- Meeting with the Client and Project Managers to clarify scope and process: held on 20 February 2007.
- Task leaders to develop project plan (March 2007).
- Production of Inception Report.

Deliverables and milestones

- Draft of Inception Report (16 April 2007).

Responsibility of the Consultant

- Ensuring that agreements reached during negotiations are incorporated in the Inception Report and conveyed to the rest of the team.
- Providing the necessary training as outlined in Chapter 5.

The budget does not allow for:

More than two rounds of comments. Detail regarding comments is covered in Section 10.1.

4.2.2 Task 2.2 Mobilisation of study team

To ensure that the team is fully briefed on their responsibilities this task will include:

- Team briefs will be designed for all team leaders and specialists responsible for deliverables. Team leaders will be responsible for allocating sub-briefs to their team.
- Briefs will be issued with attached budgets. These will clearly stipulate the hours allocated for each sub-task.
- Contracts will be drawn up for sub-consultants who have not had a previous association with KAS or WFA. These will be based on contracts for previous Reserve studies.

Task responsibility

Koekemoer S, Louw D

Trainee: Louw S

Information required

- Accepted Inception report and budget.

Actions

- Analysis of Inception Report and detailed work breakdown.
- Production of task briefs and individualised budgets.
- Production of contracts and ToR for sub-consultants.

Deliverables and milestones

- Contracts and ToR for sub-consultants (May 2007).

Responsibility of the Consultant

- Appoint the sub-consultants as approved by the DWAF. Note however that the consultant cannot be held responsible if indicated specialists resign of leave their work – however it is the responsibility of the consultant to find suitable replacements. The consultant will also not accept any replacement of specialists provided by the company which team members belonged to. Any replacements must be agreed on by the Consultant and the Client.
- Providing the necessary training as outlined in Chapter 5.

PHASE 2: STUDY IMPLEMENTATION

4.3 TASK 3: DESKTOP ECOCLASSIFICATION (QUATERNARY SCALE)

Objective and approach

This task serves as a scoping phase to investigate the WMA at a desktop level and at the scale of quaternary catchments and serves as the basis for most of the other tasks. A comprehensive assessment at Level 4 (Kleynhans *et al.,* 2005) is followed for each of the RUs with study sites (EWR sites) and is detailed in Task 9. This scoping assessment provides an overview of the WMA and a better understanding when focussing on the EWR sites and the sections of rivers where comprehensive assessments will be undertaken. The output of the information also identifies areas of potential concern based on an integrated importance (combination of EIS, SCI and PES).

The methods followed are those detailed in Kleynhans *et al.,* 2007 (in press) and will consist of a compilation of all available data, a reconnaissance survey and populating existing models developed by the Directorate: Resource Quality Services (D: RQS) for the main rivers in each quaternary catchment. The reconnaissance survey also aids in a preliminary identification of potential Ecological Water Requirement (EWR) sites.

EcoClassification (Kleynhans *et al.,* 2007) - the term used for Ecological Classification - refers to the determination and categorisation of the Present Ecological State (PES; health or integrity) of various biophysical attributes of rivers compared to the natural or close to natural reference condition. The purpose of EcoClassification is to gain insights into the causes and sources of the deviation of the PES of biophysical attributes from the reference condition. This provides the information needed to derive desirable and attainable future ecological objectives for the river. The state of the river is measured in terms of Ecological Categories (A to F).

The EcoClassification process also includes an assessment of Ecological Importance and Sensitivity (EIS) and Socio-Cultural Importance (SCI). These are measured in terms of Low to Very High (EIS) and Minimal to Very High (SCI). All assessments include a confidence assessment using a rating of 1 (low confidence) to 5 (high confidence).

4.3.1 Task 3.1 Preparation

All information required for the application of this task will be obtained. This includes amongst others land cover, photos, video material, Google Earth data, hydrology, system operation and fish reference conditions at the National River Health sites.

Task responsibility

Louw D, Huggins

Information required

- Land cover from D: RQS, DWAF.
- Helicopter flight video (potentially from D: RQS, DWAF).
- Readily available background information on the operation of the Upper Vaal. (May 2007).
- Information on important wetlands in the catchment (15 June 2007).

Actions

- Obtain data from various sources.

- Make the required logistical arrangements.

Deliverables and milestones

- No specific deliverable. All information collated and arrangements are to be made by 20 June 2007.

Responsibility of the Consultant

- Obtaining all readily available material.
- The Consultant is not responsible for:
- Flying the river or obtaining land cover data if it is necessary to buy it.

4.3.2 Task 3.2 Reconnaissance Assessment

The EcoStatus modeller, an ecological specialist with local knowledge, the Socio-Cultural Importance specialist and the hydraulician will undertake a site visit. The objective of the hydraulician is to select potential EWR sites for use later in the study. Representatives from D: RQS will be involved in this task for input regarding potential EWR sites.

Task responsibility

Louw D, Birkhead, Huggins, Kotze

Information required

- All information collated in Task 3.1.
- 1999 quaternary assessment for EIS.
- Quick Habitat Integrity model set up for each catchment.

Actions

- Reconnaissance site visit (10 – 15 June 2007).

Deliverables and milestones

- Each site visited will be photographed and the photos will be available as part of the electronic database.

Responsibility of the Consultant

- Visiting as many of the quaternary catchments in the WMA as possible.
- The consultant is not responsible for:
- Visiting all the quaternary catchments and/or any quaternary catchments in areas potentially dangerous.

4.3.3 Task 3.3 Application of EcoStatus models (PES, EIS and SCI)

The Desktop EcoStatus model (which includes the Quick Habitat Integrity) will be applied and populated during Task 3.3 and an analysis of the results will be done according to the present standard as applied on the Olifants and Komati Water Management Areas (Louw & Singh, 2006) as well as the Maputo River system (Louw & Huggins, 2007). The application of the Desktop EcoClassification will allow for comparison with stressed (from a water resources point of view) areas and indicate the important reaches that need to be studied.

Task responsibility

Louw D, Huggins, Kotze

Information required

- All information collated during the site visit.

Actions

- Populating the EcoStatus models.

Deliverables and milestones

- Desktop EcoStatus assessment of EIS, PES and SCI available for each quaternary catchment.

Responsibility of the Consultant

- Evaluation of the EcoStatus at the Desktop level only.

4.3.4 Task 3.4 Database and Reporting

The report will provide a summary of all the results, the integration, conclusions and recommendations. The models will be supplied electronically. The report will be produced according to the required standards.

Task responsibility

Louw D, Engelbrecht, Huggins

Information required

- Resource stress assessment on a scale of 0 – 5 (5 June 2007).
- All information generated during previous tasks.

Actions

- Organising the database.
- Documenting the results.

Deliverables and milestones

- First draft report (August 2007).

Responsibility of the Consultant

- Documenting the results.
- Incorporating two rounds of comments as detailed in Section 10.1.

The budget does not include:

- Not meeting the deadline if information on resource stress is not available on time from WRP.
- Documenting the methods in detail and providing a manual.

4.4 TASK 4: LIMITED PUBLIC AWARENESS ASSESSMENT

Objective and approach

A Public Awareness Programme will be undertaken. This will be limited to the production of two newsletters. The first will make the public aware of the study at the outset and the second will make known the preliminary results. The newsletter will be posted to all water users currently registered on the DWAF database. A limited number will also be distributed to key Non

Governmental Organizations (NGOs) and environmental lobby groups in the area. Local Municipalities will be informed of the study and if they request copies of newsletters to be distributed to their constituency, then these will be made available.

It must be noted however that the client has requested that the above approach could be substituted by presentation rather at specific public/forum meetings. This would be done in addition if required by the CD: RDM of the above approach and within the same budget.

Task responsibility

Huggins

Information required

- General information from project leader describing the project and its objectives as well as preliminary results.
- Database of relevant stakeholders.

Actions

- Two newsletters will be produced that explain the project, its objectives and preliminary results in a manner that is understandable to the stakeholders. These will then be distributed.

Deliverables and milestones

- Production and distribution of two newsletters.

Responsibility of the Consultant

- Provide support and input in this task according to the direction provided by the Client.

The budget does not include:

- Any other form of public participation activities.

4.5 TASK 5: BASIC HUMAN NEEDS RESERVE (BHNR)

Objective and approach

The BHNR, for the Upper Vaal Comprehensive Reserve Determination Study, will be generated following a number of steps. The first of these steps will be to use demographic data supplied by the Water Services, DWAF (or other appropriate sources) as a basis for analysis. Data would be acquired by the PSP from an appropriate source agreed upon with the PMT. The ward or sub-place name data available for the Census 2001 will be compared to the DWAF data and the most recent/accurate set will be used.

The data for the purposes of this study will then be further broken down to reflect the likely direct users of the surface water resources of the catchments. This will involve demarcating a 5km buffer zone on either side of the rivers and major tributaries. This buffer zone will then be used to estimate the numbers of people who would be likely to be reliant on the flow in the relevant river reach. It will be assumed that people outside of this area, although they might be making use of water from the rivers via a formal urban supply or a community water supply scheme, would in the main be using springs, minor streams or groundwater.

The data will further be analysed to estimate the population above and below the EWR sites identified for the study. This gives an indication of the amount of water that would need to pass certain EWR sites in order to meet the needs downstream. This would be fed into the yield planning. Should any of the information appear to be problematic, based on local knowledge of the catchment, then a groundtruthing exercise will be undertaken. A report that gives the quantity of water required for the Basic Human Needs Reserve will be produced. The report will be produced according to the required standards.

Task responsibility

Huggins
Trainee: Maasdorp

Information required

- Demography of the area.
- Location of EWR sites.

Actions

- Analysis of demographic data to generate BHNR model and dis-aggregation of model to reflect location of EWR sites.

Deliverables and milestones

- BHNR assessment and report (August and October 2007).

Responsibility of the Consultant

- Obtaining all relevant demographic data.
- Providing the necessary training as outlined in Section 5.
- Document the results and incorporating two rounds of comments as detailed in Section 10.1.

The budget does not allow for:

- Groundtruthing data as a validity check.

4.6 TASK 6 RESOURCE UNITS

Objective and approach

The purpose of this task is to define the study area for the comprehensive assessment and to delineate key rivers of the study area into RUs. Each RU represents a homogenous area which requires its own specification of the Reserve. The process followed will be that described in the updated Reserve manuals (Louw and Hughes, 2002). The individual tools and methods used to derive the RUs are described in the sub-tasks below. The focus of the study area will be the Vaal River and significant tributaries within WMA 8. Cognisance will be taken of the National River Health Programme sites as well as any relevant previous EWR studies.

4.6.1 Task 6.1 Geomorphological zones

Geomorphology provides a basis of classification for the purpose of describing the physical habitat of riparian and aquatic ecosystems, as it encompasses the physical processes which have shaped the river channel. The hierarchical classification approach of Rowntree and Wadeson (1999) will be followed. The information is available from D: RQS for South Africa and the Consultant has the information available on Geographical Information System (GIS).

4.6.2 Task 6.2 EcoRegions

EcoRegional classification allows for the grouping of rivers according to similarities. The method is based on a top-down approach as developed by DWAF (Kleynhans *et al*., 2004). The existing delineation into Level II EcoRegions is required and the results are available. The information is available from D: RQS for South Africa and the Consultant has the information available on GIS.

4.6.3 Task 6.3 System operation

An overview of system management is required to ensure an understanding of the system operation and to interpret biological responses. System operation infrastructure is also often the logical endpoint of a RU. A description on the present operation which includes present uses, abstractions, curtailments etc., and operational structures if any, within the system must be available to the specialist team. An understandable summarised description will be expected from WRP Consulting Engineers (WRP).

Task responsibility
WRP Consulting Engineers, D Louw

Actions
- Provide deadline and programme to WRP.
- Obtain information from WRP.

Deliverables and milestones
- WRP to provide data to KAS-WFA (Early August 2007).

Responsibility of the Consultant
- Informing WRP of the programme and requesting the information from them.
- The budget does not accommodate any delay in the work if this information is not available on time.

4.6.4 Task 6.4 Water quality sub-units

The objective of this task is to identify river reaches homogenous in terms of water quality, and to select the water quality variables to be evaluated. It is anticipated that water quality sub-units will exist within the RUs, but that additional areas, e.g. tributaries outside the comprehensive study area, will be assessed as refugia or hot spots where necessary. The water quality PSP (Golder Associates Africa (Golder)) will need to provide this information as a chapter in the RU report and on maps.

Task responsibility
Golder, D Louw

Deliverables and milestones
- Water quality sub-units on maps and a chapter contribution to the RU report (August 2007).

Responsibility of the Consultant
- The Consultant is only responsible for informing Golder of the programme and requesting the information from them.

- The budget does not accommodate any delay in the work if this information is not available on time.

4.6.5 Task 6.5 Groundwater sub-units

This information is to be supplied by the Groundwater PSP if available within the programme for this task.

4.6.6 Task 6.6 Identification of Resource Units

Using information generated during Task 6.1 to 6.6, as well as local knowledge, motivated RUs will be supplied and illustrated using GIS mapping. Consideration of wetland localities (see Task 7) will also be included during RU identification.

Task responsibility

Koekemoer S, Louw D

Information required

- All information collated in Task 6.1 to 6.6.
- Information on wetlands from Task 7.
- Relevant shape files for GIS presentation.
- Landcover maps from D: RQS.
- 1:50 000 topographical maps and aerial photography.

Actions

- Produce the maps and motivations.

Deliverables and milestones

- RUs available by August 2007.

Responsibility of the Consultant

- Ensuring that draft RUs are available prior to the EWR site selection.

The budget does not include:

- Geomorphological zonation to a finer level than zones.
- Any process descriptions or EcoRegional descriptions apart from that readily available from D: RQS.
- The provision of EWR sites for each RU.

4.6.7 Task 6.7 EWR site selection

EWR (quantity) sites are set at specific points on the river. These points are critical sites within a reach of river. The EWR sites must provide sufficient indicators for specialists to attach environmental flows to. The criteria for site selection as detailed in the BBM manual and DWAF (1999b) will be followed.

The ToR recommends the use of 36 EWR sites. It is however not possible, cost-effective or necessary to address that many sites at a comprehensive level. Information collated (Task 3 and 6) will indicate the key RUs for EWR site selection to be addressed at comprehensive level. Additional assessments at RUs which have no EWR sites can be addressed at a Rapid I level. It is

also possible that during the next two years, the extrapolation/estimation process will be at the stage where it can be applied using Rapid data. The budget is based on 10 EWR sites to be addressed at comprehensive level. The key EWR specialists will select sites and the first dry season survey and hydraulic calibration will be undertaken simultaneously. The Upper Vaal project team and the management Consultant should liaise with the Regions regarding input and agreement must be reached prior to the final site selection of the general locality of EWR sites.

Cross-sectional surveys to the required hydraulic standards (updated Reserve methods, Louw and Hughes, 2002 as well as DWAF, 1999 and the BBM manual, King and Louw, 1998) will also be undertaken as well as the required photopoint monitoring. Sites where two-dimensional hydraulic modelling will be undertaken will require a Digital Terrain Model (DTM). This will be undertaken at a maximum of 3 sites, depending on site characteristics. For these sites, the two-dimensional hydraulic/habitat modelling must be cost effective, i.e. the additional information and increase in confidence must warrant the additional resources required (DTM survey, hydraulic and habitat related data collection, two-dimensional hydraulic modelling).

Task responsibility

Louw D, Birkhead, Koekemoer J, Kotze, Palmer, Rountree
Trainees: Desai, Hlongwane

Information required

- Draft RUs.
- Important areas identified for detailed assessment (Task 3).
- Previous Reserve studies conducted in WMA 8 available from CD: RDM.

Actions

- Two site visits of 5 days each (August and September 2007).

Deliverables and milestones

- EWR sites and localities available (September 2007).
- EWR site selection section in the Resource Unit report (November 2007).

Responsibility of the Consultant

- Coordinating the EWR site visit.
- Selecting the most suitable EWR sites according to the site selection criteria and within constraints such as access and safety.
- Ensuring that all necessary equipment is available during the site visit.
- Providing the necessary training as outlined in Section 5.

The budget does not include:

- The selection of more than 10 comprehensive EWR sites.
- Additional site visits if adverse weather conditions occur or benchmarks are removed.
- An EWR site to be situated in each RU.
- Making arrangements, booking or paying for any non-team members that are participating.

4.6.8 Task 6.8 RU report

The final Resource Units, which represent homogenous stretches of river, will be produced. The report will be produced according to the required standards.

Task responsibility

Louw D, Engelbrecht, Koekemoer S, Louw S

Information required

- All the information produced in the previous tasks.

Actions

- Documenting and mapping of the results.

Deliverables and milestones

- RU report, which includes all the information, generated during the sub-tasks, as well as the final RUs (November 2007).

Responsibility of the Consultant

- Providing and documenting motivated RUs in the RU report.
- Supplying the report and including two rounds of comments as detailed in Section 10.1.

4.7 TASK 7: WETLAND TYPING AND ECOCLASSIFICATION

Objective and approach

Whilst the methods for the determination of reserves for riverine systems are well developed, those for wetland systems are poorly developed. DWAF had issued some guidelines for procedures for Reserve determination (DWAF, 1999b), but these guidelines do not detail any methods for the actual determination of scores or water volumes for wetland systems.

Due to the absence of any rigorous methods, the following procedure (adapted partially from the river and estuary Reserve procedures) is to be adopted to guide this study; namely:

- To develop an inventory of wetlands within the study area (mapped at the 1:50 000 or (preferentially) 1:10 000 scale).
- To classify the identified wetlands according to the HydroGeomorphic wetland classification system, this has been proposed as the wetland classification system for South Africa.
- To determine the general reference conditions of the wetlands in the catchment.
- To determine the general current ecological condition of the wetland types identified.
- To identify priority wetlands in the study area (based on size and/or ecological; social and/or economic criteria).
- To determine Ecological Integrity and Sensitivity (EIS) Categories for these priority systems.
- To undertake a Wetland Habitat Integrity (PES) assessment of a maximum of two of the high priority floodplain or channelled valley bottom wetlands identified in Task 6, and
- to compile a report detailing the outcomes and results from the above tasks.

Rapid Reserve methods for wetlands are currently under development. If these wetland Reserve methods are available at the time of the field visit, they may be tested on the priority wetland systems. However the funding for testing the Rapid wetland Reserve methods will be sourced externally from this budget.

As the first step in managing wetlands in the Upper Vaal WMA, it is necessary to know where the wetlands are located. Although the South African National Biodiversity Institute (SANBI) has recently produced a wetlands map of South Africa, a preliminary assessment of that data seems to indicate that a number of significant floodplain wetland systems present in the Upper Vaal WMA

are not yet incorporated into that dataset. Based on the present available information the localities of wetlands within the study area are unsure. It is thus proposed, as an initial step in managing the wetlands within this catchment area more effectively, that a wetlands inventory of the catchment area be undertaken.

Due to the lack of available methods; the expected large number of wetlands/pans in the catchment; and the limitations of the available budget, a desktop approach is proposed to generate information on the location, types and conditions of wetlands within the study area. CD: RDM and regional personnel will be consulted during this task for input and guidance.

The following sub-tasks are proposed below to meet the above objective.

4.7.1 Task 7.1 Wetlands inventory

Existing databases of national and/or municipal wetlands coverage will be used to assess the extent of wetland areas in the catchments. This will provide a broad overview of the number of wetlands within the area. Where available, such data will be supplemented by existing wetlands information and coverages. Additional information obtainable from 1:50 000 topographic maps, and/or 1:10 000 imagery, will be undertaken to improve the generally available wetlands information for the study areas. The output will be a broad overview of the number of wetlands within the area.

Task responsibility

Rountree

Trainee: Maphumulo

Information required

- SANBI Wetlands Map (available).
- SANBI Wetlands Probability Layer (DWAF to source).
- 1:50 000 topographic maps (available).
- 1:10 000 orthomaps, if readily available from CD: RDM.

Actions

- Desktop mapping of the wetlands within the study area.

Deliverables and milestones

- A GIS shapefile/layer of the wetlands in the Upper Vaal Water Management Area (May 2007).

Responsibility of the Consultant

- Identification of the large wetland systems; focussing specifically on riverine-associated wetlands.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- Identifying all wetlands within the Upper Vaal WMA.

4.7.2 Task 7.2 Wetland classification

The HydroGeomorphic (HGM) wetland classification will then be applied to the identified wetlands. This functional-based classification system for wetland systems (Brinson, 1993) has been adapted for South African Palustrine wetland systems (Marneweck, and Batchelor, 2002; Kotze *et al*., 2005; Ewart-Smith *et al*., 2006). Linking wetland assessments with the HGM classification will improve the decision-making abilities of the authorizing agencies, since the HGM classification provides a good initial understanding of the wetland system's functional attributes. Detailed wetland functional assessments are conducted using the HGM approach both in South Africa (Kotze *et al*., 2005) and internationally, (Smith *et al*., 1995 and Johnson, 2005). The USA Environmental Protection Agency (EPA) has gone so far as to issue instructions to all Federal agencies to initiate a National Action Plan to implement the HGM approach for assessing wetland functions (http://www.epa.gov/owow/wetlands/science). Providing local authorities with an understanding of the HGM wetland types would thus be in line with national and international trends. The HGM approach has recently been proposed as the basis of inland wetland classifications in South Africa (Ewart-Smith *et al*., 2006).

A larger (regional) scale of classification will be investigated in an effort to delineate wetland Resource Units within the catchment; most likely following geological boundaries nested within an EcoRegion classification approach.

The deliverable from this task will be a map of the study area, showing wetland presence and types; and nesting of these within geological and/or EcoRegional classifications to derive the wetland Resource Units.

Task responsibility

Rountree

Trainee: Maphumulo

Information required

- Wetland layer from Task 7.1.

Actions

- Delineate and classify identified wetlands in the study area.

Deliverables and milestones

- Classified layer of wetlands according to the HGM classification system (June 2007).

Responsibility of the Consultant

- Desktop delineation of the large wetland systems identified in Task 7.1.
- Classifying the wetlands, using the HGM wetland classification system as proposed by the WRC.
- Providing the necessary training as outlined in Chapter 5.

4.7.3 Task 7.3 Determination of general Reference Conditions

Expert knowledge, experience and research will be relied upon to identity the Reference conditions of the various HGM wetland types identified. This component of the study will be conducted at the desktop level using remotely sensed imagery. The general reference conditions of the wetland

types in the study area will be described, either by type or by the types within EcoRegions. This will be a desktop exercise using available imagery.

Task responsibility

Rountree

Trainee: Maphumulo

Information required

- Wetland layer from Task 7.2 (wetlands classified according to their HGM characteristics).

Actions

- Describe the general reference conditions of the wetland types in the Upper Vaal WMA.

Deliverables and milestones

- Reference condition descriptions of the wetland types within the Upper Vaal WMA (July 2007).

Responsibility of the Consultant

- Describing general reference conditions of the various wetland types in the study area.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- Describing the reference condition of every wetland identified or of every wetland in the Upper Vaal WMA.

4.7.4 Task 7.4 General Current Ecological Condition

Due to budgetary and logistical constraints, PES of each wetland system will not be possible to determine. However, general assessments of the overall condition of the different HGM wetland types within the catchment will be assessed, and statements of the impacts and threats acting upon the wetlands will be described.

Although most of the study will be conducted at a desktop level, more detailed field assessments of two priority floodplain or channelled valley bottom systems will be undertaken using the D: RQS Wetland Habitat integrity (Wetland IHI or WHI) tool.

Task responsibility

Rountree

Trainee: Maphumulo

Information required

- Wetland layer from Task 7.2 (wetlands classified according to their HGM characteristics) and the general reference conditions of the various wetland types (from Task 7.3).

Actions

- Description of the general current ecological conditions of the wetland types in the Upper Vaal WMA.

Deliverables and milestones

- Current ecological condition descriptions of the wetland types within the Upper Vaal WMA (July 2007).

Responsibility of the Consultant

- Description of the general current ecological conditions of the wetland types in the study area. Assessing general assessments of the overall condition of the different HGM wetland types and describing the impacts and threats acting upon the wetlands.
- Providing the necessary training as outlined in Section 5.

The budget does not include:

- Determining the PES of each wetland system.

4.7.5 Task 7.5 Identification of Priority Wetlands

Priority wetlands within the study areas will be identified using various criteria (such as size and/or ecological; social and/or economic criteria). A screening approach being developed as part of the WRC National Wetlands Research Programme (Phase I) is to be employed in this task. The priority wetlands will provide guidance for the focus of the field (EIS and Wetland Habitat Integrity (WHI) assessment) component of the study. Officials from Regional offices will be consulted regarding license applications, proposed developments or other impacts during wetland prioritization.

Task responsibility

Rountree

Trainee: Maphumulo

Information required

- Wetland layer from Task 7.2 (wetlands classified according to their HGM characteristics) and the general reference conditions and current ecological condition of the various wetland types (from Tasks 7.3 and 7.4).

Actions

- A list of high priority wetlands within the study area, based on size or other importance criteria.

Deliverables and milestones

- A list of prioritised wetlands; with the motivation for prioritisation (August 2007).

Responsibility of the Consultant

- Generating a list of high priority wetlands within the study area.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- Any wetland Reserve determinations.

4.7.6 Task 7.6 Ecological Importance and Sensitivity

For a maximum of three priority wetland systems, the EIS will be assessed. At present, new Rapid Reserve methods for wetlands are under development and, should draft versions of these tools

become available, they will be employed here. Failing that, EIS criteria used in previous wetland studies will be used to assess the EIS of the priority wetlands.

Task responsibility

Rountree

Trainee: Maphumulo

Information required

- Wetland layer from Task 7.2 (wetlands classified according to their HGM characteristics); the general reference conditions of the various wetland types (from Task 7.3) and the prioritised wetlands identified under Task 7.5.

Actions

- Describe the general EIS of selected wetlands of the Upper Vaal WMA.

Deliverables and milestones

- EIS descriptions of selected wetlands within the Upper Vaal WMA (August 2007).

Responsibility of the Consultant

- Description of the EIS of selected prioritised wetlands in the study area.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- A description of the EIS of every wetland identified; or of every wetland in the Upper Vaal WMA.

4.7.7 Task 7.7 WHI assessment of top priority floodplain wetland/s

A rapid assessment tool was recently developed by D: RQS for assessing the habitat integrity of floodplain (and channelled valley bottom) wetland systems. It is proposed to apply this assessment tool (the WHI Index) to the anticipated high priority floodplain wetlands that are identified in the above tasks.

Task responsibility

Rountree

Information required

- Outputs from Tasks 7.5 and 7.6.

Actions

- WHI (field) assessment of a maximum of two of the high priority floodplain/valley bottom wetland systems within the Upper Vaal WMA.

Deliverables and milestones

- PES scores of a maximum of two of the high priority floodplain/valley bottom wetland systems within the Upper Vaal WMA (October 2007).

Responsibility of the Consultant

- PES scores; derived from the application of the D: RQS WHI Index, for a maximum of two of the high priority floodplain or channelled valley bottom wetlands identified in the Upper Vaal WMA.

4.7.8 Task 7.8 Reporting

A report detailing the results and outcomes from the above-mentioned tasks will be compiled to document all the results from the Wetland Assessment of the Upper Vaal WMA. In addition, feedback and input into other related tasks (such as RUs and EcoClassification) will be provided. The report will be produced according to the required standards.

Task responsibility

Rountree

Information required

- Report, as well as data/information inputs into related tasks.

Actions

- Report compilation.

Deliverables and milestones

- Final Wetlands Report for the Upper Vaal WMA (January 2008).

Responsibility of the Consultant

- Documenting the results and incorporating two rounds of comments as outlined in Section 10.1.

4.8 TASK 8 COMPREHENSIVE RIVER ECOCLASSIFICATION

Objective and approach

The EcoClassification methods as described in Kleynhans *et al*., 2007 will be followed. The approach would be at Level 4 and will be undertaken for the RUs where EWR sites are selected. The EcoClassification approach includes determining the EIS, the SCI, PES and the Recommended Ecological Category (REC). The EcoClassification process will also include predicting Ecological Categories linked to flow scenarios as well as for setting Ecological Specification (EcoSpecs) as part of RQOs.

This PES phase of EcoClassification aims to obtain sufficient information to supply a PES for each component and EcoStatus for each RU represented by an EWR site. All relevant existing information will be sourced, and the required surveys will be undertaken (Task 6.8 and 9.1). The surveys will take place at the EWR sites as well as at additional points in the RU according to requirements set by D: RQS (if time allows). The frequency of surveys for geomorphology and riparian vegetation will be only once during the appropriate season. Fish and macroinvertebrate surveys in some areas, depending on sensitivity and type of assemblage, might require two surveys, one during the dry season, and one post-wet season.

The analysis of all the data collated will consist of individual indices and the PES categories for each component. The information will be documented in the required format. The rule-based models (HAI, PAI, GAI, VEGRAI, FRAI, and MIRAI), developed as part of the EcoClassification

system by D: RQS (Kleynhans *et al*., 2005) will be used to determine the PES for each of the components.

4.8.1 Task 8.1 Suite of EcoStatus models

A Hydrological Driver Assessment Index (HAI)

Hydrological information will be sourced from the WRP as natural and present day monthly data as well as any other relevant data must be supplied by the yield planning PSP. The HAI will be populated and the information provided to the other specialists to derive the responses.

Task responsibility

Hughes
Trainee: Haasbroek

Information required

- Monthly virgin and present hydrological data for each EWR site as well as any other hydrological data required. (To be supplied by WRP by November 2007).

Actions

- HAI model to be populated.

Deliverables and milestones

- PES for hydrology available for each EWR site (February 2008).
- Specialist appendix (March 2008).

Responsibility of the Consultant

- Using the hydrology to populate the appropriate level EcoStatus model within the EcoClassification process and documenting the results.
- Providing the necessary training as outlined in Section 5.

The budget does not include:

- Undertaking any hydrological modelling.
- Explaining the methods and models in documentation for this project.

B Physico Chemical Driver Assessment Index (PAI)

Golder must provide the necessary information according to Kleynhans *et al*., 2005 in the required format.

Task responsibility

Golder, Louw

Deliverables and milestones

- PAI results provided by Golder (February 2008).
- (Require information from the diatom assessment - December 2007).

Responsibility of the Consultant

- Providing the diatom assessment as well as any macroinvertebrate and fish information required.
- Informing Golder of the programme and requesting the information from Golder.

The budget does not include:

- Changes in programme if there are any delays in Golder's input.

C Geomorphological Driver Assessment Index (GAI)

Information will be collated during the site visits to undertake the specialist Level 4 GAI assessment, and possibly to undertake sediment transport modelling at selected important sites to refine the flood requirements in the WMA. Reference conditions and GAI model (PES) results will be generated, and an assessment of reasons for change from reference conditions will be provided.

Task responsibility

Rountree

Trainee: Hlongwane

Information required

- Selection of field (EWR) sites.
- Aerial photographic record of the sites.
- Cross-section and rating curve.
- Hydrology information (daily flows).
- Hydraulic parameters for various flows.
- Sediment information from the sites.

Actions

- Assessment of the Reference State of the EWR sites.
- Population of GAI model.

Deliverables and milestones

- Reference condition descriptions of the EWR sites.
- PES for geomorphology available for each EWR site (March 2008).
- Specialist appendix (March 2008).

Responsibility of the Consultant

The consultant will:

- Source the historical aerial photographs and undertake the Reference State assessment using the historical aerial photographic record as well as other sources of available information.
- Populate the appropriate level EcoStatus model within the EcoClassification process, documenting the results and providing the models as an electronic report.
- Provide the necessary training as outlined in Section 5.

D Fish Response Assessment Index (FRAI)

Information will be collated during the site visits to undertake the FRAI assessment for each EWR site. The modelled results and an assessment of reasons for change from reference conditions will be provided.

Task responsibility

Koekemoer J, Kotze

Information required

- Reference conditions established at all National River Health Programme sites as well as any additional sites in the WMA.
- FRAI model and updated FRAI manual.
- HAI, PAI, GAI and VEGRAI results.

Actions

- Additional fish survey during the post-wet hydraulic calibration (Task 9.1).
- Populating the FRAI model.

Deliverables and milestones

- Fish reference conditions and PES for each EWR site (June 2008).
- Specialist appendix (June 2008).

Responsibility of the Consultant

- Populating the appropriate level EcoStatus model within the EcoClassification process for each EWR site.
- Documenting the results and providing the models as an electronic report.

The budget does not include:

- An explanation of the methods and models in documentation for this project.

E Macroinvertebrate Response Assessment Index (MIRAI)

Information will be collated during the site visits to undertake the MIRAI assessment. The modelled results and an assessment of reasons for change from reference conditions will be provided.

Task responsibility

Palmer

Trainees: Niehaus, Senoge

Information required

- MIRAI model and updated MIRAI manual.
- HAI, PAI, GAI and VEGRAI results.

Actions

- Additional Invertebrate survey during the post-wet hydraulic calibration (9.1).
- Populating the MIRAI model.

Deliverables and milestones

- Macroinvertebrate reference conditions and PES for each EWR site (June 2008).
- Specialist appendix (June 2008).

Responsibility of the Consultant

- Populating the appropriate level EcoStatus model within the EcoClassification process for each EWR site.
- Documenting the results and providing the models as an electronic report.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- An explanation of the methods and models in documentation for this project.

F Vegetation Response Assessment Index (VEGRAI)

Information will be collated during the site visits to undertake the Level 4 VEGRAI assessment. The modelled results and an assessment of reasons for change from reference conditions will be provided.

Task responsibility

Mackenzie

Information required

- VEGRAI4 model and updated VEGRAI manual.
- Aerial photographs from the project geomorphologist.
- HAI, PAI, GAI results.

Actions

- Survey during the post-wet hydraulic calibration (Task 9.1).
- Populating the VEGRAI4 model.

Deliverables and milestones

- Macroinvertebrate reference conditions and PES for each EWR site (May 2008).
- Specialist appendix (June 2008).

Responsibility of the Consultant

- Populating the appropriate level EcoStatus model within the EcoClassification process.
- Documenting the results and providing the models as an electronic report.

The budget does not include:

- An explanation of the methods and models in documentation for this project.

G Diatom analysis

Diatoms are photosynthetic unicellular organisms and are found in almost all aquatic and semi-aquatic habitats. Diatoms are of ecological importance because of their role as primary producers, and form the base of the aquatic food web. They usually account for the highest number of species among primary producers in aquatic systems (Leira, 2005). Although diatoms are widely distributed as a group, most species occur only in habitats with specific physical, chemical, and biological characteristics, and consequently they are frequently used as biological indicators of water quality. According to Harding *et al.*, 2005 the analysis of diatom associations provides an integrative biological response and offsets the inconsistency of rapid changes in water chemistries that render the use of conventional analytical approaches inadequate. Diatom monitoring together with macroinvertebrate monitoring will provide a method that combines two independent indicator systems at different trophic levels.

Task responsibility

Koekemoer, S

Information required

- EWR site localities.

Actions

- Collect one epilithon sample from each EWR site.
- Prepare samples.
- Analyse data.
- Forward findings to Macroinvertebrate and fish specialist.
- Forward findings to Golder.

Deliverables and milestones

- Documenting the results in a Specialist appendix (December 2007).

Responsibility of the Consultant

- Collecting data according to international standards.
- Analysing data and documenting findings in a specialist report.
- Circulating results to component specialists and Golder.

The budget does not include:

- Diatom sampling and analysis other than for the 10 EWR sites.

4.8.2 Task 8.2 Index of Habitat Integrity (IHI)

The IHI as currently being modified by Dr Kleynhans will be applied for applicable river stretches (likely to be the RUs) for each EWR site. The IHI will be a more detailed assessment than the Desktop Habitat Integrity used in Task 6.5. The assessment will be done based on a site visit, Google Earth, and appropriate landuse maps as well as available video footage.

Task responsibility

Louw D

Information required

- Available videos and assessments.
- Land cover maps and associated Excel tables.
- HAI and PAI information.

Actions

- Populate the IHI model.

Deliverables and milestones

- IHI for each RU in which the EWR sites are situated (October 2008).

Responsibility of the Consultant

- Applying the latest updated IHI model within the EcoClassification process for each of the EWR sites.
- Documenting the results and providing the models as an electronic report.

The budget does not include:

- Producing a video for the river.
- Providing the IHI other than for the RUs with EWR sites.
- Explaining the methods and models in documentation for this project. The manual will be available.

4.8.3 Task 8.3 PES EcoStatus (Level 4) assessment

All the above information will be used to populate the Level 4 EcoStatus models.

Task responsibility
Louw D

Information required
- All the populated models produced in Task 8.1 and 8.2.

Actions
- Populate the models for each EWR site.

Deliverables and milestones
- PES EcoStatus for each EWR site.

Responsibility of the Consultant
- Populating the appropriate level EcoStatus model within the EcoClassification process for each of the EWR sites.
- Documenting the results and providing the models as an electronic report.

The budget does not include:
- Explaining the methods and models in documentation for this project. The version 2 manual will be available.

4.8.4 Task 8.4 EcoClassification Specialist meeting

The results of all the models will be used to set up the EcoStatus models. The models are then presented to the specialists at a specialist meeting and results are refined if necessary. The trend is determined, the EIS refined and the REC determined. The alternative ECs for EWR assessment are then established and all the models rerun in a predictive fashion for each of the ECs to be addressed.

Task responsibility
Louw D, Koekemoer S, Kotze, Louw S, Mackenzie, Palmer, Rountree
Trainees: Hlongwane, Koekemoer J, Niehaus, Senoge

Information required
- All information collated during the previous tasks.

Actions
- One workshop, dealing with all the EWR sites.

Deliverables and milestones
- EcoClassification results (June 2008).

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting.
- Undertaking the logistical arrangements for the consulting team.
- Supplying a range of ECs.

4.8.5 Task 8.5 Reporting

All the information will be collated in a report on the EcoClassification. All the models will be provided on a CD. The report will be produced according to the required standards.

Task responsibility

Koekemoer S, Louw D, Louw S

Information required

- Specialist meeting results.

Actions

- Documenting final results and collating specialist appendices.

Deliverables and milestones

- First draft available (November 2008).

Responsibility of the Consultant

- Supplying the report and including two rounds of comments as detailed in Section 10.1.

4.9 TASK 9: EWR SCENARIO ASSESSMENT

Objective and approach

The objective of this task is to determine an EWR scenario for the range of ECs to be addressed at each EWR site.

The process followed for the determination of low flows will be the HFSR method as well as a modified BBM and Downstream Response to Imposed Flow Transformations (DRIFT) (Brown and King, 2001) approach for high flows. A range of high flows and their functions will be identified. These high flows are grouped into flood classes according to similar function, and the number of high flow events within each flood category is then specified for each EC.

This approach and the EcoClassification approach address the requirements of a Flow Management Plan.

The output of this task will be the standard requirement, i.e. the .tab and .rule files for each EC at each EWR site. SPATSIM (Spatial and Time Series Information Modelling) (Hughes and Forsythe, 2006) will be used as a framework for the hydrological information used within the process, and to capture the EWR results. The output is generated at a specialist EWR meeting and serves as the initial demands for the range of ECs to be modelled using a yield model.

4.9.1 Task 9.1 and 9.2 Hydraulic calibrations, modelling and wet season site visit

The objective of the hydraulic/habitat data collection and modelling is to provide ecologically and geomorphologically relevant hydraulic and habitat information for assessing ecological water

requirements. Characterisation of the habitat availability using habitat-types for fish (defined by ranges of depth and velocity) and macroinvertebrates (defined by ranges of velocity and substrate type) will be undertaken at all EWR sites at different levels of accuracy (or confidence), using hydraulic analyses based on cross-sections and/or digital terrain mapping.

Data collection at EWR sites includes:

- Locating suitable positions for and surveying cross-sections.
- Surveying the three-dimensional topography at selected EWR sites where two-dimensional hydraulic modelling is to be undertaken (refer to explanation below).
- Surveying stage levels and longitudinal water surface gradients.
- Surveying longitudinal bed topography where these controls result in the backup of water at cross-sections (e.g. pools).
- Determining the discharge in the river.
- Surveying the location of vegetation as supplied by the vegetation specialist.
- Collecting relevant habitat information for habitat-type modelling (e.g. substrate composition and location of marginal vegetation).

All surveys are undertaken relative to local bench mark positions. The Survey Directorate of the DWAF is requested to link the bench marks relative to the global coordinate system, as soon as possible after these have been installed at EWR sites (August and September 2007). This will ensure that hydraulic data is not lost for the purposes of this study and for potential future monitoring at EWR sites.

A main objective of hydraulic data collection is to procure field data at EWR sites to enable cross-sections to be rated (relationship between discharge and stage), and the provision of the "standard hydraulic data sets" (cross-sectional relationships between discharge and depth, velocity and wetted perimeter).

At a comprehensive level of determination, the aim is to achieve the highest possible confidence in the hydraulic characterisation by undertaking data collection over at least one hydrological season to maximise the probability of procuring a range of discharges and corresponding water levels. The ability to collect a range of flow data depends on the flow regimes of the river systems during the data collection period, and therefore cannot be guaranteed. Four rating data measurements will be undertaken for Comprehensive level sites, (two are taken for intermediate level sites, and one for Rapid level III sites). Local gauging stations, including both physical structures and rated cross-sections, where they are located in the vicinity of the sites, will be used to provide measurements of discharge. Manual flow gauging, using the velocity-area method (BS 3680) will be undertaken at sites not located in the vicinity of gauging stations. Fixed-point photography will be undertaken for each flow at the time of site visits.

Task responsibility

Birkhead, Koekemoer S, Koekemoer J, Louw
Trainee: Desai

Information required

- Locality of gauging weirs.

Actions

- Three site visits (spaced over the medium-wet, wet, post-wet hydrological season (November 2007, February and May 2008).

Deliverables and milestones

- Cross-sectional profiles with the location of vegetation markers.
- Hydraulic rating data from each site visit (needed for sediment transport modelling).
- Standard hydraulic relationships per cross-section (needed for sediment transport modelling).
- Habitat-type modelling per cross-section (needed for sediment transport modelling).
- Habitat-type modelling per site where DTM mapping and two-dimensional hydraulic analyses are undertaken (needed for sediment transport modelling).

Responsibility of the Consultant

- Obtaining the rating data at intervals spaced over the hydrological season.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- Ensuring that a range of flows is procured over the study period, although every effort is made by spacing site visits over the hydrological season.
- The loss of hydraulic data arising from the loss of bench marks due to vandalism or flooding. This may be prevented by fixing the bench marks relative to the global coordinate system.
- Surveying the bench marks relative to the global coordinate system. The Survey directorate of the DWAF is requested to undertake this task.

4.9.2 Task 9.3 EcoHydrology analysis

The objective of this task is to prepare hydrological data suitable for use by the other EWR specialists in setting the Ecological Reserve for a range of ECs. A further objective is to make use of the hydrological data, as well as the Stress-Flow relationships developed by the other specialists, to compile a time-series of ecological stress for use and evaluation during the workshops.

Where possible, daily time-series data for natural conditions will be prepared and the data will be checked to ensure that they are consistent with the monthly time-series data from the systems model. It must be noted that a lack of daily data will impact on the confidence level of the results of the study. It is however unlikely that daily modelling at any level of confidence will be possible in this system. The monthly hydrology from the systems model (to be supplied by WRP) for each EWR site (present and naturalised flows) will be used and will be set up in SPATSIM. No additional systems modelling will be undertaken by this PSP.

Task responsibility

Hughes

Trainee: Haasbroek

Information required

- Monthly and all other relevant hydrological information from WRP.

Actions

- Setting up the WMA 8 on SPATSIM.

Deliverables and milestones

- All hydrological data available on SPATSIM by June 2008.

Responsibility of the Consultant

- Setting up SPATSIM using WRP data.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- Modelling any additional hydrological data.

4.9.3 Task 9.4 Data collation and specialist meeting preparation

All the data collated from the various specialists must be analysed and structured for use during the multi-disciplinary analysis session.

Task responsibility

Louw D, Koekemoer S, Louw S

Information required

- All relevant data generated during the study.

Actions

- Make all logistical arrangements.
- Undertake all preparations for the specialist meeting.

Deliverables and milestones

- N/A.

Responsibility of the Consultant

- Undertaking logistical arrangements for the specialist meeting.
- Collect all relevant data generated during the study.
- Prepare data for specialist meeting.

4.9.4 Task 9.5 EWR scenario determination

The objective is to supply a relationship between an index of stress (0 to 10) and habitat availability during different flow conditions. This information is required for the determination of required stresses for different ECs.

The information on habitat, collated during the previous tasks as well as the hydraulics will be used to determine the stress indices. These indices form the base information for the determination of low flows using the HFSR method, i.e. for setting the low flow requirements for the EWR scenarios.

The high flows will be assessed by indicating flood requirements based on the biophysical response of the floods. The floods are grouped into flood classes and the number of events required for different EWR scenarios are identified. The EWR scenario determination will be undertaken at two five-day workshops.

Task responsibility

Louw D, Birkhead, Hughes, Koekemoer S, Kotze, Louw S, Mackenzie, Palmer, Rountree
Trainees: Desai, Haasbroek, Hlongwane, Koekemoer J, Niehaus, Senoge

Information required

- All information collated during the previous tasks.
- Hydraulic information.

Actions

- Two workshops, dealing with 5 EWR sites each.

Deliverables and milestones

- EWR scenarios (July & August 2008).

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting.
- Undertaking the logistical arrangements for the consulting team.
- Supplying flow scenarios for the relevant ECs.

The budget does not include:

- Providing more than 3 flow scenarios (present, one up and one down) per EWR site.
- Booking arrangements and payments for non-specialists.

4.9.5 Task 9.6 Reporting

The results generated during Task 9 will be documented in a report supported by specialist appendices and electronic data in CD format. The report will be produced according to the required standards.

Task responsibility

Koekemoer S, Louw D, Louw S

Information required

- Results of specialist meetings.

Actions

- Documentation of results.

Deliverables and milestones

- EWR results available and supplied to WRP for yield modelling (July & August 2008).
- First draft report available (October 2008).

Responsibility of the Consultant

- Supplying one draft report, with the results and outcomes of Task 9.
- Supplying one final report and incorporating two rounds of comments as detailed in Section 10.1.

The budget does not include:

- Explanations of the methods in the documentation of this project.

4.10 TASK 10: SOCIO ECONOMIC PRESENT STATE EVALUATION

The Socio Economic task description is to comply with the ToR and RODs taken at PMT meetings and is provided below. This work is dependent on hydrology provided in a certain format for the accounting matrices. Without provision of this hydrology, no socio-economic consequences can be provided.

At present (27 October 2007) the task and details for the socio-economics have not been resolved and cannot be included in the Inception Report. The socio-economic work cannot commence neither will the socio-economic team be appointed until this has been resolved. Once agreement of the work has been reached, an addendum to the inception report or as a ROD will be supplied.

Objective and approach

The purpose of this task is to evaluate the social and economic returns of the existing water use by the various water uses. The intent of this task is to provide the baseline for comparison with the value of water for different ecological flow regimes.

Water due to its physical nature is a “high-exclusion” cost resource which means that exclusive property rights which are the basis of a market economy are relatively difficult and expensive to establish and enforce. It is useful therefore to group the types of values of water into five classes namely; (a) commodity benefits from use of water allocated to irrigation, commercial business and industries, mining, manufacturing and domestic water supply; (b) waste assimilation and; (c) public and private aesthetic, recreational, and water based activities such as fishing, etc.; (d) biodiversity and ecosystem services, and (e) social and cultural values.

In order to determine the value of water for the various uses in the Upper Vaal River catchment it is important to identify the benefits accrued from its use in each sector that the available water of the Vaal River has been allocated as well as the water left in the river at present. This will provide the baseline to compare with changes in water availability for different EWR flow scenarios.

4.10.1 Task 10.1 Identification of the sectors directly and indirectly using water from the Vaal River System

Identification and quantification of commodity benefits (includes intersectoral water use linkages in the value chain and the competition of water). In the Vaal River Supply Area, the sectors identified include the three sectors namely the domestic sector; industry, mining and power generation sector and the irrigation agricultural sector. Some of the major industries include SASOL, iron and steel manufacturing as well as SAB and Eskom. Identification and quantification of the biodiversity and ecosystem services of the catchment. The categories of the ecosystem services that will be identified and quantified will include waste assimilative capacity, regulation and stabilisation of floods, disbenefits of additional flows into the river system due to increase vulnerability to diseases and aesthetic, recreational and cultural benefits of various EWR flow scenarios.

Task responsibility

Tlou, Mullins
Trainees: Mosaka, Schwartz

Information required

- Registered Water usage database from DWAF.
- Analysis of potential relevant and significant ecosystem services.

Actions

- Analysis of the sectors and quantification of current returns.
- Analysis of demand drivers of the sectors and the production functions.

Deliverables and milestones

- Spreadsheet with water usage by sector including the production per m^3 of water.
- First cut analysis of ecosystem services likely needed to be quantified (September 2007).

Responsibility of the Consultant

- Identify economic sectors and first cut analysis.
- Generate analysis of water usage and returns.
- Providing the necessary training as outlined in Chapter 5.

4.10.2 Task 10.2 Determination of economic zones and current water allocation to each category of use

Our project team will determine the economic subsystems of the Vaal River catchment based on logical economic zones. These economic subsystems will form the geographic areas of the water accounts. The criteria for the choice of the economic sub-systems and the rationale will be determined based on the sub-catchment level. Using information from the ISPs and any updated information including information from Stats SA, the current water allocation to each category of use will be determined including the assurance of supply.

Task responsibility

Tlou, Mullins
Trainees: Mosaka, Schwartz

Information required

- Map of Basin indicating the economic activities.

Actions

- Analysis of economic activity for the catchment and disaggregating of activities into zones.

Deliverables and milestones

- Economic zone map with quantification of economic sectors per zone (November 2007).

Responsibility of the Consultant

- Generation of map and analysis.
- Providing the necessary training as outlined in Chapter 5.

4.10.3 Task 10.3 Determination of the appropriate valuation technique for each use category

For each category of water use, there are various techniques that will be used to determine the economic value of water use.

Task responsibility

Tlou, Mullins
Trainees: Mosaka, Schwartz

Information required

- Completion of Task 10.3.
- Straw Dog Economic returns on water (value per m^3).

Actions

- Interviews with key economic sectors to determine value.

Deliverables and milestones

- The recommended technique of valuing the water use (out of stream and instream water uses).
- Establishment of the economic model incorporating these techniques (September 2008).

Responsibility of the Consultant

- Data collection.
- Providing the necessary training as outlined in Chapter 5.

4.10.4 Task 10.4 Economic value of water use by each category

Production of any good or service requires a combination of resources or inputs including expendable materials, equipment, labour, management, capital and land. Each of these contributes to the total value of production. Estimating the economic benefits of one resource such as water entails isolating that portion contributed by water to the total value of the output. The approach that will be used is the Value Marginal Product (VMP) of the input in this case water. Different valuing techniques will be used for different water uses to determine the economic value of water. The marginal valuation method will be used for each economic sector rather than the value-added approach because in the last assessment made it was found to greatly overstate the appropriate measure of willingness to pay of commodity benefits to the detriment of the value of ecosystem services. The marginal valuation method has been incorporated into the Water Productivity Model that our project team members have developed.

Task responsibility

Tlou, Mullins
Trainees: Mosaka, Schwartz

Information required

- Completion of Task 10.3.
- Final analysis of economic returns on water (value per m^3).

Actions

- Interviews with key economic sectors to determine.
- Interrogation of all secondary data.

Deliverables and milestones

- Final spreadsheet showing proposed economic values of water use for each sector. The values include the use values of the resource by each sector, the non-use value and the total economic value.
- Final analysis of water usage by sector and quantification of economic return as well as job creation (September 2008).

Responsibility of the Consultant

- Supplying a report with the results and outcomes of Task 10.
- Providing the necessary training as outlined in Chapter 5.

4.11 TASK 11 RAPID III EXTRAPOLATION

Rapid data collation

Objective and approach

The objective is to collate some data according to the Rapid III requirements. This information can then be used either for assessing EWRs at the Rapid level or for extrapolation purposes. The use of the data can only be identified depending on the detail of extrapolation methods available.

Task responsibility

Louw D, Birkhead, Kotze, Palmer

Actions

- One site visit to collate data at 10 EWR sites.

Deliverables and milestones

- Rapid data available (August 2008).

Responsibility of the Consultant

- The consultant is responsible to collate the required data.

The budget does not include:

- The analysis of the data or the determination of the EWRs for the sites.

4.12 TASK 12 DETERMINING OPERATIONAL SCENARIOS AND CONSEQUENCES

Objective and approach

The objective of this task is to provide the final EWR recommendation. The EWR scenarios developed during Task 9 will be evaluated and Operational Scenarios designed which will consider the 'attainability', i.e. availability and the *present constraints* (such as outlet sizes of existing dams). In essence, this is where the Flow Management Plan is developed.

4.12.1 Task 12.1 Liaison: Yield modelling

During this task, intensive liaison between the Reserve PSP, WRP, and the client (including DWAF regions and any other relevant stakeholders (e.g. Rand Water, mining)) will be required to develop operational scenarios. As the yield modelling takes place for the Vaal system, this process must be a joint process where the Middle and Lower Vaal specialists also participate. The following interactive process will be followed:

- Provision of the EWR scenarios to the system modellers.
- Inclusion of the EWR scenarios in the system model. A no-EWR /present scenario must also be modelled.
- Design of operational scenarios (to a maximum of 6 scenarios excluding the no EWR and present EWR) considering constraints such as availability and operational aspects (for example, outlet sizes of dams).
- Modelling of the additional scenarios.

- Provision of the results at each EWR site.
- This information will then be used to determine a range of consequences.

Task responsibility

Louw D, Hughes
Trainee: Koekemoer S

Information required

- EWR scenarios.
- Results of yield modelling in usable format.

Actions

- Various meetings with WRP.

Deliverables and milestones

- Range of scenarios available for consequences assessment (May 2009).

Responsibility of the Consultant

- Designing the range of operational scenarios to be assessed with WRP.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- Setting up or reconfiguring the Water Resource Planning Model (WRPM).
- Modelling the scenarios.
- Assessing for more than 6 scenarios (final scenarios).

4.12.2 Task 12.2 Determining ecological consequences

Each of the scenarios will be assessed in terms of ecological consequences, i.e. the impact on the Ecological Category. This assessment forms part of the EcoClassification process where the rule-based models are used in a predictive manner. The first requirement will be the analysis of the scenarios in terms of impact on the physico-chemical EC using the PAI. This information must be provided by Golder. The other rule-based models will then be assessed for the rest of the components. The results will be used to generate the resulting EcoStatus. The process to determine the ecological consequences is as follows:

- The water quality consequences will be modelled for each scenario and will be supplied as an EC with a qualified explanation and motivation by Golder.
- The flows will be converted to stress for each scenario at each EWR site.
- The flow information will also be supplied in a format suitable for high flow evaluation to all the specialists during a specialist meeting.
- This information will be provided to the biological and geomorphological specialists as well as a template for completion during a specialist meeting.
- At the specialist meeting, the specialists complete their indices for the new flow/stress scenario to determine the resulting EC.
- All information is supplied to the EWR co-ordinator who will use the information as input to the EcoStatus model.
- Based on the information generated, the specialists rank the different scenarios using the standard traffic diagram approach.

Task responsibility

Louw D, Hughes, Koekemoer S, Kotze, Mackenzie, Palmer, Rountree

Information required

- Operational scenarios in a format that can be used for assessment.
- Physico-chemical consequences in terms of the PAI (from Golder).
- All information collated during the previous tasks.

Actions

- Obtain physico-chemical consequences in terms of the PAI for each operational scenarios from Golder, (June 2009).
- Specialist meeting (June 2009).

Deliverables and milestones

- Ecological consequences in terms of predicted EC available for each EWR site and each operational scenario.
- Suite of EcoStatus models run for each operational scenario.

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting where the EcoStatus of the river for each operational flow scenario will be determined.
- Translating the flow scenarios to the required format, and providing specialists with the templates and instructions of what is required.
- Integrating the results and providing the ecological consequences and recommendations.
- Undertaking the logistical arrangements for the consulting team.

The budget does not accommodate a delay in process if the PAI is not available on time as well as booking arrangements and payments for non-specialists. The budget also does not accommodate any problems with consistence or availability of the Middle and Lower Vaal results to address the yield modelling in an integrated fashion.

4.12.3 Task 12.3 Determining consequences on Socio-economics and ecosystem services (goods and services)

Objective and approach

The purpose of this task is to evaluate and forecast for each EWR scenario, the social and economic values of changes in the water availability to the socio-economic sectors as well as the value of the ecosystem services by leaving different amounts of water in the river reaches of the Vaal River catchment:

- Change in value of the macroeconomic activities for different EWR scenarios.
- Changes in value of ecosystem services for different EWR scenarios.
- Optimisation of the overall benefits from water re-allocation.

Although the ToR does not clearly state the need to quantify the consequences of changes in available water to socio-economic sectors and the ecosystems due to different EWR scenarios, this component is fundamental to balancing social and economic objectives of water allocation with the need to sustain the functioning of the ecosystems of the Upper Vaal River system.

Task responsibility

Tlou, Huggins, Koekemoer J, Louw D, Mackenzie, Mullins, Palmer, Rountree

Trainees: Mosaka, Schwartz

Information required

- Completion of Tasks 10.1 and 10.4.
- Input from ecological specialists as well as hydrological results.

Actions

- Analysis of EWR scenarios against socio-economic returns.

Deliverables and milestones

- Report showing results of analysis of EWR scenarios against socio-economic returns (August 2009).

Responsibility of the Consultant

- Generating a report section to be included in Task 12.4 showing significant and relevant socio-economic returns per scenario.
- Providing the necessary training as outlined in Chapter 5.

4.12.4 Task 12.4 Reporting

A scenario evaluation report, which includes the results of Task 12, will be produced. All the rule-based models used to predict the Ecological Category will be summarised in specialist appendices and on CD. The report will be produced according to the required standards.

Task responsibility

Koekemoer S, Louw D, Louw S, Tlou

Information required

- Results of specialist meetings.

Actions

- Documentation of results.

Deliverables and milestones

- First draft report available (August 2009).

Responsibility of the Consultant

- Supplying the report and including two rounds of comments as detailed in Section 10.1.

MANAGEMENT CLASS DETERMINATION

At this point in the programme, it is assumed that the information generated to this point will be provided for use in the Management Class decision and that a management class will be provided to the consultant by June 2009. To provide the final results of the study, it is assumed that the Management Class will be provided to the PSP during the final stages of the study as a Classification system is now available. The budget does not include the process previously associated with Comprehensive studies in the absence of a Classification system to provide a Management Class. If the Management Class is not available, then the EcoSpecs will be provided for the most realistic scenario as a surrogate for the Management Class. The Project Management Team will select the most optimised scenario based on the ecological, yield, socio-economic and

goods and services consequences. Note that this will only be possible if economic consequences to the required standard are provided as part of this project.

4.13 TASK 13 IDENTIFICATION OF ECOSPECS (ECOLOGICAL RQOS)

Objective and approach

The objective of this task is to determine the EcoSpecs (the ecological component of RQOs) for the recommended EC and link the ECs to TPCs (Thresholds of Potential Concern). EcoSpecs will be set for flow, quality, habitat and biota. The quality and flow EcoSpecs are dependent on a decision regarding an acceptable operational scenario as the Ecological Reserve. The habitat and biota EcoSpecs must be linked to the relevant category and will be quantified as far as possible.

Draft documentation (Kleynhans & Louw, 2006) is available which describes the process of using the suite of EcoStatus models to generate the EcoSpecs and TPCs. These EcoSpecs and TPCs are then used for design of a monitoring programme (not requested in the ToR).

4.13.1 Task 13.1 Component assessment

During the specialist meeting, EcoSpecs which form the ecological component of RQOs, will be set for flow, quality, habitat and biota. The quality and flow EcoSpecs are dependent on a decision regarding an acceptable operational scenario and are readily available. The habitat and biota EcoSpecs must be linked to the relevant category and will be quantified as far as possible.

Task responsibility

Louw D, Koekemoer S, Kotze, Mackenzie, Palmer, Rowntree

Information required

- Management Class converted to an EC.

Actions

- Specialist meeting (October 2009).

Deliverables and milestones

- EcoSpecs and TPCs at each EWR site.

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting where EcoSpecs and TPCs at each EWR site will be determined.
- Undertaking the logistical arrangements for the consulting team.

The budget does not include:

- Booking arrangements and payments for non-specialists.
- The assessments for more than one EC.
- The design of a monitoring programme.

4.13.2 Task 13.2 Reporting

The results generated during Task 13 will be documented in a report supported by specialist appendices and electronic data in CD format. The report will be produced according to the required standards.

Task responsibility

Koekemoer S, Louw D, Louw S

Information required

- Results of specialist meetings.

Actions

- Documentation of results.

Deliverables and milestones

- First draft report available (November 2009).

Responsibility of the Consultant

- Supplying the report and including two rounds of comments as detailed in Section 10.1.

The budget does not include:

- Explanations of the methods in the documentation of this project.

PHASE 3: STUDY TERMINATION

4.14 TASK 14 STUDY TERMINATION

Objective and approach

The objective of this task is to produce the final EWR rules, to extrapolate the result to all hydrological nodes in the catchment, and to summarise the technical reports in a main report. Note that completion of the Reserve in the required templates was not requested as part of the ToR but can be undertaken if so required.

4.14.1 Task 14.1 Preparation of final Reserve results

The EWR rules and tables which were generated during Task 12 were modified to generate scenarios. Once one of these scenarios has been accepted as the final result, the modifications have to be used to adjust the EWR rules to generate a final result that represents the final accepted scenario.

Task responsibility

Hughes

Information required

- The final operational scenarios in the required formats from WRP.

Actions

- Produce the .rul and .tab tables that fit the scenarios.

Deliverables and milestones

- .rul tables (November 2009).
- .tab tables (November 2009).

Responsibility of the Consultant

- Generating EWR rules that represent the final accepted scenario.

4.14.2 Task 14.2 Training audit and report

Objective and approach

The objective of this task is to conduct effective training of persons from previously disadvantaged individuals) – training is to be conducted in the form of workshops and one-on-one training per component. The training will briefly be covered in the progress reports, and a training Report will be available by January 2010. The report will include an audit and evaluation of the training process, as well as an assessment of each trainee's ability to operate within a Reserve team. Additional training needs will be outlined. This task is included in the training programme discussed in detail in Chapter 5.

4.14.3 Task 14.3 Compilation of main report

A summary report, which will consist of sections of all the reports produced during the study, will be compiled which include the final results of the study. Formatting requirements will be specified.

Task responsibility

Louw D, Engelbrecht, Huggins, Koekemoer S, Louw S, Tlou

Information required

- Results from all the previous tasks.

Actions

- Collating all existing project data and results.

Deliverables and milestones

- First draft report available (January 2010).

Responsibility of the Consultant

- Supplying the report and including two rounds of comments as detailed in Section 10.1.

The budget does not include:

- Explanations of the methods in the documentation of this project.

5 CAPACITY BUILDING

5.1 TASK 15 CAPACITY BUILDING: TRAINING PROGRAMME

This section summarises Tasks 15.1 – 15.13 as outlined in the main budget.

Koekemoer Aquatic Services has provided the following trainees as part of this project:

- Ahmed Desai (Africon): Hydraulics.
- Bennie Haasbroek (Innovative Solutions): Hydrology.
- Brenton Niehaus (Clean Stream): Aquatic Macroinvertebrates.
- David Mosaka (Conningarth.): Resource Economics.
- Johan Koekemoer (KAS): Fish.
- Katie Maasdorp (Water for Africa): Basic Human Needs Reserve and Resource Economics.
- Linda Schwartz (Conningarth): Resource Economics.
- Lindo Hlongwane (WCS): Geomorphology.
- Ntaki Senoge (Clean Stream): Aquatic Macroinvertebrates.
- Nonkanyiso Maphumlo (WCS): Wetlands and Pans.
- Shael Koekemoer (KAS): Reserve Process with specific reference to Task 12.
- Shileen Louw (Water for Africa): Financial administration and administrative management.

Objective and approach

The training programme has been designed to provide effective training to identified trainees. Training opportunities will also be communicated to DWAF personnel (particularly CD: RDM and regional offices) for participation in workshop and field trips.

One of the outcomes of this task is an evaluation of the training process, which will be provided to CD: RDM in the form of a Training Report. A questionnaire will be designed to gather training evaluation information from the trainees, as well as short reports from mentors. The Training Report will therefore provide recommendations regarding future training activities for RDM purposes, as well as evaluate each trainee's ability to operate within a Reserve team. It must be noted that the training provided by this study is one step in the training process and that additional exposure to Reserve studies will be required before trainees are sufficiently capacitated to operate as specialists.

The aims of the training process, and criteria against which training will be evaluated, will be communicated to mentor and trainee teams at the outset of the study. The aims of the training process are shown below. *Note that the training programme presupposes that trainees have an understanding of the Reserve concept and process.*

The main aim of the capacity building and training process is to ensure that each trainee has acquired the following information and developed or enhanced the following skills:

- An understanding of the concepts related to a specific discipline (trainee-specific).
- The ability to utilize and understand the tools or software required by a discipline (trainee-specific) within the Reserve process.
- The ability to interpret information related to a specific discipline, particularly within the broader scope of the Reserve process.
- Gather field-based data and analyse the data as required by the mentor.
- Work within a team and understand the role of each specialist within the broader Reserve process.

Task responsibility

Programme design and evaluation of the training and capacity building process will be conducted by Patsy Scherman. General management of the training programme will be undertaken by Shael Koekemoer. Lecturing at the training workshops will be undertaken by Delana Louw and Patsy Scherman, while specialist one-on-one training will be provided by the assigned mentors.
All specialist and trainees involved are outlined in Table 5.1.

Information required

- Previous exposure to the Reserve process, such as attendance of a FET Water Reserve training course, per trainee.
- Information will be provided by mentors allocated to each trainee using the budget assigned to the study.

Actions

The following training opportunities will be provided:

- Workshops: This form of training will include the attendance of the following workshops.

One specialist (EWR) workshop (July and August 2008).
Two training workshops:
(a) An *introductory EWR workshop* will be held in during July 2007 (month may change, pending PSP and trainee availability), and will focus on the link between flows and biotic responses. The principles of Ecological Water Requirements will be discussed per discipline, as well as the integration of the various disciplines to achieve EcoClassification and define EcoStatus.

(b) A technical *EWR training workshop* in June 2008. This will be a mock workshop which will prepare the trainees for the EWR specialist workshop to be attended in July and August 2008. They will be exposed to evaluating consequence to operational flow scenarios, and designing monitoring programmes and EcoSpecs per discipline.

- Attendance of a field trip per trainee in August 2007 and May 2008.
- One-on-one training in specific disciplines: to be conducted throughout the project.

Due to project timing, individual training for BHNR will start before the training programme formally commences. Due to the fact that the BHNR makes a very small component of the Reserve study and data collection will be done before the revised training programme is in place and implemented training for this task would involve:

- Acquiring appropriate data and data analysis.
- Methodology of identifying direct users of surface water resources of the catchment.
- Estimation of the number of people reliant on flow in the relevant rivers.
- Estimation of the population above and below the EWR sites identified for the study and how this indicates the amount of water that would need to pass certain EWR sites in order to meet the needs downstream.

Mentor and trainee teams are shown in Table 5.1, indicating discipline-specific teams.

Table 5.1 Mentor and trainee teams for the Upper Vaal Reserve Study

Training task	Mentor	Trainee(s)
Project Management	Delana Louw	Shileen Louw
Reserve Process	Delana Louw	Shael Koekemoer
Hydrology	Prof Denis Hughes	Bennie Haasbroek: All aspects. Shael Koekemoer: Operational flow scenarios.
Hydraulics, incl. site selection & dry season survey	Dr Andrew Birkhead	Ahmed Desai
Geomorphology	Mark Rountree	Lindo Hlongwane
Fish	Dr Pieter Kotzé	Johan Koekemoer
Macroinvertebrates	Dr Rob Palmer	Brenton Niehaus Ntaki Senoge
Wetlands	Mark Rountree	Nonkanyiso Maphumlo
Socio-economic Study	Toriso Tlou	David Mosaka Linda Schwartz
Basic Human Needs Reserve	Greg Huggins	Katie Maasdorp

Deliverables and milestones

- Training Report will be due in January 2010. The report will include an audit and evaluation of the training process, as well as an assessment of each trainee's ability to operate within a Reserve team. Additional training needs will be outlined.

Responsibility of the Consultant

- Manage and oversee the training process and ensure that the goals and objectives of training are met.
- Liaise with the client and provide information on progress as required.
- Provide the Training Report by January 2010.

5.2 DWAF TRAINEES

Five DWAF specialist trainees have been identified and will actively participate in the training programme. They are:
Mr Lungile Gaulana
Ms Pumza Maseti
Ms Jackie Jay
Ms Nceba Ncaphayi
Mr Ramogale Sekwele

DWAF officials may participate in the training programme where practically viable and necessary. An integrated programme of their involvement is being planned which will potentially be managed by the management consultant. No specific budget is available for any additional work regarding the DWAF official training as the target of the training is the Technical training.

6 PROJECT TEAM

Due to the significant scope of this study, Koekemoer Aquatic Services (KAS) has formed a Joint Venture with Water for Africa (WFA). Water for Africa has significant experience in Reserve studies and can provide the required support to KAS. KAS with Shael Koekemoer as the administrative manager will act as the lead consultant. WFA, with Delana Louw as the technical manager will be providing technical support, facilitate workshops and provide internal technical review of reports.

The key members and organisations, and their previous experience in Reserve Determination are summarised below. All resources approached have indicated that they are available for the times and tasks allocated to them according to Chapter 4.

The study has the following team leaders:

- Administrative manager – S Koekemoer
- Water Quantity team leader – D Louw
- Wetland team leader - M Rowntree
- Basic Human Needs team leader – G Huggins
- Socio-economic team leader - T Tlou
- Capacity building team leader – P-A Scherman

Most of the above-mentioned task leaders have a wide range of expertise in Reserve studies, and have worked on many Reserve studies conducted to date in South Africa. As many team members have also been part of the method development related to the various components, the latest methods and tools will be used in the Upper Vaal Comprehensive Reserve Determination Study. Figure 6.1 is a diagrammatic representation of the team.

The following organizations are represented by the teams:

- AFRICON.
- Bioriver Solutions.
- Clean Stream Biological Services.
- Coastal and Environmental Services.
- Conningarth Economists.
- Fluvius Environmental Consultants.
- Innovative Solutions.
- Koekemoer Aquatic Services.
- Nepid Consultants.
- Streamflow Solutions.
- Water for Africa.
- Wetland Consulting Services.

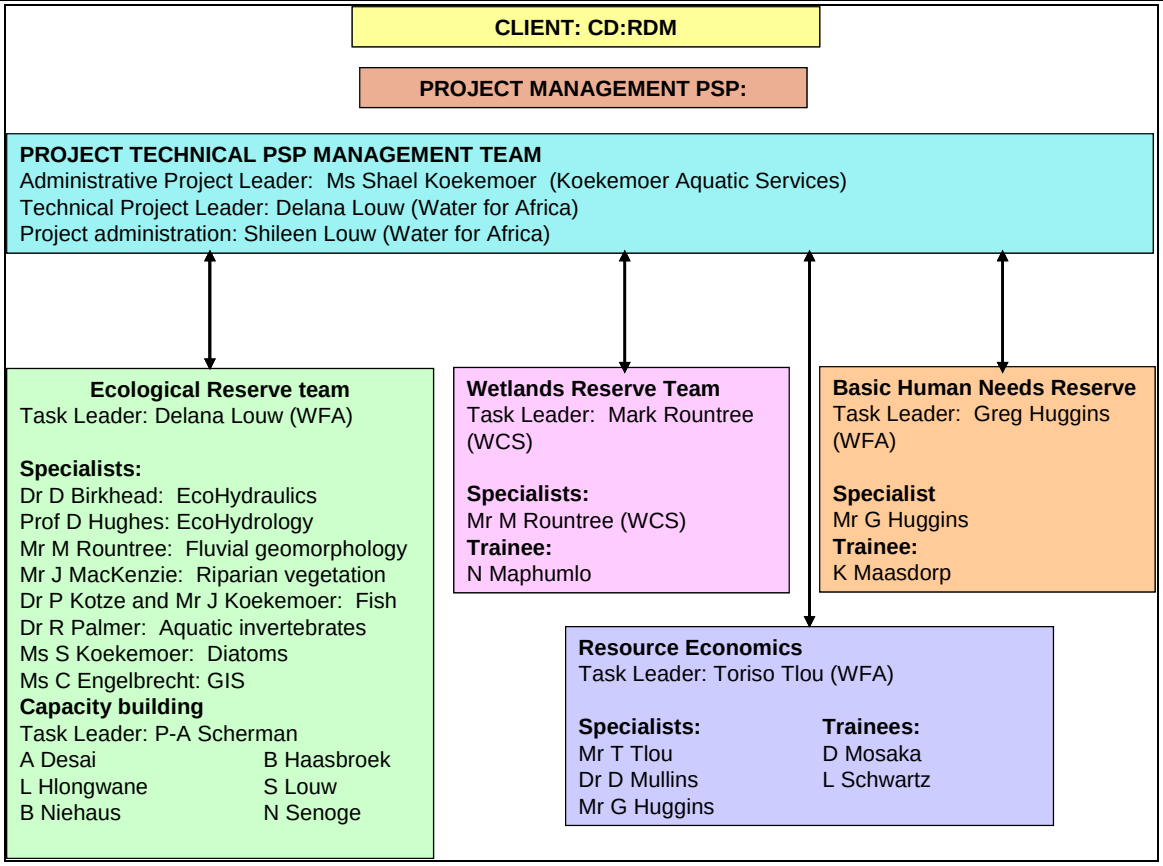

Figure 6.1 Diagrammatic representation of the team

7 STUDY PROGRAMME

7.1 KEY MILESTONES AND DELIVERABLES

The milestones and deliverables listed in Table 7.1 are in task sequence, rather than in date sequence. The date shown is the completion date of the task, as shown on the Gantt chart (Table 7.2).

Table 7.1 Milestones and deliverables

MS[1]	Deliverable	MS	Deliverable
1	Progress and financial reports.	25	EcoClassification report.
2	Steering Committee meetings.	26	Medium flow hydraulic calibration.
3	Project plan.	27	Wet season hydraulic calibration.
4	Appointment of team members.	28	Post wet hydraulic calibration.
5	Reconnaissance site visit.	29	Cross-sections and hydraulic look-up tables available.
6	Desktop EcoStatus model results.	30	SPATSIM set up.
7	Desktop EcoClassification report.	31	EWR specialist meeting.
8	BHNR assessment.	32	EWR scenario report.
9	BHNR report.	33	ID of the sectors directly and indirectly using water from the Vaal River System.
10	RUs available.	34	Economic zones and current water allocation to each category of use.
11	EWR sites selected.	35	Results of the appropriate valuation technique for each use category.
12	RU report.	36	Economic value of water use by each category.
13	Wetlands identified and mapped.	37	Rapid data collection.
14	Wetlands delineated and classified.	38	Operational scenarios available.
15	Wetland reference condition.	39	Determining consequences on Ecology.
16	Wetland PES.	40	Consequences on socio economics & Ecosystem services.
17	Wetland EIS.	41	Operation scenarios and consequences report.
18	Wetland importance prioritisation.	42	EcoSpecs - Component assessments.
19	WHI assessment.	43	EcoSpecs report.
20	Wetland report.	44	Final EWR rules available.
21	River EcoStatus models populated.	45	Training audit and report.
22	Diatom results available.	46	Compilation of main report.
23	IHI available.	47	Limited Public Awareness: Newsletters.
24	EcoClassification specialist meeting.		

1 Milestone

7.2 GANTT CHART

According to the information provided by the Client, the study is to commence during February 2007, and completed during March 2010. A Gantt chart is provided below in Table 7.2.

Total length of time per task according to programme

Length of time per sub-task according to programme

Information needed from external PSP or DWAF

Table 7.2 Gantt Chart illustrating milestones for the Upper Vaal Comprehensive Reserve study

Task Description	2007											2008											2009											2010		
	FEB	MAR	APR	MAY	JUN	JUL	AUG	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	OCT	NOV	DEC	JAN	FEB	MAR
TASK 1: PROJECT MANAGEMENT																																						
1.1 Internal technical team management and coordination																																						
1.2 PMT Meetings (Progress meetings)			1				1			1				1				1				1				1				1			1			1		
1.3 Liaison with other Upper Vaal studies																																						
1.4 Financial management																																						
PHASE I: STUDY INITIATION AND DESIGN																																						
TASK 2: PROJECT PLANNING AND PROCESS INTEGRATION																																						
2.1 Design of project plan and available current data collection		2																																				
Inception Report			3																																			
2.2 Mobilisation of study team				4																																		
PHASE II: STUDY IMPLEMENTATION																																						
TASK 3: PES, EIS and SCI: QUATERNARY BASIS																																						
3.1 Preparation																																						
3.2 Reconnaissance assessment					5																																	
3.3 Application of EcoStatus models (PES, EIS and SCI)						6																																
3.4 Database and Reporting							7																															
TASK 4: LIMITED PUBLIC AWARENESS: ASSESSMENT					47																									48b								
TASK 5: BASIC HUMAN NEEDS RESERVE																																						
Assessment									8																													
Report									9																													
TASK 6: RESOURCE UNITS																																						
6.1 & 6.2 Geomorphological zones & EcoRegions																																						
6.3 System operation																																						

Task Description	2007											2008												2009												2010		
	FEB	MAR	APR	MAY	JUN	JUL	AUG	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	OCT	NOV	DEC	JAN	FEB	MAR
6.4 Water quality sub-units																																						
6.5 Groundwater sub-units																																						
6.6 Identification of Resource Units							10																															
6.7 EWR site selection and dry season survey (10 sites)																																						
Week 1																																						
Week 2								11																														
Habitat modelling survey																																						
6.8 RU Report										12																												
TASK 7: WETLAND TYPING AND ECOCLASSIFICATION																																						
7.1 Wetland inventory				13																																		
7.2 Wetland classification					14																																	
7.3 Determination of Reference conditions						15																																
7.4 General current ecological conditions						16																																
7.5 Identification of priority wetlands							17																															
7.6 Ecological Importance and Sensitivity							18																															
7.7 WHI assessment									19																													
7.8 Reporting												20																										
OBTAIN VIRGIN HYDROLOGY DATA																																						
TASK 8: COMPREHENSIVE RIVER ECOCLASSIFICATION																																						
8.1 Suite of EcoStatus models																																						
HAI													21																										
PAI																																						
GAI														21																									
FRAI																	21																						
MIRAI																	21																						
VEGRAI																21																							
Diatom Analysis											22																												

Task Description	2007											2008											2009											2010		
	FEB	MAR	APR	MAY	JUN	JUL	AUG	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	OCT	NOV	DEC	JAN	FEB	MAR
8.2 Index of Habitat Integrity									23																													
8.3 EcoStatus assessment																																						
8.4 EcoClassification Specialist Meeting (incl Task 9.4)																			24																			
8.5 Reporting																						25																
TASK 9: EWR SCENARIO ASSESSMENT																																						
9.1 Hydraulic calibration and wet season site visit (10 sites)																																						
9.1 A High flow calibration										26																												
B Hydraulic calibration													27																									
C Hydraulic calibration and field survey																28																						
9.2 EcoHydraulic modelling and Sediment Transport Modelling																	29																					
9.3 EcoHydrology analysis																30																						
9.4 Specialist meeting preparation																																						
9.5 EWR scenario determination																																						
A Workshop 1																			31																			
B Workshop 2																			31																			
9.6 Reporting																						32																
TASK 10: SOCIO ECONOMIC PRESENT STATE EVALUATION																																						
10.1 ID of the sectors directly and indirectly using water from the Vaal River System								33																														
10.2 Determination of economic zones and current water allocation to each category of use										34																												
10.3 Determination of the appropriate valuation technique for each use category																35																						
10.4 Economic value of water use by each category																				36																		
TASK 11: RAPID DATA COLLECTION																																						
Rapid data collation																			37																			
TASK 12: DETERMINING OPERATIONAL SCENARIOS AND CONSEQUENCES																																						

Task Description	2007											2008											2009											2010		
	FEB	MAR	APR	MAY	JUN	JUL	AUG	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	OCT	NOV	DEC	JAN	FEB	MAR
12.1 Liaison: Yield modelling																												38										
12.2 Determining ecological consequences																													39									
12.3 Determining consequences on socio economics & Ecosystem services																																						
A Value change of socio-economic activities																																						
B Value change of Ecosystem services																																						
C Benefits from water re-allocation																															40							
Ecological Input																																						
12.4 Reporting																															41							
MANAGEMENT CLASS DECISION																																						
TASK 13: IDENTIFICATION OF ECOSPECS (Ecological RQO's)																																						
13.1 Component assessments																																	42						
13.2 Reporting																																		43				
PHASE III: STUDY TERMINATION																																						
TASK 14: STUDY TERMINATION																																						
14.1 Preparation of final reserve results																																		44				
14.2 Training audit and report																																				45		
14.3 Compilation of main report																																				46		
TASK 15: CAPACITY BUILDING – TRAINING PROGRAMME																																						
15.1 Design and application of training program		3																																				
15.2 Introductory EWR Workshop																																						
15.3 Individual training: Task 1 - Management																																						
15.4 Individual training: Task 5 - BHNR																																						
Assessment							8																															
Report								9																														
15.5 Task 6 - Field Survey: Resource Units																																						

Task Description	2007											2008												2009												2010		
	FEB	MAR	APR	MAY	JUN	JUL	AUG	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	OCT	NOV	DEC	JAN	FEB	MAR
15.6 Individual training: Task 7 - Wetland																																						
15.7 Individual training: Task 8																																						
15.7.1 Hydrology and Hydraulics																																						
15.7.2 Geomorphology																																						
15.7.3 Macro invertebrates																																						
15.8 Field survey: Task 9																																						
15.9 Technical EWR training workshop																																						
15.10 EWR specialist workshop: Task 9																																						
15.11 Individual training: Task 10 - Socio-economic study																																						
15.12 Individual training: Task 12.1 - Operational scenarios																																						
Task 12.2 - Socio-economic consequences																																						

8 RESOURCES AND BUDGET

The total contract value is **R 4.8 million** inclusive of R 70 000 allocated for escalation subject to DWAF approval. The contract price is inclusive of 14% VAT. Note that the escalation or increment is highly under-budgeted, but was limited by the total budget available to the study. It should be noted that **no** contingencies are allowed for in the budget. No spare budgetary capacity has been allocated to any tasks.

Budgeting accurately for tasks that are heavily fieldwork dependent is extremely difficult, particularly given the long-term nature of the project and the unpredictable nature of certain expenditure items e.g. cost of petrol and transport. In certain instances time may be exceeded but there may be under-expenditure on disbursements and *vice versa*. The project team therefore requests the right to substitute time for disbursements and *vice versa*, provided the total budget is not exceeded.

The financial detail for this project is outlined as followed:

APPENDIX A.
- Complete study budget.
- Cash flow projection.
- Resource Utilization summary.

APPENDIX B.
- Hourly rates and disbursement tariffs.

Please note that the monthly allocations are according to when the activity occurs and not necessarily when invoiced.

9 PROJECT MONITORING AND CONTROL

The project will be managed along strict project control guidelines. These will be based on the concept of "critical path management". In order to ensure that the project is managed so as to achieve all objectives on time, within budget and as per the stipulated briefs, the following will be put in place:

- A set of clear and concise briefs detailing their programme of work, budget and programme of deliverables will be sent out to all task leaders as part of their contracts once the Inception Report has been finalised.
- An example of the information required for the Progress Reports will be sent to each task leader, after discussion regarding layout with the Project Managers.
- A consolidated Progress Report will then be forwarded from the Technical Team Leader to the Client and PMT for review one week before the PMT meeting. The Progress Reports are anticipated to include information as described in Section 4.1.2.
- "Critical path management" control allows for relatively early detection of possible non-performance. Counselling will be implemented where problem areas are identified and, if necessary, team members will be replaced with the approval of the PMT and Client. Delays in deliverables will be identified to the PMT. Changes to the programme will be presented to the PMT for approval.

10 REPORT PRODUCTION, GIS AND DATA STORAGE

10.1 REPORT PRODUCTION

- The budget allows for two rounds of comments:
  - One round from the CD: RDM and PM PSP.
  - One round from the PSC.
- Four weeks are allocated for PMT and PSC review of the draft report respectively.
- Once both rounds of comments have been received, the report will be updated and a final report will be submitted.
- The technical PSP budget does not allow for external reviewers.
- All draft reports will be provided in electronic format.
- A total of four full colour final report copies will be provided for each deliverable.

10.2 CDs

A .PDF and MS WORD version of the final documents will be provided at the end of the study. Five CDs will be provided to the Client. If the budget allows, a fully interactive file with links, bookmarks and thumbnails will be produced.

10.3 GIS

The budget does allow for a GIS mapping system.

10.4 DATA STORAGE

Where possible all electronic data will be saved as part of the .PDF CD set. The budget does not, however, allow for the development of a data management system.

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APPENDIX A:

UPPER VAAL COMPREHENSIVE RESERVE DETERMINATION STUDY: FINANCIAL COMPONENTS

A1 COMPLETE STUDY BUDGET

Task No	Affil[1]	HDI	Task Cost	PROFESSIONAL FEES			DISB[2]
				Rate	Time (hr)	Cost	Cost
TASK 1 - PROJECT MANAGEMENT							
1.1 Internal technical team management and coordination							
Koekemoer, S	KAS	1	154720	320	356	113920	40800
Louw, S	WFA	1	12000	150	80	12000	
1.2 PMT Meetings (Progress meetings)							
Louw, D	WFA	1	29380	420	64	26880	2500
1.3 Liaison with other studies							
Koekemoer, S	KAS	1	25600	320	80	25600	
1.4 Financial management							
Koekemoer, S	KAS	1	25600	320	80	25600	
TOTAL TASK 1			**303260**		**788**	**244960**	**58300**
PHASE I: STUDY INITIATION AND DESIGN							
TASK 2 - PROJECT PLANNING AND PROCESS INTEGRATION							
Louw, D: Technical coordination and planning	WFA	1	6720	420	16	6720	
2.1 Design of project plan and available current data collection							
Birkhead, D	SS	0	9820	420	16	6720	3100
Koekemoer, S	KAS	1	19120	320	56	17920	1200
Louw, D	WFA	1	12180	420	24	10080	2100
Louw, S	WFA	1	3400	150	16	2400	1000
Rountree, M	WCS	0	7800	375	16	6000	1800
Inception Report							
Huggins, G	WFA	0	1680	420	4	1680	
Hughes, D	IWR	0	1040	520	2	1040	
Koekemoer, S	KAS	1	17920	320	56	17920	
Louw, D	WFA	1	8400	420	20	8400	
Louw, S	WFA	1	4600	150	24	3600	1000
Tlou, T	WFA	1	2400	600	4	2400	
2.2 Mobilisation of study team							
Koekemoer, S	KAS	1	7680	320	24	7680	
Louw, D	WFA	1	1680	420	4	1680	
Louw, S	WFA	1	5300	150	32	4800	500
TOTAL TASK 2			**109740**		**314**	**99040**	**10700**
PHASE II: STUDY IMPLEMENTATION							
TASK 3 - PES, EIS and SCI: QUATERNARY BASIS							
3.1 Preparation							
Huggins, G	WFA	0	3360	420	8	3360	
Louw, D	WFA	1	9240	420	22	9240	
Louw, S	WFA	1	1800	150	12	1800	
3.2 Reconnaissance assessment (includes prelim site selection)							
Huggins, G	WFA	0	23980	420	44	18480	5500
Kotze, P	CS	0	21700	350	44	15400	6300
Louw, D	WFA	1	31740	420	42	17640	14100
Birkhead, D	SS	0	23980	420	44	18480	5500
3.3 Application of EcoStatus models (PES, EIS							

Task No	Affil[1]	HDI	Task Cost	PROFESSIONAL FEES			DISB[2]
				Rate	Time (hr)	Cost	Cost
and SCI)							
Huggins, G	WFA	0	6720	420	16	6720	
Kotze, P	CS	0	8400	350	16	5600	2800
Louw, D	WFA	1	7420	420	16	6720	700
Koekemoer, S	KAS	1	5920	320	16	5120	800
3.4 Database and Reporting							
Huggins, G	WFA	0	3360	420	8	3360	
Koekemoer, S	KAS	1	5340	320	12	3840	1500
Louw, D	WFA	1	16800	420	40	16800	
Engelbrecht, C (GIS)	WFA	1	19600	350	56	19600	
TOTAL TASK 3			**189360**		**396**	**152160**	**37200**
TASK 4 - LIMITED PUBLIC AWARENESS: ASSESSMENT							
Huggins, G	WFA	0	40960	420	88	36960	4000
Koekemoer, S	KAS	1	5120	320	16	5120	
Louw, S	WFA	1	1200	150	8	1200	
TOTAL TASK 4			**47280**		**112**	**43280**	**4000**
TASK 5 - BASIC HUMAN NEEDS RESERVE							
Assessment							
Huggins, G	WFA	0	5360	420	8	3360	2000
Report							
Huggins, G	WFA	0	5360	420	8	3360	2000
Total Task 5			**10720**		**16**	**6720**	**4000**
TASK 6 - RESOURCE UNITS							
Louw, D: Technical coordination and planning	WFA	1	8400	420	20	8400	
Louw, D: Liaison with other modules	WFA	1	5200	420	10	4200	1000
6.1 Geomorphological zones							
6.2 EcoRegions							
6.3 System operation							
6.4 Water quality sub-units							
6.5 Groundwater sub-units							
6.6 Identification of Resource Units							
Koekemoer, S	KAS	1	6920	320	16	5120	1800
Louw, D	WFA	1	6720	420	16	6720	
6.7 EWR site selection and dry season survey (10 sites)							
A Prelim ID of sites							
Included in reconnaissance assessment							
B Dry season survey Week 1							
Birkhead, D	SS	0	30980	420	44	18480	12500
Koekemoer, J	KAS	0	16300	320	40	12800	3500
Kotze, P	CS	0	19100	350	44	15400	3700
Louw, D	WFA	1	33300	420	40	16800	16500
Palmer, R	NC	0	20560	420	43	18060	2500
Rountree, M	WCS	0	22000	375	52	19500	2500
B Dry season survey Week 2							
Birkhead, D	SS	0	30980	420	44	18480	12500
Koekemoer, J	KAS	0	16300	320	40	12800	3500
Kotze, P	CS	0	19100	350	44	15400	3700

Task No	Affil[1]	HDI	Task Cost	PROFESSIONAL FEES			DISB[2]
				Rate	Time (hr)	Cost	Cost
Louw, D	WFA	1	32300	420	40	16800	15500
Palmer, R	NC	0	20560	420	43	18060	2500
Rountree, M	WCS	0	22000	375	52	19500	2500
C Habitat modelling survey							
Birkhead, D	SS	0	17440	420	32	13440	4000
Louw, D	WFA	1	21940	420	32	13440	8500
6.8 RU Report							
Engelbrecht, C (GIS)	WFA	1	11200	350	32	11200	
Koekemoer, S	KAS	1	12160	320	38	12160	
Louw, D	WFA	1	6720	420	16	6720	
Louw, S	WFA	1	3400	150	16	2400	1000
Total Task 6			**383580**		**754**	**285880**	**97700**
TASK 7 - WETLAND TYPING AND ECOCLASSIFICATION							
7.1 Wetland inventory							
Rountree, M	Fluvius	0	11000	375	24	9000	2000
7.2 Wetland classification							
Rountree, M	Fluvius	0	14250	375	38	14250	
7.3 Determination of Reference conditions							
Rountree, M	Fluvius	0	9000	375	24	9000	
7.4 General current ecological conditions							
Rountree, M	Fluvius	0	9000	375	24	9000	
7.5 Identification of priority wetlands							
Rountree, M	Fluvius	0	9000	375	24	9000	
7.6 Ecological Importance and Sensitivity							
Rountree, M	Fluvius	0	6000	375	16	6000	
7.7 WHI assessment							
Rountree, M	Fluvius	0	17000	375	24	9000	8000
7.8 Reporting							
Rountree, M	Fluvius	0	14250	375	38	14250	
Total Task 7			**89500**		**212**	**79500**	**10000**
TASK 8 - COMPREHENSIVE RIVER ECOCLASSIFICATION							
Louw, D: Technical coordination and planning	WFA	1	6720	420	16	6720	
Louw, D: Liaison with other modules	WFA	1	6040	420	12	5040	1000
8.1 Suite of EcoStatus models							
Hughes, D	IWR	0	8320	520	16	8320	
Koekemoer, S	KAS	1	12800	320	40	12800	
Kotze, P	CS	0	16800	350	48	16800	
Louw, D	WFA	1	3360	420	8	3360	
Mackenzie, J	BRS	0	16800	350	48	16800	
Palmer, R	NC	0	20160	420	48	20160	
Rountree, M	WCS	0	24000	375	48	18000	6000
8.2 Index of Habitat Integrity							
Louw, D	WFA	1	16800	420	40	16800	
8.3 EcoStatus assessment							
Louw, D	WFA	1	10080	420	24	10080	
8.4 EcoClassification specialist meeting: Workshop							
Koekemoer, S	KAS	1	12720	320	36	11520	1200

Task No	Affil[1]	HDI	Task Cost	PROFESSIONAL FEES			DISB[2]
				Rate	Time (hr)	Cost	Cost
Kotze, P	CS	0	18600	350	38	13300	5300
Louw, D	WFA	1	18420	420	36	15120	3300
Louw, S	WFA	1	7900	150	36	5400	2500
Mackenzie, J	BS	0	15400	350	36	12600	2800
Palmer, P	NC	0	20860	420	38	15960	4900
Rountree, M	WCS	0	16300	375	36	13500	2800
8.5 Reporting							
Koekemoer, S	KAS	1	17920	320	56	17920	
Louw, D	WFA	1	12080	420	24	10080	2000
Louw, S (editing and final production)	WFA	1	2400	150	16	2400	
Total Task 8			**284480**		**700**	**252680**	**31800**
TASK 9 - EWR SCENARIO ASSESSMENT							
Louw, D: Technical coordination and planning	WFA	1	16800	420	40	16800	
Louw, D: Liaison with other modules	WFA	1	7720	420	16	6720	1000
9.1 Hydraulic calibration and wet season site visit (10 sites)							
A High flow calibration							
Birkhead, D	SS	0	24650	420	40	16800	7850
Koekemoer, J	KAS	0	16500	320	40	12800	3700
Louw, D	WFA	1	26900	420	40	16800	10100
B Hydraulic calibration							
Birkhead, D	SS	0	24050	420	40	16800	7250
Koekemoer, S	KAS	1	17020	320	36	11520	5500
C Hydraulic calibration & field surveys							
Birkhead, D	SS	0	28300	420	40	16800	11500
Koekemoer, J	KAS	0	16500	320	40	12800	3700
Kotze, P	CS	0	17700	350	40	14000	3700
Louw, D	WFA	1	24300	420	40	16800	7500
Palmer, R	NC	0	28920	420	56	23520	5400
Mackenzie, J	BRS	0	24600	350	56	19600	5000
9.2 EcoHydraulic modelling and Sediment Transport Modelling							
Birkhead, D	SS	0	73920	420	176	73920	
Rountree, M	WCS	0	9000	375	24	9000	
9.3 EcoHydrology analysis							
Hughes, D	IWR	0	62400	520	120	62400	
9.4 Specialist meeting preparation							
Koekemoer, S	KAS	1	7680	320	24	7680	
Louw, D	WFA	1	7040	420	12	5040	2000
Louw, S	WFA	1	3600	150	24	3600	
9.5 EWR scenario determination							
A Workshop 1							
Birkhead, D	SS	0	23460	420	43	18060	5400
Hughes, D	IWR	0	20360	520	28	14560	5800
Koekemoer, S	KAS	1	17000	320	40	12800	4200
Kotze, P	CS	0	20500	350	42	14700	5800
Louw, D	WFA	1	20600	420	40	16800	3800
Louw, S	WFA	1	9000	150	40	6000	3000
Mackenzie, J	BS	0	12600	350	28	9800	2800

Task No	Affil[1]	HDI	Task Cost	PROFESSIONAL FEES			DISB[2]
				Rate	Time (hr)	Cost	Cost
Palmer, P	NC	0	22200	420	40	16800	5400
Rountree, M	Fluvius	0	13300	375	28	10500	2800
B Workshop 2							
Birkhead, D	SS	0	23460	420	43	18060	5400
Hughes, D	IWR	0	20360	520	28	14560	5800
Koekemoer, S	KAS	1	17000	320	40	12800	4200
Kotze, P	CS	0	20500	350	42	14700	5800
Louw, D	WFA	1	20600	420	40	16800	3800
Louw, S	WFA	1	9000	150	40	6000	3000
Mackenzie, J	BS	0	12600	350	28	9800	2800
Palmer, P	NC	0	22200	420	40	16800	5400
Rountree, M	Fluvius	0	13300	375	28	10500	2800
9.6 Reporting							
Koekemoer, S	KAS	1	19200	320	60	19200	
Louw, D	WFA	1	18800	420	40	16800	2000
Louw, S	WFA	1	6000	150	40	6000	
Total Task 9			**799640**		**1702**	**645440**	**154200**
TASK 10 -SOCIO ECONOMIC PRESENT STATE EVALUATION							
10.1: Identification of the sectors directly and indirectly using water from the Vaal River System							
Mullins, D	CE	0	20000	500	40	20000	
Tlou, T	WFA	0	26500	600	40	24000	2500
10.2 Determination of economic zones and current water allocation to each category of use							
Mullins, D	CE	0	20000	500	40	20000	
Tlou, T	WFA	0	28500	600	40	24000	4500
10.3 Determination of the appropriate valuation technique for each use category							
Mullins, D	CE	0	18000	500	36	18000	
Tlou, T	WFA	0	26500	600	40	24000	2500
10.4 Economic value of water use by each category							
Mullins, D	CE	0	18000	500	36	18000	
Tlou, T	WFA	0	27500	600	40	24000	3500
Total Task 10			**185000**		**312**	**172000**	**13000**
TASK 11: RAPID III - EXTRAPOLATION							
Rapid data collation							
Birkhead, D	SS	0	32340	420	52	21840	10500
Kotze, P	CS	0	21700	350	52	18200	3500
Louw, D	WFA	1	37900	420	70	29400	8500
Palmer, R	NC	0	25340	420	52	21840	3500
Total Task 11			**117280**		**226**	**91280**	**26000**
TASK 12 - DETERMINING OPERATIONAL SCENARIOS AND CONSEQUENCES							
Louw, D Technical coordination and planning	WFA	1	13440	420	32	13440	
Louw, D Liaison with other modules	WFA	1	11080	420	24	10080	1000
12.1 Liaison: Yield modelling							
Hughes, D	IWR	0	41840	520	72	37440	4400
Louw, D	WFA	1	26880	420	64	26880	
12.2 Determining ecological consequences							

Task No	Affil[1]	HDI	Task Cost	PROFESSIONAL FEES			DISB[2]
				Rate	Time (hr)	Cost	Cost
Hughes, D	IWR	0	26100	520	40	20800	5300
Koekemoer, S	KAS	1	16500	320	40	12800	3700
Kotze, P	CS	0	19300	350	40	14000	5300
Louw, D	WFA	1	20100	420	40	16800	3300
Louw, S	WFA	1	8500	150	40	6000	2500
Mackenzie, J	BS	0	17300	350	40	14000	3300
Palmer, P	NC	0	21700	420	40	16800	4900
Rountree, M	WCS	0	18300	375	40	15000	3300
12.3 Determining consequences on socio economics & Ecosystem services							
A Change in value of the socio-economic activities for different EWR scenarios							
Huggins, G	WFA	0	34300	420	70	29400	4900
Mullins, D	CE	0	28000	500	56	28000	
Tlou, T	WFA	0	47100	600	70	42000	5100
Ecological input							
Koekemoer, J	KAS	0	7320	320	16	5120	2200
Louw, D	WFA	1	8520	420	16	6720	1800
Mackenzie, J	BRS	0	7400	350	16	5600	1800
Palmer, P	NC	0	10120	420	16	6720	3400
Rountree, M	WCS	0	7800	375	16	6000	1800
B Changes in value of ecosystem services for different EWR scenarios							
Huggins, G	WFA	0	29400	420	70	29400	
Mullins, D	CE	0	28000	500	56	28000	
Tlou, T	WFA	0	46500	600	70	42000	4500
C Optimisation of the overall benefits from water re-allocation scenarios							
Huggins, G	WFA	0	29400	420	70	29400	
Mullins, D	CE	0	28000	500	56	28000	
Tlou, T	WFA	0	46500	600	70	42000	4500
12.4 Reporting							
Koekemoer, S	KAS	1	17920	320	56	17920	
Louw, D	WFA	1	13440	420	32	13440	
Louw, S	WFA	1	5800	150	32	4800	1000
Tlou, T	WFA	1	24000	600	40	24000	
Total Task 12			**660560**		**1340**	**592560**	**68000**
TASK 13 - IDENTIFICATION OF ECOSPECS (Ecological RQO's)							
13.1 Identification of EcoSpecs							
Koekemoer, S	KAS	1	15720	320	36	11520	4200
Kotze, P	CS	0	17400	350	36	12600	4800
Louw, D	WFA	1	19920	420	36	15120	4800
Mackenzie, J	BRS	0	15400	350	36	12600	2800
Palmer, R	NC	0	17720	420	36	15120	2600
Rountree, M	WCS	0	16300	375	36	13500	2800
13.2 Reporting							
Koekemoer, S	KAS	1	11616	320	32	10240	1376
Louw, D	WFA	1	6720	420	16	6720	
Louw, S	WFA	1	2400	150	16	2400	
Total Task 13			**123196**		**280**	**99820**	**23376**

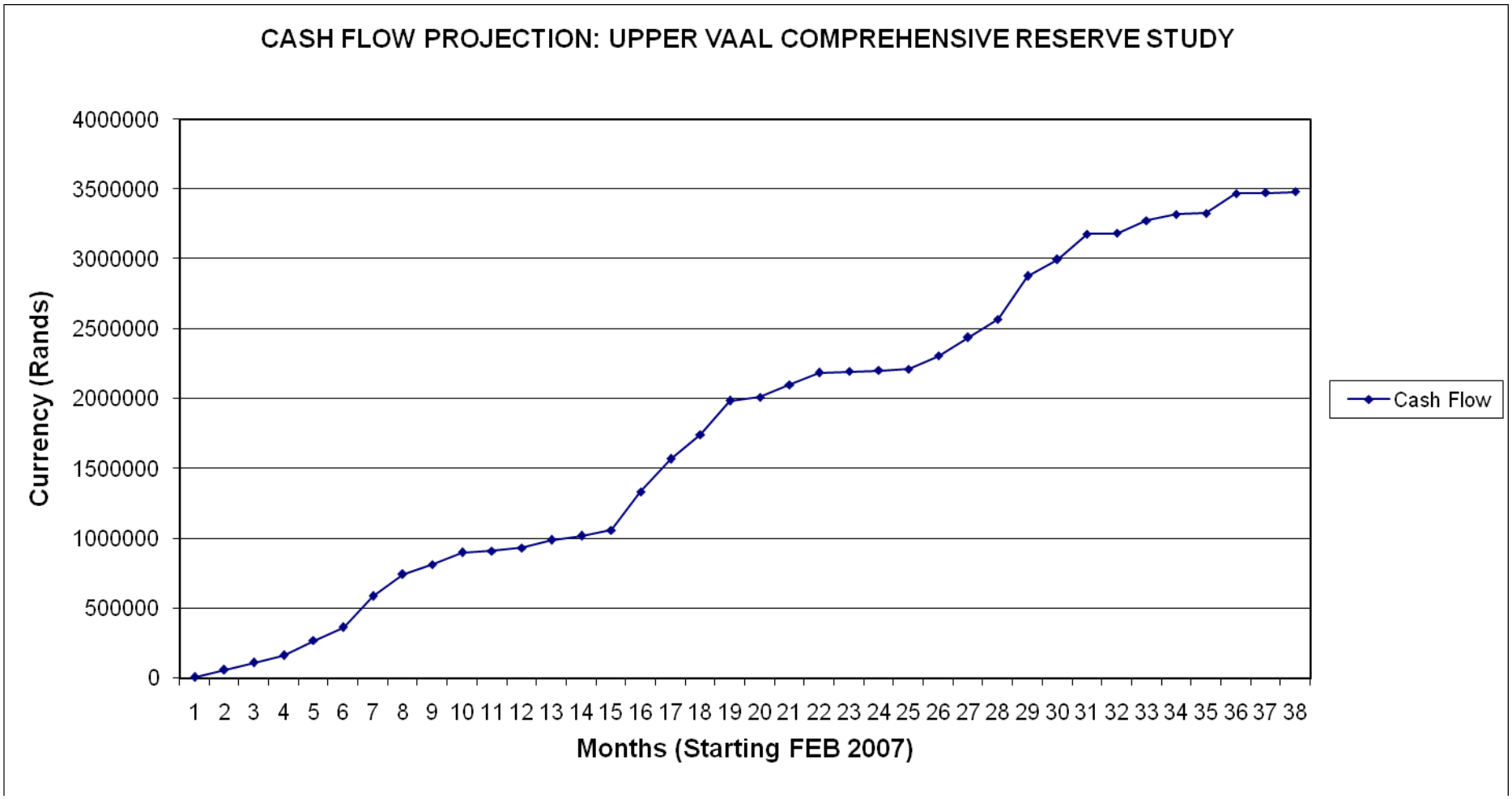
Task No	Affil[1]	HDI	Task Cost	PROFESSIONAL FEES			DISB[2]
				Rate	Time (hr)	Cost	Cost
PHASE III: STUDY TERMINATION							
TASK 14 - STUDY TERMINATION							
Louw, D Liaison with other modules	WFA	1	2680	420	4	1680	1000
14.1 Preparation of final Reserve results							
Hughes, D	IWR	0	16640	520	32	16640	
14.2 Training audit and report							
(Included in Task 15.13)							
14.3 Compilation of main report							
Huggins, G	WFA	0	13580	420	24	10080	3500
Koekemoer, S	KAS	1	45820	320	72	23040	22780
Louw, D	WFA	1	33740	420	72	30240	3500
Louw, S	WFA	1	14000	150	80	12000	2000
Tlou, T	WFA	1	21200	600	32	19200	2000
Engelbrecht, C			19600	350	56	19600	
Total Task 14			**167260**		**372**	**132480**	**34780**
TASK 15 - CAPACITY BUILDING: TRAINING PROGRAMME							
15.1 Design and application of training programme							
Koekemoer, S: Coordination + management	KAS	1	10240	320	32	10240	
Louw, D: Technical input	WFA	1	4360	420	8	3360	1000
Scherman, P: Programme design + overview	CES	1	40240	420	72	30240	10000
15.2 Introductory EWR workshop							
Niehaus, B: Macro Invertebrate trainee	CS	0	200	150		0	200
Senoge, N: Macro Invertebrate trainee	CS	1	2000	100		0	2000
Desai, A: Hydraulics trainee	AFRICON	1	400	190		0	400
Hlongwane, L: Geomorphology trainee	WCS	1	200	110		0	200
Koekemoer, J: Fish trainee	KAS	0	2600	320		0	2600
Haasbroek, B: Hydrology trainee	IS	0	400	350		0	400
Kotze, P: Fish specialist	CS	0	2100	350		0	2100
Koekemoer, S: Reserve Process	KAS	1	400	320		0	400
Louw, D: Lecturer	WFA	1	5440	420	12	5040	400
Scherman, P: Lecturer	CES	1	11620	420	16	6720	4900
15.3 Individual training: Task 1 - Management							
Louw, S: Trainee - Admin + coordination	WFA	1	6000	150	40	6000	
Louw, S: Trainee - Progress meetings	WFA	1	4800	150	32	4800	
Louw, S: Trainee - Financial admin	WFA	1	30000	150	200	30000	
Louw, D: Mentor	WFA	1	7620	420	16	6720	900
15.4 Individual training: Task 5 - BHNR							
Maasdorp, K: Trainee	WFA	1	4800	150	32	4800	
Huggins, G: Mentor (covered in Task 5)	WFA	0					
15.5 Task 6 - Field Survey: Resource Units							
Desai, A: Trainee (site selection + dry season survey)	AFRICON	1	10100	190	40	7600	2500
Hlongwane, L: Geomorphology trainee	WCS	1	8900	110	40	4400	4500
Mentors (covered in Task 6)							
15.6 Individual training: Task 7 - Wetland							
Maphumlo, N: Trainee	WCS	1	11000	110	100	11000	
Rountree, M: Mentor (covered in Task 7)	Fluvius						
15.7 Individual training: Task 8							

Task No	Affil[1]	HDI	Task Cost	PROFESSIONAL FEES			DISB[2]
				Rate	Time (hr)	Cost	Cost
15.7.1 Hydrology + Hydraulics							
Haasbroek, B: Hydrology trainee	IS	0	27600	350	56	19600	8000
Hughes, D: Mentor	IWR	0	24960	520	48	24960	
Desai, A: Hydraulics trainee	AFRICON	1	10640	190	56	10640	0
Birkhead, A: Hydraulics trainee	SS	0	13440	420	32	13440	
15.7.2 Geomorphology			0				
Rountree, M: Mentor	Fluvius	0	1500	375	4	1500	
Hlongwane, L: Geomorphology trainee	WCS	1	440	110	4	440	
15.7.3 Macro Invertebrates							
Palmer, R: Mentor	NC	0	2520	420	6	2520	
Niehaus, B: Macro Invertebrate trainee	CS	0	900	150	6	900	
Senoge, N: Macro Invertebrate trainee	CS	1	600	100	6	600	
15.8 EcoClassification specialist workshop: Task 8			0				
Niehaus, B: Macro Invertebrate trainee	CS	0	4200	150	20	3000	1200
Senoge, N: Macro Invertebrate trainee	CS	1	5300	100	20	2000	3300
Hlongwane, L: Geomorphology trainee	WCS	1	3900	110	20	2200	1700
Koekemoer, J: Fish trainee	KAS	0	6400	320	20	6400	
15.9 Field survey: Task 9							
Niehaus, B: Macro Invertebrate trainee	CS	0	6200	150	28	4200	2000
Senoge, N: Macro Invertebrate trainee	CS	1	4800	100	28	2800	2000
Mentors (covered in Task 9)							
15.10 Technical EWR training workshop							
Koekemoer, J: Fish trainee	KAS	0	2000	320		0	2000
Niehaus, B: Macro Invertebrate trainee	CS	0	200	150		0	200
Senoge, N: Macro Invertebrate trainee	CS	1	3000	100		0	3000
Haasbroek, B : Hydrology trainee	IS	0	200	350		0	200
Desai, A: Hydraulics trainee	AFRICON	1	400	190		0	400
Hlongwane, L: Geomorphology trainee	WCS	1	200	110		0	200
Louw, D: Lecturer	WFA	1	11980	420	24	10080	1900
Scherman, P: Lecturer	CES	1	13580	420	24	10080	3500
15.11 EWR specialist workshop: Task 9							
Niehaus, B: Macro Invertebrate trainee	CS	0	4900	150	24	3600	1300
Senoge, N: Macro Invertebrate trainee	CS	1	7400	100	24	2400	5000
Desai, A: Hydraulics trainee	AFRICON	1	5960	190	24	4560	1400
Haasbroek, B: Hydrology trainee	IS	0	8500	350	24	8400	100
Hlongwane, L: Geomorphology trainee	WCS	1	4340	110	24	2640	1700
Koekemoer, J: Fish trainee	KAS	0	13800	320	40	12800	1000
Mentors (covered in Task 9)							
15.12 Individual training: Task 10 - Socio-economic study							
Mosaka, D: Trainee	CE	1	78400	350	224	78400	
Schwartz, L: Trainee	CE	1	83200	400	208	83200	
Tlou, T: Mentor (covered in Task 10)							
15.13 Individual training: Task 12.1 - Operational scenarios							
Koekemoer, S: Yield modelling trainee	KAS	1	12800	320	40	12800	
Task 12.2 - Socio-economic consequences							
Mosaka, D: Socio economics consequences and ecosystem services	CE	1	58800	350	168	58800	

Task No	Affil[1]	HDI	Task Cost		PROFESSIONAL FEES				DISB[2]
					Rate	Time (hr)	Cost		Cost
Schwartz, L: Socio economics consequences and ecosystem services	CE	1	67200		400	168	67200		
15.14 Training evaluation and reporting									
Koekemoer, S	KAS	1	3910		320	8	2560		1350
Scherman, P	CES	1	12080		420	24	10080		2000
Total Task 15			**669670**			**2042**	**593720**		**75950**
TOTAL (Vat Exclusive)			**4140526**			**9566**	**3491520**		**649006**
PROJECT TOTAL BUDGET (VAT EXCLUSIVE)			**4140526**						
Escalation fee per annum applicable from Jan 2008			**70000**						
			4210526						
14% VAT			**589474**						
PROJECT TOTAL BUDGET (VAT EXCLUSIVE)			**4800000**						

1 Affiliation 2 Disbursements

A2 CASH FLOW PROJECTION



A3 RESOURCE UTILIZATION: SUMMARY

HDI	Total Hours	% Time committed	Hourly Rate	Total Income	NON HDI	Total Hours	% Time committed	Hourly Rate	Total Income
Engelbrecht, Ciske	144	2.81%	350	50400	Birkhead, Drew	646	14.57%	420	271320
Koekemoer, Shael	1526	29.73%	320	488320	Haasbroek, Bennie	80	1.80%	350	28000
Louw, Delana	1316	25.64%	420	552720	Huggins, Greg	418	9.43%	420	175560
Louw, Shileen	824	16.06%	150	123600	Koekemoer, Johan	236	5.32%	320	75520
Maasdorp, Katie	32	0.62%	150	4800	Kotze, Pieter	486	10.96%	350	170100
Mosaka, David	392	7.64%	350	137200	Mackenzie, James	288	6.50%	350	100800
Senoge, Ntake	78	1.52%	100	7800	Niehaus, Brenton	78	1.76%	150	11700
Schwartz, Lindi	376	7.33%	400	150400	Palmer, Rob	458	10.33%	420	192360
Maphumulo, Nonkanyiso	100	1.95%	110	11000	Rountree, Mark	592	13.35%	375	222000
Hlongwane, Lindo	88	1.71%	110	9680	Hughes, Denis	386	8.71%	520	200720
Scherman, Patsy	136	2.65%	420	57120	Mullins, Dawie	320	7.22%	500	160000
Desai, Ahmed	120	2.34%	190	22800	Tlou, Toriso	446	10.06%	600	267600
TOTAL	**5132**	**100.00%**		**1615840**		**4434**	**100.00%**		**1875680**

APPENDIX B

UPPER VAAL COMPREHENSIVE RESERVE DETERMINATION STUDY: HOURLY RATES AND DISBURSEMENT TARIFFS

B1 HOURLY RATES AND DISBURSEMENT TARIFFS

A summary of the PSPs involved in the Upper Vaal Comprehensive Reserve is given below (Table B1). The DWAF approval rates and disbursement tariffs are outlined in Table B2.

Table B1 Summary of PSPs and Applicable Rates

Team member	Company name	Position in company	Position in team	Resp[1] Level	Rate (R/h)	HDI	Applicable experience
						Yes/No	Years
Study team with negotiated rates below R432/h (VAT excluded)							
Desai, Ahmed	AFRICON	Hydraulics	Trainee	B	190	Yes	0
Birkhead, Drew	Streamflow Solutions	Member	Specialist	E	420	No	14
Engelbrecht, Ciske	WFA	Specialist	Specialist	E	350	Yes	12
Haasbroek, Bennie	Innovative Solutions	Hydrology	Trainee	C	350	No	10
Hlongwane, Lindo	Wetland Consulting Services	Internship	Trainee	B	110	Yes	0
Huggins, Greg	WFA	Director	Specialist	E	420	No	15
Koekemoer, Johan	KAS	Member	Specialist	D	320	No	8
Koekemoer, Shael	KAS	Member	Specialist	D	350	Yes	4
Kotze, Pieter	Clean Stream	Director	Specialist	D	350	No	8
Louw, Delana	WFA	Director	Specialist	E	420	Yes	15
Louw, Shileen	WFA	Office manager	Trainee	C	150	Yes	1
Maasdorp, Katie	WFA	Junior Consultant	Trainee	C	150	Yes	2
Mackenzie, James	BioRiver Solutions	Member	Specialist	D	350	No	8
Maphumulo, Nonkanyiso	Wetland Consulting Services	Internship	Trainee	B	110	Yes	0
Mosaka, David	Conningarth Economists	Economist	Trainee	D	350	Yes	7
Niehaus, Brenton	Clean Stream	Director	Trainee	D	150	No	8
Ntake, Senoge	Clean Stream	Junior Aquatic Scientist	Trainee	C	100	Yes	2
Palmer, Rob	Nepid	Member	Specialist	D	420	No	14
Rountree, Mark	Fluvius Environmental Consultants	Director	Specialist	D	375	No	8
Scherman, Patsy	CES	Director	Specialist	F	420	Yes	15
Schwartz, Lindi	Conningarth Economists	Econometrician	Trainee	D	400	Yes	5
Study team with negotiated rates above R432/h (VAT excluded)							
Hughes, Denis	IWR	Professor	Specialist	F	520	No	25
Mullins, Dawie	Conningarth Economists	Dr	Specialist	F	500	No	25
Tlou, Toriso	WFA	Director	Specialist	F	600	No	20

1 Responsibility

The negotiated rates are fixed to April 2008.

Table B2 In-house disbursement tariffs

(i) Printing, copying, etc. (exclusive of VAT)	
Typing and printing of original per A4 colour sheet.	R 7,50
Typing and printing of original per A4 B&W sheet.	R 2,50
Duplicating per A4 sheet (B&W).	R 0,55
Duplicating per A3 sheet.	R 0,75
Duplicating in colour per A4 sheet.	R 7,00
Duplicating in colour per A3 sheet.	R 9,50
Printing in colour on photo quality paper per A4 sheet.	R 15,00
Spiral binding with A4 covers (per book).	R 30.00
Monthly telephone and email.	R 350.00
(ii) Rates for site visit equipment (exclusive of VAT)	
Boat and engine hire.	R350 per day or part there-of
Fish shocker.	R250 per day or part there-of
Camera.	R70 per day or part there-of
GPS.	R60 per day or part there-of
Total Station.	R350 per day or part there-of
Current meter large.	R250 per day or part there-of
Current meter small.	R200 per day or part there-of
SASS Equipment.	R60 per day or part there-of
Data projector.	R350 per day or part there-of