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Classification of Significant Water Resources(River, Wetlands, Groundwater and Lakes) in the Upper Middle and Lower Vaal Water Management Areas (WMA) 8,9,10

INCEPTION REPORT





Final
March 2011

Prepared by:

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Prepared by:

WRP Consulting Engineers (Pty) Ltd in association with DMM Development Consultants CC, Rivers for Africa eFlows Consulting (Pty) Ltd, Conningarth Economists, Koekemoer Aquatic Services and Zitholele Consulting (Pty) Ltd.

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Title:	***Inception Report***
Authors:	*Study Team*
Study Name:	***Classification of Significant Water Resources (River, Wetlands, Groundwater and Lakes) in the Upper, Middle and Lower Vaal Water Management Areas (WMA) 8,9,10***
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Classification of Significant Water Resources (River, Wetlands, Groundwater and Lakes) in the Upper, Middle and Lower Vaal Water Management Areas (WMA) 8,9,10

Inception Report

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ABBREVIATIONS

Acronym	Meaning
AOA	Annual Operating Analysis
BBM	Building Block Methodology
CMA	Catchment Management Agency
CMS	Catchment Management Strategy
CV	Coefficient of Variability
Dir: NWRP	Directorate: National Water Resource Planning
Dir: WRPS	Directorate: Water Resource Planning Systems
Dir: RDM	Directorate: Resource Directed Measures
DRM	Desktop Reserve Model
DSC	Dead Storage Capacity
DWA	Department of Water Affairs
EC	Ecological Category
EGSA	Ecosystem Goods, Services and Attributes
EIS	Ecological Importance and Sensitivity
ER	Ecological Reserve
ESBC	Ecological Sustainability Base Configuration
EWR	Ecological Water Requirements
FSL	Full Supply Level
GFSC	Gross Full Supply Capacity
GGP	Gross Geographic Product
HFSR	Habitat Flow Stressor Response
HFY	Historic Firm Yield
ISP	Internal Strategic Perspective
IUA	Integrated Unit of Analysis
IVRS	Integrated Vaal River System
IWRM	Integrated Water Resource Management
LIM	Limnophilic Fish Species
LHDA	Lesotho Highlands Development Authority
LHWP	Lesotho Highlands Water Project
LSR	Large Semi-rheophilic Fish Species
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MOL	Minimum Operating Level
MVI	Marginal Vegetation Macroinvertebrate
NFSC	Net Full Supply Capacity
NWA	National Water Act
NWRS	National Water Resources Strategy
PES	Present Ecological State
REC	Recommended Ecological Category
RU	Resource Unit
SD	Standard Deviation
TDS	Total Dissolved Solids
VRESAP	Vaal River Eastern Sub-system Augmentation Project
VRESS	Vaal River Eastern Sub-system
VRSAU	Vaal River System Analysis Update
WDM	Water Demand Management
WC	Water Conservation
WMA	Water Management Area

Acronym	Meaning
WRC	Water Research Commission
WRCS	Water Resource Classification System
WRPM	Water Resource Planning Model
WRSAS	Water Resource Situation Assessment Study
WRSM2000	Water Resources Simulation Model 2000
WRYM	Water Resource Yield Model
WUA	Water User Association

Classification of Significant Water Resources (River, Wetlands, Groundwater and Lakes) in the Upper, Middle and Lower Vaal Water Management Areas (WMA) 8, 9, 10

Inception Report

1 INTRODUCTION

1.1 OVERVIEW

This Inception Report describes the proposed work to be undertaken by the appointed Professional Service Provider (PSP) for undertaking the Classification of Significant Water Resources (River, Wetlands, Groundwater and Lakes) in the Upper, Middle and Lower Vaal Water Management Areas (WMA) 8,9,10 Study. The study was commissioned by the Chief Directorate: Resource Directed Measures of the Department of Water Affairs (DWA) and the PSP team consists of **WRP Consulting Engineers (Pty) Ltd** in association with ***DMM Development Consultants CC***, ***Rivers for Africa eFlows Consulting (Pty) Ltd***, ***Conningarth Economists***, ***Koekemoer Aquatic Services*** *and* ***Zitholele Consulting (Pty) Ltd***.

The work description in the report is based on the identification that the data received for the Middle and Lower Vaal WMA on 18 March 2011 covers the data needs for the application of the proposed methods. During the execution of the activities and tasks of the study the data and information will be evaluated for consistency and any irresolvable anomalies and deficiencies will be brought under the attention of the Client for clarification by the data and information originators.

1.2 PURPOSE OF THE STUDY

It is the Consultant's understanding that the main objective of the study is to determine the Management Class of the significant water resources in the three Vaal WMAs over a period of 24 months, which includes the following main components:

- Inception phase;
- Water resource information and data sourcing;
- Implementation of the seven step Water Resource Classification System (WRCS);
- Communication and liaison;
- Capacity building; and
- Project management to ensure effective execution of the work and quality deliverables.

It is proposed that the description of the study area will include a synopsis of the current socio-economic situation in the project area. As the project area includes the most important economic region of the country data will be collected and analysed in terms of the three Water Management Areas as well as the tributaries and main stem areas in the project area. Specific attention will be given to water use in the Water Management Areas.

1.3 PURPOSE AND LAYOUT OF THE REPORT

The purpose of the Inception Report is to define the extend of work and associated costs based on the proposed methodology and availability of information, data as well as initial evaluations for that was carried out after the submission of the Proposal. **Section 2** of the Inception Report presents a brief background and lists previous and other current parallel studies that will be considered in this assignment. **Section 3** provides the information and data requirements followed by **Section 4** defining important study parameters including the Integrated Units of Analysis (IUA). **Section 5** and **6** describe the extent of work, with the study programme presented in **Section 7**. The proposed budget with all the related information is described in **Section 8** and finally, risks and uncertainties are presented in **Section 9** while the references are listed in **Section 10**.

1.4 STUDY AREA

The study area comprises of the water resource of the Vaal River System which includes the catchments of the Upper, Middle and the Lower Vaal Water Management Areas (see yellow shaded area in **Figure 1.1)**. Other sub-systems that also form part of the Integrated Vaal River System (IVRS) or are linked to the Vaal River System are indicated on **Figure 1.1.** These linked sub-systems will form part of the water resource system analysis (either directly or indirectly) to ensure the Management Class is determined in an integrated manner.

A concise description of the water resource infrastructure of the IVRS, the hydrological database available for the study area and water requirements of user groups were compiled as part of “Water Resource Modelling” report of the Comprehensive Reserve Determination Study (**DWA, 2010a**) and are repeated in **Appendix E** for easy reference purposes.

The Vaal River is one of the most highly utilised rivers in the country and this has resulted in a moderate to severe degradation of ecological state in most sections of the main river and tributaries. Isolated important areas do occur however centered around, for example, reserves, wetlands and less disturbed areas. The Vaal River is one of South Africa's largest rivers, and due to the scarceness of such river types in SA, this makes it important in its own right, irrespective of its state. Protection of these resources in some acceptable form, even as a heavily utilised river, is important. It must also be noted that Barbus kimberleyensis, the largemouth yellow fish, occurs in the Vaal River. This fish is Red Data listed (IUCN 2010) and is also a very popular flyfishing target. Furthermore, the Vaal River forms a centre part of one of South Africa's few World Heritage sites, the Vredefort Dome (UNESCO 2005). Pollution of the Vaal River and unstructured development might affect the status of the World Heritage site which could result in severe socio-economic problems (job losses amongst others).

Water quality problems, decreased flows (lower Vaal River) and increased flows (higher than natural especially in the dry season resulting in an aseasonal flow regime) are the major problems threatening the health of the Vaal System. South Africa, as a signatory of the Convention of Biodiversity (**CBD, 1992**) is obliged to determine

strategies to maintain and protect its biodiversity.

Water quality status in the Upper Vaal catchment is impacted on by discharges from gold mines, seepages from tailings dams, discharges from industry directly to the river, urban runoff and discharges from the large number of sewage treatment plants located in the urban areas. The return flows from sewage treatment plants have resulted in the flows in many of the river systems exceeding the natural flows. Coal mining is located in the Waterval and Grootdraai Dam catchments in the upper reaches of the Vaal River, along the banks of the Vaal Barrage below Vaal Dam (ORASECOM, 2007; cited in Scherman, 2010).

Although the Middle Vaal is less urbanized, discharges from mining operations and sewage treatment facilities still predominate. The predominant land use in the Lower Vaal is agriculture, with extensive irrigation schemes located on the Vaal River and along the Harts River (ORASECOM, 2007; cited in Scherman 2010). The following points summarize water quality status of the Vaal River (Scherman, 2010):

- The usage of water in the Vaal River is impacted by high levels of salinity and related macro-ions, which has major implications for domestic, industrial and agricultural water use.
- Eutrophication due to high nutrient levels is a key issue in the Vaal River, resulting in algal blooms and growth of water hyacinth. The algae resulting from eutrophication has led to odour and colour problems in the intake water to water treatment plants which are not geared for dealing with eutrophic waters.
- Microbiological pollution is an emerging concern.
- While sections of the upper part of the Vaal catchment have water of a good quality, the areas of concern include the Vaal Barrage and Lower Vaal River downstream of Harts River confluence.
- Elevated TDS concentrations are a concern for users downstream of the Vaal Barrage.
- Discharges from coal and gold mining, industrial discharges and decant from mines post closure, cause water quality problems in the Vaal system.
- Along the main stem of the Vaal organics has been raised as an issue by the water boards, with monitoring programmes identifying increases in Dissolved Organic Carbon (DOC) in raw intake water to the water treatment plants.

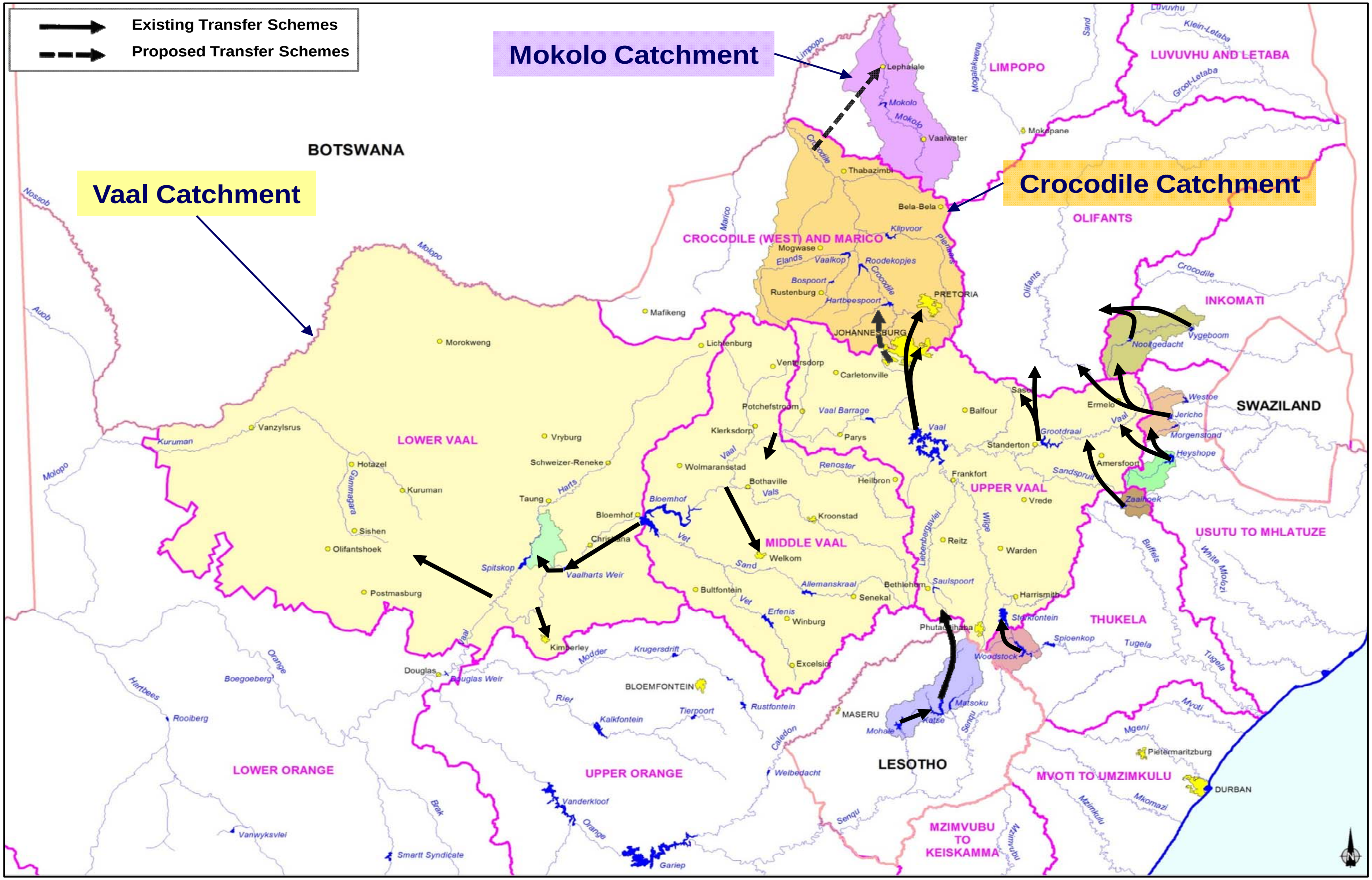


Figure 1.1: Location Map of the Vaal River System and linked sub-systems

2 BACKGROUND

2.1 OVERVIEW

The promulgation of the Regulations for the Establishment of the Water Resource Classification System (WRCS) in the Government Gazette dated 17 September 2010 paved the way for the DWA to undertake a step wise process of classifying the water resources of South Africa. This study is one of three commissioned during 2010 by the DWA and these studies are the first to implement the WRCS in the country to give effect to Section 12 of the National Water Act (Act 36 of 1998).

The seven step procedure for determining the water resource class and the associated guideline documentation were reviewed by the respective specialists who then formulated the specific methodologies applicable to the Vaal River System as described in this Inception Report. A key consideration in defining the activities, tasks and cost estimates was to rely on the availability of specific information and data from several past studies of which the most important source is the recently completed Comprehensive Reserve Determination Study.

The scale at which the analysis will be undertaken was selected in line with the resolution of the available data (the existing water resource simulation model's resolution was a key factor) as well as the main water resource features in the Vaal River System. This informed the identification of the Integrated Units of Analysis (IUA) and will be used to determine the associated additional Ecological Water Requirement nodes (sites).

The approach adopted is that new Ecological Water Requirement (EWR) nodes will be analysed by applying the extrapolation method that has already been implemented in the Upper Vaal WMA and in other catchments in the country. Details of this method can be found in (**Hughes et.al, 2006**) and (**Louw et.al. 2006**).

2.2 PREVIOUS AND PARALLEL STUDIES

The Vaal River System has been the subject of various studies in the past of which the recently completed Comprehensive Reserve Determination Study (study consisting of various separate appointments covering the surface water, groundwater, water resource system analysis as well as water quality aspects) is the most important source of information and data repository for this assignment.

Other previous and current studies that will be taken into consideration in the classification of the resources are listed below:

Recently completed studies:

- Vaal River System: Large Bulk Water Supply Reconciliation Strategy - several reports including (**DWAF, 2008a**).
- Integrated Water Quality Management Plan Study (**DWAF, 2008b**).
- Comprehensive Reserve Determination Study of the Integrated Vaal River System – several reports including (**DWA, 2010a**).

- Crocodile (West) River Reconciliation Strategy Version 1 **(DWAF 2008c).**
- Study commissioned by DWAF in the year 2005 to undertake a Situation Assessment for the Schoonspruit System and including a Reserve determination component.
- Waterval Reserve Determination Study **(DWAF, 2005).**

Current parallel studies or processes:

- Maintenance of the Vaal River System Reconciliation Strategy Study managed by the Directorate: National Water Resource Planning of DWA.
- Vaal River Annual Operating Analysis Study managed by the Directorate: Water Resources Planning Systems of DWA.
- Maintenance of the Crocodile West River System Reconciliation Strategy Study managed by the Directorate: National Water Resource Planning of DWA.
- Study to address and eradicate unlawful water use in the three Vaal Water Management Areas. Referenced in the minutes of the Vaal River System Strategy Steering Committee meeting held on 21 October 2010.
- Investigation of Bottlenecks on the Usutu GWS and Usutu Vaal Phase II GWS – several draft reports including (**DWA 2010b**).
- Inter Ministerial Committee (IMC) (supported by a team of specialists) to address the acid mine drainage (AMD) issue.
- Orange-Senqu River Commission (ORASECOM) study with the title "*Support to Phase 2 of the ORASECOM Basin-wide Integrated Water Resources Management Plan*" funded by GTZ. This study is extending the hydrological database and updating the water resources models accordingly.

3 INFORMATION REVIEW AND DATA REQUIREMENTS

Table 3.1 lists the information and data required for the execution of the work according to the methods presented in **Section 6.**

An assessment of the data and information received on 18 March 2011 for the Middle and Lower Vaal indicated that all the data and information elements that are necessary for the execution of the work are available. During the execution of the activities and tasks an evaluation of the consistency of the data will be carried out as a mater of course and any irresolvable anomalies and deficiencies will be brought under the attention of the Client for clarification by the originators.

It was also identified that the same data elements listed in **Table 3.1** would be required from other reserve determination studies that were carried out in the three Vaal WMAs (these were not part of recent Vaal River studies). These studies were conducted on the Schoonspruit, Waterval and Renoster river catchments. Request for this data was made internally in DWA as well as to the authors of those studies and an evaluation will be carried during the execution of the work once the data is received.

Data sources to be used for the assessment of the significant groundwater resources will be from existing detail hydrological studies, water use data from WARMS or the current Validation and Verification studies, appropriate groundwater characteristics data from the GRA2 and other countrywide databases, geological maps, Google Earth images and any detail studies carried out in the areas.

The information needs for the annual balance calculations (groundwater assessment) in the catchment area of the Molopo River (Lower Vaal WMA) will be based on the GRA2 database, the Vegter maps of harvest potential and exploitable potential.

The study team has been responsible for the Comprehensive Reserve Determination study of the Upper Vaal WMA and also undertook the water resource analysis of the entire Vaal River System. All the relevant information and data from these studies is therefore available and assessable.

Table 3.1: Summary of information and data requirements

Data element and Description	Importance / requirement rating	Comments
Reports		
Desktop EcoClassification report	Essential	Provides the hotspots on a catchment bases which considers a combination of ecological, socio-cultural and water resource use importance.
Basic Human Needs report	Required	
Resource Units delineation	Essential	Delineates the key rivers (identified through Desktop EcoClassification) into river stretches for which an EWR generated for an EWR site will be relevant.
Wetland Classification report	Essential	Provides on a catchment scale the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) for each quaternary catchment for wetlands.
EcoClassification at level 4 for the EWR sites	Essential	Provides the detailed PES & EIS as well as scenarios at each EWR site. Supported by all the Excel models.
Ecological Water Requirements Scenario report	Essential	Report on the EWR results for various Ecological Categories (different levels of ecological health) at each EWR site. Supported by a range of models which is also required.
Ecological and G&S consequences	Essential	Provides the ecological and G&S consequences for a range of operational scenarios. Models also required
Socio-Economic consequences	Required	Socio-economic consequences for each operational scenario
Main report	Required	
Water quality report	Essential	Report on all the water quality data collected during the study, present state assessments, water quality consequences under operational scenarios and hot spot areas.

Data element and Description		Importance / requirement rating	Comments
Desktop EcoClassification			
Photos and indexed description	Range of photographs, each with an individual name which can be linked to the above Excel file for explanations	Required	This supports the evaluation and review of the areas identified as hotspots
Database with the Desktop Ecoclassification models and all results.	The models and the results must be cross referenced to the descriptions in the report.	Essential	Database with the Desktop EcoClassification models included and provides the ratings for each quaternary catchment.
Resource Units			
Photographs at each EWR	Photos indexed and dated that were taken during each site visit. The associated flow in the river at each sites also need to be provided.	Essential	This supports the review and use of EWR results - especially as these sites will not be visited.
Benchmarks	Photographs and description of locality of benchmarks	Required	
Ecological Classification			
FRAI	Model for each site and for each Ecological Category that were assessed in terms of flow. The models for the AECs or Recommended Ecological Class should have the metrics that changed from the Present Ecological State highlighted. All supporting data and analyses for the PAI (water quality assessment) should be included.	Essential	Provides the ratings for each scenario. Without these models, additional scenarios cannot be evaluated as part of the Vaal Classification system
MIRAI		Essential	
VEGRAI4		Essential	
GAI4		Essential	
PAI		Essential	
Ecological Status		Essential	
EIS		Essential	
IHI		Essential	
Fish raw data	Raw data in standard fish forms required (included also habitat ratings)	Essential	
Invertebrate raw data	SASS sheets required	Essential	

Data element and Description		Importance / requirement rating	Comments
Ecological Water Requirements			
Hydraulics	Raw data	Required	
FFHA	Fish model to determine flows	Essential	This model forms the crux of the low flow determination and it will be required or any further analysis.
HFSR - MIRAI tables	Spreadsheet invertebrate people use	Essential	Same as above.
Flood files	Need a description of the high flow (flood requirements) for each flood at each site in terms of peak (range), duration, daily average etc.	Essential	This potentially is included in the report and if so, it will not be required as a separate excel file.
Operational Scenarios			
FRAISC	Need FRAI, MIRAI, VEGRAI, GAI, PAI, water qualtiy and EcoStatus models run for every scenario and appropriately named.	Essential	Required and will be used for running scenarios as part of the classification system.
FFHA	Need the model as run for every scenario.	Essential -	

Acronyms:

FRAI: Fish Response Assessment Index.

MIRAI: Macroinvertebrate Response Assessment Index.

VEGRAI4: Riparian Vegetation Response Assessment Index, Level 4.

GAI4: Geomorphology Driver Assessment Index.

PAI: Physico-chemical Driver Assessment Index.

IHI: Index of Habitat Integrity.

FFHA: Fish Flow Habitat Assessment (model).

HFSR: Habitat Flow Stressor response (method).

FRAISC: FRAI used for scenarios.

4 STUDY PARAMETERS

4.1 METHODOLOGY FOR EXTRAPOLATING EWRS FOR ADDITIONAL SITES

The proposed extrapolation method can best be summarised by the following direct extract from the *Comprehensive Reserve Determination Study of the Integrated Vaal River System: Upper Vaal Water Management Area: Technical Component: Estimation Report*. Report number: RDM/WMA8C000/01/CON/0510.

> "*Extrapolation consists of determining which sites are sufficiently similar to the comprehensive EWR sites in terms of biophysical similarity as well indicator guilds used for setting EWRs; and deriving the EWRs for these sites using the comprehensive EWR results at the EWR sites.*
>
> *Estimation consists of a process to estimate the EWRs at each hydronode for the Recommended Ecological Category (REC) (using the information generated as part of the Desktop EcoClassification (Kleynhans & Louw, 2007). This estimation will entail the prediction of indicator species at various hydronodes, and the determination of the EWRs at these hydronodes using a higher confidence method than the Desktop Ecological Reserve Model.*
>
> *The decision-making process to determine whether to estimate or extrapolate is summarised in the flow diagram below (**Figure 4.1**).*

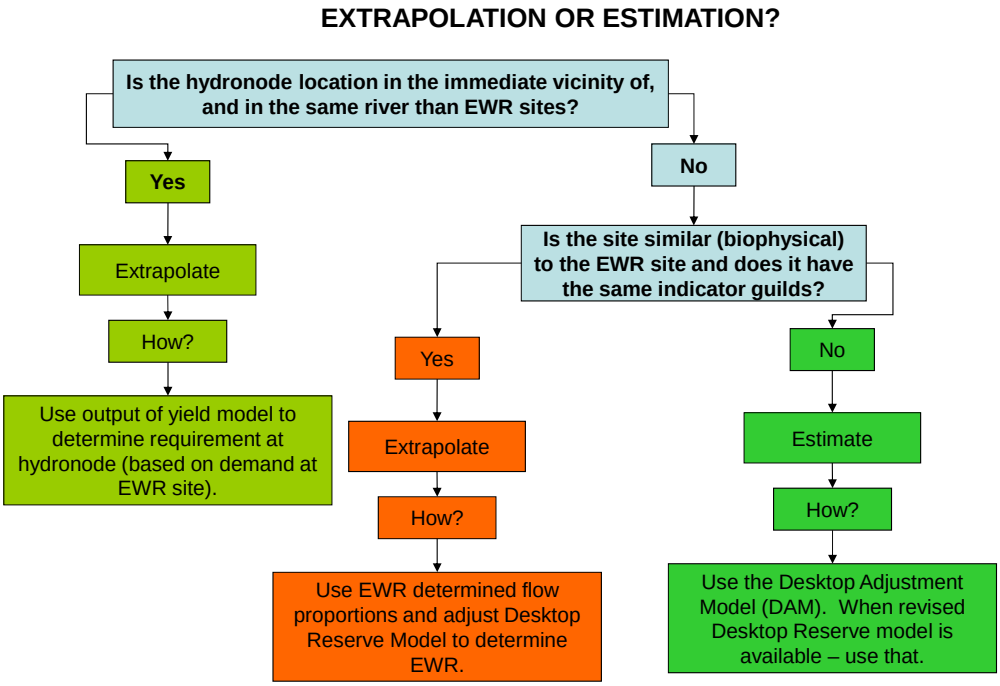


***Figure 4.1: Flow diagram showing when it is appropriate to extrapolate or when estimation is required.*"**

Further details on the method are described in **Section 6.3.3** as well as other references listed in that section.

4.2 INTEGRATED UNITS OF ANALYSIS

4.2.1 Approach in identification of IUAs

The identification and selection of the Integrated Units of Analysis (IUAs) were based on the following considerations:

- The resolution of the hydrological analysis and available water resource network configurations currently being modelled.
- Location of significant water resource infrastructure.
- Distinctive functions of the catchments in context of the larger system.
- Available budget for refinement of the existing network and undertaking scenario analysis of each IUA.

In an ideal situation it would have been preferred to have a properly calibrated higher resolution network water resource model available for use in the classification process. Such models have been developed for other systems in the country as part of Water Availability Assessment Studies where the focus was to develop installed modelling systems to support the licensing of water use. Such detailed work requires significant human resources and were not included in the proposal of this study.

It has been recognised that the characteristics of individual small tributaries can significantly differ from the larger rivers and may warrant a different class. The constraint is however that if the same intensity of investigation has to be applied for all tributaries (that is to satisfy scientific sound practice) much more time and money would be required to undertake the classification of the water resources. It is therefore proposed that a practical qualitative evaluation method be applied which will only consider the ecological aspects as well as likely implications on goods and services in a qualitative manner. The identification of the tributary catchment will form part of the evaluation of **Task 3a**.

The identified and proposed Integrated Units of Analysis for the three Vaal Water Management Areas are shown in **Figures D-1**, **D-2** and **D-3** respectively in **Appendix D** and discussed in the subsequent sections.

4.2.2 Upper Vaal IUAs

Figure D-1 presents the twelve identified Integrated Units of Analysis (IUA) of which three areas (consisting of quaternaries C22J, C22H, C23B, C22G and C23A) are defined as Secondary IUAs. The remaining nine IUAs form the sub-catchments according to which analysis will be carried out. The three secondary IUAs, as well as the tributary rivers within each main IUA, will be evaluated in a qualitative manner only.

The significant resources of the eight IUAs are:

- Upper Vaal- Vaal River Upstream of Grootdraai Dam.
- Klip River (Free State).

- Wilge River.
- Liebenbergvlei River.
- Waterval River.
- Vaal River reach upstream of Vaal Dam and Downstream of Grootdraai Dam.
- Blesbok, Suikerbosrand and Klip (Gauteng Province) rivers.
- The dolomite aquifers supporting the abstractions by Rand Water will be evaluated through simulation analysis,
- Mooi River and Loopspruit River.

Figure 4.2 presents the different types of EWR sites or nodes that were analysed as part of the Upper Vaal Reserve Determination Study and shows that there is sufficient coverage of extrapolation EWR nodes already available in the Upper Vaal.

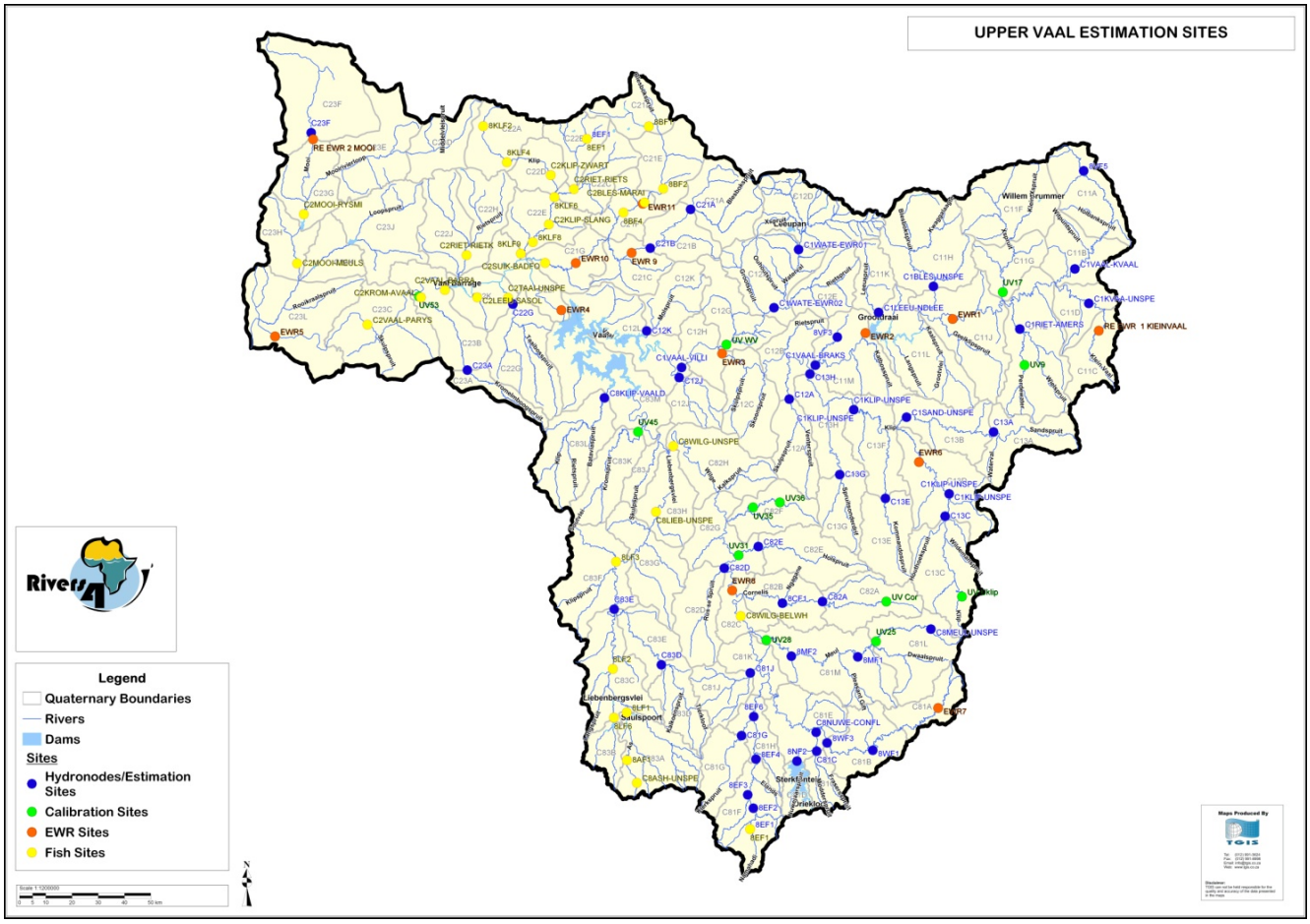


Figure 4.2: Map of the Upper Vaal WMA with different EWR sites or nodes analysed in the Reserve Determination Study (Copied from DWA, 2010c)

4.2.3 Middle Vaal IUAs

Figure D-2 presents a map of the Middle Vaal WMA and there are eleven proposed IUAs of which four are secondary IUAs.

The significant resources of the seven IUAs are:

- Schoonspruit River as well as the dolomite aquifer feeding the Schoonspruit Eye. (Simulation analysis will be carried out on the dolomites.)
- Renoster River.
- Vals River.
- Sand River.
- Vet River.
- Lower Vet River.
- Vaal River Upstream of Bloemhof Dam.

4.2.4 Lower Vaal IUAs

Figure D-3 presents a map of the Lower Vaal WMA and there are five proposed IUAs. The area covered by the light blue colour (Molopo River Catchment) was not part of the Vaal River Comprehensive Reserve Determination Study. These rivers are ephemeral and therefore cannot be evaluated with ease by following the standard reserve determination methods. Some work is currently been carried out in this area through the ORASECOM study (see **Section 2.2**) regarding ecological water requirements. Since this is "work in progress" it was not possible to evaluate the implication of this on the classification study – this will be carried out at a later stage during the course of the project.

The significant resources of the five IUAs are:

- Upper Harts River including the dolomite aquifer in the Lichtenburg area. (Simulation analysis will be carried out on the dolomites.)
- Middle Harts River.
- Dry Harts River (Tributary).
- Lower Harts River.
- Molopo River, various groundwater resources to be asses on an annual balance basis only. (No simulation models have been configured for these areas).

- Vaal River Downstream of Bloemhof Dam.

4.3 SELECTION OF EXTRAPOLATION NODES (SITES)

As indicated in **Figure 4.2** the coverage of EWR nodes or sites in the Upper Vaal WMA is extensive and limited additional work is anticipated with respect to new sites or nodes. The same extrapolation work that was carried out in the Upper Vaal WMA did not form part of the scope of services in the Middle and Lower Vaal WMA studies. It is therefore proposed that between three and four extrapolation EWR nodes will be assessed as part of the classification study.

The identification of extrapolation nodes is an integral part of the information evaluation that will take place during the execution of the activities and tasks for Step 1. The final selection of nodes will be produced by the end of April 2011.

4.4 DEFINITION OF SCENARIOS

A major potential risk for not completing the study within the 24 month period and exceeding the Proposal budget is if the number of scenarios to be analysed exceeds what was defined in the Proposal (repeated in **Section 6.3.5**).

Although it was anticipated at the proposal stage that the definition of the scenarios for analysis might be possible already during the Inception Phase, it is now realised that the definitions will form part of Step 4 and will be carried out in September 2011. .

5 STUDY PROCEDURE

5.1 OVERVIEW

The proposed study has been structured and broken down into various tasks and sub-tasks as listed in **Table 5.1.**

Table 5.1: Proposed Study tasks and deliverables

Task No.	Task description	Deliverables
1	**Project inception**	• **Inception Report** • **Integrated Units of Analysis description and map** • **Meeting minutes and decision record**
2	**Water resource information and data gathering**	• **Information summary and gap analysis** • **Inventory and recommendation on models, including water quality models**
3	**Determination of the Management Class**	
3a	Step 1: Delineate units of analysis and describe the status quo	• **Units of Analysis and status quo Report** • Socio-economic analysis framework

Task No.	Task description	Deliverables
		• Water resource infrastructure description • Ecological state and hydronode assessment
3b	Step 2: Link value and condition	• **Analysis scoring system**
3c	Step 3: Quantify Ecological Water Requirements (EWRs) and changes in non--water quality Ecosystem Goods, Services and Attributes (EGSAs)	• **Ecological Water Requirements report** • **Rule curves, summary tables, modified time series for all nodes and ecological categories** • **Socio-economic method summary**
3d	Step 4: Set Ecological Sustainability Base Configuration (ESBC) scenario and establish starter configurations	• **Definition of scenarios** • **Description of ESBC scenario**
3e	Step 5: Evaluate scenarios within the Integrated Water Resource Management (IWRM) process	• **Preliminary and final consequences report** • **WRPM model configurations of the scenarios** • **Water resource analysis report**
3f	Step 6: Evaluate scenarios with stakeholders	• **Presentations and preparation documents** • **Minutes and record of decisions** • **Recommended management class**
3g	Step 7: Gazette class configuration	• **IWRM summary templates for each IUA** • **Description of RQOs** • **Implementation plan**
4	**Communication and liaison**	• **Stakeholder database and schedule of meetings** • **Meeting documentation (all)** • **Record of stakeholder questions and responses.**
5	**Capacity Building**	• **Detailed programme** • **Progress reports during study execution** • **Closeout report (achievements)**
6	**Study management and co-ordination**	• **Project management committee meeting minutes** • **Maintain record of decisions** • **Monthly invoicing and progress reports**

Notes: Steps 1 to 7 refers to the WRCS documentation

Preliminary and final consequences report: Describes the ecological, goods and services, system yield and socio-economic implication of each scenario.

Water Resource Analysis Report: Presents the water resource system analysis work including the changes to the network, scenarios assumptions and most importantly the scenarios results in terms on water availability implications which include the implications with respect to the change in augmentation requirements for the Integrated Vaal River System.

The Study will be undertaken over a period of 24 months according to the schedule (time line) and duration of the tasks (see the Gantt Chart presented in **Appendix A)**.

In order to present the approach in context of the WRCS, the scope of work for **Task 3** "**Determination of the Management Class (seven step process)"** is presented according to the steps recommended in the WRCS documentation**.** The activity descriptions therefore demonstrate the application of the WRCS method as it is applicable to the specific characteristics of the Vaal River System. The approach proposed is founded in the knowledge and experience the team members have of both the scientific methods to be applied as well as the water resource of the Vaal River System.

It should be noted that the Inception Report was compiled in context of the work already carried out as part of the Comprehensive Reserve Determination of the Vaal River System and the proposed activities focus on adding additional value without duplicating past work.

The Study Management and Co-ordination task will continue throughout the study period to monitor performance, undertake Client liaison, track expenditure and ensure the successful execution of the study tasks.

The tasks and activities are described in **Section 6** in the respective sections.

5.2 CROSS REFERENCE WITH THE PROPOSAL

The work packages described in the proposal remained similar in this Inception Report with the following minor comments:

- Definitive definitions of the stakeholder engagement events are now defined and budgeted. The additional costs were covered by adjusting the budgets for other tasks. It will be critical to not exceed the proposed number of events to remain within budget.

- The cautious selection of the IUAs and the concept of introducing a qualitative method for dealing with the classification of selected tributary catchments made it possible for the overall budget of the study to be the same as the Proposal.

- There remains to be uncertainties with respect to the extent of work in the event that the data and information evaluation reveal anomalies and/or deficiencies. Should this be identified appropriate measures of mitigation will be discussed with the Client for implementation in the study.

6 SCOPE OF WORK

6.1 TASK 1: PROJECT INCEPTION

The project inception phase involved collating available information to refine the scope of work through liaison with the DWA manager. Information will be sourced from reports of previous studies, ongoing water resource management processes as well as current knowledge from officials in different DWA directorates that are active in the study area. Discussions were carried out in close cooperation with the DWA project management to enable prioritisation of activities and obtain agreement on the work packages. The Integrated Units of Analysis

(IUA) were defined and presented at the first Project Steering Committee (see **Appendix D** for maps).

6.2 TASK 2: WATER RESOURCE INFORMATION AND DATA GATHERING

The information and data obtained by the study team during their involvement with the Comprehensive Reserve determination of the Vaal River System in particular, and through other studies undertaken over the past 20 years, will be supplemented through a review of reports and databases focusing the requirements of the seven steps defined in the WRCS. Data from the Middle and Lower Vaal study area will be reviewed and the data for all three WMAs will be consolidated and applied for further refinement to the scope of this study at a later stage. During the Comprehensive Reserve studies the approach, assessment and analysis of the Goods and Services of the Vaal River System was standardized and therefore the results generated during this study will form the basis for this component.

An information gap analysis was carried out to identify missing data and appropriate recommendations on what alternative methods to be applied for selected tributaries (qualitative assessment of ecological aspects and goods and services) was devised..

Since the study team was instrumental in maintaining and updating the DWA water resource models of the Vaal River System, no human resources and expenditure is required to gain an understanding of the currently available models. The most appropriate and latest network configuration as well as hydrological database will be selected for use in the study. A review of other models applied in the study will be carried out and evaluated for possible application in the study. Particular attention will be given to local water quality models.

Conningarth was involved in the analysis and integration of the results for all three Comprehensive Reserve studies. The socio-economic information is available on a Water Management Area basis and for the identified economic zones in 2007 prices. The prices will be upgraded to 2009 prices and where changes in water use have emerged it will be reflected to attain a more realistic picture of the socio-economic use and implications. The analysis will include not only the quantity use but also make provision for quality, biota and riparian factors.

A wide range of information is available regarding the water quality of the Vaal River system, e.g. the Integrated Water Quality Management Plan (IWQMP) produced for the system in 2007, and the Water Quality Report for the Comprehensive Vaal Reserve study, due to be reviewed by SC&A in April 2011. The outcome of the IWQMP was the setting of Resource Water Quality Objectives (RWQO) for a wide range of users, while the Reserve study has defined the water quality EcoSpecs (or ecological specifications) for the resource.

Particular emphasis will be placed on evaluating and reviewing the water quality modelling conducted for the system, which was undertaken primarily during the IWQMP study and focussed on salinity modelling. Gaps will be identified, e.g. nutrient modelling.

6.3 TASK 3: DETERMINATION OF THE MANAGEMENT CLASS

This task forms the bulk of the work and is presented in accordance with the step layout of the Water Resource Classification System.

6.3.1 Task 3a (Step 1): Delineate units of analysis and describe the status quo

Step 1a: Describe present socio-economic status of the catchment

The present-day socio-economic status of the whole catchment will be described, based on the economic and social importance models developed for the area during the Comprehensive Reserve Studies, and the current socio-economic zones will be used.

Step 1b: Divide catchment into socio-economic zones

The zone (delineation) that was applied in the Vaal River System in the Reserve Determination study consisted of the following components:

- Vaal River main stem representing all water users receiving water from the Vaal River and supporting systems.
- Vaal River Eastern Sub-system (Grootdraai Dam and linked water resources).
- Tributary river catchments including: Sand–Vet, Vals, Mooi, Schoonspruit, Renoster and Harts river catchments.

In accordance with the concept of Integrated Units of Analysis (see **Section 4.2**) the zones will be in line with IUAs. The objective of the catchment socio-economic zones is to estimate and report on the implications of different catchment configuration scenarios on social wellbeing, economic prosperity and ecosystem health at an appropriate spatial scale. This requires dividing society into relatively homogenous communities through delineating socio-economic zones and describing community wellbeing within each zone.

Step 1c: Identify a network of significant resources, describe water resource infrastructure and identify water user allocations

The Vaal River catchment's water resource network and infrastructure information is available and has been defined in previous studies including the Vaal Comprehensive Reserve determination assignment. The existing databases of the water resource models contain the most up to date information on the water use in the study area as well as data for possible future scenarios.

A consolidated description of the water resource network and infrastructure are provided in **Appendix E** and further descriptions will be given in the study reports.. Additional nodes for analysis will be identified and presented. It is envisaged that the resolution (scale) of the network will be increased from what is currently available to accommodate the Integrated Units of Analysis as agreed in the inception task.

Step 1d: Define a network of significant resources and establish biophysical and allocation nodes

In this respect the same EWR sites that were previously selected will be used, which means that the key biophysical nodes are available. Additional nodes to represent the catchment must be selected. As a first step of this process, the hotspots as part of the Desktop EcoClassification process must be identified. This work is available as part of the Reserve Study (2007 – 2010). A review must however be undertaken of the Middle and

Lower Vaal and refinements made were necessary.

As part of the Estimation task of the Reserve Study, hydronodes (which are the same as biophysical nodes) were selected in the Upper Vaal. This work must still be undertaken for the Lower and Middle Vaal. The hydronodes will be selected considering the hotspots, hydrological data constraints and water resource modelling constraints. The number of biophysical nodes will be limited by these constraints.

The existing water resources model for the Vaal River System is not configured and calibrated for fine resolution modelling at quaternary or sub-quaternary scale. In other water resource systems such as the Crocodile East, Mhlatuze, Olifants and Berg rivers high resolution models have been developed as part of the Water Availability Assessment Studies (WAAS), which require substantive work that is outside of the scope and budget available for this assignment. The most important aspects of the WAAS are the detailed land use definitions and the calibration of the models (check against reality) that are necessary to produce a decision support system that represents the real system as close as possible and has a high level of confidence.

Therefore, in order to complete the work in the allocated budget adjustments to the network model will focus on key nodes and the ability to simulate the water balance in the selected IUA areas (see **Section 4.2**). Refinements of the network resolution will be carried out by disaggregating existing hydrological and land use data, based on catchment area ratios and readily available GIS maps and satellite images.

Note that the identification of nodes through the extrapolation / estimation process followed during recent Reserve studies did not directly include the establishment of ecological water quality status at these nodes, although a desktop-derived EC was used, which includes a desk-top evaluation of water quality. A water quality cover identifying the crucial areas where water quality (salinity and nutrients) dominates will be provided. This will include a water quality description of the three WMAs.

Step 1e: Describe communities and their wellbeing

Information from the Basic Human Needs as well as the socio-cultural importance desktop assessment undertaken during the Reserve studies will be used as basis. This will be updated where required and analysed in accordance with the requirements of the classification methodology. Where quantitative data is not available a qualitative description will be provided. The objective of describing communities and their wellbeing within each socio-economic zone is to provide the baseline against which to estimate changes in social wellbeing for each of the catchment configuration scenarios evaluated. This requires a description of the levels of financial, physical, human, social and natural capital available to each community, and constructing a measure or index of social wellbeing from the data collected.

Step 1f: Describe and value the use of water

The current value of the out of stream water will be expressed in terms of the growth indicator Gross Domestic Product (GDP) and two indicators reflecting the social impact of the water namely Employment and Low-income Households. The impacts will be determined per user group namely irrigation agriculture, commercial livestock, mining, light and heavy industries. It will firstly be expressed as total numbers per economic zone per product and then converted to multipliers expressed in terms of water volume units. The values will be provided for

Direct, Indirect and Induced parameters.

Step 1g: Describe and value the use of aquatic ecosystems

Information on the Goods and Services of the Vaal River is available and will be used for this purpose. It should be noted that the objective in describing and valuing the use of aquatic ecosystems is to determine the way in which aquatic ecosystems are currently being used in each socio-economic zone, and to estimate the value generated by that use. This will provide the baseline against which the socio-economic and ecological implications of different catchment configuration scenarios can be compared.

It is important to point out that while EGSAs will be identified and described in qualitative terms, a baseline value can often only be described for some of these, as the information required is not available without investing in a costly survey. This is particularly so for the Vaal System that is densely populated and consist of a complex array of highly disparate social groupings but almost certainly relatively few communities or population groupings that are dependent on EGSA for their livelihoods. As such it is therefore more practical to measure changes in EGSA values relative to a reference point rather than computing a baseline value.

Water quality input to Reserve Goods and Services studies will be assessed and provide water quality information as required.

Step 1h: Define Integrated Units of Analysis (IUA)

The proposed IUAs are presented in **Section 4.2** based on the network of significant resources and in line with the analysis and data from the Comprehensive Reserve Determination study. Once all required information has been obtained and reviewed, these IUAs should be refined by key members of the study team. Considering all of the information generated during Step 1a to Step 1i, the final IUAs will be defined and mapped. All nodes to be used for EWR assessment and for the Ecological Sustainable Base Configuration will also be identified.

Step 1i: Develop and/or adjust the socio-economic framework and the decision analysis framework

The economic concept to be used is “Severe Economic Prejudice”; the intention is that you determine the threshold after which further water curtailments or lower yields because of quality or other restrictions force the individual producer or groups of producers or industry out of production. It is generally accepted that if any curtailments are proposed, it will probably effect the irrigation sector and for this sector it becomes necessary that decision makers have an indication of not only what the overall macro-economic impact of the decision will be, but at what level individual irrigators are pushed to the brink where the possibility of compensation might arise. Water quality and other environmental degradation issues will also affect the irrigation sector. However, in the case of quality and other environmental issues could also impact on the social (human) quality of life of the population and in some cases even affect industrial production.

The “Severe Economic Prejudice” concept and model was tested in the Mhlatuze and Crocodile (East) catchments and will be updated for use in the three WMA’s to also make provision for quality and other restrictions. The economic ceilings will be determined in consultation with the rest of the project team. To determine the economic ceilings individual irrigation allocations according to the WARMS data base should be

available to formulate a standard irrigation unit per economic zone to develop guidelines for decision makers on the minimum allocation per zone. This will be necessary as the crop production basket differs according to climatic zones along the river and minimum ceilings will therefore differ from zone to zone.

Further it is acknowledged that this framework will probably be confronted with two sets of parameters:

- A configuration of aquatic ecosystem health categories among the water resources of the catchment with their associated flow regime; and
- An utilizable yield of water.

These two sets of parameters are generally inversely related, with increased aquatic ecosystem health requiring a reduction in utilizable yield. The yield, which is described in terms of the characteristics of water supplied to water users, influences the output of water user sectors. The catchment configuration scenarios also influence the output of EGSAs, from which a number of values are derived. Some of these values influence sectoral outputs and others are measured in terms of costs avoided or incurred. This need to be considered and weighed and the decision making model adjusted accordingly.

Step 1j: Describe present-day community wellbeing within each IUA

This step is envisaged as translating all of the information generated in Steps 1a, 1b and 1e into categories linked to the developed IUAs. In all likelihood the analysis done in steps 1a, 1b, and 1e will be at a more refined level than that of the envisaged IUA. As such this step will consist of aggregation of refined levels of data into the IUA.

6.3.2 Task 3b (Step 2): Link value and condition

Step 2a: Rationalise the choice of ecosystem values to be considered based on ecological and economic data

Approached from an economic point of view, water use and the value of water is divided into two major groups, namely the value of the used water while it is in the river and the value of the water once it has been removed from the river and applied outside the river. The team's approach will be presented (motivated) to the DWA during the inception phase for comments and approval.

Given the complexity and size of the Vaal River System a rough estimate of the changes in value of EGSAs and sectoral use of water will be given. As it is often the order of magnitude of changes in value that count, rather than the precision of the number, a table will be constructed with the following (value) information:

- Description of value;
- Probable significance in the catchment;
- Data requirements from the ecological component of the classification procedure;

- Possibility of being able to obtain relevant ecological data;
- Other data required (social, agronomic etc.); and
- Possibility of being able to obtain other relevant data.

Following this, the types of value which will be excluded in later steps of the classification procedure will be noted with justification.

Step 2b: Describe the relationships that determine how economic value and social wellbeing are influenced by ecosystem characteristics and the sectoral use of water

Especially rural communities depend on the Goods and Services supplied by the water while still in the river, but we also accept that the quantity and quality of the water inside the river impacts on a growing sector namely tourism and the quality of living of the urban and semi-urban population. Quality of the water is also a very important factor now for the irrigators, especially where large quantities of produce are exported. For valuing EGSAs that contribute to social wellbeing and economic prosperity, the following will be considered:

- Flow contribution to floodplain agriculture;
- Livestock production;
- Tourism and recreation;
- Refugia, nursery areas and export of sediment and nutrients;
- Value of harvested goods; and
- Domestic use of instream water.

For valuing EGSAs that result in costs avoided/incurred and contribute to social wellbeing and economic prosperity, the following will be considered:

- Flood attenuation;
- Erosion control and sediment trapping;
- Waste absorption;
- Pests and pathogens; and
- Domestic use of instream water.

For valuing intangible use and non-use values that contribute to social wellbeing, the following will be considered:

- Cultural and spiritual value;
- Educational and scientific value.

For valuing sectoral use of water that contributes to social wellbeing and economic prosperity, the following could be considered:

- Coal power;
- Urban industry;
- Non-urban industry;
- Domestic use;
- Mining;
- Streamflow reducing activities;
- Hydroelectric power.

Quality of water for different user sectors, e.g. irrigators and users dependent on run-of-river for water supply, will be described. Information on user sectors will be sourced from the socio-economic team of the study.

The dependency for each section of the river will be estimated for user groups to develop a scoring system for scenario evaluations.

Step 2c: Define the scoring system for scenario evaluations

The eventual choice of eco-system values will be based on a matrix that allows attaining the maximum value for both users, inside and outside the river. It is proposed that the matrix be developed listing all the values and then involve a group of knowledgeable people from both groups to populate the matrix. The methodology proposed, is the Delphi approach where a number of specialists populate the first matrix with approximate values. In the second matrix weights are allocated to the different items which are then multiplied with the first matrix to get a third matrix with answers.

The following table presents some of the issues to be considered (they will be completed by the project team).

Description	Values				
	Job Creation	Poverty Alleviation	Goods and Services	Sense of Place	Environment
In the river benefits					
Out of river benefits					

In a similar table the different weights will be allocated to the different issues identified.

Therefore, in summary, the process will involve firstly agreeing on the value interaction and then secondly listing the importance of each identified benefit which will then be converted to a score value, making it possible to identify the best option for the specific WMA, main stem or tributary, taking into consideration in river and out of river benefits.

The refinement of this approach will allow the task team to evaluate the different scenarios in a balanced and fair approach, allowing for a scientific assessment that will counter unsubstantiated emotional inputs from influential participants. The scoring system will allow for the evaluation of the implications of catchment configuration scenarios in terms of social wellbeing, ecosystem health and economic prosperity.

The scoring systems will therefore incorporate indices that account for; social wellbeing, ecosystem health, and economic prosperity.

6.3.3 Task 3c (Step 3): Quantify Ecological Water Requirements (EWRs) and changes in non-water quality Ecosystem Goods, Services and Attributes (EGSAs)

This is the most important step in the process which will require the most intensive work. However, if this step is not done comprehensively, the outcome of the study will be suspect as the Ecological Water Requirements (EWRs) form the base of water resource classification.

Step 3a: Identify nodes to which existing Resource Directed Measures (RDM) data can be extrapolated

The current EWR sites will be utilised for this task. Current ecological data will be consolidated and reviewed. The ecological data for the current Reserve studies were collected during 2007 – 2008 and the results are of sufficient confidence to use as the baseline for the application of the Classification System.

One of the requirements of the Classification System (**DWAF, 2007**) is the assessment of the Reserve by means of extrapolation to various nodes in the catchment. The estimation process designed for use in the Reserve Determination Studies carried out by the D:RDM on the Upper Vaal, Mokolo, Inkomati, Crocodile and Sabie Rivers will be used to determine whether sites can be extrapolated (**Louw et.al., 2006**) from EWR sites or whether appropriate models must be used to generated the EWR results. In this step the simulated time series of monthly flow data will be produced in tabular and graphical form at the nodes and for the categories. This data will originate from the simulation results of the Water Resource Planning Model. The output of this task will be the standard requirement, i.e. the .tab and .rul 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. It is important to note that .rul and .tab tables cannot be provided for sites where present day hydrology is higher than natural.

Water quality information and models used and developed during the Comprehensive Reserve study will be utilized for this input in the following way:

1. Evaluate the water quality assessment and Physico-chemical Driver Assessment Index (PAI) models produced during the Comprehensive Reserve study.
2. Provide the consequences of scenarios for water quality using the (PAI) model and other available tools.

Note that previous studies on extrapolation / estimation did not include the establishment of ecological water quality status at extrapolation nodes although a desktop-derived EC was used, which included a desktop evaluation of water quality. Extrapolation will be undertaken during this study where possible, but will be dependent on the availability of supporting information such as biotic response data at extrapolation nodes, i.e. selected nodes in the Upper Vaal catchment only.

Information will also be prepared and data linked to the water quality baseline and return flows in preparation for Steps 4 and 5.

Step 3b: Develop rule curves, summary tables and modified time series for all nodes for all categories

Included in **Step 3a.**

Step 3c: Quantify the changes in relevant ecosystem components, functions and attributes for each category for each node

As part of the Desktop Ecoclassification system, an estimate will be made of the condition of the key ecosystem components. The response to changes in flow for different Ecological Categories will be derived. It must be noted however that as no detailed field work on these nodes will be undertaken, estimated changes in flows for different Ecological Categories cannot be directly related to the responses of biota and the change in functions and attributes for each of these. Broad based assumptions only can be made.

This information is available for all nodes that are comprehensive EWR sites.

6.3.4 Task 3d (Step 4): Set Ecological Sustainability Base Configuration (ESBC) scenario and establish starter configurations

A thorough review of the guidelines for Step 4 and comparing the suggested methods with previous practice in Comprehensive Reserve Determination Studies (such as for the Thukela River and Inkomati River systems) lead to a more streamlined approach for this study. The text below provides an overview description of the proposed approach and further refinements of the methods will be undertaken during the execution of the work. One of the key reasons for selecting this method is the unavailability of confident (realistic) high resolution modelling networks to simulate all the EWR nodes in the system. It is acknowledged that many of these steps have been done as part of the Comprehensive Reserve study and the focus will be on the additional nodes where hydrological information is available.

Scenario evaluation at EWR sites

The scenarios will be assessed in terms of ecological consequences, i.e. the impact on the Ecological Category of the EWR site where applicable. The rule-based models used during the EcoClassification process are used in a predictive manner to determine the ecological consequences of the scenarios. The first requirement will be the analysis of the scenarios in terms of impact on the physico-chemical EC using the PAI. 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 evaluated for each scenario and will be supplied as an EC with a qualified explanation and motivation.
- 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.

Scenario evaluation: Ecological Sustainable Base Configuration

This will entail a rule-based process to be developed and applied to determine the Ecological Sustainable Base Configuration. Based on the ecological categories from the Comprehensive Reserve determination study, the EWR results from the additional extrapolation nodes along with requirements from International Water Agreements and Basic Human Needs, the Ecological Importance and Sensitivity Categories and other factors will be applied to define and describe the catchment configuration scenarios. The existing ecological consequences' results generated during the Comprehensive Reserve Study for scenarios that reflected the present state will be used as a baseline for this task.

Water quality information will be provided as required. Note that Step 4a (water quality feasibility) can only be conducted at high confidence if a water quality model of the catchment is available and a structured process for pre-screening is available. The WRCS does not yet contain such a process and a water quality model (of all quality variables) does not exist for the catchment. The following water quality modelling undertaken for the Reserve study will be used as far as possible for the consideration of situations where water quality has to be evaluated for supporting the downstream portions of the catchment.

- Physico-chemical Driver Assessment Index (PAI) models and output produced during the Comprehensive Reserve study for present state and consequences of scenarios.

- Water quality models used at selected sites during the Comprehensive Reserve study, i.e. WRPM TDS

for salts, and QUAL2K for nutrients for determining consequences of scenarios.

6.3.5 Task 3e: Evaluate scenarios within the Integrated Water Resource Management (IWRM) process

Step 5a: Run yield model for ESBC and Other catchment configuration scenarios and adjust if necessary

An important difference in the proposed methodology is that the Water Resource Planning Model (instead of the Water Resources Yield Model – WRYM) will be applied. This is to account for the operational and development planning feature of the Vaal River System (dilution, transfer require operating rule) that cannot be simulated with the WRYM. The WRPM has been designed to simulate all aspects of the system in an integrated manner.

The study cost estimate provided in the Financial Proposal makes provision for five main scenarios where full evaluation of all aspects will be carried out. Provision for a further five alternative combinations of these five scenarios are also included in the cost estimates. These five alternatives will only involve simulations and qualitative comparative analysis.

Significant groundwater resources contributing to the Vaal System exist in 3 regions underlain by dolomites:

- Lichtenburg (Lower Vaal).
- Schoonspuit (Middle Vaal).
- The Suikerbos region (Upper Vaal).

Significant groundwater abstraction from dolomites has altered flow from springs draining dolomitic compartments, reducing baseflow in to the Vaal System, affecting the yield of the system. To simulate the impacts of abstraction on groundwater resources and impacts on surface water, dolomitic compartments and their interconnection will need to be delineated. These will next be simulated using the surface-groundwater interaction model incorporated into the WRSM2000 in order to derive baseflow scenarios from different abstraction scenarios.

The groundwater assessment in the Molopo River catchment area will be based on annual balances using information from GRA2, Vegter Maps of harvesting and exploitable potential. Water abstraction data will be sourced from WARMS, current Validation and Verification study and well as detail groundwater studies if available.

Step 5b: Assess water quality implications (fitness for use) for all users.

Fitness-for-use for all users in each IUA will be assessed using the interim RWQOs designed during the IWQMP and the water quality EcoSpecs (or ecological specifications) defined for the resource during the Reserve study. This step will therefore include the production of final RWQOs for the system by amalgamating objectives for all users and the resource base, and assessing the achievability of these objectives. Information provided by recent planning options (e.g. Acid Mine Drainage and Wastewater Treatment strategies) will be incorporated as strategies to achieve RWQOs, where possible. Concentrations at IUA outflow nodes will therefore be tested

against water quality requirements of users in the downstream IUA. Note that concentrations will only be determined for selected variables.

It is assumed that the scenarios tested during previous studies will satisfy the modelling requirements of the current Classification study, as the cost estimate does not include additional water quality modelling. Requirements for such modelling will be flagged where necessary.

Step 5c: Report on ecological condition and aggregate impacts per IUA for each scenario.

Changes in relevant eco-system components, functions and attributes for each node assessed, will be quantified. The report produced under step 3 will include these findings.

Step 5d: Value changes in aquatic ecosystem and water yield

The scenario based approach followed in the Comprehensive Reserve study will be followed. Assessment of the economic impacts of the various scenarios essentially identifies the direction of change (either positive or negative) and estimates the magnitude of the change in benefits and costs that may be experienced within the River System. Included in the cost items will be the opportunity costs of any changes to water supply or quality. The choice will be either having a reasonable "healthy" river at a certain economic impact (cost) or doing nothing and eventually having to manage a much larger and detrimental economic impact (cost).

The process to be adopted will be analysis of potential economic changes based on a valuation of the status quo, that is, the value of the Goods and Services (G&S) currently provided by the water in Vaal River catchments, identifying the potential change that each of the key G&S may undergo in each of the scenario clusters. And where required the current value of G&S was then multiplied by these factors for each scenario, to provide an indication of the potential future value of the Goods and Services. The change in value was thus measured. The following calculation, as an example, would be used:

- Future value (FV) of fishing = Change Factor x The Current Value of Fishing.
- FV = 0.9 x rate.
- FV = rate per annum.
- This equates to a reduction or increase a specified rate annum.

The evaluation of the change in water yield will be in the form of defining the augmentation requirement for the main stem water users, transfer requirements for the Eastern Vaal River System and reduced allocation in the tributary catchments – see also **Step 1b** and **5e** for related tasks.

Step 5e: Describe the macro-economic and social implications of different catchment configuration scenarios

The socio-economic analysis of Vaal River main stem (refer to **Step 1b**) will revolve around the cost of water augmentation as it is reflected in the increased costs (difference among scenarios) for augmentation of the system such as further phases on the Lesotho Highlands Water Project and/or Thukela Water Project.

With respect to the Eastern Vaal River Sub-system (Grootdraai Dam and linked water resources) the economic cost of additional transfer from Vaal Dam to sustain supply to users will be determined.

The analysis of the tributary river catchments will be based on the assumption that all users other than irrigation will receive their full demand. The macro-economic impact if irrigation is curtailed, either by a water curtailment or yield reductions due to quality considerations, will be estimated plus the point of "Severe Economic Prejudice" for the specific area will be determined, which will then give the decision makers guidance in the magnitude of the negative economic impact. Obviously the point of "Severe Economic prejudice" will differ from producer to producer and eventually the determination of the impact must take place on an individual basis, but a general guide will support the decision maker in respect of deciding the volume of water that can be curtailed or the impact of quality deterioration.

Step 5f: Evaluate overall scenario implications at an IUA-level and a regional level

The integrated analysis approach followed in the Vaal River System where the overall system augmentation requirements are determined and the cost differenced between scenarios are calculated (as presented in the previous section) accounts for the overall scenario implications. The augmentation cost differences affect all domestic and industrial users receiving water from the system covering a regional footprint outside of the Vaal River catchment itself and therefore appropriately account as regional level evaluation.

Step 5g: Select a subset of scenarios for stakeholder evaluation

The outcome from Step 5 will inform the selection of scenarios for presentation to stakeholders. A key consideration will be to cover a range of conditions in order to communicate the advantages and disadvantages in a balanced manner. The selection will be undertaken in cooperation with the Client.

6.3.6 Task 3f: Evaluate scenarios with stakeholders

Step 6a: Stakeholders evaluate scenarios and agree on a short-list

The arrangements for the stakeholder engagement events are described in Task 4. Clear presentation of the selected scenarios (background, scenario descriptions, summarised results of all components and conclusions) will be prepared for the stakeholder workshops and meetings. The facilitation of the meetings will involve guiding the participants to agree on a short list of scenarios as recommended to DWA. The study team will ensure appropriate decision makers from DWA is present at the stakeholder meetings to ensure informed deliberations take place that will lead to the acceptance of the recommendation of the management classes for each Integrated Unit of Analysis.

Step 6b: DWA recommends IUA classes

The process of how the recommendations will be made by DWA has not been described in the WRCS documentations. It is proposed that the method be discussed and agreed during the inception phase of the study.

6.3.7 Task 3g: Gazette class configuration

Step 7a: Populate IWRM summary template and present to Minister or delegated authority

The PSP will prepare the IWRM summary template in accordance with the format that will be developed in cooperation with the Client. DWA officials will then submit the documentation through the appropriate internal channels for the approval by the Minister of delegated authority.

Step 7b: Minister decides on IUA classes, nested category configurations, Reserve(s), allocation schedule(s) and Catchment Management Strategy (CMS)

This is an internal DWA process and depends on the approval protocols and administration procedures.

Step 7c: Recommended Resource Quality Objectives (RQOs)

At the inaugural management meeting it was confirmed that the RQOs will form part of a separate process and information from this study will be made available where appropriate.

Step 7d: Gazette IUA classes, nested category configurations and RQOs

This is an internal DWA process and depends on the approval protocols and administration procedures.

Step 7e: Develop plan of action for implementation of recommended scenario

The study team will compile a programme that outlines the steps required and timeframe for implementation. Specific attention will be given to monitoring requirements that need to be put in place to evaluate the outcome of the implementation of the plan. The plan will take the activities involved in Integrated Water Resource Management into consideration – with particular reference to the Vaal River System Reconciliation Strategy.

6.4 TASK 4: COMMUNICATION AND LIAISON

Public participation in environmental processes is not only a statutory requirement, but a process that should lead to a joint effort by stakeholders. Stakeholders should represent all relevant interests and sectors of society, technical specialists and the various relevant organs of state who work together to produce better decisions than if they had acted independently, and better implementation of decisions through stakeholders "owning" the process.

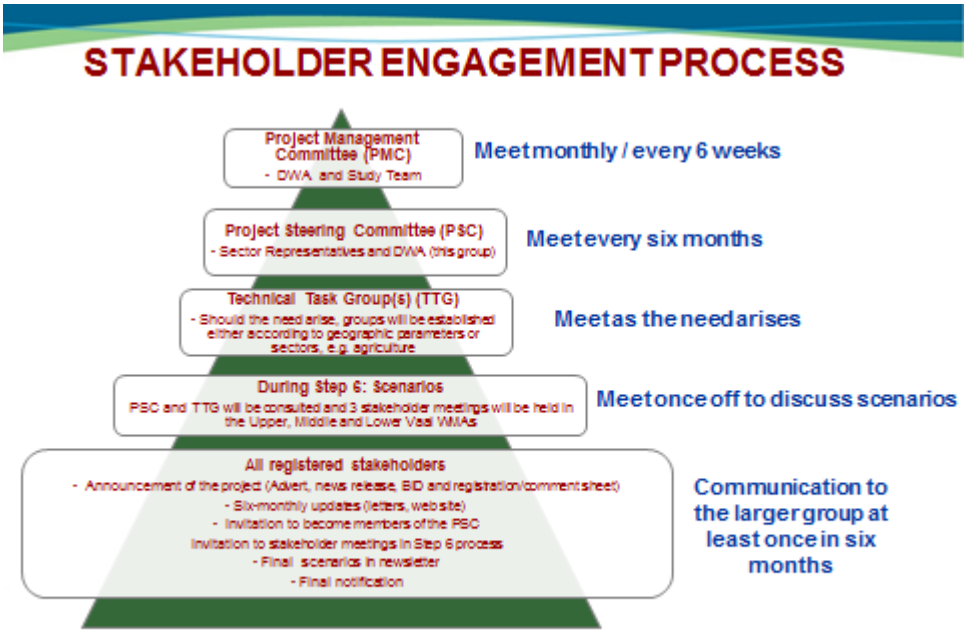
It is very important to note that the process is not measured solely by the letter of the law's minimum requirements. The principles used world-wide to characterise and measure a thorough and legitimate stakeholder participation process, and which will be applied in this process, is noted in the box below.

Universal stakeholder participation principles

- Consultation is inclusive. It takes place with all sectors of society and affords a broad range of stakeholders the opportunity to become involved.
- Information is sufficient to allow meaningful contributions, and is accessible.
- Information is presented in various ways, e.g. by way of background information documents, newsletters, media releases, letters and advertisements.
- There are various opportunities for comment, at various stages in the process.
- Stakeholders are supplied with information that assists them to understand their roles and responsibilities in the process.

These are in line with the core values of the International Association for Public Participation (IAP2). Zitholele Consulting and the individual personnel responsible for stakeholder engagement are members of the IAP2 affiliate in South Africa. Our team members have each successfully undertaken the certificate courses by the International Association to be official practitioners in public participation.

The stakeholder process for this process can be summarised as follows:



6.4.1 Stakeholder identification and database

The identification of stakeholders will be an on-going process, refined throughout the process as the on-the-ground understanding of affected stakeholders improves through interaction with various stakeholders in the three Vaal WMAs. The identification of key stakeholders and community representatives for this project is important and will be done in collaboration with the Department, and stakeholders in the study area.

Stakeholders' details will be captured on Maximiser 9, an electronic database management software programme that automatically categorises every mailing to stakeholders, thus providing an on-going record of communications. In addition, comments and contributions received from stakeholders are recorded linking each comment to the name of the person who made it.

Typically, our team would identify stakeholders representing the following sectors of society:

- national, provincial (Mpumalanga, Gauteng, Free State, Northern Cape and the North West) and local government (relevant local and district municipalities);
- relevant residents' associations, rates payers organisations, community based organisations, agricultural organisations and NGOs;

- environmental and water bodies, forums, groups and associations;
- private sector (mining, business, industries) in the vicinity;
- civil society; and
- regional and local media.

The draft database will be compiled during the first few weeks of the project implementation period; however a database is dynamic and will be constantly updated as more information becomes available and as stakeholder information change.

6.4.2 Announce the project

After the Inception Report is approved a background information document (BID) will be compiled for distribution to all stakeholders that are listed in the database. The purpose of this document will be to announce that the DWA is undertaking the classification process of significant water resources in the three WMAs of the Vaal River System, the process to be followed, anticipated activities, proposed time lines as well as how stakeholders can become involved in the project.

The same information will also be sent to the media and should be combined with a media release and advertising campaign as well.

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

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

6.4.3 Issues and Responses Report

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

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

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

(a) Establishing a Project Steering Committee

Stakeholders representing specific sectors of society (e.g. agriculture, mines, local authorities, conservation) will be identified and asked to serve on a Project Steering Committee (PSC) for the duration (two years) of this project. The PSC should be a relatively small group of people (no more than 25) that will ensure strategy

implementation and provide strategic advice and guidance.

The Vaal currently has an efficient structure in place that could be utilised for this project. The Vaal River System Strategy Steering Committee (VRS SSC) oversees the implementation of the Reconciliation Strategy and it is proposed that the Steering Committee Meetings of this study be integrated with VRS SSC. **Three** meetings are allowed for in the budget of this task. Members of the VRS SSC have years of experience and represent all sectors of society we would like to be involved in this project. The practicalities of this can be confirmed at a later stage but the VRS SSC can, for example, meet in the morning, with the Classification meeting being held in the afternoon.

Invitation letters and a proposed agenda will be distributed to the PSC members providing them with sufficient information about the status of the project, the purpose of the meeting and what will be expected of them (e.g. read through documents prior to the meeting and provide inputs and comments).

The **fourth** PSC meeting will be where the scenario results are presented for evaluation by the stakeholders.

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

(b) Establishing Technical Task Group

A Technical Task Group (TTG) will be established should the need arise. The Task Group Meetings will be held to discuss and formulate scenarios for analysis. These meeting will include various sectors in the study area, such as agriculture and industry. Stakeholders will be identified (per relevant sector of society) and invited to attend the meetings. It is anticipated that no more than **two** meetings of the TTG will be held. Prior to these meetings the necessary documentation will be compiled and distributed explaining for example the various scenarios to be investigated.

All meetings will be formally hosted with a facilitator, formal presentations of the different scenarios and thorough minutes will be taken as a record of stakeholder comments and inputs. These comments and responses will be fed into the Issues and Responses Report. The minutes of all meetings will be distributed for comment.

Should the presented scenarios have changed significantly with the consideration of stakeholder comments, the process to invite stakeholder inputs on the revised scenarios will have to be repeated to reach an acceptable level of agreement with stakeholders (costs for a repeat workshop were not included in the budget).

Once the scenarios have been agreed upon, stakeholders have to be informed of the “short-listed” scenarios which will be submitted for final sign-off. This will be done with a final newsletter at the end of the project.

(c) Meeting arrangements

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

- There must be a clear purpose for a meeting and the objectives of what needs to be achieved by the meeting is clearly defined. Stakeholders must receive notification of the meeting date and its objectives

at least three weeks in advance. A formal advance registration process was allowed. Stakeholders must receive documentation such as a draft agenda for the meeting at least five working days before the meeting.

- A dry run meeting for project team members must be conducted in advance to agree on the content of the meeting, the comprehension levels of presentations and to strategise for discussion sessions.

(d) Continuous feedback to stakeholders

Stakeholders need to be taken by the hand from the beginning to the end of a project. It is recommended that stakeholders be updated every six months on the status of the project. This will be done by the distribution of, a) the announcement background information document, b) a letter to all stakeholders on the database, including the media informing them of progress made, c) invitations to stakeholders to attend a geographic focus group meeting and lastly towards the end of the project a newsletter with information on the classification of important water resources in the three Vaal WMAs can be distributed.

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

(e) Collaborating with existing projects / structures in the Vaal WMA

Existing projects of the DWA in the Vaal WMAs such as the VRS SSC will also be used to market and promote this project.

(f) Scheduling

The following schedule is anticipated:

October – November ‘10:	Develop stakeholder database and contributions to the inception report
February ‘11:	Announcement of the project (BID, comment sheet, media announcement, etc)
March’ 11:	Gather comments on the project (Collate comments and issues into an Issues and Response Report)
April and May ‘11:	Establish the PSC and Technical Task Group
June ‘11:	Distribute the minutes of the meetings
September-October ‘11:	Distribute a letter to the stakeholder database to report on progress made
October ‘11:	Meet with the PSC
November ‘11:	Distribute the minutes of the meeting
January ‘12:	Meet with the Technical Task Groups

February '12: Distribute the minutes of the meetings

April '12: Final meeting with the PSC (Stakeholder Scenario Evaluation Workshop)

May '12: Distribute a letter to stakeholders to report on progress made

September '12: Compile and distribute final newsletter

6.5 TASK 5: CAPACITY BUILDING

The study team through the execution of the work, will facilitate knowledge sharing to capacitate PSP members and identified DWA officials. The capacity building activities will involve **demonstrations**, training **instructions** with **practical applications** of processes and the **supervision** of tasks. Available training material will be used for the dedicated training sessions. The training material will be amended where necessary to accommodate new methods and procedures. An important aspect of the capacity building will be to make sure the trainees are informed of the overall processes involved and related to the Classification process.

Table 6.1 presented the proposed training and knowledge building activities during the execution of the study.

Table 6.1: Schedule to capacity building and training activities

Code (Task)	Learning Area	Knowledge building activity	Level of training	Hours	Month
Integrated Water Resource Management					
A (Task 1)	IWRM (policy & legislation)	Overview of Water Resource Management.	Introduction: Discussion and demonstration	6	May 2011
			Detail: Demonstration	6	November 2011
Water Resource information and data sourcing					
B (Task 2)	Understanding biophysical processes: • water quantity & quality; • geomorphology • hydrology • ecology • hydraulics	Rainfall data preparation. Hydrological data preparation (WRSM2000 modelling). Ecological data preparation.	Introduction: Discussion and demonstration	16	May 2011
			Detail: Discussion, demonstration and application	32	November 2011

Code (Task)	Learning Area	Knowledge building activity	Level of training	Hours	Month
Water Resource Modelling					
C (Task 3)	Water resource modelling & decision support	Water resource assessments (WRYM and WRPM).	Introduction: Discussion and demonstration	16	May 2011
			Detail: Discussion, demonstration and application	44	February 2012
Implementation of the WRCS process					
D (Task 3)	Use of GIS and mapping of IUA's	No expert or training material available for training. Training to be provided in collaboration with Olifants Study's PSP.	Introduction: Discussion and demonstration	-	April 2011
E (Task 3)	Understanding biophysical processes: • water quantity & quality; • geomorphology • hydrology • ecology • hydraulics	Demonstration of ecological aspects.	Detail: Discussion, demonstration and application	24	July 2011
F (Task 3)	Resource economics	Explain models and fundamentals.	Introduction: Discussion and demonstration	24	March 2012
G (Task 3)	Socio-economic issues	Explain fundamentals and relationship between social, economic and ecological trade-offs.	Introduction: Discussion and demonstration	16	July 2012
H (Task 4)	Stakeholder consultation	Explain fundamentals of stakeholder engagement.	Introduction: Discussion and demonstration	16	July 2011

Code (Task)	Learning Area	Knowledge building activity	Level of training	Hours	Month
I (Task 1 to 6)	Project Management	Explain project administration and financial management.	Introduction: Discussion and demonstration	16	November 2011

Note that the hours listed in the table also include preparation of discussion material by the respective specialists in cases where material is not already available.

6.6 TASK 6: STUDY MANAGEMENT AND CO-ORDINATION

Project Management: The project management function will ensure coordination of the tasks among the study team members and maintain close liaison with the Client to fulfil the requirements of the TOR. Study management meetings (see programme) will be the main method for interaction between the PSP and the Client, however, ad hock liaison will take place when necessary.

Financial Management: A financial control system, comprising an interactive spreadsheet model, will be used to monitor and control costs. Costs will be assigned to each main task. Should deviations from the allocated costs for the key activities become evident, the Study Leader shall assess the reason/s and impact of such deviations and institute corrective action as required. Where additional work may be required, the Study Leader shall compile a detailed motivation and budget (both time and costs) for such additional activities for assessment and submission to the Study Manager for consideration and approval. No additional expenses outside the approved budget will be allowed without the prior written approval of the Client.

Study Administration: Study administration duties to be performed will include:

- Compiling, certifying and submitting monthly invoices to the Client. The Client will be presented with only one invoice monthly from the Consultant Study Team. The Study Leader will arrange payment to the other members of the Study Team after receiving the same from the Client.
- Recording of minutes of meetings with the Client and distribution thereof to the relevant parties, as required. Records of project decisions and all contractual matters related to the Study Team and/or sub-consultants will be maintained during the study period.
- Ensuring that all project files are updated regularly and accessible to the Client if and when required.

7 STUDY PROGRAMME

A bar chart programme of the tasks is provided in **Appendix A** and a breakdown of project deliverables as per financial year is given in **Table A-1** of **Appendix A**.

8 STUDY COSTS

The costs presented in this section are based on the work program and estimated person-hour schedule provided in the previous sections. The costs are applicable to the study period, which has been programmed for 24 months.

8.1 PROFESSIONAL FEES

Estimates of the total professional fees for each team member are provided in **Table C-1** of **Appendix C** while **Table C-2** provides a schedule of the person-hours for each team member as allocated to the various tasks. **Table C-3** provides the schedule of cost for each team member as allocated to the various tasks. It is important to note that the costs account for an increase in the hourly rates of all staff members at the end of the first 12 months of the study period, to account for CPIX-related escalation. The adopted increase is based on an annual rate of 10 %.

A breakdown of the proposed costs for the 6 identified tasks is provided in **Table 8.1**.

Table 8.1: Summary of the proposed costs per task

Task		Cost (R)			% of
No.	Description	Excl VAT	VAT	Incl VAT	total
1	PROJECT INCEPTION	219 600	30 744	250 344	5.7
	Disbursement costs Task 1	9 503	1 330	10 833	0.2
	Office infrastructure costs Task 1	0	0	0	0.0
2	WATER RESOURCE INFORMATION AND DATA GATHERING	278 750	39 025	317 775	7.2
	Disbursement costs Task 2	15 000	2 100	17 100	0.4
	Office infrastructure costs Task 2	0	0	0	0.0
3i	DETERMINATION OF THE MANAGEMENT CLASS: Ecological	852 150	119 301	971 451	21.9
	Disbursement costs Task 3i	170 000	23 800	193 800	4.4
	Office infrastructure costs Task 3i	0	0	0	0.0
3ii	DETERMINATION OF THE MANAGEMENT CLASS: Socio Economic	285 200	39 928	325 128	7.3
	Disbursement costs Task 3ii	10 000	1 400	11 400	0.3
	Office infrastructure costs Task 3ii	0	0	0	0.0
3iii	DETERMINATION OF THE MANAGEMENT CLASS: Water Resources	606 100	84 854	690 954	15.6
	Disbursement costs Task 3iii	20 000	2 800	22 800	0.5
	Office infrastructure costs Task 3iii	0	0	0	0.0
3iv	DETERMINATION OF THE MANAGEMENT CLASS: Integration and decision analyses	150 370	21 052	171 422	3.9
	Disbursement costs Task 3iv	5 000	700	5 700	0.1
	Office infrastructure costs Task 3iv	0	0	0	0.0
4	COMMUNICATION AND LIAISON	357 786	50 090	407 876	9.2
	Disbursement costs Task 4	85 000	11 900	96 900	2.2
	Office infrastructure costs Task 4	0	0	0	0.0
5	CAPACITY BUILDING	169 600	23 744	193 344	4.4
	Disbursement costs Task 5	10 000	1 400	11 400	0.3
	Office infrastructure costs Task 5	0	0	0	0.0
6	STUDY MANAGEMENT AND CO ORDINATION	619 664	86 753	706 417	16.0
	Disbursement costs Task 6	20 000	2 800	22 800	0.5
	Office infrastructure costs Task 6	0	0	0	0.0
Total	**Professional fees**	**3 539 220**	**495 491**	**4 034 711**	**91.1**
	Disbursement costs	**344 503**	**48 230**	**392 733**	**8.9**
	Office infrastructure costs	**0**	**0**	**0**	**0.0**
TOTAL		**3 883 723**	**543 721**	**4 427 444**	**100.0**

The breakdown of professional fees allocated to each participating company is provided in **Table 8.2**.

Table 8.2: Breakdown of professional fees allocated to each company

Company	Hours	Professional fees (R)			% of total
		Exl VAT	VAT	Incl VAT	
WRP	1384	1 206 180	168 865	1 375 045	34.1%
DMM	163	130 400	18 256	148 656	3.7%
Rivers For Africa	1223	873 525	122 294	995 819	24.7%
Sub-consultant	158	150 100	21 014	171 114	4.2%
Zitholele	401	239 110	33 475	272 585	6.8%
Conningarth & Huggins	650	399 550	55 937	455 487	11.3%
Koekemoer Aquatic services	933	540355	75 650	616 005	15.3%
Total	**4 912**	**3 539 220**	**495 491**	**4 034 711**	**100%**

8.2 DISBURSEMENTS

The disbursement costs for the Study are **R 344 503** (excl. VAT) and are allowed for as lump sum amounts. Disbursements will be charged to the Client without mark-up and economy air travel will be used in all cases. The rates for printing and copying costs are summarised in **Table 8.3**.

Table 8.3: Proposed rates for printing and copying costs

No.	Description	Size	Rate (R, excl. VAT)
1	Printing only of original/master	A4	10.00
2	Duplicating: Black & white	A4	0.38
3	Duplicating: Black & white	A3	0.74
4	Duplicating: Colour	A4	7.20
5	Duplicating: Colour	A3	10.20
6	Transparencies: Black & white	A4	4.50
7	Transparencies: Colour	A4	14.95
8	Plan plotting: Paper: Black & white	A0	86.00
9	Plan plotting: Paper: Black & white	A1	75.00
10	Plan plotting: Paper: Black & white	A2	58.00
11	Plan plotting: Paper: Black & white	A3	40.00

No.	Description	Size	Rate (R, excl. VAT)
12	Plan printing: Paper: Black & white	A0	86.00
13	Plan printing: Paper: Black & white	A1	75.00
14	Plan printing: Paper: Black & white	A2	58.00
15	Plan printing: Paper: Colour	A0	320.00
16	Plan printing: Sepia	A0	58.00
17	Plan printing: Sepia	A1	52.00
18	Plan printing: Sepia	A2	40.00
19	Spiral binding with covers (per book)	A4	9.90
20	Creating of original CDs, including labels	-	85.00
21	Copies of CDs, including labels	-	22.00

8.3 COMPARISON OF COSTS

The overall study budget has not changed since the proposal, however some task budgets have been moved around. **Table 8.4** provides a summary of these task budget changes. The main reason for the changes was the need to increase the budget for the Communication and Liaison Task.

Table 8.4: Comparison of costs: Inception vs proposal

Task	Inception budget	Proposal budget	Difference
PROJECT INCEPTION	250344	251165	-821
Disbursement costs Task 1	10833	11400	-567
WATER RESOURCE INFORMATION AND DATA GATHERING	317775	324843	-7068
Disbursement costs Task 2	17100	22800	-5700
DETERMINATION OF THE MANAGEMENT CLASS: Ecological	971451	1021320	-49869
Disbursement costs Task 3i	193800	199500	-5700
DETERMINATION OF THE MANAGEMENT CLASS: Socio Economic	325128	325128	0
Disbursement costs Task 3ii	11400	11400	0
DETERMINATION OF THE MANAGEMENT CLASS: Water Resources	690954	690954	0
Disbursement costs Task 3iii	22800	22800	0
DETERMINATION OF THE MANAGEMENT CLASS: Integration and decision analyses	171422	171422	0
Disbursement costs Task 3iv	5700	5700	0
COMMUNICATION AND LIAISON	407876	350121	57755
Disbursement costs Task 4	96900	73530	23370
CAPACITY BUILDING	193344	193344	0
Disbursement costs Task 5	11400	11400	0
STUDY MANAGEMENT AND CO ORDINATION	706417	706417	0
Disbursement costs Task 6	22800	34200	-11400
Professional fees	4034711	4034714	-3
Disbursement costs	392733	392730	3
TOTAL	4427444	4427444	0

8.4 SUMMARY OF COSTS

A summary of the Study Costs is provided in **Table 8.5** below.

Table 8.5: Summary of the Study Costs.

Cost item	Cost (R)			% of total
	Excl VAT	VAT	Incl VAT	
Professional fees	3 539 220	495 491	4 034 711	91.1%
Disbursement costs	344 503	48 230	392 733	8.9%
TOTAL	3 883 723	543 721	4 427 444	100.0%

8.5 CASH FLOW PROJECTION

A summarised cash flow projection is provided in **Table C-4** of **Appendix C**. It should be noted that five invoices have been submitted up to March 2011 with an associated total expenditure of R 489 332 (including VAT). This actual expenditure is not reflected in **Table C-4**.

9 STUDY RISKS, UNCERTAINTIES AND QUALIFICATION

The extent of the work and cost estimates assume information and data will be available form reports, data bases and in particular from the current water quality and Comprehensive Reserve determination studies.

The list of development options that were use to scale the work related to the planning scenarios are according to the latest knowledge of the study team. The current study on the Maintenance of the Vaal River System Reconciliation Strategy may identify additional or alternative options that could influence the scenarios to be analysed and the extent of the work.

The cost estimates are based on the Integrated Units of Analysis definitions that were presented in **Section 4.2**.

The following assumptions or provisos relating to the water quality assessments should be noted:

- *The availability of the Vaal Water Quality Report of the Vaal Comprehensive Reserve study:* Note that Dr Scherman is the reviewer of this report, and it is anticipated that the review will only take place in April 2011, with some time required to finalize the document.
- *The availability of all Vaal water quality modelling information when required, plus all raw data, models, EcoSpecs, RWQOs etc.*
- Water quality objectives at extrapolated nodes will only be provided where biotic response information from previous studies is available, which is assumed to be selected nodes in the Upper Vaal catchment. This information will be of low confidence.
- The water quality assessment refers to rivers only.
- Water quality implications for all users will rely on selected primary variables only.

Changes to the above assumptions will influence the work load and the cost estimate of the study. Any change in assumptions that could have a material effect on the cost estimates will be discussed with the Client and motivated during the execution of the study.

The table below lists the main risks in the execution of the study as well as associated proposed method of mitigation should these risks materialise.

Risk Category	Risk Description	Cause	Mitigation
Cost and delay	Availability of water quality reports, data and models.	No report received.	Team member will review report when available and evaluate consistencies.
Cost and delay	Inconsistency in data and information.	Status of source date to be determined during evaluations (activities).	Appropriate assumptions will be made in consultation with the Client.

Risk Category	Risk Description	Cause	Mitigation
Costs and delay	Stakeholder expectations with respect to the resolution of analysis.	Course resolution hydrology and models are available.	Negotiation and application of qualitative assessments.
Cost and delay	Stakeholder expectations with respect to the methodology.	Methodology differs from the approach presented in the guidelines.	Negotiate or change the work execution plan and costs.

10 REFERENCES

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DWA (2010a) Department of Water Affairs (DWA), 2010. Resource Directed Measures: **Comprehensive Reserve determination study of the Integrated Vaal River System. Water Resource Modelling Report**. Report produced by DMM Development Consultants/Hydrosol/WRP Consulting Engineers. Report no:

RDM/ C000/01/CON/0607

DWA (2010b) Department: Water Affairs, South Africa, 2010. **Investigation of Bottlenecks on the Usutu GWS and Usutu Vaal Phase II GWS: Water Requirements and System Analysis Report** Prepared by KV3 Engineers in Association with WRP Consulting Engineers, Aurecon, DMM Development Consultants, Golder Associates Africa and Kayamandi Development Services. (Draft Reports).

DWA (2010c) Department of Water Affairs (DWAF), 2010. **Resource Directed Measures: Comprehensive Reserve determination study of the Integrated Vaal River System. Upper Vaal Water Management Area Technical Component: Estimation Report**. Report produced by Koekemoer Aquatic Services and Rivers for Africa. Authored by Louw, D and Birkhead, AL. Report no: RDM/WMA8C000/01/CON/0510.

CBD (1992) The **Convention on Biological Diversity (CBD)** is an international agreement adopted at the Earth Summit, in Rio de Janeiro, in 1992. It has three main objectives:

- to conserve biological diversity
- to use its components in a sustainable way
- to share fairly and equitably the benefits arising from the use of genetic resources.

(http://www.biodiv.be/convention)

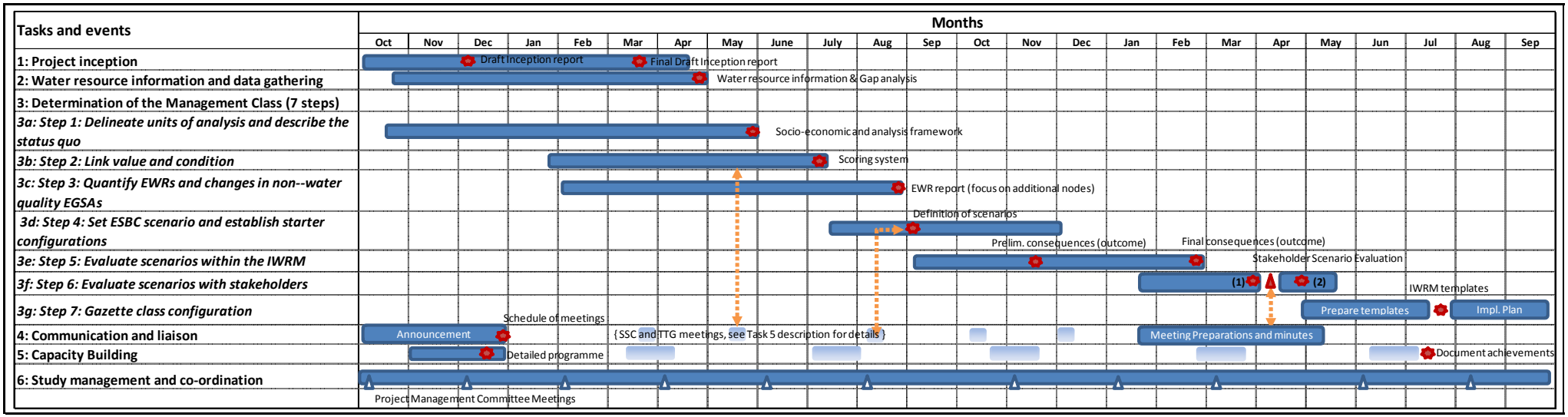
Scherman (2010) Scherman, P-A (2010). Orange River EFR study: Water quality. Appendix prepared for Rivers for Africa EFR study for ORASECOM.

Appendix A:

Study Program

Classification of Significant Water Resources (River, Wetlands, Groundwater and Lakes) in the Upper, Middle and Lower Vaal Water Management Areas (WMA) 8,9,10

Gantt Chart



Notes: EWR = Ecological Water Requirement EGSAs = Ecosystem Goods, Services and Attributes ESBC = Ecological Sustainability Base Configuration IWRM = Integrated Water Resource Management

(1) = Water Resource Analysis Report and Preliminary MC for one IUA (2) = Ecological and Goods & Services Consequences Report

Table A-1: Breakdown of Project Deliverables as per Financial Year

Quarter	Month	Deliverable/Milestone
Financial Year : 2011/2012		
Q1	April 2011 – June 2011	▪ Natural time series data for secondary nodes. ▪ Units of Analysis and status quo Report (including Socio-economic and analysis framework). ▪ Stakeholder consultation on defining scoring system for scenario evaluation.
Q2	July 2011– September 2011	▪ Analysis scoring system. ▪ Ecological Water Requirements report. ▪ Stakeholder consultation on selection of scenarios. ▪ Definition of operational scenarios to be analysed with WRPM. ▪ Configurations of Decision Support Tool (WRPM) representing defined operational scenarios.
Q3	October 2011– December 2011	▪ WRPM scenario results. ▪ Assessment of preliminary Ecological and Goods & Services consequences.
Q4	January 2012 – March 2012	▪ Additional WRPM scenario analysis results. ▪ Final Ecological and Goods & Services consequences assessment. ▪ Water Resource Analysis report. ▪ Preliminary Management Class for one IUA.
Financial Year : 2012/2013		
Q1	April 2012 – June 2012	▪ Final Stakeholder scenario evaluation. ▪ Final Ecological, Goods & Services and Socio-economic consequences report. ▪ Proposed Management Classes for IUAs.
Q2	July 2012– September 2012	▪ Final Management Classes for IUAs. ▪ IWRM templates. ▪ Documentation of capacity building achievements.

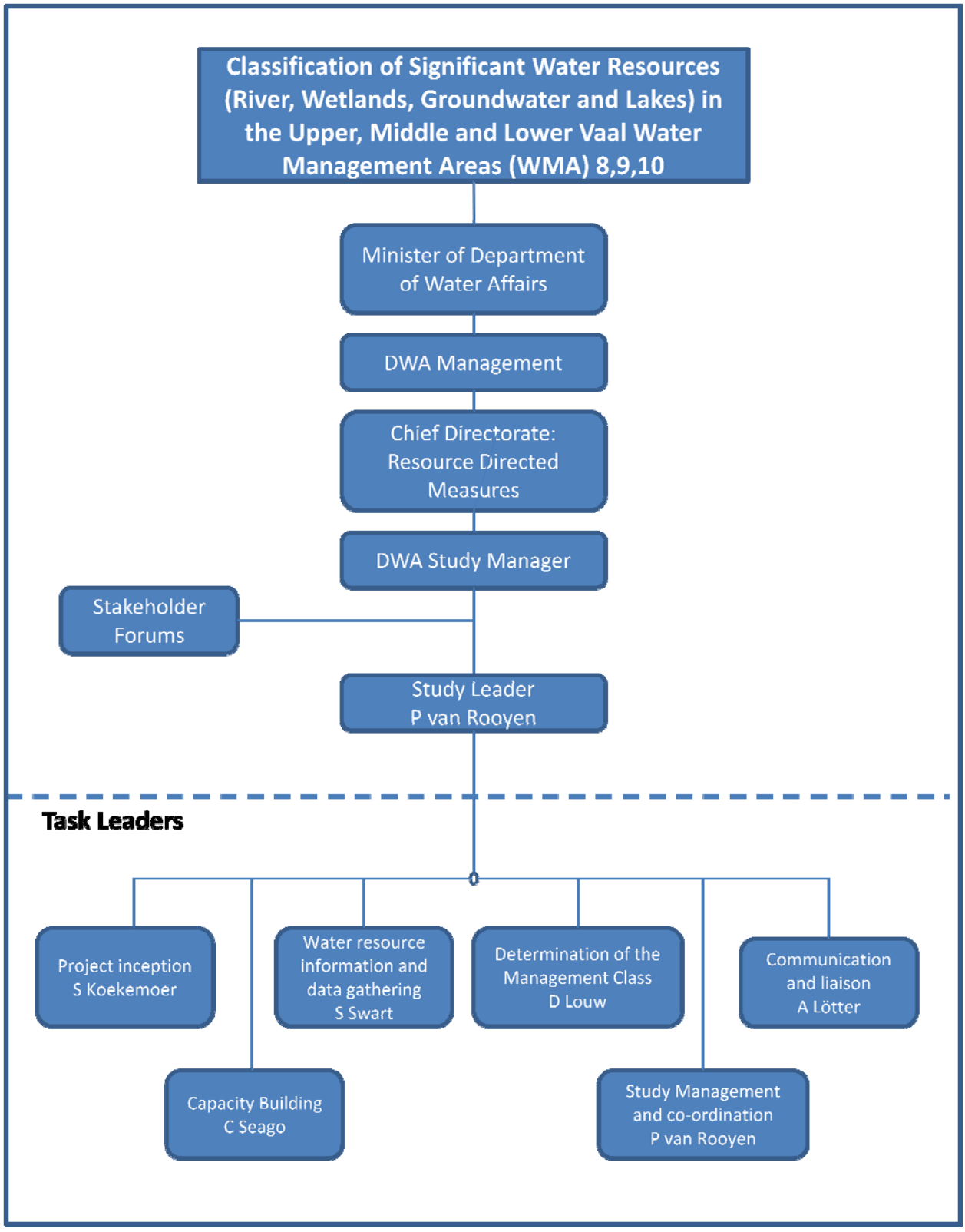
Notes: WRPM = Water Resource Planning Model

IUA = Integrated Unit of Analysis

IWRM = Integrated Water Resource Management

Appendix B:

Organogram


Classification of Significant Water Resources (River, Wetlands, Groundwater and Lakes) in the Upper, Middle and Lower Vaal Water Management Areas (WMA) 8,9,10
Minister of Department of Water Affairs
DWA Management
Chief Directorate: Resource Directed Measures
DWA Study Manager
Stakeholder Forums
Study Leader P van Rooyen
Task Leaders
Project inception S Koekemoer
Water resource information and data gathering S Swart
Determination of the Management Class D Louw
Communication and liaison A Lötter
Capacity Building C Seago
Study Management and co-ordination P van Rooyen

Appendix C:

Summary of Human Resources Breakdown

Table C-1: Professional fees for indicated team members

Name	Study Responsibility	Company	Fee category	Rate base	Hourly rate (R/h)	Hours	Professional fees (R)			% of total
							Exl VAT	VAT	Incl VAT	
Birkhead A	Key Support	Koekemoer Aquatic Services	C	17.5c/100	650	223	152 035	21 285	173 320	4.3%
Cloete R	Support	Conningarth & Huggins	B	15c/100	500	96	52 800	7 392	60 192	1.5%
de Sousa P	Support	WRP	B	15c/100	400	40	16 000	2 240	18 240	0.5%
Haasbroek B	Key Support	WRP	C	17.5c/100	700	80	56 000	7 840	63 840	1.6%
Huggins G	Key Support	Conningarth & Huggins	C	17.5c/100	600	120	72 000	10 080	82 080	2.0%
Hughes D	Key Support	Rivers for Africa	C	17.5c/100	700	76	56 000	7 840	63 840	1.6%
Joubert A	Key Support	Zitholele	C	17.5c/100	600	134	83 040	11 626	94 666	2.3%
Koekemoer S	Key Support	Koekemoer Aquatic Services	C	17.5c/100	500	300	157 300	22 022	179 322	4.4%
Kotze P	Key Support	Rivers for Africa	C	17.5c/100	550	190	109 175	15 285	124 460	3.1%
Lotter A	Task Leader	Zitholele	C	17.5c/100	770	131	102 718	14 381	117 099	2.9%
Louw D	Task Leader	Rivers for Africa	C	Negotiated	1000	587	611 800	85 652	697 452	17.3%
Louw S	Support	Rivers for Africa	B	15c/100	250	370	96 550	13 517	110 067	2.7%
Maasdorp K	Support	Conningarth & Huggins	B	15c/100	350	110	42 350	5 929	48 279	1.2%
Mackenzie J	Key Support	Koekemoer Aquatic Services	C	17.5c/100	500	80	44 000	6 160	50 160	1.2%
Mnguni DM	Key Support	DMM	D	Negotiated	800	163	130 400	18 256	148 656	3.7%
Mnqokpyi P	Support	Zitholele	C	15c/100	380	136	53 352	7 469	60 821	1.5%
Mosaka D	Key Support	Conningarth & Huggins	B	17.5c/100	700	152	109 200	15 288	124 488	3.1%
Mullins W	Task Leader	Conningarth & Huggins	B	Negotiated	700	172	123 200	17 248	140 448	3.5%
Neethling C	Support	WRP	B	15c/100	350	48	17 640	2 470	20 110	0.5%
Palmer R	Key Support	Koekemoer Aquatic Services	C	17.5c/100	580	60	38 280	5 359	43 639	1.1%
Renke R	Support	WRP	B	15c/100	400	8	3 200	448	3 648	0.1%
Rountree M	Key Support	Koekemoer Aquatic Services	C	17.5c/100	500	120	60 000	8 400	68 400	1.7%
Sami K	Task Leader	Sub-consultant	E	Negotiated	950	158	150 100	21 014	171 114	4.2%
Scherman P	Key Support	Koekemoer Aquatic Services	C	17.5c/100	580	150	88 740	12 424	101 164	2.5%
Seago C	Key Support	WRP	C	17.5c/100	750	633	478 050	66 927	544 977	13.5%
Swart HS	Key Support	WRP	D	Negotiated	850	205	174 250	24 395	198 645	4.9%
Van Rooyen PG	Study Leader	WRP	E	Negotiated	1200	370	461 040	64 546	525 586	13.0%
Total						4 912	3 539 220	495 491	4 034 711	100.0%
HDI component						2 639	1 872 310	262 123	2 134 433	52.9%

Notes: (1) “Negotiated” = Negotiated rate and “15c/100”,”16c/100” or “17.5c/100” = 15, 16.5 or 17.5 cent per hundred rand rule.

Table C-2: Hours for indicated team members per task

Person	Van Rooyen PG	Huggins G	Swart HS	Seago C	Haasbroek B	Hughes D	Neethling C	Renke R	de Sousa P	Mnguni DM	Louw D	Mullins W	Mosaka D	Cloete R
Task 1	44		60	60							40			
Task 2	12		25	21				8		83	65			
Task 3i		120				37					139			
Task 3ii												172	152	96
Task 3iii	45		80	340	80				40	80				
Task 3iv	42					39					39			
Task 4	22										92			
Task 5	13		40	120							20			
Task 6	192			92			48				192			
Total	370	120	205	633	80	76	48	8	40	163	587	172	152	96

Person	Maasdorp K	Koekemoer S	Sami K	Louw S	Lotter A	Joubert A	Mnqokpyi P	Birkhead A	Scherman P	Rountree M	Palmer R	Kotze P	Mackenzie J	Total
Task 1					40									244
Task 2			60									65		339
Task 3i	110	84		234				223	150	120	60	125	80	1482
Task 3ii														420
Task 3iii			98											763
Task 3iv		40												160
Task 4		76		40	67	134	136							567
Task 5		20												213
Task 6		80		96	24									724
Total	110	300	158	370	131	134	136	223	150	120	60	190	80	4912

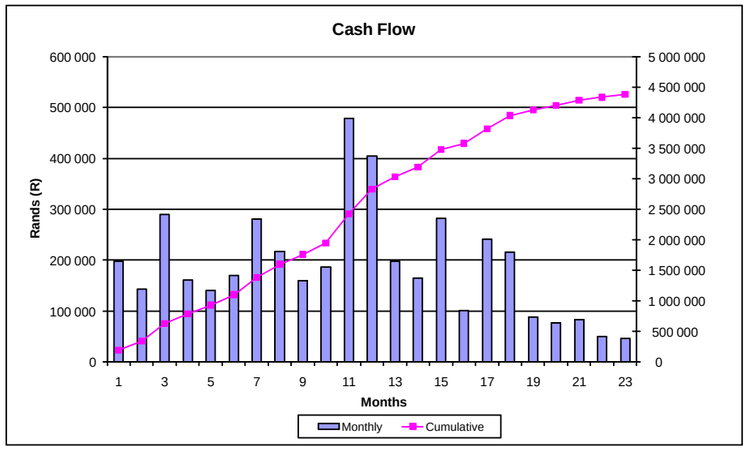
Table C-3: Cost for indicated team members per task (R, excl. VAT)

Person	Van Rooyen PG	Huggins G	Swart HS	Seago C	Haasbroek B	Hughes D	Neethling C	Renke R	de Sousa P	Mnguni DM	Louw D	Mullins W	Mosaka D	Cloete R
Task 1	52800		51000	45000							40000			
Task 2	14400		21250	15750				3200		66400	65000			
Task 3i		72000				25970					148300			
Task 3ii												123200	109200	52800
Task 3iii	54000		68000	255000	56000				16000	64000				
Task 3iv	55440					30030					42900			
Task 4	26880										94000			
Task 5	15600		34000	90000							20000			
Task 6	241920			72300			17640				201600			
Total	461040	72000	174250	478050	56000	56000	17640	3200	16000	130400	611800	123200	109200	52800

Person	Maasdorp K	Koekemoer S	Sami K	Louw S	Lotter A	Joubert A	Mnqokpyi P	Birkhead A	Scherman P	Rountree M	Palmer R	Kotze P	Mackenzie J	Total
Task 1					30800									219600
Task 2			57000									35750		278750
Task 3i	42350	45700		61350				152035	88740	60000	38280	73425	44000	852150
Task 3ii														285200
Task 3iii			93100											606100
Task 3iv		22000												150370
Task 4		38000		10000	52514	83040	53352							357786
Task 5		10000												169600
Task 6		41600		25200	19404									619664
Total	42350	157300	150100	96550	102718	83040	53352	152035	88740	60000	38280	109175	44000	3539220

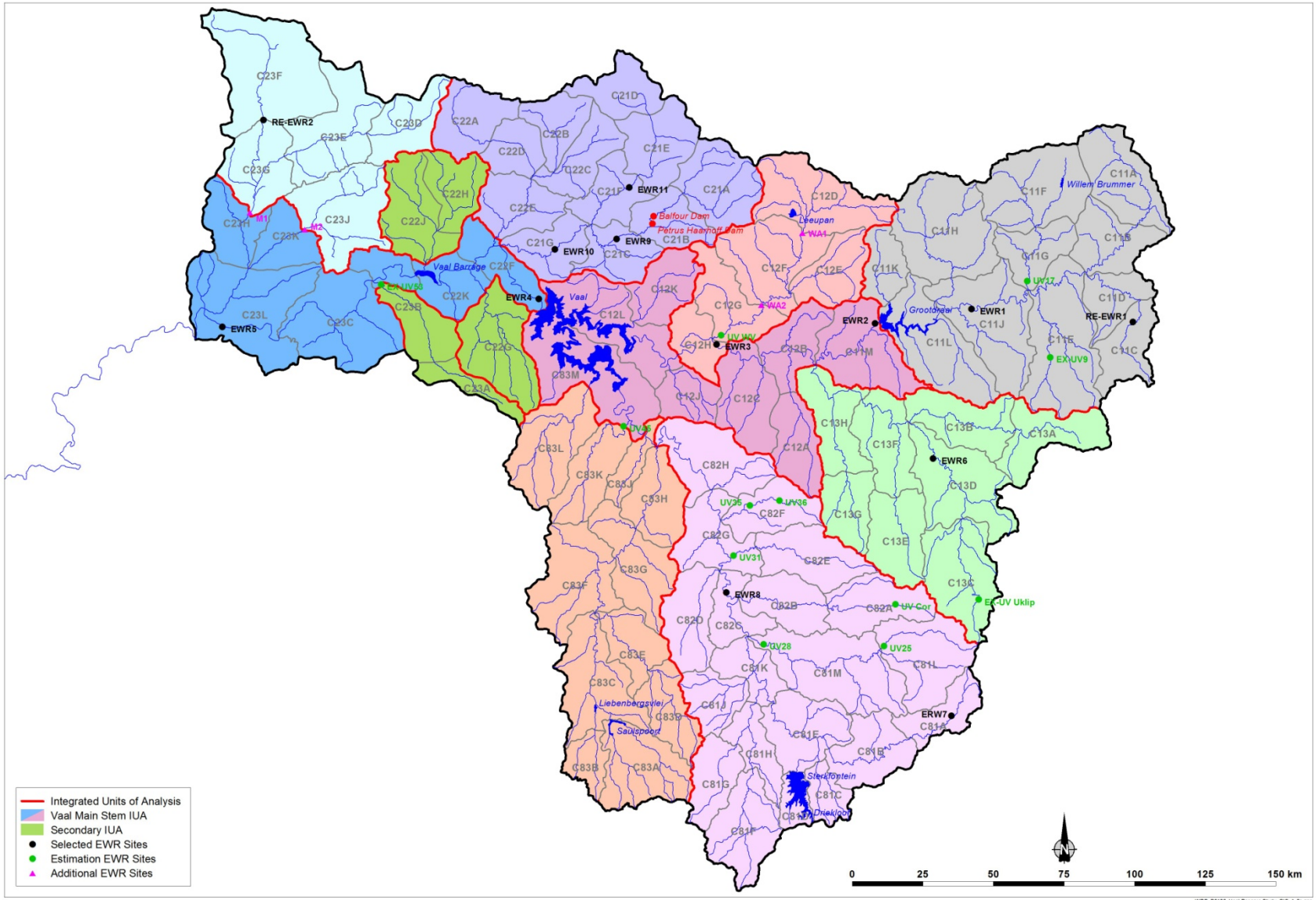
TABLE C-4:PROJECTED CASH FLOW

Task	Description	Nov 2010 Month 1	Dec 2010 Month 2	Jan 2011 Month 3	Feb 2011 Month 4	Mar 2011 Month 5	Apr 2011 Month 6	May 2011 Month 7	Jun 2011 Month 8	Jul 2011 Month 9	Aug 2011 Month 10	Sep 2011 Month 11	Oct 2011 Month 12	Nov 2011 Month 13	Dec 2011 Month 14	Jan 2012 Month 15	Feb 2012 Month 16	Mar 2012 Month 17	Apr 2012 Month 18	May 2012 Month 19	Jun 2012 Month 20	Jul 2012 Month 21	Aug 2012 Month 22	Sep 2012 Month 23	Oct 2012 Month 24	Total
1	**PROJECT INCEPTION**	135 400	84 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	219 600
2	**WATER RESOURCE INFORMATION AND DATA GATHERING**	0	0	75 750	93 250	44 250	65 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	278 750
3i	**DETERMINATION OF THE MANAGEMENT CLASS: Ecological**	0	0	0	0	0	0	79 650	69 550	72 350	57 450	60 850	64 050	26 400	71 170	47 850	50 050	76 945	72 820	41 965	26 950	28 600	5 500	0	0	852 150
3ii	**DETERMINATION OF THE MANAGEMENT CLASS: Socio Economic**	0	0	0	0	0	0	0	0	0	58 800	56 000	56 000	92 400	22 000	0	0	0	0	0	0	0	0	0	0	285 200
3iii	**DETERMINATION OF THE MANAGEMENT CLASS: Water Resources**	0	0	0	0	0	0	57 000	73 600	0	0	177 000	187 000	0	0	111 500	0	0	0	0	0	0	0	0	0	606 100
3iv	**DETERMINATION OF THE MANAGEMENT CLASS: Integration and decision analyses**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74 800	75 570	0	0	0	0	0	0	150 370
4	**COMMUNICATION AND LIAISON**	0	0	71 930	8 960	37 040	44 840	12 040	8 960	26 100	8 960	45 120	8 960	12 936	9 856	46 992	0	15 092	0	0	0	0	0	0	0	357 786
5	**CAPACITY BUILDING**	0	0	68 000	0	0	0	59 300	0	0	0	42 300	0	0	0	0	0	0	0	0	0	0	0	0	0	169 600
6	**STUDY MANAGEMENT AND CO ORDINATION**	24 300	27 380	24 300	24 300	27 380	24 300	24 300	24 300	27 380	24 300	24 300	24 300	27 918	26 730	26 730	24 530	30 118	26 730	21 230	26 730	30 118	24 530	26 730	26 730	619 664
Total professional fees		159 700	111 580	239 980	126 510	108 670	134 640	232 290	176 410	125 830	149 510	405 570	340 310	159 654	129 756	233 072	74 580	196 955	175 120	63 195	53 680	58 718	30 030	26 730	26 730	3 539 220
Disbursement costs		14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	14 354	344 503
Office infrastructure costs		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total cost excl. VAT		174 054	125 934	254 334	140 864	123 024	148 994	246 644	190 764	140 184	163 864	419 924	354 664	174 008	144 110	247 426	88 934	211 309	189 474	77 549	68 034	73 072	44 384	41 084	41 084	3 883 723 0
Total cost incl. VAT		**198 422**	**143 565**	**289 941**	**160 585**	**140 248**	**169 853**	**281 174**	**217 471**	**159 810**	**186 805**	**478 714**	**404 317**	**198 369**	**164 286**	**282 066**	**101 385**	**240 893**	**216 001**	**88 406**	**77 559**	**83 302**	**50 598**	**46 836**	**46 836**	**4 427 444**
Cumulative total cost incl. VAT		**198 422**	**341 987**	**631 928**	**792 513**	**932 761**	**1 102 615**	**1 383 789**	**1 601 260**	**1 761 070**	**1 947 876**	**2 426 589**	**2 830 907**	**3 029 276**	**3 193 562**	**3 475 628**	**3 577 013**	**3 817 906**	**4 033 906**	**4 122 312**	**4 199 872**	**4 283 174**	**4 333 772**	**4 380 608**	**4 427 444**	



Appendix D:

Catchment Maps of the Integrated Units of Analysis



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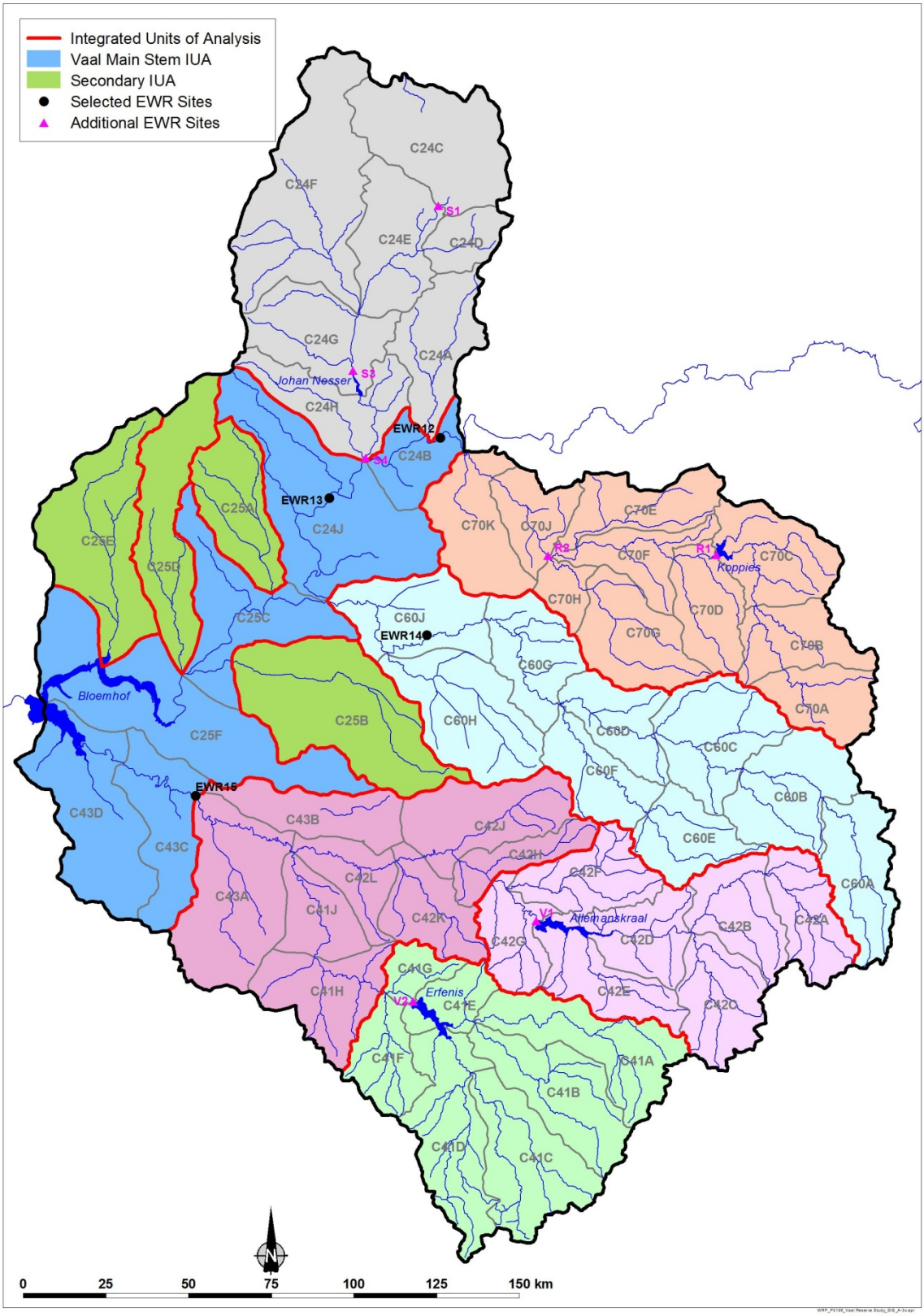
INTEGRATED VAAL RIVER SYSTEM COMPREHENSIVE
RESERVE DETERMINATION STUDY

Upper Vaal EWR Sites

D-1


Integrated Units of Analysis
Vaal Main Stem IUA
Secondary IUA
Selected EWR Sites
Additional EWR Sites
C24C
C24F
S1
C24E
C24D
C24G
C24A
Johan Nesser
S3
C24H
EWR12
S2
C24B
EWR13
C25A
C24J
C25E
C25D
C25C
C70K
C70J
C70E
R2
C70F
R1
C70C
Koppies
C70H
C70D
C60J
EWR14
C70G
C70B
C60G
Bloemhof
C25B
C60H
C70A
C60D
C25F
C60C
C60F
EWR16
C60B
C43D
C43B
C42J
C60E
C43C
C42H
C42F
C42L
C60A
C43A
C41J
C42K
V3
Allemanskraal
C42B
C42A
C42G
C42D
C41G
C41H
Erfenis
V2
C42E
C42C
C41E
C41F
C41A
C41B
C41D
C41C
N
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25
50
75
100
125
150 km
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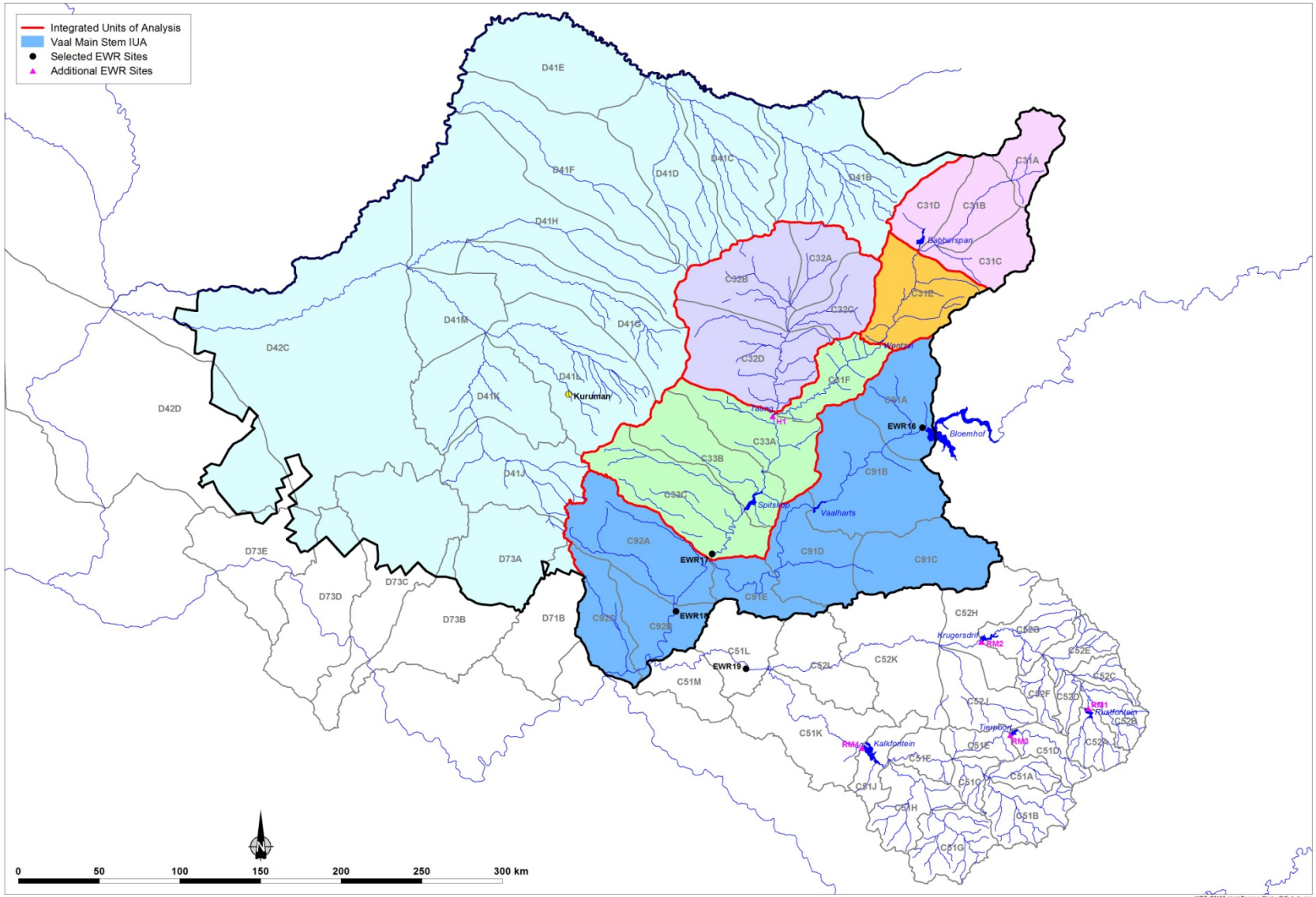
INTEGRATED VAAL RIVER SYSTEM COMPREHENSIVE
RESERVE DETERMINATION STUDY
Middle Vaal EWR Sites
D-2



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INTEGRATED VAAL RIVER SYSTEM COMPREHENSIVE RESERVE DETERMINATION STUDY

Lower Vaal EWR Sites

D-3

Appendix E:

Description of the Integrated Vaal River System

E DESCRIPTION OF THE INTEGRATED VAAL RIVER SYSTEM (IVRS) AND HYDROLOGICAL DATABASE

E.1 GENERAL

Owing to a number of inter-basin transfers both to and from the Vaal River catchment, the Vaal River System is inter-linked with various other river basins. The Integrated Vaal River System (IVRS), therefore, comprises all the individual river systems that are linked to the Vaal River (refer to **Figure 1-1** on page 4 of main report) which includes the following supporting sub-systems:

- Komati Sub-system (Nooitgedacht and Vygeboom dams);
- Usutu Sub-system (Westoe, Jericho and Morgenstond dams);
- Heyshope Dam system;
- Zaaihoek Dam system;
- Upper Thukela Sub-system (Woodstock Dam and Driel Barrage); and
- Senqu Sub-system (Katse and Mohale dams).

The Vaal River System is briefly described in **Section E.2** and summarised information on the inter-basin transfer schemes shown in **Figure 1.1** (page 4 of main report) is as follows:

- **The Heyshope to Morgenstond Transfer Scheme**: transferring water from Heyshope Dam in the Assegaai River catchment to the Morgenstond Dam (Usutu Sub-system), with a maximum transfer capacity of 1.4 m^3/s.
- **The Heyshope to Grootdraai Transfer Scheme**: transferring water from Heyshope Dam in the Assegaai River catchment to the Upper Vaal WMA (Grootdraai Dam), with a maximum transfer capacity of 4.28 m^3/s.
- **The Zaaihoek to Grootdraai Transfer Scheme**: transferring water from the Zaaihoek Dam in the Slang River in the Buffalo Catchment to the Upper Vaal WMA (Grootdraai Dam), with a maximum transfer capacity of 2.79 m^3/s.
- **Thukela-Vaal Transfer Scheme**: transferring water from Woodstock Dam and Driel Barrage in the Upper Tugela Catchment to the Upper Vaal WMA (Sterkfontein Dam), with a maximum transfer capacity 20 m^3/s.
- **The Vaal–Olifants Transfer Scheme (Grootdraai)**: transferring water from Grootdraai Dam in the Upper Vaal WMA to the Upper Olifants Catchment, with a maximum transfer capacity of 6.65 m^3/s.
- **The Inkomati Transfer system**: transferring water from Nooitgedacht and Vygeboom dams in the

Komati West Catchment to the Upper Olifants Catchment.

- **The Lesotho Highlands Transfer System**: transferring water from Katse and Mohale Dams in Lesotho to the Upper Vaal WMA, with a maximum transfer capacity of 35.7 m^3/s.

- **Vaal River Eastern Sub-system Augmentation Project (VRESAP)**: Transferring water from Vaal Dam to the Sasol Secunda complex and the Eskom Power Stations in the Upper Olifants Catchment, with a maximum transfer capacity of 5.07 m^3/s.

E.2 DESCRIPTION OF THE VAAL RIVER SYSTEM

With reference to the Vaal River System it is important to distinguish between the Main Vaal System and the smaller sub-systems in the Vaal. The Main Vaal System consists basically of four major storage dams in the Vaal River Basin, i.e. the Grootdraai Dam, Sterkfontein Dam, Vaal Dam and Bloemhof Dam. These dams are located on the main stem of the Vaal River with the exception of Sterkfontein Dam which is located on the Wilge River tributary. Within the Vaal River Basin there is, however, also several smaller sub-systems which are all operated independently from the main system. These smaller sub-systems are not used to support the Main Vaal System and it is only the spillage from the smaller sub-systems that reaches the Main Vaal System.

The Vaal River System comprises of the following three Water Management Areas (WMA):

- Upper Vaal WMA;

- Middle Vaal WMA;

- Lower Vaal WMA.

E.3 HYDROLOGICAL DATABASE

The hydrological database resulting from the Vaal River System Analysis Update (VRSAU) Study (DWA, 1999) was included in the Water Resource Planning Model (WRPM) configuration in 1999. The hydrology for sub-catchments within the Komati, Usutu, Thukela and Senqu river basins was also updated as part of the VRSAU study. The VRSAU hydrology covers the period October 1920 to September 1995 (i.e. a period of 75 years). It is important to note that the hydrological analyses of the VRSAU study were not necessarily undertaken at quaternary catchment level as the focus was on the most representative modelling of relevant sub-catchments. The strategy adopted for the Annual Operating Analysis (AOA) of the IVRS is to continuously update and enhance the WRPM configuration and database as new information becomes available. Updated hydrology of the Thukela and Schoonspruit River catchments were subsequently included in the WRPM database. The updated hydrology of the Upper Waterval catchment resulting from the most recent BKS study (BKS, 2005a) was included in the WRPM database as part of the Comprehensive Reserve Determination Study.

E.4 WATER REQUIREMENTS

The water requirement projections of water users in the IVRS are updated on an annual basis as part of the Vaal River Annual Operating Analysis (AOA). Water requirement projections of bulk water users (Rand Water, Midvaal Water Company and Sedibeng Water) and large industrial users (Eskom, Sasol and Mittal Steel) are updated on a regular basis by these users themselves. The projections of other water use sectors are updated as new information becomes available from more recent assessments.

Information on water requirements and return flows is captured within a database spreadsheet. Information is available for so-called demand centres and is summarised within the context of sub-systems and user groups rather than at quaternary catchment level.

The operation of the IVRS system is based on the principle that demands are restricted during severe drought events. The objective of these restrictions is to reduce supply to less essential use to be able to protect the assurance of supply to more essential use. The basis on which restrictions are implemented is defined by means of the user priority classification definition.

The user priority classification definition requires that the different water users be grouped together into user categories and these categories should be classified according to priority for water supply. The four user categories that were considered for the IVRS are Domestic, Industrial, Strategic Industries and Irrigation. The four user categories were each split into three different levels of assurance of supply namely a Low, Medium and High priority level.

Appendix F:

Inception Report Comments and Response Summary

Source of Comment (Date received)	No.	Comment	Response/ Reference to Inception Report
DWA: S Naidoo (15 February 2011)	1	The report needs to be revised given the information provided from the Comprehensive Reserve study.	Revision of relevant paragraphs was made in the report.
	2	Include an Annexure for acronyms	See table with acronyms on Page viii.
	3	Ensure consistent use of terminology. Regulation 810 refers to the Water Resource Classification System (WRCS) not NWRCS.	References corrected throughout the report.
	4	Section 1.2 “Purpose of the study”- include capacity building.	See Page 1, **Section 1.2**.
	5	Consider enhancing the description of the study area to include the following: • Socio-economic situation • Hydrology • Water resource infrastructure • Water allocation data at quaternary level • Aquatic ecosystem biodiversity • Water quality • Aquatic ecosystem condition & sensitivity • Transboundary implications	See Page 2, Section 1.4 as well as Appendix E.
	6	The Inception Report should ideally also summarise the IUA’s and the information available (including information gaps) for each of them.	Identification of the data elements indicate the required data is available. Evaluations of consistency will be carried out as part of the activities and tasks. Description of the assessments and results will incorporate

Source of Comment (Date received)	No.	Comment	Response/ Reference to Inception Report
			presentations the data and information in each IUA.
	7	Task 2 "Water Resource Information and data gathering"- The Inception Report should contain an approach to verify baseline information and mechanisms to address gaps.	Explanatory text was added to the task descriptions to present the methods to deal with the limitation of data. Consistency checks and evaluations will be undertaken during the execution of the activities and tasks. These checked will be against known norms and existing knowledge of the specialists of the study area as well as application of the methods in other studies in the country.
	8	It is suggested that all significant water resources at IUA scale are listed then prioritized for purposes of this study	Added text to list the significant resources (rivers and groundwater assessment areas)
	9	Indicate in the report where DWA guidance, as per the WRCS guidelines, are not followed.	Principles will remain as per WRCS guidelines. Methodology descriptions were improved in this version of the report and may be refined as the study proceeds.
	10	Due to the uncertainties and limitations that have been described in implementing the WRCS in the Olifants, it is recommended that Chapter 10 of the Report addressing the risks and uncertainties be further enhanced with the addition of a table consisting of the following elements: • Risk Category • Risk Description	Table added in Chapter 9.

Source of Comment (Date received)	No.	Comment	Response/ Reference to Inception Report
		• Cause • Mitigation Action This table will then be utilized in further DWA processes influenced by the classification process.	
	11	6.1 Task 1: Project Inception, Last sentence. Is it possible to adjust the budget at this early stage? Does it also mean that the initial budget in the proposal has been adjusted?	The total study budget remained the same as in Proposal. Changes were made to budgets of individual tasks. See Page 42, **Table 8.4**.
	12	6.2 Task 2, 4th paragraph. Clarity must be sought to ascertain if the socio-economic information was based on all parameters of the Water Resource namely Quality, Biota, Riparian habitat and quantity.	See Page 18, Task 2, 4th Paragraph for confirmation.
	13	Step 1d: Seemingly the severe economic Prejudice concept and model caters for volume allocation only. If that is the case then other aspects of the resource will not be addressed e.g. the waste load allocation for the discharge of treated or untreated waste into the resource.	The Severe Economic Prejudice concept was updated to include water quality and other restrictions. See Page 21, Step 1i, Second Paragraph.
	14	Step 5d:	Opportunity cost is included. See Page 29, Step 5d, First

Source of Comment (Date received)	No.	Comment	Response/ Reference to Inception Report
		In the estimation of the magnitude of the change in benefits and costs that may be experienced within the river system, does the cost referred to here also include the opportunity costs?	Paragraph.
	15	Step 5e: I do not think the PSPs approach is in sync with the description of this step in the WRCS guidelines. My understanding of this step is that it outlines the macro economic benefits of different uses of the resource e.g. if the resource is to be used heavily we must be able to indicate the economic benefits that should be expected. This could be direct and indirect.	The overall implication no a regional level is assessed through the implications of scenarios on the augmentation needs (translated into costs) of the Integrated Vaal River System. This cost (difference in costs between scenarios) influences water users outside of the catchment of the Vaal River through the transfers and links. The difference in the augmentation costs is therefore a practical measure of the implications of each scenario relative to each other. Text was added in steps 5e and 5f.
	16	Page 1: appropriate adjustments will be made to the work description and cost proposal after the information and data has been thoroughly reviewed: no variation order will be entertained at this stage, especially the cost.	Noted.
	17	Page 6&7: the study team received additional reports for all WMAs. Summary of information and data requirements need to be revised.	Revised. See Page 7.
	18	Page 13: paragraph need to be revised as the information (middle	Revised.

Source of Comment (Date received)	No.	Comment	Response/ Reference to Inception Report
		and lower) is available.	
	19	Page 16: the budget of the study was adjusted accordingly. When was the budget adjusted?	The total study budget remained the same. Changes were made to budgets of individual tasks. See Page 42, **Table 8.4**.
	20	Page 29: the background information is readily available.	Approval of Inception Report did not influence progress. BID was compiled and distributed.
	21	Appendix B: RDM is Chief Directorate not Directorate	Correction made. See **Appendix B**.
DWA:L Mulangaphuma (18 February 2011)	1	Consensus was reached to deliver Preliminary MC at the end of March 2012; can you please update Gantt bar chart and ensure Preliminary MC is reflected as deliverable?	Included deliverable. See **Appendix A**: Gantt Chart.
	2	Can you also ensure that milestone (Preliminary MC) is reflected in inception report table 5.1 as deliverable/milestone?	Included deliverable: **Table 5.1**.
	3	Briefly explain what are these deliverables? Water resource analysis report and Preliminary and Final consequences reports.	Notes added to **Table 5.1.**
	4	In Inception report, under scope of work heading, above mentioned reports are not explained.	Notes added to **Table 5.1.**
DWA Kimberley:	1	On page 12, 4.2.4, the first sentence is suppose to read Lower Vaal	Editorial correction made. See **Section 4.2.4**.

Source of Comment (Date received)	No.	Comment	Response/ Reference to Inception Report
RN Mazwi (7 February 2011)		& not Middle Vaal.	
	2	Page 25, Significant groundwater resources that have been identified is the Lichtenberg area, but the Postmasburg/ Kathu area is an area of major concern for the region & will appreciate if it can be prioritized as well. This area falls within the D73A drainage region.	Due to lack of information, a qualitative methodology (low confidence) will be adopted for the assessment of the Molopo River catchment. See **Section 6.3.5**.
	3	Take note that the Harts River which is a tributary to the Vaal River is also an area of great concern as we are having serious water quality issues, especially since it feeds into the Barberspan, which is a RAMSAR site.	The impact of groundwater-surface water interaction will be taken into account in the upper reaches of the Harts River. The catchment which includes Barberspan was defined as an IUA. See **Figure D-3** of **Appendix D**.
	4	I understand that through the PSC & PMC the project will be communicated, but how will we ensure that the ordinary person on the street that will 'benefit' from this project understand & know that this project exist. Especially the HDI component in areas like the Harts River.	The public participation task of this project and the events have been scheduled in accordance with the task budget. See **Section 6.4.4**.
DWA, JI Rademeyer (4 April 2011)	1	General comments: • As was discussed at a meeting we had with you earlier – the question remains whether the time is right to do the classification for the Vaal seeing that important things are	The Project Steering Committee and Technical Task Group (TTG) to be established as part of this study will be instrumental in providing strategic advice and guidance throughout the project. Several meetings have been scheduled (see **Section 6.4.4** on **page 33**). Mr JI

Source of Comment (Date received)	No.	Comment	Response/ Reference to Inception Report
		not yet in place such as the CMA. • The consequences of implementing the Reserve have not been work-shopped, which might have a huge influence on the classification. All of the above have to do with the fact that a lot of discussion/interaction amongst the stakeholders will have to happen, which is going to be much more than just having normal study Steering Committee meetings, and my question is whether this has been adequately been factored in? The consequences will have to be thoroughly work-shopped.	Rademeyer will be invited to attend the TTG meetings to ensure liaison with other parallel studies.
	2	• **General comment**: Tasks 3e to 3g disappeared in Section 8: Study costs as well as Appendix C: Summary of human Resources breakdown. I assume that the time and costs are now added as part of other tasks. • Page 28, **Section 6.3.5**, second paragraph: "The study cost estimate provided in the Financial Proposal makes provision for five main scenarios where full evaluation of all aspects will be carried out. Provision for a further five alternative combinations of these five scenarios are also included in the cost estimates. These five alternatives will	The breakdown of Task 3 "Determination of the Management Class" into sub-tasks, as described in **Section 6.3**, was based on the seven steps of the Classification Process. The study budget for undertaking Task 3 was, however, based on the following four main aspects: Ecological assessments, Socio Economic assessment, Water Resources assessments and the Integration and Decision analyses. For clarification purposes references to the latter were changed in **Section 8**.

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		only involve simulations and qualitative comparative analysis". See my note under "General" on the fact that it is not clear how tasks 3e to 3g were included in the budget.	
	3	Under References: • Vaal River Annual Operating Analysis Study managed by the Directorate: Water Resources Planning Systems of DWA. • Study to address and eradicate unlawful water use in the three Vaal Water Management Areas. Referenced in the minutes of the Vaal River System Strategy Steering Committee meeting held on 21 October 2010.	Editorial corrections were made. See Page 6, second and fourth bullet under heading "**Current parallel studies or processes**".
	4	Page 12, **Section 4.2.1**, second paragraph: "In an ideal situation it would have been preferred to have a properly calibrated higher resolution network water resource model available for use in the classification process. Such models have been developed for other systems in the country as part of Water Availability Assessment Studies where the focus was to develop installed modelling systems to support the licensing of water use. Such detailed work requires significant human resources and were not included in the proposal of this study".	The classification will be based on the most recent information available for the study area. Furthermore, the understanding is that the classification resulting from this study can be revised once updated or new information becomes available.

Source of Comment (Date received)	No.	Comment	Response/ Reference to Inception Report
		Question is whether we can proceed with what we have – in other words: will the classification be compromised without all of this in place?	
	5	**Figure D-3** presents a map of the Middle Vaal WMA and there are five proposed IUAs.	Editorial correction made. Page 14, **Section 4.2.4**: "Middle" Vaal was changed to "Lower" Vaal.
	6	Page 31, Step 7c: "At the inaugural management meeting it was confirmed that the RQOs will form part of a separate process and information from this study will be made available where appropriate". Mr Rademeyer was a bit concerned about the somewhat one way traffic that is sketched here. As he has indicated previously, he thinks that the various processes have to be debated at the same forum as they are influencing each other.	Integration of the classification study results and the subsequent setting of the RQOs will have to be carried out in subsequent processes.
	7	Page 34, third paragraph under heading "(b) Establishing Technical Task Group Meeting": (costs for a repeat workshop were not included in the budget). Although Mr Rademeyer indicated under "General" that he is a bit worried whether sufficient consultation/interaction/work-shopping was going to take place, he felt a bit better having read the	The study allows for two Technical Task Group Meetings.

Source of Comment (Date received)	No.	Comment	Response/ Reference to Inception Report
		document up to here, but he still has his doubts.	

Appendix G:

Members of Project Steering Committee

Last Name	First Name	Company
Aaron	Nontsikelelo	Leiweleputswa District Municipality
Abrahams	Abe	Department of Water Affairs (DWA)
Ah Shene Verdoorn	Carolyn	Birdlife South Africa
Armour	Jack	Free State Agriculture
Atwaru	Yakeen	Department of Water Affairs (DWA)
Augoustinos	Mario	Vaaldam Catchment Executive Committee
Bakane-Tuoane	Manana Anne	Emfuleni Local Municipality
Barnard	Hendrik	Ga-Segonyana Local Municipality
Basson	Noeline	Sedibeng Water
Batchelor	Garth	Department of Economic Development Environment and Tourism
Bezuidenhout	P J	Overberg District Council
Bierman	Bertus	Joint Water Forum and Anglo American Platinum
Blair	Vernon	Department of Water Affairs (DWA)
Boden	Denis	National Petroleum Refiners of S A (Pty) Ltd (NATREF)
Bosch	Gert	Sishen Iron Ore Mine
Bosman	Lourie	Agri Mpumalanga (Plaas Uitgezogt)
Botha	Hannes	Mpumalanga Tourism and Parks Agency
Bothes	Elizabeth	Department of Tourism, Environment and Conservation
Brink	Fanie	Grain South Africa
Broderick	Maylene	Economic Development, Environment and Tourism
Burger	Alwyn	City of Tshwane Metropolitan Municipality
Chamda	Yunus	Sedibeng District Municipality
Chauke	Lucia	Eskom
Chauke	Sydney	Emfuleni Municipality
Chewe	Victor	City of Tshwane Metropolitan Municipality
Claassens	Johan	TCTA
Cloete	Riekie	Conningworth Economists
Cogho	Vik	Optimum Coal Holdings
Collins	Nacelle	Free State Department of Tourism, Environmental and Economi
Cornelius	Steven	Gauteng Department of Agriculture and Rural Development
Critchley	John	Rand Water
Cronje	Barry	Rural Foundation
de Fontaine	Marc	Rand Water Rietspruit Blesbokspruit Forum
de Jager	Steyn	Greater Taung Municipality
de Klerk	Albert	Midvaal Local Municipality
De Kock	Abe	Farm: Mooidraai
de Villiers	D W	Koppieskraal Irrigation Board
Dhluwayo	Boy	Sol Plaatjie Municipality (Kimberley)
Dini	John	South African National Biodiversity Institute
Diniza	Maria	Gamagara Local Municipality
Dippenaar	Gideon	Sedibeng Water
Dippenaar	Gideon	Sedibeng Water
Dlabantu	Mpumelelo	Working for Water
Dlamini	Mavela	City of Johannesburg Metropolitan Municipality
Dlamini	Thami	Msukwaligwa Local Municipality
Donaldson	R	Manganese Mines
Driver	Mandy	SANBI
du Plessis	Rickus	Department of Agriculture and RuraL Development
du Toit	Hanke	Department of Water Affairs (DWA)
Du Toit	Tienie	Renoster River Water Users Association
Eilard	J	Dikgatlong Local Municipality
Eilerd	Johannes	Dikgatlong Local Municipality
Els	Nic	City Council of Klerksdorp
Erasmus	Coenie	Department of Tourism, Environment and Economic Affairs
Erasmus	Frik	Durban Roodepoort Deep Limited
Florence	Achmat	Frances Baard District Municipality
Fourie	A J	Griqualand Exploration & Finance Co Ltd
Fourie	Wynand	Department of Environmental Affairs (DEA)
Gabriel	Mary-Jean	Department of Agriculture, Forestry and Fisheries (DAFF)
Galane	Malesela	Environmental Justice Networking Forum (EJNF)

Last Name	First Name	Company
Gamede	Andries	Gert Sibande District Municipality
Gaobusiwe	Benjamin	Kgalagadi District Municipality
Gincane	Ruben	Mamusa Local Municipality
Ginster	Martin	Sasol
Gondo	Joe	National African Farmers Union (NAFU)
Gopane	Ruth	Dikgatlong Local Municipality
Gosani	Ntsikelelo	TCTA
Greeff	Henry	Kgalagadi District Municipality
Greyling	Jan	Matjhabeng Local Municipality
Greyling	S P J	Schoonspruit Irrigation Scheme
Grobler	Willem	Department of Water Affairs (DWA)
Gungubele	Mondli	Ekurhuleni Metropolitan Municipality
Hadebe	Slindokuhle	Ekurhuleni Metropolitan Municipality
Hall	Peter	Sasol Infrachem (Leeu Spruit, Taaibosch Spruit Forum)
Hanekom	Dirk	Eskom
Harrison	Pienaar	Department of Water Affairs (DWA)
Hauman	Louis	Kuruman Agricultural Union
Hendriksz	Johan	East Rand Water Company (ERWAT)
Itholeng	Kebalepile	Gauteng Department of Agriculture and Rural Development
Itumeleng	Clement	Gamagara Local Municipality
Izaaks	Saul	Siyanda Water and Sanitation District
Jacobs	Gideon	Distrik Boere Unie
Jooste	Sebastian	Department of Water Affairs (DWA)
Joubert	Andre	Zitholele Consulting (Pty) Ltd
Kadiaka	Mamogala	Department of Water Affairs (DWA)
Keet	Marius	Department of Water Affairs (DWA)
Kekesi	Albert	Bophirima District Municipality
Khan	Rafat	Midvaal Water Company
Kleynhans	Neels	Department of Water Affairs (DWA)
Kokobela	Mosimanegape	House of Traditional Leaders
Komape	Martha	Department of Water Affairs (DWA)
Kruger	Marina	Midvaal Water Company
Leeto	Nokwanje	Lejweleputswa District Municipality
Leeuw	David	Sol Plaatjie Local Municipality
Lekoko	Simon	Directorate of Traditional and Corporate Affairs
Lethoko	Itumeleng	Ditsobotla Local Municipality
Letlhogile	Tshiamo	Ditsobotla Local Municipality
Letsoalo	Mokopane	Waterberg District Municipality
Leuschner	Andries	Gold Fields South Africa Ltd
Liefferink	Mariette	Federation for a Sustainable Environment (FSE)
Liphadzi	Stanley	Water Research Commission
Lobelo	Govan	Dr Ruth Segomotisi Mompati District Municipality
Lodewijks	Henk	Anglo Coal Environmental Services
Louw	Delana	Rivers for Africa
Louw	Lonnox	Tosca Dolomite Water User Association
Mabalane	Itumeleng	Chamber of Mines
Maboe	Paul	Sasolburg Transitional Local Council
Mabuda	Solly	Department of Water Affairs (DWA)
Mafejane	Ariel	Johannesburg Water
Magodi	Omphemetse	Kgalagadi District Municipality
Mahonde	Kay	Birdlife South frica
Mahusi	Christopher	Molopo Local Municipality
Makape	G G	Tsantsabane Municipality
Makena	Gladys	Magareng Local Municipality
Makgalemane	Itumeleng	Greater Taung District Municipality
Makodi	Rebecca	Leekwa Teemane Local Municipality
Makuapane	Andrew	Leekwa Teemane Local Municipality
Malaka	Tebogo	Department of Water Affairs (DWA)
Malebye	Patrick	Dipaliseng / Balfour Local Municipality
Manamela	Sadimo	Department of Water Affairs (DWA)
Manele	Sorrious	Sedibeng District Municipality
Mapholi	Masindi	Maguassi Hills Local Municipality

Last Name	First Name	Company
Maposa		Delportshoop TLC
Marx	Karin	Wildlife and Environment Society of South Africa (WESSA)
Maseng	Benardo	Kgatelopele Local Municipality
Masondo	Amos	City of Johannesburg Metropolitan Municipality
Maswuma	Zacharia	Department of Water Affairs (DWA)
Matseba	Mogale	Department of Water Affairs (DWA)
Mazwi	Nosie	Department of Water Affairs (DWA)
McCourt	Liz	Department of Environmental Affairs (DEA)
Meintjes	Louis	Transvaal Agricultural Union South Africa (TAUSA)
Mere	Shedrick	Magareng Local Municipality
Midgley	Ian	Eskom
Mlambo-Izquierdo-	Poppy	Kgatelopele Local Municipality
Mmarete	Charles	Department of Water Affairs (DWA)
Mmoiemang	Kenneth	Kgalagadi District Municipality
Mngomezulu	Willy	Pixley Ka Seme Local Municipality
Mnisi	Jones	Johannesburg Water (Pty) Ltd
Mochware	Ontlametse	Kagisano Local Municipality
Modisakeng	Busisiwe	Lesedi Local Municipality
Mofokeng	Mahole	Sedibeng District Municipality
Mofokeng	Mpho	Greater Taung District Municipality
Mofokeng	Puleng	Department of Agriculture, Forestry and Fisheries
Mogotlhe	Paul	North West Department of Agriculture, Conservation, Environment and Tourism
Mohapi	Ndileka	Department of Water Affairs (DWA)
Mokadi	Andrew	Vaal University of Technology
Mokgosi	Mantebo	Moqhaka Local Municipality
Mokgosi	Mantebu	Moqhaka Local Municipality
Molema	Kemonna	Tribal Authority
Molema	Shelley	Bophirima District Council
Mompati	Rose	Naledi Local Municipality
Mongake	Monty	Fezile Dabi District Municipality
Mongolola	Gift	Ga-Segonyane Municipality
Moraka	William	South African Local Government Association (SALGA)
Mosai	Sipho	Rand Water
Mothibi	Dimakatso	Department of Agriculture and Land Reform
Motlhale	Kelehile	Tswelopele Local Municipality
Motoko	Phihadu	Ratlou Local Municipality
Mshudulu	S A	Emfuleni Local Municipality
Mthimunye	George	Naledi Local Municipality
Mtsuku	Samuel	Department of Tourism, Environment and Economic Affairs
Mudau	Stephinah	Chamber of Mines South Africa
Mulangaphuma	Lawrence	Department of Water Affairs (DWA)
Muller	Anton	Bloemhofdam Kom
Mutyorauta	J J	Department of Agriculture
Mutyorauta	Julius	Department of Tourism, Environment and Conservation (DTEC)
Mvula	Obed	Department of Land Affairs
Mwaka	Beason	Department of Water Affairs (DWA)
Mweli	Zandisile	Maquassi Hills Local Municipality
Nagel	Marius	Government Communication and Information Systems (GCIS)
Naidoo	Shane	Department of Water Affairs (DWA)
Nakana	Lesego	Greater Taung Local Municipality
Namusi	Sedirilwe	Molopo Local Municipality
Nast	Timothy	Midvaal Local Municipality
Naude	Piet	Free State Agricultural Water Committee
Nengovhela	Rufus	Department of Water Affairs (DWA)
Ngamole	G	Masilonyana Municipality
Ngangelizwe	Sebenzile	Matjhabeng Local Municipality
Ngcobo	Mbuleleni	Gert Sibande District Municipality
Ngcobo	Sonwabo	Tswaing Local Municipality
Ngema	Khaya	Ekurhuleni Metropolitan Municipality
Ngila	Zelna	Siyanda District Municipality
Ngomane	Lulu	Gauteng Water Sector Forum
Ngxanga	Eric	Siyanda District Municipality

Last Name	First Name	Company
Nkonyane	Martha	
Nkwane	Oupa	City of Tshwane Metropolitan Municipality
Nosi	Thabo	Frances Baard District Municipality
Ntili	Tseliso	Department of Water Affairs (DWA)
Ntsepe	Sello	Mantsopa Local Municipality
Ntsizi	Thembile	Wes Vaal Chamber of Commerce
Ntwe	Francisco	Ratlou Local Municipality
Nyamande	Tovhowani	Department of Water Affairs (DWA)
Oagile	Mothus	Kagisano Local Municipality
Oosthuizen	Christo	Louwna/Coetzerdam Water User Association
Opperman	Dirk	Land Affairs
Opperman	Nic	Agri SA
Peek	Bobby	GroundWork - Friends of the Earth South Africa
Petersen	Thabo	Matjhabeng Local Municipality
Phukuntsi	Rosy	Tswelopele Local Municipality
Pienaar	Harrison	Department of Water Affairs (DWA)
Pienaar	P G	Vyf Hoek South Management Board
Pillay	Nava	Metsweding District Municipality
Potgieter	Ampie	Sasol Mining Rights Department (SMRD)
Potgieter	Jan	Department of Agriculture, Forestry and Fisheries
Potgieter	Sandra	Dow Plastics
Pretorius	Theuns	Kaalfontein Boerevereniging Distriks Landbou Unie
Pyke	Peter	Department of Water Affairs (DWA)
Radebe	Khulu	Male Development Agency
Rademeyer	Seef	Department of Water Affairs (DWA)
Ramaema	Lowrence	Department of Tourism, Enviroment and Economic Affairs
Ramokgopa	Kgosientsho	City of Tshwane Metropolitan Municipality
Ramokhoase	Jonas	Fezile Dabi District Municipality
Rampai	Constance	Mantsopa Local Municipality
Rampine	M K	South African National Civic Organisation (SANCO) Boikhotsong
Reinecke	C J	Potchefstroom Univ for CHE
Reitz	J J C	Kalahari East Water User Association
Rossouw	Lourens	Tokologo Local Municipality
Rust	Nelia	Matjhabeng Local Municipality
Sales	Malcolm	Lebalelo Water User Association
Samson	Paballo	Moshaweng Local Municipality
Sebusho	Sipho	Kgalagadi District Municipality
Seikaneng	Tefo	Moshaweng Local Municipality
Shabalala	Sam	Emfuleni Local Municipality
Shone	Steve	Grain SA
Sindane	Jabulani	Lekwa Local Municipality
Slabbert	Nadene	Department of Water Affairs
Smit	Hennie	Department of Water Affairs (DWA)
Snyders	Louis	Department of Water Affairs (DWA)
Stoch	Leslie	Geotech (Lower Wonderfonteinspruit Forum)
Stoltz	Gert	Molopo Farmers Union
Surendra	Anesh	Eskom
Sutton	Malcolm	Anglogold
Swart	Susan	WRP Consulting Engineers (Pty) Ltd
Takalo	Mmabatho	City of Tshwane Metropolitan Municipality
Terrè-Blanche	Riana	Namaqualand Water and Sanitation Support Group (NAWASAN)
Thakurdin	Manisha	Department of Water Affairs (DWA)
Theron	Danie	Christiana Farmers Association
Theron	J H	Vaalharts Water Users Association
Theron	Piet	Munisipaliteit van Delportshoop
Thirion	Christa	Department of Water Affairs
Thompson	Isa	Department of Water Affairs (DWA)
Tlhape	Manketse	Tswaing Local Municipality
Tshipelo	Kenneth	Mamusa Local Municipality
Tsotetsi	Mabalone	Dipaliseng Local Municipality
Ubisi	Makumu	Sedibeng Water
van Aswegen	Johann	Department of Water Affairs (DWA)

Last Name	First Name	Company
van den Berg	J W	Saamstaan Agricultural Union
van den Berg	Ockie	Department of Water Affairs (DWA)
van den Bon	Patrick	Vadex Consulting cc
van der Heever	Piet	Lesedi Local Municipality
van der Merwe	Ben	Emfuleni Local Municipality
van der Merwe	Danie	Ekurhuleni Metropolitan Municipality
van der Merwe	Johan	Rand Water
van der Walt	Philip	City of Tshwane Metropolitan Municipality
van der Westhuizen	Walther	Department of Water Affairs (DWA)
van Rooyen	Johan	Department of Water Affairs (DWA)
van Rooyen	Pieter	WRP Consulting Engineers (Pty) Ltd
van Schalkwyk	V	South African Rivers Association
van Tonder	Dean	Sasol Mining
van Vuuren	Hennie	Regina Farmers Union
van Vuuren	J L	Frankfort TLC
van Wyk	Francois	Rand Water
van Wyk	Jurgo	Department of Water Affairs (DWA)
van Wyk	Niel	Department of Water Affairs (DWA)
van Zyl	Andre	Fezile Dabi District Municipality
Van Zyl	Chris	TAU SA Agricultural Union
van Zyl	J F C	Bloemhof TLC
Venter	Gerda	Department of Water Affairs (DWA)
Venter	Petrus	Department of Water Affairs (DWA)
Vilakazi	Bheki	Msukwaligwa Local Municipality
Viljoen	Peter	Vereeniging Refractories Ltd
Vorster	Albert	Kimberley Agricultural Union
Watson	Marie	Centre for Environmental Management
Wepener	Lotter	River Property Owners' Association - Save the Vaal
Williams	Bruce	Klerksdorp Irrigation Board
Woodhouse	Philip	Goldfields (West Driefontein Gold Mine)
Yawitch	Joanne	Department of Environmental Affairs (DEA)