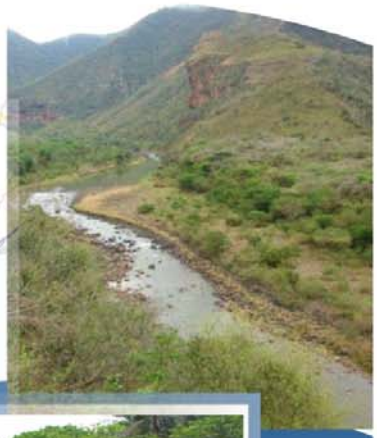
REPORT NUMBER: RDM/WMA11/00/CON/CLA/0112

CLASSIFICATION OF WATER RESOURCES AND DETERMINATION OF THE COMPREHENSIVE RESERVE AND RESOURCE QUALITY OBJECTIVES IN THE MVOTI TO UMZIMKULU WATER MANAGEMENT AREA

PROJECT NUMBER: WP 10679

INCEPTION REPORT

MARCH 2013



water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

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CLASSIFICATION OF WATER RESOURCES AND DETERMINATION OF THE COMPREHENSIVE RESERVE AND RESOURCE QUALITY OBJECTIVES IN THE MVOTI TO UMZIMKULU WATER MANAGEMENT AREA

INCEPTION REPORT

Report Number: RDM/WMA11/00/CON/CLA/0112

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DOCUMENT INDEX

Index Number	DWA Report Number	Report Title
1	Report Number: RDM/WMA11/00/CON/CLA/0112	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Inception report**
2	Report Number: RDM/WMA11/00/CON/CLA/0113	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Status quo assessment, IUA and biophysical node delineation and identification.**
3	Report Number: RDM/WMA11/00/CON/CLA/0213	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **RU and EWR sites**
4	Report Number: RDM/WMA11/00/CON/CLA/0313	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Desktop Estuary EcoClassification and EWR**
5	**Rivers EWR report Volumes**	
5.1	Report Number: RDM/WMA11/00/CON/CLA/0114	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 1: EWR estimates of the River Desktop Biophysical Nodes**
5.2	Report Number: RDM/WMA11/00/CON/CLA/0214	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 2: EcoClassification and EWR assessment at the Rapid III level**
5.3	Report Number: RDM/WMA11/00/CON/CLA/0314	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 3: EcoClassification and EWR assessment at the Comprehensive and Intermediate levels**
5.4	Report Number: RDM/WMA11/00/CON/CLA/0414	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 4: Specialist appendices**
6	Report Number: RDM/WMA11/00/CON/CLA/0212	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **BHNR**
7	Report Number: RDM/WMA11/00/CON/CLA/0514	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Water Resource Analysis Report**
8	**Operational Scenario and Management Class report volumes**	

Index Number	DWA Report Number	Report Title
8.1	Report Number: RDM/WMA11/00/CON/CLA/0614	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area**: Volume 1: River Ecological Consequences**
8.2	Report Number: RDM/WMA11/00/CON/CLA/0714	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 2: Estuary Ecological Consequences**
8.3	Report Number: RDM/WMA11/00/CON/CLA/0814	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 3: Estuary ecological consequences - specialist appendices (available electronically only)**
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8.5	Report Number: RDM/WMA11/00/CON/CLA/1014	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 5: EGSA consequences**
8.6	Report Number: RDM/WMA11/00/CON/CLA/1214	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 6: Water quality consequences**
8.7	Report Number: RDM/WMA11/00/CON/CLA/1314	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 7: Recommended Management Classes.**
9	Report Number: RDM/WMA11/00/CON/CLA/0115	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Stakeholder Report**
10	**Resource Quality Objectives report volumes**	
10.1	Report Number: RDM/WMA11/00/CON/CLA/0215	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 1: Rivers and Wetlands EcoSpecs and TPCs**
10.2	Report Number: RDM/WMA11/00/CON/CLA/0315	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Volume 2: Resource Water Quality Objectives and Groundwater RQOs**
11	Report Number: RDM/WMA11/00/CON/CLA/0415	Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: **Main report**

DEPARTMENT OF WATER AFFAIRS AND FORESTRY

CHIEF DIRECTORATE: RESOURCE DIRECTED MEASURES

CLASSIFICATION OF WATER RESOURCES AND DETERMINATION OF THE COMPREHENSIVE RESERVE AND RESOURCE QUALITY OBJECTIVES IN THE MVOTI TO UMZIMKULU WATER MANAGEMENT AREA

INCEPTION REPORT:

Approved for RFA by:

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TERMINOLOGY AND ACRONYMS

BID	Background Information Document
BBM	Building Block Methodology
BHNR	Basic Human Needs Reserve
CD: RDM	Chief Directorate: Resource Directed Measures
CERM	Comprehensive Ecological Reserve Methodology
D:RQS	Directorate: Resource Quality Services
DAM	Desktop Adjustment Method
DAP	Diatom Assessment Protocol
DRM	Desktop Reserve Model
DWA	Department Water Affairs (Name change applicable after April 2009
DWAF	Department Water Affairs and Forestry
EC	Ecological Category
EcoSpecs	Ecological Specifications
EGSA	Ecological Goods and Services Attributes
EI	Ecological Importance
EIS	Ecological Importance and Sensitivity
ES	Ecological Sensitivity
EWR	Ecological Water Requirements
EZ	Economic Zone
FFHA	Fish Flow Habitat Assessment model
FRAI	Fish Response Assessment Index
GAI	Geomorphological Driver Assessment Index
GDP	Gross Domestic product
GIS	Geographic Information System
HAI	Hydrological Assessment Index
HDI	Historically Disadvantaged Individuals
HFSR	Habitat Flow Stressor Response
IHI	Index of Habitat Integrity
IUA	Integrated Unit of Analysis
IWRM	Integrated Water Resource Management
MCDM	Multi Criteria Decision Making Model
MIRAI	Macro Invertebrate Response Assessment Index
MRU	Management Resource Units
NBA	National Biodiversity Assessment
NFEPA	National Freshwater Ecosystem Priority Area
NWA	National Water Act
PAI	Physico Chemical Driver Assessment Index
PES	Present Ecological State
PMT	Progress Management Team
PSC	Project Steering Committee
PSP	Professional Service Provider
Quat	Quaternary catchment
RDRM	Revised Desktop Reserve Model
REC	Recommended Ecological Category
RQO	Resource Quality Objectives
RU	Resource Unit
RWQO	Resource Water Quality Objective
SAM	Social Accounting Matrix

SANBI	South African National Biodiversity Institute
SCI	Socio-Cultural Importance
SPATSIM	Spatial and Time Series Information Modelling
SQ	Sub quaternary
TOR	Terms of Reference
TPC	Threshold of Potential Concern
TTG	Technical Task Group
VEGRAI	Vegetation Response Assessment Index
WARMS	Water Authorisation and Registration System
WIM	Water Impact Model
WMA	Water Management Area
WRC	Water Research Commission
WRCS	Water Resource Classification System
WRSM2005	Water Resources Simulation Model 2005
WRUI	Water Resource Use Importance
WRYM	Water Resource Yield Model
WULA	Water User Licence Application
WWTW	Waste Water Treatment Works

1 INTRODUCTION

1.1 BACKGROUND

The Chief Directorate: Resource Directed Measures (CD: RDM) of the Department of Water Affairs (DWA) initiated a study for the provision of professional services to undertake the Comprehensive Reserve, classify all significant water resources and determine the Resource Quality Objectives (RQOs) in the Mvoti to Umzimkulu Water Management Area (WMA) 11. Rivers for Africa was appointed as the Professional Service Provider (PSP) to undertake this study.

1.2 STUDY AREA

WMA 11 stretches from the Drakensberg Mountains in the west at an altitude of over 3000 m and drops to sea level in the east over a comparatively short distance of 150 km. The WMA is rugged and is characterised by steep slopes which characterises the river valleys in the inland areas. Moderate slopes are found, but comprise only 3% of the area of the WMA. These flatter areas are mainly subject to intensive agricultural activities (DWAF, 2004).

The Mvoti to Umzimkulu WMA consists of two large river systems (in terms of MAR) i.e. the Umzimkulu and Mkomazi rising in the Drakensberg. Two medium-sized river systems i.e. the Mgeni and Mvoti which rise in the Natal Midlands have been largely modified by human activities, mainly intensive agriculture, forestry and urban settlements. Several smaller river systems (e.g. Mzumbe, Mdloti, Tongaat, Fafa, and Lovu Rivers) also exist within WMA 11 (DWAF, 2004). According to DWAF (2004) eight key areas exist within WMA 11 and include:

- Mvoti (Tertiary catchments U40 and U50).
- Mdloti (Tertiary catchment U30).
- Mgeni (Tertiary catchment U20).
- Mlazi and Lovu (Tertiary catchments U60 and U70).
- Mkomazi (Tertiary catchment U30).
- Mpambanyoni to Mzumbe or South Coast (Tertiary catchment U80).
- Umzimkulu (Tertiary catchments T51 and T52); and
- Mtamvuna (Tertiary catchment T40).

The study area is illustrated in Figure 1.1.

1.3 OVERVIEW

The importance of the water resources in the Mvoti to Umzimkulu WMA is best illustrated by the high level of water stress currently being experienced in the area due to the water use being substantially more that the long term sustainable yields of the resources (DWA, 2010a). Institutions responsible for different facets of the water provision cycle are implementing targeted actions of the accepted Reconciliation Strategy (DWAF, 2007a) which include the following amongst others:

- Drought management.
- Water Conservation and Water Demand Management.
- Use of treated effluent.
- Determination of Ecological Water Requirements (EWR) in key identified catchments; and
- Water resource developments.

This study will be carried out within the Integrated Water Resource Management (IWRM) framework and the approach provides a balance between environmental protection and the socio-economic imperatives required for growth and development.

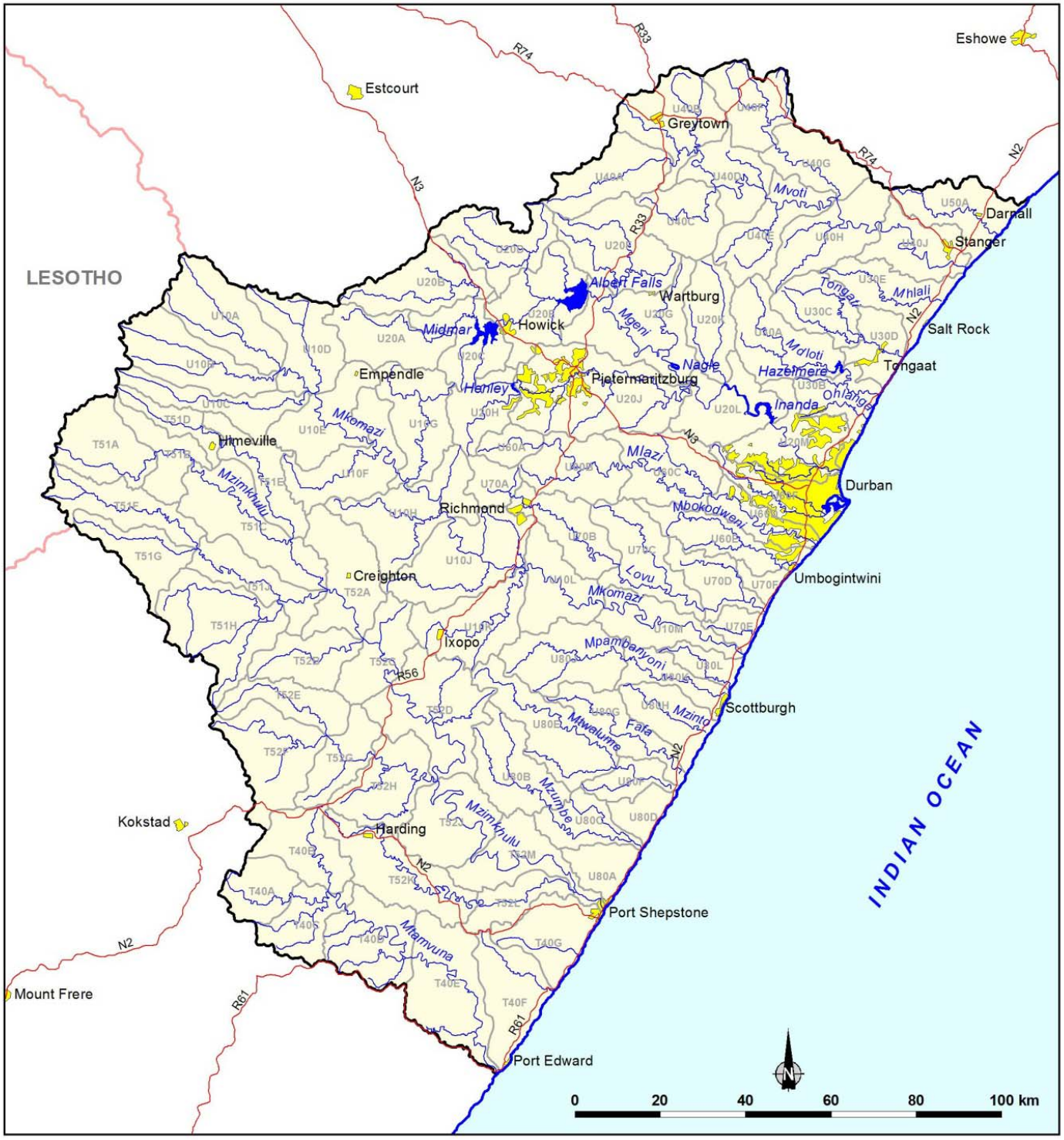

Figure 1.1 The Mvoti to Umzimkulu Water Management Area – WMA 11

2 AVAILABLE INFORMATION

2.1 HYDROLOGICAL DATA

2.1.1 Previous and parallel studies

The study area in general has been the subject of various studies in the past. Members of the study team undertook water resource analysis work in the study area in the past. The current knowledge of hydrological data and models are summarised in Table 2.1. These will be further expanded on during Task D3 in this study.

Table 2.1 Available hydrological data and models for WMA 11

River System	Network model: Type	Comments
Mtamvuna	WRYM*[1]	South Coast Study (Uncertain) (DWAF, 2002).
Umzimkulu	WRYM	A detailed hydrological analysis of the Umzimkulu River Catchment was completed by Aurecon during 2011 (DWA, 2011a).
Mzumbe	Hydrology	Only WR2005 Hydrology.
Mtwalume	WRYM	Middle South Coast Study (DWAF, 2002).
Fafa	Hydrology	Only WR2005 Hydrology.
Mzinto	WRYM	Middle South Coast Study (DWAF, 2002).
Mpambanyoni	WRYM	South Coast Study (Uncertain) (DWAF, 2002).
Mkomazi	WRYM	The detailed hydrological analysis has been completed as part of Mkomazi Pre-Feasibility study[1]. The Yield and Planning model analysis will start by September 2012.
Lovu	Hydrology	Part of Mgeni River System Study (DWAF, 1994).
Mbokodweni	Hydrology	Part of Mgeni River System Study (DWAF, 1994).
Mlazi	Hydrology	Part of Mgeni River System Study (DWAF, 1994).
Mgeni	WRPM*[2]	Mgeni Annual Operating Analysis.
Ohlanga	Hydrology	Only WR2005 Hydrology.
Mdloti	WRPM	Hazelmere Dam raising feasibility Study and Annual Operating Analysis (DWAF, 2003).
Tongati	WRYM	Estuary study.
Mhlali	Hydrology	Part of Mgeni River System Study (DWAF, 1994).
Mvoti	WRYM	Mvoti Pre-feasibility study (DWAF, 2002).

Note: Shaded areas represent a significant river system in terms of available water resources.
*1 Water Resource Yield Model *2 Water Resource Planning Model

2.1.2 Water resource modelling: Information Requirements

There are no high resolution network models available in any of the river systems in the study area. As part of the current Mkomazi Pre-Feasibility study the hydrology will be updated and a high resolution model will be developed for the Mkomazi River System which should be available in September 2012 as indicated by the Mkomazi Feasibility study team. A recent Umzimkulu River Catchment Study (DWA, 2011a) has been undertaken and it is assumed that the data from this study will be made available for use in this assignment. Where there are gaps in the data the WR2005 could be considered as a source of information, however there are several known problems with the WR2005 study data sets for this WMA, such as that no farm dams were taken into account during the calibration process.

All relevant recorded streamflow data will be obtained from the DWA database systems and cursory evaluations of the accuracy under different flow regimes will be carried out by reviewing

[1] Department of Water Affairs: Mkomazi Water Project Phase 1: Module 1: Technical Feasibility Study: Raw Water. Currently being undertaken by BKS on behalf of the Directorate: Options Analysis.

the gauge reports. A key aspect will be to prepare daily data for the estuary evaluations. Provision has been made in the budget to simulate daily flows in four of the small catchments using the ACRU or other suitable models.

2.2 RIVER RESERVE DETERMINATIONS

Information available at this stage on previous riverine Reserve determinations is summarised below. During the appropriate task in this study, this list will be expanded.

Mvoti River: An EWR study was undertaken by DWA during 1995 (DWAF, 1996). Four EWR sites were selected in this system but information such as benchmarks and raw biophysical data will probably not be available. The study results will also be outdated. Any available information will be collated for use within this study.

Mgeni River: Extensive monitoring activities are on-going and some Rapid Reserves (DWAF, 2005) have been undertaken.

Mkomazi River: A Comprehensive Reserve determination was undertaken during 1998 as part of the pre-feasibility investigations into a transfer scheme from the Mkomazi to the Mgeni catchment (DWAF, 1999a). The approach was based on the DWAF (1999b) procedures. The study was undertaken for DWA and managed by Ms Louw (as a sub-consultant to the then Ninham Shand). Four EWR sites were selected and the estuary was assessed. The current Mkomazi Pre-Feasibility Study will provide updated hydrology and appropriate available information will be incorporated into this study.

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Umzimkulu River: Recent work (DWA, 2011b).on this river has included Reserve determinations and this work will be reviewed to determine whether additional tasks are required within this study.

A range of Rapid III assessments have also been undertaken in this WMA and this data will be further investigated during the project.

2.3 ESTUARINE RESERVE DETERMINATION

The Mvoti to Umzimkulu WMA includes a vast number of estuaries – sixty four in total. A number of estuarine EWR studies have been completed in this study area at various levels of confidence, and are summarised in Table 2.2

Table 2.2 Previous estuarine EWR studies undertaken in WMA 11

Estuary	Assessment level	Year	PES determination
eZotha	Rapid	2011	Yes
Umzimkulu	Intermediate	2011	Yes
Little Manzimtoti	Rapid	2011	Yes
Mbokodweni	Rapid	2011	Yes
Mgeni	Rapid	2011	Yes
Mhlanga	Rapid	2003	Yes
Mdloti	Intermediate	2007	Yes
	Rapid	2003	Yes
Tongati	Intermediate	2007	Yes
	Rapid	2006	Yes
Mvoti	Historical Ecological Flow Requirement Study	1996	No
Mkomazi	Historical Ecological Flow Requirement Study	1998	No

Taking into account the large number of estuaries for which estuary EWR studies have not been completed, the duration of this project (3 years) and anticipated budgetary constraints, it is not considered feasible to base this EWR study on site-specific detailed field investigations for all estuaries. Rather a phased approach is recommended where initially a strategic, broad-based assessment would be conducted providing the focus for more detailed investigations in priority systems.

First, it is proposed that a comprehensive desktop assessment be conducted on all systems within the area using available information, Google Earth imagery, and expert knowledge and judgement. Previous EWR studies will be revisited if additional data is available to improve on results. This desktop method has recently been tested as part of South Africa's National Biodiversity Assessment 2011 (NBA 2011) (Van Niekerk and Turpie, 2012) and proved to be sufficiently robust for these types of larger regional assessments. In this instance the results from the NBA 2011, which primarily focussed on the PES, will be expanded on using additional data sources and more intensive expert scrutiny. Specifically the aim will be to improve results by using better quantified river inflow data – a key driver in the PES of most estuaries in South Africa.

To improve on the overall confidence of the desktop assessment, a selection of priority estuaries will be identified for which more detailed field investigations will be launched within the time and anticipated budgetary constraints. Criteria for the selection of these priority estuaries may include:

- Estuaries located within water stressed catchments;
- Extent of proposed water resource development (e.g. large dams);
- Biodiversity importance; and
- Large discrepancies between Present Ecological State (PES) and Recommended Ecological Category (REC) (e.g. systems that need significant rehabilitation to meet RECs).

Considering the overall diversity in estuary types in the study area (e.g. temporality open, permanently open, coastal bays, estuary size and catchment characteristics), it is anticipated that about 7 - 10 estuaries should be included in the more detailed investigation phase (e.g. ranging from multi-disciplinary field surveys to exploratory field recognisance). The results from these investigations will then be used to re-assess and refine the EWR of these priority systems.

2.4 WETLANDS

There have been no previous DWA wetland Reserve studies within the WMA based on the CD: RDM Reserve database for this WMA. Although a previous riverine Reserve study on the Mvoti River was undertaken in 1996, this study did not include any wetland EWR determinations. However, available information will aid in the assessment of wetlands within the WMA. The relevant available data and studies include:

- A rapid Reserve study on the Franklinvlei wetland, which is in the immediately adjacent WMA. This study may be at least partially applicable to some wetland types within the Mvoti catchment and extrapolation of results may be possible.
- The South African National Biodiversity Institute (SANBI) Wetland Inventory map and limited attribute information of wetlands within the WMA.
- National Freshwater Ecosystem Priority Area (NFEPA) data for the WMA, which identifies significant wetlands and wetland clusters.
- Landuse maps to infer risks for wetlands.

Sub-catchment PES and Ecological Importance and Sensitivity (EIS) data are currently being compiled for the WMA as part of a DWA/WRC study (see below). Although these data focus on river systems, some wetland attribute information may be included in this dataset.

2.5 PRESENT ECOLOGICAL STATE (STATUS QUO) OF BIOPHYSICAL NODES

A vital contribution to the Classification study are the results of the study that is currently being conducted: ***Review and update of the desktop Present Ecological State (PES) and Ecological Importance (EI) – Ecological Sensitivity (ES) of South African rivers according to sub-quaternary catchments: Umvoti to Umzimkulu WMA (WRC project number: K5/2846)***. This proposal is based on the assumption that the information resulting from this work will be provided by DWA to the study team prior to the stated deadlines (November 2012).

2.6 GROUNDWATER COMPONENT OF THE RESERVE

Information on the groundwater component of the Reserve is available as part of the Groundwater Resource Directed Measures: Mvoti to Umzimkulu Water Management Area Draft (DWA 2012).

2.7 STUDY RISKS AND UNCERTAINTIES

A number of factors have been identified that could have a significant influence on the execution and completion of the Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area. These factors could influence both the cost and the timing of the Study. **Table 2.3** provides a summary of the activities in the Study along with the possible delays, associated cost implications and an explanation of these.

Table 2.3 Possible delays to the study programme and additional costs resulting from Study uncertainties.

Task description	Duration (weeks)		Comment
	Possible Duration Delay (weeks)	Possible Increase in Cost (R excl VAT)	
Task D1.1: Water resources component	12	n/a	The study is dependent on information/deliverables produced by other studies i.e. Mkomazi Pre-Feasibility study team, and is regarded as a risk as any delays in producing the deliverable required by this study will have a direct impact on the study programme.
Task D3.5 Hydrology analysis	8	R150 000	There is a risk that the hydrology data from previous studies is not available electronically. The worst case scenario would be that the study team would need to resort back to the WRSM2005 for data, with the potentially additional effort required to increase the confidence of the data.
Task D3.9 Hydrological modelling (including groundwater) at desktop biophysical nodes	12		The study is dependent on models produced by other studies i.e. Mkomazi Pre-Feasibility study team, and is regarded as a risk as any delays in producing the deliverable required by this study will have a direct impact on the study programme

Task description	Duration (weeks)		Comment
	Possible Duration Delay (weeks)	Possible Increase in Cost (R excl VAT)	
Task D4.1 Defining Operational Scenarios and D6.3 Groundwater RQOs	8	R150 000	Information on the groundwater reserve was expected to be available, but no information is presented on the DWA Reserve in the Groundwater Resource Directed Measures: Mvoti to Umzimkulu Water Management Area Draft Report. It has been assumed that this information will become available during the study with a possibility of delaying the task. If the information does not become available a delay in the task duration and an increase in cost is expected.[2]
Task D1.7 PESEIS Results	Dependant on finalisation by GroundTruth and DWA, RQS	n/a	The modelled results and fact sheets are essential for providing deliverables. (IUA delineation and identification of desktop biophysical nodes) during this financial year. Presently the populated spread sheets have been provided by GroundTruth to DWA, RQS but the fact sheets comment blocks have not been completed and the fact sheets have not yet been provided. [3]
Task D4.7 Preliminary Management Classes	n/a	n/a	Inclusion of NFEPA results would be aided by a simple excel spread sheet illustrating the SQ reaches and whether a Freshwater Priority Area has been identified. A table with the motivations for each NFEPA is also important. The information in this format is apparently not available and the potential risk is that due cognisance cannot be given to the NFEPA information. The risk is that the NFEPA information will not be adequately included in the Management Classes.

[2] This information has subsequently been provided.

[3] This information has subsequently been provided.

3 PROJECT PLAN

3.1 INTEGRATION OF RESERVE, WATER RESOURCE CLASSIFICATION SYSTEM AND RESOURCE QUALITY OBJECTIVE STEPS

According to the Terms of Reference (TOR) the main aim of this study is to:

- Determine the comprehensive Reserve (and other lower levels of the Reserve where necessary) in WMA 11, using acceptable methods and compiling Reserve templates that address the environmental flows and ecosystem health of significant water resources.
- Co-ordinate the implementation of the Water Resource Classification System (WRCS) in order to classify all significant water resources in WMA 11.
- Determine Resource Quality Objectives (RQOs) using the DWA procedures.

It is therefore evident that the Reserve and Classification processes have to be applied within the scope of this study and that RQOs must be determined. To ensure integration of these processes, Reserve determination documentation for Rivers (DWAF, 1999b; Kleynhans and Louw, 2007; DWAF, 2008a) and Estuaries (DWAF, 2008b) as well as the seven step procedure for determining the water resource class (DWAF, 2007b) and for RQOs and the associated guideline documentation (DWA, 2011c) were consulted by key specialists in the study team. Based on this information an integrated project plan and approach for this study was formulated. Due to the significant overlap within these three processes, the project plan focussed on designing an integrated process and steps. Furthermore, the lessons learnt during pilot studies on the WRCS (e.g. the Vaal River) (DWAF, 2007b) were incorporated into the design of this integrated process.

To emphasize the overlap within the various processes, all RQO steps fall either within the Reserve determination and/or the WRCS process. The two RQO toolkits that have been designed are impractical as most of the information cannot be supplied within Excel spreadsheets. These toolkits can however be used as a checklist where report references are supplied and where appropriate information is provided.

The integrated process is provided in Figure 3.1 and forms the basis of the scope of this study. The scope of the study is therefore designed around the INTEGRATED STEPS and not the individual process steps.

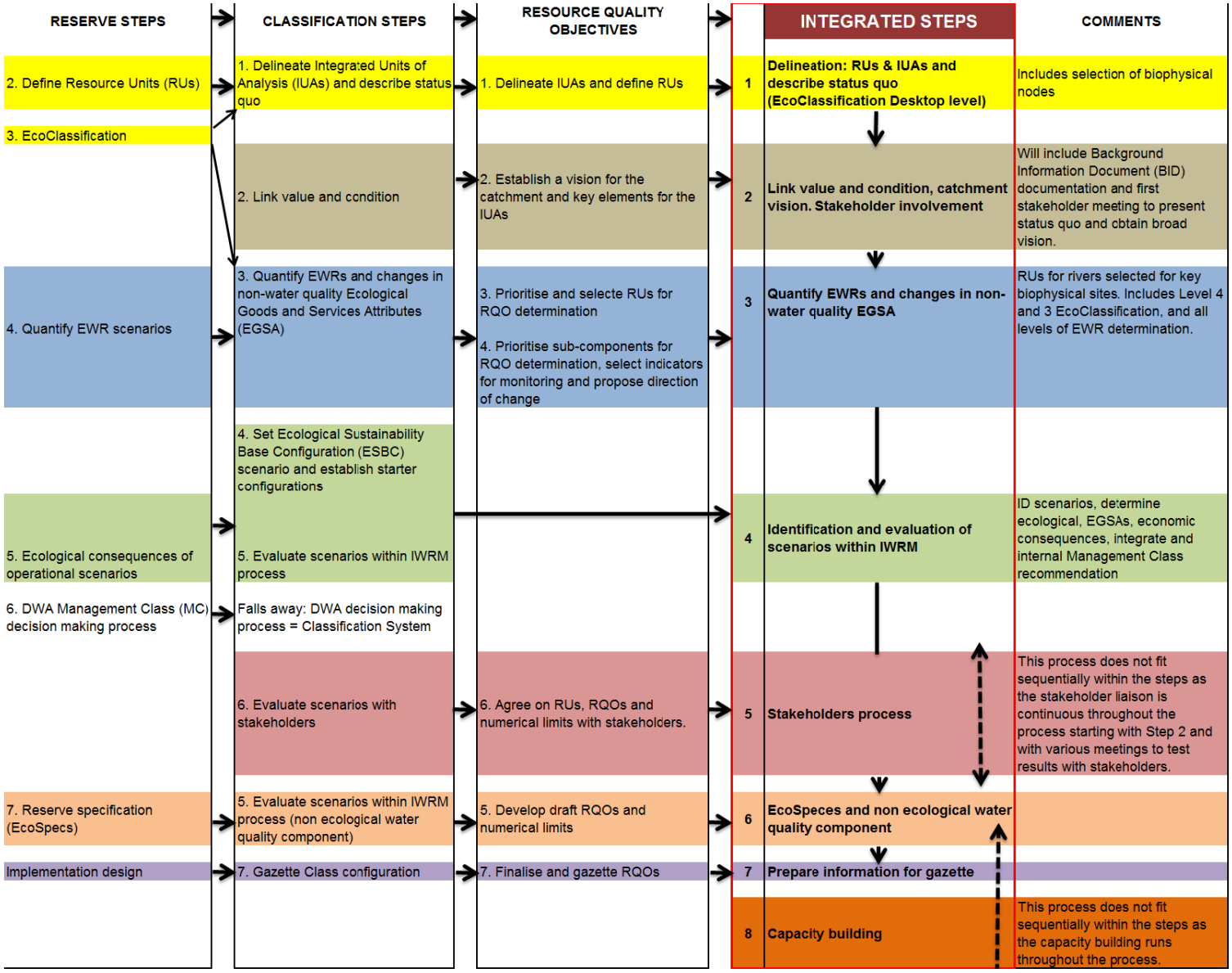

Figure 3.1 Integrated project plan derived from the Reserve and Classification

3.2 CHALLENGES

3.2.1 Study area and assessment level

This study will be the first integrated Reserve, WRCS and RQO study undertaken in South Africa. Furthermore, it is also the first study to address a Water Management Area at this scale. It is acknowledged that integrating these three processes during one study is the appropriate way to address these closely related processes. The challenge however is to deal with this at catchment and WMA scale. Addressing expectations of stakeholders regarding the level of detail will be a challenge, as comprehensive assessments can only be undertaken at a few high priority areas. The bulk of the study area will therefore be addressed at desktop or rapid level.

3.2.2 Hydrology

Minimal detailed hydrological data is available for most of the sixty four Estuaries, (excluding large systems such as the Mkomazi and the Umzimkulu where detailed models have/will become available recently). Forty six of the estuaries are situated in single quaternary catchments. For most of these estuaries only WR2005 data will be available. The natural runoff for these catchments was not determined by calibration of the small rivers but through Pitman model parameter transfers from other adjacent catchments. In addition, it is known that the WR2005 did not include any farm dams in their calibration network configurations for KZN, which also makes the parameters transferred suspect. This will make the confidence of any hydrology provided for these 64 estuaries low.

Regarding the available models for the WMA, it is approximated that 41% of the WMA catchment areas are covered by higher confidence models, 31% by medium confidence models and the remaining 28% of the catchment areas by low confidence models. The higher confidence models were done recently and with recent landuse data, while the medium confidence models were based on older analyses and landuse data, while still being relatively high resolution models.

It is important to note that this study is dependent on information/deliverables produced by other studies i.e. Mkomazi Pre-Feasibility study team, and is regarded as a risk as any delays in producing the deliverable required by this study will have a direct impact on the study programme.

3.2.3 EWR estimates at desktop biophysical nodes

EWR estimates will have to be provided for a large number of desktop biophysical nodes. During previous studies, the Desktop Reserve Model (DRM) and/or the Desktop Adjustment Model (DAM) were used to estimate these results. These results were then modified in context of the present day hydrology to ensure that estimates (based on natural hydrology) did not exceed present day hydrology unless improvement was required. Present day hydrology, at sub-quaternary scale is therefore required and will highly likely be unavailable. This could impact on the confidence in the EWR estimates.

3.2.4 Estuaries

Estimates will have to be made of the river inflow (m^3/s) to the individual 64 estuaries in the study area. These estimates will need to be provided in terms of reference condition (virgin) and present state monthly flows. Where possible an indication will need to be given of the degree to which the floods and base flows have been reduced, e.g. 90% of reference condition.

3.2.5 Wetlands

There is a dearth of information regarding wetland condition within the WMA. Although some wetland PES information may be contained within the sub-quaternary PESEIS study for the WMA, these results are not yet available.[4] It is however expected that the wetland data, because it is directly combined with other riparian indices, is not likely to yield a usable standalone indicator or metric for river-associated wetland condition. It will thus be difficult to determine the REC for wetlands within the WMA.

EWR for wetlands in terms of water quality and quantity are not available for wetlands in this WMA. There are no approved wetland Reserve studies listed on the CD:RDM Reserve database for this WMA, and limited scope for extrapolation of wetland EWR information from other WMAs across this large WMA. RQOs for wetlands, where they can be determined, will thus exclude water quantity and quality specifics.

3.2.6 Availability of Reserve and other tools

Desktop Estuary Assessment

At present there is no official method for a desktop EWR assessment of estuaries. This project will rely on:

- The desktop index developed for the NBA 2011 (Van Niekerk and Turpie, 2012) which was a simplification of the Estuary Health Index generally applied in EWR studies (DWAF, 2008b). In the NBA 2011 the simplified index was applied to 291 estuaries along the country's coast. For this study it will be re-applied using improved hydrological, physical and water quality information. The health status will be reported in terms of the Present Ecological State.
- *WRC project K5/2187: The resilience of South Africa's estuaries to future water resource development based on a provisional ecological classification of these systems,* which aims to develop rule-based models for identifying the resilience of estuaries to water resource development in data poor environments. The WRC study is focussing on the temperate regions of South Africa (i.e. West and East Coast), but some of the models should be generic.
- The level of confidences in the estuary desktop study will largely be dependent on the level of confidences in the hydrological estimates.

Riverine Assessment tools

Although some of the tools used during the Reserve determination process have been finalised and manuals provided (e.g. EcoStatus determination process manuals emanating from WRC project K8/619), some other tools are still under development or in an early stage of testing. This is the case with the Fish Flow Habitat Assessment index (FFHA) (*pers. comm*. Dr. N Kleynhans, DWA: Resource Quality Services (D:RQS)) used during Step 4 of the Ecological Reserve process. The use and applicability of these tools will be assessed during the study at the time when they are required, and the most appropriate version available at that stage of the study will be used to generate the results. The study specialists will also attempt to be in continuous contact with the developers of the relevant models to ensure they are up to date regarding new approaches and developments. It is of utmost importance that the developers of these tools and models will be prepared to provide guidance, training and manuals to ensure proper and accurate application and results.

The Revised Desktop Reserve Model (RDRM) (Hughes *et al*., 2011) has been developed and

[4] This information has subsequently become available.

documented. The revision was undertaken to provide desktop estimates for rivers with higher confidence and with direct ecological input compared to the existing Desktop Reserve Model. It is proposed to make use of this model in terms of estimating EWRs, but it is acknowledged that this model has not been rigorously tested and/or applied for numerous nodes.

3.2.7 Groundwater

Considerable challenges are expected regarding actual groundwater use in the WMA, and therefore also in the assessment of ground-surface water interactions. All possible sources of information will be used such as Water Authorisation and Registration System (WARMS) to try and estimate the extent of the use.

3.2.8 PESEIS programme

Please note that the Present Ecological State and Ecological Importance and Ecological Sensitivity study is referred to as the PESEIS study. The results of WRC project number: K5/2041 (see Section 2.5), currently being undertaken by GroundTruth Consulting, will be critical information for this study (referred to in this document as the PESEIS results). In essence, without this information provided on time and at the required detail, this study on WMA 11 will fail in terms of budget and programme scheduling. Should this information not be made available at the requested deadlines, it will have a cascading impact and result in delays of all the next steps and phases. It is therefore of utmost importance that this information is provided to the study team at the requested deadline of November 2012.[5]

3.2.9 Economic and economic related terminology

Economics, Socio economics and Ecosystems Goods, Services and Attributes: There are separate components of the study that deal with these aspects. Due to the confusion that often result in the use of the various terms (including Goods and Services, macro-economics and Ecosystem services), an explanation is provided below of the use of these terms within this study:

The economic components consider the formal and market linked economy. This relates to the aspects of the water usage that has a known or estimated value that can be measured as part of the overall economy of the catchment. This component is sometimes called “socio-economic” as changes to the economic usage of water and decisions made to alter resource allocation has a social impact. The social impact is often linked to employment creation (or loss of employment) and increases and decreases in wealth allocated to particular sectors of society.

Ecosystems Goods Services and Attributes (EGSA) (previously referred to as Goods & Services or EcoSystem services) refer to the usage of goods, services, and attributes linked to the resource in question. Usage is often, although not always, by communities that is vulnerable and defined as poor. The use of these goods and services is not captured in formal market analysis. This is of particular importance within the context of this study. Ecosystem services can provide values that contribute to overall economic wellbeing but because these services are supplied without a formal “market” intervention these are often ignored or underestimated. An example would be the value that a healthy wetland system provided in attenuating flooding. Flooding can be a cost to society but the service provided by the wetland is not taken into formal economic consideration as it has been provided by nature and not as a directly accounted expense. These are important to the overall consideration of the study area as well.

[5] This information has subsequently been provided

4 SCOPE OF WORK: PROJECT MANAGEMENT, INCEPTION, AND INFORMATION COLLATION

The integrated process described in Figure 3.1 was used to design a project plan, including the four main tasks (Task A, B, C and D) as specified in the TOR. This chapter focuses on Task A, B and C as the managerial, and inception tasks.

4.1 TASK A: PROJECT MANAGEMENT

The objective of this task is to ensure effective, efficient and pro-active management. The aim is to ensure that comprehensive technical documents that details the results of a successful study process, be delivered on time, on budget and as per brief. This task requires a multi-disciplined team and the management structure has been designed accordingly.

4.1.1 A1: Project Management Team (PMT) Meetings (Progress meetings)

The proposal caters for eleven (11) PMT meetings to be held in Durban. The Client has accepted responsibility for the provision of venues and dates of the meetings as well as providing the agenda and the minutes. A detailed progress report will be provided prior to every meeting by the Consultant. An additional PMT meeting, which serves as the inaugural or inception meeting, will be held at the initiation of the study to approve the inception report.

Task responsibility: **Louw,** Van Rooyen, Mullins, Van Niekerk

Actions

- Prepare progress reports.
- Participate in meetings.

Deliverables and milestones

- Progress reports – Deliverable 1.

Responsibility of the Consultant

- Preparation of the progress reports and participation in the meetings.
- The Consultant is not responsible for the logistical arrangements of meetings (only their own travel and participation), the agenda and the minutes.

4.1.2 A2: Technical team management and coordination

Integration and coordination between the various tasks is essential as well as the technical management of the tasks. All coordination within, and between tasks (i.e. between task leaders) are included here.

Task responsibility: **Louw,** Koekemoer, Mullins, Van Niekerk, Van Rooyen.

Actions

- Continuous liaison.

4.1.3 A3: Project steering committees

The proposal caters for five (5) Project Steering Committee (PSC) meetings to be held in the study area. The PSC will consist of members from various organisations and sectors, striving for balanced representation, who will provide strategic advice, oversight and guidance to achieve balanced view points and inputs from stakeholders within the study area. There is no limit to the number of PSC members. Existing structures which are in place in the Mvoti to Umzimkulu WMA will be utilised for this purposes. . The Project Management Committee (PMC) will approve the list of PSC members.

For each PSC meeting, invitation letters and a proposed agenda will be distributed to 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 the subjects on which to provide input and comments).

The proposed dates and focus of all planned PSC Meetings is presented hereunder:

PSC meeting 1: March 2013
Status quo assessment of WMA 11 and delineation of Integrated Unit of Analysis (IUAs).
Identification of priority areas and desktop biophysical nodes.

PSC meeting 2: November 2013
Desktop and Rapid River EWRs.
Estuary desktop EWRs.
Selection of EWR sites for detailed EWR assessment.

PSC meeting 3: August 2014
EcoClassification results for EWR sites.
EWR results for EWR sites.
Selecting and defining operational scenarios.

PSC meeting 4: January 2015
Consequences of operational scenarios (estuary, river, economics, EGSA).
Presentation of Preliminary Management Classes (MC).

PSC meeting 5: June 2015
Feedback on public meeting and final MC for gazetting.
RQOs.

A Technical Task Group (TTG) will be established **should the need arise.** Task Group Meetings will be held to discuss and formulate scenarios for analysis. The TTG will be representative of different 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 different scenarios to be investigated.

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 (please note that there is no financial provision for costs associated with repeat workshops).

Task responsibility: **Louw,** Van Rooyen, Mullins, Van Niekerk, Shinga
Information required:
- List of DWA internal officials and/or representatives from the relevant directorates.
- List of members from the Catchment Management Forums.
- DWA to provide Terms of Reference for PSC members.

Actions
- Establish database of PSC members.
- Compile invitation letter which will be accompanied by detailed TOR for PSC members.

Deliverables and milestones

Preparation and participation in the meetings, compilation and distribution of meeting minutes – Deliverable 2.

Responsibility of the Consultant

- Establishing PSC database.
- Distribution of invitations to PSC meetings.
- Preparation, participation in the meetings, compilation and distribution of meeting minutes – Deliverable 2.
- Meet with the Technical Task Group (if required)

4.1.4 A4: Financial management

Financial management consists of the management of the project budget including the monthly invoices, budget balancing and cash flow projections. Invoices will be time and cost based as per contract. Monthly invoices will be provided if work has been undertaken for the study as well as a monthly summary progress report.

Task responsibility: **Louw S,** Louw, Taljaard

Actions

- Prepare monthly cash flow projections.
- Prepare minimum of monthly invoices.
- Provide summary progress report to accompany invoices.

Deliverables and milestones

- Invoices and cash flow projections – Deliverable 3.

4.2 TASK B: PROJECT INCEPTION

The objective of the project planning and process integration task is to produce a concise, clear and unambiguous Inception Report. This is required to ensure that the Client and consultants are clear as to the deliverables, timing and budget of the programme. The inception phase will consist of:

- Team liaison to refine the approach, project plan and plan the inception report.
- Meeting with DWA to present the approach, project plan and programme.
- Provision of a draft and then final Inception Report.
- Appointment of sub-consultants.

During the project inception, agreement will be reached with the Client on the following aspects:

- Obtaining consensus on the approach of this study.
- Prioritisation of additional sites (nodes) and scenarios within the constraints of the study budget.
- Evaluation and agreement of information sources to be applied in the study especially where the data differs significantly.
- Capacity building activities.

Task responsibility: **Louw,** Huggins, Shinga, Birkhead, Koekemoer, Mullins, Cloete, Majoro, Van Niekerk, Scherman, Haasbroek, Talanda, Louw S.

Information required:

- Information from DWA regarding Rapid Reserves and the Intermediate and Comprehensive Reserves on the Mvoti, Mkomazi and Umzimkulu Rivers.
- Subjects or themes for capacity building (from DWA).
- Hydrological models and setups as they become available.

Actions

- Internal planning liaison.
- DWA inception meeting (see Task A.1.)

Deliverables and milestones

- DWA inception meeting.
- Draft Inception Report: September 2012 – Report 1.
- Sub-consultants appointed: 15 September 2012 – Deliverable 4.

Responsibility of the Consultant

- Ensuring that agreement is reached during negotiations and are incorporated in the Inception Report and conveyed to the rest of the team.
- Appoint the sub-consultants as approved by the DWA. Note however that the Consultant cannot be held responsible if indicated specialists resign or leave their work – however it is the responsibility of the Consultant to find suitable replacements. Any replacements must be agreed on by the Consultant and the Client.

4.3 TASK C: WATER RESOURCE INFORMATION AND DATA GATHERING (HYDROLOGICAL MODELLING AND RESERVE)

The focus of this task is collating water resource information for the purposes of hydrological modelling and on existing Reserve information. Data 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 within the study area. The hydrological data and system analysis network models will be collated from DWA as well as relevant PSPs and a cursory review with respect to the confidence and usability thereof will be carried out. All available flow and dams balance information will also be sourced from DWA and evaluated. The data requirements will be defined and index identification tables will be compiled to log availability and highlight gaps.

Task responsibility: **Van Rooyen**, Haasbroek, Louw, Koekemoer, Van Niekerk

Information required

- Information from previous study reports.
- Information from the DWA Reserve database and DWA directorates' active in the study area.
- All available flow and dam balance information from DWA.

Actions

- Data gathering and desktop analysis of available information.

Deliverables and milestones

- Index identification tables - 15 October 2012 (Deliverable 5).

Responsibility of the Consultant

- Collect, collate and review all the required water resources information available.

4.4 TASK D: DETERMINATION OF THE RESERVE, MANAGEMENT CLASS AND RQOs

This task forms the major components of the study and is addressed in Chapter 5 according to a hierarchical task structure which is summarised in Table 4.1.

Table 4.1 Tasks and subtasks proposed for this study

TASK A: PROJECT MANAGEMENT
A1 Project Management Meetings (Progress meetings)
A2 Technical team management and coordination
A3 Project steering committees
A4 Financial management
TASK B: PROJECT INCEPTION (PLANNING AND PROCESS INTEGRATION)
Task B1: Design Project plan
Task B2: Inception report
Task B3: Mobilisation of study team
TASK C: WATER RESOURCE INFORMATION AND DATA GATHERING
TASK D: DETERMINATION OF THE MANAGEMENT CLASS
TASK D1: DELINEATE IUAs, RUs & DESCRIBE STATUS QUO (ECOCLASSIFICATION - DESKTOP LEVEL)
Task D1.1: Water resources component
Task D1.2: Economic Component
Task D1.3: EGSA component
Task D1.4: Water quality status quo
Task D1.5: Wetlands status quo
Task D1.6: Estuaries
Task D1.7: Rivers
Task D1.8: Integration to define IUAs
Task D1.9: Identification of river biophysical nodes and level of assessment
Task D1.10: Status Quo Report
TASK D2: VALUE AND CONDITION AND STAKEHOLDER INVOLVEMENT
Task D2.1: Stakeholder identification and database management
Task D2.2: Project Announcement: BID, advertisement, personalized letter
Task D2.3: Issues and response report
Task D2.4: Newsletters
TASK D3: STEP 3 - QUANTIFY EWRs AND CHANGES IN NON-WATER QUALITY EGSAs
Task D3.1: RU determination for rivers requirement more detail Reserve assessment
Task D3.2: EWR site selection - Prelim
Task D3.3: EWR survey (Intermediate and Rapid)
Task D3.4 Analysis of data: EcoClassification for rivers
Task D3.5 Hydrology analysis
Task D3.6 Hydraulic high flow survey and modelling
Task D3.7: Intermediate Specialist meeting
Task D3.8: Rapid assessment and Desktop
Task D3.9 Hydrological modelling (including groundwater) at desktop biophysical nodes
Task D3.10: EWRs for desktop biophysical nodes (rivers)
Task D3.11: Consequences of EGSA at sites where the REC is an improvement of the PES
Task D3.12: Rivers EWR report
Task D3.13: Estuarine desktop assessment
Task D3.14 Field surveys for estuaries requiring more detailed approaches
Task D3.15: Analysis of estuarine data
Task D3.16: Basic Human Needs Reserve
TASK D4: IDENTIFICATION AND EVALUATION OF OPERATIONAL SCENARIOS TO IDENTIFY CONSEQUENCES
Task D4.1 Defining operational scenarios
Task D4.2: River Ecological Consequences
Task D4.3: Estuaries: Ecological Consequences - Intermediate estuaries
Task D4.3.1: Specialist EWR Workshop

Task D4.3.2: Estuary EWR Report
Task D4.4: Economic consequences
Task D4.5: EGSA consequences
Task D4.6: Water quality consequences
Task D4.7: Integration of consequences to provide preliminary MCs
TASK D5: PUBLIC MEETINGS
TASK D6: RESOURCE QUALITY OBJECTIVES (RQOs)
Task D6.1 EcoSpecs & TPCs: Rivers and Wetlands
Task D6.2: Non-ecological water quality
Task D6.3 Groundwater RQOs
TASK D7: PREPARING INFORMATION FOR GAZETTING (TEMPLATES)
TASK D8: CAPACITY BUILDING
Task D8.1 Training 1: Introduction &, integration
Task D8.2 Training 2: Status quo
Task D8.3 Training 3: Management Classes
TASK D9: MAIN INTEGRATED REPORT

5 DETERMINATION OF THE RESERVE, MANAGEMENT CLASS AND RQOs: TASK D

5.1 TASK D1: DESCRIBE STATUS QUO, DELINEATE IUAs AND RUs, IDENTIFY BIOPHYSICAL NODES

An IUA is a broad scale unit (or catchment area) that contains several biophysical nodes. These nodes define at a detail scale specific attributes which together describe the catchment configuration of the IUA. Scenarios are assessed within the IUA and relevant implications in terms of the Management Classes are provided for each IUA.

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.
- Constraints in terms of refinement of existing hydrological network and undertaking scenario analysis.
- The Present Ecological State (PES) of each biophysical node was considered as well the type of impacts and the homogeneity of the state and impacts..

The objective of this task is therefore to describe and document the status quo which includes various components such as water use, economy, EGSA, river and wetland ecology and to identify water quality problems. This information is used to define the IUAs. The process is summarised in a flow diagram, Figure 5.1. Once the IUAs are delineated, biophysical nodes must be identified for different levels of EWR assessment.

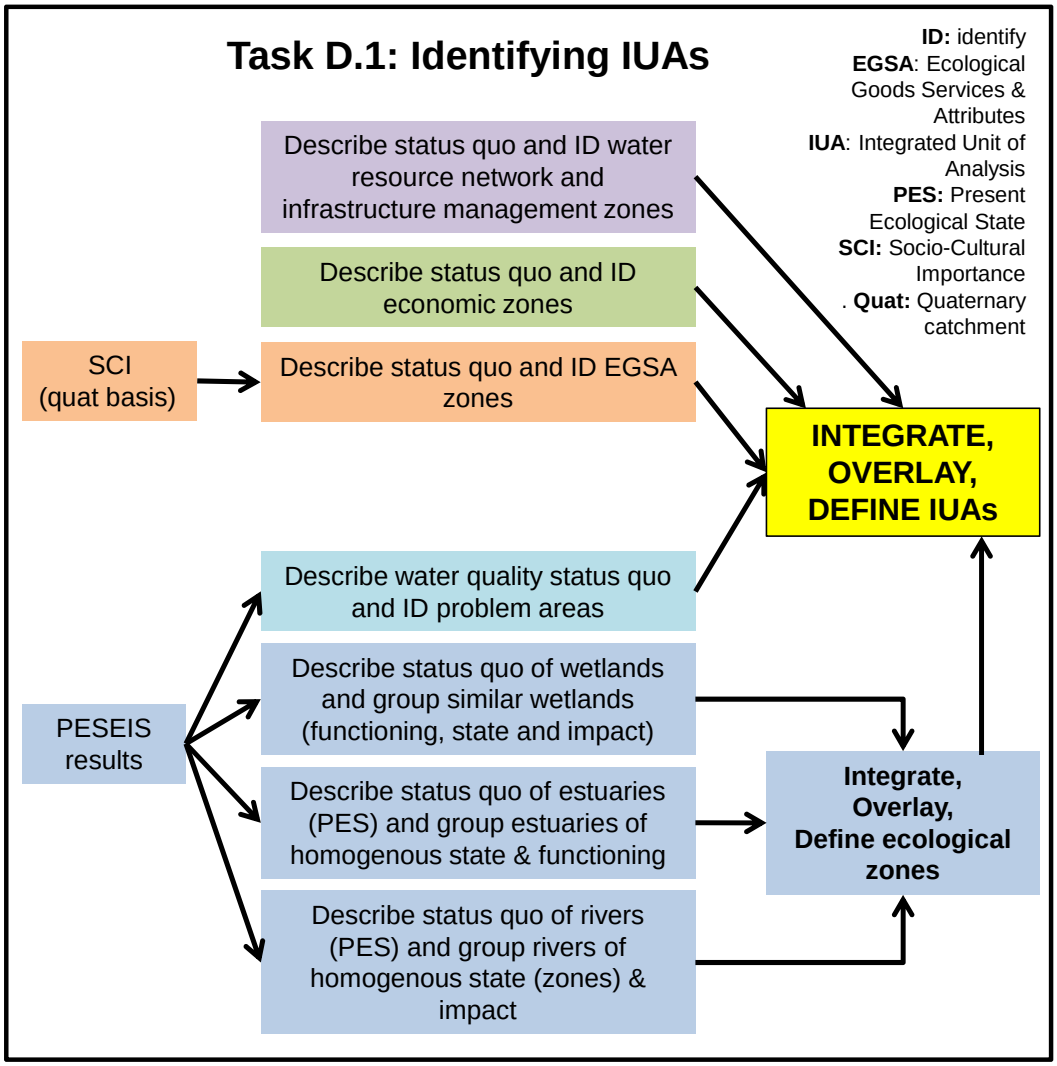

Figure 5.1 Summary of process to identify IUAs

5.1.1 Task D1.1: Water resources component

The approach relating to steps 1c and 1d of the WRCS is as follow:
The available water resource network and infrastructure information from previous studies will be obtained and assessed for the purpose of defining the IUAs, identification of nodes and sites with respect to water abstraction infrastructure and evaluation of the confidence of hydrological data. The existing databases of the water resource models will be obtained. The configuration of the model networks should be available to assess if there are appropriate levels of data in the current model to support the IUA definition. Operational and development planning information from the KZN Reconciliation Strategy Maintenance Study (DWAF, 2007a) as well as other planning processes will be integrated in the definition of the IUAs and nodes. The most up to date information on the water use (where available) as well as data for possible future scenarios will be summarised for use in the scenario evaluation task.

A consolidated description of the water resource network and infrastructure will be compiled and all 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 IUAs as will be agreed with the Client at the onset of this task. However, the only high resolution network model that will be available will be obtained from the Mkomazi Pre-Feasibility study.

Task responsibility: **Van Rooyen**, Seago, Scheepers, Haasbroek, Sikosana, Sami, Reneke, De Sousa

Information required

- Schematics of all model networks and configurations.
- Reports of all available hydrological, yield and/or WRPM studies done in the WRPM Information of Reconciliation Strategy Maintenance Study, including operational and other scenarios.

Actions

- Develop map of all important land and water use information, major dams (including planned), points with acceptable observed data and planned operational strategies. Also an indication of level of modelled data confidence.
- Develop summary of all major water and land uses.
- Undertake a Water Resource Use Importance (WRUI) assessment

Deliverables and milestones

- Spreadsheets with WRUI results: December 2012
- Status quo of water resources described and operational zones defined: January 2013 – Deliverable 6.

5.1.2 Task D1.2: Economic component

The WMA covers the very important economic hubs of eThekwini Metropolitan Municipality (Durban) and Msunduzi Local Municipality (Pietermaritzburg) which together represent more than 60% of the industrial output of the KZN Province. It is also a very important agricultural region with large sugar cane production areas throughout the WMA with accompanying sugar mills. A large variety of other agricultural products are produced varying from beef and dairy production in the inland areas to crop and horticultural production in both the coastal and inland areas.

This area also includes one of the most popular tourist and holiday areas in the country varying from a number of coastal holiday towns/resorts, Durban beaches and inland tourist destinations such as the Drakensberg region and very popular Game Parks.

The Durban port together with the N3 highway, accompanying railway and fuel lines is the most important transport node in the country.

The 2001 census (2012 census is not available yet) indicates that over 40% of the provincial population reside in the WMA. It is proposed that at least one economic region will be defined to include each major individual catchment and in the case of the Mgeni catchment, at least two economic regions.

Although the Mgeni catchment is, in terms of the KZN region, an important component, the other catchments all make an important contribution to the provincial economy:

- Mvoti catchment is an important sugar producing area complimented by commercial forestry and mixed farming in the upper reaches of the river. The larger towns are Stanger, Darnell and Greytown.
- Mdloti catchment is also an important catchment in terms of sugar cane production and includes the town of Tongaat.
- Mgeni catchment has already been discussed above.
- Mlazi and Lovu catchments are just south of the eThekwini and is mostly rural with some sugar cane production in the inland areas.

- Mkomazi catchment is at this stage relatively undeveloped, but with the planned dam to supplement Durban's water supply the situation might change. A fair amount of forestry occurs in the catchment and at the mouth of the river is a large paper factory.
- Mpambanyoni to Mzumbe or upper South Coast is overwhelmingly rural in the inland area with some mixed farming and commercial forestry. On the coast side there are large sugar production estates with a number of holiday resorts.
- Umzimkulu catchment starts in the Drakensberg area of Underberg, a mixed farming area followed by commercial forestry and communal land. Port Shepstone is the largest coastal town on the South Coast with a sugar cane mill.
- Mtamvuna River forms the boundary with the Eastern Cape Province. It is a very popular holiday area with some banana and sugar cane production.

It is proposed that each of the catchments be delineated as an Economic Zone with the possibility of sub – zones as dictated by economic, demographic and topographical conditions. An economic baseline of current economic activities will be constructed for each relevant water based activity in the defined Economic Zones. The following activities will be included:

- Tourism.
- Heavy Industry, specifically sugar cane mills, saw mills, paper factory and other identified water dependent factories.
- Commercial Forestry
- Irrigation.
- Urban Domestic Water Use.
- And other as identified.

For analysing the macro-economic situation, the following approach will be used to determine the current situation of WMA 11:

- Macro-economic models driven by water, based on the KwaZulu-Natal Social Accounting Matrix (SAM) (used in the application of the Water Impact Model (WIM)).

The macro-economic perspective study will therefore require an assessment of the economic impacts to be undertaken. To accomplish this, an econometric model approach based on the input-output model, will have to be constructed for each of the Economic Zones. The WIM will be used to express the socio-economic impacts.

The WIM, as it is currently constructed, is in the form of a dynamic computerised water entitlement model which can be used to identify and quantify the following indicators:

- Economic benefits.
- Maximum possible water reduction.
- Capitalised impact.

The first step in calculating the macro-economy of each of the Economic Zones will be to identify and establish the detailed water users in terms of volume currently used. In the case of irrigation and commercial forestry the detailed areas under production is determined together with the different crops produced.

A WIM will be constructed for the catchment and the identified Economic Zones. The model is driven by the level of production output in the specific region. It measures the social and economic effects on irrigation agriculture, commercial forestry and industry. For agriculture the model can accommodate up to ten individual products and for forestry it makes provision for pine and gum sub-species. The following impacts will be estimated by the WIM:

- Gross Domestic Product (GDP).
- Low income households and total households.

- Employment creation.

Task responsibility: **Mullins**, Cloete, Majoro

Information required

- Hydrology: Volume of water used per activity per catchment (domestic, irrigation, and industry).
- Information sourced from Mosaka Economists which include:
  - Irrigation database: Hectares, crops specification, production budget requirements (ton/ha), labour requirements for the different users in this sector.
  - Commercial Forestry: Production budget
  - Tourism information if identified as a significant economic activity
  - Heavy Industry: Saw Mills (forestry beneficiation) and sugar mills.

Actions

- Analysis of economic activity for the catchment and disaggregating of activities into zones:
- Develop applicable WIM for each Economic Zone.

Deliverables and milestones

- Prepare Economic Zone baseline of the major water users for the Status Quo Report (Report 2): December 2012 – Deliverable 7.
- Economic zone map with quantification of economic sectors per zone (provided in the Status Quo Report, Report 2).

5.1.3 Task D1.3: Ecosystem Goods, Services and Attributes component

The present day socio economic status of the whole catchment area will be described, based on the economic and social importance assessed from a literature review as well as mapping information and site visits if required. Where quantitative data is not available a qualitative description will be provided. The objective of describing communities and their well-being within each socio-economic zone is

a) to highlight those areas and associated communities for whom dependence on the Ecosystem Goods, Services and Attributes (EGSA) is likely to be important; and

b) 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 socio-economic conditions in these communities and constructing a measure or index of social well-being from the data collected. Communities in which EGSA are likely to be important are those that are typically rural and poor in nature. Tribal trust areas are likely to be particularly important.

Some information on the EGSA of WMA 11 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 these 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 EGSA 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. As such it is therefore more practical to measure changes in EGSA values relative to a reference point rather than computing a baseline value. As such values with importance are analysed in this step. The value will be attached as an output of Task D2 and D5.

It should be noted that this assessment and evaluation applies to both rivers (and river-related wetlands) and estuaries (See Section 5.1.6).

Task responsibility: **Huggins,** Grant

Information required

- Economic information.
- Demographic information.
- Formal water supply to communities.
- Maps of the study area and Economic Zones.

Actions

- Identifying EGSA, provide importance and complete a Socio-Cultural Importance evaluation.

Deliverables and milestones

- Delineating and describing communities that are deemed to be important with respect to EGSA. : January 2013 – Deliverable 8.
- SCI importance for quaternary catchments

Responsibility of the Consultant

- Provision of the Status Quo EGSA component.

5.1.4 Task D1.4: Water Quality Status Quo

This task will utilize all available information to identify water quality issues and problems in the catchment, including areas outside of the ecological biophysical nodes and EWR sites (as detailed work will take place at the EWR sites). The output will be provided graphically showing hotspots in terms of poor water quality, with associated reasons. Desktop water quality assessment for relevant nodes will be sourced via the PESEIS project currently being conducted by GroundTruth Consulting. Of importance is that the desktop water quality assessment relies on the PES water quality rating being used in association with the fact sheets to determine the causes of deterioration. Therefore the fact sheet produced during the PESEIS project has to be based on SQ reaches.

Task responsibility: **Scherman**

Information required

- Water quality metric information from the PESEIS project.
- All Reserve-related water quality data currently available for sites in the WMA.

Actions

- Water quality analysis and producing a map showing water quality hotspots, with associated reasons.

Deliverables and milestones

- Water quality component of the Status Quo Report: January 2013 – Deliverable D9.

Responsibility of the Consultant

- The Consultant is not responsible for a delay in the deliverable, if due to the lack of provision of the required information from the PESEIS project.
- Provision of the Status Quo water quality component.

5.1.5 Task D1.5: Wetlands

Status Quo and Resource Units (RUs)

There are no previous approved DWA Reserve studies on wetlands within the WMA. Limited desktop information regarding wetland extent across the WMA. In this high rainfall area of the country there are likely to be thousands of wetlands within the WMA, of several different types and

across numerous EcoRegions constituting vastly different "types". To summarise this complexity and provide relevant wetland information to the region for Water User Licence Application (WULA) purposes, a quaternary scale wetland assessment for the WMA will be undertaken. This will provide the DWA with an overview of wetland types, condition, importance and functional aspects. Similar approach and assessments have been undertaken for other WMAs (assessments (e.g., DWAF, 2009c; DWA, 2010b; DWA, 2010c). This in effect will provide a low confidence averaged desktop-level PES and EIS score for wetlands within each quaternary catchment of the WMA; providing a basis for describing the status quo and Recommended Ecological Categories (RECs) for the overall condition of wetlands in each quaternary catchment. This basic PES and EIS assessment will also provide, albeit low confidence, baseline information to enable RQOs to be generated for the wetlands within the catchment.

Prioritisation and Identification of wetland "hotspots"

Several dozen wetlands and numerous wetland clusters within the WMA have been identified as priority wetlands as part of the National Freshwater Ecosystem Priority Area (NFEPA) assessment. The NFEPA wetlands are for primarily conservation or biodiversity reasons, and are identified largely through desktop assessments. Some verification of wetland extent and condition is recommended.

A prioritisation process will be undertaken to rank these priority wetlands using procedures utilised in earlier WMA-scale wetland assessments (e.g., DWAF, 2009c; DWA, 2010b; DWA, 2010c). This prioritisation process will consider the priorities of the DWA with regard to future development scenarios and pending WULAs. Based on this process, the highest priority wetland systems in the WMA will be identified and these results will feed in to the IUAs and RU delineation.

A rapid PES and EIS assessment will be undertaken for the two highest priority wetlands in the WMA. These rapid field assessments will be undertaken to verify the desktop results of the NFEPA assessments and other potential priority wetlands identified. Additionally, the results and data derived from the rapid PES and EIS field assessments will aid the development of RQOs for the priority wetland systems.

In general, most WULA applications relating to water resource use in and around wetlands (within 500 m, as per the National Water Act (NWA) guidelines) tend to be non-consumptive water uses. It will be possible to develop generic RQOs (as part of Task D6) for non-consumptive (lower risk) water uses that will ensure protection of the wetland systems, using the RDM guideline document for wetlands (Rountree, Weston and Jay, 2012). These RQOs will enable the DWA to evaluate and process lower risk WULAs that relate to wetlands.

***Task responsibility*: Rountree**

Information required

- SANBI Wetlands Inventory Map (Version III).
- KZN wetlands maps.
- KZN landuse maps.

Actions

- Desktop review of NFEPA priority wetlands and desktop scan to identify other potential significant wetlands.
- Catchment PES and EIS assessment.
- Rapid PES and EIS assessment of two priority wetlands.
- Generic RQOs for wetlands.

Deliverables and milestones

- Catchment PES and EIS & identification of priority wetlands: December 2012 – Deliverable D10
- RQOs for wetlands: December 2013 – Deliverable 26 and included in Report 10.

Responsibility of the Consultant

- The consultant is not responsible for developing new tools and methods.
- The consultant will produce qualitative RQOs for purposes of the WULA and will not be providing detailed quality and quantity information for wetlands.

5.1.6 Task D1.6: Estuaries

A summary of existing information on estuary pressures will be provided and include:

- Degree of flow modification.
- Level of development in the estuary functional zone (i.e. below the 5 m contour).
- Fishing effort, and
- Pollution levels.

This work will only contribute to the status quo assessment of WMA 11 as the detailed desktop EWR assessment is being undertaken as part of Task D3.12.

5.1.7 Task D1.7: Rivers

Currently a country wide study, commissioned by DWA and the WRC is being undertaken to determine the PES and Ecological Importance (EI) – Ecological Sensitivity (ES) (PESEIS) of South African Rivers at SQ level. SQ reaches are delineated on the basis of hydrological changes, i.e. at tributary confluences and is provided by D:RQS. Each of the SQ reaches represents a Resource Unit (RU), i.e. the length of river for which a status assessment and EWR assessment will be valid for. Therefore it is imperative that this information generated during the DWA/WRC project is available.

The Present Ecological State (PES) information used as part of this process will therefore be sourced from the desktop PESEIS study. Based on the scope of work of the desktop study, the PESEIS results should be accompanied by a description of the land-use activities and impacts responsible for the PES (in fact sheet format). This information will form a crucial component of the current study as it will enable the team to derive whether the issues are flow or non-flow related. It is furthermore imperative that DWA should give guidance and make the final decision on which EI and ES ratings should be used (i.e. those based on medians, maximums, etc.) as it is contained in the final model.

During this task, the wetland status quo assessments will also be incorporated and used together with the river information to define the ecological zones. All of the above mentioned information will be captured in excel spreadsheets that will allow integration of the different parameters or metrics considered (such as river PES, river EI, river ES, wetland PES, wetland EIS). A similar process is being followed for estuaries in order to determine priorities and the results will be summarised in the Status Quo Report.

The water resource zones will be used as an indication of how the system is being operated and the different land uses. Within these (as these zones are usually at a larger scale than the final IUAs), the different Ecological Categories (ECs) for each of the 288 SQ reaches will be assessed and grouped according to similarity of impacts and state.

Task responsibility: **Louw,** Kotze, Mackenzie, Koekemoer, Scherman

Information required

- PESEIS results in the required format including fact sheets for every SQ reach by November 2012.
- Wetland and water quality information in the correct format.
- Economic and hydrology zones.

Actions

- Specialist session to integrate results, overlay and determine ecological zones. Status quo will also be summarised

Deliverables and milestones

- Status quo assessment of rivers and wetlands (PESEIS) and identified ecological areas of homogenous state: February 2013 - Deliverable 11.

Responsibility of the Consultant

- The consultant is not responsible for any delay in programme and resulting increase in costs if the PESEIS results are not available by November 2012.

5.1.8 Task D1.8: Integration of above components to define IUAs

All information generated during the preceding tasks will be used to integrate the results by overlaying the different zones and defining the IUAs (Figure 5.1). These IUAs will be presented to the project steering committee and the final IUAs documented in the Status Quo Report.

Task responsibility: **Louw,** Mullins, Van Rooyen, Huggins

Information required

- Maps illustrating the outcomes of all information emanating from Tasks D1.1 to D1.7.

Actions

- Meeting.

Deliverables and milestones

- IUAs identified and mapped: March 2013 - Deliverable 12

5.1.9 Task D1.9: Identification of river biophysical nodes and level of assessment

IUAs are a combination of the socio-economic zones defined in watershed boundaries, within which ecological information is provided at a finer scale. This requires that biophysical nodes be nested within the IUAs (DWA, 2007b). As a starting point, each SQ reach being assessed will represent a biophysical node. Due to the large number of nodes, the process described in the Classification guideline (which refers to the Desktop EcoClassification and the identification of hotspots (Louw & Huggins, 2007)) will be used to identify the final nodes for which EWRs will be assessed and at what level.

The process used is described in Figure 5.2 and relies on the results of the PESEIS study. Once the hotspots have been identified, the biophysical nodes which will be used for EWR assessment, and the different levels of assessment, will be identified and motivations provided. The total number of initial biophysical zones is 288 river nodes and 64 estuary nodes. It is proposed that between 150 to 200 nodes be selected, but the final number will be reliant on the results of this task, as well as an analysis of the role that flow manipulation plays or can play in future at these nodes. The levels of assessment at the estuary nodes will only be determined at a later stage (refer to Task D3.12).

As part of this assessment, the Water Resource Use Importance (WRUI) must be undertaken as well as the Socio-Cultural Importance (SCI). These will likely be undertaken on a quaternary scale

rather than sub-quaternary as sufficient detailed information required for sub quaternary scale will not be available.

Task responsibility: **Louw,** Koekemoer, Kotze, Mackenzie

Actions

- Specialist meeting (part of Task D1.7).

Deliverables and milestones

- River biophysical nodes (which can include wetlands) and level of EWR assessment identified: February 2013 – Deliverable 13.

Responsibility of the Consultant

- The consultant is not responsible for selection of biophysical nodes if the PESEIS results are not available on time, i.e. November 2012.

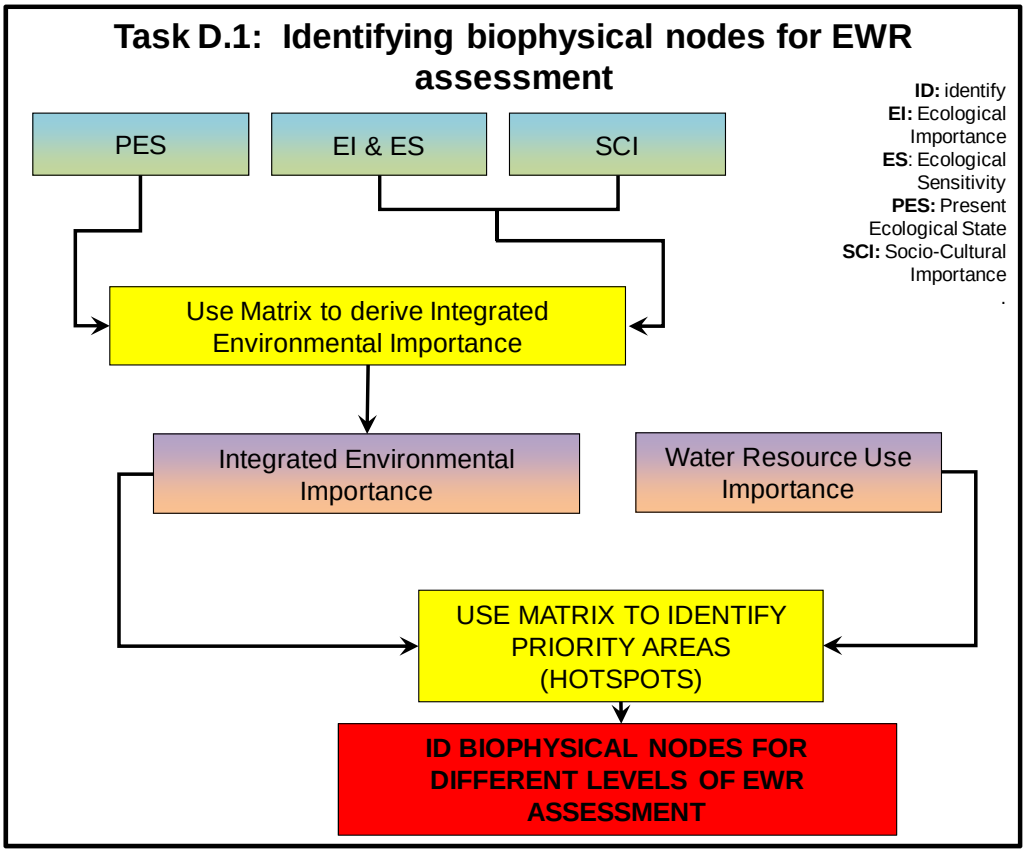

Figure 5.2 Summary of the process to identify biophysical nodes for EWR assessment

5.1.10 Task D1.10: Status Quo Report

All the above information will be documented in a report which will provide the approach, reasoning and results regarding the status quo and selection and locality of biophysical nodes and IUAs.

Task responsibility: **Louw,** Koekemoer, van Rooyen, Huggins, Mullins

Deliverables and milestones

- First draft Status Quo Report: April 2013 – Report 2 which includes all information generated during Tasks D1.1 - D1.9.

Responsibility of the Consultant

- The consultant is not responsible for developing guidelines on how to use the EI and ES in making REC recommendations. This guideline should be provided by DWA.

- The consultant is not responsible for any change in programme due to a delay in the provision of the PESEIS data which forms the backbone to the ecological input into this study

5.2 TASK D2: INITIATION OF THE STAKEHOLDER PROCESS AND CATCHMENT VISIONING

Stakeholders who will be identified and invited to be members of the PSC will be representative of all relevant interests and sectors of society in the study area. The principles used world-wide to characterise and measure a thorough and legitimate stakeholder participation process, and which will be applied in this process, are noted below.

- Consultation is inclusive. It takes place with all sectors of society and affords a broad range of stakeholders the opportunity to participate.
- Information is accessible and sufficient to enable meaningful contributions.
- Information is presented in various ways, e.g. by way of Background Information Documents, (BIDs) newsletters, letters and advertisements.
- There are different 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.

Catchment visioning is a requirement of the RQO process and has been included in Task 2 of the integrated process. At the first PSC meeting where stakeholders will be presented, the status quo in the catchment for various aspects (ecology, economy, water resources, EGSA) will be presented and the reasons for the status provided. Preliminary IUAs will also be presented. Stakeholders will be required to indicate what their catchment vision are and how they would like the status quo to change. At the end of the study, this vision will be revisited as the implications on different users and the ecology will then be presented and based on this, the future vision will be refined.

In addition to the 5 PSC and the 1 Public meeting scheduled for the Mvoti To Umzimkulu Classification study, Catchment and River forums meetings and different sector meetings (e.g. municipality, domestic, industrial, and agricultural) will be conducted by DWA in order to implement their Stakeholder Engagement Plan. The purpose of the engagement will be as follows:

- To serve as information sharing with different sectors
- To engage with the sector as key stakeholders on key water related issues of the Mvoti To Umzimkulu WMA
- To provide the opportunity for the sector to comment and raise issues on project milestones

The above is a summary of a Stakeholder Engagement Plan (provided by Ms Nyamandi, RDM) dated February, 2013.

The stakeholder involvement process which will be followed for this assignment is described hereunder. Note that this is additional to the stakeholder activities described above and undertaken by DWA.

5.2.1 Task D2.1: Stakeholder identification and database management

The identification of stakeholders will be intensive at the beginning of the project. The list of identified PSC members will be submitted to the PMC for approval. In this regard, the identification of stakeholders and community representatives who will be PSC members is important and will be done in collaboration with DWA (as assisted by stakeholders in the study area).

Stakeholders' details will be captured on an MS Access database, an electronic database management software programme that automatically categorises every mailing to stakeholders,

thus, providing an on-going record of communication. In addition, comments and contributions received from stakeholders will be recorded, linking each comment to the name of the person who made it.

All the technical outcomes have to be endorsed by the PSC members, by giving input or comments on the report produced.

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

- National, provincial and local government (relevant local and district municipalities).
- Relevant residents' associations, ratepayers' organisations, community based organisations, agricultural organisations and Non Governmental Organisations (NGOs).
- Environmental and water organisations, forums, groups, associations and government institutions.
- Private sector (business, industries, irrigation) in the Mvoti to Umzimkulu WMA.
- Civil society.
- 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 regularly updated as more information becomes available and as stakeholder information changes.

Task responsibility: **Shinga**, Nkwanyana, Engler

Information required

- List of DWA internal officials and/or representatives from the relevant directorates.
- List of members from the Catchment Management Forums.

Actions

- Establish project database.

Deliverables and milestones

- Establishment and maintenance of database – Deliverable 15a (continual).

Responsibility of the Consultant

- Establishing database.

5.2.2 Task D2.2: Project Announcement

In preparation and prior to the announcement of the project, the following activities will be undertaken:

- Interact with the relevant DWA representatives with the aim of identifying stakeholders to be invited to the PSC meetings, thereby contributing to the establishment of the database.
- DWA will prepare the Background Information Document (BID) and the relevant study team members will review and provide comments on the BID.
- Establish contact with stakeholders.
- All other public documents that will be drafted e.g. advertisements, comment sheets, letters, and proceedings of meetings and workshops will be submitted to the Study Team for approval before distribution.

The study will be announced through the following activities:

- Distribution of a BID (English and Zulu). The BID will explain the need for the project, the context of the study and show the extent of the study area (map). Information such as where additional information can be obtained, the website for downloading of information, etc. will also be provided in the BID.

- A comment sheet will accompany the BID and will provide an opportunity for people to register as a stakeholder, provide names of other possible stakeholders and to comment on the classification study.
- Placement of statutory advertisements (English and Zulu) in relevant newspapers.
- Distribution of a personalized letter to stakeholders with a copy of the BID, including an invitation to register and participate in the classification study.

Collaborating with existing projects/structures in the Mvoti to Umzimkulu WMA

Existing projects of DWA in the Mvoti to Umzimkulu WMA will be used to create awareness of this project. A Strategy Steering Committee (SSC) for the Implementation and Maintenance of the Reconciliation Strategy for the KwaZulu-Natal Coastal Metropolitan Area Water Supply System has been formed. Liaison will take place with the SSC and database information will be shared. The SCC schedules meetings twice a year and it is planned that a presentation is given during one of their bi-annual meetings.

The Stakeholder Empowerment Directorate will also engage with stakeholders in the study area to explain the different processes which DWA is undertaking and the role of stakeholders in these processes.

Task responsibility: **Shinga**, Nkwanyana, Engler

Information required

- Draft BID from DWA for review and providing inputs.

Actions

- Review of draft BID.
- Translation of public documents (advert and letter) into Zulu. DWA requires two months notification for translation of documents.
- DWA requires seven weeks notice for the placement of advertisements.
- Distribution of BID to all identified stakeholders and/or PSC members.

Deliverables and milestones

- Distribution of BID: November 2012 – Deliverable 14.
- Placement of advertisements: February 2013 – Deliverable 15b
- The translation of relevant public documents into Zulu.
- Compilation and distribution of personalised invitation letters - Deliverable 15c

Responsibility of the Consultant

- Distribution of BID, compilation of advertisement and invitation letters.

5.2.3 Task D2.3: Issues and Response Report

An Issues and Response Report will be compiled and updated throughout the duration of the project. This report will list all the comments from stakeholders (received through comment sheets, raised at meetings, *via* telephone calls, faxes and email) and responses from the project team.

Task responsibility: **Shinga**, Nkwanyana, Engler

Information required

- This will be dependent on the comments raised and/or submitted by stakeholders.

Actions

- Submission of comments to the Project Manager for coordinating the provision of responses to comments raised by stakeholders.
- Keep an updated Issues and Response Report.

Deliverables and milestones

- Stakeholder Issues and Response Report.

Responsibility of the Consultant

- Complete Issues and Response Report: June 2015 - Deliverable 15d.

5.2.4 Task D2.4: Newsletter

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

Task responsibility: **Shinga**, Nkwanyana, Engler

Information required

- Details of recommended scenarios.

Actions

- Compilation, translation and distribution of newsletter.

Deliverables and milestones

- Newsletter: January 2015 - Deliverable 15f.

Responsibility of the Consultant

- Compilation and distribution of a newsletter to all registered stakeholders.

5.3 TASK D3: QUANTIFY EWRs, AND CHANGES IN NON-WATER QUALITY EGSA

The TOR indicates a Comprehensive level of Reserve assessment. It is assumed that this implies comprehensive in terms of the coverage of study area and does not refer to the Comprehensive Ecological Reserve Methodology (CERM). Due to the size of the study area different levels of Reserve and Classification will be applied in different rivers within WMA 11.

The hotspots determined during Task D1 will provide guidance for determining different levels and broad locality of sites. Rivers that are important from a water resource perspective will be selected for Intermediate Reserve determination. WMA 11 includes all the rivers between the Mvoti to Umzimkulu Rivers and it is assumed that due to the water resource importance of WMA 11, the larger rivers that require detailed (Intermediate and/or Comprehensive) Reserve determination studies are the Mvoti and Mkomazi systems. More detailed Rapid III assessments will be utilised for probably the Umzimkulu, Mhlali, Mhlatane, Mdloti and Mgeni River systems as recommended in the Water Reconciliation Strategy study for the Kwazulu-Natal coastal metropolitan areas (DWAF, 2007a). A range of rivers will also be selected for more detailed desktop assessment.

At this stage, the following is proposed to provide guidance to the number of EWR sites at different assessment levels for planning and budgeting purposes and will be finalised after Task D1 has been completed.

Mvoti River: The EWR assessment undertaken during 1995 (coordinated by Delana Louw, then at DWA; DWAF, 1996) is now outdated and it is proposed that two EWR sites are selected within this system.

Mkomazi River: The EWR was undertaken by the now Rivers for Africa during 1998 (DWAF, 1999a). Although the methods are outdated, the Comprehensive approaches were detailed and hydraulic and ecological confidence was generally moderate to high. It is therefore proposed that three EWR sites are maintained and that the existing Reserve is updated.

Mgeni River: The necessity of a detailed assessment will be determined as it is possible that the EWR assessment for the estuary might suffice. However, taking into account that the Mgeni River is the most important source of water for Ethekwini, additional high confidence EWR sites might be required downstream of the range of dams in the system. Cognisance will be taken of the

importance of the Mzinduzi River tributary, relating to recreational importance and water quality related problems.

Umzimkulu River: A detailed assessment has recently been undertaken (DWA, 2011b). These results will be assessed and the necessity of any refinements will be decided on.

A further five EWR sites will be selected where Rapid III with a flooding component (i.e. a Rapid III with higher confidence) will be applied. The new Revised Desktop Reserve Model (RDRM) (Hughes *et al*., 2011) will be applied at five EWR sites using measured hydraulics. This will significantly improve the confidence from previous Desktop assessments.

A matrix (Table 5.1) is provided that indicates the different biophysical nodes and associated levels of EWR assessments. The difference in effort required for the different levels of EWR assessment can be derived as well as the potential confidence.

The subtasks under Task D3 are described according to the various actions required and not according to the different assessment levels. The most cost-effective approach is to link site visits for different assessment levels and specialist meetings and this will be reflected in the division of subtasks.

Table 5.1 Comparison of different levels of EWR assessments for key and desktop biophysical nodes

LEVEL OF DETAIL	LOW → HIGH				
Nodes	Desktop biophysical nodes (NO EWR assessment)	Desktop biophysical nodes (EWR assessment)	Desktop biophysical nodes (verification)	Key Biophysical Nodes	
EWR level of assessment	None	Desktop (150 - 200)	Extended Desktop (5)	Rapid III (+flood)	Comprehensive / Intermediate (6)
RU determination	SQ reaches (available)	SQ reaches (available)	SQ reaches (available)	MRU determination	MRU determination
EcoClassification Level	Desktop (PESEIS - results)	Desktop (PESEIS - results)	Desktop (PESEIS - results)	III	IV
Cross-section survey	N/A	No	Yes	Yes	Yes
No of hydraulic calibrations	N/A	None	None	One (dry) and wet if time allows	Two (dry & wet)
Hydraulic modelling	N/A	Yes, RDRM	Yes, RDRM	Yes	Yes
Instream surveys	N/A	No	No (PESEIS)	Yes	Yes
Riparian veg surveys & sp assessment	N/A	No	No	Yes	Yes
Geomorph survey & sp assessment	N/A	No	No	No	Yes
Instream specialist assessment	N/A	No	Yes	Yes	Yes
Hydrology modelling	N/A	Natural (qualitative PD assessment(	Natural (qualitative PD assesment)	Natural & PD	Natural & PD
Specialist meeting	N/A	No	Yes	Yes	Yes
.rul & .tab tables	N/A	.rul	.rul	Yes	Yes
Operational scenario assessments (yield modelling)	N/A	No	No	Yes	Yes
Ecological consequences	N/A	Qualitative statements only	Qualitative statements only	Yes	Yes
Possible Confidence levels	LOW → HIGH				

5.3.1 Task D3.1: Resource Unit determination for rivers with key biophysical nodes (Comprehensive, Intermediate and Rapid III (incl. floods))

Management Resource Units (MRUs) will be selected according to approved DWA methods outlined in DWA (2008c). This more detailed delineation method is required as it ultimately guides the selection of EWR sites and provides the reaches applicable for management. The Resource Unit (RU) process defines the MRUs as final output and plays an important role in terms of the development of operational scenarios.

Task responsibility: **Louw,** Van Rooyen, Scherman

Information required

- SQ reaches (available from DWA).
- Level II EcoRegions (available from DWA).
- Geomorphic zones (available from DWA).

Actions

- Provide a description of systems operation in the relevant rivers (Van Rooyen - February 2013).
- Generate water quality Resource Units: March 2013 – Part of Report 3.
- Overlay available information and identify Resource Units: March 2013 – Part of Report 3.

Deliverables and milestones

- RU report: First draft during June 2013 – Report 3.

Responsibility of the Consultant

- The consultant is not responsible for determining geomorphic zones at a scale other than that used by DWA.

5.3.2 Task D3.2: Preliminary EWR site selection (rivers)

Ecological Water Requirement (EWR) site selection is only relevant for rivers where either Rapid III, Intermediate or Comprehensive Ecological Reserve methodology will be followed as outlined in Kleynhans and Louw, 2007. EWR sites are set at specific points on the river. These points are critical sites within a RU. The EWR sites must provide sufficient indicators for specialists to attach environmental flows to. The criteria for site selection as detailed in the Building Block Methodology (BBM) (King and Louw, 1998) manual and DWAF (1999b) will be followed.

An initial site visit to select the sites and cross-sections will be undertaken. Water level measurements for hydraulic calibration will be measured. As many cross-sections as possible at desktop biophysical nodes will be undertaken for use in the Revised Desktop Reserve Model (RDRM) (Hughes *et al*, 2011).

Task responsibility: Birkhead, Louw

Information required

- Information on existing sites on the Mvoti, Mkomazi, and Mtamvuna Rivers and any other rivers in the WMA which can be sourced from DWA.

Actions

- Select sites and obtain as much information possible for hydraulic modelling.
- Photopoint monitoring.

Deliverables and milestones

- EWR sites selected: May 2013 – Deliverable 16 and documented in Report 3.

Responsibility of the Consultant

- The Consultant is not responsible for resurveying sites in the Mkomazi River.

- Sites situated in known problem areas in terms of safety (personal and for equipment) will not be selected.

5.3.3 Task D3.3: EWR biophysical surveys (rivers)

Biophysical surveys will be undertaken at the EWR sites, specifically the Comprehensive, Intermediate and Rapid III sites. The following components will be surveyed:

- Fish.
- Aquatic macroinvertebrates.
- Riparian vegetation.
- Fluvial geomorphology (not at Rapid III sites).
- Habitat assessment.
- Cross-sectional profiles.
- Water quality and diatom on-site data will be collected.

Hydraulic data will be collected by measuring stage levels and longitudinal riverbed and water surface gradients at sites relative to a local datum. The objective of the hydraulic data collection is to procure field data at EWR sites to enable cross-sections to be rated (relationship between discharge and stage) and provide information on the topography of the EWR sites. Photopoint monitoring will also be undertaken.

Task responsibility: **Louw,** Desai, Kotze, Deacon, Mackenzie, Rountree, Scherman

Actions

- Site visit.

Deliverables and milestones

- Availability of survey data: August 2013.

Responsibility of the Consultant

- Consultants are only responsible for linking EWR sites to a local datum (benchmark). It is advised that survey services within DWA link the local benchmarks to ensure that benchmarks can be replaced if removed.

The Consultant is not responsible for:

- Making arrangements, booking or paying for any non-team members that are participating.
- Additional site visits if adverse weather conditions occur or benchmarks are removed.
- Consultants are not responsible for any additional costs to be incurred due to *force majeure*.
- The Consultant will not be initiating water quality monitoring, but only collecting on-site water quality and diatom data during field surveys.

5.3.4 Task D3.4: Analysis of data: EcoClassification for rivers

Level IV EcoClassification will be applied at Intermediate and Comprehensive EWR sites. Methods as described in Kleynhans and Louw (2007) will be followed. The rule-based models developed as part of the EcoClassification system by D:RQS will be used to determine the PES for each of the components and includes:

- Physico-chemical Driver Assessment Index (PAI): Kleynhans *et al*. (2005).
- Geomorphological Driver Assessment Index (GAI): Rountree and du Preez (in prep).
- Fish Response Assessment Index (FRAI): Kleynhans (2007).
- Macroinvertebrate Response Assessment Index (MIRAI): Thirion (2007).
- Riparian Vegetation Response Assessment Index (VEGRAI): Kleynhans *et al*. (2007).
- Instream Habitat Integrity (IHI): Kleynhans *et al*. (2009).

Level III EcoClassification (Kleynhans and Louw, 2007) will be applied at the Rapid III sites using the FRAI, MIRAI, VEGRAI and IHI models.

Diatom analysis: Diatoms have been shown to be reliable indicators of specific water quality problems in rivers such as organic pollution, eutrophication, acidification and metal pollution (Tilman *et al*., 1982; Dixit *et al*., 1992), as well as for general water quality (Prygiel *et al*., 2002) Diatom monitoring together with macroinvertebrate monitoring will provide a method that combines two independent indicator systems at different trophic levels. Diatom samples will be taken at all sites and analysed as outlined in Taylor *et al*. (2005) and Taylor *et al*. (2007). These methods were designed and refined as part of the Diatom Assessment Protocol (DAP), a Water Research Commission (WRC) initiative. The diatom results are useful for providing information on water quality related impacts on rivers and streams.

Task responsibility: Louw, Kotze, Deacon, Mackenzie, Rountree, Scherman, Birkhead, Koekemoer.

Information required

- Historical information in readily available databases.

Actions

- Analysis of data and running of models.

Deliverables and milestones

- The preliminary output of the EcoClassification models will be available in a hierarchical manner with the last data (FRAI and MIRAI) available: May 2014 – Deliverable 18.

Responsibility of the Consultant

- The Client is responsible for using the models and applying it according to the above manuals and models.

5.3.5 Task D3.5: Hydrological analysis

Before hydrological data can be generated at any of the identified sites, the hydrological, yield or planning model configurations (as obtained in Task C) will have to be run to ensure that all the scenarios that will be used to generate the data are producing the same results as reported by the study from which the datasets originate. Thereafter the available models will be refined spatially to represent the identified EWR sites (up to 22 EWR sites). This will involve delineating the relevant catchments, splitting the land-use (farm dams and abstractions) and hydrology according to the physical layout as well as configuring the EWR structures into the models ready for analysis. Appropriate operating rule settings will also be defined and incorporated into the models.

Hydrological time series information will be prepared as input to the EWR processes. The standard set of data summaries will be provided to the EWR specialists which will include the following per site:

- Time series data (monthly or daily).
- Summary statistics data (minimum, maximum, median etc.).
- Flow durations curves.

The types of datasets will also be provided for different scenarios, depending on the availability of hydrological data and models and the level of confidence required at the point of interest. These scenarios will include:

- Long-term simulated Natural hydrology.
- Long-term simulated Present Day hydrology.
- Observed monthly or daily flows or dam levels (if available).

Detailed information will be produced where Rapid, Intermediate and Comprehensive Reserve determinations are carried out, providing all the types of scenarios as listed above. Monthly Natural and Present Day flows will be generated for all estuary sites where detailed models are available.

For the remaining Biophysical nodes and small estuaries where no high confidence data and models are available, at least natural monthly time series data will be prepared by applying appropriate hydrological disaggregation techniques using existing datasets. It will be endeavoured to provide low confidence present day flows at about 10% of the biophysical nodes, by improving the WR2005 model to represent present day conditions.

Depending on the availability of data a cursory evaluation of the land use at a maximum of 200 nodes will be carried out and summarised in tables. The water balance information sourced from studies undertaken in various towns will be used to identify the local water reconciliation status (for the areas where towns are located in the catchments upstream of the nodes.).

All the data will be prepared in properly indexed spreadsheet format for use by the EWR determination team. All above data for the key biophysical nodes will be used in Spatial and Time Series Information Modelling (SPATSIM) (Hughes and Forsythe, 2006) to prepare for the specialist meetings.

Task responsibility: **Van Rooyen**, Haasbroek, Sikosana, Scheepers, Talanda, De Sousa, Hughes

Information required

- WR2005 dataset and all available model configuration data for the WMA as well as reports for previous studies providing results of the models.
- Positions of all IUA, EWR sites, detailed estuary sites and all remaining biophysical nodes.

Actions

- Test model and implement up to 22 EWR nodes.
- Generate Natural and Present Day datasets for up to 22 EWR sites and estuary sites.
- Generate Natural datasets of the remainder of biophysical nodes.
- Generate low confidence Present Day flows at some of the biophysical nodes.
- Setting up SPATSIM using generated hydrological data.

Deliverables and milestones

- Time series data at all the biophysical nodes, EWR and estuary sites.
- Tabulated summaries of landuse at sites.
- All hydrological data available on SPATSIM: May 2014.

Responsibility of the Consultant

- The consultant is responsible for using only available hydrological data and additional systems modelling is not included in this study.

5.3.6 Task D3.6: Hydraulic high flow survey and modelling (rivers)

An additional hydraulic calibration is required at the Intermediate EWR sites. This will be collated during the wet season to ensure a range of calibration data.

Hydraulic modelling must be undertaken and the output must be according to the required standard for the Habitat Flow Stressor Response (HFSR) (IWR S2S, 2004; O'Keeffe *et al*., 2002) method. It must be emphasised that additional data automated to supply frequency of velocity-depth classes for fish as well as substrate-velocity depth classes for macroinvertebrates will be

supplied. This information is a requirement for the applications of the available tools to determine the EWR

Task responsibility: **Birkhead**, Desai, Louw

Information required

- Locality of gauging weirs.

Actions

- Site visits spaced over the different hydrological seasons (May 2013 and February 2014 (high flow calibration).
- Hydraulic modelling.

Deliverables and milestones

- High flow calibration data available: February 2014 – Deliverable 17.
- Cross-sectional profiles with the location of vegetation markers, and hydraulic lookup tables and velocity-depth classes: May 2014 – Deliverable 19.

Responsibility of the Consultant

- The Consultant will use all readily available information to ensure that a high flow is experienced during the site visit. The Consultant can however not revisit the area if flows are not high during the site visit.

The budget does not include:

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

5.3.7 Task D3.7: Intermediate/Comprehensive Reserve specialist meeting (rivers)

The objective of this task is to determine an EWR scenario for the range of ECs to be addressed at each EWR site. The process followed for the determination of low flows will be the Habitat Flow Stressor Response (HFSR) method (IWR S2S, 2004; O'Keeffe *et al*., 2002).

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

Task responsibility: **Louw**, Kotze, Deacon, Mackenzie, Rountree, Scherman, Birkhead, Koekemoer, Hughes

Information required

- Collate all information generated during Task D3.3 to D3.6.

Actions

- Specialist meeting dealing with Intermediate and Comprehensive EWR sites.

Deliverables and milestones

- EcoClassification and EWR scenario results (EWR rule and tab tables): June 2014 – Deliverable 20.

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting.
- Undertaking the logistical arrangements for the consulting team.
- The various specialists will make use of the most applicable methods and tools. It will be the responsibility of the DWA to provide guidance, training and manuals should new versions of

DWA recommended models become available for use. The various specialists will determine the best applicable methods for each specific task at the time of execution.

5.3.8 Task D3.8: Rapid assessment and Desktop EWRs (rivers)

The Rapid III approach will be followed at five EWR sites and will include a flooding component to ensure results which will be of higher confidence than what is normally associated with a Rapid III This will then also allow for scenario evaluation. The RDRM (Hughes *et al*., 2011) will be used to generate Reserve estimates which will then be modified.

An additional five EWR sites will be used for an 'extended Desktop assessment'. This will entail a review of the fish estimates only and will result in a higher confidence than a standard desktop estimate.

Task responsibility: Rapid: **Louw**, Kotze, Mackenzie, Birkhead, Koekemoer, Hughes, Deacon
Extended desktop: **Louw**, Kotze, Deacon

Information required

- Collate all information generated during Task D3.3 to D3.6.

Actions

- Specialist meeting dealing with Rapid EWR sites.

Deliverables and milestones

- EcoClassification, EWR rule and tab tables: November 2013 – Deliverable 21.

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting.
- Undertaking the logistical arrangements for the consulting team.

5.3.9 Task D3.9: Hydrological modelling (including groundwater) at desktop biophysical nodes

Catchment delineation of 150 - 200 desktop biophysical nodes will be undertaken and appropriate GIS maps will be prepared for analysis, reporting and communication purposes. Relevant GIS shape files will be converted into a format usable in Google Earth for evaluation of the ecological and environmental classifications of nodes and river reaches. In most cases only WRSM2005 networks will be available (since there are no high resolution models available – except for the Mkomazi River System). Information pertaining to the estuary evaluation approach defined in Section 2.3 will be prepared using available hydrological data. In the cases where no WRYM or WRPM models have been configured WRSM2005 information will apply. Data for very small rivers will be obtained through hydrological scaling methods. Qualitative water use data will be applied in at least 10% of the biophysical nodes where no models have been defined based on Google Earth observations.

Significant groundwater resources will be identified in the study area based on available data and reports. Particular attention will be given to areas where the groundwater-surface interaction is prominent and potentially would influence river base flow. A significant portion of the catchments in the study area generate baseflow and any groundwater abstraction will potentially have an impact on the baseflow generated from the area. It is thus required that baseflow and groundwater abstractions are adequately simulated upstream of important nodes (budget allows for a maximum of 5 nodes).

The generated EWR requirements at the biophysical nodes will be checked against the natural flows generated as input to the EWR process. Where low confidence present day flows were

generated at some of the bio-physical nodes the generated EWR will also be checked against these flows.

Task responsibility: **Van Rooyen**, Haasbroek, Seago, Scheepers, Talanda, De Sousa, Sami

Information required

- Configured water resources models and the WR2005 model configurations.
- Ground-surface water interactions data that reflects the implications on baseflow.
- Google Earth information.
- EWR information regarding biophysical nodes.

Actions

- Determine natural runoff time series at all biophysical nodes. Estimated Present Day data at least 10% of the nodes will be developed depending the availability of good models and land and water use data.
- Determine groundwater abstraction effects on baseflows at 5 nodes.
- Check generated EWR against provided hydrological information.

Deliverables and milestones

- Spreadsheets with natural and (where available) Present Day estimated time series data at each biophysical node and estuaries.
- Estimates of groundwater abstraction effects on the baseflow at 5 nodes.
- GIS Maps and Google KML files.
- Systems model with desktop biophysical nodes included: November 2013 – Deliverable 22.

Responsibility of the Consultant

The Consultants will ensure that data is generated for all the biophysical nodes as described above and provided to the rest of the project team and that resulting EWR data is checked against hydrological data.

5.3.10 Task D3.10: EWRs for desktop biophysical nodes (rivers)

One of the requirements of the Classification System (DWAF, 2007b) is the assessment of the Reserve by means of estimating EWRs at 150 – 200 desktop biophysical nodes. The estimation process designed for use in the Upper Vaal, Mokolo, Inkomati, Crocodile and Sabie Rivers (Louw *et al*., 2006) will be used to determine whether sites can be extrapolated (Kleynhans *et al*., 2008) from EWR sites or whether appropriate models must be used to estimate the EWRs. As a first option, the RDRM will be used rather than the Desktop Adjustment Model (DAM) (Birkhead, 2008) or the Desktop Reserve Model (DRM). It must be noted that this will be the first time that the RDRM is used for so many sites and if any problems arise, the DAM will be used.

The output of this task will be the standard requirement, i.e. the rule files for the REC at each EWR site. The EcoClassification information from the PESEIS study will be used to determine the REC at each of the nodes. It is important to note that the models that will be used are not appropriate where present day hydrology is higher than natural.

Task responsibility: Louw, Birkhead, Hughes

Information required

- PESEIS information.

Actions

- Modelling and generation of data.

Deliverables and milestones

- EWR rule and tab tables: February 2014 – Deliverable 23.

Responsibility of the Consultant

- The consultant is not responsible for developing or applying an ecological similarity process to determine where estimation can be used from EWR sites.
- The consultant is not responsible for developing new models. All attempts will be made to use the most appropriate model/s to estimate EWRs. Required adjustments will be made if it is possible within the scope of this project.

5.3.11 Task D3.11: Consequences of EGSA at sites where the REC is an improvement of the PES

Where the REC is an improvement on the PES at the desktop biophysical nodes, a qualitative statement will be made that will describe the likely outcome and significance of a REC that improves conditions beyond that of the PES. This qualitative statement will consider the improvements that will be required which one assumes will be mostly flow related. This will be confined to a description of changes for communities that have a livelihood dependence on the resources under consideration and the significance that the change may bring about. Only EGSA that are a) likely to change under scenarios and b) are important to vulnerable or critical communities will be described.

Task responsibility: **Huggins,** Grant

Information required

- List of EWR and or other critical geographic entities where the REC is a change from the PES.

Actions

- Qualitative analysis of the EWR and or other critical geographic entities where the REC is a change from the PES.

Deliverables and milestones

- Brief report setting out consequences arising from analysis of the EWR and or other critical geographic entities where the REC is a change from the PES: December 2013 - Deliverable 24 included in Report 5.

5.3.12 Task D3.12: Rivers EWR Report

The EWR report (referred to as Report 5) will consists of the following volumes:

- Volume 1: EWR estimates of the Desktop Biophysical Nodes.
- Volume 2: EcoClassification and EWR assessment at the Rapid III level.
- Volume 3: EcoClassification and EWR assessment at the Comprehensive and Intermediate levels.
- Volume 4: Specialist appendices (only available electronically).

Task responsibility: **Louw,** Koekemoer, Louw S

Actions

- Refer to approaches and document results.

Deliverables and milestones

- Volume 1: EWR estimates of the Desktop Biophysical Nodes: March 2014 –Report 5.1.
- Volume 2: EcoClassification and EWR assessment at the Rapid III level: January 2014 – Report 5.2.
- Volume 3: EcoClassification and EWR assessment at the Comprehensive and Intermediate levels: July 2014 – Report 5.3.
- Volume 4: Specialist appendices: July 2014 – Report 5.4.

Responsibility of the Consultant

- The Consultant is not responsible for describing methods, models or approaches which are documented elsewhere. The Consultant will refer to the documentation and where the approaches are refined or adjusted; this will be documented in these reports.

5.3.13 Task D3.13: Estuarine desktop assessment

A desktop assessment will be conducted on all systems in the study area using available information, updated hydrology, Google Earth imagery, expert knowledge and judgement. Previous EWR studies will be revisited, where deemed necessary. This desktop method has recently been tested as part of South Africa's NBA 2011 and proved to be sufficiently robust for these larger regional assessments. In this instance the results from the NBA 2011 – which primarily focussed on PES - will be expanded using additional data sources and more intensive expert scrutiny (Van Niekerk and Turpie, 2012). Specifically the aim will be to improve results by using better quantified river inflow data – a key driver in the PES of most estuaries in South Africa.

A five-day workshop will be convened (Durban) where experts with knowledge and experience on estuaries in the study areas will address the following:

- Confirm the geographical boundaries of estuaries in the study area.
- Refine the PES of the estuaries estimated in the NBA 2011 using improved flow data and inputs from experts – the PES will be based on a projected shift in condition from Reference to Present.
- Define RECs based on the PES; and EIS (DWA, 2008b; Turpie *et al*., 2012).
- Estimate the percentage river inflows required to meet the RECs of the estuaries.
- Selection the most important estuaries for more detailed assessment.

For most estuaries in the study area there are limited to no field measurements available. It would therefore not be possible to quantify ecological RQOs (or Ecological Specification) in detail. The approach adopted here will therefore be to provide generic Ecological Specification that is related to different RECs. These can then be refined as site-specific information becomes available for different systems.

Task responsibility: **Van Niekerk,** Taljaard, Forbes N, Huizinga, Theron, Bate, Adams, Forbes T, Mackay, Weerts, Allan

Information required

- Simulated hydrological data
- Information on the quantity and quality of discharges from Waste Water Treatment Works (WWTW).

Actions

- Define changes in abiotic condition based on hydrological information.
- Convene a regional expert workshop to estimate PES, REC, RQOs and EWR.

Deliverables and milestones

- Desktop assessment for all estuaries including PES, RECs, general Ecological Specification, prioritisation and prioritised monitoring requirements in the catchment: May 2013 – Report 4.
- Identify data gaps and estuaries where estimates need refining through additional field visits or hydrological modelling.

Responsibility of the Consultant

- Coordinate workshop, circulate relevant information to individual specialist and draft desktop Estuary EWR report.

5.3.14 Task D3.14: Field surveys for estuaries where more detailed approaches will be applied

A five-day sampling survey will be organised where specialist from different disciplines will jointly survey a selection of three estuaries in the study area. These estuaries will be selected based on criteria listed earlier (Section 2.3). During these surveys the following data will be collected and analysed:

- Sediments: Sediment samples for size distribution analysis and organic content.
- Hydrodynamics/ Water quality:
  - Longitudinal salinity and temperature profiles along the system.
  - Collected along the estuary (and in river and sea):
    - System variables (turbidity, suspended solids, dissolved oxygen and pH).
    - Dissolved nutrients (nitrite, nitrate, ammonia, phosphate and silicate).
- Microalgae: Water column chlorophyll measurements (phytoplankton) and intertidal/sub-tidal benthic microalgae.
- Macrophytes: Inventory and distribution of estuarine plant communities.
- Invertebrates: Sampling of zooplankton, macroinvertebrates and benthos communities.
- Fish: Seine and gill-nets sampling of the fish communities.
- Birds: Bird counts along systems.

A second five-day field sampling survey will be organised, where only limited field data will be collected from an additional 4 - 5 estuaries in the study area – again selection will be based on the criteria listed earlier (Section 2.3). The sampling will be under taken by abiotic and biotic specialists, as well as a technician and trainees on the project where possible.

Task responsibility: **Van Niekerk,** Taljaard, Forbes, Huizinga, Theron, Bate, Adams, Forbes, Mackay, Weerts, Allan

Information required

- Measured flow data from DWA.
- Measured water quality data from DWA.

Actions

- Two field surveys to preselected estuaries.

Deliverables and milestones

Two field surveys would be completed:

- Estuary detailed ecological survey on three estuaries: May – August 2013 –Deliverable 25.
- Estuary recognisance level ecological survey on 4-5 estuaries: May – August 2013 – Deliverable 25.

Responsibility of the Consultant

- Consultant to coordinate fieldtrips, inform Client of main survey dates at least four weeks in advance, and collaborate with DWA to ensure knowledge transfer.

5.3.15 Task D3.15: Analysis of estuarine data

This task involves the analysis of field data and the drafting of the data reports that supports the main EWR report. Different specialists will be required to prepare EWR templates for the three estuaries from which the multi-disciplinary field surveys would have been conducted. Assessment of their results (i.e. motivation for the entries in the templates) will be presented as Appendices to the templates – i.e. no detailed specialist reports will be presented.

Task responsibility: **Van Niekerk**, Taljaard, Huizinga, Theron, Bate, Adams, Forbes, Mackay, Weerts, Allan

Information required

- Simulated monthly flow scenarios to the selected estuaries for Reference Condition, Present State and 4 - 6 future development scenarios (including 1 or 2 sensitivity testing scenario(s)).
- Estimates of reduction in floods to the estuaries.
- Water quality reports for lowest EWR site.
- Information on the quantity and quality of discharges from WWTW.

Actions

- Analysis of field data.
- Drafting of individual data reports.

Deliverables and milestones

Individual draft data templates for the three estuaries (August 2013) will be prepared for the following estuarine components by the responsible project team member:

- Abiotic (including sediment dynamics, hydrodynamics and water quality).
- Separate biotic templates for microalgae, macrophytes, invertebrates, fish and birds
- Draft templates: December 2013 – Deliverable 27.

Responsibility of the Consultant

- To ensure the drafting of the specialists reports and routing of the required information to individual components.
- The budget does not include reproduction of reports.

5.3.16 Task D3.16: Basic Human Needs Reserve

The Basic Human Needs Reserve (BHNR) approach was revised by DWA during October 2008 and this method will be followed. In this method the BHNR only applies to the areas in which informal water sources are the means by which communities are provided with Schedule 1 rights.

Task responsibility: **Huggins**, Grant

Information required

- DWA demographic data if such data is deemed to be different from that provided by Statistics SA and as set out in 2001 census results.

Actions

- BHNR for relevant area.

Deliverables and milestones

- BHNR Report: December 2012 – Report 6.

Responsibility of the Consultant

- Obtaining all relevant demographic data.
- Production of BHNR Report.

5.4 TASK D4: IDENTIFICATION AND EVALUATION OF OPERATIONAL SCENARIOS TO IDENTIFY CONSEQUENCES

This task is associated with step 4 and 5 of the WRCS. In practice, these two steps function as one and are integrated as Task 4 (or step 4 within the integrated approach). The outcomes of this Task will be two reports; Report 7 which provides the scenario analysis, assumptions and results and Report 8 which integrate the consequences of the scenarios for the various components under Task D4.

It must be noted that there are some complications regarding the substeps and guidelines provided for the original step 4 and 5 of the WRCS. This is spelt out in the: SUMMARISED ASSESSMENT OF GAPS AND REVIEW REQUIRED OF THE WATER RESOURCE CLASSIFICATION SYSTEM

(WRCS) GUIDELINES (September 2012). The approach that will be followed follows the intent of suggested steps and process as closely as possible.

5.4.1 Task D4.1: Defining operational scenarios

Operating scenarios will be defined in accordance with the KZN Reconciliation Strategy (as refined in the Strategy Maintenance Study) (DWAF, 2010a) for the Mvoti, Mdloti, Mgeni and Mkomazi River systems. Recent planning information of proposed developments on the Umzimkulu River will be obtained from the recently completed Umzimkulu River Catchment Study DWA, 2011a) and applied. The Consultant can recommend certain scenarios and will during the selection process of operational scenarios provide guidance to DWA. However, the range of operational scenarios that have to be assessed should be ultimately selected or approved by DWA.

Scenario definition and EWR class selection will be carried out in the scenarios definition workshop where the baseline water resource reconciliation status will be presented for each IUA. Members of the study team were intimately involved in the development and are currently providing support to DWA in maintaining the Reconciliation Strategy. This will ensure alignment and ensure all aspects Integrated Water Resource Management is incorporated in the formulation of coherent scenarios. It is ultimately the responsibility of DWA to select and confirm the final operational scenarios and once selected and confirmed, the analyses will be conducted.

The water resource models will be configured for each scenario by incorporating the required EWR rule definitions at the detailed EWR sites in the network systems. The proposed approach for determining the usable water will be as follows:

- **Systems supplying urban users:**

In these IUAs (such as the Mgeni and Mdloti) an analysis of the additional augmentation that would be required to supply the urban sector (relative to the baseline scenario) will be carried out. The additional augmentation needs will be used in the socio-economic analysis to determine the relevant consequences.

- **Systems supplying irrigation users:**

In IUA areas where irrigation water use is present analysis will be carried out to determine by how much the irrigation will have to be reduced to achieve the selected EWRs and maintain their baseline assurance of supply. This information will be used in the socio-economic assessment to quantify the relevant consequences.

It is assumed for budgeting purposes that there will be a total of **five** scenarios analysed based on the historical time series. It is further proposed that stochastic risk analysis of **two** scenarios be carried out for the Mgeni and Mdloti River systems (note that the Mgeni River system includes the transfer from the Mooi River).

Water resource analysis information will be described in chapters of the relevant task report. The scenarios analysis, assumptions and results, will also be described in this report. Appropriate graphical and tabular summaries of the results will be prepared in annexure of the reports.

Task responsibility: **Louw**, Van Rooyen, Haasbroek, Sikosana, Seago, Talanda, Sami, De Sousa, Reneke, Scheepers

Information required

- KZN Reconciliation Strategy Study and the Maintenance KZN Reconciliation Strategy Study reports/information.

- Umzimkulu River Catchment Study reports/information.

Actions

- Source the information required.
- Define scenarios in conjunction with DWA.
- DWA to select and confirm the final operational scenarios.
- Conduct water resource analysis for selected scenarios.
- Present and document results.

Deliverables and milestones

- Operational scenarios defined and agreed on by DWA: August 2014 - Deliverable 28.
- The scenarios definitions, analysis, assumptions and results: September 2014 – Report 7.

Responsibility of the Consultant

- The consultant is responsible for facilitating the process to define the operational scenarios but is not responsible for the final decision making.
- The consultant is responsible for analysing the selected scenarios (selected by DWA) that have been budgeted for under this task (i.e. a total of five scenarios analysed based on the historical time series and stochastic risk analysis of two scenarios be carried out for the Mgeni and Mdloti River systems.

5.4.2 Task D4.2: River ecological consequences

At the key biophysical nodes (EWR sites), each operational scenario will be evaluated and the impact on the Ecological Category determined. This assessment forms part of the EcoClassification process where the rule-based models are used in a predictive manner. A specialist meeting will be held during which assessment will take place. The maximum operational scenarios that can be considered are four per system.

As no detailed field work on the desktop biophysical nodes will be undertaken, estimated changes in flows for different ECs 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.

Task responsibility: **Louw**, Kotze, Mackenzie, Deacon, Scherman, Huggins, Koekemoer, Rountree

Information required

- Final agreed scenarios from DWA.

Actions

- Conversion of operational scenarios into biological stress.

Deliverables and milestones

- Ecological consequences of operational scenarios: November 2014 –Report 8.1.

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting where the EcoStatus of the river for each operational flow scenario will be determined.
- Translating the flow scenarios to the required format, and providing specialists with the templates and instructions of what is required.
- Integrating the results and providing the ecological consequences and recommendations.
- Undertaking the logistical arrangements for the consulting team.
- The consultant is not responsible for analysing more than 4 flow scenarios per system.

5.4.3 Task D4.3: Estuary ecological consequences

A second 5-day workshop will be convened (Durban) specifically aimed at providing the EWR requirements of the three estuaries for which detailed investigations were done. In addition, the

information collected during the field recognisance survey will also be used to refine the EWR requirements of 4 to 5 selected estuaries.

Operational scenarios will be tested to determine the impact on estuarine health and recommendations in terms of an acceptable scenario will be made.

Task responsibility: **Van Niekerk**, Taljaard, Forbes, Bate, Adams, Mackay, Weerts, Allan

Information required

- Simulated monthly flow scenarios to the selected estuaries for Reference Condition, Present State and 4 future development scenarios (including 1 or 2 sensitivity testing scenario(s)).
- Estimates of reduction in floods to the estuaries.
- Water quality reports for lowest EWR site.
- Information on the quantity and quality of discharges from WWTWs.

Actions

- Convene 5 day workshop in Durban.
- Set PES, RECs, general Ecological Specification and prioritised monitoring requirements.
- Finalise Estuary EWR Report.

Deliverables and milestones

- Specialist workshop: October 2014 – Deliverable 29.
- First draft Estuary EWR Report: November 2014 –Report 8.2.
- Completed EWR templates as required in terms of the accepted methodology (DWAF, 2008): December 2014 – Report 8.3.

5.4.4 Task D4.4: Economic consequences

The task of estimating the impact of any water allocation changes can only be implemented once the operational scenarios are available. The application of the WIM to estimate the economic consequences of operational scenarios will be utilized to determine the relative impact of the water availability change.

Firstly, the WIM will be used to determine the current situation, which will be extended with the use of a multiplier methodology for use in calculating the impact of any water supply changes. It will be expressed in ratios on economic indicators such as GDP/Water, Labour/Water and also the different household's Income/Water. This will be derived from the sectors used in the current situation modeling such as irrigation agriculture. Furthermore, ratios will be determined on each specific Economic Zone identified. It will, as was determined for the current situation impacts, also be expressed in terms of the indicators GDP, employment creation, and the distribution of income to the low income households and total households. It will, for this analysis, identify the changes if e.g. water is reduced at a specific catchment in the irrigation sector. This strategy will assist in evaluating the most acceptable option to classify the river system from an economic viewpoint.

Task responsibility: **Mullins**, Cloete, Majoro

Information required

- Hydrological results.

Actions

- Analysis of EWR scenarios determining economic impacts.

Deliverables and milestones

- Report 8.4 showing results of analysis of EWR scenarios expressed as economic impacts: November 2014.

5.4.5 Task D4.5: Ecosystem Goods, Services and Attributes consequences

Assessment of the 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. The process adopted will ensure the analysis of potential economic changes based on a valuation of the status quo, that is, the value of the EGSA currently provided by the ecosystem in WMA 11. The potential change that each of the key EGSA may undergo in each of the scenario clusters will be identified. Where required the current value of EGSA is multiplied by these factors for each scenario, to provide an indication of the potential future value of the EGSA. The change in value is thus measured as a magnitude of impact and is not costed in "rands and cents". The magnitude of change is estimated by the relevant specialists but facilitated by the EGSA task leader. EGSA that are considered are those that are a) of consequence to identified communities and b) likely to change under identified scenarios. This will be addressed during the workshop as set out in Task D4.2. The assessment will also be applied to the estuarine component of the study.

Task responsibility: Huggins, Grant

Information required

- Input at workshop from key specialists with respect to populating the EGSA matrix.

Actions

- Workshop and consequent report and matrix production that sets out the consequences of operational scenarios of critical EGSA.

Deliverables and milestones

- Consequences of operational scenarios on EGSA: Report 8.5 – November 2014.

5.4.6 Task D4.6: Water quality consequences (other than that associated with ecology)

Step 5 of the WRCS is broadly named "assess water quality implications" and includes identifying water quality users and present state. An important factor is assessing the assimilative capacity of the water resource and impacts on downstream users. Determining the levels of protection needed for various users is critical and important information needed by DWA to effectively manage the system. The following tasks will be undertaken:

- *Assessment of status quo:* To be undertaken as part of Task D1. Present state assessments will therefore be conducted where data are available and where water quality hot spots have been identified.
- *Water quality modelling* to inform the loading of salts and available assimilative capacity. Note that this step 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. As water quality modelling is not part of the TOR for this study, water quality modelling undertaken for previous studies 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. Alternatively load calculations will be conducted where considered applicable. An approach for dealing with nutrients will be designed as part of the study, utilizing a hotspot area related to nutrient enrichment.
- *Water quality consequences* of the selected catchment configuration scenarios will be derived as part of the scenario assessment step, and at points where such scenarios are applicable. This task relates to this task at water quality hotspot areas outside of EWR sites and biophysical nodes.
- *Fitness-for-use for all users* will be assessed using any interim Resource Water Quality Objectives (RWQOs) already designed for selected catchments in the WMA and water quality EcoSpecs (or ecological specifications) available from the Reserve study. This step

will therefore include the amalgamation of ecological water quality objectives with RWQOs already produced. The achievability of these objectives and the level of protection offered, will be assessed. Note that only selected key variables will be assessed and in water quality hotspot areas.

Note that it is critical for the PSP to liaise with DWA: Water Quality Planning, both at the national and regional level.

***Task responsibility*: Scherman**

Information required

- Water quality EcoSpecs available for previous Reserve studies conducted in the WMA.
- RWQOs if produced for sites in the WMA.

Actions

- Liaison with DWA: Water Quality Planning, both at the national and regional level, in terms of an approach that meets their requirements, data availability and the review of results.

Deliverables and milestones

- An assessment of whether current levels of protection are adequate for the system.
- Consequences documented in Report 8.6: November 2014.

Responsibility of the Consultant

- The Consultant will not undertake stakeholder or DWA workshops for this task, other than input to stakeholder workshops as required during the study.
- Additional water quality modelling will not be undertaken. Requirements for such modelling will be flagged where necessary, although an approach will be developed for nutrients

5.4.7 Task D4.7: Integration of consequences to provide preliminary Management Class

All of the above consequences will be considered to determine the preliminary Management Classes (MC) which will be recommended by the study team and DWA and presented to stakeholders (refer to Task D6). Within the 2007 guidelines, there are no tested process (apart from some suggestions of possible routes that could be investigated) to integrate the different consequences and describe the Management Class. If no process is developed in the interim, a qualitative process will be followed with reasoning and arguments being provided for the recommended Management Classes (similar to the Vaal Classification process) (DWA, 2012, *in prep*.)

During task D1 and this task, due cognisance will be given to the Freshwater Priority Areas identified by NFEPA and it will be illustrated on maps.

***Task responsibility*: Louw,** Scherman, Mullins, Kotze, Huggins, Van Niekerk, Van Rooyen

Actions

- Specialist meeting.

Deliverables and milestones

- Report integrating the consequences of operational scenarios: December 2014 – Report 8.7.
- Preliminary Management Classes for stakeholder evaluation.

Responsibility of the Consultant

- The consultant is not responsible for applying Multi-Criteria Decision Making approaches unless a specific approach is recommended by DWA and can be accommodated within the existing budget.

5.5 TASK D5: PUBLIC MEETING

One public meeting at three (3) separate venues will be held in the study area towards the end of the process. In order to encourage attendance, the meetings will be strategically located and consider geographical representation of stakeholders within the study area.

The focus of the public meeting will be as follows:

- Presentation of operational scenarios, consequences and the recommended scenario.
- Presentation of preliminary management classes based on the recommended scenario.
- Qualitative RQOs.

The decision analyst will prepare, in close collaboration with the leader of the stakeholder engagement team, materials which will explain the scenarios (which include those derived from the stakeholder "visioning" exercise) to the stakeholders. Materials, including a simple Excel spreadsheet and other aids for scoring and weighting scenarios, will also be produced. These materials will enable stakeholders to contribute to the evaluation including those with little or no numeracy.

Task responsibility: Louw, Huggins, Scherman, Van Rooyen, Shinga

Information required

- Recommended scenarios for presentation at public meeting.

Actions

- Prepare materials for public meetings.
- Organise venues for meetings.
- Compile and distribute invitations to public meetings.
- Collate comments on the project and include in the Issues and Response Report.
- Distribute minutes of meetings.
- Distribute a letter to the stakeholder database to report on progress.

Deliverables and milestones

- Public Meetings: Deliverable 30.
- Issues and Response Deliverable: June 2015 - Deliverable 15d.
- Stakeholder Report: April 2015 – Report 9
- Minutes of meetings.
- Progress update letter to stakeholders: January 2015 – Deliverable 15e.

Responsibility of the Consultant

- Prepare materials for public meetings.
- Organise venues for meetings.
- Compile and distribute invitations to public meetings.
- Collate comments on the project and include in the Issues and Response Report.
- Distribute minutes of meetings.
- Distribute a letter to the stakeholder database to report on progress.

Meeting Arrangements:

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

The stakeholder engagement team will undertake the arrangements of stakeholder meetings. The 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 must be clearly defined.
- Stakeholders must receive notification of the meeting date and its objectives at least three weeks in advance. Confirmation of attendance is encouraged to assist with planning, coordination and logistics associated with a meeting.
- 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.
- The proceedings of all meetings will be recorded, by capturing/recording the exchange in dialogue on a high quality audio recording device. Audio recorded minutes will then be transferred into text and prepared for the Client within two weeks of all meetings (or sooner depending on the level of urgency). All minutes and public participation correspondence documents will be provided in a separate report or as an annexure to the main report.
- Strategies for effective stakeholder engagement will be revisited at each meeting, i.e. assess the effectiveness of the various approaches and progress made. If necessary, the strategy will be changed or adapted to achieve the expected outcomes as the study progresses.
- The DWA website be utilised as a central site for the publishing of all public information (announcement documentation, minutes of meeting, etc.) to enable stakeholders with access to electronic media to stay updated.

5.6 TASK D6: RESOURCE QUALITY OBJECTIVES (RQOs)

Figure 5.3 is modified from DWA 2011 and illustrates the approach to achieve the RQOs.

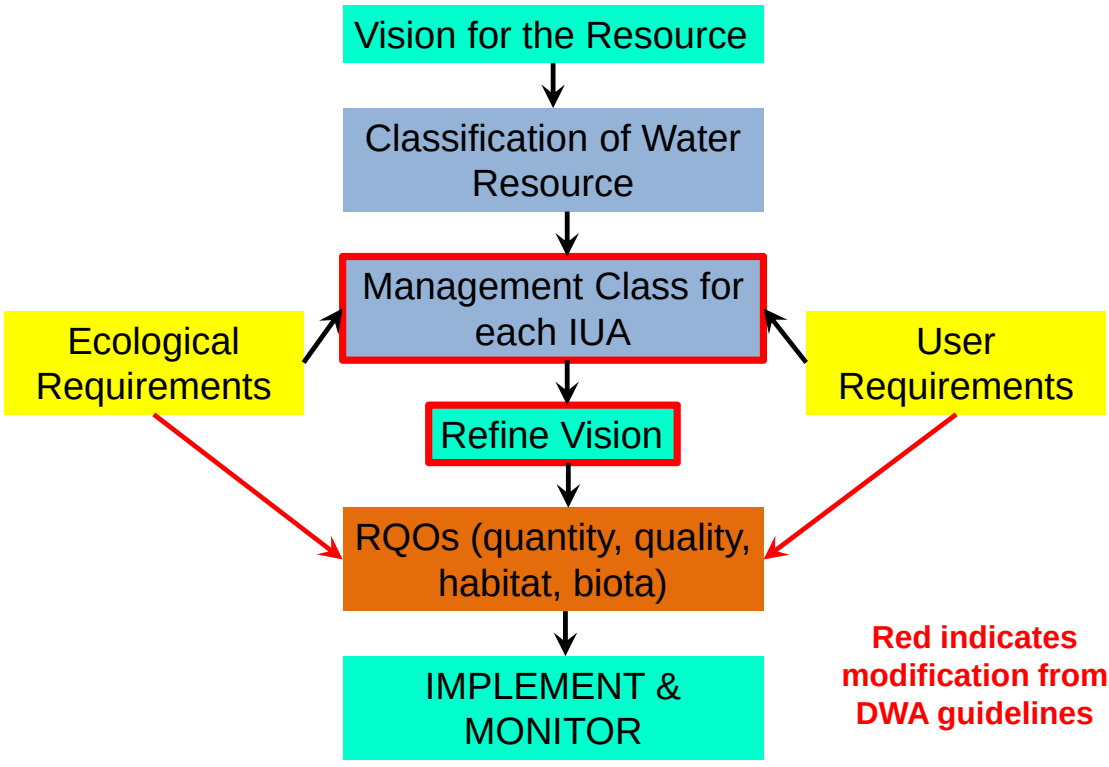

Figure 5.3 RQO process

Figure 5.4 illustrates the relationship between numerical and descriptive RQOs and the tasks where the results are generated. This task D6 integrates all the information in the other tasks and generates any RQO results that have not yet been generated.

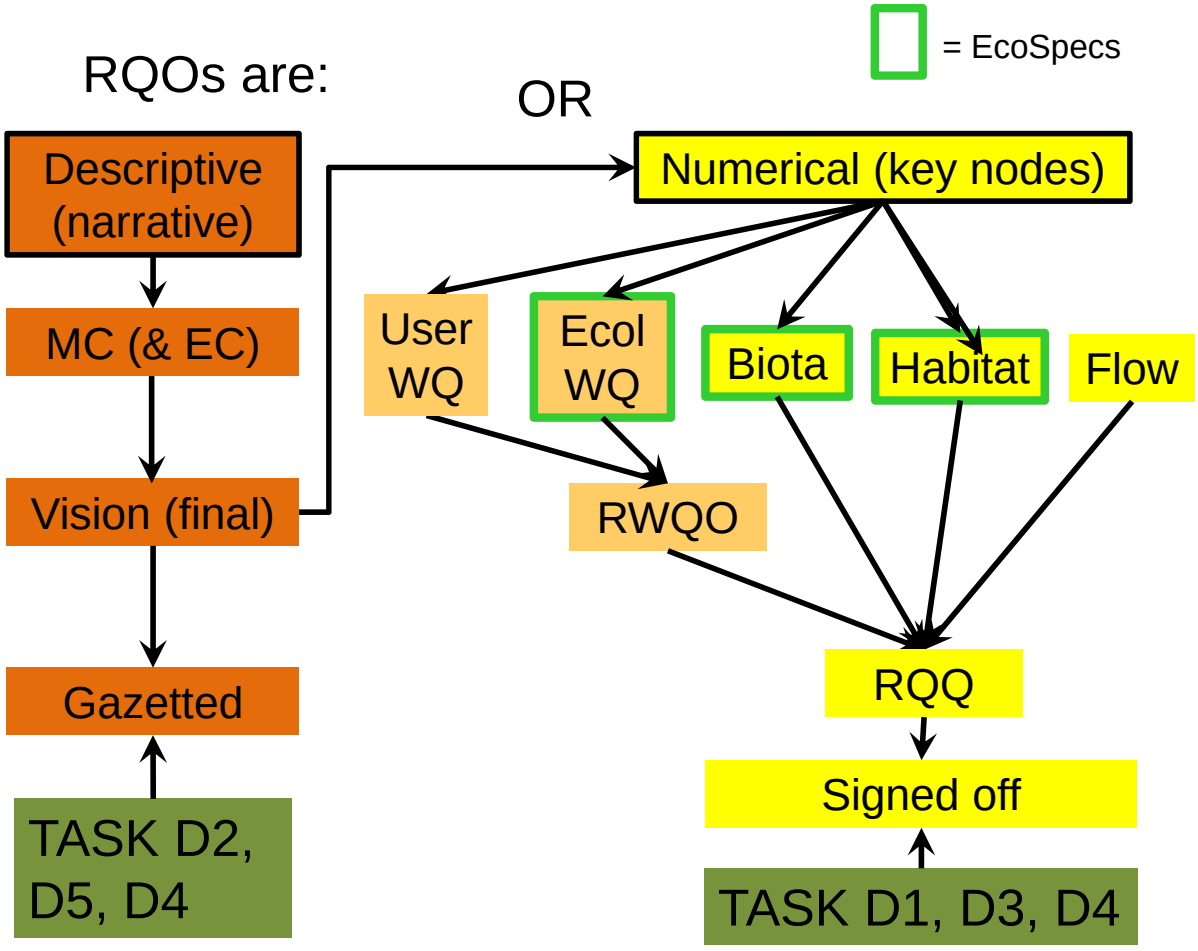

Figure 5.4 Descriptive and numerical RQOs

The only steps within RQOs which are therefore not addressed within previous tasks (as shown in the integration diagram – Figure 3.1), are the groundwater RQOs, the determination of Ecological Specifications (EcoSpecs) and Thresholds of Potential Concerns (TPCs) as well as addressing RQOs for water quality aspects which are not part of the Ecological Reserve. Both of these aspects are described below and these aspects will be combined in Report 10.

5.6.1 Task D6.1: EcoSpecs and Thresholds of Potential Concerns (Rivers and wetlands)

The objective of this task is to determine the EcoSpecs (the ecological component of RQOs) for the recommended EC and link the ECs to TPCs (Thresholds of Potential Concerns). EcoSpecs will be set for flow, quality, habitat and biota. The quality and flow EcoSpecs are dependent on a decision regarding an acceptable operational scenario as the Ecological Reserve and Management Class. The habitat and biota EcoSpecs must be linked to the relevant category and will be quantified as far as possible. Detailed EcoSpecs can only be provided for the key biophysical nodes whereas broad qualitative statements only can be made for the desktop biophysical nodes.

The Consultant is aware that D:RQS is in the process of method development of determining EcoSpecs and TPCs (*Pers. Comm*. Dr. N. Kleynhans) for rivers. The Consultant will use the most

applicable and latest available information and tools at the stage when this Task commences. The Consultant will therefore attempt to liaise with the developers on a continual basis to keep updated regarding the status of new developments. Should the new developments not be available for use, those methods applied in previous studies (Upper Vaal River, Crocodile East, and Mokolo River Reserve studies) will be applied and adapted for the purpose of the current study.

EcoSpecs for estuaries will be included in Report 8.2.

General wetland RQOs (see Section 5.1.5, Task D1.5) will also be included in this section here. The associated Deliverable 26 (December 2013) will provide the information for this input.

Task responsibility: **Louw**, Mackenzie, Kotze, Deacon, Koekemoer, Scherman, Mallory, Rountree

Information required

- Available processes or models from D:RQS.
- Wetland RQOs as part of Deliverable 26.

Actions

- Specialist meeting.

Deliverables and milestones

- EcoSpecs and TPCs: February 2015 – Report 10.1.

Responsibility of the Consultant

- The Consultant is not responsible for the development of approaches to determine EcoSpecs and TPCs other than those available, but will attempt to apply the latest development and models if adequate guidance is provided by the developers (DWA).

5.6.2 Task D6.2: Non-Ecological water quality

As the major component of the work related to setting RQOs is contained within the Classification and Reserve processes, this sub-task will focus on non-ecological water quality RQOs, and will serve primarily as a step to review and finalize the water quality component. Note that a large part of the work for this step will be undertaken during Task D4.6.

Task responsibility: **Scherman**

Information required

- Resource Water Quality Objectives (RWQOs) if produced for sites in the WMA.
- RQO model set up for the WMA, if required.

Actions

- Liaison with DWA: Water Quality Planning, both at the national and regional level, in terms of an approach that meets their requirements, data availability and the review of results.

Deliverables and milestones

- RQOs for non-ecological water quality uses: February 2015 – Report 10.2.

Responsibility of the Consultant

- The Consultant will not undertake stakeholder or DWA workshops for this task, other than liaison with national and regional water quality officers.

5.6.3 Task D6.3: Groundwater RQOs

RQOs can include any objective or goal that may need to be met to ensure that the groundwater resource is maintained in a desired and sustainable state. These typically relate to groundwater levels and gradients. Groundwater quality, groundwater abstraction volumes, land use activities

that may impact the quantity and quality of the groundwater resource and the aquifer structure and integrity (Parsons & Wentzel, 2007).

General aquifer management philosophies will be specified in terms of the groundwater RQOs as suggested in the pilot study presented in the Groundwater Resource Directed Measured Manual (Parsons & Wentzel, 2007). As also specified in the same report, it is recommended that detailed RQOs need to be set on a site specific basis per license application in future.

Task responsibility: Sami

Information required

- Groundwater abstraction volumes, water levels and gradients, water quality and landuse activities.

Actions

- Analysis of data.

Deliverables and milestones

- RQOs for non-ecological water quality uses and groundwater: February 2015 – Report 10.2.

Responsibility of the Consultant

- The Consultant is not responsible for the detailed groundwater RQOs on a site specific basis but general aquifer management philosophies will be specified.

5.7 TASK D7: PREPARE INFORMATION FOR GAZETTING

The PSP will prepare the IWRM summary template in accordance with the format that will be developed in cooperation with the Client. The gazetting will address the Management Class and RQOs. DWA officials will then submit the documentation through the appropriate internal channels for the approval by the Minister or delegated authority. Technical comments will be addressed by the consultants when received during the 60 days comment period. This will likely be after the end of contract. The 60 day comment period represents 2 months and preparing and submitting the necessary documentation could at minimum take a month. If this has to be taken into account within the study programme, it would mean that the study programme to undertake the technical work would be decreased from 24 months to 21 months. The PSP therefore agrees that they will address all comments of a technical nature received during the 60 days of gazetting after contract expiry at no additional costs. Any additional studies that might be required due to comments will not be undertaken.

Task responsibility: Louw, Van Rooyen, Hughes: Queries and input; **Koekemoer** and Scherman: Preparation of final templates.

Information required

- The required templates to be completed by the Consultant. Final templates for completion must be provided at the beginning of Task D7.

Actions

- Completion of the templates according to DWA requirements.
- Review of the information to be sent to the region, if required by DWA.

Deliverables and milestones

- Completion of draft templates for review by DWA.
- Finalization of templates: June 2015 – Deliverable 31.

Responsibility of the Consultant

- The Consultant will not provide a template for use, as this will be provided by DWA.

- The Consultant will not be responsible for completion of the legal component of the gazetting process, e.g. the signing-off of templates by the delegated authority.
- The consultant will be responsible for addressing technical comments after contract expiry received during the 60 days gazetting period. This will not include undertaking any studies that may arise from the comments

5.8 TASK D8: CAPACITY BUILDING

The TOR requires capacity building and training to focus on skills required by water resource managers in the study area, including national CD: RDM staff responsible for this area. A capacity building framework is presented below, which includes feedback from DWA regarding the number and structure of workshops, and persons identified by DWA who will participate in the training process during the study. The training proposed here will be primarily applicable to DWA personnel.

All trainees might not participate in each step or workshop, depending on their level of experience, prior training and expected outcomes of training and capacity building. Dr Scherman will be responsible for running and auditing the training programme.

Capacity building and training will therefore take place at two levels. These levels are:

- Personnel that will be participating in specific fields in as many activities as possible. These nominated personnel (see below) will be involved at levels other than just the training sessions and will participate in field work and specialist meetings.
    - Barbara Weston
    - Tinyiko Mpete: Specifically water quality and hydrology.
    - Boniwe Nobulele: Specifically water quality and ecology.
    - Philani Khoza: Specifically groundwater and water quality components.
    - Tovho Nyamande and Mmaphefo Thwala: Specifically socio-economics and the SASS5/MIRAI component of the EWR assessment.
- Training sessions for all DWA staff (head office and region).

It must be noted that the training sessions listed below are preliminary, and can be adjusted by the Client according to specific needs.

- Training session 1: Introductory session: Integration of the WRCS, the Reserve and RQO. Three very distinct processes, which show significant overlap within its individual process descriptions and manuals, were integrated and integrated steps designed. This integration process and the rationale therefore will be presented and discussed with participants. It is foreseen that this will be a one day training session. Feb 2013 – Deliverable 32.
- Training session 2: Status quo assessment. It is foreseen that this will be a two day training session. The status quo, which includes process, results and integration, will be demonstrated using this study area results. Presenters will address the following components: Ecology rivers, ecology estuary, water quality issues, economy, EGSA, and water resources (hydrology) May 2013 – Deliverable 33.
- Training session 3a: On request from DWA, this training session will be a water quality training session. The final date and course content will be determined in consultation with the both the Pretoria and DWA regional offices, but is assumed to be toward the end of 2013 - Deliverable 34a.
- Training session 3b: Integration of study results to formulate Management Classes. The results of the study is nested in the ecological, economic, EGSA, and water quality consequences of various operational scenarios. Based on a recommended scenario, the

resulting Management Classes are derived. These are tested with stakeholders. The process, consequences and the rationale for the selection of Management Classes were the original contents of Training session 3, but will now be addressed during a two hour session after the relevant PMC meeting. Jan 2015 - Deliverable 34b

Task responsibility: **Scherman**, Louw, Van Rooyen, Mullins, Huggins, Adams

Information required

- Any changes in trainee composition must be forwarded to Dr Scherman.
- Input will be requested regarding training evaluation. This information should be forwarded timeously when requested.

Actions

- Dr Scherman will be responsible for advising trainees and workshop presenters regarding training sessions.

Deliverables and milestones

- Training session 1: Introduction and integration: February 2013 – Deliverable 32.
- Training session 2: Status Quo: May 2013 – Deliverable 33.
- Training session 3a: Water quality: Dec 2013 – Deliverable 34a.
- Training session 3b: Management Classes: Jan 2015 – Deliverable 34b.
- An appendix of the Main Report regarding the capacity building and training undertaken during the study: May 2015 – contribution to Report 11.

Responsibility of the Consultant

- Plan and coordinate training sessions.
- Contact trainees and lecturers regarding training sessions.
- The budget is based on the assumption that DWA can arrange training venues at DWA Roodeplaat Training Centre.
- Audit and report on the training programme.

5.9 TASK D9: MAIN REPORT

The objective of this task is to produce the final EWR rules (based on the operational scenario recommended and final MC and configuration for gazetting) and to summarise the technical reports in a main report. The main report will also include the rationale and decision-making process regarding the selected Management Classes and in essence consists of a summary of all technical reports and other tasks not documented in standalone reports.

Accompanied with the main report will be a CD with all electronic data which will include reports, EcoClassification models, spreadsheets, photographs and raw data. The CD will be designed with folders representing the steps and subfolders the subsidiary steps. A 'readme' file will be provided to guide users through the setup of the CD.

Task responsibility: **Louw**, Van Niekerk, Mullins, Van Rooyen, Huggins, Scherman, Shinga, Koekemoer, Louw S

Information required

- Results from all the previous tasks.
- All data required for the CD

Actions

- Collating all existing project data and results.

Deliverables and milestones

- Main Report: May 2015 – Report 11.
- Electronic data CD: Jun 2015 – Deliverable 35 as part of Report 11

6 STUDY PROGRAMME

6.1 MILESTONES: DELIVERABLES AND REPORTS

All deliverables and reports are seen as milestones and are tabled in Table 6.1. The timing is provided in the Gantt (Table 6.2). All references to deliverables are preceded with a 'D' and reports with a 'R' as provided in the tables below and the Gantt. Q refers to the yearly quarter of three months, i.e. Q1-12 would refer to the first quarter in 2012 which covers April, May and June.

Table 6.1 Milestones: Deliverables and reports

DELIVERABLES & REPORTS		DATE	Q
D4	Appointment: Sub-consultants	Sep 12	Q2-12
R 1	Inception report	Sep 12	Q2-12
D1	PMC meeting	Oct 12	Q3-12
D5	Water resource info tables (hydrology and Reserve)	Oct 12	Q3-12
D6	Water Resource Use Importance (WRUI)	Dec 12	Q3-12
D10	Wetlands identification of PES, EIS and hot spots	Dec 12	Q3-12
R 6	BHNR report	Dec 12	Q3-12
D6	Water resources zones	Jan 13	Q4-13
D7	Economic zones	Jan 13	Q4-13
D14	BID	Jan 13	Q4-12
D8	EGSA component: Delineation, description and SCI	Jan 13	Q4-13
D9	Water quality status quo	Jan 13	Q4-13
D11	Status quo and ecological zones based on PESEIS information	Feb 13	Q4-13
D32	Training session 1: Introduction & integration	Feb 13	Q4-12
D13	Identification of river biophysical nodes for level of assessment.	Feb 13	Q4-13
D15b	Advertisement	Feb 13	Q4-13
D15c	Personalised Invitation Letter	Feb 13	Q4-13
D1	PMC meeting	Feb 13	Q4-13
D12	IUAs selected and mapped	Mar 13	Q4-13
D2	PCS meeting	Mar 13	Q4-13
R 2	Status quo assessment, IUA delineation and identification of biophysical nodes and level of EWR assessment.	Apr 13	Q1-13
R 3	RU and EWR site report	May 13	Q1-13
R 4	Desktop estuary EcoClassification and EWR report	May 2013	Q1-13
D33	Training session 2: Status Quo	May 13	Q1-13
D16	Preliminary EWR sites selected	May 13	Q1-13
D1	PMC meeting	Jun 2013	Q1-13
D25a	Estuary field visit	May-Aug 13	Q2-13
D25b	River field visit	Aug 13	Q2-13
D21	EWR results for Rapid EWRs	Nov 13	Q3-13
D22	Systems model including desktop biophysical nodes	Nov 13	Q3-13
D1	PMC meeting	Nov 13	Q3-13
D2	PCS meeting	Nov 13	Q3-13
D26	Wetland RQOs: Contribution to EcoSpecs and TPCs	Dec 13	Q3-13
D27	Prelim Estuarine templates	Dec 13	Q3-13
D24	EGSA related to REC (if improved from PES)	Dec 13	Q3-13
D34	Training session 3b:Management Classes	Jan 15	Q4-15
D27	Prelim Estuarine templates	Dec 13	Q3-13

DELIVERABLES & REPORTS		DATE	Q
R 5.2	Volume 2: EcoClassification and EWR assessment at the Rapid III level	Jan 14	Q4-14
D17	High flow hydraulic calibration	Feb 14	Q4-14
D23	EWR results for all desktop biophysical nodes	Feb 14	Q4-14
D1	PMC meeting	Mar 14	Q4-14
R 5.1	Volume 1: EWR estimates of the Desktop Biophysical Nodes	Mar 14	Q4-14
D18	Preliminary EcoStatus models	May 14	Q1-14
D19	Hydraulic modelling results	May 14	Q1-14
D20	EWR results for Intermediate and Comprehensive EWRs	Jun 14	Q1-14
R 5.3	Volume 3: EcoClassification and EWR assessment at the Comprehensive and Intermediate levels	Jul 14	Q2-14
R 5.4	Volume 4: Specialist appendices	Jul 14	Q2-14
D1	PMC meeting	Jul 14	Q2-14
D28	Operational scenarios defined	Aug 14	Q2-14
D2	PCS meeting	Aug 14	Q2-14
R 7	Water Resource Analysis report	Sep 14	
D29	Estuaries: Specialist EWR Workshop	Oct 14	Q3-14
R 8.1	Volume 1: River ecological consequences	Nov 14	Q3-14
R 8.2	Volume 2: Estuary ecological consequences	Nov 14	Q3-14
R 8.4	Volume 4: Economic consequences	Nov 14	Q3-14
R 8.5	Volume 4: EGSA consequences	Nov 14	Q3-14
R 8.6	Water quality consequences	Nov 14	Q3-14
D1	PMC meeting	Nov 14	Q3-14
R 8.3	Volume 3: Estuary ecological consequences (sp appendices)	Dec 14	Q3-14
R 8.7	Volume 7: Integration of consequences to recommend MC	Dec 14	Q3-14
D34	Training session 3b:Management Classes	Jan 15	Q4-15
D15f	News Letter	Jan 15	Q4-15
D15e	Progress Feedback Letters	Jan 15	Q4-15
D2	PCS meeting	Jan 15	Q4-15
D30	Public Meetings	Feb 15	Q4-15
R 10.1	Volume 1: Rivers and Wetlands EcoSpecs and TPCs	Feb 15	Q4-15
R 10.2	Volume 2: Non-ecological water quality RQOs	Feb 15	Q4-15
D1	PMC meeting	Mar 14	Q4-15
R 9	Stakeholder involvement	Apr 15	Q1-15
R 11	Main Report	May 15	Q1-15
D31	Templates	Jun 15	Q1-15
D15d	Stakeholder Issues and responses	Jun 15	Q1-15
D35	Electronic Data CD	Jun15	Q1-15
D1	PMC meeting	Jun 15	Q1-15
D2	PCS meeting	Jun 15	Q1-15

Note that all deadlines provided for reports refer to the first draft to be provided to the Client. It is expected that the Client will provide comments within a month and that the report can be finalised afterwards. Depending on the time to provide comments, reports should be able to be finalised within 6 weeks of providing the first draft.

Note that the budget caters only for one round of comments and two hard copies of final reports excluding specialist appendices that will only be in electronic format. A spreadsheet summarising

all the comments and the response of the Client will be provided with the final report to indicate how the comments have been addressed.

6.2 GANTT CHART

According to the information provided by the Client, the study is to be completed within a 39 month period. A Gantt chart is provided below in Table 6.2.

Table 6.2 Gantt chart

TASKS	2012						2013												2014												2015					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
TASK A - PROJECT MANAGEMENT																																				
A1 Project Management Team Meetings (Progress meetings)				D1				D1				D1			D1			D1			D1				D1				D1				D1			D1
A2 Technical team management and coordination																																				
A3 Project steering committees									D2								D2									D2					D2					D2
A4 Financial management	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3	D3
TASK B: PROJECT INCEPTION (PLANNING AND PROCESS INTEGRATION)																																				
Task B1: Design Project plan (Inception report meeting)																																				
Task B2: Inception report			R1																																	
Task B4: Mobilisation of study team			D4																																	
TASK C: WATER RESOURCE INFORMATION AND DATA GATHERING				D5																																
TASK D: DETERMINATION OF THE MANAGEMENT CLASS																																				
TASK D1: DELINEATE IUAs AND DESCRIBE STATUS QUO																																				
Task D1.1 Water resources component						D6	D6																													
Task D1.2 Economic Component							D7																													
Task D1.3 EGSA component							D8																													
Task D1.4 Water quality status quo							D9																													
Task D1.5 Wetlands						D10												D26																		
Task D1.6 Estuaries																																				
Task D1.7 Rivers								D11																												
Task D1.8 Integration									D12																											
Task D1.9 Identification of biophysical nodes and level of assessment.								D13																												
Task D1.10 Status Quo Report										R 2																										
TASK D2: STEP 2 - STAKEHOLDER MEETING																																				
Task D2.1 Stakeholder Identification and Database Management			D15a																																	
Task D2.2 Announcement			D15b		D14		D15c								D15c									D15c					D15c					D15c		
Task D2.3 Issues and Response Report																																				D15d
Task D2.4 Newsletters																															D15e					
TASK D3: STEP 3 - QUANTIFY EWRS AND CHANGES IN NON-WATER QUALITY EGSAs																																				
Task D3.1 RU determination for rivers requirement more detail Reserve assessment.												R 3																								
Task D3.2 EWR site selection - preliminary											D16																									
Task D3.3 EWR survey																																				
Task D3.4 Analysis of data: EcoClassification for rivers																							D18													
Task D3.5 Hydrological analysis																																				
Task D3.6 Hydraulic high flow survey and modelling																				D17			D19													
Task D3.7 Intermediate Specialist meeting																								D20												
Task D3.8 Rapid assessment and Desktop																	D21																			
Task D3.9 Hydrological modelling at desktop biophysical nodes																	D22																			
Task D3.10 EWRs for desktop biophysical nodes																				D23																
Task D3.11 Consequences of EGSA at sites where the REC is an improvement of the PES																		D24																		
Task D3.12 Rivers EWR report																									R5											
Volume 1: EWR estimates of the Desktop Biophysical Nodes																					R5.1															
Volume 2: EcoClassification and EWR assessment at the Rapid III level																			R5.2																	
Volume 3: EcoClassification and EWR assessment at the Comprehensive and Intermediate levels																									R5.3											
Volume 4: Specialist appendices																									R5.4											

TASKS	2012						2013												2014												2015					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Task D3.13 Estuarine desktop assessment											R 4																									
Task D3.14 Field surveys for estuaries requiring more detailed approaches														D25																						
Task D3.15 Analysis of estuarine data																		D27																		
Task D3.16 Basic Human Needs Reserve						R6																														
TASK D4: ID AND EVALUATION OF OPERATIONAL SCENARIOS TO IDENTIFY CONSEQUENCES																																				
Task D4.1 Defining operational scenarios																										D28	R7									
Task D4.2 River ecological consequences																													R8.1								
Task D4.3 Estuary ecological consequences																												D29	R8.2	R8.3						
Task D4.4 Economic consequences																													R8.4								
Task D4.5 EGSA consequences																													R8.5								
Task D4.6 Water quality consequences																													R8.6								
Task D4.7 Integration of consequences: Prelim MC																														R8.7						
TASK D5: PUBLIC MEETINGS																																D30		R9		
TASK D6: RESOURCE QUALITY OBJECTIVES																																				
Task D6.1 EcoSpecs & TPCs: Rivers and Wetlands																																R10.1				
Task D6.2 Non-ecological water quality																																R10.2				
Task D6.3 Groundwater RQOs																																R10.2				
TASK D7: GAZETTING (TEMPLATES)																																				D31
TASK D8: CAPACITY BUILDING																																				
Training 1: Introduction &, integration								D32																												
Training 2: Status quo											D33																									
Training 3a: Water quality																		D34a																		
Training 3b: Management Classes																															D34b					
TASK D9: MAIN REPORT																																			R11	D35

7 STUDY TEAM

Rivers for Africa was appointed to undertake the study and have appointed various sub-consultants to undertake the multidisciplinary tasks as required by the TOR. The study team consists of individuals with extensive experience in the field of water resource planning. The team members have been involved in a variety of studies for DWA since 1988. An organogram is provided to illustrate the study team structure (Figure 7.1). The task leaders are listed below:

- Study Leader – D Louw (Rivers for Africa)
- Co Study Leader – P Van Rooyen (WRP)
- River Team Leader – D Louw (Rivers for Africa)
- Estuary and Marine Team Leader – L Van Niekerk (CSIR)
- Economics Team Leader – W Mullins (Mosaka Economists)
- Ecosystem Goods, Services and Attributes Team Leader – G Huggins (Nomad Consulting)
- Stakeholder Participation Team Leader – B Shinga (Acer Africa)
- Water Quality Team Leader – P Scherman (Scherman Colloty and Associates)
- Hydrology Team Leader – P Van Rooyen (WRP)
- Capacity Building Team Leader – P Scherman (Scherman Colloty and Associates)

The following organizations are represented by the teams:

- Rivers for Africa (R4A)
- WRP
- Koekemoer Aquatic Services (KAS)
- Scherman Colloty & Associates
- Streamflow Solutions
- IWR Water Resources
- Clean Stream Biological Services (CSBS)
- Mackenzie Ecological and Development Services
- Fluvius Environmental Consultants
- Institute for Water Research (IWR)
- Council for Scientific and Industrial Research (CSIR)
- Nelson Mandela Metropolitan University (NMMU)
- Marine and Estuarine Research (MER)
- Oceanographic Research Institute (ORI)
- Durban Natural Science Museum
- Nomad Consulting
- Mosaka Economists
- ACER (Africa) Environmental Management Consultants

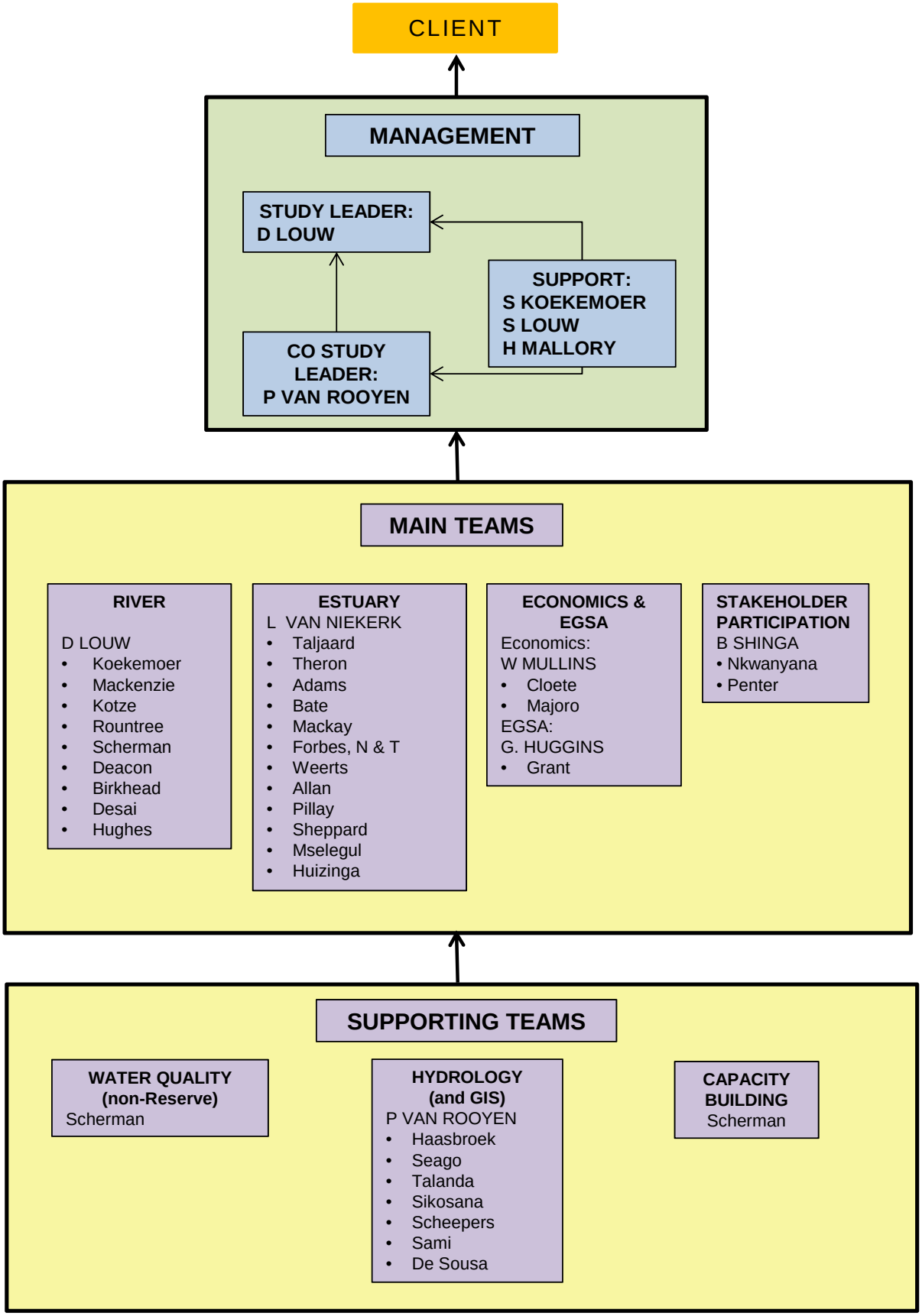

Figure 7.1 Study team organogram

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9 APPENDIX A: REPORT COMMENTS

Page & or Section	COMMENTS RECEIVED		ADDRESSED IN REPORT?	AUTHOR COMMENT
	REPORT STATEMENT	COMMENTS		
Comments from Tovho Nyamande				
General		Front pages, spelling, formatting	Yes	
General		Consistency between the use of PESEIS or PES/EIS	Yes	
Page 6-3:		Headings of the GANTT Chart not visible	No	It is clearly visible on our version. It is probably because it is set up on A3. If you do not have an A3 printer connected, it might be what the problem is. Will send Tovho an Excel version for use in her management and planning.
Page 8.3		Cash Flow Projection, Will you please add a table indicating monthly Cash Flow projections	Yes	
		Development of scenarios: Step 4: Determining of ESBC sub-steps (Step 4a - 4c) have to be followed. Then Step 5 sub-steps	Yes	There are problems with these steps. Refer to the extract of the review document below this table as part of the Vaal Classification study. An approach that does cover these steps where practical possible inherent in this proposal and it is the same approach used for the Vaal Classification. This has now been explicitly indicated in the inception report under these tasks.
Page 5-16; par 5.4.7-sentence		At this stage there are no guidelines that are practical to integrate……. Now that we are suppose to use the 2007 guidelines, how about wording the sentence as "The available guidelines do not clearly integrate……."	Yes	The issue is that there is no process/guidelines within the 2007 guidelines to integrate Management Classes. Have reworded this to be more explicit and provide more explanation.
General		Incorporation of the NFEPA Maps and information at an IUA and quaternary catchment scale	Yes	Note, NFEPA is provided at a Subquaternary scale. A problem is that on instruction from DWA, it was not considered in the PESEIS work.
General		Include changes re 60 days for gazetting as for Letaba	Yes	
Page 5-18		There is no mention of groundwater RQOs, how is it going to be incorporated?	Yes	

Page & or Section	COMMENTS RECEIVED		ADDRESSED IN REPORT?	AUTHOR COMMENT
	REPORT STATEMENT	COMMENTS		
Page 5-19:		Page 5-19: All the technical outcomes have to be endorsed by the PSC members, by giving inputs or comments on the report produced		
Page 5-20:		Capacity Building-Include Philani Khoza on the list of mentorship recipients.	Yes	
Comments from Delana Louw				
General		Similar changes to Letaba that must be made re groundwater must be brought into this document. Approach, incorporation, RQOs	Yes	
General		Similar risk table to Letaba to be incorporated		
Comments from Shane Naidoo				
Section 5.2	TASK D2: INITIATION OF THE STAKEHOLDER PROCESS AND CATCHMENT VISIONING	There is no text referring to Catchment Visioning	Yes	Paragraph has been added.
Comments from Directorate: Reserve Requirements				
General	Spelling, formatting and grammar		Yes	
Acknowledgments			No	The acknowledgements in the inception report are the authors of the report so unsure what the comment relating to hydraulics are.
Team			No	This issue is outside of the inception report. As is now known to DWA all team members were aware that they are part of the CSIR proposal.
Priority Estuary				The team will provide motivated agreements on the higher confidence estuaries to be assessed to DWA for final decision making. It must just be noted that high confidence methods cannot be applied on estuaries without the necessary hydrological and water level information.
2.7		Included a section on BHN under groundwater	No	The current BHNR approach does not include provision of groundwater as basic needs.

Page & or Section	COMMENTS RECEIVED		ADDRESSED IN REPORT?	AUTHOR COMMENT
	REPORT STATEMENT	COMMENTS		
	WRSM 2005	Included in Terminology and Acronyms	Yes	
Page 1-1 Section 1.2		Second sentence does not make sense.	Yes	
Page 1-1 Section 1.2		Reference DWAF 2004 - Is there no recent Studies	No	Reference refers to a typographical description which does not change and therefore a 2004 reference is adequate.
Page 1-1 Section 1.2		Second Paragraph, first sentence - Does this refer to the 2 large rivers and 2 medium rivers? If only the medium rivers then state something about the present status of the waters as well	Yes	
Page 1-1 Section 1.2		Differentiate in a note at the bottom what defines a large, medium, small river is it MAR, length?	Yes	
Page 1-1 Section 1.2		Also you only mention the river system, you should at least mention something about the bigger systems estuary and some of the big wetlands like the Umgeni Vlei etc.	No	A large river system will have a large estuary etc., therefore it is implicit in the description. This is a general study area description and details of wetlands will come out during the study.
Page 1-1 Section 1.2		Second paragraph, second sentence - And the smaller systems, their impacts? * Tongati catchment over allocated * Umhlanga where is it - conservations are	No	This is a general study area description and details of landuse and allocation will come out during the study.
Page 1-1. Section 1.3		First paragraph, second sentence – where you mention something that was jointly developed – by who? DWA and?	Yes	
Page 1-2. Figure 1.1		Map to small.	Yes	
Page 2-1. Table 2.1		Mkomazi River System - is the date for starting the Yield and Planning model analysis still correct?	Yes	Mkomazi system yield analysis information is available for used in the Classification study
Page 2-1. Table 2.1		Ohlanga - Estuarine Study	Yes	Estuarine studies has also been undertake for the Ohlanga, Mdlotti and Tongati rivers and appropriate hydrology from these or subsequent updates will be used in the Classification Study.
Page 2-1. Table 2.1		Mdloti - Estuarine Study	Yes	

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Page 2-1. Table 2.1		Tongati - Estuarine Study	Yes	
Page 2-1. Table 2.1		Mhlali and Mvoti - referred reports are old	No	The indicated information is what was identified as the latest and most appropriate data available from this assignment.
Page 2-1. Table 2.1		A Hydrology update was done on Mdloti and Tongati	Yes	See comment above.
Page 2-1. Section 2.1.2		Is the Umhlanga really a significant into water availability?	No	I don't see Umhlanga referenced in this section?
Page 2-1. Section 2.1.2		Second sentence - is the due date for developing the model still correct?	No	Yes
Page 2-1. Section 2.1.2		Third sentence - complete this sentence, ie has indicated ….., and replace 'assignment' with 'project'	Yes	Changed to "Data from a recent Umzimkulu River Catchment Study (DWA, 2011a) will be sourced and used in this project."
Page 2-2. Section 2.2		Mgeni River: Should mention the 'environmental flow' release built into the operating of Inanda Dam.	No	The environmental flow release is not being implemented
Page 2-2. Section 2.2		Umzimkulu River: incorrect referencing	Yes	
Page 2-2. Section 2.2		Umzimkulu River: 2nd paragraph, provided a list with dates of the Rapid III assessments	No	This is part of the task of providing all relevant reserve information as part of the actual study.
Page 2-2. Section2.3		Indicate that estuaries range from permanently (Mkomazi) open to temporarily close (Tongati) in the North	No	These details will only be supplied as part of the estuarine studies, not in the inception report, which is focusing on explaining the work that needs to be done.
Page 2-2. Table 2.2		Mdloti - as part of what study has the interim been done?	No	These details will only be supplied as part of the estuarine studies, not in the inception report, which is focusing on explaining the work that needs to be done. This date will be supplied as part of the data information index tables
Page 2-3. Paragraph 1, last sentence		Please explain this process. We need to agree on the priority estuaries.	No	The whole 2.3 section (not just the first paragraph) explains the process. Priority Estuaries will be selected and agreed on by DWA and stakeholders during the study.

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Page 2-3. Paragraph 2		Don't use the term 'comprehensive desktop assessment' – it is confusing, leave out the word 'comprehensive'. Call it a desktop-based approach	No	As comprehensive is with a small letter, it does not refer to a methodology but to normal English terminology.
Page 2-3. Paragraph 2		"previous EWR studies will be revisited, where deemed necessary" – what does this mean, give an example.	Yes	
Page 2-3. Paragraph 3		Add another bullet to state that: Umgeni estuary for instance has a high social + economic drive and its ecological or 'health' functionality should be managed for that use	No	This is not a criteria and therefore does not form part of the lists of bullets.
Page 2-3. Section 2.4		First bullet: "partially applicable" – what does this mean, please explain	Yes	
Page 2-3. Section 2.4		Two important wetlands ID in Umzimkulu study: Umgenivlei nominated for RAMSAR	No	The purpose of this section is not to identify and mention wetlands, but to list the available data.
Page 2-4. Section 2.4		2nd paragraph on page 2-4 – correction, it's not a DWA/WRC study, it's a DWA study	No	Even though DWA funded the study, WRC managed it and it is assumed that the results will be published as joint WRC/DWA reports. The contract of the work was with the WRC. RDM has been requested to provide the proper references for this study by RFA.
Page 2-4. Section 2.4		* NB: not enough effort on wetlands here. wetlands to be typed at least and priority wetlands selected to conduct higher confidence Reserve on wetlands function in landscape assessed as well as inter connectivity related to GW and SW recharge * Check with RAMSAR and WFW for priority wetlands * Wetlands functions also need to be picked up under the social component into goods and services provided.	No	The heading of this chapter is available information, not about the approach to be followed, or identifying priority wetlands.
Page 2-4. Section 2.5		Last sentence states that DWA is to provide information – this has been done.	Yes	Footnote has been added
Page 2-4. Section 2.6		* Change this title to "Groundwater component of Reserve" *Also in the 1st sentence edit for it to read: "...groundwater component of the reserve...."	Yes	
Page 2-4. Section 2.6		Nancy to address the blank section, however Draft information is available	Yes	This has been supplied

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Section 2		This section should include something related to the BHN component – since you are referring to Reserve determinations which includes the BHN component then cross reference it to section 5.3.16	No	This section is about data availability, as no BHNR has been undertaken, there is no data available.
Page 2-4. Table 2.3		Task D3.5 comment: WRSM2005 vs. WR2005 – is it the same thing?	No	There is no such acronym as WR2005
Page 2-5. Table 2.4		Task D3.9 comment: info from Reconciliation study for updated hydrology	No	Hydrology was not updated as part of the Reconciliation study.
Page 2-5. Table 2.4		Should you not have confirmed the risks here before hand? Nancy did you give info or received enquiries? What did the WRP study use for groundwater contribution in their reconciliation study?	No	
Page 2-5. Table 2.4		Task D1.7 – This info has been provided long time ago, please update your table =>to follow up with Neels	Yes	Footnote has been added
Page 2-5. Table 2.4		Task D4.7 comment column 2nd sentence – check with Jean Nel, surely there must be a motivation for 7 priority areas.		Checks with the NFEPA team as well as queries during NFEPA training has confirmed that these motivations are not available.
Page 3-1. Section 3.1		First bullet after the comma insert “for identified ‘significant’ water resources” and remove the word ‘environmental’.	No	This is quoted from the TOR
Page 3-1. Section 3.1		2nd bullet “identified ecological water requirements + BHN”	No	This is quoted from the TOR
Page 3-1. Section 3.1		3rd bullet, insert “for the selected management classes” after the bracket	No	This is quoted from the TOR
Page 3-1. Section 3.1		Second sentence where DWAF 2008b is referenced – NB there is a latest version, should you not rather refer to gazetted doc Sept 2012?	No	Document has not been finalised
Page 3-1. Section 3.1		Last sentence edit so it reads as follows: “...pilot studies for various WRCS...”	No	The reference to e.g. indicates that there are more than one study.
General		* NB Should indicate that BHN refer to communities directly dependent on water Resource and not supplied.... * Therefore, please differentiate between SW dependent communities and GW dependent communities	No	Explanation of methods not included in inception report, but will be included in the BHNR report.
Page 3-2. Figure 3-1		PES, EIS, REC	No	EIS and REC is not part of Status quo in the Classifications Step 1

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Page 3-2. Figure 3-1		Step 5. Take step 5 and combine it with step 6 in the next column 'Classification steps'	No	Reserve Step 5 is not part of Classification Step 6. These steps as presented has been accepted by the PSC and PMC for both Mvoti and Letaba
Page 3-2. Figure 3-1		Step 6. Edit DWAF to DWA and management class to Management Category	Yes	
Page 3-2. Figure 3-1		Step 6, will the ecological consequences also be discussed here, it should to evaluate against scenarios and to ???	No	Step 5 of Classification which is evaluate Scenarios within the IWRM process, includes the evaluation of all consequences to scenarios
Page 3-2. Figure 3-1	Resource Quality Objectives	Step 2 should visioning not happen during Classification – RQO not get selected for the Management Class and the associated ecological base configuration -> Ecospecs part of RQO		Absolutely agreed but, RDM approved the RQO steps with visioning as part of it.
Page 3-3. Section 3.2.1		Perhaps you should explain what this means since this statement has already caused a lot of concern amongst specialists and stakeholders. Explain what the validity use of the Rapid desktop outputs will be – how will that be used and for what?		There are not such thing as a rapid desktop output. Specialists which are part of the team should not be raising concerns to DWA but should raise it to their task leaders.
Page 3-3. Section 3.2.2		First sentence and the remaining 28% of the catchment areas with what? Low confidence	Yes	Addressed
Page 3-3. Section 3.2.2		What information does Stephen have, did he not determine the Estuaries part of the SANBI Biodiversity Study or The CSIR's estuarine PES study		Stephen has or will not do any modelling for the estuaries, he is currently doing some analysis of available date for the estuaries.
Page 3-3. Section 3.2.4		First sentence – how are they going to estimate? What is the challenge statement? That the above is not available?		The estimation process does not form part of the inception report. The challenge statement refers to the fact that hydrology is not available and estimation is required.
Page 3-4. Section 3.2.5		Second sentence – results been provided by Groundtruth – will check front end progress		Footnote has been added
Page 3-4. Section 3.2.5		There is a Reserve method for pans, seeps not just floodplain wetlands must be considered other priority or significant wetland types should be ID and assessed		The proposal that has been accepted has focused on river-related wetlands such as Valley-bottom wetlands. There are no budget to address seeps and pans. It must be noted that no significant wetlands of these types have been identified.
Page 3-4. Section 3.2.5		Last sentence – this needs to be discussed please. Was never intended to do desktop only to start from Rapids		There are 16 000 wetlands in the WMA it is impossible to asses EWRs for all these wetlands.

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Page 3-5. Section 3.2.7		Also use GW Reserve study	No	Has already been clearly stated as a source of information
Page 3-5. Section 3.2.7		WRPs rec-study – Nancy to give input		WRP is part of the study and are using all information generated during the recon study.
Page 3-5. Section 3.2.7		Change title to PESIS, also change it in the content	Yes	The original abbreviation used by Dr Kleynhans is PES and EI-ES. This now commonly referred to as the PESEIS study and the use of this abbreviation has been explained in the report
Page 3-5. Section 3.2.8		What info will the feasibility study give?	No	Do not understand the reference to feasibility
Page 3-5. Section 3.2.8		Entire paragraph – has been delivered		Footnote has been added
Page 5-1. Figure 5.1		Add EGSA	Yes	EGSA already in table but referred to as Ecosystem services
Page 5-1. Figure 5.1		PESEIS results – Third dialog Box *Can't extrapolate from one estuary to another *Related impacts can work if you group estuaries *Where you say 'homogenous state & functioning' - what would this function be?	Yes	No extrapolation is intended so unsure about the comment The function of grouping areas of homogenous states has been explained in the definition of IUAs
Page 5-2. Section 5.1.1		Tongati + Mdloti intermediate hydrology prepared – check with N. Forbes on your team		The most updated hydrology which has been verified by WRP as to its accuracy will be used in this study.
Page 5-2. Section 5.1.1		Actions Second bullet – special focus should be given to Ethekwini's WWTW Schedule		Consideration will be given to the Strategic Development Plan of Ethekwini
Page 5-3. Section 5.1.2		Second bullet – what about conservation areas such as Umhlanga? Fifth bullet – conservation areas further north? (SAPPI) Seventh bullet – conservation areas?	No	Conservation areas such as Umhlanga is not providing an important contribution to the provincial economy.
Page 5-3. Section 5.1.2		Fifth bullet – (WWTW) and must include conservation areas		Conservation areas and WWTW are not economic activities. Tourism as listed will be the relevant economic activity and will be applicable for areas such as the Umfolozi game reserve.

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Page 5-4. Section 5.1.2	Paragraph 9	What about people who have an entitlement but not using it or not using it in full currently?	No	This paragraph is about identifying water users not the water uses. This statement is relevant for Hydrological modelling, not for economic analysis.
Page 5-4. Section 5.1.2	Paragraph 9	And what about additional run off created due to increase in urbanisations?	No	Applicable for Hydrological modelling, not for economic analysis
Page 5-4. Section 5.1.2		Add to the bullets: * Tourism income generation? * Conservation areas – Oribi Gorge?	Yes	
Page 5-5. Section 5.1.3		Greg: Reference to the Basic Human Needs should be made here	No	BHNR is not part of task D1.3 or EGSAs
Page 5-5. Section 5.1.3		Formal water supply info to communities info and	Yes	
Page 5-5. Section 5.1.3		Info on communities still directly dependent – areas where these are.	No	The information required is already in the list.
Page 5-5. Section 5.1.4		Third sentence – was water quality done?		Yes water quality does form part of the PESEIS study.
Page 5-5. Section 5.1.4		Also check with Water Quality planning for the RWQO set		Yes liaison for RQOs will take place.
Page 5-5. Section 5.1.4		Look into using WMS assistance from RQS		Yes liaison for RQOs will take place.
Page 5-6. Section 5.1.5		Second sentence where you state that "...no DWA information on wetland condition exist....." -Some wetland data available as part of Umzimkulu study	Yes	
Page 5-6. Section 5.1.5		"....a quaternary scale wetland assessment for the WMA will be undertaken" "....similar assessments have been undertaken for other WMAs...." - two statements in contradiction?	No	There are no contradictions.
Page 5-6. Section 5.1.5		Edit the first sentence to include 'EWR'. And why 2 highest priority wetlands? There are many more, how decided 2		EWR assessments have not been included in the proposal which has been accepted. The number of highest priority wetlands that are indicated (2) is what has been proposed and what has been accepted. Two of the large important wetlands (Mgeni and Mvoti vleis) do not have

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				water quantity problems.
Page 5-7. Section 5.1.5		* Work that Peter Goodman for the Strategic Planning Conservation? *Mark – check with WFW – priority wetland; influence of Franklin Vlei		That information has and will be used.
Page 5-7. Section 5.1.5		Third bullet what criteria was used to select 2 from the many others? And which two are they?		No criteria was used, this was a number selected for budgetary purposes and influenced by the knowledge that the two largest wetlands that can be impacted on by water resource development is Umgeni vlei and Mvoti vlei. They are likely to be the two wetlands selected for detailed investigations, pending DWA approval
Page 5-7. Section 5.1.5		Responsibility of the Consultant *Second bullet – should be done at least for the "2" identified	No	This was not proposed or budgeted for.
Page 5-7. Section 5.1.6		Prioritization of estuaries – what criteria is going to be used?		Prioritization of estuaries is not part of this task.
Page 5-7. Section 5.1.6		Conservation estuaries that act as refuge or are rate types	No	This summary will be done based on excising information which is pre-empting the comprehensive desktop assessment. The aspect referred to in the comment will be addressed during the comprehensive desktop assessment where estuaries will be prioritised
Page 5-7. Section 5.1.7		Paragraph 1 - Estuary info only included as descriptions?	No	Estuary information not applicable to this task.
Page 5-8. Section 5.1.7		Paragraph 3, first sentence – this only caters for certain wetland types or does it include wetlands not linked directly to rivers?	No	The quaternary assessment includes all types of Wetlands.
Page 5-8. Section 5.1.7		Paragraphs 3 & 4 – Wetland + Estuary specially to be included	No	This section does not include Estuaries and Wetlands per se.
Page 5-8. Section 5.1.8		Wetlands + estuarine spes	No	This is a multi disciplinary meeting and only one Ecologist that will represent all the Aquatic ecosystems needs to be present. As all the work has been done prior to this, the information would have been provided to this one specialist

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Page 5-9. Section 5.1.9	Task D1.9: Identification of river biophysical nodes and level of assessment	Paragraph 2 – is this related to Rivers? If not then the other water resource specialist should be part of the process where "hotspots" are ID especially in the Wetland case.	No	As the task title indicates this is related to rivers
Page 5-9. Section 5.1.9	Task D1.9: Identification of river biophysical nodes and level of assessment	Paragraph 3 ...."Water Resource Use Importance (WRUI)..." – Estuaries? Where do they fit in here?	No	WRUI addresses all water recourses.
Page 5-10. Section 5.1.10		Responsibility of the Consultant *First bullet, you say "the client...." – is DWA not the client?	Yes	Addressed
Page 5-10. Section 5.1.10		Guideline that you say "should be provided by DWA" - Really! This has been provided	No	An untested DSS has been provided by Dr Kleynhans. This is therefore not a guideline.
Page 5-11. Section 5.2		* Catchment visioning – Should be part of classification, surely the 'visioning' in the RQO is more specific perhaps and related to implementation of monitoring the indicators (RQO) to meet or maintain the selected 'Class' with its associated ecological configuration * Visioning as part of the classification process	No	Absolutely agreed but, RDM approved the RQO steps with visioning as part of it.
Page 5-16. Section 5.3.2		Responsibility of the Consultant Where you say that " the consultant is not responsible for resurveying sites in the Mkomazi River" • When was it last surveyed? • Why not this study was done 2000? • Main system with Dam planned on it	No	These EWR sites are stable and there have been no significant developments in the catchment that would have significantly changed the river profile. The excellent and high confidence hydraulic information available will therefore be applicable to a representative profile of the river.
Page 5-17. Section 5.3.3		• Fourth bullet – RHAM?? Can that not be used		Don't understand the reference to RHAM
Page 5-17. Section 5.3.3		• Fifth bullet – How is this surveyed? Is this not an output	Yes	
Page 5-24. Section 5.3.13		• Based on what has this been approved and who – that info is very rigorous and for Planning only		Is this a statement?
Page 5-24. Section 5.3.13		• Second bullet – are you referring to all the estuaries		Yes
Page 5-24. Section 5.3.13		• KZN estuarine specialist not on board?		Any such allegations should have been referred timeously to the task and study leaders.

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Page 5-24. Section 5.3.13		• 5 days for PES/EIS % flow		Don't understand the statement
Page 5-24. Section 5.3.13	5.3.13 Task D3.13: Estuarine desktop assessment	Actions Second bullet – for which estuaries at what level?		Note deliverables and milestones. Desktop assessment for all estuaries including, PES, REC, general EcoSpecs …….
Page 5-24. Section 5.3.13		Where is the prioritization taking place just as with the rivers to assess and determine what level of Reserve is to be done on what estuary?	Yes	Addressed
Page 5-25. Section 5.3.14		• How was the three estuaries decided?	No	The next sentence answers the question. 'These estuaries will be selected based on criteria listed earlier (section 2.3).'
Page 5-25. Section 5.3.14		• Table – this is for one season, is this only pitched at intermediate (requires at least 2 field surveys)	No	The table only refers to what data will be collected.
Page 5-37. Section 5.8		BHN Concept + approach should also be discussed in training	No	The approach is so simple that the report will supply all information to trainees. The subject matter at the training courses have been confirmed with the PMC and does not include BHN training.
Page 5-37. Section 5.8		The latest census 2011 data must be used	No	The 2011 census was not available for assessment. (Dec 2012)
Page 5-38. Section 5.8		• Training session 3, fourth sentence, edit as follows: "....the results of selected IUAs..."	No	Training session 3 has been changed and the updated contents will be included in the inception report.
Page 5-38. Section 5.8		Information required • Wetlands, Groundwater aspects – how is that taken into account?	No	Information required refers to information regarding trainee composition and contents of training sessions.
Page 5-38. Section 5.8		Information required • As part of the "status Quo" process and when the IUA are selected, are GW not part of prioritization – how is this going to be worked in		Groundwater is part of water resources analysis and therefore incorporated in the IUA assessment
Page 5-38. Section 5.9		• RQO – where does it fit in, does it not all get gazetted together	No	Refer to Task D7 which states that Gazetting will address the management class and RQO.
Page 5-38. Section 5.9		• + Maps shape files	Yes	Reference to raw data includes shape files
Page 7-1. Section 7		• Rather make a table here, this info doesn't make sense if done separately	No	The list of Task leaders and list of Organisations are two separate issues, to accommodate the

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		• Suggestion: Link the study leader + main team ; organisation, lead discipline + Role then one can ID gaps easier		query the task leaders organisations will be accommodated in brackets. A detailed table such as recommended forms part of the contract.
Page 7- Table 7.1		• Support - has H Mallory not resigned?	No	H Mallory is still part of the study team.
Page 7- Table 7.1		• Estuary & Marine – not all these estuarine specialists confirmed on this team this is a huge problem	No	See previous comment regarding these untrue allegations
Page 7- Table 7.1		Shepard and Mselegul – what are these specialist discipline, are they trainers? And what are they going to do?	No	All team members specialist disciplines and cvs are provided as part of the proposal and in the contract
Page 7- Table 7.1		Where is a RQO specialist?	No	I am not aware of any person that can be an RQO specialist without being an existing specialist on this team. River RQO will be addressed by the river specialist etc.
Page 7- Table 7.1		Implementation/Operationalisation – Other Resources?	Yes	It has been removed from the organogram

WMA 11 INCEPTION REPORT, COMMENTS BY DR CJ KLEYNHANS

I studied the document as far as the river ecology issues are concerned. The following aspects should be noted:

1. A Preliminary versions of the PESEIS models for T4-T5 and U1-U8 were provided to the PSP prior to the required date (end November 2012).
2. Following reviewed data from Groundtruth consultants, updated (and approximately final) versions of these models were provided to the PSP by the end of January 2013.
3. Guidance on the use of EI, ES and NFEPA data etc. is provided in the front end models for the PESEIS. Discussions with the project leader around this and the formulation of the REC have taken place.
4. The PESEIS models contain a basic link to NFEPA data (including wetland information).
5. It is important to note that the PESEIS link to physico-chemical conditions are highly quantitative (even when considering supplementary data for “fact sheets”). It is assumed that the PSP will also obtain WMS data.
6. It is important that especially EWR site information where Rapid III and comprehensive or intermediate reserves will be conducted be provided to RQS in order to run the Fish Flow Habitat Assessment (FFHA) models as well as the Invertebrate version of the FFHA. This refers to the hydraulic information used in the FFHA and the hydrology needed to do this analysis. The RDRM is certainly not the appropriate approach to follow as it is a desktop approach and does not relate properly to the actual biological conditions and requirements at a site. All sites where hydraulic cross sections are measured will be useful and valuable for this purpose.
7. With reference to the future monitoring of RQOs and EcoSpecs in particular (instream biota), it is important to keep in mind that the setting of TPCs, etc. will to a large degree be based on the FFHA (and the invert version).
8. Also in relation to future monitoring, it is necessary that RHAM type measurements be taken at each hydraulic cross section as this provides a reasonable and quantitative way of determining if TPCs and RECs are being attained. Some discussion around this was held with the Project leader at the insistence of RQS. This approach applies to all similar projects initiated by DWA.
9. Regarding the application of the FRAI in particular selected SQ Reaches, a procedure was developed by RQS that provides the reference fish assemblage and frequency of occurrence per SQ Reach for input into the FRAI based on information emanating from the PESEIS. This is considered as an enhancement of the FRAI and assist considerably in determining ‘seed’ input values. It was recently applied in the Vaal RHP.
10. All ecologically related data collected by the PSP, should be provided to DWA in an agreed electronically format and structure such as Ms-Excel or a format compatible with Ms-Excel or MS-Access. This will enhance the monitoring process that should eventually follow from this project.

Response from the study team:

The study team will supply all data as requested and will meet with RQS to discuss the issues and suggestions. It is essential that the latest thinking from RQS with determining fish and macroinvertebrate EcoSpecs be incorporated in this study.

E-MAIL FROM MR BILL PFAFF.

The Email does not include direct comments on the inception report, but conceptual concerns regarding the project as well as specific issues with DWA.

Response from the study team:

The study team acknowledged the requirements and concerns expressed by eThekwini in the email from Mr Pfaff dated 3 April 2013 and will setup a technical task group to identify how the current study can benefit from and also support the City in terms of its vision as defined in their Strategic Development Plan. The task group will identify opportunities for cooperation and define a process where a coordinated pilot investigation can be undertaken within the resources and timeframe of the project.