



water affairs

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P WMA 11/U10/00/3312

The eMkhomazi Water Project Phase 1: Module 1: Technical Feasibility Study Raw Water - W 0259 (WTE)

INCEPTION REPORT

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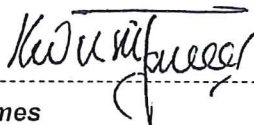
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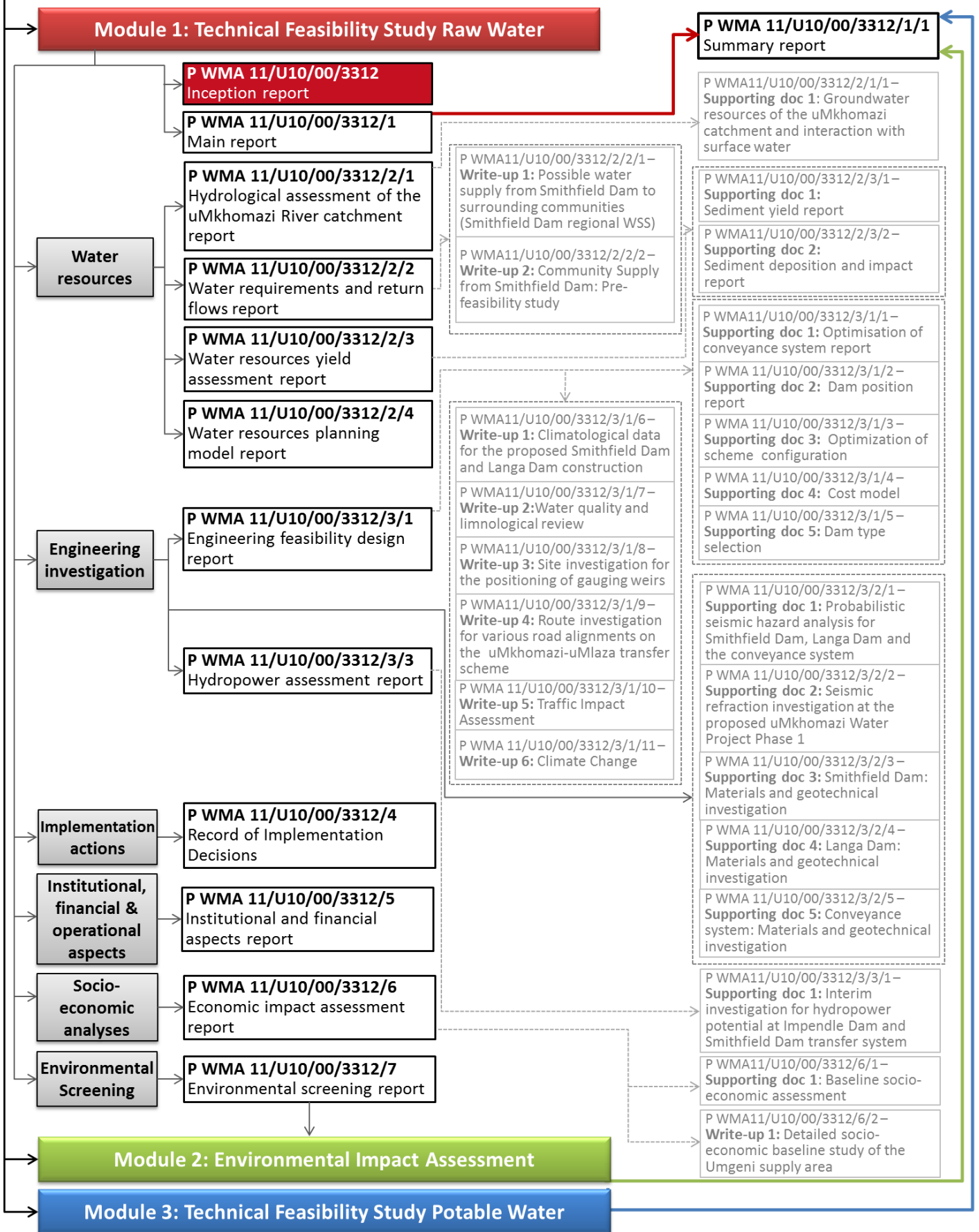
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Urban-Econ



The uMkhomazi Water Project Phase 1

LIST OF REPORTS



Preamble

Company name i.e. BKS vs AECOM

The Department of Water Affairs appointed **BKS (Pty) Ltd** in association with three sub-consultants **Africa Geo-Environmental Services, MM&A and Urban-Econ** with effect from 1 December 2011 to undertake the **uMkhomazi Water Project Phase 1: Module 1: Technical Feasibility Study Raw Water** study.

Subsequently, on 1 November 2012, BKS (Pty) Ltd was acquired by **AECOM Technology Corporation**. As a result of the change in name and ownership of the company during the study period, a decision was made that all the final study reports will be published under the AECOM name.

However, as this report (P WMA 11/U10/00/3312 – Inception report) has already been published at the time, agreement was reached that the references to BKS will remain within this report as is.

Study name i.e. eMkhomazi River vs uMkhomazi River

In 2010, the Department of Arts and Culture published a list of name changes in the Government Gazette. In this list, the Mkomazi River's name was changed to the **eMkhomazi River**. As a result, a decision was made that this published spelling will thus be used throughout this Inception Report and for the balance of this technical feasibility study.

However, in a follow-up Government Gazette (GG No 33584, 1 October 2010) the Mkomazi River's name was again amended to the **uMkhomazi River**. As such, this amended spelling was adopted for the remainder of the study as well as all reports. However, as this report (P WMA 11/U10/00/3312 – Inception report) has already been published at the time, agreement was reached that the reference to the eMkhomazi River will remain within this report as is.

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LIST OF ABBREVIATIONS

AGES	Africa Geo-Environmental Services (Pty) Ltd
BEE	Black Economic Empowerment
BEEH	Bioresources Engineering and Environmental Hydrology
BKS	BKS (Pty) Ltd
CBA	Cost Benefit Analysis
DBAC	Departmental Bid and Adjudication Committee
DM	District Municipality
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
eMMM	eMkhomazi-Mooi-Mgeni system
EMPr	Environmental Management Programme
eMWP	eMkhomazi Water Project
eMWP-1	eMkomazi Water Project – Phase 1
EWB	Ecological Water Requirements
HDI	Historically Disadvantaged Individual
I&AP	Interested and Affected Party
ICFR	Institute for Commercial Forestry Research
kℓ	kiloliter
KZN	KwaZulu-Natal
ℓ/c/d	liter per capita per day
LM	Local Municipality
m ³	Cubic meter
MAP	Mean annual precipitation
MAR	Mean annual runoff

MM	Metropolitan Municipality
MMA	Mogoba Maphuthi and Associates
MMTS-1	Mooi Mgeni Transfer Scheme – Phase 1
MMTS-2	Mooi Mgeni Transfer Scheme – Phase 2
NEMA	National Environmental Management Act
O&M	Operation and Maintenance
PMC	Project Management Committee
PR	Public Relations
PSC	Project Steering Committee
PSP	Professional Service Provider
RDM	Resource Directed Measures
RID	Record of Implementation Decisions
SANCOLD	South African National Committee on Large Dams
ToR	Terms of Reference
URV	Unit Reference Value
UW	Umgeni Water
VAPS	Vaal Augmentation Planning Study
WRPM	Water Resources Planning Model
WRYM	Water Resources Yield Model
WSA	Water Service Authority

1 INTRODUCTION

This **Inception Report** is the first deliverable for the *eMkhomazi Water Project Phase 1: Module 1: Technical Feasibility Study Raw Water*. The Inception Phase provides an opportunity to finalise the Scope of Work for the assignment, and to confirm the composition of the Project Team, the manpower schedule, work programme, expenditure budget and estimated cash flow. This report also serves as the first progress report on the project and includes a review of these items, with reference to the original Terms of Reference (*attached in Error! Reference source not found.*).

In 2010, the Department of Arts and Culture published a list of name changes in the Government Gazette. In this list, the Mkomazi River's name was changed to the eMkhomazi River. The published spelling will thus be used throughout this inception Report and for the balance of this technical feasibility study.

1.1 APPOINTMENT OF CONSULTANT

The Tender for this study was submitted on 18 April 2011, in response to the Department of Water Affairs' (DWA) request for a proposal in accordance with the DWA Guidelines and Terms of Reference. The Contract was approved with effect from 1 December 2011 and the Department of Water Affairs appointed **BKS (Pty) Ltd** in association with three sub-consultants **Africa Geo-Environmental Services (AGES)**, **Mogoba Maphuthi and Associates (MMA)** and **Urban-Econ** to undertake the **eMkhomazi Water Project Phase 1: Module 1: Technical Feasibility Study: Raw Water**.

1.2 BACKGROUND TO THE PROJECT

A sound understanding of the project's origins and previous studies completed is essential for the project team to appreciate the project's context and to effectively assist the DWA in meeting the objectives of this study effectively. BKS has reviewed the reports for previous investigations that were made available by the DWA, and will avoid unnecessary or duplicate work. This section summarises the work completed under previous studies and addresses how this feasibility study will complement and expand on the data previously collated.

The Mgeni System comprises the Midmar, Albert Falls, Nagle and Inanda Dams in KwaZulu-Natal, and a water transfer scheme from the Mooi River. The Mgeni System is the main water source that supplies the eThekweni Metropolitan Municipality (MM), Umgungundlovu District Municipality (DM) and Msunduzi Local Municipality (LM) that supplies domestic and industrial water to about five million people and industries. The four dams in the system are augmented by an emergency scheme (Mooi Mgeni Transfer Scheme Phase 1 – MMTS-1) that supplies water via the Mearns Weir during periods of high demand on Midmar Dam. The current Mgeni System (Midmar, Albert Falls, Nagel and Inanda Dams and the MMTS-1) has a stochastic yield of 334 million m³/annum (measured at Inanda Dam) at a 99% assurance of supply.

As short-term augmentation measure, Phase 2 of the Mooi Mgeni Transfer Scheme (MMTS-2) is currently being implemented with the construction of Spring Grove Dam and a water transfer scheme to increase water supply from the Mgeni system by 60 million m³/year. However, further planning and investigations for additional augmentation in order to meet the long-term water demands on the Mgeni System are required.

Pre-feasibility investigations indicated that Phase 1 of the eMkhomazi Water Project (eMWP 1), which entails the transfer of water from the undeveloped eMkhomazi River to the existing Mgeni system, is the scheme most likely to fulfil this requirement. The eMkhomazi River is the third-largest river in KwaZulu-Natal in terms of mean annual runoff (MAR).

Eight alternative schemes were initially identified as possible alternatives, and the Impendle and Smithfield scheme configurations have emerged as suitable for further investigation. The pre-feasibility investigation, concluded in 1998, recommended that the Smithfield Scheme be taken to a detailed feasibility-level investigation as its transfer conveyances would be independent of the existing Mgeni System, thus reducing the risk of limited or non-supply to eThekweni and some areas of Pietermaritzburg, and providing a back-up to the Mgeni System.

The *Mkomazi-Mgeni Transfer Pre-feasibility Study* concluded that the first phase of the eMWP would comprise a new 58m-high Smithfield Dam on the eMkhomazi River near Richmond, a multi-level intake tower and pump station, a water transfer pipeline (possibly with associated tunnels) to the existing Baynesfield Dam (which would have to be raised), a water treatment works at Baynesfield in the Mlazi River valley and a gravity pipeline to a distribution reservoir at Umlaas Road. From here, water would be distributed under gravity to eThekweni and low-lying areas of Pietermaritzburg. Phase two of the eMWP would be implemented when needed, and would comprise the construction of a large dam at Impendle further upstream on the eMkhomazi River to release water to the downstream Smithfield

Dam. Together, these developments have been identified as having a 99% assured stochastic yield of about 388 million m³/year.

The DWA aims to have this scheme implemented by 2022.

1.2.1 Previous studies

BKS has reviewed reports on previous investigations in the study area made available by the DWA and Umgeni Water (UW), and is appreciative of the extent and value of the work that has already been completed at a high level. The Study Team will avoid unnecessary work by taking maximum advantage of the information already available and has during the **Inception Phase** improved its understanding of the study requirements in order to meet the project objectives and this will continue through the study.

The Study Team has conducted a review of existing information and has engaged with key stakeholders during the Inception Phase in order to confirm the scope of work and refine the work programme and study budget. This confirmed and refined information is presented in this Inception Report. The previous studies that were reviewed and used as a base for this study are summarised in **Table 1.1**:

Table 1.1: List of previous studies and reports

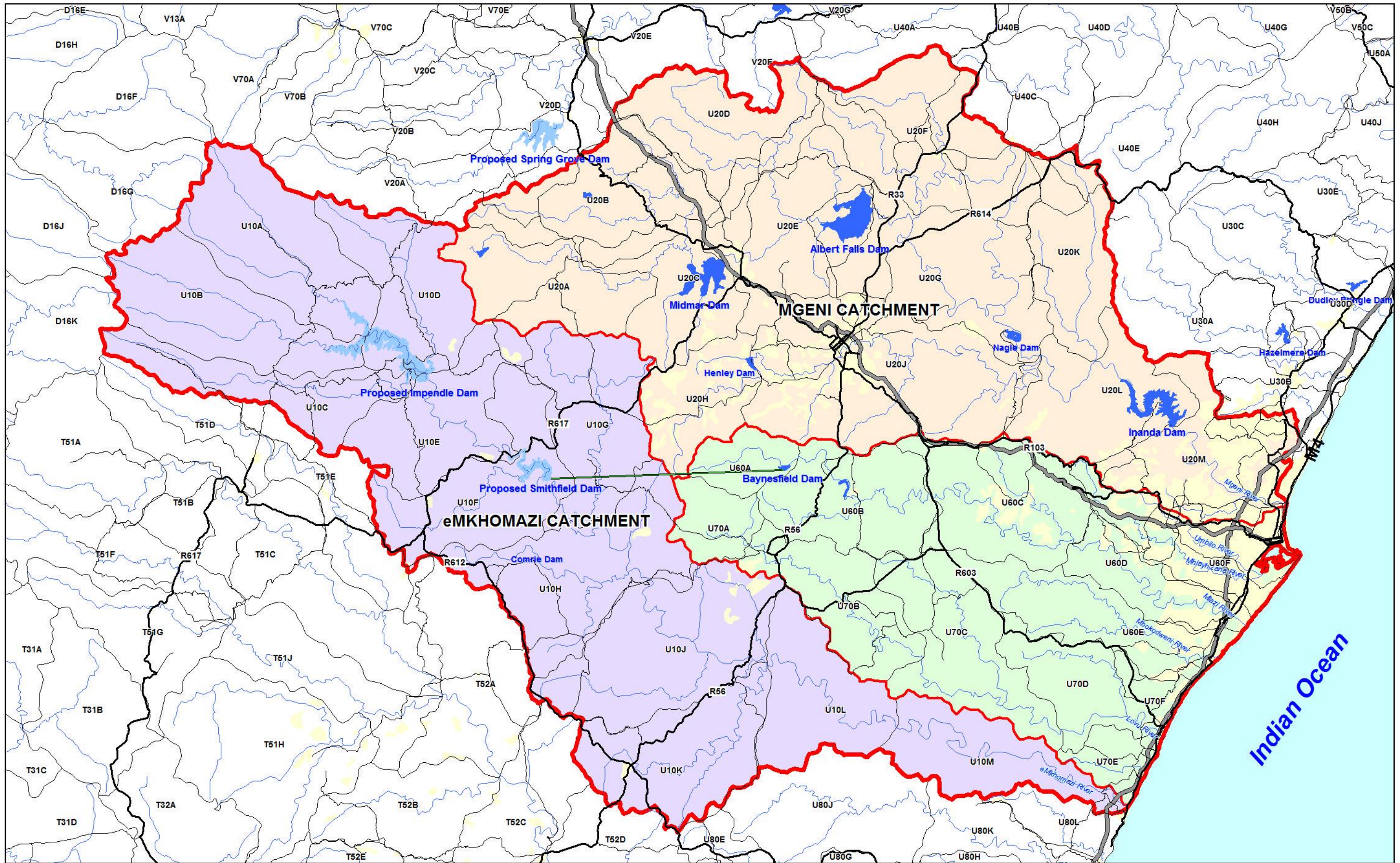
Study/Project name	Report name	Number
Internal Strategic Perspectives	Eastern Region ISP: Mvoti to Mzimkhulu WMA	PWMA 11/000/00/0304
Water Reconciliation Strategy Study for the KwaZulu Natal Coastal Metropolitan Areas	Executive Summary	PWMA 11/000/00/1107
National Water Resource Strategy	Mvoti to Umzimkulu WMA: Overview of Water Resources Availability and Utilisation	PWMA 11/000/00/0203
Water Resources Situation Assessment	Mvoti to Umzimkulu WMA - Water Resources Situation Assessment: Volume 1 of 2	P 11000/00/0101
Mkomazi/Mooi-Mgeni Transfer Scheme Pre-feasibility Study (Included the following 2 projects under the 1 study: 1. Mkomazi-Mgeni Transfer Scheme 2. Mooi-Mgeni Transfer Scheme)	Mgeni Augmentation: Overview Report	PB U100-00-0399
	Mkomazi-Mgeni Transfer Scheme: Main Report	PB U100-00-0499
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.1 - Reconnaissance Investigations	PB U100-00-0599
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.2 - Mgeni System Water Demands	PB U100-00-0699
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.3 - Reconnaissance Basin Study	PB U100-00-0799
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.4 - Hydrology & Water Resources	PB U100-00-0899
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.5 - Environmental - Volume 1	PB U100-00-0999

Study/Project name	Report name	Number
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.5 - Environmental Supplementary Documents - Volume 2	PB U100-00-1099
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.5 - Environmental Supplementary Documents - Volume 3	PB U100-00-1199
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.5 - Environmental Supplementary Documents - Volume 4	PB U100-00-1299
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.6 - Engineering Design & Costing - Volume 1	PB U100-00-1399
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.6 - Engineering Design & Costing Supplementary Documents - Volume 2	PB U100-00-1499
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.7 - Economics - Volume 1	PB U100-00-1599
	Mkomazi-Mgeni Transfer Scheme: Supporting Report No.7 - Economics Supplementary Documents - Volume 1	PB U100-00-1699
	Mooi-Mgeni Transfer Scheme: Supporting Report No.2: Hydrology and Water Resources Study	PB1 V200-01-1499
Mkomazi/Mgeni/Mooi River Hydrology and Yield Update Study	Mkomazi/Mgeni/Mooi River Hydrology Update: Volume 1	PB1 U200-00-0299
	Mkomazi/Mgeni/Mooi River Hydrology Update: Volume 2	PB1 U200-00-0299
	System Analysis Update: Volume 1	PB1 U200-00-0399
	System Analysis Update: Volume 2	PB1 U200-00-0399
Mgeni River System Analysis Study	Main Report	PB U000/00/2492
Mgeni River System	Review of the Operating Rules (Technical Report)	P671431
Mkomazi Mooi-Mgeni River Transfer Scheme Phase 2: Feasibility Study	Main Report	PB V200-00-1501
Mooi-Mgeni River Transfer Scheme Phase 2: Feasibility Study	Supporting Report No. 6: Water Resource Analysis	
Thukela Water Project Decision Support Phase: Hydrology Support, Water Resources Evaluation and System Analysis Module Study	System Configuration and Yield Analysis	PB V000-00-127/02
	ERC hydrology and streamflow sequences report	PB V000-00-123/02
	EFR hydrology and streamflow sequences report	PB V000-00-124/02
	Water requirements report	PB V000-00-126/02
	System configuration and yield analysis report	PB V000-00-127/02
	Operating rules report	PB V000-00-128/02
	River hydraulics report	PB V000-00-129/02

Study/Project name	Report name	Number
	Main Study Report	PB V000-00-1??/0?
(Same as report name)	Comparative operational reliability assessment of two transfer options for the proposed The Mkomazi-Mgeni Augmentation Scheme	256416/9902058
(Same as report name)	A Desktop study of the relevant environmental prognosis of the impact of the transfer of water from the Mkomazi River to the Mgeni Catchment and Mlazi Catchment.	Acc No: 504-2010 BRN: 505, Class: U1/U2, Box: 113
(Same as report name)	Mkomazi IFR Study	Acc No: 502-2010 BRN: 503, Class: U1/U2, Box: 113
(Same as report name)	Mkomazi sedimentation study for Umgeni Water	Acc No: 016-2009 BRN: 17, Class: U1, Box: 103
(Same as report name)	A Pre-feasibility study of the potential impact on the Fauna and Flora of the Mpendle and Smithfield Dam Sites on the Mkomazi River	Acc No: 496-2010 BRN: 497, Class: U1/U2, Box: 98
KZN Town and Regional Planning Suite of Reports	An inventory of the wetlands in the Mkomazi Catchment of KwaZulu-Natal	ISBN: 1-874961-10-7
(Same as report name)	Socio-Economic Impact of outcomes relating to the Mkomazi-Mgeni Augmentation Scheme	-
Detailed feasibility study of supply of water to Impendle, located in the Hlanganani area of KwaZulu-Natal	Annexure 1: Impendle Dam	Acc No: 015-2009 BRN: 16, Class: U1, Box: 103

1.3 STUDY AREA

- ◆ The study focus and key objective is related to the feasibility investigation of the Smithfield Dam and related conveyance infrastructure. However, this is a multi-disciplinary project with the study area defined as the eMkhomazi River catchment, stretching to the north to include the Mgeni River catchment, refer to **Figure 1.1**. The various tasks have specific focus area, defined as:
 - ◆ Water Resources task: eMkhomazi and Mgeni River catchments;
 - ◆ Water requirements: water users in the Mgeni System and the eMkhomazi River catchment;
 - ◆ Engineering Investigations task: the Impendle (only for costing purposes) and Smithfield dams, and the conveyance infrastructure corridor between Smithfield Dam and the Water Treatment Plant of Umgeni Water;
 - ◆ Socio-economic impact assessment: regional, provincial (KwaZulu-Natal (KZN)) and national



Project Name :

**eMkhomazi Water Project Phase 1: Module 1:
Technical Feasibility Study: Raw Water (eMWP1-1/RW)
Locality map - Study area (1)**



- Quaternary Catchments
- Project Area
- Town Polies
- Proposed Dams

Legend

- Roads**
- National Route
- Roads
- Secondary Road
- Proposed Conveyance Structure

FIGURE 1.1

Drawn: LC Gallagher
 Checked: H Pieterse
 Approved: H Pieterse
 Date: 2012-03-26
 Map Ref: eMkhomazi map
 View Ref: Locality Map
 Project No: J01763

1.4 OBJECTIVE, SCOPE AND ORGANISATION OF THE STUDY

1.4.1 Objective of the Study

The objective of the study project is to undertake a feasibility study to finalise the planning of the proposed eMkomazi Water Project (eMWP) at a very detailed level so that the scheme may be accurately compared with other possible alternatives and be ready for implementation (detailed design and construction) on completion of the study.

The feasibility study has been divided into the following two modules, which will run concurrently:

- ◆ Module 1: Technical Feasibility
- ◆ Module 2: Environmental Impact Assessment

Concurrent to these studies, Umgeni Water will undertake a study for the Potable Water component, ranging from the Water Treatment Plant to the tie-in point with the eThekweni distribution system.

The technical feasibility module will consider water resources aspects, engineering investigations and project planning and scheduling and implementation tasks, as well as the environmental and socio-economic impacts of the proposed project.

Some specific objectives for the feasibility study, recommended in the Mkomazi-Mgeni Transfer Scheme Pre-feasibility are listed below:

- ◆ Smithfield Dam (Phase 1) to be investigated to a detailed feasibility level;
- ◆ Investigate the availability of water from Impendle Dam (Phase 2) as a future resource to release to Smithfield Dam, and refine the phasing of the selected schemes;
- ◆ Optimise the conveyance system between Smithfield Dam and the proposed Baynesfield Water Treatment Plant;
- ◆ Undertake a water resources assessment of the eMkhomazi River Catchment, including water availability to the lower eMkhomazi;
- ◆ Evaluate the use of Baynesfield dam as a balancing dam;
- ◆ Investigate the social and economic impact of the eMWP; and
- ◆ A detailed Environmental Impact Assessment (addressed in a separate study).

The ToR stipulates that the DWA will commission a full EIA under a separate study and that this will follow the appointment of the PSP for this study. Co-ordination of activities in the two assignments is crucial to the success of both studies and sharing of information is

recognised as being essential, and is incorporated into the work schedules until the end of the EIA PSP’s contract period. The study team management will therefore work closely with the DWA, Umgeni and the PSP for the EIA to ensure that work progresses smoothly and according to schedule and quality standards.

1.4.2 Organisation of the Study

The required activities for this project have been grouped into 8 main tasks, defined in the ToR and original BKS Tender, and shown in **Figure 1.2** below. More detail is provided in **Section 2**.

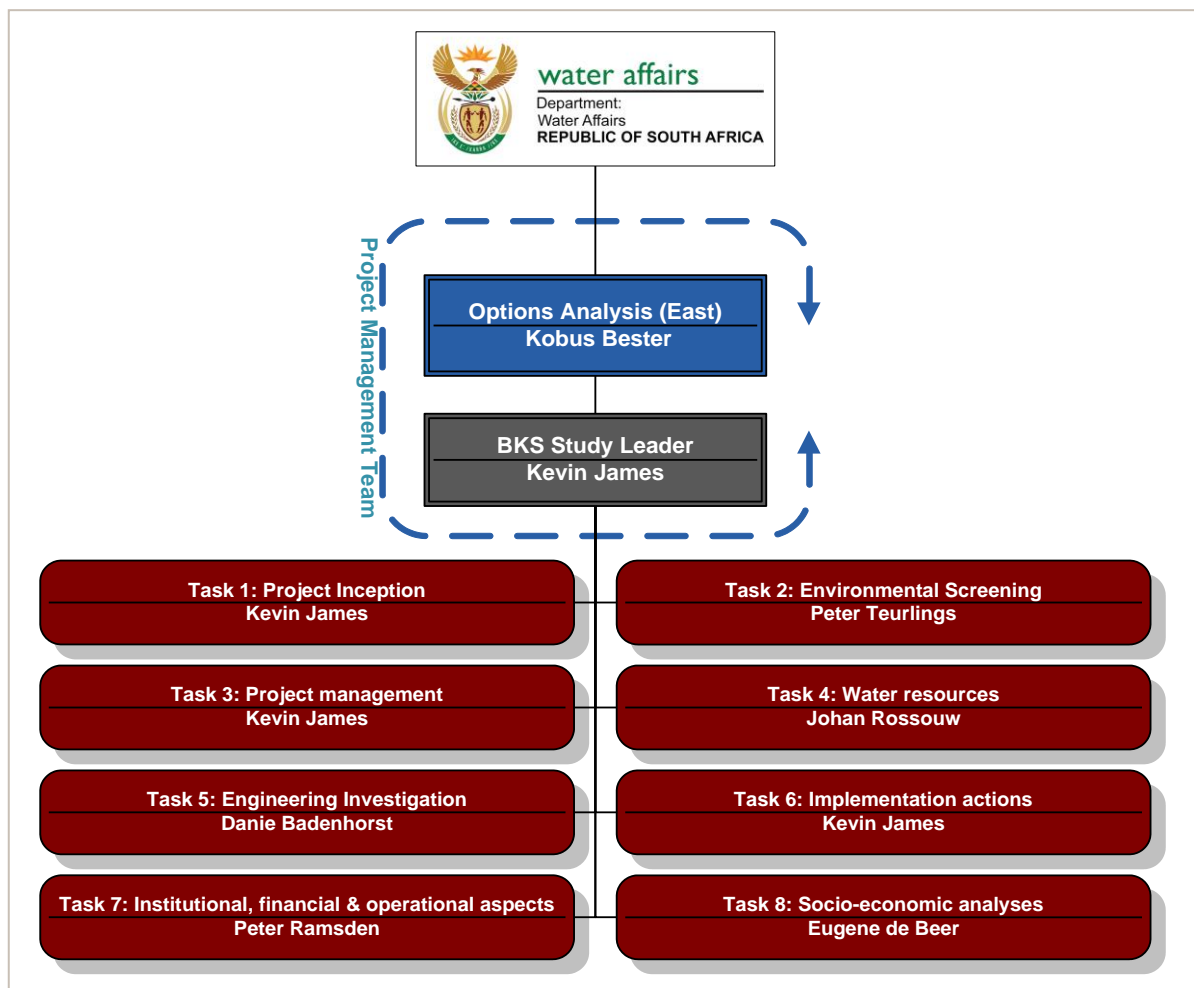


Figure 1.2: Organisation of the Study

1.4.3 Scope of the Study

The ToR for the Feasibility Study has divided the scope of work into 8 main tasks and this work breakdown structure (WBS) has been retained for ease of reference in this section, the Programme and in the Financial section.

The high level work breakdown structure, based on the proposed methodology for the study, is given in **Table 1.2**, and highlights the task activities and deliverables.

Table 1.2: Summary of proposed task activities

Study tasks	Task Leader	Task activities	Task outcomes & deliverables
1. Inception	Kevin James / Hermien Pieterse	<ul style="list-style-type: none"> ◆ Review of new information influencing the project ◆ Client liaison to agree on the proposal and obtain confirmation of study tasks and activities ◆ Compile the Inception Report 	Inception report
2. Environmental Screening	Peter Teurlings	<ul style="list-style-type: none"> ◆ First order environmental screening assessment to identify possible fatal flaws; ◆ Ongoing interaction between the engineering team and the EIA PSP to be appointed. ◆ A process specific environmental management programme (EMPr) in support of the geotechnical investigation – to be monitored by an Environmental Control officer 	<ul style="list-style-type: none"> ◆ Environmental Screening Assessment ◆ EMPr ◆ Compliance report-back on EIA
3. Project Management	Kevin James / Hermien Pieterse	<ul style="list-style-type: none"> ◆ Strong leadership and proactive project management through a very experienced and effective team 	
3.1. Project Coordination	Andriëtte Combrinck	<ul style="list-style-type: none"> ◆ Client liaison, including progress meetings ◆ Coordination of Study Team, provide as day to day link between DWA and Study Team, briefing of sub-consultants, guidance and assistance to Task Leaders and monitoring and control of tasks in close consultation with the Study Leader. 	<ul style="list-style-type: none"> ◆ Attendance of meetings, as required; ◆ Minutes of meetings, as required.
3.2. Project planning & monitoring	Kevin James	<ul style="list-style-type: none"> ◆ Performance monitoring ◆ Financial control, including assessing deviations and change of scope ◆ Study administration, including a secretariat, invoices, project filing 	Progress Reports (maximum of 30 reports) and Financial Reports with each invoice;
3.3. Information management	Andriëtte Combrinck	<ul style="list-style-type: none"> ◆ Establishment and maintenance of an information management system through appropriate tools 	Information system
3.4. Risk assessment	Kevin James	<ul style="list-style-type: none"> ◆ Development and maintenance of a risk assessment process on consultation with the DWA and stakeholders. 	Risk register
3.5. Project closure	Kevin James	<ul style="list-style-type: none"> ◆ Project closure in consultation with the Client 	Close-out Report
4. Water Resources	Johan Rossouw	<ul style="list-style-type: none"> ◆ Comprehensive analysis of the hydrology of the Entire eMkhomazi River catchment, and yield analysis of both Smithfield and Impendle dams, plus WRPM integration with the Mooi-Mgeni river catchments 	
4.1. Update and model hydrology for the whole eMkhomazi River catchment	Estelle van Niekerk	<ul style="list-style-type: none"> ◆ Update land use data ◆ Update and analyse rainfall, evaporation and streamflow data ◆ Determine groundwater resources ◆ Configure and test the WRSM ◆ Calibrate the runoff with the WRSM ◆ Naturalise runoff ◆ Verify and validate stochastic hydrology 	<ul style="list-style-type: none"> ◆ Hydrological assessment of the eMkhomazi River catchment Report ◆ Groundwater Assessment of the eMkhomazi River catchment.

Study tasks	Task Leader	Task activities	Task outcomes & deliverables
4.2. Determine existing and future water requirements for the whole eMkhomazi catchment	Hennie van Staden	<ul style="list-style-type: none"> ◆ Identification, sourcing and reviewing of all background information, ◆ Confirmation of demographic, current population figures, and current water consumption by all sectors, ◆ Confirm transfers from adjacent catchments into the eMkhomazi area ◆ Consultation with relevant 3rd parties ◆ Compiling demand projection scenarios for all sectors, including seasonal peaks ◆ Report to be included in water resource report 	<ul style="list-style-type: none"> ◆ Report consisting of tables, supported by calculations and 3rd party inputs, with presentations prepared in GIS ◆ Report entitled Existing and future water demands for the eMkhomazi River catchment
4.3. Water requirement projections for water transferred to the Mgeni system	Hennie van Staden	<ul style="list-style-type: none"> ◆ These demand projections will be made available by the Client 	Chapter in the Existing and future water demands for the eMkhomazi River catchment report
4.4. Support to the Reserve determination team in the determination of the ecological Reserve	Estelle van Niekerk	<ul style="list-style-type: none"> ◆ Development and analyses of different ecological water requirement scenarios for each Reserve site with the WRYM 	Chapter in the Water Resources Yield Assessment report
4.5. Yield analysis with the WRYM	Johan Rossouw	<ul style="list-style-type: none"> ◆ Configuration and testing of the WRYM ◆ Compilation of storage-yield curves and a priority classification table ◆ Historic and long-term yield analyses for the eMkhomazi Water Project 	Report entitled Water Resources Yield Assessment
4.6. Project future water balance	Jonathan Schroder	<ul style="list-style-type: none"> ◆ Water balances for 2010, 2020 and 2030 ◆ Indication of when augmentation of Phase 1 of the eMkhomazi Water Project will be required 	Chapter in the Water Resources Yield Assessment report
4.7. Development of short-term stochastic yield reliability curves	Andriëtte Combrinck	<ul style="list-style-type: none"> ◆ Short-term yield reliability curves for Phase 1 (Smithfield Dam alone) ◆ Short-term yield reliability curves for Phase 2 (combined Smithfield and Impendle dams) 	Chapter in the Water Resources Yield Assessment report
4.8. Water Resources Planning Model (WRPM)	Jonathan Schroder	<ul style="list-style-type: none"> ◆ Configuration and testing of the WRPM ◆ Develop and define scenarios to be analysed ◆ Recording the final operating rules 	Report entitled Water Resources Planning Model
4.9. Determine firm yields for the proposed Lower eMkhomazi Abstraction Weir	Estelle van Niekerk	<ul style="list-style-type: none"> ◆ Determine historic firm yield from potential weir on the eMkhomazi River upstream of the Estuary 	Chapter in the Water Resources Yield Assessment report
4.10. Determine firm yield of Baynesfield Dam	Estelle van Niekerk	<ul style="list-style-type: none"> ◆ Determine historic firm yield from the dam 	Chapter in the Water Resources Yield Assessment report
4.11. Storage-duration curves of both phases of the eMkhomazi Water Project	Andriëtte Combrinck	<ul style="list-style-type: none"> ◆ Preparation of storage-duration curves in support of the Technical Dams Team to assess pumping heads between the dam and the tunnel inlet 	Chapter in the Water Resources Yield Assessment report

Study tasks	Task Leader	Task activities	Task outcomes & deliverables
4.12. Assessment of the potential for hydropower generation at dams	Jonathan Schroder	<ul style="list-style-type: none"> Determine the hydropower potential of both dams taking ecological water requirement and downstream water users releases into account 	Chapter in the Hydropower Assessment report
5. Engineering Investigation	Danie Badenhorst		
5.1. Optimisation of conveyance system (including balancing dam)	Willem van Wyk	<ul style="list-style-type: none"> Identify layouts Cost alternatives Compare alternatives Identify the best conveyance structures 	Chapter in Feasibility Design report
5.2. Dam position	Danie Badenhorst	<ul style="list-style-type: none"> Identify alternative positions Compare positions 	Chapter in Feasibility Design report
5.3. Materials investigation	Monte van Schalkwyk	<ul style="list-style-type: none"> Identify and test Construction Materials for all structures 	Chapter in Geotechnical Report
5.4. Geomorphologic and seismic investigation	Monte van Schalkwyk	<ul style="list-style-type: none"> Analyse the structural geology and propose for site a seismic risk assessment 	Chapter in Geotechnical Report
5.5. Geotechnical investigation	Monte van Schalkwyk	<ul style="list-style-type: none"> Obtain information regarding the foundations and structural strength required for structures as well as the materials from quarries. 	Chapter in Geotechnical report
5.6. Survey	Mari Trumpelmann	<ul style="list-style-type: none"> Ensure contour maps are available and obtain mps for additional sites as required. 	Contour maps
5.7. Dam type selection	Danie Badenhorst	<ul style="list-style-type: none"> Consider various dam types and identify the best sectional layout 	Chapter in Feasibility Design report
5.8. Establish required storage capacity for dam	Mari Trumpelmann	<ul style="list-style-type: none"> Prepare stage/area/capacity graphs 	Chapter in Feasibility Design Report and Water Resources reports
5.9. Flood & backwater calculations for the final dam	Mari Trumpelmann	<ul style="list-style-type: none"> Analyse the water levels and flows at required positions 	Chapter in Feasibility Design report
5.10. Climatological data for the construction site	Estelle van Niekerk	<ul style="list-style-type: none"> Gather all appropriate climatological data 	Chapter in Feasibility Design report
5.11. Water quality and limnological review	Mike Howard	<ul style="list-style-type: none"> Gather all appropriate water quality and limnological information 	Separate report from Umgeni
5.12. Sediment yield (Smithfield dam and balancing dam)	Aldu le Grange	<ul style="list-style-type: none"> Determine the sediment yield and accumulation for proposed dams 	Chapter in Feasibility Design Report and Water Resources reports
5.13. Land requirements and associated costs	Mari Trumpelmann	<ul style="list-style-type: none"> Determine the land requirements and associated acquisition costs 	Annexure to Feasibility Design Report
5.14. Optimise scheme configuration	Danie Badenhorst	<ul style="list-style-type: none"> Compare components of the scheme and determine the lowest cost layout 	Chapter in Feasibility Design report

Study tasks	Task Leader	Task activities	Task outcomes & deliverables
5.15. Assessment of the potential for hydropower generation at dams	Mari Trumpelmann	<ul style="list-style-type: none"> ◆ Identify the practical options for hydropower ◆ Prepare costs ◆ Discuss / agree end-user and tariffs ◆ Propose potential for hydropower 	Chapter in the Hydropower Assessment report
5.16. Feasibility design of selected scheme	Danie Badenhorst	<ul style="list-style-type: none"> ◆ Conceptual Design of all components of the selected scheme including weirs required for monitoring, access roads etc. 	Feasibility Design Report
5.17. Creating a cost model for the dam	Peter Ramsden	<ul style="list-style-type: none"> ◆ Prepare activities, quantities, costs ◆ Prepare tariffs ◆ Prepare cost estimates ◆ Compare options in phased approach 	Feasibility Design Report
6. Implementation Actions	Kevin James		
6.1. Timing and implementation programme of the project	Danie Badenhorst	<ul style="list-style-type: none"> ◆ Develop an implementation programme 	Implementation programme to be included in Feasibility Design Report, Summary Report & RID
6.2. Project Summary Report	Kevin James	<ul style="list-style-type: none"> ◆ Draft a concise record of all investigations, conclusions and key decisions ◆ Submit to DWA for approval ◆ Distribute to key stakeholders, such as Umgeni Water ◆ Prepare documents to be published on the DWA Website 	Summary Report
6.3. Record of Implementation Decisions (RID)	Kevin James	<ul style="list-style-type: none"> ◆ Draft RID ◆ Submit RID to DWA for approval 	RID
7. Institutional, Financial And Operational Aspects	Peter Ramsden	<ul style="list-style-type: none"> ◆ Determine revenue from sales ◆ Recommended institutional arrangements for funding options and highlight relationships and arrangements (legal, financial, admin etc) ◆ Asset transfer arrangements for) & M 	Institutional, Financial and Operational Aspects Report
8. Socio-Economic Analyses	Eugene de Beer	<ul style="list-style-type: none"> ◆ 	Economic Impact Assessment Report
8.1. Desktop review	Talia Feigenbaum	<ul style="list-style-type: none"> ◆ Orientation & Background Overview ◆ Review Socio-Economic Baseline Assessment of Local Economy ◆ Review pre-feasibility study documentation 	Baseline document
8.2. Data collection	Talia Feigenbaum	<ul style="list-style-type: none"> ◆ Collect and develop additional costs markets for modelling ◆ Collect findings from social facilitation processes to determine anticipated social impacts to model ◆ Provide initial scoping of anticipated economic impacts 	Social Impacts
8.3. Impact Analysis and Assessment	Talia Feigenbaum	<ul style="list-style-type: none"> ◆ Review economic modelling ◆ Develop likely scale of impact for socio-economic impacts using Input-Output Model 	Impact Assessment Report

Study tasks	Task Leader	Task activities	Task outcomes & deliverables
8.4. Cost Benefit Model Assessment	Eugene de Beer	<ul style="list-style-type: none"> ♦ Identify potential alternatives for socio-economic impacts (non-development, carbon neutrality others) ♦ Identify Key Socio-Economic Impacts into Flag System ♦ Identify potential mitigation measures for socio-economic impacts that cannot be avoided; ♦ Development of Final Report and Conclusions 	CBA

1.4.4 Governance of the Study

As the main objective of the project is to augment water supply to the Mgeni system, an area that is managed by Umgeni Water with users mainly from eThekweni Municipality, the study will require the participation from the three spheres of government, as shown in **Figure 1.3**. Liaison with the Client, key stakeholders, interested and affected parties and team members will be managed through various committees, as shown in the diagram below.

The Project Steering Committee's (PSC) main function is to assist the DWA with strategic matters and to coordinate the contributions of other authorities. This committee will oversee the total project, including the Raw Water, Treated Water and Environmental Impact Assessment project components.

Effective liaison, coordination and synchronisation between the DWA Project Manager and the Study Leader and his team are ensured through the Project Management Committee (PMC). The PMC will be responsible for governing and driving the feasibility study, and will include the DWA Project Manager, Umgeni Water, the Study Leader (supported by Task Leaders and support staff) and representatives of any DWA Directorate wishing to participate at any stage of the project. A representative of the eThekweni Metro will also be invited *ad hoc* to the PMC meetings to ensure that the local considerations and situation of interested and affected parties are also accounted for at the appropriate level.

Integration management is crucial to the successful completion of this project and requires sound project management and a strong working relationship within the project team and between the project team and the Client. This will be dealt with in ad hoc meetings between the Client (DWA) and BKS through the **Project Management and Administration Committee**. Further, BKS has assigned Task Leaders to tend to and oversee each of the key tasks of the feasibility study. The individual Task Leaders will report to the Study Leader through the BKS project management team.

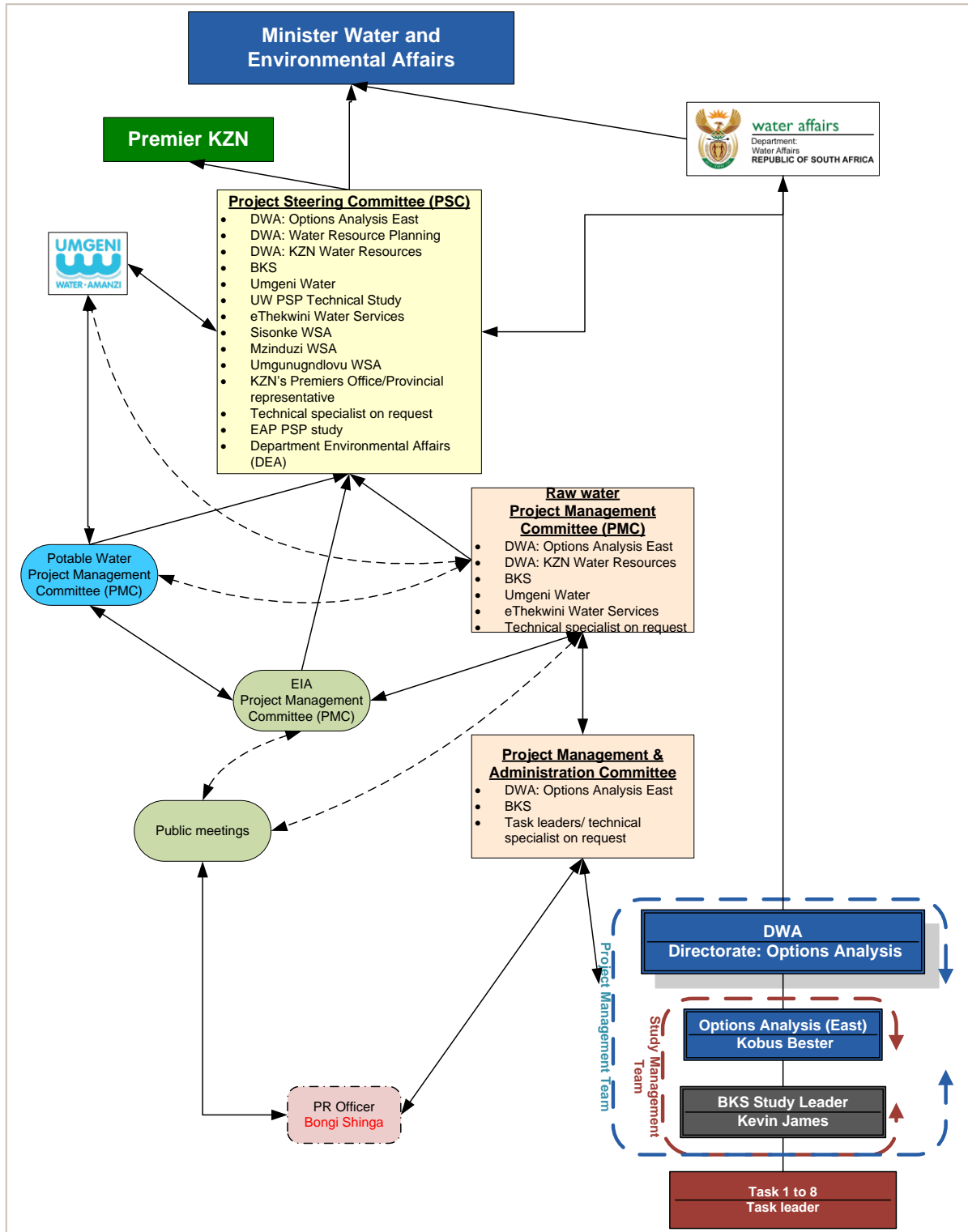


Figure 1.3: eMWP governance structure

1.5 STUDY PROGRAMME

In the original ToR it was indicated that study will run over **five years**. However, water requirement projections from Umgeni indicate imminent water shortages in their system, resulting in the urgent need to implement the eMWP BKS was therefore requested to submit a revised proposal for completing the study in **three years** in order to enable the DWA to

compare the scheme with alternative augmentation options e.g. re-use of water, desalination etc., and to expedite implementation of the appropriate augmentation schemes.

The Study Team has shortened the original tender programme (see **Appendix A**) by:

- ◆ Removing **time buffers** (reducing comments and decision-making time) and advancing some activities to start directly after appointment and before the Inception Report is finalised;
- ◆ Shortening the **project management period** to three years and reduce the number of PMC and PSC meetings; and
- ◆ Conducting a few other changes as summarised in **Table 1** in **Appendix A**.

In shortening the study period a few **assumptions** were made, which are coupled with a number of **risks** that should be managed carefully throughout the duration of the project. Some of the major risks involved are explained below:

- ◆ **External consultants**, e.g. the consultants responsible for the EIA process and the determination of the ecological Reserve, should be appointed as early as possible in the project, and managed very closely to ensure soonest completion of their studies.
- ◆ Currently, a duration of **30 months** is proposed for the separate contract for the **determination of the ecological Reserve** and the DWA plans on appointing a PSP soon. This places a constraint on the timeous completion of the eMWP as the results of the Reserve contract have to feed into the yield analyses and subsequent sizing of Smithfield and Impendle dams. To minimise the time implication, and still complete the eMWP within the required 3-year period, BKS proposes conducting the water demands and yield analyses tasks in **two phases**. The first round of analyses will be based on the current available Reserve results from the completed IFR and EFR studies, which will then be updated during a second phase when the analyses on further classes of the Reserve determination becomes available. The final sizing of the gates in the outlet structure will be done during the feasibility design phase.
- ◆ Assistance to and liaison with the **Environmental Assessment Practitioner** (EAP) was requested in the ToR. Since the EAP PSP has not yet been appointed by DWA and is only likely by about mid-2012, and as it assumed the EAP PSP will be appointed for a 3 year study period, the Client must be aware that some of the requested support activities will not be possible towards the end of the EIA contract period, as the BKS contract may have already come to an end. Also, if the appointment of the EAP is delayed it will complicate the exchange of information between the technical team responsible for the Engineering Investigation and the EAP and may result in further delays.

- ◆ It is of extreme importance that the *social issues*, included under the EIA process, are managed carefully, and that practical solutions are identified to challenges to be faced. BKS has some insights to some the social challenges in KwaZulu- Natal (with reference to the MMTS2 project) and will help identify these aspects in order to mitigate possible delays during implementation.
- ◆ The position of the proposed water treatment plant near Baynesfield should be finalized and the *battery limits of the eMWP* determined as early as possible in the study to ensure that the study can be finalised within the 3-year project duration.
- ◆ An assumption has been made that the *benefit/cost ratios* for alternative schemes will be available by May 2014 and that they will be comparable on a realistic basis. No time has been allowed for the updating of such alternative studies to make them comparable on an equal (apple versus apple) basis. This aspect poses as significant risk to the programme.

2 STUDY TASKS

2.1 TASK 1: PROJECT INCEPTION

The objective of this task was to mobilize the Study Team through the Task Leaders, set up project management and governance structures and initiate activities necessary for compiling the Inception Report.

The Feasibility Study assignment was initiated by the Study Leader on receipt of confirmation that the BKS-led team had been selected to execute the project. Initial discussions with the DWA Project Manager were held in order to shorten the study period from 5 to 3 years (also refer to **Section 1.5**), and this was achieved following with a formal presentation by BKS to members of the Departmental Bid and Adjudication Committee (DBAC) on 12 October 2011. The Inception meeting was held on 22 November 2011, followed by a site visit from 6 to 8 December. Both these occasions were attended by representatives from the DWA Project Management team, BKS Study Management Team, DWA KZN region, UW and some Task Leaders.

Subsequently, all Task Leaders were mobilized and an internal project team meeting was convened on 16 January 2012 to facilitate a full understanding of the assignment, align activities as a first step towards integration and confirm important milestones on the work programme.

According to the ToR, *“the Contract, however, allows revision upon the submission of an Inception Report, which upon agreement and approval of the Client, will then fix the final scope of work of the study”*, therefore during the Inception Phase the study team finalised and redefined the Scope of Work for the assignment, confirmed the composition of the Project Team, the manpower schedule, work programme, revised budget and cash flow.

The first task was to thoroughly review all work done in previous studies (list of previous reports consulted is shown in **Table 1.1**). The review of the reports enabled the team members to appraise the information available and familiarise themselves with the findings from the previous studies so that they could reconsider or refine the proposals made in the original tender and compile the Inception Report. Provision was made for a significant amount of start-up technical work as important reviews and preparatory work was required.

Areas of risk were also identified and mitigating measures were suggested. Where necessary, key information was updated and more detailed work was initiated, as required. Findings and recommendations are regularly discussed with the DWA Project Manager to avoid uncertainties and to help expedite the programme.

Furthermore, the proposed work plan for each task was examined in appropriate detail on the basis of the information available from previous study documents and other sources provided by the DWA.

The outcome of this review is documented in this Inception Report under the specific modules, and is recorded as the final terms of reference, methodology, project team, work programme and revised budget.

Deliverable: Inception Report

2.2 TASK 2: ENVIRONMENTAL SCREENING

The *objective* of the Environmental Screening is to:

- Update the information in the pre-feasibility study and carry out a first order due diligence assessment of the project to identify any potential fatal flaws;
- Provide the background information on the project to allow the PSP to assist the DWA in deriving a scope of work for the EIA study; and
- Integrate with the EIA PSP and peer review the deliverables from that process.

The *approach* to be followed is as follows:

- **Catchment Status Quo Assessment:** An assessment will be undertaken to characterise the nature of the upstream and receiving catchments. The Status Quo will characterise, at a desktop level, the current environmental conditions. The biophysical and social environments will be assessed.
- A **Due Diligence Review** will be undertaken on the expected impacts of the project on the receiving environment. The process utilises a matrix approach as discussed below.

The matrix methodology given in **Table 2.1** shows the parameters that will be utilised when evaluating the environmental risk associated with the property and will be employed in this analysis:

Table 2.1: Example of an Environmental Risk Table

Fatal flaw	High risk	Medium risk	Low risk	No risk	Unknown
where it will cause the potential purchase of the land to be compromised	where it will have a high risk based on existing land use	where it will have a medium risk based on existing land use	where it will have a low risk based on existing land use	where it will have no risk based on existing land use	where the risk is unknown due to insufficient information being available at this stage

The *background information* on the project will be provided along with sufficient technical information (as soon as it becomes available) to allow the EAP to draft the background information document required for the EIA public engagement. Liaison with the EAP will be important to plan the EIA process and to ensure that technical information can be provided in a manner that allows the EIA application to occur timeously.

An **Environmental Screening Report** will be produced which identifies any biophysical or social fatal flaws for the project, and will provide the necessary background information.

A crucial part of the environmental assessment report is a formal enviro-legal assessment. The enviro-legal assessment will consider all relevant environmental legislation that has relevance to the specific project. This includes the Environmental Impact Assessment Regulations (both general and waste specific), water specific, atmospheric emissions, and associated legislation such as heritage, safety and health, and biodiversity. The aim of the enviro-legal assessment is to determine what legal triggers the proposed project has in terms of the relevant legislation.

As a geotechnical investigation may have detrimental impacts on the environment, even though it is an exploratory study to determine what some of the issues for the project as a whole may be, controls to ensure that environmental damage is minimised are best practice. The tool to ensure that the geotechnical investigation is carried out in an appropriate manner is a site- and project-specific Environmental Management Programme (EMPr).

The EMPr is thus a set of controls covering the entire lifecycle of the investigation from planning, site establishment for each site (including access to each site), the drilling process itself, closure of the drilling process, and finally, rehabilitation of the site to acceptable levels (i.e. pre-drilling status as a minimum or better). The EMPr will include all relevant limitations and constraints, as well as mechanisms to ensure compliance therewith. For most effective usage, the EMPr should be monitored for compliance by an Environmental Control Officer (ECO), as a minimum at the start and end of the process, but preferentially during each drilling site establishment process and the close-out per drilling position.

The EMPr will be generated specific to the nature of the wider site to be investigated and will be overseen for compliance by an Environmental Control Officer supplied. The process will thus ultimately deliver the following:

- A process specific Environmental Management Programme (Geotechnical investigation);
- Ongoing compliance auditing will be carried out as part of the monitoring process for any non-compliances or issues that occurred during the geotechnical investigation.

The *peer review of the EIA Process and Documentation* will include the following:

- Integration with EIA PSP with respect to ToR and EIA process;
- Ongoing interaction to confirm process and scheduling;
- Peer review of all reports emanating from the EIA process to evaluate conformance to legislative requirements and best practice
- Peer review of technical aspects of the EIA to determine confidence in information being supplied.

Deliverable: **Environmental Screening Report**
Environmental Management Programme (EMPr) for Geotechnical investigation
Compliance report-back on EIA

2.3 TASK 3: PROJECT MANAGEMENT

The objective of the Project Management Module is to ensure that there is:

- Close and effective liaison between the DWA Project Manager (Kobus Bester) and the Study Management Team (Kevin James/Hermien Pieterse/Andriëtte Combrinck), and, therefore, also with all Task Leaders and their teams,
- Regular and timely progress reporting against the agreed programme,
- Effective management of project costs and expenses against budget, DWA cash flow provisions and progress,
- Assessment of project risks and mitigation thereof,
- Communication with stakeholders to elicit their support for the assignment through provision of information, facilitating fieldwork and developing their confidence in the findings and recommendations,
- Effective support for and integration with the independent and parallel Environmental Assessment Practitioner (EAP) and the public participation process, and

- ◆ Adherence to and compliance with the work programme and milestones.

2.3.1 Task 3.1: Project Co-ordination

Specific organisational arrangements were made during the Inception Phase of the assignment to ensure that the execution of all activities are supervised and managed in an effective way and in accordance with the Client's needs.

The Study Team will be responsible for all logistical arrangements for meetings (excluding the EIA public participation process) and will provide full secretarial and documentation support, such as:

- ◆ Progress Reports;
- ◆ Monthly invoicing, supported by progress reports, financial control, and HDI participation records;
- ◆ Presentations to the DWA Management Team; and
- ◆ Agendas, Minutes and other documentation.

a) *Project meetings (also refer to the Governance Structure in Section 1.4.4)*

Communication between the DWA Project Manager and the Study Leaders of both modules 1 and 2 of the feasibility study will be ensured through the establishment of **Project Management Committees (PMC)**. PMC's will be set up for the Raw water study (module 1), and the EIA study (Module 2) and will be complemented by the PMC of the Potable Water (Umgeni Water) study. The PMC's will be focused on the management of the various components/tasks of the overall project. PMC meetings are planned for every two to three months, and commenced with the Inception Meeting on 22 November 2012. PMC meetings will be held in Durban or Pietermaritzburg.

Further communication between the DWA Project Manager and the PSP will be facilitated by a **Project Management and Administration Committee**, which will be held regularly (proposed monthly) to address the contractual, administrative and project management matters of the project. It is proposed that these meetings be linked to preparation for the PMC meetings and that they be held in Pretoria.

The strategic steering and co-ordination of the project will be provided by a **Project Steering Committee (PSC)** which will bring all the components, i.e. raw water, potable water and EIA together at a higher level, and facilitate communication and sharing of information and

engagement at a strategic level. Apart from the DWA, the PSP and UW, the PSC will also include the key role players of local government such as eThekweni MM, UMgungundluvo and Sisonke DM's, and Msunduzi LM, the WSA's in the study area and key government departments. The PSC meetings are expected to be held 2 or 3 times a year to align with key dates in the work programme. The PSC meetings will be coordinated with the PMC meetings and will also be held in Pietermaritzburg or Durban. The PSC will be supported by technical working groups, which will involve the various task leaders working together to ensure good communication and integrated planning of the project.

The consultation process with the other stakeholders is critical for the successful and timeous execution of the project and therefore a specialist in *Public Relations (PR)*, with thorough understanding of the Study Area has been secured. The PR will identify the key stakeholders and contact details will be obtained and maintained. In consultation with DWA a circular will be prepared to outline the objectives of the study and the role of each of the stakeholders. Interaction with each of the stakeholders will be documented.

Further liaison and reporting on progress will take place through a formalised public participation process (as part of the EIA process) and through integration of modules 1 and 2 of the feasibility study. Further ad hoc meetings are anticipated to ensure coordination of activities, and provide for information sharing.

b) *Coordinate and manage the study team*

The Study Leader will be responsible for overall coordination, monitoring and performance control of the Study Team and will serve as the main link with DWA. The study team will be managed to ensure coordinated output towards key milestones.

2.3.2 Task 3.2: Project planning and monitoring

a) *Project office*

BKS's Head Office in Pretoria will be the *primary project office* out of which the monitoring and co-ordination of the various modules of the feasibility study will be conducted. BKS's Durban office will provide support as a valuable extension of the project office, particularly to Umgeni Water and the Local and District Municipalities. The BKS Durban office may be used for key meetings (depending on size of meetings) and video-conferences are also available if needed.

Microsoft project will be utilised to programme tasks and activities towards improved monitoring of progress under the project and for improved coordination with the other study projects including the potable water study of Umgeni Water.

The programme (refer to **Section 1.5** and **Error! Reference source not found.**) has a detailed work breakdown and provides for the dynamic identification and monitoring of the critical path. The system allows for detecting potential issues at an early stage to enable remedial measures to be instituted to ensure that the Study remains on course. The project programme will also plan and monitor the integration of the activities of modules 1 and 2 and ensure that these are aligned with the UW's Potable Water study.

All of these will be included in a "real time" virtual project office, utilising SharePoint software, and integrated with CMR management, as described in **Section 3.3**.

b) *Quality control of study reports*

Draft copies of all reports will be reviewed by the Study Leader. A hard copy of the reviewed document, marked as final draft, will be presented to the Client for comments. Allowing 10 days for a DWA comment, the documents will then be finalised and five hard copies and a CD /DVD with the files in MSWord, as well as PDF format, will be submitted to the Client.

c) *Financial management*

A financial control system, comprising an interactive spreadsheet model, will be used to monitor and manage budget versus actual expenditure. Actual expenditure against budget will be correlated with percentage completion on tasks so that variances may be managed and corrective action taken.

Invoicing will be submitted monthly, supported by progress reports, financial control, and HDI participation records.

d) *Project progress*

Progress will be tracked in MS Project and will be reported upon. Progress Reports will be submitted at each PCM meeting for discussion, and a progress summary will be submitted with each invoice.

Deliverables: Progress reports

Invoices, with financial reporting

2.3.3 Task 3.3: Information management

In support to the Client's need to use appropriate technology to manage information generated under the project, BKS operates on the full suite of Microsoft software packages and investigated the use of SharePoint as requested by DWA. BKS is positive about adopting SharePoint with the associated CMR software, as a tool to facilitate collaboration and management of information (knowledge) for the benefit of the greater project team. SharePoint has an extensive set of capabilities that could be beneficial to a project of this size and nature. Considering the scope of the works, the period over which the project will be investigated at the feasibility study level and then implemented, the locality of the project and geographical spread of stakeholders, the use of SharePoint could be beneficial if it can be implemented cost efficiently and managed.

SharePoint used within the project environment allows for:

- ◆ Team collaboration and document management;
- ◆ Centralized storage of files and information;
- ◆ Use of built-in search engines for retrieval of documents;
- ◆ Joint work, file sharing and controlled editing of documents;
- ◆ Exchange of comments on and content approval of documentation;
- ◆ Document and meeting workspaces;
- ◆ Web data bases; and
- ◆ Twitter and Facebook.

In terms of the project, the opportunities for use of SharePoint are extensive and therefore the project management team is pragmatic about its use and development over the course of the project. The focus is on "value for money" as the setting up and maintenance of information on SharePoint will be time consuming and costly. However, the benefits will be significant if well managed and therefore careful consideration of the investment was made in terms of time and money during the *Inception Stage* of the project. Discussions with DWA have indicated that SharePoint is already being successfully used within DWA and therefore the whole SharePoint database can be important into the DWA system at the end of the project. *As no budget provision was included in the BKS tender for this service, the "disbursement budget" of the study will be utilized.*

A website is also required for the project so that it may be used to communicate with stakeholders and for the sharing of information. The level of information sharing and extent is different to that achieved through SharePoint as SharePoint provides for a 'closed net of

users'. The website will be developed in conjunction with the DWA website and will have key links to other sites including the EIA process. **Figure 2.1** is an example of a "cloud-based" information system that is currently being investigated for this purpose.

BKS has a full accounting and project management information system (BST) which adequately deals with the financial matters relating to the project.

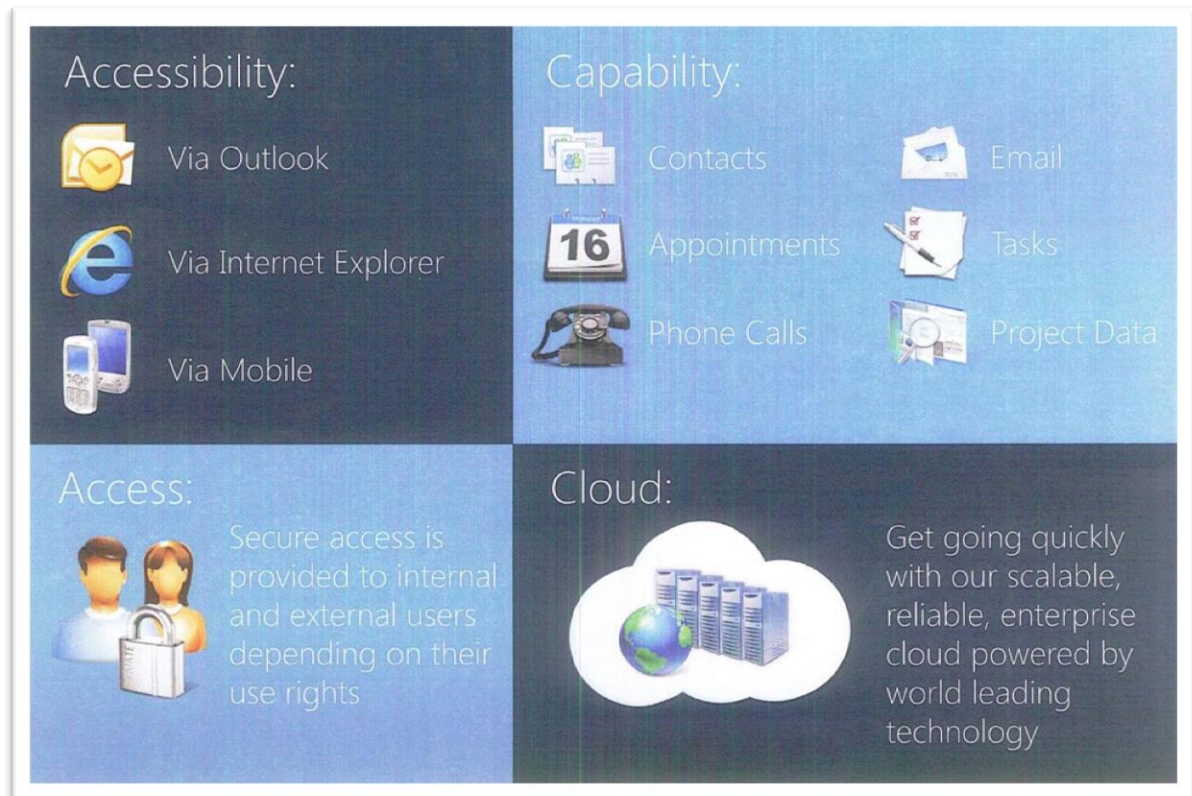


Figure 2.1: Example of a "cloud-based" information system that is currently being investigated

Deliverable: Dynamic Information system

2.3.4 Task 3.4: Risk assessment

The risk assessment will identify risks and management (mitigation) measures for the various risk categories, including technical / operational, environmental, social/political, financial, legal, and institutional. A proactive risk assessment process will be aimed at highlighting issues that may impact on project price (budgets), programme for implementation, quality of work or performance and the overall sustainability of the project. The risk assessment must be a formal process involving the Client, key stakeholders and the PSP's to ensure that a comprehensive set of *real risks* are identified and managed proactively. The resultant risk register must be maintained as a living document through the project to facilitate proactive management. The risk register must differentiate between risks evident during the study

project that impact in the study itself, and those risks that may impact in the implementation of the augmentation scheme and related component eg the potable water supply project or other water supply projects.

The risks will be assessed according to the severity of the potential impact, and the probability of occurrence thereof. A rating is calculated for each risk; being the product of the Impact and Probability. Rankings will be assessed based on **Table 2.2** below and should be agreed to by the Risk Management team.

Table 2.2: Proposed risk assessment rankings

Impact ranking		Probability (likelihood) ranking	
Ranking	Description (descriptors to be added to better define the impact)	Ranking	Description
1	Ignore – event is negligible	1	Adverse event will not occur
2	Minor	2	Highly unlikely that the event will occur
3	Significant	3	Event can occur
4	Severe	4	Highly likely that the event will occur
5	Catastrophic impact	5	Adverse event will definitely occur

The identified risks with impacts, ratings and how they will be managed are then carried in the risk register with a format along the lines of that set out in **Table 2.3**.

Table 2.3: Proposed format of risk register

Ref	Issue	Cause	Impact	Inherent Risk			Mitigation measures	Residual Risk			Status	Action Plan
				Impact	Likelihood	Rating		Impact	Likelihood	Rating		

Deliverable: Risk register

2.3.5 Task 3.5: Project Closure

The objective of this Task is to collect and transfer the final study information to DWA. All records, minutes and agendas will be provided electronically to the Client. A closure report, in the DWA format, will also be submitted.

Deliverable: Close-out Report

2.4 TASK 4: WATER RESOURCES

The overall *objective* of this task is to assess the water resources of the eMkhomazi River catchment. This will include the updating of the hydrology, water requirements and water availability (yields) in order to be able to calculate the water balance in the eMkhomazi River catchment and to determine how much water is available for transfers to support water users in the Mgeni River system. The hydrology task calibration will be done for the period ending September 2008. If longer reliable records are available, it will be extent to that date. The surface water resources of the adjacent upper uMlazi River (U60A) will also be extended to September 2008. The water resources task is a critical component of the whole study in order to be able to size the infrastructure which will be required for the water supply system.

2.4.1 Task 4.1: Update and model streamflow hydrology of the whole eMkhomazi River catchment

a) *Update and analyse rainfall data for eMkhomazi River catchment*

In order to be able to create representative rainfall records per quaternary catchment and at points of interest, the Rain-IMS model will be used together with an overlay of the topography to select, screen, validate, class, patch and create monthly catchment rainfall records. Some errors in the updated WRSM2005 project (including *inter alia* the exclusion of farm dams in the catchment) were found by the Study Team in the U10-catchment, therefore it was decided to rather re-do most of the activities linked to the updating of the hydrology and not only extend the data used in the WRSM2005 project. Rainfall data is the main driver of the WRSM2000 model and every effort will be made to select the best available stations and groupings of rainfall stations for calibration and simulation. The selected gauges will be compared with gauges used in previous studies.

b) *Update and analyse evaporation data for eMkhomazi catchment*

There are no DWA evaporation pans in the U10 catchment. The *approach* to be followed will be a combined approach of using direct (ARC-data) and indirect (Penmen-Monteith data from the University of KwaZulu-Natal) methods to measure evaporation. Careful attention will be given to the factors which transform measured evaporation to actual evaporation from dams to establish the validity of using the official Chapman factors when relying on indirect methods of measurement. A review will be done of the pan-to-dam factors using the most applicable available information. The original pan-to-dam factors were based on direct methods of measuring evaporation data. A sensitivity analysis of the pan-to-dam factors will, however, be done before any changes to the existing factors will be accepted and

implemented. Other reports and results in adjacent catchments (e.g. Mgeni River) will be consulted.

c) *Update land use data for the eMkhomazi River catchment*

Data on historical, current and future land use, water use and return flows of the various sectors, which include forestry, alien vegetation, irrigation and farm dams, will be collected from previous studies, and compared with information from the two sets of land-use database referenced in the ToR.

d) *Update and analyse streamflow data for eMkhomazi River catchment*

The DWA Directorate: Hydrological Services and the DWA KZN Regional Office will be contacted to establish the availability of the flow gauges and data. The available streamflow gauges in the U10 catchment will be assessed and evaluated in co-operation with DWA Directorate: Hydrological Services. Patching might be achieved by extension of the flow records or visual patching by using a daily graphical software package (*daily.exe*). Results and methods will, however, be discussed with the Client. There is one new flow gauge (U1H009) since 2004 in the catchment, which might be useful to evaluate and improve the patching. This gauge has only five years of data, but will be utilised as far as possible to improve the flow records, especially to fill in gaps in gauge U1H006.

Reviews: DWA

e) *Determine the groundwater resources of the eMkhomazi River catchment and its interaction with surface water*

The task will consist of two phases:

- ◆ Phase 1: Desktop study, review of existing information data evaluation and aquifer delineation
- ◆ Phase 2: Groundwater flow balance modelling and Reporting

Phase 1: Desktop Study

A desktop study will be conducted to review existing information within the study area. Specific emphasis will be on the groundwater component. Existing data will be evaluated and interpreted to obtain the following information:

- ◆ Spatial and temporal water requirements;

- ◆ Availability of groundwater relative to the exploitable yields;
- ◆ Groundwater quality and its influence on supply;
- ◆ Water use sectors within the study area;
- ◆ Rainfall distribution for quaternary catchments; and
- ◆ Estimates of the storage components and volumes of the main aquifer zones.

Phase 2: Groundwater flow balance modelling and reporting

A temporal water balance assessment will be done based on the main inflow and outflow components. The modelling will be done with a dynamic mass balance model with statistical analyses functionalities. The output of these models can be used to determine future groundwater allocations for application in the water use licensing process.

If required by the Client, detailed numerical modelling can be done on catchments identified during this phase. Numerical modelling is, however, not included in this proposal or budget.

Deliverable: Groundwater Assessment Report

f) *Configure and test the Water Resources Simulation Model (WRSM) for the eMkhomazi River catchment*

The WRSM will be configured for all 13 quaternary catchments (U10A to U10M) and other points of interest for calibration and simulation of historical and natural flow sequences.

The **approach** will be to use the latest version of the WRSM from DWA and the WR2005 setup as a starting point. As part of assessing data availability during the preparation of this proposal, some errors were noticed with the way that the WR2005-study in U10 was configured, e.g. farm dams with a total capacity exceeding 15 million m³ were ignored which is a significant oversight. This will be rectified in the WRSM model setup by the Study Team. The setup will be refined where necessary, e.g. include wetlands and potential dams. All input data will be carefully scrutinised, corrected and updated where necessary. Some quaternary catchments, e.g. U10D, U10E and U10H, contain significant wetlands and special attention to the modelling, using the wetland module, will be given. Lumping of small dams and usage from the dams will also receive priority attention. An updated schematic diagram for the whole eMkhomazi River catchment will be prepared as part of the configuration and the WRSM model will be thoroughly tested and results will be compared with measured data and previous reports.

g) Calibrate the runoff generated by the WRSM

Flow gauges considered to be reliable and valuable in calibration will be used to calibrate the observed flows against simulated flows. Preliminary assessment of the flow gauges and previous studies shows that there are two gauges, U1H005 and U1H006, where calibration might be possible. The new flow gauge, U1H009, will be used to monitor the simulated flows in the WRSM. Patching of the flow gauges has already been addressed in the flow evaluation task, but will be confirmed in this module.

The **deliverable** will be calibration parameters supported by graphs and statistics to describe the reliability of the calibration. A schematic diagram of the system will also be included.

h) Naturalise streamflow records of the various sub-catchments of the eMkhomazi River

The **approach** to be followed will be to regionalise the WRSM calibration parameters by exploring adjacent catchment and calibration parameters. Naturalised flow data will be created through simulation with the WRSM model, allowing for inclusion of the historical water abstractions and return flows. Stationary tests and validation and verification results (described below) will be the deciding factor how the final natural flow record will be assembled. Natural monthly flow records per quaternary catchment and at points of interest will be generated. Mass plots will be prepared of the natural flows to show stationarity.

i) Verify and validate stochastic hydrology generated for the eMkhomazi River catchment

This task will be executed to ensure that the stochastic streamflow sequences generated from the natural flow records are plausible and realistic.

The STOMSA model in the latest WRYM-IMS will be used to generate stochastic sequences. Various statistical characteristic values are calculated for each sequence to ensure that the stochastic streamflow sequences generated from the natural flow records are plausible and realistic. It could be possible at this stage to return to the natural flow records where possible adjustments could be required if the results from validation and verification are not satisfactory.

Reviews: The hydrology of the eMkhomazi River catchment is of primary importance in this study and it is proposed that an external reviewer, with input from DWA, may be appointed by Umgeni Water or eThekweni to review and approve results at completion of selected sub-

tasks, e.g. reviews and approval after completion of the rainfall, calibration and flow simulation actions.

Deliverable: Hydrological assessment of the eMkhomazi River catchment Report

2.4.2 Task 4.2: Determine existing and future water requirements for the whole eMkhomazi River catchment

The *objective* of this task is to review the existing studies in terms of water requirement figures and together with desktop studies provide reliable and up-to-date figures for the current and future requirements of the area to be utilised to determine water requirements.

Forecasting water requirements from a rational base is a fundamental requirement to quantify the impact of changes by population demographics, business and industrial growth and technical interventions that can alter water requirements in the supply area.

Typically the requirement scenarios would incorporate the estimated effects on requirements of future interventions per water supply area to assess the current supply capacity and to identify growth in the system over the forecast period under high, medium and low scenarios.

Figure 2.2 illustrates the approach to be adopted for the collection of data for the demand projection study.



Figure 2.2: Model for data collection

a) *Data collection and verification*

Figure 2.3 illustrates the approach to be adopted for the collection and verification of data collected.

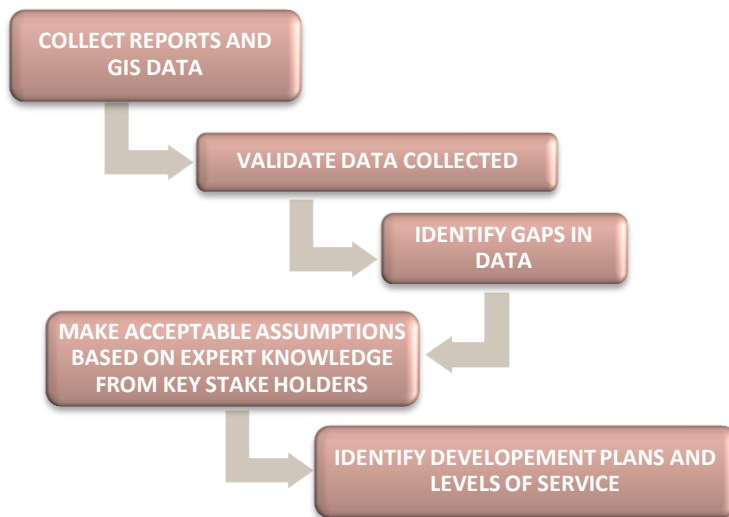


Figure 2.3: Model for data collection and verification

b) Previous reports

Previous reports relevant to the engineering study will be acquired by the study team. All reports that are relevant to the water requirement projection will be analysed, listed and referred to during the compilation of base data for the demand projections.

c) Social and technical surveys

A demographic review will commence once the latest aerial photography is obtained. The purpose of this task will be to review and analyse all base data utilised in previous studies and compared with the latest data available. The review and analysis will mainly relate to the following:

- ◆ Comparative study areas;
- ◆ Smallest geographic level of population figures (villages, sub places, etc.);
- ◆ Size of existing population;
- ◆ Historic growth rates;
- ◆ Expected future growth rates;
- ◆ Future population estimates; and
- ◆ Changes in socio-economic circumstances.

In *urban and peri-urban* areas meter readings from the billing figures will be obtained and the consumption will be calculated. Consultation with Local Municipalities and relevant Provincial Departments, such as Housing, will be undertaken. These will also be compared to the results from previous studies.

Demographic projections: Population projections will be made based on the latest demographic knowledge and information such as Stats SA Community Survey, DWA settlement data. This will be augmented with the latest research and data available on future growth expectations and distributions, including the impact of HIV and AIDS, fertility rates, mortality rates and migration and urbanization, and economic depression.

Domestic water requirements: Water demand scenarios applicable to the supply area will be adopted after approval from the DWA. All growth scenarios and projected water demands need to be confirmed with the Local Authorities. Seasonal populations are also to be catered for.

For rural areas the following guideline is suggested:

- ◆ rural villages – stand connections: 60 ℓ/c/d
- ◆ dense rural towns with some economic development and water-borne sewerage: 150 to 250 ℓ/c/d

For the purpose of determining the rural population, recent satellite images will be used to provide house counts and against which average household numbers will be used to determine population.

Commercial, industrial and agricultural water requirements: The same methodology will be followed to determine the existing water use and future projections for the commercial, industrial and agricultural sectors as with the domestic sector.

Seasonal peak factors: Peaks periods and dry months in which agriculture could play a more significant role in water consumption will be calculated for each sector and incorporated into the water resource model.

Deliverable: Spreadsheet with all water users in the eMkhomazi River catchment showing historic, current and future water requirements

2.4.3 Task 4.3: Water demand projections for water transferred to the Mgeni System

The **objective** of this task will be to determine water requirement projections for water transfer from the eMkhomazi River to the Mgeni River system.

The **approach** will be to liaise with the Client and Umgeni Water to obtain the information required. Results published from the Reconciliation Strategy (refer to **Figure 2.4**) shows that

the Mgeni System, already in deficit, will need additional augmentation by 2016 even with the commissioning of Spring Grove Dam.

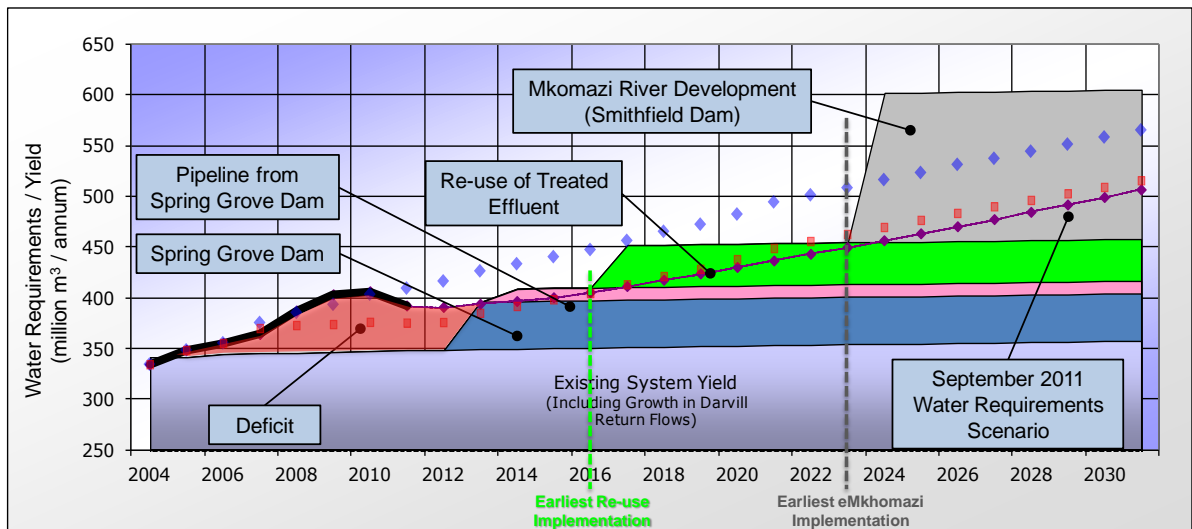


Figure 2.4: Water balance of the Mgeni System, September 2011 (source: Reconciliation Strategy)

The **deliverable** will be updated water requirement projections for the transfer of water to the Mgeni River System.

Deliverable: **Spreadsheet** with all water users in the Mgeni System showing historic, current and future water requirements

2.4.4 Task 4.4: Support to the Reserve determination team in the determination of the Ecological Reserve

The **objective** is to support the Reserve Team in developing and analysing the various scenarios for each Reserve site and will involve using the Water Resources Yield Model (WRYM) setup (described later) to run various development levels and/or scenarios at specific points of interests. Monthly flow sequences at various points in the eMkhomazi River will be analysed. Graphs showing seasonal, maximum and minimum flows as well as dam trajectories and information on supply and deficits will be produced to assist the Reserve Team in selecting the most favourable scenario.

Deliverable: **Chapter in Water Resources Yield Assessment Report**

2.4.5 Task 4.5: Yield analysis with the WRYM

A detailed WRYM model for the entire eMkhomazi River catchment will be set up, including a schematic layout of the system, incorporating all existing and future abstraction points, return

flows and potential infrastructure in the catchment. All sub-tasks discussed below will be incorporated in an overall report for this task entitled **Water Resources Yield Assessment**.

a) *Configuration and testing of a network for the WRYM*

The system will be configured in the WRIMS on at least a quaternary level, but sub-divided into smaller areas (so-called quinerries) to include potential future dams (Bulwer, Ngwadeni and the proposed Lower eMkhomazi River abstraction weir as well as Smithfield Dam). Provision will also be made to include other possible future developments e.g. irrigation as well as the Reserve sites.

The present day system, similar to the WRSM setup, will be configured and used as the base scenario. An optimised operating rule will be analysed and proposed with the potential future dams included in the layout, taking into account evaporation from the different dams, as well as pumping heads at the dams.

The WRYM will be thoroughly tested and results will be compared with actual observations as well as the WRSM. Trajectories of dam levels and storage will also support the testing of the system. Potential shortages of water supply to existing and future users will be checked to ensure that the system functions as expected.

b) *Compilation of storage-yield curves*

The output from the WRYM analyses includes storage determination for all dams, in terms of both volumes and levels. Storage-yield curves for all requested dams in the eMkhomazi River catchment will be compiled for different scenarios and different development levels. Storage-yield duration curves, also for both volumes and levels, will also be produced from the WRYM output to assist in the calculation of required pumping heads at the different dams.

c) *Compilation of a user priority classification table*

A user priority classification table will be prepared in discussions between the Study Team, DWA and Umgeni Water. The water requirements of the different users will be split into different assurances of supply. This will probably be similar to the priority classification table for the Mooi-Mgeni System and will be incorporated in the Water Resources Planning Model (WRPM) input data files.

d) Determine historic firm yields of the eMkhomazi Water Project

The historic firm yield from potential dams in the eMkhomazi River system will be determined with the WRYM at different time horizons (e.g. current, 2020, 2030, 2040) including updated water requirements and return flows as well as other infrastructure developments in the catchment at the same time horizons. The analyses will be done for both phases of the eMkhomazi Water Project, Phase 1 (Smithfield Dam) and Phase 2 (combined Smithfield and Impendle dams). The implementation dates of potential dams will be confirmed with the Client before the different scenarios are analysed. All analyses will be executed with and without ecological water requirements (Reserve). Compliance to supply the Reserve and other water users will be monitored. The impact of the ecological water requirements on water availability and/or implementation dates of new required infrastructure will be highlighted. Provision has been made for 12 scenarios to be analysed (six with the Reserve included and six without the Reserve). An assessment of the operating rules will also be done to derive the most favourable operating rule (to maximise water availability/yield) to be used in the operation of the system.

e) Determine long-term stochastic yields of the eMkhomazi Water Project

The long-term stochastic yields will be determined for both phases of the eMkhomazi Water Project derived from 1 000 stochastic generated sequences. This will be done for the medium growth requirements of the eMkhomazi River catchment at 2020, 2030 and 2040 development levels, both with and without the ecological water requirements. The yields will be determined for the following assurances of supply: 75%, 90%, 95%, 98%, 99% and 99.5%.

Deliverable: Water Resources Yield Assessment Report

2.4.6 Task 4.6: Project future water balance

The current and future water balances for the updated eMkhomazi River system will initially be calculated at 10-year intervals between 2010 and 2030 to get a 1st order indication of water availability in the catchment. The timing of augmentation from MWP-1 will primarily be determined by the water balance in the Mgeni River catchment, i.e. when the Mooi-Mgeni Phase 2 scheme can no longer meet the growing water requirements in the Mgeni River system at an acceptable assurance of supply level. This information, together with the amount of augmentation needs in the Mgeni River system, will be obtained from the on-going *Reconciliation Strategy Study*. A water balance in the eMkhomazi River catchment will confirm the water availability for the MWP-1 as well as the water balance within the

catchment, taking local water requirements growth into account. Furthermore, the water balance will provide a good initial indication of the timing of Phase 2. The confirmation of the required implementation date of Phase 2 of the MWP will then be refined with the WRPM in **Task 4.8**.

Deliverable: Chapter in **Water Resources Yield Assessment Report**

2.4.7 Task 4.7: Development of short-term stochastic yield reliability curves

Short-term yield reliability curves for both Phase 1 (Smithfield Dam alone) and Phase 2 (combined Smithfield and Impendle dams) will be determined. A decision month (or decision months) needs to be confirmed with DWA and Umgeni Water. It is foreseen that maximum three decision months will be required. The WRYM will be used to develop short-term curves based on 1 001 stochastic sequences. A decision must be taken between the Study Team and the Client whether to include or exclude the ecological water requirements when doing the analyses.

The output from the short-term curves (COF-files) will be included in the WRPM input data (FM.DAT) files.

Deliverable: Chapter in **Water Resources Yield Assessment Report**

Independent experts maybe appointed by either DWA or UW to review the methodology, results and report.

2.4.8 Task 4.8: Water Resources Planning Model (WRPM)

The approach will be to build on the WRYM configuration for the eMkhomazi River catchment and compile the additional data files required for the WRPM. The schematic layout will be very similar to the WRYM. The setup for the eMkhomazi River catchment will be configured so as to ensure that the channel and node numbers in the input data files are different from those of the existing WRPM setup of the Mooi-Mgeni system. This will be done to improve efficiency when linking the two systems. As mentioned in the ToR, and discussed under **Section 2.4.5c**) of this report, the correct water user priority classifications will be used for each respective system.

a) Configuration and testing of the WRPM

The WRPM set up for the eMkhomazi River catchment on its own will be tested to ensure correct operation and behaviour of the system. Thereafter the WRPM for the eMkhomazi River catchment will be linked with the Mooi-Mgeni system to form the eMkhomazi-Mooi-Mgeni (eMMM) system. The Study Team will propose decision dates for the WRPM, to be confirmed by DWA and Umgeni Water. The decision dates will also be used in the derivation of the short-term curves (see **Task 4.7**). Copies of the working WRPM setup for the eMMM system will be made available to DWA and Umgeni Water.

It is proposed that the DWA Project Manager appoint an independent expert PSP to review the methodology, results and report.

b) Develop and define scenarios to be analysed with the WRPM

The approach will be to develop, define and then analyse various scenarios in consultation with DWA and UW. These scenarios could consider alternative operating rules and different water requirement scenarios, variations in user priority classifications, alternative sources of water as well as the assessment of the extent to which existing transfers from the Mooi River will continue to provide water to the Mgeni River. The extent to which Spring Grove Dam and Mearns Weir (Mooi-Mgeni Transfer Scheme – MMTS Phases 1 and 2) will be used after phasing in and implementation of Phases 1 and 2 of the eMkhomazi Water Project will also be assessed to determine the extent to which the Mgeni River system will rely on the yield from the MMTS over time, as well the extent of yield from the MMTS that could supply other areas, such as the Lower Thukela. The knowledge of the extent to which the Mgeni River will rely on the yield from the MMTS will also allow the operations and maintenance costs of the MMTS to be taken into account in the cost of water from the Mgeni River. The possibility of it being more economical to continue using the MMTS after implementation of the eMWP will also be explored. The WRPM will be used to confirm and refine the timing of eMWP-2 as initially estimated in **Task 4.6**. The scenarios will be evaluated for the period until 2030, or until a date as specified by DWA during the execution of the project.

Results from the analyses in the form of box plots for the total eMMM system will be presented to and discussed with the Client and Mgeni Water. These box plots could include dam trajectories, water supply to different users or other results as specified/requested by the Client and will also be included in the report. Twelve scenarios have been allowed for in the budget.

c) **Recording the final operating rules recommended for the eMkhomazi Water Project**

All the sub-tasks discussed under this task will be described and summarised in a report entitled **Water Resources Planning Model**. This will include results emanating from the WRPM analyses to cover, *inter alia*, final operating rules for the eMkhomazi River catchment, the eMMM System, the utilisation of water from the different dams inside the eMMM System, as well as possibility of utilising water from Spring Grove Dam (on the Mooi River) to support the lower Thukela River during periods when Spring Grove Dam will not be required to transfer water to Midmar Dam.

Deliverable: Water Resources Planning Model Report

2.4.9 Task 4.9: Determine firm yields for the proposed Lower eMkhomazi Abstraction Weir

The yield from a potential weir on the eMkhomazi River upstream of the eMkhomazi Estuary to support water supply to possibly eThekweni Municipality and the Middle South Coast users will be determined with the WRYM. This abstraction weir will be supported with water releases made from Smithfield Dam. Water losses between Smithfield Dam and the weir, ecological water requirements (both river and estuary) and expected water abstractions for users from the river between the dam and the weir needs to be taken into account. Water requirements for the supply area will be obtained from Umgeni Water.

Deliverable: Chapter in Water Resources Yield Assessment Report

2.4.10 Task 4.10: Determine firm yield from Baynesfield Dam

The yield from Baynesfield Dam at the outlet of the proposed eMkhomazi River transfer tunnel will be determined with the WRYM using the extended hydrology of the uMlazi River if the dam needs to be included in the eMkhomazi Water Project. The historic firm yield will be determined *after* obtaining the water requirements from the dam. If the water requirements are more than the determined historic firm yield, i.e. no surplus yield is available after supplying the water demands, then the assurance of supply at which the water is currently supplied to the owner of the dam will be determined.

This task will only be executed on instruction from the Client as it is dependent on the decision whether to include Baynesfield in the augmentation scheme.

Deliverable: Chapter in Water Resources Yield Assessment Report

2.4.11 Task 4.11: Storage-duration curves of both phases of the eMkhomazi Water Project

Storage-duration curves, similar to the description under **Task 4.5**, will be prepared for Smithfield and Impendle dams from output from the WRYM, taking into account the recommended operating rules and medium growth water requirement projections in 2020, 2030 and 2040. The storage can either be included as volumes or levels. The storage level results, abstracted from the WRYM output, will be used to prepare water surface level duration curves for the engineering investigations to assess pumping heads between the dam and the tunnel inlet.

Sedimentation will be taken into account when determining the live (or net) capacities of both dams (see **Task 5.12**).

Deliverable: Chapter in **Water Resources Yield Assessment Report**

2.4.12 Task 4.12: Assessment of the potential for hydropower generation at dams

The *objective* of the task is to determine the hydropower potential of both dams taking releases for ecological water requirement and downstream water users into account.

The *approach* to be followed will be to utilise the WRYM set-up for **Tasks 4.5** and **4.11** and determine the time series of water releases and associated water levels in the dams based on the medium water requirement scenario for three time slices (2020, 2030 and 2040). Although the WRYM models hydropower on a monthly basis and not on a daily basis, the conversion of monthly flows to daily flows and changes in water levels, will be important in establishing the characteristics of the potential hydropower plants e.g. design head, operating range and associated efficiency and potential load factors, that need to be included in the WRYM to model hydropower. The conversion of monthly flows to daily flows will be conducted based on the daily flow records at gauging station U1H005, which lies in between the two dam sites, and for which daily flow records are available from 1960 to 2000. Once the suitable configurations of the hydropower plants have been established the WRYM will be used to model hydropower potential for two scenarios for each of the time slices. The first scenario will model the hydropower potential based on only the water releases for downstream users and the Reserve. The second scenario will model the hydropower potential for these releases, plus additional water that can be released after satisfying the projected water requirements of the Mgeni River system for the various time slices. The results will be presented as average power production as well as energy and power duration curves.

Previously a favourable pumped-storage scheme was identified by Eskom that could be linked to the Impendle Dam. BKS will update the information on this scheme, should it be required, and will compare this scheme with the most favourable scheme in the Mzimvubu River catchment and the possible scheme in the Steelpoort River (Project Tubatse), and thereby provide a concise updated and comparative assessment of the pumped-storage potential linked to the MWP.

The **deliverable** will be the graphical and tabular results of the hydropower generation potential of the 2 dams, which will be further analysed for economic viability in **Task 5.15**. The work executed under this task will be **reviewed** and used by the engineering team working on **Task 5.15**.

Deliverable: Hydropower Assessment Report

2.5 TASK 5: ENGINEERING INVESTIGATIONS¹

The general approach regarding the engineering investigations will include the following:

- ◆ Identification of the most economical and lowest cost scheme meeting the requirements of supplying water into the Umlaas Road/Cato Ride pipeline from the eMkhomazi River. Focus will be placed on the identification, comparison and optimization of alternative conveyance systems and applicable Smithfield Dam positions, considering phasing and possible future Impendle Dam contributions.
- ◆ Liaison with the environmental screening and EIA processes will be provided for to ensure that all environmental alternatives are identified and applicable information is provided timeously. The process will be fast tracked as far as possible. A matrix will be determined with all processes to ensure that all approvals are obtained when required.
- ◆ A phased approach will be followed throughout the investigation programme, and all work will be conducted through close collaboration amongst the Engineering Team, Environmental Team and the Geotechnical Investigation Team to ensure continuous exchange of information and maximum efficiency. This phased approach is demonstrated in the project programme.
- ◆ On-going comparison on a phased basis of schemes supplying water to the Umgeni Water Supply area. Information received from Umgeni Water regarding their alternative schemes (including desalination) will be brought into the comparison using discounting techniques to ensure the comparison of schemes on an equal footing.

¹ Unless otherwise specified, all references to a dam in this section refers to Smithfield Dam (Phase 1 of the eMWP)

2.5.1 Task 5.1: Optimisation of conveyance system (including balancing dam)

The **objective** of this task is to identify, compare and optimize the conveyance systems (tunnel, pipelines, pump stations) from the proposed Smithfield Dam via a balancing dam in the Baynesfield area from where water will be conveyed by a pumping/gravity pipeline system to the planned Water Treatment Plant of Umgeni Water. On the request of the Client it was agreed that the system to be analysed will include all conveyance structures from Smithfield Dam to Umlaas Road/Cato Ridge pipeline tie in point.

The **approach** to be followed will include identification and conceptual design of gravity and/or pressure (almost horizontal) tunnel(s), as well as pump station/pipeline options for economical supply of water to the new water treatment plant. Costs and implementation programmes of the options will be determined.

Alternative conveyance routes will initially be considered to discharge in the upper reaches of the Mzunduzi River and the Mlazi River in the Baynesfield area. A screening approach based on a first order total (capital cost plus operational costs) present value cost comparison will be followed. The deliverable following this screening exercise will be the identification of the preferred conveyance route which will be further optimized. This screening analysis will be described in an appendix to the feasibility study.

The selected conveyance option will make provision for the following: (For this inception Report it is assumed that the conveyance system will discharge into the Baynesfield area)

- ◆ Phase 1 (supply of water from Smithfield Dam) of the project as well as Phase 2 (supply of water from Impendle Dam).
- ◆ Emphasis will be given to providing one outlet structure at the Smithfield Dam to supply water to the Baynesfield area and to meet the ecological water requirements of the eMkhomazi River.
- ◆ Provision of a complete gravity tunnel from Smithfield Dam with one pumping station on the downstream end will be considered.
- ◆ The possibility of canals/ or pipelines for the last 5 km of the conveyance structure will be assessed.
- ◆ The position of a balancing dam at the downstream end of the tunnel will be determined and the possible use of the Baynesfield Dam will be considered. It is already noted that the Baynesfield Dam spillway is not conventional and may require replacement if the dam is to be raised for storage balance.

- ◆ The potential for hydropower will be considered for both the gravity feed and pumping systems. Hydropower generated from water supply will be used for the pumping of water into the system as well as for incorporation into the national grid by selling it to Eskom.
- ◆ A site visit will be undertaken by members of the Engineering team to identify potential pipeline routes at the feasibility study level after due consideration of topography, geographic features, potential environmental impacts, existing infrastructure and accessibility for construction and future maintenance purposes. Hydraulic gradients and longitudinal sections will be established for alternative pipeline diameters and routes. Required pipeline wall thicknesses and pressure ratings will be determined for each pipeline alternative to allow for realistic capital cost estimates. Hydraulic and cost calculations will be prepared for both pressurized and free surface flow tunnel conveyance systems. Pumping energy requirements and energy generation potential will be considered for both pipeline and tunnel conveyance systems.
- ◆ For the investigation of pumped systems, preliminary pipeline system curves will be plotted once the preliminary pipeline design has been completed (pipeline lengths and diameters have been determined). Initial selection of pumps and motors will be performed for all the options. Pump well depths will be determined and draft pump station layouts will be prepared to establish the footprints of the various stations. Potential sites for the pump stations will be identified. Budget estimates for the various options will be estimated and a total budget for the required works will be determined.

Comparison of options will be carried out using URV discounting techniques and the following are important issues:

- ◆ Capital and running (O&M) costs will be determined for projected demands using the cost model (hydro economic analyses). All standard parameters (analysis period, economic or replacement life of each component will be used in accordance with the DWA-VAPS Guidelines.
- ◆ The pipeline route and diameter, pump station power and electricity relationships of the rising mains will be optimized.
- ◆ Both pressurized and free surface flow systems and associated pumping energy requirements and energy generation potential will be considered for the tunnel conveyance system, whichever is applicable.
- ◆ BKS will endeavour to establish an energy pricing structure for the scheme with Eskom but if such an agreement on a tariff structure going forward cannot be obtained from Eskom then a 'best' assumption as to future escalation will be proposed (based on

Eskom guidelines) for DWA approval prior to undertaking the calculations. It is not expected that Eskom will be prepared to guarantee estimated future tariff escalations.

- ◆ Sensitivity analysis of cost or the sale of electricity will be carried out.
- ◆ Potential phasing of the conveyance system infrastructure will be considered.
- ◆ The potential to implement operating rules to eliminate or minimize the energy requirements and capital cost of the conveyance system (consider minimum Smithfield dam operating level to transfer projected demands before and after the construction of the Impendle Dam) will be assessed.

The selected conveyance system (and related dam position – see next task) to be investigated further (including geotechnical investigations) will be the *deliverable*. Preliminary layout drawings of the tunnel or pump station sites and internal arrangement of pump stations will be provided. This conveyance system will be optimised in **Task 5.14**, Optimization of scheme.

This task will be carried out in conjunction with **Task 5.2**, Dam position, as only one outlet structure may be required for Smithfield Dam thus negating having an Intake to the tunnel/pipeline and a further outlet works at the dam for releases.

Deliverable: Annexure to **Feasibility Design Report**

2.5.2 Task 5.2: Dam position

The *objective* of this task is to finally determine the Smithfield Dam site and the balancing dam site downstream of the tunnel in the Baynesfield area.

The following *approach* will be followed:

- ◆ Alternative dam sites will be identified in the vicinity of the dam site identified in the Pre-feasibility study. One site will be positioned upstream of the proposed tunnel intake so as to combine it with the dam outlet structure. The existing proposed layout provides for separate structures for the dam outlet and the intake to the proposed tunnel/conveyance structure. The dam position in relation to the tunnel entrance will therefore be carefully considered.
- ◆ Topographical constraints as well as spillway options will be considered, for example an embankment dam in the main river channel with a spillway in the saddle may be an option.
- ◆ Lowest cost dam to be identified. This will be done in conjunction with the task for the dam type selection.

- The existing Baynesfield Dam is an embankment with a central overspill section that has been covered by a concrete slab and provided with splitters on the downstream slope. This safety of this type of dam is questionable and may not be easily raised. It is therefore suggested that a new balancing dam site be investigated at a location downstream of the Baynesfield Dam which was previously proposed for balance storage.
- Location of borrow areas for construction materials and quarries will be considered. The location of these material sources will preferably be located below FSL in the dam basin to limit the environmental impact.

The *deliverable* of this task will include finally selected positions for the Smithfield and Balancing dams meeting environmental requirements, and lowest cost requirements and considering best access to the water conveyance structures. This will allow for the further investigation of foundations and availability of construction materials.

Deliverable: Chapter in Feasibility Design Report

2.5.3 Task 5.3: Materials investigation

In the ToR a Provisional Sum of R1.5 million (VAT inclusive) has been allowed to cover the physical investigations that will be required for the materials investigation. This sum will cover the costs for work by a geophysics contractor, an excavator contractor, a drilling contractor and a soils laboratory. Supervision of these contracts, the logging of test pits and boreholes cores and the preparation of reports on these investigations, will remain the responsibility of the PSP, and the cost for this is included in the professional fees. The Provisional Sum may have to be adjusted once quotations from contractors have been received.

During the 1997 pre-feasibility investigations, no detailed investigations for rock as rockfill, concrete aggregate, rip-rap or filter materials or for semi-pervious embankment materials had been conducted. These investigations must be conducted during the present investigation stage.

Preliminary investigations (8 test pits and laboratory tests on 6 samples) of two potential borrow areas for impervious embankment fill had been conducted during 1997. Although sufficient quantities (>1,5 million m³) had been estimated, the clay contents of a number of samples were above the acceptable limit. More detailed investigations (closer spaced test pits and more laboratory testing) are required.

The **objective** of the materials investigation is to locate and investigate suitable sources for dam construction materials (i.e. semi-pervious and impervious embankment fill, filter materials, coarse and fine concrete aggregates, rockfill and rip-rap) as close as possible to and preferably within the dam basins of the Smithfield dam site, the raised/improved Baynesfield Dam or an alternative balancing dam. Suitable borrow areas for pipeline bedding and backfill material must also be located and investigated at intervals of not more than 10 km along the conveyance route between the Smithfield Dam and the Baynesfield area, should a pipeline become part of the conveyance system and if suitable material cannot be sourced from the pipe trench. For all material types, it will be attempted to prove the availability and suitability of 200% of the actual quantity required for construction.

A phased **approach** will be followed throughout the investigation programme, and all work will be conducted in close collaboration with the Engineering Team to ensure continuous exchange of information and maximum efficiency. The following phases are envisaged:

- ◆ Desk study of all available geotechnical information, topographical maps and satellite images to identify possible sources of construction materials.
- ◆ Initial site visit with members of the Engineering Team to confirm, as far as possible, the results of desktop studies and to determine the best methods for further investigations.
- ◆ Preliminary materials investigation will be conducted by means of a tracked excavator to dig widely spaced test pits to a depth of about 5 m in potential borrow areas and along the conveyance route. Access to properties and the methods of investigation will need to be negotiated with land owners compensation for disturbance to land has not been provided for in the budget. Representative disturbed samples will be taken for laboratory testing. Seismic refraction surveys will be conducted (to determine depth of weathering) at potential quarry sites for aggregate, rip-rap and rockfill. Samples of sand from natural and commercial sources will be collected and subjected to laboratory tests to determine their suitability as fine aggregate and filter materials.

Information obtained during the Desktop study and Preliminary material investigation will be used by the Engineering Team to compare the feasibility of various types of dams and conveyance systems so that the detailed material investigations can focus on the material types that actually will be required.

- ◆ Detailed materials investigations will include TLB test pits on a 50 m to 100 m grid in selected borrow areas and at 250 m intervals along the pipeline route, laboratory testing of representative samples, core drilling on a spacing of about 50m in selected

sites for rock quarries and testing of rock specimens for suitability as concrete aggregate, rockfill, crusher sand and rip-rap.

The following *deliverables*:

- ◆ The results of the Desktop Study and initial site visit will be incorporated in the Inception Report.
- ◆ The results of the Preliminary materials investigations will be documented in a draft report that will be used by the Engineering Team to assist with the selection of the most appropriate type of dam and conveyance system.
- ◆ The results of the preliminary and the detailed materials investigations will be documented in a geotechnical feasibility report that will contain sufficient information for tender design and costing of the scheme.
- ◆ All material sources will be indicated on a GIS map (surveyed with sub-meter GPS) and will show their aerial extent and distances to the respective dams.

Deliverable: Chapter in **Geotechnical Report**

2.5.4 Task 5.4: Geomorphologic and seismic investigation (Structural geology and Seismic risk assessment)

A study of available geological maps will be conducted in order to identify all potentially active faults that might affect the Smithfield and other dam site and the conveyance route. This information will also be used in a probabilistic and deterministic seismic risk assessment that will be conducted by a specialist seismologist.

Deliverable: Chapter in **Geotechnical Report**

2.5.5 Task 5.5: Geotechnical investigation

In the ToR, a Provisional Sum of R2.5 million (VAT inclusive) has been allowed to cover the physical investigations that will be required for the geotechnical investigation. This will cover the costs for work by a geophysics contractor, an excavator contractor drilling contractor and a soil and rock testing laboratory. *Supervision of these contracts, the logging of test pits and boreholes cores, the taking of samples for laboratory testing and the preparation of reports on these investigations, will remain the responsibility of the PSP*, and the cost for that is included in the professional fees. The Provisional Sum will have to be adjusted once quotations from contractors have been received and additional funds will almost certainly be required if a tunnel option has to be investigated. It is anticipated that an additional amount

of approximately R3 million will be required to complete the investigation work required for a tunnel option. Subsequently, a motivation was submitted on 2 February 2012 to motivate and explain the additional work required. The motivation is included in **Appendix E**. Since this amount has not been approved, it has not been included in the budget.

a) Dam foundations

The **objectives** of the geotechnical investigations for the Smithfield Dam and the upgrading of the Baynesfield Dam (if adopted otherwise for a new balancing dam) are (i) to assist the Engineering Team with the selection of the most suitable dam centre line and type of dam, (ii) to identify possible fatal flaws in the foundation conditions of the selected site and (iii) to investigate the geotechnical properties of the founding materials in order to recommend suitable founding depths and treatment of the foundations.

During reconnaissance investigations in October 1997, 4 alternative centre lines, designated “Centre line A”, “Centre line B”, “Centre line C” and “Upper centre line” were identified for the proposed Smithfield Dam. Centre lines A, B and C are predominantly underlain by mudstone with a dolerite intrusion on the left flanks. These rocks are expected to be deeply weathered and not suitable for the founding of a concrete dam. The Upper centre line is underlain by a 25 m to 30 m thick dolerite sill that occupies both flank and has caused induration of the siltstone in the river section.

The Upper centre line was investigated by means of 4 cored boreholes during the pre-feasibility investigations. The depth of weathering was found to vary between about 2 m to 5 m along the dolerite flanks, about 7,5 m in the indurated siltstone river section, 9 m in the weathered siltstone of the upper left flank and >12 m beneath a thick layer of transported soil on the upper right flank. Uncertainties that remain are (i) founding conditions on the right flank, particularly the nature and extent of the thick alluvium and the siltstone/dolerite contact, (ii) the extent of the dolerite sill along the flanks and (iii) founding conditions for potential spillways along the flanks.

A phased **approach** will be followed throughout the investigation programme, and all work will be conducted in close collaboration with the Engineering Team to ensure continuous exchange of information and maximum efficiency. The following phases are envisaged:

- ◆ Desktop study of all available geotechnical information, topographical maps and satellite images to identify alternative centre lines, major faults and areas of potential slope instability within the dam basins.

- ◆ Initial site visit with members of the Engineering team to confirm the results of the desk study and to collect information on alternative centre lines, potentially unstable slopes and other factors that might affect the suitability of the sites, e.g. faults or shear zones.
- ◆ Preliminary site investigation by means of seismic refraction surveys along alternative dam centre lines (to determine depth of weathering, particularly along faults). During this investigation, a traxcavator (same as the one used for the preliminary materials investigation) will be employed for the digging of deep test pits to inspect the properties (permeability and compressibility) of foundation materials along the flanks and at faults. The traxcavator will also be used to investigate the properties of colluvial deposits that may pose a threat for instability around the rim of the reservoir.
- ◆ Detailed site investigations will involve geological mapping of the dam site and core drilling within the footprint of the selected position for a dam and for all ancillary structures (e.g. spillway, outlet works, tunnel inlet etc.) Detailed logging of the cores will be undertaken and the foundation and downstream materials will be classified and evaluated in terms of deformability, shear strength permeability and erodibility.

The following *deliverables*:

- ◆ The results of the first phase investigations will be documented in a draft report that will be used by the Engineering Team to select the most favourable centre line and preferred type of dam.
- ◆ The results of the first and final phases will be documented in a geotechnical feasibility report that contains sufficient information for the tender design and preliminary costing of the dam.

b) Slopes of dam basin

The *objective* is to determine the risk that any part or parts of the reservoir rim will be subject to large scale slope failure as a result of fluctuating water levels or due to other natural causes.

The first phase *approach* will comprise a desktop study of topographical and geological maps and satellite images to identify potentially unstable slopes. This will be followed up with an inspection of conditions on the ground as well as limited test pitting, sampling and testing of colluvial materials and joint surveys on exposed rock faces. This information will be used to assess the risk of mobilising material of sufficient volume to significantly raise the level of the reservoir.

The final **geotechnical report** will contain a section describing the results of the investigation and will include mapping of areas that pose a significant risk. Protective measures will be recommended if needed.

c) Conveyance system

During the 1997 reconnaissance investigations, the surface geology along a proposed conveyance route was studied from available geological mapping. It was concluded that the proposed tunnel will pass through sedimentary rocks intruded by dolerite. At tunnel level, the rock masses were expected to be unweathered or slightly weathered except at the portals and areas of low cover where moderately to completely weathered rock was anticipated. The sedimentary rocks are typically of medium strength (35 MPa – 100MPa), while the dolerite is very strong (<200 MPa). The mudstones and some siltstones might be prone to slaking upon exposure to the atmosphere, while some of the dolerites might also be non-durable. The most important discontinuities in the rock mass are the sub-horizontal bedding planes in the sedimentary rocks and irregular contact zones between the dolerite intrusions and the sedimentary rocks. The proposed inlet portal at the Smithfield Dam is on a steep slope in moderately strong rock, while at Richmond and Baynesfield the topography is flat and deep weathering is anticipated.

The **objectives** of the investigation are to determine the geological conditions at the pump station sites and along the conveyance route in as far as they would affect (i) construction (e.g. excavatability, trench stability, potential water problems and use of excavated material for pipe bedding and backfill) and (ii) tunnel construction (excavation methods, support requirements and potential problems with water and gas).

A phased **approach** will be followed throughout the investigation programme, and all work will be conducted in close collaboration with the Engineering Team to ensure continuous exchange of information and maximum efficiency. The following phases are envisaged:

- ◆ Desktop study of all available geotechnical and geohydrological information (e.g. water levels and yields of existing boreholes), topographical maps and satellite images to identify rock types, dykes, shear zones and fault zones that intersect the conveyance route.
- ◆ Initial site visit with members of the Engineering Team to confirm the results of the desk study and to collect information on alternative alignments if necessary, and to determine the most suitable methods for further investigations.

- ◆ Preliminary site investigation by means of seismic refraction surveys at tunnel portals and areas of shallow tunnel cover, and tracked excavator pits (same machine as used for the preliminary materials investigation) to determine excavability for pipeline construction.
- ◆ Detailed site investigation will be conducted for either the tunnel option or the pipeline option. For both options geological mapping of the route corridor will be conducted to facilitate the location of boreholes or test pits. For the tunnel option, cored boreholes will be drilled at selected points to intersect typical and potential problematic tunnel conditions. Detailed logging of the cores will be undertaken and the material will be classified in terms of excavation and support categories. Trenches excavated at portals will, also, supply discontinuity data. Laboratory tests will be conducted to determine the strength, deformability and durability of representative material types. For the pipeline option, TLB pits will be dug at 250 m (or closer) intervals along the route. Additional pits will be excavated at all crossings and where a variance in conditions is evident. Core drilling will be undertaken at road and river crossings where pipe jacking or other structures might be required.

The **results** of the investigation will be documented in a geotechnical feasibility report with sufficient information for the tender design and preliminary costing of the conveyance structures.

Deliverable: Chapter in **Geotechnical Report**

2.5.6 Task 5.6: Survey

The **objective** of the task is to provide sufficient topographical surveys of the areas for all required infrastructure to support the water resources analyses and feasibility study level designs. Coverage of the following must be provided for:

- ◆ All infrastructures for the full water supply scheme. This will include all structures mentioned under **Task 5.16** - Feasibility study level design. A disbursement cost is included for addressing changes of the layout e.g. a different position for the Smithfield Dam upstream of the proposed Intake to the tunnel;
- ◆ All developed areas e.g. housing in the dam reservoir area. This activity must be completed at an early stage to provide base information for the study, including the water demand estimates.

**Tunnel
geotechnical
investigations
additional R3
million**

The DWA have surveys available for most of the areas. A small disbursement provision of R50 000 is included in the budget for additional lidar surveys, such as maybe required for the balancing dam.

Deliverable: Land use and **Contour maps** at appropriate scales (electronic and hard copy)

2.5.7 Task 5.7: Dam type selection

The identified Smithfield Dam and the possible raising, rehabilitation of Baynesfield Dam (if required) or the possible additional balancing dam position determined in **Task 5.2** will be evaluated for various dam types and spillway layouts.

The **approach** will include:

- ◆ Identification of various layouts regarding spillway location and combined dam wall configurations.
- ◆ Safety Inspection of the Baynesfield Dam and identification of the preferred method of dam rising (if required) considering safety criteria.
- ◆ Identification of various material zones for embankment dams, e.g. earth core rockfill dams, concrete face rockfill dams, asphalt core rockfill dams, earthfill embankment dams and the like. (Available materials to be accommodated as far as possible)
- ◆ Consideration of Roller Compacted Concrete (RCC) and the possibility of the new wet-paste RCC mix developed for Spring Grove Dam for concrete dams.
- ◆ Costing of all the identified layouts.
- ◆ Identification and consideration of other aspects e.g. those related to environmental impacts and constructability.
- ◆ A phased approach will be followed throughout the investigation programme, and all work will be conducted in close collaboration with the Environmental, Materials and Foundation Investigation Team to ensure continuous exchange of information and maximum efficiency.

The **deliverable** will be the identification of the most attractive dam types considering costs, environmental criteria, foundation conditions and availability of construction materials.

This task will be carried out in conjunction with the tasks related to optimization.

Deliverable: Chapter in **Feasibility Design Report**

2.5.8 Task 5.8: Establish required storage capacity for dam

The objective of this task is to prepare the storage capacity relationship for all dam sites and establish the size of the dam required.

The following approach will be followed:

- The contour plans will be studied and the area - stage storage volume will be determined.
- Working with the water resources team on **Task 4.5**, the storage yield curves will be converted to yield-cost curves using URV's to establish the best reservoir capacity and dam height from a cost and yield perspective. Environmental issues that may impact on the size of dam will be taken into account.

The *deliverable* will include the graphs and associated information for use in the yield determination and selection of the dam capacity for feasibility design.

Deliverable: Chapter in Feasibility Design and Water Resources reports

2.5.9 Task 5.9: Flood & backwater calculations for the final dam

The *objective* is to provide water level and flow information required for the design of the dams, weirs and the outlet for the conveyance structure etc.

Backwater analyses will be carried out in the eMkhomazi River as well as in the Mlazi River at the outlet of the conveyance structure. The following will be determined:

- Backwater curves for the 1:100 year flood condition to establish the purchase line of the dams (The impact of a 50 year sediment deposition will be taken into consideration).
- Flood levels in the rivers at strategic positions will be determined, e.g. backwater effect at the toes of dams.
- Information for the design of inundation of the gauging weirs at floods with acceptable recurrence intervals.

The following *deliverables*:

- Backwater levels required for dam design.
- Backwater levels around the dam reservoir associated with the 1:100 year spilling of the dam for determination of purchase lines.

Deliverable: Chapter in Feasibility Design Report

2.5.10 Task 5.10: Climatological data for the construction site

The *objective* is to provide climatological data for the various development sites.

The *approach* will be to collect climatological records, which will include daily and monthly rainfall, monthly evaporation data as well as temperature data in the study area. A decision on the most appropriate records applicable to the construction sites will be made on studying the topography, Mean Annual Precipitation (MAP), Mean Annual Evaporation (MAE) and other characteristics of the area. Daily data from the 2004-WRC-study (Developed by The Institute for Commercial Forestry Research (ICFR) in conjunction with the School of Bioresources Engineering and Environmental Hydrology (BEEH), University of KwaZulu-Natal, (Pietermaritzburg Campus) will be used in setting the mean annual precipitation (MAP) and number of days with rainfall above 10 mm for construction purposes.

Climatological data will be *delivered* for the determination of system yields and for the design of the infrastructure.

Deliverable: Chapter in Feasibility Design Report

2.5.11 Task 5.11: Water quality and limnological review

The *objective* of the Water Quality and Limnology Specialist Task will be to assess the limnological and water quality requirements of the selected dam and to request and manage the information required for the following aspects:

- ◆ Access and Analyse Existing Water Quality Data;
- ◆ Catchment Assessment;
- ◆ Limnological assessment; and
- ◆ Need for Multiple Off-takes.

Deliverable: Chapter in Feasibility Design Report

2.5.12 Task 5.12: Sediment yield (Smithfield dam and balancing dam)

As the storage of water is the main purpose of dams (reservoirs), sedimentation in reservoirs has resulted in serious economic losses and environmental and aesthetic problems. It is therefore important to consider sedimentation issues, such as catchment sediment yield

potential and the associated reservoir sediment deposition potential, in the planning of a water resources system as sediment related factors can impact on the active life of a dam, positioning of outlets, designing of abstraction works, backwater curves upstream of dams and weirs and can have detrimental impact on the riverine ecology.

Sediment yield has previously been determined during the Mgeni River System Analysis Study (1994). It is assumed that these sediment predictions were based on previous sediment yield methodologies.

The **objective** of this task is to verify the 50-year sediment deposition related information for both the Smithfield Dam and the balancing dam (if necessary). Previous related work will be evaluated and refined, if possible.

The **approach** will be to evaluate or improve the previously determined sedimentation yield. It is proposed that the catchment sediment yield be re-determined in terms of updated regional sediment yield information. It is proposed that the methodology as per the *Sediment Yield Prediction for South Africa: 2010 Edition* be used to determine the required sediment yields. This sediment yield prediction methodology caters for ten relatively homogenous sediment yield regions with specific sediment yield prediction methods to be applied to each.

Since the eMkhomazi River Catchment is located in Sediment Region 5, for which measured sediment yield values vary between 30 t/km².a and 1 037 t/km².a, the study related sediment yield predictions will be based on the relevant Region 5 derived empirical equation.

Based on sediment yield values, reservoir sediment values will be determined by the empirical Rooseboom equation to compute equivalent 50 year-sediment volumes. The **results** of the sediment yield investigation will be used during the yield analyses as well as the engineering investigation.

Deliverable: Chapter in **Feasibility Design and Water Resources Yield Assessment reports**

2.5.13 Task 5.13: Land requirements and associated costs

The **objective** is to identify the required land and the ownership of the land at a **desktop level**.

In the **approach** the selected scheme will be analysed regarding ownership and developmental requirements. Information relating to land acquisition for the selected scheme will be provided.

The **deliverable** will be the identification of land ownership types and estimation of budget requirements for land acquisition and will be covered in the design report. Provision for a Specialist Valuer has been included in the budget under disbursements and the Valuer will be secured during the course of the project once the extent of the infrastructure to be developed has been finalized. Valuers utilized during the implementation of Spring Grove Dam will have the recent experience and knowledge for this task and will be able to provide information suitable for the feasibility study level. Agreement on the approach and level of detail will be ascertained before work commences.

Deliverable: Chapter in Feasibility Design Report

2.5.14 Task 5.14: Optimise scheme configuration

The **objective** of this task will be to optimise the scheme configuration based on the following:

- ◆ Findings of the optimization of the conveyance structure (tunnel or pipeline);
- ◆ Geotechnical investigations;
- ◆ Environmental considerations identified during the environmental screening and EIA studies;
- ◆ Specific requirements by the various affected institutions; and
- ◆ Other requirements as may be identified during the course of the study.

The **approach** will be to assess a combination of scheme components to identify optional scheme layouts using the cost model and already prepared cost estimates. These optional scheme layouts will be compared using unit reference value calculations as described in the task on optimization of the conveyance structure.

In this task emphasis will be placed on assessing the sensitivity of:

- ◆ Cost of electricity;
- ◆ Sales of electricity;
- ◆ Capital cost variations for construction of the scheme; and
- ◆ Commencement date of the project and cost of finance over the period of implementation.

The **deliverable** of this task is an optimised scheme configuration which will be designed at the feasibility study level.

Deliverable: Chapter in Feasibility Design Report

2.5.15 Task 5.15: Assessment of the potential for hydropower generation at dams

The objective is to consider the potential of hydropower generation for the selected scheme .

The following positions will be considered for hydropower development:

- In stream flow releases from Smithfield Dam;
- Water supply through the conveyance structure, to the Baynesfield Dam or new Balancing Dam; and
- In stream flow releases and water supply from Impendle Dam.

The water flow information received from the Water Resources Team will be evaluated regarding the possibility of the generation of power. The characteristics of the hydro power plants, such as capacity [say 80 % assurance], type of turbine, rated speed, number of sets, vertical or horizontal shaft will be prepared and drawings showing indicative layout will be prepared. The civil structural and M&E requirements as well as the transmission requirements and the total cost will be determined. Unit reference values for the hydropower installation as well as for the total scheme will be determined. These calculations will be tailored to suit connecting to the ESKOM network and selling power to ESKOM as well as for BOOT private contracts supplying power to areas in close proximity e.g. Richmond. It is noted that, in one of the transfer options, water has to be pumped from Smithfield Dam to the higher lying tunnel entrance and that the tunnel will be sloped to accommodate frictional losses, however this will be confirmed during the optimisation of the conveyance infrastructure. In this case very little energy will be available for hydro-power development at the outlet of the tunnel. Despite this, various configurations will be considered during the layout phase to assess the hydro-power potential of the scheme.

All other associated infrastructure required for the project e.g. bulk electricity transmission lines, access roads etc will be identified and included in the cost estimate to assess final feasibility of the project.

The **deliverable** will be the identification of hydro-power potential, revenue to be generated through sales, operational, legal and institutional arrangements.

Deliverable: Chapter in **Hydropower Assessment Report**

2.5.16 Task 5.16: Feasibility design of selected scheme

The *objective* of this task is to design the selected scheme to an appropriate level to expedite the process for reaching tender design stage during implementation.

The development final infrastructure layouts will be done in close consultation with the Environmental and Geotechnical Teams after completion of the aforementioned tasks and especially the materials and geotechnical investigation. Throughout the design, the availability of construction materials will be considered to ensure the lowest cost option is identified. Furthermore, operating rules developed for the system will be accommodated and the structures will be designed to meet the requirements.

The design considerations for the various components of the schemes will include, but will not necessarily be limited to, the following:

For the dams:

- ◆ Determination of frequency analysis required for the flood hydrology of the design of the Smithfield Dam, Baynesfield Dam or new Balancing Dam, as required.
- ◆ Best and most economical spillway and type of dam. The Baynesfield dam (if required) will be designed at the feasibility study level to include rehabilitation works to meet international safety standards.
- ◆ Sizing of the dams in accordance with the water yield analyses to ensure required system yields are met.
- ◆ River diversion requirements during construction.
- ◆ Compliance with environmental requirements.
- ◆ Sedimentation and limnological aspects.
- ◆ Backwater analysis, downstream and upstream of the dams.
- ◆ Foundation conditions at the dam structures as well as the conveyance structure.
- ◆ Hydraulic design aspects.
- ◆ Seepage control in the dam foundation, e.g. grouting or slurry trench or core trench if necessary.
- ◆ Slope stability for embankment dams as well as overturning and sliding stability of concrete gravity structures.
- ◆ Low maintenance design e.g. durable medium for slope protection of embankment.
- ◆ Multiple draw off outlet structure for the dams.
- ◆ Access roads and relocation of services impacted upon by the proposed infrastructure.
- ◆ Power supply and electrical connections.

- ◆ Monitoring structures e.g. gauging weirs in the river upstream and downstream of the Smithfield and Baynesfield Dams or new balancing dam as well as downstream of the conveyance structure.
- ◆ Determination of quantities and use of unit rates obtained from recent tenders for the determination of realistic final cost estimates for the proposed scheme.
- ◆ Telemetry for the operation of the scheme.

The design considerations for the conveyance structures (pump station, pipelines and tunnel if applicable), including connection infrastructure from the outlet portal to the balancing dam and/or the new proposed treatment works in the Baynesfield area and the connecting infrastructure from possible new balancing dam to the proposed treatment works at Baynesfield, will include:.

- ◆ Design of the conveyance structure, considering air requirements, access adits, surcharge chambers.
- ◆ Rock support and liner design.
- ◆ Groundwater effects.
- ◆ Multiple Intake structure with pump station included, if required.
- ◆ Hydraulic design of all components including energy absorption structures e.g. at the outlet of the tunnel, flow gauging structures, if required, etc.

It is understood that the conveyance structures from the downstream end of the tunnel to Umlaas Road pipelines will be investigated and designed by Umgeni Water.

Deliverables

- ◆ Final layout and conceptual design of the complete raw water scheme for realistic cost estimates.
- ◆ A Design Report including final cost estimations at the feasibility study level.

Deliverable: Feasibility Design Report

2.5.17 Task 5.17: Creating a cost model for the dam

The *objective* is to develop a cost model for the estimation of capital costs for the various components of the scheme (all components from eMkhomazi River to Umlaas Road into Mgeni Pipeline) and to carry out analyses to compare options.

Options for comparison as follows will be identified with DWA and Umgeni Water:

- ◆ The scheme described in this report, the eMkhomazi River to Umlaas Road pipeline transfer scheme (with inputs from UW on the potable water scheme).
- ◆ Desalination of seawater and supply to common areas.
- ◆ Treatment of used water and distribution into an existing system by e.g. adding water into Inanda Dam for re-use.
- ◆ These schemes will be identified, described and costed such that they are comparable with each other and therefore completion of this task is dependent on the inputs of others at the key times reached in the programme which is a major risk.

The costing of components of the eMkhomazi transfer scheme will be done in phases and then updated as further information becomes available, especially following completion of the geotechnical investigations. There will be close consultation between the design team and the cost estimator during the development of the model. The following phases are foreseen:

- ◆ Costing of conveyance structures during optimization of the conveyance structure task;
- ◆ Costing of dam options during the dam position task;
- ◆ Costing during the screening phase;
- ◆ Ongoing costing of dam and conveyance structure options during the geotechnical investigations;
- ◆ Costing of the rehabilitation and raising of Baynesfield Dam (if required) or a new balancing dam;
- ◆ Costing of the connection conveyance structures between the tunnel and the Baynesfield Dam or to the new Balancing Dam;
- ◆ Costing of all additional infrastructure required, e.g. gauging weirs, transmission lines et; and
- ◆ The cost of the final selected scheme will be determined at the feasibility study level.
- ◆ Provision of conveyance infrastructure from the Balancing Dam to Umlaas Road pipeline with information to be supplied by Umgeni Water.

Rates for activities that will make up 80% of the project capital cost will be developed from first principles considering the cost for labour, plant, material, energy and transport (hauling). A disbursement cost has been included for obtaining the break down costs from a Professional Service Provider. The activities mentioned in the VAPS study will be followed, but site specific aspects will be considered, e.g. specialised costs for cut-offs for dams as well as the new RCC mix developed for RCC.

The principles on which the costing model is based, and assumptions made, will be described in a stand-alone report. Reference will also be made to the rates required for determining the reference unit value of the water supplied.

Provision has been made for two updates of the cost model to make it comparable with other alternative schemes using URV's based on discounting techniques e.g. the desalination option being prepared by Umgeni Water.

Deliverable: Chapter in **Feasibility Design Report** with
Electronic version of the costing model

2.6 TASK 6: IMPLEMENTATION ACTIONS

2.6.1 Task 6.1: Timing and implementation programme

The deficit of water in the Mgeni System, will determine the desired commission date of the eMkhomazi Scheme, as determined **Tasks 4.6** and **4.8**. The *objective* of this task is to develop a realistic implementation programme for the development of the selected dam and conveyance infrastructure, with guidelines for the development of the overall scheme, based on future water use projections. It is however, a distinct reality that the implementation programme for the supply of water may not be able to meet the desired implementation date and therefore other water supply and water demand measures will have to be implemented in parallel with the project.

An implementation programme based on experience of the team in design, construction and construction monitoring and based on additional information from suppliers and manufacturers will be provided. As far as possible, a realistic assessment of the milestones up to commissioning and handover stage of the project will be made. A recommendation with motivation regarding the packaging of works for successful implementation will be included.

The *deliverable* will be an MSProject programme accompanied by a concise write-up containing the assumptions made in developing the implementation programme as well as recommendations on 'project packaging' and phasing.

Deliverable: MSProject programme in **RID, Feasibility Design** and **Summary reports**

2.6.2 Task 6.2: Project Summary Report

The **objective** of the Project Summary Report is to provide decision makers and key stakeholders a concise record for the study covering all the investigations, findings and recommendations, also including findings from the EIA should it be completed in time for its inclusion.

The document will summarise all reports from the study, and will give a summarised reference to previous studies describing the sequence of investigations. This document will provide a complete description of the project and the key decisions taken, without elaborating too much on the technical detail of the work completed as this will be included in separate study reports. Conclusions and recommendations will be given along with proposals for further work to be done or actions to be taken before implementation of the scheme. As requested in the ToR, the Project Summary Report will be drafted in a format related to the former White Papers, to be suitable for publication in both the Government Gazette and other DWA publications.

The deliverable is a Project Summary Report as required by the Client, written in 11-point size Arial font of up to approximately 10 pages. This report will contain some elementary drawings, showing the layout and basic design.

Deliverable: Project Summary Report

2.6.3 Task 6.3: Record of Implementation Decisions (RID)

A Memorandum of Agreement between the Chief Directorates Integrated Water Resources Planning (IWRP) and Infrastructure Development (ID) dated March 2005, clarifies *“the division and/or sharing of roles, responsibilities and accountability of the Chief Directorates through the various project phases from planning to the commissioning of a project”*.

The Memorandum further states that once the *detail planning of a Project has been concluded* and the scheme configuration and other related requirements for implementation has been approved by the Minister, the project shall be **formally handed** over from the CD:IWRP to the CD:ID for implementation. This formal handing-over of the Project is concluded through an official document, the RID. The RID describes the scope of the Project the specific configuration of the scheme, summarises all decisions as approved, the required implementation timelines, the financing or funding arrangements and the finalisation of required institutional arrangements.

The **RID** will be submitted to the DWA: Integrated Water Resources Planning (IWRP) and Infrastructure Development for comments and approval as a key deliverable under the project.

Deliverable: Record of Implementation Decisions

2.7 TASK 7: INSTITUTIONAL, FINANCIAL AND OPERATIONAL ASPECTS

2.7.1 Operations

The **approach** will be to consider various institutional arrangements and to consult on these with DWA and UW. It is recognised that the operation of the dam and transfer works must be integrated with the Mgeni System (Midmar Dam, Spring Grove Dam, etc.) and therefore it must be seen in a systems context, i.e. the institutional arrangement for operations is likely to comprise a contractual relationship between DWA and UW whereby UW operates and maintains the works.

It is proposed that a draft heads of agreement for such a contract be provided as a **deliverable** for this task.

2.7.2 Development Phase

The most suitable arrangement for the development phase will be determined. The decision will be influenced by the funding arrangements, i.e. the extent to which the project is developed on UW's Balance Sheet, funded by the National Treasury or through loan financing.

2.7.3 Financial

The **approach** will be to develop a long term funding model which will be used in consultation with UW, eThekweni, DWA and National Treasury to consider various approaches to funding the works (on UW's Balance Sheet, National Treasury contribution, or on another utility's balance sheet).

There are however a number of important factors to be considered when assessing the financial/funding model:

- ◆ UW / DWA are currently developing Spring Grove Dam during the same repayment window as the eMkhomazi project. Umgeni Water's Balance Sheet is already highly

leveraged. The impact on the balance sheet of both schemes will thus have to be assessed.

- The National Water Infrastructure Agency was not implemented even though it was approved by Cabinet, and it may be some time before it is implemented, if at all.
- The major customers supplied with bulk potable water by Umgeni Water (e.g. eThekweni) are tariff sensitive. The resulting impact of the scheme on Umgeni Water's bulk water tariff will need to be assessed.

2.7.4 Raw Water Tariff

The raw water tariff required to repay the scheme (capital and interest, operations and maintenance, and energy, Return on Assets, etc.) will be determined in accordance with the latest *National Water Pricing Strategy*. The Pricing Strategy is currently being revised and progress will be monitored in order to finally determine the approach to tariffing that will be used.

Energy costs are increasing in accordance with a NERSA agreed formulae. Discussions will be required with Eskom to determine whether the exceptional increases are likely to continue beyond the currently agreed window.

It will also be determined to what extent the raw water tariff can be offset through energy sales (i.e. hydro power generation).

Deliverable: **Institutional, Financial and operational aspects Report**

2.8 TASK 8: SOCIO-ECONOMIC ANALYSES

The *objective* of this task is to develop a detailed socio-economic impact assessment of the Dam(s) and transfer infrastructure. This will include a review of typically anticipated social impacts such: access to community land, relocation of communities, impact on job creation and health and safety factors related to construction of the dam. Economic impacts include new business growth, expansion of production capability associated with additional water resources as well as the impact of construction input purchases on the local community. The review will also include **an assessment of non-development as an option** as well as alternatives to the development like **desalination or re-use of effluent** as part of the cost-benefit analysis proposed. In addition, carbon neutrality and carbon credit generation options

will be reviewed if applicable to the project. The possible production of carbon credits represents a positive outcome within a cost benefit analysis study.

The *approach* will include adopting economic modelling techniques a carrying out a cost-benefit analysis and multiplier analysis.

Obtain social
impact from EIA
public
participation
process

2.8.1 Socio-Economic Impact Modelling

Socio-economic impact assessments predict the socio-economic effects on a *regional, provincial or national* scale of a new business location, a new project venture occurring in a regional economy or a change in government policy. These impacts refer to the effects on the level of economic activity in a given area, as result of some form of external intervention in the economy. In addition, these economic impacts have a social impact, i.e. job creation, loss of access to farming or grazing land etc. Many of the social impacts will emerge through stakeholder engagements during the EIA scoping process and these will then be included and quantified in the socio-economic impact process. The timing of the information to be made available from the EIA is crucial to the completion of this task and the study.

a) *Areas to be addressed*

The development of the dam will result in a significant increase in capital investment in the affected areas and will result in the local economy being affected, both directly and indirectly. In order to quantify the extent of this change, this impact needs to be scoped.

A number of economic variable categories have to be measured in order to determine the extent to which an economy has been impacted on due to an exogenous change. Scoping that will be used in this assessment are as follows:

- ◆ Total employment reflects the number of additional jobs created by economic growth.
- ◆ Value Added (which is normally equivalent to Gross Domestic Product or, in this case, Gross Geographic Product - GGP) is a broader economic measure of the full income effect.
- ◆ Change in Output (new business sales) new business sales equates to additional business turnover as a result of the introduction of an exogenous change in the economy.
- ◆ New salaries and wages measure the increase in existing salaries and wages as a result of the exogenous change in the economy.

- ◆ Increased tax revenue. The direct and indirect economic impacts will lead to fiscal impacts, which are changes in government revenues and expenditures.
- ◆ These will be determined through a high level input/output modelling exercise based on data made available by the engineering and quantity surveying processes.

2.8.2 Anticipated Tools and Techniques

There are two different tools that can be used in socio-economic modelling while the technical processes are unique their outputs are comparable as both determine impact severity and mitigation options.

a) *Cost Benefit Analysis (CBA)*

While the development of infrastructure services is essential for the support of KZN's future economic growth, this provision will have an impact on the local and regional environment. These in turn may impact upon the quality of life of local residents in the area surrounding the proposed Dam. Environmental impacts, land quality, water management, biodiversity will impact upon health and social constructs. An example of this can easily be made if the local river or estuarine systems are negatively impacted by development of adjacent infrastructure, causing local sources of potable water, water for agriculture as well as for industry to all be impacted. Well planned infrastructure projects can produce positive environmental impacts, reducing run-offs and water pollution, or mitigating negative environmental externalities through emissions controls.

Should environmental consequences not be taken into account as a component of planning for additional damming of the river, this could pose serious threats to the environment and quality of life to local residents.

Specifically, *CBA is designed to identify the trade-off costs of negative environmental impacts* that could arise from development, like land degradation, flooding, water and air pollution – this Cost Benefit Analysis will assess in developing the pipeline of prioritised projects in the area, by providing a basis for informed decision making.

The CBA will focus on four levels:

- ◆ Appraisal of the project;
- ◆ Identification of externalities (notably environmental, social as well as economic);

- ◆ Provide a discounted view of impacts, essential for the correct allocation of impacts on environmental goods; and
- ◆ Evaluation of development and no-development scenarios.

The basics of the CBA process require the following key activities:

- ◆ Define the scope and objectives of the infrastructure intervention;
- ◆ Identification of alternatives (if there are any);
- ◆ Sensitivity modelling Scenario building – how likely are the outcomes identified and developing the scale of uncertainty of the actual values of the costs and benefit;
- ◆ Modelling Discounted Futures which examines the discounting future benefits and the incorporation of decision rule (i.e. NPV, BCR or IRR);
- ◆ Comparison of Costs and Benefits to determine the net social rate of return, identify accountability measures, identify complex trade-offs and develop decision matrix tool; and
- ◆ Generating mitigation plans to develop set of suggested mitigation parameters based on the rate of returns.

b) *Input/Output Modelling of Economic Impact*

This economic impact assessment used the *Input / Output (I/O) or Social Accounting Matrix (SAM)* model methodology to anticipate and quantify the direct and indirect economic impacts of the development.

The basis of the I/O and SAM model methodology is the principle of economic cause and effect. For any economic action, there can be a multitude of different economic forward and backward reactions (effects). This then results in a number of direct potential/probable effects, which also have a range of indirect potential/probable effects. The models are used to measure the effect of the development on employment creation (and its resulting change in household income), GGP contribution and business output.

c) *Aspects to take into account*

The following aspects need to be taken into account in the application of the methodology:

- ◆ The economic impact assessment will be able to indicate key issues that arise out of the exercise and will be essential for consideration before informed EIA decision making.
- ◆ This study will be based on existing available data and information and augmented by surveys and interviews with key role players. However, as noted in the Tender, *no*

provision is currently made for substantial data collection or model building. Available economic data will be accessed through Urban-Econ's subscription to Quantec's EasyData data files.

- Urban-Econ's Adjusted KZN Input/Output Model™ will be used to assess the economic impact of the proposed project.

Deliverable: Economic Impact Assessment Report

Baseline document, Social impacts, CBA

3 STUDY TEAM

3.1 TEAM COMPOSITION

BKS (Pty) Ltd is the lead consultant for this project, and will receive specialist inputs and support from the following sub-consultants: Africa Geo-Environmental Services (Pty) Ltd (AGES), Mogoba Maphuthi & Associates (SC&A), Urban-Econ and several specialist sub-consultants. Detailed company profiles for each of these companies were provided in the Tender submitted by BKS on 18 April 2011. **Figure 3.1** provides an organogram of the team composition.

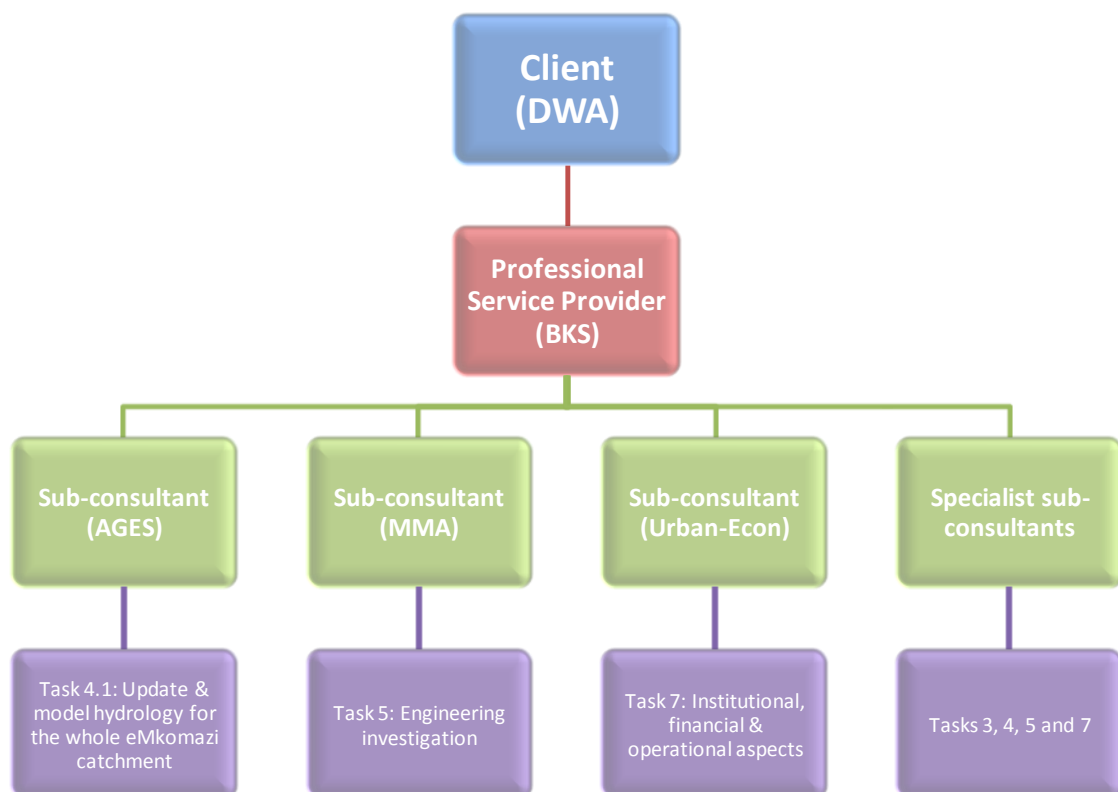


Figure 3.1: Organogram of the team composition

3.1.1 Changes to the study team

As agreed on during the tender phase, the Study Team proposed in the Tender will perform the work, except where staff has resigned and where replacements have been made with people of similar or better experiences and expertise. Also, the shortened study duration (discussed in **Section 1.5**), necessitates more capacity, to be able to deliver on time and therefore additional resources are proposed.

In the original tender we allowed for a Specialist Reviewer on the Water Resources task without providing a specific name. **Mr Pieter van Rooyen**, a well-known water resource specialist that has in depth knowledge of the Mgeni System specialist, is proposed as Specialist Reviewer.

Approval will be requested for the following team members:

Name	Position in study team	HDI status [§]	Impact on budget	Comment
Pieter van Rooyen	Water Resource specialist	White male	Zero	Proposed Specialist Reviewer
Mpshe, Boitumelo	Project administrator	Black female	Zero	General administrative support – improve capacity
Mapolisa, Lonwabo	Support: water resources and public participation	Black male	Zero	To replace Eddie Mashau* and partly to Kagiso Kwele [#]
Reynders, Theresa	Project administrator	White female	Zero	Replace Emile Enslin due to capacity limitations
Le Roux, Betsie	Support: water resources	White female	Zero	Additional capacity
De Jager, Gerald	Water Resource modeller	White male	Zero	To increase capacity
Van der Merwe, Deon	Key support: dam design	White male	Zero	To increase capacity and partly to replace Tshireletso Rammutla*
Griffiths, Bronwen	Key support: Environmental Screening	White female	Zero	To increase capacity
Swanepoel, Robin	Key support: Environmental Screening	White male	Zero	To increase capacity
Naidoo, Parveshen	Support	Black male	Zero	Assist S Masongo

* Staff members that resigned during the procurement period to date.

Kagiso Kwele won't be available for 2012 due her involvement on site on another project

§ Additional members won't alter the HDI composition as was foreseen in the Tender – refer to Section 3.5

3.2 STUDY MANAGEMENT

The **Study Management Team** (Kevin James/Hermien Pieterse and Andriëtte Combrinck) will be responsible for liaison with the Client, the general supervision of the Study and providing direction on all tasks. Their collective previous experience in feasibility studies, water resources planning and management studies will ensure that they provide the necessary

direction to the Study Team in undertaking the Study and enable efficient liaison with representatives of the Client. As requested in the ToR, **Hermien Pieterse** was nominated as Alternate Study Leader in the event that Kevin James is unable to continue with his duties for any reasons or is unavailable for certain activities during the course of the project. Hermien will also be involved in some of the Technical Tasks.

Included in the Study Management Team, Ms Bonggi Shinga was selected as **Public Relations Officer**. Ms Bonggi Shinga, an inhabitant of KwaZulu Natal, will with her extensive experience in running complex public participation programmes manage the project PR as described in **Section 3.1**.

Study Leader:

Mr Kevin James

Alternate Study Leader:

Ms Hermien Pieterse

Project Co-ordinator:

Ms Andriette Combrinck

Public Relations Officer:

Bonggi Shinga

3.3 TASK LEADERS

The Task Leaders, listed in **Table 1.2**, will manage the various tasks. They are responsible for directing and co-ordinating the personnel working on each task, as well as ensuring technical precision and applicability. They will ensure that each task is completed within budget and on time, and to acceptable standards. Their responsibility is also to provide timeous and adequate warning of any problems encountered that could either delay the study or result in budget overruns.

3.4 STUDY TEAM

[Contractual information not included.]

3.5 HDI COMPONENT

Building capacity of historically disadvantaged individuals (HDIs) in the engineering field of water resource planning and development is viewed as an integral part of the study. Capacity building entails giving HDIs the requisite practical exposure and background training to be able to participate meaningfully in the study.

BKS is committed to promoting the South African government's policies regarding employment equity and black economic empowerment. As such, the company ensures uniform and equitable employment practices and employs significant numbers of personnel

and board members with HDI (Historically Disadvantaged Individual) status and by contracting and supporting HDEs (Historically Disadvantaged Enterprises), such as *MMA*, for numerous projects.

The project team makes a positive contribution towards HDI participation in that HDI members are placed in project management and key support roles with the Specialists. Those HDI's in support roles will benefit from mentoring by their seniors and from being in a multidisciplinary environment.

4 COST ESTIMATE

[Contractual information not included.]