P WMA 12/T30/00/5212/1

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

DIRECTORATE: OPTIONS ANALYSIS

FEASIBILITY STUDY FOR THE MZIMVUBU WATER PROJECT

INCEPTION REPORT

JANUARY 2014

FEASIBILITY STUDY FOR THE MZIMVUBU WATER PROJECT

APPROVAL

Report title:	***Inception Report***
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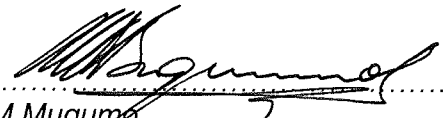

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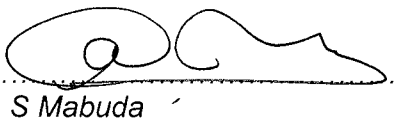

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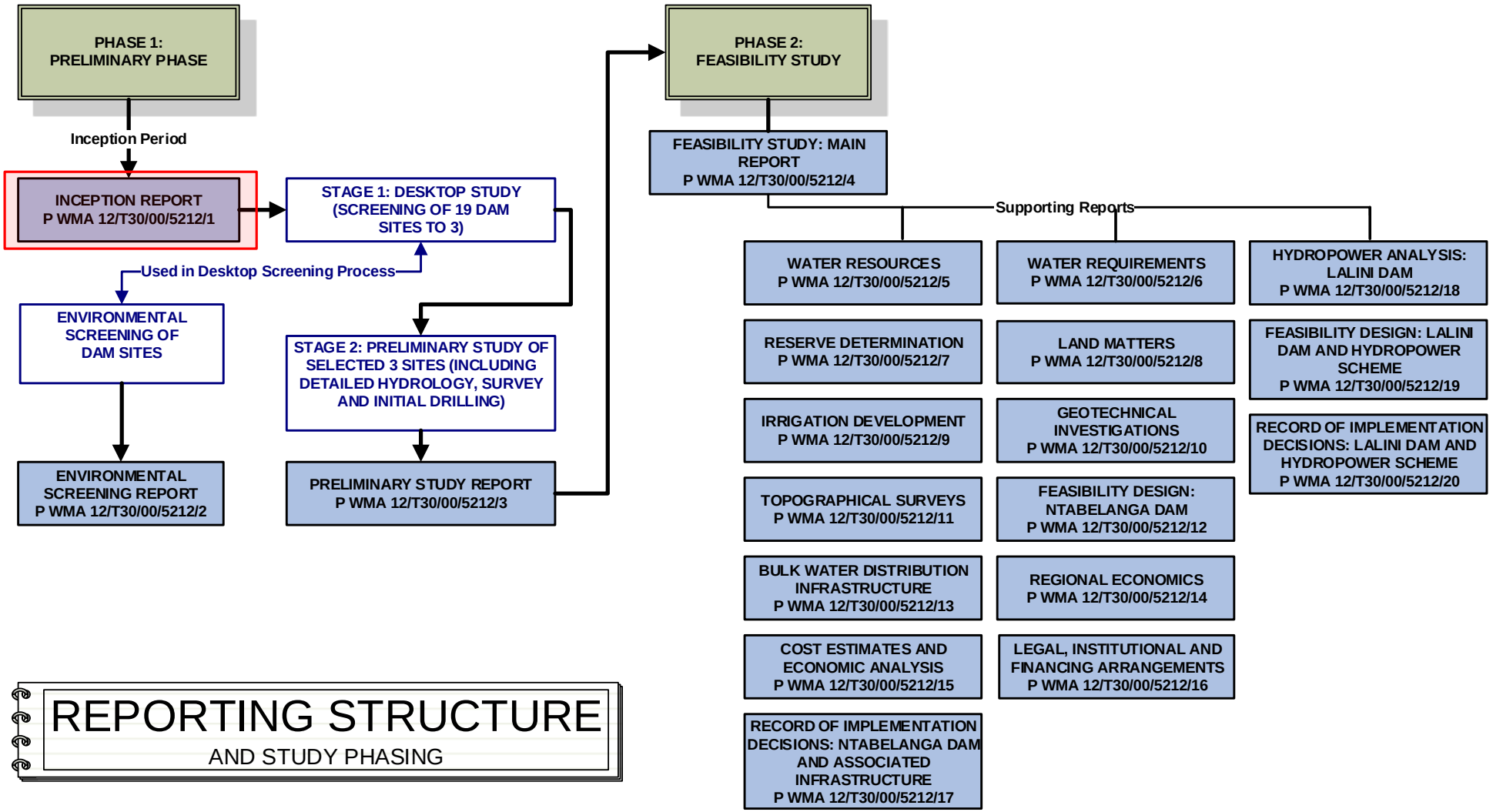
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REFERENCE

This report is to be referred to in bibliographies as:

Department of Water and Sanitation (2014). ***Feasibility Study for the Mzimvubu Water Project: Inception Report***

DWS Report No: P WMA 12/T30/00/5212/1

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Note on Departmental Name Change:

In 2014, the Department of Water Affairs changed its name to the Department of Water and Sanitation, which happened during the course of this study. In some cases this was after some of the study reports had been finalized. The reader should therefore kindly note that references to the Department of Water Affairs and the Department of Water and Sanitation herein should be considered to be one and the same.

Note on Spelling of Laleni:

The settlement named Laleni on maps issued by the Surveyor General is locally known as Lalini and both names therefore refer to the same settlement.

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LIST OF ACRONYMS

AsgiSA-EC	Accelerated and Shared Growth Initiative for South Africa – Eastern Cape
DM	District Municipality
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EC	Eastern Cape
ESIA	Environmental and Social Impact Assessment
EWR	Environmental Water Requirements
GW	Gigawatt
GWh/a	Gigawatt hour per annum
ISO	International Standards Organisation
kW	Kilowatt
LM	Local Municipality
ℓ/s	Litres per second
Mm^3	Million cubic metres
MW	Megawatt
PMC	Project Management Committee
PSC	Project Steering Committee
PSP	Professional Services Provider
SMC	Study Management Committee
TCTA	Trans Caledon Tunnel Authority
WRYM	Water Resources Yield Model

1. PROJECT BACKGROUND

The Mzimvubu River catchment in the Eastern Cape Province is one of the poorest and least developed regions of South Africa. Development of the area with the express purpose of accelerating the social and economic upliftment of the people in the region was therefore identified as one of the priority initiatives of the Government.

Harnessing the water resources of the Mzimvubu River, the only major river in the country which is still largely unutilised, is considered by the Government as offering one of the best opportunities in the province to achieve such development.

In 2007, a special-purpose vehicle called AsgISA-Eastem Cape (Pty) Ltd (AsgiSA-EC) was formed in terms of the Companies Act to initiate planning and to facilitate and drive the Mzimvubu River Water Resources Development.

The five pillars on which the Eastern Cape Provincial Government and AsgiSA-EC proposed to model the Mzimvubu River Water Resources Development are:

- Afforestation;
- Irrigation;
- Hydropower;
- Water transfer; and
- Tourism.

1.1 Previous Studies

Three particular studies of importance have been undertaken with reference to the development of a dam in the Mzimvubu River catchment for multi-purpose use. They are as follows:

- Republic of Transkei Mzimvubu Basin Development :1987;
- DWA Water Resources Study to assist AsgiSA-EC: 2010 (BKS); and
- AsgiSA-EC Business Case for Water Related Opportunities – 2010 (Ingerop).

Another significant study of relevance to this project was DWA Report, *Mzimvubu River Basin – Water Utilization Opportunities – April 2005 (Report No. P WMA 12/000/00/0505)*, which was the forerunner to the above 2010 DWA Report, and was undertaken at a “desk top” level.

The first report focussed on a single dam while the other reports assessed a series of dam sites and utilization options throughout the catchment. The two 2010 reports (the BKS and Ingerop Reports) were both undertaken at conceptual level only.

The report undertaken in 1987 focussed on the development of a large dam at the Mbokazi site in the lower portion of the Mzimvubu River catchment. This dam would have been of strategic importance and would have been used for the following:

- 1600 MW hydropower plus transmission to East London and KwaZulu Natal;
- Orange-Fish transfer up to 50 m3/sec over 550 km and lifting 1600 m; and
- Export of up to 90 million m3/yr of water to the Middle East by tanker.

The cost of such a dam would have been extremely high and the potential environmental impacts would be significant both in terms of the large impounded area as well as altering the flow regime into the sensitive river estuary at Port St Johns. Most of the issues raised and options considered in this report have long since been overtaken by changes in government policy, and by other alternative projects such as the Lesotho Highlands Water Project.

The DWA Water Resources Study to assist AsgiSA-EC in 2010 followed on from the above 2005 DWA study and was undertaken by BKS. This report was undertaken at a conceptual/desktop level and identified 19 possible dam sites throughout the Mzimvubu River catchment and assessed each dam in terms of their potential use for hydropower, irrigation, domestic water supply, inter catchment transfers and overall economic stimulus. A map showing the 19 dam sites is provided in Figure 1-1 overleaf.

Following the BKS Report an additional study was undertaken by Ingerop, who produced the report referred to as the *ASGISA-EC Business Case for Water Related Opportunities – 2010*. This report, also undertaken at conceptual level, looked at the same 19 dam sites plus one additional site (Tsitsa Dam Site) and undertook a dam site screening process based on a set of criteria that included the following:

- Capex per MW produced;
- Irrigation potential;
- Forestry potential;
- Population;
- Accessibility / proximity to main transport infrastructure; and
- Potential use of dams in long term water transfer schemes.

Based on these criteria the two highest ranked dams were taken forward into a Business Case Study. These two sites were the Ntabelanga and Laleni Sites.

It must be reiterated that both the BKS and the Ingerop reports were undertaken purely at desktop level only. No site investigations to confirm the available yield, the founding geology or the availability of materials for construction were undertaken. As a result of this, as well as the fact that no detailed survey (to obtain detailed contour information) was undertaken, all cost estimates were based on assumed dam wall heights and volumes. This is why a detailed feasibility study was needed to not only confirm the most suitable dam site for a multi-purpose structure, but to also obtain economic information at a significantly higher level of confidence in order to make a final decision on the viability of the project and the form and size of subsidies that could be necessary.

In addition to the three studies mentioned above an additional document of importance is the *Assessment of the Ultimate Potential Future Marginal Cost of Water Resources in South Africa, 2010 (Report no. P RSA 000/00/12610)* prepared by the DWA.

This report discusses the future potential use of water from the Mzimvubu River catchment for augmentation of the water supply needs in the Vaal and Orange River Systems.

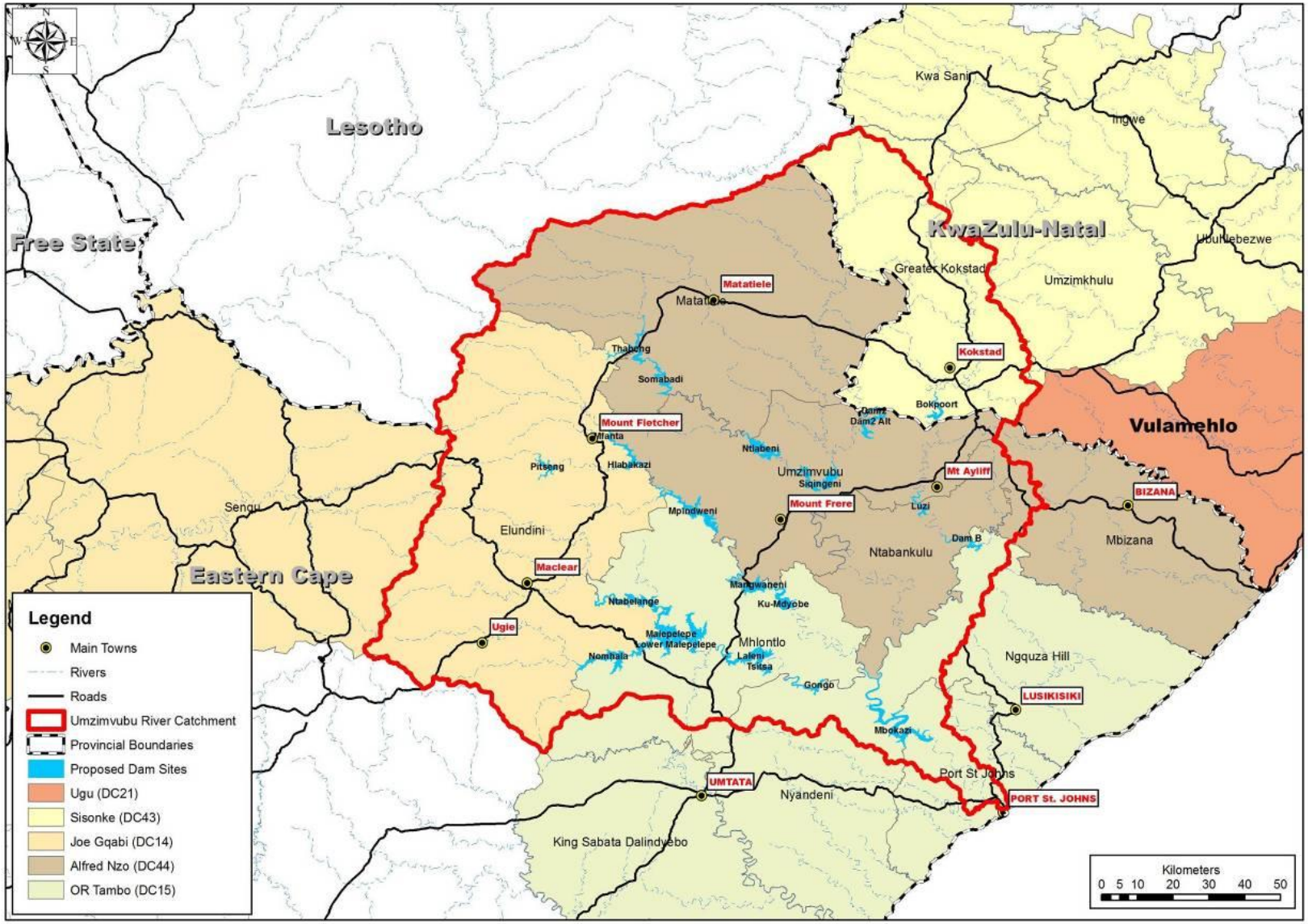


Figure 1-1: Mzimvubu River Catchment

The report indicates that the Orange River System may have a need in 2048 for additional water and discusses the possibility of transferring water from the Mzimvubu River (specifically from the proposed Ntabelanga Dam) into the Kraai River (headwaters of the Orange River). However the report goes further to conclude that it is doubtful whether the transfer of water from the Mzimvubu River catchment for the express purpose of augmenting supplies along the Orange River will ever be necessary and justifiable.

1.2 Scope of this Study

The Department of Water and Sanitation (DWS) has now undertaken to investigate the project at a feasibility level of detail. The project is being implemented by the DWS in collaboration with the Eastern Cape Provincial Government, and ESKOM. The study area of the Mzimvubu River catchment is shown in red on Figure 1-1 above.

The study has been divided into two distinct phases of which the first phase will be a preliminary screening process to take the most promising option to a detailed level of investigation. The most recent study undertaken by the DWS in association with AsgiSA-EC has recommended the Ntabelanga Scheme as the preferred multi-purpose water resource development to be investigated further at detailed feasibility level of detail but the current study will revisit all the options with an open mind to add value to work already undertaken in previous studies. Once all the role players have agreed upon the finally chosen development option, that option will be taken into the second phase for more detailed investigation.

1.3 Inception Report

This Inception Report summarises the agreed revised approach and scope of the study, which inputs and deliverables will fully meet the requirements of the original Terms of Reference, and stays within the overall Contract Price given in Jeffares & Green's original financial proposal plus the additional Provisional Sum provided by the DWS. The approved Inception Report, read together with the original Terms of Reference, becomes a part of the Contract.

2. ACTIONS UNDERTAKEN DURING INCEPTION PHASE

The commencement date for this study was 9 January 2012, and the original inception period was 3 months.

This Inception Report is the first task to be undertaken by Jeffares & Green (Pty) Ltd prior to approval of the scope of work, methodology, study programme and budget. This Inception Report presents the revised scope of work for the study and contains, *inter alia*, the following:

- A detailed review of all the data and information sources that are available for the assignment;
- Revised study methodology and scope of work;
- A detailed project schedule, work plan and work breakdown structure indicating major milestones;
- An updated organogram and human resources schedule; and
- An updated project budget and monthly cash flow projections.

During the inception period the Proposal of Jeffares & Green was discussed with the DWS and all aspects and uncertainties clarified.

As described below, the Inception Phase for this study has been significantly longer than was envisaged due to the need to revisit the approach and scope of some of the tasks following discussions of such needs with the Study Management Committee and the Project Steering Committee.

2.1 Discussions with DWS and Key Stakeholders

Apart from regular email correspondence and telephone conversations, the following meetings have been held:

a. Inception Meeting – An inception meeting was held at DWS's offices in Pretoria on 1 February 2012. This "kick-off" meeting gave both parties an opportunity to introduce themselves to each other, and to establish the protocols and modus operandi for the management of the study.
b. Project Steering Committee (PSC) meeting – The first Project Steering Committee meeting was held in East London on 15 March 2012, which itself was preceded by a Study Management Committee (SMC) meeting essentially between the DWS Project Manager and Jeffares & Green Study Leader.
c. Further PSC and SMC meetings were also held in East London on 17 May, 26 July and 27 September 2012
d. A proposed schedule of future PSC meetings has been produced but the actual dates of meetings will be reviewed and these will be held at appropriate stages during the study period.
e. DWS provided a letter of introduction for Jeffares & Green to use to submit requests to various key sources of data and information for such to be provided to the professional services provider (PSP).
f. An Options Screening Workshop, attended by main stakeholders, was held on 27 June 2012 in Mthatha.

2.2 Review of Data and Information Sources

To date, the following organizations have been contacted for data and information:

- AsgiSA-EC;
- AURECON Consulting Engineers;
- BKS Consulting Engineers;
- DWS;
- ESKOM;
- University of Pretoria;
- Department of Environmental Affairs (ENPAT data); and
- Water Research Commission (WRC).

2.2.1 Overview of data and information received

During the Inception Phase Jeffares & Green have pro-actively attempted to locate as much background information as possible related to the project in order to improve their understanding of the history of the project and to assist the decision making process of dam site selection. This has included the following:

- Spatial data sets relating to water services, population, agricultural potential and existing infrastructure;
- Previous related studies undertaken in the Mzimvubu River catchment including obtaining of reports, spatial data used and even hydrological models; and
- Streamflow and rainfall data from DWS Cradock.

A summary of this information is outlined in Table 2-1 below.

Table 2-1: Water resources related information

WATER RESOURCES INFORMATION INVENTORY					
Information	**Acquired**	**Source**	**Dated**	**Likely Usefulness**	**Additional Requirements**
HYDROLOGY					
Naturalised Streamflow Files	Yes	BKS	June 2009	Moderate	None at this stage
WRSM2000/Pitman Input Files	Yes	BKS	June 2009	Useful	Pitman System Diagrams/Schematics
WATER RESOURCES					
WRYM-IMS Configuration/Set-up	Yes	BKS	June 2009	Useful	None at this stage
ENVIRONMENTAL WATER REQUIREMENTS					
EWR Desktop Model Files	Yes	BKS	June 2009	Useful	TAB and RUL Outputs Files
STREAMFLOW INFORMATION					
Observed Gauged Streamflow Data for Several Gauges in Mzimvubu Catchment	Yes	DWA	Mar 2012	Useful	None at this stage

The amount of spatial data and number of reports collected during the Inception Phase is considerable and can be made available on request.

Jeffares & Green has gathered significant background information that has already provided useful information in terms of the implementation of this project. The previous reports and the electronic data from some of them have enabled an in-depth look into the historical planning of a dam development in the Mzimvubu River catchment and for the main part no additional information is required in this regard. However it was considered important to gain more information in terms of the planning of the District Municipalities (DM), from a water services provision perspective, and ESKOM, from a strategic planning perspective for potential hydropower within the Mzimvubu River catchment.

Jeffares & Green met with Mr Allestair Wensley of DWS on 10 April 2013 in order to obtain the latest information on water services provision and future planning in each of the affected DM's.

In addition, Jeffares & Green has held meetings with each of the following DM's in order to further verify the planning information obtained, and to gather more information regarding the water supply needs of these DMs in the region:

- Alfred Nzo;
- Sisonke;
- OR Tambo; and
- Joe Gqabi.

It appears from the background information that a multipurpose dam is warranted in order to improve project economics and for this reason close co-operation with ESKOM was deemed necessary.

Although it initially appeared from discussions with them that ESKOM had little interest or plans in developing either a conventional hydropower or pumped-storage scheme in the Mzimvubu River catchment, Jeffares & Green met with the National Strategic Planning Section of ESKOM.

ESKOM have provided a copy of their 2004 Report on the Hydropower Potential in the Eastern Cape which includes many of the same potential dam sites that are being investigated in this study.

Contacts have been established with ESKOM's Chief Engineer - Grid Operations in the Eastern Cape Region - and the potential for multi-purpose usage of dams in the Mzimvubu River catchment to include significant hydropower generation is being discussed.

ESKOM's senior management for the Renewable Energy Division undertook a field reconnaissance mission of the existing and potential hydropower generation sites in the region in early November 2013.

Preliminary findings from Phase 1 investigations and analyses indicate that the sustainability of the Mzimvubu project could be significantly enhanced if the water supply dam could be developed and operated in tandem with a hydropower scheme. This is of particular relevance in the Tsitsa River catchment which includes the Ntabelanga dam.

This is to be further considered and will be discussed at a meeting to be held between DWS, the Department of Energy, ESKOM and Jeffares & Green on 25 January 2013.

3. WORK PLAN AND WORK BREAKDOWN STRUCTURE

Key tasks proposed in the work plan and methodology are as follows:

- **Inception Report**

- **Preliminary Study**
  - Desktop Study to Confirm Preferred three (3) Sites;
  - Stakeholder Involvement;
  - Water Requirements;
  - Environmental Screening;
  - Geotechnical Reconnaissance;
  - Hydrology review; and
  - Prepare and Submit Preliminary Study Report.

- **Feasibility Study (of the selected one dam site)**
  - Hydrology;
  - Reserve Determination (Estuary and River);
  - Water Requirements;
  - Final Site Identification and Selection;
  - Topographical Survey;
  - Geotechnical Investigations;
  - Feasibility Dam Design;
  - Costing and Economic Analysis;
  - Land Matters;
  - Regional Economics;
  - Legal, Institutional and Financing Arrangements; and
  - Environmental and Social Impacts Assessment.

- **Irrigation Development**

- **Bulk Water Infrastructure**

This additionally includes Project Management and Client Liaison throughout the study.

3.1 Scope and Workplan Schedule

The Terms of Reference set the following time periods to be followed for the completion of the study:

Inception Period:	3 months
Phase 1 – Preliminary Study:	6 months
Phase 2: Feasibility Study:	18 months
Total for Study:	**27 months**

Given the start date of 9 January 2012, this means that the planned completion date for the study would be 8 April 2014.

The inception period has allowed Jeffares & Green the opportunity to collect and review available data and thus to provide better information for them to be able to review the scope of work and the resources required for each of the above tasks.

It has also become apparent during the inception period that this project has been given a very high priority at both regional and national level, and there is a desire to implement the construction of the recommended scheme as early as possible. This is discussed in more detail in Section 8.

An initial draft of the Inception Report was prepared and submitted in April 2012. At the SMC and PSC meetings held on 26 July 2013, the findings of the Stakeholder Workshop were presented and discussed and the final selection of three dam sites was agreed.

In Phase 1, the current contract and Terms of Reference allowed for only reconnaissance level geotechnical studies, and desktop review of the hydrology of the three dams sites, and in additional this would make use of existing 20 metre contour interval mapping to investigate dam options. In the contract, the detailed hydrology, surveys and geotechnical investigations were only to be undertaken in Phase 2 on the single dam site selected from Phase 1.

Discussions were held at the SMC Meeting in this regard and the SMC team agreed that there was a risk of fatal flaws being discovered too late if the three dam sites were analysed at only desk top level in Phase 1. It was therefore agreed that a much more robust, reliable and lower risk analysis should be undertaken on all three potential dam sites at the Phase 1 stage instead of on one dam site in Phase 2 as was originally envisaged. Whilst this would incur some increased costs on Phase 1 tasks, there would likely be a benefit in being able to accelerate (or avoid possible delays) in the Phase 2 activities, and to facilitate more reliable decision-making. This would also mean that certain Phase 2 task budgets could be reduced.

More detail on the agreed changes of approach and scope are given below, but in summary these comprised:

Detailed hydrology, topographical surveys and some geotechnical investigations (drilling), on all three “finalist” dam sites in Phase 1 instead of only one dam site in Phase 2.

This required more resources to be allocated to cover the additional scope of work, as well as a longer time period to undertake these tasks (including the procurement and undertaking of the survey and geotechnical services) in Phase 1.

Once Phase 1 is completed, there will also need to be further, more intensive, land surveys as well as geotechnical investigations, construction materials sourcing, borrow pit location, soils sampling, and associated testing, in the region of the preferred single dam site in Phase 2, again requiring site supervision, interpretation, and reporting. However, given that the advance information gained from Phase 1 will greatly assist the smoother implementation of Phase 2, it is still expected that the study can be completed on or before 8 April 2014.

This has the following effect on the sequencing of the study phases:

Inception Period: *9 months (but now overlapping with other Phase 1 activities)*
Phase 1 – Preliminary Study: *10 months (overlapping with the Inception Period)*

Therefore:

Phase 1 – Total required	16 months
Phase 2 - Feasibility Study:	11 months
Total for Study:	**27 months**

Thus, the overall completion period remains the same.

Unless other factors emerge later in the study, the above changed approach and increased scope of work in Phase 1, should not require a change of overall total budget for this study. The changes as described above will be accommodated through the reallocation and rescheduling of individual task budgets, and judicious allocations of the Provisional Sums that have been provided for such purposes. Use of the provisional sums will not be undertaken without the prior approval of DWS. This is described in more detail below.

A revised Study Master Schedule has been prepared using *MS Project*, and this is included in **Appendix A**. This reflects the situation as it was when this report was submitted, and shows the timings, sequencing and dependencies of the above tasks and their associated activities to be undertaken, as were described in the Terms of Reference and the Technical Proposal, but as then amended in accordance with the agreed change of approach and scope, as described above.

This Gantt chart is used to track actual progress against planned, as the project proceeds. The programme will be reviewed regularly and updated in the light of progress achieved and anticipated challenges.

Key milestone dates covering report deliveries, task completions, and meetings are given thereon. It should be noted that some critical activities are marked in red, indicating that delays in these activities could affect the overall completion date for the study or phases thereof.

Decision-making regarding the end of one phase and the commencement of another is a key issue as it has been assumed that the study will flow seamlessly through all of its phases without pause.

Procurement of other service providers such as for the land surveys, geotechnical site investigations, and Environmental and Social Impact Assessments (ESIA), also fall into these critical path activities.

The procurement process for the land surveys and the drilling aspects of the geotechnical investigations has taken longer than was expected, but has now been completed, and the successful tenderers will be appointed to commence these aspects early in January 2013.

This has delayed the completion of Phase 1, but the extension of this Phase is justified in that it provides a more robust analysis of the single dam site selection process, and will provide more detailed information to be used in Phase 2, enabling the second Phase to still be completed within the original Contract Period.

For the above reasons, certain Phase 1 activities have proceeded without final approval of the Inception Report, however the approach will still be modifiable should this be required following the review of this Inception Report.

3.1.1 SMC and PSC meetings

These meetings are to be held periodically (normally at two-month intervals unless a particular stage has been reached requiring the meeting date to be adjusted accordingly), and the planned dates for these meetings are as shown on the schedule in Appendix A.

3.1.2 Stakeholder consultation workshops

Under this Contract, these meetings are to be held during the study period to ensure that stakeholders are fully consulted and are a part of the decision-making process. The first screening workshop was held on 26 June 2012, at which the dam site options were discussed and ranked to form a shortlist. It is proposed that a second workshop be held to present and seek consensus of the findings and its recommendations for the preferred dam site, to the stakeholders.

3.2 Accelerated Detailed Design and Construction

The current Terms of Reference have been structured assuming that the detailed design, tendering and construction of the project would proceed after the submission, review and approval of the Feasibility Study.

Given such a situation, it could be expected that the above process would be such that the dam would only be completed and starting to impound water by the end of 2018 or possibly early 2019, depending upon the time taken for the several tender procurement stages required.

As this project is a Strategic Integrated Project, the PSP has been requested by DWS to adopt a fast track programme whereby the detailed design, tendering and construction are accelerated to try to bring the date of first impoundment forward as much as possible.

Logically, a decision to move forward with the detailed design should only be taken once sufficient reliable information is available.

Given the current feasibility study schedule in **Appendix A**, this point will be reached during the dam design task, upon submission of the Optimum Dam Design and Cost Estimates Report (which coincides with dates for delivery of similar reports on both water delivery infrastructure and irrigation infrastructure requirements).

The study schedule indicates that the procurement and detailed design services will need to be commenced by end July 2013 so that an appointment of the PSP can be made by the end of October 2013.

Hence the detailed design team can mobilize in early November 2013. This commencement date could even be brought forward if it is considered necessary, but this would increase the risk of abortive work if the findings of the Feasibility Study subsequently require a change of approach.

The Project Implementation Schedule is given in **Appendix B**. The design and tender documentation preparation period will include time for any additional final geotechnical investigations and land survey required, and to undertake Computational Fluid Dynamics (CFD) and lab modelling of the spillway. In parallel to this, a contractor prequalification process will need to be undertaken so that a shortlist of qualified contractors can be made in time for the issuance of invitations to tender. Approximately 12 months have been allowed for this design and tender documentation process, including the process of prequalification of contractors to tender.

The Feasibility Study itself will be completed by April 2014, so there will still be adequate time to incorporate the findings and recommendations of the study into the detailed design process.

Some 20 weeks have been allowed for the tendering and tender adjudication period, with an award scheduled at the end of December 2014. It should be noted that this award date is coincident with the seasonal holiday period of the year, which is the traditional closedown period for most Contractors, hence it is likely that the actual commencement on site will be in mid-January 2015 or early February.

In parallel to the above, there will be the need to obtain the necessary environmental permissions, to develop an Environmental Management Plan, and to meet the conditions attached to any approval thereof, before construction commences. This will be a process that continues on from the Environmental Screening being undertaken in the Feasibility Study, and will need to take on board the final designs developed above.

Also in parallel to the above, the financing of the project as well as the institutional arrangements for its implementation, operation and maintenance should be completed before construction commences.

A three year construction period is proposed, commencing in January 2015, and targeting the first impoundment of the dam by the wet season (commencing, say, October of 2017).

As is described above, the implementation of the project is not currently a part of the scope of work of this Feasibility Study. However, the scenario described above indicates that one year could be saved from a more conventional implementation process if the schedule given in **Appendix B** is followed.

4. REVISED SCOPE OF WORK AND BUDGET

This section describes and explains the agreed changes that have been made to the approach and methodology as compared to that given in the original proposal. Such changes have been made in the light of more detailed information obtained during the inception period, and strategic decisions made in July 2012 by the SMC, following the better understanding thus gained of the requirements of the assignment.

Where changes to budgetary allocations are required, these are described under each task, and the overall revised budget allocation summaries and impacts on the cashflow are described below in Section 6.

As things stand, and in the absence of any more major changes of approach or scope, the end result will be the redistribution of individual task budget allocations but with no overall increase in total Contract Price required.

4.1 Impacts on the Main Activities

4.1.1 Inception report

The Inception Report has undergone several cycles of revision, as a significant change of approach in Phase 1 as described below has resulted in the Inception Report being redrafted to accommodate these changes so that it forms the correct contractual basis for monitoring and evaluation of the study, and so that it contains the correct task budgets and cashflow used in the progress and financial reports that are submitted.

4.1.2 Phase 1 - preliminary study

a) *Desktop Study to Confirm Preferred Three Sites*

This was a critical activity at the start of Phase 1 and was to be undertaken in the first 4 or 5 weeks of that phase. All of the available information and previous studies undertaken – especially the desk top/reconnaissance level work undertaken on behalf of AsgiSA-EC by BKS and Ingerop, were critically reviewed and a due diligence approach was applied. The focus of such a review was to check that the philosophy and analyses applied when ranking the 19 potential dam sites were indeed valid and still apply when taking into account the latest information available.

This included taking into consideration any on-going and planned projects being implemented by the District Municipalities and Department of Agriculture in the region, as many of these will coincide with the areas that would be potentially served by the proposed dam development in the Mzimvubu River catchment.

Similarly, clarity was sought regarding the power supply needs of the study area and regions adjacent to it and ESKOM's strategic national planning department was consulted in this regard, to ascertain whether power generation potential would be a major factor in the choice of a dam site in the Mzimvubu River catchment.

The objective of this task was to confirm which three dam sites should be taken forward for the undertaking of more detailed analysis. From the desk top work already undertaken by Ingerop in the Business Case Study, the previously preferred multi-purpose dam sites were at Ntabelanga (ranked 1), Laleni Dam on Tsitsa River (ranked 2), and Mbokazi which is on the lower Mzimvubu River, close to the estuary (ranked 3).

Whilst this latter dam has been the subject of significant studies in the past and has potentially the highest yield and power generation potential, it is probably not as ideally located to provide water supply benefits, it captures the whole basin flow, and would therefore have the highest impact on the estuary, which might be considered a fatal flaw from the outset. However, such ideas were not pre-empted, and an unbiased investigation was undertaken for all potential dam sites.

This process has again been a longer one than was envisaged, as the stakeholder consultation process required a two-stage elimination of potential dam sites, firstly to seek consensus on the criteria to use to select the highest ranked dam sites, secondly to reduce the 19 sites to a shortlist of seven, and finally, a further desk top analysis to agree on the final three dam sites as is described in the next section.

It has also taken a long time to obtain the co-operation and participation of ESKOM who only recently have started to become involved in consideration of multi-purpose usage of dams in the Mzimvubu River catchment, despite numerous contacts from the study team.

Therefore, whilst there has been no real change to the approach that was described in the contract agreement for this task, there has been a more drawn-out process in selecting the final three dam sites than was originally envisaged.

b) *Stakeholder Involvement*

As described above, the process undertaken to date has been more drawn-out than was programmed, and Jeffares & Green has also been requested to facilitate more extensive and early consultation with representatives of the Traditional Leaders and in particular the Kingdom of Pondoland.

Whilst more intense public consultations will eventually fall under the duties of the ESIA PSP still to be appointed, in the meantime Jeffares & Green needed to make special arrangements to undertake these special stakeholder consultations.

In Phase 1, the stakeholder consultation process includes:

- Invitations issued to many organs of state and provincial stakeholders to either participate directly on the PSC or to be listed as a stakeholder who receives regular bulletins and other information;
- Participation of interested parties in a screening workshop held in Mthatha on 27 June 2012 to be involved and consulted in the decision-making regarding the selection of the short-list of three dam site options to be investigated in Phase 1;
- Regular contact with key Provincial departments and other organisations such as ESKOM; and
- Development of an additional Project Governance process so that the relevant Provincial and National Departments and Ministries, up to the Presidential Infrastructure Co-ordinating Commission, can be kept informed of the project process and progress (see later section on Project Management).

Given that this task is substantially underway at the time of writing it can be reported that the consultation process has to date been reasonably successful, and, as mentioned above, the first stakeholder's newsletter was published in August 2012 which summarises the progress made.

c) *Water Requirements*

The objectives and the approach for this task are as originally proposed. A summary of the approach is outlined below:

The water requirements from the five identified pillars of development within the Mzimvubu River catchment will be assessed largely at a desktop level and used in the decision as to which is the preferred site for development. These five areas that will be investigated are as follows:

- Domestic requirements – demographics study to determine most recent and accurate population figures to determine the demand from a domestic use perspective;
- Irrigation potential – a soils investigation and crop type selection process will be undertaken in order to determine the requirements these crops will have on the water resources;
- Afforestation potential – undertake an assessment of the existing afforestation affecting each of the three sites from a streamflow reduction perspective; and
- Hydropower potential – The Water Resources Yield Model (WRYM) configuration developed for the Mzimvubu River system in the earlier Water Resource Study in Support of the ASGISA-EC Mzimvubu Development Project (BKS, 2009) will be updated to incorporate the improved hydrological data set obtained from the hydrology analysis of the Preliminary Study.

d) *Environmental Screening*

As a result of the information collected during the Inception Phase of the project and the resultant better understanding of the project requirements, including the revised project programme, a revised approach to the Reserve Determination portion is proposed.

Having discussed this important task with the environmental/reserve determination team, it was agreed that it would be beneficial to apply more emphasis to the reserve issue at as early stage as possible, and we have therefore moved some time for some of the environmental, River and estuary reserve determination team members from Phase 2 into Phase 1 activities (desk top study and environmental screening). This has the result of increasing the inputs for the environmental screening in Phase 1, and a slight reduction of same in Phase 2.

With regards to the Phase 1 reserve determination aspects of the environmental screening task, this approach is as follows:

- A review of the desktop information available from the pre-feasibility study undertaken by BKS, Ingerop, and others;
- Provide inputs to the design team during the first portion of Phase 1 of the project in order to assist in moving from the pre-identified 19 dam sites down to three preferred dam sites that will then be investigated in more detail during Phase 1;
- During the second portion of Phase 1 during the dry months of the year (i.e. July/August 2012), a Rapid Reserve Determination will be undertaken on all three identified sites. Jeffares & Green have also included desk top/advisory inputs into this phase of the study by the estuarine reserve determination team, in case their winter flow reserve determination activities need to be postponed until next year (see reasons below);
- A workshop will be undertaken after the Phase 1 Rapid Level Assessments to discuss and finalise the present state and the flow requirements based on the maintenance low flows and freshettes (information on floods will come out of the second sampling exercise). This will enable environmental water requirements (EWR) information to be fed into the final site selection where the one dam site is identified for full feasibility study investigations;

- The estuarine reserve determination team will undertake their first assessment in the dry season of 2012 (which will be during Phase 1 of the study) which is a critical path item in terms of obtaining the necessary information to feed into the design process; and
- The environmental screening will also include identification of the potential impacts of the bulk water distribution infrastructure footprint.

This task also includes the development of a Scope of Work for the independent ESIA PSP to be procured and appointed by DWS in time for Phase 2 of the study.

e) *Geotechnical Reconnaissance*

The approach and methodology for this reconnaissance have not been revised, and a summary of the approach is outlined below.

It is confirmed that a reconnaissance level geotechnical study which will review all available and relevant geotechnical information, existing plans and maps, aerial photography, etc, of the three preferred sites, coupled with a walk-over site visit to the study area by the project team will be undertaken.

This task will aim to identify the underlying geology of each site, the potential or presence of geological faults in the vicinity of the sites, and investigate the availability of suitable construction materials in the area. A preliminary assessment of slope stability of the dam positions and sides of the basins will also be carried out.

The output from this portion of the study will be to recommend a preferred site for each dam from a geotechnical perspective and to scope and outline the work required for a detailed investigation on the preferred site.

4.1.3 Increased detailed investigations in Phase 1

At the SMC and PSC meetings held on 26 July 2013, the findings of the Stakeholder Workshop were presented and discussed and the final selection of three dam sites was agreed.

In Phase 1, the original contract allowed for only reconnaissance level geotechnical studies, and desktop review of the hydrology of the three dam sites, and in addition assumed this approach would make use of existing 20 metre contour interval mapping to investigate dam options. In the original contract, the detailed hydrology, surveys and geotechnical investigations were only to be undertaken in Phase 2 on the single dam site selected from Phase 1.

Discussions were held at the SMC Meeting in this regard and the SMC agreed that there was a risk of fatal flaws being discovered too late if the three dam sites were analysed at only desk top level in Phase 1. It was agreed that a much more robust, reliable and lower risk analysis should be undertaken on all three potential dam sites at the Phase 1 stage instead of on one dam site in Phase 2.

Whilst this would incur some increased costs on Phase 1 tasks, there would likely be a benefit in being able to accelerate (or avoid possible delays) in the Phase 2 activities, and to facilitate more reliable decision-making. This would also mean that certain Phase 2 task budgets could be reduced.

Provisional sums had also already been allowed in the original contract agreement in case such changes of scope and approach were found to be necessary.

In order to achieve these new objectives, it was agreed that the following additional activities should be undertaken on *all three* dam options in Phase 1:

a. Detailed stochastic hydrological analyses instead of using existing data and the standard WRYM/WR2005 methodology.
b. Accurate land survey of the dam wall locations and the impounded area of each dam (to 0.5 m accuracy instead of 20 m)
c. Advance geotechnical investigations to ascertain the foundation conditions at each of the three dam sites.

The following section describes the additional activities required for a), b) and c) above.

a) *Detailed Hydrology*

The original budget only allowed for the detailed hydrology of one site in Phase 2. It was agreed that the detailed hydrology task of Phase 2 of the project be moved forward into Phase 1 and also include an additional River system (for the additional dams under detailed consideration) in order to provide comprehensive yield-related information that may influence the decision to select one dam site over another.

While there will be some overlap in undertaking the hydrology for a second site (covering the Thabeng and Somabadi dams which are on the same River) there will be significant additional costs incurred because it is on a different River system.

Some of the time and cost budget from the Phase 1 Hydrology Review Task can be reallocated to the additional detailed hydrological assessment, but this amount is insufficient to complete the overall additional study requirements.

The following is a summary of the additional tasks to be undertaken in order to complete the detailed hydrology including an additional site:

- Detailed catchment rainfall analysis to develop quaternary catchment rainfall data within the catchment, which will include obtaining additional rainfall data from South African Weather Service (SAWS);
- Water requirements study of the additional catchment to quantify the water use from all sectors in each quaternary catchment;
- The establishment, building, calibration and simulation of additional catchment hydrology in the WRSM2000 (Pitman) model;
- The establishment, building and simulation of additional catchment yield using the WRYM-IMS, including additional historical simulations for various storage capacities; and
- An analysis of the results to determine the appropriate Yield/Storage curves to assist in the selection of the final sites.

The detailed hydrological analysis will be undertaken for the catchment area upstream of the three dam sites identified in the screening process. The hydrology will be at a very high level of confidence as appropriate for application in a detailed technical feasibility study and will cover a 90-year period from 1920 to 2009 hydrological years (i.e. October 1920 to September 2010).

The task will include a number of sub-tasks as outlined below.

- Site visit: Key members of the hydrology team will visit the study area and travel around the catchment for a period of three days in order to make a preliminary visual assessment of its hydrological characteristics, including topography, dominant soil types and land cover;
- Rainfall data analysis: Unprocessed monthly rainfall data will be obtained for all rainfall gauges located within and in the proximity of the catchment from the SAWS and other sources, as required. The data sets will be screened in order to select appropriate

gauges and also to identify unreliable data values. This process will be undertaken using the CLASSR and PATCHR suite of software. Missing and unreliable data will be in-filled, or "patched" using PATCHR;

- Stream flow data analysis: Stream flow data will be obtained for gauges located inside the selected dam catchment area and for each gauge the quality of the available data record be evaluated. The DWS, Directorate: Hydrological Services will be consulted in this regard. Missing and unreliable stream flow data values will be in-filled using simulated stream flows from the calibrated WRSM2000 rainfall-runoff model, described later. In-filled values will be carefully evaluated, for example by considering recorded daily flow values, the associated rainfall event, or by comparison to that recorded at nearby gauges;
- Rainfall-runoff modelling: Monthly rainfall-runoff modelling will be undertaken using the Water Resources Simulation Model 2000 (WRSM2000). The model will be calibrated to accurately represent the rainfall-runoff response characteristics of the catchment, based on the stream flow data available for selected gauges;
- Development of natural stream flows: In-filled stream flow data for selected gauges will be naturalised in order to obtain natural stream flow data sets for gauged catchments;
- Stochastic stream flow analysis: Natural stream flow data will be used to undertake a stochastic stream flow analysis using the Monthly Multi-Site Stochastic Stream Flow Model of South Africa (STOMSA), which incorporates Mark 7.1 of the ANNUAL and CROSSYR programs; and
- Reporting: The analysis will be documented in a detailed Water Resources Report.

The hydrology task fee and disbursement budgets in Phase 1 therefore need an increased allocation to take into account the change of scope – i.e. an increased number of analyses at high levels of detail.

Details of the revised budgetary requirements for the hydrology tasks in Phases 1 and 2 are given in Section 6, but in summary, the required net budgetary increase required is R263 901 including VAT.

b) *Topographical Survey*

For the same reasons give above, it was agreed to undertake a rapid aerial survey of all three potential dam sites in Phase 1, instead of the survey being undertaken in Phase 2 on only one dam.

The benefit will be a much more accurate terrain model, to be able to optimize dam location, type, yield, size and cost etc., for all three options, resulting in a more reliable and robust decision being made as to which is the preferred dam site. This again means that some of the survey provisional sum would need to be used in Phase 1 instead of Phase 2, and there would be an additional budget (again drawn from the Provisional Sum) required to cover the increased scope, i.e. the additional two dam footprints.

Following a competitive tender procurement process, DWS instructed Jeffares & Green to appoint Southern Mapping as the topographical survey sub-contractor, in the sum of R717 886.50 including VAT.

c) *Advance Geotechnical Investigations*

Also for similar reasons given above, it was agreed that some advance geotechnical investigations should be undertaken in Phase 1 on all three dam sites, rather than just the final single dam site in Phase 2. It was concluded by the SMC that, in Phase 1, at least two holes should be drilled at each of the three dam sites.

Ignoring the investigations to be undertaken on one of the dam sites which were included in the original budget, such an approach adds the following additional tasks to the project, that were not included in the original contract agreement:

- Four boreholes to be drilled, logged and cores stored
- Procurement, management and supervision of the drilling contracts
- Undertaking geotechnical investigations and interpretation

This adds both the cost of the site investigations plus there is an additional cost for Jeffares & Green to undertake the supervision, interpretation and reporting for the additional two dams investigations.

The fees and disbursements allocation will cover the procurement, supervision and reporting aspects that are now being undertaken in Phase 1 instead of Phase 2. The provisional sum allocation covers the first stage of geotechnical investigations, including drilling and testing, on the three dam sites in Phase 1 instead of the one dam site in Phase 2. The revised estimated total costs, including supervision fees and disbursement costs, for the drilling investigation are summarised in the table below:

ORIGINAL FEES AND DISBURSEMENTS FOR GEOTECHNICAL INVESTIGATIONS TASKS		
Description	**Fees**	**Disbursements**
Phase 1: Geotechnical Reconnaissance	R 58 100	R 10 500
Phase 2: Geotechnical Investigations - Final Dam Site	R 170 200	R 24 600
Sub Totals:	*R 228 300*	*R 35 000*
VAT	*R 31 962*	*R 4 900*
Grand Total:	**R 260 262**	**R 39 900**

REVISED FEES AND DISBURSEMENTS FOR GEOTECHNICAL INVESTIGATIONS TASKS		
Description	**Fees**	**Disbursements**
Phase 1: Geotechnical Reconnaissance	R 58 100	R 10 500
Phase 1: Geotechnical Investigations - 3 dam Sites	R 165 775	R 24 600
Phase 2: Geotechnical Investigations - Final Dam Site	R 123 200	R 24 600
Sub Totals:	*R 347 075*	*R 59 700*
VAT	*R 48 591*	*R 8 358*
Grand Total:	**R 395 666**	**R 68 058**

The net difference between the original and revised professional fees and disbursements is **R 163 448 incl VAT**.

Following a competitive tendering procurement process, DWS instructed Jeffares & Green to award the drilling sub-contract to Weppelmann Geotechnical Services, in the sum of R 1 889 444.55 incl VAT.

Thus the total budget required to be drawn from the Provisional Sum is **R 2 052 892.55 incl VAT.**

The above budgets are for the drilling and core logging of the three dam sites in general and the selected single dam site in particular. Further site investigations will be required that focus on the selected dam site and supply zone in Phase 2, which will include trial pitting for construction materials investigations, borrow pit locations and sampling, soils investigations, conditions along access roads, major structure foundations, and ground conditions at major water supply infrastructure components. These investigations and the associated testing will be undertaken by Jeffares & Green utilizing part of the remaining Provisional Sum for the hire of TLBs and testing etc.

4.1.4 *Preliminary study report*

This report will summarize the findings of the Phase 1 activities and make recommendations as to which single dam site should be investigated in more detail in Phase 2. If any changes to the Phase 2 approach or scope of the study need to be made, this will be included in this document. This will include revisiting the budget allocations of the tasks to be undertaken in Phase 2 and adjusting these to make best use of the remaining budget available within the overall Contract Price, and to produce a diligently researched and viable feasibility study. This report will be produced firstly in draft, and will be discussed at the appropriate SMC and PMC meetings during Phase 1, before being finalized after all comments have been received.

4.1.5 *Phase 2 - feasibility study (of the selected one dam site)*

a) *Hydrology*

This task will build upon the work undertaken in Phase 1, but will focus on the selected single dam site. The budget for this Phase 2 task has been reduced as there has been an overall increase in the hydrological inputs allowed in Phase 1, the benefits of which results will be realised in Phase 2.

This work will focus upon adding to the yield hydrology undertaken in Phase 1, including dam-specific flood hydrology, flood routing, spillway design, flood lines and impounded area backwater analyses, all for the selected, single dam site. Scenarios will also be run to simulate hydropower potential for the selected single dam site.

As detailed hydrology of dam sites other than the three investigated in Phase 1 will not have been undertaken, simulations of hydropower potential on any other potential dams to be used in tandem with the selected single dam site would have to be at desk top level using the standard WRYM hydropower simulation model.

The net effect of this on the task budget has already been taken into consideration in 4.1.3 a) above.

NB: *If the above "conjunctive" option looks promising, and inclusion of one or more additional dam sites into the scheme is considered to be essential to improve the feasibility of development of the selected single dam site, then it is probable that additional survey, detailed hydrology, and hydropower simulation modelling would be required to verify the viability of such an option at a reasonable level of confidence. In such a case, it is probable that there would still be some of the unallocated provisional sum available for this purpose.*

b) *Reserve Determination (Estuary and River)*

- As described above and shown on the schedule, the reserve determination task now commences during Phase 1, which is a function of the timing of the start of the project and the need to undertake dry and wet sampling in certain months.
- During the wet (high flow) season of 2012/13, a sampling exercise by the full reserve determination team will be undertaken on the single dam site identified in Phase 1.
- A workshop will be held approximately four to six weeks after this sampling exercise in order to determine the EWR based on both sampling exercises.
- The timing of the second sampling exercise is planned such that it will enable the hydrology investigation and the water requirements module to feed information into the reserve determination and also allows the outcomes of the reserve determination to feed the necessary information into the design process.

1.

c) *Water Requirements*

This task will again build upon the preliminary work undertaken in Phase 1. The total budget for this task is approximately the same as tendered with some minor adjustments to allow more disbursements. A summary of the approach is outlined below:

It is envisaged that the water demand determination for this dam will be based on the agricultural demands and the domestic demands for the areas that can be economically supplied from the selected single dam. The hydropower potential of the selected dam site will also be investigated, and the dam type, capacity and configuration developed such that the potential of all three main water requirements is economically optimized.

Inputs will be made by the agricultural development team to establish the potential for irrigation based on rainfall, suitable irrigable land availability, farmer interest, possible crop types and rotation and planting patterns for the agricultural land. Areas that meet such qualifying criteria, and can be supplied with water either directly from the dam or from a limited amount of pumping from the regulated River flowing downstream of the proposed dam will be identified, and water use and demand patterns (daily, monthly, seasonally) will be analysed to determine the economics and social impacts of such a scheme. This is discussed further below.

The 30 year projected water requirements for what is considered to be the optimum irrigated agriculture scheme will be included into the yield versus cost modelling to be undertaken when identifying the optimum dam location, type and size.

In terms of the determination of the domestic demand, the current population and class of households, i.e domestic urban or domestic rural, will initially be determined by using Census figures combined with GIS mapping of the area to establish the household count and description. In undertaking this GIS image analysis of the site a more realistic quantum of households can be established and this number can be compared with the Census figures.

Having established the current situation in terms of households and population, the current water demand can be established using industry norms and experience with similar areas. Once the current domestic demand is established, a projection for the future domestic requirements can be made assuming growth rates and the possible influx of people into the project area.

If there are any significant industrial or commercial users existing or planned in the study area, these will also be taken into consideration.

Water supply planning information will be gathered from DWS and the relevant District Municipalities to identify the longer-term needs of the communities that can be economically supplied from the proposed dam. This will typically cover an area upstream and downstream of the proposed dam wall, which can be supplied by pumping water (either from the dam itself or from the regulated River flow downstream of the dam) no more than (say) a head of 160 m, and for up to 50 km downstream of the dam wall.

As with water for agriculture, factors such as water losses, daily and seasonal demand variations, and water supply uptake will be included in the water requirement forward projection for a 30 year period.

The combined demands from agricultural and domestic users and for hydropower generation can then be developed into an annual demand for use in developing the dam design.

d) *Final Site Identification and Selection*

The preferred single site location will have been generally identified during Phase 1 of the study.

When undertaking detailed investigation of the single site in Phase 2, there will be further “homing-in” of the location of the dam wall based upon the results of the investigations carried out and reinforced by additional field visits to the site itself.

Apart from the main technical aspects, this will also take into consideration temporary and permanent access, areas to be allocated for abstraction, outlet works, spillway, construction camps, requirements for operational buildings and structures, routes for pipelines and power lines, and existing land use.

e) *Topographical Survey*

Once the final dam site has been selected for detailed investigations and preliminary design in Phase 2, there may be a need to undertake further survey, e.g. for ancillary works, camps, access roads, services alignments and delivery infrastructure. As described in Section 6, there will still be an adequate Provisional Sum remaining for such purposes, should this be required.

f) *Geotechnical Investigations*

Once Phase 1 is completed, there will also need to be further, more intensive, geotechnical investigations of the preferred single dam site in Phase 2, again requiring site supervision, interpretation, and reporting, which will again be funded from the available provisional sum budget.

Apart from any additional drilling of the foundations of the proposed dam wall and spillway, for which budget has already been allowed in the drilling sub-contract awarded to Weppelmann Geotechnical Services, this second phase will also include some other appropriate investigations such as geophysics (seismics and resistivity) to infill between, and be calibrated by, the boreholes drilled, plus the identification of suitable materials sources/borrow pits and quarry sites within close proximity of the dam, which will be critical in providing an economical solution for the project. The aim will be to minimize haulage costs of construction material.

A detailed materials investigation will be undertaken to locate and prove suitable construction materials within the vicinity of the dam. These materials will broadly fall into the following categories; core material (impermeable), shoulder material (semi impermeable), rock fill (permeable), filter material (permeable), rip rap, and aggregate and sand for use in filters and concrete.

The aim will be to source material quantities which are approximately two times the amount required for construction. Should the materials investigation not identify sufficient or suitable materials, e.g. filter sand, or concrete aggregate, then an investigation to determine the nearest commercial sources will be carried out. Once the location of the abstraction works and outlet works from the dam have been agreed a geotechnical investigation (trial pitting) will also be carried out to determine the founding conditions for the respective structures.

Other trial pitting and soils testing will also be required to investigate the water supply infrastructure alignment and foundation conditions.

Whilst it is difficult to currently predict exactly what the overall costs will be for these additional Phase 2 activities, it is expected that these additional investigations will be drawn from the unallocated contract provisional sum, and this also applies to the associated supervision and reporting tasks to be undertaken by Jeffares & Green.

g) *Dam Design*

The approach and methodology proposed for the undertaking of the preliminary design of the selected dam has not been changed. Jeffares & Green has, however, made certain adjustments to the relative inputs of the proposed team members, and has strengthened the team by the inclusion of a specialist dam structures engineer – David Ochan – who has recently joined Jeffares & Green from the DWS Dams Design Section.

A brief summary of the scope of work to be undertaken is outlined below:

The project design team comprising the geotechnical engineers, hydrologists and water engineers will workshop the various options available in terms of dam type selection. The main factor influencing the type of dam to be selected will predominantly be driven by the geotechnical parameters encountered during the investigation, such as suitable founding medium for the dam foundation, the topography of the site, and the availability of suitable construction material within the dam basin and surrounds.

The hydrological study will determine the dam wall height and the sizing of the spillway. The position of the spillway will also need to be investigated, and a decision reached in regard to incorporating the spillway into the dam wall itself or to have a side channel spillway.

The main options for construction will be:

- An earth core earthfill embankment dam;
- A rockfill embankment – both concrete-face and earth-core types;
- A Roller Compacted Concrete (RCC) dam; and
- Composite embankment using both concrete and earthfill.

Each option will be costed at a feasibility level of detail so that an economical comparison can be made.

The dam sizing will largely be determined by the yield modelling of the catchment and the impoundment volume of the dam. Allowance will need to be made for dead storage, including the capture of sediment over 50 years of operation, which at this scale the dam would likely have a sediment trapping efficiency nearing 100%.

The water requirements identified, as explained above, will be used to provide the basic target draft of the dam, but other factors will need to be taken into consideration including water releases required to meet downstream EWR requirements, other abstractions downstream of the dam, the generation of hydropower at the dam wall itself, and flow regulation for a potential hydropower scheme(s) operated in tandem with the dam.

Various iterations will be carried out to determine the yield of the dam for various storage volumes at varying levels of assurance of supply. From this model, yield versus storage, and yield versus wall height curves will be produced, leading directly to yield versus cost curves for each dam type being considered and compared economically. From this data, a Unit Reference Value (URV) analysis will be undertaken to determine the most economically beneficial capital cost and long term Operation and Maintenance (O and M) cost of the water supplied. This analysis will be repeated for each dam type/arrangement being considered, at various discount rates e.g. 6%, 8% and 10% per annum.

Based on the outcome of this analysis it will be possible to determine the optimum and preferred Full Supply Level (FSL) for the above water requirements. Throughout this process close liaison with the client will be maintained to determine the preferred yield and the preferred economical solution. The final decision as to the size of the dam will be made with the approval of the client.

Once the preferred dam type has been agreed with the client, the design to feasibility level will be undertaken. All work will be carried out under the direction of an Approved Professional Person (APP).

As mentioned above, the hydrological and geotechnical studies will provide the starting point for the design phase.

A comprehensive stability analysis of each proposed option will be carried out.

For a RCC dam option, or for the concrete section of a composite dam structure, the analysis undertaken comprises of a beam theory stability analysis to check on overturning and sliding factors of safety. This also includes a check that maximum tensile stresses in the concrete structure are not exceeded.

For earth or rockfill embankment dam options the stability and seepage analysis will be undertaken using the SLIDE programme which is part of the Rocscience Suite of geotechnical software.

The Morgenstern – Price method of analysis will be used. The following scenarios will be analysed:

- Upstream and Downstream slopes; Full Supply Level, (steady state seepage);
- Upstream and Downstream End of Construction (often the most critical case, where pore pressures in the underlying layers have not had time to dissipate, hence effective strength is lower than the long term case);
- Upstream slopes; for the rapid draw down case, where water level is rapidly reduced to the minimum operating level; and
- Upstream and downstream slopes with a seismic loading (earthquake condition).

2.

The feasibility design will follow the ICOLD guidelines, and it is proposed that the applicable minimum Factors of Safety that would be applied are as follows;

Full Supply Level:	1.5
End of Construction:	1.3
Rapid Drawdown:	1.2
Seismic Loading (Earthquake conditions):	1.2

The Natural Hazard Centre at the University of Pretoria will be commissioned to undertake an assessment to determine the Maximum Design Earthquake (MDE) and hence the Peak Ground Acceleration (PGA).

An assessment of the susceptibility of the embankment materials to liquefaction will be assessed according to standard design criteria. Under earthquake conditions the dam materials will often re-orientate and cause settlement of the crest rather than a complete failure of the dam.

Once the PGA has been confirmed then an estimate of the likely crest settlement will be determined.

Consolidation testing will be used to determine any long term consolidation settlement of the embankment so that this can be allowed for during the construction phase. A seepage analysis will be carried out using the same model developed in the SLIDE programme. A finite element mesh will be developed which will be used to model the flow nets through the embankment.

The design of the dam will also include a filter design for a chimney type filter to be incorporated into the downstream face of the core. The filter will be designed according to the "*US Department of Agriculture, Natural Resources Conservation Service Part 633 National Engineering Handbook, Chapter 26, Gradation Design of Sand and Gravel Filters*".

A sensitivity analysis will be carried out which will determine the effects on the Factors of Safety by varying the design parameters of the materials.

A monitoring programme will be developed which will include for the installation of piezometers, so that pore pressures can be monitored during construction, and the rate of placement of the embankment material programmed accordingly.

Apart from the feasibility design of the dam wall and spillway, the needs for additional infrastructure will be identified. This may include the construction or realignment of access roads, which may or may not include new bridges and culverts.

The outlet structure will also need to be designed which will include a pump station and bulk distribution lines to supply domestic and irrigation water requirements. No allowance has been made in the proposal to cost for the design of water treatment works as this was not listed as a requirement in the terms of reference. The project team does however include road, structural and water engineers who will be available to undertake feasibility level designs for all of the additional associated infrastructure requirements.

If the optimum dam solution has hydropower potential, then a feasibility level design of the hydropower plant and associated works will be included in the dam outlet works.

h) *Cost Estimate and Economic Appraisal*

In order to undertake a viable comparison of various options, accurate cost estimates for the construction, management, operation and maintenance costs of the infrastructure in each option are required. These cost estimates will be based upon costing models that we have recently prepared for the following projects undertaken by Jeffares & Green among others:

1. Nacala Dam Raising Project – Feasibility Study, Design, Tendering, and Construction Supervision - Mozambique (construction commenced in July 2011);
2. Bulwer Dam Feasibility Study, Design and Tender Documents – Sisonke District, KwaZulu Natal;
3. Dikgathlong Dam Design, Tender Documents, and Site Supervision - Botswana (under construction); and
4. Metolong Dam, Water Treatment Works, and Downstream Conveyance System – Lesotho (tenders received indicate that models are accurate).

Costing models and information from the VAPS (Vaal Augmentation Planning Study) have also been used, but Jeffares & Green continually updates its costing system using rates from tenders as they are opened, and the aim is to be able to provide estimates for all aspects of such a scheme within a ± 10% margin of error.

Management, operation and maintenance costs are also estimated for each scheme using industry standard costing methods.

Most dam, water treatment and water transmission projects also require significant advance and ancillary works such as access roads, geotechnical and environmental investigations, materials source investigations, contractor's camps, plant compounds, and lay down areas, and temporary works such as cofferdams, temporary power, water, sanitation and solid waste disposal facilities. All of these will be costed separately for each option, together with expected expenditure timelines.

i) *Preliminary Financial Impact*

In addition to undertaking economic analyses as described above to provide URVs of the various options being compared, a preliminary financial impact assessment tool will also be applied. This models the financial sustainability of each scheme in isolation, and produces an internal rate of return as well as an indication of the expected operational cashflow of the project during its operation.

The preliminary financial analyses takes into account the terms and tenor of loan repayment, (not applicable if grant funding is available) and the cost of financing the works. It is important to recognize whether it is a grant, or a loan requiring repayment with interest, and sometimes it is a mixture of the two, which is also catered for in the model. In this case, the general assumption will be that the scheme will be 100% Government grant funded.

The financial impact model also includes an income stream based upon the sales of water (and energy in case of hydropower) using appropriate tariffs and the expected cost recovery factors thereof, bearing in mind the free water proportion and any expected losses and other unaccounted-for water.

This tariff structure can be adjusted in the model to test what adjustments to tariffs might be required to achieve financial sustainability for the scheme in isolation.

The model allows the user to test the sensitivity to various loan/grant/subsidy options and conditions including interest rate, repayment periods, grace periods, tariff banding, sales figures, cost recovery efficiency, as well as sensitivity to power cost and water sales fluctuations.

The end result produces a net cashflow projection which, until water sales increase to sustainable levels, often shows that additional operational working capital funding is required in addition to the capital and operational expenditures to meet the financial needs of the project before it “breaks even”. This factor is often overlooked in some economic and financial models.

The model also produces an IRR value based upon the above income and expenditure streams over the same 30 to 40 year period (to be agreed with DWS) used for the URV analyses. This is also a good indicator to use when the operator is seeking investors or other project finance, and would certainly be an important factor if a PPP or private operator approach were to be considered.

j) *Land Matters*

The management of land for the water supply scheme needs to be carefully managed to ensure than the scheme meets all legal land requirements, and receives support at National, Provincial and Local Government levels. It is also crucial that it receives the support of the community, and any landowners who stand to lose land, or have servitudes registered over their land.

To this end, an in-house team member who has several years of experience dealing with the Surveyor-General’s Office as well as The Registrar of Deeds Office will make investigations and provide advice on the transfer of any real rights in land that may be necessary in the future implementation of this scheme. This will include the secure and efficient positioning and registration of temporary servitudes during construction/implementation and permanent transfers of real rights after completion. This will involve the possible subdividing and deduction from present land parcels for the dam and reservoir, as well as servitudes over encumbered land in favour of beneficiating land parcels for canals, irrigation furrows, roads, pipelines, pump stations etc.

The optimal allocation of new farming units or allotments especially for the proposed irrigated agriculture will be investigated, and recommendations made thereon. This will include recommendations on the type of land tenure to be held, for what duration, and a cost structure for prospective emerging farmers. These investigations will be undertaken in consultation with key stakeholders such as Department of Rural Development and Land Reform, Provincial Government and Traditional Leadership.

Proposed subdivisions will be provided on a plan of cadastral boundaries of the downstream farms in the area, based on the land available for sale by commercial farmers. Establishing the amount of land available for purchase from commercial farmers will require extensive consultation with the farmers, local communities and other key stakeholders. The scope of the investigation will be limited to quantifying the amount of land available on a willing seller basis through a questionnaire to be sent out to farmers – it is understood that negotiations around securing the land on behalf of any purchaser is excluded from this terms of reference.

Cost estimates will be derived for servitudes and land to be purchased from realistic land appraisals for agricultural land in the region.

k) *Environmental and Social Impact Assessment*

It is understood that the Environmental and Social Impact Assessment (ESIA) will be undertaken by an independent team of environmental specialists (ESIA PSP) and that it will be run in parallel to Phase 2 of the study.

This ESIA team will undertake extensive stakeholder consultation and public participation activities and will be the main point of contact for the study in this regard.

The design team will ensure that there is close liaison with the ESIA team, to ensure that any options and alternatives assessed consider potential social and environmental impacts and that any options are screened at an early stage to ensure that no environmental fatal flaws exist.
The technical team will make themselves available for project meetings and also for meetings with interested and affected parties to be arranged by the ESIA PSP, either in a public forum or in stakeholder workshops, where the technical details and alternatives to the project will be explained.

l) *Public Participation*

It is understood that the independent ESIA PSP will manage this process and that the Jeffares & Green team will provide technical support and liaison only.

The study team will hand over information pertaining to the Stakeholder Forum that had been set up in Phase 1, as well as the database of Interested and Affected Parties that would have been created in Phase 1.

Further involvement from Jeffares & Green's team will be to attend, give presentations and answer queries at various workshops to be held in Phase 2, including those covering Progress Reporting, presentation and discussion of the Draft Feasibility Report, and presentation of the final Feasibility Report and proposed way forward for implementation of the project.

m) *Regional Economics*

The overall approach to be used in assessing the potential impacts of the project is an economic valuation framework that links changes in yield and ecosystem characteristics to socio-economic values. The framework must enable forecasting of changes in socio-economic values due to changes in water yield and ecosystem characteristics for different economic interventions. The following steps are therefore proposed:

- In order to assess the current economic base and activities in the catchment, information from the 2007 community Survey of Statistics South Africa as well as the social accounting matrix (SAM) for the Eastern Cape (published by the Development Bank SA) will be used. The Eastern Cape SAM provides production data for water-using sectors which fall within the catchment;

- Environmental Economic Accounts for Water (Water EEAs) will model the transactions between economic production and water resources (and expands the Water sector component of the SAM);
- Once the base economic conditions are known, the socio-economic as well as the ecosystem service impacts and benefits of the chosen intervention will be assessed using the framework developed in the Millennium Ecosystem Assessment (MEA 2005);
- The contribution in the gross domestic product (GDP) and gross geographic product (GGP) will be measured using changes in the SAM;
- Employment opportunities (both to the primary and secondary economies) will be measured using changes in the SAM; and
- Assessment of the economic consequences of the operational scenarios of the preferred dam option.

n) *Legal, Institutional and Financing Arrangements*

The need to integrate legal, institutional and financing issues into the more main stream technical aspects of water resource development is an important aspect of the feasibility study. Jeffares & Green will, during the Preliminary Study (Phase 1), focus on the review of existing reports, master plans, strategies (National and Regional) and water resource assessments. The objective will be to extract issues and stakeholders which will require specific investigation and assessment during the Feasibility Study (Phase 2).

Jeffares & Green will investigate and document all existing institutional arrangements within the region that have an interest and/or role on the project. It is anticipated that institutions such as:-

- Department of Local Government and Traditional Affairs;
- Department of Minerals and Energy;
- Department Water Affairs;
- Department of Agriculture and Environmental Affairs;
- Provincial Government;
- ESKOM;
- Local Agricultural Societies or Associations;
- Water User Associations and Irrigation Boards;
- Department of Agriculture Forestry and Fisheries;
- Chamber of Commerce and representatives from Industry;
- Local and District Authorities; and
- Tribal Authority for the project area.

It is anticipated that the above organisations will be involved in the project at various levels. The institutional team will incorporate various specialists in the fields of Legal and Transaction Advisors.

The study team will undertake the development of a legal, administrative and financial model detailing responsibilities and ownership models of the infrastructure through the assessment and development of the following aspects of the project during the development of the Feasibility Report (Phase 2) :-

- Review legislative impacts on various dam options;
- Assess and advise on legal issues during the planning process with specific focus on:
  - Social impact;
  - HDI impact;
  - Land ownership and occupation; and
  - Environmental impact.
- Develop an implementation plan to ensure legislative compliance;

- Determine Capital and Operational Expenditure (Capex and Opex) costs and develop a financial model;
- Investigate alternative funding options for Capex;
- Project implementation cash flow analysis; and
- Develop institutional model and staffing organogram for operations phase.

4.1.6 *Increased project management scope*

It was agreed with the Project Steering Committee (PSC) that all PSC and Study Management Committee (SMC) meetings should be held in East London instead of half of them being held within Jeffares & Green's home offices as was included in the approach given in the original contract agreement.

This changed approach saves much time and cost for the PSC members travelling to and attending these meetings and also allows them to potentially combine such meeting travel with attendance at other project meetings in the same area. Unfortunately this has increased the travel time and cost and venue costs of the Jeffares & Green team and this has already significantly eaten into the Project Management Budget and will continue to do so.

At the same time, and given the high political profile of the project, Jeffares & Green has also been asked to undertake several extra-ordinary inputs such as assisting the Department of Water and Sanitation to prepare internal presentations, responding to parliamentary and other questions, preparing and undertaking additional presentations to District Municipalities, preparing Aide Memoires, and making preparations for (and eventually attendance of) a potential visit to the three final dam development sites by the Minister of Water and Environmental Affairs.

Jeffares & Green were also requested to draw up a Terms of Reference for the Project Governance Structure, which was not part of the original Terms of Reference.

There have also been some additional unplanned meetings and site visits whereby Jeffares & Green were requested to attend and present the project status at a Local Municipality as well as at a Municipal Manager's workshop in East London.

Other examples of this was a special presentation to the DWS Chief Director: IWRP held in Pretoria, and the upcoming additional meeting with/presentation to ESKOM/DWS/Department of Energy to be held in Pretoria on 25 January 2013.

Further unforeseen additional Project Management costs can be expected in the same vein throughout the project and it is important that an additional allowance of time and cost be added to the Project Management Task.

Increased time inputs have therefore been budgeted for the Team Leader and his Deputy, as well as increased air travel, transport, accommodation and venue hire costs that have and will continue to be incurred.

Motivations for an increased Project Management and Stakeholder Involvement budget have therefore been formally submitted by Jeffares & Green to the DWS, who have confirmed that this budget should be increased by R250 306 including VAT.

Section 4.10 of the TOR talked about the establishment of a Stakeholder Forum which will be part of the Public Participation process that will be linked to the ESIA component of the study. Jeffares & Green priced this portion of the project accordingly at tender stage.

However in addition to this forum Jeffares & Green were requested to draw up Terms of Reference for a series of additional strategic committees that will be developed in order to

ensure the involvement of all levels of government and roleplayers. The structure developed is shown in Figure 4-1 below.

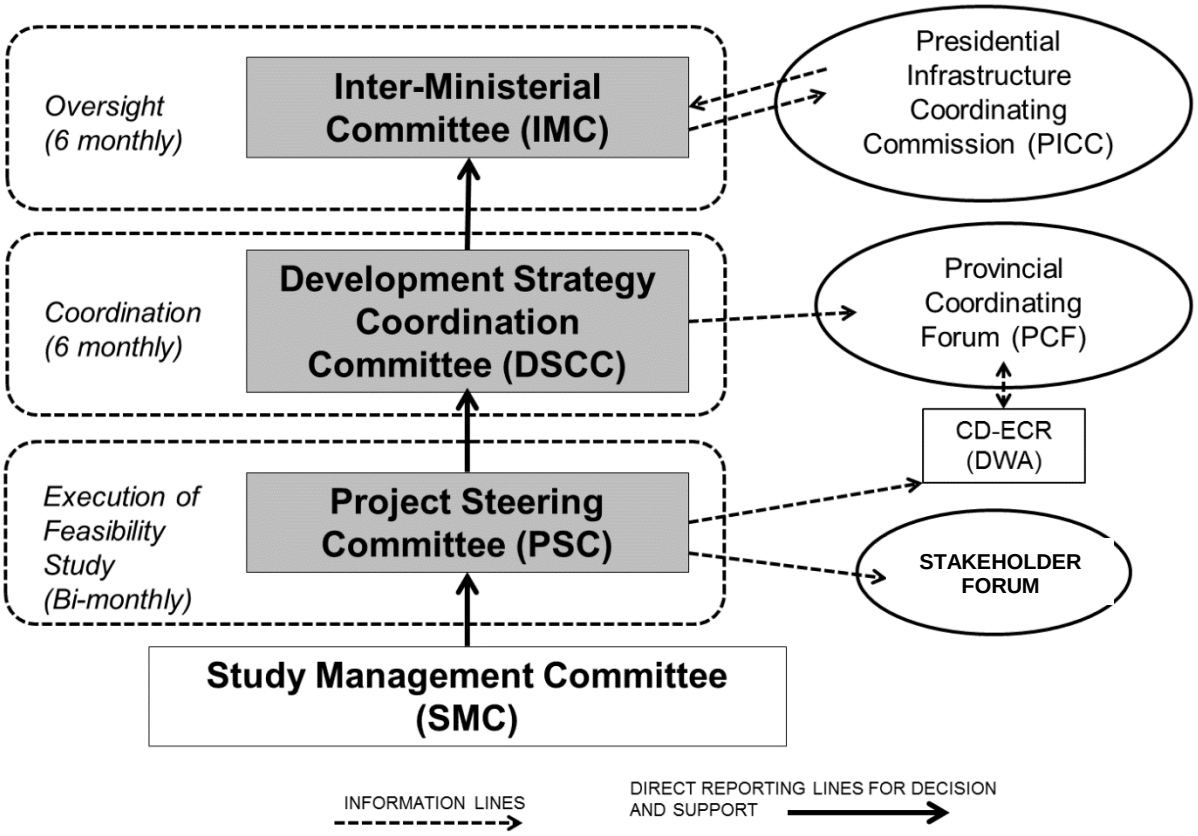


Figure 4-1: Project Governance Structure

- Frequency of meetings:
  - IMC – 6 monthly or as advised;
  - DSCC – 6 monthly or as advised;
  - PSC – Bi-monthly or as might be required; and
  - SMC – Bi-monthly or as might be required.

- Likely attendees of different forums:
  - MTT – Ministers, MEC's and Premier;
  - DSCC – Directors-General, Municipal Managers, local councillors and CEOs of relevant government institutions (e.g. Water Boards, DBSA, IDZ, TCTA, ESKOM);
  - PCF – DWS CD – EC Region to represent the group and to provide feedback;
  - PSC – Those directly involved with the reviewing or implementing the project; and
  - SMC – Study leaders from DWS and Jeffares & Green.

TCTA have been tasked by the Presidential Infrastructure Coordinating Commission to co-ordinate the Strategic Integrated Projects(s) in the study area, which "SIP3" includes the Mzimvubu Water Project. At PSC meeting No. 5 on 11 December 2012, it was proposed that TCTA therefore be made responsible for the DSCC above.

4.1.7 *Provisional sums*

As will be shown in more detail below, the above estimated task budget requirements have been achieved through the re-allocation of budgets between tasks, which includes the use of a portion of the available provisional sum which has been included in the original Contract Price for this purpose.

As things stood,

- ✓ the overall Contract Price will not be exceeded, and
- ✓ there is still a sum of R 1 889 974 (incl VAT) available under the unallocated provisional sum.

4.1.8 *Additional Detailed Investigations for Lalini Dam and Hydropower Scheme*

Further detailed investigations were undertaken for a second dam on the Tsitsa at Lalini (just above the Tsitsa Falls) which would be operated conjunctively with the Ntabelanga Dam to generate significant hydropower for supply into the national grid.

The scope of work for these additional investigations are described in Appendix E.

5. ORGANOGRAM AND HUMAN RESOURCES SCHEDULE

The tender for this project was submitted in June 2011 and in the time taken for the adjudication process to run its course, certain team members have left the company, or are otherwise assigned or undertaking academic studies, and new staff members have replaced them. In addition to this Jeffares & Green has, during the Inception Phase, become more familiar with the requirements of the project and as a result will, in due course, motivate for additional staff members to be approved on the Project Team. Approval of the proposed additional study team members will not result in an increase of the approved budget.

These team members are largely support staff and are not replacing any of the key personnel initially proposed in the tender. Jeffares & Green believe that all of the additional team members will add value to the study by providing strength and depth to the study team. At the time of writing, DWS have confirmed their approval to these proposed staffing changes. A list of the additional staff members required is provided in Table 5-1 below.

Table 5-1: Additional Staff Members

New Team Member	Company	Qualification	Charge Out Rate
David Ochan	Jeffares & Green	BSc (Civ Eng), MSc (Civ Eng)	R750
Andrew Viles	Jeffares & Green	MCse Cert GIS	R300
Samantha Moodley	Jeffares & Green	BSc Eng (Agric), MSc (Eng)	R450
Ernest Oakes	Jeffares & Green	BSc MSc (Hydrology)	R400
Tom Speirs	Jeffares & Green	BSc MSc (Geology)	R800
Meeressa Pillay	MBB	BSc Eng (Civil)	R575
Andrew Pullin	MBB	BSc Eng (Agric)	R575
Thandeka Meyiwa	MBB	BSc Eng (Agric)	R440
Nkosinathi Nsele	MBB	BSc Eng (Agric)	R440
Karlin Naidoo	MBB	BSc Eng (Civil)	R440
Andile Khumalo	MBB	B Tech (Struc Eng)	R325

Table 5-2 below indicates where certain team members are no longer available to be used on the project for various reasons and also indicates the person proposed to replace them.

Table 5-2: Replacement of Staff Members

Person Replacing	Reason for Leaving	Proposed Position	Replacement Team Member	Qualification	Charge Out Rate
Gerald De Jager	Resigned from Company	Hydrology Task Leader	Simon Johnson	BSc (Hons) Hydrology	R850
Reshina Maharaj	Resigned from Company	Water Requirements and Design Support	Mutz Thakurdin	B Tech (Civ Eng)	R650
Ntaki Sinoge	Undertaking academic studies	Assistance on Geomorphology	Andrew De Villiers	BSc (Conservation Ecology)	R350
Melissa Blouw	Resigned from Company	Environmental screening support services	Leanne Miskey	BSoc Sci Geographical Sciences)	R420

Gerald De Jager was proposed as the Hydrology Task Leader and despite having left Jeffares & Green will still be involved in the project. Budget allocation has been left for him to be involved in the hydrology task of this project as a technical specialist, but it is however proposed that he be replaced as the Task Leader by Simon Johnson who is a hydrologist with 13 years of experience in this field. Simon Johnson is already an approved team member.

An updated organogram with the proposed team member changes is provided in **Appendix C**.

6. STUDY BUDGET

6.1 Summary Budget Allocations

As described above, Jeffares & Green has reviewed all of the tasks and activities that were detailed in the Terms of Reference, and has reconsidered the allocation of staff resources, disbursements and provisional sums that were assigned to each task.

In some cases there has been some reallocation of task budgets in line with the changed programme, approach and scope described above.

The detail of the revised staff resources and disbursements allocated to each task is given on the sheets included in **Appendix D**.

The sequencing and timing of the inputs shown reflect the revised master schedule in **Appendix A**.

Table 6-1 below shows a comparison between the original task budget allocations versus the revised task budget allocations as described above, as at the date of this report. As can be seen, there is no change in the Contract Price, and there is a significant unallocated provisional sum still available.

Table 6-1: Original versus Inception Budget Allocations

Summary of Task Budgets (May 2013)											
Task		Costs (R, incl. VAT)								NET CHANGE	
		Fees Incl Escalation		Disbursements		Provisional Sums		Totals Incl VAT			
No.	Description	Original	Inception	Original	Inception	Original	Inception	Original	Inception	Rand	%
1	Inception Report	R 336 790	R 336 790	R 25 365	R 25 365	R 0	R 0	R 362 155	R 362 155	*R 0*	0.0%
2	Phase 1: Desktop Study	R 290 951	R 290 951	R 5 140	R 5 140	R 0	R 0	R 296 091	R 296 091	*R 0*	0.0%
3	Phase 1: Stakeholder Involvement	R 76 973	R 76 973	R 12 540	R 12 540	R 0	R 0	R 89 513	R 89 513	*R 0*	0.0%
4	Phase 1: Water Requirements (Enterprise Economics)	R 499 933	R 499 933	R 14 649	R 14 649	R 0	R 0	R 514 582	R 514 582	*R 0*	0.0%
5	Phase 1: Environmental Screening	R 283 655	R 283 655	R 34 314	R 34 314	R 0	R 0	R 317 969	R 317 969	*R 0*	0.0%
6	a) Phase 1: Geotechnical Reconnaissance	R 66 234	R 66 234	R 11 970	R 11 970	R 0	R 0	R 78 204	R 78 204	*R 0*	0.0%
	b) Phase 1/2: Geotechnical Investigations - 3 dam Sites - Supervision/Reporting	R 0	R 188 984	R 0	R 28 044	R 0	R 0	R 0	R 217 028	*R 217 028*	rev. approach
	c) Phase 1/2: Geotechnical Investigations - 3 dam Sites - Drilling Contractor	R 0	R 0	R 0	R 0	R 0	R 1 889 445	R 0	R 1 889 445	*R 1 889 445*	rev. approach
	d) Phase 1/2 Survey of 3 Dam Sites & Irrigation Areas	R 0	R 0	R 0	R 0	R 0	R 717 887	R 0	R 717 887	*R 717 887*	rev. approach
7	a) Phase 1: Hydrology Review	R 107 593	0	R 14 250	0	R 0	0	R 121 843	0	*-R 121 843*	rev. approach
	b) Phase 1/2: Detailed Hydrology of 3 Dams	R 0	R 500 831	R 0	R 4 560	R 0	R 0	R 0	R 505 391	*R 505 391*	rev. approach
8	Phase 1: Preliminary Study Report	R 39 033	R 39 033	R 5 700	R 5 700	R 0	R 0	R 44 733	R 44 733	*R 0*	0.0%
9	Phase 2: Final Hydrology of Preferred Dam - Flood, Backwater, Spillway	R 231 215	R 120 459	R 12 312	R 3 420	R 0	R 0	R 243 527	R 123 878	*-R 119 650*	-49.1%
10	Phase 2: Reserve Determination	R 1 115 353	R 1 115 353	R 198 944	R 198 944	R 0	R 0	R 1 314 297	R 1 314 297	*R 0*	0.0%
11	Phase 2: Water Requirements	R 856 721	R 856 106	R 34 200	R 34 816	R 0	R 0	R 890 921	R 890 921	*R 0*	0.0%

Summary of Task Budgets (May 2013)											
Task		Costs (R, incl. VAT)								NET CHANGE	
		Fees Incl Escalation		Disbursements		Provisional Sums		Totals Incl VAT			
No.	Description	Original	Inception	Original	Inception	Original	Inception	Original	Inception	Rand	%
12	Phase 2: Topographical Survey - Final Dam Site - Roads, Water Supplies**	R 0	R 0	R 0	R 0	R 570 000	see below	R 570 000	see below	*-R 570 000*	rev. approach
13	Phase 2: Site Identification	R 64 752	R 64 753	R 570	R 570	R 0	R 0	R 65 322	R 65 322	*R 0*	0.0%
14	Phase 2: Geotechnical Investigations - Borrow Pits and Soils Investigations	R 194 028	R 140 448	R 28 044	R 28 044	R 0	R 0	R 222 072	R 168 491	*-R 53 582*	-24.1%
	Phase 2: Geotechnical Investigations - Borrow Pits and Soils Investigations**	R 0	R 0	R 0	R 0	R 1 140 000	see below	R 1 140 000	see below	*-R 1 140 000*	rev. approach
15	Phase 2: Dam Design	R 1 405 415	R 1 405 414	R 55 575	R 55 575	R 0	R 0	R 1 460 990	R 1 460 989	*R 0*	0.0%
16	Phase 2: Land Matters	R 146 944	R 146 944	R 26 220	R 26 220	R 0	R 0	R 173 164	R 173 164	*R 0*	0.0%
17	Phase 2: Environmental & Social Impact Assessment	R 50 388	R 50 388	R 18 525	R 18 525	R 0	R 0	R 68 913	R 68 913	*R 0*	0.0%
18	Phase 2: Public Participation	R 107 552	R 107 552	R 18 525	R 18 525	R 0	R 0	R 126 077	R 126 077	*R 0*	0.0%
19	Phase 2: Regional Economics	R 185 467	R 185 467	R 13 224	R 13 224	R 0	R 0	R 198 691	R 198 691	*R 0*	0.0%
20	Phase 2: Legal, Institutional & Financial Arrangements	R 202 646	R 202 646	R 22 572	R 22 572	R 0	R 0	R 225 218	R 225 218	*R 0*	0.0%
	Other Provisional Sums - Not yet allocated (incl borrow pits, sampling, testing)	R 0	R 0	R 0	R 0	R 3 500 000	**R 1 889 974**	R 3 500 000	R 1 889 974	*-R 1 610 025*	-46.0%
21	Project Management and Client Liaison	R 772 955	R 974 172	R 80 028	R 164 160	R 0	R 0	R 852 983	R 1 138 331	*R 285 349*	33.5%

Table 6-2 overleaf shows a summary of the projected utilization of each staff member, based on the above inception budgets.

This also summarizes the expected HDI proportion of staff costs, which stands at 38% by time, and 29% by cost. Jeffares & Green's ultimate goal is to achieve at least a 35% HDI target content by the end of the study.

Additional and alternative staff members as recently approved by DWS may also be used that are not shown in the list below.

Table 6-2: Projected Utilization of Staff Members

SUMMARY OF STAFF TIME INPUTS		HDI status			Utilization by Hours		Utilization by Cost	
Name	**Position in Team**	**(W/B)**	**(M/F)**	**(Y/N)**	**non-HDI**	**HDI**	**non-HDI**	**HDI**
Andy Pepperell	Study Leader	W	M	**N**	730	0	1 031 141	0
Jan Norris	Task Leader: Geotech Recon & Geotechnical Investigations	W	F	**N**	208	0	265 743	0
Neal Bromley	Task Leader: Legal, Instit, Finance Arrangements	W	M	**N**	16	0	19 360	0
Simon Johnson	Task Leader: Hydrology, Desktop Study & Prelim Study Report	W	M	**N**	812	0	719 185	0
Roshan Roopchund	Task Leader: Water Requirements	B	M	**Y**	0	225	0	244 124
Kobus Burger	Structural Engineer	W	M	**N**	88	0	91 960	0
Magnus Van Rooyen	Environmental screening support	W	M	**N**	116	0	70 800	0
Mutz Thakurdin	Water requirements support	B	M	**Y**	0	184	0	124 460
Khuthalile Mahlaba	Task Leader: Stakeholder Involvement	B	F	**Y**	0	138	0	73 944
Ryan Gray	Water resources support	W	M	**N**	711	0	337 458	0
Gugu Ndlela	Geotechnical investigation support	B	F	**Y**	0	372	0	174 600
Ernest Oakes	Assistant Hydrologist	B	M	**Y**	0	0	0	0
Bronwyn Newton	Design support	W	F	**Y**	0	272	0	117 760
Ingrid Eweg	Design support	W	F	**Y**	0	270	0	111 375
Melissa Moffett	Task Leader: Environmental Screening and EIA	W	F	**Y**	0	53	0	38 440
Faye Balfour	Institutional analyst	W	F	**Y**	0	120	0	79 200
Leanne Miskey	GIS support	W	F	**Y**	0	420	0	171 992
Mike Udal	Irrigation Potential Support	W	M	**N**	271	0	281 000	0
Mark Zartmann	Irrigation Potential	W	M	**N**	104	0	142 800	0
A Whitfield	Estuarine Reserve Determination	W	M	**N**	132	0	81 840	0
Pranesh Moodley	Irrigation Potential Support	B	M	**Y**	0	182	0	145 780
J Turpie	Estuarine Reserve Determination	B	F	**Y**	0	88	0	61 472
Dr Colin Smith	Afforestation Specialist	W	M	**N**	84	0	67 800	0
Mark Graham	Vegetation Assessment EWR	W	M	**N**	185	0	112 560	0
Retha Stassen	Task Leader: Reserve Determination	W	F	**Y**	0	238	0	117 216
Leo Quayle	Water quality EWR	W	M	**N**	84	0	41 952	0
Angelina Jordonova	Hydraulics EWR	W	F	**Y**	0	66	0	60 480
Lindo Hlongwane	Geomorphology EWR	B	M	**Y**	0	82	0	29 120
Andrew de Villiers	Macrinvertebrates EWR	w	M	**N**	80	0	26 112	0
Anton Bok	Fish EWR	W	M	**N**	108	0	49 410	0
Cas Isherwood	Geotechnical investigation support	W	M	**N**	59	0	44 475	0
Phillip Hull	Hydrology support	W	M	**N**	472	0	204 850	0
G Bate	Estuarine Reserve Determination	W	M	**N**	128	0	66 000	0
Janine Adams	Estuarine Reserve Determination	W	M	**N**	128	0	66 000	0

SUMMARY OF STAFF TIME INPUTS		HDI status			Utilization by Hours		Utilization by Cost	
Name	**Position in Team**	**(W/B)**	**(M/F)**	**(Y/N)**	**non-HDI**	**HDI**	**non-HDI**	**HDI**
Jackie Crafford	Task Leader: Regional Economics	W	M	**N**	170	0	158 610	0
Oscar Ashton	Agricultural support	W	M	**N**	296	0	225 680	0
Sandy Melvill	Task Leader: Dam Design	W	M	**N**	140	0	136 800	0
David Ochan	Dams Design Engineer	B	M	**N**	130	0	143 000	0
Prof Klijko	Seismic analysis	W	M	**N**	40	0	44 000	0
N Forbes	Estuarine Reserve Determination	W	F	**Y**	0	124	0	76 684
A Forbes	Estuarine Reserve Determination	W	M	**N**	132	0	98 184	0
Lara Van Niekerk	Estuarine Reserve Determination	W	F	**Y**	0	128	0	79 200
Andre Theron	Estuarine Reserve Determination	W	M	**N**	128	0	84 480	0
S Taljaard	Estuarine Reserve Determination	W	F	**Y**	0	128	0	91 740
Caroline Pepperman	Legal Expert	W	F	**Y**	0	16	0	36 960
Andrew Barclay	Project Finance Specialist	W	M	**N**	32	0	42 240	0
Chris Brand	Spillway Design	W	M	**N**	40	0	50 600	0
Colin Scott	Roads Design	W	M	**N**	32	0	42 240	0
Preggy Pillay	Roads Design	B	M	**Y**	0	70	0	48 510
Vishane Ramharak	Design Support	B	M	**Y**	0	120	0	40 920
Sharma Maharaj	Task Leader: Land Matters	B	M	**Y**	0	112	0	60 368
					5 657	**3 408**	**4 746 280**	**1 984 345**
					62%	**38%**	**71%**	**29%**

6.2 Monthly Cashflows

Table 6-3 below show the projected monthly cashflow of the revised inception budgeted professional fees, disbursements and provisional sums expenditure (in Rand and incl VAT)

Table 6-3: Monthly Cashflow Projection

MONTHLY CASHFLOW PROJECTION (INCL VAT)				
Month	**Professional Fees**	**Disbursements**	**Provisional Sums**	**Total**
Jan-12	R 106 947.28	R 11 648.31	R 0.00	R 118 595.59
Feb-12	R 55 711.80	R 11 270.01	R 0.00	R 66 981.81
Mar-12	R 175 935.06	R 28 091.24	R 0.00	R 204 026.30
Apr-12	R 89 877.60	R 3 799.52	R 0.00	R 93 677.12
May-12	R 307 441.98	R 0.00	R 0.00	R 307 441.98
Jun-12	R 187 687.32	R 6 270.00	R 0.00	R 193 957.32
Jul-12	R 719 350.26	R 55 860.00	R 0.00	R 775 210.26
Aug-12	R 423 959.46	R 111 277.68	R 0.00	R 535 237.14
Sep-12	R 159 436.44	R 24 202.20	R 0.00	R 183 638.64
Oct-12	R 254 439.74	R 10 545.00	R 0.00	R 264 984.74
Nov-12	R 279 274.07	R 35 454.00	R 0.00	R 314 728.07
Dec-12	R 441 054.60	R 1 140.00	R 0.00	R 442 194.60
Jan-13	R 396 622.47	R 107 901.00	R 1 026 000.00	R 1 530 523.47
Feb-13	R 301 185.98	R 46 740.00	R 969 000.00	R 1 316 925.98
Mar-13	R 686 914.95	R 25 992.00	R 90 886.50	R 803 793.45
Apr-13	R 692 890.18	R 59 382.60	R 0.00	R 752 272.78
May-13	R 703 993.84	R 32 262.00	R 1 262 445.12	R 1 998 700.96
Jun-13	R 509 182.94	R 18 582.00	R 798 000.00	R 1 325 764.94
Jul-13	R 379 298.57	R 38 304.00	R 349 930.10	R 767 532.67
Aug-13	R 150 241.69	R 13 680.00	R 0.00	R 163 921.69
Sep-13	R 159 484.40	R 35 169.00	R 0.00	R 194 653.40
Oct-13	R 253 073.50	R 19 380.00	R 0.00	R 272 453.50
Nov-13	R 141 852.48	R 25 251.00	R 0.00	R 167 103.48
Dec-13	R 47 909.07	R 4 674.00	R 0.00	R 52 583.07
Jan-14	R 15 180.30	R 0.00	R 0.00	R 15 180.30
Feb-14	R 15 180.30	R 0.00	R 0.00	R 15 180.30
Mar-14	R 0.00	R 0.00	R 0.00	R 0.00
Apr-14	R 0.00	R 0.00	R 0.00	R 0.00
	R 7 654 126.26	**R 726 875.56**	**R 4 496 261.72**	**R 12 877 263.54**

Actual expenditure of Provisional Sums will be entirely at DWS's discretion.

Figures 6-1 and 6-2 below show these monthly and cumulative cashflow projections in a graphical format, together with the actual invoicing that had taken place at the effective due date of this Report.

Such charts are used to track actual versus projected expenditures.

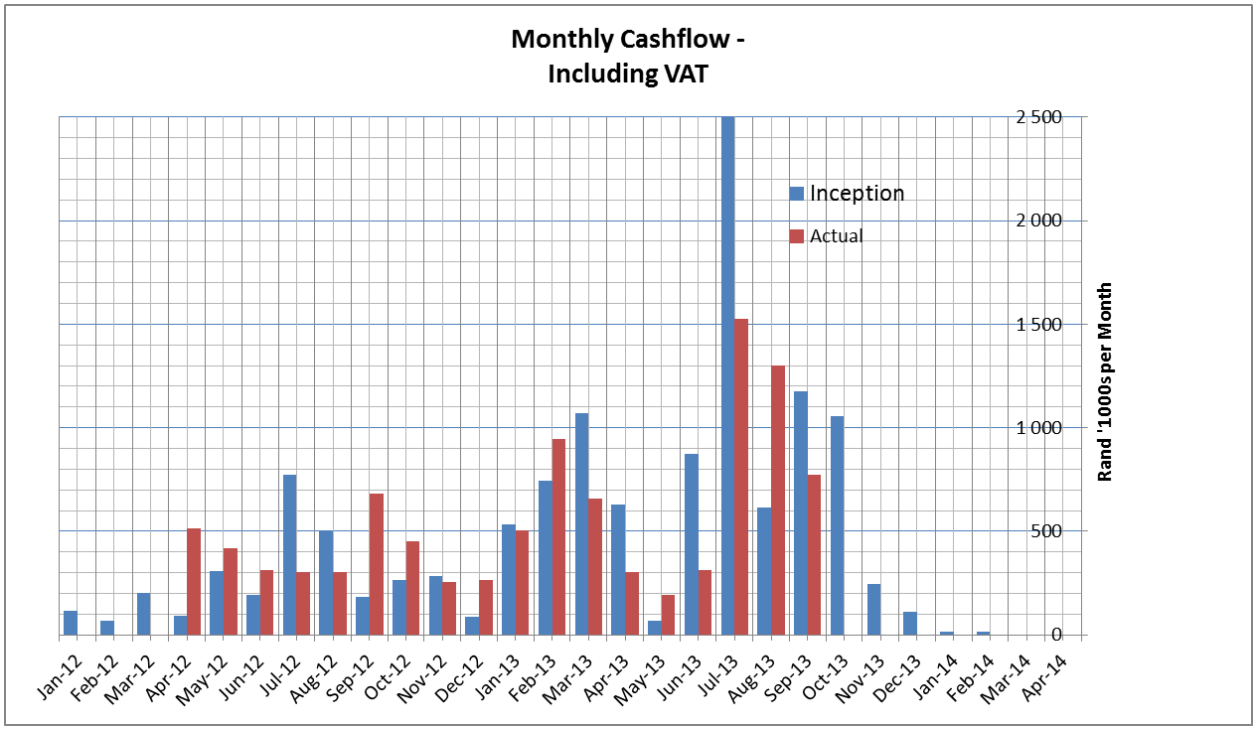


Figure 6-1: Projected Monthly Expenditures

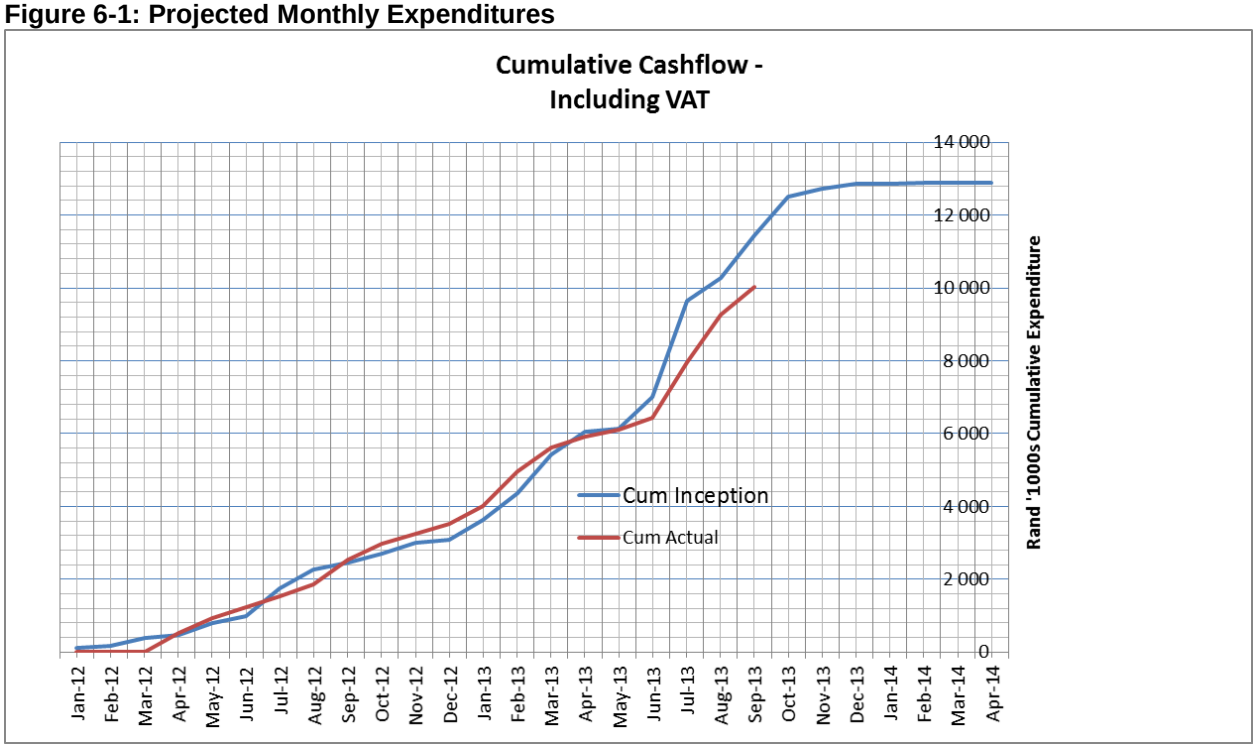


Figure 6-2: Projected Cumulative Expenditures

6.3 Annual Budgets over Study Period

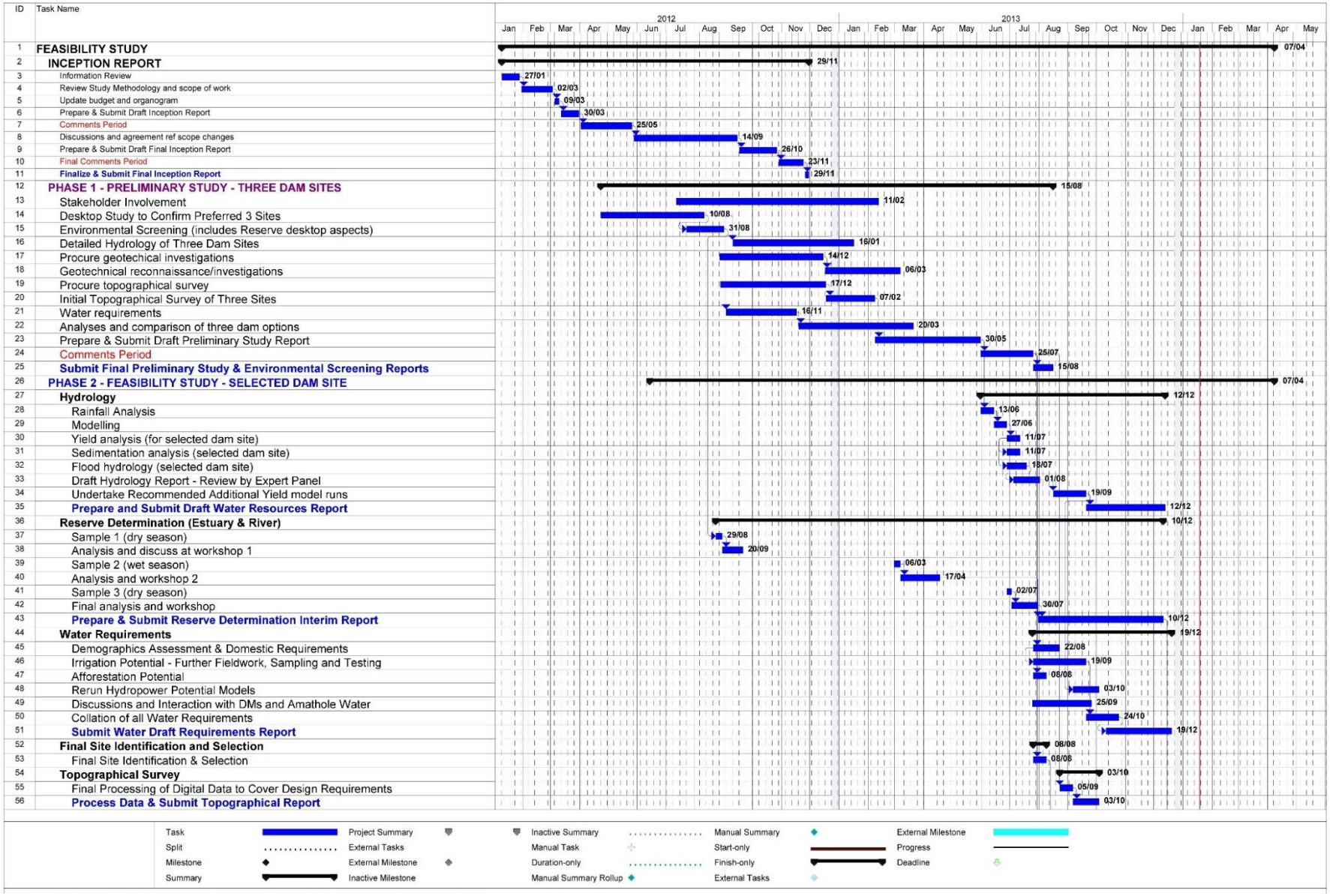
Table 6-4 summarises the projected annual budget requirements.

Table 6-4: Annual Budgeting Requirements

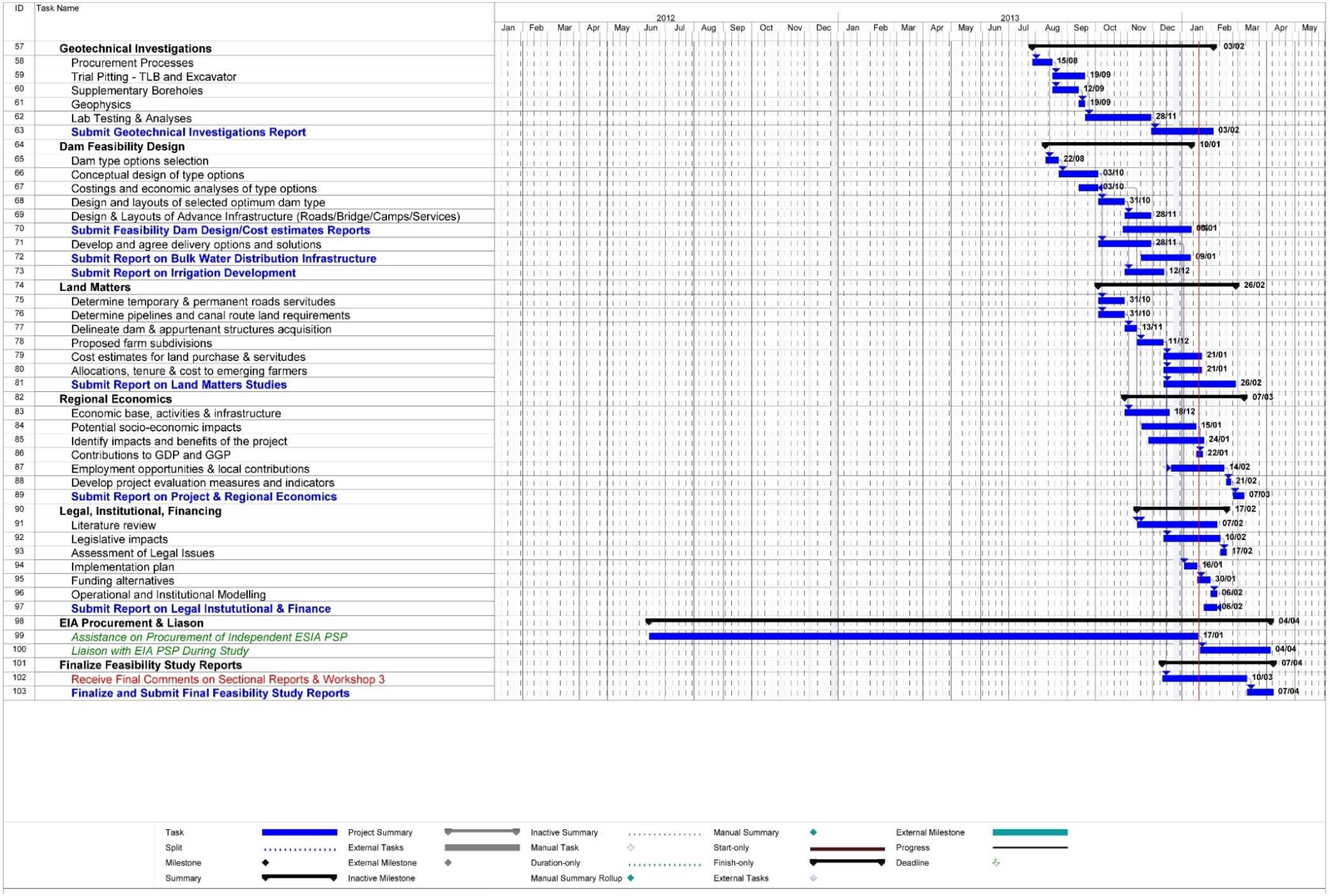
SUMMARY OF ANNUAL BUDGET REQUIREMENTS (INCEPTION)			
Revised Annual Budgets:	**Amount**	**VAT**	**Total**
January 2012 to March 2012	R 341 758	R 47 846	R 389 604
April 2012 to March 2013	R 5 931 853	R 830 459	R 6 762 313
April 2013 to March 2014	R 5 022 234	R 703 113	R 5 725 347
Totals:	**R 11 295 845**	**R 1 581 418**	**R 12 877 264**

APPENDIX A

INCEPTION REPORT SCHEDULE



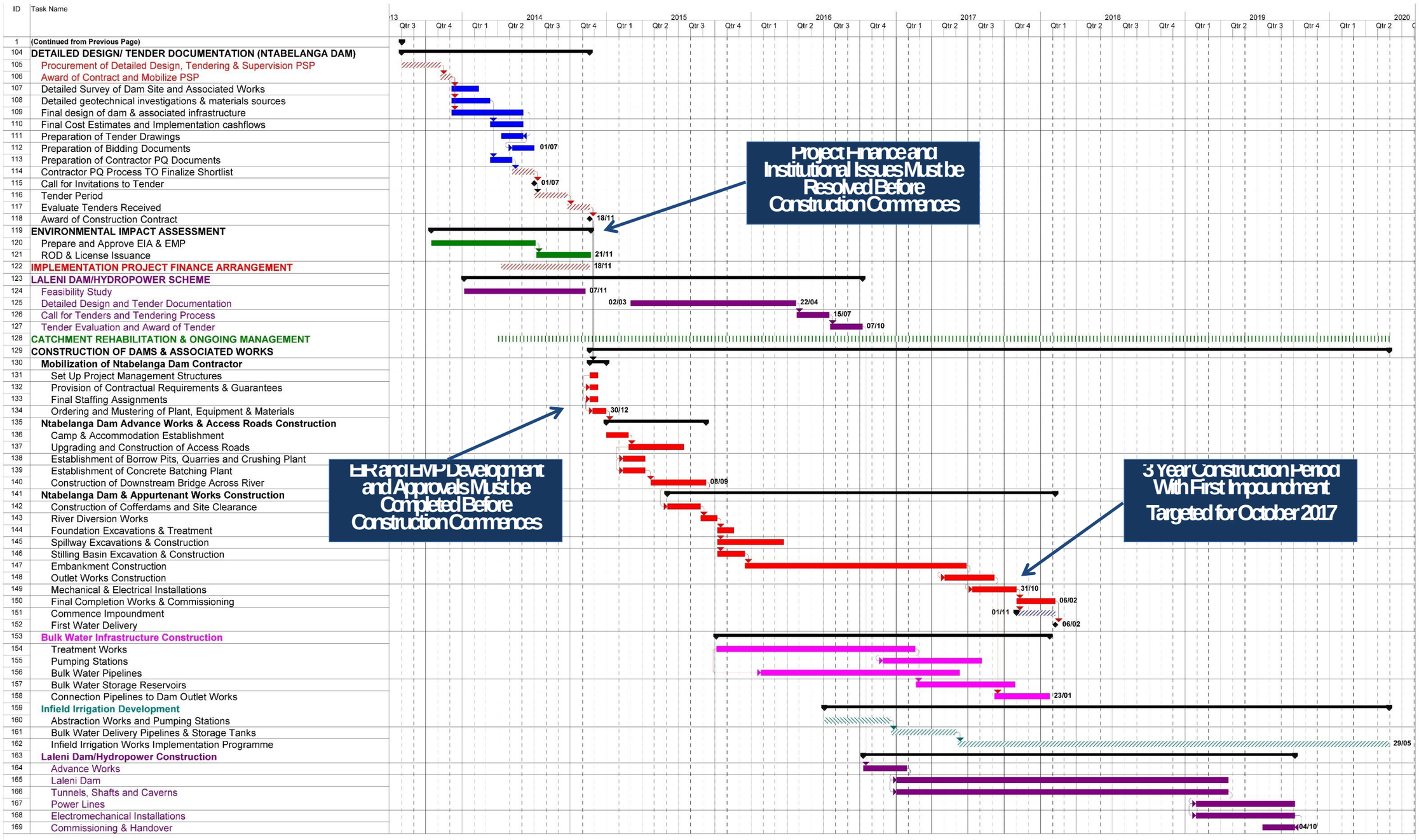
Appendix A – Inception Report Schedule Page 1 of 2



Appendix A – Inception Report Schedule Page 2 of 2

APPENDIX B

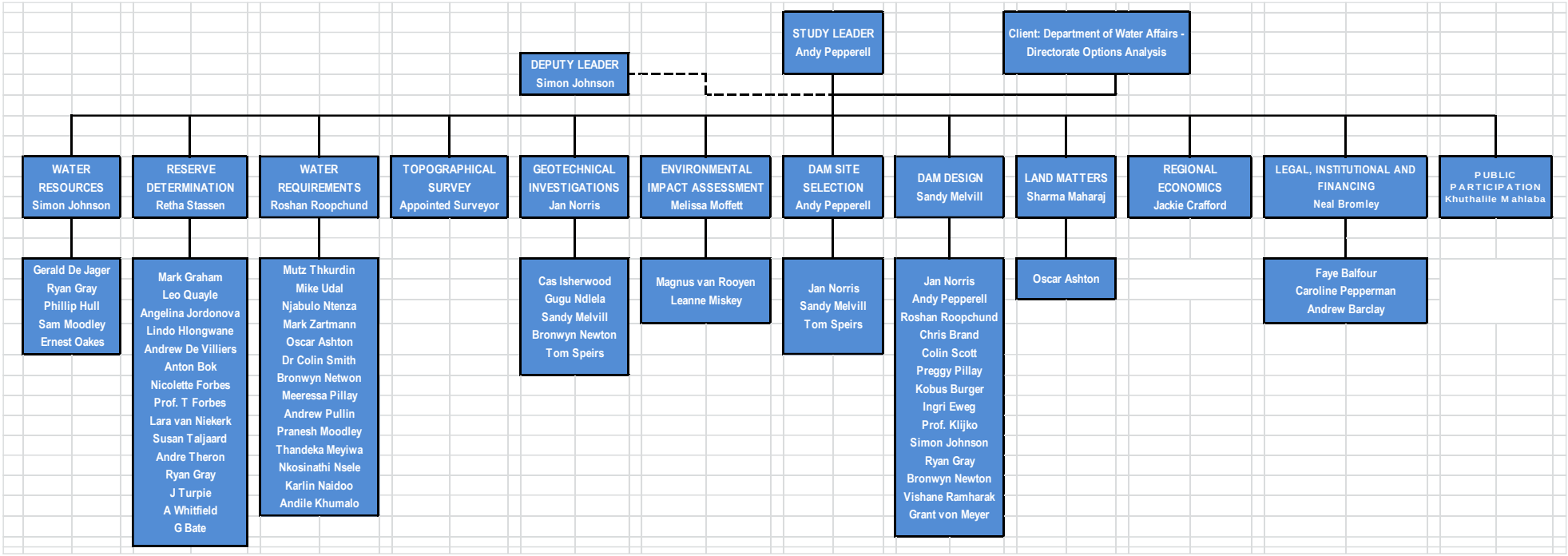
PROJECT IMPLEMENTATION SCHEDULE



Appendix B – Project Implementation Schedule

APPENDIX C

REVISED ORGANOGRAM



Appendix C - Revised Organogram

NB: *Overall, the Organisation has not changed, but some of the staff have had to be replaced and others added in their place.*

APPENDIX D

STUDY TEAM INPUTS, COSTS AND DISBURSEMENTS

Appendix D – Sheet 1 of 8

Task 1.1	Inception Report								
Task 1.1	*Information Review*								
Task 1.1	*Review Study Methodology and scope of work*								
Task 1.1	*Update budget and organogram*								
Task 1.1	***Prepare & Submit Draft Inception Report***								
Task 1.1	*Comments Period*								
Task 1.1	***Submit Final Inception Report***								
Task 1.1	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 1.1	*Andy Pepperell*	*Study Leader*	**198 128**	1351	1486	1635	146.7	0.0	0.0
	Simon Johnson	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**56 100**	850	935	1029	66.0	0.0	0.0
	Leanne Miskey	*GIS support*	**30 402**	390	429	472	78.0	0.0	0.0
	Jan Norris	*Task Leader: Geotech Recon & Geotechnical Investigations*	**10 800**	1200	1320	1452	9.0	0.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					12 008	0.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					10 242	0.0	0
Task 1.1		***Total for Task 1.1 (Rand)***	**295 430**	295430	0	0	**22 250**	**0**	**0**

	Phase 1 - Preliminary Study								
Task 1.2	***Desktop Study to Confirm Preferred 3 Sites***								
Task 1.2	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 1.2	*Simon Johnson*	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**72 250**	850	935	1029	85.0	0.0	0.0
	Ryan Gray	*Water resources support*	**11 730**	460	506	557	25.5	0.0	0.0
	Andy Pepperell	*Study Leader*	**70 252**	1351	1486	1635	52.0	0.0	0.0
	Mike Udal	*Irrigation Potential Support*	**16 000**	1000	1100	1210	16.0	0.0	0.0
	Dr Colin Smith	*Afforestation Specialist*	**3 000**	750	825	908	4.0	0.0	0.0
	Melissa Moffett	*Task Leader: Environmental Screening and EIA*	**2 800**	700	770	847	4.0	0.0	0.0
	Retha Stassen	*Task Leader: Reserve Determination*	**4 800**	480	528	581	10.0	0.0	0.0
	N Forbes	*Estuarine Reserve Determination*	**4 800**	600	660	726	8.0	0.0	0.0
	Roshan Roopchund	*Task Leader: Water Requirements*	**62 588**	1050	1155	1271	59.6	0.0	0.0
	Jackie Crafford	*Task Leader: Regional Economics*	**3 400**	850	935	1029	4.0	0.0	0.0
	Sandy Melvill	*Task Leader: Dam Design*	**3 600**	900	990	1089	4.0	0.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					3 978.4	0.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					530.0	0.0	0
	Disbursements	*Accommodation costs*					0.0	0.0	0
Task 1.2		***Total for Task 1.2 (Rand)***	**255 220**	255220	0	0	**4 508**	**0**	**0**

Appendix D – Sheet 2 of 8

Task 1.3	*Stakeholder Involvement*								
Task 1.3	*Task Resources*	*Team Position*	Total fees	rate2012	rate2013	rate2104	hours2012	hours2013	hours2014
TASK 1.3	*Khuthalile Mahlaba*	*Task Leader: Stakeholder Involvement*	**49 912**	520	572	629	96.0	0.0	0.0
	Andy Pepperell	*Study Leader*	**10 808**	1351	1486	1635	8.0	0.0	0.0
	Simon Johnson	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**6 800**	850	935	1029	8.0	0.0	0.0
	Disbursements		Disbursement totals:				cost'12	cost'13	cost'14
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					6 000.0	0.0	0
	Disbursements	*Venues etc*					0.0	0.0	0
	Disbursements	*Accommodation costs*					5 000.0	0.0	0
Task 1.3		*Total for Task 1.3 (Rand)*	**67 520**	67520	0	0	**11 000**	**0**	**0**

Task 1.4	*Water requirements*								
Task 1.4	*Task Resources*	*Team Position*	Total fees	rate2012	rate2013	rate2104	hours2012	hours2013	hours2014
TASK 1.4	*Roshan Roopchund*	*Task Leader: Water Requirements*	**88 401**	1050	1155	1271	84.2	0.0	0.0
	Mutz Thakurdin	*Water requirements support*	**40 640**	635	699	768	64.0	0.0	0.0
	Mike Udal	*Irrigation Potential Support*	**102 000**	1000	1100	1210	102.0	0.0	0.0
	Mark Zartmann	*Irrigation Potential*	**30 600**	1275	1403	1543	24.0	0.0	0.0
	Oscar Ashton	*Agricultural support*	**22 400**	700	770	847	32.0	0.0	0.0
	Dr Colin Smith	*Afforestation Specialist*	**12 000**	750	825	908	16.0	0.0	0.0
	Leanne Miskey	*GIS support*	**46 118**	390	429	472	118.3	0.0	0.0
	Bronwyn Newton	*Design support*	**6 400**	400	440	484	16.0	0.0	0.0
	Simon Johnson	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**52 700**	850	935	1029	62.0	0.0	0.0
	Phillip Hull	*Hydrology support*	**13 600**	425	468	514	32.0	0.0	0.0
	Pranesh Moodley	*Irrigation Potential Support*	**23 680**	740	814	895	32.0	0.0	0.0
	Disbursements		Disbursement totals:				cost'12	cost'13	cost'14
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					9 000.0	0.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					850.0	0.0	0
	Disbursements	*Accommodation costs*					3 000.0	0.0	0
Task 1.4		*Total for Task 1.4 (Rand)*	**438 538**	438538	0	0	**12 850**	**0**	**0**

Task 1.5	*Environmental Screening (includes Reserve desktop aspects)*								
Task 1.5	*Task Resources*	*Team Position*	Total fees	rate2012	rate2013	rate2104	hours2012	hours2013	hours2014
TASK 1.5	*Melissa Moffett*	*Task Leader: Environmental Screening and EIA*	**11 840**	700	770	847	16.9	0.0	0.0
	Magnus Van Rooyen	*Environmental screening support*	**50 400**	600	660	726	84.0	0.0	0.0
	Mark Graham	*Vegetation Assessment EWR*	**60 600**	600	660	726	101.0	0.0	0.0
	Retha Stassen	*Task Leader: Reserve Determination*	**37 440**	480	528	581	78.0	0.0	0.0
	Leo Quayle	*Water quality EWR*	**8 640**	480	528	581	18.0	0.0	0.0
	N Forbes	*Estuarine Reserve Determination*	**4 800**	600	660	726	8.0	0.0	0.0
	Angelina Jordonova	*Hydraulics EWR*	**27 000**	900	990	1089	30.0	0.0	0.0
	Ryan Gray	*Water resources support*	**12 880**	460	506	557	28.0	0.0	0.0
	Lindo Hlongwane	*Geomorphology EWR*	**11 200**	350	385	424	32.0	0.0	0.0
	Andrew de Villiers	*Macrinvertebrates EWR*	**5 120**	320	352	387	16.0	0.0	0.0
	Anton Bok	*Fish EWR*	**18 900**	450	495	545	42.0	0.0	0.0
	Disbursements		Disbursement totals:				cost'12	cost'13	cost'14
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					18 750.0	0.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					550.0	0.0	0
	Disbursements	*Accommodation costs*					10 800.0	0.0	0
Task 1.5		*Total for Task 1.5 (Rand)*	**248 820**	248820	0	0	**30 100**	**0**	**0**

Appendix D – Sheet 3 of 8

Task 1.6	*Geotechnical reconnaissance*								
Task 1.6	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 1.6	*Jan Norris*	*Task Leader: Geotech Recon & Geotechnical Investigations*	**24 000**	1200	1320	1452	20.0	0.0	0.0
	Gugu Ndlela	*Geotechnical investigation support*	**14 400**	450	495	545	32.0	0.0	0.0
	Cas Isherwood	*Geotechnical investigation support*	**16 500**	750	825	908	22.0	0.0	0.0
	Bronwyn Newton	*Design support*	**3 200**	400	440	484	8.0	0.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					6 000.0	0.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					500.0	0.0	0
	Disbursements	*Accommodation costs*					4 000.0	0.0	0
Task 1.6		***Total for Task 1.6 (Rand)***	**58 100**	58100	0	0	**10 500**	**0**	**0**

Task 1.7	*Hydrology (Detailed on Three dams)*								
Task 1.7	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
Task 1.7	*Simon Johnson*	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**65 450**	850	935	1029	55.0	20.0	0.0
	Ryan Gray	*Water resources support*	**209 300**	460	506	557	378.0	70.0	0.0
	Phillip Hull	*Hydrology support*	**164 576**	425	468	514	329.4	52.6	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					0.0	0.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					2 000.0	2 000.0	0
	Disbursements	*Accommodation costs*					0.0	0.0	0
Task 1.7		***Total for Task 1.7 (Rand)***	**439 326**	360629	78696	0	**2 000**	**2 000**	**0**

Task 1.8	*Prepare & Submit Draft Preliminary Study Report*								
Task 1.8	***Prepare & Submit Draft Preliminary Study Report***								
Task 1.8	*Comments Period*								
Task 1.8	***Submit Final Preliminary Study Report***								
Task 1.8	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 1.8	*Simon Johnson*	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**11 220**	850	935	1029	0.0	12.0	0.0
	Leanne Miskey	*GIS support*	**0**	390	429	472	0.0	0.0	0.0
	Bronwyn Newton	*Design support*	**0**	400	440	484	0.0	0.0	0.0
	Andy Pepperell	*Study Leader*	**23 020**	1351	1486	1635	0.0	15.5	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Printing, Purchase of Maps and data, etc*					0.0	5 000.0	0
Task 1.8		***Total for Task 1.8 (Rand)***	**34 240**	0	34240	0	**0**	**5 000**	**0**

Appendix D – Sheet 4 of 8

	Phase 2 - Feasibility Study								
Task 2.1	*2.1 Hydrology*								
	Rainfall Analysis								
	Modelling								
	Yield analysis (for selected dam site)								
	Sedimentation analysis (selected dam site)								
	Flood hydrology (selected dam site)								
	Submit Hydrology Report								
Task 2.1	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
Task 2.1	*Simon Johnson*	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**14 960**	850	935	1029	0.0	16.0	0.0
	Ryan Gray	*Water resources support*	**40 480**	460	506	557	0.0	80.0	0.0
	Phillip Hull	*Hydrology support*	**28 050**	425	468	514	0.0	60.0	0.0
	Retha Stassen	*Task Leader: Reserve Determination*	**8 448**	480	528	581	0.0	16.0	0.0
	Leanne Miskey	*GIS support*	**13 728**	390	429	472	0.0	32.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					0.0	0.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					0.0	3 000.0	0
	Disbursements	*Accommodation costs*					0.0	0.0	0
	Disbursements	*Special allowances for absence >24hrs*					0.0	0.0	0
Task 2.1		***Total for Task 2.1 (Rand)***	**105 666**	0	105666	0	**0**	**3 000**	**0**

Task 2.2	*2.2 Reserve Determination (Estuary & River)*								
	Sample 1 (dry season)								
	Analysis and discuss at workshop 1								
	Sample 2 (wet season)								
	Analysis and discuss at workshop 2								
	Submit Reserve Determination Interim Report								
Task 2.2	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.2	*Mark Graham*	*Vegetation Assessment EWR*	**51 960**	600	660	726	58.0	26.0	0.0
	Retha Stassen	*Task Leader: Reserve Determination*	**58 464**	480	528	581	80.0	38.0	0.0
	Leo Quayle	*Water quality EWR*	**33 312**	480	528	581	32.0	34.0	0.0
	Angelina Jordonova	*Hydraulics EWR*	**33 480**	900	990	1089	24.0	12.0	0.0
	Lindo Hlongwane	*Geomorphology EWR*	**17 920**	350	385	424	38.0	12.0	0.0
	Andrew de Villiers	*Macrinvertebrates EWR*	**20 992**	320	352	387	48.0	16.0	0.0
	Anton Bok	*Fish EWR*	**30 510**	450	495	545	48.0	18.0	0.0
	Ryan Gray	*Water resources support*	**35 742**	460	506	557	48.0	27.0	0.0
	N Forbes	*Estuarine Reserve Determination*	**67 084**	600	660	726	69.0	38.9	0.0
	A Forbes	*Estuarine Reserve Determination*	**98 184**	720	792	871	92.4	40.0	0.0
	Lara Van Niekerk	*Estuarine Reserve Determination*	**79 200**	600	660	726	88.0	40.0	0.0
	Andre Theron	*Estuarine Reserve Determination*	**84 480**	640	704	774	88.0	40.0	0.0
	S Taljaard	*Estuarine Reserve Determination*	**91 740**	695	765	841	88.0	40.0	0.0
	Janine Adams	*Estuarine Reserve Determination*	**66 000**	500	550	605	88.0	40.0	0.0
	G Bate	*Estuarine Reserve Determination*	**66 000**	500	550	605	88.0	40.0	0.0
	J Turpie	*Estuarine Reserve Determination*	**61 472**	680	748	823	64.0	24.0	0.0
	A Whitfield	*Estuarine Reserve Determination*	**81 840**	600	660	726	88.0	44.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					31 012.0	35 000.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					20 000.0	15 000.0	0
	Disbursements	*Accommodation costs*					29 300.0	44 200.0	0
Task 2.2		***Total for Task 2.2 (Rand)***	**978 380**	645004	333376	0	**80 312**	**94 200**	**0**

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Task 2.3	*2.3 Water Requirements (Enterprise Economics)*								
	Demographics Assessment & Domestic Requirements								
	Irrigation Potential								
	Afforestation Potential								
	Hydropower Potential								
	Collation of all Water Requirements								
	Submit Water Requirements Report								
Task 2.3	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.3	*Roshan Roopchund*	*Task Leader: Water Requirements*	**48 510**	1050	1155	1271	0.0	42.0	0.0
	Mutz Thakurdin	*Water requirements support*	**83 820**	635	699	768	0.0	120.0	0.0
	Mike Udal	*Irrigation Potential Support*	**83 600**	1000	1100	1210	0.0	76.0	0.0
	Mark Zartmann	*Irrigation Potential*	**112 200**	1275	1403	1543	0.0	80.0	0.0
	Oscar Ashton	*Agricultural support*	**147 840**	700	770	847	0.0	192.0	0.0
	Dr Colin Smith	*Afforestation Specialist*	**52 800**	750	825	908	0.0	64.0	0.0
	Leanne Miskey	*GIS support*	**51 480**	390	429	472	0.0	120.0	0.0
	Simon Johnson	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**29 920**	850	935	1029	0.0	32.0	0.0
	Phillip Hull	*Hydrology support*	**18 700**	425	468	514	0.0	40.0	0.0
	Pranesh Moodley	*Irrigation Potential Support*	**122 100**	740	814	895	0.0	150.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					0.0	20 000.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					0.0	540.0	0
	Disbursements	*Accommodation costs*					0.0	10 000.0	0
Task 2.3		***Total for Task 2.3 (Rand)***	**750 970**	0	750970	0	**0**	**30 540**	**0**

Task 2.4	*2.4 Final Site Identification and Selection*								
	Final Site Identification & Selection								
Task 2.4	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.4	*Jan Norris*	*Task Leader: Geotech Recon & Geotechnical Investigations*	**10 551**	1200	1320	1452	0.0	8.0	0.0
	Sandy Melvill	*Task Leader: Dam Design*	**7 920**	900	990	1089	0.0	8.0	0.0
	Simon Johnson	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**13 570**	850	935	1029	0.0	14.5	0.0
	Andy Pepperell	*Study Leader*	**11 889**	1351	1486	1635	0.0	8.0	0.0
	Leanne Miskey	*GIS support*	**12 870**	390	429	472	0.0	30.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Printing, Purchase of Maps and data, etc*					0.0	500.0	0
Task 2.4		***Total for Task 2.4 (Rand)***	**56 800**	0	56800	0	**0**	**500**	**0**

Task 2.5	*2.5 Topographical Survey*								
	Procurement of Surveying Services (3 quotes system)								
	Field Work								
	Process Data & Submit Topographical Report								
Task 2.5	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.5	*Surveying Sub-Contractor to be procured*	*Sub-Contractor (budget allowed)*					0.0	0.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Will be included in survey quotation*					0.0	629 725.0	0
	Disbursements	*Additionla infill on final design*					0.0	400 000.0	0
Task 2.5		***Total for Task 2.5 (Rand)***	**0**				**0**	**629 725**	**0**

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Task 2.6	2.6 Geotechnical Investigations (including supervision)								
	Advertise, Procure & Appoint Drilling Contractor (3 quotes)								
	Geophysics								
	Trial Pitting								
	Supplementary Boreholes								
	Lab Testing & Analyses								
	Submit Geotechnical Investigations Report								
Task 2.6	**Task Resources**	**Team Position**	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.6	Jan Norris	Task Leader: Geotech Recon & Geotechnical Investigations	**60 720**	1200	1320	1452	0.0	46.0	0.0
	Cas Isherwood	Geotechnical investigation support	**30 773**	750	825	908	0.0	37.3	0.0
	Gugu Ndlela	Geotechnical investigation support	**151 723**	450	495	545	0.0	306.5	0.0
	Sandy Melvill	Task Leader: Dam Design	**31 680**	900	990	1089	0.0	32.0	0.0
	Bronwyn Newton	Design support	**14 080**	400	440	484	0.0	32.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Drilling Sub-Contractor - orig P Sum	Procured through 3 quotation system					0.0	1 657 408.0	0
	Drilling Sub-Contractor - other P Sum	Borow Pits & Soils Investigations & Testing					0.0	1 256 956.2	0
	Disbursements	Travel - Own Vehicle, Air, Hire Car					0.0	15 200.0	0
	Disbursements	Printing, Purchase of Maps and data, etc					0.0	6 000.0	0
	Disbursements	Accommodation costs					0.0	28 000.0	0
Task 2.6		***Total for Task 2.6 (Rand)***	**288 975**	0	288975	0	**0**	**2 963 564**	**0**

Task 2.7	2.7 Dam Design								
	Dam type options selection								
	Conceptual design of type options								
	Costings and economic analyses of type options								
	Design and layouts of selected optimum dam type								
	Submit Optimum Dam Design/cost estimates Report								
	Develop and agree delivery options and solutions								
	Submit Report on Bulk Water Distribution Infrastructure								
	Submit Report on Irrigation Development								
Task 2.7	**Task Resources**	**Team Position**	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.7	Jan Norris	Task Leader: Geotech Recon & Geotechnical Investigations	**138 571**	1200	1320	1452	0.0	105.0	0.0
	Sandy Melvill	Task Leader: Dam Design	**95 040**	900	990	1089	0.0	96.0	0.0
	David Ochan	Dams Design Engineer	**143 000**	1000	1100	1210	0.0	130.0	0.0
	Andy Pepperell	Study Leader	**166 443**	1351	1486	1635	0.0	112.0	0.0
	Roshan Roopchund	Task Leader: Water Requirements	**40 425**	1050	1155	1271	0.0	35.0	0.0
	Chris Brand	Spillway Design	**50 600**	1150	1265	1392	0.0	40.0	0.0
	Colin Scott	Roads Design	**42 240**	1200	1320	1452	0.0	32.0	0.0
	Preggy Pillay	Roads Design	**48 510**	630	693	762	0.0	70.0	0.0
	Ingrid Eweg	Design support	**111 375**	375	413	454	0.0	270.0	0.0
	Kobus Burger	Structural Engineer	**91 960**	950	1045	1150	0.0	88.0	0.0
	Bronwyn Newton	Design support	**88 000**	400	440	484	0.0	200.0	0.0
	Ryan Gray	Water resources support	**60 676**	460	506	557	0.0	119.9	0.0
	Vishane Ramharak	Design Support	**40 920**	310	341	375	0.0	120.0	0.0
	Simon Johnson	Task Leader: Hydrology, Desktop Study & Prelim Study Report	**71 060**	850	935	1029	0.0	76.0	0.0
	Prof Klijko	Seismic analysis	**44 000**	1000	1100	1210	0.0	40.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	Travel - Own Vehicle, Air, Hire Car					0.0	25 000.0	0
	Disbursements	Printing, Purchase of Maps and data, etc					0.0	13 750.0	0
	Disbursements	Accommodation costs					0.0	10 000.0	0
Task 2.7		***Total for Task 2.7 (Rand)***	**1 232 820**	0	1232820	0	**0**	**48 750**	**0**

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Task 2.8	***2.8 Land Matters***								
	Determine temporary & permanent roads servitudes								
	Determine pipelines and canal route land requirements								
	Delineate dam & appurtenant structures acquisition								
	Proposed farm subdivisions								
	Cost estimates for land purchase & servitudes								
	Allocations, tenure & cost to emerging farmers								
	Submit Report on Land Matters Studies								
Task 2.8	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.8	*Sharma Maharaj*	*Task Leader: Land Matters*	**60 368**	490	539	593	0.0	112.0	0.0
	Oscar Ashton	*Agricultural support*	**55 440**	700	770	847	0.0	72.0	0.0
	Simon Johnson	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**13 090**	850	935	1029	0.0	14.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					0.0	12 000.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					0.0	5 000.0	0
	Disbursements	*Accommodation costs*					0.0	6 000.0	0
Task 2.8		***Total for Task 2.8 (Rand)***	**128 898**	0	128898	0	**0**	**23 000**	**0**

Task 2.9	***2.9 Regional Economics***								
	Economic base, activities & infrastructure								
	Potential socio-economic impacts								
	Identify impacts and benefits of the project								
	Contributions to GDP and GGP								
	Employment opportunities & local contributions								
	Develop project evaluation measures and indicators								
	Submit Report on Project & Regional Economics								
Task 2.9	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.9	*Jackie Crafford*	*Task Leader: Regional Economics*	**155 210**	850	935	1029	0.0	166.0	0.0
	Simon Johnson	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**7 480**	850	935	1029	0.0	8.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					0.0	7 600.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					0.0	1 000.0	0
	Disbursements	*Accommodation costs*					0.0	3 000.0	0
Task 2.9		***Total for Task 2.9 (Rand)***	**162 690**	0	162690	0	**0**	**11 600**	**0**

Task 2.10	***2.10 Legal, Institutional, Financing***								
	Literature review								
	Legislative impacts								
	Assessment of Legal Issues								
	Implementation plan								
	Funding alternatives								
	Operational and Institutional Modelling								
	Submit Report on Legal Instututional & Finance								
Task 2.10	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.10	*Neal Bromley*	*Task Leader: Legal, Instit, Finance Arrangements*	**19 360**	1100	1210	1331	0.0	16.0	0.0
	Faye Balfour	*Institutional analyst*	**79 200**	600	660	726	0.0	120.0	0.0
	Caroline Pepperman	*Legal Expert*	**36 960**	2100	2310	2541	0.0	16.0	0.0
	Andrew Barclay	*Project Finance Specialist*	**42 240**	1200	1320	1452	0.0	32.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					0.0	13 800.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					0.0	1 000.0	0
	Disbursements	*Accommodation costs*					0.0	5 000.0	0
Task 2.10		***Total for Task 2.10 (Rand)***	**177 760**	0	177760	0	**0**	**19 800**	**0**

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Task 2.11	*2.11 Environmental & Social Impacts Assessment (Assistance/Liaison with PSP Only)*								
	Assistance on Procurement of Independent ESIA PSP								
	Liaison with ESIA PSP During Study								
Task 2.11	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
TASK 2.11	***Environmental Aspects***								
	Melissa Moffett	*Task Leader: Environmental Screening and EIA*	**23 800**	700	770	847	12.0	20.0	0.0
	Magnus Van Rooyen	*Environmental screening support*	**20 400**	600	660	726	12.0	20.0	0.0
	Melissa Blouw	*Environmental screening support*	**0**	360	396	436	0.0	0.0	0.0
	Public Participation Aspects								
	Andy Pepperell	*Study Leader*	**45 360**	1351	1486	1635	16.0	16.0	0.0
	Khuthalile Mahlaba	*Task Leader: Stakeholder Involvement*	**48 984**	520	572	629	48.0	42.0	0.0
	Claudia Mckenzie	*Public Consultation Assistant*	**0**	400	440	484	0.0	0.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Travel - Own Vehicle, Air, Hire Car*					14 000.0	10 500.0	0
	Disbursements	*Printing, Purchase of Maps and data, etc*					1 000.0	1 000.0	0
	Disbursements	*Accommodation costs*					3 000.0	3 000.0	0
Task 2.11		***Total for Task 2.11 (Rand)***	**138 544**	62142	76402	0	**18 000**	**14 500**	**0**

	Project Management								
PM	***Task Resources***	***Team Position***	**Total fees**	**rate2012**	**rate2013**	**rate2104**	**hours2012**	**hours2013**	**hours2014**
PROJECT MANAGEMENT/CLIENT LIAISON	*Andy Pepperell*	*Study Leader*	**504 383**	1351	1486	1635	162.0	181.1	10.0
	Simon Johnson	*Task Leader: Hydrology, Desktop Study & Prelim Study Report*	**266 985**	850	935	1029	137.0	150.0	10.0
	Jan Norris	*Task Leader: Geotech Recon & Geotechnical Investigations*	**24 701**	1200	1320	1452	11.2	8.5	0.0
	Mike Udal	*Irrigation Potential Support*	**50 400**	1000	1100	1210	24.0	24.0	0.0
	Roshan Roopchund	*Task Leader: Water Requirements*	**0**	1050	1155	1271	0.0	0.0	0.0
	Retha Stassen	*Task Leader: Reserve Determination*	**8 064**	480	528	581	8.0	8.0	0.0
	Disbursements		**Disbursement totals:**				**cost'12**	**cost'13**	**cost'14**
	Disbursements	*Air tickets*					37 452.9	40 000.0	0
	Disbursements	*Printing*					7 472.6	2 500.0	0
	Disbursements	*Venue hire and associated meetings expenses*					13 762.7	17 500.0	0
	Disbursements	*Mileage*					4 213.1	5 000.0	0
	Disbursements	*Car hire*					1 348.4	1 750.0	0
	Disbursements	*Accommodation costs*					7 000.0	6 000.0	0
PM		***Total for Task PM (Rand)***	**854 533**	376592	451309		**71 250**	**72 750**	**0**

APPENDIX E

SCOPE OF WORK FOR THE LALINI DAM AND HYDROPOWER SCHEME DETAILED INVESTIGATIONS

PHASE 2: LALENI DAM & HYDROPOWER SCHEME INVESTIGATIONS

At the request of the DWS, J&G have prepared an approach, methodology and costing proposal to undertake sufficient additional studies and investigations to ensure that the level of detail of engineering and economic analyses of the Laleni Dam & Hydropower Scheme aspects of the study is sufficient to meet the requirements expected of a Feasibility Study, and to thus provide conclusions, recommendations and cost estimates at a level of confidence required to reliably inform strategic development decision-making.

SCOPE OF WORK

Reconnaissance Studies

Site reconnaissance will be undertaken to visit all of the components of the project and surrounding areas. The project components will include:

- Confirm dam site coordinates;
- Tunnel alignments and potential locations of access shafts and surge shafts;
- Power line alignments and connection point to existing grid;
- Potential location of the power generation cavern;
- Access roads into gorge and dam construction site;
- Areas required for construction camp;
- Availability of power supply for construction; and
- Geotechnical reconnaissance to investigate surface morphology, potential construction materials, and to plan the detailed site investigation requirements.

The recommendations emanating from these missions will be to agree on:

- Target dam site location;
- Tunnel alignment and cavern location;
- Routing for power transmission lines;
- Materials investigation requirements; and
- Extent of topographical survey required.

Procurement of Specialist Services

This will involve the undertaking of topographical surveys and site investigations.

Topographical Survey
It is required that a LiDAR survey be flown to provide up to date imagery and to produce an accurate digital terrain model with 0.5 m contours so that the design and hydrological yield modelling can be accurately undertaken.

This should cover all of the infrastructure listed above including the maximum likely area to be inundated under SEF flood conditions, plus a buffer zone to include other works such as advance works and construction camp.

Geotechnical Site Investigations
This will include separate sub-contracts as follows:

a) An extensive core drilling programme to investigate dam foundation conditions, spillway options, other major infrastructure such as outlet works, stilling basin, tunnel, shafts and caverns, and materials quarries for rock-fill and concrete aggregate.

b) Excavation of trial pits to explore other construction materials including embankment shell material, core material, filters, sand, as well as the evaluation of foundation conditions under structures and buildings.

c) Seismic refraction surveys will also be required at the dam and spillway locations.

d) Laboratory testing of all the above materials to determine chemical and physical parameters for selection and design purposes

In general, these investigations will be geared towards proving materials sources between 1.5 to 2 times the expected quantities required for the works as well as assessing the founding conditions for all components of the development.

It is understood that no procurement process will be required for any of the proposed sub-contractors as their existing appointment from the first phase of the project will be extended.

Hydropower Modelling

The detailed hydrology has already been undertaken for the Tsitsa River up to Tsitsa Falls. Whilst this has been used within WRYM models to develop yield and hydropower potential results, these models will have to be updated and rerun for a range of Laleni dam sizes, and taking into account the following parameters:

a) The new depth *versus* volume/surface area curve for Laleni dam at its selected location using the new accurate survey information.
b) Calculated sedimentation values for the Laleni dam.

The EWR downstream of Laleni dam will be reviewed by the EIA PSP, and this value for EWR releases will be used in the final yield and hydropower modelling. This is based on the assumption of the timeous provision of the revised EWR values in line with the programme for this Detailed Feasibility Study. If information is not timeously updated, hydropower modelling will be based on EWR information available.

The output from these new modelling runs will be a new set of results for yield and hydropower output potential (the latter at 99% assurance) for the conjunctive scheme with the following scenarios:

- Large Ntabelanga + small Laleni (i.e. the currently recommended scheme);
- A “full sized” Laleni dam in conjunction with a “minimum-sized” Ntabelanga dam (i.e if Ntabelanga built for water supply and irrigation only); and
- A large Ntabelanga and a “full sized” Laleni.

The second option is required to estimate the incremental cost of the conjunctive scheme to calculate the levelized cost of energy produced by the conjunctive scheme.

The third option investigates the maximum energy output that might be achieved and cost benefits thereof.

The design flood hydrology for the Laleni dam site will need to be undertaken including the calculation of the Recommended Design Flood (RDF) and the Safety Evaluation Flood (SEF). The return periods for these floods will be calculated in accordance with the SANCOLD Guidelines for a dam of this nature. These figures are to be used in the sizing and design of the spillway, freeboard allowance and associated infrastructure. In addition the intermediate return periods are to be calculated for use in processes such as designing the construction sequencing and river diversion works, to deal with water during construction.

Dam Feasibility Design

Dam Type Selection and Optimisation
This will include consideration of the following dam types:

- Rockfill;
- Earth Core Earth Shell Embankment; and
- Roller Compacted Concrete (RCC).

Both in-stream and side channel spillways will be investigated at a high level at the start of the process with the intention of moving rapidly onto the preferred arrangement and focussing on this.

Cognisance will need to be taken of the results of the geotechnical site investigations (Section 3.2) as regards materials location and availability, and therefore this part of the study can only be concluded once the above activities have produced usable results.

The above new topographical survey information will be used to undertake the investigations of the various dam types and spillway arrangements for the range of dam sizes used in the yield and hydropower modelling. These analyses of dam types and spillway arrangements will be used only for comparative purposes and the selected dam type and spillway arrangement will then be taken forward to feasibility level design (i.e. preliminary design) in the same manner as is happening in the current study.

These options will be quantified and costed based upon typical design parameters (i.e. foundation excavation depths, crest widths, embankment slopes, core details, face slab thicknesses, filter layer thicknesses, etc) using the same methodology and costing database as in the current study, which produces a VAPS type of bill of quantities.

Sensitivity to ranges of all major item rates will be undertaken to check whether changes to these rates affect the overall cost ranking of dam types.

Final choice of dam type will be primarily based on cost, but other factors such as construction period, risk assessment, operational requirements, operation and maintenance costs, and environmental impacts might also affect the decision-making process.

Outlet Works, Conduits and Tunnels
Once the dam location and likely range of flow regimes through the hydropower scheme have been determined, and following the results of the site investigations, the underground works specialists will undertake studies to optimise the transfer system design.

This will include the following factors:

- Hydraulic capacity design, including tunnel sizing, flow velocity, transient pressure control, losses, etc.;
- Construction methodology – drill and blast, TBM, etc.;
- Design requirements – rock mechanics analyses, lined or unlined sections, portal and transition designs, grouting requirements, dewatering needs, risks, etc.; and
- Ancillary works requirements – access and surge shafts, access roads, camps, power supplies, disposal of spoil, use of excavated material in other works, etc.

The output of this activity will be a series of options which might vary (e.g. diameter of tunnel) for different hydropower regimes being evaluated. For example, the tunnel size would be larger diameter if the scheme is to be used for peaking power, where flow rate through the tunnel could be several times that if only used as a base load station.

These underground works options will be costed for usage in the economic comparison modelling.

It should be noted that upon selection of the optimal scheme arrangement the analysis for that preferred arrangement will then be taken forward to feasibility design level as outlined in Section 7.5 below.

Electro-Mechanical Plant
The above range of options will produce a range of hydropower generation plant options, requiring appropriate choice of turbine runners, and associated generation and control systems. The electromechanical specialists on the team will undertake this optimisation process as well as determining the power transformation and transmission needs, which will require very close co-operation with ESKOM, who will be the recipient of the energy produced.

These electro-mechanical works options will also be costed for usage in the economic comparison modelling.

Economic Analyses
For each option developed above (Section 5.1), an economic model will be developed, which will take into consideration the proposed implementation programme, capital works construction cashflow, as well as other engineering, environmental, plant replacement costs, operations and maintenance costs, over a 50 year operational lifespan.

This will be analysed on a discounted cashflow (present value) methodology, for a range of discount rates from 6% to 10% per annum.

For each option, the energy produced will also be included on an annual basis and discounted back to a present value using the same discount rates.

Dividing total net present cost by the net present energy produced, gives the levelized cost of energy produced (Rand/MWh), which is the principal methodology used by the energy sector to compare options and viability.

NB: *Recent research into world hydropower-produced energy schemes indicates that hydropower levelized costs are currently ranging from about R800/MWh to R1400/MWh.*

Once these analyses have been undertaken, the optimum-sized scheme will be identified, and the results will be presented for discussion.

Feasibility Design of Recommended Scheme
Once agreement on the optimum scheme has been made, more detailed analyses will be undertaken to take the design to feasibility level (feasibility design), providing more detail on important issues such as an analysis of site layouts and construction processes, ancillary and advance works, to minimise the capital works cost, reduce risks, and to improve the accuracy of the cost estimates.

Reports and drawings will be prepared to include sufficient detail for a detailed design team to move forward with their design processes.

Recommendations will also be included for special studies such as CFD or laboratory modelling of spillway hydraulics behaviour, the tunnel hydraulics and surge suppression, and the hydraulics of the dam outlet conduit and generator house discharge works, and their respective stilling basins.

Review Panel
The current scope of work for the existing review panel only covers the specific aspects being undertaken on the existing feasibility study.

A review panel will be needed for the Laleni Dam detailed investigations as follows:

- Dam design specialist;
- Hydropower plant specialist;
- Tunnelling specialist; and
- Transmission specialist.

PROPOSED METHODOLOGY

Reconnaissance Study

It is proposed that a team of specialists undertake a site visit at the start of the project in order to familiarise themselves with the proposed infrastructure layout. The J&G staff, who have been involved in the first phase of the project, will lead the team as they have the knowledge of the area and the proposed layouts. The specialists will include:

- A tunnelling specialist;
- Dam engineers;
- Senior Engineering Geologist; and
- Roads engineer.

It is proposed to undertake a detailed surface geological mapping exercise during the Reconnaissance Study along the length of the proposed tunnel route. A team of geotechnical specialists will undertake this exercise. An initial aerial photo-interpretation would be undertaken to identify geological features and lineaments. This would be followed by a field walk-over and drive-over reconnaissance for a visual assessment and mapping of surface features and geology. This exercise would assist in optimising borehole positions for the subsequent drilling investigation.

The outcome of this task will be the following:

- Confirmation of dam site coordinates;
- Identification of possible tunnel alignments and potential locations of access shafts and surge shafts. These will be used to inform the detailed drilling investigation to follow;
- Identification of possible power line alignments and connection point to existing grid;
- Identification of potential location of the power generation cavern;
- Initial conceptual proposals for alignments of access roads into gorge and dam construction site;
- Identification of areas required for construction camp;
- Identification of availability of power supply for construction; and
- The geotechnical reconnaissance to investigate surface morphology, potential construction materials, and to plan the detailed site investigation requirements.

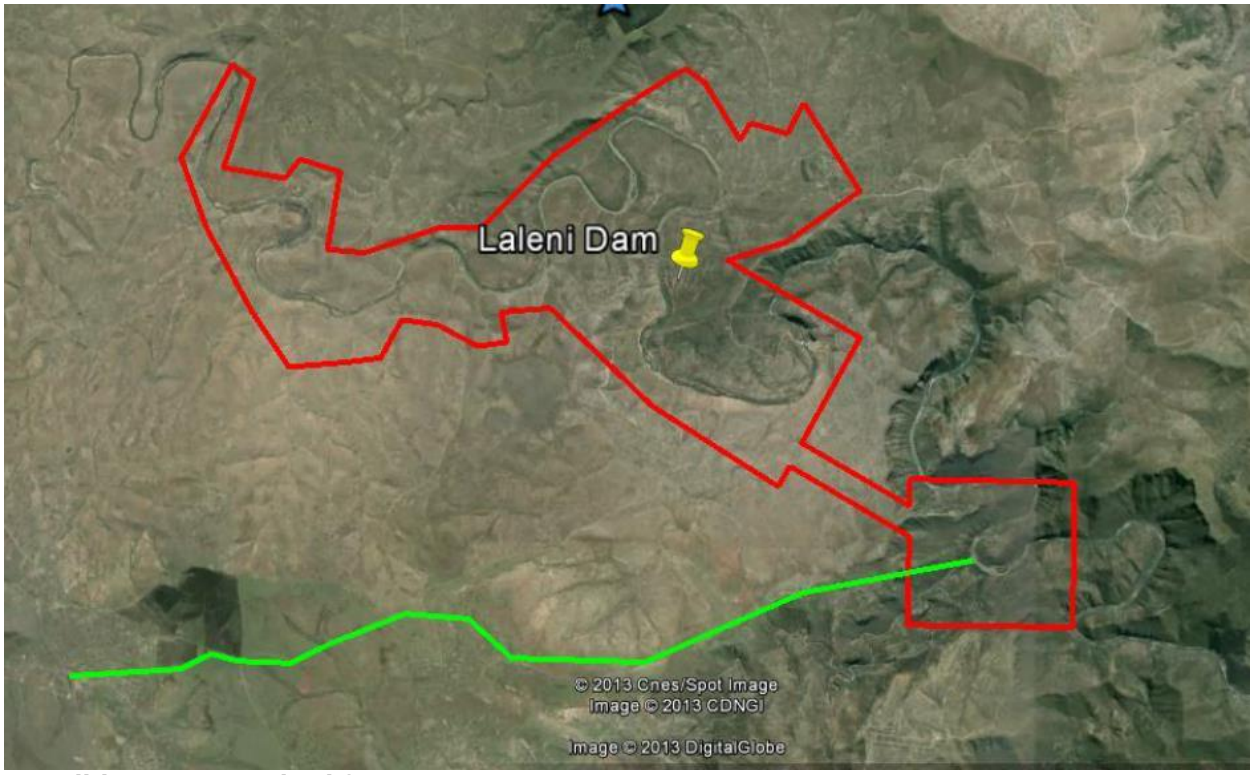
All of these outcomes will inform both the detailed geotechnical and the detailed survey investigation proposed.

Procurement of Specialist Services

Topographical Survey
As per the scope of work it is proposed to undertake a Lidar survey of the required project area in order to provide 0.5 m contour information to be used in the design of all aspects of the scheme (including the basin characteristics).

The exact extent of the required area will only be known after the Reconnaissance Study but it is likely to include the following (as per Figure below):

- The proposed dam wall site including areas either side for possible spillway alignments;
- The proposed tunnel alignment;
- The impounded area;
- The area between the dam site and Tsitsa Falls; and
- A stretch of river downstream of the cavern to enable modelling of flood levels in that area.



Possible Area Required for Survey

This preliminary estimated area is 5 760 ha as well as approximately 17 km of powerline.

Geotechnical Investigations

It is understood that the proposed Laleni Dam will have a maximum height of about 35m high and a length of about 300m. The valley profile is understood to favour a RCC dam type. Whilst the dam site has not been visited by Jeffares & Green's geotechnical division, perusal of geological maps indicated the dam site to be underlain by an extensive dolerite sill. Founding conditions are expected to be good.

Dam Site

Preliminary Reconnaissance and Dam Site Selection

At the outset, the investigation would entail a visual reconnaissance for the purpose of optimising the location of the dam site, based upon geotechnical and other interrelated criteria. Potential sources of construction materials would also be identified, preferably within the future impoundment area of the dam basin.

As part of this exercise cursory basin mapping would be undertaken to identify any potential instability problems that could be triggered by future impoundment.

Rotary Core Drilling
A cursory rotary core drilling investigation would be carried out to prove founding conditions on the selected proposed dam alignments. Provision has been made to investigate one alignment comprising four boreholes, varying in length between 20 m and 25 m.

The cumulative drilling length for this aspect of the investigation would be approximately 90 m.

Geophysical Seismic Refraction and Electrical Resistivity Survey
Once a preferred dam alignment has been identified, based upon the foregoing rotary core drilling investigation, geophysics would be conducted with traverses orientated both parallel and transverse to the chosen dam axis in order to determine bedrock depths, geological contacts and areas of adverse weathering and fracturing. The information obtained from geophysics would be used to site additional boreholes for the detailed rotary core drilling investigation.

Provision has been made for 500 m of geophysical traverses.

Trial Pitting and Materials Investigations
As part of the feasibility level investigations, materials for various dam alternatives would be investigated by means of tractor-loader-backhoe (TLB) excavated trail pits. This would include the evaluation of potential sources of core, shoulder fill and sand. Representative samples would be retrieved from trial pits for laboratory testing.

Provision has been made for five days work with a TLB.

Potential rock quarries in the basin and dam flanks would be identified for further investigation during the rotary core drilling investigation. Rock occurring within the tunnel section would also be evaluated for suitability as crushed rock aggregate and rockfill.

Laboratory Testing
Provision has been made for the following testing on rock cores retrieved from the rotary core drilling investigation:

- Unconfined compressive strength: 6
- Petrographic analysis: 4

Provision has been made for the following testing on borrow pit materials:

- Sieve & hydrometer analyses & Atterberg limits: 25
- Sieve analyses & Atterberg limits: 20
- Standard Proctor moisture / density: 15
- Double hydrometer: 10
- Consolidated un-drained tri-axial: 4
- Consolidation test 4

Tunnel
It is understood that the proposed tunnel from the Laleni Dam to the downstream power generating point will be about 7km long, with an internal diameter of about 5m and a maximum cover thickness of about 300m.

Rotary Core Drilling
Provision has been made to drill three vertical boreholes along the tunnel centreline to depths equivalent to 5m below invert level. Borehole length would vary between 100m and 350m. Due to the length of the boreholes, wire-line drilling methods would be employed. Core orientation surveys would be required from 5m above roof level to 5m below floor level to enable rock mass rating to be carried out for the tunnel section. Provision has been made for a cumulative drilling length of 540m. A considerable amount of additional drilling will need to be undertaken in future phases of the project

as the three boreholes to be undertaken in this study will merely provide an indication of what may be encountered during the tunnelling process.

It is assumed that the existing drilling sub-contractor would be appointed to undertake the drilling of both the dam site and the tunnel alignment and that the drilling of both would occur concurrently. Rock strength testing would be conducted on cores from above roof level, through the tunnel section and below floor level. Testing would include unconfined compressive strength (UCS) and point load strength index (PLSI) tests.

Provision has been made for the following testing:

- UCS: 8
- PLSI: 30
- Petrographic analysis: 4

Portal Mapping and Stability Analysis
Lithological and joint orientation mapping would be carried out on any rock exposures present at the tunnel portals for the purposes of visually assessing rock quality and undertaking stability analyses.

Hydropower Modelling

This task will look to develop on the findings of the preliminary hydropower assessment completed in the first part of the study which looked at the conjunctive scheme. The original water resource study was undertaken to primarily assess the water resource potential of the Ntabelanga Dam, with a high level assessment of a conjunctive use scheme incorporating a hydropower generation option at Laleni. The conjunctive use scheme would include the Laleni Dam with a balancing dam at Ntabelanga that can meet the domestic and irrigation requirements, whilst supplying additional flow assurance to the Laleni Dam site. In order to undertake a more detailed study of the hydropower assessment at Laleni, the following tasks will need to be completed:

- Using the existing Water Resources Yield Model configuration for the proposed conjunctive use system (i.e. Ntabelanga and Laleni Dams) as a starting point, update the configuration where applicable. Examples of foreseen updates include:
    - Detailed topographical survey of the dam basin and tunnel outlet area in order to accurately account for changes in storage volume and height of water in the dam, through to the outlet of the hydropower system (effective head contributing to the hydropower generation);
    - Detailed environmental water requirements for the Laleni Dam site, assumed to be at an Intermediate Level. This component is important as the required flow volumes and timing of releases will have a direct impact on the hydropower generation potential at the site;
    - Various hydropower configuration options including the hydropower plant and tunnel system; and
    - Confirmation that the system will be used for base load supply, or constant power generation without peaking power.

- Once the updated conjunctive use system has been configured, undertake testing of the system to ensure that the hydropower, and other abstractions, are being simulated correctly. As this system will include off-takes for domestic and irrigation water supply, in conjunction with hydropower requirements, this process will be complex and, hence, needs to be given sufficient time and budget to ensure the correct system operations.
- Undertake a scenario analysis for various dam size combinations between the two impoundment locations. The scenarios are undertaken in an iterative manner and, as such, this task has been costed based on ten (10) scenarios.
- Produce a report updating the information used in the feasibility level study for hydropower generation from the Tsitsa River conjunctive use scheme.

Feasibility Dam Design

Dam Type Selection and Spillway Options Analysis
In the same manner as was done for the Ntabelanga Dam a thorough dam type analysis will be undertaken. The main factors influencing the type of dam to be selected will predominantly be driven by the geotechnical conditions (founding conditions) encountered during the investigation, the availability of suitable construction material within the dam basin and surrounds, the topography and the resultant cost estimates of the various types. Other factors that will be considered will include environmental impacts of the different types and the knowledge of the different construction methods of the different types within the industry and DWS.

The alternative dam types will be developed at a basic level, making allowances for all necessary appurtenant works and construction requirements and programme at an appropriate level of sophistication to ensure a meaningful comparison of dam types and to allow realistic cost estimations. A great deal of this exercise will involve the judgment and experience of the dam design team backed up by data and figures from similar works implemented in the recent past without necessarily detailing all of the associated works,.

Issues to be addressed for each potential dam type will include the following:

- The required spillway capacity and an appropriate spillway & flood energy dissipation arrangement. Spillway options will be considered at a high level first and then focussing only on one option thereafter;
- The optimal river diversion/management approach and the construction programme. In this case (as was the case for Ntabelanga), low order recurrence interval floods typically used for construction flow management are likely to be relatively large and due consideration of facilities to cater for these floods, must be given; and
- An appropriate outlet works arrangement. Consideration will be given to integral or separated outlet works facilities and suitable layouts developed as best fits the requirements. Cognisance will be taken of constructability and sequencing in relation to other dam components.

Outlet Works, Conduits and Tunnel
As is known by the PSP the anticipated configuration of the Laleni Hydropower arrangement is an intake on the right bank of the impoundment, with a tunnel through the mountain on the same side all the way down to the proposed cavern in the Tsitsa River Gorge below the Tsitsa Falls.

Structures
Conventional structural design will be done in accordance with international standards such as BS8110, BS 8007 or EC2. Element sizing will primarily be based on the Project Team's extensive experience in the design of hydraulic structures.

Tunnels
On the basis of the required flow capacity and topographical and geotechnical information developed as part of the proposed investigations, the power tunnel will be designed. The requirements for support will be developed on the basis of the anticipated geotechnical conditions, while a review of the lining requirements will consider full steel lining, concrete lining and shotcrete lining options. The tunnel will be designed as a pressure conduit, with actual pressure conditions depending on the optimal configuration and depth of the tunnel, and an allowance for steel-lining will be made for the high-pressure sections.

Tailrace
The outlet tailrace pool and stilling basin will be designed to feasibility level using HEC-RAS and other methodologies recommended by the US Army Corps of Engineers.

Electro Mechanical Plant and Transmission Systems

Energy production studies for the selected layout will be developed; obtaining the following results:

- Plant Factor / energy production analysis; and
- Plant scheme / energy production analysis.

Following international standard methodologies, these results will form the base for reviewing the cost-benefit analysis for the optimization of the plant (together with the land use, topography, geology, etc.). Alternative scenarios will be compared by means of the basic energy production analysis using average year inflows data.

The selected scheme will be analysed with a detailed reservoir operation modelling. This will have a daily step and will include all the detailed results of the relevant hydraulic / hydrological studies (average inflows sequence, reservoir volume curves, tailwater rating curve, head losses curves, EM equipment efficiencies diagrams, outlet works rating curves).A flow sequence study basing on the flow data series obtaining :

- Average energy: flows sequences analysis;
- Firm energy : flows sequences analysis; and
- Firm and secondary energy production analysis.

The scope of this optimization will be to enhance the operating flexibility of the scheme to obtain:

- Relevant firm power / energy production;
- Relevant power supply during the most severe droughts; and
- Energy supply during the valuable peak hours.

Operating rules that can be modified during the plant operating life, following the requirements of the energy market, without substantially changing the average energy production

For Feasibility Studies purposes, the main equipment components are described and preliminary performance specifications prepared, defining operating conditions, main equipment parameters, etc.

The selection of powerhouse arrangements will basically depend on the detailed comparison of the turbine type. During the Feasibility Studies, the main features and key aspects of the electromechanical equipment will be evaluated and set for basic assumption of project definition. Synchronous generator main technical data and dimensions, unit spacing, required turbines submergence and spiral casing dimensions are only a few of the aforementioned items required for optimising the above scope of the study. Other factors which may influence the location of the powerhouse will be evaluated, such as foundation conditions, tailwater elevation, accessibility and valley width.

The electromechanical equipment selection will be done by adopting a methodology and strategy of the relevant engineering activities proposed to complete the feasibility study, following the best engineering practices to:

- Allow a prompt implementation of the project;
- Avoid any relevant technical and/or economical risk or uncertainty during the project construction;
- Minimize the environmental impact of the project;
- Develop the full hydropower potential of the river stretch, possibly in phases; and
- Have a design optimized to well suit the Client’s needs and requirements.

The basic principles of the methodology in chronological order are:

- Review all possible technical solutions for each main project component comparing the most promising layout with technical, economic and environmental analysis;
- Select the most promising layout, based also on the findings of the surface geological and topographical survey; and
- Completing the feasibility study carefully optimizing the selection of each electromechanical component, basing on the findings of the investigations, according to international best practice and strictly respecting the time schedule foreseen for the assignment.

Economic Analyses and Financing Options

Economic Analyses

Cost Estimates for various options will have been prepared in the above tasks and these will be analysed and modelled to compare options and determine the best economic solution. Discounted cash flow methodology will be used which will include capital costs, annual operation, maintenance, power and other consumables costs, plant replacement costs, , etc.
An option including the annual cost of water licensing fees can also be tested.

Included in the capital cost will be the cost of engineering, supervision, land acquisition, compensation and mitigation costs, environmental studies, servitudes, etc.
The net present value of all of the above costs will be calculated at 4%, 6%, 8% and 10% discount rate, and will cover a 50 year period of operation.

Annual power supplied into the grid will also be calculated using the simulated historical flow series produced by the hydrology models to determine available power outputs on an annual basis. This annual energy supplied into the grid (in GWh) will be discounted back to a present value at the same discount rates as above.

Dividing the NPV of cost by the NPV of energy supplied will produce a levelised cost of power in Rand per kWh.

Comparing different options (i.e. different dam sizes and conjunctive configurations, load factors, tunnel sizes, installed capacities, etc.) will demonstrate the most economical solution, and determine whether the levelised cost of power is deemed to be an economic viability.
Models can also be run with and without capital cost to check on the impact of partial or full grant funding availability.

Financing Options

A financial impact model will be built for the preferred scheme which will take into consideration the cost of financing the capital works, and financing initial operating deficits until break even and profitability is reached.

This will be able to model various types of loans, tenor of repayments, mixed loans and grants, refurbishment costs, taxation, etc., and will be able to test the Internal Rate of Return on investment for various input tariff scenarios, including wholesale input arrangements based upon a starting tariff and escalation formula, to a wheeling arrangement tied to the power inputs being wheeled in and out of the grid and used by the rest of the project infrastructure for pumping.
Discussions will be held with potential IPP investors if these have been identified at that time, and this task will conclude with applying the model to the various institutional arrangement options that were identified in the main feasibility study, test these for financial impacts.
Identifying opportunities to feed surplus revenue or “royalties” from this power generation project back into the economic and social development of the region will also be investigated at this stage.

Feasibility Design of Recommended Scheme

Upon conclusion of the analysis of the various arrangements of the scheme as a whole (including dam and associated infrastructure as well as the tunnel and hydropower arrangements) a recommended scheme configuration will be adopted. This scheme will then be designed at feasibility level. This will include design of the following:

- The Laleni dam wall structure (including stability analysis);
- Spillway (including 1D hydraulic modelling using HEC-RAS);
- Intake and outlet works;
- Tunnel (and all associated aspects);
- The electro mechanical plant required for the hydropower; and
- Road realignments including any bridges and culverts.

River management during the construction of a dam plays an intrinsic role in establishing an appropriate construction programme and determining the implementation cost of the associated works. With detailed, seasonal flow measurement records available, definitive river construction management strategies will be defined succinctly. The works and river management strategies will be specifically configured to accommodate the chosen dam type with iterative development of the layout and strategies in tandem. The final schemes will be presented in sketch format, but in sufficient detail to ensure a clear understanding of the associated arrangements.

On the basis of the findings of the geological/geotechnical investigations, the requirements for consolidation and curtain grouting and drainage will be evaluated. An evaluation of the consequential grouting programme and the grout quantities will subsequently be made for the purposes of estimating the associated implementation cost.

The seismicity assessment undertaken for the Ntabelanga Dam will be used to provide information to the Laleni Dam and similar ground accelerations will be applied.

Review Panel

An allowance has been made in this proposal for the continued input of the review panel in this project.

It is proposed that the following people be included on the review panel:

- Mike Shand – Dam Engineer and Water Resources Specialist; and
- Heinrich Elges – Dam Engineer.

The Project Team includes international tunnelling and hydropower experts and therefore it is felt that with the inclusion of these highly specialised team members as well as the two review panel experts there will be sufficient review capacity within the study.

Project Management

The same Project Management team that has been adopted through the first part of this project is proposed for this phase. This includes Mr Andy Pepperell as the Study Leader and Mr Simon Johnson as the Deputy Study Leader. Mr Pepperell is responsible for the overall project management and will be the primary point of contact for liaison with the client which is currently Mr Menard Mugumo, the Chief Engineer Options Analysis (South) of the Options Analysis Directorate of the Department of Water and Sanitation.

In the cost estimate provided allowance has been made for the following:

- Two Project Steering Committee (PSC) Meetings to be held in the months after April 2014 (i.e. originally planned end date of the Mzimvubu Water Project). These meetings will be held in East London as they have been throughout the duration of the project to date;
- Two Study Management Committee (SMC) Meetings to be held in the months after April 2014 (i.e. originally planned end date of the Mzimvubu Water Project). These meetings have been costed to be held in the offices of the PSP in Hilton; and
- Two meetings in Pretoria or Johannesburg with the Department of Energy and Eskom.

Please note that no allowance has currently been made for any additional Stakeholder Engagement other than those listed in the bullet points above. Should these be required additional costs will need to be incurred.

In terms of Progress Reporting the PSP understands and has made cost allocation for the current frequency of reporting including invoice progress reports, bi-monthly reports and quarterly reports.

COST ESTIMATE

Summary of Cost Estimate

The cost estimate has been structured in accordance with the tasks outlined in the Terms of Reference. It is presented in the Table.

Summary of Proposed Costs per Activity for the Laleni Dam Feasibility Study

Task		Costs (R. excl. VAT)				VAT @ 14%	Costs (incl. VAT)
No.	Description	Fees	Disburse-ments	Sub Contractor	Total		
1	Reconnaissance Studies	R 188 400	R 73 900	R 0	R 262 300	R 36 722	R 299 022
2	Topographical Survey	R 11 448	R 3 000	R 450 000	R 464 448	R 65 023	R 529 471
3	Geotechnical Investigations	R 502 881	R 97 000	R 1 950 000	R 2 549 881	R 356 983	R 2 906 864
4	Yield Hydrology and Hydropower Update	R 247 170	R 3 500	R 0	R 250 670	R 35 094	R 285 764
5	Dam Type Selection and Spillway Options Analysis	R 321 090	R 5 000	R 0	R 326 090	R 45 653	R 371 743
6	Outlet Works, Shafts, Tunnel and Caverns	R 964 008	R 61 700	R 0	R 1 025 708	R 143 599	R 1 169 307
7	Electro-Mechanical Plant and Transmission Systems	R 525 000	R 75 500	R 0	R 600 500	R 84 070	R 684 570
8	Economic Analyses and Financing Options	R 210 532	R 1 000	R 0	R 211 532	R 29 614	R 241 146
9	Feasibility Design of Recommended Scheme	R 1 542 668	R 32 000	R 0	R 1 574 668	R 220 454	R 1 795 122
10	Review Panel	R 216 000	R 26 900	R 0	R 242 900	R 34 006	R 276 906
11	Project Management and Client Liaison	R 849 318	R 72 600	R 0	R 921 918	R 129 069	R 1 050 987
Total professional fees:		**R 5 578 515**	**R 452 100**	**R 2 400 000**	**R 8 430 615**	**R 1 180 286**	**R 9 610 901**

It is important to note the following:

- The topographical survey sub-contractor amount is for Southern Mapping who undertook the survey work in the first phase of the project;
- The subcontractor amount of R1 950 000 (excl. VAT) for the Geotechnical Investigations is made up of the following amounts:
  - Drilling contract: R1 695 000 (excl. VAT) (630m of drilling)
  - Geophysics contract: R125 000 (excl. VAT)
  - TLB hire: R40 000 (excl. VAT)
  - Laboratory testing: R90 000 (excl. VAT)

- The Project Management Budget has made allowance for meetings as stipulated in this document.

Summary of Professional Fee Breakdown of the Study Team

No.	Name	Hours	Professional fees (R)			% of total
			Excl. VAT	VAT @ 14 %	Incl. VAT	
1	J&G	4657.0	4 235 665	592 993	4 828 658	75.9%
2	Amberg	148.0	292 800	40 992	333 792	5.2 %
3	Independent	80.0	108 000	15 120	123 120	1.9%
4	ARQ	434.0	454 050	63 567	517 617	8.1%
5	Aurecon	80.0	108 000	15 120	123 120	1.9%
6	ELC Electroconsult	200.0	340 000	47 600	387 600	6.1%
8	Prime Africa	40.0	40 000	5 600	45 600	0.7%
Totals:		**5639.0**	**5 578 515**	**780 992**	**6 359 507**	**100.0%**

Timeframes and Cash Flow Projection

The proposed timeframe for the implementation of this phase of the Mzimvubu Water Project is 9 months and is proposed to be undertaken between February and October of 2014. This means the current Feasibility Study contract period would be extended by a total of seven months. The cash flow projection reflecting the tasks, their budgets and the proposed timeframes is shown in the Table below. A detailed project programme can be submitted upon approval and finalisation of the approach for the study.

ENVIRONMENTAL ISSUES

Liaison with Environmental Impact Assessment (EIA) PSP

No allowance has been made in this proposal for continual liaison with the EIA PSP including attendance of stakeholder meetings. This can be included should the client wish it to be.

Public Participation

As indicated previously in this proposal no additional allowance has been made for public participation other than through the proposed PSC meetings and the meetings with the Department of Energy and Eskom.

Cash Flow Projection for the Laleni Dam Feasibility Study

Task		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Totals
No.	**Description**	**Feb 14**	**Mar 14**	**Apr 14**	**May 14**	**Jun 14**	**Jul 14**	**Aug 14**	**Sep 14**	**Oct 14**	
1	Reconnaissance Studies	188 400	0	0	0	0	0	0	0	0	**188 400**
2	Topographical Survey	11 448	0	0	0	0	0	0	0	0	**11 448**
3	Geotechnical Investigations	93 150	318 831	90 900	0	0	0	0	0	0	**502 881**
4	Yield Hydrology and Hydropower Update	0	96 150	96 150	54 870	0	0	0	0	0	**247 170**
5	Dam Type Selection and Spillway Options Analysis	0	0	0	321 090	0	0	0	0	0	**321 090**
6	Outlet Works, Shafts, Tunnel and Caverns	0	0	0	482 004	482 004	0	0	0	0	**964 008**
7	Electro-Mechanical Plant and Transmission Systems	0	0	0	0	262 500	262 500	0	0	0	**525 000**
8	Economic Analyses and Financing Options	0	0	0	0	0	0	210 532	0	0	**210 532**
9	Feasibility Design of Recommended Scheme	0	0	0	0	771 334	771 334	0	0	0	**1 542 668**
10	Review Panel	0	0	0	0	0	0	108 000	108 000	0	**216 000**
11	Project Management and Client Liaison	43 992	43 992	43 992	43 992	134 670	134 670	134 670	134 670	134 670	**849 318**
Total professional fees:		**336 990**	**458 973**	**231 042**	**901 956**	**1 650 508**	**1 168 504**	**453 202**	**242 670**	**134 670**	**5 578 515**
Disbursement costs:		**527 900**	**1024 500**	**1 026 000**	**53 600**	**125 700**	**30 200**	**38 700**	**25 500**	**0**	**2 852 100**
Total costs (excl. VAT):		**864 890**	**1 483 473**	**1 257 042**	**955 556**	**1 776 208**	**1 198 704**	**491 902**	**268 170**	**134 670**	**8 430 615**
Total costs (incl. VAT):		**985 975**	**1 691 159**	**1 433 028**	**1 089 334**	**2 024 877**	**1 366 523**	**560 768**	**305 714**	**153 524**	**9 610 901**
Cumulative total costs (incl. VAT):		**985 975**	**2 677 134**	**4 110 162**	**5 199 496**	**7 224 373**	**8 590 895**	**9 151 664**	**9 457 377**	**9 610 901**	