P WMA 12/T30/00/5212/15

water & sanitation

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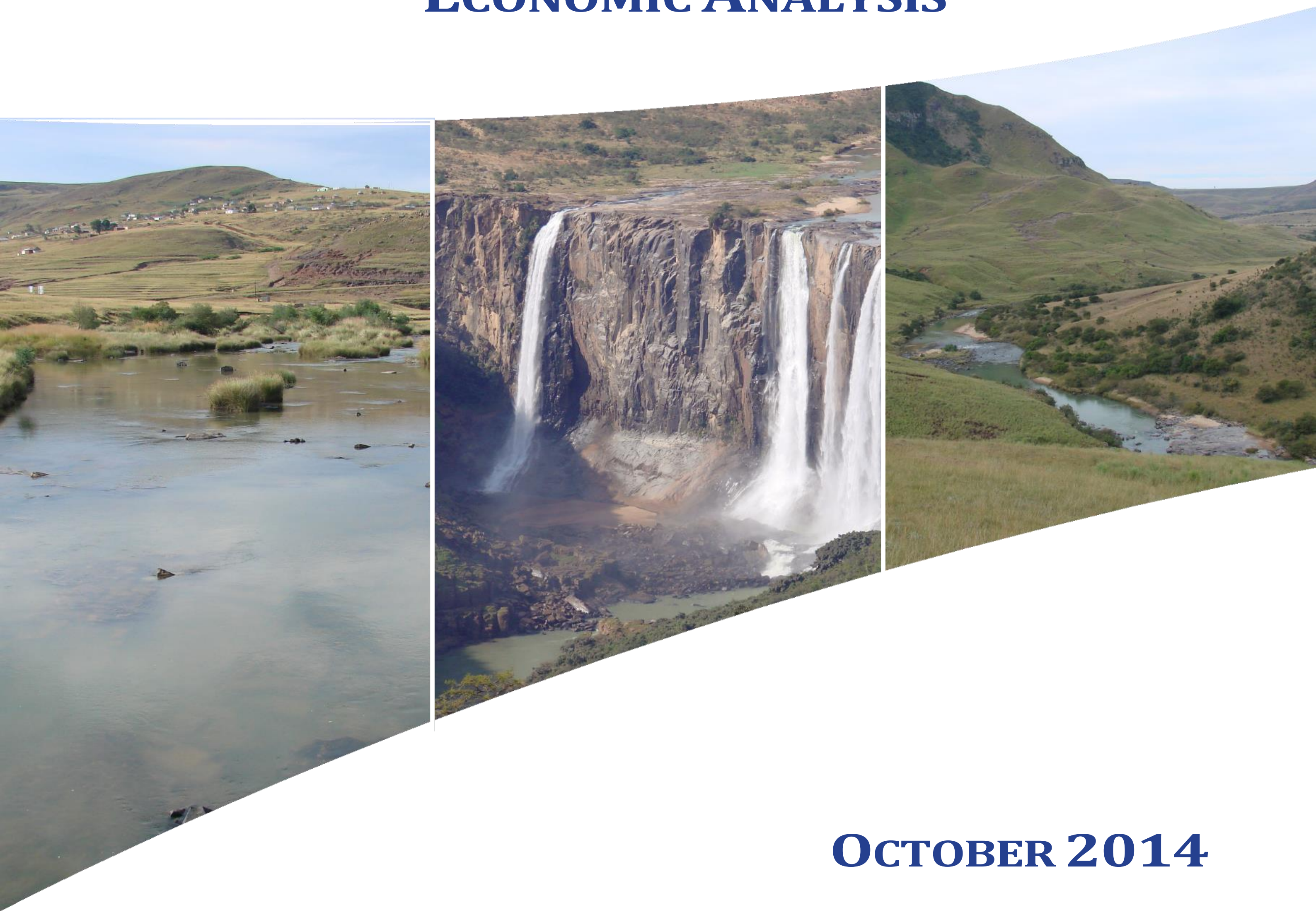
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

DIRECTORATE: OPTIONS ANALYSIS

FEASIBILITY STUDY FOR THE MZIMVUBU WATER PROJECT

COST ESTIMATES AND ECONOMIC ANALYSIS



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FEASIBILITY STUDY FOR THE MZIMVUBU WATER PROJECT

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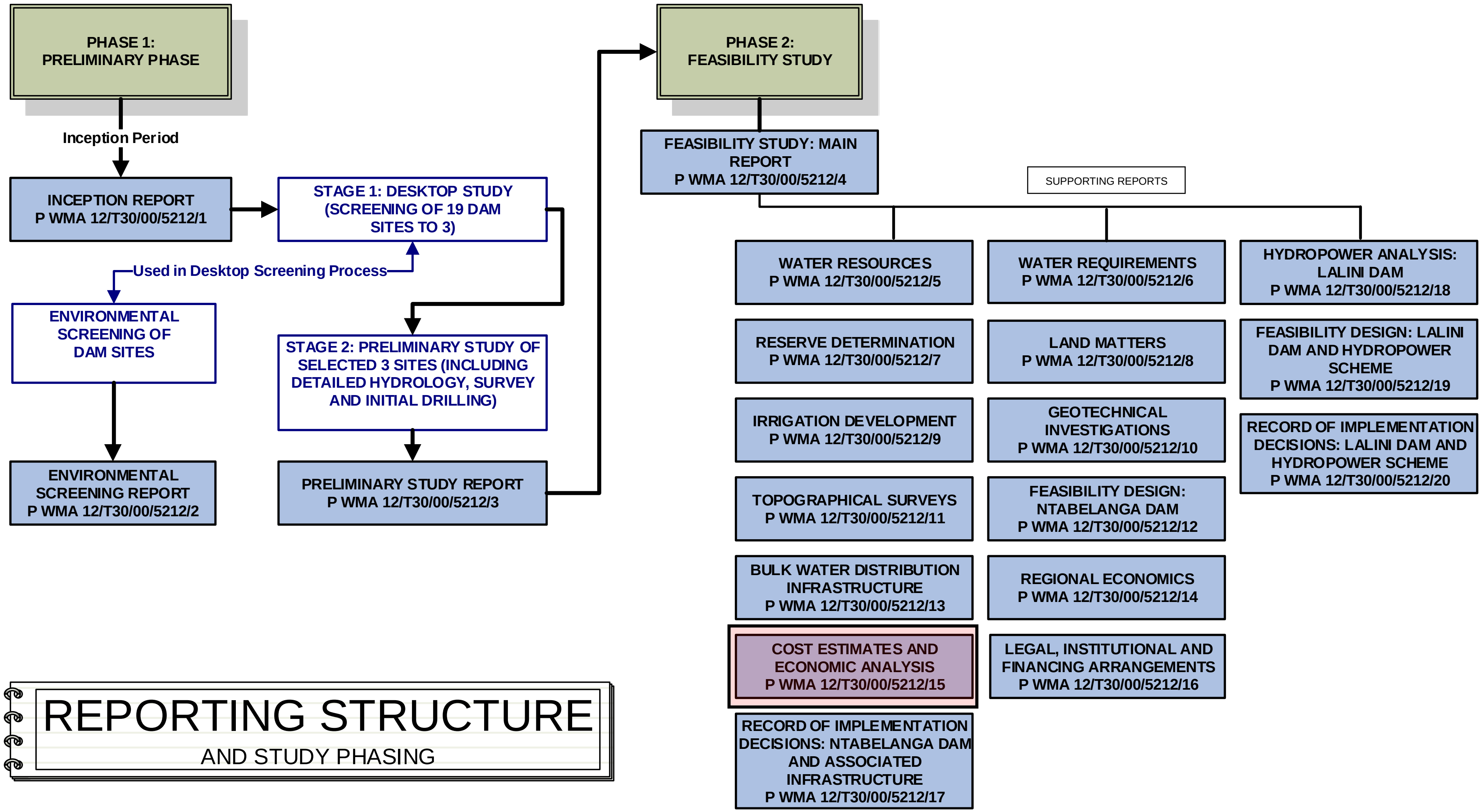
LIST OF REPORTS


PHASE 1:
PRELIMINARY PHASE
Inception Period
INCEPTION REPORT
P WMA 12/T30/00/5212/1
STAGE 1: DESKTOP STUDY (SCREENING OF 19 DAM SITES TO 3)
Used in Desktop Screening Process
ENVIRONMENTAL SCREENING OF DAM SITES
STAGE 2: PRELIMINARY STUDY OF SELECTED 3 SITES (INCLUDING DETAILED HYDROLOGY, SURVEY AND INITIAL DRILLING)
ENVIRONMENTAL SCREENING REPORT
P WMA 12/T30/00/5212/2
PRELIMINARY STUDY REPORT
P WMA 12/T30/00/5212/3
PHASE 2:
FEASIBILITY STUDY
FEASIBILITY STUDY: MAIN REPORT
P WMA 12/T30/00/5212/4
SUPPORTING REPORTS
WATER RESOURCES
P WMA 12/T30/00/5212/5
WATER REQUIREMENTS
P WMA 12/T30/00/5212/6
HYDROPOWER ANALYSIS: LALINI DAM
P WMA 12/T30/00/5212/18
RESERVE DETERMINATION
P WMA 12/T30/00/5212/7
LAND MATTERS
P WMA 12/T30/00/5212/8
FEASIBILITY DESIGN: LALINI DAM AND HYDROPOWER SCHEME
P WMA 12/T30/00/5212/19
IRRIGATION DEVELOPMENT
P WMA 12/T30/00/5212/9
GEOTECHNICAL INVESTIGATIONS
P WMA 12/T30/00/5212/10
RECORD OF IMPLEMENTATION DECISIONS: LALINI DAM AND HYDROPOWER SCHEME
P WMA 12/T30/00/5212/20
TOPOGRAPHICAL SURVEYS
P WMA 12/T30/00/5212/11
FEASIBILITY DESIGN: NTABELANGA DAM
P WMA 12/T30/00/5212/12
BULK WATER DISTRIBUTION INFRASTRUCTURE
P WMA 12/T30/00/5212/13
REGIONAL ECONOMICS
P WMA 12/T30/00/5212/14
COST ESTIMATES AND ECONOMIC ANALYSIS
P WMA 12/T30/00/5212/15
LEGAL, INSTITUTIONAL AND FINANCING ARRANGEMENTS
P WMA 12/T30/00/5212/16
RECORD OF IMPLEMENTATION DECISIONS: NTABELANGA DAM AND ASSOCIATED INFRASTRUCTURE
P WMA 12/T30/00/5212/17
REPORTING STRUCTURE
AND STUDY PHASING

FEASIBILITY STUDY FOR THE MZIMVUBU WATER PROJECT

REFERENCE

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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.

EXECUTIVE SUMMARY

INTRODUCTION

The Mzimvubu River catchment in the Eastern Cape Province of South Africa is within one of the poorest and least developed regions of the country. Development of the area to accelerate the social and economic upliftment of the people was therefore identified as one of the priority initiatives of the Eastern Cape Provincial 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 Eastern Cape Provincial Government as offering one of the best opportunities in the Province to achieve such development. In 2007, a special-purpose vehicle (SPV) 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.*

As a result of this the Department of Water and Sanitation (DWS) commissioned the Mzimvubu Water Project Feasibility Study with the overarching aim of developing water resources schemes (dams) that can be multi-purpose reservoirs in order to provide benefits to the surrounding communities and to provide a stimulus for the regional economy, in terms of irrigation, forestry, domestic water supply and the potential for hydropower generation amongst others.

The study commenced in January 2012 and was completed in October 2014 in several stages as follows:

- *Inception;*
- *Phase 1 – Preliminary Study; and*
- *Phase 2 – Feasibility Study.*

The purpose of this study was not to repeat or restate the research and analyses undertaken on the several key previous studies described below, but to make use of that information previously collected, to update and add to this information, and to undertake more focussed and detailed investigations and feasibility level analyses on the dam site options that have then been identified as being the most promising and cost beneficial.

Report numbers P WMA 12/T30/00/5212/2 to 20 describe the feasibility study processes undertaken to prepare solutions that would be implemented to meet the development goals and social benefits.

Following the completion of the above feasibility study stages it was confirmed and agreed that the sizing and modus operandi of the Ntabelanga Dam and its associated works would take into account its multi-purpose role, namely:

i. *To supply potable water to an estimated current population of 502 822 people (rising to some 726 616 people in 2050), and other potable water consumers in the region;*
ii. *To supply raw water for irrigation of some 2 868 ha of high potential agricultural land;*
iii. *To generate hydropower locally at the dam wall to reduce the cost of energy consumption when pumping water;*
iv. *To provide sufficient flow of water downstream of the Ntabelanga Dam to meet environmental water requirements for an ecological Class C; and*
v. *To provide additional balancing storage volume and consistent downstream flow releases to enable a second dam at Lalini (just above the Tsitsa Falls) to generate significant hydropower for supply into the national grid.*

The basis of approach listed in item v) was that the generating of hydropower could be used to cross-subsidize both operation and maintenance costs as well as the significant energy costs required for pumping water for the irrigation and domestic water supply schemes proposed to be supplied from the Ntabelanga Dam. The agricultural water requirements proposed for the Tsolo area would require lifting the water more than 150 m, which would normally render such a scheme non-viable in terms of the pumping cost component of water supplied, unless hydropower is developed to reduce the net unit cost of water.

The purpose of this second dam and hydropower scheme at Lalini would thus be to generate significant revenue by selling energy into the ESKOM grid, thus generating a net positive income stream which would be used to subsidise the energy and operating costs of the main Ntabelanga water supply and irrigation scheme, thus providing self-sustainability.

A more detailed hydropower analysis and feasibility design study was therefore undertaken to assess the output potential of the Lalini Dam hydropower scheme when used conjunctively with the Ntabelanga Dam. This analysis used the detailed hydrology developed for the catchment and the naturalised and historical flow series that was developed therefrom.

It was confirmed and agreed that the sizing and modus operandi of the Lalini Dam and its associated works would take into account its main role, namely:

a) *to generate hydropower both locally at the dam wall and in the Tsitsa River gorge downstream of the Tsitsa Falls, and*
b) *to provide sufficient flow of water downstream of the Lalini Dam and these hydroelectrric plants (HEPs) to meet environmental water requirements for an ecological Class B/C.*

In order to facilitate this analysis, detailed investigations were undertaken of the Lalini Dam components of the scheme, inter alia:

- *detailed topographical survey and positioning of the proposed Lalini Dam,*
- *geotechnical investigations of the dam site, sources of construction materials, and tunnel alignments,*
- *investigation of various Lalini hydropower scheme configuration options, and*
- *hydropower modelling simulations of the Lalini hydropower plant and two mini-hydropower plants at Ntabelanga and Lalini dams for the conjunctive scheme.*

The resulting project infrastructure comprises the following:

- *A new dam on the Tsitsa River at Ntabelanga, with capacity to supply the raw and potable water requirements for i) and ii) above,*
- *A water treatment works at the Ntabelanga dam to supply the potable water requirements,*
- *Primary and secondary bulk water distribution systems the deliver potable water to the area to be supplied by the Ntabelanga Dam,*
- *A bulk raw water distribution system from Ntabelaenga Dam to supply irrigation water to some 2 868 ha of high potential land,*
- *A mini hydroelectric plant (HEP) at Ntabelanga Dam to generate up to 5 MW of power, and*
- *A hydropower scheme supplied with water by a new dam at Lalini, located on the Tistsa River some 3.5 km above the Tsitsa Falls. This would have a similar mini HEP to Ntabelanga at Lalini Dam itself, producing up to 5 MW, and a main HEP located in the gorge downstream of the Tsitsa Falls, supplied through a 7.85 km long conduit, which could produce up to 37.5 MW power on a base load basis.*

An extensive tertiary pipelines system would also be required to distribute potable water in bulk to the settlements in the Ntabelanga Dam supply area. These tertiary lines would be supplied from the above primary and secondary bulk water distribution system to be developed by the DWS, and would be implemented by the relevant District Municipalities (DMs) that are the Water Service Authorities (WSAs) and Water Service Providers (WSPs) in the supply area.

The project components listed above would also include associated works such as roads, bridges, temporary water supplies, wastewater treatment facilities, accommodation villages, operations facilities, power supplies, and flow gauging stations. Other social and environmental mitigation infrastructure will be required as will be determined under the Environmental Impact Assessment (EIA) and its management Plan (EMP) as is being developed by an independent EIA Professional Services Provider (PSP).

PURPOSE OF REPORT

This report summarises the cost estimates prepared for the above Ntabelanga-Lalini Conjunctive Scheme components, and the results of economic and financial analyses undertaken on each component and on the fully integrated scheme. These analyses have been undertaken to optimise sub-components and to test for the viability and sustainability of the scheme, in terms of the Unit Reference Value (URV) of the water supplied by the scheme when comparing different options and also the Financial Impacts of proposed solutions. In particular, the beneficial impact on this viability created by the inclusion of the hydropower component is demonstrated.

Various scenarios are included to show the impact of various proportions of the works being grant funded rather than to have to include capital redemption in the water sales tariff. It is made clear that such a scheme, with its large indigent consumer base, is only sustainable if a significant portion of the works are grant funded. This is the norm in such scattered rural situations, and is especially so given the remote and rugged terrain which comprises the whole of the supply area.

A summary of the implementation cost estimates, and annual cash flow projections are given, with costs escalated from a 2014 costing baseline, to the actual expenditure year, at 5.5% p.a.

The impacts of various possible financing options for the hydropower component of the conjunctive scheme are also presented, with conclusions that a fully or partially grant-funded solution would enable the energy costs of the water supply scheme components to be fully cross-subsidized, as well as providing surplus energy sales revenue, which can be used for repaying either the full grant funding, or loan funding aspects, or otherwise used to fund other development projects in the region.

SUMMARY OF FINDINGS

Table 1 shows the overall cost estimate for the Ntabelanga-Lalini Conjunctive Scheme

This summarises the financial requirements for infrastructure implementation, based upon the proposed conjunctive scheme which includes potable and irrigation water supply, as well as the Ntabelanga and Lalini hydropower components, operated as a single ring-fenced project.

As shown, the Department of Environmental Affairs (DEA) allocated a budget of approximately R450 million to be spent over the next 10 years for the catchment restoration and rehabilitation programme which commenced in April 2014. This budget therefore already exists and has been allocated proportionally to the two dams.

Also shown is the estimated budget for the implementation of the tertiary pipelines. This component is not part of the DWS responsibility and falls under the jurisdiction of the three District Municipalities and their Implementing Agents. Such funding is normally sourced from the Regional Bulk Infrastructure Grant (RBIG) and Municipal Infrastructure Grant (MIG) programme,

Allowance has also been made for the potential investment costs for the establishment and equipping of each of the 60 ha (average) farming units, which are expected to be between R3 and 5 million per farming unit. A budget of R4 million including VAT has therefore been allowed per average farming unit, for 45 farms.

There are other potential offset costs might include:

- *Environmental impact offsets including replacement of lost wetlands,*
- *Improvements to other infrastructure in the region for those directly affected by the works – including upgrades to schools, clinics, water supplies and sanitation, and other community facilities,*
- *Development of aquaculture,*
- *Development of tourism and recreational infrastructure, and*
- *Development of local industries and agri-processing.*

Each of these aspects will require further studies to determine their specific requirements, viability and cost benefits.

The ongoing EIA study is to investigate the environmental and social impacts, and to determine resettlement, mitigations and compensation requirements, as well as these potential offset requirements.

In the meantime, a provisional budget of R100 million has been allowed for these offsets which has been evenly distributed between the Ntabelanga and Lalini components of the conjunctive scheme.

The capital works budgets include allowances for engineering (project management, design and supervision services providers) as well as the implementation of the EMP requirements. Escalation has been calculated from the 2014 baseline to the date of commissioning at 5.5 % p.a., based upon the original implementation programme.

A draft implementation programme has been submitted and is under review by DWS. The cash flows shown on Table 1 are based upon this provisional programme. This will need to be regularly reviewed and updated in the light of the most likely implementation programme, which will be dependent upon the way that the various scheme components are packaged, the funding availability, the procurement and approvals processes, and the time taken to resolve the many institutional and social issues that are always a feature of such a large project.

Table 1: Overall Conjunctive Scheme Cost Estimate and Cashflow Projection

COST ESTIMATES		ANNUAL EXPENDITURES R'MILLION									
COMPONENT	**R'million**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Ntabelanga dam and associated works	1 075		81	322	215	215	215	27			
Ntabelanga dam hydropower works	88				9	35	35	9			
Ntabelanga land compensation/mitigation costs	18		1	4	4	4	4	1			
Ntabelanga power transmission	29		3	23	3						
Sub-Total Ntabelanga Dam and Associated Works	1 209		85	349	231	254	254	37			
Engineering and EMP Costs (12%)	145		10	42	28	30	30	4			
Sub-Total Ntabelanga Dam and Associated Works incl Eng & EMP	1 354		95	391	259	284	284	41			
Escalation in Each Year @ 5.5% p.a.	265		5	44	45	68	87	16			
Sub-Total Ntabelanga Dam and Associated Works incl Eng, EMP & ESC	1 619		100	435	304	352	371	57			
VAT (14%)	227		14	61	43	49	52	8			
Add in R22 million per year for catchment management (no esc)	220	22	22	22	22	22	22	22	22	22	22
Allowance for other offset activities (50% of R100 million)	50				10	15	15	10			
Total Ntabelanga Dam and Associated Works (incl Esc + VAT)	**2 116**	**22**	**136**	**518**	**378**	**438**	**460**	**97**	**22**	**22**	**22**
COMPONENT	**R'million**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Ntabelanga water treatment works	643		32	32	193	193	129	64			
Ntabelanga primary & secondary bulk treated water distribution system	1 234			123	247	370	370	123			
Ntabelanga tertiary bulk treated water distribution system (DM's)	1 425			143	285	428	428	143			
Ntabelanga bulk irrigation water supply system	497				50	149	199	75	25		
Sub-Total Ntabelanga WTW and Bulk Water Systems	3 799		32	298	774	1 140	1 125	405	25		
Engineering and EMP Costs (12%)	456		4	36	93	137	135	49	3		
Sub-Total Ntabelanga WTW and Bulk Water Systems incl Eng & EMP	4 255		36	334	867	1 277	1 260	453	28		
Escalation in Each Year @ 5.5% p.a.	1 067		2	38	151	305	387	172	13		
Sub-Total Ntabelanga WTW and Bulk Water Systems incl Eng, EMP & ESC	5 322		38	372	1 019	1 581	1 647	625	40		
VAT (14%)	745		5	52	143	221	231	88	6		
Total Ntabelanga WTW and Bulk Water Systems (incl Esc + VAT)	**6 068**		**43**	**424**	**1 161**	**1 803**	**1 878**	**713**	**46**		
COMPONENT	**R'million**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
In-farm irrigation investment costs	**105**						53	53			
Engineering and EMP Costs (12%)	13						6	6			
Sub-Total in-farm irrigation investment costs incl Eng & EMP	118						59	59			
Escalation in Each Year @ 5.5% p.a.	40						18	22			
Sub-Total in-farm irrigation investment costs incl Eng, EMP & ESC	158						77	81			
VAT (14%)	22						11	11			
Total in-farm irrigation investment costs (incl Esc + VAT)	**180**						**88**	**92**			
COMPONENT	**R'million**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Lalini dam and associated works	802				267	267	267				
Lalini Access Roads and Bridges	487			73	195	195	24				
Lalini land compensation/mitigation costs	50				17	17	17				
Lalini water delivery tunnel, shafts and penstocks	756				113	302	302	38			
Lalini hydropower E&M equipment	175					26	79	61	9		
Lalini hydropower civil works	49						24	24			
Lalini power transmission lines to grid	29			14	14						
Sub-Total Lalini Dam and HEP	2 347			87	607	807	714	124	9		
Engineering and EMP Costs (12%)	282			10	73	97	86	15	1		
Sub-Total Lalini Dam and HEP incl Eng and EMP	2 629			98	679	904	799	138	10		
Escalation in Each Year @ 5.5% p.a.	648			11	118	216	245	52	4		
Sub-Total Lalini Dam and HEP incl Eng, EMP and Esc	3 277			109	798	1 120	1 045	191	14		
VAT (14%)	459			15	112	157	146	27	2		
Add in R22 million per year for catchment management (no esc)	230	23	23	23	23	23	23	23	23	23	23
Allowance for other offset activities (50% 0f R100 million)	50				10	15	15	10			
Total Lalini Dam and HEP (incl Esc + VAT)	**3 966**	**23**	**23**	**147**	**932**	**1 300**	**1 214**	**241**	**39**	**23**	**23**
		2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
GRAND TOTAL ALL COMPONENTS (R'MILLION INCL ESC AND VAT)	**12 329**	45	203	1 089	2 472	3 541	3 640	1 143	107	45	45

It should be noted that there are several risks involved in the accuracy of the above cost estimate:

- *Estimating at feasibility level at best has a confidence level of ± 10%*
- *Escalation rates could increase or decrease, especially given the volatile nature of the economy at the moment*
- *Rand foreign exchange rates are also volatile and this will affect the cost of all imported materials, services and equipment.*
- *The timing of the various components implementation may change which, if later, would increase the escalation cost.*
- *The amount of non-grant finance is unknown, and if significant will increase costs, depending on the terms of such loans, interest rates and foreign exchange rates.*

One example of the impact of the above risks is that every month's delay in fully implementing a R12.5 billion project increases escalation cost by R57 million (at 5.5% p.a.)

ECONOMIC ANALYSES RESULTS

The analysis was run for the potable scheme including the tertiary lines (Table 2 summarises the results) and for the scheme excluding the tertiary lines (Table 3).

Table 2: URV for Ntabelanga Potable Water Scheme Alone – Including Tertiary Pipeines

URV: POTABLE WATER SCHEME ONLY INCL TERTIARIES				
Scenario	Components Grant Funded	URV OF WATER SUPPLIED (R/m^3)		
		6%	8%	10%
1	Full Capital Redemption	14.21	15.49	16.71
2	Fully grant funded	3.22	2.96	2.72
3	Fully grant funded + 50% Energy Subsidized	2.80	2.57	2.37
4	Fully grant funded + 100% Energy Subsidized	2.37	2.19	2.01

Table 3: URV for Ntabelanga Potable Water Scheme Alone – Excluding Tertiary Pipelines

URV: POTABLE WATER SCHEME ONLY EXCL TERTIARIES				
Scenario	Components Grant Funded	URV OF WATER SUPPLIED (R/m^3)		
		6%	8%	10%
1	Full Capital Redemption	9.45	10.20	10.92
2	Fully grant funded	2.47	2.27	2.08
3	Fully grant funded + 50% Energy Subsidized	2.05	1.88	1.73
4	Fully grant funded + 100% Energy Subsidized	1.62	1.49	1.38

The results in Table 2 and 3 serve as an illustration of the obvious benefits of grant funding and the impacts of partial or full subsidization of the energy costs.

Whilst a URV value does not relate directly to the tariff requirements for a viable scheme, experience on other studies has shown that this value should be below R2.00/m^3 in order to produce a unit water cost that would be affordable to the consumer, and financial sustainable from the operations and maintenance viewpoint.

Financial impact models have been built to test such sustainability and are presented in the next section.

As would be expected, the inclusion of the tertiary pipelines significantly increases the URV of water, but the analysis is based upon the DWS-developed scheme which includes delivery of potable water in bulk to the primary and secondary system only.
The tertiary pipelines would be the responsibility of the DMs to implement, and these are normally funded via grants under the RBIG and MIG funding process.

URV OF BULK IRRIGATION WATER SYSTEM

Appendix H shows the discounted cash flow models used to calculate the URV of potable water supplied, including all costs of abstracting raw water from the Ntabelanga Dam, the raw water pumping station, the intermediate bulk storage reservoir, and gravity pipelines to local tanks at each of the proposed farming units. The delivery of raw water to some of the farm units at higher elevation will also require two small booster pumping stations, which are also included in the analysis. In-field distribution costs and associated equipment are not included, and the URV of water supplied therefore relates to the bulk water to be purchased by the farm unit developers.

Capital redemption scenarios have again been modelled from no grant funding to full grant funding of the various system components. In this case, 50% and 100% subsidy of power cost was therefore also modelled.

Table 4 summarises the results of this analysis.

Table 4: Summary of Results of Irrigation Water System URV Analysis

URV: IRRIGATION SCHEME COMPONENTS ONLY				
Scenario	**Components Grant Funded**	**URV OF WATER SUPPLIED (R/m³)**		
		6%	**8%**	**10%**
1	Full Capital Redemption	3.94	4.26	4.56
2	Fully Grant Funded	0.53	0.48	0.44
3	Grant Funded and 50% Energy Subsidized	0.44	0.40	0.37
4	Grant Funded and 100% Energy Subsidized	0.35	0.32	0.29

The results again serve as an illustration of the obvious benefits of grant funding and the impacts of partial or full subsidization of the energy costs.

Whilst a URV value does not relate directly to the tariff requirements for a viable scheme, experience has shown that for irrigated agriculture, where low unit cost of water is required for viability, this value should be well below R0.50/m^3 on grant funded schemes where operation, maintenance and staffing costs need to be recovered for sustainability.

The Table 3 shows the significant impact on the URV of raw water delivered in bulk to the edge of field of the proposed farming units, when capital costs and power costs are subsidized.

This is reflected when taking a straightforward non-discounting approach to the operation and maintenance cost of this component, as is shown in Table 5.

Reduction of this unit cost to around R0.25/m^3 by subsidisation of energy (i.e. through the hydropower component), would considerably increase the gross margin produced by each farming unit, and viability of the irrigation component in total.

Table 5: Annual Operation and Maintenance Costs for Irrigation Component

OPTION 3 - IRRIGATION PIPELINE DIRECT FROM DAM						
ITEM	**DESCRIPTION**	**AMOUNT**		**O&M per year**		
1	Pipelines	R	405 636 748	0.50%	R	2 028 184
2	Abstraction works	R	8 000 000	0.25%	R	20 000
3	Pumpstations	R	23 280 152	4%	R	931 206
4	Reservoirs	R	50 000 000	0.25%	R	125 000
5	Electrical supply	R	10 000 000	4%	R	400 000
6	Contingencies	R	49 691 690	1%	R	496 917
7	Engineering fees	R	32 796 515			
	Allowance for M&E depreciation and replacement funding				R	956 515
	Total 1	**R**	**579 405 105**		**R**	**4 957 822**
	VAT	R	81 116 715		R	694 095
	Total	**R**	**660 521 820**		**R**	**5 651 917**
				Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power				21 240 366		R 0.27
Power Cost per year		**R**	**18 559 958**	21 240 366		R 0.87
Cost for supply of raw water to edge of field including power				**R/m^3**		**R 1.14**

OVERALL URV OF CONJUNCTIVE SCHEME

The above discounted cash flow/URV models have been combined to test the impact of operating the potable water, irrigation water, and hydropower components as an integrated scheme. The combined URV models are given in Appendix I.

Whilst the URV models for the potable and irrigation water were added incrementally together with the capital, operating and maintenance costs of the conjunctive Ntabelanga-Lalini hydropower components, the value of an annual credit from the surplus energy income from the hydropower component over the annual energy costs of the water supply components was made.

This had the effect of significantly reducing the overall URV of water supplied as is shown on Table 6 and Figure 1. Again, the impact of various proportions of grant funding of the capital costs of the conjunctive scheme were also considered. Seven scenarios are shown, ranging from no grant funding (full capital redemption) to full grant funding, only operation and maintenance costs redeemed.

Table 6: URV for Fully Conjunctive Ntabelanga-Lalini Scheme – Incl. Tertiaries

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME INCL TERTIARIES				
Scenario	***Components Grant Funded***	***URV OF WATER SUPPLIED (R/m^3)***		
		6%	*8%*	*10%*
1	*None - Full Capital Redemption*	*11.47*	*12.95*	*14.33*
2	*Lalini Scheme Only*	*7.78*	*8.78*	*9.71*
3	*Ntabelanga Scheme Only*	*4.69*	*5.27*	*5.81*
4	*Lalini + Tertiaries*	*5.86*	*6.59*	*7.26*
5	*Lalini + Tertiaries + Irrigation*	*5.01*	*5.64*	*6.23*
6	*Lalini + Tertiaries + Irrigation + Prim and Sec Bulk System*	*3.40*	*3.80*	*4.17*
7	*All Works Grant Funded*	*0.77*	*0.82*	*0.87*

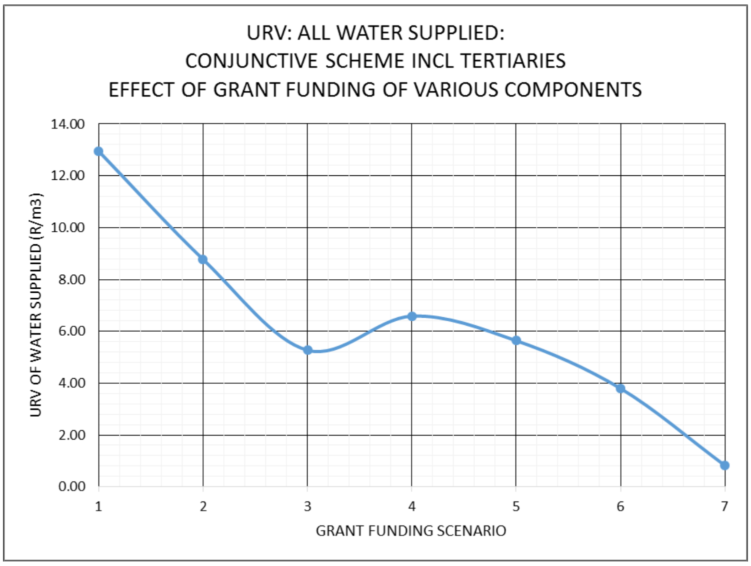


Figure 1: Conjunctive Scheme - URVs for Various Grant Funding Scenarios (Incl. Tertiaries)

Alternatives of only grant funding the Ntabelanga scheme or the Lalini scheme components are shown as scenarios 2 and 3.

The same analysis was repeated for the fully conjunctive scheme, but without the tertiary pipeline system included. Table 7 and Figure 2 show the results.

Table 7: URV for Fully Conjunctive Ntabelanga-Lalini Scheme – Excl. Tertiaries

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME EXCL TERTIARIES				
Scenario	**Components Grant Funded**	**URV OF WATER SUPPLIED (R/m^3)**		
		6%	**8%**	**10%**
1	None - Full Capital Redemption	9.37	10.60	11.75
2	Lalini Scheme Only	5.51	6.27	6.98
3	Ntabelanga Scheme Only	4.29	4.89	5.45
4	Lalini	5.47	6.22	6.92
5	Lalini + Irrigation	4.63	5.28	5.89
6	Lalini + Irrigation + Prim and Sec Bulk System	3.02	3.44	3.85
7	All Works Grant Funded	0.41	0.49	0.57

As can be expected the exclusion of the tertiary pipelines reduces the URV significantly and under the fully grant funded option almost halves the URV of water supplied.

Comparing the URV of water produced for scenario 2 on Table 1 (Ntabelanga scheme only – no energy subsidy as no hydropower included) with the URV of water produced in scenario 7 for the full conjunctive scheme on Table 7, shows the impact of the cross-subsidization of energy costs, and the benefit of surplus revenue generated by the conjunctive scheme, which produces (at 8% discount rate) a drop in URV value from R2.96/m3 to R0.82/m3.

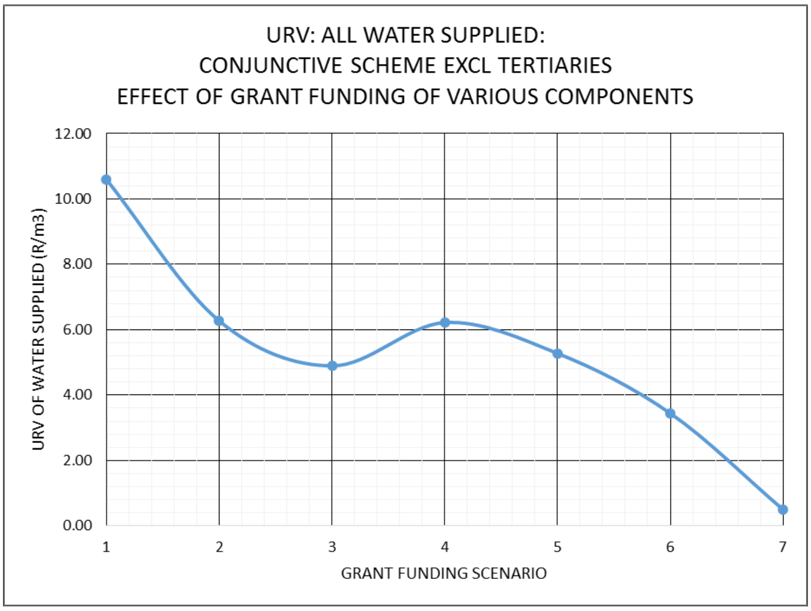


Figure 2: Conjunctive Scheme - URVs for Various Grant Funding Scenarios Excl Tertiaries

This finding indicated that there could be significant merit in development the conjunctive scheme instead of the Ntabelanga scheme only, and it was agreed that both options would be investigated in terms of financial impact assessment.

This is especially pertinent given the high proportion of operating costs that are due to energy charges, and the likely continuing increase in energy costs in the future at much higher a rate than normal inflation.

FINANCIAL IMPACTS ANALYSES

The financial impact models are different from the economic models in that they take into account the escalated costs, tariffs and cash flow year on year using realistic bulk water tariffs and projected escalation rates which take into account current the current and project economy indicators.

As with the URV models, these financial models were run for a 30 year simulation from this current year, and it was assumed that the bulk water supply operations would be undertaken by an implementing agent such as Amatola Water, who currently operate similar schemes in this region.

Water tariffs, costs and revenue streams were escalated to the date of expenditure, as follows:

- *Capital and O&M cost are escalated at 5.5 % p.a., and*
- *Energy costs escalated at 8.5% p.a. for 3 years then at 6.5% p.a.*

The scheme components analysed excluded the tertiary pipelines in order to replicate the limits of infrastructure that would be operated by the bulk water supply operator (such as Amatola Water), and it would then be up to the Water Services Providers (DMs) to reticulate and deliver the potable water onwards from this bulk supplier's terminal reservoirs to the customers.

In terms of actual sales quantities, the water requirements projections were used and adjusted for expected unaccounted for water in terms of losses, and deducting water supplied as free basic water (the latter estimated as some 25% of the total potable water produced).

Using Alfred Nzo DM as an example, their water supply tariffs to domestic customers allow for the first 6 m^3/month per household free to indigent customers, but they also charge some R1.60/m^3 in this lower consumption band if the customer is determined to be "non-indigent". Above 6 m^3/month per household consumption, the tariffs increase steeply to R5.5/m^3 for up to 21 m^3/month/household consumption, and to R10.9/m^3 in the next tariff band, and so on up to a maximum of R22/m^3.

Commercial/industrial customer tariffs start at R5.70/m^3 in the first 10 m^3/month band, rising to R11.5/m^3 in the next 20 m^3/month band and rising steadily to R28.6/m^3 for consumption above 120 m^3/month.

These tariffs bands are set to ensure that the poorer customers are cross-subsidized. In addition, each DM receives annual subsidies through the Local Government Equitable Share programme. These subsidies are to fund the provision of basic services to indigent households, which is currently of the order of R275 per month per indigent household, and of which some R87 per month (average nationally) is typically allocated for water supply services.

The above information was used as an indicator to try to ascertain what bulk potable water supply tariff could be afforded by the DMs that would be supplied by the proposed bulk water supply scheme.

As described in the Legal Institutional and Financing Arrangement Report No. P WMA 12/T30/00/5212/16, it is recommended that a well-resourced and experience bulk water supply operator be appointed to operate and maintain the bulk water supply system, and sites Amatola Water as a strong possible for this role.

According to Amatola Water's Annual Report 2014, they sell bulk raw water at a tariff of R1.57/m^3, and potable water at a tariff of R6.36/m^3, with a resulting composite average water sales tariff of R5.39/m^3 (2014). This is relatively high when compared with the much larger Water Boards such as Rand Water and Umgeni Water, and reflects the benefits of economies of scale that these larger Water Boards enjoy.

The appointment of Amatola Water to operate and maintain the Ntabelanga bulk water supply scheme would more than double this organisation's annual potable water sales and triple the overall water sales, which would certainly add economies of scale to Amatola's operation, which could mean a lowering of the average bulk water tariff to sustain their business.

SOURCES OF CAPITAL WORKS FUNDING

Different sources of capital works funding were investigated:

Grant funding: *Interest free and with no repayment requirement. The source of such funding would normally be from the National Treasury, although some international agencies can provide grant funding – normally for social upliftment project which otherwise would not be financially viable.*

Loan funding: *Borrowing funds at a certain interest rate per annum, with a requirement to repay the loan over a period (tenor) normally of the order of 20 to 25 years. The lender would set terms and conditions which would need to be complied with by the borrower. Loans which do not have an agreed fixed interest rate would have a higher risk than those which have fixed interest rates. If the loan funding is to be sourced and repaid in foreign currency, then there would be an exchange rate risk.*

Equity funding: *An investor raises funding for the purchase of a share in the works for which the investor receives an agreed annual dividend. The equity investment is not repaid but could be traded to other investors as shares.*

NTABELANGA BULK WATER SUPPLY SCHEME

This analysis was based upon the infrastructure illustrated on Figure 5-2, and excludes the tertiary pipeline system to be implemented by the DMs.

Taking the above situation into consideration, and in order to test the financial viability of the study scheme options, the initial potable and irrigation water sales tariffs in year 1 (2015) were set at R5.00/m^3 and R0.30/m^3 respectively.

Power cost projections were based upon the estimated initial power consumption, and expected power tariff, in the first year of operation (2020), escalated thereafter at 6.5% p.a. Capital works and associated implementation expenditures were escalated from the 2014-based cost estimates at 5.5% p.a. with annual expenditure cash flow estimated from the projected implementation programme timing.

Figure 3 shows that even with all capital costs grant funded, the income from water sales would not be sufficient to sustain the management, operation, maintenance and energy costs of the scheme.

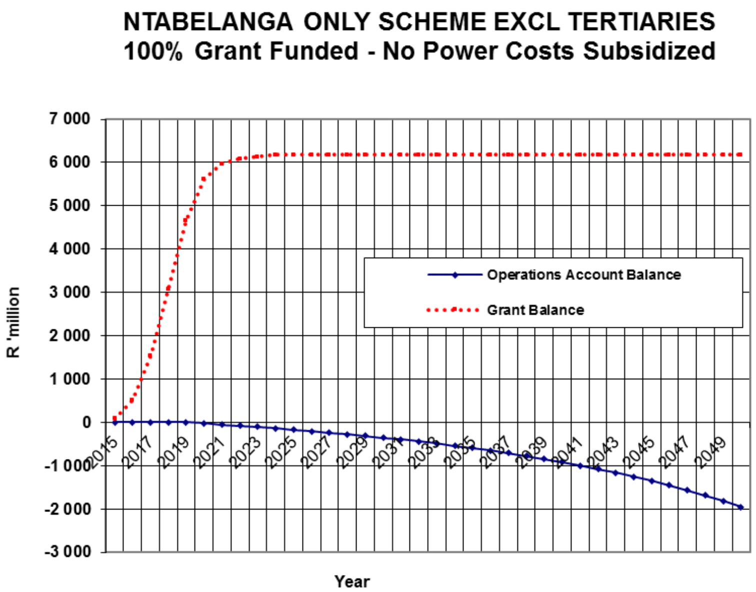


Figure 3: Grant Funded Ntabelanga Water Supply Scheme – R5.00/m^3 potable initial tariff

The operations account balance shows annual operating losses commencing at R25 million per year in the first year of operation rising to R130 million per year in 2050. Thus this scheme would not be financially sustainable in the absence of some subsidy of the management, operation, maintenance and energy costs.

Raising the initial (year 1) bulk water tariff to R6.00/m^3 does bring the operating account into balance, but this is likely to be a non-affordable bulk water tariff for the DMs to pay when the additional management, operation and maintenance costs of the tertiary distribution systems are taken into consideration, together with the high proportion of indigent households to be supplied by this scheme. See Figure 4.

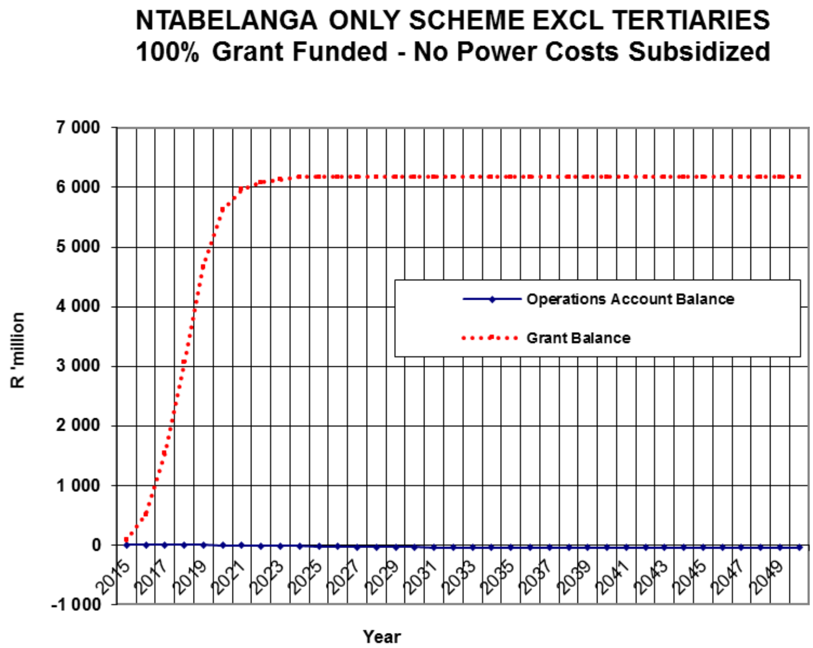


Figure 4: Grant Funded Ntabelanga Water Supply Scheme – R6.00/m^3 initial tariff

GRANT FUNDED CONJUNCTIVE SCHEME EXCLUDING TERTIARY SYSTEM

This financial impact model was initially run for a fully grant funded situation, and using the same base data as for the Ntabelanga scheme excluding the tertiary system.

Apart from higher capital, operations and maintenance costs, the model also includes credit for the energy sold into the grid from the hydropower components of the conjunctive scheme. This energy would be sold as green energy trading certificates (as with the AGP example) and the year 1 (2015) tariff allowed for this was R0.80/kWh, which was then escalated at national escalation rate of 5.5 %p.a.

As shown in Figure 5, even with water sales tariffs set at ZERO for both potable and irrigation water sold, the revenue generated by hydropower sales alone would sufficient to financial sustain management, operation, maintenance and power costs for the conjunctive scheme.

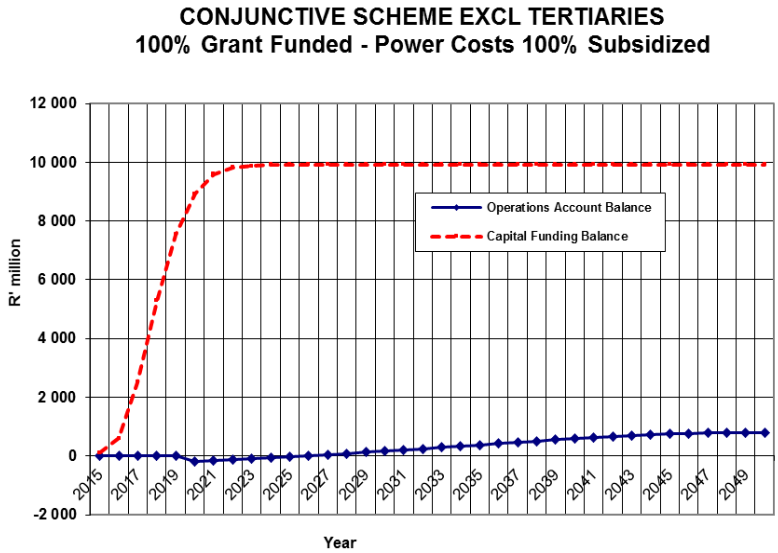


Figure 5: Grant Funded Conjunctive Water Supply Scheme – R ZERO/m^3 initial tariff

It is of course not sensible to deliver bulk water at zero tariff and two more scenarios were explored for the fully grant funded conjunctive scheme, setting the bulk potable water tariff to R3.00/m^3 and R5.00/m^3 respectively, and setting the initial irrigation water tariff at R0.30/m^3 in both cases. The results are shown in Figures 6 and 7.

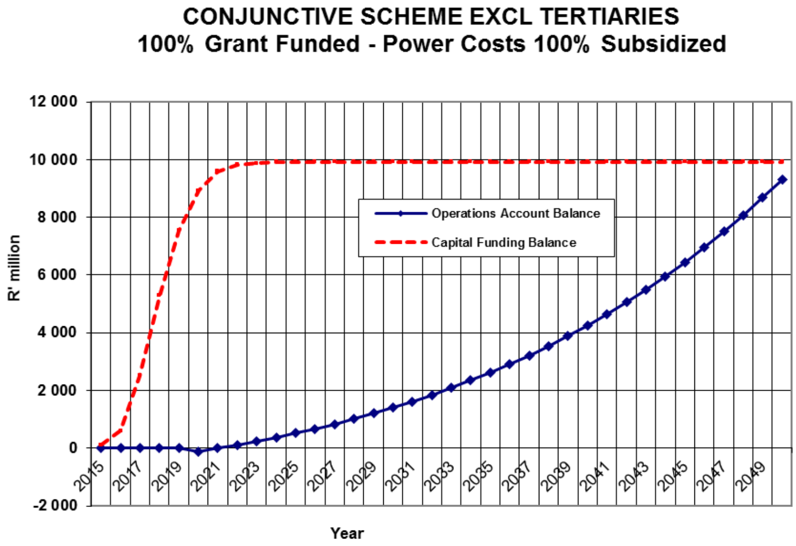


Figure 6: Grant Funded Conjunctive Water Supply Scheme – R3.00/m^3 initial tariff

This scenario shows that by charging an initial bulk water tariff equivalent to R3.00/m^3 for potable water and R0.30/m^3 for irrigation water, all recurring costs can be met as well as generating cash surpluses, which over the 30 year period of analysis accumulate to over R9 billion and which could be utilized to either repay the grant funding or put into other social and economic development projects in the region.

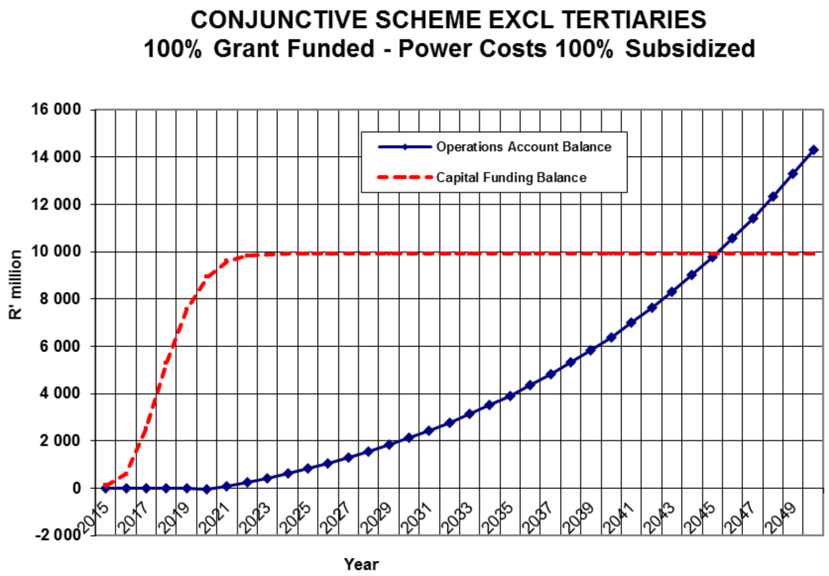


Figure 7: Grant Funded Conjunctive Water Supply Scheme – R5.00/m^3 initial tariff

Figure 7 shows that increasing the potable bulk water initial tariff to R5.00/m^3 produces even more of cash surplus per annum which would accumulate to more than R14 billion over 30 years.

Under both of these circumstances there would be many options available for the utilisation of such surplus, from the above described usage for other development projects to the simpler action of treating the grant funding as an interest free loan from Treasury, which could be repaid over a given period.

OTHER CONJUNCTIVE SCHEME FINANCING OPTIONS

The options considered in this respect were as follows:

- *Lalini 40% loan funded @ 9% interest p.a. with R3.00/m^3 initial tariff*
- *Lalini 60% loan funded @ 6% interest p.a. with R3.00/m^3 initial tariff*
- *Lalini 60% loan funded @ 9% interest p.a. with R5.00/m^3 initial tariff*
- *Lalini 100% loan funded @ 6% interest p.a. with R5.00/m^3 initial tariff*
- *Lalini 25% equity funded @ 15% return on investment - with R5.00/m^3 initial tariff*

Each of these models was run and percentages of Lalini funded by loans adjusted until a stable operations account balance was maintained after meeting all other costs and debt repayment conditions.

This indicates the effect of different loan interest rates as well as the initial tariff impacts upon the size of loan that could be repaid within a reasonable period (less than 30 years).

The findings are summarized in Figures 8 to 12.

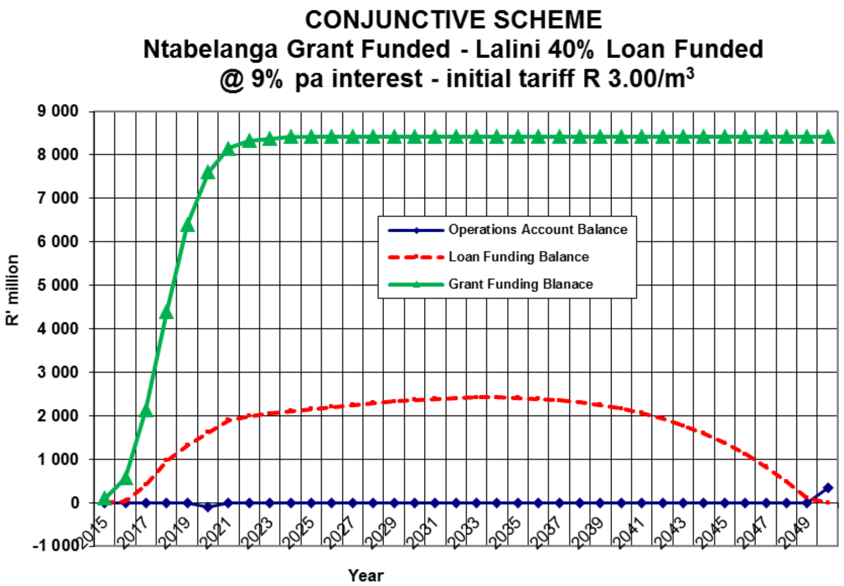


Figure 8: Conjunctive Scheme: Lalini 40% Loan Funded @ 9% interest: R3.00/m^3 initial tariff

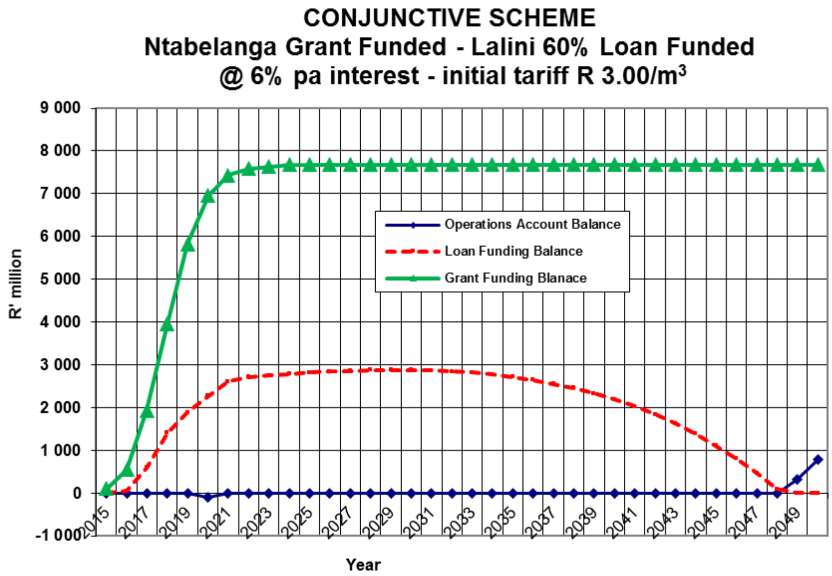


Figure 9: Conjunctive Scheme: Lalini 60% Loan Funded @ 6% interest: R3.00/m^3 initial tariff

In these two cases it is indicated that from a relatively low bulk water tariff of R3.00/m^3, a loan of between 40% and 60% of the Lalini component capital cost could be repaid through revenue generated, depending upon the interest terms of such a loan.

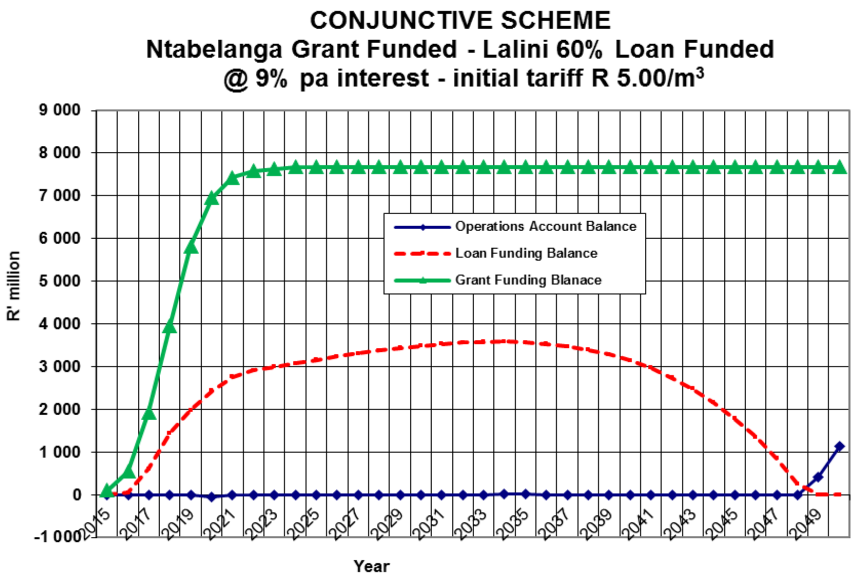


Figure 10: Conjunctive Scheme: Lalini 60% Loan Funded @ 9% interest: R5.00/m^3 initial tariff

For a loan of 60% of the Lalini scheme cost to be repaid at 9% interest, the initial tariff would need to be increased to R5.00/m^3.

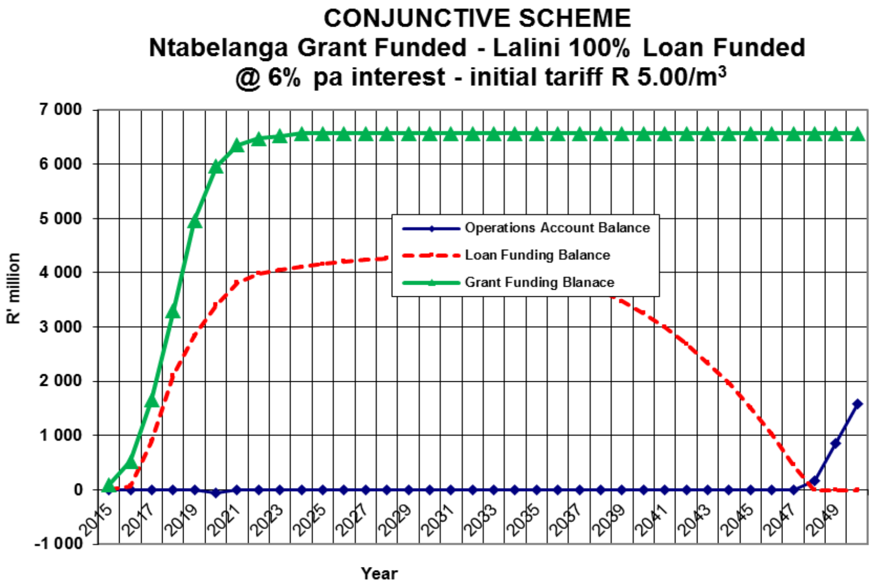


Figure 11: Conjunctive Scheme: Lalini 100% Loan Funded @ 6% interest: R5.00/m^3 initial tariff

For a 100% loan for the Lalini scheme cost to be repaid at 6% interest, the initial tariff would again need to be set to R5.00/m^3.

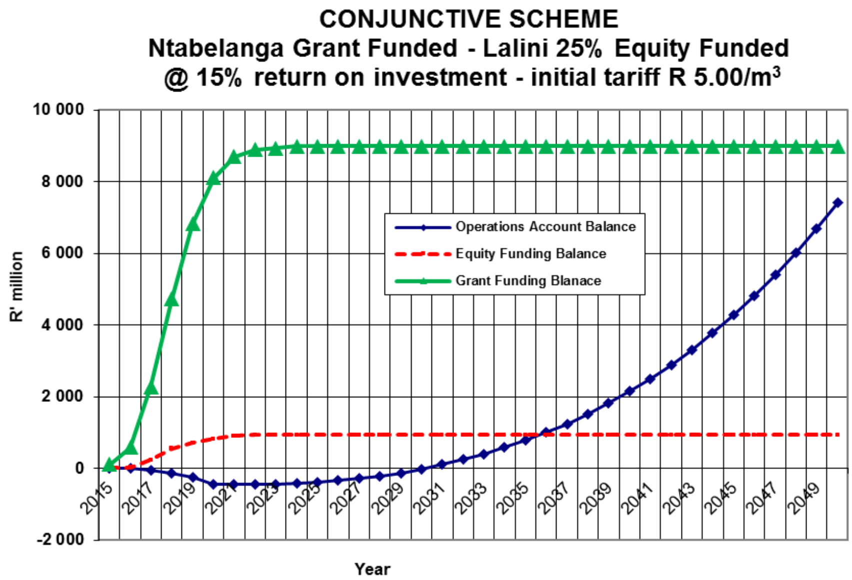


Figure 12: Conjunctive Scheme: Lalini 25% Equity @ 15% investment return: R5.00/m^3 initial tariff

Equity investments are another option where the principal capital is not repaid, but an annual dividend (the equity investor's expected return on investment – normally of the order of 15% p.a.) must be paid. In this case it might be attractive for such an equity investor to also be involved in the operation and maintenance aspects, and there are certain entities that specialise in such utilities management. The financial impact model for a 25% equity investment of the Lalini components of the conjunctive scheme would be viable if the initial bulk water tariff was set to R5.00/m^3.

SUMMARY OF FINANCIAL ANALYSIS

In summary, the fully grant funded Ntabelanga scheme would require a high starting base for the bulk potable water tariff in order to be financially sustainable. This being of the order of R6.00/m^3 before being further transferred and distributed through a new tertiary pipeline system that would need to be implemented by the DMs. This is therefore not considered a viable solution.

The conjunctive scheme would still require significant grant funding, as is normally the case on regional water supply systems – especially where constructed in mountainous rural areas with a high proportion of indigent households.

Grant funding of the full conjunction scheme including the Lalini hydropower component would allow low bulk water tariffs to be charged (say R3.00/m^3) as well as generating cash surpluses, which over the 30 year period of analysis accumulate to over R9 billion and which could be utilized to either repay the grant funding or put into other social and economic development projects in the region.

If Amatola Water were to become the operator of the conjunctive scheme, this could radically improve their economies of scale which could also have the impact of reducing the overall average cost of bulk water to all of their other customers as well, which would widen the benefits to a larger area than just the Ntabelanga-Lalini region.

If it is considered necessary to reduce the amount of grant funding of the project through the sourcing of loans or equity investments, then there is also potential for this to happen at the same time as keeping the required bulk potable and irrigation water tariffs to a financially viable and sustainable level. However, the financial burdens imposed upon the scheme due to the need to repay loans, interest, and or equity shareholders dividends, would absorb the potential surplus revenue that could otherwise be used to repay grants and/or to spend on further social upliftment and economic development programmes in this area.

CONCLUSION

Given the above results, there is a business case for the implementation of a conjunctive integrated multi-purpose scheme incorporating potable water supply, irrigated agriculture, and hydropower under a single, ring-fenced institutional entity.

This concept has been discussed at several forums including the Project Steering Committee meetings, the Wildcoast Integrated Development Forum, and at the Eastern Cape Social Economic Consultative Council (ECSECC), who have been tasked with stewardship of the implementation of this project on behalf of the Provincial Government.

A recent critical review of the above study findings was also undertaken by Mr Mike Muller on behalf of ECSECC, who came to similar conclusions.

TABLE OF CONTENTS

APPENDICES

FIGURES

TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ASGISA-EC	Accelerated and Shared Growth Initiative for South Africa – Eastern Cape
CAPEX	Capital Expenditure
CFRD	Concrete-faced rockfill dam
CMA	Catchment Management Agency
CTC	Cost to Company
CV	Coefficient of Variability
DAFF	Department of Agriculture, Forestry and Fisheries
DBSA	Development Bank of Southern Africa
DEA	Department of Environment Affairs
DM	District Municipality
DME	Department of Minerals and Energy
DoE	Department of Energy
DRDAR	Department of Rural Development and Agrarian Reform
DRDLR	Department of Rural Development and Land Reform
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EC	Eastern Cape
ECRD	Earth core rockfill dam
EF	Earthfill (dam)
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPWP	Expanded Public Works Programme
ESIA	Environmental and Social Impact Assessment
EWR	Environmental Water Requirements
FSL	Full Supply Level
GERCC	Grout enriched RCC
GN	Government Notices
GW	Gigawatt
GWh/a	Gigawatt hour per annum
IAPs	Invasive Alien Plants
IB	Irrigation Board
IFC	International Finance Corporation
IPP	Independent Power Producer
IRR	Internal Rate of Return
IVRCC	Internally vibrated RCC
ISO	International Standards Organisation
kW	Kilowatt
LM	Local Municipality
ℓ/s	Litres per second
ℓ/c/d	Litres per capita per day

MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MEC	Member of the Executive Council
MIG	Municipal Infrastructure Grant
million m^3	Million cubic metres
MW	Megawatt
NEMA	National Environmental Management Act
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act
NOCL	Non-overspill crest level
NWA	National Water Act
NWPR	National Water Policy Review
NWRMS	National Water Resources Management Strategy
O&M	Operations and Maintenance
OPEX	Operational Expenditure
PICC	Presidential Infrastructure Co-Ordinating Committee
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PSC	Project Steering Committee
PSP	Professional Services Provider
RBIG	Regional Bulk Infrastructure Grant
RCC	Roller-compacted concrete
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RWI	Regional Water Institution
RWU	Regional Water Utilities
SAWS	South African Weather Service
SEZ	Special Economic Zone
SIP	Strategic Integrated Project
SMC	Study Management Committee
SPV	Special Purpose Vehicle
TCTA	Trans Caledon Tunnel Authority
ToR	Terms of Reference
UOS	Use of System
URV	Unit Reference Value
WEF	Water Energy Food
WRYM	Water Resources Yield Model
WSA	Water Services Authority
WSP	Water Services Provider
WTE	Water Trade Entity
WUA	Water User Association

LIST OF UNITS

Description	Standard unit
Elevation	m a.s.l.
Height	m
Distance	m, km
Dimension	mm, m
Area	m^2 , ha or km^2
Volume (storage)	m^3
Yield, Mean Annual Runoff	m^3/a
Rotational speed	rpm
Head of Water	m
Pressure	Pa
Diameter	mm or m
Temperature	ºC

Description	Standard unit
Velocity, speed	m/s, km/hr
Discharge	m^3/s
Mass	kg, tonne
Force, weight	N
Gradient (V:H)	%
Slope (H:V) or (V:H)	1:5 (H:V) or 5:1 (V:H)
Volt	V
Power	W
Energy used	kWh
Acceleration	m/s^2
Density	kg/m^3
Frequency	Hz

1. BACKGROUND AND INTRODUCTION

The Mzimvubu River catchment in the Eastern Cape Province of South Africa is situated in one of the poorest and least developed regions of the country. Development of the area to accelerate the social and economic upliftment of the people was therefore identified as one of the priority initiatives of the Eastern Cape Provincial 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 Eastern Cape Provincial Government as offering one of the best opportunities in the Province to achieve such development. In 2007, a special-purpose vehicle (SPV) 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:

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

The Department of Water and Sanitation (DWS) commissioned the Mzimvubu Water Project with the overarching aim of developing water resources schemes (dams) that can be multi-purpose reservoirs in order to provide benefits to the surrounding communities and to provide a stimulus for the regional economy, in terms of irrigation, forestry, domestic water supply and the potential for hydropower generation amongst others.

1.1 Study Locality

The Mzimvubu River Catchment is situated in the Eastern Cape (EC) Province of South Africa which consists of six District Municipalities (DM) and two Metropolitan Municipalities (Buffalo City and Nelson Mandela Bay). These include Cacadu DM in the west across to the Alfred Nzo DM in the east with the two Metropolitan Areas being located around the two major centres of the province, East London and Port Elizabeth, both of which border the Indian Ocean.

The Mzimvubu River Catchment is situated within three of the DM's namely the Joe Gqabi DM in the north west, the OR Tambo DM in the south and the Alfred Nzo DM in the east and north east. A locality map of the whole catchment area and its position in relation to the DM's in the area is provided in Figure 1-1.

1.2 Study Programme

The study commenced in January 2012 and was completed in October 2014 in three stages as follows:

- Inception ;
- Phase 1 – Preliminary Study; and
- Phase 2 – Feasibility Study.

The purpose of the study is not to repeat or restate the research and analyses undertaken on the several key previous studies described below, but to make use of that information previously collected, to update and add to this information, and to undertake more focussed and detailed investigations and feasibility level analyses for the dam site options identified as being the most promising and cost beneficial.

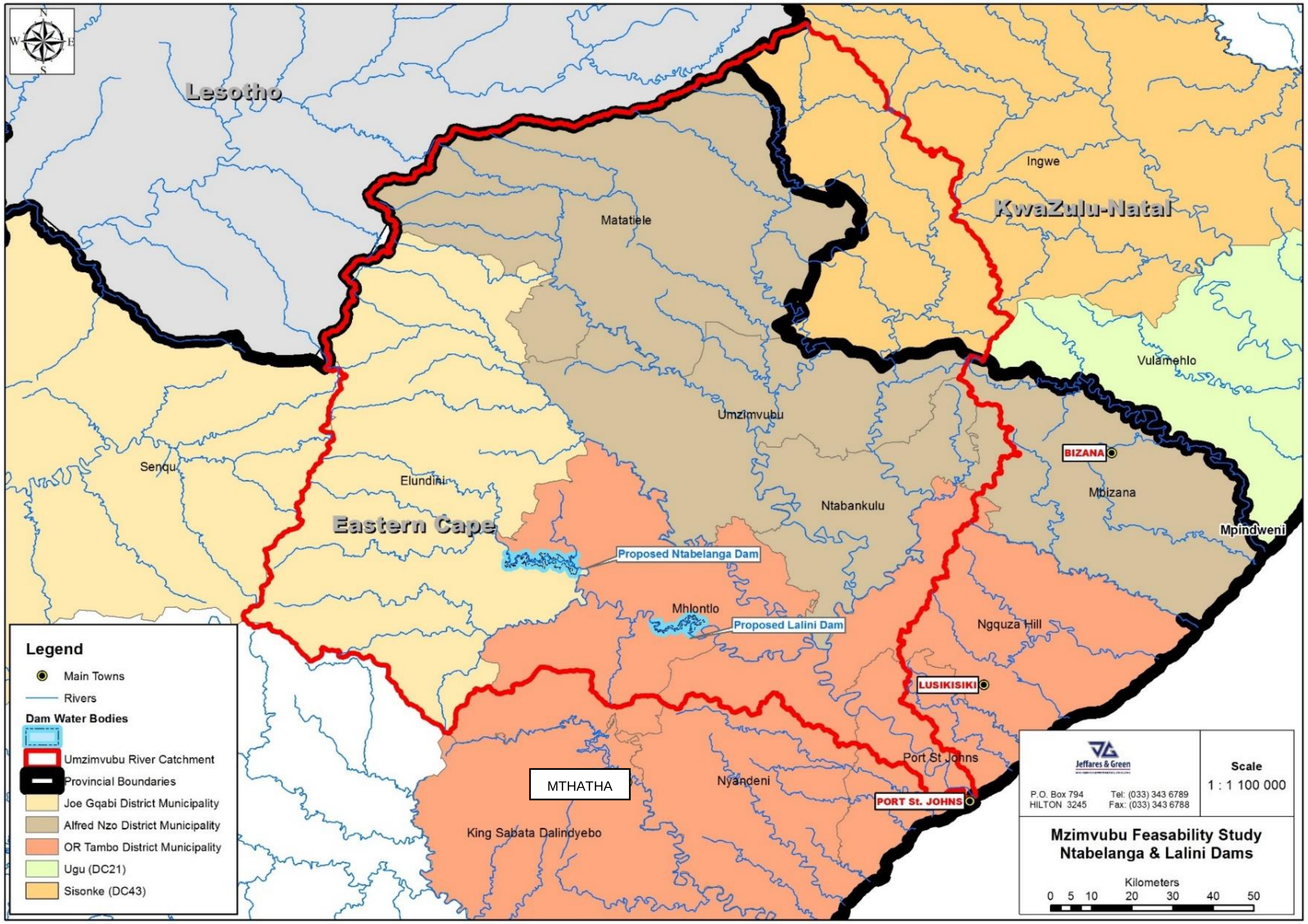


Figure 1-1: Mzimvubu River Catchment Area

1.2.1 Inception Phase

The aim of the Inception Phase was to finalise the Terms of Reference (TOR) as well as to include, *inter alia,* the following:

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

The Inception Phase has been completed and culminated in the production of an Inception Report (DWS Report Number P WMA 12/T30/00/5212/1) which also constitutes the final TOR for the study.

1.2.2 Preliminary Study Phase

This Preliminary Report describes the activities undertaken during the preliminary study phase, summarizes the findings and conclusions, and provides recommendations for the way forward and scope of work to be undertaken during the Feasibility Study phase.

The Preliminary Study Phase was divided into two Stages:

1. Desktop Study
2. Preliminary Study

The aim of the Desktop Study was, through a process of desktop review, analyses of existing reports and data, and screening, to determine the three best development options from the pre-identified 19 development options (from the previous investigation). This process is described in Section 2 of this Report.

The aim of the Preliminary Study was to gather more information with regard to the three selected development options as well as to involve the Eastern Cape Provincial Government and key stakeholders in the process of selecting the single best development option to be taken forward into Phase 2 of the Study.

The main activities undertaken during of the second stage of Phase 1 were as follows:

- Stakeholder involvement;
- Environmental screening;
- Water requirements (including domestic water supply, irrigation and hydropower);
- Hydrological investigations;
- Geotechnical investigations;
- Topographical survey investigations;
- Selection process; and
- Reporting.

1.2.3 Phase 2 – Feasibility Study

The Preliminary Study recommended a preferred dam site and scheme development to be taken forward to Feasibility Study level.

The key activities undertaken during the Feasibility Study are as follows:

- Detailed hydrology (over and above that undertaken during the Preliminary Study);
- Reserve determination;
- Water requirements investigation (including agricultural and domestic water supply investigations);
- Topographical survey (over and above that undertaken during the Preliminary Study);
- Geotechnical investigation (more detailed investigations than during the Preliminary Study);
- Dam design;
- Land matters;
- Public participation;
- Regional economics; and
- Legal, institutional and financial arrangements.

An Environmental Impact Assessment was undertaken by and independent PSP in a separate study that ran in parallel to this one.

1.2.4 Scheme Components

Following the completion of the above feasibility study stages it was agreed that the sizing and modus operandi of the Ntabelanga Dam and its associated works would take into account its multi-purpose role, namely:

i) to supply potable water to some 726 616 people and other water consumers in the region;

ii) to supply raw water for irrigation of some 2 868 ha of high potential agricultural land;

iii) to generate hydropower locally at the dam wall to reduce the cost of energy consumption when pumping water;

iv) to provide sufficient flow of water downstream of the Ntabelanga Dam to meet environmental water requirements for an ecological Class C; and

v) to provide additional balancing storage volume and consistent downstream flow releases to enable a second, smaller dam at Lalini (located on the Tsitsa River some 3.5 km above the Tsitsa Falls) to generate significant hydropower for supply into the national grid.

The suite of study reports describe the development of solutions for these multi-purposes, and the resulting project infrastructure, which comprises the following:

- A new dam on the Tsitsa River at Ntabelanga, with capacity to reliably supply the raw and potable water requirements for i) and ii) above;
- A water treatment works at the Ntabelanga dam to supply the potable water requirements;
- Primary and secondary bulk water distribution systems the deliver potable water to the whole supply area. Tertiary distribution systems to the consumers will be implemented by the District Municipalities;
- A bulk raw water distribution system to supply irrigation water to some 2 868 ha of high potential land; and
- A mini hydropower plant at Ntabelanga Dam to generate up to 5 MW of power.

The Ntabelanga scheme is also expected to work conjunctively with a second hydropower scheme at the Lalini Dam, which is located on the same river and downstream of the Ntabelanga Dam, and which could produce an average of 23 MW of power on a continuous basis. This particular component of the conjunctive scheme has to date been studied only at high level, and it is planned to undertake a full feasibility study of this component shortly.

The relative locations of Ntabelanga Dam and Lalini Dam are shown on the above Figure 1-1 and Figure 1-2.

Figures 1-3 and 1-4 show the layouts of the potable and irrigation water bulk distribution systems.

1.3 Purpose of this Report

This report summarizes the cost estimates prepared for the many components of the above works, as well as the results of economic analysis undertaken to assist in the decision-making when considering different options.

1.4 Approach Taken

The Terms of Reference called for construction cost estimates to be prepared for the various different dam types considered, so that these options can be compared and an informed selected made of the best solution.

The first section of this report details the cost estimates and results of this selection process.

Having selected the preferred dam type option, the costs of the project project-related infrastructure such as access roads, power supplies, site buildings, bulk water distribution infrastructure and irrigation development were also to be estimated so that economic analyses could be undertaken and financing and implementation requirements established.

The second section of this report gives these cost estimates in detailed and summary format.

The fundamental principle as regards economic viability is for the capital, operation and maintenance costs of a proposed scheme to be redeemed by tariffs payable by the end beneficiaries of the scheme – e.g. the District Municipalities and their customers.

Whilst this is often the case with large bulk water supply schemes that benefit from economies of scale, in the case of scattered rural water supplies with a high proportion of indigent consumers there is a normally need to provide grant funding, e.g. Municipal Infrastructure Grants (MIG) and Regional Bulk Infrastructure Grants (RBIG), in order to reduce the burden of such cost recover on the beneficiaries, and to ensure that at least the full operation, maintenance and recurring plant replacement costs can be fully redeemed through tariffs.

The economic analysis models developed and presented herein therefore consider scenarios for both full capital redemption and grant-funded options, so that a comparison can be made between these options.

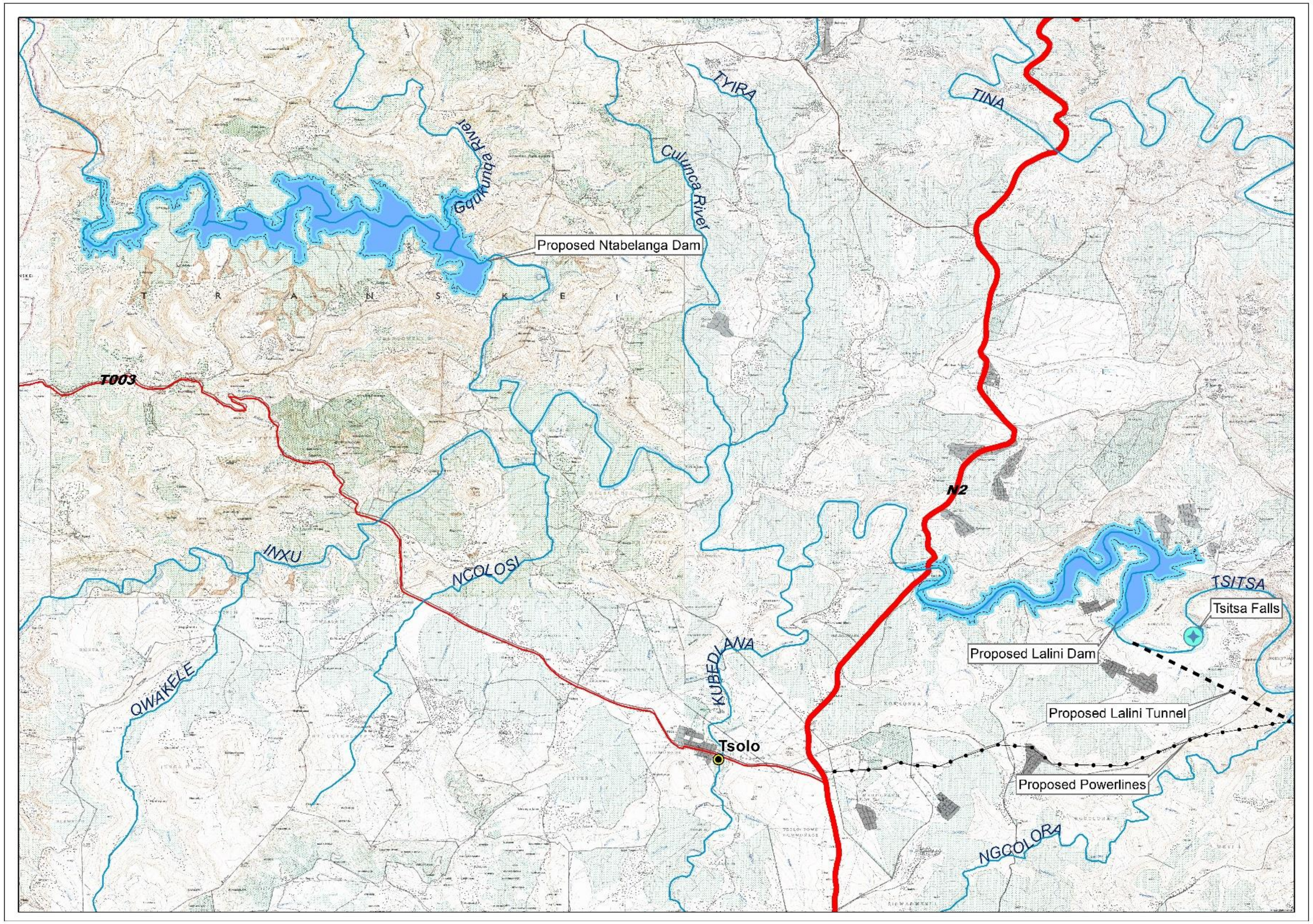


Figure 1-2: Relative Locations of Ntabelanga and Lalini Dams

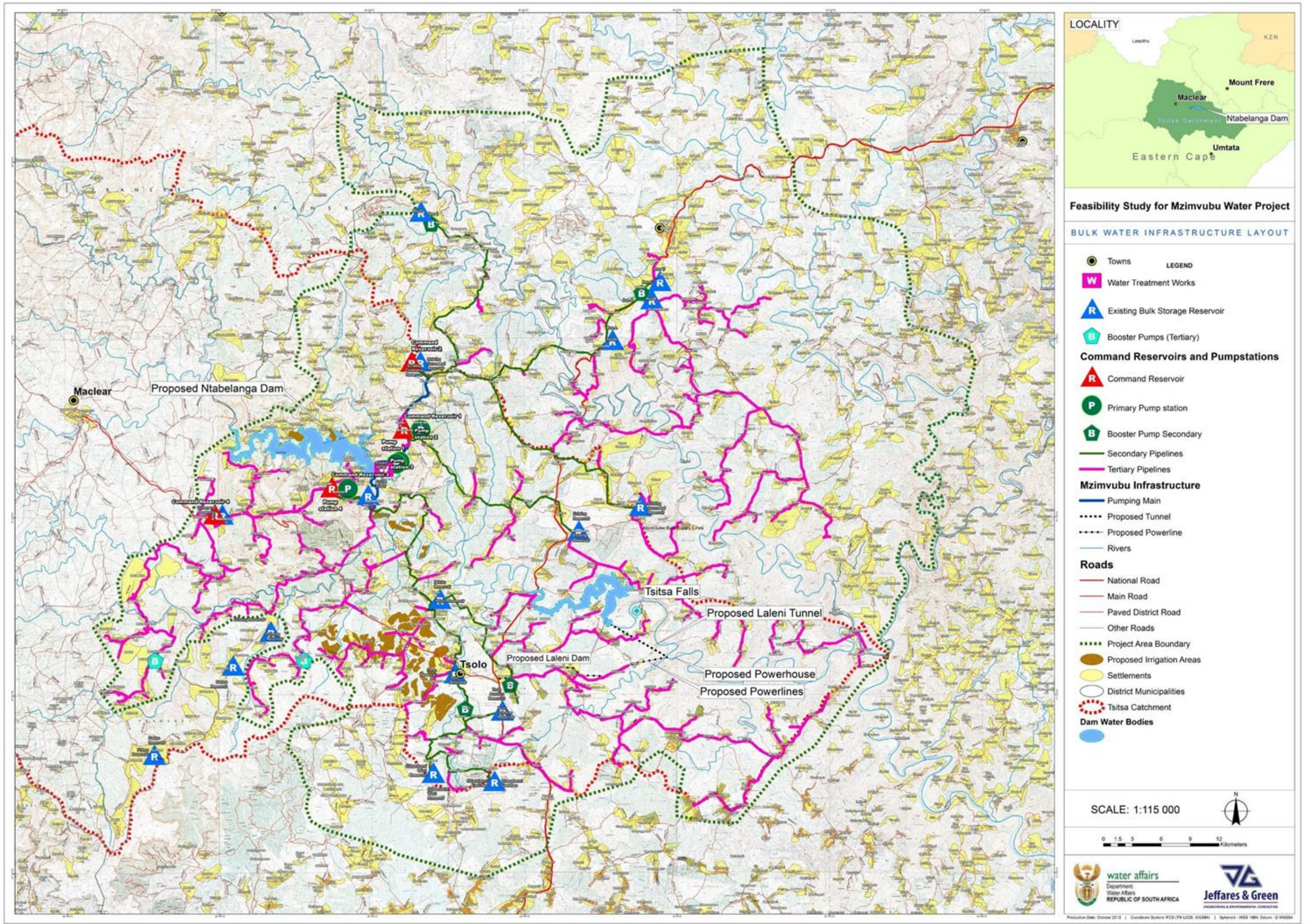


Figure 1-3: Layout of Proposed Primary, Secondary and Tertiary Bulk Water Distribution System

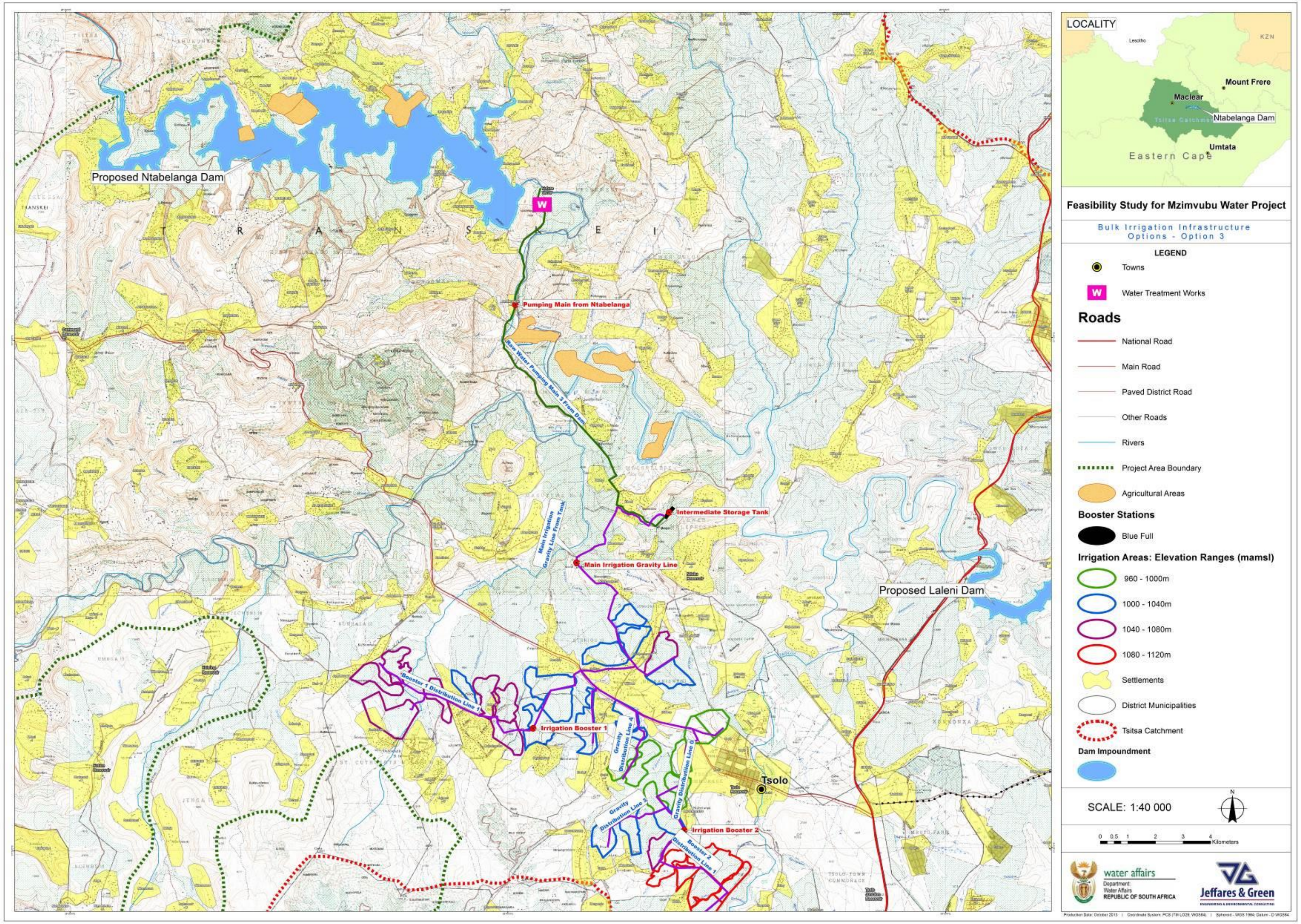


Figure 1-4: Layout Plan of Proposed Irrigation System

1.5 Basis of Cost Estimates

All cost estimates used for comparison of options were at 2014 price levels.

The cost estimates were based upon costing models that have recently been prepared for the following projects undertaken by Jeffares & Green:

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

Additional costing information has also been derived from several other sources including internal cost estimation databases, the Department of Transport's annually published estimating rates, and information received on past and ongoing dam construction projects, including the following dams:

- De Hoop;
- Berg River;
- Braamhoek;
- Bedford;
- Spring Grove; and
- Ludeke.

Cost estimates of specific equipment such as raw and treated water pumps, large control valves, hydropower turbines and control systems, have been sourced through supplier quotations.

Sensitivity analyses were carried out on the major construction items including soft and hard excavation, reinforced concrete, steel, RCC, embankment material, clay core material, and filter material.

For each large volume item, a range of rates was developed based upon the contract rates sourced during research into the above projects. Some outlier values were ignored where special circumstances (eg very long haul for materials sources) did not apply to the particular situation at the Ntabelanga Dam site.

Management, operation and maintenance costs are also estimated by applying the following factors recommended in the DWS's "Technical Guidelines for the Development of Water and Sanitation Infrastructure":

Pump station:	0,50 % per annum (p.a.) of total pipeline costs
	0,25 % p.a. of pump station civil costs
	4.00% p.a. of pump station mechanical and electrical costs
Pipeline:	0,50 % p.a. of total costs
Civil Works:	0.25 % p.a. of total costs

In some cases, and due to the very large nature of some of the scheme components, these percentages produce excessively high annual costs considered to be unrealistic. In such cases, some discretion was applied in developing realistic annual costs which were used in the economic analysis.

2. DAM TYPE OPTIONS COST ESTIMATES

The cost estimates for both Ntabelanga and Lalini dams, and for all dam type and spillway options, were run using low, medium and high unit rate scenarios to test whether the ranking of different dam types changed with each scenario.

These consider not only the dam wall and spillway costs, but also take into account the costs of outlet works, routes of raw water pipelines, stilling basins, access roads, and temporary works requirements.

Haulage distances and costs of construction materials not available close to the dam and within the impoundment area were taken into consideration in the unit rates, as well as the additional cost implications of the removal and disposal of excess excavated materials, and the environmental costs of reinstating of those borrow pits and quarries which would not be inundated following impoundment.

Sensitivity to ranges of the major quantities unit rates was also tested to produce a ranking of total capital cost for the dam type options investigated.

In addition, for the highly sensitive cost of an RCC mix, a costing was developed for both low and high paste solutions from basic principles and taking into account all the individual processes required, as well as the cost of materials sourcing and processing, delivery of cement, fly ash and other special additives.

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.

For the various dam options analysed, most of these associated works were common to all options with only minor variations.

The following dam types were investigated:

- Roller compacted concrete (RCC) dam;
- Concrete faced rockfill dam (CFRD);
- Earth core rockfill dam (ECRD);
- Earthfill embankment dam with earth core (EF); and
- Composite central concrete gravity spillway/embankment flank options (CCS).

Key factors used in determining the optimum dam type were as follows:

- Availability of sufficient quantities and quality of construction materials in the vicinity of the dam wall;
- Constructability issues, especially relating to dealing with river flow during construction;
- The ability of DWS to design and construct the dam in-house;
- Spillway location and capacity requirements;
- Operational requirements and outlet works arrangements;
- Environmental impacts; and
- The cost of the works.

In order to assess materials requirements, quantities were calculated for all of the above dam types, based upon typical design criteria (foundation excavation depths, embankment slopes, etc), which were undertaken for all of the above dam types and their spillway options.

Appendix A – Tables A.1 and A.2 provide the Bills of Quantity thus derived, as well as the ranges used for the rates of major quantity items to test the sensitivity of changes in these rates to the ranking of the options.

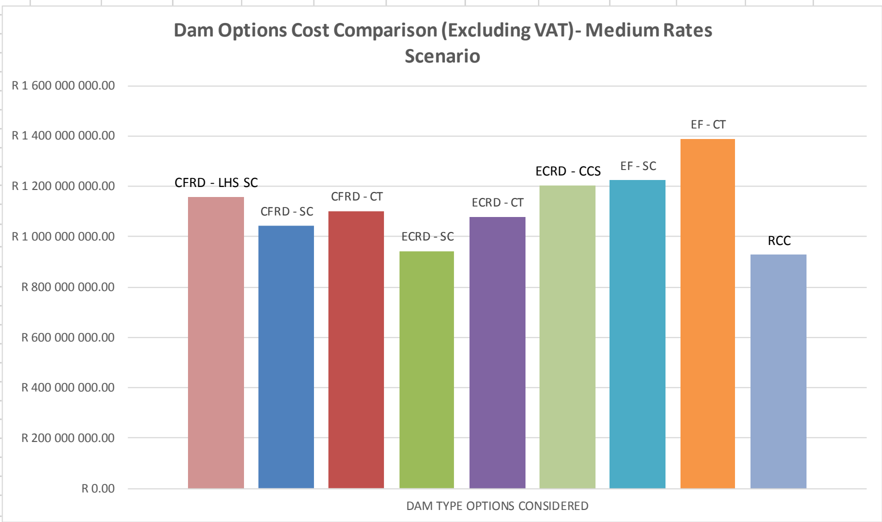
Table 2-1 below summarises the results of this analysis for the Ntabelanga Dam for the low, medium and high rates ranges applied.

Table 2-1: Capital Cost Comparison of Ntabelanga Dam Type & Spillway Options

Option No.	Dam Wall Type	Spillway Type	Capital Cost (R million)		
			Low	Medium	High
1	CFRD	Side Channel (SC)on Right Flank	932	1 043	1 153
2	CFRD	Cut-Through	989	1 103	1 218
3	CFRD	SC Left	1 036	1 158	1 279
4	**ECRD**	**SC Right**	**848**	**944**	**1 040**
5	ECRD	CT	977	1 079	1 181
6	Earth fill	SC Right	1 147	1 224	1 301
7	Earth fill	CT	1 305	1 390	1 474
8	**RCC**	**Central Ogee**	**769**	**929**	**1 089**
9	CCS	Composite Central Channel Spillway	1 009	1 203	1 397

(green)	Lowest
(yellow)	Second Lowest

The green highlighted cells show the lowest cost option. For the low and medium rate ranges of major quantity unit rates this is Option No. 8, an RCC dam, with Option No.4, the ECRD dam with a Side Channel Spillway cut through the Right-hand Flank, coming second lowest. Only for the highest rates does this ranking reverse. Figure 2 shows the comparative costs of all the options for the medium rates case, as well as main materials quantity information and how much excavated material needs to be disposed of to spoil.



Percentage of lowest cost option	125%	112%	119%	102%	116%	130%	132%	150%	100%
Cost Excluding VAT R'millions	**1 158**	**1 043**	**1 103**	**944**	**1 079**	**1 203**	**1 224**	**1 390**	**929**
Total rock excavation used in embankment	450 000	780 400	1 186 179	815 600	927 600	166 700	0	0	382 381
Total rock excavation to spoil	0	0	452 500	0	737 300	0	858 400	1 716 650	39 413
Total all materials to spoil	187 700	79 000	610 500	79 000	895 300	23 000	978 200	1 915 350	0

Figure 2-1: Dam Options Cost Comparison

As can be seen for the “medium rates” scenario, which is considered to be a reasonable assumption given the nature of the dam site and proximity to construction materials, the RCC and ECRD (with right hand side channel spillway) options are ranked very closely, with all other options more than 10% higher in cost.

It is therefore concluded that there is little to choose between these two options as far as costs are concerned, and other factors were therefore considered to inform the decision-making process.

2.1 Other Factors Affecting Decision-Making

The following considerations were made:

- Speed of implementation to first water delivery;
- Ability of DWS Infrastructure division to undertake detailed design in-house;
- Ability of DWS construction unit division to undertake construction in-house;
- Simplified infrastructure layout and access;
- Low maintenance inputs;
- Less risk when dealing with floods during construction; and
- Environmental impacts.

2.1.1 Speed of implementation to first water delivery

One of the advantages of an RCC solution over the embankment dam is faster speed of construction and, provided that the outlet works can be completed in time, delivery of water could commence well before the main structure of the dam is completed.

2.1.2 Ability of DWS Infrastructure division to undertake detailed design in-house

This project falls under a Strategic Infrastructure Projects (SIP) category and is therefore a very high priority project. Should there be a need to undertake a procurement process to appoint a PSP to undertake the detailed design of the works, this fast-track implementation programme would be significantly delayed. The solution being considered is for DWS’s Infrastructure Directorate to undertake the design in-house. The Infrastructure Directorate has good experience of designing RCC structures but has limited experience of rock-fill dams.

2.1.3 Ability of DWS construction unit division to undertake construction in-house

For similar reasons to those given above, DWS are also considering construction of the works using their in-house construction division, rather than further extending the implementation period by having to undertake a prolonged contractor procurement process. Once again, the in-house expertise of RCC construction is available whereas there is limited recent in-house experience of construction of rock-fill embankments.

2.1.4 Simplified infrastructure layout and access

The optimum ECRD dam solution would have a right-bank side channel spillway which discharges back into the stilling basin below the dam wall. Given that the outlet works and water treatment works would also be sited on the right bank of the river below the dam, the outlet works and access road would need to cross over the spillway discharge chute. This would limit the space available for locating the hydropower plant near to the dam wall, and more complicated access would be required across the spillway chute.

The RCC dam would have a central discharge spillway, and the outlet works on the right bank of the river, leaving the right flank area downstream of the dam clear for the efficient location and development of a hydropower plant, water transfer pipelines to the water treatment works, and access roads to these works and to the dam itself.

2.1.5 Low maintenance inputs

Generally, an all-concrete solution such as an RCC dam, may have lower maintenance requirements than an embankment dam, given the need to regularly monitor and maintain embankment slopes, the more complex outlet tower, and its access bridge. A side channel spillway would also be mainly unlined, and regular inspection and maintenance of the rock channel surfaces may be needed.

2.1.6 Less risk when dealing with river diversion during construction

An RCC dam is more resilient to overtopping during construction than an earth core rock-fill dam, should unexpected flood events happen during construction, and temporary works fail to contain such floods. For example, both Ludeke and Dikgathlong dams mentioned above had unforeseen, and previously unrecorded flood events which damaged the works under construction, and delayed the completion of the works, with consequential increased costs.

2.1.7 Environmental impacts

An ECRD will require more rock excavation than the RCC dam option, and would source such rock from the right bank side channel spillway, whereas the rock for concrete for the RCC dam would be sourced from a quarry on the right bank, which quarry would be inundated when the dam fills.

The ECRD option also requires clay and filter sand sources, whereas the RCC dam requires sources of sand, all of which would be obtained from within the river basin above the dam wall. Once again, whilst the temporary environmental impacts of the winning and hauling of these materials would likely be higher for the ECRD option, it can be argued that the RCC option would have different temporary impact due to the need to transport other materials such as cement, fly ash and other additives from sources outside of the local area, via the national road network.

2.2 Conclusion on Ntabelanga Dam Type Selection

Taking the above decision-making factors into consideration, it is concluded that the preferred dam type is the RCC solution.

This would provide for a simplified operational layout, and better aesthetics and less environmental impact than an ECRD dam with a side channel spillway, and would offer the better opportunity for implementation in a shorter time period.

The fact that the DWS infrastructure and construction divisions are considering the implementation of the project in-house to reduce the implementation time, and that they have more experience with RCC technology than rock-fill, would further justify the preference of RCC as the dam type to be implemented.

Therefore the dam and ancillary works that will be further described in the following sections are based on the **RCC solution.**

A general arrangement and elevations of the Ntabelanga RCC dam solution is given on Figures 2-3, 2-4 and 2-5 overleaf.

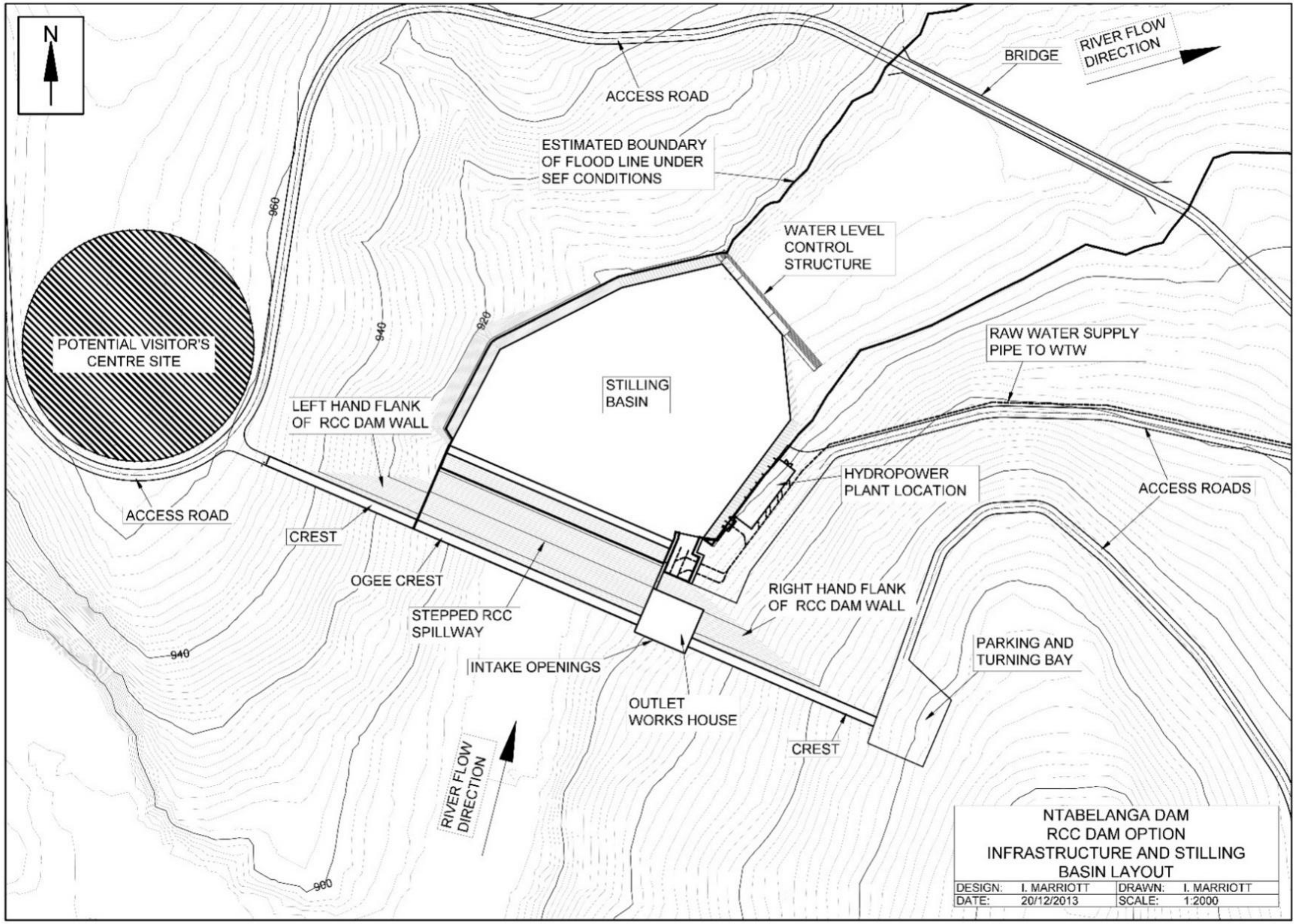
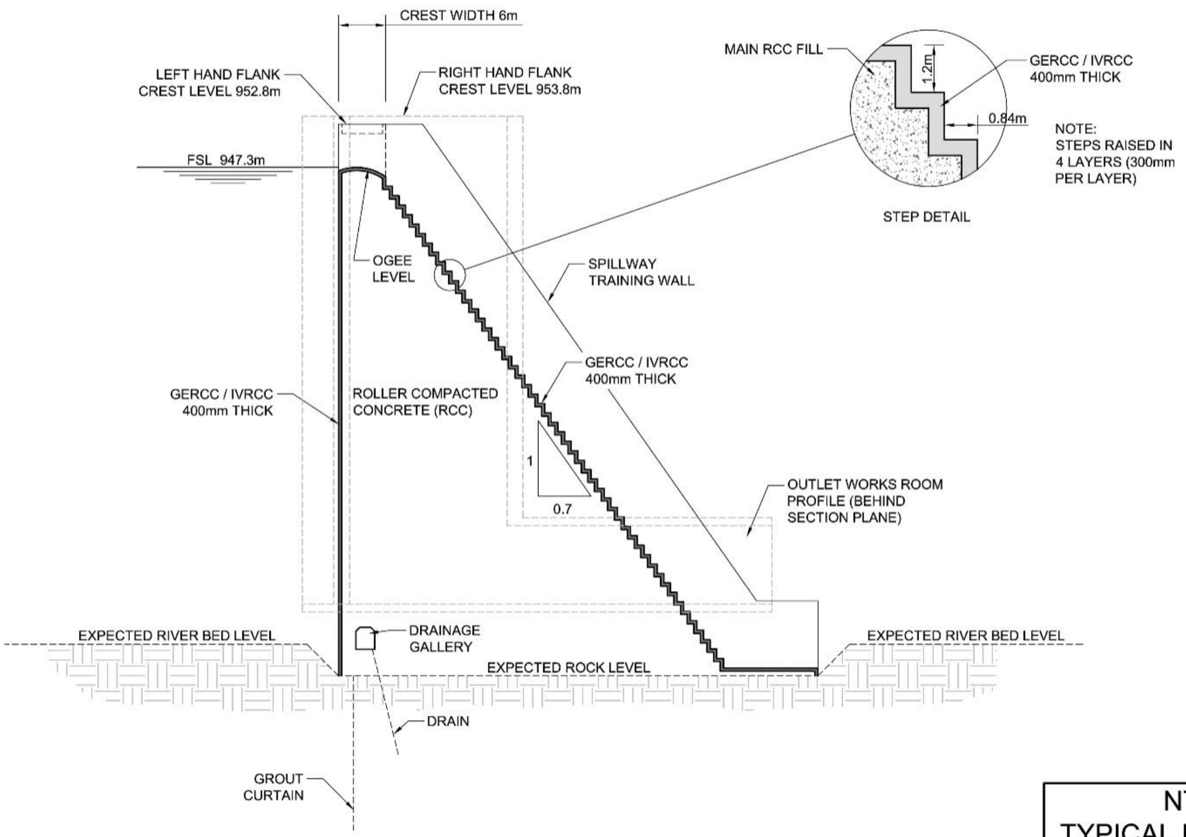


Figure 2-2: RCC Dam and Stilling Basin Layout



NTABELANGA DAM TYPICAL ELEMENTS OF A ROLLER COMPACTED CONCRETE DAM SECTION			
DESIGN:	A. PEPPERELL	DRAWN:	I. MARRIOTT
DATE:	23/09/2013	SCALE:	NTS

Figure 2-3: RCC Dam Wall and Spillway Typical Cross Section

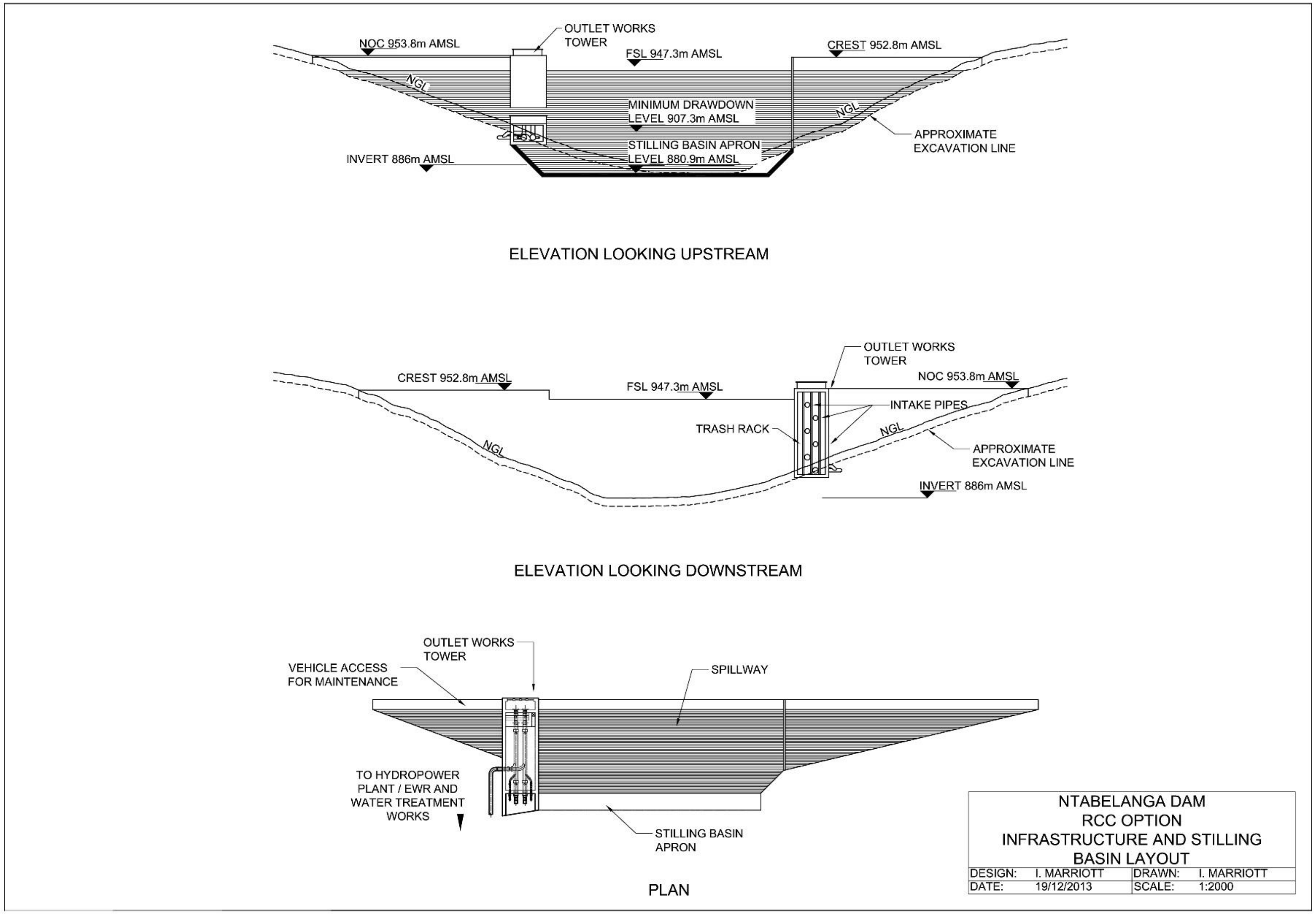


Figure 2-4: RCC Dam Embankment Plan and Longitudinal Elevations

3. NTABELANGA DAM COST ESTIMATE

3.1 Dam Cost Estimate

As described in the preceding sections, an RCC gravity dam is recommended, with an ogee spillway with stepped downstream face, with a slope of 1 to 0.70, or step dimensions of 1200 mm high by 840 mm wide.

During the undertaking of the feasibility design of this dam, the design process and relevant associated reports were reviewed by specialists on the Review Panel.

The main review expert also visited the site with the study team, and fine tuning of dam centreline alignments and other details were agreed. This involved adjusting the axis of the dam wall to be squarer to the contours on both flanks, and this effectively moved the centre point of the dam very slightly upstream. This also has the advantage of reducing the maximum dam wall height by 1.7 m and the crest length by some 33 m.

The proposed maximum height Ntabelanga Dam has the following parameters:

Full Supply Level (FSL):	947.3 m.a.s.l.
Non-Overspill Crest Level (NOCL):	952.8 m.a.s.l.
Minimum bed level in river at dam:	886.7 m.a.s.l.
Crest width:	6 m
Minimum operating level (MOL):	918.0 m.a.s.l.
Emergency drawdown min. outlet level:	907.0 m.a.s.l.
Maximum dam wall height to NOC:	66.1 m
Wall crest length (incl spillway):	407 m
Spillway crest length:	150 m
Gross stored volume at FSL:	490 million m^3
Mean Annual Runoff (present day) at dam:	415 million m^3
Surface area of lake behind dam:	31.5 km^2
Backwater reach upstream of dam:	15.5 km

As described in Feasibility Design: Ntabelanga Dam Report No. P WMA 12/T30/00/5212/12, the cost estimates were reviewed and reworked having undertaken more detailing of the dam wall, the spillway, the stilling pond, the outlet works, and transfer conduits to the hydropower plant, raw water pumping station (irrigation), and water treatment works.

Appendix B provides a breakdown of the cost estimate for the dam. This is summarised in Table 3-1 below.

Table 3-1: Summary Ntabelanga Dam Cost Estimate

Item	Capital Cost Estimate (2014 Price Levels) R'million
Dam Structure incl P&Gs	753.95
Contingencies (10.0 %)	75.40
Sub-Total	***829.35***
Engineering/EMP (12 %)	99.52
Sub-Total	***928.87***
VAT (14%)	130.04
Grand Total (Incl VAT)	**1 058.91**

Note: Current (2014) price levels - Excludes escalation to date of construction

3.2 Associated and Appurtenant Works

Other associated and appurtenant works common to both dam size options were also costed, which included:

- Main access roads;
- Other local feeder roads requiring upgrade and/or realignment;
- Temporary haulage roads during construction;
- Temporary water treatment works;
- Operator housing;
- Wastewater treatment works for the above;
- Other earthworks, site roads and services;
- Power supplies; and
- Gauging stations.

Provisional Sums were also allowed for:

- Expropriation Costs;
- Environmental Mitigation;
- Resettlement; and
- Servitudes.

The actual cost provisions for these latter items should be confirmed during the EIA study.

The cost estimates are included in Appendix B, which also provides an explanation of the basis of calculation of key items.

Figure 3-1 shows the general layouts of the associated works and water treatment works located close to the Ntabelanga Dam.

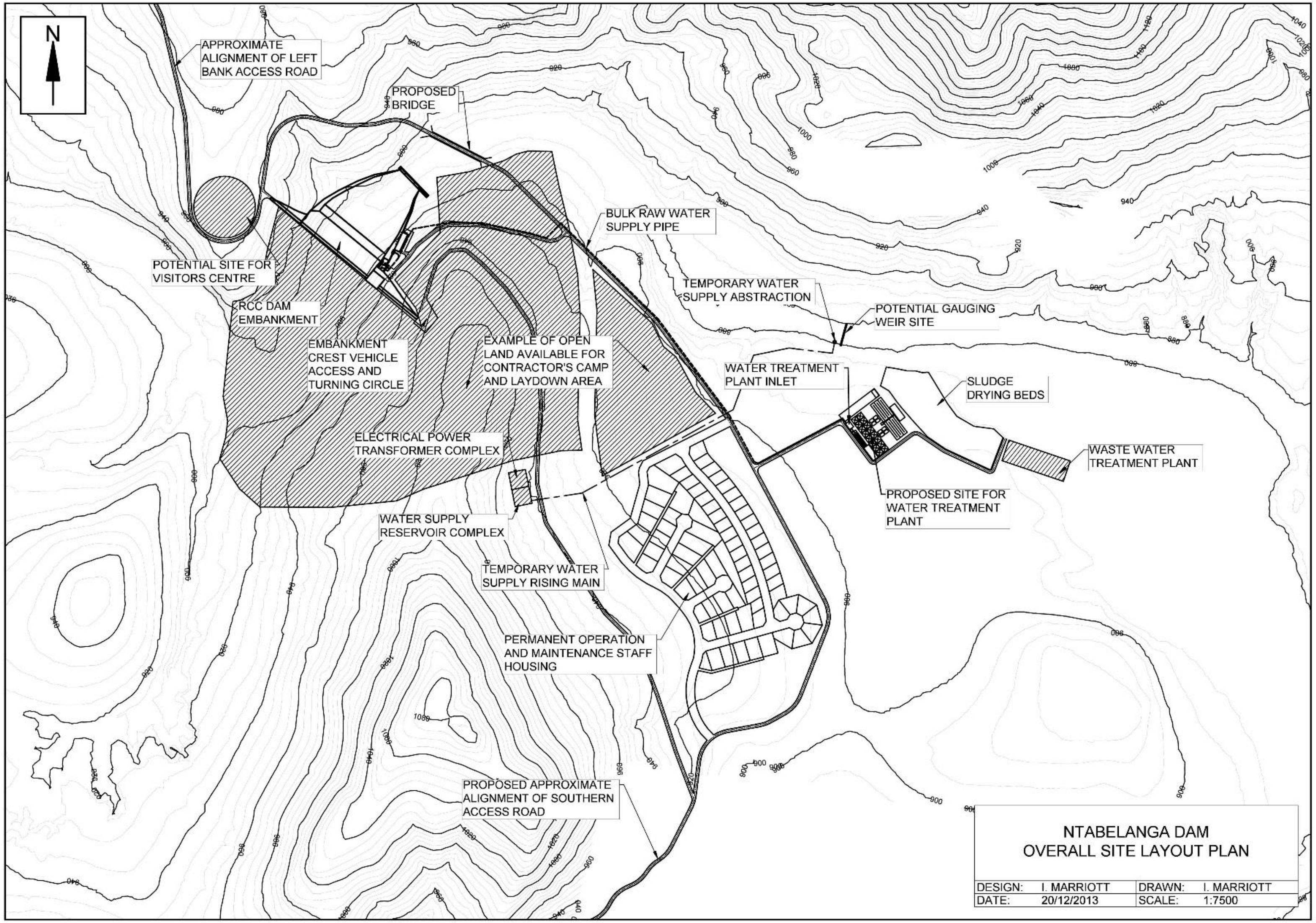


Figure 3-1: Ntabelanga Dam and Associated Works Layouts

Table 3-2: Cost Estimates for Associated and Appurtenant Works

NTABELANGA DAM ASSOCIATED INFRASTRUCTURE WORKS					
Roads & Bridges	Upgrading surfaced main access roads	km	R 4 000 000	14	R56 000 000
	Upgrading gravel main access roads	km	R 2 000 000	20	R40 000 000
	Upgrade and realignment of villages access roads	km	R 750 000	33	R24 750 000
	Temporary haul roads	km	R 500 000	10	R 5 000 000
	Downstream bridge across river	Sum	R25 000 000	1	R25 000 000
				Sub-Total	*R150 750 000*
			Contingencies	*10%*	*R 15 075 000*
				Sub-Total	*R165 825 000*
			Engineering/EMP	*12%*	*R 19 899 000*
				Sub-Total	*R185 724 000*
			VAT	*14%*	*R 26 001 360*
		Roads & Bridges		***Total***	***R 211 725 360***
Operations Infrastructure	Operator Housing Complex	Sum	R26 000 000	1	R26 000 000
(excludes WTW)	Visitors Centre	Sum	R15 000 000	1	R15 000 000
	Temporary water supply, abstraction, treatment and supply	Sum	R1 500 000	1	R 1 500 000
	Wastewater treatment plant	Sum	R15 000 000	1	R15 000 000
	Gauging Weirs	Sum	R3 000 000	5	R15 000 000
				Sub-Total	*R 72 500 000*
			Contingencies	*10%*	*R 7 250 000*
				Sub-Total	*R 79 750 000*
			Engineering/EMP	*12%*	*R 9 570 000*
				Sub-Total	*R 89 320 000*
			VAT	*14%*	*R 12 504 800*
		Operations Infrastructure		***Total***	***R 101 824 800***
Power lines etc (22 kVA)		km	R1 000 000	26	R 26 000 000
				Sub-Total	*R 26 000 000*
			Contingencies	*10%*	*R 2 600 000*
				Sub-Total	*R28 600 000*
			Engineering/EMP	*12%*	*R 3 432 000*
				Sub-Total	*R32 032 000*
			VAT	*14%*	*R 4 484 480*
		Power lines etc (22 kVA)		***Total***	***R 36 516 480***
Other Mitigations	Expropriation Costs	Sum	R5 000 000	1	R 5 000 000
	Environmental Mitigation	Sum	R5 000 000	1	R 5 000 000
	Resettlement	Sum	R5 000 000	1	R 5 000 000
	Servitudes	Sum	R1 000 000	1	R 1 000 000
				Sub-Total	*R16 000 000*
			Contingencies	*10%*	*R 1 600 000*
				Sub-Total	*R17 600 000*
			Engineering/EMP	*12%*	*R 2 112 000*
				Sub-Total	*R19 712 000*
			VAT	*14%*	*R 2 759 680*
		Other Mitigations		***Total***	***R22 471 680***

Note: Current (2014) price levels - Excludes escalation to date of construction

4. NTABELANGA WATER TREATMENT WORKS

A cost estimate for the Ntabelanga Water Treatment Works (WTW) was prepared using a costing model developed under the Metolong Dam project in Lesotho for a similar type and capacity works. Figure 4-1 shows a general WTW arrangement.

The treatment process for the Ntabelanga WTW is expected to be similar to the Metolong Dam WTW given the similarities in raw water source being treated.

The full breakdown of the cost estimate for the full capacity works (year 2050 water demand) is given in Appendix C.

Table 4-1 summarises this cost estimate.

Table 4-1: Ntabelanga WTW Cost Estimate – Full Capacity - 85 000 m^3/day

	Civil	Mechanical	Electrical	Non-Works	Total
Component Cost Estimates	***239 009 024***	***103 463 246***	***76 921 681***	***48 171 874***	***467 565 825***
P&Gs 25%	*59 752 256*	*25 865 811*	*19 230 420*	*12 042 969*	*116 891 456*
Sub-total	***298 761 280***	***129 329 057***	***96 152 101***	***60 214 843***	***584 457 281***
Contingencies 10%	*29 876 128*	*12 932 906*	*9 615 210*	*6 021 484*	*58 445 728*
Sub-total	***328 637 408***	***142 261 963***	***105 767 311***	***66 236 327***	*642 903 009*
Detail Design fees 12%	*39 436 489*	*17 071 436*	*12 692 077*	*7 948 359*	*77 148 361*
Sub-Total (Excl VAT)	***368 073 896***	***159 333 398***	***118 459 389***	***74 184 686***	*720 051 370*
VAT 14%	*51 530 346*	*22 306 676*	*16 584 314*	*10 385 856*	*100 807 192*
TOTAL COST RAND (incl vat)	**419 604 242**	**181 640 074**	**135 043 703**	**84 570 542**	**820 858 562**

Note: Current (2014) price levels - Excludes escalation to date of construction

It should be noted that this cost estimate includes for 4 MW of standby power supply so that the works and dam can continue to run at a nominal output during a power outage, ensuring that at least a basic level of water supply can be maintained at all times.

Also included is an allowance for 6 months of assisted operation, during which the WTW contractor will be required to undertake the operation and maintenance of the plant, and train the future operator’s staff before handing over the plant fully to the operator.

A second cost estimate is also included in Appendix C, which is for the same WTW, but with only those units installed that will produce 50% of the ultimate design capacity.

This has been prepared to show the impact of implementing the works in stages to match projected demand. The resulting cost estimate is summarized below in Table 4-2.

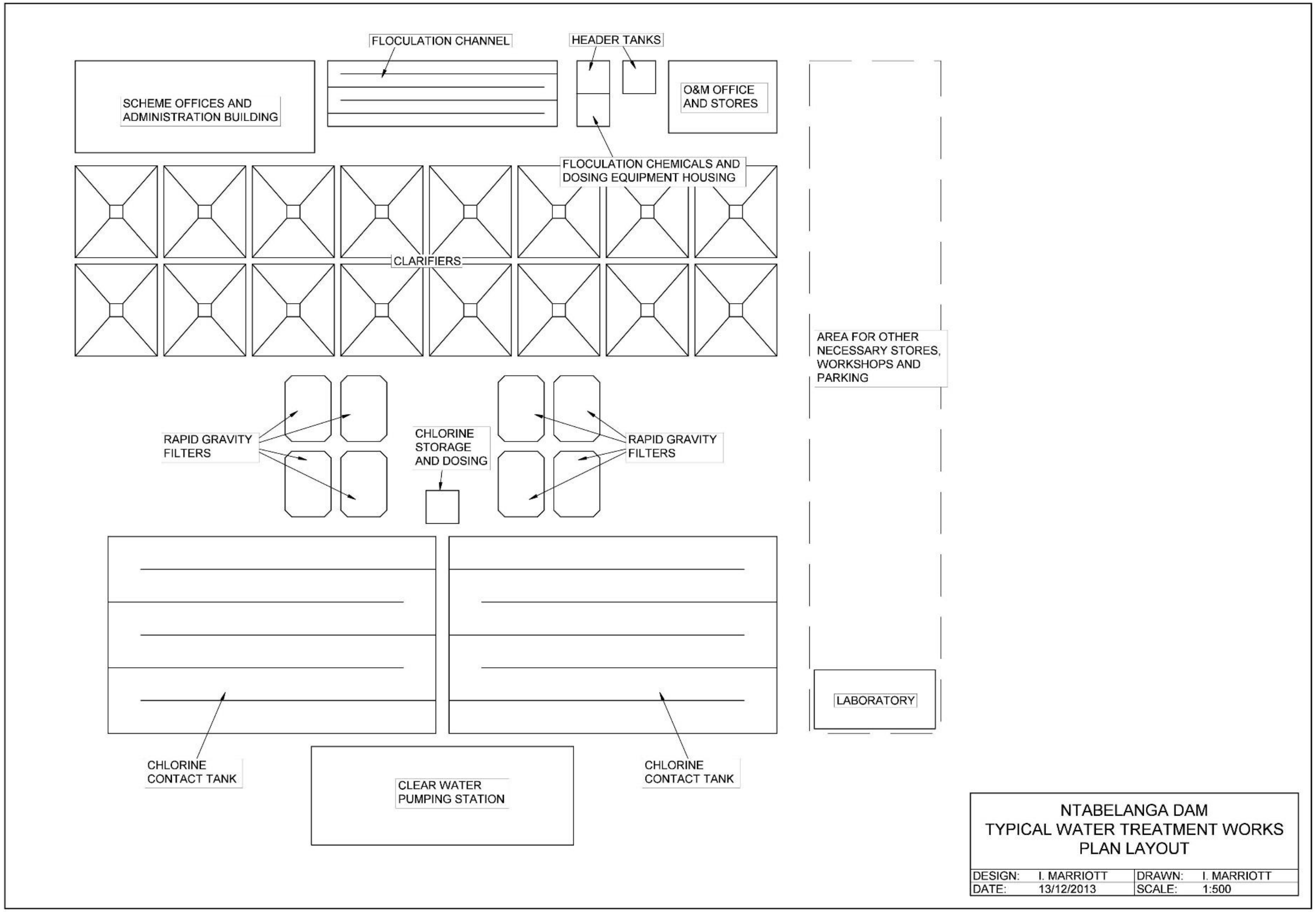


Figure 4-1: Typical Arrangement of the Water Treatment Works

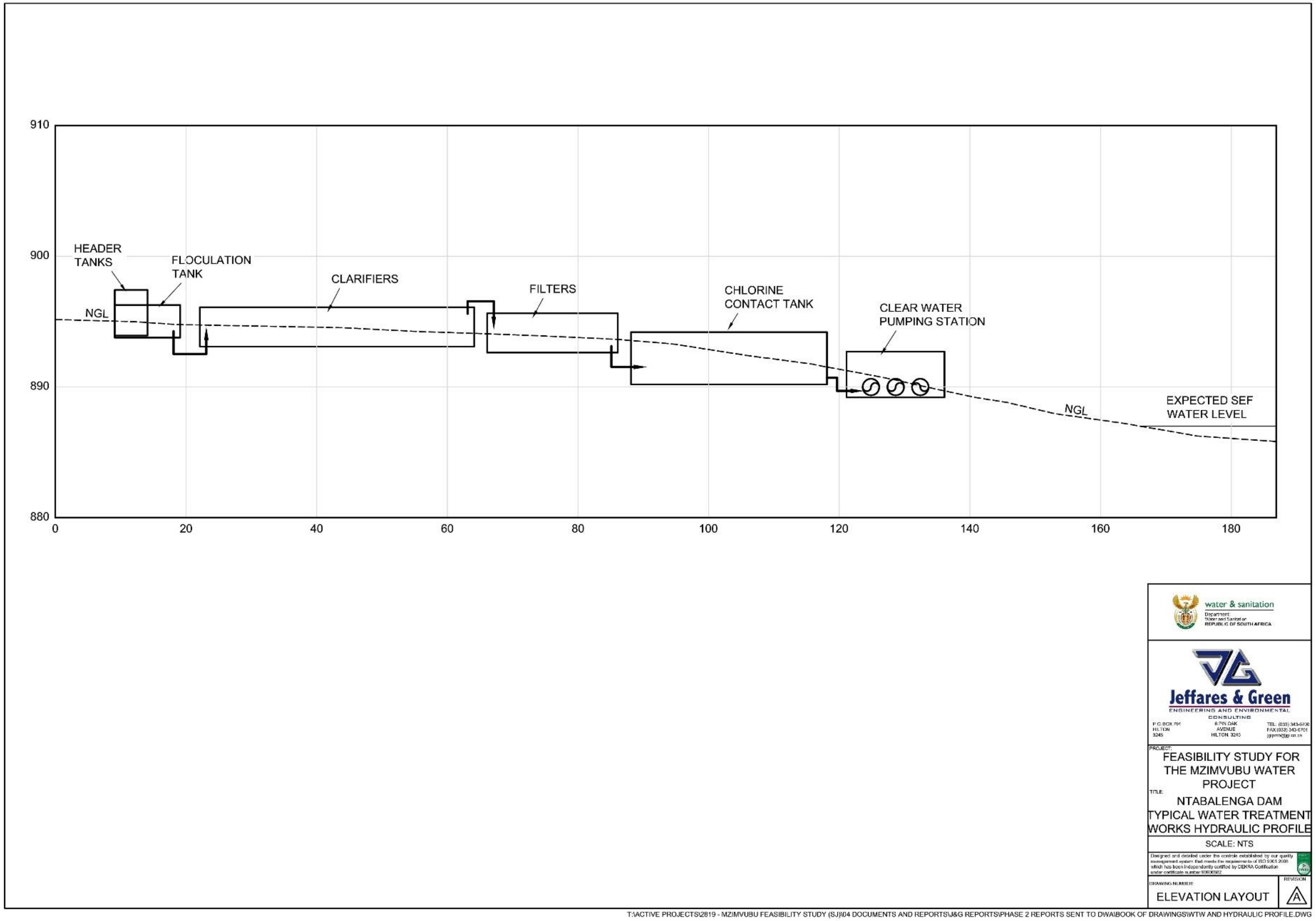


Figure 4-2: Hydraulic Profile through WTW

Table 4-2: Ntabelanga WTW Cost Estimate –Staged @ Half Capacity - 42 500 m³/day

	Civil	Mechanical	Electrical	Non-Works	Total
Component Cost Estimates	***192 593 642***	***69 607 320***	***58 355 528***	***29 558 138***	***350 114 629***
P&Gs 25%	*48 148 411*	*17 401 830*	*14 588 882*	*7 389 534*	*87 528 657*
Sub-total	***240 742 053***	***87 009 151***	***72 944 410***	***36 947 672***	***437 643 286***
Contingencies 10%	*24 074 205*	*8 700 915*	*7 294 441*	*3 694 767*	*43 764 329*
Sub-total	***264 816 258***	***95 710 066***	***80 238 851***	***40 642 440***	***481 407 615***
Detail Design fees 12%	*31 777 951*	*11 485 208*	*9 628 662*	*4 877 093*	*57 768 914*
Sub-Total (Excl VAT)	***296 594 209***	***107 195 273***	***89 867 514***	***45 519 532***	***539 176 529***
VAT 14%	*41 523 189*	*15 007 338*	*12 581 452*	*6 372 735*	*75 484 714*
TOTAL COST RAND (incl vat)	**338 117 398**	**122 202 612**	**102 448 966**	**51 892 267**	**614 661 243**

As can be seen, it would be possible to defer the expenditure of some R206 million if the decision is made at the detailed design stage to implement the system in several stages.

However, this will depend upon the eventual programming of the bulk water delivery infrastructure implementation and the actual uptake of water demand on that new system.

If the more detailed design of the bulk distribution system determines that the initial demand on the scheme will be greater than the 43 000 m³/d half-sized WTW, then it would be prudent to develop the full capacity WTW in one stage.

5. BULK WATER DISTRIBUTION INFRASTRUCTURE

Report No. P WMA 12/T30/00/5212/13 describes the approach taken in developing the potable and irrigation water distribution systems. The cost estimates herein are based upon the quantities developed from the feasibility design models.

5.1 Potable Bulk Water Distribution Infrastructure

This system commences at the clear water pumping station within the water treatment works compound where treated water is pumped northwards and southwards to command reservoirs at strategic locations and elevations such that they can command and supply two major supply zones.

From these two command reservoirs, a proportion of the total water supplied from the dam is further pumped to two more command reservoirs as higher elevation, which supply the remaining areas in two other supply zones.

This Primary Bulk Water Distribution System layout is illustrated diagrammatically in Figure 5-1. The layouts of the whole Primary and Secondary bulk potable water distribution system to be implemented by DWS, and its interface with the Tertiary pipelines to be implemented by the District Municipalities are shown on Figures 5-2 and 5-3.

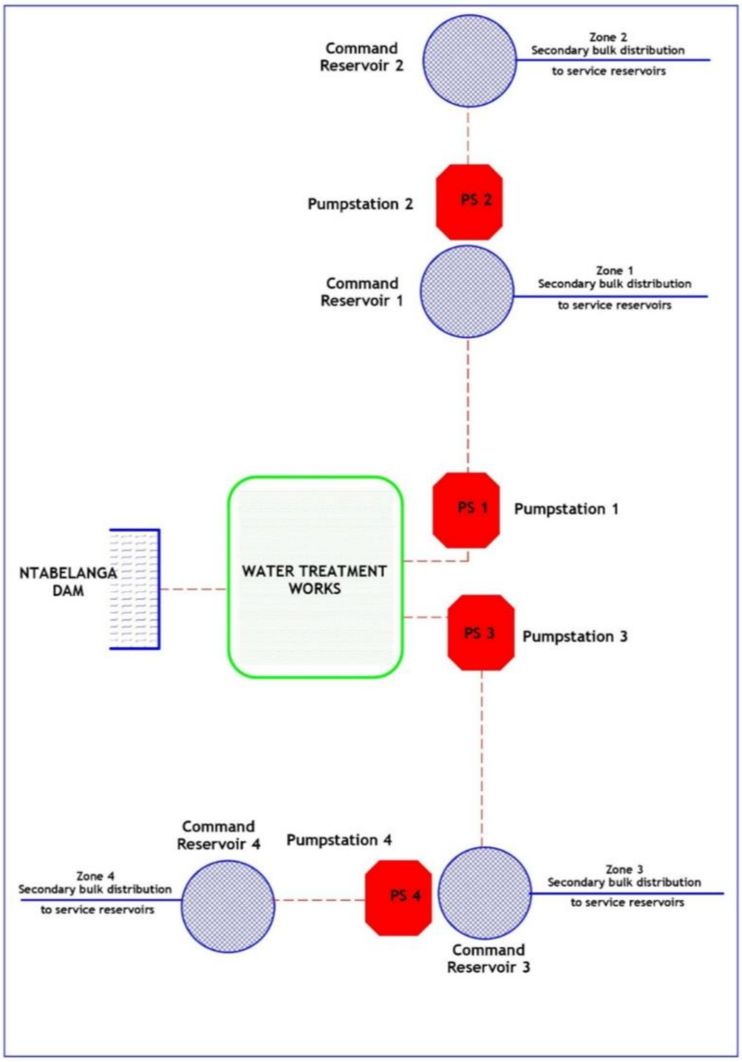


Figure 5-1: Diagram of Primary Bulk Water Distribution System

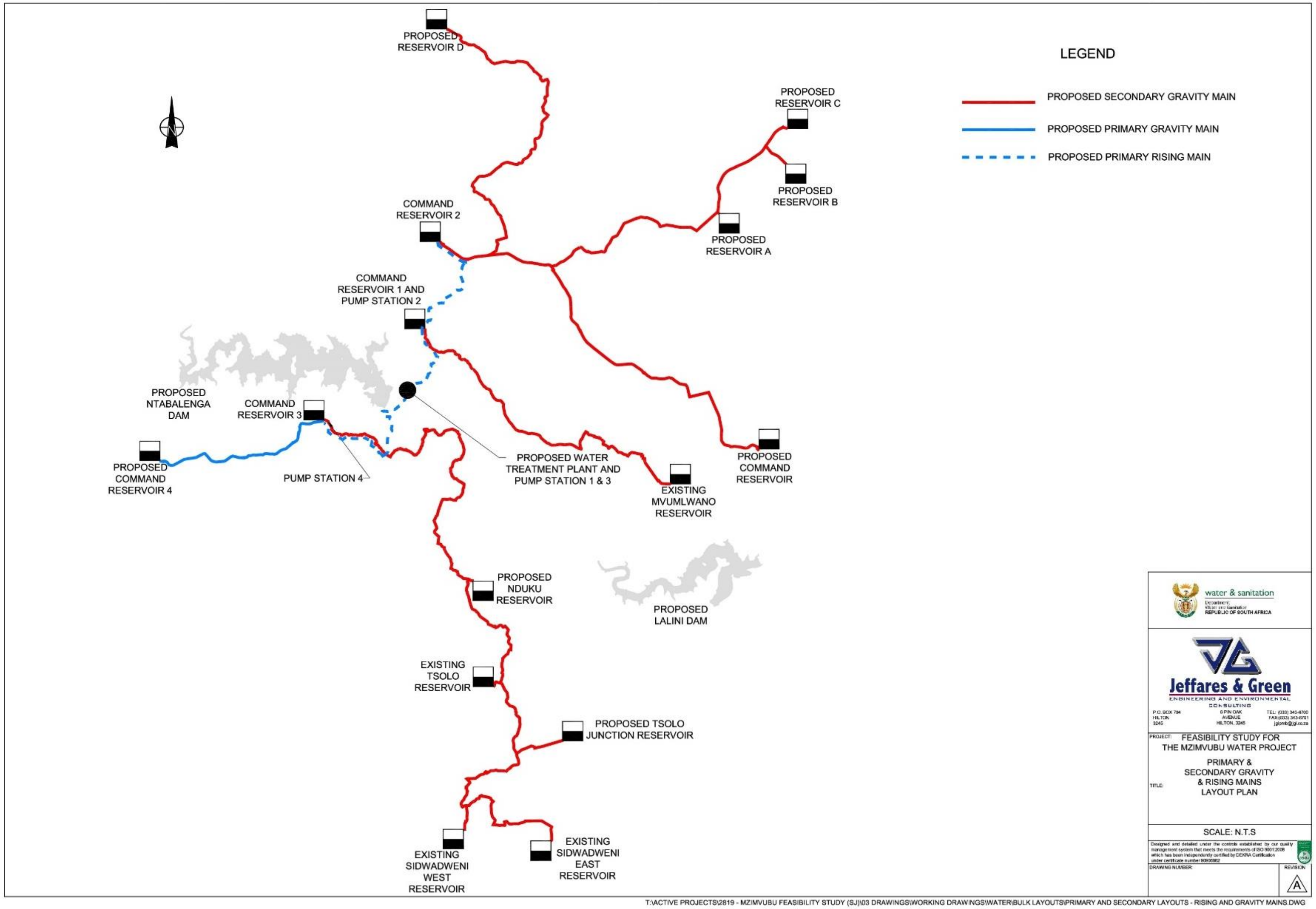


Figure 5-2: Illustration of Primary and Secondary Gravity and Rising Mains Layout

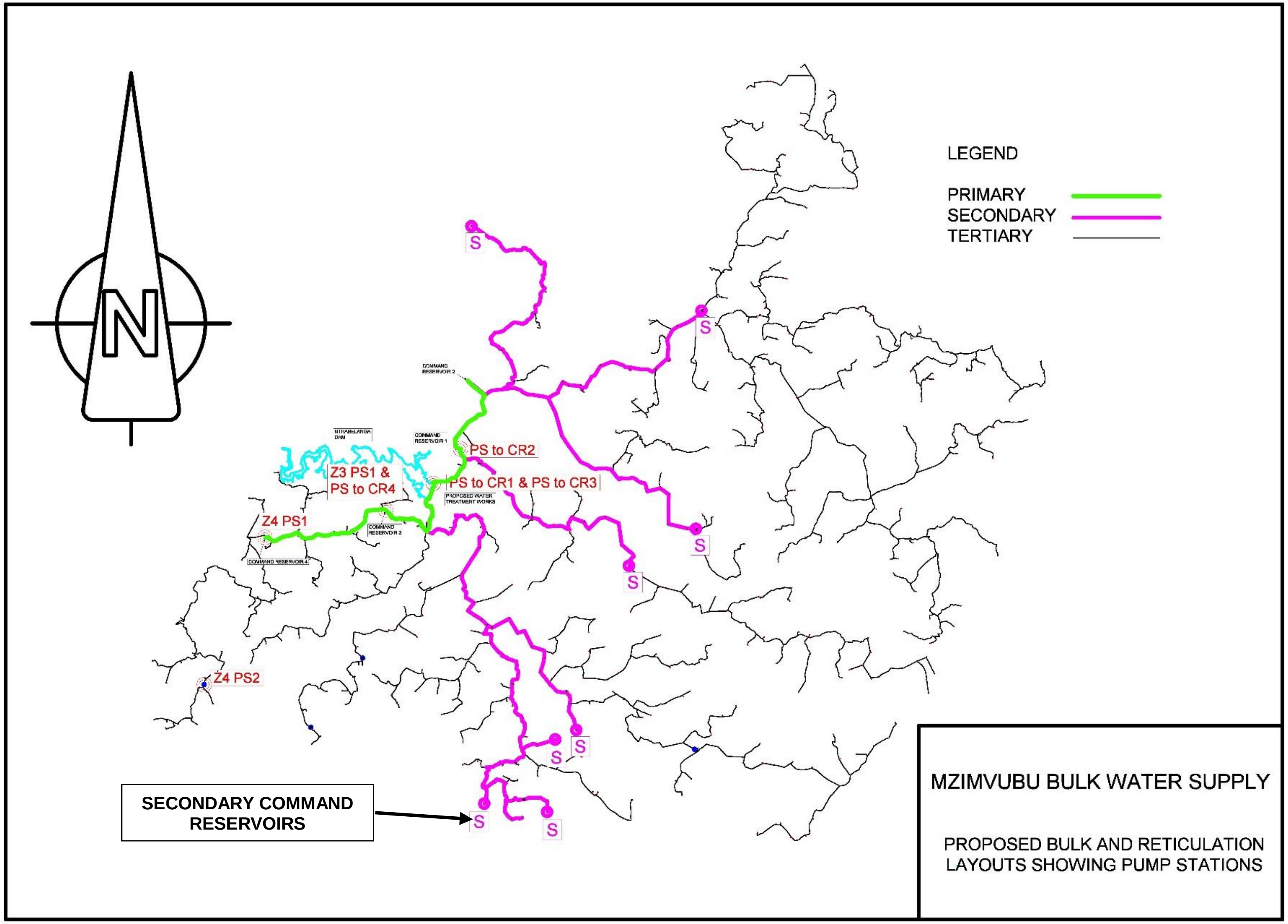


Figure 5-3: Illustration of Primary, Secondary and Tertiary Parts of the Overall Distribution System

These four command reservoirs supply a *Secondary bulk* distribution system predominantly by gravity, but with a small amount of local booster pumping required terminating in a series of secondary command reservoirs (both existing and new). These secondary pipelines and reservoirs are the limits of the main Mzimvubu Project itself, with the remaining extensive network of *Tertiary* pipelines to be implemented by the three relevant DMs within which the settlements to be supplied are located.

Each of the four primary command reservoirs service a supply zone, with secondary infrastructure also serving parts of these four zones. The cost estimates have been broken down into the Primary, Secondary and Tertiary elements of each of the four supply zones.

Unit costs of pipelines of various diameters, pressure classes and materials have been built-up using costing data taken from recently constructed pipelines, and taking cognisance of expected local conditions as regards excavation, bedding materials, etc.

Reservoir costs have also been estimated using all-in costing curves developed for various projects, which have proven to be reasonably accurate models on recent similar projects.

The build-up of these cost estimates are given in Appendix D.

Planning and implementation of these systems is still being undertaken by the three DMs through their Implementing Agent – Amatola Water – and the final sizing and phasing in of these systems will be reviewed during the detailed design and implementation phases of the project.

For the purposes of economic and financial impact analysis, it has been assumed that the design, construction and commissioning of all of the above bulk potable water supply infrastructure will be implemented over the next 6 years, with all systems in service by the beginning of the year 2020.

The economic optimisation of the pumping station plant and rising main diameters were undertaken using industry-standard unit reference value (URV) analysis which takes into account capital, operation and maintenance, and energy costs over a given operational lifespan, for a varying range of pipeline diameters.

The results are shown in the Bulk Water Distribution Infrastructure Report No P WMA 12/T30/00/5212/13.

The optimum pipeline diameters thus determined are also given in Appendix D.

A summary of the total capital cost estimate for this infrastructure is given in Table 5-1.

This is also presented by Primary, Primary and Secondary, and Tertiary pipelines in Table 5-2, and apportioned by the population served in each District Municipality in Table 5-3.

Table 5-1: Capital Costs: Primary and Secondary Bulk Water System

ITEM	COMPONENT	PRIMARY SYSTEM COST (R)				SECONDARY SYSTEM COST (R)				TOTAL (R)
		ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 1	ZONE 2	ZONE 3	ZONE 4	
1	Pipelines	60 117 760	99 224 769	80 782 214	44 233 915	97 519 488	200 148 761	227 791 205	0	809 818 112
2	Pumpstations	20 000 000	20 000 000	20 644 000	16 500 000	0	0	8 814 000	0	85 958 000
3	Reservoirs	6 500 000	71 500 000	30 000 000	11 000 000	0	23 500 000	0	0	142 500 000
4	Electrical supply	10 000 000	10 000 000	7 500 000	5 000 000	0	0	2 500 000	0	35 000 000
	Sub-Total	***96 617 760***	***200 724 769***	***138 926 214***	***76 733 915***	***97 519 488***	***223 648 761***	***239 105 205***	***0***	***1 073 276 112***
5	Contingencies (15%)	14 492 664	30 108 715	20 838 932	11 510 087	14 627 923	33 547 314	35 865 781	0	160 991 417
	Sub-Total	***111 110 424***	***230 833 484***	***159 765 147***	***88 244 002***	***112 147 411***	***257 196 075***	***274 970 986***	***0***	***1 234 267 528***
6	Engineering/EMP Costs (12%)	13 333 251	27 700 018	19 171 818	10 589 280	13 457 689	30 863 529	32 996 518	0	148 112 103
	Sub-Total	***124 443 675***	***258 533 502***	***178 936 964***	***98 833 282***	***125 605 100***	***288 059 604***	***307 967 504***	***0***	***1 382 379 632***
	VAT 14%	*17 422 114*	*36 194 690*	*25 051 175*	*13 836 660*	*17 584 714*	*40 328 345*	*43 115 451*	*0*	*193 533 148*
	Total (Rand)	**141 865 789**	**294 728 193**	**203 988 139**	**112 669 942**	**143 189 814**	**328 387 949**	**351 082 954**	**0**	**1 575 912 780**

Note: Current (2014) price levels - Excludes escalation to date of construction

Table 5-2: Capital Costs: Tertiary Bulk Water System Only

ITEM	COMPONENT	TERTIARY SYSTEM COST (R)				TOTAL (R)
		ZONE 1	ZONE 2	ZONE 3	ZONE 4	
1	Pipelines	164 061 029	439 024 905	413 039 272	108 386 050	1 124 511 256
2	Pumpstations	0	0	4 238 000	2 184 000	6 422 000
3	Reservoirs	13 455 000	46 135 000	30 955 000	12 975 000	103 520 000
4	Electrical supply	0	0	3 750 000	1 250 000	5 000 000
	Sub-Total	***177 516 029***	***485 159 905***	***451 982 272***	***124 795 050***	***1 239 453 256***
5	Contingencies (15%)	26 627 404	72 773 986	67 797 341	18 719 257	185 917 988
	Sub-Total	***204 143 433***	***557 933 891***	***519 779 613***	***143 514 307***	***1 425 371 244***
6	Engineering/EMP Costs (12%)	24 497 212	66 952 067	62 373 554	17 221 717	171 044 549
	Sub-Total	***228 640 645***	***624 885 958***	***582 153 167***	***160 736 024***	***1 596 415 794***
	VAT 14%	*32 009 690*	*87 484 034*	*81 501 443*	*22 503 043*	*223 498 211*
	Total (Rand)	**260 650 336**	**712 369 992**	**663 654 610**	**183 239 067**	**1 819 914 005**

Note: Current (2014) price levels - Excludes escalation to date of construction

Table 5-3: Split of Budgets Required by DMs to Implement Tertiary Lines

Tertiary Pipelines Funding	Alfed Nzo DM	Joe Gqabi DM	OR Tambo DM	TOTAL
Total cost by DM incl VAT	**R 599 861 932**	**R121 298 035**	**R 1 098 754 038**	**R1 819 914 005**

5.2 Irrigation Bulk Water Distribution Infrastructure

Four options were investigated for irrigation water distribution:

Options 1 and 2 considered pumping raw water directly from the two alternative sources given above to a single command reservoir located at a strategic location, to control flow and maintain pressure along this single rising main. Branches off the rising main are then fed to the edge of fields of the various irrigable land areas described above. Local distribution and sprinkler systems in-field are provided by the farm unit operators. One advantage of these options is the single pumping solution, but a disadvantage is that there will need to be pressure reduction on some branch lines and that all of the raw water is effectively being pumped to the maximum elevation. The end point command reservoir would also need to be an expensive reinforced concrete structure, as there is no suitable location at sufficient elevation for a simpler open, earth-bunded storage structure.

Options 3 and 4 considered breaking the delivery of the total bulk water transfer into a shorter rising main to an intermediate open-topped, earth-bunded storage tank, from where it gravitates flow to the distribution system supplying the majority of the land areas at elevations coded in green and blue on Figure 5-4.

The intermediate storage structure will have a volume of one day's storage of the full system demand, allowing for some flexibility in selection of pumping tariff bands, as well as catering for power outages. This storage facility is located on a ridge en route at an elevation of 1 068 m.a.s.l. Within this distribution system, two smaller booster pumping stations will be required to lift raw water further to the areas at higher elevation, shown in purple and red on Figure 5-4. Table 5-4 shows the elevation colour coding used on Figure 5-4.

Table 5-4: Farm Unit Average Land Elevation Key

Avearge Elevation Ranges:	
(green)	*930 to 1 000 m.a.s.l*
(blue)	*1 000 to 1 040 m.a.s.l*
(purple)	*1 040 to 1 080 m.a.s.l*
(red)	*1 080 to 1 120 m.a.s.l*

Smaller balancing storage tanks will be provided at the end points of the branch lines, which will effect pressure regulation and pump control, and have six hours storage to cater for short power outages. Figures 5-5 to 5-8 show the proposed alignments and end delivery arrangements of these four options.

A discounted cash flow/URV analysis was undertaken to optimally size the rising mains and raw water pumping configurations of Options 1 to 4. The results are summarized in Tables 5-1 to 5-4. These models were run for a 30 year period of operation.

As with the potable water system, this analysis again uses the cost of pumps, power, pipelines, operation and maintenance for a range of pipeline diameter and pumping head combinations to seek the best solution. Other common costs such as the pumping station building structure, and command reservoir were not included, and this analysis is therefore only comparative rather than all-inclusive. From the feasibility design process, quantities were taken of the proposed infrastructure and an engineer's estimate was undertaken to establish the capital costs for the implementation of this infrastructure.

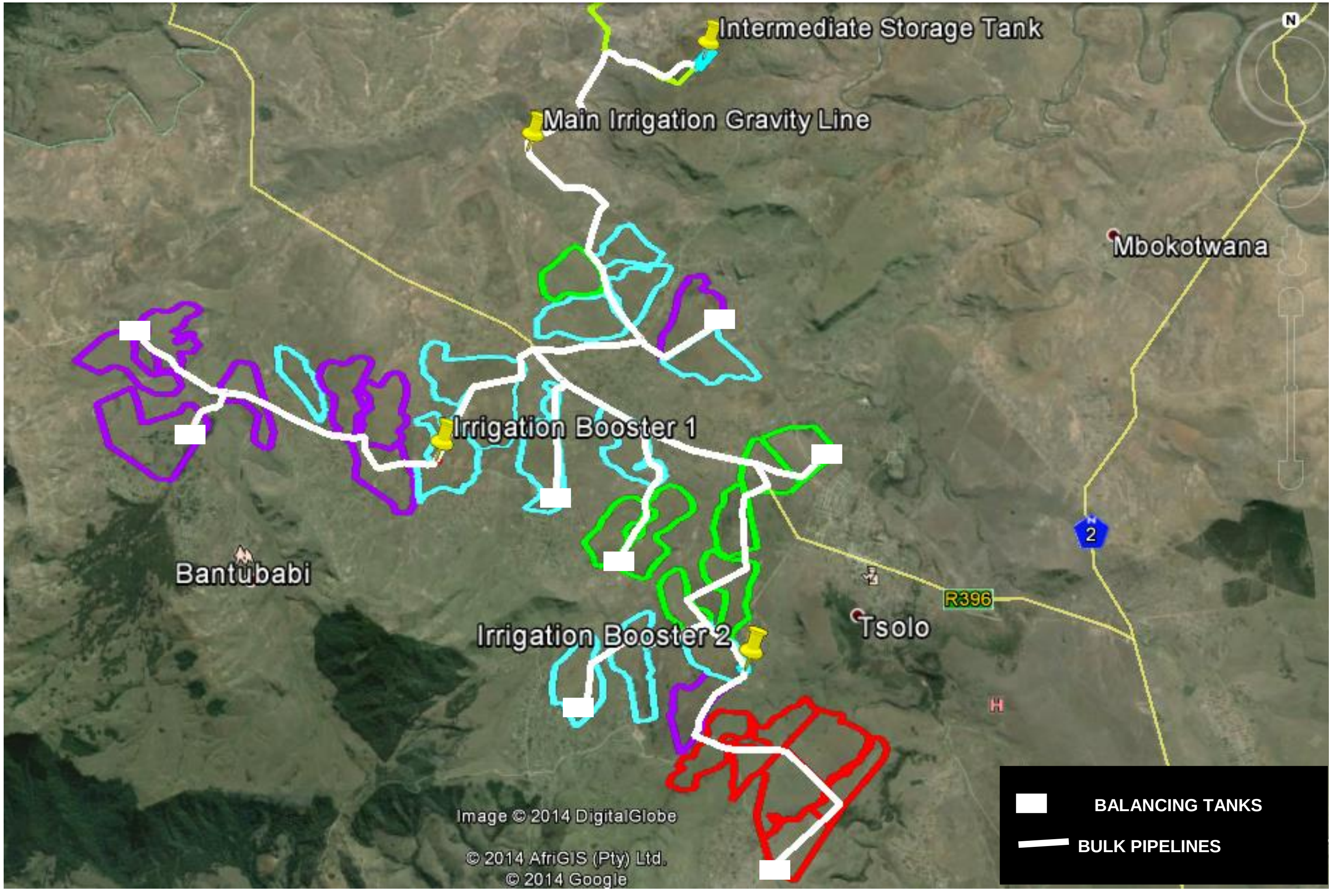


Figure 5-4: Irrigation Areas and Bulk Distribution System

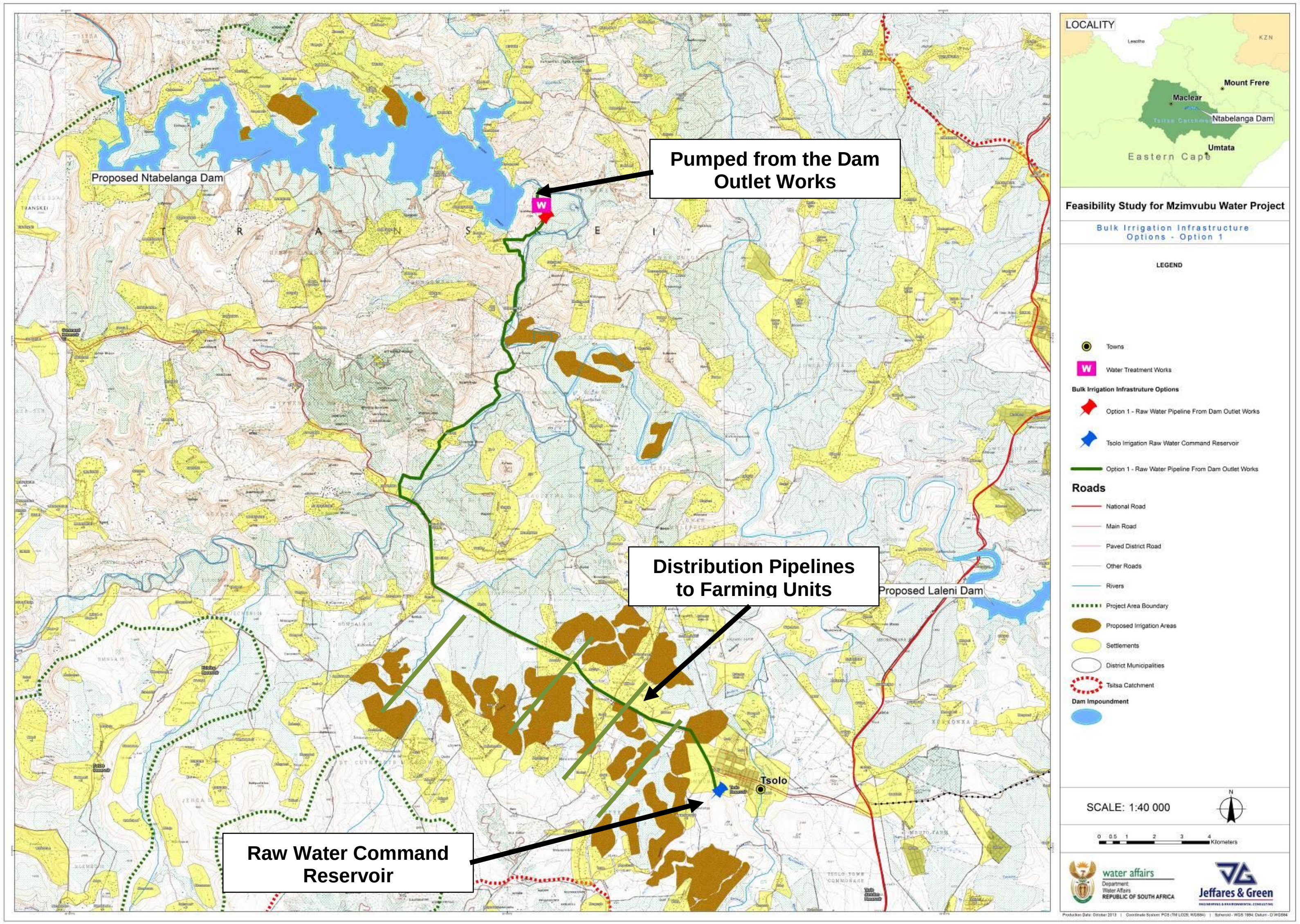


Figure 5-5: Overall Layout Plan of Irrigation System Option 1

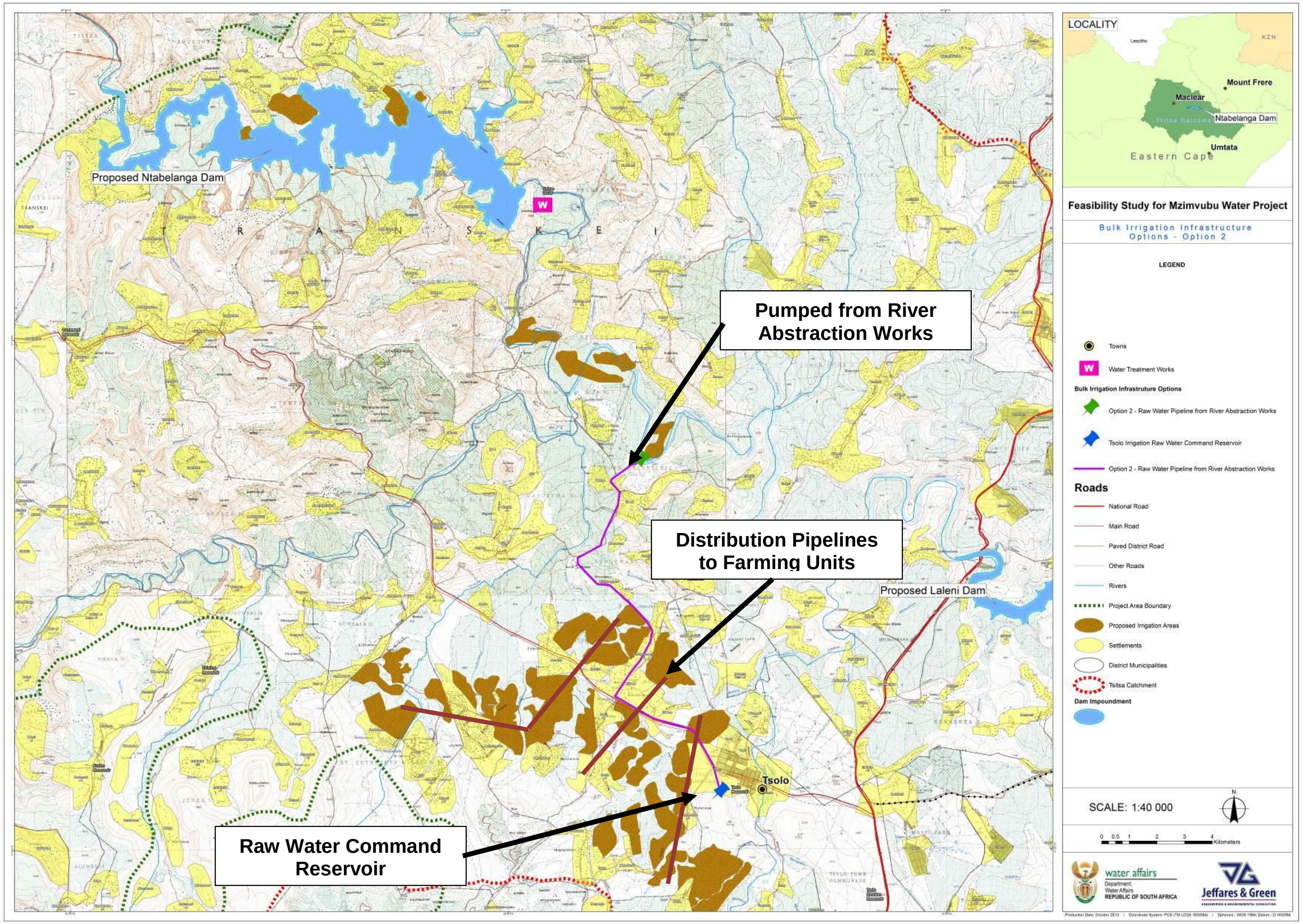


Figure 5-6: Overall Layout Plan of Irrigation System Option 2

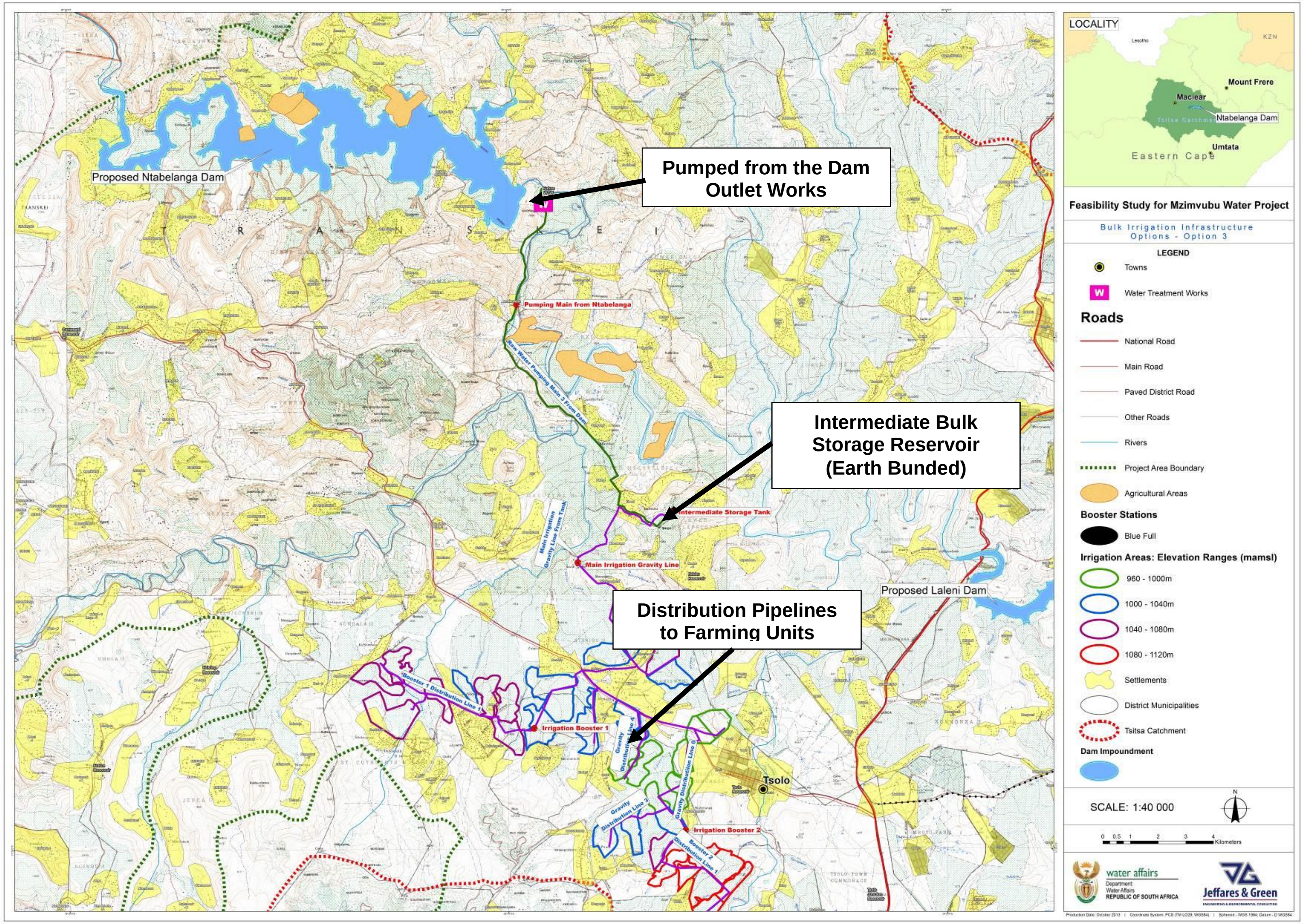


Figure 5-7: Overall Layout Plan of Irrigation System Option 3

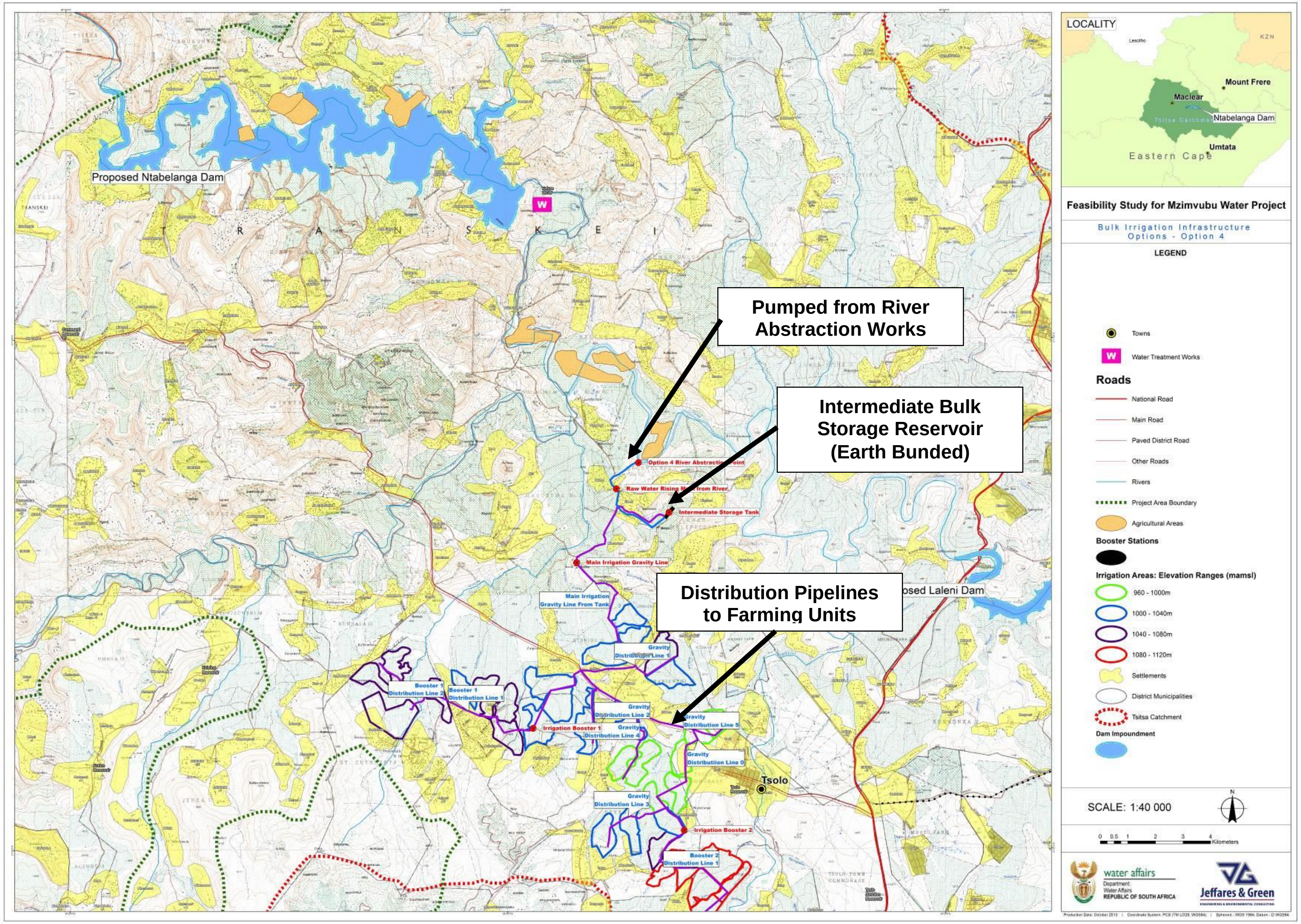


Figure 5-8: Overall Layout Plan of Irrigation System Option 4

Power costs were based upon an average current ESKOM Ruraflex tariff of R49.6 cents/kWh (incl VAT) which is based upon 20 hours pumping per day, thus avoiding peak hour tariff charges. This tariff is an aggregated average based upon hourly and seasonal tariff changes over each year.

Given that the bulk water pipelines are high pressure, all of the analysis was undertaken using steel pipeline materials. Various standard outside diameter options were analysed, and maximum working pressures calculated, taking into account the worst case as regard surge pressures are concerned. This, and other required pipe structure criteria were then used to determine the minimum wall thickness required for each option, and this determined the internal diameter to be used for hydraulic velocity and head loss calculation purposes.

Thus, pipeline internal diameters on the tables below are not nominal rounded figures but actual figures calculated from the standard production outside diameter sizes and with allowance for he designed pipe wall thickness requirements.

Appendix E provides breakdowns of the cost estimates for these options.

5.1.1 Economic Analysis to Compare Options

A discounted cash flow/URV analysis was undertaken to optimally size the rising mains and raw water pumping configurations of these options. Results are summarized in Tables 5-5 to 5-8.

Table 5-5: URV Analysis of Raw Water Transfer – Option 1

Raw Water - Option 1						
INTERNAL PIPE DIA (mm):>			**799**	**898**	**1000**	**1102**
MAX VELOCITY (m/s):			**2.11**	**1.67**	**1.35**	**1.11**
MAX HEAD: (m)			**349.30**	**277.86**	**237.80**	**218.98**
MAX POWER (kW):			**6 055**	**4 816**	**4 157**	**3 796**
URV (R/m^3)	4%		2.012	1.908	**1.906**	2.035
	6%		2.146	**2.085**	2.118	2.277
	8%		2.294	**2.279**	2.350	2.540
	10%		**2.451**	2.484	2.594	2.819

NB: lowest URV for each discount rate marked in red

Table 5-6: URV Analysis of Raw Water Transfer – Option 2

Raw Water - Option 2						
INTERNAL PIPE DIA (mm):>			**799**	**898**	**1000**	**1102**
MAX VELOCITY (m/s):			**2.11**	**1.67**	**1.35**	**1.11**
MAX HEAD: (m)			**334.65**	**297.31**	**275.17**	**266.53**
MAX POWER (kW):			**5 801**	**5 153**	**4 809**	**4 620**
URV (R/m^3)	4%		1.630	1.576	**1.575**	1.642
	6%		1.690	**1.659**	1.676	1.759
	8%		1.758	**1.751**	1.787	1.887
	10%		**1.832**	1.849	1.907	2.024

NB: lowest URV for each discount rate marked in red

Table 5-7: URV Analysis of Raw Water Transfer – Option 3

Raw Water - Option 3						
INTERNAL PIPE DIA (mm):>			**799**	**898**	**1000**	**1102**
MAX VELOCITY (m/s):			**2.11**	**1.67**	**1.35**	**1.11**
MAX HEAD: (m)			**232.65**	**197.04**	**178.07**	**167.69**
MAX POWER (kW):			**4 033**	**3 415**	**3 087**	**2 907**
URV (R/m³)	**4%**		1.225	1.174	**1.173**	1.237
	6%		1.289	**1.258**	1.275	1.354
	8%		1.359	**1.351**	1.386	1.482
	10%		**1.434**	1.450	1.505	1.617

NB: lowest URV for each discount rate marked in red

Table 5-8: URV Analysis of Raw Water Transfer – Option 4

Raw Water - Option 4						
INTERNAL PIPE DIA (mm):>			**799**	**898**	**1000**	**1102**
MAX VELOCITY (m/s):			**2.11**	**1.67**	**1.35**	**1.11**
MAX HEAD: (m)			**230.24**	**220.82**	**215.80**	**213.05**
MAX POWER (kW):			**3 991**	**3 828**	**3 741**	**3 693**
URV (R/m³)	4%		1.105	1.092	**1.091**	1.108
	6%		1.117	**1.109**	1.113	1.134
	8%		1.132	**1.130**	1.139	1.164
	10%		**1.148**	1.153	1.167	1.197

NB: lowest URV for each discount rate marked in red

Optimum pipe sizing lies between 914 mm and 1016 mm diameter and given that these URVs are within a few percent of each other, the recommendation would be made to opt for the larger sized pipeline, in order to reduce power costs and the risk of increased operating costs in the future.

In all options therefore, the 1 016 mm diameter pipeline is recommended.

5.1.2 Raw Water Pumping Configurations

The raw water pumping configurations for these options are based upon locally-available pumps suitable for the duties required and able to deal with sediment laden water.

As discussed in the Bulk Water Distribution Infrastructure Report No P WMA 12/T30/00/5212/13, pumping directly from the river downstream of the dam (option 4) was not considered to be the best operational solution given that raw water would still require extensive de-silting, and that the intake works would require a separate power supply and operational management establishment, would be at higher risk of damage during flood flows, and would have a higher energy cost.

Option 3, fed directly from the Ntabelanga dam outlet works, benefitted from clearer water pre-settled in the dam, less pumping head, no risk of flood damage, shared operational regime with the other works at the dam, and shared power supplies. In addition, this option had the lowest energy requirement. The present day capital and operational costs for this option were as shown in Table 5-9.

Table 5-9: Estimated Annual Operation and Maintenance Costs for Raw Water – Option 3

OPTION 3 - IRRIGATION PIPELINE DIRECT FROM DAM						
ITEM	**DESCRIPTION**	**AMOUNT**		**O&M per year**		
1	Pipelines	R	405 636 748	0.50%	R	2 028 184
2	Abstraction works	R	8 000 000	0.25%	R	20 000
3	Pumpstations	R	23 280 152	4%	R	931 206
4	Reservoirs	R	50 000 000	0.25%	R	125 000
5	Electrical supply	R	10 000 000	4%	R	400 000
6	Contingencies	R	49 691 690	1%	R	496 917
7	Engineering fees	R	32 796 515			
	Allowance for M&E depreciation and replacement funding				R	956 515
	Total 1	**R**	**579 405 105**		**R**	**4 957 822**
	VAT	R	81 116 715		R	694 095
	Total	**R**	**660 521 820**		**R**	**5 651 917**
				Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power				21 240 366		R 0.27
Power Cost per year		**R**	**18 559 958**	21 240 366		R 0.87
Cost for supply of raw water to edge of field including power				**R/m³**		**R 1.14**

As can be seen the *prima face* indication is that, even with no capital redemption included, and at current average ESKOM energy tariffs, the unit cost of supplying raw water to the edge of fields at the proposed new Tsolo farming units is some R1.14/m^3, which is considered to be non-viable economically.

According to the experience of agricultural development experts, including scheme roleplayers at the Eastern Cape Department of Rural Development and Agrarian Reform, this unit cost of water supplied should be of the order of R0.25/m^3 or at least less than R0.50/m^3, which is considered to be the maximum range of cost of water that would allow a reasonable annual margin to be made to viably sustain each farming unit. Given that energy is the majority of the cost component, the focus of seeking a solution to this problem was to reduce the effective cost of energy to the scheme, and hence, studies were made into the potential for self-generation of hydropower.

Energy costs form a major proportion of the overall unit cost of water supplied in both potable water and irrigation water schemes.

The estimated annual costs of energy expected from the proposed schemes are as given in Table 5-10. These are at 2014 tariff levels, and it should be noted that, given the current difficulties that ESKOM are experiencing, it is indicated that energy tariffs will increase at significantly higher a rate than general inflation for at least the next three to five years.

Table 5-10: Annual Energy Cost Estimates

Scheme Power Requirements at Year 2050									
Scheme Component	**Flow (l/s)**	**Head (m)**	**Duty Water Power (kW)**	**Pump Efficiency (%)**	**Maximum Electricity Demand (kW)**	**Maximum Electricity Demand (kVA)**	**Max hours per day**	**Usage - kWh per year**	**Power cost/year (Rand)**
Pump station PS1	935.27	246	2 257	75%	3 010	3 168	20	21 972 238	10 908 609
Pump station PS2	827.70	270	2 193	75%	2 924	3 077	20	21 342 186	10 595 806
Pump station PS3	476.66	279	1 305	75%	1 740	1 831	20	12 700 333	6 305 364
Pump station PS4	92.69	333	303	75%	404	425	20	2 947 673	1 463 438
Booster pump station Z3 PS1	170	94	157	75%	209	220	20	1 526 086	757 659
Booster pump station Z4 PS1	12.8	66	8	75%	11	12	20	80 678	40 054
Booster pump station Z4 PS2	3.53	195	7	75%	9	9	20	65 737	32 637
Water treatment plant processes	Estimated				500	526	varies	572 998	284 478
Waste water treatment works	Estimated				100	105	20	730 000	362 425
Housing	Estimated				250	263	12	1 095 000	543 637
Other, incl lighting etc	Estimated				250	263	12	1 095 000	543 637
TOTALS EXCL RAW WATER			**6 230**		**9 406**	**9 901**		**64 127 929**	**31 837 745**
Raw Water for Irrigation	1060	275	2 860	75%	3 813	4 014	20	23 110 937	11 473 942
TOTALS INCL RAW WATER			**9 090**		**13 220**	**13 915**	**Year 2050**	**87 238 866**	**43 311 687**
				Estimated at Commissioning			**Year 2020**	**69 791 093**	**34 649 350**

…..(cont.)

Other ESKOM Charges: (2050)									
					days/a		**kWh/a**		**Charge/a**
Service and admin charge (per account per day)				221.23	365				80 749
Reliability service charge (c/kWh)				0.33			87 238 866		287 888
Network demand charge (c/kWh)				18.97			87 238 866		16 549 213
Reactive charge (c/kWh) high season				7.2			21 809 716		1 570 300
									18 488 150
Other ESKOM Charges: (2020)									
					days/a		**kWh/a**		**Charge/a**
Service and admin charge (per account per day)				221.23	365		69 791 093		80 749
Reliability service charge (c/kWh)				0.33			69 791 093		230 311
Network demand charge (c/kWh)				18.97			69 791 093		13 239 370
Reactive charge (c/kWh) high season				7.2			17 447 773		1 256 240
									14 806 670
						TOTAL POWER COST (2020): Rand/a			**49 456 019**
						TOTAL POWER COST (2050): Rand/a			**61 799 837**

These estimated energy costs were used in the undertaking of the economic analyses of various options described in Section 7 of this report.

6. HYDROPOWER GENERATION INFRASTRUCTURE

6.1 Introduction

Given the significant proportion of energy costs on the overall cost of water produced by the above schemes, investigations were carried out to ascertain whether the inclusion of hydropower into the overall scheme would have significant cost benefits, by reducing these energy costs.

From the investigations and analysis undertaken in Phases 1 and 2 of the study, it was agreed that the study should include the conjunctive operation of the Ntabelanga Dam with a second dam and hydropower scheme at Lalini, also located on the Tsitsa River, and downstream of Ntabelanga Dam.

Due to the constraints of the original study scope and budget, these hydropower investigations were initially undertaken at high level only. Preliminary analyses undertaken to date, indicated that there could be economies of scale and other cost-benefits by constructing a “large” capacity Ntabelanga dam to regulate flow to a “small” capacity Lalini dam, and thence through the hydropower scheme tunnel and powerhouse.

The general arrangement of this conjunctive usage scheme is shown in Figure 6-1.

Hydrological data were updated in Phase 2 of the study, and the hydropower module of the WRYM model was used to investigate two options:

i. A Lalini Dam scheme with a “large” dam capacity of 0.78 MAR (Mean Annual Runoff), and with the Ntabelanga Dam only developed at its “minimum” capacity (0.15 MAR) required purely for water supply purposes.
ii. Using a raised “maximum” capacity Ntabelanga Dam of 1.15 MAR together with a “smallest” Lalini dam (0.15 MAR).

At the Phase 2 stage under the original feasibility study scope, high level cost estimations were undertaken, and the incremental cost of implementing the conjunctive option ii) over and above building the basic Ntabelanga Dam, option i) for water supply only, was allowed for in the overall analysis.

For option ii), the raised Ntabelanga Dam’s average supply level provided an increased pressure head at the dam, creating an opportunity to install a small hydropower plant at Ntabelanga Dam itself in addition to the plant at Lalini Dam.

The installed capacities of plant at each dam were determined to be:

Ntabelanga: 5 MW, with an average output estimated at approximately 2 MW
Lalini: 30 MW, with an average output estimated at 26 MW

Cost estimates of dam, tunnel, hydropower plant, and transmission lines were built up at high level using a similar database as was used for the Ntabelanga dam, as well as quotations from plant suppliers. However, in the absence of highly accurate survey information, and not having yet undertaken geotechnical investigations for dam foundations, materials, and tunnelling conditions, the confidence levels for such cost estimates for the Lalini scheme were at that stage not considered to be as high as for the Ntabelanga Dam studies.

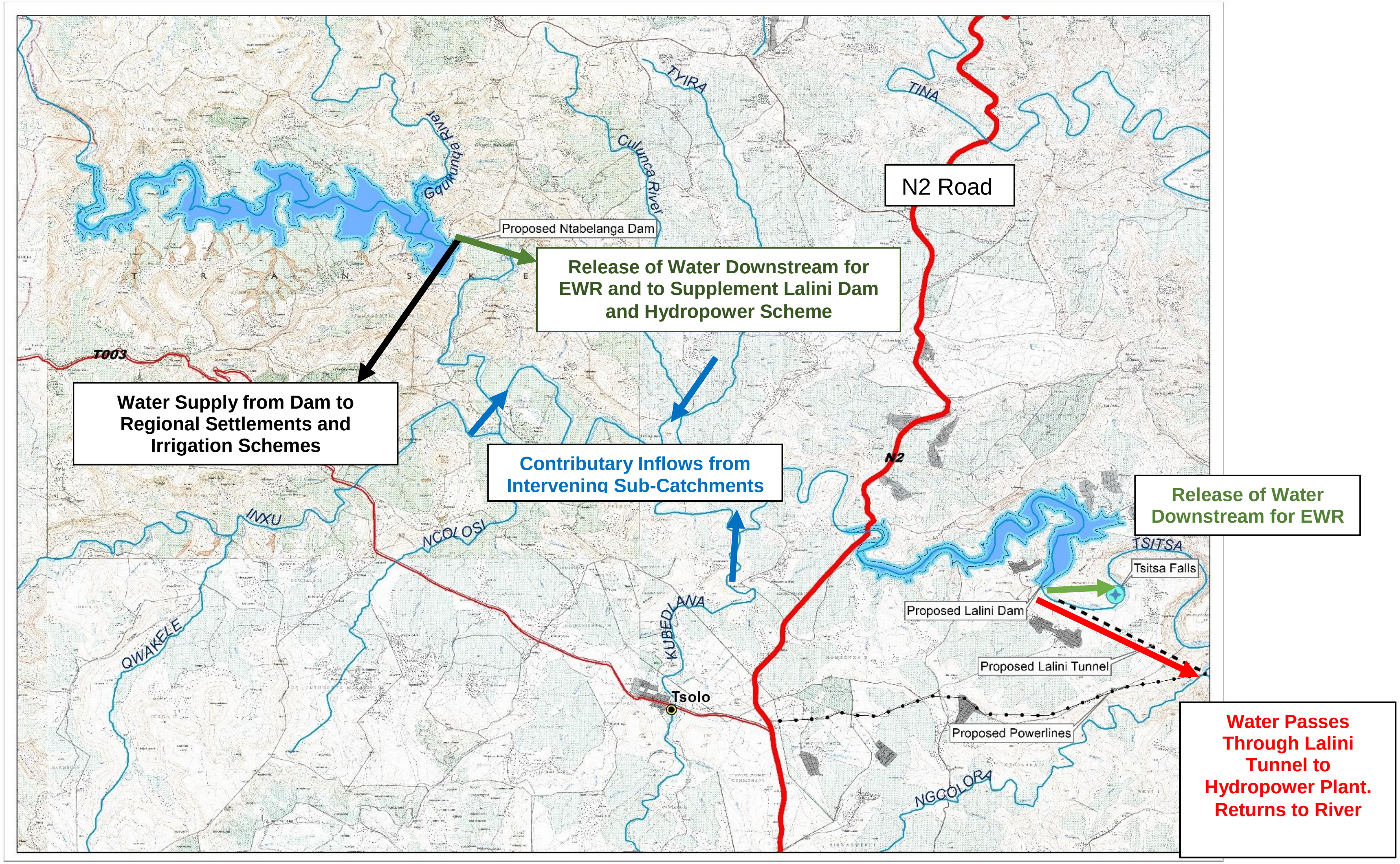


Figure 6-1: Conjunctive Hydropower Scheme

For comparison purposes, the Levelized Cost of Energy produced was calculated at a load factor of 100% (continuous power).

Appendix F shows the models used to calculate the Levelized Cost of Energy produced by the combined Ntabelanga-Lalini Hydropower scheme components, as well as a scenario to test the viability of increasing the minimum size of the Ntabelanga Dam to generate hydropower at this site only.

The analysis was run for the largest capacity Ntabelanga Dam operated in conjunction with the smallest capacity Lalini Dam, as well as the smallest capacity Ntabelanga Dam in conjunction with the largest capacity Lalini Dam.

A further scenario was investigated where the Lalini scheme was not built, but the Ntabelanga Dam hydropower plant was developed alone including the incremental cost of building the maximum capacity Ntabelanga Dam.

The objective of this was to determine whether to proceed with more detailed investigations for the Lalini Dam and Hydropower Scheme.

This is discussed in more detail in the Lalini Hydropower Analysis Report No. P WMA 12/T30/00/5212/18 but, in summary, the results of both conjunctive and single plant hydropower analysis are given in Table 6-1.

Table 6-1: Comparison of Levelized (URV) Cost of Power Produced by the Hydropower Options

					LEVELIZED COST OF POWER (R/kWh) FOR DISCOUNT RATES					
	DAM CAPACITY (MAR x)		INSTALLED HYDROPOWER		WITH FULL CAPEX INCLUDED			O&M AND REFURB COSTS ONLY		
OPTION	NTABELANGA	LALINI	NTABELANGA	LALINI	6%	8%	10%	6%	8%	10%
NTABELANGA DAM ONLY	1.18	NO DAM	5 MW	NIL	R3.24	R3.60	R3.97	R0.76	R0.67	R0.60
NTABELANGA DAM PLUS LALINI DAM	1.18	0.15	5 MW	30 MW	R0.82	R0.94	R1.06	R0.11	R0.10	R0.09
NTABELANGA DAM PLUS LALINI DAM	0.15	0.78	NIL	30 MW	R0.97	R1.11	R1.24	R0.13	R0.11	R0.10

This shows that developing the Ntabelanga hydropower option only is not viable, having a levelized cost of power ranging from R3.24/kWh to R3.97/kWh, including capital redemption. A benchmark for levelized costs for a viable hydropower scheme is currently in the range of R1.00/kWh to R1.50/kWh. Therefore, only if this option were to be grant funded would it be considered to be viable.

The conjunctive use options, however, showed levelized costs well within the range currently considered to be viable, even allowing for full capital cost (“capex”) redemption.

The large Ntabelanga/small Lalini option had the lowest levelized cost of power ranging from R0.82/kWh to R1.06/kWh, including capital redemption, which could drop as low as R0.09/kWh if grant funding can be provided and only operation and maintenance and plant refurbishment costs are considered.

Given this result, a more detailed water resources, dam optimisation and hydropower analysis was undertaken on the Lalini Dam site based upon the large capacity Ntabelanga Dam (1.18 MAR) and for a range of Lalini Dam capacity options.

6.2 Detailed Investigations of Conjunctive Scheme

The process and results of this detailed hydropower potential assessment and the feasibility design of the Lalini Dam and its hydropower scheme are described in Report Nos. P WMA 12/T30/00/5212/18 and 19.

The process of dam type selection and optimisation of the Lalini Dam and associated works followed the same process as was undertaken for the Ntabelanga Dam. The decision-making on the optimum dam type and other infrastructure planning and feasibility design was informed by a topographical survey as well as detailed geotechnical investigations of dam foundations, construction materials availability, and to identify potential tunnelling conditions.

The hydropower analyses took into account the specific environmental water requirements and operating rules that have been established following reserve determination studies on the Tsitsa River at both dam sites.

Various configurations were investigated for Lalini Dam capacity, hydroelectric plant (HEP) locations, and hydropower transfer conduit/tunnel routes. It was determined that the development of a Lalini Dam of capacity greater than 0.6 x the present day mean annual runoff (MAR_{PD}) was not possible due to terrain constraints and overtopping of watersheds, and that a Lalini Dam of capacity greater than 0.28 MAR_{PD} would have a very high social and environmental impact in the area, as well as requiring major resettlement and infrastructure realignments.

Given that the purpose of the study was to maximise the energy output of the conjunctive scheme, the optimum configuration proved to involve the Ntabelanga Dam constructed at its maximum capacity of 1.18 MAR_{PD}, and the Lalini Dam at 0.28 $MAR_{PD.}$

The proposed layout plan, typical wall and spillway cross-sections, and longitudinal cross-sections for the recommended dam type and spillway are shown in Figures 6-2 to 6-5.

The proposed Lalini Dam has the following characteristics:

Full Supply Level (FSL):	765.58 m.a.s.l.
Non-Overspill Crest Level (NOCL):	770.41 m.a.s.l.
Minimum bed level in river at dam:	717.00 m.a.s.l.
Crest width:	6 m
Minimum operating level (MOL):	740.14 m.a.s.l.
Main outlet conduit minimum invert level:	736.14 m.a.s.l.
Maximum dam wall height to NOC:	53.41 m
Wall crest length (incl spillway):	365 m
Spillway crest length:	320 m
Gross stored volume at FSL:	232 million m^3
Mean Annual Runoff (Present Day) at dam:	828 million m^3
Storage below MOL (V_{50} sedimentation):	31.2 million m^3
Surface area of lake behind dam:	31.5 km^2
Backwater reach upstream of dam:	22 km

The dam wall height, impoundment volume, and downstream risk factors for the Lalini Dam put this structure into a Category 3 dam under Gazetted Dam Safety regulation R139 of 2012.

As discussed in Appendix A, and as reviewed and accepted by the DWS Hydrological Services, the flood criteria for design of this dam are as follows:

1 in 200 year return period Design Flood: 3 500 m^3/s

Safety Evaluation Flood (SEF): 7 100 m^3/s

Further hydropower analysis was undertaken to investigate various HEP installation capacities and modes of operation, from base load (operated 24/7) installations of 37.5 MW and 50 MW, to a peaking arrangement (only operated at peak hours of the day) with 150 MW of installed capacity.

Each of these options required different water transfer conduit and tunnel sizes with consequently different capital costs.

Following the feasibility design of these three options and preparation of capital cost estimates for the dam, conduit, HEP and associated works, cost estimates were prepared for each option and compared with the average energy produced by each option using, as before, the levelized cost of power approach used in the energy industry to indicate viability.

For more details of this process, refer to the Feasibility Design: Lalini Dam and Hydropower Scheme Report No. P WMA 12/T30/00/5212/19, but the results are summarized herein in Table 6-2. As described in that report the peaking option proved non-viable in terms of very high capital cost and in terms of the non-acceptability of discharging very high flows into the river system for short periods each day. The levelized cost analysis of the other two base load options indicated a unit cost of R1.20/kWh for both options.

Given this result, and to minimize capital cost expenditure, it was recommended that the 37.5 MW option be used in the financing impacts analyses. In addition, each dam would also have a mini-HEP constructed just downstream of the dam wall which makes use of the head of water in the dam and the water to be released from the dam. In each case this involves installing HEP capacity of 5MW and these two mini-HEPs would on average produce 1.57 MW and 1.83 MW of power, which can also be sold into the grid.

This does not mean that a 50 MW scheme should be ignored when considering the more detailed design of the scheme, and it is recommended that both 37.5 and 50 MW options be investigated at a more detailed level before finalizing this implementation decision. Such a decision would not affect the Lalini Dam capacity, but would require a larger water transfer conduit and HEP. The final decision would depend upon the actual energy sales feed-in tariff to be negotiated, which will determine the return on the increase investment of a 50 MW scheme over a 37.5 MW scheme.

Figures 6-6 to 6-10 are included to provide an overview of the Lalini scheme and the associated infrastructure required.

Table 6-2: Summary of Lalini Options Costing Analyses

Component	**Main HEP Installed Capacity Option**		
	37.5 MW	**50 MW**	**150 MW**
kWh Produced per Year	**199 421 590**	**217 561 957**	**217 561 957**
Lalini Dam (0.28 x MAR Capacity)	601.64	601.64	601.64
Associated Works	127.01	127.01	127.01
Mini-Hydropower Plant			
Building Structure incl O/H Crane	11.55	11.55	11.55
Turbines & Generators Electro-Mech	37.00	37.00	37.00
Transformer Station	2.00	2.00	2.00
Power lines (22 kV) to Grid (say 8 km)	6.00	6.00	6.00
Access Roads			
Lalini Main Road Upgrade	52.31	52.31	52.31
Tunnel Entrance Access Road	11.20	11.20	11.20
Dam & Pipeline Access Road	15.43	15.43	15.43
HEP Access Road Option 1	173.02	173.02	173.02
Roads and Bridges Realignments			
Mtshazi Main Road Upgrade & Realignment	87.36	87.36	87.36
Lalini Bridge Realignment	103.70	103.70	103.70
Hydropower Water Delivery Conduit	2 500 mm dia.	3 000 mm dia.	4 500 mm dia.
Longer tunnel option	687.07	860.88	1 320.68
Main Hydropower Plant			
Building Structure incl O/H Crane	28.80	38.40	42.24
Turbines & Generators Electro-Mech	119.59	163.27	907.50
Switching and Transformer Station	3.00	5.00	incl
Earthworks	7.50	10.00	10.00
Power Lines to Grid 12.7 km (132 kV)	17.50	17.50	17.50
Sub-Total Cost Estimates	***2 091.69***	***2 323.28***	***3 526.14***
Contingencies (10%)	*209.17*	*232.33*	*352.61*
Engineering and EIA Mitigations (12%)	*276.10*	*306.67*	*465.45*
Escalation (averages 18%)	*463.85*	*515.21*	*781.96*
VAT (14%)	*425.71*	*472.85*	*717.66*
Grand Total (R'million)	**3 466.53**	**3 850.34**	**5 843.83**

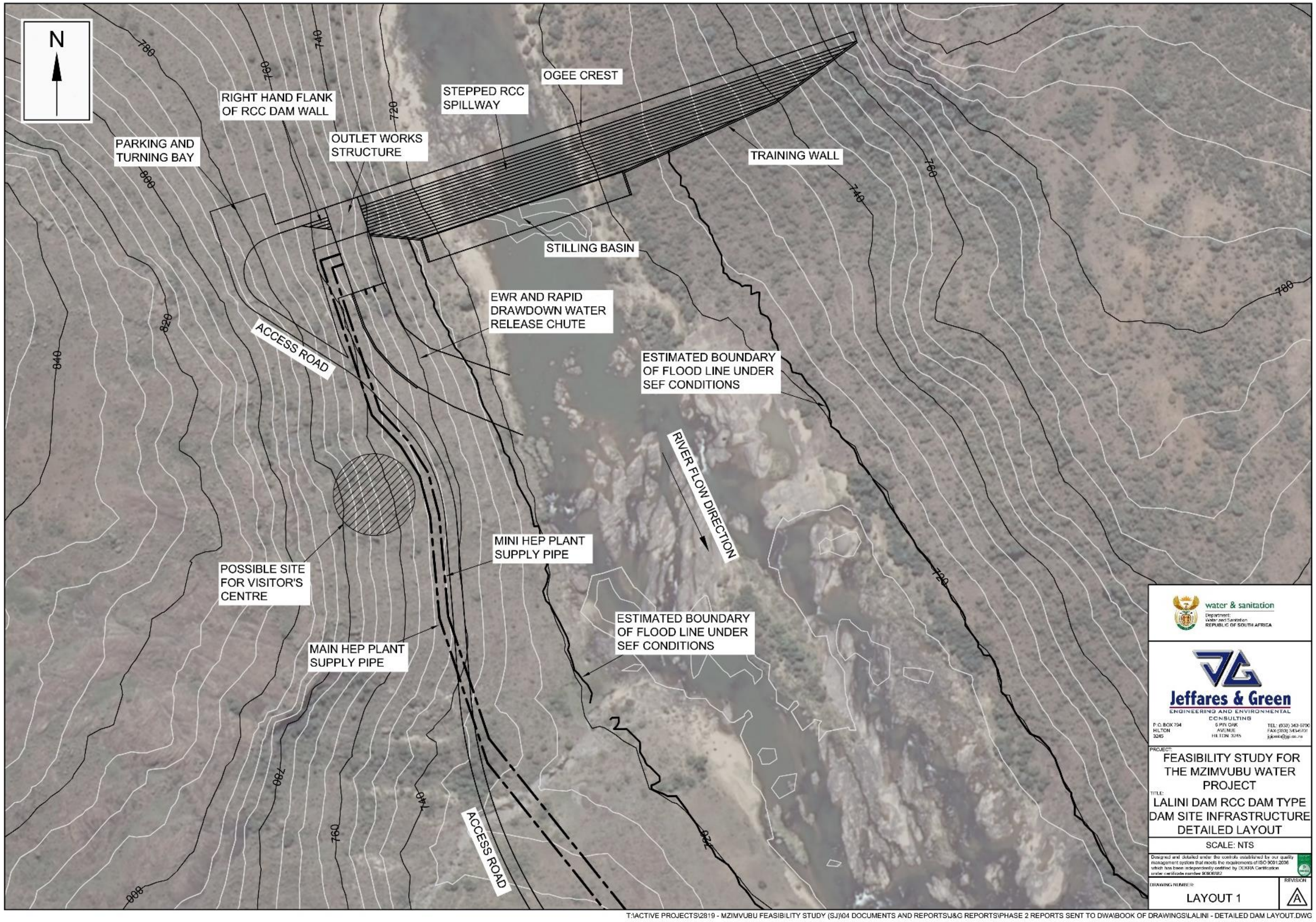


Figure 6-2: General Arrangement of the RCC Dam Option and Associated Infrastructure

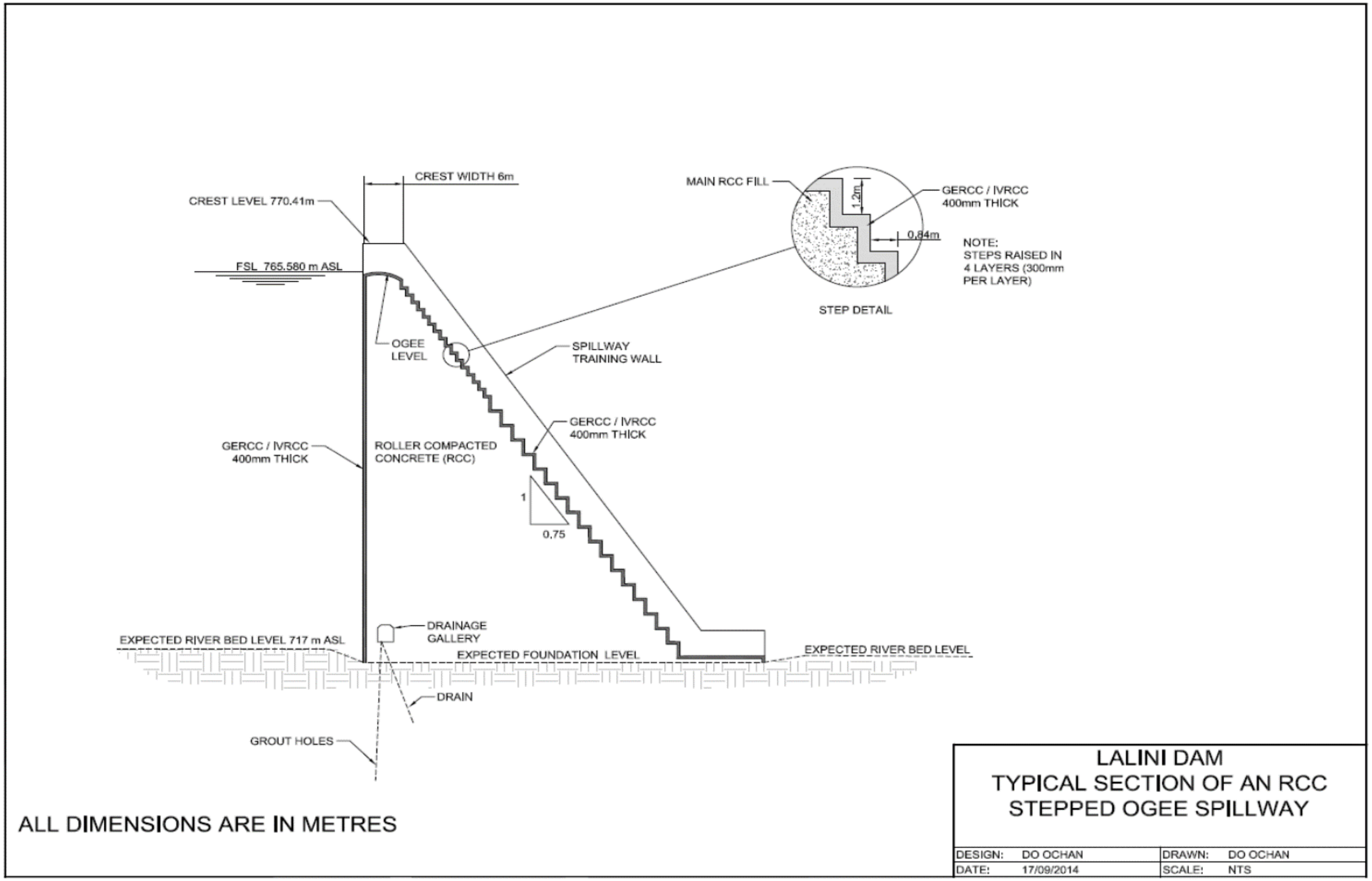


Figure 6-3: RCC Dam Wall and Spillway Typical Cross Section

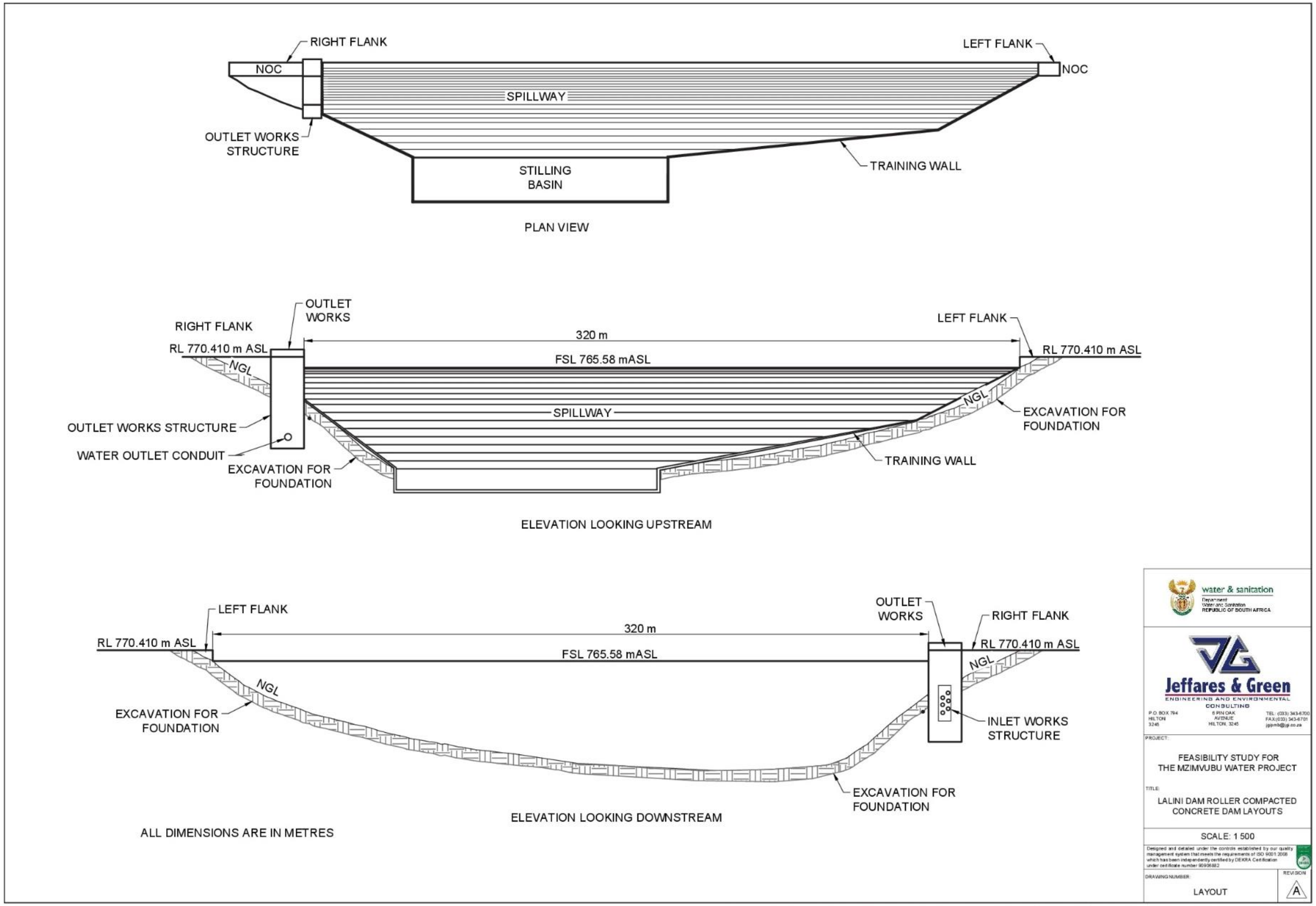


Figure 6-4: RCC Dam Embankment Plan and Elevations

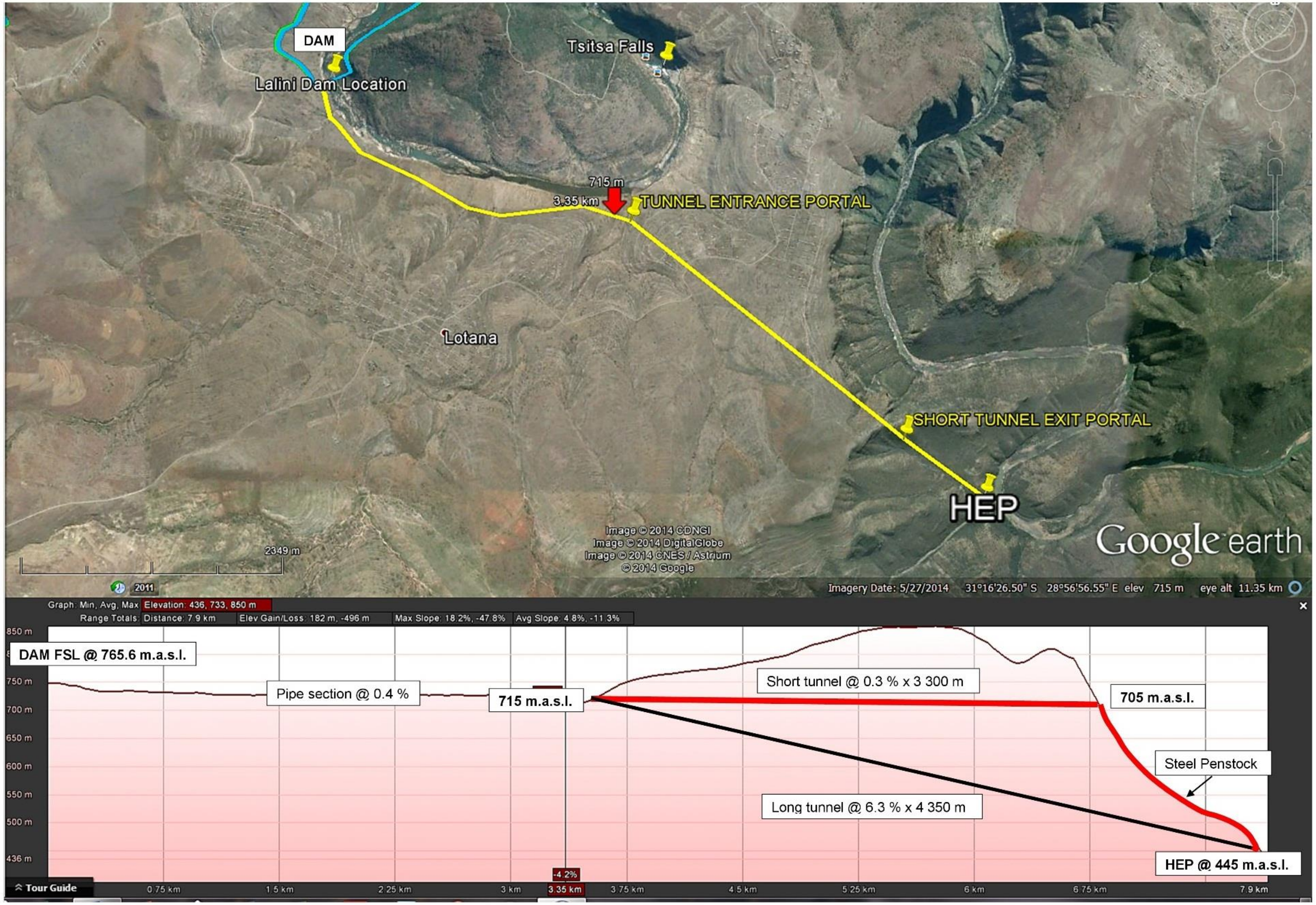


Figure 6-5: Tunnel Horizontal and Vertical Alignment Options

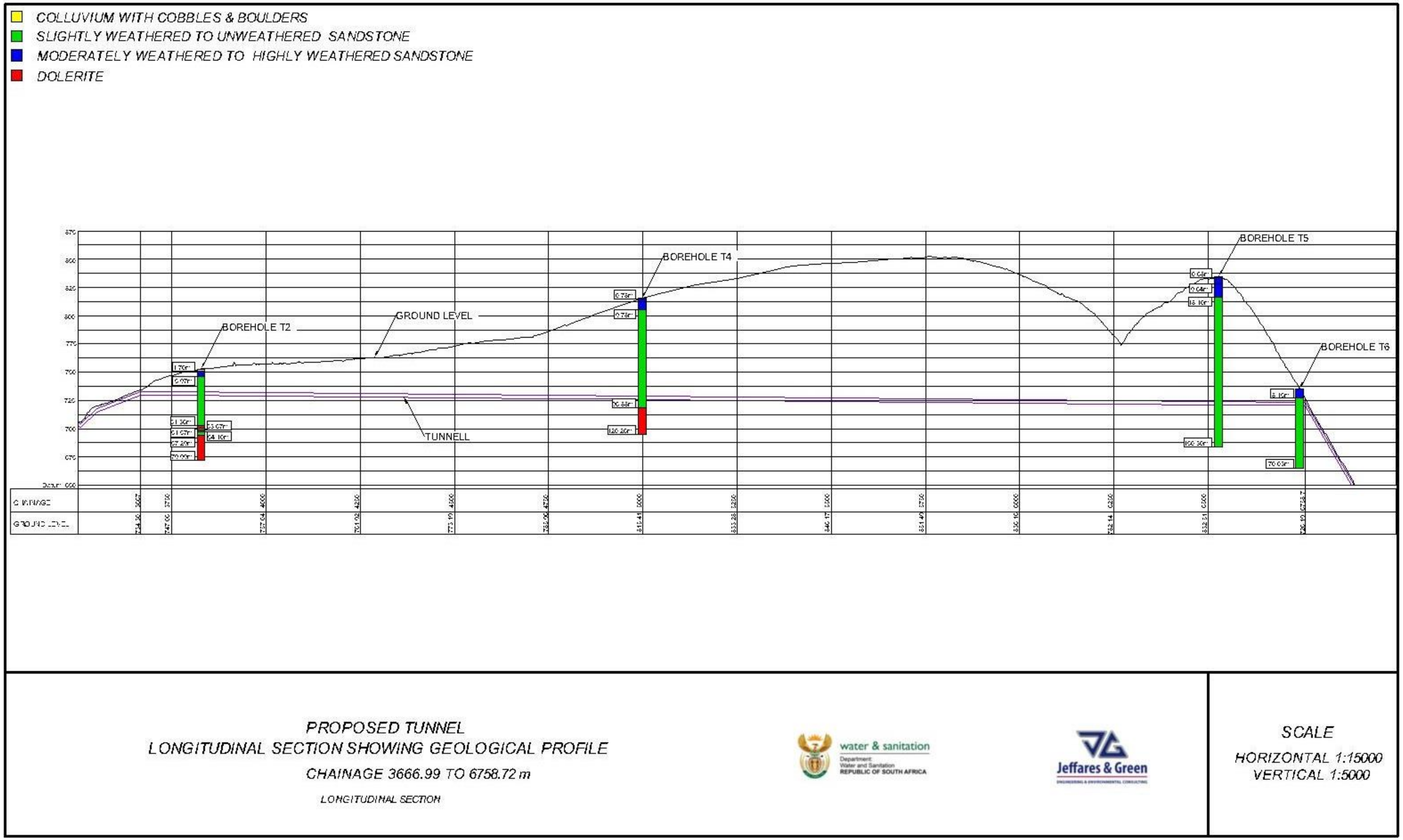


Figure 6-6: Boreholes Drilled along Tunnel Alignment

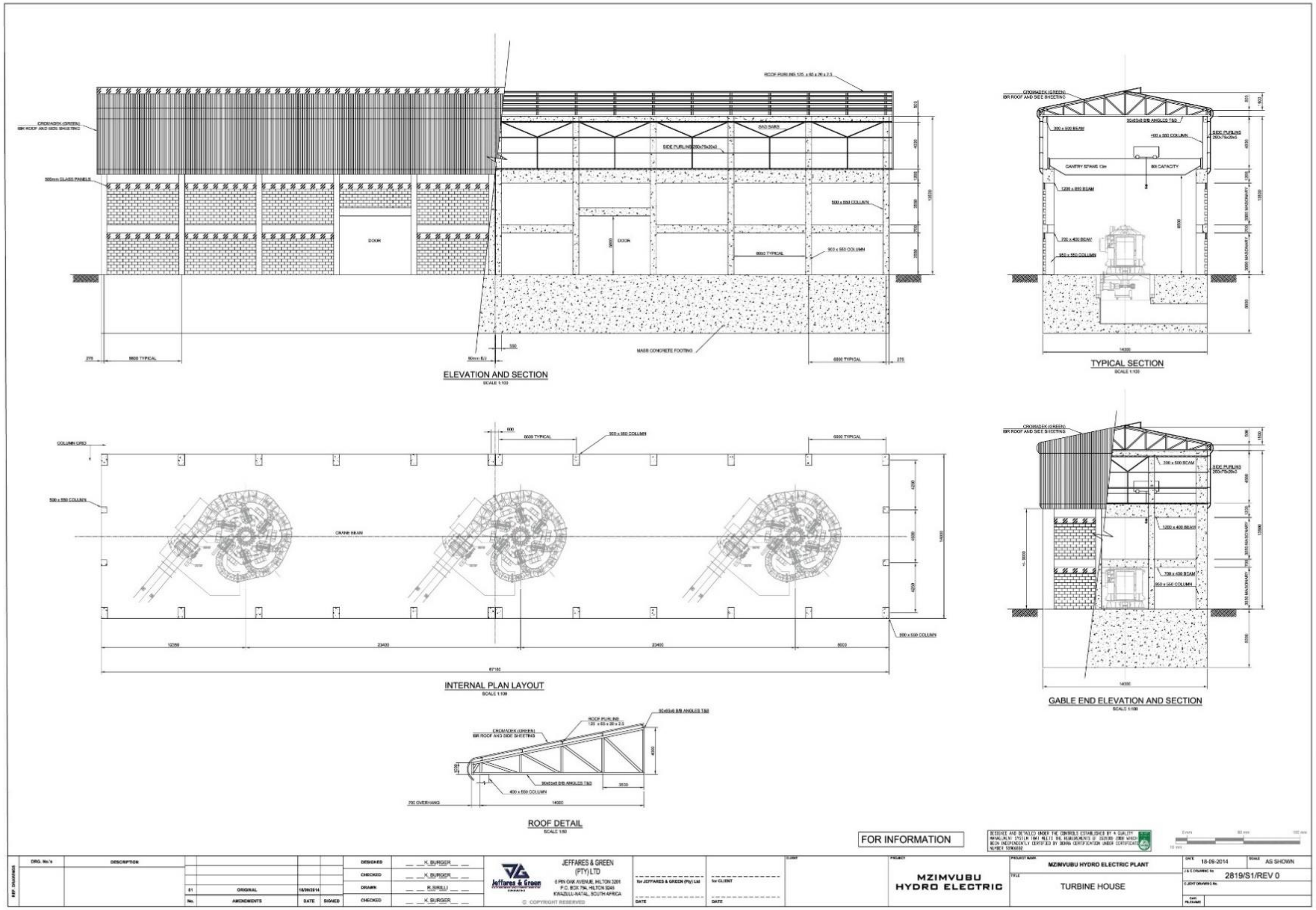


Figure 6-7: Hydroelectric Power Plant Building (3 Turbine Option)

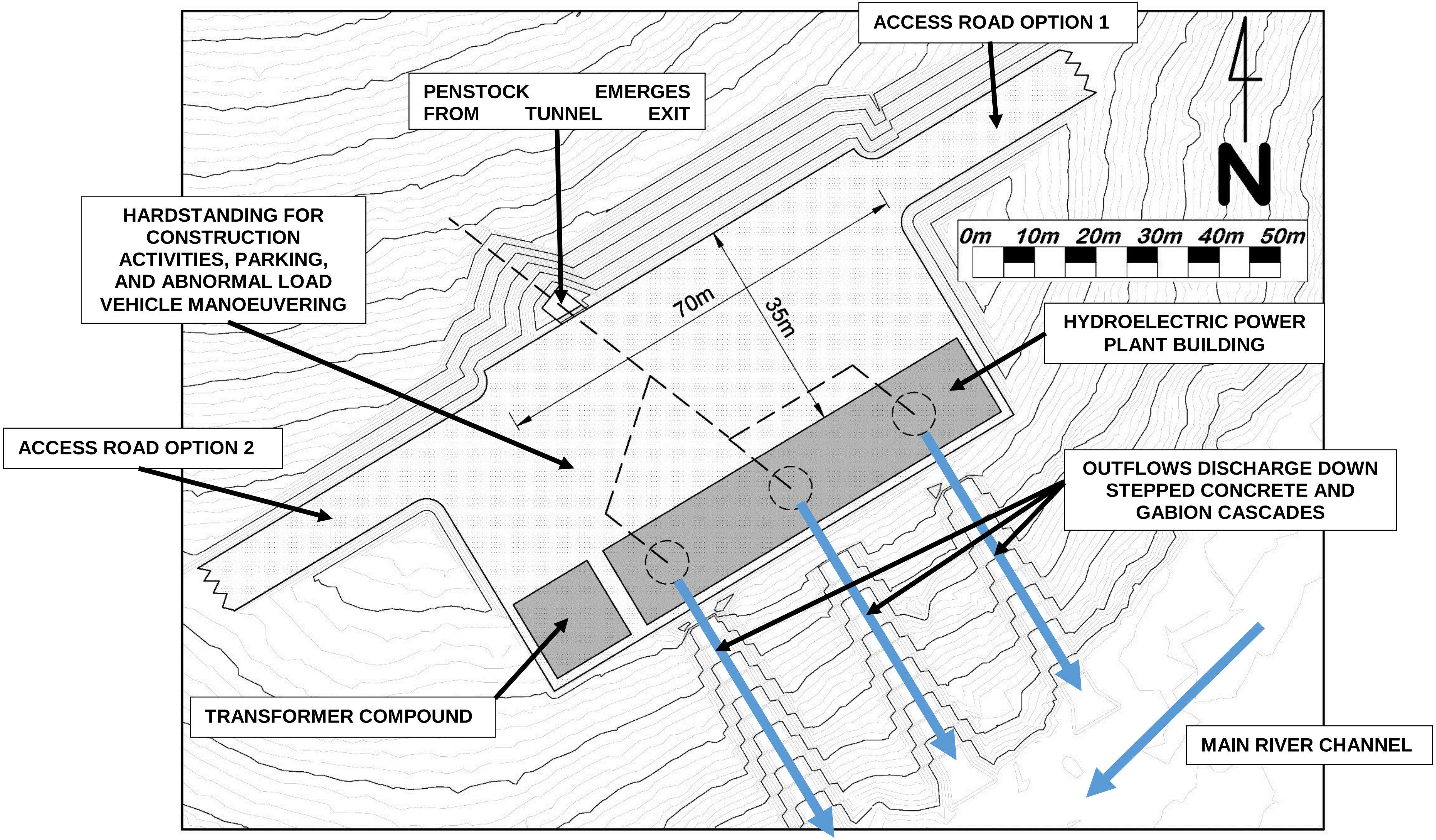


Figure 6-8: Lalini Main Hydropower Plant Site Layout

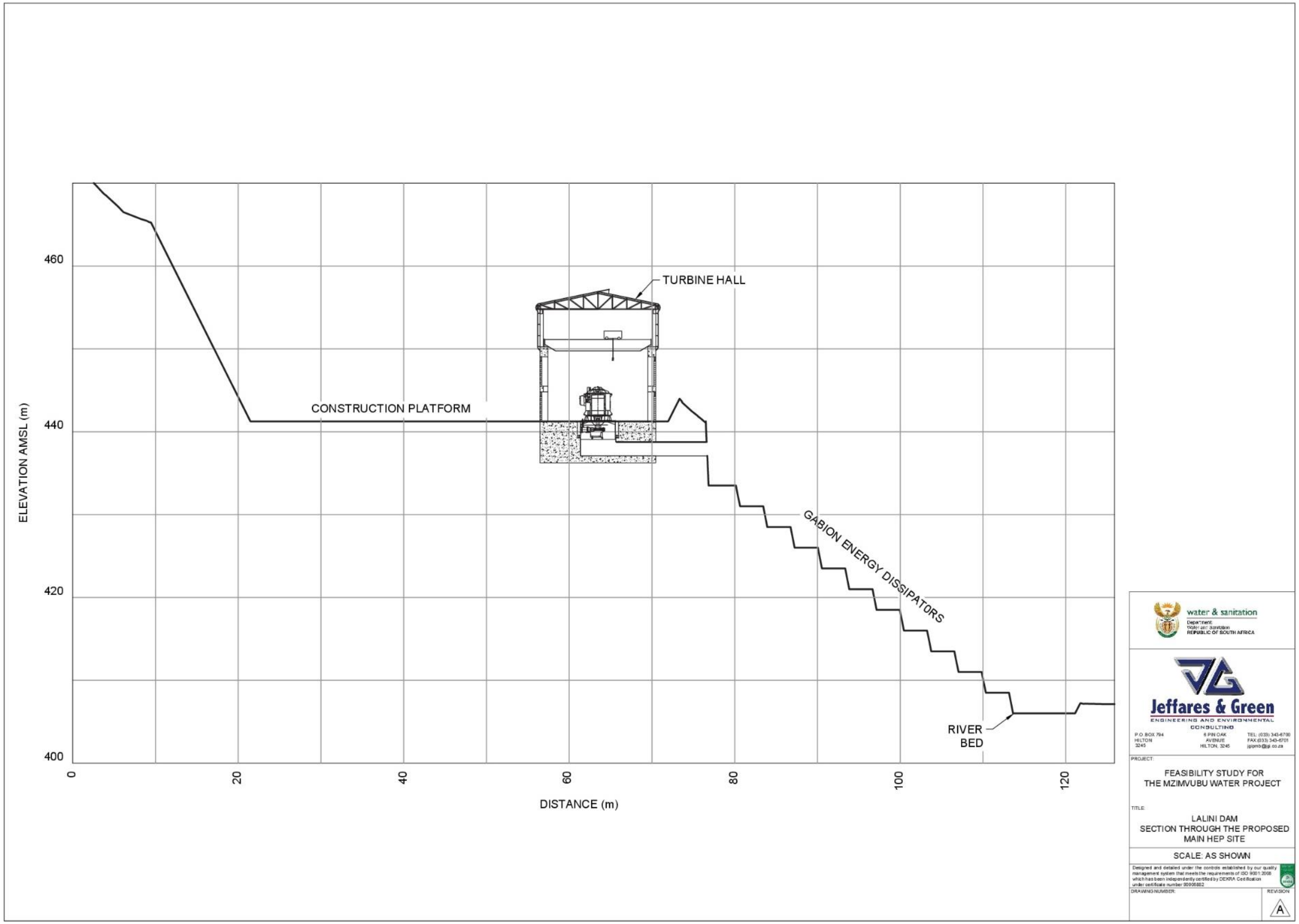


Figure 6-9: Turbine House and Outlet Works Cross-section

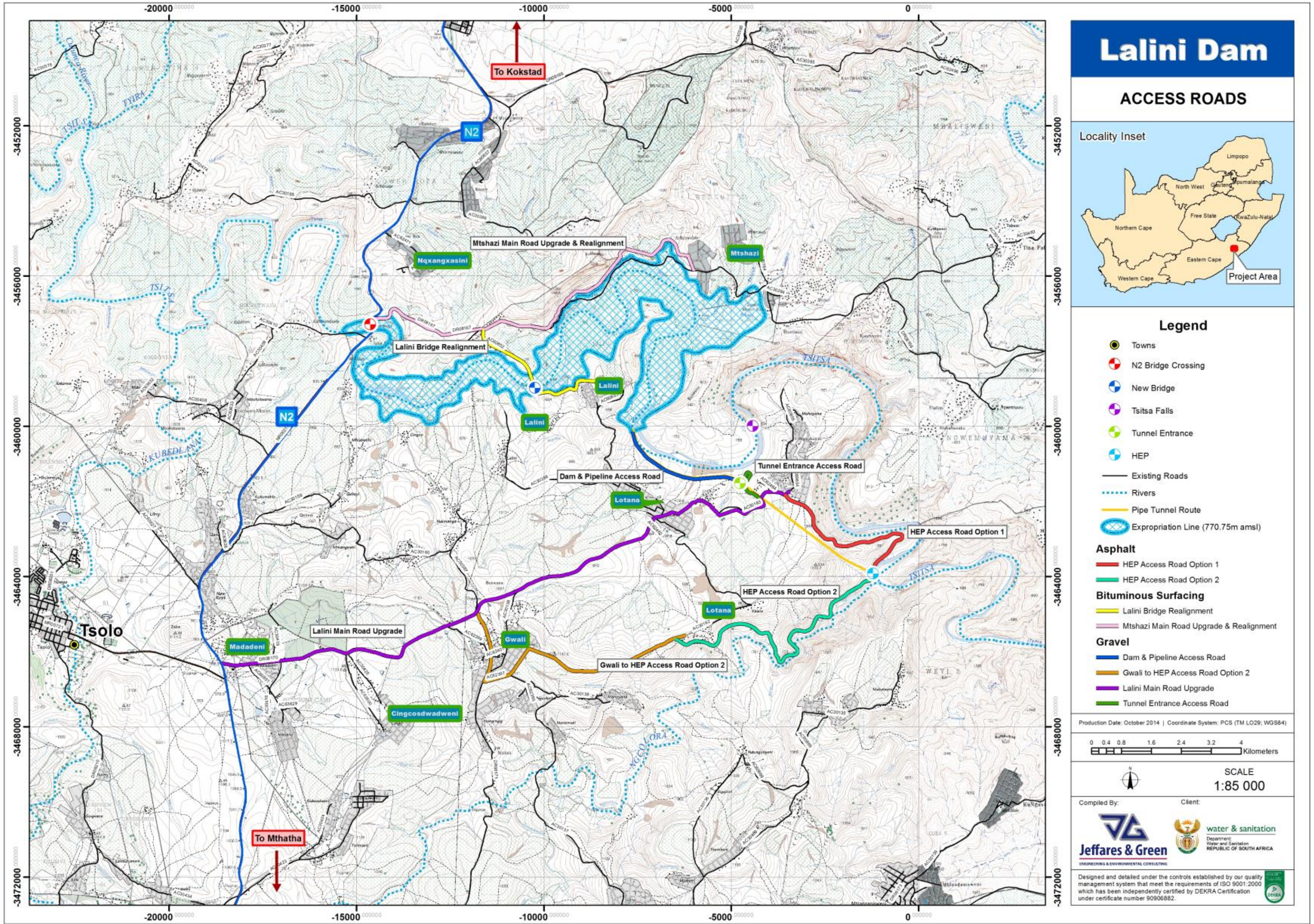


Figure 6-10: Proposed New and Upgraded Access Roads and Bridges

7. ECONOMIC ANALYSIS OF THE NTABELANGA-LALINI CONJUNCTIVE SCHEME

In order to investigate whether the combining of potable water supply, irrigation water supply and hydropower generation as a single multi-purpose project can improve the otherwise marginal viability of the water supply parts of the scheme, economic analyses were run for the scheme components, both as individual components and combined as one scheme.

For the two water supply scheme components, the industry-standard discounted cash flow analysis was undertaken, which produces a unit reference value (URV) of water supplied.

It should be noted that the URV methodology is not an indication of actual tariffs that should be charged for water supplied, but is more a means of options comparison.

This methodology includes:

- Capital cost of implementation, split into the expected annual expenditure;
- Engineering and environmental costs;
- Annual operation and maintenance costs (using percentages of capital costs);
- Water treatment costs (e.g chemicals);
- Recurrent expenditure on periodical (circa 15 years) replacement of plant and equipment; and
- Annual energy costs based upon ESKOM tariffs.

As this method compares net present values, all price levels were set at current day prices without escalation.

7.1 Hydropower Component

The main purpose of the hydroelectric plant (HEP) component of the conjunctive scheme is to generate an income stream through energy sales into the grid, which will be higher than the cost of energy used by the water supply components of the scheme. Such surplus revenue could be used to cross-subsidise the overall scheme, and effectively reduces the net cost of energy. This significantly reduces the unit cost of water supplied for potable and irrigation purposes, greatly improves the viability and sustainability of both water supply components.

Such an option also has the advantage of delivering its surplus energy into the grid, adding to the green energy component of power supply, as well as being able to be bought on line at very short notice to meet peaks, unlike coal-fired stations which require long cold-start and shutdown periods.

The proposed arrangement is for a base load HEP to be developed, which would be able to operate on a constant output 24 hours per day basis, rather than a peaking station only operating for a few hours per day.

Environmental water requirement govern how much water can be released in this way on a seasonal basis, and the recommended configuration will allow for the HEP to be able to produce up to 37.5 MW during the summer wet season months, and not less than 12.5 MW during the winter dry season months.

Such a scheme should therefore not be confused with a pumped storage scheme which only produces peak power output for the few peak hours of each day, and then consumes energy re-pumping the volumes of water utilized back up to the upper dam for the rest of each day.

7.2 Arrangements for Connection to the Grid

Discussions have been held with the regional ESKOM Grid Access Office in East London. They confirmed that energy supplied by the Lalini scheme can be evacuated into the regional grid through interconnector power lines and appropriate transformers, switching systems and metering arrangements.

The same interconnectors can be used at the beginning of the project to provide power for the works construction, as well as the transmission of surplus power generated into the regional grid.

There are several options for receiving revenue for the energy evacuated into the ESKOM grid.

a) Energy Offset with ESKOM

ESKOM allows for energy generators who produce power for their own use to also export surplus generated energy on to ESKOM's network. ESKOM does not buy this energy but a financial credit adjustment is given to the customer (in lieu of purchasing the energy) at the standard tariffs in the time of use period.

In all options, the generator will be required to pay connection fees and use-of-system charges based upon the generator's location and MW generated.

The generator cannot have an account that is a negative Rand value due to large surplus generation, instead the maximum the account can be credited is to take the generator to a zero amount. See Figure 7-1.

The generator would receive credits (not cash) from ESKOM for the energy sold into the grid. Typically this will be credited at the Megaflex tariff, which, for a 24 hr average supply operation is currently averaging R0.48/kWh.

Higher tariffs would be possible if peak period generation is established, but the investigation undertaken for the Lalini scheme concluded that a peaking station is non-viable in terms of the environmental impacts in the river downsteam and the significant increased capital costs.

The cost of energy consumed by the other two components of the scheme, predominantly for water pumping, will be charged at the normal ESKOM tariff applicable. For the purposes of this analysis, the typical tariff used is the Ruraflex tariff, which, on a non-peak 20 hr per day average usage basis, has a current average cost of R0.50/kWh. It should be noted that if pumping is operated on a 24 hrs per day basis, this would increase the average power tariff to some R0.80/kWh.

Given that the average energy consumption for the water supply components of the scheme will range from 8 to 10 MW, and the average output of the hydropower scheme will supply some 24 MW, this produces a net surplus energy that is in excess of the total energy cost. There is no existing mechanism with ESKOM for the value of all the excess energy generated to be credited to the project, thus significantly limiting the ability to subsidise the project, and thus limiting the positive economic benefits from the Lalini hydropower plant.

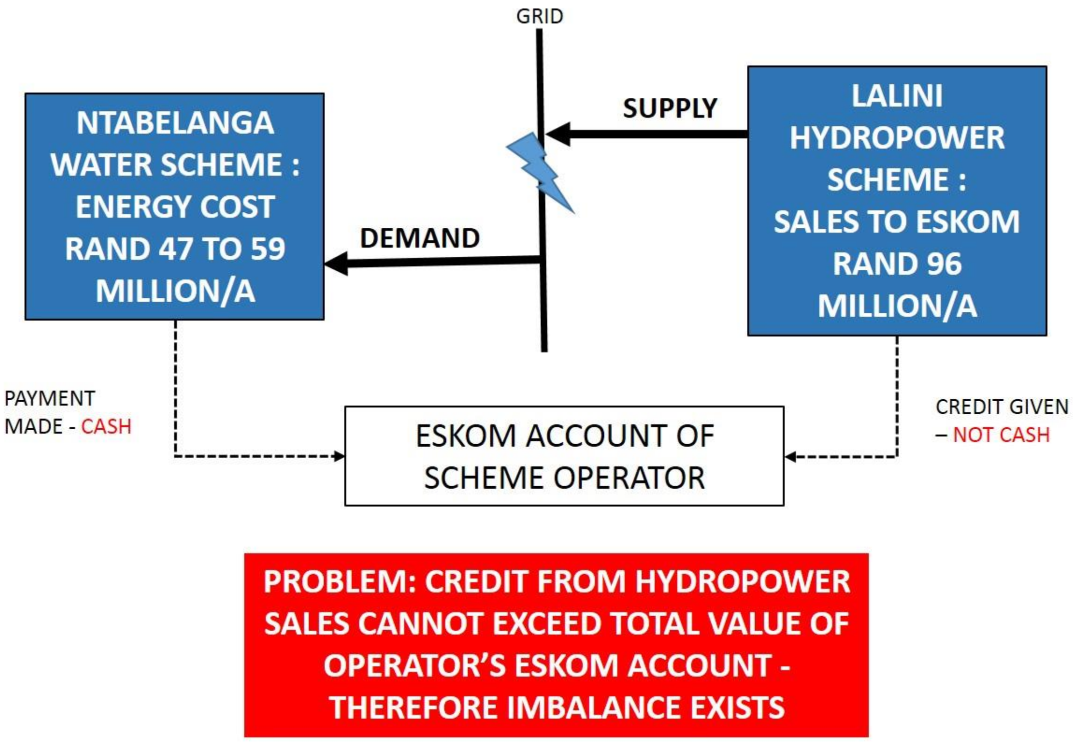


Figure 7-1: Energy offsetting with ESKOM

b) Green Energy Trading with Amatola Green Power

Instead of wheeling power directly with ESKOM, another option is to develop an agreement with Amatola Green Power (AGP), which has a license to trade in green energy anywhere in South Africa.

AGP pays generators in cash for the energy that they supply into the ESKOM grid. The generators pay ESKOM only for the grid access usage charges. In this case AGP would pay the generator between R0.62 and R1.05/kWh at current price levels.

For each 1 000 kWh (1 MWh) purchased by AGP, a number is generated as a credit with ESKOM by an independent auditing body called the “Issuing Body” and kept in a national database. Tradable Renewable Energy Credits / Certificates (TRECS) certificates are sold by AGP to energy consumers to allow them to obtain their energy requirements from their local grid (ESKOM or Municipality), which energy is duly certified to have been generated from renewable sources. See Figures 7-2 and 7-3.

TRECS are traded on the South African market at present, which is an entirely voluntary market. The buyer of TRECS could end up being a different one than the buyer of the Green Power.

With this energy trading option, the full economic benefit of the power generation from Laleni Hydropower plant could be realised, as Amatola Green Power will pay cash to the scheme for every kWh supplied to the power grid.

In this model, not only is the full cost of energy for the conjunctive scheme covered, but very significant additional surplus income is realised to further subsidize the project, operations and maintenance.

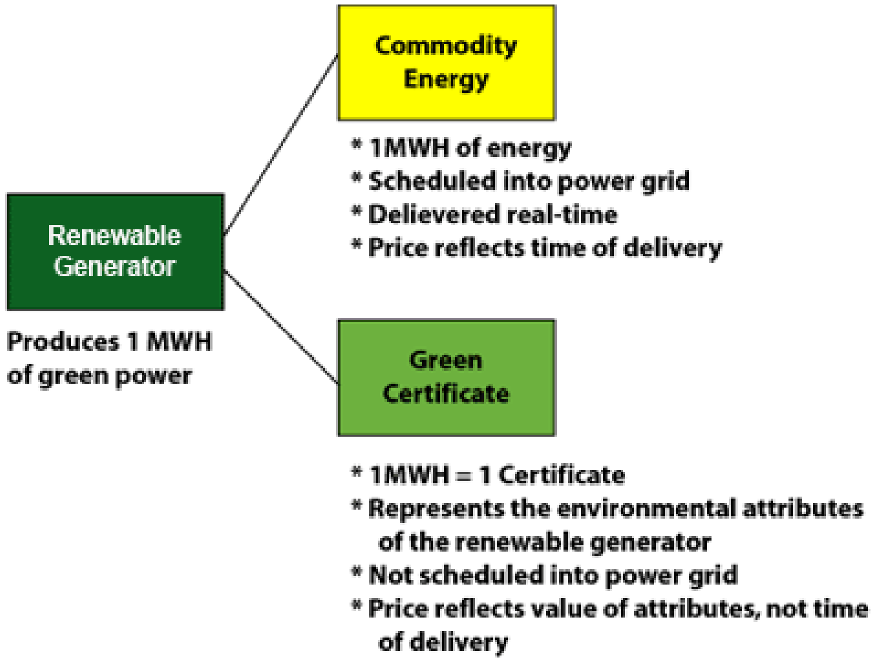


Figure 7-2: Illustration of the Tradable Renewable Energy Credits / Certificates Arrangement

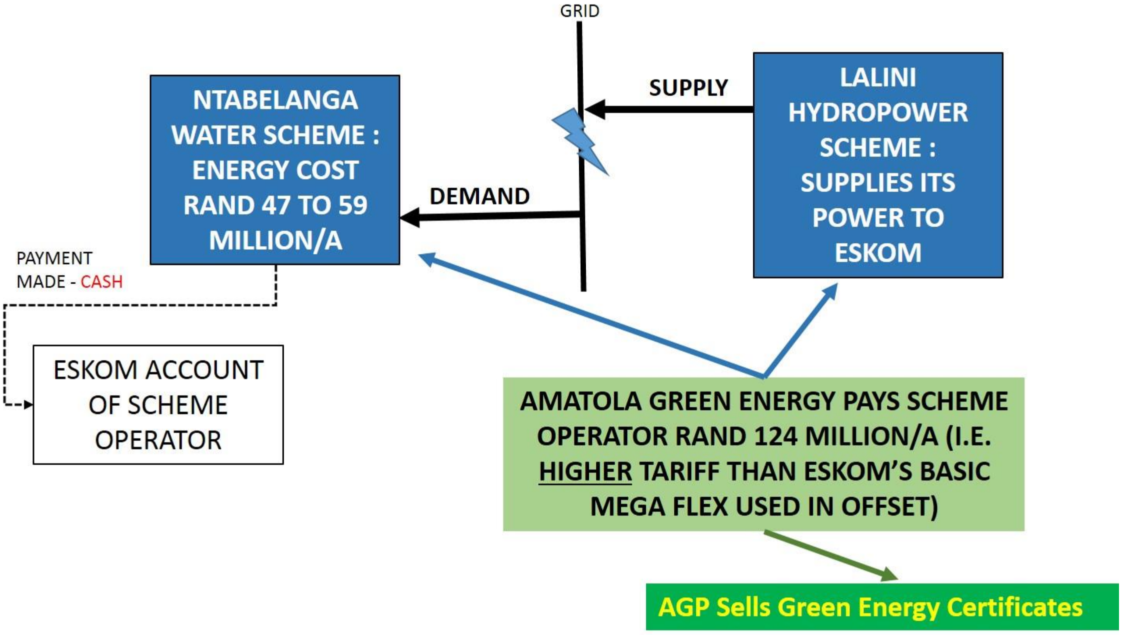


Figure 7-3: Energy Trading with AGP

The cost of energy consumed by the other components of the scheme, predominantly for water pumping, will be charged at the normal ESKOM tariff applicable. For the purposes of this analysis, the typical tariff used is the *Ruraflex* tariff, which, based on a non-peak 20 hrs per day average usage basis, has a current average cost of some R0.50/kWh.

7.3 Economic Analysis of Scheme Configurations and Funding

URV models have been run to take into account either full capital redemption, or for various proportions or components of the works being grant funded. In general, it is normal for water supply systems to scattered rural communities with high indigent populations to require significant or total grant funding, with the revenue from the equitable share and water sales being used to fund operation and maintenance costs only.

Various capital redemption scenarios have been modelled from no grant funding (100 % capital cost taken into account in Net Present Value) to full grant funding of the various system components.

For grant funded options, the full cost of operation, maintenance, staffing and power cost is generally always still included, with the exception of scenarios where the impact of partial or full subsidization of power costs are investigated.

In all cases the unit rate for power consumption is averaged as described above, based on the 20 hours per day operational regime, and on scenarios which include hydropower generation, the revenue stream is based upon the option of the green energy trading, with a current tariff averaging R0.8/kWh.

Appendices G and H, contain the detailed discounted cash flow models for the potable water, and irrigation water components when considered separately, with Appendix I containing the combined models for the conjunctive scheme.

7.4 URV of Ntabelanga Potable Bulk Water System

Appendix G shows the discounted cash flow models used to calculate the URV of potable water supplied, including all costs from the Ntabelanga Dam, water treatment works, pumping stations, primary and secondary bulk water distribution and storage reservoirs, and tertiary lines to local tanks at each of the settlements to be supplied in the three District Municipalities.

For this analysis, no hydropower installations were included, and the dam and associated infrastructure costing has been proportionally allocated to allow for only those elements or share of costs that would be required to supply the potable water requirements to the planning horizon of the 2050 (i.e. not including the irrigation water components).

The analysis was run for the potable scheme including the tertiary lines (Table 7-1 summarises the results) and for the scheme excluding the tertiary lines (Table 7-2).

Table 7-1: URV for Ntabelanga Potable Water Scheme Alone – Including Tertiary Pipeines

URV: POTABLE WATER SCHEME ONLY INCL TERTIARIES				
Scenario	Components Grant Funded	URV OF WATER SUPPLIED (R/m^3)		
		6%	8%	10%
1	Full Capital Redemption	14.21	15.49	16.71
2	Fully grant funded	3.22	2.96	2.72
3	Fully grant funded + 50% Energy Subsidized	2.80	2.57	2.37
4	Fully grant funded + 100% Energy Subsidized	2.37	2.19	2.01

Table 7-2: URV for Ntabelanga Potable Water Scheme Alone– Excluding Tertiary Pipelines

URV: POTABLE WATER SCHEME ONLY EXCL TERTIARIES				
Scenario	**Components Grant Funded**	**URV OF WATER SUPPLIED (R/m^3)**		
		6%	**8%**	**10%**
1	Full Capital Redemption	9.45	10.20	10.92
2	Fully grant funded	2.47	2.27	2.08
3	Fully grant funded + 50% Energy Subsidized	2.05	1.88	1.73
4	Fully grant funded + 100% Energy Subsidized	1.62	1.49	1.38

The results serve as an illustration of the obvious benefits of grant funding and the impacts of partial or full subsidization of the energy costs.

Whilst a URV value does not relate directly to the tariff requirements for a viable scheme, experience has shown that this value should be below R2.00/m^3 on grant funded schemes where operation, maintenance and staffing costs need to be recovered for sustainability.

Financial impact models have been built to test such sustainability and are presented in the next section.

As would be expected, the inclusion of the tertiary pipelines would significantly increase the URV of water, but the analysis is based upon the DWS-developed scheme which includes delivery of potable water in bulk to the primary and secondary system only.

The tertiary pipelines would be the responsibility of the DMs to implement, and these are normally funded via grants under the RBIG and MIG funding process.

7.5 URV of Bulk Irrigation Water System

Appendix H shows the discounted cash flow models used to calculate the URV of bulk irrigation water supplied, including all costs of abstracting raw water from the Ntabelanga Dam, the raw water pumping station, the intermediate bulk storage reservoir, and gravity pipelines to local tanks at each of the proposed farming units.

The delivery of raw water to some of the farm units at higher elevation will also require two small booster pumping stations, which are also included in the analysis. In-field distribution costs and associated equipment are not included, and the URV of water supplied therefore relates to the bulk water to be purchased by the farm unit developers.

Once again, various capital redemption scenarios have been modelled from no grant funding (100 % capital cost taken into account in Net Present Value) to full grant funding of the various system components.

For grant funded options, the full cost of operation, maintenance, staffing and power cost is again included, with the exception of scenarios where the impact of partial or full subsidization of power costs are investigated.

Table 7-3 summarises the results of this analysis.

Table 7-3: Summary of Results of Irrigation Water System URV Analysis

URV: IRRIGATION SCHEME COMPONENTS ONLY				
Scenario	Components Grant Funded	URV OF WATER SUPPLIED (R/m³)		
		6%	8%	10%
1	Full Capital Redemption	3.94	4.26	4.56
2	Fully Grant Funded	0.53	0.48	0.44
3	Grant Funded and 50% Energy Subsidized	0.44	0.40	0.37
4	Grant Funded and 100% Energy Subsidized	0.35	0.32	0.29

The results again serve as an illustration of the obvious benefits of grant funding and the impacts of partial or full subsidization of the energy costs.

Whilst a URV value does not relate directly to the tariff requirements for a viable scheme, experience has shown that for irrigated agriculture, where low unit cost of water is required for viability, this value should be well below R0.50/m^3 on grant funded schemes where operation, maintenance and staffing costs need to be recovered for sustainability.

The above table and figure show the significant impact on the URV of raw water delivered in bulk to the edge of field of the proposed farming units, when capital costs and power costs are subsidized.

This is reflected when taking a straightforward non-discounting approach to the operation and maintenance cost of this component, as is shown in Table 7-4.

Table 7-4: Annual Operation and Maintenance Costs for Irrigation Component

OPTION 3 - IRRIGATION PIPELINE DIRECT FROM DAM						
ITEM	DESCRIPTION	AMOUNT		O&M per year		
1	Pipelines	R	405 636 748	0.50%	R	2 028 184
2	Abstraction works	R	8 000 000	0.25%	R	20 000
3	Pumpstations	R	23 280 152	4%	R	931 206
4	Reservoirs	R	50 000 000	0.25%	R	125 000
5	Electrical supply	R	10 000 000	4%	R	400 000
6	Contingencies	R	49 691 690	1%	R	496 917
7	Engineering fees	R	32 796 515			
	Allowance for M&E depreciation and replacement funding				R	956 515
	Total 1	**R**	**579 405 105**		**R**	**4 957 822**
	VAT	R	81 116 715		R	694 095
	Total	**R**	**660 521 820**		**R**	**5 651 917**
				Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power				21 240 366		R 0.27
Power Cost per year		**R**	**18 559 958**	21 240 366		R 0.87
Cost for supply of raw water to edge of field including power				**R/m³**		**R 1.14**

Reduction of this unit cost to around R0.25/m^3 by subsidisation of energy (i.e. through the hydropower component), would considerably increase the gross margin produced by each farming unit, and viability of the irrigation component in total.

This is further investigated in the financial impact analyses in the next section.

7.6 Overall URV of Conjunctive Scheme

The above discounted cash flow/URV models have been combined to test the impact of operating the potable water, irrigation water, and hydropower components as an integrated scheme. The combined URV models are given in Appendix I.

Whilst the URV models for the potable and irrigation water were added incrementally together with the capital, operating and maintenance costs of the conjunctive Ntabelanga-Lalini hydropower components, the value of an annual credit from the surplus energy income from the hydropower component over the annual energy costs of the water supply components was made.

This had the effect of significantly reducing the overall URV of water supplied as is shown on Table 7-5 and Figure 7-4.

Again, the impact of various proportions of grant funding of the capital costs of the conjunctive scheme were also considered. Seven scenarios are shown, ranging from no grant funding (full capital redemption) to full grant funding, only operation and maintenance costs redeemed.

Table 7-5: URV for Fully Conjunctive Ntabelanga-Lalini Scheme – Incl. Tertiaries

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME INCL TERTIARIES				
Scenario	Components Grant Funded	URV OF WATER SUPPLIED (R/m^3)		
		6%	8%	10%
1	None - Full Capital Redemption	11.47	12.95	14.33
2	Lalini Scheme Only	7.78	8.78	9.71
3	Ntabelanga Scheme Only	4.69	5.27	5.81
4	Lalini + Tertiaries	5.86	6.59	7.26
5	Lalini + Tertiaries + Irrigation	5.01	5.64	6.23
6	Lalini + Tertiaries + Irrigation + Prim and Sec Bulk System	3.40	3.80	4.17
7	All Works Grant Funded	0.77	0.82	0.87

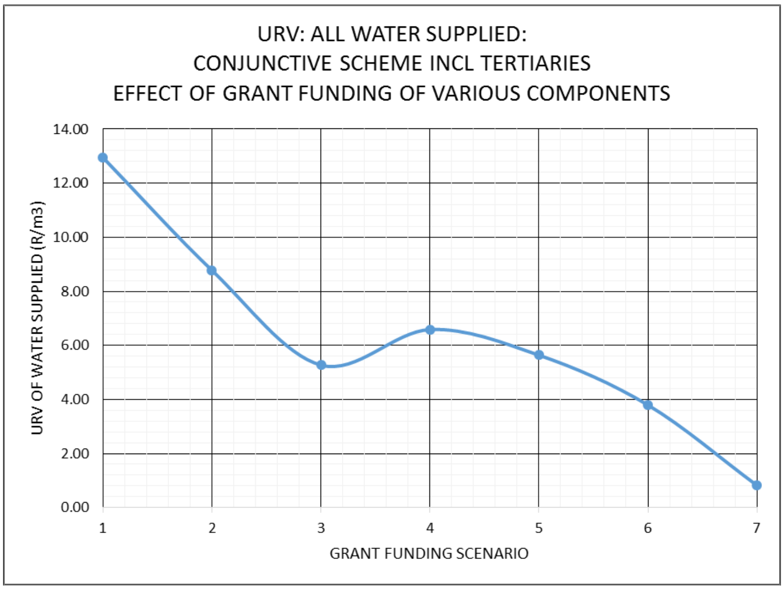


Figure 7-4: Conjunctive Scheme - URVs for Various Grant Funding Scenarios (Incl. Tertiaries)

Alternatives of only grant funding the Ntabelanga scheme or the Lalini scheme components are shown as scenarios 2 and 3. The same analysis was repeated for the fully conjunctive scheme, but without the tertiary pipeline system included. Table 7-6 and Figure 7-5 show the results.

Table 7-6: URV for Fully Conjunctive Ntabelanga-Lalini Scheme – Excl. Tertiaries

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME EXCL TERTIARIES				
Scenario	**Components Grant Funded**	**URV OF WATER SUPPLIED (R/m^3)**		
		6%	**8%**	**10%**
1	None - Full Capital Redemption	9.37	10.60	11.75
2	Lalini Scheme Only	5.51	6.27	6.98
3	Ntabelanga Scheme Only	4.29	4.89	5.45
4	Lalini	5.47	6.22	6.92
5	Lalini + Irrigation	4.63	5.28	5.89
6	Lalini + Irrigation + Prim and Sec Bulk System	3.02	3.44	3.85
7	All Works Grant Funded	0.41	0.49	0.57

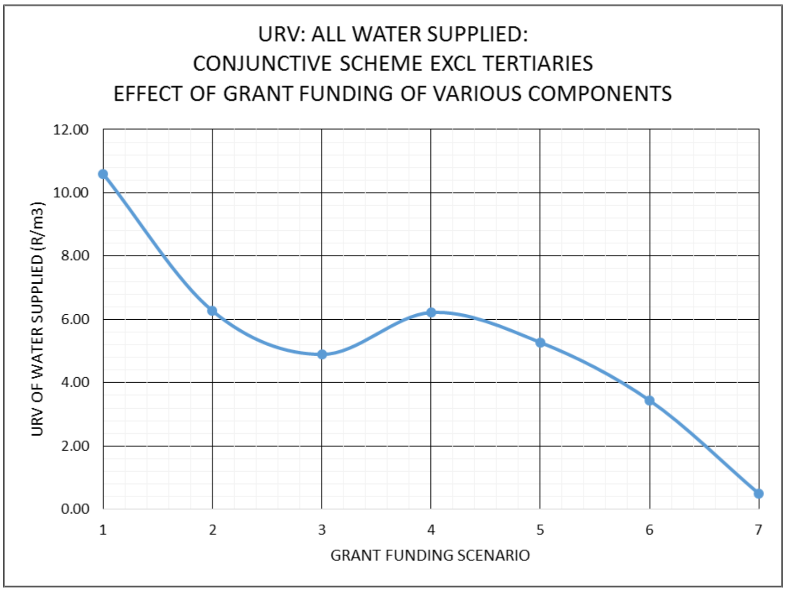


Figure 7-5: Conjunctive Scheme - URVs for Various Grant Funding Scenarios Excl Tertiaries

As can be expected the exclusion of the tertiary pipelines reduces the URV significantly and under the fully grant funded option almost halves the URV of water supplied.

Comparing the URV of water produced for scenario 2 on Table 7-1 (Ntabelanga scheme only – no energy subsidy as no hydropower included) with the URV of water produced in scenario 7 for the full conjunctive scheme on Table 7-5, shows the impact of the cross-subsidization of energy costs, and the benefit of surplus revenue generated by the conjunctive scheme, which produces (at 8% discount rate) a drop in URV value from $R2.96/m^3$ to $R0.82/m^3$. The findings indicated that there could be significant merit in development the conjunctive scheme instead of the Ntabelanga scheme only, and it was agreed that both options would be investigated in terms of financial impact assessment.

This is especially pertinent given the high proportion of operating costs that are due to energy charges, and the likely continuing increase in energy costs in the future at much higher a rate than normal inflation.

8. FINANCIAL IMPACT ASSESSMENT

8.1 Overview

The financial impact models are different from the economic models in that they take into account the escalated costs, tariffs and cash flow year on year using realistic bulk water tariffs and projected escalation rates which take into account current the current and project economy indicators.

As with the URV models, these financial models were run for a 30 year simulation from this current year, and it was assumed that the bulk water supply operations would be undertaken by an implementing agent such as Amatola Water, who currently operate similar schemes in this region.

Water tariffs, costs and revenue streams were escalated to the date of expenditure, as follows:

- Capital and O&M cost are escalated at 5.5 % p.a., and
- Energy costs escalated at 8.5% p.a. for 3 years then at 6.5% p.a.

The scheme components analysed excluded the tertiary pipelines in order to replicate the limits of infrastructure that would be operated by the bulk water supply operator (such as Amatola Water), and it would then be up to the Water Services Providers (DMs) to reticulate and deliver the potable water onwards from this bulk supplier's terminal reservoirs to the customers.

In terms of actual sales quantities, the water requirements projections were used and adjusted for expected unaccounted for water in terms of losses, and deducting water supplied as free basic water (the latter estimated as some 25% of the total potable water produced).

Using Alfred Nzo DM as an example, their water supply tariffs to domestic customers allow for the first 6 m^3/month per household free to indigent customers, but they also charge some R1.60/m^3 in this lower consumption band if the customer is determined to be "non-indigent". Above 6 m^3/month per household consumption, the tariffs increase steeply to R5.5/m^3 for up to 21 m^3/month/household consumption, and to R10.9/m^3 in the next tariff band, and so on up to a maximum of R22/m^3.

Commercial/industrial customer tariffs start at R5.7/m^3 in the first 10 m^3/month band, rising to R11.5/m^3 in the next 20 m^3/month band and rising steadily to R28.6/m^3 for consumption above 120 m^3/month.

These tariffs bands are set to ensure that the poorer customers are cross-subsidized. In addition, each DM receives annual subsidies through the Local Government Equitable Share programme. These subsidies are to fund the provision of basic services to indigent households, which is currently of the order of R275 per month per indigent household, and of which some R87 per month (average nationally) is typically allocated for water supply services.

The above information was used as an indicator to try to ascertain what bulk potable water supply tariff could be afforded by the DMs that would be supplied by the proposed bulk water supply scheme.

As described in the Legal Institutional and Financing Arrangement Report No. P WMA 12/T30/00/5212/16, it is recommended that a well-resourced and experience bulk water supply operator be appointed to operate and maintain the bulk water supply system, and sites Amatola Water as a strong possible for this role.

According to Amatola Water's Annual Report 2014, they sell bulk raw water at a tariff of R1.57/m^3, and potable water at a tariff of R6.36/m^3, with a resulting composite average water sales tariff of R5.39/m^3 (2014). This is relatively high when compared with the much larger Water Boards such as Rand Water and Umgeni Water, and reflects the benefits of economies of scale that these larger Water Boards enjoy.

The appointment of Amatola Water to operate and maintain the Ntabelanga bulk water supply scheme would more than double this organisation's annual potable water sales and triple the overall water sales, which would certainly add economies of scale to Amatola's operation, which could mean a lowering of the average bulk water tariff to sustain their business.

8.1.1 Sources of Capital Works Funding

Different sources of capital works funding were investigated:

Grant funding: Interest free and with no repayment requirement. The source of such funding would normally be from the National Treasury, although some international agencies can provide grant funding – normally for social upliftment project which otherwise would not be financially viable.

Loan funding: Borrowing funds at a certain interest rate per annum, with a requirement to repay the loan over a period (tenor) normally of the order of 20 to 25 years. The lender would set terms and conditions which would need to be complied with by the borrower. Loans which do not have an agreed fixed interest rate would have a higher risk than those which have fixed interest rates. If the loan funding is to be sourced and repaid in foreign currency, then there would be an exchange rate risk.

Equity funding: An investor raises funding for the purchase of a share in the works for which the investor receives an agreed annual dividend. The equity investment is not repaid but could be traded to other investors as shares.

8.1.2 Ntabelanga Bulk Water Supply Scheme

This analysis was based upon the infrastructure illustrated on Figure 5-2, and excludes the tertiary pipeline system to be implemented by the DMs.

Taking the above situation into consideration, and in order to test the financial viability of the study scheme options, the initial potable and irrigation water sales tariffs in year 1 (2015) were set at R5.00/m^3 and R0.30/m^3 respectively.

Power cost projections were based upon the estimated initial power consumption, and expected power tariff, in the first year of operation (2020), escalated thereafter at 6.5% p.a. Capital works and associated implementation expenditures were escalated from the 2014-based cost estimates at 5.5% p.a. with annual expenditure cash flow estimated from the projected implementation programme timing.

Figure 8-1 shows that even with all capital costs grant funded, the income from water sales would not be sufficient to sustain the management, operation, maintenance and energy costs of the scheme.

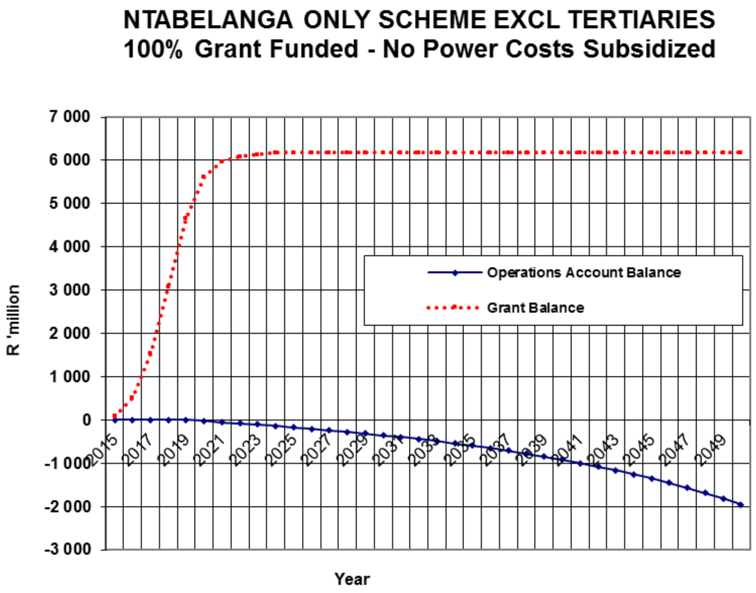


Figure 8-1: Grant Funded Ntabelanga Water Supply Scheme – R5.00/m^3 initial tariff

The operations account balance shows annual operating losses commencing at R25 million per year in the first year of operation rising to R130 million per year in 2050. Thus this scheme would not be financially sustainable in the absence of some subsidy of the management, operation, maintenance and energy costs.

Raising the initial (year 1) bulk water tariff to R6.00/m^3 does bring the operating account into balance, but this is likely to be a non-affordable bulk water tariff for the DMs to pay when the additional management, operation and maintenance costs of the tertiary distribution systems are taken into consideration, together with the high proportion of indigent households to be supplied by this scheme. See Figure 8-2.

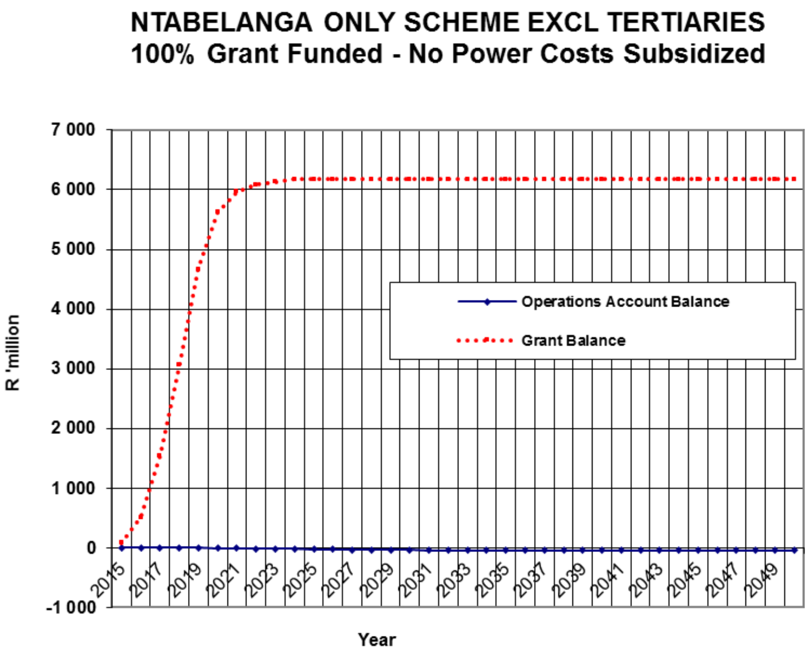


Figure 8-2: Grant Funded Ntabelanga Water Supply Scheme – R6.00/m^3 initial tariff

8.1.3 Grant Funded Conjunctive Scheme Excluding Tertiary System

This financial impact model was initially run for a fully grant funded situation, and using the same base data as for the Ntabelanga scheme excluding the tertiary system.

Apart from higher capital, operations and maintenance costs, the model also includes credit for the energy sold into the grid from the hydropower components of the conjunctive scheme. This energy would be sold as green energy trading certificates (as with the AGP example) and the year 1 (2015) tariff allowed for this was R0.80/kWh, which was then escalated at national escalation rate of 5.5% p.a.

As shown in Figure 8-3, even with water sales tariffs set at ZERO for both potable and irrigation water sold, the revenue generated by hydropower sales alone would sufficient to financial sustain management, operation, maintenance and power costs for the conjunctive scheme.

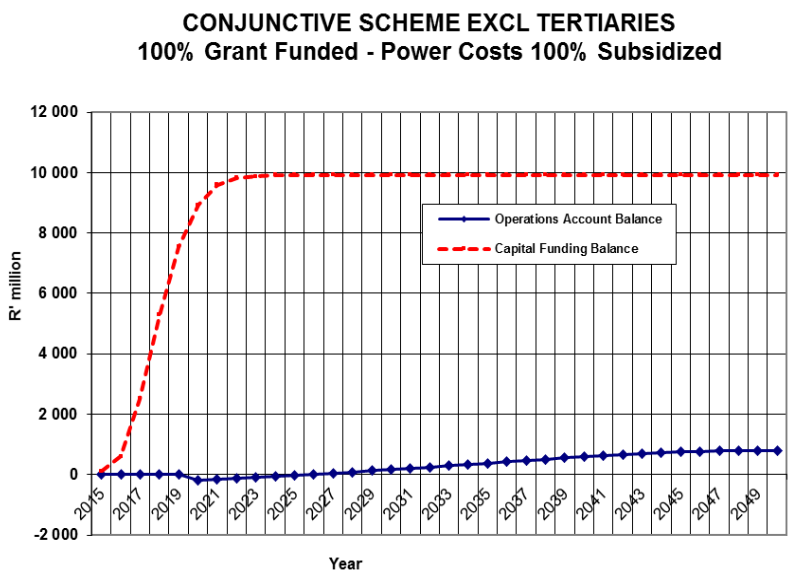


Figure 8-3: Grant Funded Conjunctive Water Supply Scheme – R ZERO/m^3 initial tariff

It is of course not sensible to deliver bulk water at zero tariff and two more scenarios were explored for the fully grant funded conjunctive scheme, setting the bulk potable water tariff to R3.00/m^3 and R5.00/m^3 respectively, and setting the initial irrigation water tariff at R0.30/m^3 in both cases. The results are shown in Figures 8-4 and 8-5.

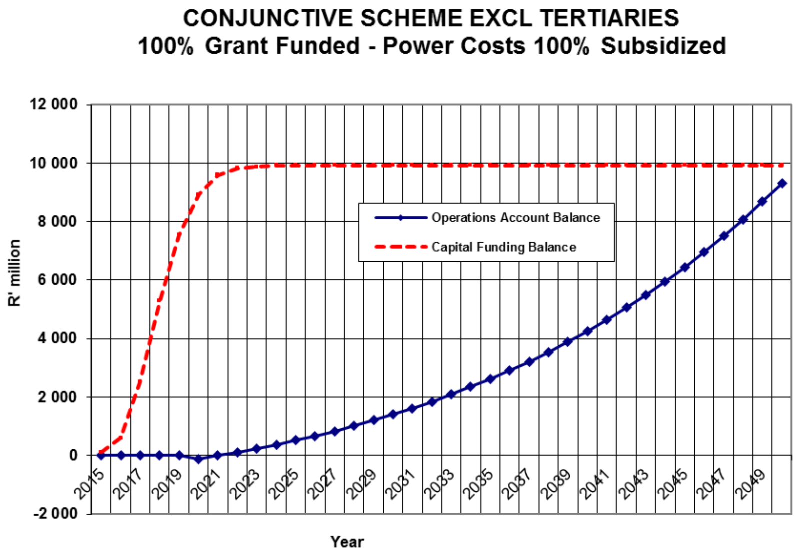


Figure 8-4: Grant Funded Conjunctive Water Supply Scheme – R3.00/m^3 initial tariff

This scenario shows that by charging an initial bulk water tariff equivalent to R3.00/m^3 for potable water and R0.30/m^3 for irrigation water, all recurring costs can be met as well as generating cash surpluses, which over the 30 year period of analysis accumulate to over R9 billion and which could be utilized to either repay the grant funding or put into other social and economic development projects in the region.

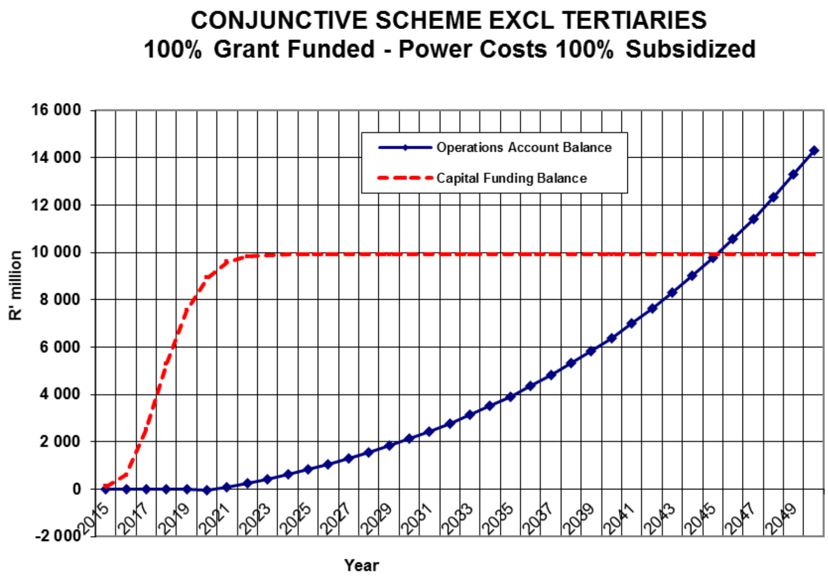


Figure 8-5: Grant Funded Conjunctive Water Supply Scheme – R5.00/m^3 initial tariff

Figure 8-5 shows that increasing the potable bulk water initial tariff to R5.00/m^3 produces even more of cash surplus per annum which would accumulate to more than R14 billion over 30 years.

Under both of these circumstances there would be many options available for the utilisation of such surplus, from the above described usage for other development projects to the simpler action of treating the grant funding as an interest free loan from Treasury, which could be repaid over a given period.

8.1.4 *Other Conjunctive Scheme Financing Options*

The options considered in this respect were as follows:

- Lalini 40% loan funded @ 9% interest p.a. with R3.00/m^3 initial tariff
- Lalini 60% loan funded @ 6% interest p.a. with R3.00/m^3 initial tariff
- Lalini 60% loan funded @ 9% interest p.a. with R5.00/m^3 initial tariff
- Lalini 100% loan funded @ 6% interest p.a. with R5.00/m^3 initial tariff
- Lalini 25% equity funded @ 15% return on investment - with R5.00/m^3 initial tariff

Each of these models was run and percentages of Lalini funded by loans adjusted until a stable operations account balance was maintained after meeting all other costs and debt repayment conditions.

This indicates the effect of different loan interest rates as well as the initial tariff impacts upon the size of loan that could be repaid within a reasonable period (less than 30 years).

The findings are summarized in Figures 8-6 to 8-10.

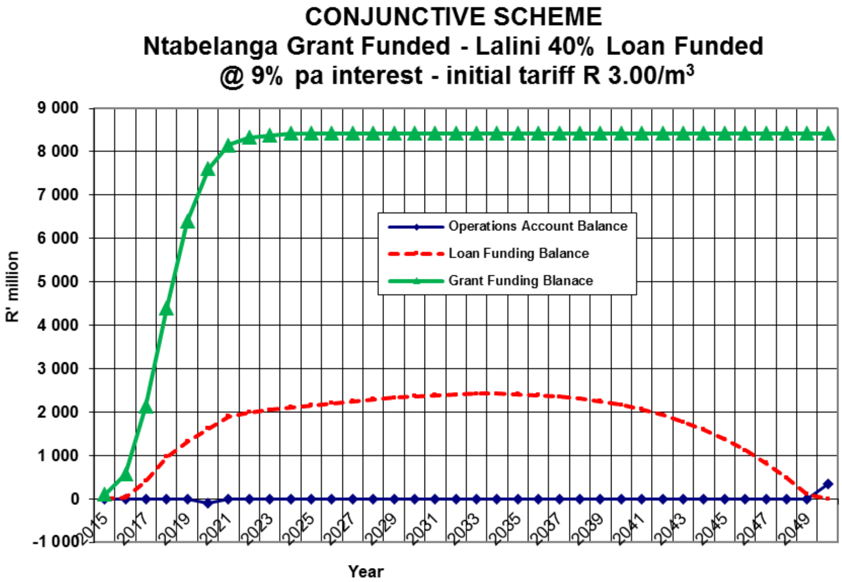


Figure 8-6: Conjunctive Scheme: Lalini 40% Loan Funded @ 9% interest: R3.00/m^3 initial tariff

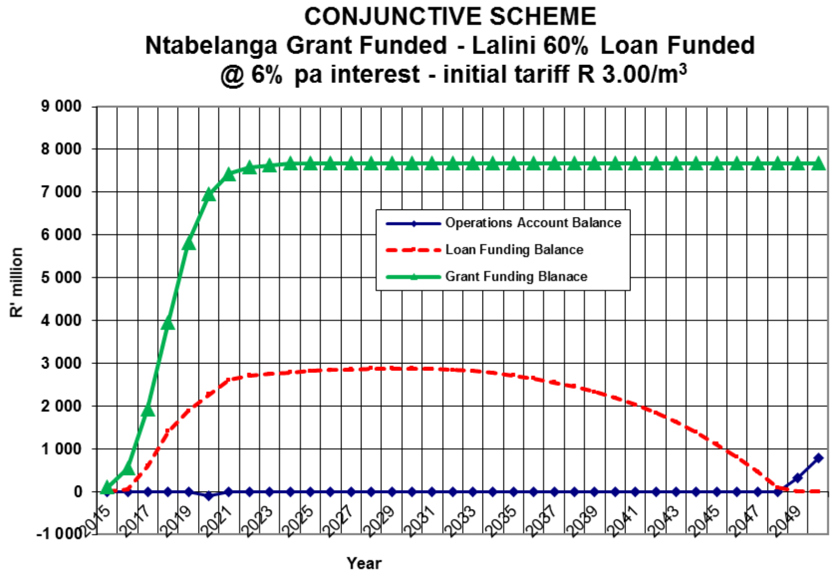


Figure 8-7: Conjunctive Scheme: Lalini 60% Loan Funded @ 6% interest: R3.00/m^3 initial tariff

In these two cases it is indicated that from a relatively low bulk water tariff of R3.00/m^3, a loan of between 40% and 60% of the Lalini component capital cost could be repaid through revenue generated, depending upon the interest terms of such a loan.

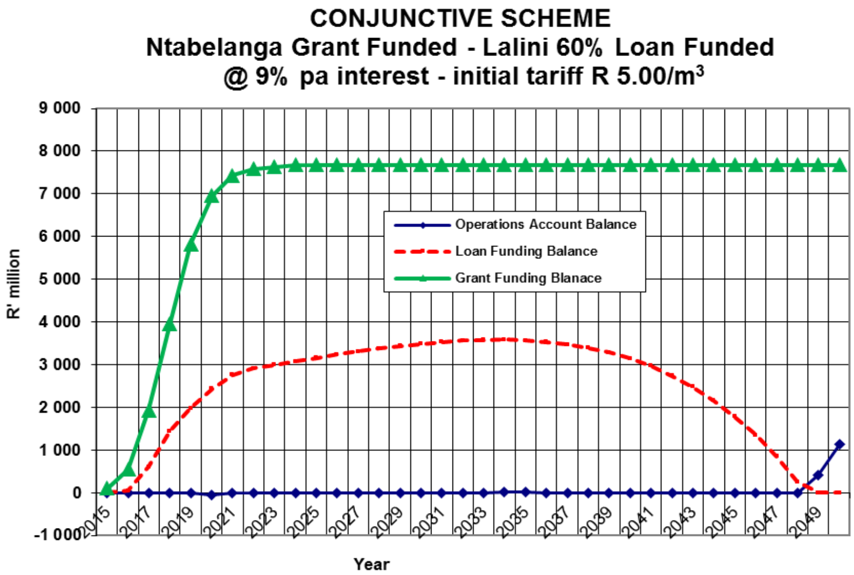


Figure 8-8: Conjunctive Scheme: Lalini 60% Loan Funded @ 9% interest: R5.00/m^3 initial tariff

For a loan of 60% of the Lalini scheme cost to be repaid at 9% interest, the initial tariff would need to be increased to R5.00/m^3.

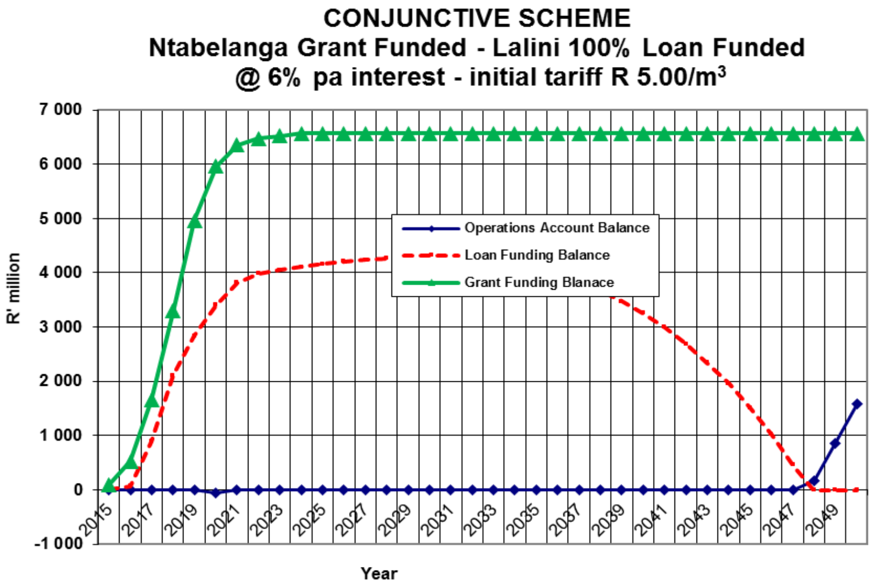


Figure 8-9: Conjunctive Scheme: Lalini 100% Loan Funded @ 6% interest: R5.00/m^3 initial tariff

For a 100% loan for the Lalini scheme cost to be repaid at 6% interest, the initial tariff would again need to be set to R5.00/m^3.

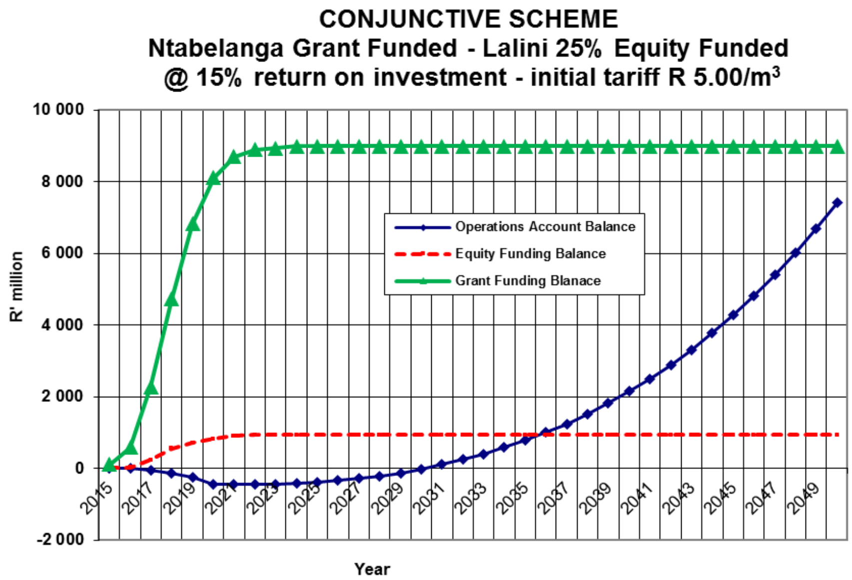


Figure 8-10: Conjunctive Scheme: Lalini 25% Equity @ 15% investment return: R5.00/m^3 initial tariff

Equity investments are another option where the principal capital is not repaid, but an annual dividend (the equity investor's expected return on investment – normally of the order of 15% p.a.) must be paid. In this case it might be attractive for such an equity investor to also be involved in the operation and maintenance aspects, and there are certain entities that specialise in such utilities management. The financial impact model for a 25% equity investment of the Lalini components of the conjunctive scheme would be viable if the initial bulk water tariff was set to R5.00/m^3.

8.1.5 Summary of Financial Analysis

In summary, the fully grant funded Ntabelanga only scheme would require a high starting base for the bulk potable water tariff in order to be financially sustainable. This being of the order of R6.00/m^3 before being further transferred and distributed through a new tertiary pipeline system that would need to be implemented by the DMs. This is therefore not considered a viable solution.

The conjunctive scheme would still require significant grant funding, as is normally the case on regional water supply systems – especially where constructed in mountainous rural areas with a high proportion of indigent households.

Grant funding of the full conjunction scheme including the Lalini hydropower component would allow low bulk water tariffs to be charged (say R3.00/m^3) as well as generating cash surpluses, which over the 30 year period of analysis accumulate to over R9 billion and which could be utilized to either repay the grant funding or put into other social and economic development projects in the region.

If Amatola Water were to become the operator of the conjunctive scheme, this could radically improve their economies of scale which could also have the impact of reducing the overall average cost of bulk water to all of their other customers as well, which would widen the benefits to a larger area than just the Ntabelanga-Lalini region.

If it is considered necessary to reduce the amount of grant funding of the project through the sourcing of loans or equity investments, then there is also potential for this to happen at the same time as keeping the required bulk potable and irrigation water tariffs to a financially viable and sustainable level. However, the financial burdens imposed upon the scheme due to the need to repay loans, interest, and or equity shareholders dividends, would absorb the potential surplus revenue that could otherwise be used to repay grants and/or to spend on further social upliftment and economic development programmes in this area.

8.2 Conclusion

Given the above results, there is a business case for the implementation of a conjunctive integrated multi-purpose scheme incorporating potable water supply, irrigated agriculture, and hydropower under a single, ring-fenced institutional entity.

This concept has been discussed at several forums including the Project Steering Committee meetings, the Wildcoast Integrated Development Forum, and at the Eastern Cape Social Economic Consultative Council (ECSECC), who have been tasked with stewardship of the implementation of this project on behalf of the Provincial Government.

A recent critical review of the above study findings was also undertaken by Mr Mike Muller on behalf of ECSECC, who came to similar conclusions.

9. OVERALL COST ESTIMATE AND IMPLEMENTATION CASHFLOW

Table 9-1 shows the overall cost estimate and annual cash flow projection for the Ntabelanga-Lalini Conjunctive Scheme.

9.1 Other Costs

In addition to the capital works costs, additional budgets have be allocated in order to implement:

- Catchment restoration and management above the Ntabelanga and Lalini Dams, and
- other potential environmental and social offset costs as might be identified during the EMP preparation process.

The DEA has already allocated a budget of approximately R450 million to be spent over the next 10 years for the catchment restoration and rehabilitation programme. This has already commenced.

There are other potential offset costs might include:

- Environmental impact offsets including replacement of lost wetlands
- Improvements to other infrastructure in the region for those directly affected by the works – including upgrades to schools, clinics, water supplies and sanitation, and other community facilities
- Development of aquaculture
- Development of tourism and recreational infrastructure
- Development of local industries and agri-processing

Each of these aspects will require further studies to determine their specific requirements, viability and cost benefits.

The ongoing EIA study is to investigate the environmental and social impacts, and to determine resettlement, mitigations and compensation requirements, as well as these potential offset requirements.

In the meantime, a provisional budget of R100 million has been allowed for these offsets which has been evenly distributed between the Ntabelanga and Lalini components of the conjunctive scheme.

Table 9-1: Overall Conjunctive Scheme Cost Estimate and Cashflow Projection

COST ESTIMATES		**ANNUAL EXPENDITURES R'MILLION**									
COMPONENT	**R'million**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Ntabelanga dam and associated works	1 075		81	322	215	215	215	27			
Ntabelanga dam hydropower works	88				9	35	35	9			
Ntabelanga land compensation/mitigation costs	18		1	4	4	4	4	1			
Ntabelanga power transmission	29		3	23	3						
Sub-Total Ntabelanga Dam and Associated Works	*1 209*		*85*	*349*	*231*	*254*	*254*	*37*			
Engineering and EMP Costs (12%)	*145*		*10*	*42*	*28*	*30*	*30*	*4*			
Sub-Total Ntabelanga Dam and Associated Works incl Eng & EMP	*1 354*		*95*	*391*	*259*	*284*	*284*	*41*			
Escalation in Each Year @ 5.5% p.a.	265		5	44	45	68	87	16			
Sub-Total Ntabelanga Dam and Associated Works incl Eng, EMP & ESC	*1 619*		*100*	*435*	*304*	*352*	*371*	*57*			
VAT (14%)	227		14	61	43	49	52	8			
Add in R22 million per year for catchment management (no esc)	220	22	22	22	22	22	22	22	22	22	22
Allowance for other offset activities (50% of R100 million)	50				10	15	15	10			
Total Ntabelanga Dam and Associated Works (incl Esc + VAT)	**2 116**	**22**	**136**	**518**	**378**	**438**	**460**	**97**	**22**	**22**	**22**
COMPONENT	**R'million**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Ntabelanga water treatment works	643		32	32	193	193	129	64			
Ntabelanga primary & secondary bulk treated water distribution system	1 234			123	247	370	370	123			
Ntabelanga tertiary bulk treated water distribution system (DM's)	1 425			143	285	428	428	143			
Ntabelanga bulk irrigation water supply system	497				50	149	199	75	25		
Sub-Total Ntabelanga WTW and Bulk Water Systems	*3 799*		*32*	*298*	*774*	*1 140*	*1 125*	*405*	*25*		
Engineering and EMP Costs (12%)	*456*		*4*	*36*	*93*	*137*	*135*	*49*	*3*		
Sub-Total Ntabelanga WTW and Bulk Water Systems incl Eng & EMP	*4 255*		*36*	*334*	*867*	*1 277*	*1 260*	*453*	*28*		
Escalation in Each Year @ 5.5% p.a.	1 067		2	38	151	305	387	172	13		
Sub-Total Ntabelanga WTW and Bulk Water Systems incl Eng, EMP & ESC	*5 322*		*38*	*372*	*1 019*	*1 581*	*1 647*	*625*	*40*		
VAT (14%)	745		5	52	143	221	231	88	6		
Total Ntabelanga WTW and Bulk Water Systems (incl Esc + VAT)	**6 068**		**43**	**424**	**1 161**	**1 803**	**1 878**	**713**	**46**		
COMPONENT	**R'million**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
In-farm irrigation investment costs	**105**						53	53			
Engineering and EMP Costs (12%)	*13*						*6*	*6*			
Sub-Total in-farm irrigation investment costs incl Eng & EMP	*118*						*59*	*59*			
Escalation in Each Year @ 5.5% p.a.	40						18	22			
Sub-Total in-farm irrigation investment costs incl Eng, EMP & ESC	*158*						*77*	*81*			
VAT (14%)	22						11	11			
Total in-farm irrigation investment costs (incl Esc + VAT)	**180**						**88**	**92**			
COMPONENT	**R'million**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Lalini dam and associated works	802				267	267	267				
Lalini Access Roads and Bridges	487			73	195	195	24				
Lalini land compensation/mitigation costs	50				17	17	17				
Lalini water delivery tunnel, shafts and penstocks	756				113	302	302	38			
Lalini hydropower E&M equipment	175					26	79	61	9		
Lalini hydropower civil works	49						24	24			
Lalini power transmission lines to grid	29			14	14						
Sub-Total Lalini Dam and HEP	*2 347*			*87*	*607*	*807*	*714*	*124*	*9*		
Engineering and EMP Costs (12%)	*282*			*10*	*73*	*97*	*86*	*15*	*1*		
Sub-Total Lalini Dam and HEP incl Eng and EMP	*2 629*			*98*	*679*	*904*	*799*	*138*	*10*		
Escalation in Each Year @ 5.5% p.a.	648			11	118	216	245	52	4		
Sub-Total Lalini Dam and HEP incl Eng, EMP and Esc	*3 277*			*109*	*798*	*1 120*	*1 045*	*191*	*14*		
VAT (14%)	459			15	112	157	146	27	2		
Add in R22 million per year for catchment management (no esc)	230	23	23	23	23	23	23	23	23	23	23
Allowance for other offset activities (50% 0f R100 million)	50				10	15	15	10			
Total Lalini Dam and HEP (incl Esc + VAT)	**3 966**	**23**	**23**	**147**	**932**	**1 300**	**1 214**	**241**	**39**	**23**	**23**
		2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
GRAND TOTAL ALL COMPONENTS (R'MILLION INCL ESC AND VAT)	**12 329**	45	203	1 089	2 472	3 541	3 640	1 143	107	45	45

APPENDIX A

BILLS OF QUANTITY AND RATES OF MAJOR QUANTITY ITEMS IN DAM TYPE ANALYSES

Table A.1: Buildup of Dam Type Analysis Costings

DAM TYPE ANALYSIS - BUILD UP OF DAM AND SPILLWAY COST ESTIMATES (RANDS - 2013 PRICE LEVELS)

				CFRD - LHS SC		CFRD - RHS SC		CFRD - RHS CT		ECRD - RHS SC		ECRD - RHS CT		ECRD - CCS		EF - RHS SC		EF - RHS CT		RCC	
				Concrete-faced Rockfill Dam with Left Hand Side Channel Spillway		Concrete-faced Rockfill Dam with Right Hand Side Channel Spillway		Concrete-faced Rockfill Dam with Right Hand Cut ThroughSpillway		Earth Core Rockfill Dam with Right Hand Side Channel Spillway		Earth-Core Rockfill Dam with Right Hand Cut ThroughSpillway		Earth-Core Rockfill Dam (Composite) with Central Concrete Spillway		Earth Fill (Earth Core) Dam with Right Hand Side Channel Spillway		Earth Fill (Earth Core) Dam with Right Hand Side Cut Through Spillway		Roller Compacted Concrete Dam and Spillway	
ITEM NO.	DESCRIPTION	UNIT	RATE	QUANTITY	AMOUNT	QUANTITY	AMOUNT	QUANTITY	AMOUNT	QUANTITY	AMOUNT	QUANTITY	AMOUNT	QUANTITY	AMOUNT	QUANTITY	AMOUNT	QUANTITY	AMOUNT	QUANTITY	AMOUNT
SECTION 1: SITE CLEARING																							
1.1	Clearing and grubbing	ha	18 000	9	162 000	10	180 000	15	270 000	10	180 000	15	270 000	6	108 000	13	234 000	17	306 000	11	191 898
1.2	Topsoil stripping	m²	5	89 000	445 000	97 000	485 000	146 000	730 000	97 000	485 000	146 000	730 000	60 000	300 000	125 000	625 000	170 000	850 000		
1.3	Other items	%	0	607 000	30 350	665 000	33 250	1 000 000	50 000	665 000	33 250	1 000 000	50 000	408 000	20 400	859 000	42 950	1 156 000	57 800	191 898	9 595
	SUBTOTAL CARRIED TO SUMMARY				637 350		698 250		1 050 000		698 250		1 050 000		428 400		901 950		1 213 800		201 493
SECTION 2: DEALING WITH WATER																							
2.1	Dewatering	Sum	200 000	1	200 000	1	200 000	1	200 000	1	200 000	1	200 000	1	200 000	1	200 000	1	200 000	1	200 000
2.2	Settling pond	Sum	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000
2.3	Pollution control measures	Sum	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000
2.4	Other items	%	5.0%	1 200 000	60 000	1 200 000	60 000	1 200 000	60 000	1 200 000	60 000	1 200 000	60 000	1 200 000	60 000	1 200 000	60 000	1 200 000	60 000	1 200 000	60 000
	SUBTOTAL CARRIED TO SUMMARY				1 260 000		1 260 000		1 260 000		1 260 000		1 260 000		1 260 000		1 260 000		1 260 000		1 260 000
SECTION 3: RIVER DIVERSION CONDUIT																							
3.1	Steel pipe conduit	t	22 000	3 050	67 100 000	3 050	67 100 000	3 050	67 100 000	3 050	67 100 000	3 050	67 100 000	3 050	67 100 000	3 560	78 320 000	3 560	78 320 000	Scheduled elsewhere	Scheduled elsewhere
3.2	Structural concrete	m³	3 150	19 520	61 488 000	19 520	61 488 000	19 520	61 488 000	19 520	61 488 000	19 520	61 488 000	19 520	61 488 000	22 784	71 769 600	22 784	71 769 600	Scheduled elsewhere	Scheduled elsewhere
3.3	Reinforcement	t	20 000	1 952	39 040 000	1 952	39 040 000	1 952	39 040 000	1 952	39 040 000	1 952	39 040 000	1 952	39 040 000	2 278	45 568 000	2 278	45 568 000	Scheduled elsewhere	Scheduled elsewhere
3.4	Other items	%	5.0%	167 628 000	8 381 400	167 628 000	8 381 400	167 628 000	8 381 400	167 628 000	8 381 400	167 628 000	8 381 400	167 628 000	8 381 400	195 657 600	9 782 880	195 657 600	9 782 880	Scheduled elsewhere	Scheduled elsewhere
	SUBTOTAL CARRIED TO SUMMARY				176 009 400		176 009 400		176 009 400		176 009 400		176 009 400		176 009 400		205 440 480		205 440 480		0
SECTION 4: EMBANKMENT EARTHWORKS																							
	Necessary excavation to fill																				
4.1	Graded filter	m³	197	17 620	3 462 330	5 425	1 066 013	9 580	1 882 470	5 425	1 066 013	9 580	1 882 470	1 200	235 800	6 300	1 237 950	10 500	2 063 250	Not Applicable	Not Applicable
4.2	Soft	m³	41	24 050	974 025	24 050	974 025	24 050	974 025	24 050	974 025	24 050	974 025	24 050	974 025	0	0	0	0	Not Applicable	Not Applicable
4.3	Hard	m³	118	450 000	53 100 000	780 400	92 087 200	1 186 179	139 969 122	815 600	96 240 800	927 600	109 456 800	166 700	19 670 600	0	0	0	0	Not Applicable	Not Applicable
4.4	Compacted mudstone to 95% MOD. AASHTO in coffer dams	m³	33	14 500	478 500	14 500	478 500	14 500	478 500	14 500	478 500	14 500	478 500	14 500	478 500	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Scheduled elsewhere	Scheduled elsewhere
4.5	Compacted mudstone facing in coffer dams	m³	64	3 500	222 250	3 500	222 250	3 500	222 250	3 500	222 250	3 500	222 250	3 500	222 250	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Scheduled elsewhere	Scheduled elsewhere
4.6	Hard excavation to stockpile	m³	95	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable		40 070 451
	Necessary excavation to spoil																				
4.7	Soft	m³	60	187 700	11 262 000	79 000	4 740 000	158 000	9 480 000	79 000	4 740 000	158 000	9 480 000	23 000	1 380 000	119 800	7 188 000	198 700	11 922 000	56 209	3 221 750
4.8	Hard	m³	125		0	0	0	452 500	56 336 250	0	0	737 300	91 793 850	0	0	858 400	106 870 800	1 716 650	213 722 925	Not Applicable	Not Applicable
	Borrow excavation to fill																				
4.9	Graded filter	m³	222	182 381	40 397 392	194 600	43 103 900	190 420	42 178 030	194 600	43 103 900	190 450	42 184 675	146 500	32 449 750	93 700	20 754 550	89 550	19 835 325	Not Applicable	Not Applicable
4.10	Core Zone	m³	64	12 600	800 100	12 600	800 100	12 600	800 100	271 200	17 221 200	271 200	17 221 200	203 600	12 928 600	273 000	17 335 500	273 000	17 335 500	Not Applicable	Not Applicable
4.11	Soft	m³	91		0	0	0	0	0	0	0	0	0	0	0	2 025 450	183 303 225	2 025 425	183 300 963	Not Applicable	Not Applicable
4.12	Hard	m³	168	736 540	123 738 720	405 800	68 174 400	0	0	112 000	18 816 000	0	0	518 350	87 082 800	0	0	0	0	Not Applicable	Not Applicable
4.13	Riprap	m³	30	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	30 103	903 090	30 103	903 090	Not Applicable	Not Applicable
4.14	Stage 1 diversion works - coffer dams	Sum	636 000	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	1	700 750
4.15	Stage 2 - permanent works - flood channel and berms	Sum	20 000 000	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	Scheduled elsewhere	1	20 000 000
4.16	Foundations																				
4.17	Foundation Prep for core	m³	47	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	8 750	411 250	8 750	411 250	8 750	411 250	16 832	791 086	16 832	791 086		859 453
4.18	Foundation treatment	m²	550	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	19 246	9 360 465
4.19	Overbreak	m²	50	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1 500	75 000
4.20	Rock bolts	Nr	1 000																	100	100 000
4.21	Concrete elements	m³	3 150	13 850	43 627 500	13 850	43 627 500	13 850	43 627 500	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Scheduled elsewhere	Scheduled elsewhere
4.22	Other items	%	5.0%	278 062 817	13 903 141	255 273 888	12 763 694	295 948 247	14 797 412	183 273 938	9 163 697	274 105 020	13 705 251	155 833 575	7 791 679	338 384 201	16 919 210	449 874 139	22 493 707	74 387 869	3 719 393
	SUBTOTAL CARRIED TO SUMMARY				291 965 957		268 037 582		310 745 659		192 437 634		287 810 271		163 625 254		355 303 411		472 367 846		78 107 262
SECTION 5: GROUTING, DRAIN HOLES AND INSTRUMENTATION																							
5.1	Mobilisation of plant	Sum	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000
5.2	Set ups - grouting	Nr	1 250	300	375 000	300	375 000	300	375 000	300	375 000	300	375 000	300	375 000	300	375 000	300	375 000	300	375 000
5.3	Set ups - control holes	Nr	1 250	15	18 750	15	18 750	15	18 750	15	18 750	15	18 750	15	18 750	15	18 750	15	18 750	15	18 750
5.4	Drilling grout holes	m	1 800	9 000	16 200 000	9 000	16 200 000	9 000	16 200 000	12 000	21 600 000	12 000	21 600 000	12 000	21 600 000	12 000	21 600 000	12 000	21 600 000	9 000	16 200 000
5.5	Drilling control holes (with core recovery)	m	2 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000
5.6	Grouting in stages	Nr	1 000	396	396 000	396	396 000	396	396 000	396	396 000	396	396 000	396	396 000	396	396 000	396	396 000	396	396 000
5.7	Water testing in stages	Nr	2 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000	450	900 000
5.8	Cement	t	2 000	250	500 000	250	500 000	250	500 000	250	500 000	250	500 000	250	500 000	250	500 000	250	500 000	250	500 000
5.9	Bentonite	t	3 750	25	93 750	25	93 750	25	93 750	25	93 750	25	93 750	25	93 750	25	93 750	25	93 750	25	93 750
5.10	Place drain holes	Nr	1 200	100	120 000	100	120 000	100	120 000	100	120 000	100	120 000	100	120 000	100	120 000	100	120 000	100	120 000
5.11	Drill drain holes	m	1 250	1 500	1 875 000	1 500	1 875 000	1 500	1 875 000	1 500	1 875 000	1 500	1 875 000	1 500	1 875 000	1 500	1 875 000	1 500	1 875 000	1 500	1 875 000
5.12	Other items	%	5.0%	21 878 500	1 093 925	21 878 500	1 093 925	21 878 500	1 093 925	27 278 500	1 363 925	27 278 500	1 363 925	27 278 500	1 363 925	27 278 500	1 363 925	27 278 500	1 363 925	21 878 500	1 093 925
	SUBTOTAL CARRIED TO SUMMARY				22 972 425		22 972 425		22 972 425		28 642 425		28 642 425		28 642 425		28 642 425		28 642 425		22 972 425
SECTION 6: INTAKE TOWER AND ACCESS BRIDGE																							
6.1	Mass concrete	m3	1 200	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable		9 473 280
6.2	Structural concrete	m3	3 465	1 750	6 063 750	1 750	6 063 750	1 750	6 063 750	1 750	6 063 750	1 750	6 063 750	1 750	6 063 750	2 200	7 623 000	2 200	7 623 000		10 735 087
6.3	Reinforcement	t	20 000	175	3 500 000	175	3 500 000	175	3 500 000	175	3 500 000	175	3 500 000	175	3 500 000	220	4 400 000	220	4 400 000		12 923 768
6.4	Rough formwork	m2	500	720	360 000	720	360 000	720	360 000	720	360 000	720	360 000	720	360 000	1 050	525 000	1 050	525 000		2 331 520
6.5	Smooth formwork	m2	600	4 000	2 400 000	4 000	2 400 000	4 000	2 400 000	4 000	2 400 000	4 000	2 400 000	4 000	2 400 000	5 750	3 450 000	5 750	3 450 000		2 870 376
6.6	Soffit formwork	m2	750	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	630	472 500
6.7	Structural steelwork	Sum	2 000 000	1	2 000 000	1	2 000 000	1	2 000 000	1	2 000 000	1	2 000 000	1	2 000 000	2	4 000 000	2	4 000 000	Scheduled elsewhere	Scheduled elsewhere
6.8	Concrete slide for plant removal	Sum	600 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1	600 000
6.9	Other items	%	5.0%	14 323 750	716 188	14 323 750	716 188	14 323 750	716 188	14 323 750	716 188	14 323 750	716 188	14 323 750	716 188	19 998 000	999 900	19 998 000	999 900	39 406 531	1 970 327
SUBTOTAL CARRIED TO SUMMARY					15 039 938		15 039 938		15 039 938		15 039 938		15 039 938		15 039 938		20 997 900		20 997 900		41 376 858
SECTION 7: OUTLET WORKS																							
7.1	Mechanical & Electrical Works - Incl Gates and Pipework*	Sum	50 000 000	1	50 000 000	1	50 000 000	1	50 000 000	1	50 000 000	1	50 000 000	1	50 000 000	1	50 000 000	1	50 000 000	1	50 000 000
7.2	Other items	%	5.0%	50 000 000	2 500 000	50 000 000	2 500 000	50 000 000	2 500 000	50 000 000	2 500 000	50 000 000	2 500 000	50 000 000	2 500 000	50 000 000	2 500 000	50 000 000	2 500 000	50 000 000	2 500 000
	SUBTOTAL CARRIED TO SUMMARY				52 500 000		52 500 000		52 500 000		52 500 000		52 500 000		52 500 000		52 500 000		52 500 000		52 500 000
SECTION 8: HYDROPOWER PLANT																							
8.1	Pumping station / hydropower generation building	Sum	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000		0
8.2	Mechanical & Electrical Works - Incl Gates and Pipework*	Sum	50 000 000		0		0		0		0		0		0		0		0		0
8.3	Other items	%	5.0%	10 000 000	500 000	10 000 000	500 000	10 000 000	500 000	10 000 000	500 000	10 000 000	500 000	10 000 000	500 000	10 000 000	500 000	10 000 000	500 000	0	0
	SUBTOTAL CARRIED TO SUMMARY				10 500 000		10 500 000		10 500 000		10 500 000		10 500 000		10 500 000		10 500 000		10 500 000		0
SECTION 9: SPILLWAY AND CHUTE																							
9.1	RCC Mix	m3	650	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	320 000	208 000 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		248 547 577
9.2	IVRCC upstream face	m2	312	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	4 000	1 248 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		6 173 005
9.3	IVRCC downstream face	m2	312	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	12 000	3 744 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		8 257 080
9.4	Formwork for IVRCC on downstream face	m2	400	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	12 000	4 800 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		10 586 001
9.5	Reinforcement	t	20 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1 000	20 000 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		720 720
9.6	IVRCC to drainage gallery	m2	312	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	300	93 600	Not Applicable	Not Applicable	Not Applicable	Not Applicable		156 000
9.7	300mm waterstop	m	1 800	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1 000	1 800 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		2 700 000
9.8	Drain holes from dam crest to gallery - set up	Nr	2 500	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	50	125 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		250 000
9.9	Drain holes from dam crest to gallery - drilling	m	3 500	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	2 000	7 000 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		13 650 000
9.1	Precast concrete copings on parapet wall	Nr	1 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	500	500 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		880 000
9.11	Dowels into RCC	Nr	1 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	250	250 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		400 000
9.12	Rock anchors	Nr	1 500	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	250	375 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable		675 000
9.13	Reinforced concrete work	m3	3 150	16 700	52 605 000	6 000	18 900 000	6 000	18 900 000	6 000	18 900 000	6 000	18 900 000	1 000	3 150 000	6 000	18 900 000	6 000	18 900 000	Scheduled elsewhere	Scheduled elsewhere
9.14	Reinforcement	t	20 000	1 670	33 400 000	600	12 000 000	600	12 000 000	600	12 000 000	600	12 000 000	100	2 000 000	600	12 000 000	600	12 000 000	20	400 000
9.15	Rough formwork	m2	400	3 300	1 320 000	3 300	1 320 000	3 300	1 320 000	3 300	1 320 000	3 300	1 320 000	1 000	400 000	3 300	1 320 000	3 300	1 320 000	Scheduled elsewhere	Scheduled elsewhere
9.16	Smooth formwork	m2	500	3 100	1 550 000	3 100	1 550 000	3 100	1 550 000	3 100	1 550 000	3 100	1 550 000	1 000	500 000	3 100	1 550 000	3 100	1 550 000	Scheduled elsewhere	Scheduled elsewhere
9.17	Other items	%	5.0%	88 875 000	4 443 750	33 770 000	1 688 500	33 770 000	1 688 500	33 770 000	1 688 500	33 770 000	1 688 500	253 985 600	12 699 280	33 770 000	1 688 500	33 770 000	1 688 500	292 995 383	7 344 885
	SUBTOTAL CARRIED TO SUMMARY				93 318 750		35 458 500		35 458 500		35 458 500		35 458 500		266 684 880		35 458 500		35 458 500		300 740 267
SECTION 10: OTHER MECHANICAL AND ELECTRICAL WORKS																							
10.1	30 kVA standby diesel generator set	Nr	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000
10.2	Full capacity standby generator	Nr	15 000 000	1	15 000 000	1	15 000 000	1	15 000 000	1	15 000 000	1	15 000 000	1	15 000 000	1	15 000 000	1	15 000 000	1	15 000 000
10.3	High mast tower	Nr	200 000	2	400 000	2	400 000	2	400 000	2	400 000	2	400 000	2	400 000	2	400 000	2	400 000	2	400 000
10.4	All electrical fittings and wirings	Sum	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000
10.5	Instrumentation	Sum	1 000 000	1	1 000 000	1	1 000 000	1	1 000 000	1	1 000 000	1	1 000 000	1	1 000 000	1	1 000 000	1	1 000 000	1	1 000 000
10.6	Ventilation system to gallery	Sum	200 000	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1	200 000
10.7	Other items	%	5.0%	21 900 000	1 095 000	21 900 000	1 095 000	21 900 000	1 095 000	21 900 000	1 095 000	21 900 000	1 095 000	21 900 000	1 095 000	21 900 000	1 095 000	21 900 000	1 095 000	21 100 000	1 055 000
	SUBTOTAL CARRIED TO SUMMARY				22 995 000		22 995 000		22 995 000		22 995 000		22 995 000		22 995 000		22 995 000		22 995 000		23 155 000
SECTION 11: ROAD WORKS AND OTHER ADVANCED WORKS																							
11.1	Gravel access roads	km	750 000	40	30 000 000	40	30 000 000	40	30 000 000	40	30 000 000	40	30 000 000	40	30 000 000	40	30 000 000	40	30 000 000		20 000 000
11.2	Temporary haul roads	km	500 000	10	5 000 000	10	5 000 000	10	5 000 000	10	5 000 000	10	5 000 000	10	5 000 000	10	5 000 000	10	5 000 000		
11.3	Downstream bridge across river	Sum	25 000 000	1	25 000 000	1	25 000 000	1	25 000 000	1	25 000 000	1	25 000 000	1	25 000 000	1	25 000 000	1	25 000 000	1	25 000 000
11.4	Bridge across spillway discharge chute	Sum	7 500 000	1	7 500 000	1	7 500 000	1	7 500 000	1	7 500 000	1	7 500 000	0	0	1	7 500 000	1	7 500 000	Not Applicable	Not Applicable
11.5	Culvert crossing under discharge chute	Sum	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	0	0	1	10 000 000	1	10 000 000	Not Applicable	Not Applicable
11.6	Surfacing access road adjacent to dam	m²	250	40 000	10 000 000	40 000	10 000 000	40 000	10 000 000	40 000	10 000 000	40 000	10 000 000	40 000	10 000 000	40 000	10 000 000	40 000	10 000 000	40 000	10 000 000
11.7	Administration Buildings & Accommodation	Sum	20 000 000	1	20 000 000	1	20 000 000	1	20 000 000	1	20 000 000	1	20 000 000	1	20 000 000	1	20 000 000	1	20 000 000	1	20 000 000
11.8	Other items	%	5.0%	107 500 000	5 375 000	107 500 000	5 375 000	107 500 000	5 375 000	107 500 000	5 375 000	107 500 000	5 375 000	90 000 000	4 500 000	107 500 000	5 375 000	107 500 000	5 375 000	75 000 000	3 750 000
	SUBTOTAL CARRIED TO SUMMARY				112 875 000		112 875 000		112 875 000		112 875 000		112 875 000		94 500 000		112 875 000		112 875 000		78 750 000
SUMMARY																							
	PRELIMINARY AND GENERAL	%	20.0%	800 073 820	160 014 764	718 346 094	143 669 219	761 405 922	152 281 184	648 416 147	129 683 229	744 140 534	148 828 107	832 185 296	166 437 059	846 874 666	169 374 933	964 250 951	192 850 190	599 063 305	119 812 661
	SECTION 1				637 350		698 250		1 050 000		698 250		1 050 000		428 400		901 950		1 213 800		201 493
	SECTION 2				1 260 000		1 260 000		1 260 000		1 260 000		1 260 000		1 260 000		1 260 000		1 260 000		1 260 000
	SECTION 3				176 009 400		176 009 400		176 009 400		176 009 400		176 009 400		176 009 400		205 440 480		205 440 480		0
	SECTION 4				291 965 957		268 037 582		310 745 659		192 437 634		287 810 271		163 625 254		355 303 411		472 367 846		78 107 262
	SECTION 5				22 972 425		22 972 425		22 972 425		28 642 425		28 642 425		28 642 425		28 642 425		28 642 425		22 972 425
	SECTION 6				15 039 938		15 039 938		15 039 938		15 039 938		15 039 938		15 039 938		20 997 900		20 997 900		41 376 858
	SECTION 7				52 500 000		52 500 000		52 500 000		52 500 000		52 500 000		52 500 000		52 500 000		52 500 000		52 500 000
	SECTION 8				10 500 000		10 500 000		10 500 000		10 500 000		10 500 000		10 500 000		10 500 000		10 500 000		0
	SECTION 9				93 318 750		35 458 500		35 458 500		35 458 500		35 458 500		266 684 880		35 458 500		35 458 500		300 740 267
	SECTION 10				22 995 000		22 995 000		22 995 000		22 995 000		22 995 000		22 995 000		22 995 000		22 995 000		23 155 000
	SECTION 11				112 875 000		112 875 000		112 875 000		112 875 000		112 875 000		94 500 000		112 875 000		112 875 000		78 750 000
			SUBTOTAL A		960 088 584		862 015 313		913 687 106		778 099 376		892 968 640		998 622 356		1 016 249 600		1 157 101 141		718 875 966
OTHER COSTS (PRELIM ESTIMATES - SIMILAR FOR ALL OPTIONS)																							
	Expropriation Costs	Prov Sum	4 000 000	1	4 000 000	1	4 000 000	1	4 000 000	1	4 000 000	1	4 000 000	1	4 000 000	1	4 000 000	1	4 000 000	1	4 000 000
	Environmental Mitigation	Prov Sum	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000
	Servitudes	Prov Sum	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000	1	500 000
	Power lines	Prov Sum	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000	1	10 000 000
	Gauging Weir	Prov Sum	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000	1	5 000 000
			SUBTOTAL B		984 588 584		886 515 313		938 187 106		802 599 376		917 468 640		1 023 122 356		1 040 749 600		1 181 601 141		743 375 966
	OVERALL CONTINGENCIES (% OF SUBTOTAL B)	%	5.0%	984 588 584	49 229 429	886 515 313	44 325 766	938 187 106	46 909 355	802 599 376	40 129 969	917 468 640	45 873 432	1 023 122 356	51 156 118	1 040 749 600	52 037 480	1 181 601 141	59 080 057	743 375 966	37 168 798
			SUBTOTAL C		1 033 818 013		930 841 079		985 096 462		842 729 345		963 342 072		1 074 278 473		1 092 787 080		1 240 681 198		796 044 765
	EIA, AND ENGINEERING COSTS (FOR DESIGN, CONTRACT ADMIN & MONITORING)																				
	Fees and disbursements	%	12.0%	1 033 818 013	124 058 162	930 841 079	111 700 929	985 096 462	118 211 575	842 729 345	101 127 521	963 342 072	115 601 049	1 074 278 473	128 913 417	1 092 787 080	131 134 450	1 240 681 198	148 881 744	796 044 765	95 525 372
			SUBTOTAL D		1 157 876 175		1 042 542 008		1 103 308 037		943 856 866		1 078 943 121		1 203 191 890		1 223 921 529		1 389 562 942		928 738 935
	PLUS VAT	%	14.0%	1 157 876 175	162 102 664	1 042 542 008	145 955 881	1 103 308 037	154 463 125	943 856 866	132 139 961	1 078 943 121	151 052 037	1 203 191 890	168 446 865	1 223 921 529	171 349 014	1 389 562 942	194 538 812	928 738 935	130 023 451
			GRAND TOTAL		1 319 978 839		1 188 497 890		1 257 771 162		1 075 996 828		1 229 995 158		1 371 638 755		1 395 270 543		1 584 101 754		1 154 287 758

Table A.2 – Range of Rates Used for Major Cost Items Sensitivity Analysis

Sensitive rates table (/m^3 unless stated)		Adopted Rates Range		
Item	**Unit**	**Low**	**Medium**	**High**
Necessary soft excavation to graded filter	m^3	R 93.00	R 196.50	R 300.00
Necessary soft excavation to fill	m^3	R 35.00	R 40.50	R 46.00
Necessary hard excavation to fill	m^3	R 96.00	R 118.00	R 140.00
Necessary soft excavation to spoil	m^3	R 55.00	R 60.00	R 65.00
Necessary hard excavation to spoil	m^3	R 119.00	R 124.50	R 130.00
Necessary hard excavation to stockpile	m^3	R 90.00	R 95.00	R 100.00
Borrow soft excavation to graded filter	m^3	R 118.00	R 221.50	R 325.00
Borrow soft excavation to clay core	m^3	R 45.00	R 63.50	R 82.00
Borrow soft excavation to fill	m^3	R 85.00	R 90.50	R 96.00
Borrow hard excavation to fill	m^3	R 146.00	R 168.00	R 190.00
Structural concrete	m^3	R 2 500.00	R 3 150.00	R 3 800.00
RCC	m^3	R 400.00	R 650.00	R 900.00
IVRCC rate/m^2	m^2	R 192.00	R 312.00	R 432.00
GERCC rate/m^2	m^2	R 650.00	R 825.00	R 1 000.00

APPENDIX B

COST ESTIMATE FOR TWO RCC DAM WALL OPTIONS

Tables B.1: Revised Cost Estimates for the Maximum Sized Ntabelanga Dam

ITEM NO.	DESCRIPTION	UNIT	RATE	QUANTITY	AMOUNT
SECTION 1: SITE CLEARING					
1.1	Clearing and grubbing	ha	R 18 000.00	9	R 162 000.00
1.2	Topsoil stripping	m²	R 5.00	90000	R 450 000.00
1.3	Other items	%	5%	R 612 000.00	R 30 600.00
	SUBTOTAL CARRIED TO SUMMARY				**R 642 600.00**
SECTION 2: DEALING WITH WATER					
2.1	Dewatering	Sum	R 200 000.00	1	R 200 000.00
2.2	Settling pond	Sum	R 500 000.00	1	R 500 000.00
2.3	Pollution control measures	Sum	R 500 000.00	1	R 500 000.00
2.4	Other items	%	5%	R 1 200 000.00	R 60 000.00
	SUBTOTAL CARRIED TO SUMMARY				**R 1 260 000.00**
SECTION 3: RIVER DIVERSION					
3.1	Stage 1 diversion works - coffer dams	Sum	R 5 000 000.00	1	R 5 000 000.00
3.2	Stage 2 - permanent works - flood culverts and berms	Sum	R 41 168 000.00	1	R 41 168 000.00
	SUBTOTAL CARRIED TO SUMMARY				**R 46 168 000.00**
SECTION 4: EARTHWORKS					
	Necessary excavation to fill				
4.1	Graded filter	m³	R 196.50	Not Applicable	Not Applicable
4.2	Soft	m³	R 40.50	Not Applicable	Not Applicable
4.3	Hard	m³	R 118.00	Not Applicable	Not Applicable
4.4	Compacted mudstone to 95% MOD. AASHTO in coffer dams	m³	R 40.50	See Section 3	See Section 3
4.5	Compacted mudstone facing in coffer dams	m³	R 40.50	See Section 3	See Section 3
4.6	Hard excavation to stockpile	m³	R 95.00	248305	R 23 588 975.00
	Necessary excavation to spoil				
4.7	Soft	m³	R 60.00	34473	R 2 068 380.00
4.8	Hard	m³	R 124.50	Not Applicable	Not Applicable
	Borrow excavation to fill				
4.9	Graded filter	m³	R 221.50	Not Applicable	Not Applicable
4.10	Core Zone	m³	R 63.50	Not Applicable	Not Applicable
4.11	Soft	m³	R 90.50	Not Applicable	Not Applicable
4.12	Hard	m³	R 168.00	Not Applicable	Not Applicable
4.13	Riprap	m³	R 30.00	Not Applicable	Not Applicable
4.14	Foundations				
4.15	Foundation Prep for core	m³	R 47.00	16440	R 772 680.00
4.16	Foundation treatment	m²	R 550.00	15473	R 8 510 150.00
4.17	Overbreak	m²	R 50.00	1500	R 75 000.00
4.18	Rock bolts	Nr	R 1 000.00	100	R 100 000.00
4.19	Concrete elements	m³	R 3 150.00	Scheduled elsewhere	Scheduled elsewhere
4.20	Other items	%	5%	R 35 115 185.00	R 1 755 759.25
	SUBTOTAL CARRIED TO SUMMARY				**R 36 870 944.25**
SECTION 5: DRILLING, GROUTING, AND ASSOCIATED WORKS					
5.1	Mobilisation of plant	Sum	R 500 000.00	1	R 500 000.00
5.2	Set ups - grouting	Nr	R 1 250.00	300	R 375 000.00
5.3	Set ups - control holes	Nr	R 1 250.00	15	R 18 750.00
5.4	Drilling grout holes	m	R 1 800.00	9000	R 16 200 000.00
5.5	Drilling control holes (with core recovery)	m	R 2 000.00	450	R 900 000.00
5.6	Grouting in stages	Nr	R 1 000.00	396	R 396 000.00
5.7	Water testing in stages	Nr	R 2 000.00	450	R 900 000.00
5.8	Cement	t	R 2 000.00	250	R 500 000.00
5.9	Bentonite	t	R 3 750.00	25	R 93 750.00
5.10	Place drain holes	Nr	R 1 200.00	100	R 120 000.00
5.11	Drill drain holes	m	R 1 250.00	1500	R 1 875 000.00
5.12	Other items	%	5%	R 21 878 500.00	R 1 093 925.00
	SUBTOTAL CARRIED TO SUMMARY				**R 22 972 425.00**
SECTION 6: DRAWOFF AND OUTLET STRUCTURE					
6.1	Mass concrete	m3	R 1 200.00	0	R -
6.2	Structural concrete	m3	R 3 150.00	18655	R 58 763 250.00
6.3	Reinforcement	t	R 20 000.00	2798	R 55 960 000.00
6.4	Rough formwork	m2	R 500.00	4912	R 2 456 000.00
6.5	Smooth formwork	m2	R 600.00	15275	R 9 165 000.00
6.6	Soffit formwork	m2	R 750.00	703	R 527 250.00
6.7	Structural steelwork	Sum	R 2 000 000.00	1	R 2 000 000.00
6.8	Concrete slide for plant removal	Sum	R 600 000.00	1	R 600 000.00
6.9	Other items	%	5%	R 129 471 500.00	R 6 473 575.00
SUBTOTAL CARRIED TO SUMMARY					**R 135 945 075.00**
SECTION 7: DRAWOFF AND OUTLET CONDUITS ETC (INCL PIPELINES TO WTW)					
7.1	Mechanical & Electrical Works - Incl Gates and Pipework*	Sum	R 84 500 000.00	1	R 84 500 000.00
7.2	Other items	%	5%	R 84 500 000.00	R 4 225 000.00
	SUBTOTAL CARRIED TO SUMMARY				**R 88 725 000.00**

ITEM NO.	DESCRIPTION	UNIT	RATE	QUANTITY	AMOUNT
SECTION 8: DAM WALL AND SPILLWAY					
8.1	RCC Mix	m3	R 650.00	361000	R 234 650 000.00
8.2	IVRCC upstream face	m2	R 312.00	15200	R 4 742 400.00
8.3	IVRCC downstream face	m2	R 312.00	17000	R 5 304 000.00
8.4	Formwork for IVRCC on downstream face	m2	R 400.00	17000	R 6 800 000.00
8.5	Reinforcement	t	R 20 000.00	31	R 620 000.00
8.6	IVRCC to drainage gallery	m2	R 312.00	500	R 156 000.00
8.7	300mm waterstop	m	R 1 800.00	1500	R 2 700 000.00
8.8	Drain holes from dam crest to gallery - set up	Nr	R 2 500.00	100	R 250 000.00
8.9	Drain holes from dam crest to gallery - drilling	m	R 3 500.00	3900	R 13 650 000.00
8.10	Precast concrete copings on parapet wall	Nr	R 1 000.00	800	R 800 000.00
8.11	Dowels into RCC	Nr	R 1 000.00	400	R 400 000.00
8.12	Rock anchors	Nr	R 1 500.00	450	R 675 000.00
8.13	Reinforced concrete work	m3	R 3 150.00	Scheduled elsewhere	Scheduled elsewhere
8.14	Reinforcement	t	R 20 000.00	20	R 400 000.00
8.15	Rough formwork	m2	R 400.00	Scheduled elsewhere	Scheduled elsewhere
8.16	Smooth formwork	m2	R 500.00	Scheduled elsewhere	Scheduled elsewhere
8.17	Other items	%	5%	R 270 747 400.00	R 13 537 370.00
			SUBTOTAL CARRIED TO SUMMARY		**R 284 684 770.00**
SECTION 9: OTHER MECHANICAL AND ELECTRICAL WORKS					
9.1	Standby generator set	Nr	R 500 000.00	1	R 500 000.00
9.2	Other mechniacal equipment	Sum	R 2 000 000.00	1	R 2 000 000.00
9.3	High mast tower	Nr	R 200 000.00	2	R 400 000.00
9.4	All electrical fittings and wirings	Sum	R 5 000 000.00	1	R 5 000 000.00
9.5	Instrumentation	Sum	R 2 000 000.00	1	R 2 000 000.00
9.6	Ventilation system to gallery	Sum	R 200 000.00	1	R 200 000.00
9.7	Other items	%	5%	R 10 100 000.00	R 505 000.00
			SUBTOTAL CARRIED TO SUMMARY		**R 10 605 000.00**
SUMMARY					
	PRELIMINARY AND GENERAL	%	20%	R 627 873 814.25	R 125 574 762.85
	SECTION 1				R 642 600.00
	SECTION 2				R 1 260 000.00
	SECTION 3				R 46 168 000.00
	SECTION 4				R 36 870 944.25
	SECTION 5				R 22 972 425.00
	SECTION 6				R 135 945 075.00
	SECTION 7				R 88 725 000.00
	SECTION 8				R 284 684 770.00
	SECTION 9				R 10 605 000.00
			SUBTOTAL A		**R 753 448 577.10**
	OVERALL CONTINGENCIES (% OF SUBTOTAL A)	%	5%	R 753 448 577.10	R 37 672 428.86
			SUBTOTAL B		**R 791 121 005.96**
	EIA, AND ENGINEERING COSTS (FOR DESIGN, CONTRACT ADMIN & MONITORING)				
	Fees and disbursements	%	12.5%	R 791 121 005.96	R 98 890 125.74
			SUBTOTAL CARRIED TO SUMMARY		**R 890 011 131.70**
	PLUS VAT	%	14%	R 890 011 131.70	R 124 601 558.44
			GRAND TOTAL		**R 1 014 612 690.14**

Tables B.2: Revised Cost Estimates for the Minimum Sized Ntabelanga Dam

ITEM NO.	DESCRIPTION	UNIT	RATE	QUANTITY	AMOUNT
SECTION 1: SITE CLEARING					
1.1	Clearing and grubbing	ha	R 18 000.00	7	R 126 000.00
1.2	Topsoil stripping	m²	R 5.00	70000	R 350 000.00
1.3	Other items	%	5%	R 476 000.00	R 23 800.00
			SUBTOTAL CARRIED TO SUMMARY		**R 499 800.00**
SECTION 2: DEALING WITH WATER					
2.1	Dewatering	Sum	R 200 000.00	1	R 200 000.00
2.2	Settling pond	Sum	R 500 000.00	1	R 500 000.00
2.3	Pollution control measures	Sum	R 500 000.00	1	R 500 000.00
2.4	Other items	%	5%	R 1 200 000.00	R 60 000.00
			SUBTOTAL CARRIED TO SUMMARY		**R 1 260 000.00**
SECTION 3: RIVER DIVERSION					
3.1	Stage 1 diversion works - coffer dams	Sum	R 5 000 000.00	1	R 5 000 000.00
3.2	Stage 2 - permanent works - flood culverts and berms	Sum	R 33 725 000.00	1	R 33 725 000.00
			SUBTOTAL CARRIED TO SUMMARY		**R 38 725 000.00**
SECTION 4: EARTHWORKS					
	Necessary excavation to fill				
4.1	Graded filter	m³	R 196.50	Not Applicable	Not Applicable
4.2	Soft	m³	R 40.50	Not Applicable	Not Applicable
4.3	Hard	m³	R 118.00	Not Applicable	Not Applicable
4.4	Compacted mudstone to 95% MOD. AASHTO in coffer dams	m³	R 40.50	See Section 3	See Section 3
4.5	Compacted mudstone facing in coffer dams	m³	R 40.50	See Section 3	See Section 3
4.6	Hard excavation to stockpile	m³	R 95.00	223704	R 21 251 880.00
	Necessary excavation to spoil				
4.7	Soft	m³	R 60.00	28539	R 1 712 340.00
4.8	Hard	m³	R 124.50	Not Applicable	Not Applicable
	Borrow excavation to fill				
4.9	Graded filter	m³	R 221.50	Not Applicable	Not Applicable
4.10	Core Zone	m³	R 63.50	Not Applicable	Not Applicable
4.11	Soft	m³	R 90.50	Not Applicable	Not Applicable
4.12	Hard	m³	R 168.00	Not Applicable	Not Applicable
4.13	Riprap	m³	R 30.00	Not Applicable	Not Applicable
4.14	Foundations				
4.15	Foundation Prep for core	m³	R 47.00	10641	R 500 127.00
4.16	Foundation treatment	m²	R 550.00	9374	R 5 155 700.00
4.17	Overbreak	m²	R 50.00	1500	R 75 000.00
4.18	Rock bolts	Nr	R 1 000.00	100	R 100 000.00
4.19	Concrete elements	m³	R 3 150.00	Scheduled elsewhere	Scheduled elsewhere
4.20	Other items	%	5%	R 28 795 047.00	R 1 439 752.35
			SUBTOTAL CARRIED TO SUMMARY		**R 30 234 799.35**
SECTION 5: DRILLING, GROUTING, AND ASSOCIATED WORKS					
5.1	Mobilisation of plant	Sum	R 500 000.00	1	R 500 000.00
5.2	Set ups - grouting	Nr	R 1 250.00	220	R 275 000.00
5.3	Set ups - control holes	Nr	R 1 250.00	10	R 12 500.00
5.4	Drilling grout holes	m	R 1 800.00	6600	R 11 880 000.00
5.5	Drilling control holes (with core recovery)	m	R 2 000.00	300	R 600 000.00
5.6	Grouting in stages	Nr	R 1 000.00	300	R 300 000.00
5.7	Water testing in stages	Nr	R 2 000.00	325	R 650 000.00
5.8	Cement	t	R 2 000.00	180	R 360 000.00
5.9	Bentonite	t	R 3 750.00	20	R 75 000.00
5.10	Place drain holes	Nr	R 1 200.00	75	R 90 000.00
5.11	Drill drain holes	m	R 1 250.00	1100	R 1 375 000.00
5.12	Other items	%	5%	R 16 117 500.00	R 805 875.00
			SUBTOTAL CARRIED TO SUMMARY		**R 16 923 375.00**
SECTION 6: DRAWOFF AND OUTLET STRUCTURE					
6.1	Mass concrete	m3	R 1 200.00	0	R -
6.2	Structural concrete	m3	R 3 150.00	12872	R 40 546 800.00
6.3	Reinforcement	t	R 20 000.00	1931	R 38 620 000.00
6.4	Rough formwork	m2	R 500.00	2945	R 1 472 500.00
6.5	Smooth formwork	m2	R 600.00	10970	R 6 582 000.00
6.6	Soffit formwork	m2	R 750.00	703	R 527 250.00
6.7	Structural steelwork	Sum	R 2 000 000.00	1	R 2 000 000.00
6.8	Concrete slide for plant removal	Sum	R 600 000.00	1	R 600 000.00
6.9	Other items	%	5%	R 90 348 550.00	R 4 517 427.50
SUBTOTAL CARRIED TO SUMMARY					**R 94 865 977.50**
SECTION 7: DRAWOFF AND OUTLET CONDUITS ETC (INCL PIPELINES TO WTW)					
7.1	Mechanical & Electrical Works - Incl Gates and Pipework*	Sum	R 55 000 000.00	1	R 55 000 000.00
7.2	Other items	%	5%	R 55 000 000.00	R 2 750 000.00
			SUBTOTAL CARRIED TO SUMMARY		**R 57 750 000.00**

ITEM NO.	DESCRIPTION	UNIT	RATE	QUANTITY	AMOUNT
SECTION 8: DAM WALL AND SPILLWAY					
8.1	RCC Mix	m3	R 650.00	141000	R 91 650 000.00
8.2	IVRCC upstream face	m2	R 312.00	6916	R 2 157 792.00
8.3	IVRCC downstream face	m2	R 312.00	12036	R 3 755 232.00
8.4	Formwork for IVRCC on downstream face	m2	R 400.00	12036	R 4 814 400.00
8.5	Reinforcement	t	R 20 000.00	31	R 620 000.00
8.6	IVRCC to drainage gallery	m2	R 312.00	500	R 156 000.00
8.7	300mm waterstop	m	R 1 800.00	1500	R 2 700 000.00
8.8	Drain holes from dam crest to gallery - set up	Nr	R 2 500.00	100	R 250 000.00
8.9	Drain holes from dam crest to gallery - drilling	m	R 3 500.00	3900	R 13 650 000.00
8.10	Precast concrete copings on parapet wall	Nr	R 1 000.00	880	R 880 000.00
8.11	Dowels into RCC	Nr	R 1 000.00	400	R 400 000.00
8.12	Rock anchors	Nr	R 1 500.00	450	R 675 000.00
8.13	Reinforced concrete work	m3	R 3 150.00	Scheduled elsewhere	Scheduled elsewhere
8.14	Reinforcement	t	R 20 000.00	20	R 400 000.00
8.15	Rough formwork	m2	R 400.00	Scheduled elsewhere	Scheduled elsewhere
8.16	Smooth formwork	m2	R 500.00	Scheduled elsewhere	Scheduled elsewhere
8.17	Other items	%	5%	R 121 708 424.00	R 6 085 421.20
	SUBTOTAL CARRIED TO SUMMARY				**R 128 193 845.20**
SECTION 9: OTHER MECHANICAL AND ELECTRICAL WORKS					
9.1	Standby generator set	Nr	R 500 000.00	1	R 500 000.00
9.2	Other mechniacal equipment	Sum	R 2 000 000.00	1	R 2 000 000.00
9.3	High mast tower	Nr	R 200 000.00	2	R 400 000.00
9.4	All electrical fittings and wirings	Sum	R 5 000 000.00	1	R 5 000 000.00
9.5	Instrumentation	Sum	R 2 000 000.00	1	R 2 000 000.00
9.6	Ventilation system to gallery	Sum	R 200 000.00	1	R 200 000.00
9.7	Other items	%	5%	R 10 100 000.00	R 505 000.00
	SUBTOTAL CARRIED TO SUMMARY				**R 10 605 000.00**
SUMMARY					
	PRELIMINARY AND GENERAL	%	20%	R 379 057 797.05	R 75 811 559.41
	SECTION 1				R 499 800.00
	SECTION 2				R 1 260 000.00
	SECTION 3				R 38 725 000.00
	SECTION 4				R 30 234 799.35
	SECTION 5				R 16 923 375.00
	SECTION 6				R 94 865 977.50
	SECTION 7				R 57 750 000.00
	SECTION 8				R 128 193 845.20
	SECTION 9				R 10 605 000.00
	SUBTOTAL A				**R 454 869 356.46**
	OVERALL CONTINGENCIES (% OF SUBTOTAL A)	%	5%	R 454 869 356.46	R 22 743 467.82
	SUBTOTAL B				**R 477 612 824.28**
	EIA, AND ENGINEERING COSTS (FOR DESIGN, CONTRACT ADMIN & MONITORING)				
	Fees and disbursements	%	12.5%	R 477 612 824.28	R 59 701 603.04
	SUBTOTAL CARRIED TO SUMMARY				**R 537 314 427.32**
	PLUS VAT	%	14%	R 537 314 427.32	R 75 224 019.82
	GRAND TOTAL				**R 612 538 447.14**

Table B.3: Cost Estimates of Associated and Appurtenant Works

	OTHER INFRASTRUCTURE WORKS				
	Upgrading surfaced main access roads	km	R 4 000 000.00	14	R 56 000 000.00
	Upgrading gravel main access roads	km	R 2 000 000.00	20	R 40 000 000.00
	Upgrade and realignment of villages access roads	km	R 750 000.00	33	R 24 750 000.00
	Temporary haul roads	km	R 500 000.00	10	R 5 000 000.00
	Downstream bridge across river	Sum	R 25 000 000.00	1	R 25 000 000.00
	Operator Housing Complex	Sum	R 26 000 000.00	1	R 26 000 000.00
	Visitors Centre	Sum	R 15 000 000.00	1	R 15 000 000.00
	Temporary water supply, abstraction, treatment and supply	Sum	R 1 500 000.00	1	R 1 500 000.00
	Wastewater treatment plant	Sum	R 15 000 000.00	1	R 15 000 000.00
	Power lines & Transformers (2 x 11 kVA)	km	R 1 000 000.00	26	R 26 000 000.00
	Gauging Weir	Prov Sum	R 3 000 000.00	1	R 3 000 000.00
	Other items	%	10%	R 208 250 000.00	R 20 825 000.00
			SUB-TOTAL A		**R 258 075 000.00**
	OTHER PROVISIONAL SUMS				
	Expropriation Costs	Prov Sum	R 5 000 000.00	1	R 5 000 000.00
	Environmental Mitigation	Prov Sum	R 5 000 000.00	1	R 5 000 000.00
	Resettlement	Prov Sum	R 5 000 000.00	1	R 5 000 000.00
	Servitudes	Prov Sum	R 1 000 000.00	1	R 1 000 000.00
			SUBTOTAL B		**R 16 000 000.00**
			SUBTOTAL A + B		**R 274 075 000.00**
	Engineering and EMP Services	%	12.5%	R 274 075 000.00	R 34 259 375.00
			SUB-TOTAL C		**R 308 334 375.00**
	PLUS VAT	%	14%	R 308 334 375.00	R 43 166 812.50
	GRAND TOTAL INFRASTRUCTURE AND PROVSIONAL SUMS				**R 351 501 187.50**

Table B.4: Basis of Estimation for Some Key Items

Cost Estimates	Unit	Qty	Rate	Amount	Remarks
Roads					
Surfaced	km	20	R 4 000 000.00	R 80 000 000.00	All-in rates obtained from J&G's Roads Division
Good quality gravel	km	20	R 2 000 000.00	R 40 000 000.00	All-in rates obtained from J&G's Roads Division
Gravel	km	33	R 750 000.00	R 24 750 000.00	All-in rates obtained from J&G's Roads Division
Temp haul roads	km	10	R 500 000.00	R 5 000 000.00	All-in rates obtained from J&G's Roads Division
River Bridge	m²	1110	R 14 000.00	R 15 540 000.00	Confirmed m² rate from J&G Bridges Experts
Hydropower building at Ntabelanga	m²	550	R 10 000.00	R 5 500 000.00	Estimated m² rate based on buildings with basement and requiring overhead crane facilities
Admin block	m²	35	R 6 000.00	R 210 000.00	Rate for admin buildings from building estimation handbook
Outlet works					
Pipework	t	1400	R 36 000.00	R 50 400 000.00	Escalated Dikgatlong dam rate x steel volume in pipes
Large Valves					
3000mm diameter butterfly valves	no.	9	R 3 000 000.00	R 27 000 000.00	R2 600 000 per valve with 15% markup for transport handling (quotation from supplier)
2200mm diameter butterfly valves	no.	1	R 1 320 000.00	R 1 320 000.00	R1 100 000 per valve with 20% markup for transport handling (quotation from supplier)
1600mm diameter butterfly valves	no.	1	R 775 000.00	R 775 000.00	R620 000 per valve with 25% markup for transport handling (quotation from supplier)
1600mm sleeve valve	no.	1	R 3 330 000.00	R 3 330 000.00	R2 775 000 per valve with 20% markup for transport handling (quotation from supplier)
			Sub-Total	R 32 425 000.00	
Allowance for electronic/hydraulic valve actuation equipment	%	5%	R 32 425 000.00	R 1 621 250.00	
Temporary Water Supply	Sum	1	R 400 000.00	R 400 000.00	Quotation from *GR Solutios* for 6m³/hr plant)
Temporary water abstraction	Sum	1	R 500 000.00	R 500 000.00	Provisional sum based on similar projects
Temporary water transfer	Sum	1	R 500 000.00	R 500 000.00	Provisional sum based on similar projects
Wastewater treatment plant	Sum	1	R 15 000 000.00	R 15 000 000.00	Escalated cost from Metolong dam advance works schedules
Housing	Sum	1	R 26 000 000.00	R 26 000 000.00	Escalated cost from Metolong schedules (includes limited units - see email 9/01/2014)

APPENDIX C

COST ESTIMATE FOR WATER TREATMENT WORKS

Table C.1: Cost Estimate for the Ntabelanga WTW – Full Capacity – 85 000 m^3/day

NTABELANGA WTW - COST ESTIMATE - FULL CAPACITY							
Capacity	**85**	**Ml/d**	**av**				
	102	**Ml/d**	**peak**				
DESCRIPTION	**Civil**		**Mechanical**		**Electrical**		**Sub-total**
MAIN WORKS							
Inlet works	2 400 000	sum	300 000		55 000		2 755 000
Aeration	4 000 000	sum	2 500 000		250 000		6 750 000
Sedimentation basins (coag & floc)	55 000 000	sum	42 000 000		25 000 000		122 000 000
Rapid sand filtration	30 000 000	sum	20 000 000		9 000 000		59 000 000
Backwash storage	1 250 000	sum	75 000		75 000		1 400 000
Chlorine dosing	350 000	sum	1 000 000		500 000		1 850 000
Sludge thickeners	8 000 000	sum	1 500 000		500 000		10 000 000
Sub-Total	101 000 000	50%	67 375 000	#	35 380 000	17%	203 755 000
Factor: Rural area	*10 100 000*		*6 737 500*		*3 538 000*	10%	20 375 500
Factor: Rock excavation	*20 200 000*		*13 475 000*		*7 076 000*	20%	40 751 000
Sub-total 1- Main Works							***264 881 500***
OTHER WORKS	**Quant**	**Unit**	**Rate Rand**	**and**			**Total Rand**
Clear water reservoir	25 000	m3	1 500				37 500 000
	Civil		***Mechanical***		***Electrical***		
	31 875 000		*3 750 000*		*1 875 000*		
Sludge lagoons							33 700 000
Lagoons	3 000	m3	10 800				
Chlorination	1	Sum	150 000				
Stormwater Berms	1	Sum	1 000 000				
	Civil		***Mechanical***		***Electrical***		
	28 645 000		*3 370 000*		*1 685 000*		
Telemetry/control							3 350 000
Telemetry							
Cabling	4 000	m	100				
Other							
	Civil		***Mechanical***		***Electrical***		
	167 500		*335 000*		*2 847 500*		
Buildings							30 500 000
Admin	900	m2	20 000				
First Aid Room	100	m2	20 000				
Lab	150	m2	20 000				
Mechanical workshop	150	m2	15 000				
Electrical workshop	150	m2	15 000				
Sub-station	100	m2	10 000				
Stores	200	m2	10 000				
	Civil		***Mechanical***		***Electrical***		
	25 925 000		*1 525 000*		*3 050 000*		
Electrical infrastructure from Sub-station							2 475 000
11 kV cable	400	m	2 000				
Switchgear	1	sum	100 000				
Sub-station/transformer	1	sum	500 000				
low voltage	150	m	1 500				
Meter	1	sum	200 000				
Connection fee	1	sum	400 000				
Breaker at sub-station	1	sum	250 000				
	Civil		***Mechanical***		***Electrical***		
	123 750		*247 500*		*2 103 750*		

….(cont)

Standby Gen Sets at WTW					17 100 000
Gensets - 2 X 2000 kVA sets					
Small genset - 100 kVA					
Change-over panel					
Synchronisation panel					
Storage tank/bunding/lining					
Diesel					
Building for gensets 80 m2@R 10000/m2					
Transport to site					
	Civil		***Mechanical***	***Electrical***	
	855 000		*1 710 000*	*14 535 000*	
Spares					10 000 000
Internal Roads					7 000 000
Paving	20 000	m2	300		
Kerbs	5 000	m	200		
	Civil		***Mechanical***	***Electrical***	
	7 000 000		*-*	*-*	
Site lighting, security and fencing					1 870 000
Site lighting	4	No.	200 000		
Street lighting	600	No.	600		
Security fencing	1 500	m	300		
Security gate	2	No.	20 000		
Gate house	2	No.	20 000		
Temporary fencing security	600	m	300		
	Civil		***Mechanical***	***Electrical***	
	710 000		*-*	*1 160 000*	
Landscaping					1 000 000
	Civil		***Mechanical***	***Electrical***	
	1 000 000		*-*	*-*	
Assisted operation (6 months)	m3/d	R/m3	days		35 872 656
Human resources	85 000	0.25	183		
Power costs incl pumping	85 000	1.00	183		
Chemicals	85 000	0.25	183		
Maintenance costs	85 000	0.20	183		
Other costs	85 000	0.15	183		
H/O overheads & profits (25%)		0.25			
Sub-Total 2 - Other Works					***180 367 656***
Sub-Total 1 + Sub-Total 2					***445 249 156***
P&Gs					*111 312 289*
Sub-total 3					***556 561 445***
Contingencies					*83 484 217*
Sub-total 4					***640 045 662***
Detail Design fees					*80 005 708*
			TOTAL COST RAND (excl vat)		**720 051 370**
			VAT 14%		*100 807 192*
			TOTAL COST RAND (incl vat)		**820 858 562**

	Civil	Mechanical	Electrical	Non-Works	Total
Component Cost Estimates	***239 009 024***	***103 463 246***	***76 921 681***	***48 171 874***	***467 565 825***
P&Gs 25%	*59 752 256*	*25 865 811*	*19 230 420*	*12 042 969*	*116 891 456*
Sub-total	***298 761 280***	***129 329 057***	***96 152 101***	***60 214 843***	***584 457 281***
Contingencies 10%	*29 876 128*	*12 932 906*	*9 615 210*	*6 021 484*	*58 445 728*
Sub-total	***328 637 408***	***142 261 963***	***105 767 311***	***66 236 327***	***642 903 009***
Detail Design fees 12%	*39 436 489*	*17 071 436*	*12 692 077*	*7 948 359*	*77 148 361*
Sub-Total (Excl VAT)	***368 073 896***	***159 333 398***	***118 459 389***	***74 184 686***	***720 051 370***
VAT 14%	*51 530 346*	*22 306 676*	*16 584 314*	*10 385 856*	*100 807 192*
TOTAL COST RAND (incl vat)	**419 604 242**	**181 640 074**	**135 043 703**	**84 570 542**	**820 858 562**

TOTAL COST RAND	**820 858 562**

Table C.2: Cost Estimate for the Ntabelanga WTW – Phase 1 Capacity – 43 500 m^3/day

Capacity	**43**	**Ml/d**	**av**				
	51	**Ml/d**	**peak**				
DESCRIPTION	**Civil**		**Mechanical**		**Electrical**		**Sub-total**
MAIN WORKS							
Inlet works	2 400 000	sum	300 000		55 000		2 755 000
Aeration	4 000 000	sum	2 500 000		250 000		6 750 000
Sedimentation basins (coag & floc)	33 000 000	sum	25 200 000		15 000 000		73 200 000
Rapid sand filtration	18 000 000	sum	12 000 000		5 400 000		35 400 000
Backwash storage	1 250 000	sum	75 000		75 000		1 400 000
Chlorine dosing	350 000	sum	1 000 000		500 000		1 850 000
Sludge thickeners	8 000 000	sum	1 500 000		500 000		10 000 000
Sub-Total	67 000 000	51%	42 575 000	32%	21 780 000	17%	131 355 000
Factor: Rural area	*6 700 000*		*4 257 500*		*2 178 000*	10%	13 135 500
Factor: Rock excavation	*13 400 000*		*8 515 000*		*4 356 000*	20%	26 271 000
Sub-total 1- Main Works							***170 761 500***
OTHER WORKS	**Quant**	**Unit**	**Rate Rand**	**Rand**			**Total Rand**
Clear water reservoir	25 000	m3	1 500				37 500 000
	Civil		***Mechanical***		***Electrical***		
	31 875 000		*3 750 000*		*1 875 000*		
Sludge lagoons							33 700 000
Lagoons	3 000	m3	10 800	32 400 000			
Chlorination	1	Sum	150 000	300 000			
Stormwater Berms	1	Sum	1 000 000	1 000 000			
	Civil		***Mechanical***		***Electrical***		
	28 645 000		*3 370 000*		*1 685 000*		
Telemetry/control							3 350 000
Telemetry				2 500 000			
Cabling	4 000	m	100	400 000			
Other				450 000			
	Civil		***Mechanical***		***Electrical***		
	167 500		*335 000*		*2 847 500*		
Buildings							30 500 000
Admin	900	m2	20 000	18 000 000			
First Aid Room	100	m2	20 000	2 000 000			
Lab	150	m2	20 000	3 000 000			
Mechanical workshop	150	m2	15 000	2 250 000			
Electrical workshop	150	m2	15 000	2 250 000			
Sub-station	100	m2	10 000	1 000 000			
Stores	200	m2	10 000	2 000 000			
	Civil		***Mechanical***		***Electrical***		
	25 925 000		*1 525 000*		*3 050 000*		
Electrical infrastructure from Sub-station							2 475 000
11 kV cable	400	m	2 000	800 000			
Switchgear	1	sum	100 000	100 000			
Sub-station/transformer	1	sum	500 000	500 000			
low voltage	150	m	1 500	225 000			
Meter	1	sum	200 000	200 000			
Connection fee	1	sum	400 000	400 000			
Breaker at sub-station	1	sum	250 000	250 000			
	Civil		***Mechanical***		***Electrical***		
	123 750		*247 500*		*2 103 750*		

…./(cont)

Standby Gen Sets at WTW							17 100 000
Gensets - 2 X 2000 kVA sets				15 000 000			
Small genset - 100 kVA				200 000			
Change-over panel				200 000			
Synchronisation panel				200 000			
Storage tank/bunding/lining				250 000			
Diesel				150 000			
Building for gensets 80 m2@R 10000/m2				800 000			
Transport to site				300 000			
	Civil		***Mechanical***		***Electrical***		
	855 000		*1 710 000*		*14 535 000*		
Spares							10 000 000
				10 000 000			
Internal Roads							7 000 000
Paving	20 000	m2	300	6 000 000			
Kerbs	5 000	m	200	1 000 000			
	Civil		***Mechanical***		***Electrical***		
	7 000 000		-		-		
Site lighting, security and fencing							1 870 000
Site lighting	4	No.	200 000	800 000			
Street lighting	600	No.	600	360 000			
Security fencing	1 500	m	300	450 000			
Security gate	2	No.	20 000	40 000			
Gate house	2	No.	20 000	40 000			
Temporary fencing security	600	m	300	180 000			
	Civil		***Mechanical***		***Electrical***		
	710 000		-		*1 160 000*		
Landscaping							1 000 000
	Civil		***Mechanical***		***Electrical***		
	1 000 000		-		-		
Assisted operation (6 months)	m3/d	R/m3	days				18 147 344
Human resources	43 000	0.25	183	1 961 875			
Power costs incl pumping	43 000	1.00	183	7 847 500			
Chemicals	43 000	0.25	183	1 961 875			
Maintenance costs	43 000	0.20	183	1 569 500			
Other costs	43 000	0.15	183	1 177 125			
H/O overheads & profits (25%)		0.25		3 629 469			
Sub-Total 2 - Other Works							***162 642 344***
Sub-Total 1 + Sub-Total 2							***333 403 844***
P&Gs					*25%*		*83 350 961*
Sub-total 3							***416 754 805***
Contingencies					*15%*		*62 513 221*
Sub-total 4							***479 268 025***
Detail Design fees					*12.5%*		*59 908 503*
				TOTAL COST RAND		**Excl VAT**	**539 176 529**
						VAT 14%	*75 484 714*
				TOTAL COST RAND		**Incl VAT**	**614 661 243**

BREAKDOWN:

	Civil		Mechanical		Electrical		Non-Works
Sub-Total 1 + Sub-Total 2	*183 401 250*		*66 285 000*		*55 570 250*		*28 147 344*
P&Gs 25%	*45 850 313*		*16 571 250*		*13 892 563*		*7 036 836*
Sub-total	***229 251 563***		***82 856 250***		***69 462 813***		***35 184 180***
Contingencies 15%	*34 387 734*		*12 428 438*		*10 419 422*		*5 277 627*
Sub-total	***263 639 297***		***95 284 688***		***79 882 234***		***40 461 807***
Detail Design fees 12.5%	*32 954 912*		*11 910 586*		*9 985 279*		*5 057 726*
TOTAL COST RAND (EXCL VAT)	***296 594 209***		***107 195 273***		***89 867 514***		***45 519 532***
VAT 14%	*41 523 189*		*15 007 338*		*12 581 452*		*6 372 735*
TOTAL COST RAND (incl vat)	**338 117 398**		**122 202 612**		**102 448 966**		**51 892 267**
				TOTAL COST RAND		**Incl VAT**	**614 661 243**

APPENDIX D

COST ESTIMATE FOR BULK POTABLE WATER DISTRIBUTION INFRASTRUCTURE

Table D.1: Cost Estimate Build-up for Bulk Potable Water Distribution Infrastructure

PRIMARY ZONE 1

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		25	
1.1.2	50 HDPE Class 12	m		32	
1.1.3	63 uPVC Class 12	m		49	
1.1.4	75 uPVC Class 12	m		68	
1.1.5	90 uPVC Class 12	m		97	
1.1.6	110 uPVC Class 12	m		119	
1.1.7	160 uPVC Class 12	m		249	
1.1.8	200 uPVC Class 12	m		388	
1.1.9	250 uPVC Class 12	m		611	
1.1.10	315 uPVC Class 12	m		1 019	
1.1.11	355 uPVC Class 12	m		1 228	
1.1.12	400 steel	m		2 124	
1.1.13	450 STEEL	m		2 500	
1.1.14	500 steel	m		2 736	
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	
1.1.17	700 steel	m		4 601	
1.1.18	800 steel	m		5 732	
1.1.19	900 steel	m	5 920	7 020	41 558 400
1.1.20	1000 steel	m		8 383	
1.1.21	1200 steel	m		8 674	
1.1.22	1400 steel	m		12 759	
1.1.23	1600 steel	m		15 647	
1.1.24	1800 steel	m		20 000	
1.2	Bulk connectors				
1.2.1	50 HDPE Class 12	m		32	
1.2.2	63 uPVC Class 12	m		49	
1.2.3	75 uPVC Class 12	m		68	
1.2.4	90 uPVC Class 12	m		97	
1.2.5	110 uPVC Class 12	m		44	
1.2.6	160 uPVC Class 12	m		249	
1.2.7	200 uPVC Class 12	m		388	
1.2.8	250 uPVC Class 12	m		611	
1.2.9	315 uPVC Class 12	m		535	
1.2.10	355 uPVC Class 12	m		647	
1.2.11	400 uPVC Class 12	m		683	
1.2.12	500 steel	m		2 736	
1.2.13	600 steel	m		3 564	
1.2.14	700 steel	m		4 601	
1.2.15	800 steel	m		5 732	
1.2.16	900 steel	m		7 020	
1.2.17	1000 steel	m		8 383	
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m		43	
1.3.2	0 - 2 m	m	5 920	71	419 138
1.3.3	0- 3 m	m		191	
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	651	20	13 024
1.3.4.2	Intermediate	m3	6 512	80	520 960
1.3.4.3	Hard rock	m3	4 558	350	1 595 440
1.3.4.4	Boulder	m3	1 302	172	223 492
1.4	Bedding				
1.4.1	From trench	m3	577	30	17 316
1.4.2	From borrow pit	m3	3 463	60	207 792
1.4.3	Borrow pit haul	m3km	34 632	10	346 320
1.4.4	Commercial sources	m3	7 504	350	2 626 260

1.5	Backfill				
1.5.1	From trench	m3	740	25	18 500
1.5.2	Import from borrow	m3	740	40	29 600
1.5.3	Borrow haul	m3km	7 400	10	74 000
1.6	Allowance for fittings	%	41 558 400	15	6 233 760
1.7	Allowance for sundries	%	41 558 400	15	6 233 760
2	Abstraction & Treatment Works				
2.1	Up to 30 Ml/d	sum		30 000 000	
2.2	Up to 40 Ml/d	sum		40 000 000	
2.3	Up to 4 Ml/d	sum		5 000 000	
2.4	Up to 80 Ml/d	sum		560 000 000	
2.5	Up to 120 Ml/d	sum		840 000 000	
2.6	Up to 140 Ml/d	sum		120 000 000	
3	Pumpstations				
3.1	20 l/s @ 15m	sum		780 000	
3.2	30 l/s @ 105m	sum		1 404 000	
3.3	50 l/s @175m	sum		2 639 000	
3.4	100 l/s @100m	sum		2 834 000	
3.5	1300 l/s @ 260m	sum		25 000 000	
3.6	120 l/s @100m	sum		3 250 000	
3.7	120 l/s@ 200 m	sum		5 720 000	
3.8	150 l/s @ 150m	sum		5 304 000	
3.9	200 l/s @ 200m	sum		8 814 000	
3.10	92 l/s @ 30m	sum		13 546 000	
3.11	300 l/s @ 200 m	sum		12 935 000	
3.12	400 l/s @ 200 m	sum		16 718 000	
3.13	500 l/s @ 200m	sum		20 644 000	
3.14	600 l/s @ 150 m	sum		18 785 000	
3.15	700 l/s @150 m	sum		21 190 000	
3.16	950 l/s @ 260 m	sum	1	20 000 000	20 000 000
3.17	1000 l/s @ 200m	sum		28 743 000	
3.18	2000l/s @ 150m	sum		34 892 000	
4	Reservoirs				
4.1	500 kl	sum		1 000 000	
4.2	1 Ml	sum		3 000 000	
4.3	2 Ml	sum		4 500 000	
4.4	2.5 Ml	sum		5 000 000	
4.5	3 Ml	sum	1	6 500 000	6 500 000
4.6	4 Ml	sum		8 000 000	
4.7	5 Ml	sum		11 000 000	
4.8	10 Ml	sum		25 000 000	
4.9	20 Ml	sum		33 000 000	
4.10	25 Ml	sum		45 000 000	
4.11	40 Ml	sum		65 000 000	
5	Electrical supply	sum	4	2 500 000	10 000 000
	Total 1				***96 617 760***
	Contingencies	%	96 617 760	15	14 492 664
	Total 2				***111 110 424***
	Engineering fees	%	111 110 424	15	16 666 564
	Total 3				***127 776 987***
	VAT	%	127 776 987	14	17 888 778
	Total				***145 665 766***

PRIMARY ZONE 2

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		25	
1.1.2	50 HDPE Class 12	m		32	0
1.1.3	63 uPVC Class 12	m		49	0
1.1.4	75 uPVC Class 12	m		68	0
1.1.5	90 uPVC Class 12	m		97	0
1.1.6	110 uPVC Class 12	m		119	0
1.1.7	160 uPVC Class 12	m		249	0
1.1.8	200 uPVC Class 12	m		388	0
1.1.9	250 uPVC Class 12	m		611	0
1.1.10	315 uPVC Class 12	m		1 019	0
1.1.11	355 uPVC Class 12	m		1 228	0
1.1.12	400 steel	m		2 124	0
1.1.13	450 STEEL	m		2 500	0
1.1.14	500 steel	m		2 736	0
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	0
1.1.17	700 steel	m		4 601	0
1.1.18	800 steel	m		5 732	0
1.1.19	900 steel	m	9 771	7 020	68 592 420
1.1.20	1000 steel	m		8 383	0
1.1.21	1200 steel	m		8 674	0
1.1.22	1400 steel	m		12 759	0
1.1.23	1600 steel	m		15 647	0
1.1.24	1800 steel	m		20 000	0
				0	
1.2	Bulk connectors			0	
1.2.1	50 HDPE Class 12	m		32	0
1.2.2	63 uPVC Class 12	m		49	0
1.2.3	75 uPVC Class 12	m		68	0
1.2.4	90 uPVC Class 12	m		97	0
1.2.5	110 uPVC Class 12	m		44	0
1.2.6	160 uPVC Class 12	m		249	0
1.2.7	200 uPVC Class 12	m		388	0
1.2.8	250 uPVC Class 12	m		611	0
1.2.9	315 uPVC Class 12	m		535	0
1.2.10	355 uPVC Class 12	m		647	0
1.2.11	400 uPVC Class 12	m		683	0
1.2.12	500 steel	m		2 736	0
1.2.13	600 steel	m		3 564	0
1.2.14	700 steel	m		4 601	0
1.2.15	800 steel	m		5 732	0
1.2.16	900 steel	m		7 020	0
1.2.17	1000 steel	m		8 383	0
				0	0
1.3	Excavation in all materials			0	0
1.3.1	0 - 1.5m	m	0	43	0
1.3.2	0 - 2 m	m	9 771	71	691 787
1.3.3	0- 3 m	m	0	191	0
				0	0
1.3.4	Extra over for :			0	0
1.3.4.1	Soft Class 3	m3	1 075	20	21 496
1.3.4.2	Intermediate	m3	10 748	80	859 848
1.3.4.3	Hard rock	m3	7 524	350	2 633 285
1.3.4.4	Boulder	m3	2 150	172	368 875
				0	0
1.4	Bedding			0	0
1.4.1	From trench	m3	953	30	28 580
1.4.2	From borrow pit	m3	5 716	60	342 962
1.4.3	Borrow pit haul	m3km	57 160	10	571 604
1.4.4	Commercial sources	m3	12 385	350	4 334 660

				0	0
1.5	Backfill			0	0
1.5.1	From trench	m3	1 221	25	30 534
1.5.2	Import from borrow	m3	1 221	40	48 855
1.5.3	Borrow haul	m3km	12 214	10	122 138
1.6	Allowance for fittings	%	68 592 420	15	10 288 863
1.7	Allowance for sundries	%	68 592 420	15	10 288 863
2	Abstraction & Treatment Works				
2.1	Up to 30 Ml/d	sum		30 000 000	0
2.2	Up to 40 Ml/d	sum		40 000 000	0
2.3	Up to 4 Ml/d	sum		5 000 000	0
2.4	Up to 80 Ml/d	sum		560 000 000	0
2.5	Up to 120 Ml/d	sum		840 000 000	0
2.6	Up to 140 Ml/d	sum		120 000 000	0
				0	0
3	Pumpstations			0	0
3.1	20 l/s @ 15m	sum		780 000	0
3.2	30 l/s @ 105m	sum		1 404 000	0
3.3	50 l/s @175m	sum		2 639 000	0
3.4	100 l/s @100m	sum		2 834 000	0
3.5	1300 l/s @ 260m	sum		25 000 000	0
3.6	120 l/s @100m	sum		3 250 000	0
3.7	120 l/s@ 200 m	sum		5 720 000	0
3.8	150 l/s @ 150m	sum		5 304 000	0
3.9	200 l/s @ 200m	sum		8 814 000	0
3.10	92 l/s @ 30m	sum		13 546 000	0
3.11	300 l/s @ 200 m	sum		12 935 000	0
3.12	400 l/s @ 200 m	sum		16 718 000	0
3.13	500 l/s @ 200m	sum		20 644 000	0
3.14	600 l/s @ 150 m	sum		18 785 000	0
3.15	700 l/s @150 m	sum		21 190 000	0
3.16	950 l/s @ 260 m	sum	1	20 000 000	20 000 000
3.17	1000 l/s @ 200m	sum		28 743 000	0
3.18	2000l/s @ 150m	sum		34 892 000	0
				0	0
4	Reservoirs			0	0
4.1	500 kl	sum		1 000 000	0
4.2	1 Ml	sum		3 000 000	0
4.3	2 Ml	sum		4 500 000	0
4.4	2.5 Ml	sum		5 000 000	0
4.5	3 Ml	sum	1	6 500 000	6 500 000
4.6	4 Ml	sum		8 000 000	0
4.7	5 Ml	sum		11 000 000	0
4.8	10 Ml	sum		25 000 000	0
4.9	20 Ml	sum		33 000 000	0
4.10	25 Ml	sum		45 000 000	0
4.11	40 Ml	sum	1	65 000 000	65 000 000
				0	0
5	Electrical supply	sum	4	2 500 000	10 000 000
	Total 1				***200 724 769***
	Contingencies	%	200 724 769	15	30 108 715
	Total 2				***230 833 484***
	Engineering fees	%	230 833 484	15	34 625 023
	Total 3				***265 458 507***
	VAT	%	265 458 507	14	37 164 191
	Total				***302 622 698***

PRIMARY ZONE 3

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		25	
1.1.2	50 HDPE Class 12	m		32	0
1.1.3	63 uPVC Class 12	m		49	0
1.1.4	75 uPVC Class 12	m		68	0
1.1.5	90 uPVC Class 12	m		97	0
1.1.6	110 uPVC Class 12	m		119	0
1.1.7	160 uPVC Class 12	m		249	0
1.1.8	200 uPVC Class 12	m		388	0
1.1.9	250 uPVC Class 12	m		611	0
1.1.10	315 uPVC Class 12	m		1 019	0
1.1.11	355 uPVC Class 12	m		1 228	0
1.1.12	400 steel	m		2 124	0
1.1.13	450 STEEL	m		2 500	0
1.1.14	500 steel	m		2 736	0
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	0
1.1.17	700 steel	m	11 692	4 601	53 794 892
1.1.18	800 steel	m		5 732	0
1.1.19	900 steel	m		7 020	0
1.1.20	1000 steel	m		8 383	0
1.1.21	1200 steel	m		8 674	0
1.1.22	1400 steel	m		12 759	0
1.1.23	1600 steel	m		15 647	0
1.1.24	1800 steel	m		20 000	0
				0	
1.2	Bulk connectors			0	
1.2.1	50 HDPE Class 12	m		32	0
1.2.2	63 uPVC Class 12	m		49	0
1.2.3	75 uPVC Class 12	m		68	0
1.2.4	90 uPVC Class 12	m		97	0
1.2.5	110 uPVC Class 12	m		44	0
1.2.6	160 uPVC Class 12	m		249	0
1.2.7	200 uPVC Class 12	m		388	0
1.2.8	250 uPVC Class 12	m		611	0
1.2.9	315 uPVC Class 12	m		535	0
1.2.10	355 uPVC Class 12	m		647	0
1.2.11	400 uPVC Class 12	m		683	0
1.2.12	500 steel	m		2 736	0
1.2.13	600 steel	m		3 564	0
1.2.14	700 steel	m		4 601	0
1.2.15	800 steel	m		5 732	0
1.2.16	900 steel	m		7 020	0
1.2.17	1000 steel	m		8 383	0
				0	0
1.3	Excavation in all materials			0	0
1.3.1	0 - 1.5m	m	0	43	0
1.3.2	0 - 2 m	m	11 692	71	827 794
1.3.3	0- 3 m	m	0	191	0
				0	0
1.3.4	Extra over for :			0	0
1.3.4 1	Soft Class 3	m3	1 286	20	25 722
1.3.4 2	Intermediate	m3	12 861	80	1 028 896
1.3.4 3	Hard rock	m3	9 003	350	3 150 994
1.3.4 4	Boulder	m3	2 572	172	441 396
				0	0
1.4	Bedding			0	0
1.4.1	From trench	m3	836	30	25 079
1.4.2	From borrow pit	m3	5 016	60	300 952
1.4.3	Borrow pit haul	m3km	50 159	10	501 587
1.4.4	Commercial sources	m3	10 868	350	3 803 700

				0	0
1.5	Backfill			0	0
1.5.1	From trench	m3	4 501	25	112 536
1.5.2	Import from borrow	m3	4 501	40	180 057
1.5.3	Borrow haul	m3km	45 014	10	450 142
1.6	Allowance for fittings	%	53 794 892	15	8 069 234
1.7	Allowance for sundries	%	53 794 892	15	8 069 234
2	Abstraction & Treatment Works				
2.1	Up to 30 Ml/d	sum		30 000 000	0
2.2	Up to 40 Ml/d	sum		40 000 000	0
2.3	Up to 4 Ml/d	sum		5 000 000	0
2.4	Up to 80 Ml/d	sum		560 000 000	0
2.5	Up to 120 Ml/d	sum		840 000 000	0
2.6	Up to 140 Ml/d	sum		120 000 000	0
				0	0
3	Pumpstations			0	0
3.1	20 l/s @ 15m	sum		780 000	0
3.2	30 l/s @ 105m	sum		1 404 000	0
3.3	50 l/s @175m	sum		2 639 000	0
3.4	100 l/s @100m	sum		2 834 000	0
3.5	1300 l/s @ 260m	sum		25 000 000	0
3.6	120 l/s @100m	sum		3 250 000	0
3.7	120 l/s@ 200 m	sum		5 720 000	0
3.8	150 l/s @ 150m	sum		5 304 000	0
3.9	200 l/s @ 200m	sum		8 814 000	0
3.10	92 l/s @ 30m	sum		13 546 000	0
3.11	300 l/s @ 200 m	sum		12 935 000	0
3.12	400 l/s @ 200 m	sum		16 718 000	0
3.13	500 l/s @ 200m	sum	1	20 644 000	20 644 000
3.14	600 l/s @ 150 m	sum		18 785 000	0
3.15	700 l/s @150 m	sum		21 190 000	0
3.16	950 l/s @ 260 m	sum		20 000 000	0
3.17	1000 l/s @ 200m	sum		28 743 000	0
3.18	2000l/s @ 150m	sum		34 892 000	0
				0	0
4	Reservoirs			0	0
4.1	500 kl	sum		1 000 000	0
4.2	1 Ml	sum		3 000 000	0
4.3	2 Ml	sum		4 500 000	0
4.4	2.5 Ml	sum		5 000 000	0
4.5	3 Ml	sum		6 500 000	0
4.6	4 Ml	sum		8 000 000	0
4.7	5 Ml	sum		11 000 000	0
4.8	10 Ml	sum	1.2	25 000 000	30 000 000
4.9	20 Ml	sum		33 000 000	0
4.10	25 Ml	sum		45 000 000	0
4.11	40 Ml	sum		65 000 000	0
				0	0
5	Electrical supply	sum	3	2 500 000	7 500 000
	Total 1				***138 926 214***
	Contingencies	%	138 926 214	15	20 838 932
	Total 2				***159 765 147***
	Engineering fees	%	159 765 147	15	23 964 772
	Total 3				***183 729 919***
	VAT	%	183 729 919	14	25 722 189
	Total				***209 452 107***

PRIMARY ZONE 4

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		25	
1.1.2	50 HDPE Class 12	m		32	0
1.1.3	63 uPVC Class 12	m		49	0
1.1.4	75 uPVC Class 12	m		68	0
1.1.5	90 uPVC Class 12	m		97	0
1.1.6	110 uPVC Class 12	m		119	0
1.1.7	160 uPVC Class 12	m		249	0
1.1.8	200 uPVC Class 12	m		388	0
1.1.9	250 uPVC Class 12	m		611	0
1.1.10	315 uPVC Class 12	m		1 019	0
1.1.11	355 uPVC Class 12	m		1 228	0
1.1.12	350 STEEL	m	14 413	1 950	28 105 350
1.1.13	450 STEEL	m		2 500	0
1.1.14	500 steel	m		2 736	0
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	0
1.1.17	700 steel	m		4 601	0
1.1.18	800 steel	m		5 732	0
1.1.19	900 steel	m		7 020	0
1.1.20	1000 steel	m		8 383	0
1.1.21	1200 steel	m		8 674	0
1.1.22	1400 steel	m		12 759	0
1.1.23	1600 steel	m		15 647	0
1.1.24	1800 steel	m		20 000	0
				0	
1.2	Bulk connectors			0	
1.2.1	50 HDPE Class 12	m		32	0
1.2.2	63 uPVC Class 12	m		49	0
1.2.3	75 uPVC Class 12	m		68	0
1.2.4	90 uPVC Class 12	m		97	0
1.2.5	110 uPVC Class 12	m		44	0
1.2.6	160 uPVC Class 12	m		249	0
1.2.7	200 uPVC Class 12	m		388	0
1.2.8	250 uPVC Class 12	m		611	0
1.2.9	315 uPVC Class 12	m		535	0
1.2.10	355 uPVC Class 12	m		647	0
1.2.11	400 uPVC Class 12	m		683	0
1.2.12	500 steel	m		2 736	0
1.2.13	600 steel	m		3 564	0
1.2.14	700 steel	m		4 601	0
1.2.15	800 steel	m		5 732	0
1.2.16	900 steel	m		7 020	0
1.2.17	1000 steel	m		8 383	0
				0	0
1.3	Excavation in all materials			0	0
1.3.1	0 - 1.5m	m	14 413	43	618 318
1.3.2	0 - 2 m	m	0	71	0
1.3.3	0- 3 m	m	0	191	0
				0	0
1.3.4	Extra over for :			0	0
1.3.4.1	Soft Class 3	m3	919	20	18 377
1.3.4.2	Intermediate	m3	9 188	80	735 063
1.3.4.3	Hard rock	m3	6 432	350	2 251 130
1.3.4.4	Boulder	m3	1 838	172	315 342
				0	0
1.4	Bedding			0	0
1.4.1	From trench	m3	577	30	17 296
1.4.2	From borrow pit	m3	3 459	60	207 547
1.4.3	Borrow pit haul	m3km	34 591	10	345 912
1.4.4	Commercial sources	m3	7 495	350	2 623 166

				0	0
1.5	Backfill			0	0
1.5.1	From trench	m3	3 423	25	85 577
1.5.2	Import from borrow	m3	3 423	40	136 924
1.5.3	Borrow haul	m3km	34 231	10	342 309
1.6	Allowance for fittings	%	28 105 350	15	4 215 803
1.7	Allowance for sundries	%	28 105 350	15	4 215 803
2	Abstraction & Treatment Works				
2.1	Up to 30 Ml/d	sum		30 000 000	0
2.2	Up to 40 Ml/d	sum		40 000 000	0
2.3	Up to 4 Ml/d	sum		5 000 000	0
2.4	Up to 60 Ml/d	sum		560 000 000	0
2.5	Up to 120 Ml/d	sum		840 000 000	0
2.6	Up to 140 Ml/d	sum		120 000 000	0
				0	0
3	Pumpstations			0	0
3.1	20 l/s @ 15m	sum		780 000	0
3.2	30 l/s @ 105m	sum		1 404 000	0
3.3	50 l/s @175m	sum		2 639 000	0
3.4	100 l/s @100m	sum		2 834 000	0
3.5	1300 l/s @ 260m	sum		25 000 000	0
3.6	120 l/s @100m	sum		3 250 000	0
3.7	120 l/s@ 200 m	sum		5 720 000	0
3.8	150 l/s @ 150m	sum		5 304 000	0
3.9	200 l/s @ 200m	sum		8 814 000	0
3.10	92 l/s @ 330m	sum	1	16 500 000	16 500 000
3.11	300 l/s @ 200 m	sum		12 935 000	0
3.12	400 l/s @ 200 m	sum		16 718 000	0
3.13	500 l/s @ 200m	sum		20 644 000	0
3.14	600 l/s @ 150 m	sum		18 785 000	0
3.15	700 l/s @150 m	sum		21 190 000	0
3.16	950 l/s @ 260 m	sum		20 000 000	0
3.17	1000 l/s @ 200m	sum		28 743 000	0
3.18	2000l/s @ 150m	sum		34 892 000	0
				0	0
4	Reservoirs			0	0
4.1	500 kl	sum		1 000 000	0
4.2	1 Ml	sum		3 000 000	0
4.3	2 Ml	sum		4 500 000	0
4.4	2.5 Ml	sum		5 000 000	0
4.5	3 Ml	sum		6 500 000	0
4.6	4 Ml	sum		8 000 000	0
4.7	5 Ml	sum	1	11 000 000	11 000 000
4.8	10 Ml	sum		25 000 000	0
4.9	20 Ml	sum		33 000 000	0
4.10	25 Ml	sum		45 000 000	0
4.11	40 Ml	sum		65 000 000	0
				0	0
5	Electrical supply	sum	2	2 500 000	5 000 000
	Total 1				***76 733 915***
	Contingencies	%	76 733 915	15	11 510 087
	Total 2				***88 244 002***
	Engineering fees	%	88 244 002	15	13 236 600
	Total 3				***101 480 603***
	VAT	%	101 480 603	14	14 207 284
	Total				***115 687 887***

				0	0
1.5	Backfill			0	0
1.5.1	From trench	m3	3 423	25	85 577
1.5.2	Import from borrow	m3	3 423	40	136 924
1.5.3	Borrow haul	m3km	34 231	10	342 309
1.6	Allowance for fittings	%	28 105 350	15	4 215 803
1.7	Allowance for sundries	%	28 105 350	15	4 215 803
2	Abstraction & Treatment Works				
2.1	Up to 30 Ml/d	sum		30 000 000	0
2.2	Up to 40 Ml/d	sum		40 000 000	0
2.3	Up to 4 Ml/d	sum		5 000 000	0
2.4	Up to 80 Ml/d	sum		560 000 000	0
2.5	Up to 120 Ml/d	sum		840 000 000	0
2.6	Up to 140 Ml/d	sum		120 000 000	0
				0	0
3	Pumpstations			0	0
3.1	20 l/s @ 15m	sum		780 000	0
3.2	30 l/s @ 105m	sum		1 404 000	0
3.3	50 l/s @175m	sum		2 639 000	0
3.4	100 l/s @100m	sum		2 834 000	0
3.5	1300 l/s @ 260m	sum		25 000 000	0
3.6	120 l/s @100m	sum		3 250 000	0
3.7	120 l/s@ 200 m	sum		5 720 000	0
3.8	150 l/s @ 150m	sum		5 304 000	0
3.9	200 l/s @ 200m	sum		8 814 000	0
3.10	92 l/s @ 330m	sum	1	16 500 000	16 500 000
3.11	300 l/s @ 200 m	sum		12 935 000	0
3.12	400 l/s @ 200 m	sum		16 718 000	0
3.13	500 l/s @ 200m	sum		20 644 000	0
3.14	600 l/s @ 150 m	sum		18 785 000	0
3.15	700 l/s @150 m	sum		21 190 000	0
3.16	950 l/s @ 260 m	sum		20 000 000	0
3.17	1000 l/s @ 200m	sum		28 743 000	0
3.18	2000l/s @ 150m	sum		34 892 000	0
				0	0
4	Reservoirs			0	0
4.1	500 kl	sum		1 000 000	0
4.2	1 Ml	sum		3 000 000	0
4.3	2 Ml	sum		4 500 000	0
4.4	2.5 Ml	sum		5 000 000	0
4.5	3 Ml	sum		6 500 000	0
4.6	4 Ml	sum		8 000 000	0
4.7	5 Ml	sum	1	11 000 000	11 000 000
4.8	10 Ml	sum		25 000 000	0
4.9	20 Ml	sum		33 000 000	0
4.10	25 Ml	sum		45 000 000	0
4.11	40 Ml	sum		65 000 000	0
				0	0
5	Electrical supply	sum	2	2 500 000	5 000 000
	Total 1				***76 733 915***
	Contingencies	%	76 733 915	15	11 510 087
	Total 2				***88 244 002***
	Engineering fees	%	88 244 002	15	13 236 600
	Total 3				***101 480 603***
	VAT	%	101 480 603	14	14 207 284
	Total				***115 687 887***

SECONDARY ZONE 1

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		20	
1.1.2	50 HDPE Class 12	m	110	32	3 571
1.1.3	63 uPVC Class 12	m		49	
1.1.4	75 uPVC Class 12	m	28	68	1 893
1.1.5	90 uPVC Class 12	m		97	
1.1.6	110 uPVC Class 12	m		119	
1.1.7	160 uPVC Class 12	m		249	
1.1.8	200 uPVC Class 12	m		388	
1.1.9	250 uPVC Class 12	m		611	
1.1.10	315 uPVC Class 12	m		1 019	
1.1.11	355 uPVC Class 12	m	5 863	1 228	7 199 823
1.1.12	400 uPVC Class 12	m	6 894	1 648	11 360 760
1.1.13	450 uPVC Class 12	m		2 192	
1.1.14	500 steel	m	15 641	2 736	42 793 776
1.1.15	550 steel	m		315	
1.1.16	600 steel	m		3 564	
1.1.17	700 steel	m		4 601	
1.1.18	800 steel	m		5 732	
1.1.19	900 steel	m		7 020	
1.1.20	1000 steel	m		8 383	
1.1.21	1200 steel	m		8 674	
1.1.22	1400 steel	m		12 759	
1.1.23	1600 steel	m		15 647	
1.1.24	1800 steel	m		20 000	
1.2	Bulk connectors				
1.2.1	50 HDPE Class 12	m		32	
1.2.2	63 uPVC Class 12	m		49	
1.2.3	75 uPVC Class 12	m		68	
1.2.4	90 uPVC Class 12	m		97	
1.2.5	110 uPVC Class 12	m		44	
1.2.6	160 uPVC Class 12	m		249	
1.2.7	200 uPVC Class 12	m		388	
1.2.8	250 uPVC Class 12	m		611	
1.2.9	315 uPVC Class 12	m		535	
1.2.10	355 uPVC Class 12	m		647	
1.2.11	400 uPVC Class 12	m		683	
1.2.12	500 steel	m		2 736	
1.2.13	600 steel	m		3 564	
1.2.14	700 steel	m		4 601	
1.2.15	800 steel	m		5 732	
1.2.16	900 steel	m		7 020	
1.2.17	1000 steel	m		8 383	
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	12 895	43	553 196
1.3.2	0 - 2 m	m	15 641	71	1 107 383
1.3.3	0- 3 m	m		191	
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	2 543	20	50 851
1.3.4.2	Intermediate	m3	25 426	80	2 034 053
1.3.4.3	Hard rock	m3	17 798	350	6 229 287
1.3.4.4	Boulder	m3	5 085	172	872 609

1.4	Bedding				
1.4.1	From trench	m3	6 317	30	189 512
1.4.2	From borrow pit	m3	7 580	60	454 830
1.4.3	Borrow pit haul	m3km	75 805	10	758 049
1.4.4	Commercial sources	m3	11 371	350	3 979 759
1.5	Backfill				
1.5.1	From trench	m3	17 908	25	447 703
1.5.2	Import from borrow	m3	7 675	40	306 996
1.5.3	Borrow haul	m3km	76 749	10	767 490
1.6	Allowance for fittings	%	61 359 823	15	9 203 973
1.7	Allowance for sundries	%	61 359 823	15	9 203 973
2	Reservoirs				
	100 kl	sum		250 000	
	150 kl	sum		300 000	
	200 kl	sum		350 000	
	250 kl	sum		400 000	
	300 kl	sum		450 000	
	350 kl	sum		500 000	
2.1	500 kl	sum		1 000 000	
	600 kl	sum		1 500 000	
	750 kl	sum		2 000 000	
	850 kl	sum		2 500 000	
2.2	1 Ml	sum		3 000 000	
	1.25 Ml	sum		3 500 000	
	1.5 Ml	sum		4 000 000	
2.3	2 Ml	sum		4 500 000	
2.4	2.5 Ml	sum		5 000 000	
2.5	3 Ml	sum		6 500 000	
2.6	4 Ml	sum		8 000 000	
2.7	5 Ml	sum		11 000 000	
2.8	10 Ml	sum		25 000 000	
2.9	15 Ml	sum		33 000 000	
2.1	25 Ml	sum		45 000 000	
2.11	40 Ml	sum		65 000 000	
3	Electrical supply	sum		2 500 000	
	Total 1				***97 519 488***
	Contingencies	%	97 519 488	15	14 627 923
	Total 2				***112 147 411***
	Engineering fees	%	112 147 411	15	16 822 112
	Total 3				***128 969 522***
	VAT	%	128 969 522	14	18 055 733
	Total				***147 025 256***

SECONDARY ZONE 2

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		20	
1.1.2	50 HDPE Class 12	m	12 890	32	418 409
1.1.3	63 uPVC Class 12	m	63	49	3 071
1.1.4	75 uPVC Class 12	m	976	68	65 978
1.1.5	90 uPVC Class 12	m	86	97	8 309
1.1.6	110 uPVC Class 12	m	7 759	119	926 890
1.1.7	160 uPVC Class 12	m	5 564	249	1 383 322
1.1.8	200 uPVC Class 12	m	926	388	359 121
1.1.9	250 uPVC Class 12	m	6 091	611	3 721 662
1.1.10	315 uPVC Class 12	m	9 297	1 019	9 471 784
1.1.11	355 uPVC Class 12	m		1 228	
1.1.12	400 uPVC Class 12	m		1 648	
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m	22 599	2 736	61 830 864
1.1.15	550 steel	m			
1.1.16	600 steel	m	9 054	3 564	32 268 456
1.1.17	700 steel	m		4 601	
1.1.18	800 steel	m		5 732	
1.1.19	900 steel	m		7 020	
1.1.20	1000 steel	m		8 383	
1.1.21	1200 steel	m		8 674	
1.1.22	1400 steel	m		12 759	
1.1.23	200 steel	m	7 816	750	5 862 000
1.1.24	50 STEEL	m	3 435	200	687 000
1.2	Bulk connectors				
1.2.1	50 HDPE Class 12	m		32	
1.2.2	63 uPVC Class 12	m		49	
1.2.3	75 uPVC Class 12	m		68	
1.2.4	90 uPVC Class 12	m		97	
1.2.5	110 uPVC Class 12	m		44	
1.2.6	160 uPVC Class 12	m		249	
1.2.7	200 uPVC Class 12	m		388	
1.2.8	250 uPVC Class 12	m		611	
1.2.9	315 uPVC Class 12	m		535	
1.2.10	355 uPVC Class 12	m		647	
1.2.11	400 uPVC Class 12	m		683	
1.2.12	500 steel	m		2 736	
1.2.13	600 steel	m		3 564	
1.2.14	700 steel	m		4 601	
1.2.15	800 steel	m		5 732	
1.2.16	900 steel	m		7 020	
1.2.17	1000 steel	m		8 383	
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	43 652	43	1 872 671
1.3.2	0 - 2 m	m	31 653	71	2 241 032
1.3.3	0- 3 m	m	11 251	191	2 153 104
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	8 965	20	179 298
1.3.4.2	Intermediate	m3	89 649	80	7 171 908
1.3.4.3	Hard rock	m3	62 754	350	21 963 968
1.3.4.4	Boulder	m3	17 930	172	3 076 749
1.4	Bedding				
1.4.1	From trench	m3	2 860	30	85 793
1.4.2	From borrow pit	m3	17 159	60	1 029 520
1.4.3	Borrow pit haul	m3km	171 587	10	1 715 867
1.4.4	Commercial sources	m3	37 177	350	13 011 989
1.5	Backfill				
1.5.1	From trench	m3	61 051	25	1 526 277
1.5.2	Import from borrow	m3	61 051	40	2 442 043

1.5.3	Borrow haul	m3km	610 511	10	6 105 107
1.6	Allowance for fittings	%	117 006 866	15	17 551 030
1.7	Allowance for sundries	%	117 006 866	15	17 551 030
2	Booster Pumps				
2.1	20 l/s @ 15m	sum		780 000	
2.2	30 l/s @ 10m	sum		1 404 000	
2.3	50 l/s @175m	sum		2 639 000	
2.4	100 l/s @100m	sum		2 834 000	
2.5	100 l/s @200m	sum		4 901 000	
2.6	120 l/s @100m	sum		3 250 000	
2.7	120 l/s@ 200 m	sum		5 720 000	
2.8	150 l/s @ 150m	sum		5 304 000	
2.9	314 l/s @ 164m	sum		8 814 000	
2.1	250 l/s @ 532m	sum		13 546 000	
2.11	353 l/s @ 211 m	sum		12 935 000	
2.12	400 l/s @ 315 m	sum		16 718 000	
2.13	500 l/s @ 129m	sum		20 644 000	
2.14	600 l/s @ 150 m	sum		18 785 000	
2.15	700 l/s @150 m	sum		21 190 000	
2.16	950 l/s @ 200 m	sum		43 459 000	
2.17	1000 l/s @ 200m	sum		28 743 000	
2.18	2000l/s @ 150m	sum		34 892 000	
3	Reservoirs				
3.1	11 kl	sum		50 000	
3.2	100 kl	sum		250 000	
3.3	150 Kl	sum		300 000	
3.4	200 Kl	sum		350 000	
3.5	250 Kl	sum		400 000	
3.6	300 Kl	sum		450 000	
3.7	350 Kl	sum		500 000	
3.8	400 Kl	sum		600 000	
3.9	450 Kl	sum		750 000	
3.1	500 Kl	sum		1 000 000	
3.11	550 Kl	sum		1 250 000	
3.12	600 Kl	sum		1 500 000	
3.13	750 Kl	sum		2 000 000	
3.14	1 Ml	sum		3 000 000	
3.15	1.25 Ml	sum		3 500 000	
3.16	1.5 Ml	sum		4 000 000	
3.17	2 Ml	sum	1	4 500 000	4 500 000
3.18	2.5 Ml	sum		5 000 000	
3.19	3 Ml	sum		6 500 000	
3.2	4 Ml	sum	1	8 000 000	8 000 000
3.21	5 Ml	sum	1	11 000 000	11 000 000
3.22	10 Ml	sum		25 000 000	
3.23	15 Ml	sum		33 000 000	
3.24	25 Ml	sum		45 000 000	
3.25	40 Ml	sum		65 000 000	
4	Electrical supply	sum		2 500 000	
	Total 1				***240 184 252***
	Contingencies	%	240 184 252	15	36 027 638
	Total 2				***276 211 890***
	Engineering fees	%	276 211 890	15	41 431 783
	Total 3				***317 643 673***
	VAT	%	317 643 673	14	44 470 114
	Total				***362 113 787***

SECONDARY ZONE 3

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		20	
1.1.2	50 HDPE Class 12	m	17 668	32	573 503
1.1.3	63 uPVC Class 12	m	2 570	49	125 288
1.1.4	75 uPVC Class 12	m	5 721	68	386 740
1.1.5	90 uPVC Class 12	m		97	
1.1.6	110 uPVC Class 12	m	1 166	119	139 290
1.1.7	160 uPVC Class 12	m	4 762	249	1 183 928
1.1.8	200 uPVC Class 12	m		388	
1.1.9	250 uPVC Class 12	m	6 009	611	3 671 559
1.1.10	315 uPVC Class 12	m		1 019	
1.1.11	355 uPVC Class 12	m	6 222	1 228	7 640 678
1.1.12	400 uPVC Class 12	m	6 737	1 648	11 102 037
1.1.13	400 steel	m	4 917	2 000	9 834 000
1.1.14	500 steel	m	7 197	2 736	19 690 992
1.1.15	550 steel	m			
1.1.16	600 steel	m	20 207	3 564	72 017 748
1.1.17	700 steel	m		4 601	
1.1.18	750 steel	m			
1.1.19	800 steel	m		5 732	
1.1.20	900 steel	m		7 020	
1.1.21	1000 steel	m		8 383	
1.1.22	1200 steel	m		8 674	
1.1.23	1400 steel	m		12 759	
1.1.24	1600 steel	m		15 647	
1.125	300 steel	m	8 268	1 050	8 681 400
1.2	Bulk connectors				
1.2.1	50 HDPE Class 12	m		32	
1.2.2	63 uPVC Class 12	m		49	
1.2.3	75 uPVC Class 12	m		68	
1.2.4	90 uPVC Class 12	m		97	
1.2.5	110 uPVC Class 12	m		44	
1.2.6	160 uPVC Class 12	m		249	
1.2.7	200 uPVC Class 12	m		388	
1.2.8	250 uPVC Class 12	m		611	
1.2.9	315 uPVC Class 12	m		535	
1.2.10	355 uPVC Class 12	m		647	
1.2.11	400 uPVC Class 12	m		683	
1.2.12	500 steel	m		2 736	
1.2.13	600 steel	m		3 564	
1.2.14	700 steel	m		4 601	
1.2.15	800 steel	m		5 732	
1.2.16	900 steel	m		7 020	
1.2.17	1000 steel	m		8 383	
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	62 969	43	2 701 370
1.3.2	0 - 2 m	m	28 475	71	2 016 030
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	9 131	20	182 617
1.3.4.2	Intermediate	m3	91 308	80	7 304 675
1.3.4.3	Hard rock	m3	63 916	350	22 370 567
1.3.4.4	Boulder	m3	18 262	172	3 133 706

1.4	Bedding				
1.4.1	From trench	m3	3 198	30	95 928
1.4.2	From borrow pit	m3	19 186	60	1 151 130
1.4.3	Borrow pit haul	m3km	191 855	10	1 918 550
1.4.4	Commercial sources	m3	41 569	350	14 549 005
1.5	Backfill				
1.5.1	From trench	m3	59 333	25	1 483 315
1.5.2	Import from borrow	m3	59 333	40	2 373 304
1.5.3	Borrow haul	m3km	593 326	10	5 933 260
1.6	Allowance for fittings	%	135 047 164	15	20 257 075
1.7	Allowance for sundries	%	135 047 164	15	20 257 075
2	Pumpstations				
2.9	170 l/s @ 100m	sum	1	8 814 000	8 814 000
5	Electrical supply	sum	1.0	2 500 000	2 500 000
	Total 1				***253 671 017***
	Contingencies	%	253 671 017	15	38 050 653
	Total 2				***291 721 669***
	Engineering fees	%	291 721 669	15	43 758 250
	Total 3				***335 479 920***
	VAT	%	335 479 920	14	46 967 189
	Total				***382 447 109***

SECONDARY ZONE 4

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		20	
1.1.2	50 HDPE Class 12	m		32	
1.1.3	63 uPVC Class 12	m		49	
1.1.4	75 uPVC Class 12	m		68	
1.1.5	90 uPVC Class 12	m		97	
1.1.6	110 uPVC Class 12	m		119	
1.1.7	160 uPVC Class 12	m		249	
1.1.8	200 uPVC Class 12	m		388	
1.1.9	250 uPVC Class 12	m		611	
1.1.10	315 uPVC Class 12	m		1 019	
1.1.11	355 uPVC Class 12	m		1 228	
1.1.12	400 uPVC Class 12	m		1 648	
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m		2 736	
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	
1.1.17	700 steel	m		4 601	
1.1.18	800 steel	m		5 732	
1.1.19	900 steel	m		7 020	
1.1.20	1000 steel	m		8 383	
1.1.21	1200 steel	m		8 674	
1.1.22	1400 steel	m		12 759	
1.1.23	1600 steel	m		15 647	
1.1.24	1800 steel	m		20 000	
1.2	Bulk connectors				
1.2.1	50 HDPE Class 12	m		32	
1.2.2	63 uPVC Class 12	m		49	
1.2.3	75 uPVC Class 12	m		68	
1.2.4	90 uPVC Class 12	m		97	
1.2.5	110 uPVC Class 12	m		44	
1.2.6	160 uPVC Class 12	m		249	
1.2.7	200 uPVC Class 12	m		388	
1.2.8	250 uPVC Class 12	m		611	
1.2.9	315 uPVC Class 12	m		535	
1.2.10	355 uPVC Class 12	m		647	
1.2.11	400 uPVC Class 12	m		683	
1.2.12	500 steel	m		2 736	
1.2.13	600 steel	m		3 564	
1.2.14	700 steel	m		4 601	
1.2.15	800 steel	m		5 732	
1.2.16	900 steel	m		7 020	
1.2.17	1000 steel	m		8 383	
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m		43	
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3		20	
1.3.4.2	Intermediate	m3		80	
1.3.4.3	Hard rock	m3		350	
1.3.4.4	Boulder	m3		172	

1.4	Bedding				
1.4.1	From trench	m3		30	
1.4.2	From borrow pit	m3		60	
1.4.3	Borrow pit haul	m3km		10	
1.4.4	Commercial sources	m3		350	
1.5	Backfill				
1.5.1	From trench	m3		25	
1.5.2	Import from borrow	m3		40	
1.5.3	Borrow haul	m3km		10	
1.6	Allowance for fittings	%		15	
1.7	Allowance for sundries	%		15	
	Total 1				
	Contingencies	%		15	
	Total 2				
	Engineering fees	%		15	
	Total 3				
	VAT	%		14	
	Total				

TERTIARY ZONE 1

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		20	
1.1.2	50 HDPE Class 12	m	19 400	32	629 724
1.1.3	63 uPVC Class 12	m	329	49	16 039
1.1.4	75 uPVC Class 12	m	699	68	47 252
1.1.5	90 uPVC Class 12	m	3 304	97	319 232
1.1.6	110 uPVC Class 12	m	6 876	119	821 407
1.1.7	160 uPVC Class 12	m	414	249	102 929
1.1.8	200 uPVC Class 12	m	1 878	388	728 326
1.1.9	250 uPVC Class 12	m		611	
1.1.10	315 uPVC Class 12	m		1 019	
1.1.11	355 uPVC Class 12	m	5 878	1 228	7 218 243
1.1.12	400 uPVC Class 12	m		1 648	
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m		2 736	
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	
1.1.17	700 steel	m		4 601	
1.1.18	800 steel	m		5 732	
1.1.19	250 steel	m	6 610	1 025	6 775 250
1.1.20	200 steel	m	8 839	750	6 629 250
1.1.21	150 steel	m	4 429	550	2 435 950
1.1.22	100 steel	m	13 420	400	5 368 000
1.1.23	80 steel	m	1 273	300	381 900
1.1.24	50 steel	m	29 330	200	5 866 000
1.2	Bulk connectors				
1.2.1	50 HDPE Class 12	m		32	
1.2.2	63 uPVC Class 12	m		49	
1.2.3	75 uPVC Class 12	m		68	
1.2.4	90 uPVC Class 12	m		97	
1.2.5	110 uPVC Class 12	m		44	
1.2.6	160 uPVC Class 12	m		249	
1.2.7	200 uPVC Class 12	m		388	
1.2.8	250 uPVC Class 12	m		611	
1.2.9	315 uPVC Class 12	m		535	
1.2.10	355 uPVC Class 12	m		647	
1.2.11	400 uPVC Class 12	m		683	
1.2.12	500 steel	m		2 736	
1.2.13	600 steel	m		3 564	
1.2.14	700 steel	m		4 601	
1.2.15	800 steel	m		5 732	
1.2.16	900 steel	m		7 020	
1.2.17	1000 steel	m		8 383	
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	38 778	43	1 663 576
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	15 224	20	304 484
1.3.4.2	Intermediate	m3	152 242	80	12 179 358
1.3.4.3	Hard rock	m3	106 569	350	37 299 284
1.3.4.4	Boulder	m3	30 448	172	5 224 945

1.4	Bedding				
1.4.1	From trench	m3	6 143	30	184 288
1.4.2	From borrow pit	m3	36 858	60	2 211 461
1.4.3	Borrow pit haul	m3km	368 577	10	3 685 768
1.4.4	Commercial sources	m3	79 858	350	27 950 404
1.5	Backfill				
1.5.1	From trench	m3	90 813	25	2 270 313
1.5.2	Import from borrow	m3	90 813	40	3 632 501
1.5.3	Borrow haul	m3km	908 125	10	9 081 251
1.6	Allowance for fittings	%	37 339 502	15	5 600 925
1.7	Allowance for sundries	%	37 339 502	15	5 600 925
3	Reservoirs				
3.1					
3.2	300 Kl	sum	4	600 000	2 400 000
3.3	450 Kl	sum	2	750 000	1 500 000
3.4	500 Kl	sum		1 000 000	
3.5	550 Kl	sum		1 250 000	
3.6	750 Kl	sum		2 000 000	
3.7	850 Kl	sum		2 500 000	
3.8	10 kl	sum	7	50 000	350 000
3.9	20 kl	sum	5	75 000	375 000
3.10	30 kl	sum	3	100 000	300 000
3.11	40 kl	sum	4	120 000	480 000
3.12	50 kl	sum	3	200 000	600 000
3.13	75 kl	sum	7	300 000	2 100 000
3.14	100 kl	sum	2	350 000	700 000
3.15	150 kl	sum	1	400 000	400 000
3.16	200 kl	sum	5	450 000	2 250 000
3.17	250 kl	sum	4	500 000	2 000 000
4	Electrical supply	sum		2 500 000	
	Total 1				***177 516 029***
	Contingencies	%	177 516 029	15	26 627 404
	Total 2				***204 143 433***
	Engineering & EMP fees	%	204 143 433	15	30 621 515
	Total 3				***234 764 948***
	VAT	%	234 764 948	14	32 867 093
	Total				***267 632 041***

TERTIARY ZONE 2

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		20	
1.1.2	50 HDPE Class 12	m	154 546	32	5 016 563
1.1.3	63 uPVC Class 12	m	49 826	49	2 429 018
1.1.4	75 uPVC Class 12	m	50 442	68	3 409 879
1.1.5	90 uPVC Class 12	m	12 533	97	1 210 938
1.1.6	110 uPVC Class 12	m	42 481	119	5 074 780
1.1.7	160 uPVC Class 12	m	39 931	249	9 927 645
1.1.8	200 uPVC Class 12	m	19 005	388	7 370 519
1.1.9	250 uPVC Class 12	m	33 145	611	20 251 926
1.1.10	315 uPVC Class 12	m	22 013	1 019	22 426 844
1.1.11	355 uPVC Class 12	m	5 926	1 228	7 277 187
1.1.12	400 uPVC Class 12	m		1 648	
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m		2 736	
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	
1.1.17	700 steel	m		4 601	
1.1.18	800 steel	m		5 732	
1.1.19	900 steel	m		7 020	
1.1.20	1000 steel	m	2 112	8 383	17 704 896
1.1.21	150 steel	m	1 504	550	827 200
1.1.22	100 steel	m	6 856	400	2 742 400
1.1.23	80 steel	m	13 847	300	4 154 100
1.1.24	50 steel	m	29 190	200	5 838 000
1.2	Bulk connectors				
1.2.1	50 HDPE Class 12	m		32	
1.2.2	63 uPVC Class 12	m		49	
1.2.3	75 uPVC Class 12	m		68	
1.2.4	90 uPVC Class 12	m		97	
1.2.5	110 uPVC Class 12	m		44	
1.2.6	160 uPVC Class 12	m		249	
1.2.7	200 uPVC Class 12	m		388	
1.2.8	250 uPVC Class 12	m		611	
1.2.9	315 uPVC Class 12	m		535	
1.2.10	355 uPVC Class 12	m		647	
1.2.11	400 uPVC Class 12	m		683	
1.2.12	500 steel	m		2 736	
1.2.13	600 steel	m		3 564	
1.2.14	700 steel	m		4 601	
1.2.15	800 steel	m		5 732	
1.2.16	900 steel	m		7 020	
1.2.17	1000 steel	m		8 383	
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	429 848	43	18 440 479
1.3.2	0 - 2 m	m	3 616	71	256 013
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	39 775	20	795 498
1.3.4.2	Intermediate	m3	397 749	80	31 819 912
1.3.4.3	Hard rock	m3	278 424	350	97 448 481
1.3.4.4	Boulder	m3	79 550	172	13 650 742

1.4	Bedding				
1.4.1	From trench	m3	13 130	30	393 908
1.4.2	From borrow pit	m3	78 782	60	4 726 895
1.4.3	Borrow pit haul	m3km	787 816	10	7 878 158
1.4.4	Commercial sources	m3	170 693	350	59 742 696
1.5	Backfill				
1.5.1	From trench	m3	266 446	25	6 661 157
1.5.2	Import from borrow	m3	266 446	40	10 657 851
1.5.3	Borrow haul	m3km	2 664 463	10	26 644 627
1.6	Allowance for fittings	%	115 661 897	15	17 349 285
1.7	Allowance for sundries	%	115 661 897	15	17 349 285
3	Reservoirs				
3.1					
3.2	300 Kl	sum	2	600 000	1 200 000
3.3	450 Kl	sum	4	750 000	3 000 000
3.4	500 Kl	sum	3	1 000 000	3 000 000
3.5	550 Kl	sum		1 250 000	
3.6	750 Kl	sum	2	2 000 000	4 000 000
3.7	850 Kl	sum		2 500 000	
3.8	10 kl	sum	21	50 000	1 050 000
3.9	20 kl	sum	21	75 000	1 575 000
3.10	30 kl	sum	27	100 000	2 700 000
3.11	40 kl	sum	18	120 000	2 160 000
3.12	50 kl	sum	19	200 000	3 800 000
3.13	75 kl	sum	29	300 000	8 700 000
3.14	100 kl	sum	6	350 000	2 100 000
3.15	150 kl	sum	10	400 000	4 000 000
3.16	200 kl	sum	13	450 000	5 850 000
3.17	250 kl	sum	6	500 000	3 000 000
4	Electrical supply	sum		2 500 000	
	Total 1				***485 159 905***
	Contingencies	%	485 159 905	15	72 773 986
	Total 2				***557 933 891***
	Engineering fees	%	557 933 891	15	83 690 084
	Total 3				***641 623 974***
	VAT	%	641 623 974	14	89 827 356
	Total				***731 451 331***

TERTIARY ZONE 3

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		20	
1.1.2	50 HDPE Class 12	m	62 501	32	2 028 782
1.1.3	63 uPVC Class 12	m	7 257	49	353 779
1.1.4	75 uPVC Class 12	m	31 416	68	2 123 722
1.1.5	90 uPVC Class 12	m	10 989	97	1 061 757
1.1.6	110 uPVC Class 12	m	18 887	119	2 256 241
1.1.7	160 uPVC Class 12	m	38 333	249	9 530 350
1.1.8	200 uPVC Class 12	m	9 430	388	3 657 143
1.1.9	250 uPVC Class 12	m	6 916	611	4 225 745
1.1.10	315 uPVC Class 12	m	16 925	1 019	17 243 190
1.1.11	355 uPVC Class 12	m	2 053	1 228	2 521 105
1.1.12	400 uPVC Class 12	m		1 648	
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m		2 736	
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	
1.1.17	700 steel	m		4 601	
1.1.18	300 steel	m	8 555	1 050	8 982 750
1.1.19	250 steel	m	8 832	1 025	9 052 800
1.1.20	200 steel	m	3 139	750	2 354 250
1.1.21	150 steel	m	15 740	550	8 657 000
1.1.22	100 steel	m	18 228	400	7 291 200
1.1.23	80 steel	m	31 733	300	9 519 900
1.1.24	50 steel	m	28 074	200	5 614 800
1.2	Bulk connectors				
1.2.1	50 HDPE Class 12	m		32	
1.2.2	63 uPVC Class 12	m		49	
1.2.3	75 uPVC Class 12	m		68	
1.2.4	90 uPVC Class 12	m		97	
1.2.5	110 uPVC Class 12	m		44	
1.2.6	160 uPVC Class 12	m		249	
1.2.7	200 uPVC Class 12	m		388	
1.2.8	250 uPVC Class 12	m		611	
1.2.9	315 uPVC Class 12	m		535	
1.2.10	355 uPVC Class 12	m		647	
1.2.11	400 uPVC Class 12	m		683	
1.2.12	500 steel	m		2 736	
1.2.13	600 steel	m		3 564	
1.2.14	700 steel	m		4 601	
1.2.15	800 steel	m		5 732	
1.2.16	900 steel	m		7 020	
1.2.17	1000 steel	m		8 383	
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	204 707	43	8 781 930
1.3.2	0 - 2 m	m	36 266	71	2 567 633
1.3.3	0- 3 m	m	78 035	191	14 933 558
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	35 768	20	715 355
1.3.4.2	Intermediate	m3	357 677	80	28 614 185
1.3.4.3	Hard rock	m3	250 374	350	87 630 942

TERTIARY ZONE 4

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		20	
1.1.2	50 HDPE Class 12	m	42 878	32	1 391 820
1.1.3	63 uPVC Class 12	m	8 967	49	437 141
1.1.4	75 uPVC Class 12	m	14 547	68	983 377
1.1.5	90 uPVC Class 12	m	11 627	97	1 123 401
1.1.6	110 uPVC Class 12	m	4 332	119	517 501
1.1.7	160 uPVC Class 12	m	46 470	249	11 553 371
1.1.8	200 uPVC Class 12	m	3 083	388	1 195 649
1.1.9	250 uPVC Class 12	m		611	
1.1.10	315 uPVC Class 12	m	470	1 019	478 836
1.1.11	355 uPVC Class 12	m		1 228	
1.1.12	400 uPVC Class 12	m		1 648	
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m		2 736	
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	
1.1.17	700 steel	m		4 601	
1.1.18	800 steel	m		5 732	
1.1.19	900 steel	m		7 020	
1.1.20	1000 steel	m		8 383	
1.1.21	1200 steel	m		8 674	
1.1.22	1400 steel	m		12 759	
1.1.23	1600 steel	m		15 647	
1.1.24	150 steel	m	950	20 000	19 000 000
1.2	Bulk connectors				
1.2.1	50 HDPE Class 12	m		32	
1.2.2	63 uPVC Class 12	m		49	
1.2.3	75 uPVC Class 12	m		68	
1.2.4	90 uPVC Class 12	m		97	
1.2.5	110 uPVC Class 12	m		44	
1.2.6	160 uPVC Class 12	m		249	
1.2.7	200 uPVC Class 12	m		388	
1.2.8	250 uPVC Class 12	m		611	
1.2.9	315 uPVC Class 12	m		535	
1.2.10	355 uPVC Class 12	m		647	
1.2.11	400 uPVC Class 12	m		683	
1.2.12	500 steel	m		2 736	
1.2.13	600 steel	m		3 564	
1.2.14	700 steel	m		4 601	
1.2.15	800 steel	m		5 732	
1.2.16	900 steel	m		7 020	
1.2.17	1000 steel	m		8 383	
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	132 374	43	5 678 845
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	8 667	20	173 337
1.3.4.2	Intermediate	m3	86 668	80	6 933 474
1.3.4.3	Hard rock	m3	60 668	350	21 233 764
1.3.4.4	Boulder	m3	17 334	172	2 974 460
1.4	Bedding				
1.4.1	From trench	m3	2 371	30	71 141
1.4.2	From borrow pit	m3	14 228	60	853 695
1.4.3	Borrow pit haul	m3km	142 283	10	1 422 826
1.4.4	Commercial sources	m3	30 828	350	10 789 761

1.5	Backfill				
1.5.1	From trench	m3	62 955	25	1 573 867
1.5.2	Import from borrow	m3	62 955	40	2 518 187
1.5.3	Borrow haul	m3km	629 547	10	6 295 466
1.6	Allowance for fittings	%	36 681 096	15	5 502 164
1.7	Allowance for sundries	%	36 681 096	15	5 502 164
2	Pumpstations				
2.1	20 l/s @ 70m	sum	1	780 000	780 000
2.2	4 l/s @ 186m	sum	1	1 404 000	1 404 000
2.3	50 l/s @175m	sum		2 639 000	
2.4	100 l/s @100m	sum		2 834 000	
2.5	100 l/s @534m	sum		4 901 000	
2.6	121 l/s @134m	sum		3 250 000	
2.7	120 l/s@ 200 m	sum		5 720 000	
2.8	161 l/s @ 165m	sum		5 304 000	
2.9	200 l/s @ 200m	sum		8 814 000	
2.1	250 l/s @ 250m	sum		13 546 000	
2.11	300 l/s @ 200 m	sum		12 935 000	
2.12	400 l/s @ 315 m	sum		16 718 000	
2.13	539 l/s @ 65m	sum		20 644 000	
2.14	600 l/s @ 150 m	sum		18 785 000	
2.15	700 l/s @150 m	sum		21 190 000	
2.16	950 l/s @ 200 m	sum		43 459 000	
2.17	1000 l/s @ 38m	sum		28 743 000	
2.18	2000l/s @ 230m	sum		34 892 000	
3	Reservoirs				
3.1					
3.2	300 Kl	sum		600 000	
3.3	450 Kl	sum	1	750 000	750 000
3.4	500 Kl	sum		1 000 000	
3.5	550 Kl	sum		1 250 000	
3.6	750 Kl	sum		2 000 000	
3.7	850 Kl	sum		2 500 000	
3.8	10 kl	sum	3	50 000	150 000
3.9	20 kl	sum	9	75 000	675 000
3.10	30 kl	sum	6	100 000	600 000
3.11	40 kl	sum	5	120 000	600 000
3.12	50 kl	sum	4	200 000	800 000
3.13	75 kl	sum	1	300 000	300 000
3.14	100 kl	sum		350 000	
3.15	150 kl	sum	8	400 000	3 200 000
3.16	200 kl	sum	2	450 000	900 000
3.17	250 kl	sum	10	500 000	5 000 000
4	Electrical supply	sum	0.5	2 500 000	1 250 000
	Total 1				***124 795 050***
	Contingencies	%	124 795 050	15	18 719 257
	Total 2				***143 514 307***
	Engineering fees	%	143 514 307	15	21 527 146
	Total 3				***165 041 453***
	VAT	%	165 041 453	14	23 105 803
	Total				***188 147 257***

APPENDIX E

COST ESTIMATES FOR BULK IRRIGATION WATER SYSTEMS

Table E.1: Cost Estimate Build-up for Irrigation Water Distribution Infrastructure

IRRIGATION OPTION 1 FROM DAM

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		25	
1.1.2	50 HDPE Class 12	m		32	0
1.1.3	63 uPVC Class 12	m		49	0
1.1.4	75 uPVC Class 12	m		68	0
1.1.5	90 uPVC Class 12	m		97	0
1.1.6	110 uPVC Class 12	m		119	0
1.1.7	160 uPVC Class 12	m		249	0
1.1.8	200 uPVC Class 12	m		388	0
1.1.9	250 uPVC Class 12	m		611	0
1.1.10	315 uPVC Class 12	m		1 019	0
1.1.11	355 uPVC Class 12	m		1 228	0
1.1.12	400 steel	m		2 124	0
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m		2 736	0
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	0
1.1.17	700 steel	m		4 601	0
1.1.18	800 steel	m	3 920	5 732	22 469 440
1.1.19	900 steel	m		7 020	0
1.1.20	1000 steel	m	28 980	8 383	242 939 340
1.1.21	1200 steel	m		8 674	0
1.1.22	1400 steel	m		12 759	0
1.1.23	1600 steel	m		15 647	0
1.1.24	1800 steel	m		20 000	0
1.2	Bulk connectors			0	
1.2.1	50 HDPE Class 12	m		32	0
1.2.2	63 uPVC Class 12	m		49	0
1.2.3	75 uPVC Class 12	m		68	0
1.2.4	90 uPVC Class 12	m		97	0
1.2.5	110 uPVC Class 12	m		44	0
1.2.6	160 uPVC Class 12	m		249	0
1.2.7	200 uPVC Class 12	m		388	0
1.2.8	250 uPVC Class 12	m		611	0
1.2.9	315 uPVC Class 12	m		535	0
1.2.10	355 uPVC Class 12	m		647	0
1.2.11	400 uPVC Class 12	m	30 000	683	20 490 000
1.2.12	500 steel	m		2 736	0
1.2.13	600 steel	m		3 564	0
1.2.14	700 steel	m		4 601	0
1.2.15	800 steel	m		5 732	0
1.2.16	900 steel	m		7 020	0
1.2.17	1000 steel	m		8 383	0
1.3	Excavation in all materials			0	0
1.3.1	0 - 1.5m	m	0	43	0
1.3.2	0 - 2 m	m	62 900	71	4 453 320
1.3.3	0- 3 m	m	0	191	0
1.3.4	Extra over for :			0	0
1.3.4.1	Soft Class 3	m3	6 919	20	138 380
1.3.4.2	Intermediate	m3	69 190	80	5 535 200
1.3.4.3	Hard rock	m3	48 433	350	16 951 550
1.3.4.4	Boulder	m3	13 838	172	2 374 601
1.4	Bedding			0	0
1.4.1	From trench	m3	4 775	30	143 251
1.4.2	From borrow pit	m3	28 650	60	1 719 014
1.4.3	Borrow pit haul	m3km	286 502	10	2 865 024
1.4.4	Commercial sources	m3	62 076	350	21 726 432
1.5	Backfill			0	0

1.5.1	From trench	m3	21 440	25	535 990
1.5.2	Import from borrow	m3	21 440	40	857 584
1.5.3	Borrow haul	m3km	214 396	10	2 143 960
1.6	Allowance for fittings	%	285 898 780	5	14 294 939
1.7	Allowance for sundries	%	285 898 780	5	14 294 939
2	Pumphouse				
2.1	Up to 30 Ml/d	sum		30 000 000	0
2.2	Up to 40 Ml/d	sum		40 000 000	0
2.3	Up to 4 Ml/d	sum		5 000 000	0
2.4	Up to 80 Ml/d	sum			15 000 000
2.5	Up to 10 Ml/d	sum		12 000 000	0
2.6	Up to 140 Ml/d	sum		120 000 000	0
3	Pumpstations				
3.1	20 l/s @ 15m	sum		780 000	0
3.2	30 l/s @ 105m	sum		1 404 000	0
3.3	50 l/s @175m	sum		2 639 000	0
3.4	100 l/s @100m	sum		2 834 000	0
3.5	100 l/s @200m	sum		4 901 000	0
3.6	120 l/s @100m	sum		3 250 000	0
3.7	120 l/s@ 200 m	sum		5 720 000	0
3.8	150 l/s @ 150m	sum		5 304 000	0
3.9	200 l/s @ 200m	sum		8 814 000	0
3.10	250 l/s @ 250m	sum		13 546 000	0
3.11	300 l/s @ 200 m	sum		12 935 000	0
3.12	400 l/s @ 200 m	sum		16 718 000	0
3.13	500 l/s @ 200m	sum		20 644 000	0
3.14	600 l/s @ 150 m	sum		18 785 000	0
3.15	700 l/s @150 m	sum		21 190 000	0
3.16	950 l/s @ 500 m	sum		43 459 000	0
3.17	1000 l/s @ 200m	MW	6.4	3 000 000	19 313 896
4	Reservoirs			0	0
4.1	500 kl	sum		1 000 000	0
4.2	1 Ml	sum		3 000 000	0
4.3	2 Ml	sum		4 500 000	0
4.4	2.5 Ml	sum		5 000 000	0
4.5	3 Ml	sum		6 500 000	0
4.6	4 Ml	sum		8 000 000	0
4.7	5 Ml	sum		11 000 000	0
4.8	10 Ml	sum		25 000 000	0
4.9	20 Ml	sum		33 000 000	0
4.10	25 Ml	sum		45 000 000	45 000 000
4.11	40 Ml	sum	1	65 000 000	
5	Electrical supply	KM	15	2 000 000	30 000 000
	Total 1				***483 246 860***
	Contingencies	%	483 246 860	10	48 324 686
	Total 2				***531 571 546***
	Engineering fees	%	531 571 546	6	31 894 293
	Total 3				***563 465 839***
	VAT	%	563 465 839	14	78 885 217
	Total				***642 351 057***

IRRIGATION OPTION 2 FROM RIVER

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		25	
1.1.2	50 HDPE Class 12	m		32	0
1.1.3	63 uPVC Class 12	m		49	0
1.1.4	75 uPVC Class 12	m		68	0
1.1.5	90 uPVC Class 12	m		97	0
1.1.6	110 uPVC Class 12	m		119	0
1.1.7	160 uPVC Class 12	m		249	0
1.1.8	200 uPVC Class 12	m		388	0
1.1.9	250 uPVC Class 12	m		611	0
1.1.10	315 uPVC Class 12	m		1 019	0
1.1.11	355 uPVC Class 12	m		1 228	0
1.1.12	400 steel	m		2 124	0
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m		2 736	0
1.1.15	550 steel	m			
1.1.16	600 steel	m		3 564	0
1.1.17	700 steel	m		4 601	0
1.1.18	800 steel	m	3 920	5 732	22 469 440
1.1.19	900 steel	m		7 020	0
1.1.20	1000 steel	m	13 280	8 383	111 326 240
1.1.21	1200 steel	m		8 674	0
1.1.22	1400 steel	m		12 759	0
1.1.23	1600 steel	m		15 647	0
1.1.24	1800 steel	m		20 000	0
1.2	Bulk connectors			0	
1.2.1	50 HDPE Class 12	m		32	0
1.2.2	63 uPVC Class 12	m		49	0
1.2.3	75 uPVC Class 12	m		68	0
1.2.4	90 uPVC Class 12	m		97	0
1.2.5	110 uPVC Class 12	m		44	0
1.2.6	160 uPVC Class 12	m		249	0
1.2.7	200 uPVC Class 12	m		388	0
1.2.8	250 uPVC Class 12	m		611	0
1.2.9	315 uPVC Class 12	m		535	0
1.2.10	355 uPVC Class 12	m		647	0
1.2.11	400 uPVC Class 12	m	30 000	683	20 490 000
1.2.12	500 steel	m		2 736	0
1.2.13	600 steel	m		3 564	0
1.2.14	700 steel	m		4 601	0
1.2.15	800 steel	m		5 732	0
1.2.16	900 steel	m		7 020	0
1.2.17	1000 steel	m		8 383	0
1.3	Excavation in all materials			0	0
1.3.1	0 - 1.5m	m	0	43	0
1.3.2	0 - 2 m	m	47 200	71	3 341 760
1.3.3	0- 3 m	m	0	191	0
1.3.4	Extra over for :			0	0
1.3.4.1	Soft Class 3	m3	5 192	20	103 840
1.3.4.2	Intermediate	m3	51 920	80	4 153 600
1.3.4.3	Hard rock	m3	36 344	350	12 720 400
1.3.4.4	Boulder	m3	10 384	172	1 781 894
1.4	Bedding			0	0
1.4.1	From trench	m3	3 017	30	90 499
1.4.2	From borrow pit	m3	18 100	60	1 085 990
1.4.3	Borrow pit haul	m3km	180 998	10	1 809 984
1.4.4	Commercial sources	m3	39 216	350	13 725 712
1.5	Backfill			0	0

1.5.1	From trench	m3	21 754	25	543 840
1.5.2	Import from borrow	m3	21 754	40	870 144
1.5.3	Borrow haul	m3km	217 536	10	2 175 360
1.6	Allowance for fittings	%	154 285 680	5	7 714 284
1.7	Allowance for sundries	%	154 285 680	5	7 714 284
2	Pumphouse				
2.1	Up to 30 Ml/d	sum		30 000 000	0
2.2	Up to 40 Ml/d	sum		40 000 000	0
2.3	Up to 4 Ml/d	sum		5 000 000	0
2.4	Up to 80 Ml/d	sum			25 000 000
2.5	Up to 10 Ml/d	sum		12 000 000	0
2.6	Up to 140 Ml/d	sum		120 000 000	0
3	Pumpstations				
3.1	20 l/s @ 15m	sum		780 000	0
3.2	30 l/s @ 105m	sum		1 404 000	0
3.3	50 l/s @175m	sum		2 639 000	0
3.4	100 l/s @100m	sum		2 834 000	0
3.5	100 l/s @200m	sum		4 901 000	0
3.6	120 l/s @100m	sum		3 250 000	0
3.7	120 l/s@ 200 m	sum		5 720 000	0
3.8	150 l/s @ 150m	sum		5 304 000	0
3.9	200 l/s @ 200m	sum		8 814 000	0
3.10	250 l/s @ 250m	sum		13 546 000	0
3.11	300 l/s @ 200 m	sum		12 935 000	0
3.12	400 l/s @ 200 m	sum		16 718 000	0
3.13	500 l/s @ 200m	sum		20 644 000	0
3.14	600 l/s @ 150 m	sum		18 785 000	0
3.15	700 l/s @150 m	sum		21 190 000	0
3.16	950 l/s @ 500 m	sum		43 459 000	0
3.17	1000 l/s @ 200m	MW	7.3	3 000 000	21 910 061
4	Reservoirs			0	0
4.1	500 kl	sum		1 000 000	0
4.2	1 Ml	sum		3 000 000	0
4.3	2 Ml	sum		4 500 000	0
4.4	2.5 Ml	sum		5 000 000	0
4.5	3 Ml	sum		6 500 000	0
4.6	4 Ml	sum		8 000 000	0
4.7	5 Ml	sum		11 000 000	0
4.8	10 Ml	sum		25 000 000	0
4.9	20 Ml	sum		33 000 000	0
4.10	25 Ml	sum		45 000 000	45 000 000
4.11	40 Ml	sum	1	65 000 000	
5	Electrical supply	KM	15	2 000 000	30 000 000
	Total 1				***334 027 333***
	Contingencies	%	334 027 333	10	33 402 733
	Total 2				***367 430 066***
	Engineering fees	%	367 430 066	6	22 045 804
	Total 3				***389 475 870***
	VAT	%	389 475 870	14	54 526 622
	Total				***444 002 492***

IRRIGATION OPTION 3 FROM DAM WITH INTERMEDIATE STORAGE

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		25	
1.1.2	50 HDPE Class 12	m	0	32	0
1.1.3	63 uPVC Class 12	m	0	49	0
1.1.4	75 uPVC Class 12	m	0	68	0
1.1.5	90 uPVC Class 12	m	0	97	0
1.1.6	110 uPVC Class 12	m	0	119	0
1.1.7	160 uPVC Class 12	m	0	249	0
1.1.8	200 uPVC Class 12	m	2 143	388	831 098
1.1.9	250 uPVC Class 12	m	0	611	0
1.1.10	315 uPVC Class 12	m	9 970	1 019	10 157 436
1.1.11	355 uPVC Class 12	m	1 770	1 228	2 173 578
1.1.12	400 steel	m		2 124	0
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m	3 100	2 736	8 481 600
1.1.15	550 steel	m	0		
1.1.16	600 steel	m		3 564	0
1.1.17	700 steel	m		4 601	0
1.1.18	800 steel	m	9 660	5 732	55 371 120
1.1.19	900 steel	m	2 000	7 020	14 040 000
1.1.20	1000 steel	m	16 400	8 383	137 481 200
1.1.21	1200 steel	m	9 780	8 674	84 831 720
1.1.22	1400 steel	m		12 759	0
1.1.23	1600 steel	m		15 647	0
1.1.24	1800 steel	m		20 000	0
1.2	Bulk connectors			0	
1.2.1	50 HDPE Class 12	m		32	0
1.2.2	63 uPVC Class 12	m		49	0
1.2.3	75 uPVC Class 12	m		68	0
1.2.4	90 uPVC Class 12	m		97	0
1.2.5	110 uPVC Class 12	m		44	0
1.2.6	160 uPVC Class 12	m		249	0
1.2.7	200 uPVC Class 12	m		388	0
1.2.8	250 uPVC Class 12	m		611	0
1.2.9	315 uPVC Class 12	m		535	0
1.2.10	355 uPVC Class 12	m		647	0
1.2.11	400 uPVC Class 12	m	5 900	683	4 029 700
1.2.12	500 steel	m		2 736	0
1.2.13	600 steel	m		3 564	0
1.2.14	700 steel	m		4 601	0
1.2.15	800 steel	m		5 732	0
1.2.16	900 steel	m		7 020	0
1.2.17	1000 steel	m		8 383	0
1.3	Excavation in all materials			0	0
1.3.1	0 - 1.5m	m	13 883	43	595 581
1.3.2	0 - 2 m	m	46 840	71	3 316 272
1.3.3	0- 3 m	m	0	191	0
1.3.4	Extra over for :			0	0
1.3.4.1	Soft Class 3	m3	6 037	20	120 749
1.3.4.2	Intermediate	m3	60 374	80	4 829 953
1.3.4.3	Hard rock	m3	42 262	350	14 791 731
1.3.4.4	Boulder	m3	12 075	172	2 072 050
1.4	Bedding			0	0
1.4.1	From trench	m3	5 350	30	160 500
1.4.2	From borrow pit	m3	32 100	60	1 925 994
1.4.3	Borrow pit haul	m3km	320 999	10	3 209 990
1.4.4	Commercial sources	m3	69 550	350	24 342 427
1.5	Backfill			0	0

1.5.1	From trench	m3	6 875	25	171 864
1.5.2	Import from borrow	m3	6 875	40	274 983
1.5.3	Borrow haul	m3km	68 746	10	687 457
1.6	Allowance for fittings	%	317 397 452	5	15 869 873
1.7	Allowance for sundries	%	317 397 452	5	15 869 873
2	Pumphouse				
2.1	Up to 30 Ml/d	sum		30 000 000	0
2.2	Up to 40 Ml/d	sum		40 000 000	0
2.3	Up to 4 Ml/d	sum		5 000 000	0
2.4	Up to 80 Ml/d	sum			8 000 000
2.5	Up to 10 Ml/d	sum		12 000 000	0
2.6	Up to 140 Ml/d	sum		120 000 000	0
3	Pumpstations				
3.1	20 l/s @ 15m	sum		780 000	0
3.2	30 l/s @ 105m	sum		1 404 000	0
3.3	50 l/s @175m	sum		2 639 000	0
3.4	100 l/s @100m	sum		2 834 000	0
3.5	100 l/s @200m	sum	1	4 901 000	4 901 000
3.6	120 l/s @100m	sum		3 250 000	0
3.7	120 l/s@ 200 m	sum		5 720 000	0
3.8	150 l/s @ 150m	sum		5 304 000	0
3.9	200 l/s @ 200m	sum	1	8 814 000	8 814 000
3.10	250 l/s @ 250m	sum		13 546 000	0
3.11	300 l/s @ 200 m	sum		12 935 000	0
3.12	400 l/s @ 200 m	sum		16 718 000	0
3.13	500 l/s @ 200m	sum		20 644 000	0
3.14	600 l/s @ 150 m	sum		18 785 000	0
3.15	700 l/s @150 m	sum		21 190 000	0
3.16	950 l/s @ 500 m	sum		43 459 000	0
3.17	1000 l/s @ 200m	MW	3.2	3 000 000	9 565 152
4	Reservoirs			0	0
4.1	500 kl	sum		1 000 000	0
4.2	1 Ml	sum	5	3 000 000	15 000 000
4.3	2 Ml	sum	2	4 500 000	9 000 000
4.4	2.5 Ml	sum		5 000 000	0
4.5	3 Ml	sum		6 500 000	0
4.6	4 Ml	sum		8 000 000	0
4.7	5 Ml	sum	1	11 000 000	11 000 000
4.8	10 Ml	sum		25 000 000	0
4.9	20 Ml	sum		33 000 000	0
4.10	25 Ml	sum		45 000 000	
4.11	40 Ml - Earth Bund	sum	1	15 000 000	15 000 000
5	Electrical supply	KM	5	2 000 000	10 000 000
	Total 1				***496 916 900***
	Contingencies	%	496 916 900	10	49 691 690
	Total 2				***546 608 590***
	Engineering fees	%	546 608 590	6	32 796 515
	Total 3				***579 405 105***
	VAT	%	579 405 105	14	81 116 715
	Total				***660 521 820***

IRRIGATION OPTION 4 FROM RIVER WITH INTERMEDIATE STORAGE

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.1	40 HDPE Class 12	m		25	
1.1.2	50 HDPE Class 12	m	0	32	0
1.1.3	63 uPVC Class 12	m	0	49	0
1.1.4	75 uPVC Class 12	m	0	68	0
1.1.5	90 uPVC Class 12	m	0	97	0
1.1.6	110 uPVC Class 12	m	0	119	0
1.1.7	160 uPVC Class 12	m	0	249	0
1.1.8	200 uPVC Class 12	m	2 143	388	831 098
1.1.9	250 uPVC Class 12	m	0	611	0
1.1.10	315 uPVC Class 12	m	9 970	1 019	10 157 436
1.1.11	355 uPVC Class 12	m	1 770	1 228	2 173 578
1.1.12	400 steel	m		2 124	0
1.1.13	450 uPVC Class 12	m			
1.1.14	500 steel	m	3 100	2 736	8 481 600
1.1.15	550 steel	m	0		
1.1.16	600 steel	m		3 564	0
1.1.17	700 steel	m		4 601	0
1.1.18	800 steel	m	9 660	5 732	55 371 120
1.1.19	900 steel	m	2 000	7 020	14 040 000
1.1.20	1000 steel	m	4 340	8 383	36 382 220
1.1.21	1200 steel	m	9 780	8 674	84 831 720
1.1.22	1400 steel	m		12 759	0
1.1.23	1600 steel	m		15 647	0
1.1.24	1800 steel	m		20 000	0
1.2	Bulk connectors			0	
1.2.1	50 HDPE Class 12	m		32	0
1.2.2	63 uPVC Class 12	m		49	0
1.2.3	75 uPVC Class 12	m		68	0
1.2.4	90 uPVC Class 12	m		97	0
1.2.5	110 uPVC Class 12	m		44	0
1.2.6	160 uPVC Class 12	m		249	0
1.2.7	200 uPVC Class 12	m		388	0
1.2.8	250 uPVC Class 12	m		611	0
1.2.9	315 uPVC Class 12	m		535	0
1.2.10	355 uPVC Class 12	m		647	0
1.2.11	400 uPVC Class 12	m	5 900	683	4 029 700
1.2.12	500 steel	m		2 736	0
1.2.13	600 steel	m		3 564	0
1.2.14	700 steel	m		4 601	0
1.2.15	800 steel	m		5 732	0
1.2.16	900 steel	m		7 020	0
1.2.17	1000 steel	m		8 383	0
1.3	Excavation in all materials			0	0
1.3.1	0 - 1.5m	m	13 883	43	595 581
1.3.2	0 - 2 m	m	34 780	71	2 462 424
1.3.3	0- 3 m	m	0	191	0
1.3.4	Extra over for :			0	0
1.3.4.1	Soft Class 3	m3	4 711	20	94 217
1.3.4.2	Intermediate	m3	47 108	80	3 768 673
1.3.4.3	Hard rock	m3	32 976	350	11 541 561
1.3.4.4	Boulder	m3	9 422	172	1 616 761
1.4	Bedding			0	0
1.4.1	From trench	m3	3 999	30	119 978
1.4.2	From borrow pit	m3	23 996	60	1 439 735
1.4.3	Borrow pit haul	m3km	239 956	10	2 399 558
1.4.4	Commercial sources	m3	51 990	350	18 196 651
1.5	Backfill			0	0

1.5.1	From trench	m3	7 116	25	177 894
1.5.2	Import from borrow	m3	7 116	40	284 631
1.5.3	Borrow haul	m3km	71 158	10	711 577
1.6	Allowance for fittings	%	216 298 472	5	10 814 924
1.7	Allowance for sundries	%	216 298 472	5	10 814 924
2	Pumphouse				
2.1	Up to 30 Ml/d	sum		30 000 000	0
2.2	Up to 40 Ml/d	sum		40 000 000	0
2.3	Up to 4 Ml/d	sum		5 000 000	0
2.4	Up to 80 Ml/d	sum			8 000 000
2.5	RIVER INTAKE WORKS & settlement basin	sum		25 000 000	25 000 000
2.6	Up to 140 Ml/d	sum		120 000 000	0
3	Pumpstations				
3.1	20 l/s @ 15m	sum		780 000	0
3.2	30 l/s @ 105m	sum		1 404 000	0
3.3	50 l/s @175m	sum		2 639 000	0
3.4	100 l/s @100m	sum		2 834 000	0
3.5	100 l/s @200m	sum	1	4 901 000	4 901 000
3.6	120 l/s @100m	sum		3 250 000	0
3.7	120 l/s@ 200 m	sum		5 720 000	0
3.8	150 l/s @ 150m	sum		5 304 000	0
3.9	200 l/s @ 200m	sum	1	8 814 000	8 814 000
3.10	250 l/s @ 250m	sum		13 546 000	0
3.11	300 l/s @ 200 m	sum		12 935 000	0
3.12	400 l/s @ 200 m	sum		16 718 000	0
3.13	500 l/s @ 200m	sum		20 644 000	0
3.14	600 l/s @ 150 m	sum		18 785 000	0
3.15	700 l/s @150 m	sum		21 190 000	0
3.16	950 l/s @ 500 m	sum		43 459 000	0
3.17	1000 l/s @ 200m	MW	3.8	3 000 000	11 329 951
4	Reservoirs			0	0
4.1	500 kl	sum		1 000 000	0
4.2	1 Ml	sum	5	3 000 000	15 000 000
4.3	2 Ml	sum	2	4 500 000	9 000 000
4.4	2.5 Ml	sum		5 000 000	0
4.5	3 Ml	sum		6 500 000	0
4.6	4 Ml	sum		8 000 000	0
4.7	5 Ml	sum	1	11 000 000	11 000 000
4.8	10 Ml	sum		25 000 000	0
4.9	20 Ml	sum		33 000 000	0
4.10	25 Ml	sum		45 000 000	
4.11	40 Ml - Earth Bund	sum	1	15 000 000	15 000 000
5	Electrical supply	KM	15	2 000 000	30 000 000
	Total 1				***419 382 511***
	Contingencies	%	419 382 511	10	41 938 251
	Total 2				***461 320 763***
	Engineering fees	%	461 320 763	6	27 679 246
	Total 3				***489 000 008***
	VAT	%	489 000 008	14	68 460 001
	Total				***557 460 010***

Table E.2: Capital and Operating Costs Summary for Irrigation Water Distribution Infrastructure

IRRIGATION OPTION 1 FROM DAM						
ITEM	**DESCRIPTION**	**AMOUNT**		**O&M per year**		
1	Pipelines	R	373 932 964	0.50%	R	1 869 665
2	Abstraction works	R	15 000 000	0.25%	R	37 500
3	Pumpstations	R	19 313 896	4%	R	772 556
4	Reservoirs	R	45 000 000	0.25%	R	112 500
5	Electrical supply	R	30 000 000	4%	R	1 200 000
6	Contingencies	R	48 324 686	1%	R	483 247
7	Engineering fees	R	31 894 293			
	Allowance for M&E depreciation and replacement funding				R	1 931 390
	Total 1	**R**	**563 465 839**		**R**	**6 406 857**
	VAT	R	78 885 217		R	896 960
	Total	**R**	**642 351 057**		**R**	**7 303 817**
				Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power				21 240 366		R 0.34
Power Cost per year		**R**	**20 063 277**	21 240 366		R 0.94

Cost for supply of raw water to edge of field including power	R/m^3	**R 1.29**

IRRIGATION OPTION 2 FROM RIVER						
ITEM	**DESCRIPTION**	**AMOUNT**		**O&M per year**		
1	Pipelines	R	212 117 272	0.50%	R	1 060 586
2	Abstraction works	R	25 000 000	0.25%	R	62 500
3	Pumpstations	R	21 910 061	4%	R	876 402
4	Reservoirs	R	45 000 000	0.25%	R	112 500
5	Electrical supply	R	30 000 000	4%	R	1 200 000
6	Contingencies	R	33 402 733	1%	R	334 027
7	Engineering fees	R	22 045 804			
	Allowance for M&E depreciation and replacement funding				R	2 191 006
	Total 1	**R**	**389 475 870**		**R**	**5 837 022**
	VAT	R	54 526 622		R	817 183
	Total	**R**	**444 002 492**		**R**	**6 654 205**
				Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power				21 240 366		R 0.31
Power Cost per year		**R**	**22 760 173**	21 240 366		R 1.07

Cost for supply of raw water to edge of field including power	R/m^3	**R 1.38**

IRRIGATION OPTION 3 FROM DAM WITH INTERMEDIATE STORAGE						
ITEM	DESCRIPTION	AMOUNT		O&M per year		
1	Pipelines	R	405 636 748	0.50%	R	2 028 184
2	Abstraction works	R	8 000 000	0.25%	R	20 000
3	Pumpstations	R	23 280 152	4%	R	931 206
4	Reservoirs	R	50 000 000	0.25%	R	125 000
5	Electrical supply	R	10 000 000	4%	R	400 000
6	Contingencies	R	49 691 690	1%	R	496 917
7	Engineering fees	R	32 796 515			
	Allowance for M&E depreciation and replacement funding				R	956 515
	Total 1	**R**	**579 405 105**		**R**	**4 957 822**
	VAT	R	81 116 715		R	694 095
	Total	**R**	**660 521 820**		**R**	**5 651 917**
				Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power				21 240 366		R 0.27
Power Cost per year		**R**	**18 559 958**	21 240 366		R 0.87

Cost for supply of raw water to edge of field including power	R/m^3	**R 1.14**

IRRIGATION OPTION 4 FROM RIVER WITH INTERMEDIATE STORAGE						
ITEM	DESCRIPTION	AMOUNT		O&M per year		
1	Pipelines	R	281 337 560	0.50%	R	1 406 688
2	Abstraction works	R	33 000 000	0.25%	R	82 500
3	Pumpstations	R	25 044 951	4%	R	1 001 798
4	Reservoirs	R	50 000 000	0.25%	R	125 000
5	Electrical supply	R	30 000 000	4%	R	1 200 000
6	Contingencies	R	41 938 251	1%	R	419 383
7	Engineering fees	R	27 679 246			
	Allowance for M&E depreciation and replacement funding				R	1 132 995
	Total 1	**R**	**489 000 008**		**R**	**5 368 364**
	VAT	R	68 460 001		R	751 571
	Total	**R**	**557 460 010**		**R**	**6 119 934**
				Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power				21 240 366		R 0.29
Power Cost per year		**R**	**21 309 869**	21 240 366		R 1.00

Cost for supply of raw water to edge of field including power	R/m^3	**R 1.29**

APPENDIX F

LEVELIZED COST OF ENERGY MODELS FOR HYDROPOWER COMPONENTS

NTAB 1.15 MAR + LALENI 0.15 MAR - CONJUNCTIVE HYDROPOWER LEVELIZED COST - INCL FULL CAPITAL REDEMPTION

ITEM	CAPITAL COST COMPONENTS (R*10^6) TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	CAPITAL COST COMPONENTS (R*10^6) TOTAL	DAM	PIPELINES	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
	PHASE 1									PHASE 2								
laleni & Ntabelanga Dams	1315.6	920.9				263.1	131.6			0.0	0.0				0.0			
Pipelines/Tunnel	1026.0		872.1			102.6	51.3			0.0		0.0						
Reservoirs	0.0			0.0			0.0			0.0			0.0					
Electromechanical	442						259.9	182.4		0.0						0.0	0.0	
Treatment Works	0.0				0.0		0.0			0.0				0.0				
Abstraction Works	0.0					0.0				0.0					0.0			
Power	126.6								126.6	0.0								0.0
Engineering & EMP	363.8									0.0								
TOTAL	3274.3	920.9	872.1	0.0	0.0	365.7	442.8	182.4	126.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ITEM	PHASE 3 TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
Dam	0.0	0.0				0.0			
Pipelines	0.0		0.0						
Reservoirs	0.0			0.0					
Pumping Stations	0.0						0.0	0.0	
Treatment Works	0.0				0.0				
Abstraction Works	0.0					0.0			
Power	0.0								0.0
Other	0.0								
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

OPERATIONAL COSTS (R*10^6)

MAINTENANCE COSTS

RATE	ITEM	COST PH. 1	COST PH. 2	COST PH. 3
0.25%	Dam	2.30	0.00	0.00
0.50%	Pipelines, Reservoirs	4.36	0.00	0.00
1.00%	Treatment Works, Civil Works, Buildings	5.48	0.00	0.00
4.00%	M & E	17.71	0.00	0.00
0.00%	Power	0.00	0.00	0.00
	Total	29.85	0.00	0.00

TREATMENT COSTS	
Using cost Rand per m3 =	N/A
PUMPING COSTS	
Max.Demand Charge / Kw	N/A
Energy Cost : Rand/ kWHr	N/A

YEAR	YEAR NO.	ENERGY SUPPLIED kWh/YEAR	THIS SECTION NOT USED			CAPITAL & REFURBISHMENT COSTS (R*10^6) Dams	Pipelines & Tunnels	Electro Mech	Civil Works Builds	Power	ENG & EMP	MAINTENANCE COSTS (R*10^6) Dam	Pipelines + Reservoirs	Treatment, Civil Works+ Buildings	M & E		DISCOUNTED ENERGY SUPPLIED DISCOUNT RATES 6%	8%	10%	TOTAL COSTS RAND million DISCOUNT RATES 6%	8%	10%
2015	0					230.2	218.0	110.7	137.0	31.7	91.0									818.59	818.59	818.59
2016	1					230.2	218.0	110.7	137.0	31.7	91.0									818.59	818.59	818.59
2017	2					230.2	218.0	110.7	137.0	31.7	91.0									818.59	818.59	818.59
2018	3					230.2	218.0	110.7	137.0	31.7	91.0									818.59	818.59	818.59
2019	4	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2020	5	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2021	6	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2022	7	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2023	8	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2024	9	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2025	10	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2026	11	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2027	12	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2028	13	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2029	14	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2030	15	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2031	16	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2032	17	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2033	18	281 896 513	0.00	0.00	0.00			221.4				2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	251.24	251.24	251.24
2034	19	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2035	20	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2036	21	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2037	22	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2038	23	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2039	24	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2040	25	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2041	26	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2042	27	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2043	28	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2044	29	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2045	30	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2046	31	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2047	32	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2048	33	281 896 513	0.00	0.00	0.00	0.0	0.0	221.4	0.0			2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	251.24	251.24	251.24
2049	34	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2050	35	281 896 513	0.00	0.00	0.00							2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85

LEVELIZED COST Rand/ kWh 6%	8%	10%	NPV - Energy 6%	8%	10%	NPV 6%	8%	10%
0.82	0.94	1.06	3 970 242 717	3 223 486 464	2 685 452 059	3273.25	3029.67	2833.93

NTAB 1.15 MAR + LALENI 0.15 MAR - CONJUNCTIVE HYDROPOWER LEVELIZED COST - NO CAPITAL REDEMPTION

ITEM	CAPITAL COST COMPONENTS (R*10^6)									CAPITAL COST COMPONENTS (R*10^6)								
	TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	TOTAL	DAM	PIPELINES	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
	PHASE 1									PHASE 2								
laleni & Ntabelanga Dams	1315.6	920.9				263.1	131.6			0.0	0.0				0.0			
Pipelines/Tunnel	1026.0		872.1			102.6	51.3			0.0		0.0						
Reservoirs	0.0			0.0			0.0			0.0			0.0					
Electromechanical	442						259.9	182.4		0.0						0.0	0.0	
Treatment Works	0.0				0.0		0.0			0.0				0.0				
Abstraction Works	0.0					0.0				0.0					0.0			
Power	126.6								126.6	0.0								0.0
Engineering & EMP	363.8									0.0								
TOTAL	3274.3	920.9	872.1	0.0	0.0	365.7	442.8	182.4	126.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ITEM	PHASE 3								
	TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
Dam	0.0	0.0				0.0			
Pipelines	0.0		0.0						
Reservoirs	0.0			0.0					
Pumping Stations	0.0						0.0	0.0	
Treatment Works	0.0				0.0				
Abstraction Works	0.0					0.0			
Power	0.0								0.0
Other	0.0								
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

OPERATIONAL COSTS (R*10^6)

MAINTENANCE COSTS				
RATE	ITEM	COST PH. 1	COST PH. 2	COST PH. 3
0.25%	Dam	2.30	0.00	0.00
0.50%	Pipelines, Reservoirs	4.36	0.00	0.00
1.00%	Treatment Works, Civil Works, Buildings	5.48	0.00	0.00
4.00%	M & E	17.71	0.00	0.00
0.00%	Power	0.00	0.00	0.00
	Total	29.85	0.00	0.00

TREATMENT COSTS	
Using cost Rand per m3 =	N/A
PUMPING COSTS	
Max.Demand Charge / Kw	N/A
Energy Cost : Rand/ kWHr	N/A

YEAR	YEAR NO.	ENERGY SUPPLIED kWh/YEAR	THIS SECTION NOT USED			CAPITAL & REFURBISHMENT COSTS (R*10^6) Dams	Pipelines & Tunnels	Electro Mech	Civil Works Builds	Power	ENG & EMP			MAINTENANCE COSTS (R*10^6) Dam	Pipelines + Reservoirs	Treatment, Civil Works+ Buildings	M & E		DISCOUNTED ENERGY SUPPLIED DISCOUNT RATES 6%	8%	10%	TOTAL COSTS RAND million DISCOUNT RATES 6%	8%	10%
2015	0																					0.00	0.00	0.00
2016	1																					0.00	0.00	0.00
2017	2																					0.00	0.00	0.00
2018	3																					0.00	0.00	0.00
2019	4	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2020	5	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2021	6	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2022	7	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2023	8	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2024	9	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2025	10	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2026	11	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2027	12	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2028	13	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2029	14	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2030	15	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2031	16	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2032	17	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2033	18	281 896 513	0.00	0.00	0.00			221.4						2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	251.24	251.24	251.24
2034	19	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2035	20	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2036	21	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2037	22	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2038	23	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2039	24	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2040	25	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2041	26	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2042	27	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2043	28	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2044	29	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2045	30	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2046	31	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2047	32	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2048	33	281 896 513	0.00	0.00	0.00	0.0	0.0	221.4	0.0					2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	251.24	251.24	251.24
2049	34	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85
2050	35	281 896 513	0.00	0.00	0.00									2.30	4.36	5.48	17.71	0.00	281 896 513	281 896 513	281 896 513	29.85	29.85	29.85

LEVELIZED COST Rand/ kWh 6%	8%	10%	NPV - Energy 6%	8%	10%	NPV 6%	8%	10%
0.11	0.10	0.09	3 970 242 717	3 223 486 464	2 685 452 059	436.76	318.40	239.12

NTAB 0.15 MAR + LALENI 0.78 MAR - CONJUNCTIVE HYDROPOWER LEVELIZED COST - INCL FULL CAPITAL REDEMPTION

ITEM	CAPITAL COST COMPONENTS (R*10^6)								
	TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
	PHASE 1								
laleni &Laleni Dam	1641.0	1148.7				328.2	164.1		
Pipelines/Tunnel	1026.0		872.1			102.6	51.3		
Reservoirs	0.0			0.0			0.0		
Electromechanical	342						259.9	182.4	
Treatment Works	0.0				0.0		0.0		
Abstraction Works	0.0					0.0			
Power	97.0								97.0
Engineering & EMP	388.3								
TOTAL	3494.3	1148.7	872.1	0.0	0.0	430.8	475.3	182.4	97.0
	PHASE 3								
Dam	0.0	0.0				0.0			
Pipelines	0.0		0.0						
Reservoirs	0.0			0.0					
Pumping Stations	0.0						0.0	0.0	
Treatment Works	0.0				0.0				
Abstraction Works	0.0					0.0			
Power	0.0								0.0
Other	0.0								
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CAPITAL COST COMPONENTS (R*10^6)								
TOTAL	DAM	PIPELINES	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
PHASE 2								
0.0	0.0				0.0			
0.0		0.0						
0.0			0.0					
0.0						0.0	0.0	
0.0				0.0				
0.0					0.0			
0.0								0.0
0.0								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

OPERATIONAL COSTS (R*10^6)

MAINTENANCE COSTS				
RATE	ITEM	COST PH. 1	COST PH. 2	COST PH. 3
0.25%	Dam	2.87	0.00	0.00
0.50%	Pipelines, Reservoirs	4.36	0.00	0.00
1.00%	Treatment Works, Civil Works, Buildings	6.13	0.00	0.00
4.00%	M & E	19.01	0.00	0.00
0.00%	Power	0.00	0.00	0.00
	Total	32.38	0.00	0.00

TREATMENT COSTS	
Using cost Rand per m3 =	N/A
PUMPING COSTS	
Max.Demand Charge / Kw	N/A
Energy Cost : Rand/ kWHr	N/A

YEAR	YEAR NO.	ENERGY SUPPLIED kWh/YEAR	THIS SECTION NOT USED			CAPITAL & REFURBISHMENT COSTS (R*10^6) Dams	Pipelines & Tunnels	Electro Mech	Civil Works Builds	Power	ENG & EMP
2015	0					287.2	218.0	118.8	153.3	24.3	97.1
2016	1					287.2	218.0	118.8	153.3	24.3	97.1
2017	2					287.2	218.0	118.8	153.3	24.3	97.1
2018	3					287.2	218.0	118.8	153.3	24.3	97.1
2019	4	262 800 000	0.00	0.00	0.00						
2020	5	262 800 000	0.00	0.00	0.00						
2021	6	262 800 000	0.00	0.00	0.00						
2022	7	262 800 000	0.00	0.00	0.00						
2023	8	262 800 000	0.00	0.00	0.00						
2024	9	262 800 000	0.00	0.00	0.00						
2025	10	262 800 000	0.00	0.00	0.00						
2026	11	262 800 000	0.00	0.00	0.00						
2027	12	262 800 000	0.00	0.00	0.00						
2028	13	262 800 000	0.00	0.00	0.00						
2029	14	262 800 000	0.00	0.00	0.00						
2030	15	262 800 000	0.00	0.00	0.00						
2031	16	262 800 000	0.00	0.00	0.00						
2032	17	262 800 000	0.00	0.00	0.00						
2033	18	262 800 000	0.00	0.00	0.00			237.7			
2034	19	262 800 000	0.00	0.00	0.00						
2035	20	262 800 000	0.00	0.00	0.00						
2036	21	262 800 000	0.00	0.00	0.00						
2037	22	262 800 000	0.00	0.00	0.00						
2038	23	262 800 000	0.00	0.00	0.00						
2039	24	262 800 000	0.00	0.00	0.00						
2040	25	262 800 000	0.00	0.00	0.00						
2041	26	262 800 000	0.00	0.00	0.00						
2042	27	262 800 000	0.00	0.00	0.00						
2043	28	262 800 000	0.00	0.00	0.00						
2044	29	262 800 000	0.00	0.00	0.00						
2045	30	262 800 000	0.00	0.00	0.00						
2046	31	262 800 000	0.00	0.00	0.00						
2047	32	262 800 000	0.00	0.00	0.00						
2048	33	262 800 000	0.00	0.00	0.00	0.0	0.0	237.7	0.0		
2049	34	262 800 000	0.00	0.00	0.00						
2050	35	262 800 000	0.00	0.00	0.00						

YEAR	MAINTENANCE COSTS (R*10^6) Dam	Pipelines + Reservoirs	Treatment, Civil Works+ Buildings	M & E		DISCOUNTED ENERGY SUPPLIED – DISCOUNT RATES 6%	8%	10%	TOTAL COSTS RAND million – DISCOUNT RATES 6%	8%	10%
2015									898.65	898.65	898.65
2016									898.65	898.65	898.65
2017									898.65	898.65	898.65
2018									898.65	898.65	898.65
2019	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2020	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2021	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2022	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2023	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2024	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2025	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2026	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2027	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2028	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2029	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2030	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2031	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2032	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2033	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	270.04	270.04	270.04
2034	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2035	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2036	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2037	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2038	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2039	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2040	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2041	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2042	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2043	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2044	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2045	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2046	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2047	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2048	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	270.04	270.04	270.04
2049	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2050	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38

LEVELIZED COST Rand/ kWh 6%	8%	10%	NPV - Energy 6%	8%	10%	NPV 6%	8%	10%
0.97	1.11	1.24	3 701 286 603	3 005 117 852	2 503 531 506	3586.46	3321.02	3107.44

NTAB 0.15 MAR + LALENI 0.78 MAR - CONJUNCTIVE HYDROPOWER LEVELIZED COST - NO CAPITAL REDEMPTION

ITEM	CAPITAL COST COMPONENTS (R*10^6) TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	CAPITAL COST COMPONENTS (R*10^6) TOTAL	DAM	PIPELINES	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
	PHASE 1									PHASE 2								
laleni &Laleni Dam	1641.0	1148.7				328.2	164.1			0.0	0.0				0.0			
Pipelines/Tunnel	1026.0		872.1			102.6	51.3			0.0		0.0						
Reservoirs	0.0			0.0			0.0			0.0			0.0					
Electromechanical	342						259.9	182.4		0.0						0.0	0.0	
Treatment Works	0.0				0.0		0.0			0.0				0.0				
Abstraction Works	0.0					0.0				0.0					0.0			
Power	97.0								97.0	0.0								0.0
Engineering & EMP	388.3									0.0								
TOTAL	3494.3	1148.7	872.1	0.0	0.0	430.8	475.3	182.4	97.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ITEM	TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
	PHASE 3								
Dam	0.0	0.0				0.0			
Pipelines	0.0		0.0						
Reservoirs	0.0			0.0					
Pumping Stations	0.0						0.0	0.0	
Treatment Works	0.0				0.0				
Abstraction Works	0.0					0.0			
Power	0.0								0.0
Other	0.0								
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

OPERATIONAL COSTS (R*10^6)

MAINTENANCE COSTS

RATE	ITEM	COST PH. 1	COST PH. 2	COST PH. 3
0.25%	Dam	2.87	0.00	0.00
0.50%	Pipelines, Reservoirs	4.36	0.00	0.00
1.00%	Treatment Works, Civil Works, Buildings	6.13	0.00	0.00
4.00%	M & E	19.01	0.00	0.00
0.00%	Power	0.00	0.00	0.00
	Total	32.38	0.00	0.00

TREATMENT COSTS	
Using cost Rand per m3 =	N/A
PUMPING COSTS	
Max.Demand Charge / Kw	N/A
Energy Cost : Rand/ kWHr	N/A

YEAR	YEAR NO.	ENERGY SUPPLIED	ENERGY SUPPLIED kWh/YEAR	THIS SECTION NOT USED			CAPITAL & REFURBISHMENT COSTS (R*10^6) Dams	Pipelines & Tunnels	Electro Mech	Civil Works Builds	Power	ENG & EMP		
2015	0													
2016	1													
2017	2													
2018	3													
2019	4		262 800 000	0.00	0.00	0.00								
2020	5		262 800 000	0.00	0.00	0.00								
2021	6		262 800 000	0.00	0.00	0.00								
2022	7		262 800 000	0.00	0.00	0.00								
2023	8		262 800 000	0.00	0.00	0.00								
2024	9		262 800 000	0.00	0.00	0.00								
2025	10		262 800 000	0.00	0.00	0.00								
2026	11		262 800 000	0.00	0.00	0.00								
2027	12		262 800 000	0.00	0.00	0.00								
2028	13		262 800 000	0.00	0.00	0.00								
2029	14		262 800 000	0.00	0.00	0.00								
2030	15		262 800 000	0.00	0.00	0.00								
2031	16		262 800 000	0.00	0.00	0.00								
2032	17		262 800 000	0.00	0.00	0.00								
2033	18		262 800 000	0.00	0.00	0.00			237.7					
2034	19		262 800 000	0.00	0.00	0.00								
2035	20		262 800 000	0.00	0.00	0.00								
2036	21		262 800 000	0.00	0.00	0.00								
2037	22		262 800 000	0.00	0.00	0.00								
2038	23		262 800 000	0.00	0.00	0.00								
2039	24		262 800 000	0.00	0.00	0.00								
2040	25		262 800 000	0.00	0.00	0.00								
2041	26		262 800 000	0.00	0.00	0.00								
2042	27		262 800 000	0.00	0.00	0.00								
2043	28		262 800 000	0.00	0.00	0.00								
2044	29		262 800 000	0.00	0.00	0.00								
2045	30		262 800 000	0.00	0.00	0.00								
2046	31		262 800 000	0.00	0.00	0.00								
2047	32		262 800 000	0.00	0.00	0.00								
2048	33		262 800 000	0.00	0.00	0.00	0.0	0.0	237.7	0.0				
2049	34		262 800 000	0.00	0.00	0.00								
2050	35		262 800 000	0.00	0.00	0.00								

YEAR	MAINTENANCE COSTS (R*10^6) Dam	Pipelines + Reservoirs	Treatment, Civil Works+ Buildings	M & E		DISCOUNTED ENERGY SUPPLIED DISCOUNT RATES 6%	8%	10%	TOTAL COSTS RAND million DISCOUNT RATES 6%	8%	10%
2015									0.00	0.00	0.00
2016									0.00	0.00	0.00
2017									0.00	0.00	0.00
2018									0.00	0.00	0.00
2019	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2020	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2021	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2022	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2023	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2024	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2025	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2026	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2027	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2028	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2029	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2030	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2031	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2032	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2033	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	270.04	270.04	270.04
2034	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2035	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2036	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2037	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2038	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2039	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2040	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2041	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2042	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2043	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2044	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2045	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2046	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2047	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2048	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	270.04	270.04	270.04
2049	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38
2050	2.87	4.36	6.13	19.01	0.00	262 800 000	262 800 000	262 800 000	32.38	32.38	32.38

LEVELIZED COST Rand/ kWh 6%	8%	10%	NPV - Energy 6%	8%	10%	NPV 6%	8%	10%
0.13	0.11	0.10	3 701 286 603	3 005 117 852	2 503 531 506	472.53	344.56	258.83

NTAB 1.15 MAR ONLY - HYDROPOWER LEVELIZED COST - INCL FULL CAPITAL REDEMPTION

ITEM	TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
	CAPITAL COST COMPONENTS (R*10^6)								
	PHASE 1								
Ialeni & Laleni Dam	357.4	250.2				71.5	35.7		
Pipelines/Tunnel	0.0		0.0			0.0	0.0		
Reservoirs	0.0			0.0			0.0		
Electromechanical	163						259.9	182.4	
Treatment Works	0.0				0.0		0.0		
Abstraction Works	0.0					0.0			
Power	29.6								29.6
Engineering & EMP	68.8								
TOTAL	619.3	250.2	0.0	0.0	0.0	71.5	295.7	182.4	29.6
	PHASE 3								
Dam	0.0	0.0				0.0			
Pipelines	0.0		0.0						
Reservoirs	0.0			0.0					
Pumping Stations	0.0						0.0	0.0	
Treatment Works	0.0				0.0				
Abstraction Works	0.0					0.0			
Power	0.0								0.0
Other	0.0								
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TOTAL	DAM	PIPELINES	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
CAPITAL COST COMPONENTS (R*10^6)								
PHASE 2								
0.0	0.0				0.0			
0.0		0.0						
0.0			0.0					
0.0						0.0	0.0	
0.0				0.0				
0.0					0.0			
0.0								0.0
0.0								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

OPERATIONAL COSTS (R*10^6)

MAINTENANCE COSTS RATE	ITEM	COST PH. 1	COST PH. 2	COST PH. 3
0.25%	Dam	0.63	0.00	0.00
0.50%	Pipelines, Reservoirs	0.00	0.00	0.00
1.00%	Treatment Works, Civil Works, Buildings	2.54	0.00	0.00
4.00%	M & E	11.83	0.00	0.00
0.00%	Power	0.00	0.00	0.00
	Total	14.99	0.00	0.00

TREATMENT COSTS	
Using cost Rand per m3 =	N/A
PUMPING COSTS	
Max.Demand Charge / Kw	N/A
Energy Cost : Rand/ kWHr	N/A

YEAR	YEAR NO.	ENERGY SUPPLIED kWh/YEAR	THIS SECTION NOT USED			CAPITAL & REFURBISHMENT COSTS (R*10^6) Dams	Pipelines & Tunnels	Electro Mech	Civil Works Builds	Power	ENG & EMP
2015	0					62.5	0.0	73.9	63.5	7.4	17.2
2016	1					62.5	0.0	73.9	63.5	7.4	17.2
2017	2					62.5	0.0	73.9	63.5	7.4	17.2
2018	3					62.5	0.0	73.9	63.5	7.4	17.2
2019	4	22 209 862	0.00	0.00	0.00						
2020	5	22 209 862	0.00	0.00	0.00						
2021	6	22 209 862	0.00	0.00	0.00						
2022	7	22 209 862	0.00	0.00	0.00						
2023	8	22 209 862	0.00	0.00	0.00						
2024	9	22 209 862	0.00	0.00	0.00						
2025	10	22 209 862	0.00	0.00	0.00						
2026	11	22 209 862	0.00	0.00	0.00						
2027	12	22 209 862	0.00	0.00	0.00						
2028	13	22 209 862	0.00	0.00	0.00						
2029	14	22 209 862	0.00	0.00	0.00						
2030	15	22 209 862	0.00	0.00	0.00						
2031	16	22 209 862	0.00	0.00	0.00						
2032	17	22 209 862	0.00	0.00	0.00						
2033	18	22 209 862	0.00	0.00	0.00			147.8			
2034	19	22 209 862	0.00	0.00	0.00						
2035	20	22 209 862	0.00	0.00	0.00						
2036	21	22 209 862	0.00	0.00	0.00						
2037	22	22 209 862	0.00	0.00	0.00						
2038	23	22 209 862	0.00	0.00	0.00						
2039	24	22 209 862	0.00	0.00	0.00						
2040	25	22 209 862	0.00	0.00	0.00						
2041	26	22 209 862	0.00	0.00	0.00						
2042	27	22 209 862	0.00	0.00	0.00						
2043	28	22 209 862	0.00	0.00	0.00						
2044	29	22 209 862	0.00	0.00	0.00						
2045	30	22 209 862	0.00	0.00	0.00						
2046	31	22 209 862	0.00	0.00	0.00						
2047	32	22 209 862	0.00	0.00	0.00						
2048	33	22 209 862	0.00	0.00	0.00	0.0	0.0	147.8	0.0		
2049	34	22 209 862	0.00	0.00	0.00						
2050	35	22 209 862	0.00	0.00	0.00						

YEAR	MAINTENANCE COSTS (R*10^6) Dam	Pipelines + Reservoirs	Treatment, Civil Works+ Buildings	M & E		DISCOUNTED ENERGY SUPPLIED DISCOUNT RATES 6%	8%	10%	TOTAL COSTS RAND million DISCOUNT RATES 6%	8%	10%
2015									224.54	224.54	224.54
2016									224.54	224.54	224.54
2017									224.54	224.54	224.54
2018									224.54	224.54	224.54
2019	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2020	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2021	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2022	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2023	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2024	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2025	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2026	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2027	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2028	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2029	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2030	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2031	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2032	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2033	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	162.82	162.82	162.82
2034	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2035	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2036	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2037	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2038	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2039	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2040	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2041	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2042	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2043	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2044	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2045	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2046	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2047	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2048	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	162.82	162.82	162.82
2049	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2050	0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99

LEVELIZED COST Rand/ kWh 6%	8%	10%	NPV - Energy 6%	8%	10%	NPV 6%	8%	10%
3.24	3.60	3.97	312 804 666	253 969 765	211 579 492	1014.55	914.76	839.27

NTAB 1.15 MAR ONLY - HYDROPOWER LEVELIZED COST - INCL FULL CAPITAL REDEMPTION

ITEM	CAPITAL COST COMPONENTS (R*10^6) TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	CAPITAL COST COMPONENTS (R*10^6) TOTAL	DAM	PIPELINES	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
	PHASE 1									PHASE 2								
laleni &Laleni Dam	357.4	250.2				71.5	35.7			0.0	0.0				0.0			
Pipelines/Tunnel	0.0		0.0			0.0	0.0			0.0		0.0						
Reservoirs	0.0			0.0			0.0			0.0			0.0					
Electromechanical	163						259.9	182.4		0.0						0.0	0.0	
Treatment Works	0.0				0.0		0.0			0.0				0.0				
Abstraction Works	0.0					0.0				0.0					0.0			
Power	29.6								29.6	0.0								0.0
Engineering & EMP	68.8									0.0								
TOTAL	619.3	250.2	0.0	0.0	0.0	71.5	295.7	182.4	29.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ITEM	TOTAL	DAM	PIPELINES TUNNEL	RESERVOIRS	TREATMENT WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY
	PHASE 3								
Dam	0.0	0.0				0.0			
Pipelines	0.0		0.0						
Reservoirs	0.0			0.0					
Pumping Stations	0.0						0.0	0.0	
Treatment Works	0.0				0.0				
Abstraction Works	0.0					0.0			
Power	0.0								0.0
Other	0.0								
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

OPERATIONAL COSTS (R*10^6)

MAINTENANCE COSTS RATE	ITEM	COST PH. 1	COST PH. 2	COST PH. 3
0.25%	Dam	0.63	0.00	0.00
0.50%	Pipelines, Reservoirs	0.00	0.00	0.00
1.00%	Treatment Works, Civil Works, Buildings	2.54	0.00	0.00
4.00%	M & E	11.83	0.00	0.00
0.00%	Power	0.00	0.00	0.00
	Total	14.99	0.00	0.00

TREATMENT COSTS	
Using cost Rand per m3 =	N/A
PUMPING COSTS	
Max.Demand Charge / Kw	N/A
Energy Cost : Rand/ kWHr	N/A

YEAR	YEAR NO.	ENERGY SUPPLIED kWh/YEAR	THIS SECTION NOT USED			CAPITAL & REFURBISHMENT COSTS (R*10^6) Dams	Pipelines & Tunnels	Electro Mech	Civil Works Builds	Power	ENG & EMP			MAINTENANCE COSTS (R*10^6) Dam	Pipelines + Reservoirs	Treatment, Civil Works+ Buildings	M & E		DISCOUNTED ENERGY SUPPLIED DISCOUNT RATES 6%	8%	10%	TOTAL COSTS RAND million DISCOUNT RATES 6%	8%	10%
2015	0																					0.00	0.00	0.00
2016	1																					0.00	0.00	0.00
2017	2																					0.00	0.00	0.00
2018	3																					0.00	0.00	0.00
2019	4	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2020	5	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2021	6	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2022	7	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2023	8	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2024	9	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2025	10	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2026	11	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2027	12	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2028	13	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2029	14	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2030	15	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2031	16	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2032	17	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2033	18	22 209 862	0.00	0.00	0.00			147.8						0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	162.82	162.82	162.82
2034	19	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2035	20	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2036	21	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2037	22	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2038	23	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2039	24	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2040	25	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2041	26	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2042	27	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2043	28	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2044	29	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2045	30	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2046	31	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2047	32	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2048	33	22 209 862	0.00	0.00	0.00	0.0	0.0	147.8	0.0					0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	162.82	162.82	162.82
2049	34	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99
2050	35	22 209 862	0.00	0.00	0.00									0.63	0.00	2.54	11.83	0.00	22 209 862	22 209 862	22 209 862	14.99	14.99	14.99

LEVELIZED COST Rand/ kWh 6%	8%	10%	NPV - Energy 6%	8%	10%	NPV 6%	8%	10%
0.76	0.67	0.60	312 804 666	253 969 765	211 579 492	236.48	171.05	127.50

RESULTS SUMMARY:					**LEVELIZED COST OF POWER (R/kWh) FOR DISCOUNT RATES**					
	DAM CAPACITY (MAR x)		**INSTALLED HYDROPOWER**		**WITH FULL CAPEX INCLUDED**			**O&M AND REFURB COSTS ONLY**		
OPTION	**NTABELANGA**	**LALINI**	**NTABELANGA**	**LALINI**	**6%**	**8%**	**10%**	**6%**	**8%**	**10%**
NTABELANGA DAM ONLY	1.18	NO DAM	5 MW	NIL	R 3.24	R 3.60	R 3.97	R 0.76	R 0.67	R 0.60
NTABELANGA DAM PLUS LALINI DAM	*1.18*	*0.15*	*5 MW*	*30 MW*	*R 0.82*	*R 0.94*	*R 1.06*	*R 0.11*	*R 0.10*	*R 0.09*
NTABELANGA DAM PLUS LALINI DAM	0.15	0.78	NIL	30 MW	R 0.97	R 1.11	R 1.24	R 0.13	R 0.11	R 0.10

APPENDIX G

MODEL USED TO CALCULATE THE URV OF POTABLE WATER SUPPLIED

URV: POTABLE WATER SCHEME ONLY EXCL TERTIARIES

100% Grant Funded | **No power cross-subsidized**

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	285.2	242.4					42.8				
Increment for HEP	187.2	159.1					28.1			4.2	
Small HEP											
Pipelines											
Primary & Secondary	1060.6		901.5			53.0	106.1			4.1	
Reservoirs											
Primary & Secondary	186.8			149.5		18.7	18.7				
Pumping Stations											
Primary & Secondary	112.7						95.8	16.9			
Power supplies											
Primary & Secondary	45.9								45.9		
Treatment Works	716.6				75.2	359.9	281.5			12.3	
Irrigation Supply											
Incl bulk and farms dev											
Roads	94.5					94.5					
Other Items and Mitigations	259.1				259.1						
Power lines	16.3								16.3		
Engineering & EMP	355.8				355.8						
SUB-TOTAL	*3320.8*	*401.6*	*901.5*	*149.5*	*690.1*	*526.1*	*572.9*	*16.9*	*62.2*	*20.6*	-
SUB-TOTAL	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-
GRAND TOTAL	**3320.8**	**401.6**	**901.5**	**149.5**	**690.1**	**526.1**	**572.9**	**16.9**	**62.2**	**20.6**	-

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0% = grant funding)

Year	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%	
Year	**66.4**	**472.4**	**156.7**	**716.6**	**0.0**	**1360.2**	**0.0**	**0.0**	**548.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**3321**
2015	9.5								27.4						0.0	0.0	**37**
2016	9.5	47.2	74.4		0.0				82.3						0.0	0.0	**213**
2017	9.5	100.4	74.4	143.3	0.0	272.0	0.0		82.3	0.0	0.0	0.0	0.0		0.0	0.0	**682**
2018	9.5	100.4	7.8	250.8	0.0	544.1	0.0	0.0	82.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**995**
2019	9.5	100.4		250.8		408.0	0.0	0.0	82.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**851**
2020	9.5	100.4		71.7		68.0	0.0	0.0	82.3	0.0			0.0	0.0	0.0	0.0	**332**
2021	9.5	23.6				68.0	0.0	0.0	54.9	0.0				0.0	0.0	0.0	**156**
2022									54.9	0.0					0.0	0.0	**55**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check>	66.4	472.4	156.7	716.6	0.0	1360.2	0.0	0.0	548.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3321

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS

RATE	ITEM	COST/A
0.25%	Dam	1.00
0.50%	Pipelines, Reservoirs	5.25
0.50%	Treatment Works, Civil Works, Buildings	6.17
2.00%	M & E	11.46
	Total	**23.88**

TREATMENT COSTS

Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment
2015	0			0.0	0.0	0.0	0.0	9.5	0.0										
2016	1			121.7	0.0	0.0	0.0	9.5	0.0										
2017	2			174.8	272.0	0.0	143.3	9.5	0.0										
2018	3			108.2	544.1	0.0	250.8	9.5	0.0										
2019	4			100.4	408.0	0.0	250.8	9.5	0.0										
2020	5	20.63		100.4	68.0	0.0	71.7	9.5	0.0			7.05	23.18	1.00	5.25	6.17	11.46	20.60	5.16
2021	6	20.87		23.6	68.0	0.0	0.0	9.5	0.0			7.13	23.46	1.00	5.25	6.17	11.46	20.60	5.22
2022	7	21.11		0.0	0.0	0.0	0.0	0.0	0.0			7.21	23.75	1.00	5.25	6.17	11.46	20.60	5.28
2023	8	21.34		0.0	0.0	0.0	0.0	0.0	0.0			7.29	24.04	1.00	5.25	6.17	11.46	20.60	5.34
2024	9	21.58		0.0	0.0	0.0	0.0	0.0	0.0			7.37	24.33	1.00	5.25	6.17	11.46	20.60	5.40
2025	10	21.82		0.0	0.0	0.0	0.0	0.0	0.0			7.45	24.62	1.00	5.25	6.17	11.46	20.60	5.45
2026	11	22.06										7.52	24.91	1.00	5.25	6.17	11.46	20.60	5.51
2027	12	22.29										7.60	25.20	1.00	5.25	6.17	11.46	20.60	5.57
2028	13	22.53										7.68	25.49	1.00	5.25	6.17	11.46	20.60	5.63
2029	14	22.77										7.76	25.77	1.00	5.25	6.17	11.46	20.60	5.69
2030	15	23.01										7.84	26.06	1.00	5.25	6.17	11.46	20.60	5.75
2031	16	23.24										7.92	26.35	1.00	5.25	6.17	11.46	20.60	5.81
2032	17	23.48										8.00	26.64	1.00	5.25	6.17	11.46	20.60	5.87
2033	18	23.72										8.07	26.93	1.00	5.25	6.17	11.46	20.60	5.93
2034	19	23.96				0.0	179.1	<:Refurbishment funding				8.15	27.22	1.00	5.25	6.17	11.46	20.60	5.99
2035	20	24.19										8.23	27.51	1.00	5.25	6.17	11.46	20.60	6.05
2036	21	24.43										8.31	27.80	1.00	5.25	6.17	11.46	20.60	6.11
2037	22	24.67										8.39	28.08	1.00	5.25	6.17	11.46	20.60	6.17
2038	23	24.91										8.47	28.37	1.00	5.25	6.17	11.46	20.60	6.23
2039	24	25.14										8.54	28.66	1.00	5.25	6.17	11.46	20.60	6.29
2040	25	25.38										8.62	28.95	1.00	5.25	6.17	11.46	20.60	6.35
2041	26	25.62										8.70	29.24	1.00	5.25	6.17	11.46	20.60	6.40
2042	27	25.86										8.78	29.53	1.00	5.25	6.17	11.46	20.60	6.46
2043	28	26.09										8.86	29.82	1.00	5.25	6.17	11.46	20.60	6.52
2044	29	26.33										8.94	30.11	1.00	5.25	6.17	11.46	20.60	6.58
2045	30	26.57										9.01	30.39	1.00	5.25	6.17	11.46	20.60	6.64
2046	31	26.81										9.09	30.68	1.00	5.25	6.17	11.46	20.60	6.70
2047	32	27.05										9.17	30.97	1.00	5.25	6.17	11.46	20.60	6.76
2048	33	27.28										9.25	31.26	1.00	5.25	6.17	11.46	20.60	6.82
2049	34	27.52		0.0	0.0	0.0	179.1	<:Refurbishment funding				9.33	31.55	1.00	5.25	6.17	11.46	20.60	6.88
2050	35	27.76										9.41	31.84	1.00	5.25	6.17	11.46	20.60	6.94

URV OF WATER SUPPLIED

6%	8%	10%	2%
9.45	10.20	10.92	8.00

YEAR	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015					9	9	9	9.49
2016					131	131	131	131.17
2017					600	600	600	599.66
2018					913	913	913	912.58
2019					769	769	769	768.73
2020	20.63	20.63	20.63	20.63	322	322	322	322.36
2021	20.87	20.87	20.87	20.87	174	174	174	174.28
2022	21.11	21.11	21.11	21.11	74	74	74	73.51
2023	21.34	21.34	21.34	21.34	74	74	74	73.86
2024	21.58	21.58	21.58	21.58	74	74	74	74.21
2025	21.82	21.82	21.82	21.82	75	75	75	74.56
2026	22.06	22.06	22.06	22.06	75	75	75	74.90
2027	22.29	22.29	22.29	22.29	75	75	75	75.25
2028	22.53	22.53	22.53	22.53	76	76	76	75.60
2029	22.77	22.77	22.77	22.77	76	76	76	75.95
2030	23.01	23.01	23.01	23.01	76	76	76	76.30
2031	23.24	23.24	23.24	23.24	77	77	77	76.65
2032	23.48	23.48	23.48	23.48	77	77	77	76.99
2033	23.72	23.72	23.72	23.72	77	77	77	77.34
2034	23.96	23.96	23.96	23.96	257	257	257	256.83
2035	24.19	24.19	24.19	24.19	78	78	78	78.04
2036	24.43	24.43	24.43	24.43	78	78	78	78.39
2037	24.67	24.67	24.67	24.67	79	79	79	78.73
2038	24.91	24.91	24.91	24.91	79	79	79	79.08
2039	25.14	25.14	25.14	25.14	79	79	79	79.43
2040	25.38	25.38	25.38	25.38	80	80	80	79.78
2041	25.62	25.62	25.62	25.62	80	80	80	80.13
2042	25.86	25.86	25.86	25.86	80	80	80	80.48
2043	26.09	26.09	26.09	26.09	81	81	81	80.82
2044	26.33	26.33	26.33	26.33	81	81	81	81.17
2045	26.57	26.57	26.57	26.57	82	82	82	81.52
2046	26.81	26.81	26.81	26.81	82	82	82	81.87
2047	27.05	27.05	27.05	27.05	82	82	82	82.22
2048	27.28	27.28	27.28	27.28	83	83	83	82.56
2049	27.52	27.52	27.52	27.52	262	262	262	262.05
2050	27.76	27.76	27.76	27.76	83	83	83	83.26

NPV WATER SUPPLIED

6%	8%	10%	2%
322	259	214	546

NPV COSTS

6%	8%	10%	2%
3 045	2 646	2 340	4 369

URV: POTABLE WATER SCHEME ONLY EXCL TERTIARIES

100% Grant Funded | **No power cross-subsidized**

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	285.2	242.4					42.8				
Increment for HEP	187.2	159.1					28.1			4.2	
Small HEP											
Pipelines											
Primary & Secondary	1060.6		901.5			53.0	106.1			4.1	
Reservoirs											
Primary & Secondary	186.8			149.5		18.7	18.7				
Pumping Stations											
Primary & Secondary	112.7						95.8	16.9			
Power supplies											
Primary & Secondary	45.9								45.9		
Treatment Works	716.6				75.2	359.9	281.5			12.3	
Irrigation Supply											
Incl bulk and farms dev											
Roads	94.5					94.5					
Other Items and Mitigations	259.1				259.1						
Power lines	16.3								16.3		
Engineering & EMP	355.8				355.8						
SUB-TOTAL	***3320.8***	*401.6*	*901.5*	*149.5*	*690.1*	*526.1*	*572.9*	*16.9*	*62.2*	*20.6*	-
SUB-TOTAL	***0.0***	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-
GRAND TOTAL	**3320.8**	**401.6**	**901.5**	**149.5**	**690.1**	**526.1**	**572.9**	**16.9**	**62.2**	**20.6**	**-**

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0% = grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Year	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**614.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**615**
2015	0.0								30.7						0.0	0.0	**31**
2016	0.0	0.0	0.0		0.0				92.2						0.0	0.0	**92**
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0		92.2	0.0	0.0	0.0	0.0		0.0	0.0	**92**
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**92**
2019	0.0	0.0		0.0		0.0	0.0	0.0	92.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**92**
2020	0.0	0.0		0.0		0.0	0.0	0.0	92.2	0.0			0.0	0.0	0.0	0.0	**92**
2021	0.0	0.0				0.0	0.0	0.0	61.5	0.0				0.0	0.0	0.0	**61**
2022									61.5	0.0					0.0	0.0	**61**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check:>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	614.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	615

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS RATE	ITEM	COST/A
0.25%	Dam	1.00
0.50%	Pipelines, Reservoirs	5.25
0.50%	Treatment Works, Civil Works, Buildings	6.17
2.00%	M & E	11.46
	Total	23.88

TREATMENT COSTS		
Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m^3/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment	DISCOUNTED WATER SUPPLIED (million m^3) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015	0			0.0	0.0	0.0	0.0	0.0	0.0															0	0	0	0.00
2016	1			0.0	0.0	0.0	0.0	0.0	0.0															0	0	0	0.00
2017	2			0.0	0.0	0.0	0.0	0.0	0.0															0	0	0	0.00
2018	3			0.0	0.0	0.0	0.0	0.0	0.0															0	0	0	0.00
2019	4			0.0	0.0	0.0	0.0	0.0	0.0															0	0	0	0.00
2020	5	20.63		0.0	0.0	0.0	0.0	0.0	0.0			7.05	23.18	1.00	5.25	6.17	11.46	20.60	5.16	20.63	20.63	20.63	20.63	73	73	73	72.82
2021	6	20.87		0.0	0.0	0.0	0.0	0.0	0.0			7.13	23.46	1.00	5.25	6.17	11.46	20.60	5.22	20.87	20.87	20.87	20.87	73	73	73	73.16
2022	7	21.11		0.0	0.0	0.0	0.0	0.0	0.0			7.21	23.75	1.00	5.25	6.17	11.46	20.60	5.28	21.11	21.11	21.11	21.11	74	74	74	73.51
2023	8	21.34		0.0	0.0	0.0	0.0	0.0	0.0			7.29	24.04	1.00	5.25	6.17	11.46	20.60	5.34	21.34	21.34	21.34	21.34	74	74	74	73.86
2024	9	21.58		0.0	0.0	0.0	0.0	0.0	0.0			7.37	24.33	1.00	5.25	6.17	11.46	20.60	5.40	21.58	21.58	21.58	21.58	74	74	74	74.21
2025	10	21.82		0.0	0.0	0.0	0.0	0.0	0.0			7.45	24.62	1.00	5.25	6.17	11.46	20.60	5.45	21.82	21.82	21.82	21.82	75	75	75	74.56
2026	11	22.06										7.52	24.91	1.00	5.25	6.17	11.46	20.60	5.51	22.06	22.06	22.06	22.06	75	75	75	74.90
2027	12	22.29										7.60	25.20	1.00	5.25	6.17	11.46	20.60	5.57	22.29	22.29	22.29	22.29	75	75	75	75.25
2028	13	22.53										7.68	25.49	1.00	5.25	6.17	11.46	20.60	5.63	22.53	22.53	22.53	22.53	76	76	76	75.60
2029	14	22.77										7.76	25.77	1.00	5.25	6.17	11.46	20.60	5.69	22.77	22.77	22.77	22.77	76	76	76	75.95
2030	15	23.01										7.84	26.06	1.00	5.25	6.17	11.46	20.60	5.75	23.01	23.01	23.01	23.01	76	76	76	76.30
2031	16	23.24										7.92	26.35	1.00	5.25	6.17	11.46	20.60	5.81	23.24	23.24	23.24	23.24	77	77	77	76.65
2032	17	23.48										8.00	26.64	1.00	5.25	6.17	11.46	20.60	5.87	23.48	23.48	23.48	23.48	77	77	77	76.99
2033	18	23.72										8.07	26.93	1.00	5.25	6.17	11.46	20.60	5.93	23.72	23.72	23.72	23.72	77	77	77	77.34
2034	19	23.96				0.0	0.0	<:Refurbishment funding				8.15	27.22	1.00	5.25	6.17	11.46	20.60	5.99	23.96	23.96	23.96	23.96	78	78	78	77.69
2035	20	24.19										8.23	27.51	1.00	5.25	6.17	11.46	20.60	6.05	24.19	24.19	24.19	24.19	78	78	78	78.04
2036	21	24.43										8.31	27.80	1.00	5.25	6.17	11.46	20.60	6.11	24.43	24.43	24.43	24.43	78	78	78	78.39
2037	22	24.67										8.39	28.08	1.00	5.25	6.17	11.46	20.60	6.17	24.67	24.67	24.67	24.67	79	79	79	78.73
2038	23	24.91										8.47	28.37	1.00	5.25	6.17	11.46	20.60	6.23	24.91	24.91	24.91	24.91	79	79	79	79.08
2039	24	25.14										8.54	28.66	1.00	5.25	6.17	11.46	20.60	6.29	25.14	25.14	25.14	25.14	79	79	79	79.43
2040	25	25.38										8.62	28.95	1.00	5.25	6.17	11.46	20.60	6.35	25.38	25.38	25.38	25.38	80	80	80	79.78
2041	26	25.62										8.70	29.24	1.00	5.25	6.17	11.46	20.60	6.40	25.62	25.62	25.62	25.62	80	80	80	80.13
2042	27	25.86										8.78	29.53	1.00	5.25	6.17	11.46	20.60	6.46	25.86	25.86	25.86	25.86	80	80	80	80.48
2043	28	26.09										8.86	29.82	1.00	5.25	6.17	11.46	20.60	6.52	26.09	26.09	26.09	26.09	81	81	81	80.82
2044	29	26.33										8.94	30.11	1.00	5.25	6.17	11.46	20.60	6.58	26.33	26.33	26.33	26.33	81	81	81	81.17
2045	30	26.57										9.01	30.39	1.00	5.25	6.17	11.46	20.60	6.64	26.57	26.57	26.57	26.57	82	82	82	81.52
2046	31	26.81										9.09	30.68	1.00	5.25	6.17	11.46	20.60	6.70	26.81	26.81	26.81	26.81	82	82	82	81.87
2047	32	27.05										9.17	30.97	1.00	5.25	6.17	11.46	20.60	6.76	27.05	27.05	27.05	27.05	82	82	82	82.22
2048	33	27.28										9.25	31.26	1.00	5.25	6.17	11.46	20.60	6.82	27.28	27.28	27.28	27.28	83	83	83	82.56
2049	34	27.52		0.0	0.0	0.0	0.0	<:Refurbishment funding				9.33	31.55	1.00	5.25	6.17	11.46	20.60	6.88	27.52	27.52	27.52	27.52	83	83	83	82.91
2050	35	27.76										9.41	31.84	1.00	5.25	6.17	11.46	20.60	6.94	27.76	27.76	27.76	27.76	83	83	83	83.26

	6%	8%	10%	2%
URV OF WATER SUPPLIED	2.47	2.27	2.08	2.95
NPV WATER SUPPLIED	322	259	214	546
NPV COSTS	796	588	446	1 610

URV: POTABLE WATER SCHEME ONLY EXCL TERTIARIES

100% Grant Funded | **50% power cross-subsidized**

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	285.2	242.4					42.8				
Increment for HEP	187.2	159.1					28.1			4.2	
Small HEP											
Pipelines											
Primary & Secondary	1060.6		901.5			53.0	106.1			4.1	
Reservoirs											
Primary & Secondary	186.8			149.5		18.7	18.7				
Pumping Stations											
Primary & Secondary	112.7						95.8	16.9			
Power supplies											
Primary & Secondary	45.9								45.9		
Treatment Works	716.6				75.2	359.9	281.5			12.3	
Irrigation Supply											
Incl bulk and farms dev											
Roads	94.5					94.5					
Other Items and Mitigations	259.1				259.1						
Power lines	16.3								16.3		
Engineering & EMP	355.8				355.8						
SUB-TOTAL	***3320.8***	*401.6*	*901.5*	*149.5*	*690.1*	*526.1*	*572.9*	*16.9*	*62.2*	*20.6*	-
SUB-TOTAL	***0.0***	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-
GRAND TOTAL	**3320.8**	**401.6**	**901.5**	**149.5**	**690.1**	**526.1**	**572.9**	**16.9**	**62.2**	**20.6**	-

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0% = grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Year	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**614.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**615**
2015	0.0								30.7						0.0	0.0	**31**
2016	0.0	0.0	0.0		0.0				92.2						0.0	0.0	**92**
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0		92.2	0.0	0.0	0.0	0.0		0.0	0.0	**92**
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**92**
2019	0.0	0.0		0.0		0.0	0.0	0.0	92.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**92**
2020	0.0	0.0		0.0		0.0	0.0	0.0	92.2	0.0			0.0	0.0	0.0	0.0	**92**
2021	0.0	0.0				0.0	0.0	0.0	61.5	0.0				0.0	0.0	0.0	**61**
2022									61.5	0.0					0.0	0.0	**61**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	614.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	615

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS

RATE	ITEM	COST/A
0.25%	Dam	1.00
0.50%	Pipelines, Reservoirs	5.25
0.50%	Treatment Works, Civil Works, Buildings	6.17
2.00%	M & E	11.46
	Total	23.88

TREATMENT COSTS

Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment
2015	0			0.0	0.0	0.0	0.0	0.0	0.0										
2016	1			0.0	0.0	0.0	0.0	0.0	0.0										
2017	2			0.0	0.0	0.0	0.0	0.0	0.0										
2018	3			0.0	0.0	0.0	0.0	0.0	0.0										
2019	4			0.0	0.0	0.0	0.0	0.0	0.0										
2020	5	20.63		0.0	0.0	0.0	0.0	0.0	0.0			7.05	11.59	1.00	5.25	6.17	11.46	20.60	5.16
2021	6	20.87		0.0	0.0	0.0	0.0	0.0	0.0			7.13	11.73	1.00	5.25	6.17	11.46	20.60	5.22
2022	7	21.11		0.0	0.0	0.0	0.0	0.0	0.0			7.21	11.88	1.00	5.25	6.17	11.46	20.60	5.28
2023	8	21.34		0.0	0.0	0.0	0.0	0.0	0.0			7.29	12.02	1.00	5.25	6.17	11.46	20.60	5.34
2024	9	21.58		0.0	0.0	0.0	0.0	0.0	0.0			7.37	12.17	1.00	5.25	6.17	11.46	20.60	5.40
2025	10	21.82		0.0	0.0	0.0	0.0	0.0	0.0			7.45	12.31	1.00	5.25	6.17	11.46	20.60	5.45
2026	11	22.06										7.52	12.45	1.00	5.25	6.17	11.46	20.60	5.51
2027	12	22.29										7.60	12.60	1.00	5.25	6.17	11.46	20.60	5.57
2028	13	22.53										7.68	12.74	1.00	5.25	6.17	11.46	20.60	5.63
2029	14	22.77										7.76	12.89	1.00	5.25	6.17	11.46	20.60	5.69
2030	15	23.01										7.84	13.03	1.00	5.25	6.17	11.46	20.60	5.75
2031	16	23.24										7.92	13.18	1.00	5.25	6.17	11.46	20.60	5.81
2032	17	23.48										8.00	13.32	1.00	5.25	6.17	11.46	20.60	5.87
2033	18	23.72										8.07	13.46	1.00	5.25	6.17	11.46	20.60	5.93
2034	19	23.96				0.0	0.0	<:Refurbishment funding				8.15	13.61	1.00	5.25	6.17	11.46	20.60	5.99
2035	20	24.19										8.23	13.75	1.00	5.25	6.17	11.46	20.60	6.05
2036	21	24.43										8.31	13.90	1.00	5.25	6.17	11.46	20.60	6.11
2037	22	24.67										8.39	14.04	1.00	5.25	6.17	11.46	20.60	6.17
2038	23	24.91										8.47	14.19	1.00	5.25	6.17	11.46	20.60	6.23
2039	24	25.14										8.54	14.33	1.00	5.25	6.17	11.46	20.60	6.29
2040	25	25.38										8.62	14.48	1.00	5.25	6.17	11.46	20.60	6.35
2041	26	25.62										8.70	14.62	1.00	5.25	6.17	11.46	20.60	6.40
2042	27	25.86										8.78	14.76	1.00	5.25	6.17	11.46	20.60	6.46
2043	28	26.09										8.86	14.91	1.00	5.25	6.17	11.46	20.60	6.52
2044	29	26.33										8.94	15.05	1.00	5.25	6.17	11.46	20.60	6.58
2045	30	26.57										9.01	15.20	1.00	5.25	6.17	11.46	20.60	6.64
2046	31	26.81										9.09	15.34	1.00	5.25	6.17	11.46	20.60	6.70
2047	32	27.05										9.17	15.49	1.00	5.25	6.17	11.46	20.60	6.76
2048	33	27.28										9.25	15.63	1.00	5.25	6.17	11.46	20.60	6.82
2049	34	27.52		0.0	0.0	0.0	0.0	<:Refurbishment funding				9.33	15.77	1.00	5.25	6.17	11.46	20.60	6.88
2050	35	27.76										9.41	15.92	1.00	5.25	6.17	11.46	20.60	6.94

YEAR	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015					0	0	0	0.00
2016					0	0	0	0.00
2017					0	0	0	0.00
2018					0	0	0	0.00
2019					0	0	0	0.00
2020	20.63	20.63	20.63	20.63	61	61	61	61.23
2021	20.87	20.87	20.87	20.87	61	61	61	61.43
2022	21.11	21.11	21.11	21.11	62	62	62	61.64
2023	21.34	21.34	21.34	21.34	62	62	62	61.84
2024	21.58	21.58	21.58	21.58	62	62	62	62.04
2025	21.82	21.82	21.82	21.82	62	62	62	62.25
2026	22.06	22.06	22.06	22.06	62	62	62	62.45
2027	22.29	22.29	22.29	22.29	63	63	63	62.65
2028	22.53	22.53	22.53	22.53	63	63	63	62.86
2029	22.77	22.77	22.77	22.77	63	63	63	63.06
2030	23.01	23.01	23.01	23.01	63	63	63	63.27
2031	23.24	23.24	23.24	23.24	63	63	63	63.47
2032	23.48	23.48	23.48	23.48	64	64	64	63.67
2033	23.72	23.72	23.72	23.72	64	64	64	63.88
2034	23.96	23.96	23.96	23.96	64	64	64	64.08
2035	24.19	24.19	24.19	24.19	64	64	64	64.28
2036	24.43	24.43	24.43	24.43	64	64	64	64.49
2037	24.67	24.67	24.67	24.67	65	65	65	64.69
2038	24.91	24.91	24.91	24.91	65	65	65	64.90
2039	25.14	25.14	25.14	25.14	65	65	65	65.10
2040	25.38	25.38	25.38	25.38	65	65	65	65.30
2041	25.62	25.62	25.62	25.62	66	66	66	65.51
2042	25.86	25.86	25.86	25.86	66	66	66	65.71
2043	26.09	26.09	26.09	26.09	66	66	66	65.92
2044	26.33	26.33	26.33	26.33	66	66	66	66.12
2045	26.57	26.57	26.57	26.57	66	66	66	66.32
2046	26.81	26.81	26.81	26.81	67	67	67	66.53
2047	27.05	27.05	27.05	27.05	67	67	67	66.73
2048	27.28	27.28	27.28	27.28	67	67	67	66.93
2049	27.52	27.52	27.52	27.52	67	67	67	67.14
2050	27.76	27.76	27.76	27.76	67	67	67	67.34

URV OF WATER SUPPLIED 6%	8%	10%	2%
2.05	1.88	1.73	2.43

NPV WATER SUPPLIED 6%	8%	10%	2%
322	259	214	546

NPV COSTS 6%	8%	10%	2%
660	488	370	1 329

URV: POTABLE WATER SCHEME ONLY EXCL TERTIARIES

100% Grant Funded | **100% power cross-subsidized**

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	285.2	242.4					42.8				
Increment for HEP	187.2	159.1					28.1			4.2	
Small HEP											
Pipelines											
Primary & Secondary	1060.6		901.5			53.0	106.1			4.1	
Reservoirs											
Primary & Secondary	186.8			149.5		18.7	18.7				
Pumping Stations											
Primary & Secondary	112.7						95.8	16.9			
Power supplies											
Primary & Secondary	45.9								45.9		
Treatment Works	716.6				75.2	359.9	281.5			12.3	
Irrigation Supply											
Incl bulk and farms dev											
Roads	94.5					94.5					
Other Items and Mitigations	259.1				259.1						
Power lines	16.3								16.3		
Engineering & EMP	355.8				355.8						
SUB-TOTAL	***3320.8***	*401.6*	*901.5*	*149.5*	*690.1*	*526.1*	*572.9*	*16.9*	*62.2*	*20.6*	-
SUB-TOTAL	***0.0***	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	
GRAND TOTAL	**3320.8**	**401.6**	**901.5**	**149.5**	**690.1**	**526.1**	**572.9**	**16.9**	**62.2**	**20.6**	-

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0% = grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Year	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**614.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**615**
2015	0.0								30.7						0.0	0.0	**31**
2016	0.0	0.0	0.0		0.0				92.2						0.0	0.0	**92**
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0		92.2	0.0	0.0	0.0	0.0		0.0	0.0	**92**
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**92**
2019	0.0	0.0		0.0		0.0	0.0	0.0	92.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**92**
2020	0.0	0.0		0.0		0.0	0.0	0.0	92.2	0.0			0.0	0.0	0.0	0.0	**92**
2021	0.0	0.0				0.0	0.0	0.0	61.5	0.0				0.0	0.0	0.0	**61**
2022									61.5	0.0					0.0	0.0	**61**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	614.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	615

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS

RATE	ITEM	COST/A
0.25%	Dam	1.00
0.50%	Pipelines, Reservoirs	5.25
0.50%	Treatment Works, Civil Works, Buildings	6.17
2.00%	M & E	11.46
	Total	23.88

TREATMENT COSTS

Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m^3/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment
2015	0			0.0	0.0	0.0	0.0	0.0	0.0										
2016	1			0.0	0.0	0.0	0.0	0.0	0.0										
2017	2			0.0	0.0	0.0	0.0	0.0	0.0										
2018	3			0.0	0.0	0.0	0.0	0.0	0.0										
2019	4			0.0	0.0	0.0	0.0	0.0	0.0										
2020	5	20.63		0.0	0.0	0.0	0.0	0.0	0.0			7.05		1.00	5.25	6.17	11.46	20.60	5.16
2021	6	20.87		0.0	0.0	0.0	0.0	0.0	0.0			7.13		1.00	5.25	6.17	11.46	20.60	5.22
2022	7	21.11		0.0	0.0	0.0	0.0	0.0	0.0			7.21		1.00	5.25	6.17	11.46	20.60	5.28
2023	8	21.34		0.0	0.0	0.0	0.0	0.0	0.0			7.29		1.00	5.25	6.17	11.46	20.60	5.34
2024	9	21.58		0.0	0.0	0.0	0.0	0.0	0.0			7.37		1.00	5.25	6.17	11.46	20.60	5.40
2025	10	21.82		0.0	0.0	0.0	0.0	0.0	0.0			7.45		1.00	5.25	6.17	11.46	20.60	5.45
2026	11	22.06										7.52		1.00	5.25	6.17	11.46	20.60	5.51
2027	12	22.29										7.60		1.00	5.25	6.17	11.46	20.60	5.57
2028	13	22.53										7.68		1.00	5.25	6.17	11.46	20.60	5.63
2029	14	22.77										7.76		1.00	5.25	6.17	11.46	20.60	5.69
2030	15	23.01										7.84		1.00	5.25	6.17	11.46	20.60	5.75
2031	16	23.24										7.92		1.00	5.25	6.17	11.46	20.60	5.81
2032	17	23.48										8.00		1.00	5.25	6.17	11.46	20.60	5.87
2033	18	23.72										8.07		1.00	5.25	6.17	11.46	20.60	5.93
2034	19	23.96				0.0	0.0	<:Refurbishment funding				8.15		1.00	5.25	6.17	11.46	20.60	5.99
2035	20	24.19										8.23		1.00	5.25	6.17	11.46	20.60	6.05
2036	21	24.43										8.31		1.00	5.25	6.17	11.46	20.60	6.11
2037	22	24.67										8.39		1.00	5.25	6.17	11.46	20.60	6.17
2038	23	24.91										8.47		1.00	5.25	6.17	11.46	20.60	6.23
2039	24	25.14										8.54		1.00	5.25	6.17	11.46	20.60	6.29
2040	25	25.38										8.62		1.00	5.25	6.17	11.46	20.60	6.35
2041	26	25.62										8.70		1.00	5.25	6.17	11.46	20.60	6.40
2042	27	25.86										8.78		1.00	5.25	6.17	11.46	20.60	6.46
2043	28	26.09										8.86		1.00	5.25	6.17	11.46	20.60	6.52
2044	29	26.33										8.94		1.00	5.25	6.17	11.46	20.60	6.58
2045	30	26.57										9.01		1.00	5.25	6.17	11.46	20.60	6.64
2046	31	26.81										9.09		1.00	5.25	6.17	11.46	20.60	6.70
2047	32	27.05										9.17		1.00	5.25	6.17	11.46	20.60	6.76
2048	33	27.28										9.25		1.00	5.25	6.17	11.46	20.60	6.82
2049	34	27.52		0.0	0.0	0.0	0.0	<:Refurbishment funding				9.33		1.00	5.25	6.17	11.46	20.60	6.88
2050	35	27.76										9.41		1.00	5.25	6.17	11.46	20.60	6.94

URV OF WATER SUPPLIED

6%	8%	10%	2%
1.62	1.49	1.38	1.92

YEAR	DISCOUNTED WATER SUPPLIED (million m^3) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015					0	0	0	0.00
2016					0	0	0	0.00
2017					0	0	0	0.00
2018					0	0	0	0.00
2019					0	0	0	0.00
2020	20.63	20.63	20.63	20.63	50	50	50	49.64
2021	20.87	20.87	20.87	20.87	50	50	50	49.70
2022	21.11	21.11	21.11	21.11	50	50	50	49.76
2023	21.34	21.34	21.34	21.34	50	50	50	49.82
2024	21.58	21.58	21.58	21.58	50	50	50	49.88
2025	21.82	21.82	21.82	21.82	50	50	50	49.94
2026	22.06	22.06	22.06	22.06	50	50	50	50.00
2027	22.29	22.29	22.29	22.29	50	50	50	50.06
2028	22.53	22.53	22.53	22.53	50	50	50	50.12
2029	22.77	22.77	22.77	22.77	50	50	50	50.18
2030	23.01	23.01	23.01	23.01	50	50	50	50.23
2031	23.24	23.24	23.24	23.24	50	50	50	50.29
2032	23.48	23.48	23.48	23.48	50	50	50	50.35
2033	23.72	23.72	23.72	23.72	50	50	50	50.41
2034	23.96	23.96	23.96	23.96	50	50	50	50.47
2035	24.19	24.19	24.19	24.19	51	51	51	50.53
2036	24.43	24.43	24.43	24.43	51	51	51	50.59
2037	24.67	24.67	24.67	24.67	51	51	51	50.65
2038	24.91	24.91	24.91	24.91	51	51	51	50.71
2039	25.14	25.14	25.14	25.14	51	51	51	50.77
2040	25.38	25.38	25.38	25.38	51	51	51	50.83
2041	25.62	25.62	25.62	25.62	51	51	51	50.89
2042	25.86	25.86	25.86	25.86	51	51	51	50.95
2043	26.09	26.09	26.09	26.09	51	51	51	51.01
2044	26.33	26.33	26.33	26.33	51	51	51	51.07
2045	26.57	26.57	26.57	26.57	51	51	51	51.13
2046	26.81	26.81	26.81	26.81	51	51	51	51.19
2047	27.05	27.05	27.05	27.05	51	51	51	51.24
2048	27.28	27.28	27.28	27.28	51	51	51	51.30
2049	27.52	27.52	27.52	27.52	51	51	51	51.36
2050	27.76	27.76	27.76	27.76	51	51	51	51.42

NPV WATER SUPPLIED

6%	8%	10%	2%
322	259	214	546

NPV COSTS

6%	8%	10%	2%
523	388	295	1 048

APPENDIX H

MODELS USED TO CALCULATE THE URV OF IRRIGATION WATER SUPPLIED

URV: IRRIGATION SCHEME COMPONENTS ONLY | 100% Capital Redemption | No power cross-subsidized

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	285.2	242.4					42.8				
Increment for HEP	187.2	159.1					28.1			4.2	
Associated Dam Works	51.7					12.9	12.9	25.9			
Small HEP											
Pipelines											
Primary & Secondary											
Tertiary											
Reservoirs											
Primary & Secondary											
Tertiary											
Pumping Stations											
Primary & Secondary											
Tertiary											
Power supplies											
Primary & Secondary											
Tertiary											
Treatment Works											
Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	94.5					94.5					
Other Items and Mitigations	259.1				259.1						
Power lines	16.3								16.3		
Engineering & EMP	197.3				197.3						
SUB-TOTAL	***1841.6***	*401.6*	*519.2*	*62.7*	*456.4*	*183.4*	*143.7*	*45.8*	*28.8*	*6.7*	-
Lalini Dam											
Associated Dam Works											
Conduit/Tunnel											
HEPs											
Small											
Main											
Roads											
Other Items & Mitigations											
Engineering & EMP											
SUB-TOTAL	***0.0***	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-
GRAND TOTAL	**1841.6**	**401.6**	**519.2**	**62.7**	**456.4**	**183.4**	**143.7**	**45.8**	**28.8**	**6.7**	**-**

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0%= grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%	
Year	**36.8**	**472.4**	**110.8**	**0.0**	**51.7**	**0.0**	**0.0**	**750.2**	**419.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1842**
2015	5.3								21.0						0.0	0.0	**26**
2016	5.3	47.2	52.6		24.6				62.9						0.0	0.0	**193**
2017	5.3	100.4	52.6	0.0	24.6	0.0	0.0		62.9	0.0	0.0	0.0	0.0		0.0	0.0	**246**
2018	5.3	100.4	5.5	0.0	2.6	0.0	0.0	150.0	62.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**327**
2019	5.3	100.4		0.0		0.0	0.0	300.1	62.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**469**
2020	5.3	100.4		0.0		0.0	0.0	262.6	62.9	0.0			0.0	0.0	0.0	0.0	**431**
2021	5.3	23.6				0.0	0.0	37.5	42.0	0.0				0.0	0.0	0.0	**108**
2022									42.0	0.0					0.0	0.0	**42**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check:>	36.8	472.4	110.8	0.0	51.7	0.0	0.0	750.2	419.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1842

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS

RATE	ITEM	COST/A
0.25%	Dam	1.00
0.50%	Pipelines, Reservoirs	2.91
0.50%	Treatment Works, Civil Works, Buildings	3.43
2.00%	M & E	2.87
	Total	10.21

TREATMENT COSTS

Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment
2015	0			0.0	0.0	0.0	0.0	5.3	0.0										
2016	1			124.5	0.0	0.0	0.0	5.3	0.0										
2017	2			177.6	0.0	0.0	0.0	5.3	0.0										
2018	3			108.5	150.0	0.0	0.0	5.3	0.0										
2019	4			100.4	300.1	0.0	0.0	5.3	0.0										
2020	5		25.24	100.4	262.6	0.0	0.0	5.3	0.0			3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2021	6		25.24	23.6	37.5	0.0	0.0	5.3	0.0			3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2022	7		25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2023	8		25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2024	9		25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2025	10		25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2026	11		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2027	12		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2028	13		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2029	14		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2030	15		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2031	16		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2032	17		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2033	18		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2034	19		25.24			0.0	0.0	<:Refurbishment funding				3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2035	20		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2036	21		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2037	22		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2038	23		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2039	24		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2040	25		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2041	26		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2042	27		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2043	28		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2044	29		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2045	30		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2046	31		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2047	32		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2048	33		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2049	34		25.24	0.0	0.0	0.0	0.0	<:Refurbishment funding				3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00
2050	35		25.24									3.81	11.47	1.00	2.91	3.43	2.87	6.70	0.00

YEAR	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015					5	5	5	5.26
2016					130	130	130	129.72
2017					183	183	183	182.87
2018					264	264	264	263.81
2019					406	406	406	405.72
2020	25.24	25.24	25.24	25.24	397	397	397	396.60
2021	25.24	25.24	25.24	25.24	95	95	95	94.78
2022	25.24	25.24	25.24	25.24	28	28	28	28.39
2023	25.24	25.24	25.24	25.24	28	28	28	28.39
2024	25.24	25.24	25.24	25.24	28	28	28	28.39
2025	25.24	25.24	25.24	25.24	28	28	28	28.39
2026	25.24	25.24	25.24	25.24	28	28	28	28.39
2027	25.24	25.24	25.24	25.24	28	28	28	28.39
2028	25.24	25.24	25.24	25.24	28	28	28	28.39
2029	25.24	25.24	25.24	25.24	28	28	28	28.39
2030	25.24	25.24	25.24	25.24	28	28	28	28.39
2031	25.24	25.24	25.24	25.24	28	28	28	28.39
2032	25.24	25.24	25.24	25.24	28	28	28	28.39
2033	25.24	25.24	25.24	25.24	28	28	28	28.39
2034	25.24	25.24	25.24	25.24	28	28	28	28.39
2035	25.24	25.24	25.24	25.24	28	28	28	28.39
2036	25.24	25.24	25.24	25.24	28	28	28	28.39
2037	25.24	25.24	25.24	25.24	28	28	28	28.39
2038	25.24	25.24	25.24	25.24	28	28	28	28.39
2039	25.24	25.24	25.24	25.24	28	28	28	28.39
2040	25.24	25.24	25.24	25.24	28	28	28	28.39
2041	25.24	25.24	25.24	25.24	28	28	28	28.39
2042	25.24	25.24	25.24	25.24	28	28	28	28.39
2043	25.24	25.24	25.24	25.24	28	28	28	28.39
2044	25.24	25.24	25.24	25.24	28	28	28	28.39
2045	25.24	25.24	25.24	25.24	28	28	28	28.39
2046	25.24	25.24	25.24	25.24	28	28	28	28.39
2047	25.24	25.24	25.24	25.24	28	28	28	28.39
2048	25.24	25.24	25.24	25.24	28	28	28	28.39
2049	25.24	25.24	25.24	25.24	28	28	28	28.39
2050	25.24	25.24	25.24	25.24	28	28	28	28.39

	6%	8%	10%	2%
URV OF WATER SUPPLIED	3.94	4.26	4.56	3.26
NPV WATER SUPPLIED	352	286	239	579
NPV COSTS	1 385	1 221	1 090	1 888

URV: IRRIGATION SCHEME COMPONENTS ONLY

100% Grant Funded | **No power cross-subsidized**

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	285.2	242.4					42.8				
Increment for HEP	187.2	159.1					28.1			4.2	
Associated Dam Works	51.7					12.9	12.9	25.9			
Small HEP											
Pipelines											
Primary & Secondary											
Tertiary											
Reservoirs											
Primary & Secondary											
Tertiary											
Pumping Stations											
Primary & Secondary											
Tertiary											
Power supplies											
Primary & Secondary											
Tertiary											
Treatment Works											
Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	94.5					94.5					
Other Items and Mitigations	259.1				259.1						
Power lines	16.3								16.3		
Engineering & EMP	197.3				197.3						
SUB-TOTAL	***1841.6***	*401.6*	*519.2*	*62.7*	*456.4*	*183.4*	*143.7*	*45.8*	*28.8*	*6.7*	-
Lalini Dam											
Associated Dam Works											
Conduit/Tunnel											
HEPs											
Small											
Main											
Roads											
Other Items & Mitigations											
Engineering & EMP											
SUB-TOTAL	***0.0***	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-
GRAND TOTAL	**1841.6**	**401.6**	**519.2**	**62.7**	**456.4**	**183.4**	**143.7**	**45.8**	**28.8**	**6.7**	-

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0%= grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Year	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**456.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**456**
2015	0.0								22.8						0.0	0.0	**23**
2016	0.0	0.0	0.0		0.0				68.5						0.0	0.0	**68**
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0		68.5	0.0	0.0	0.0	0.0		0.0	0.0	**68**
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**68**
2019	0.0	0.0		0.0		0.0	0.0	0.0	68.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**68**
2020	0.0	0.0		0.0		0.0	0.0	0.0	68.5	0.0			0.0	0.0	0.0	0.0	**68**
2021	0.0	0.0				0.0	0.0	0.0	45.6	0.0				0.0	0.0	0.0	**46**
2022									45.6	0.0					0.0	0.0	**46**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	456.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	456

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS

RATE	ITEM	COST/A
0.25%	Dam	1.00
0.50%	Pipelines, Reservoirs	2.91
0.50%	Treatment Works, Civil Works, Buildings	3.43
2.00%	M & E	2.87
	Total	**10.21**

TREATMENT COSTS

Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge
2015	0			0.0	0.0	0.0	0.0	0.0	0.0				
2016	1			0.0	0.0	0.0	0.0	0.0	0.0				
2017	2			0.0	0.0	0.0	0.0	0.0	0.0				
2018	3			0.0	0.0	0.0	0.0	0.0	0.0				
2019	4			0.0	0.0	0.0	0.0	0.0	0.0				
2020	5	20.63	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47
2021	6	20.87	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47
2022	7	21.11	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47
2023	8	21.34	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47
2024	9	21.58	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47
2025	10	21.82	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	11.47
2026	11	22.06	25.24									3.81	11.47
2027	12	22.29	25.24									3.81	11.47
2028	13	22.53	25.24									3.81	11.47
2029	14	22.77	25.24									3.81	11.47
2030	15	23.01	25.24									3.81	11.47
2031	16	23.24	25.24									3.81	11.47
2032	17	23.48	25.24									3.81	11.47
2033	18	23.72	25.24									3.81	11.47
2034	19	23.96	25.24			0.0	0.0	<:Refurbishment funding				3.81	11.47
2035	20	24.19	25.24									3.81	11.47
2036	21	24.43	25.24									3.81	11.47
2037	22	24.67	25.24									3.81	11.47
2038	23	24.91	25.24									3.81	11.47
2039	24	25.14	25.24									3.81	11.47
2040	25	25.38	25.24									3.81	11.47
2041	26	25.62	25.24									3.81	11.47
2042	27	25.86	25.24									3.81	11.47
2043	28	26.09	25.24									3.81	11.47
2044	29	26.33	25.24									3.81	11.47
2045	30	26.57	25.24									3.81	11.47
2046	31	26.81	25.24									3.81	11.47
2047	32	27.05	25.24									3.81	11.47
2048	33	27.28	25.24									3.81	11.47
2049	34	27.52	25.24	0.0	0.0	0.0	0.0	<:Refurbishment funding				3.81	11.47
2050	35	27.76	25.24									3.81	11.47

YEAR	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015											0	0	0	0.00
2016											0	0	0	0.00
2017											0	0	0	0.00
2018											0	0	0	0.00
2019											0	0	0	0.00
2020	1.00	2.91	3.43	2.87	6.70	5.16	45.87	45.87	45.87	45.87	34	34	34	33.55
2021	1.00	2.91	3.43	2.87	6.70	5.22	46.11	46.11	46.11	46.11	34	34	34	33.61
2022	1.00	2.91	3.43	2.87	6.70	5.28	46.34	46.34	46.34	46.34	34	34	34	33.67
2023	1.00	2.91	3.43	2.87	6.70	5.34	46.58	46.58	46.58	46.58	34	34	34	33.72
2024	1.00	2.91	3.43	2.87	6.70	5.40	46.82	46.82	46.82	46.82	34	34	34	33.78
2025	1.00	2.91	3.43	2.87	6.70	5.45	47.06	47.06	47.06	47.06	34	34	34	33.84
2026	1.00	2.91	3.43	2.87	6.70	5.51	47.29	47.29	47.29	47.29	34	34	34	33.90
2027	1.00	2.91	3.43	2.87	6.70	5.57	47.53	47.53	47.53	47.53	34	34	34	33.96
2028	1.00	2.91	3.43	2.87	6.70	5.63	47.77	47.77	47.77	47.77	34	34	34	34.02
2029	1.00	2.91	3.43	2.87	6.70	5.69	48.01	48.01	48.01	48.01	34	34	34	34.08
2030	1.00	2.91	3.43	2.87	6.70	5.75	48.24	48.24	48.24	48.24	34	34	34	34.14
2031	1.00	2.91	3.43	2.87	6.70	5.81	48.48	48.48	48.48	48.48	34	34	34	34.20
2032	1.00	2.91	3.43	2.87	6.70	5.87	48.72	48.72	48.72	48.72	34	34	34	34.26
2033	1.00	2.91	3.43	2.87	6.70	5.93	48.96	48.96	48.96	48.96	34	34	34	34.32
2034	1.00	2.91	3.43	2.87	6.70	5.99	49.19	49.19	49.19	49.19	34	34	34	34.38
2035	1.00	2.91	3.43	2.87	6.70	6.05	49.43	49.43	49.43	49.43	34	34	34	34.44
2036	1.00	2.91	3.43	2.87	6.70	6.11	49.67	49.67	49.67	49.67	34	34	34	34.50
2037	1.00	2.91	3.43	2.87	6.70	6.17	49.91	49.91	49.91	49.91	35	35	35	34.56
2038	1.00	2.91	3.43	2.87	6.70	6.23	50.15	50.15	50.15	50.15	35	35	35	34.62
2039	1.00	2.91	3.43	2.87	6.70	6.29	50.38	50.38	50.38	50.38	35	35	35	34.67
2040	1.00	2.91	3.43	2.87	6.70	6.35	50.62	50.62	50.62	50.62	35	35	35	34.73
2041	1.00	2.91	3.43	2.87	6.70	6.40	50.86	50.86	50.86	50.86	35	35	35	34.79
2042	1.00	2.91	3.43	2.87	6.70	6.46	51.10	51.10	51.10	51.10	35	35	35	34.85
2043	1.00	2.91	3.43	2.87	6.70	6.52	51.33	51.33	51.33	51.33	35	35	35	34.91
2044	1.00	2.91	3.43	2.87	6.70	6.58	51.57	51.57	51.57	51.57	35	35	35	34.97
2045	1.00	2.91	3.43	2.87	6.70	6.64	51.81	51.81	51.81	51.81	35	35	35	35.03
2046	1.00	2.91	3.43	2.87	6.70	6.70	52.05	52.05	52.05	52.05	35	35	35	35.09
2047	1.00	2.91	3.43	2.87	6.70	6.76	52.28	52.28	52.28	52.28	35	35	35	35.15
2048	1.00	2.91	3.43	2.87	6.70	6.82	52.52	52.52	52.52	52.52	35	35	35	35.21
2049	1.00	2.91	3.43	2.87	6.70	6.88	52.76	52.76	52.76	52.76	35	35	35	35.27
2050	1.00	2.91	3.43	2.87	6.70	6.94	53.00	53.00	53.00	53.00	35	35	35	35.33

URV OF WATER SUPPLIED

6%	8%	10%	2%
0.53	0.48	0.44	0.63

NPV WATER SUPPLIED

6%	8%	10%	2%
674	546	453	1125

NPV COSTS

6%	8%	10%	2%
356	263	200	714

URV: IRRIGATION SCHEME COMPONENTS ONLY

100% Capital Redemption | **50% power cross-subsidized**

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	285.2	242.4					42.8				
Increment for HEP	187.2	159.1					28.1			4.2	
Associated Dam Works	51.7					12.9	12.9	25.9			
Small HEP											
Pipelines											
Primary & Secondary											
Tertiary											
Reservoirs											
Primary & Secondary											
Tertiary											
Pumping Stations											
Primary & Secondary											
Tertiary											
Power supplies											
Primary & Secondary											
Tertiary											
Treatment Works											
Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	94.5					94.5					
Other Items and Mitigations	259.1				259.1						
Power lines	16.3								16.3		
Engineering & EMP	197.3				197.3						
SUB-TOTAL	***1841.6***	*401.6*	*519.2*	*62.7*	*456.4*	*183.4*	*143.7*	*45.8*	*28.8*	*6.7*	-
Lalini Dam											
Associated Dam Works											
Conduit/Tunnel											
HEPs											
Small											
Main											
Roads											
Other Items & Mitigations											
Engineering & EMP											
SUB-TOTAL	***0.0***	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-
GRAND TOTAL	**1841.6**	**401.6**	**519.2**	**62.7**	**456.4**	**183.4**	**143.7**	**45.8**	**28.8**	**6.7**	**-**

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0%= grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Year	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**456.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**456**
2015	0.0								22.8						0.0	0.0	**23**
2016	0.0	0.0	0.0		0.0				68.5						0.0	0.0	**68**
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0		68.5	0.0	0.0	0.0	0.0		0.0	0.0	**68**
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**68**
2019	0.0	0.0		0.0		0.0	0.0	0.0	68.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**68**
2020	0.0	0.0		0.0		0.0	0.0	0.0	68.5	0.0			0.0	0.0	0.0	0.0	**68**
2021	0.0	0.0				0.0	0.0	0.0	45.6	0.0				0.0	0.0	0.0	**46**
2022									45.6	0.0					0.0	0.0	**46**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check:>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	456.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	456

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS RATE	ITEM	COST/A
0.25%	Dam	1.00
0.50%	Pipelines, Reservoirs	2.91
0.50%	Treatment Works, Civil Works, Buildings	3.43
2.00%	M & E	2.87
	Total	10.21

TREATMENT COSTS		
Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment
2015	0			0.0	0.0	0.0	0.0	0.0	0.0										
2016	1			0.0	0.0	0.0	0.0	0.0	0.0										
2017	2			0.0	0.0	0.0	0.0	0.0	0.0										
2018	3			0.0	0.0	0.0	0.0	0.0	0.0										
2019	4			0.0	0.0	0.0	0.0	0.0	0.0										
2020	5	20.63	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.16
2021	6	20.87	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.22
2022	7	21.11	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.28
2023	8	21.34	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.34
2024	9	21.58	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.40
2025	10	21.82	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.45
2026	11	22.06	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.51
2027	12	22.29	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.57
2028	13	22.53	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.63
2029	14	22.77	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.69
2030	15	23.01	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.75
2031	16	23.24	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.81
2032	17	23.48	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.87
2033	18	23.72	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.93
2034	19	23.96	25.24			0.0	0.0	<:Refurbishment funding				3.81	5.74	1.00	2.91	3.43	2.87	6.70	5.99
2035	20	24.19	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.05
2036	21	24.43	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.11
2037	22	24.67	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.17
2038	23	24.91	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.23
2039	24	25.14	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.29
2040	25	25.38	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.35
2041	26	25.62	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.40
2042	27	25.86	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.46
2043	28	26.09	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.52
2044	29	26.33	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.58
2045	30	26.57	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.64
2046	31	26.81	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.70
2047	32	27.05	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.76
2048	33	27.28	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.82
2049	34	27.52	25.24	0.0	0.0	0.0	0.0	<:Refurbishment funding				3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.88
2050	35	27.76	25.24									3.81	5.74	1.00	2.91	3.43	2.87	6.70	6.94

URV OF WATER SUPPLIED 6%	8%	10%	2%
0.44	0.40	0.37	0.53

YEAR	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015					0	0	0	0.00
2016					0	0	0	0.00
2017					0	0	0	0.00
2018					0	0	0	0.00
2019					0	0	0	0.00
2020	45.87	45.87	45.87	45.87	28	28	28	27.81
2021	46.11	46.11	46.11	46.11	28	28	28	27.87
2022	46.34	46.34	46.34	46.34	28	28	28	27.93
2023	46.58	46.58	46.58	46.58	28	28	28	27.99
2024	46.82	46.82	46.82	46.82	28	28	28	28.05
2025	47.06	47.06	47.06	47.06	28	28	28	28.11
2026	47.29	47.29	47.29	47.29	28	28	28	28.17
2027	47.53	47.53	47.53	47.53	28	28	28	28.23
2028	47.77	47.77	47.77	47.77	28	28	28	28.28
2029	48.01	48.01	48.01	48.01	28	28	28	28.34
2030	48.24	48.24	48.24	48.24	28	28	28	28.40
2031	48.48	48.48	48.48	48.48	28	28	28	28.46
2032	48.72	48.72	48.72	48.72	29	29	29	28.52
2033	48.96	48.96	48.96	48.96	29	29	29	28.58
2034	49.19	49.19	49.19	49.19	29	29	29	28.64
2035	49.43	49.43	49.43	49.43	29	29	29	28.70
2036	49.67	49.67	49.67	49.67	29	29	29	28.76
2037	49.91	49.91	49.91	49.91	29	29	29	28.82
2038	50.15	50.15	50.15	50.15	29	29	29	28.88
2039	50.38	50.38	50.38	50.38	29	29	29	28.94
2040	50.62	50.62	50.62	50.62	29	29	29	29.00
2041	50.86	50.86	50.86	50.86	29	29	29	29.06
2042	51.10	51.10	51.10	51.10	29	29	29	29.12
2043	51.33	51.33	51.33	51.33	29	29	29	29.18
2044	51.57	51.57	51.57	51.57	29	29	29	29.23
2045	51.81	51.81	51.81	51.81	29	29	29	29.29
2046	52.05	52.05	52.05	52.05	29	29	29	29.35
2047	52.28	52.28	52.28	52.28	29	29	29	29.41
2048	52.52	52.52	52.52	52.52	29	29	29	29.47
2049	52.76	52.76	52.76	52.76	30	30	30	29.53
2050	53.00	53.00	53.00	53.00	30	30	30	29.59

NPV WATER SUPPLIED 6%	8%	10%	2%
674	546	453	1125

NPV COSTS 6%	8%	10%	2%
296	219	167	594

URV: IRRIGATION SCHEME COMPONENTS ONLY

100% Capital Redemption | **All power cross-subsidized**

ITEM	TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
	CAPITAL COST COMPONENTS (R'million)										
Ntabelanga Dam											
Water Supply Only	285.2	242.4					42.8				
Increment for HEP	187.2	159.1					28.1			4.2	
Associated Dam Works	51.7					12.9	12.9	25.9			
Small HEP											
Pipelines											
Primary & Secondary											
Tertiary											
Reservoirs											
Primary & Secondary											
Tertiary											
Pumping Stations											
Primary & Secondary											
Tertiary											
Power supplies											
Primary & Secondary											
Tertiary											
Treatment Works											
Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	94.5					94.5					
Other Items and Mitigations	259.1				259.1						
Power lines	16.3								16.3		
Engineering & EMP	197.3				197.3						
SUB-TOTAL	*1841.6*	*401.6*	*519.2*	*62.7*	*456.4*	*183.4*	*143.7*	*45.8*	*28.8*	*6.7*	-
Lalini Dam											
Associated Dam Works											
Conduit/Tunnel											
HEPs											
Small											
Main											
Roads											
Other Items & Mitigations											
Engineering & EMP											
SUB-TOTAL	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-
GRAND TOTAL	**1841.6**	**401.6**	**519.2**	**62.7**	**456.4**	**183.4**	**143.7**	**45.8**	**28.8**	**6.7**	-

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0%= grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Year	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**456.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**456**
2015	0.0								22.8						0.0	0.0	**23**
2016	0.0	0.0	0.0		0.0				68.5						0.0	0.0	**68**
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0		68.5	0.0	0.0	0.0	0.0		0.0	0.0	**68**
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**68**
2019	0.0	0.0		0.0		0.0	0.0	0.0	68.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**68**
2020	0.0	0.0		0.0		0.0	0.0	0.0	68.5	0.0			0.0	0.0	0.0	0.0	**68**
2021	0.0	0.0				0.0	0.0	0.0	45.6	0.0				0.0	0.0	0.0	**46**
2022									45.6	0.0					0.0	0.0	**46**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	456.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	456

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS		
RATE	ITEM	COST/A
0.25%	Dam	1.00
0.50%	Pipelines, Reservoirs	2.91
0.50%	Treatment Works, Civil Works, Buildings	3.43
2.00%	M & E	2.87
	Total	10.21

TREATMENT COSTS		
Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge
2015	0			0.0	0.0	0.0	0.0	0.0	0.0				
2016	1			0.0	0.0	0.0	0.0	0.0	0.0				
2017	2			0.0	0.0	0.0	0.0	0.0	0.0				
2018	3			0.0	0.0	0.0	0.0	0.0	0.0				
2019	4			0.0	0.0	0.0	0.0	0.0	0.0				
2020	5	20.63	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	
2021	6	20.87	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	
2022	7	21.11	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	
2023	8	21.34	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	
2024	9	21.58	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	
2025	10	21.82	25.24	0.0	0.0	0.0	0.0	0.0	0.0			3.81	
2026	11	22.06	25.24									3.81	
2027	12	22.29	25.24									3.81	
2028	13	22.53	25.24									3.81	
2029	14	22.77	25.24									3.81	
2030	15	23.01	25.24									3.81	
2031	16	23.24	25.24									3.81	
2032	17	23.48	25.24									3.81	
2033	18	23.72	25.24									3.81	
2034	19	23.96	25.24			0.0	0.0	<:Refurbishment funding				3.81	
2035	20	24.19	25.24									3.81	
2036	21	24.43	25.24									3.81	
2037	22	24.67	25.24									3.81	
2038	23	24.91	25.24									3.81	
2039	24	25.14	25.24									3.81	
2040	25	25.38	25.24									3.81	
2041	26	25.62	25.24									3.81	
2042	27	25.86	25.24									3.81	
2043	28	26.09	25.24									3.81	
2044	29	26.33	25.24									3.81	
2045	30	26.57	25.24									3.81	
2046	31	26.81	25.24									3.81	
2047	32	27.05	25.24									3.81	
2048	33	27.28	25.24									3.81	
2049	34	27.52	25.24	0.0	0.0	0.0	0.0	<:Refurbishment funding				3.81	
2050	35	27.76	25.24									3.81	

YEAR	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015											0	0	0	0.00
2016											0	0	0	0.00
2017											0	0	0	0.00
2018											0	0	0	0.00
2019											0	0	0	0.00
2020	1.00	2.91	3.43	2.87	6.70	5.16	45.87	45.87	45.87	45.87	22	22	22	22.07
2021	1.00	2.91	3.43	2.87	6.70	5.22	46.11	46.11	46.11	46.11	22	22	22	22.13
2022	1.00	2.91	3.43	2.87	6.70	5.28	46.34	46.34	46.34	46.34	22	22	22	22.19
2023	1.00	2.91	3.43	2.87	6.70	5.34	46.58	46.58	46.58	46.58	22	22	22	22.25
2024	1.00	2.91	3.43	2.87	6.70	5.40	46.82	46.82	46.82	46.82	22	22	22	22.31
2025	1.00	2.91	3.43	2.87	6.70	5.45	47.06	47.06	47.06	47.06	22	22	22	22.37
2026	1.00	2.91	3.43	2.87	6.70	5.51	47.29	47.29	47.29	47.29	22	22	22	22.43
2027	1.00	2.91	3.43	2.87	6.70	5.57	47.53	47.53	47.53	47.53	22	22	22	22.49
2028	1.00	2.91	3.43	2.87	6.70	5.63	47.77	47.77	47.77	47.77	23	23	23	22.55
2029	1.00	2.91	3.43	2.87	6.70	5.69	48.01	48.01	48.01	48.01	23	23	23	22.61
2030	1.00	2.91	3.43	2.87	6.70	5.75	48.24	48.24	48.24	48.24	23	23	23	22.67
2031	1.00	2.91	3.43	2.87	6.70	5.81	48.48	48.48	48.48	48.48	23	23	23	22.73
2032	1.00	2.91	3.43	2.87	6.70	5.87	48.72	48.72	48.72	48.72	23	23	23	22.79
2033	1.00	2.91	3.43	2.87	6.70	5.93	48.96	48.96	48.96	48.96	23	23	23	22.84
2034	1.00	2.91	3.43	2.87	6.70	5.99	49.19	49.19	49.19	49.19	23	23	23	22.90
2035	1.00	2.91	3.43	2.87	6.70	6.05	49.43	49.43	49.43	49.43	23	23	23	22.96
2036	1.00	2.91	3.43	2.87	6.70	6.11	49.67	49.67	49.67	49.67	23	23	23	23.02
2037	1.00	2.91	3.43	2.87	6.70	6.17	49.91	49.91	49.91	49.91	23	23	23	23.08
2038	1.00	2.91	3.43	2.87	6.70	6.23	50.15	50.15	50.15	50.15	23	23	23	23.14
2039	1.00	2.91	3.43	2.87	6.70	6.29	50.38	50.38	50.38	50.38	23	23	23	23.20
2040	1.00	2.91	3.43	2.87	6.70	6.35	50.62	50.62	50.62	50.62	23	23	23	23.26
2041	1.00	2.91	3.43	2.87	6.70	6.40	50.86	50.86	50.86	50.86	23	23	23	23.32
2042	1.00	2.91	3.43	2.87	6.70	6.46	51.10	51.10	51.10	51.10	23	23	23	23.38
2043	1.00	2.91	3.43	2.87	6.70	6.52	51.33	51.33	51.33	51.33	23	23	23	23.44
2044	1.00	2.91	3.43	2.87	6.70	6.58	51.57	51.57	51.57	51.57	23	23	23	23.50
2045	1.00	2.91	3.43	2.87	6.70	6.64	51.81	51.81	51.81	51.81	24	24	24	23.56
2046	1.00	2.91	3.43	2.87	6.70	6.70	52.05	52.05	52.05	52.05	24	24	24	23.62
2047	1.00	2.91	3.43	2.87	6.70	6.76	52.28	52.28	52.28	52.28	24	24	24	23.68
2048	1.00	2.91	3.43	2.87	6.70	6.82	52.52	52.52	52.52	52.52	24	24	24	23.74
2049	1.00	2.91	3.43	2.87	6.70	6.88	52.76	52.76	52.76	52.76	24	24	24	23.80
2050	1.00	2.91	3.43	2.87	6.70	6.94	53.00	53.00	53.00	53.00	24	24	24	23.85

URV OF WATER SUPPLIED			
6%	8%	10%	2%
0.35	0.32	0.29	0.42

NPV WATER SUPPLIED			
6%	8%	10%	2%
674	546	453	1125

NPV COSTS			
6%	8%	10%	2%
236	175	133	475

APPENDIX I

MODELS USED TO CALCULATE THE URV OF CONJUNCTIVE SCHEME

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME INCL TERTIARIES

100% Capital Redemption | **All power cross-subsidized**

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	570.4	484.9					85.6				
Increment for HEP	374.4	318.3					56.2			4.2	29 064 021
Associated Dam Works	103.5					25.9	25.9	51.7			
Small HEP	100.3					15.0	85.3				
Pipelines											
Primary & Secondary	1060.6		901.5			53.0	106.1			4.1	
Tertiary	1474.9		1253.6			73.7	147.5				
Reservoirs											
Primary & Secondary	186.8			149.5		18.7	18.7				
Tertiary	135.7			108.6		13.6	13.6				
Pumping Stations											
Primary & Secondary	112.7						95.8	16.9			
Tertiary	8.4						7.2	1.3		11.6	
Power supplies											
Primary & Secondary	45.9								45.9		
Tertiary	6.6								6.6		
Treatment Works	716.6				75.2	359.9	281.5			12.3	
Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	189.0					189.0					
Other Items and Mitigations	518.2				518.2						
Power lines	32.6								32.6		
Engineering & EMP	766.4				766.4						
SUB-TOTAL	***7153.3***	*803.2*	*2674.3*	*320.7*	*1359.8*	*824.8*	*983.0*	*89.9*	*97.6*	*34.7*	*29 064 021*
Lalini Dam	754.5	641.3					113.2			6.8	173 374 226
Associated Dam Works	159.3					135.4	23.9				
Conduit/Tunnel	861.6		430.8			430.8					
HEPs											
Small	70.9						48.3	12.5	10.0		
Main	221.2					9.4	156.0	33.9	21.9		
Roads	555.5					555.5					
Other Items & Mitigations	50.0				50.0						
Engineering & EMP	320.8				320.8						
SUB-TOTAL	***2993.7***	*641.3*	*430.8*	*0.0*	*370.8*	*1131.1*	*341.4*	*46.4*	*32.0*	*6.8*	*173 374 226*
GRAND TOTAL	**10147.0**	**1444.4**	**3105.1**	**320.7**	**1730.6**	**1955.9**	**1324.4**	**136.3**	**129.6**	**41.5**	***202 438 247***

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0%= grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Year	**202.9**	**944.9**	**267.5**	**716.6**	**103.5**	**1360.2**	**1625.6**	**750.2**	**631.7**	**754.5**	**587.5**	**159.3**	**861.6**	**360.4**	**370.8**	**450.0**	**10147**
2015	29.0								31.6						18.5	45.0	**124**
2016	29.0	94.5	127.1		49.1				94.8						55.6	45.0	**495**
2017	29.0	200.8	127.1	143.3	49.1	272.0	325.1		94.8	75.4	411.3	75.7	172.3		55.6	45.0	**2077**
2018	29.0	200.8	13.4	250.8	5.2	544.1	650.2	150.0	94.8	160.3	146.9	75.7	560.0	72.1	55.6	45.0	**3054**
2019	29.0	200.8		250.8		408.0	487.7	300.1	94.8	160.3	29.4	8.0	86.2	180.2	55.6	45.0	**2336**
2020	29.0	200.8		71.7		68.0	81.3	262.6	94.8	160.3			43.1	72.1	55.6	45.0	**1184**
2021	29.0	47.2				68.0	81.3	37.5	63.2	160.3				36.0	37.1	45.0	**605**
2022									63.2	37.7					37.1	45.0	**183**
2023																45.0	**45**
2024																45.0	**45**
2025																	
Check:>	202.9	944.9	267.5	716.6	103.5	1360.2	1625.6	750.2	631.7	754.5	587.5	159.3	861.6	360.4	370.8	450.0	10147

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS RATE	ITEM	COST/A
0.25%	Dam	3.61
0.50%	Pipelines, Reservoirs	17.13
0.50%	Treatment Works, Civil Works, Buildings	19.11
2.00%	M & E	26.49
	Total	66.34

TREATMENT COSTS		
Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m^3/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge
2015	0			0.0	0.0	0.0	0.0	29.0	63.5				
2016	1			270.7	0.0	0.0	0.0	29.0	100.6				
2017	2			939.4	769.5	0.0	143.3	29.0	100.6				
2018	3			602.2	1904.4	72.1	250.8	29.0	100.6				
2019	4			398.5	1281.9	180.2	250.8	29.0	100.6				
2020	5	20.63	25.24	361.1	454.9	72.1	71.7	29.0	100.6			8.33	49.46
2021	6	20.87	25.24	207.6	186.8	36.0	0.0	29.0	82.1	202 438 247	155.74	8.40	49.87
2022	7	21.11	25.24	37.7	0.0	0.0	0.0	0.0	82.1	202 438 247	155.74	8.47	50.28
2023	8	21.34	25.24	0.0	0.0	0.0	0.0	0.0	45.0	202 438 247	155.74	8.54	50.69
2024	9	21.58	25.24	0.0	0.0	0.0	0.0	0.0	45.0	202 438 247	155.74	8.61	51.10
2025	10	21.82	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74	8.68	51.51
2026	11	22.06	25.24							202 438 247	155.74	8.75	51.92
2027	12	22.29	25.24							202 438 247	155.74	8.82	52.34
2028	13	22.53	25.24							202 438 247	155.74	8.89	52.75
2029	14	22.77	25.24							202 438 247	155.74	8.96	53.16
2030	15	23.01	25.24							202 438 247	155.74	9.03	53.57
2031	16	23.24	25.24							202 438 247	155.74	9.10	53.98
2032	17	23.48	25.24							202 438 247	155.74	9.17	54.39
2033	18	23.72	25.24							202 438 247	155.74	9.24	54.81
2034	19	23.96	25.24			81.1	179.1	<:Refurbishment funding		202 438 247	155.74	9.31	55.22
2035	20	24.19	25.24							202 438 247	155.74	9.38	55.63
2036	21	24.43	25.24							202 438 247	155.74	9.44	56.04
2037	22	24.67	25.24							202 438 247	155.74	9.51	56.45
2038	23	24.91	25.24							202 438 247	155.74	9.58	56.86
2039	24	25.14	25.24							202 438 247	155.74	9.65	57.27
2040	25	25.38	25.24							202 438 247	155.74	9.72	57.69
2041	26	25.62	25.24							202 438 247	155.74	9.79	58.10
2042	27	25.86	25.24							202 438 247	155.74	9.86	58.51
2043	28	26.09	25.24							202 438 247	155.74	9.93	58.92
2044	29	26.33	25.24							202 438 247	155.74	10.00	59.33
2045	30	26.57	25.24							202 438 247	155.74	10.07	59.74
2046	31	26.81	25.24							202 438 247	155.74	10.14	60.15
2047	32	27.05	25.24							202 438 247	155.74	10.21	60.57
2048	33	27.28	25.24							202 438 247	155.74	10.28	60.98
2049	34	27.52	25.24	0.0	0.0	81.1	179.1	<:Refurbishment funding		202 438 247	155.74	10.35	61.39
2050	35	27.76	25.24							202 438 247	155.74	10.42	61.80

YEAR	YEAR NO.	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment	DISCOUNTED WATER SUPPLIED (million m^3) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015	0											93	93	93	92.53
2016	1											400	400	400	400.31
2017	2											1 982	1 982	1 982	1981.75
2018	3											2 959	2 959	2 959	2959.04
2019	4											2 241	2 241	2 241	2241.02
2020	5	3.61	17.13	19.11	26.49	41.50	5.16	45.87	45.87	45.87	45.87	1 252	1 252	1 252	1251.84
2021	6	3.61	17.13	19.11	26.49	41.50	5.22	46.11	46.11	46.11	46.11	549	549	549	548.66
2022	7	3.61	17.13	19.11	26.49	41.50	5.28	46.34	46.34	46.34	46.34	127	127	127	127.46
2023	8	3.61	17.13	19.11	26.49	41.50	5.34	46.58	46.58	46.58	46.58	53	53	53	53.13
2024	9	3.61	17.13	19.11	26.49	41.50	5.40	46.82	46.82	46.82	46.82	54	54	54	53.60
2025	10	3.61	17.13	19.11	26.49	41.50	5.45	47.06	47.06	47.06	47.06	9	9	9	9.08
2026	11	3.61	17.13	19.11	26.49	41.50	5.51	47.29	47.29	47.29	47.29	10	10	10	9.55
2027	12	3.61	17.13	19.11	26.49	41.50	5.57	47.53	47.53	47.53	47.53	10	10	10	10.02
2028	13	3.61	17.13	19.11	26.49	41.50	5.63	47.77	47.77	47.77	47.77	10	10	10	10.49
2029	14	3.61	17.13	19.11	26.49	41.50	5.69	48.01	48.01	48.01	48.01	11	11	11	10.96
2030	15	3.61	17.13	19.11	26.49	41.50	5.75	48.24	48.24	48.24	48.24	11	11	11	11.43
2031	16	3.61	17.13	19.11	26.49	41.50	5.81	48.48	48.48	48.48	48.48	12	12	12	11.90
2032	17	3.61	17.13	19.11	26.49	41.50	5.87	48.72	48.72	48.72	48.72	12	12	12	12.37
2033	18	3.61	17.13	19.11	26.49	41.50	5.93	48.96	48.96	48.96	48.96	13	13	13	12.84
2034	19	3.61	17.13	19.11	26.49	41.50	5.99	49.19	49.19	49.19	49.19	274	274	274	273.56
2035	20	3.61	17.13	19.11	26.49	41.50	6.05	49.43	49.43	49.43	49.43	14	14	14	13.78
2036	21	3.61	17.13	19.11	26.49	41.50	6.11	49.67	49.67	49.67	49.67	14	14	14	14.25
2037	22	3.61	17.13	19.11	26.49	41.50	6.17	49.91	49.91	49.91	49.91	15	15	15	14.73
2038	23	3.61	17.13	19.11	26.49	41.50	6.23	50.15	50.15	50.15	50.15	15	15	15	15.20
2039	24	3.61	17.13	19.11	26.49	41.50	6.29	50.38	50.38	50.38	50.38	16	16	16	15.67
2040	25	3.61	17.13	19.11	26.49	41.50	6.35	50.62	50.62	50.62	50.62	16	16	16	16.14
2041	26	3.61	17.13	19.11	26.49	41.50	6.40	50.86	50.86	50.86	50.86	17	17	17	16.61
2042	27	3.61	17.13	19.11	26.49	41.50	6.46	51.10	51.10	51.10	51.10	17	17	17	17.08
2043	28	3.61	17.13	19.11	26.49	41.50	6.52	51.33	51.33	51.33	51.33	18	18	18	17.55
2044	29	3.61	17.13	19.11	26.49	41.50	6.58	51.57	51.57	51.57	51.57	18	18	18	18.02
2045	30	3.61	17.13	19.11	26.49	41.50	6.64	51.81	51.81	51.81	51.81	18	18	18	18.49
2046	31	3.61	17.13	19.11	26.49	41.50	6.70	52.05	52.05	52.05	52.05	19	19	19	18.96
2047	32	3.61	17.13	19.11	26.49	41.50	6.76	52.28	52.28	52.28	52.28	19	19	19	19.43
2048	33	3.61	17.13	19.11	26.49	41.50	6.82	52.52	52.52	52.52	52.52	20	20	20	19.90
2049	34	3.61	17.13	19.11	26.49	41.50	6.88	52.76	52.76	52.76	52.76	281	281	281	280.62
2050	35	3.61	17.13	19.11	26.49	41.50	6.94	53.00	53.00	53.00	53.00	21	21	21	20.85

URV OF WATER SUPPLIED 6%	8%	10%	2%
11.47	12.95	14.33	8.39

NPV WATER SUPPLIED 6%	8%	10%	2%
674	546	453	1125

NPV COSTS 6%	8%	10%	2%
7 728	7 070	6 500	9 436

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME INCL TERTIARIES

Lalini Grant Funded | **All power cross-subsidized**

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
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Reservoirs											
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Tertiary	135.7			108.6		13.6	13.6				
Pumping Stations											
Primary & Secondary	112.7						95.8	16.9			
Tertiary	8.4						7.2	1.3		11.6	
Power supplies											
Primary & Secondary	45.9								45.9		
Tertiary	6.6								6.6		
Treatment Works	716.6				75.2	359.9	281.5			12.3	
Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	189.0					189.0					
Other Items and Mitigations	518.2				518.2						
Power lines	32.6								32.6		
Engineering & EMP	766.4				766.4						
SUB-TOTAL	***7153.3***	*803.2*	*2674.3*	*320.7*	*1359.8*	*824.8*	*983.0*	*89.9*	*97.6*	*34.7*	*29 064 021*
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Associated Dam Works	159.3					135.4	23.9				
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Roads	555.5					555.5					
Other Items & Mitigations	50.0				50.0						
Engineering & EMP	320.8				320.8						
SUB-TOTAL	***2993.7***	*641.3*	*430.8*	*0.0*	*370.8*	*1131.1*	*341.4*	*46.4*	*32.0*	*6.8*	*173 374 226*
GRAND TOTAL	**10147.0**	**1444.4**	**3105.1**	**320.7**	**1730.6**	**1955.9**	**1324.4**	**136.3**	**129.6**	**41.5**	***202 438 247***

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0%= grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%	
Year	**202.9**	**944.9**	**267.5**	**716.6**	**103.5**	**1360.2**	**1625.6**	**750.2**	**1081.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**370.8**	**0.0**	**7424**
2015	29.0								54.1						18.5	0.0	**102**
2016	29.0	94.5	127.1		49.1				162.3						55.6	0.0	**518**
2017	29.0	200.8	127.1	143.3	49.1	272.0	325.1		162.3	0.0	0.0	0.0	0.0		55.6	0.0	**1364**
2018	29.0	200.8	13.4	250.8	5.2	544.1	650.2	150.0	162.3	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**2061**
2019	29.0	200.8		250.8		408.0	487.7	300.1	162.3	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**1894**
2020	29.0	200.8		71.7		68.0	81.3	262.6	162.3	0.0			0.0	0.0	55.6	0.0	**931**
2021	29.0	47.2				68.0	81.3	37.5	108.2	0.0				0.0	37.1	0.0	**408**
2022									108.2	0.0					37.1	0.0	**145**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check:>	202.9	944.9	267.5	716.6	103.5	1360.2	1625.6	750.2	1081.7	0.0	0.0	0.0	0.0	0.0	370.8	0.0	7424

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS

RATE	ITEM	COST/A
0.25%	Dam	3.61
0.50%	Pipelines, Reservoirs	17.13
0.50%	Treatment Works, Civil Works, Buildings	19.11
2.00%	M & E	26.49
	Total	**66.34**

TREATMENT COSTS

Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge
2015	0			0.0	0.0	0.0	0.0	29.0	18.5				
2016	1			270.7	0.0	0.0	0.0	29.0	55.6				
2017	2			377.0	597.1	0.0	143.3	29.0	55.6				
2018	3			219.3	1344.3	0.0	250.8	29.0	55.6				
2019	4			200.8	1195.8	0.0	250.8	29.0	55.6				
2020	5	20.63	25.24	200.8	411.8	0.0	71.7	29.0	55.6			8.33	49.46
2021	6	20.87	25.24	47.2	186.8	0.0	0.0	29.0	37.1	202 438 247	155.74	8.40	49.87
2022	7	21.11	25.24	0.0	0.0	0.0	0.0	0.0	37.1	202 438 247	155.74	8.47	50.28
2023	8	21.34	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74	8.54	50.69
2024	9	21.58	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74	8.61	51.10
2025	10	21.82	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74	8.68	51.51
2026	11	22.06	25.24							202 438 247	155.74	8.75	51.92
2027	12	22.29	25.24							202 438 247	155.74	8.82	52.34
2028	13	22.53	25.24							202 438 247	155.74	8.89	52.75
2029	14	22.77	25.24							202 438 247	155.74	8.96	53.16
2030	15	23.01	25.24							202 438 247	155.74	9.03	53.57
2031	16	23.24	25.24							202 438 247	155.74	9.10	53.98
2032	17	23.48	25.24							202 438 247	155.74	9.17	54.39
2033	18	23.72	25.24							202 438 247	155.74	9.24	54.81
2034	19	23.96	25.24			0.0	179.1	<:Refurbishment funding		202 438 247	155.74	9.31	55.22
2035	20	24.19	25.24							202 438 247	155.74	9.38	55.63
2036	21	24.43	25.24							202 438 247	155.74	9.44	56.04
2037	22	24.67	25.24							202 438 247	155.74	9.51	56.45
2038	23	24.91	25.24							202 438 247	155.74	9.58	56.86
2039	24	25.14	25.24							202 438 247	155.74	9.65	57.27
2040	25	25.38	25.24							202 438 247	155.74	9.72	57.69
2041	26	25.62	25.24							202 438 247	155.74	9.79	58.10
2042	27	25.86	25.24							202 438 247	155.74	9.86	58.51
2043	28	26.09	25.24							202 438 247	155.74	9.93	58.92
2044	29	26.33	25.24							202 438 247	155.74	10.00	59.33
2045	30	26.57	25.24							202 438 247	155.74	10.07	59.74
2046	31	26.81	25.24							202 438 247	155.74	10.14	60.15
2047	32	27.05	25.24							202 438 247	155.74	10.21	60.57
2048	33	27.28	25.24							202 438 247	155.74	10.28	60.98
2049	34	27.52	25.24	0.0	0.0	0.0	179.1	<:Refurbishment funding		202 438 247	155.74	10.35	61.39
2050	35	27.76	25.24							202 438 247	155.74	10.42	61.80

YEAR	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015											48	48	48	47.53
2016											355	355	355	355.31
2017											1 202	1 202	1 202	1202.07
2018											1 899	1 899	1 899	1899.06
2019											1 732	1 732	1 732	1731.97
2020	3.61	17.13	19.11	26.49	41.50	5.16	45.87	45.87	45.87	45.87	931	931	931	931.35
2021	3.61	17.13	19.11	26.49	41.50	5.22	46.11	46.11	46.11	46.11	307	307	307	307.30
2022	3.61	17.13	19.11	26.49	41.50	5.28	46.34	46.34	46.34	46.34	45	45	45	44.74
2023	3.61	17.13	19.11	26.49	41.50	5.34	46.58	46.58	46.58	46.58	8	8	8	8.13
2024	3.61	17.13	19.11	26.49	41.50	5.40	46.82	46.82	46.82	46.82	9	9	9	8.60
2025	3.61	17.13	19.11	26.49	41.50	5.45	47.06	47.06	47.06	47.06	9	9	9	9.08
2026	3.61	17.13	19.11	26.49	41.50	5.51	47.29	47.29	47.29	47.29	10	10	10	9.55
2027	3.61	17.13	19.11	26.49	41.50	5.57	47.53	47.53	47.53	47.53	10	10	10	10.02
2028	3.61	17.13	19.11	26.49	41.50	5.63	47.77	47.77	47.77	47.77	10	10	10	10.49
2029	3.61	17.13	19.11	26.49	41.50	5.69	48.01	48.01	48.01	48.01	11	11	11	10.96
2030	3.61	17.13	19.11	26.49	41.50	5.75	48.24	48.24	48.24	48.24	11	11	11	11.43
2031	3.61	17.13	19.11	26.49	41.50	5.81	48.48	48.48	48.48	48.48	12	12	12	11.90
2032	3.61	17.13	19.11	26.49	41.50	5.87	48.72	48.72	48.72	48.72	12	12	12	12.37
2033	3.61	17.13	19.11	26.49	41.50	5.93	48.96	48.96	48.96	48.96	13	13	13	12.84
2034	3.61	17.13	19.11	26.49	41.50	5.99	49.19	49.19	49.19	49.19	192	192	192	192.45
2035	3.61	17.13	19.11	26.49	41.50	6.05	49.43	49.43	49.43	49.43	14	14	14	13.78
2036	3.61	17.13	19.11	26.49	41.50	6.11	49.67	49.67	49.67	49.67	14	14	14	14.25
2037	3.61	17.13	19.11	26.49	41.50	6.17	49.91	49.91	49.91	49.91	15	15	15	14.73
2038	3.61	17.13	19.11	26.49	41.50	6.23	50.15	50.15	50.15	50.15	15	15	15	15.20
2039	3.61	17.13	19.11	26.49	41.50	6.29	50.38	50.38	50.38	50.38	16	16	16	15.67
2040	3.61	17.13	19.11	26.49	41.50	6.35	50.62	50.62	50.62	50.62	16	16	16	16.14
2041	3.61	17.13	19.11	26.49	41.50	6.40	50.86	50.86	50.86	50.86	17	17	17	16.61
2042	3.61	17.13	19.11	26.49	41.50	6.46	51.10	51.10	51.10	51.10	17	17	17	17.08
2043	3.61	17.13	19.11	26.49	41.50	6.52	51.33	51.33	51.33	51.33	18	18	18	17.55
2044	3.61	17.13	19.11	26.49	41.50	6.58	51.57	51.57	51.57	51.57	18	18	18	18.02
2045	3.61	17.13	19.11	26.49	41.50	6.64	51.81	51.81	51.81	51.81	18	18	18	18.49
2046	3.61	17.13	19.11	26.49	41.50	6.70	52.05	52.05	52.05	52.05	19	19	19	18.96
2047	3.61	17.13	19.11	26.49	41.50	6.76	52.28	52.28	52.28	52.28	19	19	19	19.43
2048	3.61	17.13	19.11	26.49	41.50	6.82	52.52	52.52	52.52	52.52	20	20	20	19.90
2049	3.61	17.13	19.11	26.49	41.50	6.88	52.76	52.76	52.76	52.76	200	200	200	199.52
2050	3.61	17.13	19.11	26.49	41.50	6.94	53.00	53.00	53.00	53.00	21	21	21	20.85

URV OF WATER SUPPLIED 6%	8%	10%	2%
7.78	8.78	9.71	5.72

NPV WATER SUPPLIED 6%	8%	10%	2%
674	546	453	1125

NPV COSTS 6%	8%	10%	2%
5 244	4 792	4 401	6 439

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME INCL TERTIARIES

Lalini & Tertiaries Grant Funded | **All power cross-subsidized**

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	570.4	484.9					85.6				
Increment for HEP	374.4	318.3					56.2			4.2	29 064 021
Associated Dam Works	103.5					25.9	25.9	51.7			
Small HEP	100.3					15.0	85.3				
Pipelines											
Primary & Secondary	1060.6		901.5			53.0	106.1			4.1	
Tertiary	1474.9		1253.6			73.7	147.5				
Reservoirs											
Primary & Secondary	186.8			149.5		18.7	18.7				
Tertiary	135.7			108.6		13.6	13.6				
Pumping Stations											
Primary & Secondary	112.7						95.8	16.9			
Tertiary	8.4						7.2	1.3		11.6	
Power supplies											
Primary & Secondary	45.9								45.9		
Tertiary	6.6								6.6		
Treatment Works	716.6				75.2	359.9	281.5			12.3	
Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	189.0					189.0					
Other Items and Mitigations	518.2				518.2						
Power lines	32.6								32.6		
Engineering & EMP	766.4				766.4						
SUB-TOTAL	*7153.3*	*803.2*	*2674.3*	*320.7*	*1359.8*	*824.8*	*983.0*	*89.9*	*97.6*	*34.7*	*29 064 021*
Lalini Dam	754.5	641.3					113.2			6.8	173 374 226
Associated Dam Works	159.3					135.4	23.9				
Conduit/Tunnel	861.6		430.8			430.8					
HEPs											
Small	70.9						48.3	12.5	10.0		
Main	221.2					9.4	156.0	33.9	21.9		
Roads	555.5					555.5					
Other Items & Mitigations	50.0				50.0						
Engineering & EMP	320.8				320.8						
SUB-TOTAL	*2993.7*	*641.3*	*430.8*	*0.0*	*370.8*	*1131.1*	*341.4*	*46.4*	*32.0*	*6.8*	*173 374 226*
GRAND TOTAL	**10147.0**	**1444.4**	**3105.1**	**320.7**	**1730.6**	**1955.9**	**1324.4**	**136.3**	**129.6**	**41.5**	***202 438 247***

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0%= grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	80%	100%	100%	100%	100%	100%	0%	100%	80%	0%	0%	0%	0%	0%	0%	0%	
Year	**162.4**	**944.9**	**267.5**	**716.6**	**103.5**	**1360.2**	**0.0**	**750.2**	**1122.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**370.8**	**0.0**	**5798**
2015	23.2								56.1						18.5	0.0	**98**
2016	23.2	94.5	127.1		49.1				168.3						55.6	0.0	**518**
2017	23.2	200.8	127.1	143.3	49.1	272.0	0.0		168.3	0.0	0.0	0.0	0.0		55.6	0.0	**1040**
2018	23.2	200.8	13.4	250.8	5.2	544.1	0.0	150.0	168.3	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**1411**
2019	23.2	200.8		250.8		408.0	0.0	300.1	168.3	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**1407**
2020	23.2	200.8		71.7		68.0	0.0	262.6	168.3	0.0			0.0	0.0	55.6	0.0	**850**
2021	23.2	47.2				68.0	0.0	37.5	112.2	0.0				0.0	37.1	0.0	**325**
2022									112.2	0.0					37.1	0.0	**149**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check:>	162.4	944.9	267.5	716.6	103.5	1360.2	0.0	750.2	1122.3	0.0	0.0	0.0	0.0	0.0	370.8	0.0	5798

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS RATE	ITEM	COST/A
0.25%	Dam	3.61
0.50%	Pipelines, Reservoirs	17.13
0.50%	Treatment Works, Civil Works, Buildings	19.11
2.00%	M & E	26.49
	Total	**66.34**

TREATMENT COSTS		
Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge
2015	0			0.0	0.0	0.0	0.0	23.2	18.5				
2016	1			270.7	0.0	0.0	0.0	23.2	55.6				
2017	2			377.0	272.0	0.0	143.3	23.2	55.6				
2018	3			219.3	694.1	0.0	250.8	23.2	55.6				
2019	4			200.8	708.1	0.0	250.8	23.2	55.6				
2020	5	20.63	25.24	200.8	330.6	0.0	71.7	23.2	55.6			8.33	49.46
2021	6	20.87	25.24	47.2	105.5	0.0	0.0	23.2	37.1	202 438 247	155.74	8.40	49.87
2022	7	21.11	25.24	0.0	0.0	0.0	0.0	0.0	37.1	202 438 247	155.74	8.47	50.28
2023	8	21.34	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74	8.54	50.69
2024	9	21.58	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74	8.61	51.10
2025	10	21.82	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74	8.68	51.51
2026	11	22.06	25.24							202 438 247	155.74	8.75	51.92
2027	12	22.29	25.24							202 438 247	155.74	8.82	52.34
2028	13	22.53	25.24							202 438 247	155.74	8.89	52.75
2029	14	22.77	25.24							202 438 247	155.74	8.96	53.16
2030	15	23.01	25.24							202 438 247	155.74	9.03	53.57
2031	16	23.24	25.24							202 438 247	155.74	9.10	53.98
2032	17	23.48	25.24							202 438 247	155.74	9.17	54.39
2033	18	23.72	25.24							202 438 247	155.74	9.24	54.81
2034	19	23.96	25.24			0.0	179.1	<:Refurbishment funding		202 438 247	155.74	9.31	55.22
2035	20	24.19	25.24							202 438 247	155.74	9.38	55.63
2036	21	24.43	25.24							202 438 247	155.74	9.44	56.04
2037	22	24.67	25.24							202 438 247	155.74	9.51	56.45
2038	23	24.91	25.24							202 438 247	155.74	9.58	56.86
2039	24	25.14	25.24							202 438 247	155.74	9.65	57.27
2040	25	25.38	25.24							202 438 247	155.74	9.72	57.69
2041	26	25.62	25.24							202 438 247	155.74	9.79	58.10
2042	27	25.86	25.24							202 438 247	155.74	9.86	58.51
2043	28	26.09	25.24							202 438 247	155.74	9.93	58.92
2044	29	26.33	25.24							202 438 247	155.74	10.00	59.33
2045	30	26.57	25.24							202 438 247	155.74	10.07	59.74
2046	31	26.81	25.24							202 438 247	155.74	10.14	60.15
2047	32	27.05	25.24							202 438 247	155.74	10.21	60.57
2048	33	27.28	25.24							202 438 247	155.74	10.28	60.98
2049	34	27.52	25.24	0.0	0.0	0.0	179.1	<:Refurbishment funding		202 438 247	155.74	10.35	61.39
2050	35	27.76	25.24							202 438 247	155.74	10.42	61.80

YEAR	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015											42	42	42	41.73
2016											350	350	350	349.51
2017											871	871	871	871.16
2018											1 243	1 243	1 243	1243.04
2019											1 239	1 239	1 239	1238.50
2020	3.61	17.13	19.11	26.49	41.50	5.16	45.87	45.87	45.87	45.87	844	844	844	844.27
2021	3.61	17.13	19.11	26.49	41.50	5.22	46.11	46.11	46.11	46.11	220	220	220	220.22
2022	3.61	17.13	19.11	26.49	41.50	5.28	46.34	46.34	46.34	46.34	45	45	45	44.74
2023	3.61	17.13	19.11	26.49	41.50	5.34	46.58	46.58	46.58	46.58	8	8	8	8.13
2024	3.61	17.13	19.11	26.49	41.50	5.40	46.82	46.82	46.82	46.82	9	9	9	8.60
2025	3.61	17.13	19.11	26.49	41.50	5.45	47.06	47.06	47.06	47.06	9	9	9	9.08
2026	3.61	17.13	19.11	26.49	41.50	5.51	47.29	47.29	47.29	47.29	10	10	10	9.55
2027	3.61	17.13	19.11	26.49	41.50	5.57	47.53	47.53	47.53	47.53	10	10	10	10.02
2028	3.61	17.13	19.11	26.49	41.50	5.63	47.77	47.77	47.77	47.77	10	10	10	10.49
2029	3.61	17.13	19.11	26.49	41.50	5.69	48.01	48.01	48.01	48.01	11	11	11	10.96
2030	3.61	17.13	19.11	26.49	41.50	5.75	48.24	48.24	48.24	48.24	11	11	11	11.43
2031	3.61	17.13	19.11	26.49	41.50	5.81	48.48	48.48	48.48	48.48	12	12	12	11.90
2032	3.61	17.13	19.11	26.49	41.50	5.87	48.72	48.72	48.72	48.72	12	12	12	12.37
2033	3.61	17.13	19.11	26.49	41.50	5.93	48.96	48.96	48.96	48.96	13	13	13	12.84
2034	3.61	17.13	19.11	26.49	41.50	5.99	49.19	49.19	49.19	49.19	192	192	192	192.45
2035	3.61	17.13	19.11	26.49	41.50	6.05	49.43	49.43	49.43	49.43	14	14	14	13.78
2036	3.61	17.13	19.11	26.49	41.50	6.11	49.67	49.67	49.67	49.67	14	14	14	14.25
2037	3.61	17.13	19.11	26.49	41.50	6.17	49.91	49.91	49.91	49.91	15	15	15	14.73
2038	3.61	17.13	19.11	26.49	41.50	6.23	50.15	50.15	50.15	50.15	15	15	15	15.20
2039	3.61	17.13	19.11	26.49	41.50	6.29	50.38	50.38	50.38	50.38	16	16	16	15.67
2040	3.61	17.13	19.11	26.49	41.50	6.35	50.62	50.62	50.62	50.62	16	16	16	16.14
2041	3.61	17.13	19.11	26.49	41.50	6.40	50.86	50.86	50.86	50.86	17	17	17	16.61
2042	3.61	17.13	19.11	26.49	41.50	6.46	51.10	51.10	51.10	51.10	17	17	17	17.08
2043	3.61	17.13	19.11	26.49	41.50	6.52	51.33	51.33	51.33	51.33	18	18	18	17.55
2044	3.61	17.13	19.11	26.49	41.50	6.58	51.57	51.57	51.57	51.57	18	18	18	18.02
2045	3.61	17.13	19.11	26.49	41.50	6.64	51.81	51.81	51.81	51.81	18	18	18	18.49
2046	3.61	17.13	19.11	26.49	41.50	6.70	52.05	52.05	52.05	52.05	19	19	19	18.96
2047	3.61	17.13	19.11	26.49	41.50	6.76	52.28	52.28	52.28	52.28	19	19	19	19.43
2048	3.61	17.13	19.11	26.49	41.50	6.82	52.52	52.52	52.52	52.52	20	20	20	19.90
2049	3.61	17.13	19.11	26.49	41.50	6.88	52.76	52.76	52.76	52.76	200	200	200	199.52
2050	3.61	17.13	19.11	26.49	41.50	6.94	53.00	53.00	53.00	53.00	21	21	21	20.85

URV OF WATER SUPPLIED 6%	8%	10%	2%
5.86	6.59	7.26	4.36

NPV WATER SUPPLIED 6%	8%	10%	2%
674	546	453	1125

NPV COSTS 6%	8%	10%	2%
3 948	3 595	3 294	4 910

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME INCL TERTIARIES | Lalini, Tertiary & Irrigation Grant | All power cross-subsidized

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	570.4	484.9					85.6				
Increment for HEP	374.4	318.3					56.2			4.2	29 064 021
Associated Dam Works	103.5					25.9	25.9	51.7			
Small HEP	100.3					15.0	85.3				
Pipelines											
Primary & Secondary	1060.6		901.5			53.0	106.1			4.1	
Tertiary	1474.9		1253.6			73.7	147.5				
Reservoirs											
Primary & Secondary	186.8			149.5		18.7	18.7				
Tertiary	135.7			108.6		13.6	13.6				
Pumping Stations											
Primary & Secondary	112.7						95.8	16.9			
Tertiary	8.4						7.2	1.3		11.6	
Power supplies											
Primary & Secondary	45.9								45.9		
Tertiary	6.6								6.6		
Treatment Works	716.6				75.2	359.9	281.5			12.3	
Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	189.0					189.0					
Other Items and Mitigations	518.2				518.2						
Power lines	32.6								32.6		
Engineering & EMP	766.4				766.4						
SUB-TOTAL	*7153.3*	*803.2*	*2674.3*	*320.7*	*1359.8*	*824.8*	*983.0*	*89.9*	*97.6*	*34.7*	*29 064 021*
Lalini Dam	754.5	641.3					113.2			6.8	173 374 226
Associated Dam Works	159.3					135.4	23.9				
Conduit/Tunnel	861.6		430.8			430.8					
HEPs											
Small	70.9						48.3	12.5	10.0		
Main	221.2					9.4	156.0	33.9	21.9		
Roads	555.5					555.5					
Other Items & Mitigations	50.0				50.0						
Engineering & EMP	320.8				320.8						
SUB-TOTAL	*2993.7*	*641.3*	*430.8*	*0.0*	*370.8*	*1131.1*	*341.4*	*46.4*	*32.0*	*6.8*	*173 374 226*
GRAND TOTAL	**10147.0**	**1444.4**	**3105.1**	**320.7**	**1730.6**	**1955.9**	**1324.4**	**136.3**	**129.6**	**41.5**	***202 438 247***

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0% = grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
% redemption	70%	100%	100%	100%	100%	100%	0%	0%	70%	0%	0%	0%	0%	0%	0%	0%	
Year	**142.1**	**944.9**	**267.5**	**716.6**	**103.5**	**1360.2**	**0.0**	**0.0**	**1142.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**370.8**	**0.0**	**5048**
2015	20.3								57.1						18.5	0.0	**96**
2016	20.3	94.5	127.1		49.1				171.4						55.6	0.0	**518**
2017	20.3	200.8	127.1	143.3	49.1	272.0	0.0		171.4	0.0	0.0	0.0	0.0		55.6	0.0	**1040**
2018	20.3	200.8	13.4	250.8	5.2	544.1	0.0	0.0	171.4	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**1261**
2019	20.3	200.8		250.8		408.0	0.0	0.0	171.4	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**1107**
2020	20.3	200.8		71.7		68.0	0.0	0.0	171.4	0.0			0.0	0.0	55.6	0.0	**588**
2021	20.3	47.2				68.0	0.0	0.0	114.3	0.0				0.0	37.1	0.0	**287**
2022									114.3	0.0					37.1	0.0	**151**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check>	142.1	944.9	267.5	716.6	103.5	1360.2	0.0	0.0	1142.6	0.0	0.0	0.0	0.0	0.0	370.8	0.0	5048

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS RATE	ITEM	COST/A
0.25%	Dam	3.61
0.50%	Pipelines, Reservoirs	17.13
0.50%	Treatment Works, Civil Works, Buildings	19.11
2.00%	M & E	26.49
	Total	66.34

TREATMENT COSTS		
Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other
2015	0			0.0	0.0	0.0	0.0	20.3	18.5
2016	1			270.7	0.0	0.0	0.0	20.3	55.6
2017	2			377.0	272.0	0.0	143.3	20.3	55.6
2018	3			219.3	544.1	0.0	250.8	20.3	55.6
2019	4			200.8	408.0	0.0	250.8	20.3	55.6
2020	5	20.63	25.24	200.8	68.0	0.0	71.7	20.3	55.6
2021	6	20.87	25.24	47.2	68.0	0.0	0.0	20.3	37.1
2022	7	21.11	25.24	0.0	0.0	0.0	0.0	0.0	37.1
2023	8	21.34	25.24	0.0	0.0	0.0	0.0	0.0	0.0
2024	9	21.58	25.24	0.0	0.0	0.0	0.0	0.0	0.0
2025	10	21.82	25.24	0.0	0.0	0.0	0.0	0.0	0.0
2026	11	22.06	25.24						
2027	12	22.29	25.24						
2028	13	22.53	25.24						
2029	14	22.77	25.24						
2030	15	23.01	25.24						
2031	16	23.24	25.24						
2032	17	23.48	25.24						
2033	18	23.72	25.24						
2034	19	23.96	25.24			0.0	179.1	<:Refurbishment funding	
2035	20	24.19	25.24						
2036	21	24.43	25.24						
2037	22	24.67	25.24						
2038	23	24.91	25.24						
2039	24	25.14	25.24						
2040	25	25.38	25.24						
2041	26	25.62	25.24						
2042	27	25.86	25.24						
2043	28	26.09	25.24						
2044	29	26.33	25.24						
2045	30	26.57	25.24						
2046	31	26.81	25.24						
2047	32	27.05	25.24						
2048	33	27.28	25.24						
2049	34	27.52	25.24	0.0	0.0	0.0	179.1	<:Refurbishment funding	
2050	35	27.76	25.24						

YEAR	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment
2015										
2016										
2017										
2018										
2019										
2020			8.33	49.46	3.61	17.13	19.11	26.49	41.50	5.16
2021	202 438 247	155.74	8.40	49.87	3.61	17.13	19.11	26.49	41.50	5.22
2022	202 438 247	155.74	8.47	50.28	3.61	17.13	19.11	26.49	41.50	5.28
2023	202 438 247	155.74	8.54	50.69	3.61	17.13	19.11	26.49	41.50	5.34
2024	202 438 247	155.74	8.61	51.10	3.61	17.13	19.11	26.49	41.50	5.40
2025	202 438 247	155.74	8.68	51.51	3.61	17.13	19.11	26.49	41.50	5.45
2026	202 438 247	155.74	8.75	51.92	3.61	17.13	19.11	26.49	41.50	5.51
2027	202 438 247	155.74	8.82	52.34	3.61	17.13	19.11	26.49	41.50	5.57
2028	202 438 247	155.74	8.89	52.75	3.61	17.13	19.11	26.49	41.50	5.63
2029	202 438 247	155.74	8.96	53.16	3.61	17.13	19.11	26.49	41.50	5.69
2030	202 438 247	155.74	9.03	53.57	3.61	17.13	19.11	26.49	41.50	5.75
2031	202 438 247	155.74	9.10	53.98	3.61	17.13	19.11	26.49	41.50	5.81
2032	202 438 247	155.74	9.17	54.39	3.61	17.13	19.11	26.49	41.50	5.87
2033	202 438 247	155.74	9.24	54.81	3.61	17.13	19.11	26.49	41.50	5.93
2034	202 438 247	155.74	9.31	55.22	3.61	17.13	19.11	26.49	41.50	5.99
2035	202 438 247	155.74	9.38	55.63	3.61	17.13	19.11	26.49	41.50	6.05
2036	202 438 247	155.74	9.44	56.04	3.61	17.13	19.11	26.49	41.50	6.11
2037	202 438 247	155.74	9.51	56.45	3.61	17.13	19.11	26.49	41.50	6.17
2038	202 438 247	155.74	9.58	56.86	3.61	17.13	19.11	26.49	41.50	6.23
2039	202 438 247	155.74	9.65	57.27	3.61	17.13	19.11	26.49	41.50	6.29
2040	202 438 247	155.74	9.72	57.69	3.61	17.13	19.11	26.49	41.50	6.35
2041	202 438 247	155.74	9.79	58.10	3.61	17.13	19.11	26.49	41.50	6.40
2042	202 438 247	155.74	9.86	58.51	3.61	17.13	19.11	26.49	41.50	6.46
2043	202 438 247	155.74	9.93	58.92	3.61	17.13	19.11	26.49	41.50	6.52
2044	202 438 247	155.74	10.00	59.33	3.61	17.13	19.11	26.49	41.50	6.58
2045	202 438 247	155.74	10.07	59.74	3.61	17.13	19.11	26.49	41.50	6.64
2046	202 438 247	155.74	10.14	60.15	3.61	17.13	19.11	26.49	41.50	6.70
2047	202 438 247	155.74	10.21	60.57	3.61	17.13	19.11	26.49	41.50	6.76
2048	202 438 247	155.74	10.28	60.98	3.61	17.13	19.11	26.49	41.50	6.82
2049	202 438 247	155.74	10.35	61.39	3.61	17.13	19.11	26.49	41.50	6.88
2050	202 438 247	155.74	10.42	61.80	3.61	17.13	19.11	26.49	41.50	6.94

URV OF WATER SUPPLIED 6%	8%	10%	2%
5.01	5.64	6.23	3.75

YEAR	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015					39	39	39	38.83
2016					347	347	347	346.61
2017					868	868	868	868.26
2018					1 090	1 090	1 090	1090.11
2019					936	936	936	935.54
2020	45.87	45.87	45.87	45.87	579	579	579	578.82
2021	46.11	46.11	46.11	46.11	180	180	180	179.81
2022	46.34	46.34	46.34	46.34	45	45	45	44.74
2023	46.58	46.58	46.58	46.58	8	8	8	8.13
2024	46.82	46.82	46.82	46.82	9	9	9	8.60
2025	47.06	47.06	47.06	47.06	9	9	9	9.08
2026	47.29	47.29	47.29	47.29	10	10	10	9.55
2027	47.53	47.53	47.53	47.53	10	10	10	10.02
2028	47.77	47.77	47.77	47.77	10	10	10	10.49
2029	48.01	48.01	48.01	48.01	11	11	11	10.96
2030	48.24	48.24	48.24	48.24	11	11	11	11.43
2031	48.48	48.48	48.48	48.48	12	12	12	11.90
2032	48.72	48.72	48.72	48.72	12	12	12	12.37
2033	48.96	48.96	48.96	48.96	13	13	13	12.84
2034	49.19	49.19	49.19	49.19	192	192	192	192.45
2035	49.43	49.43	49.43	49.43	14	14	14	13.78
2036	49.67	49.67	49.67	49.67	14	14	14	14.25
2037	49.91	49.91	49.91	49.91	15	15	15	14.73
2038	50.15	50.15	50.15	50.15	15	15	15	15.20
2039	50.38	50.38	50.38	50.38	16	16	16	15.67
2040	50.62	50.62	50.62	50.62	16	16	16	16.14
2041	50.86	50.86	50.86	50.86	17	17	17	16.61
2042	51.10	51.10	51.10	51.10	17	17	17	17.08
2043	51.33	51.33	51.33	51.33	18	18	18	17.55
2044	51.57	51.57	51.57	51.57	18	18	18	18.02
2045	51.81	51.81	51.81	51.81	18	18	18	18.49
2046	52.05	52.05	52.05	52.05	19	19	19	18.96
2047	52.28	52.28	52.28	52.28	19	19	19	19.43
2048	52.52	52.52	52.52	52.52	20	20	20	19.90
2049	52.76	52.76	52.76	52.76	200	200	200	199.52
2050	53.00	53.00	53.00	53.00	21	21	21	20.85

NPV WATER SUPPLIED 6%	8%	10%	2%
674	546	453	1125

NPV COSTS 6%	8%	10%	2%
3 379	3 078	2 824	4 215

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME INCL TERTIARIES | Lalini, Prim/Sec/Tert & Irr Grant | All power cross-subsidized

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Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	189.0					189.0					
Other Items and Mitigations	518.2				518.2						
Power lines	32.6								32.6		
Engineering & EMP	766.4				766.4						
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GRAND TOTAL	**10147.0**	**1444.4**	**3105.1**	**320.7**	**1730.6**	**1955.9**	**1324.4**	**136.3**	**129.6**	**41.5**	***202 438 247***

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0%= grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
%	50%	100%	100%	100%	100%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	
Year	**101.5**	**944.9**	**267.5**	**716.6**	**103.5**	**0.0**	**0.0**	**0.0**	**1183.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**370.8**	**0.0**	**3688**
2015	14.5								59.2						18.5	0.0	**92**
2016	14.5	94.5	127.1		49.1				177.5						55.6	0.0	**518**
2017	14.5	200.8	127.1	143.3	49.1	0.0	0.0		177.5	0.0	0.0	0.0	0.0		55.6	0.0	**768**
2018	14.5	200.8	13.4	250.8	5.2	0.0	0.0	0.0	177.5	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**718**
2019	14.5	200.8		250.8		0.0	0.0	0.0	177.5	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**699**
2020	14.5	200.8		71.7		0.0	0.0	0.0	177.5	0.0			0.0	0.0	55.6	0.0	**520**
2021	14.5	47.2				0.0	0.0	0.0	118.3	0.0				0.0	37.1	0.0	**217**
2022									118.3	0.0					37.1	0.0	**155**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check>	101.5	944.9	267.5	716.6	103.5	0.0	0.0	0.0	1183.2	0.0	0.0	0.0	0.0	0.0	370.8	0.0	3688

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS

RATE	ITEM	COST/A
0.25%	Dam	3.61
0.50%	Pipelines, Reservoirs	17.13
0.50%	Treatment Works, Civil Works, Buildings	19.11
2.00%	M & E	26.49
	Total	66.34

TREATMENT COSTS

Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m^3/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other
2015	0			0.0	0.0	0.0	0.0	14.5	18.5
2016	1			270.7	0.0	0.0	0.0	14.5	55.6
2017	2			377.0	0.0	0.0	143.3	14.5	55.6
2018	3			219.3	0.0	0.0	250.8	14.5	55.6
2019	4			200.8	0.0	0.0	250.8	14.5	55.6
2020	5	20.63	25.24	200.8	0.0	0.0	71.7	14.5	55.6
2021	6	20.87	25.24	47.2	0.0	0.0	0.0	14.5	37.1
2022	7	21.11	25.24	0.0	0.0	0.0	0.0	0.0	37.1
2023	8	21.34	25.24	0.0	0.0	0.0	0.0	0.0	0.0
2024	9	21.58	25.24	0.0	0.0	0.0	0.0	0.0	0.0
2025	10	21.82	25.24	0.0	0.0	0.0	0.0	0.0	0.0
2026	11	22.06	25.24						
2027	12	22.29	25.24						
2028	13	22.53	25.24						
2029	14	22.77	25.24						
2030	15	23.01	25.24						
2031	16	23.24	25.24						
2032	17	23.48	25.24						
2033	18	23.72	25.24						
2034	19	23.96	25.24			0.0	179.1	<:Refurbishment funding	
2035	20	24.19	25.24						
2036	21	24.43	25.24						
2037	22	24.67	25.24						
2038	23	24.91	25.24						
2039	24	25.14	25.24						
2040	25	25.38	25.24						
2041	26	25.62	25.24						
2042	27	25.86	25.24						
2043	28	26.09	25.24						
2044	29	26.33	25.24						
2045	30	26.57	25.24						
2046	31	26.81	25.24						
2047	32	27.05	25.24						
2048	33	27.28	25.24						
2049	34	27.52	25.24	0.0	0.0	0.0	179.1	<:Refurbishment funding	
2050	35	27.76	25.24						

YEAR	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income	PUMPING COSTS (R'million) Power MW	Energy Charge	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment
2015										
2016										
2017										
2018										
2019										
2020			8.33	49.46	3.61	17.13	19.11	26.49	41.50	5.16
2021	202 438 247	155.74	8.40	49.87	3.61	17.13	19.11	26.49	41.50	5.22
2022	202 438 247	155.74	8.47	50.28	3.61	17.13	19.11	26.49	41.50	5.28
2023	202 438 247	155.74	8.54	50.69	3.61	17.13	19.11	26.49	41.50	5.34
2024	202 438 247	155.74	8.61	51.10	3.61	17.13	19.11	26.49	41.50	5.40
2025	202 438 247	155.74	8.68	51.51	3.61	17.13	19.11	26.49	41.50	5.45
2026	202 438 247	155.74	8.75	51.92	3.61	17.13	19.11	26.49	41.50	5.51
2027	202 438 247	155.74	8.82	52.34	3.61	17.13	19.11	26.49	41.50	5.57
2028	202 438 247	155.74	8.89	52.75	3.61	17.13	19.11	26.49	41.50	5.63
2029	202 438 247	155.74	8.96	53.16	3.61	17.13	19.11	26.49	41.50	5.69
2030	202 438 247	155.74	9.03	53.57	3.61	17.13	19.11	26.49	41.50	5.75
2031	202 438 247	155.74	9.10	53.98	3.61	17.13	19.11	26.49	41.50	5.81
2032	202 438 247	155.74	9.17	54.39	3.61	17.13	19.11	26.49	41.50	5.87
2033	202 438 247	155.74	9.24	54.81	3.61	17.13	19.11	26.49	41.50	5.93
2034	202 438 247	155.74	9.31	55.22	3.61	17.13	19.11	26.49	41.50	5.99
2035	202 438 247	155.74	9.38	55.63	3.61	17.13	19.11	26.49	41.50	6.05
2036	202 438 247	155.74	9.44	56.04	3.61	17.13	19.11	26.49	41.50	6.11
2037	202 438 247	155.74	9.51	56.45	3.61	17.13	19.11	26.49	41.50	6.17
2038	202 438 247	155.74	9.58	56.86	3.61	17.13	19.11	26.49	41.50	6.23
2039	202 438 247	155.74	9.65	57.27	3.61	17.13	19.11	26.49	41.50	6.29
2040	202 438 247	155.74	9.72	57.69	3.61	17.13	19.11	26.49	41.50	6.35
2041	202 438 247	155.74	9.79	58.10	3.61	17.13	19.11	26.49	41.50	6.40
2042	202 438 247	155.74	9.86	58.51	3.61	17.13	19.11	26.49	41.50	6.46
2043	202 438 247	155.74	9.93	58.92	3.61	17.13	19.11	26.49	41.50	6.52
2044	202 438 247	155.74	10.00	59.33	3.61	17.13	19.11	26.49	41.50	6.58
2045	202 438 247	155.74	10.07	59.74	3.61	17.13	19.11	26.49	41.50	6.64
2046	202 438 247	155.74	10.14	60.15	3.61	17.13	19.11	26.49	41.50	6.70
2047	202 438 247	155.74	10.21	60.57	3.61	17.13	19.11	26.49	41.50	6.76
2048	202 438 247	155.74	10.28	60.98	3.61	17.13	19.11	26.49	41.50	6.82
2049	202 438 247	155.74	10.35	61.39	3.61	17.13	19.11	26.49	41.50	6.88
2050	202 438 247	155.74	10.42	61.80	3.61	17.13	19.11	26.49	41.50	6.94

YEAR	DISCOUNTED WATER SUPPLIED (million m^3) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015					33	33	33	33.03
2016					341	341	341	340.82
2017					590	590	590	590.43
2018					540	540	540	540.25
2019					522	522	522	521.70
2020	45.87	45.87	45.87	45.87	505	505	505	505.01
2021	46.11	46.11	46.11	46.11	106	106	106	106.01
2022	46.34	46.34	46.34	46.34	45	45	45	44.74
2023	46.58	46.58	46.58	46.58	8	8	8	8.13
2024	46.82	46.82	46.82	46.82	9	9	9	8.60
2025	47.06	47.06	47.06	47.06	9	9	9	9.08
2026	47.29	47.29	47.29	47.29	10	10	10	9.55
2027	47.53	47.53	47.53	47.53	10	10	10	10.02
2028	47.77	47.77	47.77	47.77	10	10	10	10.49
2029	48.01	48.01	48.01	48.01	11	11	11	10.96
2030	48.24	48.24	48.24	48.24	11	11	11	11.43
2031	48.48	48.48	48.48	48.48	12	12	12	11.90
2032	48.72	48.72	48.72	48.72	12	12	12	12.37
2033	48.96	48.96	48.96	48.96	13	13	13	12.84
2034	49.19	49.19	49.19	49.19	192	192	192	192.45
2035	49.43	49.43	49.43	49.43	14	14	14	13.78
2036	49.67	49.67	49.67	49.67	14	14	14	14.25
2037	49.91	49.91	49.91	49.91	15	15	15	14.73
2038	50.15	50.15	50.15	50.15	15	15	15	15.20
2039	50.38	50.38	50.38	50.38	16	16	16	15.67
2040	50.62	50.62	50.62	50.62	16	16	16	16.14
2041	50.86	50.86	50.86	50.86	17	17	17	16.61
2042	51.10	51.10	51.10	51.10	17	17	17	17.08
2043	51.33	51.33	51.33	51.33	18	18	18	17.55
2044	51.57	51.57	51.57	51.57	18	18	18	18.02
2045	51.81	51.81	51.81	51.81	18	18	18	18.49
2046	52.05	52.05	52.05	52.05	19	19	19	18.96
2047	52.28	52.28	52.28	52.28	19	19	19	19.43
2048	52.52	52.52	52.52	52.52	20	20	20	19.90
2049	52.76	52.76	52.76	52.76	200	200	200	199.52
2050	53.00	53.00	53.00	53.00	21	21	21	20.85

URV OF WATER SUPPLIED	6%	8%	10%	2%
	3.40	3.80	4.17	2.60

NPV WATER SUPPLIED	6%	8%	10%	2%
	674	546	453	1125

NPV COSTS	6%	8%	10%	2%
	2 289	2 072	1 893	2 929

URV: ALL WATER SUPPLIED: CONJUNCTIVE SCHEME INCL TERTIARIES | 100% Grant Funded | All power cross-subsidized

ITEM	CAPITAL COST COMPONENTS (R'million) TOTAL	DAM	PIPELINES	TANKS	NON-WORKS	CIVIL WORKS	M & E	BUILDING	POWER SUPPLY	STAFF P.A.	HEP OUTPUT kWh
Ntabelanga Dam											
Water Supply Only	570.4	484.9					85.6				
Increment for HEP	374.4	318.3					56.2			4.2	29 064 021
Associated Dam Works	103.5					25.9	25.9	51.7			
Small HEP	100.3					15.0	85.3				
Pipelines											
Primary & Secondary	1060.6		901.5			53.0	106.1			4.1	
Tertiary	1474.9		1253.6			73.7	147.5				
Reservoirs											
Primary & Secondary	186.8			149.5		18.7	18.7				
Tertiary	135.7			108.6		13.6	13.6				
Pumping Stations											
Primary & Secondary	112.7						95.8	16.9			
Tertiary	8.4						7.2	1.3		11.6	
Power supplies											
Primary & Secondary	45.9								45.9		
Tertiary	6.6								6.6		
Treatment Works	716.6				75.2	359.9	281.5			12.3	
Irrigation Supply											
Incl bulk and farms dev	750.2		519.2	62.7		75.9	59.9	20.0	12.5	2.5	
Roads	189.0					189.0					
Other Items and Mitigations	518.2				518.2						
Power lines	32.6								32.6		
Engineering & EMP	766.4				766.4						
SUB-TOTAL	*7153.3*	*803.2*	*2674.3*	*320.7*	*1359.8*	*824.8*	*983.0*	*89.9*	*97.6*	*34.7*	*29 064 021*
Lalini Dam	754.5	641.3					113.2			6.8	173 374 226
Associated Dam Works	159.3					135.4	23.9				
Conduit/Tunnel	861.6		430.8			430.8					
HEPs											
Small	70.9						48.3	12.5	10.0		
Main	221.2					9.4	156.0	33.9	21.9		
Roads	555.5					555.5					
Other Items & Mitigations	50.0				50.0						
Engineering & EMP	320.8				320.8						
SUB-TOTAL	*2993.7*	*641.3*	*430.8*	*0.0*	*370.8*	*1131.1*	*341.4*	*46.4*	*32.0*	*6.8*	*173 374 226*
GRAND TOTAL	**10147.0**	**1444.4**	**3105.1**	**320.7**	**1730.6**	**1955.9**	**1324.4**	**136.3**	**129.6**	**41.5**	***202 438 247***

IMPLEMENTATION EXPENDITURE TIMING

PERCENTAGE OF CAPITAL REDEMPTION (i.e. 0%= grant funding)

	Proj. mangt	Ntab Dam	Ntab Advance	Ntab WTW	Ntab Ops Village	Prim & Sec Lines	Tertiary Lines	Ntab Irrigation	Eng & Other	Lalini Dam	Lalini Advance	Lalini Ops Village	Lalini Conduit	HEP Plants	Eng & Other	DEA	TOTAL:
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Year	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1284.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**370.8**	**0.0**	**1655**
2015	0.0								64.2						18.5	0.0	**83**
2016	0.0	0.0	0.0		0.0				192.7						55.6	0.0	**248**
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0		192.7	0.0	0.0	0.0	0.0		55.6	0.0	**248**
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	192.7	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**248**
2019	0.0	0.0		0.0		0.0	0.0	0.0	192.7	0.0	0.0	0.0	0.0	0.0	55.6	0.0	**248**
2020	0.0	0.0		0.0		0.0	0.0	0.0	192.7	0.0			0.0	0.0	55.6	0.0	**248**
2021	0.0	0.0				0.0	0.0	0.0	128.5	0.0				0.0	37.1	0.0	**166**
2022									128.5	0.0					37.1	0.0	**166**
2023																0.0	**0**
2024																0.0	**0**
2025																	
Check>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1284.7	0.0	0.0	0.0	0.0	0.0	370.8	0.0	1655

OPERATIONS COSTS (R'million)

MAINTENANCE COSTS RATE	ITEM	COST/A
0.25%	Dam	3.61
0.50%	Pipelines, Reservoirs	17.13
0.50%	Treatment Works, Civil Works, Buildings	19.11
2.00%	M & E	26.49
	Total	66.34

TREATMENT COSTS		
Using cost Rand per m3 =		0.25
POWER		
Energy Cost : R/ kWHr	Pumping	0.50
Energy Cost : R/ kWHr	Sales	0.8

YEAR	YEAR NO.	WATER SUPPLIED (million m³/a) POTABLE	IRRIGATION	CAPITAL & REFURBISHMENT EXPENDITURE (R'million) Dam & Ass. Inf.	Pipelines & Reservoirs	HEPs	WTW	Proj Mant	Eng EMP & Other	HYDROPOWER INCOME (R'million) Power Output kWh/a	Energy Income
2015	0			0.0	0.0	0.0	0.0	0.0	18.5		
2016	1			0.0	0.0	0.0	0.0	0.0	55.6		
2017	2			0.0	0.0	0.0	0.0	0.0	55.6		
2018	3			0.0	0.0	0.0	0.0	0.0	55.6		
2019	4			0.0	0.0	0.0	0.0	0.0	55.6		
2020	5	20.63	25.24	0.0	0.0	0.0	0.0	0.0	55.6		
2021	6	20.87	25.24	0.0	0.0	0.0	0.0	0.0	37.1	202 438 247	155.74
2022	7	21.11	25.24	0.0	0.0	0.0	0.0	0.0	37.1	202 438 247	155.74
2023	8	21.34	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74
2024	9	21.58	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74
2025	10	21.82	25.24	0.0	0.0	0.0	0.0	0.0	0.0	202 438 247	155.74
2026	11	22.06	25.24							202 438 247	155.74
2027	12	22.29	25.24							202 438 247	155.74
2028	13	22.53	25.24							202 438 247	155.74
2029	14	22.77	25.24							202 438 247	155.74
2030	15	23.01	25.24							202 438 247	155.74
2031	16	23.24	25.24							202 438 247	155.74
2032	17	23.48	25.24							202 438 247	155.74
2033	18	23.72	25.24							202 438 247	155.74
2034	19	23.96	25.24			0.0	0.0	<Refurbishment funding		202 438 247	155.74
2035	20	24.19	25.24							202 438 247	155.74
2036	21	24.43	25.24							202 438 247	155.74
2037	22	24.67	25.24							202 438 247	155.74
2038	23	24.91	25.24							202 438 247	155.74
2039	24	25.14	25.24							202 438 247	155.74
2040	25	25.38	25.24							202 438 247	155.74
2041	26	25.62	25.24							202 438 247	155.74
2042	27	25.86	25.24							202 438 247	155.74
2043	28	26.09	25.24							202 438 247	155.74
2044	29	26.33	25.24							202 438 247	155.74
2045	30	26.57	25.24							202 438 247	155.74
2046	31	26.81	25.24							202 438 247	155.74
2047	32	27.05	25.24							202 438 247	155.74
2048	33	27.28	25.24							202 438 247	155.74
2049	34	27.52	25.24	0.0	0.0	0.0	0.0	<Refurbishment funding		202 438 247	155.74
2050	35	27.76	25.24							202 438 247	155.74

YEAR	PUMPING COSTS (R'million) Power MW	Energy Charge	OPERATIONAL COSTS (R'million) Dams	Pipelines Reservoirs	WTW Civil & Buildings	M & E	STAFF	Treatment
2015								
2016								
2017								
2018								
2019								
2020	8.33	49.46	3.61	17.13	19.11	26.49	41.50	5.16
2021	8.40	49.87	3.61	17.13	19.11	26.49	41.50	5.22
2022	8.47	50.28	3.61	17.13	19.11	26.49	41.50	5.28
2023	8.54	50.69	3.61	17.13	19.11	26.49	41.50	5.34
2024	8.61	51.10	3.61	17.13	19.11	26.49	41.50	5.40
2025	8.68	51.51	3.61	17.13	19.11	26.49	41.50	5.45
2026	8.75	51.92	3.61	17.13	19.11	26.49	41.50	5.51
2027	8.82	52.34	3.61	17.13	19.11	26.49	41.50	5.57
2028	8.89	52.75	3.61	17.13	19.11	26.49	41.50	5.63
2029	8.96	53.16	3.61	17.13	19.11	26.49	41.50	5.69
2030	9.03	53.57	3.61	17.13	19.11	26.49	41.50	5.75
2031	9.10	53.98	3.61	17.13	19.11	26.49	41.50	5.81
2032	9.17	54.39	3.61	17.13	19.11	26.49	41.50	5.87
2033	9.24	54.81	3.61	17.13	19.11	26.49	41.50	5.93
2034	9.31	55.22	3.61	17.13	19.11	26.49	41.50	5.99
2035	9.38	55.63	3.61	17.13	19.11	26.49	41.50	6.05
2036	9.44	56.04	3.61	17.13	19.11	26.49	41.50	6.11
2037	9.51	56.45	3.61	17.13	19.11	26.49	41.50	6.17
2038	9.58	56.86	3.61	17.13	19.11	26.49	41.50	6.23
2039	9.65	57.27	3.61	17.13	19.11	26.49	41.50	6.29
2040	9.72	57.69	3.61	17.13	19.11	26.49	41.50	6.35
2041	9.79	58.10	3.61	17.13	19.11	26.49	41.50	6.40
2042	9.86	58.51	3.61	17.13	19.11	26.49	41.50	6.46
2043	9.93	58.92	3.61	17.13	19.11	26.49	41.50	6.52
2044	10.00	59.33	3.61	17.13	19.11	26.49	41.50	6.58
2045	10.07	59.74	3.61	17.13	19.11	26.49	41.50	6.64
2046	10.14	60.15	3.61	17.13	19.11	26.49	41.50	6.70
2047	10.21	60.57	3.61	17.13	19.11	26.49	41.50	6.76
2048	10.28	60.98	3.61	17.13	19.11	26.49	41.50	6.82
2049	10.35	61.39	3.61	17.13	19.11	26.49	41.50	6.88
2050	10.42	61.80	3.61	17.13	19.11	26.49	41.50	6.94

YEAR	DISCOUNTED WATER SUPPLIED (million m³) DISCOUNT RATES 6%	8%	10%	2%	TOTAL COSTS R'million DISCOUNT RATES 6%	8%	10%	2%
2015					19	19	19	18.54
2016					56	56	56	55.61
2017					56	56	56	55.61
2018					56	56	56	55.61
2019					56	56	56	55.61
2020	45.87	45.87	45.87	45.87	218	218	218	218.07
2021	46.11	46.11	46.11	46.11	44	44	44	44.27
2022	46.34	46.34	46.34	46.34	45	45	45	44.74
2023	46.58	46.58	46.58	46.58	8	8	8	8.13
2024	46.82	46.82	46.82	46.82	9	9	9	8.60
2025	47.06	47.06	47.06	47.06	9	9	9	9.08
2026	47.29	47.29	47.29	47.29	10	10	10	9.55
2027	47.53	47.53	47.53	47.53	10	10	10	10.02
2028	47.77	47.77	47.77	47.77	10	10	10	10.49
2029	48.01	48.01	48.01	48.01	11	11	11	10.96
2030	48.24	48.24	48.24	48.24	11	11	11	11.43
2031	48.48	48.48	48.48	48.48	12	12	12	11.90
2032	48.72	48.72	48.72	48.72	12	12	12	12.37
2033	48.96	48.96	48.96	48.96	13	13	13	12.84
2034	49.19	49.19	49.19	49.19	13	13	13	13.31
2035	49.43	49.43	49.43	49.43	14	14	14	13.78
2036	49.67	49.67	49.67	49.67	14	14	14	14.25
2037	49.91	49.91	49.91	49.91	15	15	15	14.73
2038	50.15	50.15	50.15	50.15	15	15	15	15.20
2039	50.38	50.38	50.38	50.38	16	16	16	15.67
2040	50.62	50.62	50.62	50.62	16	16	16	16.14
2041	50.86	50.86	50.86	50.86	17	17	17	16.61
2042	51.10	51.10	51.10	51.10	17	17	17	17.08
2043	51.33	51.33	51.33	51.33	18	18	18	17.55
2044	51.57	51.57	51.57	51.57	18	18	18	18.02
2045	51.81	51.81	51.81	51.81	18	18	18	18.49
2046	52.05	52.05	52.05	52.05	19	19	19	18.96
2047	52.28	52.28	52.28	52.28	19	19	19	19.43
2048	52.52	52.52	52.52	52.52	20	20	20	19.90
2049	52.76	52.76	52.76	52.76	20	20	20	20.38
2050	53.00	53.00	53.00	53.00	21	21	21	20.85

	6%	8%	10%	2%
URV OF WATER SUPPLIED	0.77	0.82	0.87	0.67
NPV WATER SUPPLIED	674	546	453	1125
NPV COSTS	518	449	395	748