DWAF Report No. P WMA 17/E10/00/1809

DEPARTMENT OF
WATER AFFAIRS
AND FORESTRY

Feasibility Study for the Raising of Clanwilliam Dam

Financial Evaluation

Final
February 2009

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DEPARTMENT OF WATER AFFAIRS AND FORESTRY
DIRECTORATE OPTIONS ANALYSIS

FEASIBILITY STUDY FOR THE RAISING OF THE CLANWILLIAM DAM

FINANCIAL EVALUATION

Final

February 2009

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This report is to be referred to in bibliographies as:

Department of Water Affairs and Forestry, South Africa. 2009. *Financial Evaluation*. Prepared by E van der Berg and M Killick of Ninham Shand (Pty) Ltd as part of the Feasibility Study for the Raising of Clanwilliam Dam. DWAF Report No. PWMA 17/E10/00/1809.

Department of Water Affairs and Forestry
Directorate Options Analysis

FEASIBILITY STUDY FOR THE RAISING OF THE CLANWILLIAM DAM

APPROVAL

Title	:	Financial evaluation
DWAF Report No.	:	PWMA 17/E10/00/1809
NS Report No.	:	4455/400415
Authors	:	E van der Berg, M Killick
Status of Report	:	Final
Date	:	February 2009

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EXECUTIVE SUMMARY

Report objective

This report focuses on the cost of the dam, as well as the cost of water and its affordability. It further evaluates the various options available for the financing of the dam raising scheme, as well as the financing options available to resource-poor farmers. Recommendations are made on the feasibility of raising the dam, and on the preferred height of raising.

The main conclusions that can be drawn are discussed under the following headings:

Capital costs

Capital costs have been determined, with a base year of 2006, to make the dam safe for extreme events (0 m for dam safety), as well as for the raising of the dam by 5 m, 10 m and 15 m. At each full supply level (FSL) an ogee and a labyrinth spillway option were investigated and costed. For the three raisings the option of lengthening the spillway by 21,35 m was also considered. At each raising level a capital cost was selected (generally the lowest) and the cost relative to the 0 m raising for an ogee spillway was determined, and was used for the unit reference value (URV) calculations. Capital costs for the dam safety work is R165.9 million, and for the three raising options vary from R172.9 to R422.1 million for Scenario 2.

Scenarios for yields and costs determination

Due to the uncertainty about how the Reserve would be implemented with respect to the financing thereof, four scenarios were formulated, specifically addressing various ways in which the Reserve could be implemented and paid for.

The implementation of Scenario 1 is not recommended, as water cost would be too high, and it is unacceptable that only additional/new users pay for the implementation of the Reserve.

Scenarios 2 or 3 are recommended, with Scenario 3 being preferred to Scenario 2, as it makes sense that all users have to contribute towards the Reserve.

The selection of Scenario 4 is fully dependent on the position of the Department of Water Affairs and Forestry (DWAF) in terms of responsibility for the Reserve. If DWAF would decide to fund the implementation of the Reserve, water costs would be much lower, and more affordable.

Diversion potential and rules upstream of Clanwilliam Dam

The potential for additional diversion from this river reach was assessed by analysing diversions for a range of flows, up to 3 m^3/s, from daily flows, for a 72-year period. It was concluded that the potential to pump additional water from the upper Olifants River during winter, for use during summer, does not pose any constraint.

It is recommended that the increased pumping of winter water, for storage and use during summer, be encouraged, to significantly limit the pumping from the river during the summer months, to improve the ecological condition of the upper Olifants River. This requires a change in the licence condition for current abstraction, from the Olifants River, upstream of Clanwilliam Dam, strict enforcement of limited pumping during summer, and outlawing of boreholes in, or close to, the riverbed, that affects river flow.

Increased yield of Clanwilliam Dam

Yields were determined for the various Scenarios, for the range of dam raising options, relative to the yield of the existing Olifants River Government Water Scheme (ORGWS), which comprises Clanwilliam Dam, Bulshoek Weir and the associated distribution infrastructure. Yields range from 16 million m^3/a to

73 million m^3/a. The decrease in yield, due to the implementation of the Reserve, was determined for the existing dam (dam safety work), as well as for the three dam raising options.

Unit reference values
URVs were determined for three scenarios, based on a range of assumptions, for the various dam raising options, and for discount rates of 4%, 6% and 8%, respectively.

Incremental URVs have been determined for Scenario 2, which are indicative for the other scenarios as well. Indications are that a raising increment of between the 0-5 m raising and the 5-10 m raising would have the lowest URV, while the 5-15 m incremental raising is on the high side, and especially so for the higher discount rates.

A range of criteria for the selection of the recommended height of raising has been recommended.

Water cost and affordability
Implications were determined for the potential situation where the reduction in yield, as a result of the implementation of the Reserve, needs to be absorbed by the current Olifants River irrigators users, which could vary from 4%, for dam safety work only, to 5.8% for a 10 m or 15 m raising.

It is concluded that the cost of additional water would vary in a range of about R0.40/m^3 to R0.80/m^3, depending on the raising level and discounting rate and based on a loan redemption period of 25 years. The sensitivity analysis (i.e. farm profits versus unit water cost) shows that water cost *per se* (i.e. at the envisaged cost levels that are associated with the alternative dam raisings) will only have a minor impact on the profitability of farms.

The scheme is very affordable to existing urban water users, without taking the cost of any further downstream infrastructure into account.

URVs determined for groundwater sub-schemes, in the Clanwilliam Trough Scheme and for the Citrusdal Syncline Scheme, as part of the groundwater resources investigation of this study, are of a similar order as that of the dam raising, but at a lower level of confidence.

Recommended height of raising
A 15m raising, the maximum potential level of raising, is technically feasible, with a URV of R0.48/m^3, at a 6% discount rate, for Scenario 2.

There is adequate demand for water and significant support for the dam raising from the Lower Olifants River Water User Association (LORWUA) and in general.

This scheme offers significant opportunities for water allocation reform and this should be pursued.

The recommended level of raising is a level between 12.5 m and 15 m, to limit the raising over the last few meters of raising that would have unacceptably high URVs. A raising level of 13 m therefore seems sensible, based on existing information.

Should the financial Scenario 4 (the DWAF pays for implementation of the Reserve) be selected for implementation, a 15 m raising is recommended, as URVs for this scheme would be significantly lower. Current DWAF policy does not however, favour this scenario.

Motivation for investing in this scheme
The active encouragement of allocations of water to resource-poor farmers from the dam raising scheme can address significant income and social disparities, low-income levels, and fluctuating seasonal

unemployment in the Olifants River Valley. The commitment to achieving social development and equity through the preferential allocation of water to resource-poor farmers is one of the key poverty eradication strategies for the area. The nature of employment in the area is predominantly in agriculture, with a lack of opportunities for women in this industry. The percentage of the possible population that is not economically active is also high, particularly amongst women. Half of all jobs in the area are in agriculture.

The raising of the Dam provides a significant opportunity for transformation of the commercial agricultural sector in this area. A further potential benefit to society would be the contribution to racial and gender equity in the area, as well as the amount of employment creation.

It is necessary to distinguish between making water available for the enhancement of livelihoods and the eradication of poverty on the one hand, and for the transformation of commercial agriculture on the other.

Scheme financing options

Because Clanwilliam Dam is owned by the DWAF, all charges, following the dam raising, would be levied in terms of the *Pricing Strategy for Raw Water Use Charges*. New farmers would only be given access to irrigation, or existing farmers be allowed to expand, on condition that the full financial cost (O&M plus depreciation plus return on assets) be paid for the development.

A number of options for financing of the scheme, as set out in the Pricing Strategy, are discussed. These include:

- Return on assets (ROA);
- Government schemes funded off-budget;
- Schemes Owned by Catchment Management Agencies (CMAs) and Water User Associations (WUAs);
- Betterment charges;
- Combinations of financing mechanisms;
- Phasing in of charges.

Financing options for resource-poor farmers

A suite of possible opportunities have been recommended, to be considered for the potential use of water from the Clanwilliam Dam, to support the development of resource-poor farmers in the area.

The lack of financial support has been highlighted as one of the main hindrances to emerging farmers. Funding is required for capital expenses as well as to fund equity acquisition in a joint venture. A wide range of potential sources of funding for resource-poor farmers have therefore been identified and discussed, and includes:

- Department of Land Affairs;
- Department of Water Affairs and Forestry;
- Agricultural organisations;
- Department of Provincial and Local Government;
- Department of Labour; and
- Land Bank.

Recommendations

Based on the findings, the following recommendations are made:

It is concluded that the raising of the Clanwilliam Dam is technical feasible, up to the 15 m raising level, and is socially desirable. It is further concluded that the difference between the 5,10 and 15 m impacts are not sufficient to motivate one raising option strongly over another for environmental reasons. There are no impacts therefore that, with mitigation, are so significant that they would rule out a raising up to the 15 m option.

On existing information, a 13 m raising is recommended, as it would make the water available from the scheme more affordable. This scheme would have a yield of 69.5 million m^3/a, for a capital cost of R370.6 million and a unit reference value of R0.45/m^3, for the Scenario 2 option, at a 6% discount rate. The URV for Scenario 3 for the 13 m raising, at a 6% discount rate, would be R0.47/m^3.

A study on the financing of the scheme should be undertaken. The dam could be implemented either by the DWAF, LORWUA, the Trans Caledon Tunnel Authority (TCTA), or the Infrastructure Agency.

A portion of the increased yield of the Dam should be reserved to increase the assurance of supply of the LOGWS to a more acceptable level, and be paid for by all current, and future, users. The LORWUA must indicate their specific requirements in this regard.

The DWAF should either cover the cost of the implementation of the Reserve, or such cost should be distributed amongst all users, existing and future. The potential waiving of such cost, for new (and possibly existing) resource-poor farmers should be considered.

All irrigation initiatives for uptake of water from the dam raising should be proven to be feasible and beneficial.

In order to ensure the equitable distribution of the benefits from the raising of the Dam, a multi-stakeholder Olifants/Doring River Development Agency (ODDA) should be established. The ODDA should be responsible for developing a vision for the catchment, identifying possible opportunities and partnerships and preparing a business plan for the equitable allocation of water. The ODDA should be responsible for co-ordinating the development of the proposed initiatives and monitoring the progress so that changes can be made when necessary or in response to new opportunities that arise.

The increased pumping of winter water upstream of Clanwilliam Dam, for storage and use during summer, should be managed through revised licence conditions, to significantly limit the pumping from the river during the summer months, to improve the ecological condition of the upper Olifants River.

CONTENTS

List of Tables

List of Figures

APPENDICES

GLOSSARY AND ABBREVIATIONS

BEE	Black economic empowerment
CCAW	Co-ordinating Committee on Agricultural Water
CCT	City of Cape Town
CMA	Catchment Management Agency
CUC	Capital unit charge
DEVCO	Development Company
DLA	Department of Land Affairs
DPLG	Department of Provincial and Local government
DWAF	Department of Water Affairs and Forestry
FSL	Full supply level
ha	Hectare
LAD	Land Distribution for Agricultural Development
LORWUA	Lower Olifants River Water User Association
Mm^3/a	million cubic metres per annum
m3	cubic meter (equal to 1 kilolitre or 1 000 litres)
m^3/a	cubic metres per annum
m^3/s	cubic metres per second
MIG	Municipal infrastructure grant
NWA	National Water Act
O&M	Operation and Maintenance
ODDA	Olifants/Doring River Development Agency
ORGWS	Olifants River Government Water Scheme
%	percentage
PAETA	Primary Agricultural Education and Training Authority
PPI	Producer Pricing Index
R	Rand
ROA	return on assets
RPF	Resource-poor farmers
SAWIT	South African Wine Industry Trust
TCTA	Trans Caledon Tunnel Authority
URV	Unit Reference Value
VAT	Value added Tax
WODRIS	Western Cape Olifants/Doring River Irrigation Study
WUA	Water User Association

1. INTRODUCTION

1.1 Study background and objective

The Clanwilliam Dam is situated close to the town of Clanwilliam, on the Olifants River in the Western Cape Province. The Dam was completed in 1935 and has since been raised to its current full supply level. Stored water from the Dam is mainly used for irrigation, with small relative volumes being used for urban, light industrial, domestic and mining purposes. An irrigated area of over 14 000 ha is currently being supplied by releases from the Dam.

Clanwilliam Dam requires remedial work for dam safety reasons, which presents an opportunity to simultaneously and cost-effectively raise the Dam by up to 15m.

The aim of the study is to verify the technical, environmental, social, economic and financial viability of raising the Clanwilliam Dam, at feasibility level. A preferred raising height would also be recommended, should the raising be feasible.

The study area, showing the three study regions is shown in **Figure 1.1**.

1.2 Report objectives

This report focuses on the cost of the Dam as well as the cost of water and its affordability. It further evaluates the various options available for the financing of the Dam raising scheme, as well as the financing options available to resource-poor farmers. Recommendations are made on the feasibility of raising the Dam, and on the preferred height of raising.

1.3 Report sections

This report starts with a description of scheme costs, unit reference values and water cost in **Section 2**. **Section 3** addresses options available for the financing of the Dam raising scheme, while **Section 4** deals with the financing options available for resource-poor farmers. Findings are described in **Section 5** and **Section 6** contains the recommendations.

Figure 1.1 The study area zones and municipalities

2. FINANCIAL COSTING

2.1 Capital costs

Capital costs for dam construction are as contained in the *Feasibility Design of Raising Report* by the DWAF, of this study. The calculated 2006 values include estimates for the professional fees, 10% contingencies, access roads, instrumentation and mechanical components, **but not VAT**. These costs are as shown in **Table 2.1**.

Table 2.1 Relative capital cost of dam raising

Option	Variation	Spillway type	Cost (R million)	Relative cost (R million)
0 m Raising	Exist Width	Ogee	**165.933**	
		Labyrinth	185.598	
5 m Raising	Exist Width	Ogee	**212.627**	**46.694**
		Labyrinth	230.936	74.003
	Extended	Ogee	226.944	61.011
		Labyrinth	237.880	71.947
10 m Raising	Exist Width	Ogee	**266.390**	**100.457**
		Labyrinth	279.095	113.162
	Extended	Ogee	276.804	110.871
		Labyrinth	288.489	122.556
15 m Raising	Exist Width	Ogee	343.706	177.773
		Labyrinth	**344.152**	**178.219**
	Extended	Ogee	342.545	176.612
		Labyrinth	353.783	187.850

The cost to make the Dam safe for extreme events has been budgeted for, on the existing DWAF Capital Programme for Dam Safety work. The capital cost required for raising the Dam is therefore the additional capital cost. For these calculations, it has been assumed that this would be R 165.933 million, for an ogee spillway. For the 5 m and 10 m raising options, the option for each raising height that has the lowest capital cost has been used for further calculation. For the 15 m raising option, capital costs are very similar for the four evaluated options, and the cost for an existing width labyrinth spillway has been used, because of the likely savings in affected infrastructure, relative to an ogee spillway.

The cost of affected roads and other infrastructure is as described in the report *Impacts on roads and other infrastructure* of this study. The total capital cost is shown in **Table 2.2** and **Figure 2.1**.

Table 2.2 Capital costs for URV calculations

Component	Raising		
	5 m	10 m	15 m
Dam	46.694	100.457	178.219
Other infrastructure	126.200	192.800	243.900
TOTAL	**172.894**	**293.257**	**422.119**

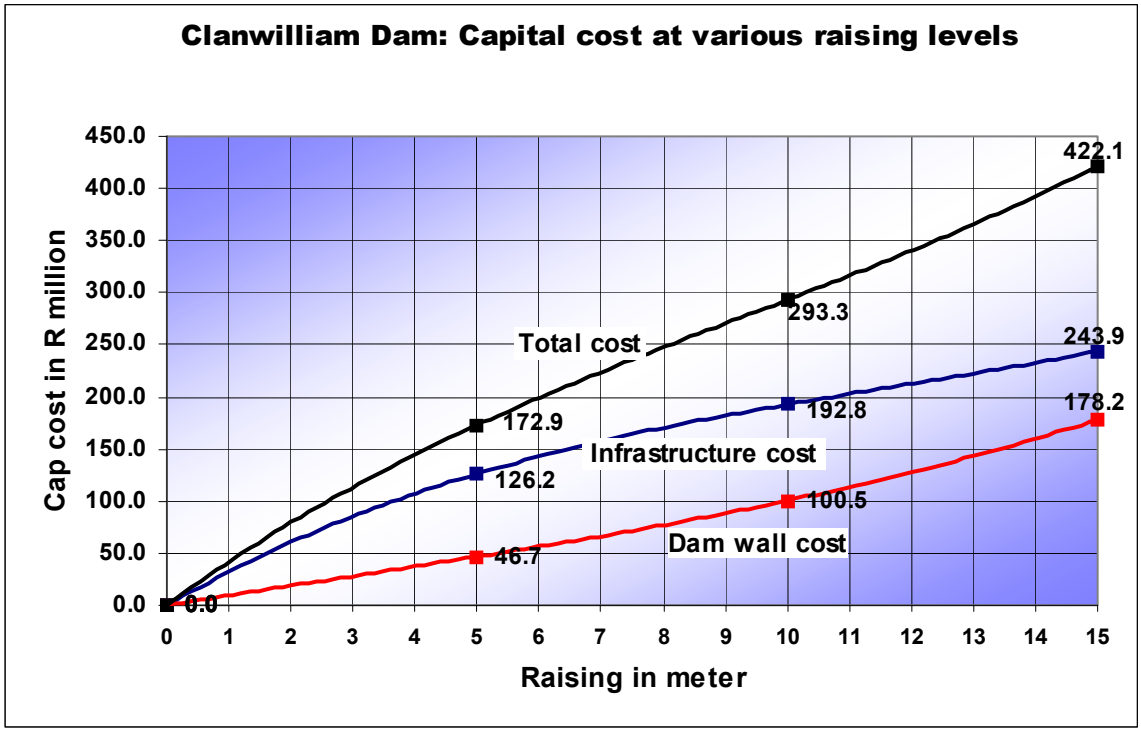

Figure 2.1 Capital costs

2.2 Scenarios for yields and costs determination

Additional yield from the raising of Clanwilliam Dam were determined by monthly modelling, with provision for releases for the Reserve, relevant to the yield of the current unraised Dam (with provision for the Reserve), as described in Section 2.3.

Due to the uncertainty about how the Reserve would be implemented with respect to the financing thereof, the additional yield as a result of the Dam raising has been calculated for the following financial scenarios. All these scenarios determine yields relative to the yield of the existing Olifants River Government Water Scheme (ORGWS), which comprises Clanwilliam Dam, Bulshoek Weir and the associated distribution infrastructure.

These Scenarios are:

Scenario 1: New users pay for the Reserve

This scenario assumes that the Reserve be implemented for the raising options, without any reduction in the allocations of existing users, or any payment by users or the Department of Water Affairs and Forestry (the DWAF) towards the implementation of the Reserve. Additional yield is the yield of the raising options (Reserve implemented) relative to the reduced yield of the existing dam (Reserve implemented). In this Scenario new users fully pay for the implementation of the Reserve.

Scenario 2: Existing users pay for the Reserve

This scenario assumes that the Reserve first be implemented for the existing dam (reduction of 16 million m^3/a in current Dam yield), and that any additional yield, following raising, then be available to be allocated. Existing Olifants River water users (alternatively, all Olifants and Doring Rivers water users) therefore have to either pay for the portion of raising to re-instate yield lost due to the implementation of the Reserve, to retain their allocations, or accept reduced water allocations to provide for the Reserve, or a combination of these. In this scenario, existing users fully pay for the implementation of the Reserve.

Scenario 3: All users pay for the Reserve

This scenario assumes that all existing, as well as new users, pay (or, if existing users are unwilling to pay, accept reduced allocations) for the portion of raising to re-instate yield lost due to the implementation of the Reserve. In this scenario, the bulk of the cost would however still be borne by existing users, because of the large existing user base. URVs of the raising scheme for this scenario are likely to be only marginally higher than that of Scenario 2, and these URVs have therefore not been determined.

Scenario 4: The DWAF pays for the Reserve

This scenario entails implementation of the Reserve for the raising options, with the DWAF paying the estimated R114 million cost, for raising of about 3.3 m to restore lost yield of 21 million m^3/a, due to the implementation of the Reserve. Current DWAF policy does not however support this option.

2.3 Diversion potential and rules upstream of Clanwilliam Dam

The *System Analysis* Report of this study describes the potential for diversion of water from the Olifants River, upstream of Clanwilliam Dam. Water is currently pumped into farm dams during the winter months, and is then mainly used during the dry, hot summer months. The potential for additional diversion from this river reach was assessed by analysing diversions for a range of flows, up to 3 m^3/s, from daily flows, for the years 1935 for 2006, a 72-year period. The analysis assumes pumping from June to October. It has been assumed that such pumped water would have to be stored in off-channel farm dams.

An analysis of the annual average diversions over the 72-year period *vs*. an analysis of the annual average diversions for the last 10 years (1997 to 2006) shows that this potential has only decreased slightly over the last 10-year period. As this 10-year period includes significant

droughts, it is reasonable to assume that the entire period is representative of the current situation. The potential volumes that can be diverted annually are shown in **Table 2.3**.

Table 2.3 Potential volumes to be diverted

Abstraction rate (m^3/s)	Average over period (Mm^3/a)	Last 10-year average (Mm^3/a)	% decrease
0.5	6.42	6.35	1.1%
1.0	12.78	12.66	0.9%
2.0	25.26	24.94	1.3%
3.0	37.33	36.57	2.0%

It can therefore be concluded that there is potential to pump additional water from the upper Olifants River during winter, for use during summer. Additional allocations would however mean decreased flows and a reduction in the yield of Clanwilliam Dam, which would require evaluation.

It is in fact recommended, in view of these findings, that the further pumping of winter water, for storage and use during summer, be encouraged, to significantly limit the pumping from the river during the summer months. This would require a change in a licence condition for current abstraction, from the Olifants River, upstream of Clanwilliam Dam. The current condition is that the maximum allowable capacities of farm dams, in the Olifants River catchment upstream of Clanwilliam Dam, may not exceed 50% of allocated water. Farmers should be allowed to store a higher percentage of their allocated water in farm dams. For this change to be effective, it would be critical to ensure strict enforcement of limited pumping during summer, to limit the impact on base flow during the summer months. Unless this can be ensured, it is doubtful whether this change should be implemented. Boreholes in, or close to, the riverbed, that affect river flow, should be outlawed. The aim of the amendment of this licence condition would be to achieve an improved river baseflow in summer, and should lead to an improvement in the ecological condition of the upper Olifants River.

2.4 Increased yield of Clanwilliam Dam

The *System Analysis Report* of this study describes the yield available from the Olifants River System, for the current system, without and with the implementation of a Reserve, as well as for the various levels of raising. This is shown in **Table 2.4**. The additional system yield from Bulshoek Weir, of 22 million m^3/a, has not been incorporated in these yields.

Table 2.4 Additional yield for various dam raising options

Raising (m)	Total yield (Mm^3/a)	Decrease in yield due to Reserve (Mm^3/a)	Additional yield (Mm^3/a)
0 m (no Reserve)	124	0	0
0 m (Reserve)	108	16	0
5 m	140	19	32
10 m	167	21	59
15 m	181	21	73

The additional yields for the various financial Scenarios, for each dam raising option, are shown in **Table 2.5**.

Table 2.5 Additional yield for various scenarios and dam raising options (Mm^3/a)

Raising (m)	Scenario 1	Scenario 2	Scenario 3	Scenario 4
5 m	16	32	32	32
10 m	43	59	59	59
15 m	57	73	73	73

Up to 73 million m^3/a would therefore potentially be available for allocation, for a 15 m raising of the Dam, the highest level of raising that is considered technically feasible. **Figure 2.2** shows the additional scheme yields for the various dam raising options. A curve has been fitted through these points. It is clear from the curve that the incremental yield drops after the 10m raising and drops severely after the 12.5 m raising. The additional yield at a 12.5 m raising is read off at 68 million m^3/a.

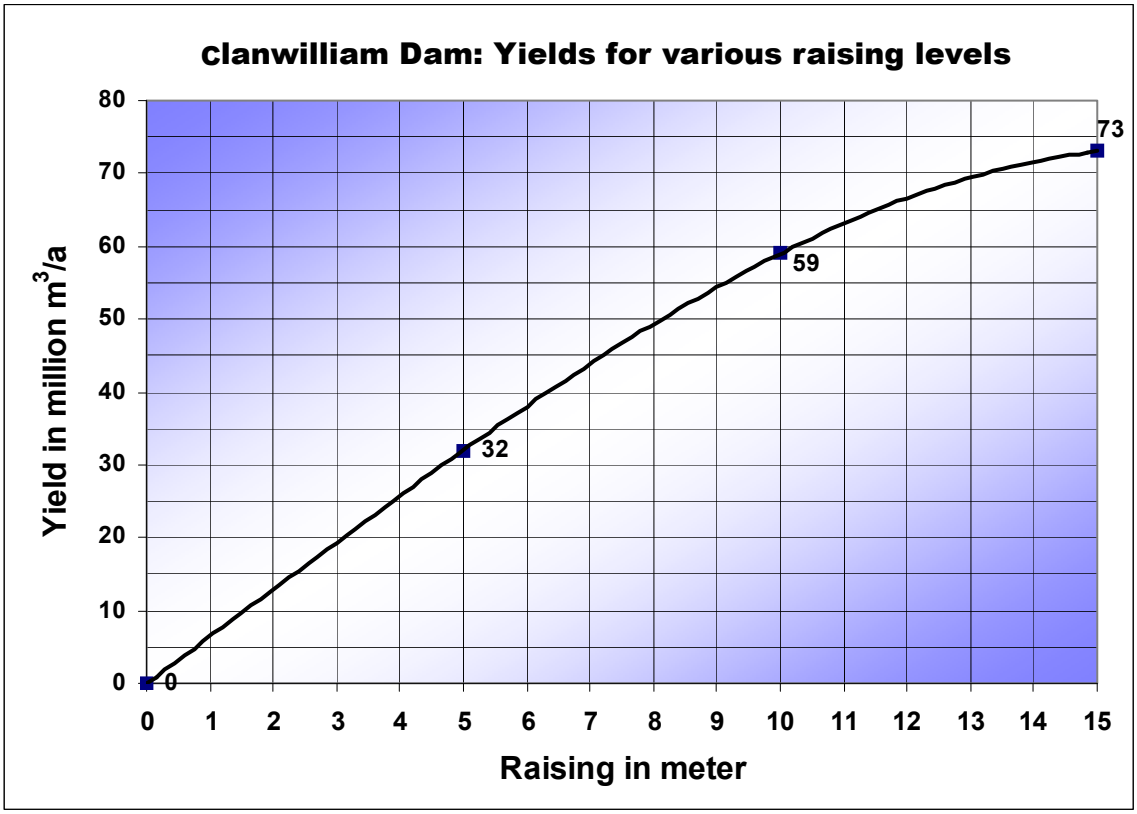

Figure 2.2 Yields for various dam raising levels

2.5 Unit Reference Values

2.5.1 Assumptions

Unit reference values (URVs) were then determined for Scenarios 1, 2 and 4, with the following assumptions:

- Total capital costs for 5 m, 10 m and 15 m raising levels were used as calculated, and were determined by interpolation, for in-between raising levels.
- Mechanical maintenance costs were disregarded as negligible, as only replacement of valves are involved;
- Annual civil maintenance costs of 0.25% per year were assumed, starting the year after scheme commissioning;
- As no pump stations or pipelines form part of the scheme, electrical maintenance costs were disregarded as negligible;
- Capitalised 2006 costs were determined for discount rates of 4%, 6% and 8% respectively, over a 45-year period.

2.5.2 Unit reference values for various financial Scenarios

URVs for Scenario 1 are shown in **Table 2.6**.

Table 2.6 URVs for Scenario 1

Discount rate (%)	Raising		
	5 m	10 m	15 m
4	R0.62	R0.40	R0.45
6	R0.85	R0.55	R0.62
8	R1.12	R0.73	R0.83

URVs for Scenario 2 are shown in **Table 2.7 and Figure 2.3**.

Table 2.7 URVs for Scenario 2

Discount rate (%)	Raising			
	5 m	10 m	12.5 m	15 m
4	R0.31	R0.29	R0.32	R0.35
6	R0.43	R0.40	R0.44	R0.48
8	R0.56	R0.54	R0.59	R0.65

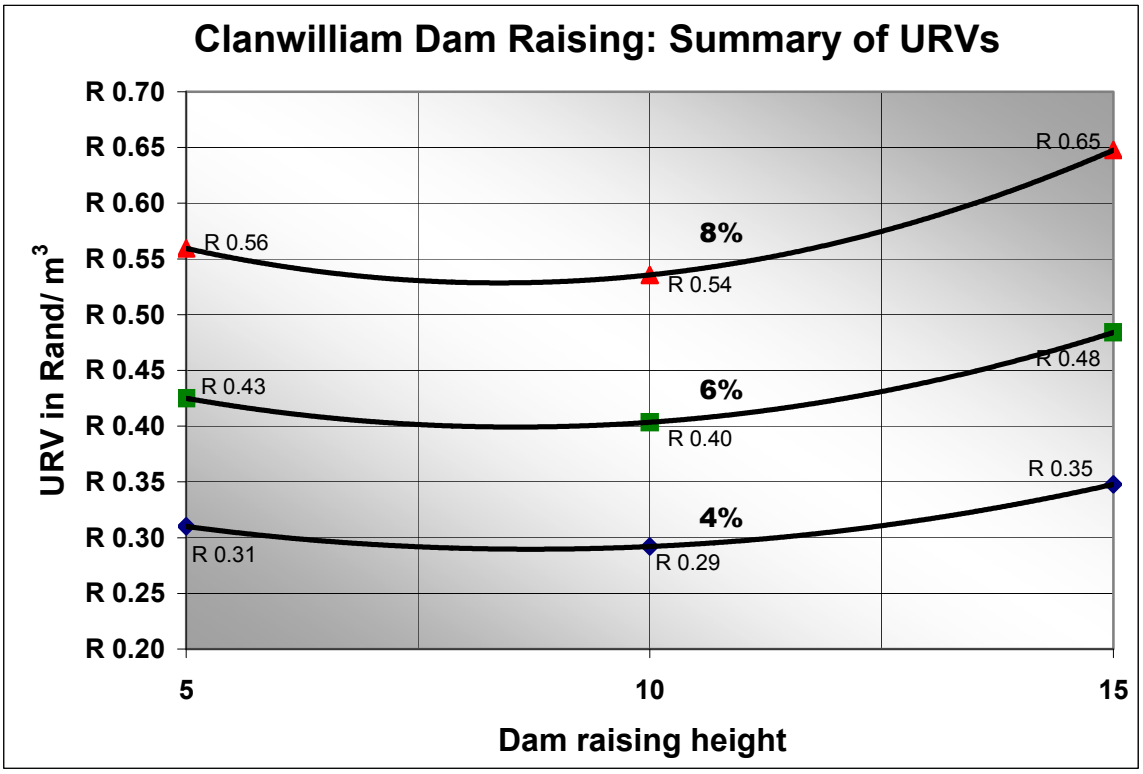

Figure 2.3 URVs for Scenario 2 at various dam raising levels

URVs for Scenario 4 are shown in **Table 2.8**.

Table 2.8 URVs for Scenario 4

Discount rate (%)	Raising		
	5 m	10 m	15 m
4	R0.21	R0.24	R0.33
6	R0.29	R0.34	R0.45
8	R0.38	R0.45	R0.61

URV calculation sheets are attached in **Appendix A**.

2.5.3 Incremental URVs

Incremental URVs have been determined for Scenario 2, as shown in **Table 2.9**. These are indicative for the other scenarios as well.

Table 2.9 Incremental URVs for Scenario 2

Incremental raising	Capital cost			Incremental yield (Mm^3/a)	URV (R/m^3)		
	Dam (10^6 R)	Other infra-structure (10^6 R)	Total cost (10^6 R)		4%	6%	8%
Raise 5 m	46.694	126.200	172.894	32	R0.31	R0.43	R0.56
Raising from 5 m to 10 m	53.763	66.600	120.363	27	R0.26	R0.36	R0.48
Raising from 10 m to 12.5 m	-	-	64.431	9	R0.43	R0.60	R0.80
Raising from 12.5 m to 15 m	-	-	64.431	5	R0.78	R1.08	R1.44

Incremental URVs for Scenario 2 are graphically depicted in **Figure 2.4**. Curves have been fitted through the points, to indicate trends.

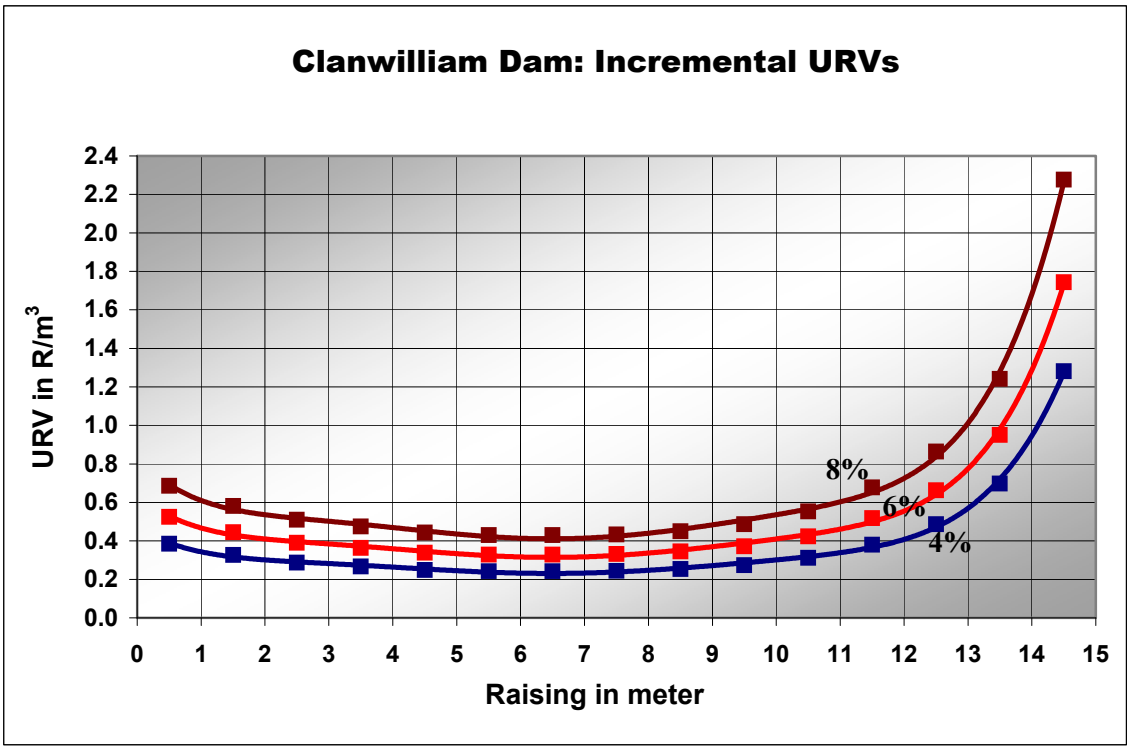

Figure 2.4 Incremental URVs for Scenario 2

2.5.4 Interpretation of the URVs

Indications are that a raising increment of about a 9 m raising would have the lowest incremental URV. The 12.5-15 m incremental raising is on the high side, and especially so for the higher discount rates, mainly because this raising increment only increases the scheme yield by 5 million m^3/a.

Selection of the recommended height of raising is a function of:

- The real demand for uptake of the increased yield;
- The URV of the scheme, for a specific level of raising;

- Incremental URVs, for the raising intervals evaluated;
- Environmental or social considerations limiting the height of raising;
- Who would be required to pay for the implementation of the Reserve; and
- Affordability/ profitability, i.e. the cost of additional water from the scheme relative to what is affordable by irrigation farmers, and notably resource-poor farmers, in terms of profit margins, cash flow and viability.

2.6 Water cost and affordability

2.6.1 Implications to existing irrigators of implementing the Reserve

The implementation of Scenario 2, for example, could potentially imply that the 21 million m^3/a reduction in yield as a result of the implementation of the Reserve, for a 10 m or 15 m raising, needs to be absorbed by the current users. An analysis under this study estimated the current irrigation water use in the Olifants River valley at 37 253 ha, using 360 million m^3/a. This calculates as a 5.8% reduction in use/allocation on average, if all irrigators in the Olifants River valley, but excluding the Doring tributary catchment, absorb this yield reduction, instead of paying for the cost to raise the Dam to re-instate the yield lost due to the implementation of the Reserve. If only the dam safety work would be done, this calculates as 4% reduction.

2.6.2 Comparative cost of other dams constructed for irrigation

A comparison of cost with recent dams, being implemented in the Western Cape, for irrigation purposes, indicate that the 2.7 million m^3 Osplaas Dam has a URV of R1, 56/m^3 (2007), although it only increases the average overall cost to existing users by about R0.27/m^3, and to increase insurance of supply from the scheme. The scheme by the Worcester-East WUA has a URV of R1,05/m^3 (2005). These are however higher than the generally accepted norm of what is regarded as affordable for irrigation schemes, likely because these mentioned schemes are for areas mainly producing table grapes, which is enjoying extremely favourable market conditions.

2.6.3 Cost of water from the scheme

The present water tariff (July 2007) per listed hectare for farmers in the LORWUA area is R2 046 (VAT incl.), of which R1 595/listed hectare is operating cost. The present cost of water upstream of the Clanwilliam Dam (i.e. Citrusdal region) is R416 per listed hectare at 12 200 m^3/ha. According to the report *Financial viability of irrigation farming* of this study, the cost of additional water would vary in a range of about R0.40/m^3 to R0.80/m^3, depending on the raising level and discounting rate and based on a loan redemption period of 25 years. The discounting of the expected future financial results was done at a real interest rate of 4% per year (i.e. a nominal interest rate of approximately 10% per year at a yearly inflation rate of, say, 6%).

2.6.4 Affordability

It is likely that a portion of the increased yield (from a raised Clanwilliam Dam), that may be reserved to increase the assurance of supply of the LOGWS to a more acceptable level, would be paid for by all current, and future, users. It would be important that this be affordable.

The *Financial viability of irrigation farming* report concludes that: "*Varying water costs are associated with the alternative possibilities as far as the raising of the Clanwilliam Dam is*

concerned. The increment between the expected highest unit water cost (i.e. R0.81/m^3) and the lowest (i.e. R0.37/m^3) is relatively small. The cost of irrigation water from the Clanwilliam Dam is a relatively small component of the total cost structure of the mainly capital intensive farming developments that are envisaged. The sensitivity analysis (i.e. farm profits versus unit water cost) thus showed that water cost per se (i.e. at the envisaged cost levels that are associated with the alternative dam raisings) will only have a minor impact on the profitability of farms".

The scheme is very affordable to existing urban water users, without taking the cost of any further downstream infrastructure into account.

2.6.5 URVs from groundwater schemes

URVs determined for groundwater sub-schemes, in the Clanwilliam Trough Scheme and for the Citrusdal Syncline Scheme, as part of the groundwater resources investigation of this study, are of a similar order as that of the Dam raising, albeit with a lower level of confidence.

2.7 Recommended height of raising

It is clear that there is a need and a desire to use additional water, made available through the raising of the Clanwilliam Dam, to support resource-poor farming projects and other broad-based black economic empowerment opportunities. LORWUA has indicated that they are also keen to take up additional water to increase the assurance of supply of the scheme, based on the interim URVs and unit water costs that were presented to them. They have further indicated that they are in favour of the maximum level of raising.

The URVs for the various raising levels are within the limits of affordability for this region, downstream of Clanwilliam Dam, although not for all crop mixes in all areas, but for an adequate range of potential areas/crop mixes to indicate that enough potential for expansion of irrigation exists. Study findings also indicate that water cost *per se*, at the envisaged cost levels associated with the alternative dam raising levels, will only have a minor impact on the profitability of farms.

The much higher incremental relative URV for the 12.5 m-15 m raising, relative to the other incremental URVs, and limited increase in yield for this increment, indicates that the option of raising the Dam to a level between 12.5 m and 15 m needs to be carefully considered. By only raising the Dam to about 13 m, unacceptable incremental water costs can be avoided, which would make the water more affordable, with a very limited decrease in the additional yield that would be made available by the raising of the Dam to 15 m.

It has been concluded that the difference between the 5,10 and 15 m impacts are not sufficient to motivate one raising option strongly over another for environmental reasons. There are no impacts therefore that, with mitigation, are so significant that they would rule out a raising of up to the 15 m option.

Various scenarios have been considered regarding payment for the implementation of the Reserve. If this cost would be included in the cost of the scheme for new users, it would significantly increase the URVs and subsequently the cost of water. This option (Scenario 1) is therefore not recommended. It is rather recommended that such cost be distributed among all users, existing and future (Scenario 3). This could even be further refined, by potentially waiving

such cost, for new (and possibly existing) resource-poor farmers, but the further evaluation of the consequences of such a decision is required.

Affordability of the cost of water from the raising scheme is not seen as a stumbling block, with the condition that all further irrigation initiatives should be proven feasible.

2.8 Motivation for investing in this scheme

The Olifants River Valley, like much of South Africa, is characterised by significant income and social disparities and fluctuating seasonal unemployment. The active encouragement of allocations of water to resource-poor farmers has been identified as one way of addressing some of these development issues. This commitment to achieving social development and equity through the allocation of water to resource-poor farmers is also captured in the DWAF's Olifants/Doorn Internal Strategic Perspective (DWAF, 2005) where it is identified as one of the key poverty eradication strategies for the area.

The distribution of individual monthly income in the Cederberg and Matzikama municipalities show a very high percentage of individuals (58%) earning R800 or less per month. This is a far higher proportion of low wage earners than elsewhere in the Western Cape, which has only 26% of individuals earning R800 or less.

Although employment levels are relatively high in the study area compared to national figures, the seasonality of employment is not visible from the Census figures. The percentage of the possible population that is not economically active is also high, particularly amongst women, which results in the much lower employment level of women in the study area. This may be due to the nature of employment in the area, which is predominantly in agriculture, with a lack of opportunities for women in this industry. Two thirds of the employees in this sector are men. The relative split between men and women in each sector is consistent with the average employment characteristics of the Western Cape. Half of all jobs in the area are in agriculture. This is significantly higher than for the Western Cape where agriculture accounts on average for only 13% of jobs.

If the level of assurance for existing farmers is to be raised then this could be used for the purposes of poverty eradication and development of the historically disadvantaged communities in the area provided the commercial gains from the increased level of assurance are reflected in increased wages for farm workers.

Raising of the Dam provides a significant opportunity for transformation of the commercial agricultural sector in this area. The current inequity in the distribution of water across South Africa has resulted in a focus on the National Water Act in facilitating a degree of redistribution to achieve water allocation reform. The current inequity in the distribution of water across South Africa has resulted in a focus on the National Water Act in facilitating a degree of redistribution. This can take place through the re-allocation of existing resources, and through the preferential allocation of newly available water to previously disadvantaged users. This second situation would prevail in the case of the raising of the Clanwilliam Dam, with the potential benefit to society of how this water is allocated measured in terms of the contribution to racial and gender equity in the area as well as the amount of employment creation.

It is however necessary to distinguish between making water available for the enhancement of livelihoods and the eradication of poverty on the one hand, and for the transformation of commercial agriculture on the other.

3. SCHEME FINANCING OPTIONS

3.1 Introduction

A key factor in the financing of future water resource infrastructure is the issue of ownership. If the asset were owned by the DWAF, then the finance charges for the construction, or betterment of the asset, would fall under the *Pricing Strategy for Raw Water Use Charges*. Clanwilliam Dam is currently owned by the DWAF and therefore all charges levied would have to be in terms of the Pricing Strategy.

It is not the DWAF's policy to develop new Government irrigation schemes. Where a storage scheme is developed for other purposes than for irrigation, and when established irrigation farmers would benefit by an increased assurance of supply, the full operation and maintenance costs will be payable. New farmers would only be given access to irrigation, or existing farmers be allowed to expand, on condition that the full financial cost (O&M plus depreciation plus return on assets) be paid for such a new development.

3.2 Assets owned by DWAF

There are a number of options set out in the Pricing Strategy for the financing of Water Resource Infrastructure.

3.2.1 Return on assets (ROA)

This charge reflects payment for the development and betterment capital value of waterworks on government water schemes. It is determined by fixing a charge to earn a specific rate of return on the current depreciated replacement value of the infrastructure.

ROA is based on the social opportunity cost of capital to government and this should approach a level sufficient to fund the annual capital expenditure budget requirement for the development of new waterworks and betterment of existing infrastructure from the fiscus.

In terms of the proposed revised Pricing Strategy, once a ring-fenced provision account for ROA has been established, ROA revenue will be applied to the funding of water resource development, prioritised as follows:

(i) Planning and feasibility of future augmentation;
(ii) Betterment;
(iii) Social projects.

The raising of Clanwilliam Dam could fall into the category of "betterment" and to a large degree under "social project", as part of the yield would be allocated to assist resource-poor farmers.

3.2.2 Government schemes funded off-budget

Water management institutions such as the Trans Caledon Tunnel Authority (TCTA), which are directed by the Minister of the DWAF, to implement and fund government water schemes off-

budget, are entitled by the NWA to raise loans to finance the development of new water resource infrastructure, and should therefore be able to service these loans through cost recovery. These institutions, in consultation with stakeholders, can determine the extent of charges on a project-by-project basis, as determined by the proposed financial modelling. The primary charge will be the Capital Unit Charge (CUC). An example of this funding arrangement is the construction of the Berg Water Project to augment water to the City of Cape Town (CCT). The CCT has an Agreement with DWAF, who in turn have an Agreement with TCTA. The loans are raised by TCTA on the strength of these Agreements and the end-user (i.e. CCT's consumers) pay for the full cost of the Berg Water Project.

3.2.3 Schemes Owned by CMAs and WUAs

Catchment management agencies and water user associations can levy charges for the development and use of waterworks. These charges, in terms of the Pricing Strategy, must *inter alia* take the following into account:

(a) Recovery of overheads/management, operations and maintenance costs;
(b) Recovery of capital costs and the servicing of loans (water management institutions are entitled by the Act to raise loans to finance new water supply infrastructure, and should therefore be able to service these loans through cost recovery);
(c) Reasonable provision for the depreciation of assets, which can be placed in a reserve fund for utilisation at the appropriate time for refurbishment;

Charges levied by water management institutions may be levied on a proportional or differential basis, depending on the relevant constitution, or if directed so by the Minister to give effect to the provisions regarding the rendering of financial assistance in terms of the National Water Act (NWA).

3.2.4 Betterment charges

A betterment implies an improvement of an asset, resulting in an increased capital value thereof. Examples are the raising of an existing dam to increase the yield, the enlargement of a canal to increase capacity and the improvement of the stability of dams, for safety purposes.

On existing and new government-funded schemes, betterments will be funded through the ROA provision. After betterment is introduced, the real value of the asset will increase, resulting in an increased ROA amount for charge-setting purposes. On off-budget schemes, the Minister of the DWAF, or the water management institution, may levy the charge in consultation with the end-users, following construction of the new water infrastructure. The charge may, at the discretion of the end-user, either be determined on an actual costs-recovery basis, or be determined, taking into consideration the need to smooth, over time, the impact of the charge, if high capital costs have to be incurred to increase the availability of water, or to maintain the assurance of supply.

The same principles of the Capital Unit Charge will apply in collecting revenue from the charge.

3.2.5 Combinations of financing mechanisms

There is the possibility that a combination of the abovementioned financing options could be implemented. For example, TCTA may implement the raising of Clanwilliam Dam, but because a portion of the yield would be allocated to resource-poor farmers, the DWAF may subsidise a portion of the financing costs through the ROA charge.

The dam safety work will be paid for by the DWAF.

3.2.6 Phasing in of charges

In terms of the proposed revised Pricing Strategy, the water use charges will be phased in, in the following manner, for established farmers and for resource-poor farmers.

Established farmers

(a) Full Operation and Maintenance costs will be recovered annually, with an annual increase limited to 50%, if the current unit charge is still sufficiently far below the calculated unit cost to render reaching the full unit cost in one annual step impossible.
(b) Depreciation charges for existing schemes will be capped at 1.5 cents per meter^3 plus producer pricing index (PPI) (rate) with 2006/07 as base year.
(c) Full financial cost recovery (including ROA) for new schemes.

Resource-poor farmers

(a) Operation and maintenance charges will be phased in over five years from date of registration of the relevant water use.
(b) Depreciation charges will be waived for five years. Thereafter charges will be capped at 1.5 cent per meter^3 plus PPI (rate).
(c) Capital cost for new development will be subsidised by the fiscus.
(d) Further waiving of charges will be considered for a limited time period on request by the custodian Department, where land and agricultural reform programmes are involved.

3.3 Assets not owned by the DWAF

This would involve transfer of the asset to the WUAs.

4. FINANCING OPTIONS FOR RESOURCE-POOR FARMERS

4.1 Opportunities to support Resource-poor Farmers

A separate study, into the potential to use water from the Clanwilliam Dam to support the development of resource-poor farmers (RPF) in the area, concluded that a suite of possible opportunities should be considered. The research team argues that the large-scale black irrigation schemes, common in our history, serve to entrench the process of separate development, whereas the range of options suggested and required here will result in more integrated development and with that a normalisation of society. There are some opportunities to establish black farmers on new areas, but these would need to be complemented by a range of other options for using the water. These options may also prove to have a higher chance of success and greater benefits than the development of new schemes. This suite of options that should be considered includes:

- Ensuring the protection of the Reserve;
- Allocation of additional water to the municipalities;
- Allocation of water to ensure availability for municipal commonage schemes;
- Establishment of a development company (DEVCO) to co-ordinate the development of a sustainable broad-based black economic empowerment agricultural project;
- Support for Joint ventures between existing commercial farmers and RPFs;
- Encourage black commercial farmers and investors;
- Encourage existing commercial farmers to provide sufficient land and water to existing farm workers;
- Use allocation of additional water as an incentive to make land available for land reform;
- Retain water "in trust" for future allocation.

4.2 Possible Sources of Funding for Resource-poor Farmers

The lack of financial support has been highlighted as one of the main hindrances to emerging farmers. Funding is required for capital expenses as well as to fund equity acquisition in a joint venture. There is however, a wide range of potential sources of funding for resource-poor farmers and some of these are discussed below.

4.2.1 Department of Land Affairs

The *Land Redistribution for Agricultural Development* (LRAD) programme is a sub-programme of the Redistribution Programme of the Department of Land Affairs (DLA) and is designed to provide grants to black South African citizens to access land specifically for agricultural purposes. There are two parts to the LRAD. First, there is the part that deals with transfer of agricultural land to specific individuals or groups. Second, there is the part dealing with commonage projects, which aim to improve people's access to municipal and tribal land primarily for grazing purposes. Both these parts of the sub-programme deal with agricultural land redistribution. However, they

operate according to different financial mechanisms, different target groups, and different delivery systems. The key objectives of the LRAD programme are summarised below[1]:

- LRAD focuses on Blacks and will assist them to gain increased access to agricultural land, for use and ownership.
- The grant, which the State provides, is free and does not need to be repaid. However, it is expected of applicants to provide an own contribution to the value of at least R5 000, in the form of cash, labour or agricultural implements. A larger own contribution by applicants will result in a larger grant from the State. To receive the minimum grant amount of R20 000 an applicant must make an own contribution of R5 000, while an own contribution of R40 000 is required in order to access the maximum grant amount of R100 000.
- The grant may be used for land acquisition, investments in infrastructure, short-term agricultural inputs, as well as land improvements in cases where applicants already have access to land. The grant may also be applied for where land is currently leased with the intention to buy at a later stage.
- The Department of Land Affairs will ensure that applicants who require assistance are provided access to design agents, who will aid with the planning and implementation of the projects. The Department will pay design agents appointed in this manner. However, the grant, which applicants may receive, will not be affected.
- Applicants who possess the necessary resources to appoint and pay design agents may do so without prior consultation with the Department. This will also be regarded as a form of own contribution to the project.

4.2.2 Department of Water Affairs and Forestry

Financial assistance is available to resource-poor farmers in terms of Sections 61 and 62 of the National Water Act. The details of these grants are given in the DWAF's Policy on Financial Assistance to Resource-poor Irrigation Farmers.

There are six proposed forms of grants, which the DWAF can provide to resource-poor farmers who are members of WUAs or other approved legal entities. These are:

- Grants on the capital cost for the construction and/or upgrading of irrigation schemes;
- Grant or subsidy on operation and maintenance of waterworks and water resource management and depreciation charges, phased out over a six year period;
- Grant for the acquisition of water entitlements for irrigation;
- Grant for preliminary or remedial socio-economic viability studies and investigations on irrigation schemes;
- Grant on training of Management Committees of WUAs; and
- Grant on rainwater tanks for family food production and other productive uses.

Applications for these grants or subsidies should be channelled through the provincial Co-ordinating Committees on Agricultural Water (CCAWs) and each has different financial extents and conditions that need to be satisfied in order to qualify for the grant.

4.2.3 Agricultural Organisations

The majority of agricultural organisations have some development and empowerment initiatives that could be accessed by emerging farmers to provide financial assistance as well as

[1] http://www.elsenburg.com/settlement/lrad.html

development support and training. An example of this is the South African Wine Industry Trust (SAWIT).

The SAWIT[2], through its Development Company (DEVCO), provides support to Black communities linked to the wine and spirits industry in the facilitation of entrepreneurial development and BEE equity transactions. SAWIT makes funds available to individual communities for the purposes of land acquisition and capital expenses as well as to support other initiatives such as the Rural Development Network (Rudnet), which is involved in the training and capacity building of farm workers in the wine industry.

The primary objectives of the DEVCO are:

- Establishment of new farmers in the wine industry and wine industry related businesses, from previously disadvantaged groups;
- Support and upliftment of farm workers in the wine industry and their Communities;
- Assist in:
  - Marketing of wine products;
  - The cost of surplus removal of wine and wine products;
  - Extension services for the new wine grower entrants.

To be eligible for funding, potential recipients must submit a full proposal for consideration by the Board of SAWIT. No guidelines are given on the amount of funds available.

The above example refers to only one example of an agricultural organisation that could provide support for the development of RPF projects. Depending on the nature of the project, it is possible that other organisations active in the citrus, vegetable or other agricultural sector would be able to provide similar support for RPF schemes. These would have to be considered on an individual project basis.

4.2.4 Department of Provincial and Local Government

The Department of Provincial and Local Government (DPLG) provides partial funding for the development of municipal infrastructure projects primarily through the municipal infrastructure grant (MIG). This funding is intended for the development of domestic water supply infrastructure rather than irrigation systems. Improving and increasing the supply of domestic water, however, can also play a significant role in providing opportunities for the enhancement of basic livelihoods and poverty reduction through vegetable gardening and small scale commercial uses (see for example Moriarty and Butterworth, 2003).

4.2.5 Department of Labour

Funds are available for skills development through the Primary Agriculture Education and Training Authority (PAETA)[3]. R33 million has been approved from the National Skills Fund administered by the Department of Labour to promote skills development in the agricultural sector. These funds are administered by PAETA and the beneficiaries of the programme are levy-paying farmers as well as small and emerging farmers.

[2] http://www.sawit.co.za
[3] http://www.paeta.co.za

4.2.6 Land Bank

The Land Bank, in its commitment to BEE in the agricultural industry has developed a suite of low interest finance products to encourage the transformation of the industry. These include:

- Equity Finance: a product designed specifically to support black economic empowerment in agriculture and agri-business.
- Loans for beneficiaries of land reform: to help finance the government's land redistribution efforts
- Step up micro-loans: for people starting an enterprise or a small farming business but who can't get loans from other banks. The micro-loan helps people get a track record of good borrowing so that they can get bigger loans in future.

A summary of the various options for financial support to resource-poor farmers for the water supply infrastructure and water resource management costs is given in **Table 4.1**.

Table 4.1 Possible sources of financial support to RPFs

Institution	Financial support	Bulk Infra-structure	On-farm Infra-structure	Water Resource Charges	Operation and Maint.	Other costs	Value	Conditions
DWAF	Capital costs	X	X				Proportional Share, R15 000/ha or R75 000 per member	Grant made available to WUA
	Operation and Maintenance Costs			X	X		100% in 1st year reducing to 0% in 6th year	Grant phased out over six-year period.
	Acquisition of water entitlements					X	75% of purchase price, R7 500/ha or R37 500/ member	Section 34 of NWA.
	Viability studies					X	Proportional share, R500/ha or R2500 per member	Grant made available to WUA only.
	Training of Management Committees					X	R1 800/ member or 90% of course fees	Subject to recommendation of CCAW and approval by DWAF
	Rain Water tanks					X	R5 000 per tank	One tank per household
DLA	LRAD		X			X	R20 000 to R40 000	Requires own contribution of R5 000 to R100 000.
DoL	PAETA					X	Variable	R33 million available for skills training
Land Bank	Equity finance		X	X	X	X	Variable	
	Loans		X	X	X	X	Variable	Beneficiaries of land reform
	Step up Micro Loans		X	X	X	X	Variable	
DPLG	MIG Funding	X				X	Variable	Primarily for municipal projects such as providing bulk water for domestic consumption

4.3 Olifants/Doring River Development Agency

The main conclusion from this study was that there is potential to use water to support the development of previously disadvantaged individuals in the area, but the solution is not a single large-scale RPF scheme. Instead, a suite of development options should be considered. The proposed development options recognised the duel objectives of using water to support poverty alleviation and sustainable livelihoods on the one hand, and the need for transformation of commercial agriculture, on the other. The proposed development options will, however, require significant engagement by DWAF and close co-operation with other spheres of government to ensure the success of any initiative.

In order to ensure the equitable distribution of the benefits from the raising of the Dam, it will be necessary to establish a multi-stakeholder ODDA. The ODDA should be responsible for developing a vision for the catchment, identifying possible opportunities and partnerships and preparing a business plan for the equitable allocation of water. The ODDA should be responsible for co-ordinating the development of the proposed initiatives and monitoring the progress so that changes can be made when necessary or in response to new opportunities that arise.

5. FINDINGS

The main conclusions that can be drawn are discussed under the following headings:

5.1 Capital costs

i) Capital costs have been determined, with a base year of 2006, to make the dam safe for extreme events (0m for dam safety), as well as for the raising of the dam by 5 m, 10 m and 15 m. At each FSL an ogee and a labyrinth spillway option were investigated and costed. For the three raisings the option of lengthening the spillway by 21,35 m was also considered. At each raising level a capital cost was selected (generally the lowest) and the cost relative to the 0 m raising for an ogee spillway was determined, and was used for the URV calculations. Capital costs dam safety work is R165.9 million, and for the three raising options vary from R172.9 to R422.1 million for Scenario 2.

5.2 Scenarios for yields and costs determination

ii) Due to the initial uncertainty about how the Reserve would be implemented with respect to the financing thereof, four scenarios were formulated, specifically addressing various ways in which the Reserve could be implemented and paid for.

iii) The implementation of Scenario 1 is not recommended, as water cost would be too high, and it is unacceptable that only additional/new users pay for the implementation of the Reserve.

iv) Scenarios 2 or 3 are recommended, with Scenario 3 being preferred to Scenario 2, as it makes sense that all users have to contribute towards the Reserve.

v) The selection of Scenario 4 is fully dependent on the position of the DWAF in terms of responsibility for the Reserve. If DWAF decides to fund the implementation of the Reserve, which under present DWAF policy is considered unlikely, water costs would be much lower, and more affordable.

5.3 Diversion potential and rules upstream of Clanwilliam Dam

vi) The potential for additional diversion from this river reach was assessed by analysing diversions for a range of flows, up to 3 m^3/s, from daily flows, for a 72-year period. It was concluded that the potential to pump additional water from the upper Olifants River during winter, for use during summer, does not pose any constraint.

vii) It is recommended that the increased pumping of winter water, for storage and use during summer, be encouraged, to significantly limit the pumping from the river during the summer

months, to improve the ecological condition of the upper Olifants River. This requires a change in the licence condition for current abstraction, from the Olifants River, upstream of Clanwilliam Dam, strict enforcement of limited pumping during summer, and outlawing of boreholes in, or close to, the riverbed, that affects river flow.

viii) The reduction in the yield of Clanwilliam Dam would need to be considered.

5.4 Increased yield of Clanwilliam Dam

ix) Yields were determined for the various Scenarios, for the range of dam raising options, relative to the yield of the existing Olifants River Government Water Scheme (ORGWS), which comprises Clanwilliam Dam, Bulshoek Weir and the associated distribution infrastructure. Yields range from 16 million m^3/a to 73 million m^3/a. The decrease in yield, due to the implementation of the Reserve, was determined for the existing dam (dam safety work), as well as for the three dam raising options.

5.5 Unit reference values

x) URVs were determined for three scenarios, based on a range of assumptions, for the various dam raising options, and for discount rates of 4%, 6% and 8% respectively.

xi) Incremental URVs have been determined for Scenario 2, which are indicative for the other Scenarios as well. Indications are that a raising increment of between the 0-5 m raising and the 5-10 m raising would have the lowest URV, while the 5-15 m incremental raising is on the high side, and especially so for the higher discount rates.

xii) A range of criteria for the selection of the recommended height of raising has been recommended.

5.6 Water cost and affordability

xiii) Implications were determined for the potential situation where the reduction in yield, as a result of the implementation of the Reserve, needs to be absorbed by the current Olifants River irrigators users, which could vary from 4%, for dam safety work only, to 5.8% for a 10 m or 15 m raising.

xiv) It is concluded that the cost of additional water would vary in a range of about R0.40/m^3 to R0.80/m^3, depending on the raising level and discounting rate and based on a loan redemption period of 25 years. The sensitivity analysis (i.e. farm profits versus unit water cost) shows that water cost *per se* (i.e. at the envisaged cost levels that are associated with the alternative dam raisings) will only have a minor impact on the profitability of farms.

xv) The scheme is very affordable to existing urban water users, without taking the cost of any further downstream infrastructure into account.

xvi) URVs determined for groundwater sub-schemes, in the Clanwilliam Trough Scheme and for the Citrusdal Syncline Scheme, as part of the groundwater resources investigation of this study, are of a similar order as that of the dam raising, but at a lower level of confidence.

5.7 Recommended height of raising

xvii) A 15 m raising, which is the maximum potential level of raising, is technical feasible, with a URV that could vary, depending on the financing scenario selected, but is of acceptable order.

xviii) There is adequate demand for water and significant support for the dam raising from LORWUA and in general.

xix) This scheme offers significant opportunities for water allocation reform and this should be pursued.

xx) The uncertainty around the financial implementations of the implementation of the Reserve must be urgently clarified.

xxi) The recommended level of raising is a level between 12.5 m and 15 m, to limit the raising of the last meters of raising that would have unacceptably high URVs. A raising level of 13 m therefore seems sensible, based on existing information.

xxii) Should the financial Scenario 4 (the DWAF pays for implementation of the Reserve) be selected for implementation, a 15 m raising is recommended, as URVs for this scheme would be significantly lower.

5.8 Motivation for investing in this scheme

xxiii) The active encouragement of allocations of water to resource-poor farmers from the dam raising scheme can address significant income and social disparities, low-income levels, and fluctuating seasonal unemployment in the Olifants River Valley. The commitment to achieving social development and equity through the preferential allocation of water to resource-poor farmers is one of the key poverty eradication strategies for the area. The nature of employment in the area is predominantly in agriculture, with a lack of opportunities for women in this industry. The percentage of the possible population that is not economically active is also high, particularly amongst women. Half of all jobs in the area are in agriculture.

xxiv) The raising of the Dam provides a significant opportunity for transformation of the commercial agricultural sector in this area. A further potential benefit to society would be the contribution to racial and gender equity in the area, as well as the amount of employment creation.

xxv) It is necessary to distinguish between making water available for the enhancement of livelihoods and the eradication of poverty on the one hand, and for the transformation of commercial agriculture on the other.

5.9 Scheme financing options

xxvi) Because Clanwilliam Dam is owned by the DWAF, all charges, following the dam raising, would be levied in terms of the *Pricing Strategy for Raw Water Use Charges*. New farmers would only be given access to irrigation, or existing farmers be allowed to expand, on condition that the full financial cost (O&M plus depreciation plus return on assets) be paid for the development.

xxvii) A number of options for financing of the scheme, as set out in the Pricing Strategy, are discussed. These include:

- Return on assets (ROA);
- Government schemes funded off-budget;
- Schemes Owned by CMAs and WUAs;
- Betterment charges;
- Combinations of financing mechanisms;
- Phasing in of charges.

5.10 Financing options for resource-poor farmers

xxviii) A suite of possible opportunities have been recommended, to be considered for the potential use of water from the Clanwilliam Dam, to support the development of resource-poor farmers in the area.

xxix) The lack of financial support has been highlighted as one of the main hindrances to emerging farmers. Funding is required for capital expenses as well as to fund equity acquisition in a joint venture. A wide range of potential sources of funding for resource-poor farmers have therefore been identified and discussed, and includes:

- Department of Land Affairs;
- Department of Water Affairs and Forestry;
- Agricultural organisations;
- Department of Provincial and Local Government;
- Department of Labour; and
- Land Bank.

6. RECOMMENDATIONS

Based on the findings, the following recommendations are made:

i) It is concluded that the raising of the Clanwilliam Dam is technically feasible, up to the 15 m raising level, and is socially desirable. It is further concluded that the difference between the 5,10 and 15 m impacts are not sufficient to motivate one raising option strongly over another for environmental reasons. There are no impacts therefore that, with mitigation, are so significant that they would rule out a raising up to the 15 m option.

ii) On existing information, a 9 m raising results in the lowest URV for the most likely scenarios (i.e. 2 or 3), but a 13 m raising is recommended, as it would make additional water available from the scheme for only a slight increase in unit cost. This scheme would have a yield of 69.5 million m^3/a, for a capital cost of R370.6 million and a unit reference value of R0.45/m^3, for the Scenario 2 option, at a 6% discount rate. The URV for Scenario 3 for the 13 m raising, at a 6% discount rate, would be R0.47/m^3.

iii) The Dam could be implemented either by the DWAF, LORWUA, the TCTA, or the Infrastructure Agency. The DWAF has indicated that the scheme will most likely be implemented by its own Implementation Branch with funding by Treasury.

iv) A portion of the increased yield of the Dam should be reserved to increase the assurance of supply of the LOGWS to a more acceptable level, and be paid for by all current, and future, users. The LORWUA must indicate their specific requirements in this regard.

v) According to current DWAF policy, the cost of the implementation of the Reserve should be distributed amongst all users. The potential waiving of such cost, for new (and possibly existing) resource-poor farmers could be considered.

vi) All irrigation initiatives for uptake of water from the Dam raising should be proven to be feasible and beneficial, taking into account the additional water distribution cost.

vii) In order to ensure the equitable distribution of the benefits from the raising of the Dam, the establishment of a multi-stakeholder ODDA should be considered. The ODDA would be responsible for developing a vision for the catchment, identifying possible opportunities and partnerships and preparing a business plan for the equitable allocation of water. The ODDA would be responsible for co-ordinating the development of the proposed initiatives and monitoring the progress so that changes could be made when necessary or in response to new opportunities that arise.

viii) The increased pumping of winter water upstream of Clanwilliam Dam, for storage and use during summer, should be managed through revised licence conditions, to significantly limit the pumping from the river during the summer months, to improve the ecological condition of the upper Olifants River.

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Johan Matthee, Lower Olifants River Water User Association, pers. comm.

APPENDIX A

Unit Reference Value Sheets

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 1: New users pay for the Reserve

Yield: 16.000 M m³

Scheme: 5m Raising

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 0.4322 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2010>	172.894			172.894
	172.894			*172.894*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	172.894	0.000	0.000	172.894

Cal Year	*Year*	*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	Check>> *Elec.*
								172.894
2007	1	0.00	0.00	172.894	0.000	0.000	0.000	0.000
2008	2	0.00	0.00		0.000	0.000	0.000	0.000
2009	3	0.00	0.00		0.000	0.000	0.000	0.000
2010	4	8.00	8.00		0.000	0.000	0.216	0.000
2011	5	16.00	16.00		0.000	0.000	0.432	0.000
2012	6	16.00	16.00		0.000	0.000	0.432	0.000
2013	7	16.00	16.00		0.000	0.000	0.432	0.000
2014	8	16.00	16.00		0.000	0.000	0.432	0.000
2015	9	16.00	16.00		0.000	0.000	0.432	0.000
2016	10	16.00	16.00		0.000	0.000	0.432	0.000
2017	11	16.00	16.00		0.000	0.000	0.432	0.000
2018	12	16.00	16.00		0.000	0.000	0.432	0.000
2019	13	16.00	16.00		0.000	0.000	0.432	0.000
2020	14	16.00	16.00		0.000	0.000	0.432	0.000
2021	15	16.00	16.00			0.000	0.432	0.000
2022	16	16.00	16.00			0.000	0.432	0.000
2023	17	16.00	16.00			0.000	0.432	0.000
2024	18	16.00	16.00			0.000	0.432	0.000
2025	19	16.00	16.00			0.000	0.432	0.000
2026	20	16.00	16.00			0.000	0.432	0.000
2027	21	16.00	16.00			0.000	0.432	0.000
2028	22	16.00	16.00				0.432	0.000
2029	23	16.00	16.00				0.432	0.000
2030	24	16.00	16.00				0.432	0.000
2031	25	16.00	16.00				0.432	0.000
2032	26	16.00	16.00				0.432	0.000
2033	27	16.00	16.00				0.432	0.000
2034	28	16.00	16.00				0.432	0.000
2035	29	16.00	16.00				0.432	0.000
2036	30	16.00	16.00				0.432	0.000
2037	31	16.00	16.00				0.432	0.000
2038	32	16.00	16.00				0.432	0.000
2039	33	16.00	16.00				0.432	0.000
2040	34	16.00	16.00				0.432	0.000
2041	35	16.00	16.00				0.432	0.000
2042	36	16.00	16.00				0.432	0.000
2043	37	16.00	16.00				0.432	0.000
2044	38	16.00	16.00				0.432	0.000
2045	39	16.00	16.00				0.432	0.000
2046	40	16.00	16.00				0.432	0.000
2047	41	16.00	16.00				0.432	0.000
2048	42	16.00	16.00				0.432	0.000
2049	43	16.00	16.00				0.432	0.000
2050	44	16.00	16.00				0.432	0.000
2051	45	16.00	16.00				0.432	0.000

									Sum
Present Value @	***4.00%***	280.281							
			166.244	0.000	0.000	0.000	0.000	7.572	0.000	173.816
			Unit Reference Value =				0.620		
Present Value @	***6.00%***	198.188							
			163.108	0.000	0.000	0.000	0.000	5.354	0.000	168.462
			Unit Reference Value =				0.850		
Present Value @	***8.00%***	146.621							
			160.087	0.000	0.000	0.000	0.000	3.961	0.000	164.048
			Unit Reference Value =				1.119		

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 1: New users pay for the Reserve

Yield: 43.000 M m³

Scheme: **10m Raising**

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 0.7331 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2010>	293.257			293.257
	293.257			*293.257*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	293.257	0.000	0.000	293.257

Cal Year	*Year*	*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	*Elec.*
							Check>>	293.257
2007	1	0.00	0.00	293.257	0.000	0.000	0.000	0.000
2008	2	0.00	0.00		0.000	0.000	0.000	0.000
2009	3	0.00	0.00		0.000	0.000	0.000	0.000
2010	4	0.00	0.00		0.000	0.000	0.000	0.000
2011	5	43.00	43.00		0.000	0.000	0.733	0.000
2012	6	43.00	43.00		0.000	0.000	0.733	0.000
2013	7	43.00	43.00		0.000	0.000	0.733	0.000
2014	8	43.00	43.00		0.000	0.000	0.733	0.000
2015	9	43.00	43.00		0.000	0.000	0.733	0.000
2016	10	43.00	43.00		0.000	0.000	0.733	0.000
2017	11	43.00	43.00		0.000	0.000	0.733	0.000
2018	12	43.00	43.00		0.000	0.000	0.733	0.000
2019	13	43.00	43.00		0.000	0.000	0.733	0.000
2020	14	43.00	43.00		0.000	0.000	0.733	0.000
2021	15	43.00	43.00			0.000	0.733	0.000
2022	16	43.00	43.00			0.000	0.733	0.000
2023	17	43.00	43.00			0.000	0.733	0.000
2024	18	43.00	43.00			0.000	0.733	0.000
2025	19	43.00	43.00			0.000	0.733	0.000
2026	20	43.00	43.00			0.000	0.733	0.000
2027	21	43.00	43.00			0.000	0.733	0.000
2028	22	43.00	43.00				0.733	0.000
2029	23	43.00	43.00				0.733	0.000
2030	24	43.00	43.00				0.733	0.000
2031	25	43.00	43.00				0.733	0.000
2032	26	43.00	43.00				0.733	0.000
2033	27	43.00	43.00				0.733	0.000
2034	28	43.00	43.00				0.733	0.000
2035	29	43.00	43.00				0.733	0.000
2036	30	43.00	43.00				0.733	0.000
2037	31	43.00	43.00				0.733	0.000
2038	32	43.00	43.00				0.733	0.000
2039	33	43.00	43.00				0.733	0.000
2040	34	43.00	43.00				0.733	0.000
2041	35	43.00	43.00				0.733	0.000
2042	36	43.00	43.00				0.733	0.000
2043	37	43.00	43.00				0.733	0.000
2044	38	43.00	43.00				0.733	0.000
2045	39	43.00	43.00				0.733	0.000
2046	40	43.00	43.00				0.733	0.000
2047	41	43.00	43.00				0.733	0.000
2048	42	43.00	43.00				0.733	0.000
2049	43	43.00	43.00				0.733	0.000
2050	44	43.00	43.00				0.733	0.000
2051	45	43.00	43.00				0.733	0.000

								Sum
Present Value @	***4.00%***	734.876						
		281.978	0.000	0.000	0.000	0.000	12.530	0.000	294.507
		Unit Reference Value =				0.401		
Present Value @	***6.00%***	515.601						
		276.658	0.000	0.000	0.000	0.000	8.791	0.000	285.448
		Unit Reference Value =				0.554		
Present Value @	***8.00%***	378.240						
		271.534	0.000	0.000	0.000	0.000	6.449	0.000	277.983
		Unit Reference Value =				0.735		

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 1: New users pay for the Reserve

Yield: 57.000 M m³

Scheme: 15m Raising

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 1.0553 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2011>	422.119			422.119
	422.119			*422.119*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	422.119	0.000	0.000	422.119

Cal Year	*Year*				*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	Check>> *Elec.*	422.119
2007	1				0.00	0.00	422.119	0.000	0.000	0.000	0.000	
2008	2				0.00	0.00		0.000	0.000	0.000	0.000	
2009	3				0.00	0.00		0.000	0.000	0.000	0.000	
2010	4				0.00	0.00		0.000	0.000	0.000	0.000	
2011	5				28.50	28.50		0.000	0.000	0.528	0.000	
2012	6				57.00	57.00		0.000	0.000	1.055	0.000	
2013	7				57.00	57.00		0.000	0.000	1.055	0.000	
2014	8				57.00	57.00		0.000	0.000	1.055	0.000	
2015	9				57.00	57.00		0.000	0.000	1.055	0.000	
2016	10				57.00	57.00		0.000	0.000	1.055	0.000	
2017	11				57.00	57.00		0.000	0.000	1.055	0.000	
2018	12				57.00	57.00		0.000	0.000	1.055	0.000	
2019	13				57.00	57.00		0.000	0.000	1.055	0.000	
2020	14				57.00	57.00		0.000	0.000	1.055	0.000	
2021	15				57.00	57.00			0.000	1.055	0.000	
2022	16				57.00	57.00			0.000	1.055	0.000	
2023	17				57.00	57.00			0.000	1.055	0.000	
2024	18				57.00	57.00			0.000	1.055	0.000	
2025	19				57.00	57.00			0.000	1.055	0.000	
2026	20				57.00	57.00			0.000	1.055	0.000	
2027	21				57.00	57.00			0.000	1.055	0.000	
2028	22				57.00	57.00				1.055	0.000	
2029	23				57.00	57.00				1.055	0.000	
2030	24				57.00	57.00				1.055	0.000	
2031	25				57.00	57.00				1.055	0.000	
2032	26				57.00	57.00				1.055	0.000	
2033	27				57.00	57.00				1.055	0.000	
2034	28				57.00	57.00				1.055	0.000	
2035	29				57.00	57.00				1.055	0.000	
2036	30				57.00	57.00				1.055	0.000	
2037	31				57.00	57.00				1.055	0.000	
2038	32				57.00	57.00				1.055	0.000	
2039	33				57.00	57.00				1.055	0.000	
2040	34				57.00	57.00				1.055	0.000	
2041	35				57.00	57.00				1.055	0.000	
2042	36				57.00	57.00				1.055	0.000	
2043	37				57.00	57.00				1.055	0.000	
2044	38				57.00	57.00				1.055	0.000	
2045	39				57.00	57.00				1.055	0.000	
2046	40				57.00	57.00				1.055	0.000	
2047	41				57.00	57.00				1.055	0.000	
2048	42				57.00	57.00				1.055	0.000	
2049	43				57.00	57.00				1.055	0.000	
2050	44				57.00	57.00				1.055	0.000	
2050	45				57.00	57.00				1.055	0.000	

								Sum
Present Value @	***4.00%***	950.713						
		405.884	0.000	0.000	0.000	0.000	17.601	0.000	423.485
		Unit Reference Value =				0.445		
Present Value @	***6.00%***	662.175						
		398.225	0.000	0.000	0.000	0.000	12.259	0.000	410.485
		Unit Reference Value =				0.620		
Present Value @	***8.00%***	481.991						
		390.851	0.000	0.000	0.000	0.000	8.924	0.000	399.775
		Unit Reference Value =				0.829		

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 2: Existing users pay for the Reserve

Yield: 32.000 M m³

Scheme: 5m Raising

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 0.4322 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2010>	172.894			172.894
	172.894			*172.894*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	172.894	0.000	0.000	172.894

Cal Year	*Year*	*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	*Elec.*
							Check>>	172.894
2007	1	0.00	0.00	172.894	0.000	0.000	0.000	0.000
2008	2	0.00	0.00		0.000	0.000	0.000	0.000
2009	3	0.00	0.00		0.000	0.000	0.000	0.000
2010	4	16.00	16.00		0.000	0.000	0.216	0.000
2011	5	32.00	32.00		0.000	0.000	0.432	0.000
2012	6	32.00	32.00		0.000	0.000	0.432	0.000
2013	7	32.00	32.00		0.000	0.000	0.432	0.000
2014	8	32.00	32.00		0.000	0.000	0.432	0.000
2015	9	32.00	32.00		0.000	0.000	0.432	0.000
2016	10	32.00	32.00		0.000	0.000	0.432	0.000
2017	11	32.00	32.00		0.000	0.000	0.432	0.000
2018	12	32.00	32.00		0.000	0.000	0.432	0.000
2019	13	32.00	32.00		0.000	0.000	0.432	0.000
2020	14	32.00	32.00		0.000	0.000	0.432	0.000
2021	15	32.00	32.00			0.000	0.432	0.000
2022	16	32.00	32.00			0.000	0.432	0.000
2023	17	32.00	32.00			0.000	0.432	0.000
2024	18	32.00	32.00			0.000	0.432	0.000
2025	19	32.00	32.00			0.000	0.432	0.000
2026	20	32.00	32.00			0.000	0.432	0.000
2027	21	32.00	32.00			0.000	0.432	0.000
2028	22	32.00	32.00				0.432	0.000
2029	23	32.00	32.00				0.432	0.000
2030	24	32.00	32.00				0.432	0.000
2031	25	32.00	32.00				0.432	0.000
2032	26	32.00	32.00				0.432	0.000
2033	27	32.00	32.00				0.432	0.000
2034	28	32.00	32.00				0.432	0.000
2035	29	32.00	32.00				0.432	0.000
2036	30	32.00	32.00				0.432	0.000
2037	31	32.00	32.00				0.432	0.000
2038	32	32.00	32.00				0.432	0.000
2039	33	32.00	32.00				0.432	0.000
2040	34	32.00	32.00				0.432	0.000
2041	35	32.00	32.00				0.432	0.000
2042	36	32.00	32.00				0.432	0.000
2043	37	32.00	32.00				0.432	0.000
2044	38	32.00	32.00				0.432	0.000
2045	39	32.00	32.00				0.432	0.000
2046	40	32.00	32.00				0.432	0.000
2047	41	32.00	32.00				0.432	0.000
2048	42	32.00	32.00				0.432	0.000
2049	43	32.00	32.00				0.432	0.000
2050	44	32.00	32.00				0.432	0.000
2051	45	32.00	32.00				0.432	0.000

									Sum
Present Value @	***4.00%***	560.561							
			166.244	0.000	0.000	0.000	0.000	7.572	0.000	173.816
			Unit Reference Value =				0.310		
Present Value @	***6.00%***	396.377							
			163.108	0.000	0.000	0.000	0.000	5.354	0.000	168.462
			Unit Reference Value =				0.425		
Present Value @	***8.00%***	293.241							
			160.087	0.000	0.000	0.000	0.000	3.961	0.000	164.048
			Unit Reference Value =				0.559		

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 2: Existing users pay for the Reserve

Yield: 59.000 M m³

Scheme: 10m Raising

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 0.7331 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2010>	293.257			293.257
	293.257			*293.257*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	293.257	0.000	0.000	293.257

Cal Year	*Year*	*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	Check>> *Elec.* 293.257
2007	1	0.00	0.00	293.257	0.000	0.000	0.000	0.000
2008	2	0.00	0.00		0.000	0.000	0.000	0.000
2009	3	0.00	0.00		0.000	0.000	0.000	0.000
2010	4	0.00	0.00		0.000	0.000	0.000	0.000
2011	5	59.00	59.00		0.000	0.000	0.733	0.000
2012	6	59.00	59.00		0.000	0.000	0.733	0.000
2013	7	59.00	59.00		0.000	0.000	0.733	0.000
2014	8	59.00	59.00		0.000	0.000	0.733	0.000
2015	9	59.00	59.00		0.000	0.000	0.733	0.000
2016	10	59.00	59.00		0.000	0.000	0.733	0.000
2017	11	59.00	59.00		0.000	0.000	0.733	0.000
2018	12	59.00	59.00		0.000	0.000	0.733	0.000
2019	13	59.00	59.00		0.000	0.000	0.733	0.000
2020	14	59.00	59.00		0.000	0.000	0.733	0.000
2021	15	59.00	59.00			0.000	0.733	0.000
2022	16	59.00	59.00			0.000	0.733	0.000
2023	17	59.00	59.00			0.000	0.733	0.000
2024	18	59.00	59.00			0.000	0.733	0.000
2025	19	59.00	59.00			0.000	0.733	0.000
2026	20	59.00	59.00			0.000	0.733	0.000
2027	21	59.00	59.00			0.000	0.733	0.000
2028	22	59.00	59.00				0.733	0.000
2029	23	59.00	59.00				0.733	0.000
2030	24	59.00	59.00				0.733	0.000
2031	25	59.00	59.00				0.733	0.000
2032	26	59.00	59.00				0.733	0.000
2033	27	59.00	59.00				0.733	0.000
2034	28	59.00	59.00				0.733	0.000
2035	29	59.00	59.00				0.733	0.000
2036	30	59.00	59.00				0.733	0.000
2037	31	59.00	59.00				0.733	0.000
2038	32	59.00	59.00				0.733	0.000
2039	33	59.00	59.00				0.733	0.000
2040	34	59.00	59.00				0.733	0.000
2041	35	59.00	59.00				0.733	0.000
2042	36	59.00	59.00				0.733	0.000
2043	37	59.00	59.00				0.733	0.000
2044	38	59.00	59.00				0.733	0.000
2045	39	59.00	59.00				0.733	0.000
2046	40	59.00	59.00				0.733	0.000
2047	41	59.00	59.00				0.733	0.000
2048	42	59.00	59.00				0.733	0.000
2049	43	59.00	59.00				0.733	0.000
2050	44	59.00	59.00				0.733	0.000
2051	45	59.00	59.00				0.733	0.000

									Sum
Present Value @	***4.00%***	1008.319							
			281.978	0.000	0.000	0.000	0.000	12.530	0.000	294.507
			Unit Reference Value =				0.292			
Present Value @	***6.00%***	707.453							
			276.658	0.000	0.000	0.000	0.000	8.791	0.000	285.448
			Unit Reference Value =				0.403			
Present Value @	***8.00%***	518.980							
			271.534	0.000	0.000	0.000	0.000	6.449	0.000	277.983
			Unit Reference Value =				0.536			

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 2: Existing users pay for the Reserve

Yield: 68.000 M m³

Scheme: **12.5m Raising**

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 0.8942 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2011>	357.688			357.688
	357.688			*357.688*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	357.688	0.000	0.000	357.688

Cal Year	*Year*	*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	*Elec.*
							Check>>	357.688
2007	1	0.00	0.00	357.688	0.000	0.000	0.000	0.000
2008	2	0.00	0.00		0.000	0.000	0.000	0.000
2009	3	0.00	0.00		0.000	0.000	0.000	0.000
2010	4	0.00	0.00		0.000	0.000	0.000	0.000
2011	5	34.00	34.00		0.000	0.000	0.447	0.000
2012	6	68.00	68.00		0.000	0.000	0.894	0.000
2013	7	68.00	68.00		0.000	0.000	0.894	0.000
2014	8	68.00	68.00		0.000	0.000	0.894	0.000
2015	9	68.00	68.00		0.000	0.000	0.894	0.000
2016	10	68.00	68.00		0.000	0.000	0.894	0.000
2017	11	68.00	68.00		0.000	0.000	0.894	0.000
2018	12	68.00	68.00		0.000	0.000	0.894	0.000
2019	13	68.00	68.00		0.000	0.000	0.894	0.000
2020	14	68.00	68.00		0.000	0.000	0.894	0.000
2021	15	68.00	68.00			0.000	0.894	0.000
2022	16	68.00	68.00			0.000	0.894	0.000
2023	17	68.00	68.00			0.000	0.894	0.000
2024	18	68.00	68.00			0.000	0.894	0.000
2025	19	68.00	68.00			0.000	0.894	0.000
2026	20	68.00	68.00			0.000	0.894	0.000
2027	21	68.00	68.00			0.000	0.894	0.000
2028	22	68.00	68.00				0.894	0.000
2029	23	68.00	68.00				0.894	0.000
2030	24	68.00	68.00				0.894	0.000
2031	25	68.00	68.00				0.894	0.000
2032	26	68.00	68.00				0.894	0.000
2033	27	68.00	68.00				0.894	0.000
2034	28	68.00	68.00				0.894	0.000
2035	29	68.00	68.00				0.894	0.000
2036	30	68.00	68.00				0.894	0.000
2037	31	68.00	68.00				0.894	0.000
2038	32	68.00	68.00				0.894	0.000
2039	33	68.00	68.00				0.894	0.000
2040	34	68.00	68.00				0.894	0.000
2041	35	68.00	68.00				0.894	0.000
2042	36	68.00	68.00				0.894	0.000
2043	37	68.00	68.00				0.894	0.000
2044	38	68.00	68.00				0.894	0.000
2045	39	68.00	68.00				0.894	0.000
2046	40	68.00	68.00				0.894	0.000
2047	41	68.00	68.00				0.894	0.000
2048	42	68.00	68.00				0.894	0.000
2049	43	68.00	68.00				0.894	0.000
2050	44	68.00	68.00				0.894	0.000
2050	45	68.00	68.00				0.894	0.000

									Sum
Present Value @	***4.00%***	1134.184							
			343.931	0.000	0.000	0.000	0.000	14.915	0.000	358.846
			Unit Reference Value =				0.316		
Present Value @	***6.00%***	789.963							
			337.442	0.000	0.000	0.000	0.000	10.388	0.000	347.830
			Unit Reference Value =				0.440		
Present Value @	***8.00%***	575.007							
			331.193	0.000	0.000	0.000	0.000	7.562	0.000	338.754
			Unit Reference Value =				0.589		

CLANWILLIAM DAM RAISING FEASIBILITY STUDY — **Scenario 2: Existing users pay for the Reserve**

Yield: 69.500 M m³

Scheme: 13m Raising

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 0.9264 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2011>	370.574			370.574
	370.574			*370.574*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	370.574	0.000	0.000	370.574
			Check>>	370.574

Cal Year	*Year*	*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	*Elec.*
2007	1	0.00	0.00	370.574	0.000	0.000	0.000	0.000
2008	2	0.00	0.00		0.000	0.000	0.000	0.000
2009	3	0.00	0.00		0.000	0.000	0.000	0.000
2010	4	0.00	0.00		0.000	0.000	0.000	0.000
2011	5	34.75	34.75		0.000	0.000	0.463	0.000
2012	6	69.50	69.50		0.000	0.000	0.926	0.000
2013	7	69.50	69.50		0.000	0.000	0.926	0.000
2014	8	69.50	69.50		0.000	0.000	0.926	0.000
2015	9	69.50	69.50		0.000	0.000	0.926	0.000
2016	10	69.50	69.50		0.000	0.000	0.926	0.000
2017	11	69.50	69.50		0.000	0.000	0.926	0.000
2018	12	69.50	69.50		0.000	0.000	0.926	0.000
2019	13	69.50	69.50		0.000	0.000	0.926	0.000
2020	14	69.50	69.50		0.000	0.000	0.926	0.000
2021	15	69.50	69.50			0.000	0.926	0.000
2022	16	69.50	69.50			0.000	0.926	0.000
2023	17	69.50	69.50			0.000	0.926	0.000
2024	18	69.50	69.50			0.000	0.926	0.000
2025	19	69.50	69.50			0.000	0.926	0.000
2026	20	69.50	69.50			0.000	0.926	0.000
2027	21	69.50	69.50			0.000	0.926	0.000
2028	22	69.50	69.50				0.926	0.000
2029	23	69.50	69.50				0.926	0.000
2030	24	69.50	69.50				0.926	0.000
2031	25	69.50	69.50				0.926	0.000
2032	26	69.50	69.50				0.926	0.000
2033	27	69.50	69.50				0.926	0.000
2034	28	69.50	69.50				0.926	0.000
2035	29	69.50	69.50				0.926	0.000
2036	30	69.50	69.50				0.926	0.000
2037	31	69.50	69.50				0.926	0.000
2038	32	69.50	69.50				0.926	0.000
2039	33	69.50	69.50				0.926	0.000
2040	34	69.50	69.50				0.926	0.000
2041	35	69.50	69.50				0.926	0.000
2042	36	69.50	69.50				0.926	0.000
2043	37	69.50	69.50				0.926	0.000
2044	38	69.50	69.50				0.926	0.000
2045	39	69.50	69.50				0.926	0.000
2046	40	69.50	69.50				0.926	0.000
2047	41	69.50	69.50				0.926	0.000
2048	42	69.50	69.50				0.926	0.000
2049	43	69.50	69.50				0.926	0.000
2050	44	69.50	69.50				0.926	0.000
2050	45	69.50	69.50				0.926	0.000

								Sum
Present Value @	***4.00%***	1159.203						
		356.321	0.000	0.000	0.000	0.000	15.452	0.000	371.773
		Unit Reference Value =				0.321		
Present Value @	***6.00%***	807.388						
		349.598	0.000	0.000	0.000	0.000	10.762	0.000	360.361
		Unit Reference Value =				0.446		
Present Value @	***8.00%***	587.691						
		343.124	0.000	0.000	0.000	0.000	7.834	0.000	350.958
		Unit Reference Value =				0.597		

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 2: Existing users pay for the Reserve

Yield: 73.000 M m³

Scheme: 15m Raising

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 1.0553 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2011>	422.119			422.119
	422.119			*422.119*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	422.119	0.000	0.000	422.119
			Check>>	422.119

Cal Year	*Year*	*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	*Elec.*
2007	1	0.00	0.00	422.119	0.000	0.000	0.000	0.000
2008	2	0.00	0.00		0.000	0.000	0.000	0.000
2009	3	0.00	0.00		0.000	0.000	0.000	0.000
2010	4	0.00	0.00		0.000	0.000	0.000	0.000
2011	5	36.50	36.50		0.000	0.000	0.528	0.000
2012	6	73.00	73.00		0.000	0.000	1.055	0.000
2013	7	73.00	73.00		0.000	0.000	1.055	0.000
2014	8	73.00	73.00		0.000	0.000	1.055	0.000
2015	9	73.00	73.00		0.000	0.000	1.055	0.000
2016	10	73.00	73.00		0.000	0.000	1.055	0.000
2017	11	73.00	73.00		0.000	0.000	1.055	0.000
2018	12	73.00	73.00		0.000	0.000	1.055	0.000
2019	13	73.00	73.00		0.000	0.000	1.055	0.000
2020	14	73.00	73.00		0.000	0.000	1.055	0.000
2021	15	73.00	73.00			0.000	1.055	0.000
2022	16	73.00	73.00			0.000	1.055	0.000
2023	17	73.00	73.00			0.000	1.055	0.000
2024	18	73.00	73.00			0.000	1.055	0.000
2025	19	73.00	73.00			0.000	1.055	0.000
2026	20	73.00	73.00			0.000	1.055	0.000
2027	21	73.00	73.00			0.000	1.055	0.000
2028	22	73.00	73.00				1.055	0.000
2029	23	73.00	73.00				1.055	0.000
2030	24	73.00	73.00				1.055	0.000
2031	25	73.00	73.00				1.055	0.000
2032	26	73.00	73.00				1.055	0.000
2033	27	73.00	73.00				1.055	0.000
2034	28	73.00	73.00				1.055	0.000
2035	29	73.00	73.00				1.055	0.000
2036	30	73.00	73.00				1.055	0.000
2037	31	73.00	73.00				1.055	0.000
2038	32	73.00	73.00				1.055	0.000
2039	33	73.00	73.00				1.055	0.000
2040	34	73.00	73.00				1.055	0.000
2041	35	73.00	73.00				1.055	0.000
2042	36	73.00	73.00				1.055	0.000
2043	37	73.00	73.00				1.055	0.000
2044	38	73.00	73.00				1.055	0.000
2045	39	73.00	73.00				1.055	0.000
2046	40	73.00	73.00				1.055	0.000
2047	41	73.00	73.00				1.055	0.000
2048	42	73.00	73.00				1.055	0.000
2049	43	73.00	73.00				1.055	0.000
2050	44	73.00	73.00				1.055	0.000
2050	45	73.00	73.00				1.055	0.000

								Sum
Present Value @ 4.00%	1217.580							
	405.884	0.000	0.000	0.000	0.000	17.601	0.000	423.485
	Unit Reference Value =				0.348			
Present Value @ 6.00%	848.048							
	398.225	0.000	0.000	0.000	0.000	12.259	0.000	410.485
	Unit Reference Value =				0.484			
Present Value @ 8.00%	617.287							
	390.851	0.000	0.000	0.000	0.000	8.924	0.000	399.775
	Unit Reference Value =				0.648			

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 4: The DWAF pays for the Reserve

Yield: 16.000 M m³

Scheme: 5m Raising

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 0.1470 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2010>	58.784			58.784
	58.784			*58.784*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	58.784	0.000	0.000	58.784

Cal Year	*Year*				*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	Check>> *Mainten.*	58.784 *Elec.*
2007	1				0.00	0.00	58.784	0.000	0.000	0.000	0.000
2008	2				0.00	0.00		0.000	0.000	0.000	0.000
2009	3				0.00	0.00		0.000	0.000	0.000	0.000
2010	4				8.00	8.00		0.000	0.000	0.073	0.000
2011	5				16.00	16.00		0.000	0.000	0.147	0.000
2012	6				16.00	16.00		0.000	0.000	0.147	0.000
2013	7				16.00	16.00		0.000	0.000	0.147	0.000
2014	8				16.00	16.00		0.000	0.000	0.147	0.000
2015	9				16.00	16.00		0.000	0.000	0.147	0.000
2016	10				16.00	16.00		0.000	0.000	0.147	0.000
2017	11				16.00	16.00		0.000	0.000	0.147	0.000
2018	12				16.00	16.00		0.000	0.000	0.147	0.000
2019	13				16.00	16.00		0.000	0.000	0.147	0.000
2020	14				16.00	16.00		0.000	0.000	0.147	0.000
2021	15				16.00	16.00			0.000	0.147	0.000
2022	16				16.00	16.00			0.000	0.147	0.000
2023	17				16.00	16.00			0.000	0.147	0.000
2024	18				16.00	16.00			0.000	0.147	0.000
2025	19				16.00	16.00			0.000	0.147	0.000
2026	20				16.00	16.00			0.000	0.147	0.000
2027	21				16.00	16.00			0.000	0.147	0.000
2028	22				16.00	16.00				0.147	0.000
2029	23				16.00	16.00				0.147	0.000
2030	24				16.00	16.00				0.147	0.000
2031	25				16.00	16.00				0.147	0.000
2032	26				16.00	16.00				0.147	0.000
2033	27				16.00	16.00				0.147	0.000
2034	28				16.00	16.00				0.147	0.000
2035	29				16.00	16.00				0.147	0.000
2036	30				16.00	16.00				0.147	0.000
2037	31				16.00	16.00				0.147	0.000
2038	32				16.00	16.00				0.147	0.000
2039	33				16.00	16.00				0.147	0.000
2040	34				16.00	16.00				0.147	0.000
2041	35				16.00	16.00				0.147	0.000
2042	36				16.00	16.00				0.147	0.000
2043	37				16.00	16.00				0.147	0.000
2044	38				16.00	16.00				0.147	0.000
2045	39				16.00	16.00				0.147	0.000
2046	40				16.00	16.00				0.147	0.000
2047	41				16.00	16.00				0.147	0.000
2048	42				16.00	16.00				0.147	0.000
2049	43				16.00	16.00				0.147	0.000
2050	44				16.00	16.00				0.147	0.000
2051	45				16.00	16.00				0.147	0.000

									Sum
Present Value @	***4.00%***	280.281							
		56.523	0.000	0.000	0.000	0.000	2.574	0.000	59.097
		Unit Reference Value =				0.211			
Present Value @	***6.00%***	198.188							
		55.457	0.000	0.000	0.000	0.000	1.820	0.000	57.277
		Unit Reference Value =				0.289			
Present Value @	***8.00%***	146.621							
		54.430	0.000	0.000	0.000	0.000	1.347	0.000	55.776
		Unit Reference Value =				0.380			

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 4: The DWAF pays for the Reserve

Yield: 43.000 M m³

Scheme: **10m Raising**

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 0.4479 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2010>	179.147			179.147
	179.147			*179.147*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	179.147	0.000	0.000	179.147

Cal Year	*Year*	*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	Check>> *Elec.*	
2007	1	0.00	0.00	179.147	0.000	0.000	0.000	0.000	
2008	2	0.00	0.00		0.000	0.000	0.000	0.000	
2009	3	0.00	0.00		0.000	0.000	0.000	0.000	
2010	4	0.00	0.00		0.000	0.000	0.000	0.000	
2011	5	43.00	43.00		0.000	0.000	0.448	0.000	
2012	6	43.00	43.00		0.000	0.000	0.448	0.000	
2013	7	43.00	43.00		0.000	0.000	0.448	0.000	
2014	8	43.00	43.00		0.000	0.000	0.448	0.000	
2015	9	43.00	43.00		0.000	0.000	0.448	0.000	
2016	10	43.00	43.00		0.000	0.000	0.448	0.000	
2017	11	43.00	43.00		0.000	0.000	0.448	0.000	
2018	12	43.00	43.00		0.000	0.000	0.448	0.000	
2019	13	43.00	43.00		0.000	0.000	0.448	0.000	
2020	14	43.00	43.00		0.000	0.000	0.448	0.000	
2021	15	43.00	43.00			0.000	0.448	0.000	
2022	16	43.00	43.00			0.000	0.448	0.000	
2023	17	43.00	43.00			0.000	0.448	0.000	
2024	18	43.00	43.00			0.000	0.448	0.000	
2025	19	43.00	43.00			0.000	0.448	0.000	
2026	20	43.00	43.00			0.000	0.448	0.000	
2027	21	43.00	43.00			0.000	0.448	0.000	
2028	22	43.00	43.00				0.448	0.000	
2029	23	43.00	43.00				0.448	0.000	
2030	24	43.00	43.00				0.448	0.000	
2031	25	43.00	43.00				0.448	0.000	
2032	26	43.00	43.00				0.448	0.000	
2033	27	43.00	43.00				0.448	0.000	
2034	28	43.00	43.00				0.448	0.000	
2035	29	43.00	43.00				0.448	0.000	
2036	30	43.00	43.00				0.448	0.000	
2037	31	43.00	43.00				0.448	0.000	
2038	32	43.00	43.00				0.448	0.000	
2039	33	43.00	43.00				0.448	0.000	
2040	34	43.00	43.00				0.448	0.000	
2041	35	43.00	43.00				0.448	0.000	
2042	36	43.00	43.00				0.448	0.000	
2043	37	43.00	43.00				0.448	0.000	
2044	38	43.00	43.00				0.448	0.000	
2045	39	43.00	43.00				0.448	0.000	
2046	40	43.00	43.00				0.448	0.000	
2047	41	43.00	43.00				0.448	0.000	
2048	42	43.00	43.00				0.448	0.000	
2049	43	43.00	43.00				0.448	0.000	
2050	44	43.00	43.00				0.448	0.000	
2051	45	43.00	43.00				0.448	0.000	

								Sum
Present Value @	***4.00%***	734.876						
		172.257	0.000	0.000	0.000	0.000	7.654	0.000	179.911
		Unit Reference Value =				0.245		
Present Value @	***6.00%***	515.601						
		169.007	0.000	0.000	0.000	0.000	5.370	0.000	174.377
		Unit Reference Value =				0.338		
Present Value @	***8.00%***	378.240						
		165.877	0.000	0.000	0.000	0.000	3.940	0.000	169.816
		Unit Reference Value =				0.449		

CLANWILLIAM DAM RAISING FEASIBILITY STUDY

Scenario 4: The DWAF pays for the Reserve

Yield: 57.000 M m³

Scheme: **15m Raising**

Notes: 1 Costs in R million
2 Prices = 2006
3 Maintenance:
0.25% * civil
4.00% * mech & elec
0.50% * pipeline
4 Annual running cost:
R 0.7700 mill Maint
R 0.0000 R 0.0000 mill Elec
R 0.0000

Components	*Civil*	*Mech.*	*Elec.*	*Total*
Pump Stations				
				0.000
				0.000
				0.000
	0.000	*0.000*	*0.000*	*0.000*
Dams (mech & elec included)				
Dam raising <2007-2011>	308.009			308.009
	308.009			*308.009*
Pipelines				
				0.000
				0.000
				0.000
				0.000
	0.000			*0.000*
Total Cost	308.009	0.000	0.000	308.009

Cal Year	*Year*	*Demand Mm3/y*	*Demand met*	*Reserv.*	*Pipeline*	*Pump Station*	*Mainten.*	Check>> 308.009 *Elec.*
2007	1	0.00	0.00	308.009	0.000	0.000	0.000	0.000
2008	2	0.00	0.00		0.000	0.000	0.000	0.000
2009	3	0.00	0.00		0.000	0.000	0.000	0.000
2010	4	0.00	0.00		0.000	0.000	0.000	0.000
2011	5	28.50	28.50		0.000	0.000	0.385	0.000
2012	6	57.00	57.00		0.000	0.000	0.770	0.000
2013	7	57.00	57.00		0.000	0.000	0.770	0.000
2014	8	57.00	57.00		0.000	0.000	0.770	0.000
2015	9	57.00	57.00		0.000	0.000	0.770	0.000
2016	10	57.00	57.00		0.000	0.000	0.770	0.000
2017	11	57.00	57.00		0.000	0.000	0.770	0.000
2018	12	57.00	57.00		0.000	0.000	0.770	0.000
2019	13	57.00	57.00		0.000	0.000	0.770	0.000
2020	14	57.00	57.00		0.000	0.000	0.770	0.000
2021	15	57.00	57.00			0.000	0.770	0.000
2022	16	57.00	57.00			0.000	0.770	0.000
2023	17	57.00	57.00			0.000	0.770	0.000
2024	18	57.00	57.00			0.000	0.770	0.000
2025	19	57.00	57.00			0.000	0.770	0.000
2026	20	57.00	57.00			0.000	0.770	0.000
2027	21	57.00	57.00			0.000	0.770	0.000
2028	22	57.00	57.00				0.770	0.000
2029	23	57.00	57.00				0.770	0.000
2030	24	57.00	57.00				0.770	0.000
2031	25	57.00	57.00				0.770	0.000
2032	26	57.00	57.00				0.770	0.000
2033	27	57.00	57.00				0.770	0.000
2034	28	57.00	57.00				0.770	0.000
2035	29	57.00	57.00				0.770	0.000
2036	30	57.00	57.00				0.770	0.000
2037	31	57.00	57.00				0.770	0.000
2038	32	57.00	57.00				0.770	0.000
2039	33	57.00	57.00				0.770	0.000
2040	34	57.00	57.00				0.770	0.000
2041	35	57.00	57.00				0.770	0.000
2042	36	57.00	57.00				0.770	0.000
2043	37	57.00	57.00				0.770	0.000
2044	38	57.00	57.00				0.770	0.000
2045	39	57.00	57.00				0.770	0.000
2046	40	57.00	57.00				0.770	0.000
2047	41	57.00	57.00				0.770	0.000
2048	42	57.00	57.00				0.770	0.000
2049	43	57.00	57.00				0.770	0.000
2050	44	57.00	57.00				0.770	0.000
2050	45	57.00	57.00				0.770	0.000

								Sum
Present Value @ ***4.00%***	950.713							
	296.163	0.000	0.000	0.000	0.000	12.843	0.000	309.006
	Unit Reference Value =				0.325			
Present Value @ ***6.00%***	662.175							
	290.575	0.000	0.000	0.000	0.000	8.945	0.000	299.520
	Unit Reference Value =				0.452			
Present Value @ ***8.00%***	481.991							
	285.194	0.000	0.000	0.000	0.000	6.511	0.000	291.705
	Unit Reference Value =				0.605			

FEASIBILITY STUDY FOR THE RAISING OF CLANWILLIAM DAM

Study Reports

No	Report name	6.1.1 DWAF Report numbers	6.1.2 NS Report numbers
1	Inception	No report number	4414
2	Screening of Options	P WMA 17/E10/00/0405	4415
3	Water Quality	P WMA 17/E10/00/0509	4416
4	System Analysis	P WMA 17/E10/00/0609	4417
5	Groundwater Resources	P WMA 17/E10/00/0709	4418
6	Environmental Scoping	P WMA 17/E10/00/0809	4419
7	Environmental Impact	P WMA 17/E10/00/0909	4420
8	Soils, Water Requirements and Crops	P WMA 17/E10/00/1109	4422
9	Water Management Plan for the Olifants-Doorn Catchment Management Area	P WMA 17/E10/00/1209	4423
10	Opportunities for the Supply of Water to Resource-poor Farmers	P WMA 17/E10/00/1309	4424
11	Irrigation Development and Water Distribution Options	P WMA 17/E10/00/1409	4425
12	Impacts on Roads and other Infrastructure	P WMA 17/E10/00/1509	4426
13	Financial Viability of Irrigation Farming	P WMA 17/E10/00/1609	4427
14	Socio-economic Impact Assessment	P WMA 17/E10/00/1709	4428
15	Financial Evaluation	P WMA 17/E10/00/1809	4455
16	Main	P WMA 17/E10/00/1909	4429

6.1.3 No	6.1.4 Reports by DWAF	DWAF Report numbers	NS Report numbers
17	Feasibility Design of Raising (Engineering Design) and Design Report Addendum	-	4430
18	First Engineering Geological Materials Report (Course Aggregate) For Proposed Raising (Council for Geoscience)	-	4431
19	Farm Dams (Options Analysis): include under Report 4 as Appendix	-	4432