CHAPTER 2

PROJECT AREA

TABLE OF CONTENTS

CHAPTER 2 PROJECT AREA

2.1 Climate and Geophysical Environment

The Moretele 2 Feasibility Study Area is shown in on the Project Location Map. The area corresponds with the Moretele 2 Magisterial District of Mpumalanga Province and is essentially rural in nature.

Average annual rainfall is approximately 510 mm and summer rainfall predominates falling mainly between October and March. The area drains to the Gotwane, a tributary of the Elands River in the Olifants River System, and most of the area lies in the catchment upstream of Mkombo Dam. Annual average evaporation is over 2,200 mm and is higher in summer than in winter. Annual monthly temperatures vary from 12 to 25° C. Prevailing winds are light to moderate in a northeasterly direction and typical wind speeds are 2.5 to 3.5 m/s.

The Area does not include any Nature Reserves or National Parks which merit particular consideration from an environmental perspective.

2.2 Present Water Supply Conditions

Within the FS Area the existing source of water for domestic use is almost exclusively groundwater (94%) while the remainder is bought from water vendors. The source of water supplied by water vendors is mostly untreated surface water and partly groundwater.

Most of the existing boreholes in the Area are less than 60 m deep. The depth to groundwater rest level is typically less than 30 m in these boreholes and mostly less than 10 m in the areas west of Kalkfontein. This situation means that the boreholes are quite susceptible to human contamination.

Most of the boreholes in use provide a point supply source without reticulation pipes and are equipped with either a hand pump (53%), a diesel engine (42%), or an electric motor (5%). Windmills were used more often in the past but are seldom used nowadays. Approximately 40% of the borehole users who answered the JICA questionnaire survey conducted in March 1997 replied that they experience frequent problems regarding the operation and maintenance of the boreholes. Nearly 70% of the respondents replied that mechanical breakdown of pumps is the major cause of such problems.

Water quality in the Area is generally unsatisfactory, particularly with respect to nitrate concentrations, and instances of fecal contamination are common. Accessibility (the probability of a borehole yielding more than 0.1 l/s) is greater than 60% while exploitability (the probability of a borehole yielding more than 2 l/s) is greater than 40%. However the quality is particularly variable in the Area which compounds problems when trying to exploit further groundwater sources.

Current average monthly water consumption per household is 1,761 litres which, in terms of average per capita water consumption, is 9.2 lcd assuming 6.4 persons per household.

2.3 Socio Economic Conditions

The Moretele 2 Area comprises 17 communities and has an estimated 16,370 households or a population of 104,768 based on 6.4 persons per household. These figures were based on interviews with leaders in each community supplemented where necessary by counting the number of houses.

The Area is rural and contains virtually no industry being rather remote from the corridor of development running from Witbank to Pretoria and north to Temba. Although some arable and cattle farming takes place, many of the residents commute to jobs in urban centres such as Pretoria or even Johannesburg (around 68%), while others rely on pension income (22%) or income remitted from urban areas. If the transport subsidy to the KwaNdebele region is cut, the effect on the population may be significant.

Average monthly income indicated by the JICA survey was R1,466 per household. On average residents are paying water vendors R23.30 per month or if they obtain water from boreholes, they are paying only R 0.90 per month. The average willingness to pay for the RDP level of service was R9.10 per household per month however for yard connections, the figure per household was R28.50 per month.

Around 80% of the households who answered the JICA questionnaires expressed the view that water supply is a higher priority than sanitation. Women play a central role in the management (fetching and storing) of household water in 53% of the households who answered the questionnaire survey.

2.4 Institutional Situation

2.4.1 First and Second Tiers

The Moretele 2 Area lies outside the proclaimed supply area of MW. The Area formed part of the former Bophuthatswana and as such suffered from under investment in terms of water supply in comparison with the adjoining area to the south, which formed part of KwaNdebele. At that time O&M of water supply infrastructure in Moretele 2 was the responsibility of NWWA while the assets belonged to the Bophuthatswana Government. However, when NWWA was broken up, ownership of the assets and responsibility for the third tier function were transferred to the Mpumalanga provincial office of DWAF. Agreement has recently been reached to create a new Highveld Water Board in the upper Olifants basin that is likely to encompass Moretele 2, KwaNdebele, Bronkhorstspruit and the area east to beyond Groblersdal, Witbank and Middelburg. The Highveld Water and Sanitation Association considered options for the short to medium term which included establishing the organization as a separate business unit of an established board such as MW with a view to becoming independent at some point in the future. Instead however a decision was reached to form a new Board from scratch. It is likely to be several years before this organization is established and has sufficient capacity to implement new water supply projects. As an interim measure in the short to medium term, DWAF (Mpumalanga) remains primarily responsible for service delivery in the region.

2.4.2 Third Tier

Moretele 2 District falls under the jurisdiction of Highveld District Council which lacks capacity. The system of zonal councilors has not been implemented within the Highveld DC area so there is a lack of direct accountability and therefore less effort directed at development and service initiatives than is the case in the Rustenburg DC area. Several communities on the southern fringe of the FS Area including Sehoko fall under Mbibane TLC, which also lacks capacity.

CHAPTER 3

WATER DEMAND

TABLE OF CONTENTS

LIST OF TTABLES

CHAPTER 3 WATER DEMAND

3.1 Population Served

The Study Team conducted a comprehensive study of demographic and socio-economic conditions of the JICA Master Plan Area during 1996. The study envisaged that whilst movement of the rural population from outside the Master Plan Area to Soshanguve, Wonderboom, Brits, Moretele 1 and Odi 1 will continue, less significant numbers of the rural population living within the Master Plan Area will move out to PWV and other urban areas, and that the overall growth rate of the population in the Area will therefore remain at 2.7 % during the next two decades, slightly higher than the current natural national growth rate of population which is around 2.3 %.

The Master Plan Study also forecasted that primary growth will take place in the Pretoria, Ga-Rankuwa, Mabopane and Temba areas in the central region, and that a secondary growth area will be that of Rustenburg in the western region with a growth axis extending up to Monakato - Mogwase - Northam - Thabazimbi.

With regard to the communities in the Moretele 2 FS Area, the Master Plan viewed that there will be no future growth in population, as the natural growth in these communities will be offset by migration of an approximately equal number of people to urban areas.

In February and March 1997, the Study Team conducted extensive surveys of these communities, which included questionnaire surveys regarding the present population and number of households. These surveys were based on interviews with leaders in each community supplemented where necessary by counting the number of houses. Comparison of the information obtained from these surveys with the 1/10,000 scale ortho-photos of the communities taken in 1989 reinforced the view adopted during the master plan, in that virtually no increase in the number of households in these communities was observed. For this reason, it is also assumed in this Feasibility Study that there will be no growth of population in these communities in the future.

Table 3-1 shows the population and number of households estimated for each of the communities included in the FS Area. In this Feasibility Study it is assumed that the water supply plan proposed will serve all of the population enumerated in the table.

Table 3-1 Population, Lecvel of Service & Water Demand for Moretele 2

Moretele 2 Settlement	Alternative Name	Number of Households	Population	Water Demand (AADD in l/day)* Service Level A 100% RDP **	Service Level B 90 % Y.C. + 10 % S.P.*** Y.C.	S.P.	Total
1 Lefiso/Mmutlestad	Mutlestad, Geelbeksvlei	850	5,440	163,200	419,098	16,320	435,418
2 Lefiswane	Radijoko, Ditlhagane	900	5,760	172,800	443,750	17,280	461,030
3 Ramantsho		86	550	16,512	42,403	1,651	44,054
4 Semohiase	Roodekoppies	70	448	13,440	34,514	1,344	35,858
5 Moletsi	Segokgo	260	1,664	49,920	128,195	4,992	133,187
6 Marapyane	Schilpadfontein	3,360	21,504	645,120	1,656,668	64,512	1,721,180
7 Opgeruimd		290	1,856	55,680	142,986	5,568	148,554
8 Ga-Ramantshane	Seabe	2,300	14,720	441,600	1,134,029	44,160	1,178,189
9 Kalkfontein		1,500	9,600	288,000	739,584	28,800	768,384
Sub-Total for Moretele 2 East		*9,616*	*61,542*	*1,846,272*	*4,741,226*	*184,627*	*4,925,854*
10 Lefifi	Nokaneng, Rooifontein	1,900	12,160	364,800	936,806	36,480	973,286
11 Rapotokwane	Witlaagte	860	5,504	165,120	424,028	16,512	440,540
12 Norman		84	538	16,128	41,417	1,613	43,030
13 Bamokgoko	Mmametlhake	1,500	9,600	288,000	739,584	28,800	768,384
14 Phake C		360	2,304	69,120	177,500	6,912	184,412
15 Phake B		200	1,280	38,400	98,611	3,840	102,451
16 Phake A	Rankaile	350	2,240	67,200	172,570	6,720	179,290
17 Mantiole	Pankop, Masabe	1,500	9,600	288,000	739,584	28,800	768,384
Sub-Total for Moretele 2 West		*6,754*	*43,226*	*1,296,768*	*3,330,100*	*129,677*	*3,459,777*
TOTAL		16,370	104,768	3,143,040	8,071,327	314,304	8,385,631

* : including an allowance of approximately 15% for leakage

** : per capita consumption for RDP level : 30 lcd

*** : Yard Connection, per capita consumption : 85.6 lcd

: Standpipe, per capita consumption : 30.0 lcd

: weighted average per capita consumption: 80.0 lcd

3.2 Level of Service

In the Phase 1 Master Plan Study it was envisaged that the level of service required in these communities would be mostly the RDP minimum so the preliminary water supply infrastructure development plans were prepared for these communities primarily on the basis of the RDP level of service.

However, surveys conducted by the JICA Study Team in February and March 1997 clearly indicated that communities are demanding a water supply through yard connections rather than through standpipes, and that they are willing to pay a higher price for this higher level of service.

Generally, communities express dissatisfaction with the RDP level of service and show a preference for supply through yard connections. In some areas, communities have rejected newly installed RDP water supply schemes and, in some extreme cases, the facilities have been vandalized. Such communities cite the following as the major reasons for their rejection of the RDP standpipe supply.

- A long cartage distance
- A uniform water charge per household being applied irrespective of the actual consumption rate of each household

Experience indicates that community acceptance of the service level is the key to the success of a water supply project, including achieving cost recovery. On the other hand, it is still questionable whether or not communities can actually afford to pay for the level of service they are demanding. A decision regarding the appropriate service level can only be made after the following two parameters have been compared.

1) level of water tariff which needs to be installed to recover both capital and operational costs

2) the level of affordability

In the provision of water supply, it has been the clear policy of the new South African Government that it will subsidize the full capital cost for providing the RDP level of service (25 lcd and 200 m cartage distance), but that if communities want a higher level of service, they should pay for any additional costs which are necessary to acquire such a service.
Not withstanding this, Government policy for the planning and funding of RDP water supply schemes has abeen as follows:

- Even for a water supply scheme based on the RDP level of service, certain components of the infrastructure should be constructed with a larger capacity from the outset, as this will facilitate the future upgrading of the service level. The capital cost for providing this extra capacity will also be fully subsidized by Government.

- Such infrastructure includes raw water conduits, clear water bulk pipelines, clear water distribution mains between service reservoirs and reticulation systems, as well as other infrastructure for which the incremental capital cost of providing a slightly larger capacity is marginal at the time of initial construction but much higher if done at a later stage. Pumping stations, water treatment works, reservoirs and reticulation systems are not included under this policy, as they can readily be constructed on an incremental basis and can be easily upgraded in the future by adding extra units or additional pipes.

- The extra capacity to which this Government policy is applicable is for yard connections with a per-capita consumption rate of approximately 80 lcd on an annual average daily demand (AADD) basis.

Against the background mentioned above, the Study Team developed the following two levels of service for estimating water demands and the subsequent planning of infrastructure.

Service Level A : 100% of households in the community will be supplied through standpipes at the RDP level of service at an average per capita consumption rate of 30 lcd (AADD) including an allowance of approximately 15% for leakage.

Service Level B : 90% of households in the community will be supplied through yard connections (85.6 lcd) and the remaining 10% through standpipes (30 lcd) in accordance with the RDP level of service, giving a weighted average consumption rate of 80 lcd (AADD) including an allowance of approximately 15 % for leakage.

Households that will still be supplied through standpipes for Service Level B are those around the periphery of the community. The extension of reticulation to such households is not economically viable, as it will result in a significant increase in the reticulation cost.

3.3 Water Demand

The per capita consumption rate of water is an important factor that determines the size of water demand. In general, the rate gradually increases as the standard of living improves. A planning horizon of approximately 10 years is therefore usually adopted in a feasibility study to determine the future water demand based on which the size or capacity of infrastructure is determined.
As mentioned earlier in Section 3.2, the survey conducted by the Study Team in February and March 1997 provided a different perspective to this. The real issue was identified as being not the gradual increase of the per capita consumption rate, but rather the matter of whether water supply should, from the outset, be planned on the basis of RDP standpipes or on the basis of yard connections. The survey indicated that the expectation of communities is already higher than the RDP level of 25 lcd, and that the real question therefore is whether or not communities can actually afford to pay for the level of service that they are demanding.

The average water consumption rate of 25 lcd (85% of 30 lcd) assumed for standpipes is not likely to increase in the future, given the labour intensive nature of water cartage. Similarly it is also unlikely that the average per capita consumption rate of 73 lcd (85% of 85.6 lcd) assumed for yard connections will increase significantly within the next decade. In terms of summer peak day demand, these consumption rates are 38 lcd (150% of 25 lcd) and 110 lcd (150% of 73 lcd) respectively assuming a peak day factor of 1.5.

For the reasons mentioned above, no provision has been made for the future increase of these per capita water consumption rates, instead water demand was estimated for each of the two service levels discussed in Section 3.2 using the assumed population served mentioned in Section 3.1.

Table 3-1 shows the water demand estimated for each of the two service levels. The figures shown in the table were presented at both the Project Execution Group (PEG) Meeting held in Rustenburg on 20 March 1997 and at the Project Steering Committee (PSC) Meeting held in Pretoria on 25 March 1997 and they were accepted by all of the stakeholders for use by the Study Team for the subsequent infrastructure planning and other purposes associated with the Feasibility Study. The same figures were also included in the Interim Report that was issued by the Study Team in July 1997 and accepted by the stakeholders in the joint PSC/PEG meeting held in Pretoria on 29 July 1997.

CHAPTER 4

PROPOSED WATER SUPPLY PLAN AND CONSTRUCTION COST

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 4 PROPOSED WATER SUPPLY PLAN AND CONSTRUCTION COST

4.1 Assumptions for Planning of Infrastructure

Technical assumptions used in this Feasibility Study have been discussed with key stakeholders such as DWAF and Magalies Water. Such assumptions were first prepared during the Phase 1 Study and compiled in the Databook of the Mater Plan Study Report which was issued in December 1996; during this Feasibility Study, these assumptions have been further reviewed and refined with the stakeholders for finalization. Major technical assumptions used in this Feasibility Study for planning infrastructure are compiled in A.1 of Annex A.

4.2 Study of Alternative Water Supply Plans

4.2.1 Alternative Water Supply Plans

With respect to the planning of water supply infrastructure, three technical alternatives were evaluated for this FS Area during the Master Plan Study. As part of this Feasibility Study, the Study Team re-evaluated those technical alternatives on the basis of Service Level B. This exercise was conducted to identify the most preferable water supply option for this FS Area as well as to determine the capital cost required for implementation.

Figures 4-1, 4-2 and 4-3 illustrate these three alternative water supply plans.

Under Alternative 1, the entire area which consists of the Moretele 2 West and Moretele 2 East Supply Blocks is assumed to be supplied from the existing Weltevreden WTW.

In Alternative 2, only the Moretele 2 East Supply Block is assumed to be supplied from Weltevreden WTW while the Moretele 2 West Supply Block is supplied from Klipdrift WTW either through the existing Klipdrift-Nylstroom pipeline or from a new pipeline.

Alternative 3 is similar to Alternative 2, but the Moretele 2 West Supply Block is assumed to be supplied from a new water treatment works to be built at Rust de Winter Dam.

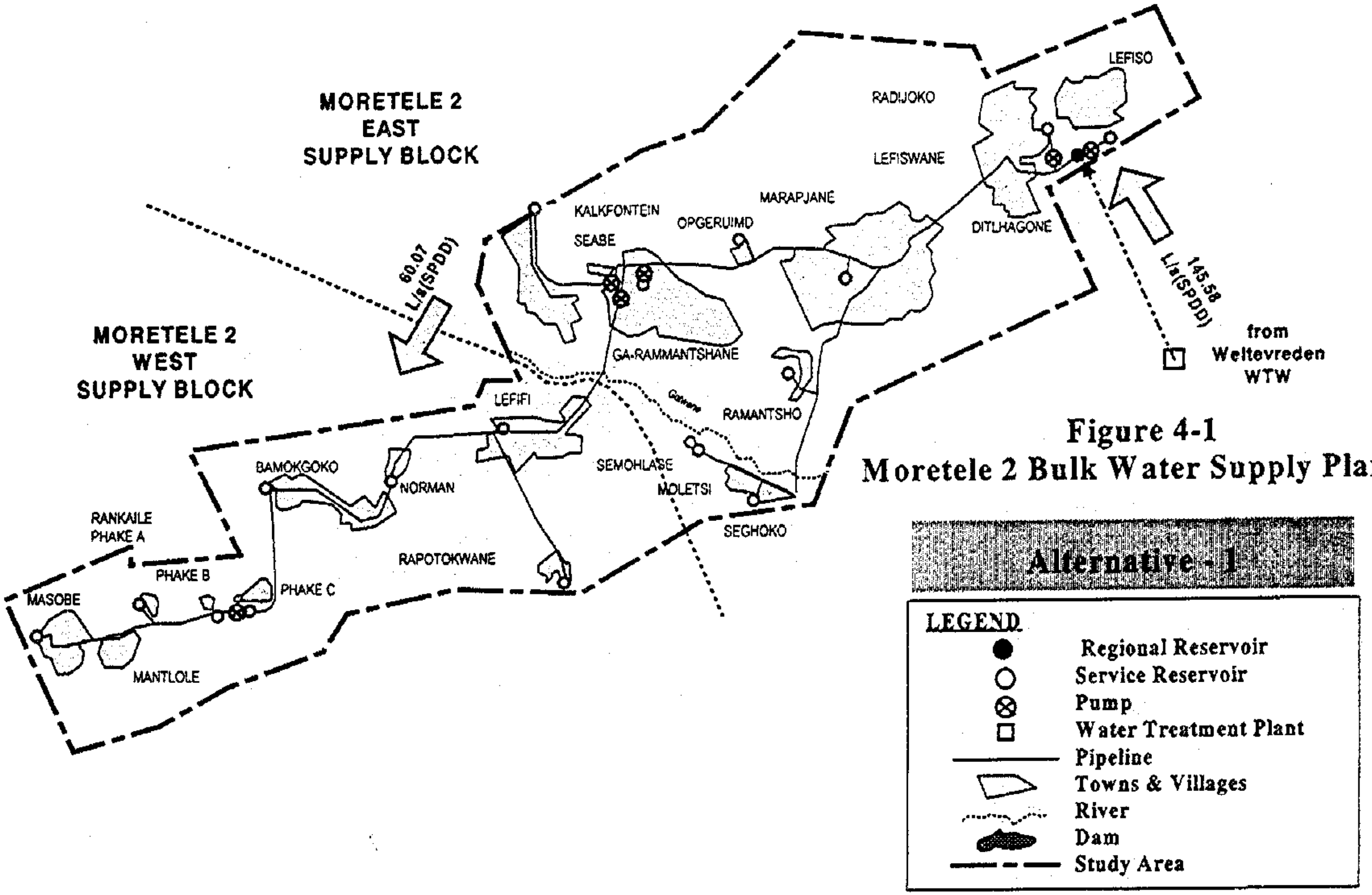


Figure 4-1
Moretele 2 Bulk Water Supply Plan

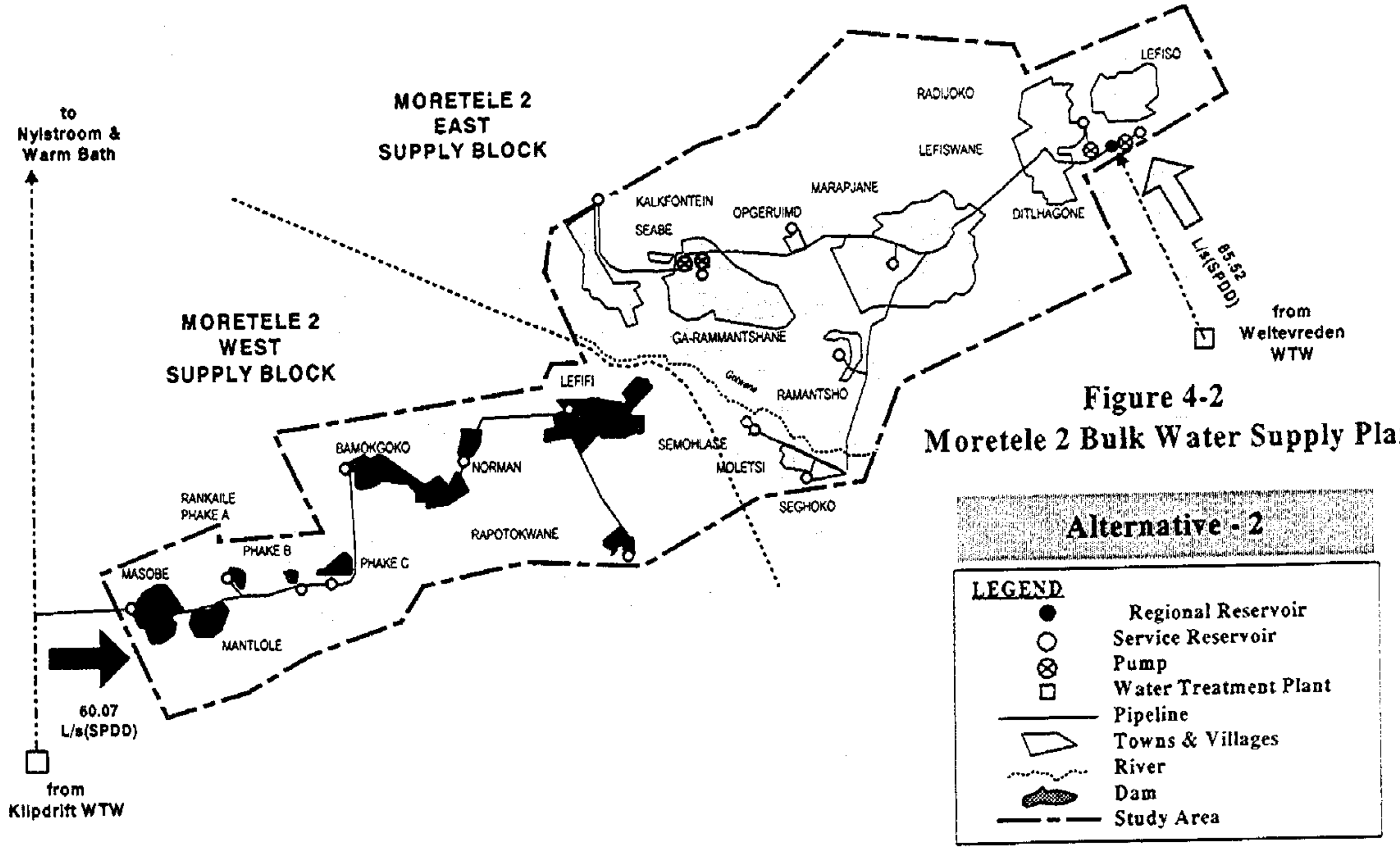


Figure 4-2
Moretele 2 Bulk Water Supply Plan

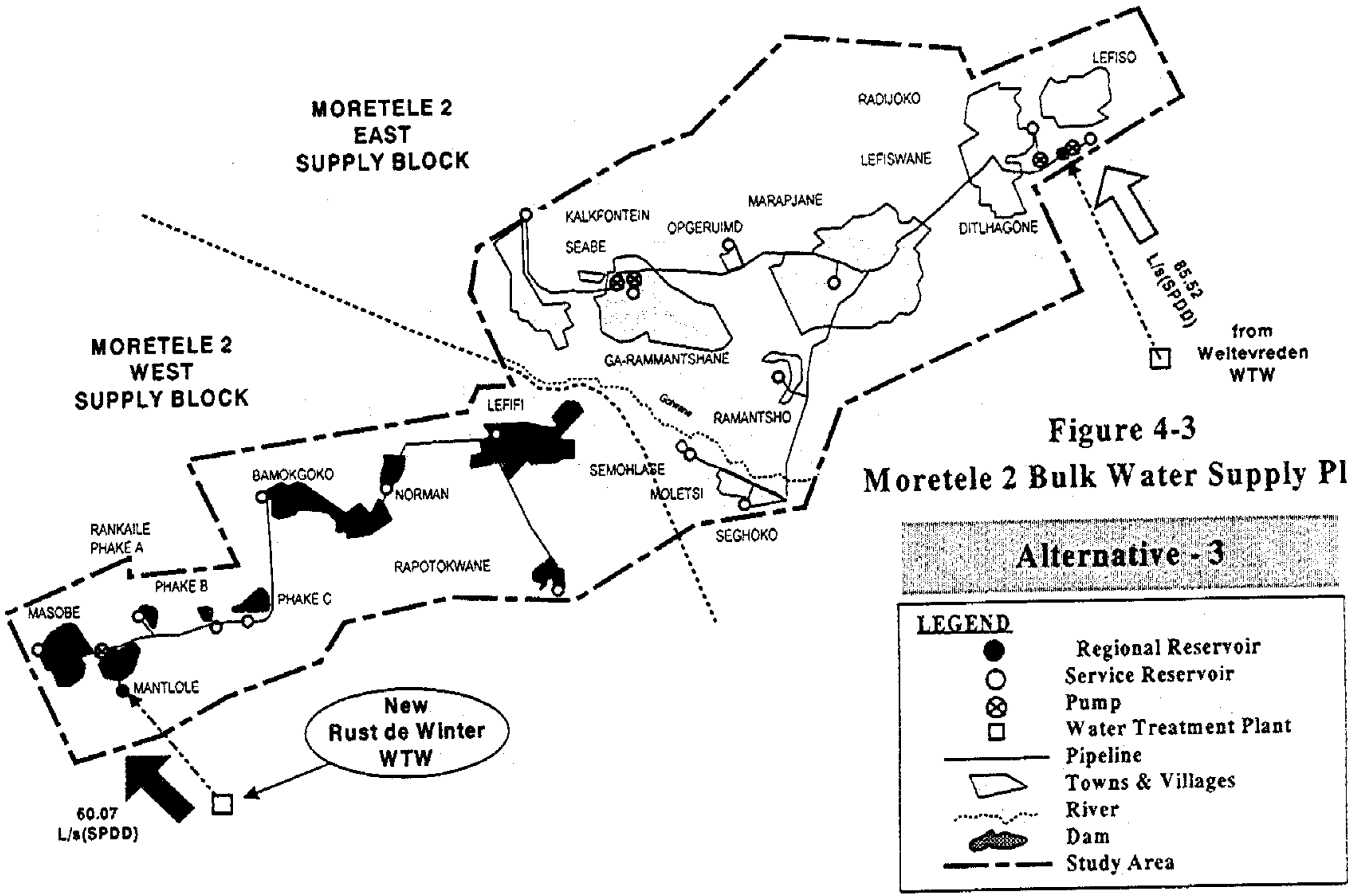


Figure 4-3
Moretele 2 Bulk Water Supply Plan

4.2.2 Infrastructure Planning

For each of the three alternatives, a plan for the requisite water supply infrastructure was developed and costed. The alternatives are shown schematically in Figures A.2-1 through A.2-4 of Annex A. A summary of the proposed infrastructure and the associated costs is shown in Tables 4-1 through 4-3. Tables A.3-1 through A.3-8 of Annex A provide greater detail.

As a general principle, water from a treatment works is assumed to be pumped to a regional reservoir from where it is distributed through bulk supply pipelines to service reservoirs constructed in each community. A water meter on the service reservoir inlet is assumed to form the interface between the bulk and retail infrastructure, thus service reservoirs form part of the retail infrastructure.

The methodology adopted by the Study Team in developing infrastructure plans is described briefly as follows.

(1) Bulk Infrastructure

FS communities were identified on 1/10,000 ortho-photos and a location was selected for a service reservoir on high ground either within or immediately adjacent to each village. Water will be supplied to these service reservoirs from either a treatment works or from a regional reservoir through bulk supply pipelines. The service reservoirs will in turn feed the reticulation system in the community by gravity. Given the relatively small capacity required to serve most communities, it is planned that most will be pressed cellular steel elevated tanks.

Bulk supply pipelines connecting water treatment works to service reservoirs were then routed on 1/50,000 scale standard maps and 1/10,000 scale ortho-photos. The routes selected follow existing roadways to minimize both the amount of land acquisition that is necessary and adverse impacts of pipeline construction on the environment.

The routes selected were plotted on the 1/10,000 scale ortho-photos and nodes were defined at off-take points to service reservoirs and at high points along the pipeline routes and allocated numbers. The distance between adjacent nodes was measured on the ortho-photos and the elevation of nodes was recorded.

All of the above information was used as the inputs to a series of hydraulic analyses that were conducted on the basis of Service Level B. The purpose of the analyses was to ensure that the dynamic water pressure will always remain higher than the ground elevations along the proposed bulk supply pipeline routes, and that the summer peak day demand can be met in each community. This exercise determined the size of bulk supply pipelines as well as the head where pumping was found to be necessary.

(2) Retail Infrastructure

The capacity of each service reservoir was determined, taking into account the water demand of the community and whether the reservoir is fed by pumping or by gravity. This exercise was done for both Service level A and Service Level B, and the number of units and their capacities were determined for each of these two service levels.

Reticulation pipelines were firstly planned for Service Level B. Pipelines were sized to ensure that the residual dynamic pressure throughout the reticulation system is adequate to maintain a supply through yard connections under the designed instantaneous peak flow condition. For Service Level A, some of the pipes planned for Service Level B were omitted, taking the distribution of standpipes into consideration.

Table 4-1 Summary of Alternative-1 (Service Level B)

MORETELE 2

ITEMS			MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
POPULATION AND WATER DEMAND					
No. of Communities		nos.	8	9	17
No. of Households		nos.	6,754	9,616	16,370
Population		person	43,226	61,542	104,768
Ave. No. of Persons per Household		person	6.4	6.4	6.4
Pop. Served by Yard Connection		person	38,903	55,388	94,291
Pop. Served by Standpipe		person	4,323	6,154	10,477
Total Water Demand (AADD)		kL/day	3,460	4,926	8,386
Total Water Demand (SPDD)		kL/day	5,190	7,389	12,578
OUTLINE OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Source of Water			N.A.	Mkombho Dam	
Raw Water Supply Pipeline	450 mm	km	N.A.	0.1	0.1
Water Treatment Works/Pump Stations		mL/day	N.A.	15	15.0
Regional Reservoirs	3.2 to 5.2 ML	nos. of tank	0	2	2
Bulk Supply Pipelines	90 to 500 mm	km	51	84	135
Pump Stations		nos.	2	4	6
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	20 to 490 m3	nos. of tank	24	28	52
Reticulation Pipelines	63 to 200 mm	km	139	343	483
Yard connections		nos.	6,079	8,654	14,733
Standpipes		nos.	115	305	420
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station		x 1,000 R		454	454
Raw Water Pipeline		x 1,000 R		56	56
WTW/Pump Station		x 1,000 R		10,290	10,290
Bulk Supply Pipelines		x 1,000 R	13,448	32,937	46,385
Regional Reservoirs		x 1,000 R	0	3,600	3,600
Pump Stations		x 1,000 R	787	389	1,177
Sub-Total		***x 1,000 R***	***14,235***	***47,726***	***61,962***
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs		x 1,000 R	5,165	6,155	11,320
Reticulation Pipelines		x 1,000 R	9,418	23,580	32,998
Yard Connections		x 1,000 R	6,383	9,087	15,470
Standpipes		x 1,000 R	184	488	672
Sub-Total		***x 1,000 R***	***21,150***	***39,310***	***60,460***
Total		**x 1,000 R**	**35,385**	**87,036**	**122,421**

Table 4-1 Summary of Alternative-1 (Service Level B)

MORETELE 2

ITEMS			MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
POPULATION AND WATER DEMAND					
No. of Communities		nos.	8	9	17
No. of Households		nos.	6,754	9,616	16,370
Population		person	43,226	61,542	104,768
Ave. No. of Persons per Household		person	6.4	6.4	6.4
Pop. Served by Yard Connection		person	38,903	55,388	94,291
Pop. Served by Standpipe		person	4,323	6,154	10,477
Total Water Demand (AADD)		kL/day	3,460	4,926	8,386
Total Water Demand (SPDD)		kL/day	5,190	7,389	12,578
OUTLINE OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Source of Water			N.A.	Mkombho Dam	
Raw Water Supply Pipeline	450 mm	km	N.A.	0.1	0.1
Water Treatment Works/Pump Stations		ml /day	N.A.	15	15.0
Regional Reservoirs	3.2 to 5.2 ML	nos. of tank	0	2	2
Bulk Supply Pipelines	90 to 500 mm	km	51	84	135
Pump Stations		nos.	2	4	6
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	20 to 490 m3	nos. of tank	24	28	52
Reticulation Pipelines	63 to 200 mm	km	139	343	483
Yard connections		nos.	6,079	8,654	14,733
Standpipes		nos.	115	305	420
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station		x 1,000 R		454	454
Raw Water Pipeline		x 1,000 R		56	56
WTW/Pump Station		x 1,000 R		10,290	10,290
Bulk Supply Pipelines		x 1,000 R	13,448	32,937	46,385
Regional Reservoirs		x 1,000 R	0	3,600	3,600
Pump Stations		x 1,000 R	787	389	1,177
Sub-Total		***x 1,000 R***	***14,235***	***47,726***	***61,962***
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs		x 1,000 R	5,165	6,155	11,320
Reticulation Pipelines		x 1,000 R	9,418	23,580	32,998
Yard Connections		x 1,000 R	6,383	9,087	15,470
Standpipes		x 1,000 R	184	488	672
Sub-Total		***x 1,000 R***	***21,150***	***39,310***	***60,460***
Total		**x 1,000 R**	**35,385**	**87,036**	**122,421**

Table 4-2 Summary of Alternative-2 (Service Level B)

MORETELE 2

ITEMS			MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
POPULATION AND WATER DEMAND					
No. of Communities		nos.	8	9	17
No. of Households		nos.	6,754	9,616	16,370
Population		person	43,226	61,542	104,768
Ave. No. of Persons per Household		person	6.4	6.4	6.4
Pop. Served by Yard Connection		person	38,903	55,388	94,291
Pop. Served by Standpipe		person	4,323	6,154	10,477
Total Water Demand (AADD)		kL/day	3,460	4,926	8,386
Total Water Demand (SPDD)		kL/day	5,190	7,389	12,578
OUTLINE OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Source of Water			Roodeplaat Dam	Mkombho Dam	
Raw Water Supply Pipeline/Cana	450 mm	km	0.1	0.1	0.2
Water Treatment Works/Pump Stations		mL/day	18.0	15.0	33.0
Regional Reservoirs	1.9 to 3.1 ML	nos. of tank	0	2	2
Bulk Supply Pipelines	90 to 450 mm	km	59	84	143
Pump Stations		nos.	0	4	4
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	10 to 480 m3	nos. of tank	24	28	52
Reticulation Pipelines	63 to 200 mm	km	139	343	483
Yard connections		nos.	6,079	8,654	14,733
Standpipes		nos.	115	305	420
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station		x 1,000 R	560	454	1,015
Raw Water Pipeline or Canal		x 1,000 R	56	56	112
WTW/Pump Station		x 1,000 R	11,970	10,290	22,260
Bulk Supply Pipelines		x 1,000 R	21,839	26,078	47,917
Regional Reservoirs		x 1,000 R	0	2,600	2,600
Pump Stations		x 1,000 R	0	362	362
Sub-Total		***x 1,000 R***	***34,425***	***39,840***	***74,266***
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs		x 1,000 R	5,165	6,155	11,320
Reticulation Pipelines		x 1,000 R	9,418	23,580	32,998
Yard Connections		x 1,000 R	6,383	9,087	15,470
Standpipes		x 1,000 R	184	488	672
Sub-Total		***x 1,000 R***	***21,150***	***39,310***	***60,460***
Total		**x 1,000 R**	**55,575**	**79,150**	**134,725**

Table 4-2 Summary of Alternative-2 (Service Level B)

MORETELE 2

ITEMS			MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
POPULATION AND WATER DEMAND					
No. of Communities		nos.	8	9	17
No. of Households		nos.	6,754	9,616	16,370
Population		person	43,226	61,542	104,768
Ave. No. of Persons per Household		person	6.4	6.4	6.4
Pop. Served by Yard Connection		person	38,903	55,388	94,291
Pop. Served by Standpipe		person	4,323	6,154	10,477
Total Water Demand (AADD)		kl/day	3,460	4,926	8,386
Total Water Demand (SPDD)		kl/day	5,190	7,389	12,578
OUTLINE OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Source of Water			Roodeplaat Dam	Mkombho Dam	
Raw Water Supply Pipeline/Cana	450 mm	km	0.1	0.1	0.2
Water Treatment Works/Pump Stations		ml/day	18.0	15.0	33.0
Regional Reservoirs	1.9 to 3.1 ML	nos. of tank	0	2	2
Bulk Supply Pipelines	90 to 450 mm	km	59	84	143
Pump Stations		nos.	0	4	4
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	10 to 480 m3	nos. of tank	24	28	52
Reticulation Pipelines	63 to 200 mm	km	139	343	483
Yard connections		nos.	6,079	8,654	14,733
Standpipes		nos.	115	305	420
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station		x 1,000 R	560	454	1,015
Raw Water Pipeline or Canal		x 1,000 R	56	56	112
WTW/Pump Station		x 1,000 R	11,970	10,290	22,260
Bulk Supply Pipelines		x 1,000 R	21,839	26,078	47,917
Regional Reservoirs		x 1,000 R	0	2,600	2,600
Pump Stations		x 1,000 R	0	362	362
Sub-Total		***x 1,000 R***	***34,425***	***39,840***	***74,266***
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs		x 1,000 R	5,165	6,155	11,320
Reticulation Pipelines		x 1,000 R	9,418	23,580	32,998
Yard Connections		x 1,000 R	6,383	9,087	15,470
Standpipes		x 1,000 R	184	488	672
Sub-Total		***x 1,000 R***	***21,150***	***39,310***	***60,460***
Total		**x 1,000 R**	**55,575**	**79,150**	**134,725**

Table 4-3 Summary of Alternatvie-3 (Service Level B)

MORETELE 2

ITEMS			MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
POPULATION AND WATER DEMAND					
No. of Communities		nos.	8	9	17
No. of Households		nos.	6,754	9,616	16,370
Population		person	43,226	61,542	104,768
Ave. No. of Persons per Household		person	6.4	6.4	6.4
Pop. Served by Yard Connection		person	38,903	55,388	94,291
Pop. Served by Standpipe		person	4,323	6,154	10,477
Total Water Demand (AADD)		kL/day	3,460	4,926	8,386
Total Water Demand (SPDD)		kL/day	5,190	7,389	12,578
OUTLINE OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Source of Water			Rust de Winter Dam	Mkombho Dam	
Raw Water Supply Pipeline/Can	300-450 mm	km	0.1	0.1	0.2
Water Treatment Works/Pump Stations		mL/day	5.4	15.0	20.4
Regional Reservoirs	1.3 to 3.1 ML	nos. of tank	2	2	4
Bulk Supply Pipelines	90 to 450 mm	km	78	84	162
Pump Stations		nos.	1	4	5
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	10 to 480 m3	nos. of tank	21	28	49
Reticulation Pipelines	63 to 200 mm	km	139	343	483
Yard connections		nos.	6,079	8,654	14,733
Standpipes		nos.	115	305	420
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station		x 1,000 R	167	454	621
Raw Water Pipeline or Cannal		x 1,000 R	36	56	92
WTW/Pump Station		x 1,000 R	4,960	10,290	15,250
Bulk Supply Pipelines		x 1,000 R	23,835	26,078	49,913
Regional Reservoirs		x 1,000 R	2,100	2,600	4,700
Pump Stations		x 1,000 R	114	362	476
Sub-Total		***x 1,000 R***	***31,211***	***39,840***	***71,051***
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs		x 1,000 R	4,045	6,155	10,200
Reticulation Pipelines		x 1,000 R	9,418	23,580	32,998
Yard Connections		x 1,000 R	6,383	9,087	15,470
Standpipes		x 1,000 R	184	488	672
Sub-Total		***x 1,000 R***	***20,030***	***39,310***	***59,340***
Total		**x 1,000 R**	**51,241**	**79,150**	**130,391**

Table 4-3 Summary of Alternatvie-3 (Service Level B)

MORETELE 2

ITEMS			MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
POPULATION AND WATER DEMAND					
No. of Communities		nos.	8	9	17
No. of Households		nos.	6,754	9,616	16,370
Population		person	43,226	61,542	104,768
Ave. No. of Persons per Household		person	6.4	6.4	6.4
Pop. Served by Yard Connection		person	38,903	55,388	94,291
Pop. Served by Standpipe		person	4,323	6,154	10,477
Total Water Demand (AADD)		kL/day	3,460	4,926	8,386
Total Water Demand (SPDD)		kL/day	5,190	7,389	12,578
OUTLINE OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Source of Water			Rust de Winter Dam	Mkombho Dam	
Raw Water Supply Pipeline/Can	300-450 mm	km	0.1	0.1	0.2
Water Treatment Works/Pump Stations		ml/day	5.4	15.0	20.4
Regional Reservoirs	1.3 to 3.1 ML	nos. of tank	2	2	4
Bulk Supply Pipelines	90 to 450 mm	km	78	84	162
Pump Stations		nos.	1	4	5
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	10 to 480 m3	nos. of tank	21	28	49
Reticulation Pipelines	63 to 200 mm	km	139	343	483
Yard connections		nos.	6,079	8,654	14,733
Standpipes		nos.	115	305	420
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station		x 1,000 R	167	454	621
Raw Water Pipeline or Cannal		x 1,000 R	36	56	92
WTW/Pump Station		x 1,000 R	4,960	10,290	15,250
Bulk Supply Pipelines		x 1,000 R	23,835	26,078	49,913
Regional Reservoirs		x 1,000 R	2,100	2,600	4,700
Pump Stations		x 1,000 R	114	362	476
Sub-Total		***x 1,000 R***	***31,211***	***39,840***	***71,051***
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs		x 1,000 R	4,045	6,155	10,200
Reticulation Pipelines		x 1,000 R	9,418	23,580	32,998
Yard Connections		x 1,000 R	6,383	9,087	15,470
Standpipes		x 1,000 R	184	488	672
Sub-Total		***x 1,000 R***	***20,030***	***39,310***	***59,340***
Total		**x 1,000 R**	**51,241**	**79,150**	**130,391**

4.2.3 Comparison of Alternative Water Supply Plans

The three alternatives were further evaluated and a comparison made as shown in Table 4-4. As can be seen in the table, Alternative 1 will require the least capital cost followed by Alternative 3 with Alternative 2 being the most expensive.

The present capacity of Weltevreden WTW (18.0 Mld) has already been fully committed or utilized, so expansion of the treatment works is necessary for all three alternatives. In terms of the additional treatment capacity required, Alternatives 1, 2 and 3 require the works to be extended by 13.2 Mld, 7.8 Mld and 7.8 Mld respectively. DWAF has confirmed that the minimum expandable treatment stream size for the works is 15.0 Mld, and that there are no immediate plans to extend the works. For this reason, the full cost for a 15.0 Mld extension has been included for all three alternatives despite the much smaller water demands for Alternatives 2 and 3.

Given the supply problems that are currently experienced in the adjoining Moutse area, the capacity of the existing bulk supply pipeline from Weltevreden WTW northwards to Bloedfontein Regional Reservoir appears not to have spare capacity and so cannot accommodate the additional demand for Moretele 2. For this reason, a new completely separate bulk supply pipeline approximately 25 km in length has been planned between the treatment works and Lefiso for each of the three alternatives.

A hydraulic analysis of the existing bulk supply line from Klipdrift WTW to Warmbaths and Nylstroom indicated that the pipeline can accommodate the water demand for Moretele 2 West under Alternative 2. For this alternative, a cost was included for sharing the existing bulk supply pipeline that was calculated on the following basis.

Sharing Cost = A x (B / C)

where,

A: Construction cost at current prices

B: Alternative 2 water demand

C: Hydraulic capacity of existing pipeline

Under Alternative 3, the treatment capacity to be provided at the new Rust de Winter WTW is only 5.4 Mld which appears to be too small for continuous operation (i.e. on a 24 hours per day and 7 days per week basis). Some extra treatment capacity, therefore, might have to be

Table 4-4 Comparison of Water Supply Alternatives

MORETELE 2

ITEMS	UNIT	ALTERNATIVE-1 (Service Level B)	ALTERNATIVE-2 (Service Level B)	ALTERNATIVE-3 (Service Level B)
Total Water Demand(SPDD)	kl/day	12,578	12,578	12,578
	l/sec	145.58	145.58	145.58
Supply from WTW(SPDD)				
Klipdrift WTW	kl/day	0	5,190	0
	l/sec	0	60.07	0
Weltevreden WTW	kl/day	12,578	7,389	7,389
	l/sec	145.58	85.52	85.52
Rust de Winter WTW	kl/day	0	0	5,190
	l/sec	0	0	60.07
Total	kl/day	12,578	12,579	12,579
	l/sec	145.58	145.59	145.59
Amount of Intake for Treatment				
Klipdrift WTW	Ml/day	0	5.45	0
Weltevreden WTW	Ml/day	13.21	7.76	7.76
Rust de Winter WTW	Ml/day	0	0	5.45
Total	Ml/day	13.21	13.21	13.21
Treatment Capacity to be Installed				
Klipdrift WTW *	Ml/day	0	18	0
Weltevreden WTW**	Ml/day	15	15	15
Rust de Winter WTW	Ml/day	0	0	5.4
Total	Ml/day	15	33	20.4
Capital Cost Required	x 1000R	122,421	134,725	130,391
Impacts on Operation of Existing System		Medium	Medium	Medium
Operability of Rust de Winter WTW(in terms of scale)		N.A.	N.A.	Poor
Total Energy Required for Pumping	m3/sec x m	39.2	40.6	34.5

* Minimum expandable treatment stream size is 18.0 Ml/day.

** Minimum expandable treatment stream size is 15.0 Ml/day.

Table 4-4 Comparison of Water Supply Alternatives

MORETELE 2

ITEMS	UNIT	ALTERNATIVE-1 (Service Level B)	ALTERNATIVE-2 (Service Level B)	ALTERNATIVE-3 (Service Level B)
Total Water Demand(SPDD)	kl/day	12,578	12,578	12,578
	l/sec	145.58	145.58	145.58
Supply from WTW(SPDD)				
Klipdrift WTW	kl/day	0	5,190	0
	l/sec	0	60.07	0
Weltevreden WTW	kl/day	12,578	7,389	7,389
	l/sec	145.58	85.52	85.52
Rust de Winter WTW	kl/day	0	0	5,190
	l/sec	0	0	60.07
Total	kl/day	12,578	12,579	12,579
	l/sec	145.58	145.59	145.59
Amount of Intake for Treatment				
Klipdrift WTW	Ml/day	0	5.45	0
Weltevreden WTW	Ml/day	13.21	7.76	7.76
Rust de Winter WTW	Ml/day	0	0	5.45
Total	Ml/day	13.21	13.21	13.21
Treatment Capacity to be Installed				
Klipdrift WTW *	Ml/day	0	18	0
Weltevreden WTW**	Ml/day	15	15	15
Rust de Winter WTW	Ml/day	0	0	5.4
Total	Ml/day	15	33	20.4
Capital Cost Required	x 1000R	122,421	134,725	130,391
Impacts on Operation of Existing System		Medium	Medium	Medium
Operability of Rust de Winter WTW(in terms of scale)		N.A.	N.A.	Poor
Total Energy Required for Pumping	m3/sec x m	39.2	40.6	34.5

* Minimum expandable treatment stream size is 18.0 Ml/day.

** Minimum expandable treatment stream size is 15.0 Ml/day.

added for this alternative in order for the works to be able to operate on an 8 hours per day and 5 days per week basis. However no extra costs have been included in this regard for Alternative 3 for the purpose of this comparison.

For each alternative, the energy required for pumping was estimated as the product of (a) volume of water to be pumped and (b) required head of the pump.

This calculation was conducted for each pumping station and the products obtained were summed for each alternative. Table A.4-1 of Annex A shows the results of this exercise, which indicated that Alternative 3 would require less energy than Alternative 1. As the situation is reversed in terms of the capital cost, the present values of both capital and energy costs were estimated for each of these two alternatives to seek the least cost solution. This analysis was conducted for a period of 30 years using three different discount rates of 5%, 9% and 17 %. All three cases indicated that Alternative 1 is the least cost option. The results of this analysis are presented in Table A.4-2 of Annex A. With respect to other components of O&M costs such as those for chemicals and personnel, there seems to be no significant difference between the three alternatives.

The impact on the operation of the existing Weltevreden water supply system due to implementation of any of the three alternatives will be equally small. Institutional arrangements (particularly the likely area of jurisdiction of the proposed Highveld Water Board) and the viability of a small treatment works at Rust de Winter mitigate against Alternatives 2 and 3.

Taking all of the above into consideration, the JICA Study Team identified Alternative 1 as the most preferable water supply plan for the Moretele 2 Feasibility Study Area.

4.2.4 Further Study of the Recommended Water Supply Plan

Following the exercise mentioned in Section 4.2.3 which identified Alternative 1 as the most preferable water supply option for this FS Area, the same water supply plan was then re-examined on the basis of the Service Level A. Pumping stations, water treatment works, reservoirs and reticulation systems were planned or sized to meet the RDP level of service and the capital cost required to implement the same water supply scheme but on the basis of the RDP level of service was identified as shown in Table 4-5. The difference in capital cost between the two different levels of service was then calculated as shown in Table 4-6.

Table 4-5 Summary of Alternative-1 (Service Level A)

MORETELE 2

ITEMS			MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
POPULATION AND WATER DEMAND					
No. of Communities		nos.	8	9	17
No. of Households		nos.	6,754	9,616	16,370
Population		person	43,226	61,542	104,768
Ave. No. of Persons per Household		person	6.4	6.4	6.4
Pop. Served by Yard Connection		person	0	0	0
Pop. Served by Standpipe		person	43,226	61,542	104,768
Total Water Demand (AADD)		kL/day	1,297	1,846	3,143
Total Water Demand (SPDD)		kL/day	1,945	2,769	4,715
OUTLINE OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Source of Water			N.A.	Mkombho Dam	
Raw Water Supply Pipeline	450 mm	km	N.A.	0.1	0.1
Water Treatment Works/Pump Stations		mL/day	N.A.	15	15.0
Regional Reservoirs	3.2 ML	nos. of tank	0	1	1
Bulk Supply Pipelines	90 to 500 mm	km	51	84	135
Pump Stations		nos.	2	4	6
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	20 to 450 m3	nos. of tank	11	12	23
Reticulation Pipelines	63 to 200 mm	km	74	214	288
Yard connections		nos.	0	0	0
Standpipes		nos.	149	395	544
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station		x 1,000 R	0	303	303
Raw Water Pipeline		x 1,000 R	0	56	56
WTW/Pump Station		x 1,000 R	0	10,290	10,290
Bulk Supply Pipelines		x 1,000 R	13,448	32,937	46,385
Regional Reservoirs		x 1,000 R	0	1,600	1,600
Pump Stations		x 1,000 R	525	259	784
Sub-Total		***x 1,000 R***	***13,973***	***45,445***	***59,418***
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs		x 1,000 R	2,110	2,455	4,565
Reticulation Pipelines		x 1,000 R	5,841	16,897	22,738
Yard Connections		x 1,000 R	0	0	0
Standpipes		x 1,000 R	238	632	870
Sub-Total		***x 1,000 R***	***8,189***	***19,984***	***28,174***
Total		**x 1,000 R**	**22,162**	**65,429**	**87,592**

Table 4-5 Summary of Alternative-1 (Service Level A)

MORETELE 2

ITEMS			MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
POPULATION AND WATER DEMAND					
No. of Communities		nos.	8	9	17
No. of Households		nos.	6,754	9,616	16,370
Population		person	43,226	61,542	104,768
Ave. No. of Persons per Household		person	6.4	6.4	6.4
Pop. Served by Yard Connection		person	0	0	0
Pop. Served by Standpipe		person	43,226	61,542	104,768
Total Water Demand (AADD)		kl/day	1,297	1,846	3,143
Total Water Demand (SPDD)		kl/day	1,945	2,769	4,715
OUTLINE OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Source of Water			N.A.	Mkombho Dam	
Raw Water Supply Pipeline	450 mm	km	N.A.	0.1	0.1
Water Treatment Works/Pump Stations		ml/day	N.A.	15	15.0
Regional Reservoirs	3.2 ML	nos. of tank	0	1	1
Bulk Supply Pipelines	90 to 500 mm	km	51	84	135
Pump Stations		nos.	2	4	6
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	20 to 450 m3	nos. of tank	11	12	23
Reticulation Pipelines	63 to 200 mm	km	74	214	288
Yard connections		nos.	0	0	0
Standpipes		nos.	149	395	544
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station		x 1,000 R	0	303	303
Raw Water Pipeline		x 1,000 R	0	56	56
WTW/Pump Station		x 1,000 R	0	10,290	10,290
Bulk Supply Pipelines		x 1,000 R	13,448	32,937	46,385
Regional Reservoirs		x 1,000 R	0	1,600	1,600
Pump Stations		x 1,000 R	525	259	784
Sub-Total		***x 1,000 R***	***13,973***	***45,445***	***59,418***
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs		x 1,000 R	2,110	2,455	4,565
Reticulation Pipelines		x 1,000 R	5,841	16,897	22,738
Yard Connections		x 1,000 R	0	0	0
Standpipes		x 1,000 R	238	632	870
Sub-Total		***x 1,000 R***	***8,189***	***19,984***	***28,174***
Total		**x 1,000 R**	**22,162**	**65,429**	**87,592**

Table 4-6 Comparison of Alternative-1 (Service Level B) & Alternative-1(Service Level B)

MORETELE 2

		MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
ALTERNATIVE-1 (SERVICE LEVEL B)				
CAPITAL COST OF PROPOSED INFRASTRUCTURE				
BULK SUPPLY INFRASTRUCTURE				
Intake/Pump Station	x 1,000 R	0	454	454
Raw Water Pipeline/Pump Station	x 1,000 R	0	56	56
WTW/Pump Station	x 1,000 R	0	10,290	10,290
Bulk Supply Pipelines	x 1,000 R	13,448	32,937	46,385
Regional Reservoirs	x 1,000 R	0	3,600	3,600
Pump Stations	x 1,000 R	787	389	1,177
Sub-Total	*x 1,000 R*	*14,235*	*47,726*	*61,962*
RETAIL SUPPLY INFRASTRUCTURE				
Service Reservoirs	x 1,000 R	5,165	6,155	11,320
Reticulation Pipelines	x 1,000 R	9,418	23,580	32,998
Yard Connections	x 1,000 R	6,383	9,087	15,470
Standpipes	x 1,000 R	184	488	672
Sub-Total	*x 1,000 R*	*21,150*	*39,310*	*60,460*
Total	**x 1,000 R**	**35,385**	**87,036**	**122,421**
ALTERNATIVE-1 (SERVICE LEVEL A)				
CAPITAL COST OF PROPOSED INFRASTRUCTURE				
BULK SUPPLY INFRASTRUCTURE				
Intake/Pump Station	x 1,000 R	0	303	303
Raw Water Pipeline/Pump Station	x 1,000 R	0	56	56
WTW/Pump Station	x 1,000 R	0	10,290	10,290
Bulk Supply Pipelines	x 1,000 R	13,448	32,937	46,385
Regional Reservoirs	x 1,000 R	0	1,600	1,600
Pump Stations	x 1,000 R	525	259	784
Sub-Total	*x 1,000 R*	*13,973*	*45,445*	*59,418*
RETAIL SUPPLY INFRASTRUCTURE				
Service Reservoirs	x 1,000 R	2,110	2,455	4,565
Reticulation Pipelines	x 1,000 R	5,841	16,897	22,738
Yard Connections	x 1,000 R	0	0	0
Standpipes	x 1,000 R	238	632	870
Sub-Total	*x 1,000 R*	*8,189*	*19,984*	*28,174*
Total	**x 1,000 R**	**22,162**	**65,429**	**87,592**
(SERVICE LEVEL B) - (SERVICE LEVEL A)				
CAPITAL COST OF PROPOSED INFRASTRUCTURE				
BULK SUPPLY INFRASTRUCTURE				
Intake/Pump Station	x 1,000 R	0	151	151
Raw Water Pipeline/Pump Station	x 1,000 R	0	0	0
WTW/Pump Station	x 1,000 R	0	0	0
Bulk Supply Pipelines	x 1,000 R	0	0	0
Regional Reservoirs	x 1,000 R	0	2,000	2,000
Pump Stations	x 1,000 R	262	130	393
Sub-Total	*x 1,000 R*	*262*	*2,281*	*2,544*
RETAIL SUPPLY INFRASTRUCTURE				
Service Reservoirs	x 1,000 R	3,055	3,700	6,755
Reticulation Pipelines	x 1,000 R	3,577	6,683	10,260
Yard Connections	x 1,000 R	6,383	9,087	15,470
Standpipes	x 1,000 R	-54	-144	-198
Sub-Total	*x 1,000 R*	*12,960*	*19,326*	*32,286*
Total	**x 1,000 R**	**13,223**	**21,607**	**34,830**

Table 4-6 Comparison of Alternative-1 (Service Level B) & Alternative-1(Service Level B)

MORETELE 2

		MORETELE 2 WEST	MORETERE 2 EAST	TOTAL
ALTERNATIVE-1 (SERVICE LEVEL B)				
CAPITAL COST OF PROPOSED INFRASTRUCTURE				
BULK SUPPLY INFRASTRUCTURE				
Intake/Pump Station	x 1,000 R	0	454	454
Raw Water Pipeline/Pump Station	x 1,000 R	0	56	56
WTW/Pump Station	x 1,000 R	0	10,290	10,290
Bulk Supply Pipelines	x 1,000 R	13,448	32,937	46,385
Regional Reservoirs	x 1,000 R	0	3,600	3,600
Pump Stations	x 1,000 R	787	389	1,177
Sub-Total	*x 1,000 R*	*14,235*	*47,726*	*61,962*
RETAIL SUPPLY INFRASTRUCTURE				
Service Reservoirs	x 1,000 R	5,165	6,155	11,320
Reticulation Pipelines	x 1,000 R	9,418	23,580	32,998
Yard Connections	x 1,000 R	6,383	9,087	15,470
Standpipes	x 1,000 R	184	488	672
Sub-Total	*x 1,000 R*	*21,150*	*39,310*	*60,460*
Total	**x 1,000 R**	**35,385**	**87,036**	**122,421**
ALTERNATIVE-1 (SERVICE LEVEL A)				
CAPITAL COST OF PROPOSED INFRASTRUCTURE				
BULK SUPPLY INFRASTRUCTURE				
Intake/Pump Station	x 1,000 R	0	303	303
Raw Water Pipeline/Pump Station	x 1,000 R	0	56	56
WTW/Pump Station	x 1,000 R	0	10,290	10,290
Bulk Supply Pipelines	x 1,000 R	13,448	32,937	46,385
Regional Reservoirs	x 1,000 R	0	1,600	1,600
Pump Stations	x 1,000 R	525	259	784
Sub-Total	*x 1,000 R*	*13,973*	*45,445*	*59,418*
RETAIL SUPPLY INFRASTRUCTURE				
Service Reservoirs	x 1,000 R	2,110	2,455	4,565
Reticulation Pipelines	x 1,000 R	5,841	16,897	22,738
Yard Connections	x 1,000 R	0	0	0
Standpipes	x 1,000 R	238	632	870
Sub-Total	*x 1,000 R*	*8,189*	*19,984*	*28,174*
Total	**x 1,000 R**	**22,162**	**65,429**	**87,592**
(SERVICE LEVEL B) - (SERVICE LEVEL A)				
CAPITAL COST OF PROPOSED INFRASTRUCTURE				
BULK SUPPLY INFRASTRUCTURE				
Intake/Pump Station	x 1,000 R	0	151	151
Raw Water Pipeline/Pump Station	x 1,000 R	0	0	0
WTW/Pump Station	x 1,000 R	0	0	0
Bulk Supply Pipelines	x 1,000 R	0	0	0
Regional Reservoirs	x 1,000 R	0	2,000	2,000
Pump Stations	x 1,000 R	262	130	393
Sub-Total	*x 1,000 R*	*262*	*2,281*	*2,544*
RETAIL SUPPLY INFRASTRUCTURE				
Service Reservoirs	x 1,000 R	3,055	3,700	6,755
Reticulation Pipelines	x 1,000 R	3,577	6,683	10,260
Yard Connections	x 1,000 R	6,383	9,087	15,470
Standpipes	x 1,000 R	-54	-144	-198
Sub-Total	*x 1,000 R*	*12,960*	*19,326*	*32,286*
Total	**x 1,000 R**	**13,223**	**21,607**	**34,830**

4.3 Proposed Water Supply Plan and Availability of Raw Water

4.3.1 Proposed Water Supply Plan

The water supply plan proposed for this FS Area is shown in Figure 4-4. Under the recommended plan, a new rising main from Weltevreden WTW will feed a regional reservoir at Lefiso. A booster pumping station will be required to supply Lefiso and Mmutlestad to the east. Most of the flow will gravitate to the west from the regional reservoir. A booster pumping station will be necessary on a branch running northwards to Lefiswane. Just upstream of Marapyane a branch to the south will provide a gravity supply to Moletsi and Seghoko with sub-branches eastwards to Ramantsho and Semohlase. The gravity main from the Lefiso Regional Reservoir extends eastwards beyond Ga Ramantshane with gravity fed branches to Marapyane and Opgeruimd and pumped branches to Ga Ramantshane and Kalkfontein.

Beyond Ga Ramantshane an in-line booster pumping station is required to supply westwards to Phake C with branches to Rapotokwane and Lefifi, Norman, Bamokgoko and Phake C. A further in-line booster is required in Phake C to supply the western extremities of the system including branches to Phake A, Phake B and Mantlole and Masobe.

4.3.2 Availability of Raw Water

As described above there is some doubt concerning the long-term firm yield of Mkombo Dam. If the water available from Mkombo is insufficient to meet existing demands plus the additional demand of Moretele 2, the boundary between the supply area of Weltevreden WTW and that of Bronkhorstspruit WTW will move northwards slightly. Due to the location of the proposed development in Moretele 2, the area must be fed from Weltevreden even if some areas further south in KwaNdebele must be shifted onto the Bronkhorstspruit supply system as a result.

Technical issues which require further consideration but which do not affect the Feasibility Study are that transmission losses are believed to be high between Rust de Winter Dam and Mkombo Dam and that the raw water supply from Loskop Dam is unreliable and over committed at present.

As described for the Klipvoor Feasibility Study Area, sufficient water is available within the

Pienaars River system to meet the demand in the Moretele 2 area. DWAF is keen to exploit the surplus water available in the Apies / Pienaars system to augment the Mkombo catchment. In the medium to long term, inter basin transfers may be needed to augment flows in the Rust de Winter / Mkombo basin.

4.4 Preliminary Design of Major Infrastructure

Under the recommended scheme for the Moretele 2 Area, all communities will be served from a new extension (15 Mld) of the existing Weltevreden Water Treatment Works. The works is supplied with raw water from Mkombo Dam on the Elands River and via transfers from Loskop Dam.

Figure 4-5 shows the proposed layout plan for the 15 Mld extension of the existing Weltevreden WTW. It is proposed that the process units for the extension should mirror the existing process that comprises flocculation, sedimentation and filtration. There is space at the site for up to an additional 60 Mld of treatment capacity to be provided. The existing plant does not include facilities for dissolved air flotation; however based on raw water quality data obtained from the DWAF database, the risk of microcystis blooms in Mkombo Dam is medium to slight and the water body is oligotrophic therefore DAF appears to be unnecessary. Meaningful treated water quality data for the existing works at Weltevreden is not available so a proper assessment of the suitability of the existing process has not been possible. The process to be used should be reconsidered during the detailed design stage.

Preliminary designs of the other major components of the water supply system such as regional reservoirs, service reservoirs, pumping stations and pipework are shown in Figures A.5-1 through A.5-6 of Annex A. These preliminary designs are only intended to indicate general features of the infrastructure included in the proposed water supply plan. Designs meeting the site-specific requirements will be prepared during the detailed design stage.

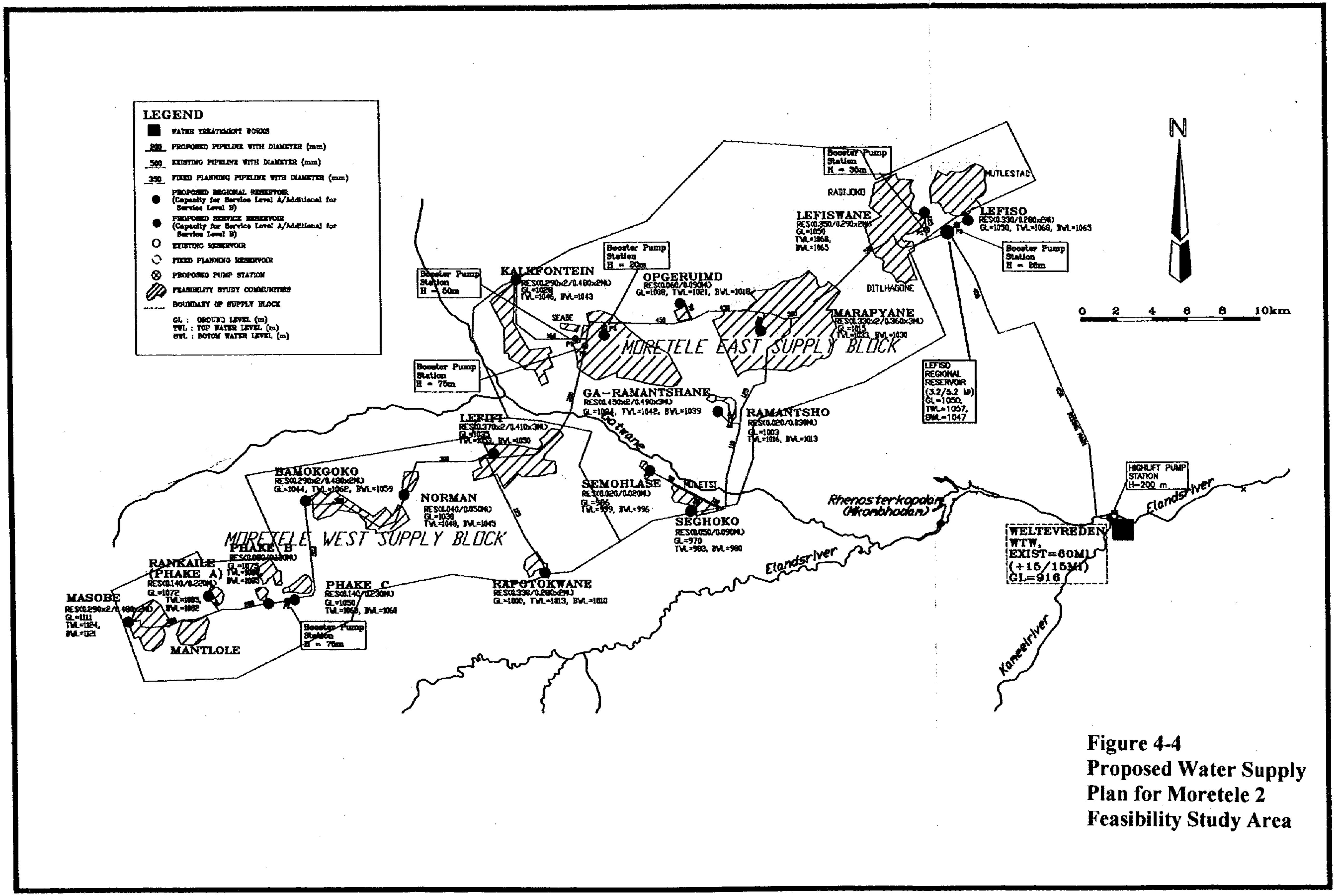


Figure 4-4
Proposed Water Supply Plan for Moretele 2 Feasibility Study Area

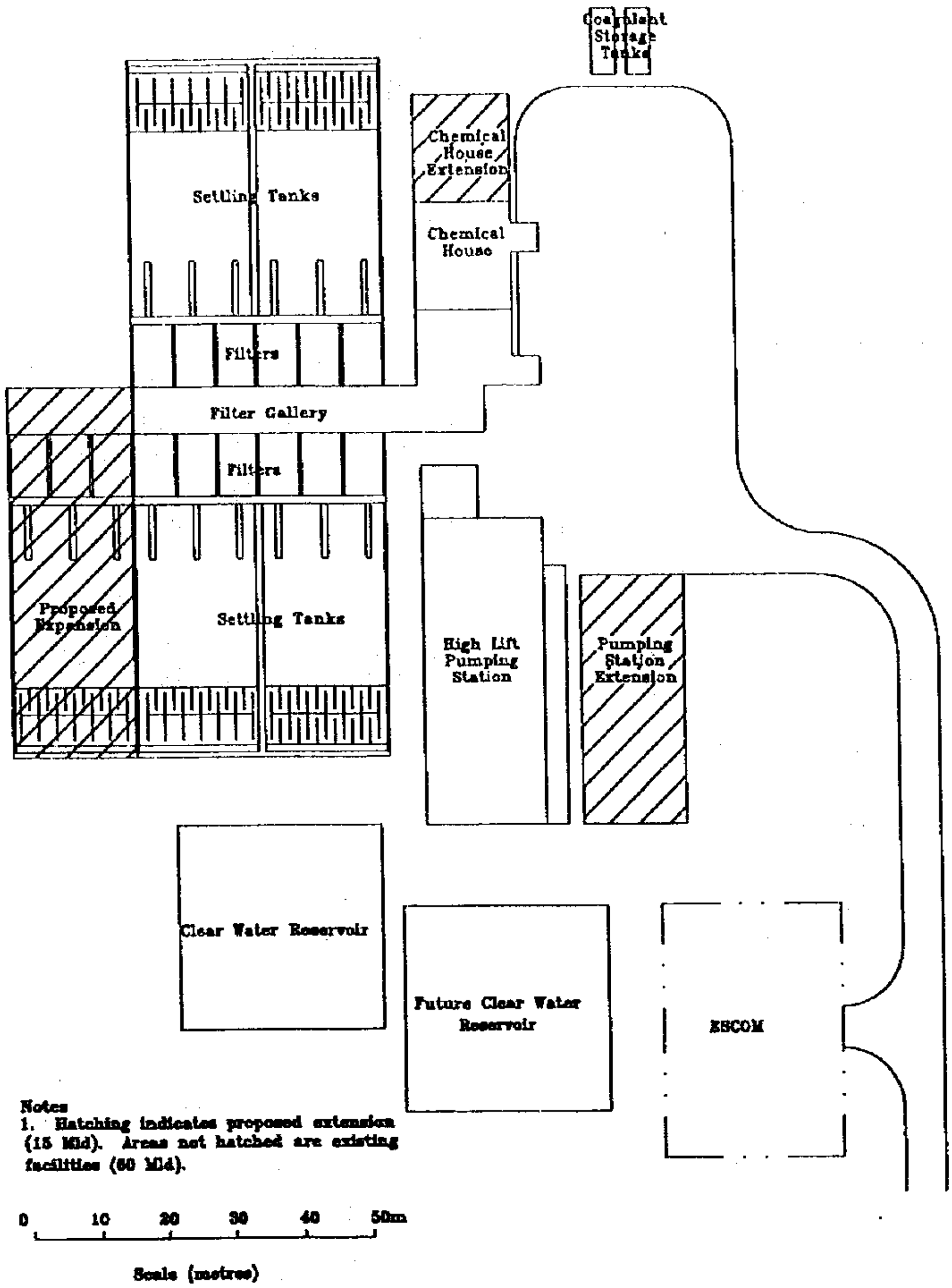


Figure 4-5

Proposed Layout for 15 MLD Extension of Weltevreden WTW

4.5 Construction Costs at 1997 Prices

Costs for the proposed water supply plan (Alternative 1 / Service Level B) shown in Table 4-1 are pure construction costs at 1997 prices and do not include P&G or any contingencies. Construction costs estimated on the same basis but for the RDP level of service (Service Level A) are presented in Table 4-5.

For each of the two levels of service, the difference in construction cost is provided in Table 4-6 for each component of the water supply system. As can be seen in the table, the cost difference is not as significant for bulk infrastructure as it is for retail infrastructure. This is mainly because the cost of bulk supply pipelines, which usually comprises a major portion of the total bulk infrastructure cost, is same for both levels of service. In summary, the construction costs estimated for each service level are as follows:

Service Level	Construction Costs at 1997 Prices
Alternative 1, Service Level B	R122,421,000
Alternative 1, Service Level A	R 87,592,000
Difference (Level B - Level A)	R 34,830,000

As mentioned earlier, these costs are pure construction costs at 1997 prices to which various other costs and fees, such as P&G, an allowance for physical contingencies, inflation, engineering fees, administration costs and VAT must be added to derive the actual project cost.

It should be noted that the construction cost for Service Level B includes the cost of providing yard connections to 90% of households in each community, which amounts to approximately R15.5 million, constituting a significant portion (around 45%) of the difference in cost between the two levels of service.

Considering the relatively small size and capacity of the constituent components of the scheme, and given the manufacturing capability of local industry, it was assumed that all of the materials, equipment and goods required for the construction of the proposed infrastructure, (such as pumps, motors, pipes, fittings, valves, etc.), are manufactured within South Africa.

CHAPTER 5

FINANCIAL APPRAISAL

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 5 FINANCIAL APPRAISAL

5.1 Preliminary Analysis on Case A and Case B

On the basis of the facility planning, the following possible options were analysed and assessed mainly from financial viewpoints:

Case A: Implementation of the level A services (standpipe) only; and

Case B: Implementation of the level B services (yard connection: 90% + standpipe: 10%) only

5.1.1 Premises

(1) Willingness to Pay and Affordability

The socio-economic survey showed that the average monthly income for households in Moretele 2 is about R1,466. The average size of the household is approximately 6.4 persons, 67% of monthly income is derived from employment. Consumers in the Moretele 2 Area currently spend R23.3 per month on water purchased from vendors or R0.9 per month on borehole water, but water purchased from vendors only represented 1% of total water purchases. Consumer's average Willingness to Pay (WTP) for the RDP level of service was R9.1 per month and R28.5 per month for yard connections as shown in Figure 5-1. The average willingness to pay for yard connections only represents 1.94% of total monthly household income. Current income and affordability levels of beneficiaries in the Project Area will impact on the size of the tariff that can be levied and expected revenues / income.

Generally, respondents seem to state their income smaller, but expenditures bigger. As such, they also have tendency to express lesser amount as WTP, and approximately 3 % of household income is applicable for their affordability to water supply on the basis of World Bank's experience in the planning of this sector.

In addition, the beneficiaries are categorised into three groups in terms of their income with their affordability for water supply as shown below:

Table 5-1 Income Group and Affordability

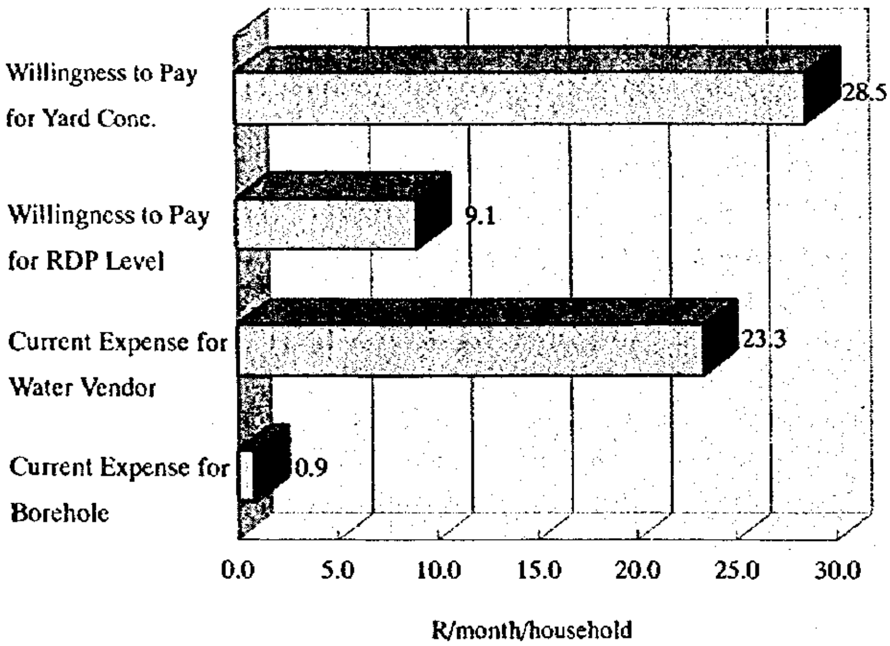
Income Group (%)	Ave. Monthly Income (R)	Affordability (R)
Low : - R499/m (32%)	337	10.11
Middle : R500 - R1999/m (49%)	1,179	35.37
High : R2,000/m - (19%)	2,882	86.46
Average	1,446	43.98

Figure 5-1 Comparison of Current Expese and Willingness to Pay

Moretele 2

Current Expense for Borehole	0.9	R/month/household	0.06%
Current Expense for Water Vendor	23.3	R/month/household	1.59%
Willingness to Pay for RDP Level	9.1	R/month/household	0.62%
Willingness to Pay for Yard Conc.	28.5	R/month/household	1.95%
Average Monthly Income	1,466	R/month/household	

Comparison of Current Expense and Willingness to Pay



(2) Implementation Period

In both cases of A and B, overall implementation would requires five (5) years including fund procurement procedures, detailed design and construction supervision as well as institutional development.

5.1.2 Project Cost

(1) Initial Capital Cost

To determine the required initial capital cost, the following cost model has been applied to the bulk and the retail water supply system excluding the specific cost of yard connections.

- Direct Construction Cost (DCC);
- Provisional and General (P&G) Cost: 15% of (1);
- Base Cost: (1) + (2);
- Engineering Fee: 10% of (3);
- Miscellaneous: 2% of (1);
- Institutional Support and Development: 2.5% of (3);
- Sub-total: (3) + (4) + (5) + (6);
- Physical Contingency: 15% of (7);
- Price Contingency: 10% of compound rate for the sum of (7) and (8) at the specified year of disbursement; and
- VAT: 14% of sum of (7), (8) and (9)
- Initial Capital Cost: Sum of (7), (8), (9) and (10)

The cost of the yard connections consists of a direct construction cost, a price contingency and VAT.

Direct construction cost has been estimated on the basis of the proposed water supply system and represents pure construction cost excluding P&G's, any allowance for physical contingencies and the other factors described in (2) to (10) above. More detail concerning the engineering aspects of the assumptions are provided in Chapter 4 of this report.

The estimated initial capital cost for both Case A and Case B is summarised in Table 5-2 and in greater detail in Table C.1-2 in Annex C. In this table, the following definition is applied:

Bulk Supply: Bulk water supply infrastructures covering from raw water intake to bulk supply pipeline until service reservoirs;

Retail Supply: Retail water supply infrastructures covering from service reservoirs to standpipes; and

Yard Connection: Connecting facilities between reticulation pipeline and yard taps.

Table 5-2 Composition of Initial Capital Cost (Unit : R 1,000)

	Case A	Case B	Difference
Bulk Supply			
Base Cost	68,331	71,256	2,925
Engineering etc.	9,729	10,146	427
Contingencies	48,731	50,828	2,097
VAT	17,751	18,512	761
Total	**144,542**	**150,742**	**6,200**
Retail Supply (Main)			
Base Cost	32,399	51,739	19,340
Engineering etc.	4,050	6,467	2,417
Contingencies	23,837	38,066	14,229
VAT	8,440	13,478	5,038
Total	**68,726**	**109,750**	**41,024**
Yard Connections			
Direct Construction Cost	-	15,470	15,470
Price Contingency	-	7,221	7,221
VAT	-	3,177	3,177
Total	-	**25,868**	**25,868**
Total Capital Cost	**213,268**	**286,360**	**73,092**

(2) Operation and Maintenance Cost

To operate the water supply system, expenses such as raw water, power for pumping, and chemicals for purification are incurred as well as salaries for staff. The operation and maintenance costs for bulk water supply and the administration cost for retail water supply are estimated separately.

The estimated annual operation and maintenance cost for both Case A and Case B is summarised its Table 5-3 and its greater detail is provided in Table C.1-3 of Annex C.

Table 5-3 Annual Operation and Maintenance Cost (Unit : R1,000)

Case (Annual Demand)	Bulk Water Supply						Retail Water Supply	Total
	Raw water	Electricity	Chemicals	Salaries	Maintenance	Sub-Total	Administration	
	0.013R/kl	0.15R/kl	0.04R/kl	0.025R/kl	0.015R/kl			
Case A (1,147,210kl)	14.9	205.5	45.9	28.7	17.2	312.2	204.9	517.1
Case B (3,059,226kl)	39.8	547.9	122.4	76.5	45.9	832.4	507.3	1,339.7

(a) Operation and Maintenance Cost for Bulk Water Supply

The operating cost for Vaalkop WTW and other bulk water supply infrastructure in the North Mankwe Area are estimated from data for existing Vaalkop WTW schemes.

i) Raw Water Cost: 0.013 R/kl
Weltervreden WTW treats raw water from Mkombo Dam and Loskop Dam.
The raw water tariff is currently not applicable to extracted from Mkombo Dam. The raw water cost for Weltervreden WTW is assumed to be 0.013 R/kl which was paid for water from Loskop Dam in the 1996/97 fiscal year.

ii) ESKOM Power: 0.15 R/kl
The cost of energy for all of the pumps and purification plant is assumed to be 0.15 R/kl of purified water produced. Any real price increase is estimated at 3% per annum and is based on data from Eskom.

iii) Chemicals:0.04 R/kl
The cost of chemicals is assumed to be 0.04 R/kl which was the chemical cost at Weltervreden WTW in 1996.

iv) Salaries: 0.025 R/kl
Staff salaries are calculated based on the salary at Weltervreden WTW in 1996.

v) Maintenance Cost: 0.015 R/kl
Maintenance cost is assumed to be 0.015 R/kl, the average for MW in 1996.

(b) Administration Cost for Retail Water Supply

The administration cost of the Water Services Provider, which will also be the implementation institution for retail water supply, is estimated based on the institutional development plan. The cost is calculated from the organisational structure together with the number of staff for Service Level A (RDP minimum level) and Service Level B (90%Yard Connections and 10% RDP minimum level).

The proposed organisational structure is determined based on the size of the community. For example, a small community is assumed to have a population of 2,100 or 350 Households (approximately 6 persons/household) while a medium size community is assumed to have a population of 4,800 or 800 households. Of the 17 communities in the Moretele 2 Area, 9 are classified as small and 8 as medium sized communities.

The costs to a small community for Service Level A and Service Level B are estimated to be R700 per month and R1,150 per month respectively. Whereas the costs of Service Level A and B to a medium sized community are R1,275 and R3,675 per month respectively. The applicable annual retail supply administration costs for Service Level A and Service Level B are R204,900 and R507,300 respectively (See Table C.1-4 through C.1-6 of Annex C).

5.1.3 Calculated Tariff and Implications

(1) General

The financial consideration of the proposed project has two different aspects: the supply side and the demand side approach through which sustainability of the project will be sought.

In considering the financial aspects, the following basic conditions have been applied:

- While the first tier (DWAF) will subsidise the initial capital cost required for the RDP level of service (Case A), it will not extend financial support for a service level higher than the RDP minimum level. This includes grant funding, subsidies, or loan guarantees on behalf of a Services Authority or Services Provider;
- The average affordability of beneficiaries for water supply is around 3% of their household income;
- The real rate of interest in South Africa is around 8% per annum;
- Future perspectives of the inflation rate range from 8% to 10% per annum;
- Full cost recovery (i.e. 100% tariff collection);
- Analysis period is 30 years.

(2) Water Tariff

By applying the basic conditions above, an overall water tariff was determined. Viewed from the standpoint of a Water Services Provider the water tariff should be enough to cover the bulk and retail supply systems.

(a) Case A

i) Bulk Water Tariff

In the cash flow analysis for the bulk water supply system, basic information such as operation, maintenance and administration costs were compared with the current data from Weltervreden Water Treatment Works. A bulk water tariff of R0.40/kl (at constant 1997 prices) which included replacement cost for components with an economic life less than the analysis period was computed. This tariff was also applied to the tariff calculation of the retail water supply system

ii) Retail Water Tariff

In regard to the third tier, a retail water tariff was also computed as a means to offset the recurrent costs including the bulk water tariff, maintenance and administration costs. This computation resulted in a tariff of R0.68/kl or R3.3/household at constant 1997 prices in 2003 when all beneficiaries will be able to receive the RDP level of service. The same tariff represents about 1.0% and 0.2% of household income of the lower income (R337/month in 1997) and the average income (R1,466/month) groups respectively.

(b) Case B

The water tariff for Case B has been calculated subject to the following additional conditions:

- Long-term loan : real rate of interest 8%, 20 yerars equal repayment
- Yard connection fee is included in the tariff calculation.

i) Bulk Water Tariff

Bulk supply is similar to Case A except that the second tier will acquire loan funding for the initial capital cost for the service level higher than the RDP level. A bulk water tariff of R0.58/kl was calculated for the bulk water supply system.

ii) Retail Water Tariff

The retail water tariff to cover recurrent costs and loan repayment was computed resulting in R2.97/kl. The calculated figure implies monthly expenditure per household for water supply of R38.8 and R14.3 for the average and low-income groups respectively. This is equivalent to 2.6% and 4.2% of the monthly income of each respective group.

Process of caluculation of tariff setting for bouth Case A and Case B is shown in Table C.1-7 of Annex C.

(2) Implications

Project evaluation included the financial viability and sustainability of Case A and Case B. The results of the evaluation are summarised in Table 5-4.

Table 5-4 Implication of Case A and B

		Case A	Case B
Service Level	Standpipes	100%	10%
	Yard Connections	0%	90%
	Consumption (AADD)	25 lcd	68 lcd
1. Community Preference		Very low	Rather High
2. Monthly Tariff	Low Group	R3.3 (25 lcd)	R14.3 (25 lcd)
	Avge. Group	R3.3 (25 lcd)	R38.8 (68 lcd)
3. Affordability	Low Group	R10.11	R10.11
	Avge. Group	R43.98	R43.98
4. Risk of Illegal / Unauthorised connections		Extremely high	Possibly low
5. Fund Mobilisation	2nd Tier	Not necessary	Possibly no problem
	3 rd Tier	Not necessary	Rather difficult
6. Institutional Capacity	2nd Tier	No problem	Unknown
	3 rd Tier	Need strong reinforcement	Need strong reinforcement

As can be seen from the table, Case A is affordable to the beneficiaries of the low-income group. However, the community survey conducted by the Study Team showed that the RDP minimum level of service is, generally, not welcomed by the communities and has a higher risk of illegal or unauthorised connections. Non-payment is also a major problem. On the other hand, Case B which provides the higher service level with 90% yard connections is the preferred alternative to most communities but the tariff is higher than the affordability level of beneficiaries. Consequently, a responsible Services Provider may not face great difficulty in mobilising the external funding required for the initial capital investment and working capital requirements.

5.2 Staged Development Approach

5.2.1 General

Based on the above evaluation, it would appear that neither simply implementing Case A nor Case B would be the best alternative considering the viability and sustainability of the project. To this end, it is proposed that a staged development approach, "Case C", be introduced that will start the project with Case A in the earlier years and then upgrade the system towards Case B. The proposed option includes a period of five years operation at Service Level A after completion of the infrastructure development in year 2002.

5.2.2 Alternative Plan

To implement the proposed option as Case C, the following two options were further reviewed from financial viewpoints:

Case C-1: A part of the cost required for upgrading service level shall be borne by beneficiaries through prior deposit during the Service Level A period, which must be included in the water tariff of the Level A.

Case C-2: The full cost required for upgrading service level shall be procured through an external loan fund.

5.2.3 Water Tariff and Implications

As similar manner that was applied for financial analysis of Case A and Case B in the earlier part of this chapter, a water tariff is calculated as shown in Table 5-5 and its implications are evaluated in Table 5-6.

Table 5-5 Water Tariff for Case C-1 and C-2

	2002-2007 R/HH	2008-2012 R/Kl	2013-2017 R/Kl	2018-2022 R/Kl	2023-2027 R/Kl
Case C-1	22.62	2.12	2.14	2.18	2.20
Case C-2	3.22	2.97	2.99	3.03	3.05

As mentioned in Table 5-6, it can be said that Case C-1 will be the most realistic option for implementing North Mankwe Water Supply Scheme under the framework of Magalies Water Expansion Project.

Table 5-6 **Evaluation on Alternative Plans (Cases C-1 and C-2)**

Particulars		**Alternative Plan (Case)**			
		C-1		**C-2**	
Water Tariff and Beneficiaries' Share *(While the zero growth for beneficiaries' income is expected, the tariff includes real increase of electricity charge at 3% per annum.)*	1st Stage	Since the tariff includes reserve fund for upgrading service level (a part of retail water supply facility and connection fee), it occupies about 3% of household income of average income group, while it does 6.7% of household income of low income group.		The tariff occupies less than 3% of household income in both average and low income groups.	
	2nd Stage	Through introduction of quantity base water tariff, it occupies 1.9-2.0% of household income of average income group. On the other hand, it does 3.0-3.1% of that of low income group, respectively.		Similar to Case C-1, the tariff occupies 2.6-2.7% of household income of average group. On the other hand, it does 4.2-4.3% of that of low income group, respectively.	
	Total Water Charges per Household (2002-2027) (Rand)	Average Income Group	Low Income Group	Average Income Group	Low Income Group
		8,125	3,846	9,296	3,540
Contribution to Improvement of Financial Ground of Service Provider		Through the reserve fund accumulated during the 1st Stage, North Mankwe will be able to secure about 18.4 million Rand as original fund. Due to the original reserve fund, credibility of service providers will be improved for external funding institutions, and it facilitates the service providers to obtain the required loan more easily than Case C-2 in the 2nd Stage.		All the cost to be required for upgrading the service level will be depending on external funding institutions, the proposed service provider, especially Highveld District Councils as 3rd Tier will face lack of credibility taking into account the present financial situation.	
Overall Evaluation		While the tariff in Case C-1 for the 1st Stage exceeds affordability of low income group due to reserve fund as prior investment in the FS area, the tariff for the 2nd Stage occupies household income by 0.7 to 1.2% lower than Case C-2. As for total expenditure for water charge during the calculation period of 25 years, average group of Case C-1 bears lesser burden than Case C-2, low income group of Case C-1 must expend a little bit more water charge by about 300 Rand for 25 years than Case C-2. In this context, the low income group of Case C-1 situates rather severer position than Case C-2, the average group of Case C-1 could enjoy more favourable condition than Case C-2 in terms of their cost sharing for water tariff. In addition, Case C-1 will be able to improve credibility of service providers. Therefore, the Case C-1 is considered the most realistic option when proper measures will be taken for the low income group.			

5.3 Details of Case C-1

5.3.1 Development Concept

The proposed option "Case C-1" aims to ultimately provide the service level B (yard connection) to all beneficiaries of the target communities in the North Mankwe FS area, with lesser cost burden to the beneficiaries and with sound management of the supply system by the service provider. The proposed option shall start to provide the water supply facilities under the service level A, which does not impose any financial burden for the initial capital cost to the beneficiaries. During the course of the service level A, every community has enough time to discuss and to obtain consensus about the possibility to upgrade the water supply system to the service level B. Especially, countermeasures must be fully argued among community members, which should support the low income group.

In order to attain the said target on the sustainable basis, it is prerequisite to reinforce and strengthen the institutional capacity of the 3rd tier including the target communities. In this connection, the proposed staged development approach will facilitate the required institutional development. The way and method of the institutional development of the 3rd tier are detailed in Chapter 6 of this report.

The scenario of the proposed option is shown schematically in Figure 5-2.

5.3.2 Project Cost and Allocation

(1) Initial Cost

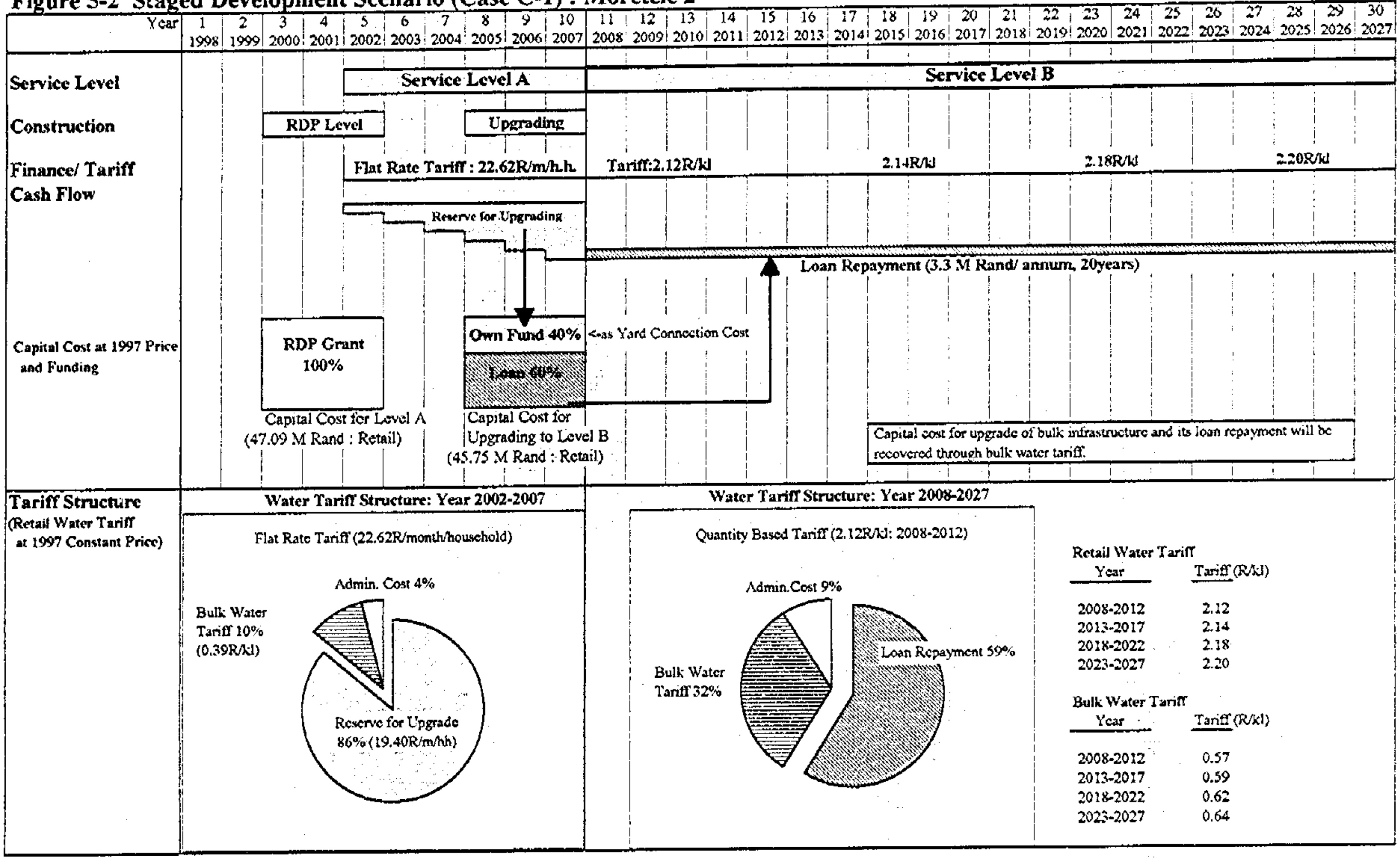
The proposed option requires two sets of initial capital investment, firstly those cost to be invested for providing the infrastructure under the level A services and an institutional development; and secondly those for upgrading the infrastructure from the level A to the level B services and institutional development. Table 5-7 Summarises the initial investment cost, of which detail is given in Table C.1-8 of Annex C.

Table 5-7 Initial Investment Cost (Case C-1) (Unit: R1,000)

	1st Stage (Level A)	2nd Stage (Upgrade)	Total	Executing Body
Bulk Supply	144,542	9,986	154,528	HW
Retail Supply	68,726	66,070	134,796	JV (HW+EDC)
Yard Cnnection	-	41,660	41,660	- ditto -
Total	213,268	117,716	330,984	
Remarks	1998-2002	2003-2007		

Note: At 1997 prices with price escalation of 10% p.a.

Figure 5-2 Staged Development Scenario (Case C-1) : Moretele 2



The necessary fund for the 1st stage amounting to R111 million must be shouldered by the 1st tier (DWAF Central Office), while those fund for the 2nd stage will be arranged both by the service provider (JV of HW and HDC) and the beneficiaries. A part of the cost required for the 2nd stage should be collected from the beneficiaries as water tariff.

Disbursement schedule of initial cost is shown in Table 5-8 below, and its detail in Table C.1-8 of Annex C.

Table 5-8 Disbursement Schedule of Initial Cost for Case C (Unit:R1,000)

Stage	Stage 1						Stage 2						Total
	1	2	3	4	5	Sub-Total	6	7	8	9	10	Sub-Total	
Year	1998	1999	2000	2001	2002		2003	2004	2005	2006	2007		
Bulk Supply	429	3,647	44,416	68,603	27,447	144,542	30	251	3,085	4,489	2,131	9,986	154,528
Retail Supply	203	1,341	12,782	38,935	15,465	68,726	195	1,289	19,849	62,381	24,017	107,730	176,436
Total	632	4,988	57,198	107,538	42,912	213,268	225	1,540	22,933	66,870	26,148	117,716	330,984

(2) Operation and Maintenance Cost

In order to maintain the project facilities on sustainable basis, an operation and maintenance cost (O & M cost) including administration cost will be required. The basis for calculating the O & M cost is stated in the earlier part of this Chapter. The proposed project requires the following operation and maintenance cost:

Table 5-9 Annual Operation and Maintenance Cost for Case C (Unit: R1,000)

	Stage 1 (Level A)	Stage 2 (Level B)	Executing Body
Bulk Supply	312	920	HW
Retail Supply	205	507	JV (HW+HDC)
Total	517	1,427	
Remarks	2002 – 2007	2008 onward	

All the O & M cost must be reflected in the proposed water tariff.

5.3.3 Water Tariff

(1) General

The Moretele 2 FS area is located in economically backward area, and most of all communities have almost none of economic prospect in future, resulted in difficulty to expect income growth of community people. On the other hand, Highveld District Council as the 3rd tier institution for water supply sector has very short history since established in 1994, and its financial ground is still weak, relying on a half of revenue from levies, taxes and grants from the central government.

Under such situation, it is quite difficult for the proposed option Case C-1 to fully satisfy with the requirements from both the supply side and the demand side, in other words, the option faces so-called antinomy. In this context, quite careful analysis on financial aspect of the proposed option has been carried out. However, the result of water tariff calculation is not favourable for the low income group for which careful attention should be paid as mentioned below.

(2) Cash Flow Analysis

By applying the same method and provisions that are used in the preliminary analysis for Case A and Case B in this Chapter 5, cash flow analysis is carried out for both the bulk supply and the retail supply. In this cash flow analysis, firstly the bulk water supply system is analysed for MW as the service provider under the closed system of the proposed option. Then, the retail water supply system is done taking a calculated bulk tariff into consideration. These processes of analysis are shown in Annex C of this report.

(3) Retail Water Tariff

During the 1st stage operation (Level A: 2002 - 2007), a flat rate of water tariff, R22.62 per month per household will be charged, of which 86 %, 10 % and 4 % are allocated to the reserve fund for upgrading, the bulk water tariff and the administration cost, respectively. In other words, R0.67 per month per household is a pure water tariff to be charged to beneficiaries. In year 2007, the accumulated reserve fund will occupy about 40 % of the upgrading cost (R45.75 million), and the rest 60 % or R27.34 million will be secured from the external fund agency.

After upgraded to the level B services, a retail water tariff of R2.12-2.20 per Kl will be chargeable, which includes redemption of a part of the initial capital cost (upgrading cost) and O & M cost.

(4) Issues Relating to Water Tariff Setting

(a) Community level

It is rather difficult to introduce different service levels into a single community from technical viewpoint, hence the community must obtain consensus of community members on the service level. During the process on the above, community members should discuss on appropriate consideration for the low income group including:

- Possibility of cross-subsidisation within the community
- Positive utilisation of low income group for labour works during construction stage as income increase even temporary basis
- Mobilisation of low income group for O & M works of water supply facilities within the community

(b) Service Provider level

In order to attain full recovery of water tariff, the following items will be examined:

- It is defined that the operation and maintenance of facilities and water charge collection are responsible for the community itself, and incentive and penalty system will be applied on the occasions
- To prepare and distribute easily understandable document on the impact of the reserve fund and to remove uneasiness of beneficiaries through preparation of separate accounting system for the reserve fund for which periodical audit will be applied

(c) Low income group level

In order that the group will be able to participate for the higher service level, the following item must be examined:

- To reduce cost burden of connection cost between the retail supply pipe and yard tap, the low income group shall contribute by offering their efforts for the required labour works

(d) Feedback of experience obtained from Pilot Project

In order to realise the various measures stated above, experiences and best practices obtained during the process and the implementation of the pilot projects, must be reflected including on the following items:

- Approach method and process of establishing Local Project Steering Committees in the three pilot project communities; and
- Method of water tariff computed on the own initiative of the concerned communities (Kameelboom and Segokgo) and the process to obtain consensus of community members on the set tariff.

5.3.4 Funding

(1) General

Table 5-10 shows selected financial data of stakeholders responsible for providing retail water supply to FS areas. These institutions are also responsible for securing funding required to finance the cost of bulk and retail infrastructure for the proposed water supply projects. HW will be the designated second tier authority (Water Board) responsible for bulk water supply to the Moretele 2 FS area while Highveld DC has responsibility for retail water supply. HW will be statutory not-for-profit organizations (also known in South Africa as Section 21 companies) which can borrow short and long-term funds from the capital market or commercial and investment banks. It receives no central government subsidies or loan guarantees. It also has to follow sound business practices and are subject to certain regulatory, labor law, and accounting standards and practices as commercially-driven enterprises.

As section 21 companies, HW will not be allowed to make a profit or declare dividends. Net operating income will be appropriated to various funds such as a Capital Redemption Fund used for providing redemption of loans for capital expenditure. Other funds include Betterment/Improvement Funds used to finance future capital expenditure and upgrading and Depreciation and Replacement Funds used to replace existing plant and equipment that has become worn-out or obsolete. The programs and activities of HW will be guided through a board of directors who are all appointed for a specific duration by the Minister for Water Affairs & Forestry. The role of the Board is to set broad policy guidelines and procedures on the HW's activities, ensures that policies are being interpreted and implemented correctly and reviews major policy areas in order to keep them current. The Board will have responsibility for preparing annual financial statements that fairly represent the financial position and the results of the water utilities.

The directors will be also responsible for ensuring that the HW's maintains adequate accounting records and systems of internal control. These are designed to provide reasonable assurance as to the reliability of the annual financial statements and to adequately safeguard the utility's assets and detect irregularities. As a pre-requisite, most borrowers in South Africa require that fund applicants have a solid financial track record and be in good financial standing evidenced by a strong balance sheet.

The HDC covering the FS area has only been in existence since 1994 and is primarily responsible for retail water supply in rural areas where the presence of local government does not exist. Because of their recent development, the HDC does not have a strong movable and immovable asset base and do not meet most of the funding criteria required by lending institutions.

Table 5-10 Financial Status of Stakeholders

(Unit: ' 000R)

Description	1996 Magalies Water	1996 Rand Water	1996 Eastern DC	Bud. 6/77 Highveld DC	1996 Rustenbrg DC	1996 Brits TLC
Revenues/Income						
Bulk water sales	36,227	948,899	22,300	0	14,246	8,682
Levy income	0		16,000	65,132	36,597	
Central/Provincial Govt. transfers/allocations	0					166
Subsidies & grants	0		10,063		670	
Interest on investments					3939	
Other (sundry income, regional function)	611		2,448	2,790	647	146
Total (budgeted) revenues	**36,838**	**948,899**	**50,811**	**67,922**	**56,099**	**8,994**
Less expenses/budget allocations						
Water purchases	5,002	109,369	20,300	0	14,246	256
Lesotho Highlands Water Project Levy		123,591				
Operating costs	13,262	433,059	4,505	6,677	4,261	8,849
Contributions: provisions and reserves	0				28,264	105
Regional function			14,927	29,270		
Contributions/Allocations to: local bodies, capital outlay			6,607	25,659	1,106	104
Other						
Total expenses	**18,264**	**666,019**	**46,339**	**61,606**	**47,877**	**9,314**
Net operating income/surplus	**18,574**	**282,880**	**4,472**	**6,316**	**8,222**	**-320**
Net margin %	50.42%	29.81%	8.80%	9.30%	14.66%	-3.56%
Less:						
Interest and finance charges	8,339	39,241				
Statutory Transfers		130,088				
Betterment Fund		52,298				
Redemption Fund	0	77,790		25		
Annual Appropriations/Net Surplus	**10,235**	**113,551**	**4,472**	**6,291**	**8,222**	**-320**
Appropriation to Funds						
Betterment Fund		51,985				
Reserve Fund		54,566				
Depreciation & Renewals Fund		7,000				
Current assets (cash, inventory, accounts receivable)	22,560	326,264		22,987	20,632	6,625
Current liabilities (accounts payable)	10,893	230,028		21,238	10,239	6,625
Net current assets (working capital)	**11,667**	**96,236**	**0**	**1,749**	**10,393**	**0**
Fixed assets	194,912	2,301,850		2,735	113	16,765
Investments	69,139	35,560		22,987	24,000	11,027
Other assets	16,162	0			167	
Total	**280,213**	**2,337,410**	**0**	**25,722**	**24,280**	**27,792**
Total assets	**302,773**	**2,663,674**	**0**	**48,709**	**44,912**	**34,417**
Long-term debt (loans, long-term commitments)	184,670	900,205		2,735	113	16,765
Reserves and provisions	44,444			22,094	34,560	9,335
Capital contributions	62,766	73,700		0		
Accumulated Funds	0	1,459,741		2,642		1,692
Total	**291,880**	**2,433,646**	**0**	**27,471**	**34,673**	**27,792**
Total liabilities	**302,773**	**2,663,674**	**0**	**48,709**	**44,912**	**34,417**

Source: RW 1996 Annual Report; MW 1996 Annual Report; Eastern DC, Highveld DC; Rustenberg DC, Brits TLC

Unlike MW, they do not have direct sources of revenue since a substantial percentage of their income is derived from levies (taxes), subsidies and grants. Personnel is typically the largest single item of local government expenditures and the ability of local authorities to recruit, train, and motivate staff is critical to its ability to provide retail water delivery services efficiently.

Under the Green Paper on Local Government published October 1997, local authorities (such as DC's, TRCs, and TLCs) are responsible for delivery of retail water and sewage services to end users/consumers. Loan financing by local authorities for water supply infrastructure has several desirable attributes. Firstly, it depoliticizes the allocation process on the basis of the user's willingness to incur debt. Secondly, lending also forces potential beneficiaries to reveal their degree of commitment to the project. The private market's demonstrated interest in South Africa in lending to local authorities without any implicit or explicit subsidies is extremely limited. Long-term financial commitment of any kind to local authorities is viewed as extremely risky because, as political entities local authorities lack readily marketable collateral and is typically viewed as unattractive to private capital. Local authorities are unable to attract private capital on market terms or obtain the assistance of central government.

(2) Financial Viability and Possible Funding Source

(a) 1st Tier (DWAF)

DWAF is currently implementing water projects under RDP Programmes 1, 2 and 3 of which main features are summarised in table 5-11.

Table 5-11 RDP Budget Allocation

RDP Number	Target Population	Numbers of Projects	Estimated Cost (Millions)	Remarks
1	978,000	12	282	The projects are completed or nearing completion
2	2,765,000	328	629	Projects have been started under this programme
3	2,664,000	345	950	Projects have been started under this programme

From the above table, unit project cost varies from R1.92 million in RDP 3 to R23.5 million in RDP 1. Following to the above, RDP Programme 4 is planned and budgeted amounting to R1.3 billion including R0.3 billion of RDP 2 and 3 cost overruns. Except the cost overrun, the budget allocated new RDP 4 Programmes will be disbursed over 4 years from 1997/98 to 2000/01.

Under the RDP 4, total of R639 million has been allocated for new water projects in which KwaNdebel (Project No. 4101) receives the highest budget for single project, amounting to R28.9 million. In this context, the required capital cost for the Level A services in the North Mankwe FS area, about R111 million is comparatively high, therefore, it is prerequisite for DWAF to secure external loan funding to implement the proposed project in due course.

(b) 3rd Tier (HDC)

As can be seen in Table 5-10, HDC dose not nave significant fixed assets although its has R22 million in reserves and provisions, almost all of which is invested. Its current ratio is 1.1, but again like EDC and RDC, it have any fixed assets on the balance sheet. HDC is also the only DC not engaged in water sales. Its income is derived from levies which is not sustainable in the long term.

It is proposed that the portion of the tariff over and above the O&M component be transferred to a reserve fund and invested with reasonable and safe return on investment over the five year period for operating at Service Level A. At a flat rate of R22.62/month, 86% (R19.40) of the tariff could be transferred to the reserve fund. The goal is to accumulate 40% of the R45.75 million (at 1997 price) required to upgrade the system from Service Level A to Service Level B. It is anticipated that 40% of the capital cost for upgrading from Level A to B will be available from the reserve fund after five years. It is also hoped that the financial position of the Services Provider would have greatly improved after the five-year period so that loan funding will be possible, when the reserved fund will be kept and accumulated in a certain bank account who will become a possible lending institution to the service provider (JV of HW and HDC).

The possibility of obtaining funding in the form of soft loans or grants is extremely limited due to the current policy of DWAF of not obtaining loans, grants or guaranteeing loans on behalf of local authorities. This limits the funding sources to primarily DBSA, Commercial Banks (including special infrastructure and developments funds), and Merchant Banks (e.g. public finance departments) who would lend at commercial interest rates.