SAULSPOORT REGIONAL WATER SUPPLY SCHEME
PHASE II

DRAFT DESIGN REPORT

MAY 1989

SAULSPOORT REGIONAL WATER SUPPLY SCHEME : PHASE II

DESIGN REPORT

TABLE OF CONTENTS

3.3.2 Stage 2

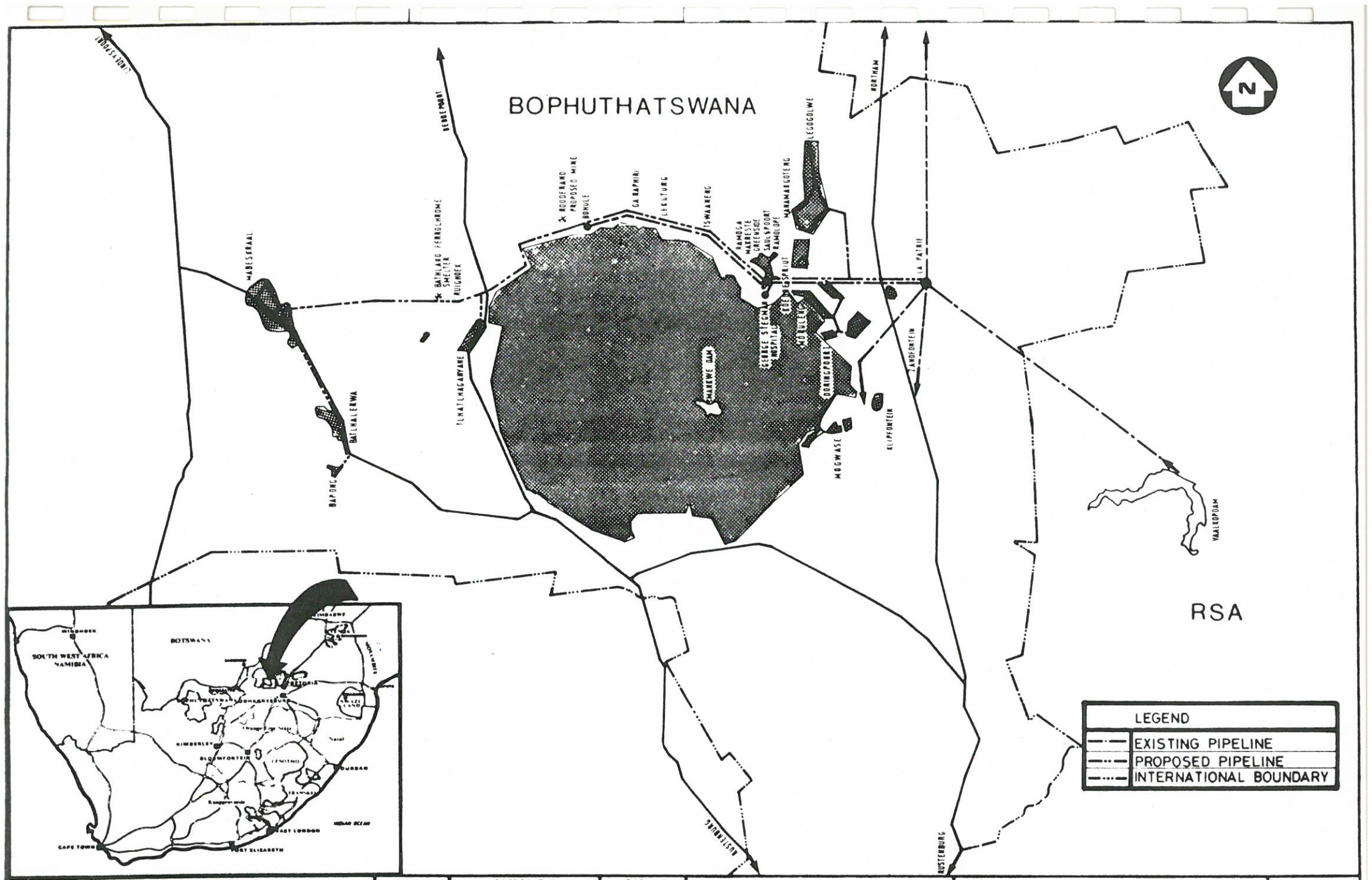
3.3.3 Stage 3

3.4 Financial

3.4.1 Estimated project cost

3.4.2 Estimated cash flow

3.4.3 Cost vs discount rate



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SAULSPOORT REGIONAL WATER SUPPLY SCHEME - PHASE II

EKSTEEN, VAN DER WALT & NISSEN
RAADGEWENDE INGENIEURS
CONSULTING ENGINEERS

11-84

1370 ARCHINEER

SAULSPOORT REGIONAL WATER SUPPLY SCHEME : PHASE II

1. BACKGROUND

1.1 INTRODUCTION

Saulspoort is located in the Mankwe district of Bophuthatswana which itself lies within development region J. The area is well known due to its close proximity to Pilanesberg and the Sun City complex.

The project area stretches along the northern perimeter of the Pilanesberg Game Reserve from La Patrie in the east to Mabeskraal/Ruighoek in the west. The project area houses some 47 000 people in 20 larger rural villages. The area is also known for its emerging mining activities. Mining includes a chrome mine and ferrochrome smelter at Batlhako and a proposed chrome mine and ferrochrome smelter at Rooderand.

At the generally accepted design criteria of 25 l/cap/day present day demand would be 1 175m^3 for household consumption. The Batlhako chrome mine and ferrochrome smelter presently uses 150m^3 per day and will use 630 m^3/day once full production is attained. Water for this enterprise is drawn from the flooded Palmietfontein mine which may soon be withdrawn for alternative use.

The "Saulspoort Pipeline" (Phase I) currently serves a number of rural villages north of and adjacent to the Pilanesberg Game Reserve, such as Ramoga, Lesetlheng, Tswaaneng, Lekutung, Phorome, Ga-Phiri, Boriteng, Bohule, Makreste, Greenside, Ramolope, Marapallo and Zandfontein, as well as the George Stegman Hospital. The village of Zandfontein was not included in the original scheme.

Since inclusion of the village of Zandfontein to the Phase I water supply system, adequacy of supply could only be guaranteed until 1989. Villages at the end of the existing Saulspoort pipeline are at present experiencing water shortages at certain times of the day.

The present demand for water at the Ruighoek mine and Batlhako ferrochrome smelter, the new proposed Rooderand mine and ferrochrome smelter as well as to rural villages such as Legogolwe, Manamakgoteng, Doringpoort and Koedoespruit, necessitates an upgrading of the supply of the "Saulspoort Pipeline". The existing infrastructure requires both upgrading (due to inadequate capacities) and extension to the new consumption points.

The source of water supply is the Vaalkop dam in South Africa. In terms of the 1983 agreement between SA and Bophuthatswana a maximum rate of withdrawal of 17,8 Ml/day is currently allocated to Bophuthatswana from this source. A maximum supply rate of 20 Ml/day is to be supplied by the RSA as from 1990. This source is under-utilised by Bophuthatswana by approximately 50% of allocation at present. Groundwater resources in the Saulspoort area are limited in quantity and its generally high fluoride content restricts the use of this source for human consumption.

1.2 PROJECT DESCRIPTION

1.2.1 Existing Infrastructure (Phase I)

The source of water is the Vaalkop dam. Water is pumped to the La Patrie reservoirs from where the Magalies Water Board utilises 4 main pipelines to serve its consumers in SA and Bophuthatswana. One of these pipelines is the Saulspoort pipeline.

The Saulspoort pipeline of approximately 33km connects to reservoirs located at Saulspoort, George Stegman Hospital, Tswaaneng, Lesetlheng, Lekutung, Masilela and Bohule. Reticulation within villages is by means of unattended standpipes.

1.2.2 Proposed upgrading and extensions (Phase II)

- A second main pipeline from La Patrie reservoirs to Mabeskraal - a distance of approximately 50km.

- Four reservoirs - at the villages of Doringpoort, Koedoespruit, Mabeskraal and Tlhatlhaganyane.

- A booster pump station for serving water to Mabeskraal, Bapong and Bothlalerwa.

- A booster pumpstation for serving water to Tlhatlhaganyane.

- Pipeline connections to the Ruighoek/Batlhako and Rooderand mines.

- Rudimentary village reticulation with standpipes to 9 villages. (All usable existing village reticulation will be incorporated into the system).

When this project (Phase II) is completed the distribution network will include the following consumption points:

1 Zandfontein
2 Madutle (Welgeval)*
3 Dikweipi *
4 Doringpoort (Lerome) *

5 Koedoespruit (Thotwaneng)
6 Manamakgoteng (Modderkuil)*
7 Legogolwe *
8 Lesunyaneng (Saulspoort)*
9 Greenside (Saulspoort)
10 Makreste (Saulspoort)
11 Ramolope (Saulspoort)
12 George Stegman Hospital (Saulspoort)
13 Phiribatho (Saulspoort)
14 Marapallo (Saulspoort)
15 Mabodisa (Saulspoort)*
16 Ramonkgwe (Saulspoort)
17 Ramoga
18 Lesetlheng
19 Tswaaneng
20 Lekutung
21 Masilela
22 Phorome
23 Raphiri (Legkraal)
24 Boriteng
25 Bohule
26 Rooderand Ferrochrome Mine and Smelter *
27 Tlhatlhaganyane *
28 Mmorogong *
29 Ruighoek Chrome Mine *
30 Batlhako Ferrochrome Smelter *
31 Mabeskraal (Tlhakong)*
32 Kwa-Makoshong*
33 Bapong
34 Gevonden
35 Batlhalerwa

* Note:
Those villages marked with and asterisk are not served by the existing supply system.

1.3. DEVELOPMENT OBJECTIVE

The primary objective is to improve the utilisation of the allocation of potable water by serving 25 rural villages, a hospital and 2 mines with associated ferrochrome smelters as a vehicle to enhance and sustain the economic growth of the area and to raise the standard of living of the inhabitants of the area over time.

The project further aims at stimulating community involvement, will utilise appropriate technology, create job opportunities and provide training during construction.

2. STATUS OF THE PROJECT

2.1 THE DBSA LOAN APPLICATION

The Development Bank of Southern Africa received a letter identifying a project and indicating the intention to apply for a loan from the Bophuthatswana Department of Water Affairs on 4 August 1987. Following confirmation of receipt on 26 August 1987, Eksteen, v/d Walt and Nissen were appointed in their capacity as Engineering Consultants to identify the project, to formulate objectives and to indicate relative cost estimates.

The information was compiled in a draft pre-appraisal report and submitted to the DBSA for consideration during November 1987. The draft document was revised and improved and a final pre-appraisal submitted to the DBSA on 8 February 1988.

The pre-appraisal was considered on 8 March 1988 and towards the end of March the DBSA notified the designated agent to proceed with investigation and appraisal of the project.

Socio-Economic issues were raised on 13 April 1988 when the DBSA formulated thirteen questions and a meeting was held on 14 April 1988 to discuss all aspects of the project.

On 2 May 1988 the Engineering Consultants, Eksteen, van der Walt & Nissen were appointed to undertake the feasibility study.

The Socio-Economic aspect of the project quickly rose in importance as research got underway, with many issues being raised. The DWA finally decided to lodge a full socio-economic investigation and informed the DBSA on 20 July 1988 of their intention to appoint ECORES. On 25 July 1988 the DBSA responded with questions about ECORES, such as their Curriculum Vitae. The DWA supplied the info on 17 August 1988 and the socio-economic research was undertaken. When the socio-economic report came to hand, a feasibility study was undertaken and submitted in November 1988.

The project was considered by the Functional Management Committee (FMC) on 21 February 1989 and submitted for appraisal by the Management Committee on 31 March 1989. On 20 April 1989 the DBSA Board of Directors approved a loan of R25 970,00, in accordance with the normal wording of the DBSA standard loan agreement.

2.2 DEVELOPMENT STRATEGY

The project necessitated staging for two reasons :

(i) To alleviate the impact that a high cost-minimum time project would have on a governmental budget.

(ii) To render priority to serving consumers with greater urgency.

Due to the enormous value of the Ruighoek Mine and associated Batlhako Ferrochrome smelter in the region, both as an industry and as an employer, it has been agreed that the mine be served as a first priority. A pipeline would be constructed from Bohule reservoir to Ruighoek, a distance of thirteen kilometres. Spare capacity is presently available during nocturnal hours and will be increased with the re-installation of Lister engines to drive the existing pumps at a station near Masilela.

The main pipeline from La Patrie to Bohule would then be constructed and continued from Ruighoek to Mabeskraal.

With knowledge gained from the work done by the Steering Committee on community involvement, the needs of the communities would become clear in time to ensure they be served by a reticulation system of their requirement and affordability. The villages would be reticulated on priority by mutual consent.

2.3 DEVELOPMENT STAGES

The proposed new Saulspoort pipeline, from La Patrie reservoir to Mabeskraal, is designated as the "Saulspoort Regional Water Supply Scheme Phase II", in order to distinguish it from the existing pipeline, which stretches from La Patrie reservoir to Bohule.

When it was decided that the new pipeline would not be constructed in a single contract, it became necessary to define the three-part development as stages one, two and three.

Stage 1 would comprise the main pipeline and branch pipelines between La Patrie to Ruighoek and village reservoirs.

The branch pipelines will be linked to the villages of:

- Manamakgoteng
- Doringpoort
- Koedoespruit
- Ramonkgwe
- Tlhatlhaganyane

The reservoirs will be constructed at :

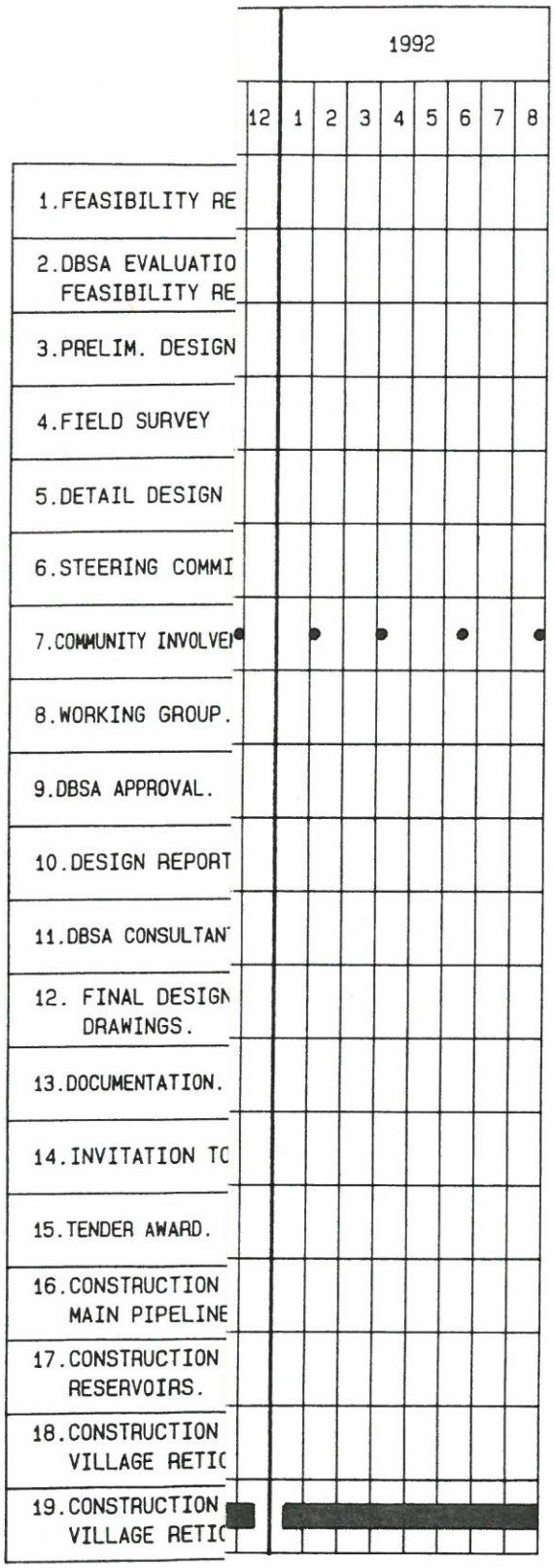
- Manamakgoteng ($600m^3$)
- Doringpoort ($200m^3$)
- Tlhatlhaganyane ($600m^3$)
- Mabeskraal ($3000m^3$)

Stage 2 would see the internal reticulation of villages located along the pipeline between La Patrie and Ruighoek. The standard of reticulation, be it rudimentary (i.e. a standpipe system), yard connections or house connection would depend on the community's choice, affordability and willingness to contribute.

Stage 3 would complete the scheme by serving Mabeskraal and other villages in the sub system, along similar basis as stage 2.

It is envisaged that Stage 1 would be constructed initially, but that Stages 2 or 3 need not be started in that order - they may even run concurrently, depending on the recommendation of the Steering Committee through continuous community involvement and through requirements of the Department of Water Affairs.

2.4 F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15.TENDER AWARD.
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3.1 DESIGN

3.1.1 Design Standards

(a) Planning Period

For design purposes, the planning period is taken equal to the design life of the pipeline, i.e. 20 years.

(b) Population

- Population figures are based on :

(i) Census figures of 1985.

(ii) Number of stands as determined from 1:5000 ortophotos

(iii) Previous design by EVN of the Saulspoort supply line, dd 7/85.

- Population growth rate adopted :

1986	- 1990	-	3%
1991	- 1995	-	2%
1996	- 2000	-	1%
2001	- 2005	-	0,5%
2006	- 2010	-	0,4%

(c) Water Demand

(i) Institutions, i.e. Mines and G Stegman Hospital

Fixed values, as provided by the future consumers, were used for the design period up to the year 2010.

(ii) Primary consumption

- Consumption of : 501/cap/day
  add 10% losses : 551/cap/day (total)
  add 20% for summer peak factor : 651/cap/day (total)

(iii) Pipeline Design

Friction losses were determined according to the formula by Hazen Williams using a CH value of 130.

Supply period of main gravity pipeline : 24h
Supply period of pumpmain : 20h

(iv) Provision of Balance Reservoirs

Reservoirs were sized to supply the following amount of storage :

Reservoirs fed by gravity main : 24h
Reservoirs fed by pumpmain : 48h

(d) Rudimentary Supply

(i) No person should have to walk more than 250m to a source of potable water, i.e. standpipe.

(ii) The pressure head at the standpipe will be between 12m minimum and 60m maximum. This will ensure that conversion to house connection is possible when needed.

3.1.2. Water Demands

Name	Alt. name	1985 pop	2010 pop	2010 summer demand m^3/d	l/s
1. Saulspoort	Moruleng	7 338	6 325	681	7,89
2. Zandfontein		3 630	5 107	337	3,90
3. Madutle	Welgeval	765	1 076	71	0,82
4. Dikweipi		500	703	46	0,54
5. Doringpoort	Lerome	2 260	3 180	210	2,43
6. Manamakgoteng	Modderkuil	2 800	3 940	260	3,01
7. Legogolwe		500	703	46	0,54
8. Koedoespruit	Thotwaneng	1 608	2 262	149	1,73
9. Ramoga		237	333	22	0,25
10. Lesetlheng		1 236	1 739	115	1,33
11. Tswaaneng		494	695	46	0,53
12. Lekutung		227	319	21	0,24
13. Phorome		464	653	43	0,50
14. Masilela		464	653	43	0,50
15. Raphiri	Legkraal	422	594	39	0,45
16. Boriteng		330	464	31	0,35
17. Bohule		464	653	43	0,50
18. Tlhatlhaganyane	Mmorogong	3 376	4 750	314	3,63
19. Mabeskraal	Tlhakong	16 911	23 794	1 570	18,18
20. Kwa-Makoshong		634	892	59	0,68
21. Gevonden		500	703	46	0,54
22. Bothlalerwa		3 878	5 456	360	4,17
23. Bapong		2 830	3 982	263	3,04
24. George Stegman Hosp				400	4,63
25. Rooderand Mine				1 460	16,89
26. Ruighoek Mine					
27. Batlhako Smelter				630	7,29
28. Additional for future mines				1 500	17,35
TOTAL			72 978	8 807	127,30

3.2 THE OVERALL SCHEME

3.2.1 Basis for route selection

(a) La Patrie to Bohule

The same route as the existing pipeline between La Patrie has benefits regarding survey, mapping, registration of servitude, maintenance, control, access and function.

(b) Bohule to Ruighoek

(i) The shortest route was considered. This route would follow the fence of the Pilanesberg Game Reserve to the point when the Rooderand 46 JQ farm meets Zandspruit 168 JP farm. From thereon the pipeline would cut straight across the Zandspruit farm, cutting through to the farm Vlakfontein 164 JP at approximately 400m north of the point where Ruighoek 169 JP, Zandspruit 168 JP and Vlakfontein meet. This route was discarded following the objection of Rand Mines (Mining and Services) Limited (Mr John Berry, Manager, Legal Services, 17 February 1988), on the grounds of known mineralisation of the farm Zandspruit 168 JP.

(ii) The most feasible route would then entail the laying of the pipeline immediately adjacent, but north of, the Pilanesberg Game Park perimeter fence, to a point where the farm Ruighoek 169 JP is intersected. From there, the Ruighoek 169 JP northern boundary would be followed to within one kilometre of the Vlakfontein

boundary where the increased altitude due to the Tlhoresane koppie renders the straight line unfeasible. A feasible contour around the koppie is followed, cutting through a corner of the farm Zandspruit 168 JP. This route is fully accessible by means of a fence patrol road.

(iii) Ruighoek to Mabeskraal

From the eastern perimeter of Vlakfontein, the shortest route will be followed, dictated by the topography. This route follows land owned by the tribe of Chief Mabe and there are no permanent roads. The pipeline will be accessible by means of an adjacent farm road an a flat, sparsely grown terrain.

(iv) Mabeskraal to Bapong

Mabeskraal is linked to Bapong by means of a good gravel road, which is scheduled for upgrading. Should Bapong, Bothlalerwa and Gevonden be linked to this water scheme, the same route as the road is most feasible.

3.2.2 Alternative water supply systems

(a) The Reticulation System

A village would be served with a combination of rudimentary supply (standpipes), yard connections and house connections, depending on need, development potential, Governmental development strategy, willingness to purchase water and affordability.

A current community involvement programme will determine exact requirements. Early indications show approximately ten per cent of households to require house connections and the greater proportion yard connections.

(b) The main pipeline

(i) Option 1 - Gravity Line

It is possible to gravitate the water all the way from La Patrie reservoirs to a point approximately five kilometres before Mabeskraal, where the water would be pumped to a reservoir on the eastern slope of a hill adjacent to Mabeskraal.

The gravity line would consist of :

pipe dia (mm)	type	class	length (m)
350	AC	12	5 700
350	AC	18	3 300
300	AC	24	15 100
300	AC	18	13 500
300	AC	12	16 800

R 61 m

(ii) Option 2 - Lesetlheng Pump Station (95m lift)

As a first alternative, the first 31,2 km of the 350 mm diameter gravity pipeline could be replaced by a 300mm diameter pipeline for 7 km

and a 250 mm diameter pipeline for the remainder, with a pumpstation at chainage 20,4 km.

This pipeline would consist of :

	pipe dia (mm)	type	class	length (m)
Gravity	300	AC	12	5 700
	300	AC	18	1 300
	250	AC	18	3 700
	250	AC	24	9 700
Pump	300	AC	18	1 000
	300	AC	12	22 000
	250	AC	18	7 800
	250	AC	12	3 000

(iii) Option 3 - Lesetlheng Pump station (121m lift)

It is also possible to utilise a 250 mm diameter pipeline from chainage 7 km to the Mabeskraal Pump Station. With a pump station placed at chainage 20,4 km.

The pipeline would consist of :

	pipe dia (mm)	type	class	length (m)
Gravity	300	AC	12	5 700
	300	AC	18	1 300
	250	AC	18	3 700
	250	AC	24	9 700
Pump	250	AC	24	2 900
	250	AC	18	18 400
	250	AC	12	12 500

(iv) Option 4 - Lekutung pump station (90 m lift)

The first 31,2 km of the gravity main could also be replaced by 300 mm diameter pipeline for 9 km and a 250 mm diameter pipeline gravitating to a pump station at chainage 22,6 km.

This pipeline would consist of :

	pipe dia (mm)	type	class	length (m)
Gravity	300	AC	12	5 700
	300	AC	18	3 300
	250	AC	18	1 700
	250	AC	24	11 900
Pump	300	AC	12	23 000
	250	AC	18	5 600
	250	AC	12	3 000

(v) Option 5 - Lekutung Pump Station (116 m lift)

The gravity main section is the same as for the previous option. The stronger pump, however, allows the use of 250 mm diameter pipeline all the way to the Mabeskraal Pump Station (Similar to option 3)

This pipeline would comprise :

	pipe dia (mm)	type	class	length (m)
Gravity	300	AC	12	5 700
	300	AC	18	3 300
	250	AC	18	1 700
	250	AC	24	11 900
Pump	250	AC	18	17 600
	250	AC	12	13 900

(vi) Option 6 - Boriteng Pump Station (21m lift)

A 300mm diameter gravity main would carry the water over a distance of 29,5km before pumping becomes necessary. Pumpline over the high point at Bohule, a 300mm diameter line could be resumed to the Mabeskraal pump station.

This pipeline would comprise :

	pipe dia (mm)	type	class	length (m)
Gravity	300	AC	12	7 300
	300	AC	18	8 500
	300	AC	24	15 400
Pump	300	AC	12	14 900
	300	AC	18	1 200
	300	AC	12	8 600

(vii) Option 7 - Boriteng Pump Station (53m lift)

The gravity main section is exactly the same as for the previous option. Pumping to a hydraulic gradient of 55m, however, allows the use of 250mm diameter pipeline all the way to the Mabeskraal Pump Station.

The pipeline would consist of :

	pipe dia (mm)	type	class	length (m)
Gravity	300	AC	12	5 700
	300	AC	18	8 500
	300	AC	24	15 400
	250	AC	12	13 000
	250	AC	18	400
Pump	250	AC	12	4 100
	250	AC	18	10 400
	250	AC	12	6 600
	250	AC	18	2 000

3.2.4 Electrical Supply

(a) Lesetheng/Lekutung Pump Station

An existing Bophuthatswana Electricity Corporation (BECOR) 11kV line could deliver sufficient electricity to drive pump motors placed at either Lesetlheng or Lekutung. The present line carries electricity through Saulspoort to Lesetlheng, where a transformer would be placed for the pumpstation.

(b) Tlhatlhaganyane pump station

BECOR has a substation adjacent to the Batlhako Ferrochrome Smelter where 22 kV is available. Electricity is supplied to the smelter and to Tlhatlhaganyane, and could be extended a further m northwards to serve the pump station.

(c) Mabeskraal Pump Station

A 22kV power line takes electricity from Matrooster via Bothlalerwa to Mabeskraal, from where it could be extended the five kilometres eastwards to the pump station needed to supply water to the 3000 m^3 reservoir on the western side of Mabeskraal.

3.2.5 Control System

(a) Gravity Supply - Option 1

An hydraulic valve assembly will automatically control the level in the reservoirs and break pressure tank.

(b) Pump supply - Options 1 to 7

The pumps will be switched by telemetry from the reservoirs at :

1. Lesetlheng ($600m^3$) (existing)
2. Bothlalerwa ($600m^3$) (existing)
3. Bapong ($600m^3$) (existing)
4. Bohule ($200m^3$) (existing)
5. Rooderand Mine (own storage) (new)
6. Tlhatlhaganyane ($600m^3$) (new)
7. Ruighoek Mine (own storage) (new)
8. Mabeskraal (new)

The hydraulic valve assembly will allow the isolation of supply to individual reservoirs according to specific need or requirement, with the pump in full motion.

Each reservoir will be supplied with two level probes - one to signal the pump that a particular reservoir has reached full supply level (FSL), and a second to indicate when 40% reservoir storage level occurs. The pump will be activated, should any (the first) reservoir water level drop to 40% capacity.
The pump is shut off only once all reservoirs attain full storage level, i.e. when all FSL probes signal thus.

3.2.6 Environmental Impact

The proposed pipeline is to be laid underground for its entire length and with adequate supervision no permanent damage to the environment is envisaged during construction.

Where the route runs adjacent to the Pilanesberg Game Park perimeter fence, special care will be taken during construction as the game park fence

is protected by means of well maintained stormwater control in the form of stone pitching and open channels and drains.

At crossings to farm boundaries and fences, gates will be provided so as to allow access along the servitudes.

3.3 PROJECT TIMING AND CONSTRUCTION

3.3.1 Stage 1

Stage 1 will be constructed in three phases. The first phase would comprise the main pipeline from Bohule to the Ruighoek Chrome Mine, in order to alleviate the critical water shortage that is crippling the production of the mine at present. Construction could start in August 1989 and be completed within three months.

The second phase would comprise the main pipeline from La Patrie to Bohule reservoir, as well as the branch pipelines to Manamakgoteng, Doringpoort, Koedoespruit, Ramonkgwe and Tlhatlhaganyane. Construction could start in November 1989 and be completed in September 1990.

The construction of reservoirs at Manamakgoteng ($600m^3$), Doringpoort ($200m^3$), Tlhatlhaganyane ($600m^3$) and Mabeskraal ($3000m^3$) should be undertaken under a separate contract to ensure the work be undertaken by a known specialist. The construction will commence five months before the completion of stage 1, to ensure the contractor is on site to test the reservoirs on completion.

3.3.2 Stage 2

Stage 2 would be constructed on completion of Stage 1, construction commencing in September 1990. A single contract would be awarded for the construction of internal reticulation of villages between La Patrie and Ruighoek.

3.3.3 Stage 3

Construction will commence in June 1991 and under a single contract, a pumpstation, extension of the main pipeline from Ruighoek, the internal reticulation of Mabeskraal, Kwa Makoshong and Gevonden and extensions to Bapong and Batlhalerwa would see the whole project complete by the end of February 1992.

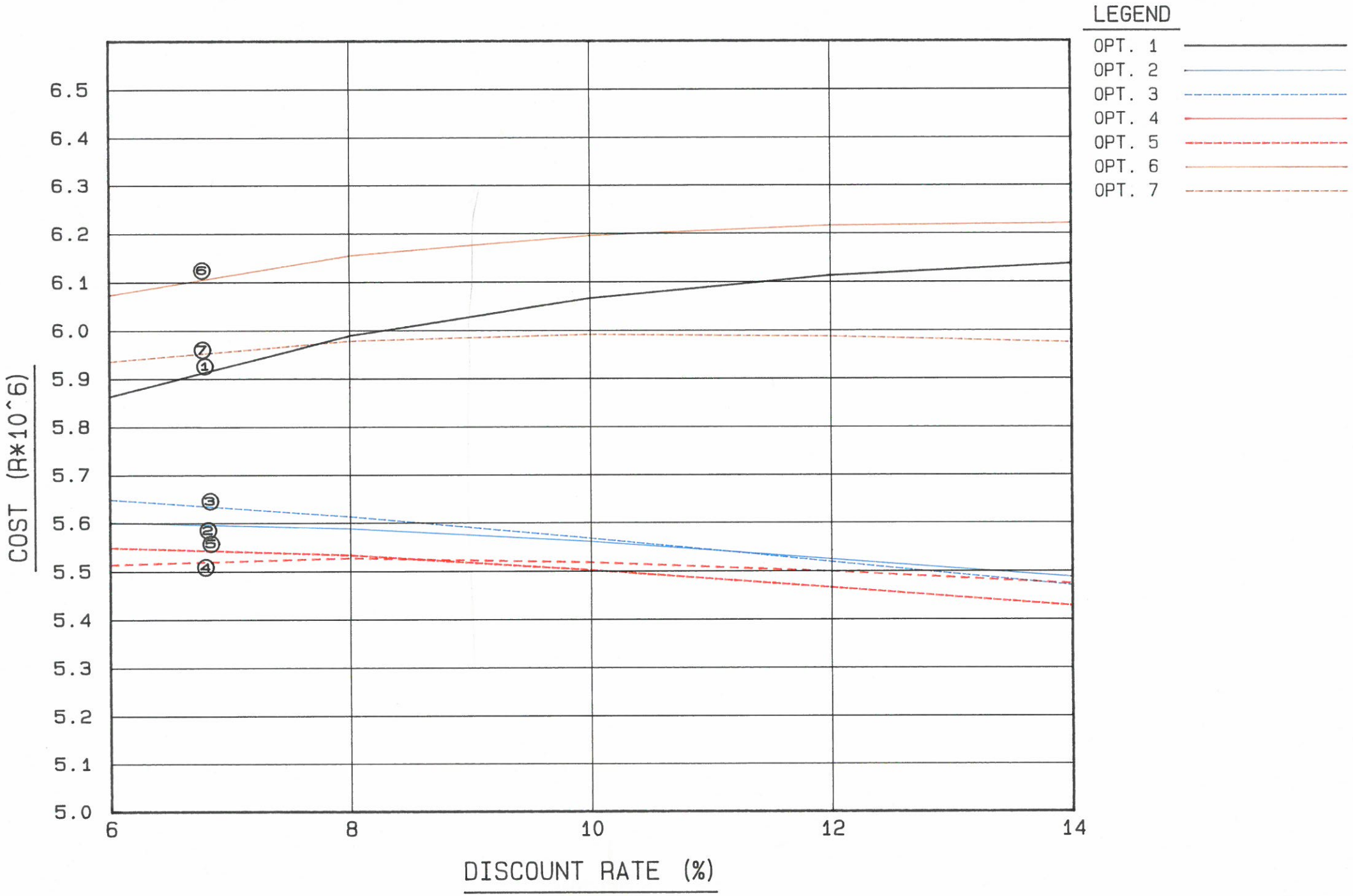
3.4 FINANCIAL

3.4.1 ESTIMATED PROJECT COSTS

PHASE OF CONSTRUCTION	PROPOSED CONSTRUCTION STAGES		
	STAGE 1	STAGE 2	STAGE 3
CONSTRUCTION PERIOD	12 MONTHS	12 MONTHS	12 MONTHS
Storage Reservoirs			
3Ml	0	0	328 000
2 x 600m^3	175 000	0	0
200m^3	60 000	0	0
600m^3 Break Pressure Tank	60 000	0	0
Pumpstation			
Pumpstation to Thlathlaganyane	109 000	0	164 000
Main Pipeline			
7 000m of 350mm	1 072 000	0	0
27 000m of 300mm	3 690 000	0	0
13 500m of 300mm	1 255 000	0	0
10 100m of 200mm	61 000	0	601 000
7 500m of 160mm	0	0	450 500
6 000m of 110mm	0	0	197 000
Secondary Pipelines			
Branch to Thlathlaganyane	306 000	0	0
Branch to Legogalwe	383 000	0	0
Branch to Doringpoort	164 000	0	0
Reticulation			
Mabeskraal	0	0	2 392 000
Thlathlaganyane	0	615 000	0
Manamakgoteng/Legolwe	0	547 000	0
Koedoespruit	0	273 000	0
Doringpoort	0	171 000	0
Saulspoort Area	0	662 000	0
SUB-TOTAL:	**7 341 000**	**2 268 000**	**4 132 000**
Design Contingencies	734 000	227 000	413 000
SUB-TOTAL:	**8 075 000**	**2 495 000**	**4 545 000**
Pre-Tender Escalation at 18% compounded monthly with Base Date Jan 1989	1 580 000	1 070 000	2 562 000
SUB-TOTAL:	**9 655 000**	**3 565 000**	**7 107 000**
Construction Escalation based on an S-curve cash flow at 18% p.a.	875 000	220 000	426 000
Non-contractual Contingencies (approx. 10%)	962 000	350 000	711 000
SUB-TOTAL:	**11 492 000**	**4 135 000**	**8 244 000**
Professional Fees (8% - Credit of approx. R60 000)	918 000	295 000	667 000
Contract Administration & Disbursements	109 000	55 000	55 000
TOTAL:	**R12 519 000**	**R 4 485 000**	**R 8 966 000**
GRAND TOTAL:		**R25 970 000**	

3.4.2 ESTIMATED CASHFLOW STAGES 1 , 2 AND 3

MONTH No	MONTH	STAGE	AMOUNT FOR MONTH	CUMULATIVE AMOUNT	AMOUNT FOR STAGE
	1989				
1	MAY		11621	11621	
2	JUNE		12551	24172	
3	JULY		23242	47413	
4	AUG		25566	72979	
5	SEPT		766982	839961	
6	OCT		790224	1630185	
7	NOV		918054	2548238	
8	DEC		441595	2989834	
	1990	STAGE 1			
9	JAN		453216	3443050	
10	FEB		976158	4419209	
11	MARCH		1115610	5534819	
12	APRIL		1510721	7045540	
13	MAY		1533963	8579503	
14	JUNE		1499101	10078604	STAGE 1
15	JULY		1545584	11624188	
16	AUG		894812	12519000	12519000
17	SEPT		351765	12870765	
18	OCT		347136	13217901	
19	NOV		361022	13578923	
20	DEC		148111	13727034	
	1991				
21	JAN	STAGE 2	129598	13856632	
22	FEB		356393	14213025	
23	MARCH		361022	14574046	
24	APRIL		472105	15046152	
25	MAY		523019	15569170	
26	JUNE		490619	16059789	STAGE 2
27	JULY		490619	16550409	
28	AUG		453591	17004000	4485000
29	SEPT		749770	17753770	
30	OCT		734150	18487920	
31	NOV		718530	19206449	
32	DEC		734150	19940599	
	1992				
33	JAN	STAGE 3	718530	20659129	
34	FEB		601378	21260507	
35	MARCH		609188	21869695	
36	APRIL		796631	22666326	
37	MAY		882542	23548868	
38	JUNE		827871	24376739	STAGE 3
39	JULY		827871	25204610	
40	AUG		765390	25970000	8966000
			TOTAL PROJECT		25970000


LEGEND
OPT. 1
OPT. 2
OPT. 3
OPT. 4
OPT. 5
OPT. 6
OPT. 7
COST (R*10^6)
6.5
6.4
6.3
6.2
6.1
6.0
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5.0
6
8
10
12
14
DISCOUNT RATE (%)