ANNEX

ANNEX A

ENGINEERING

FEASIBILITY STUDY FOR KLIPVOOR

ANNEX A: ENGINEERING

A.1.1 ASSUMPTIONS FOR PLANNING OF INFRASTRUCTURE

The following technical assumptions have been made in the planning of water supply infrastructure in this Feasibility Study.

1. **Clear Water Pumping Stations**
   - At least 50 % standby equipment is provided.
   - Number of pumps comprises two sets on duty and one set for standby.

2. **Bulk and Distribution Pipeline**

Flow rate and peak factors

	Flow rate
Bulk water delivery supply line to bulk reservoir which supplies a service reservoir	1.5 AADD
Bulk water delivery supply line to service reservoir which supplies a distribution network	1.5 AADD
Bulk water delivery supply line to distribution network	4.5 AADD

AADD : Annual Average Daily Demand

Type of pipe to use

Diameter range (mm)	**Internal Pressure**	**Type of pipe**
<= 400	<=1600 kPa	uPVC, Steel (API 5L Grade B), FC
<= 400	> 1600 kPa	Steel (API 5L Grade B)
> 400	<7000 kPa	Steel (API 5L Grade B)

Pipelines which will be subjected to a pressure more than 9 kg/cm2 is planned as steel; and pipelines less than 9 kg/cm2 is planned as uPVC.

3. Reservoirs

Service Reservoir

Water Source	Bulk Storage Provision	Service Reservoir Storage requirement
From Magalies Water direct by gravity or pumped to service reservoir		
by gravity to service reservoir	-	24 h
pumped to service reservoir	-	48 h
From Bulk Reservoir of Magalies water	24 h	
by gravity to service reservoir		24 h
pumped to service reservoir		48 h

Note : in hours of Annual Average Daily Demand

Reservoir Construction : Material

Type of storage	Capacity	Material
Elevated Service Reservoir	0 - 0.5 Ml	Pressed Steel
Ground Regional Reservoir	0.5 Ml and Larger	Concrete

4. Reticulation

Residual Pressures

Type of connections	Minimum design pressures	
	For connections	For services mix
House connections	12 m	12 m
Yard taps	10 m	
Street taps*	5 m	

* : 10 l/min of water flow from each tap should be secured

Pipe Selections for Reticulations

Pipe Diameter	Pipe material and Class
63 dia up to 250 dia	uPVC class 9 with push-fit couplings or z-lock

Sizing of Reticulation

In order to cost the proposed infrastructure it is necessary to estimate the length of pipework and hence the cost of the reticulation in each community. With a total of 76 communities in the three Feasibility Study areas it is neither practicable nor necessary to design the reticulation in each community in detail during the feasibility

study. Therefore a methodology was developed for estimating the length of pipework and number of standpipes required.

Initially the reticulation required in each pilot project community was considered however this sample was not sufficiently representative of the entire Study Area so instead the communities in Klipvoor West were considered (a total of 6 excluding Ga Rasai). The average area of these communities is 224 ha and they include a range of different sizes of settlement so the sample is representative of the communities in the feasibility study areas. When designing RDP level reticulation systems, it is normal practise in South Africa to allow for future upgrading by designing for the higher demand but then omitting some of the pipes for the RDP case. This obviates relaying pipes with a slightly larger size when demand increases.

For each of the six communities mentioned above the reticulation system was designed in detail using the 1:10,000 scale Orthophotos for Level B and then some of the pipes were removed to represent the Level A scenario. The data obtained from this exercise was then used to investigate the correlation between various parameters. Pipe length was tested against population, population density and area and unit length (metres of pipework per capita) was tested against the same parameters; population, population density and area. It was found for both Level A and B that pipe length versus area gave the best correlation. The relationships that were established are as follows:

Level A - $y = 36.657 x + 4473.8$

Level B - $y = 25.77 x + 155.24$

where y is the total pipe length and x is the area of service (this is determined from the orthophotos and constitutes approximately 90 or 95% of the households in a given community i.e. those which are still sufficiently dense to warrant an RDP level standpipe system)

From the six communities for which the reticulation was designed in detail, a good correlation was found for Level A between the area of supply and the number of standpipes. The relationship is as follows:

$$y = 0.0453 x + 2.6399$$

where y is the number of standpipes and x is the area of supply.

For Level B, there are still 10% of households which will remain on standpipes. It is assumed that these will be those households on the periphery of the communities where the cost of upgrading will be highest. By investigating the six typical communities in Klipvoor West it was found that the average number of standpipes per community for Level A is 13 while the average number required for Level B is still 10. This proportion was used for all of the communities.

Having established the total length of pipework required to reticulate a community to each level of service, it is still necessary to determine the breakdown for each pipe size. To do this a standard reticulation design was prepared for Level B for a fictional community. The layout corresponded with the average area of the 35 communities in the Klipvoor Area and the total length of pipework corresponded to the average length for the Klipvoor Area. Each component of the network was sized for the average summer peak daily demand which gave the proportion of each size for a typical system. As the pipe sizes for Level A tend to be of larger diameter than the additional pipes added for Level B, and as the actual size is dependant on the diameter of the incoming pipeline from the service reservoir, a range of incoming sizes was considered and a series of variations from the typical case were determined to allow for variations in this key parameter.

For Level A it was assumed that all pipes of 125 mm diameter and above from the Level B design will also be necessary for Level A. For pipes smaller than 125 mm diameter, the standard design amended for Level A was used to derive the distribution in pipe sizes.

To derive the number of yard connections, 90% of households are assumed to require yard connections as is assumed for the Level B service level. For Level A, no yard connection are included.

From the above methodology it is possible to determine the length of pipework of each size and the number of yard connections and standpipes in each community given the area to be supplied and the diameter of the incoming pipeline.

FigureA.1-1 CORRELATION OF AREA AND RETICULATION PIPE LENGTH

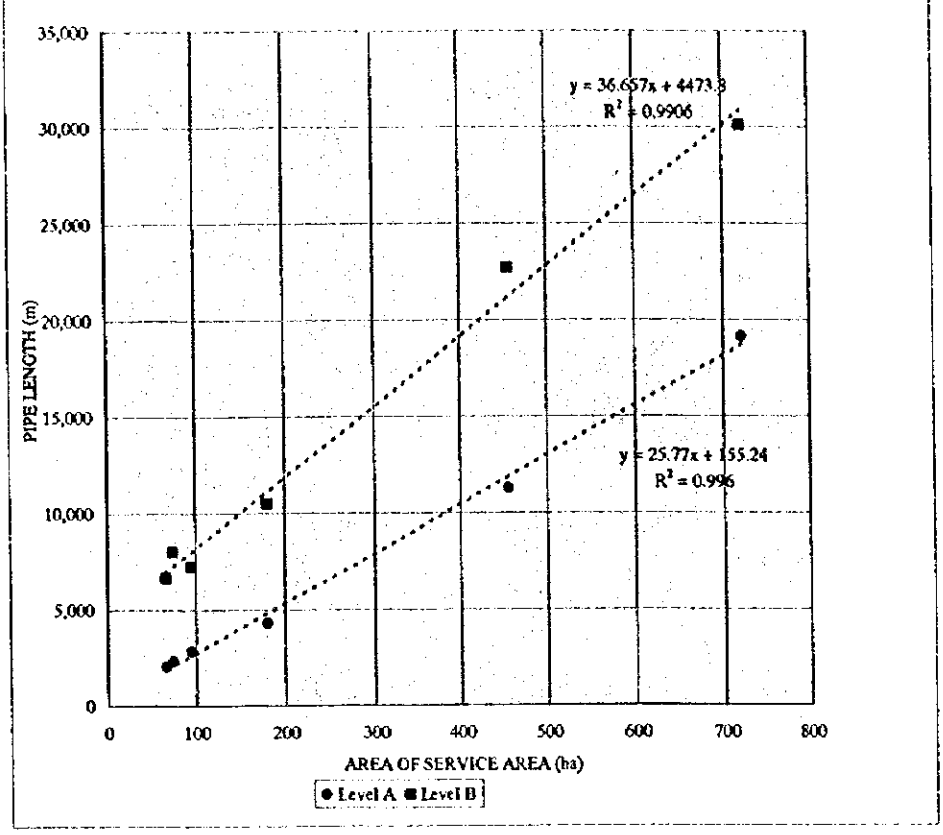


Figure A.1-2 CORRELATION OF AREA AND NUMBER OF STANDPIPE

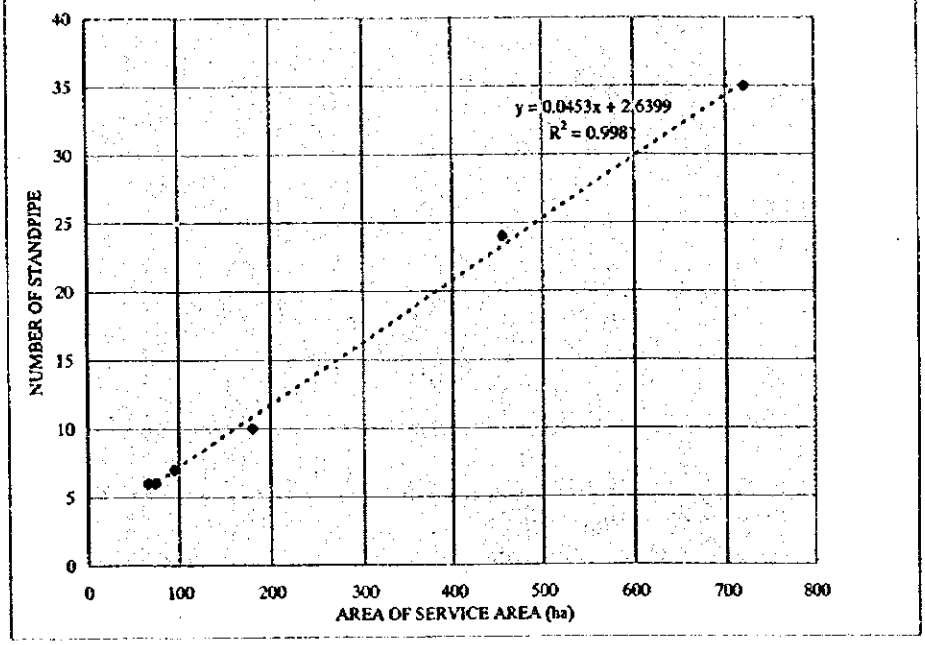


FIGURE A.2-1 FLOW DIAGRAM IN KLIPVOOR WEST (ALT-1, ALT-2 & ALT-3)

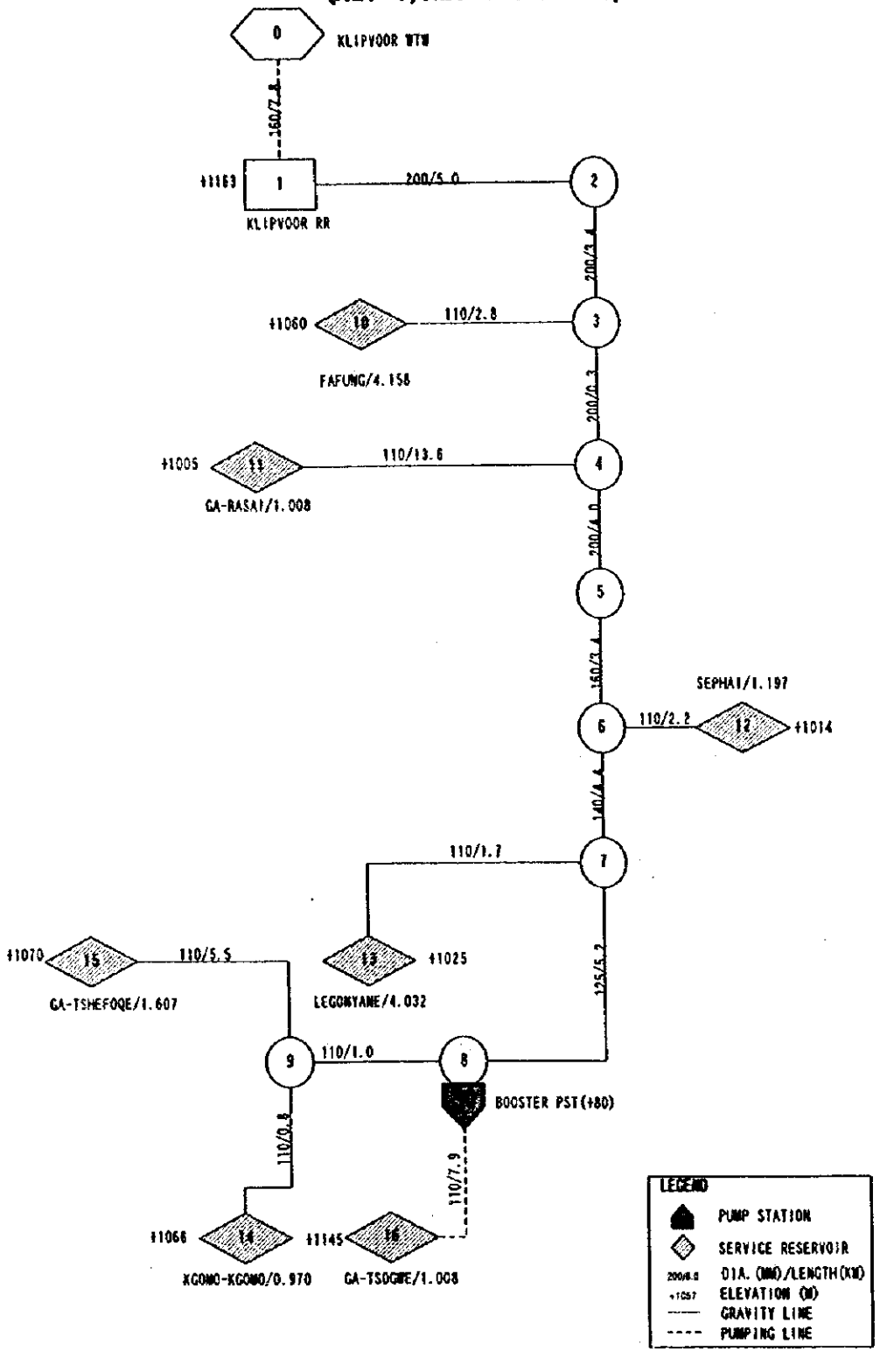


FIGURE A.2-1 FLOW DIAGRAM IN KLIPVOOR WEST (ALT-1, ALT-2 & ALT-3)

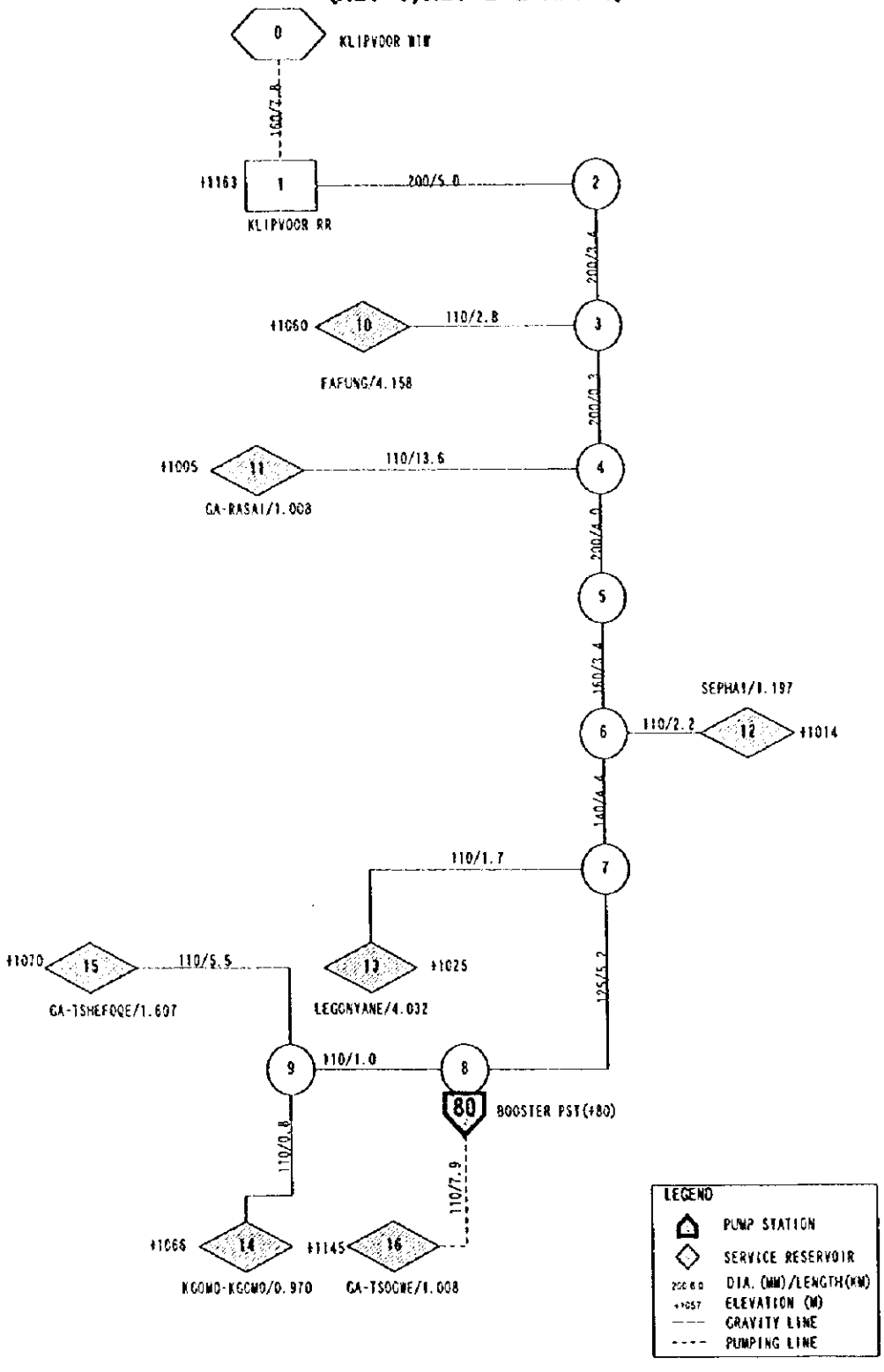


FIGURE A.2-2 FLOW DIAGRAM IN KLIPVOOR EAST(ALT-1)

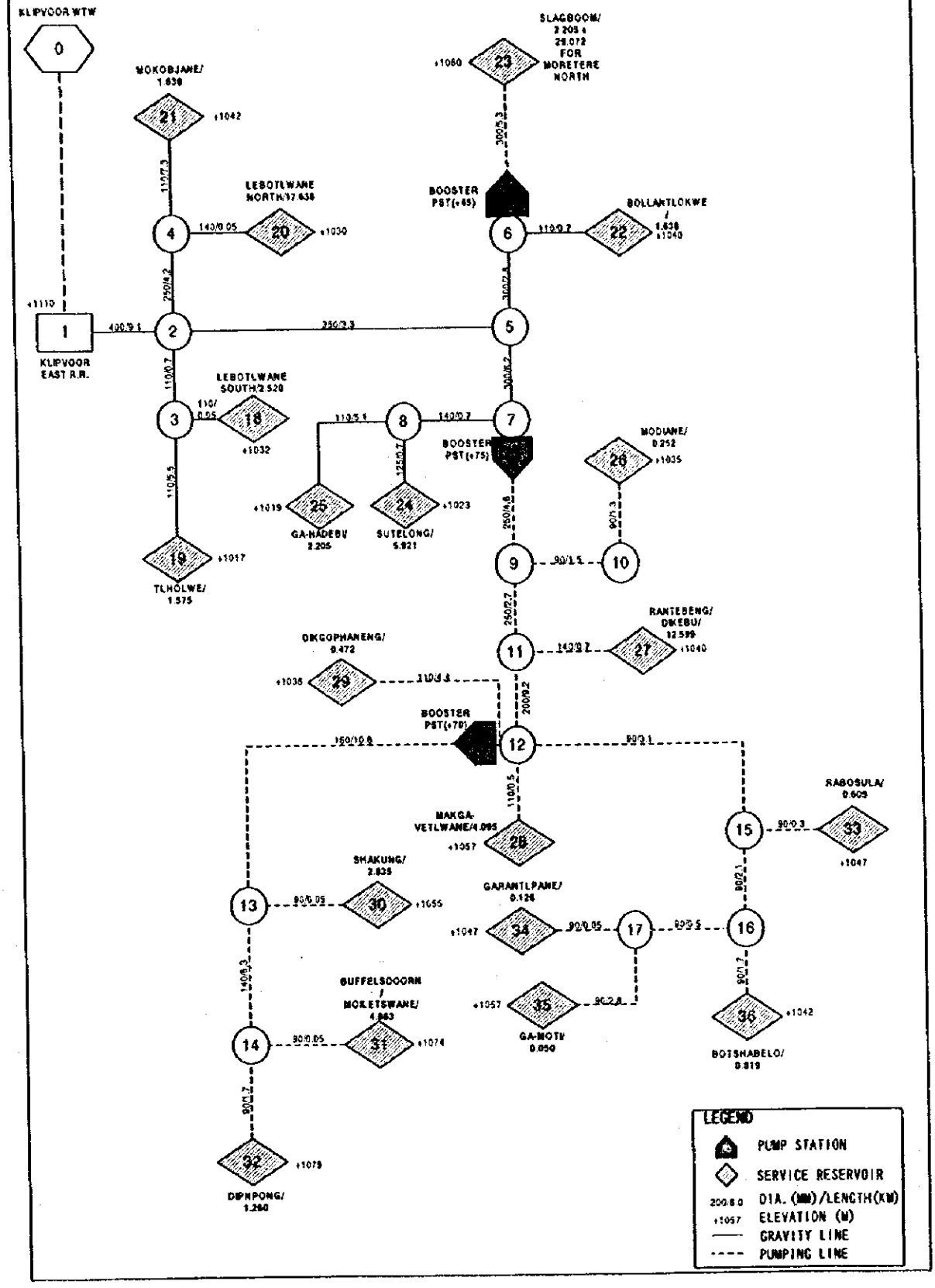


FIGURE A.2-2 FLOW DIAGRAM IN KLIPVOOR EAST(ALT-1)

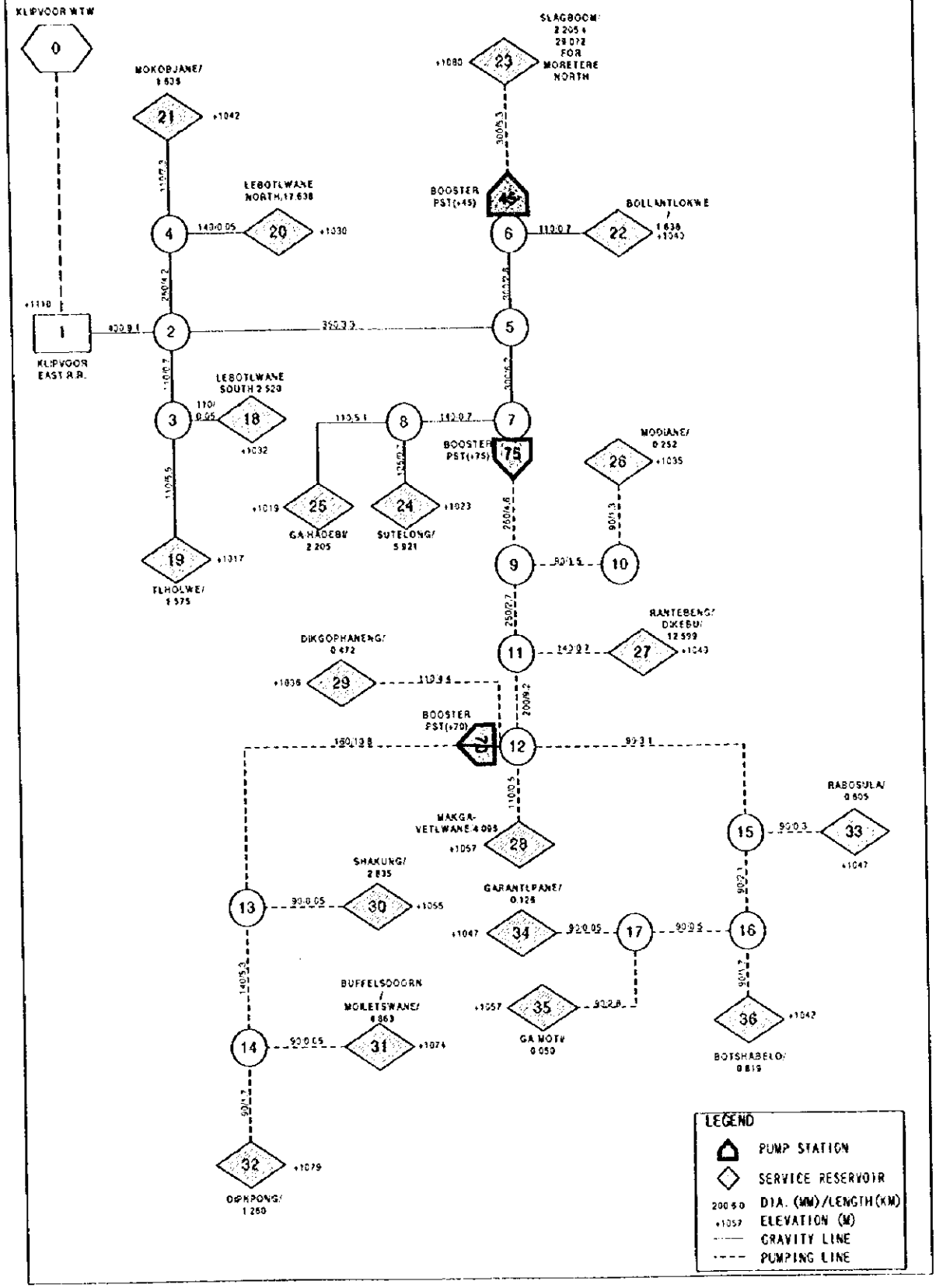


FIGURE A.2-3 FLOW DIAGRAM IN KLIPVOOR EAST (ALT-2)

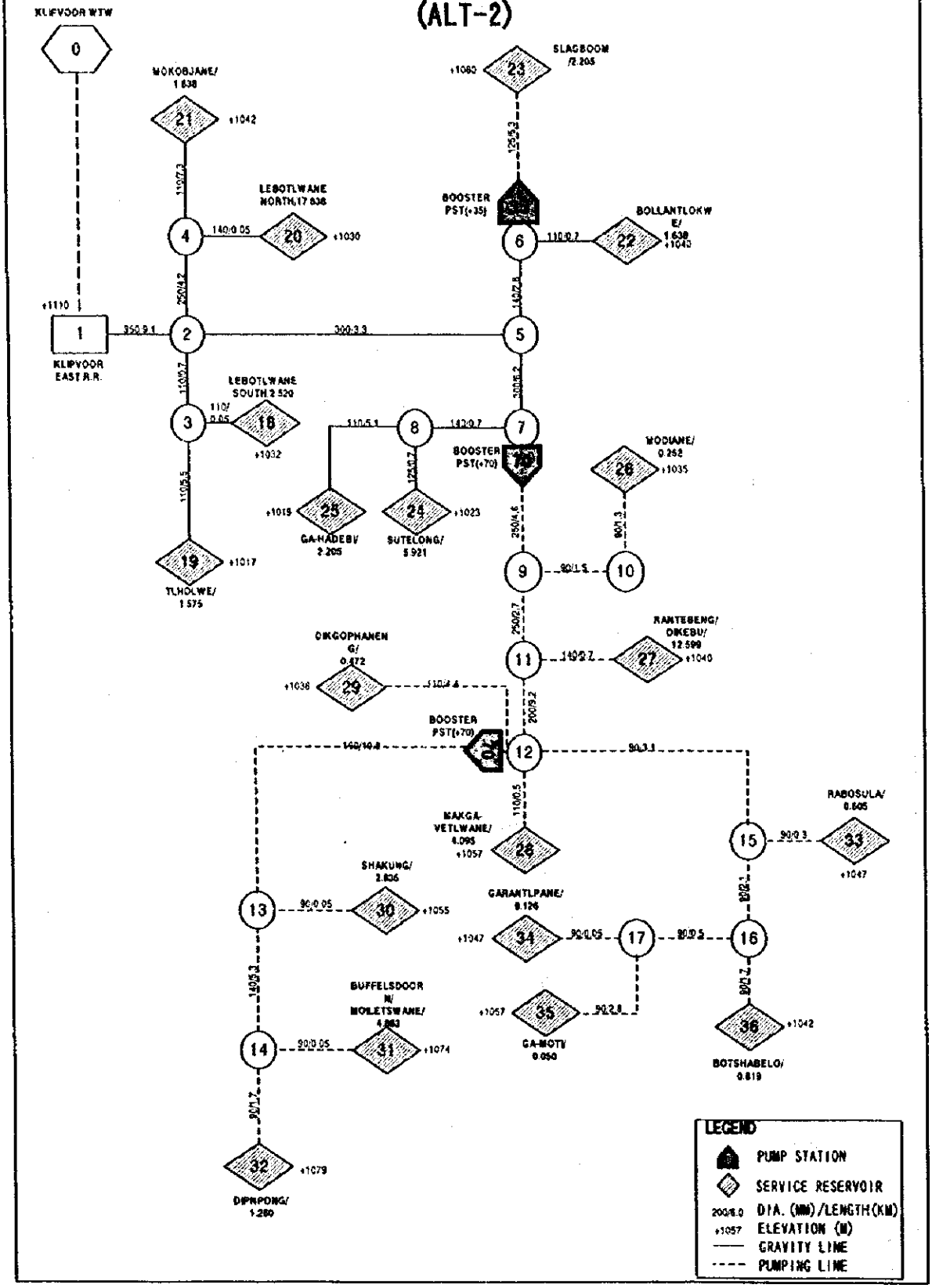


FIGURE A. 2-3 FLOW DIAGRAM IN KLIPVOOR EAST (ALT-2)

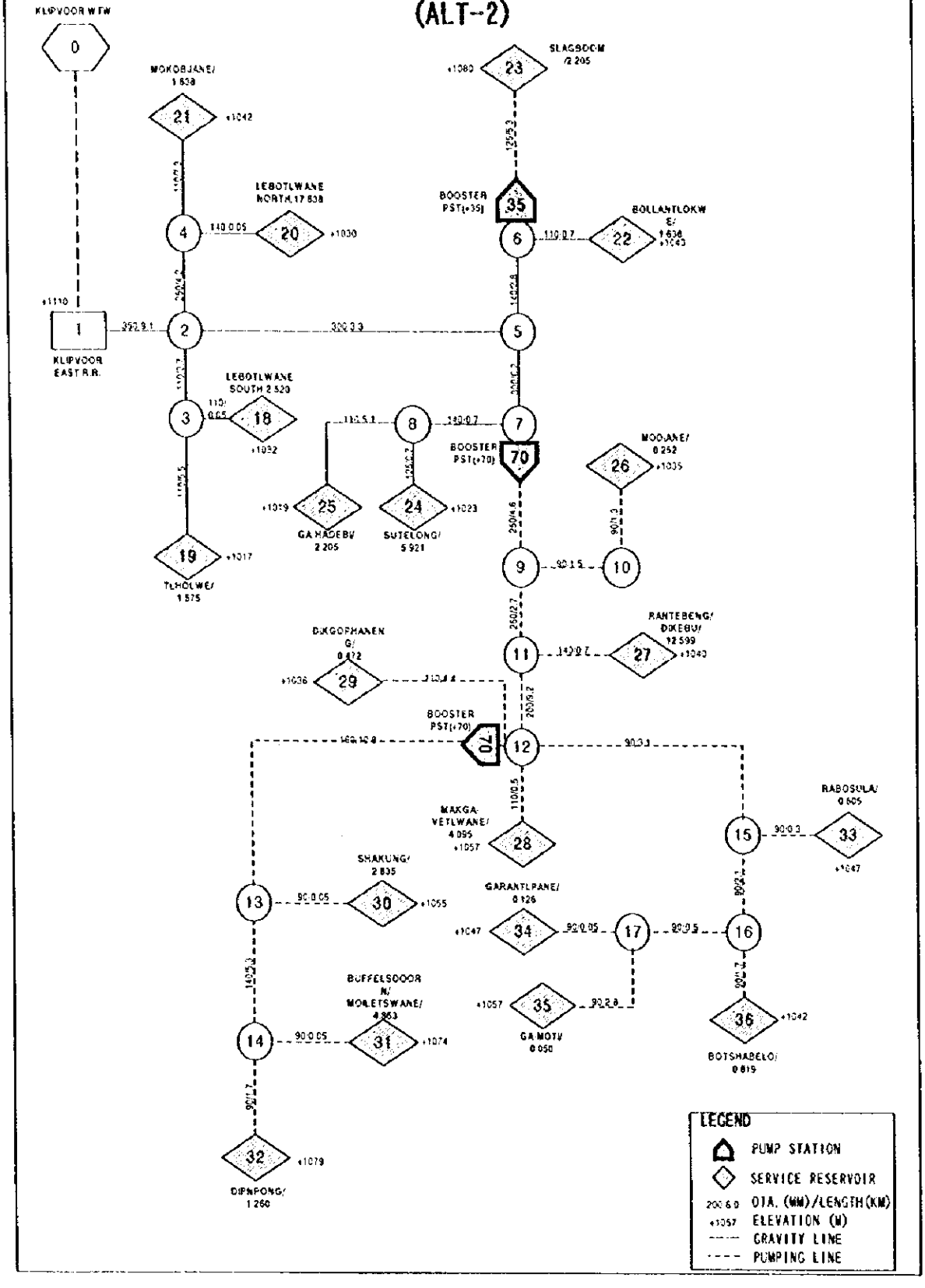


FIGURE A.2-4 FLOW DIAGRAM IN KLIPVOOR EAST (ALT-3)

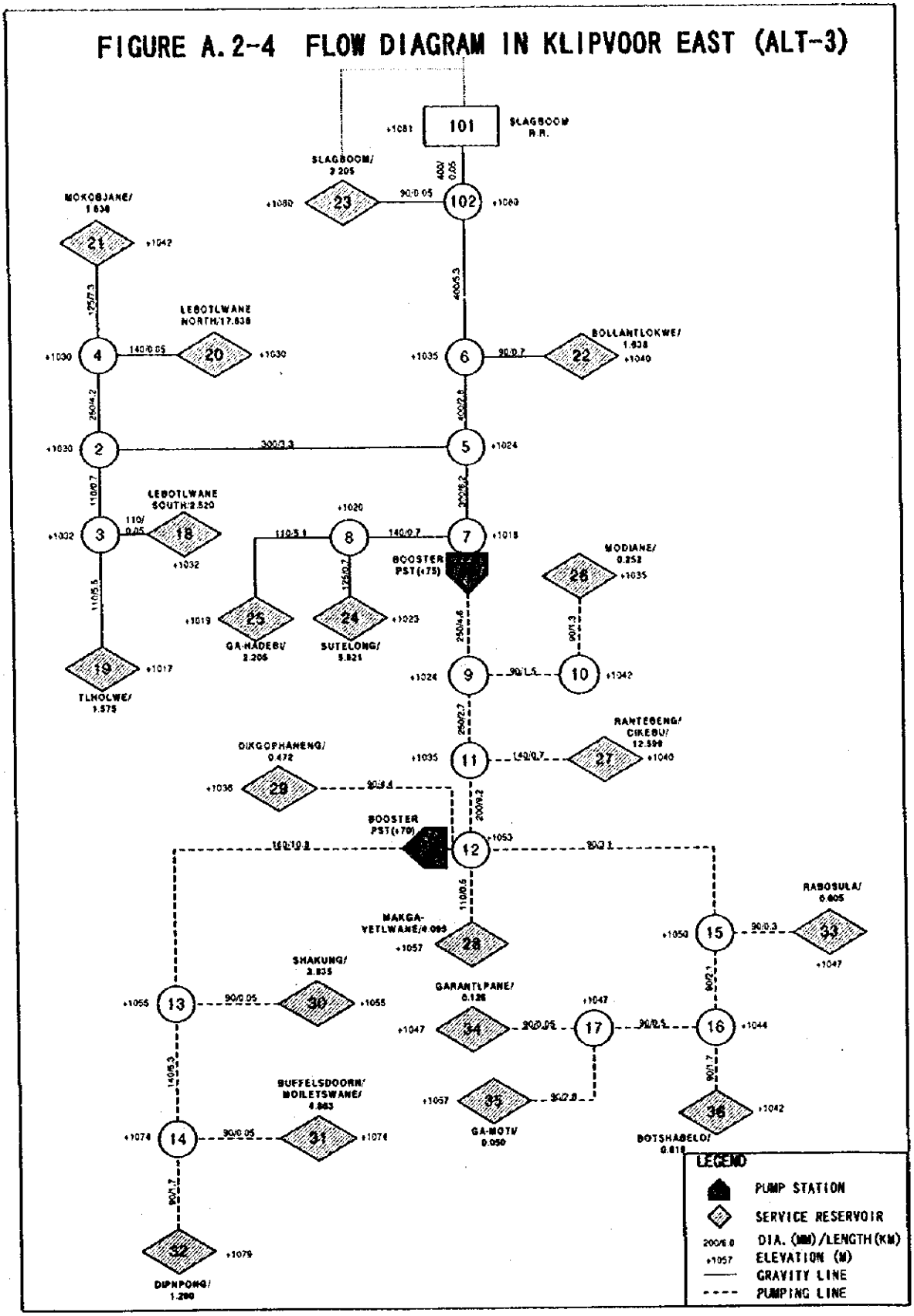
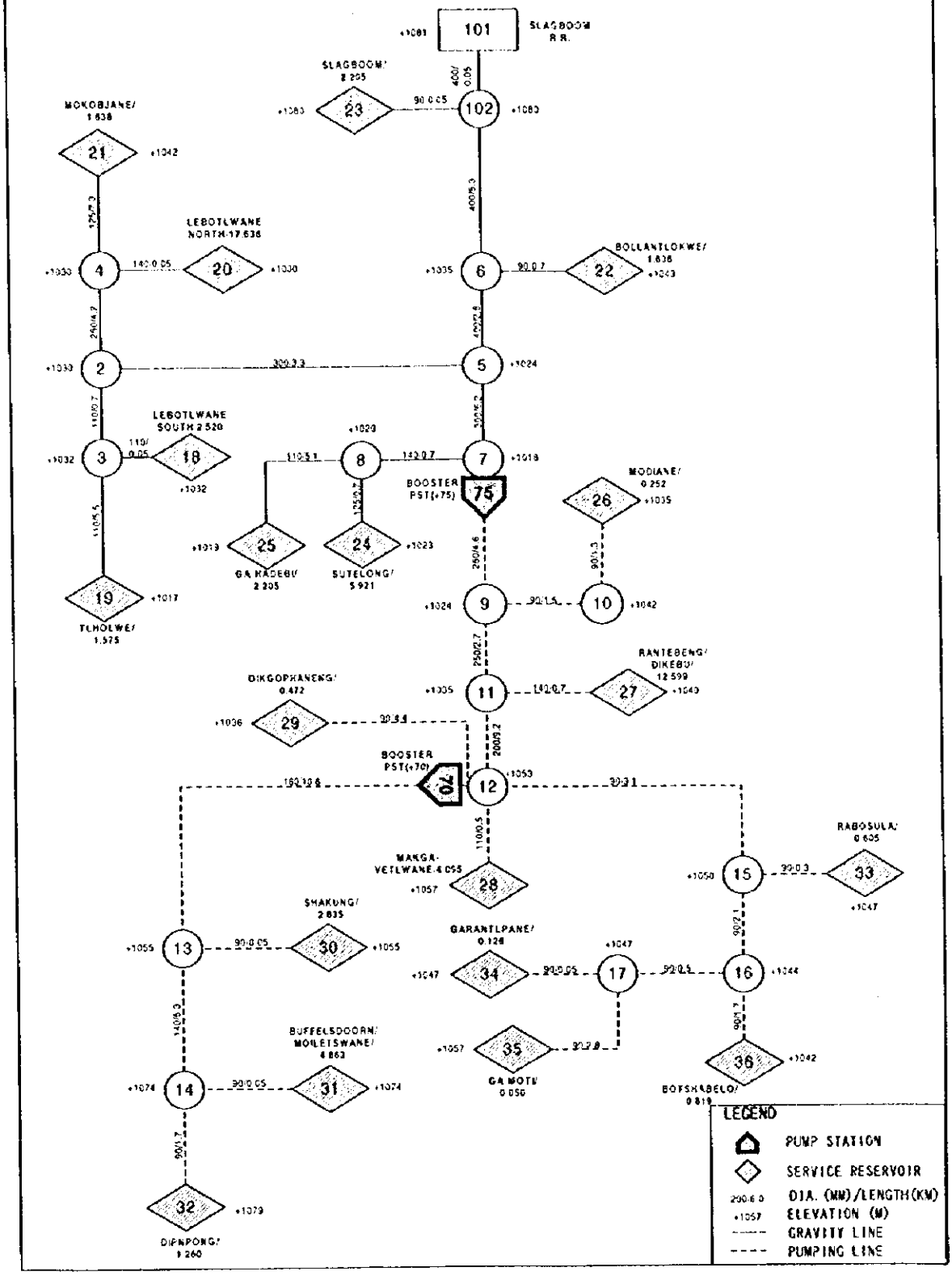


FIGURE A.2-4 FLOW DIAGRAM IN KLIPVOOR EAST (ALT-3)



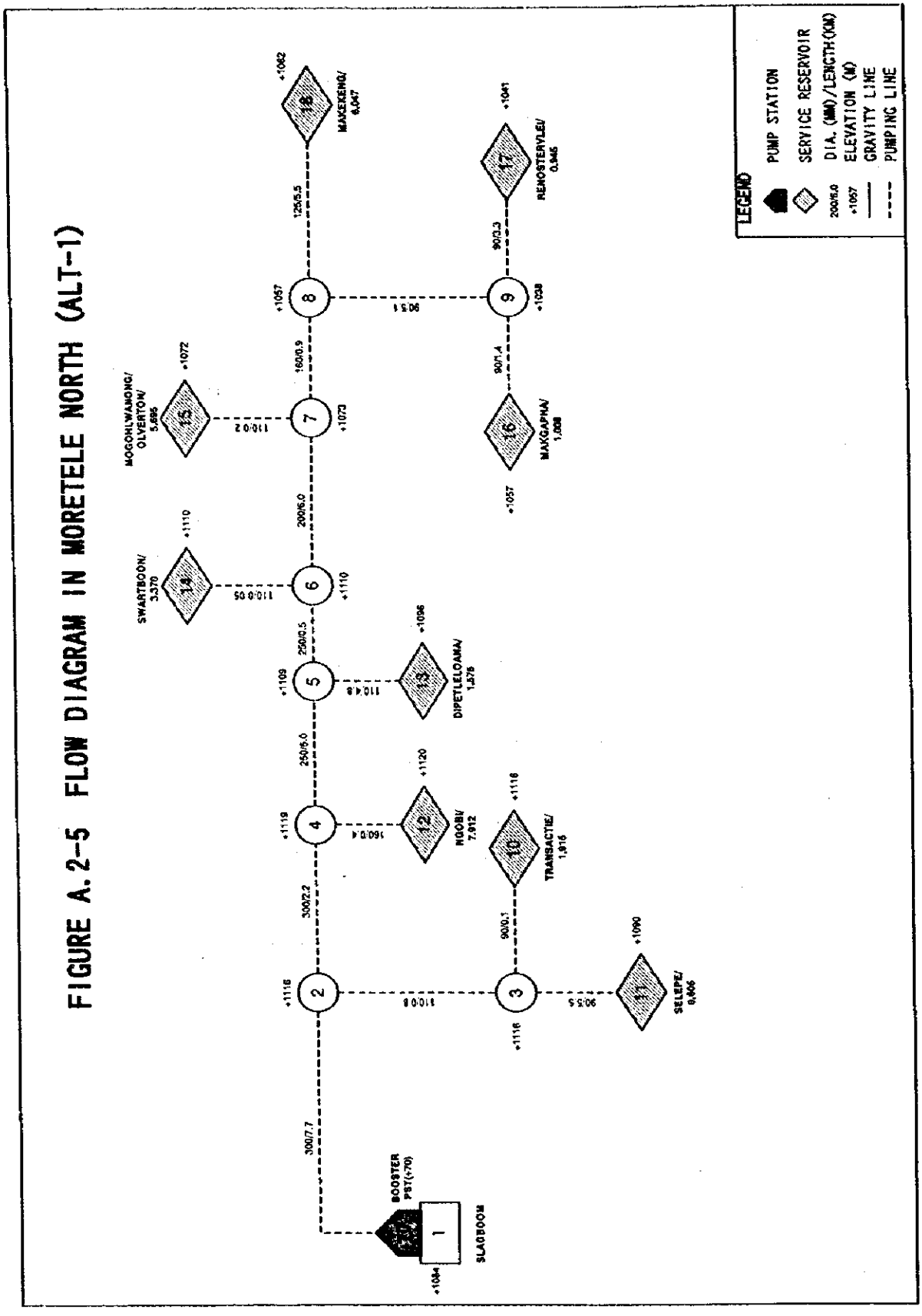


FIGURE A.2-5 FLOW DIAGRAM IN MORETELE NORTH (ALT-1)
LEGEND
PUMP STATION
SERVICE RESERVOIR
DIA. (MM)/LENGTH(KM)
ELEVATION (M)
GRAVITY LINE
PUMPING LINE
BOOSTER PST(+70)
SLAGBOOM
SELLEPE/ 6,466
TRANSACTIE/ 1,916
NGOBI/ 7,912
DIPETLELOANA/ 1,676
SWARTBOOM/ 3,370
MOGOHLWANONG/ OLVERTON/ 5,695
MAXGAPNA/ 1,208
REHOSTERVLEI/ 0,945
MAKEKENG/ 4,047

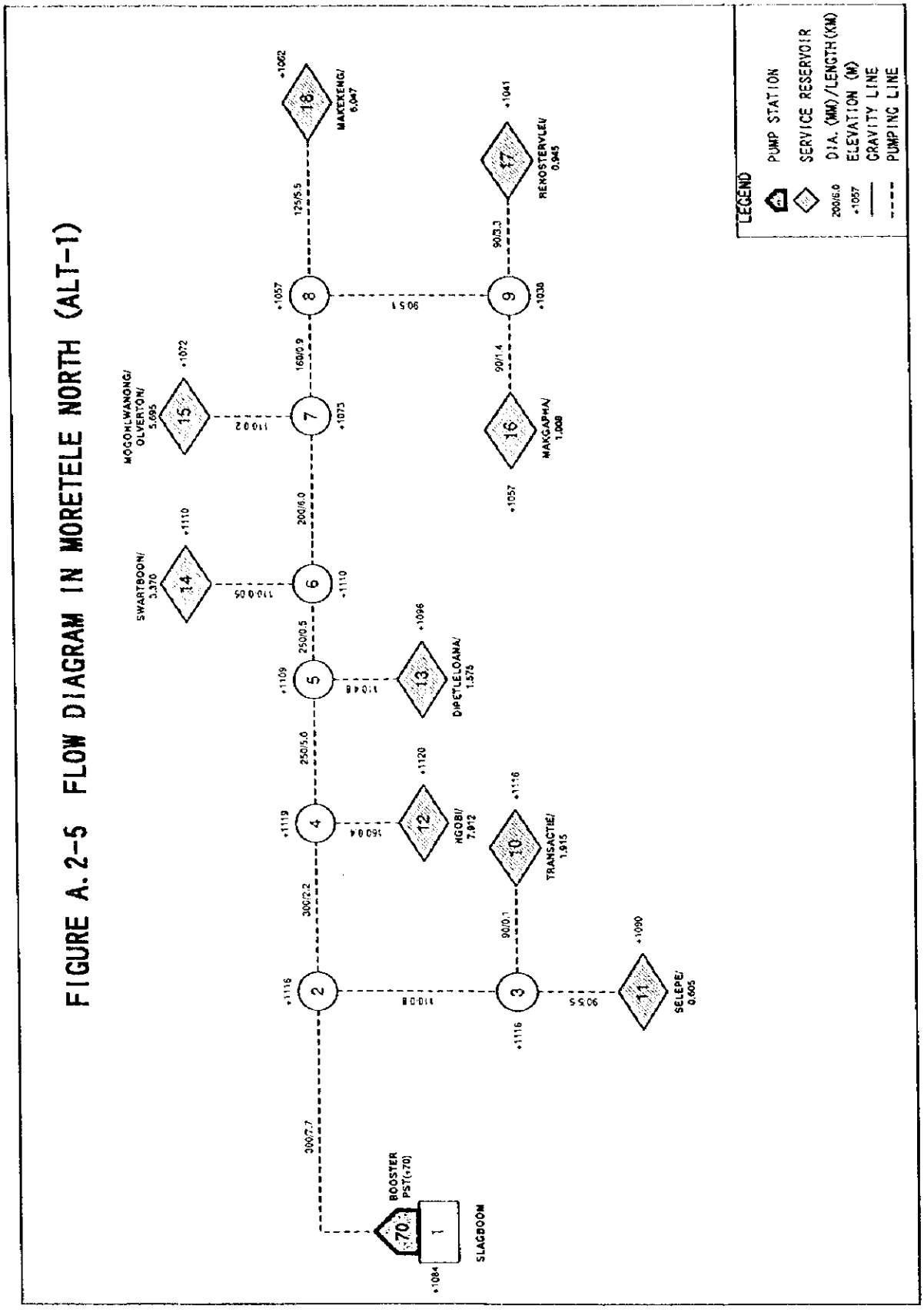


FIGURE A.2-5 FLOW DIAGRAM IN MORETELE NORTH (ALT-1)
LEGEND
PUMP STATION
SERVICE RESERVOIR
DIA. (MM)/LENGTH (KM)
ELEVATION (M)
GRAVITY LINE
PUMPING LINE
BOOSTER PST(+70)
SLAGBOOM
MOGOHLWANONG/ OLVERTON/ 5.695
SWARTBOOM/ 3.370
DIPETLELOANA/ 1.575
HGOBI/ 7.912
TRANSACTIE/ 1.915
SELEPE/ 0.605
MAKGAPHA/ 1.008
REKOSTERVLEI/ 0.945
MAKEKENG/ 6.047

FIGURE A.2-6 FLOW DIAGRAM IN MORETELE NORTH (ALT-2)

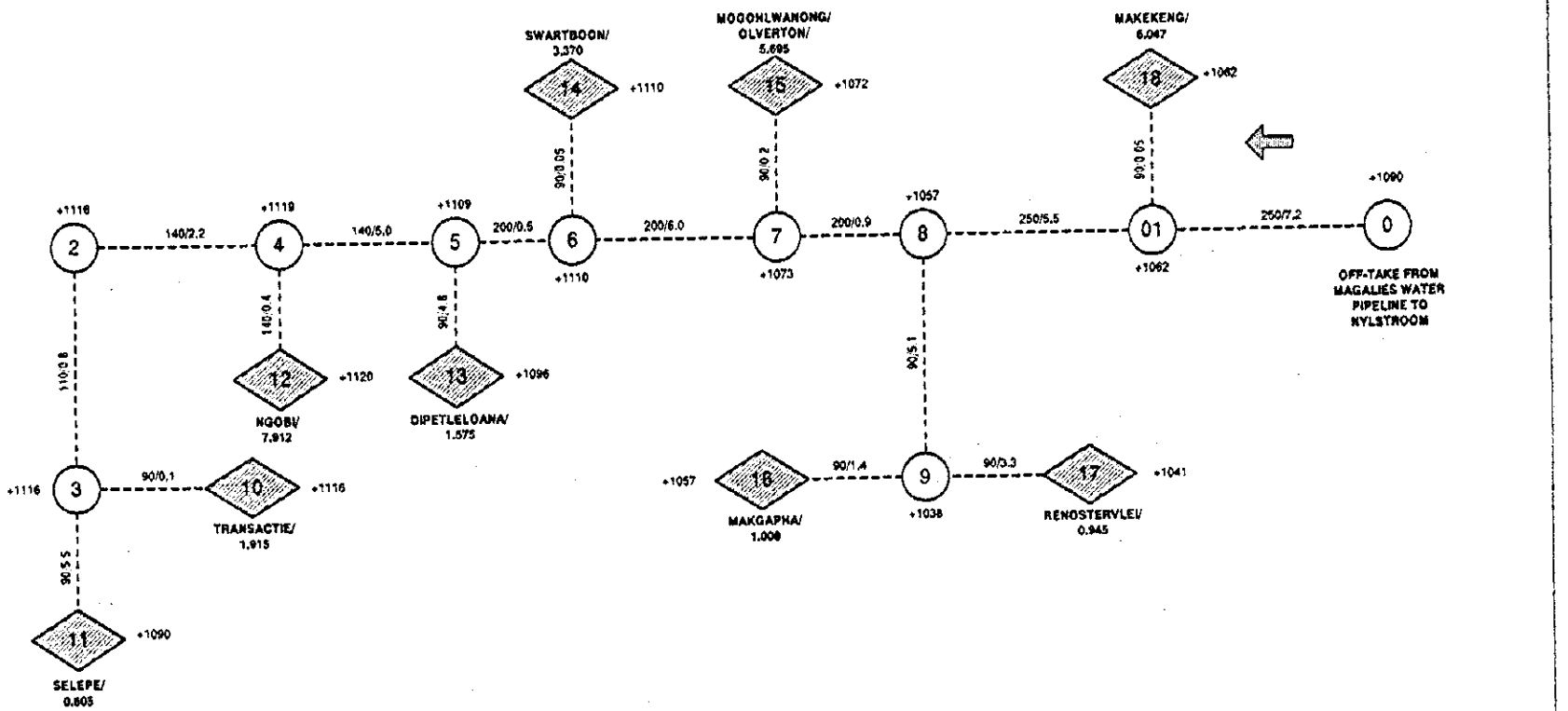


FIGURE A.2-6 FLOW DIAGRAM IN MORETELE NORTH (ALT-2)

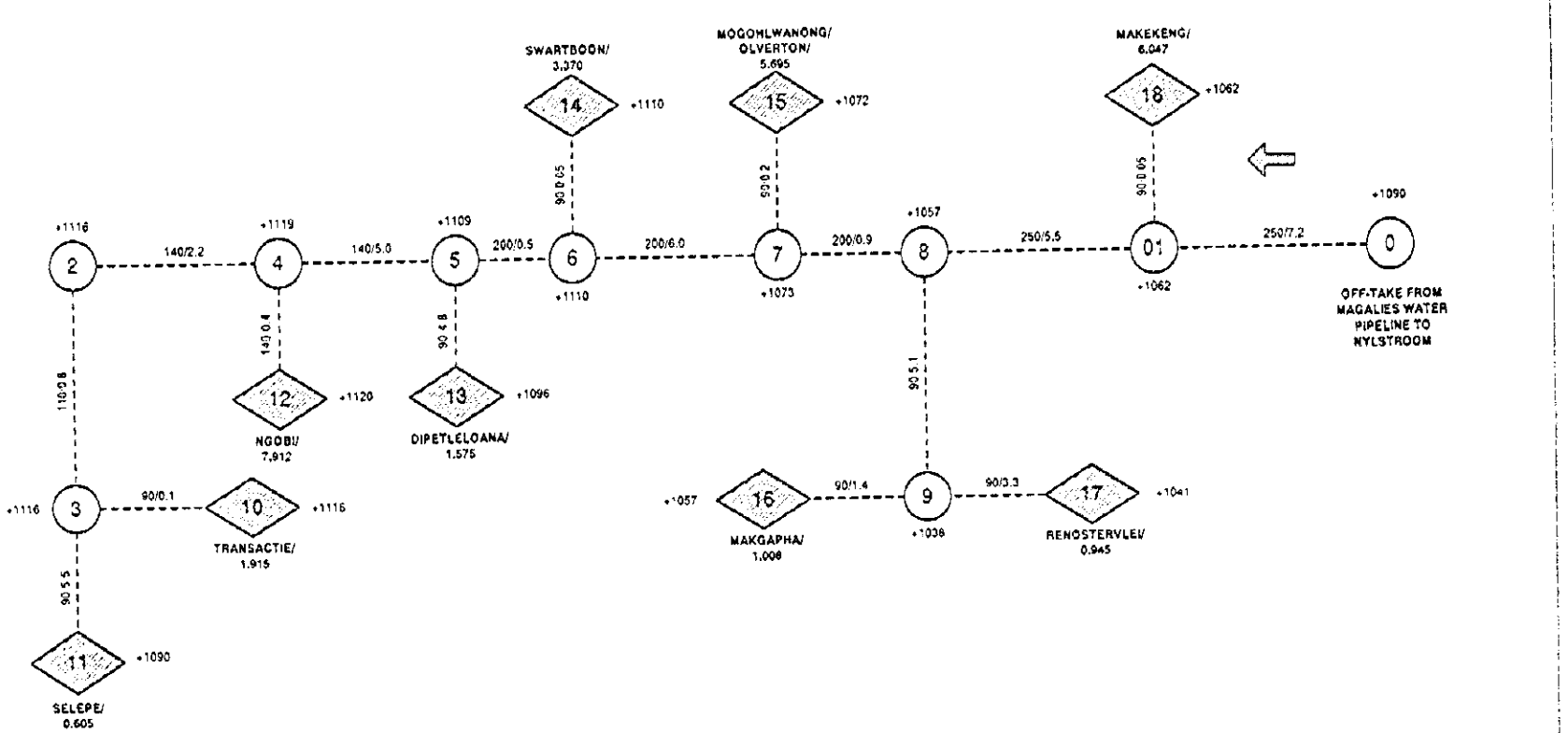


FIGURE A.2-7 FLOW DIAGRAM IN MORETELE NORTH (ALT-3)

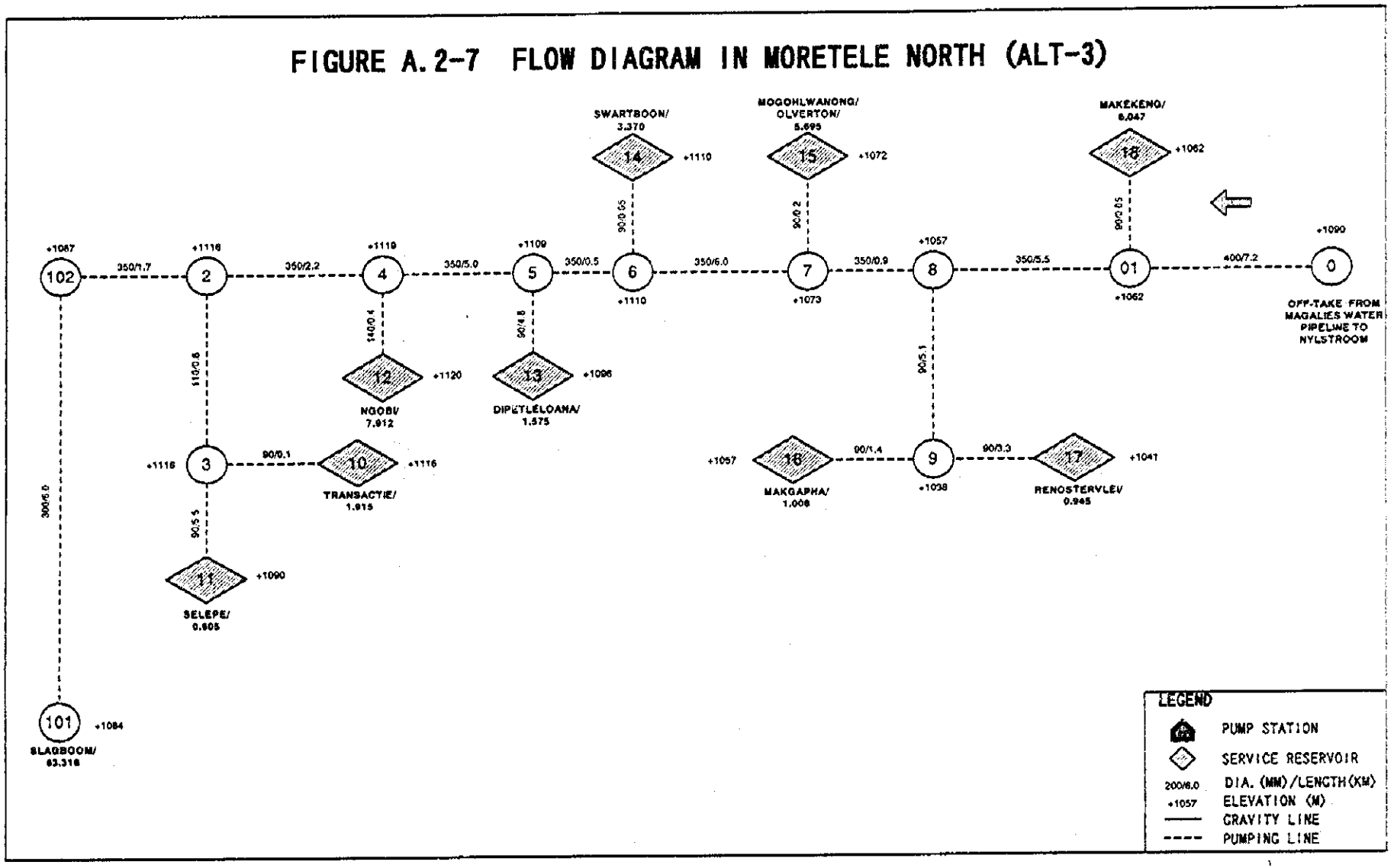


TABLE A.3-1 SUMMARY OF RESERVOIRS (*Total 3 Sheets*)

Reservoirs	Capacity Required		Height	Reservoir for Level A				Reservoir for Level B					
	Level B (m3)	Level A (m3)	G.L-Ground (m)	Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Cost (x1,000 R)	Addition (m3)	Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Add. Cost (x1,000 R)	Total Cost (x1,000 R)
Klipvoor West (Alt.-1, 2 & 3)													
Regional Reservoir	*1,208*	*453*	*G*	*460*	*1*	*300*	*300*	*748*	*800*	*1*	*700*	*700*	*1,000*
Klipvoor	1,208	453	G	460	1	300	300	748	800	1	700	700	1,000
Service Reservoir	*1,295*	*486*	*80*	*530*	*1*	*670*	*670*	*765*	*790*	*1*	*855*	*855*	*1,525*
Fafung	359	135	15	140	1	145	145	219	220	1	210	210	355
Sephai	103	39	15	40	1	75	75	63	70	1	110	110	185
Legonyane	348	131	10	140	1	135	135	208	210	1	175	175	310
Kgomo-Kgomo	84	31	10	40	1	70	70	44	50	1	75	75	145
Ga-Tshwee	139	52	10	60	1	85	85	79	80	1	95	95	180
Ga-Tsogwe	174	65	10	70	1	90	90	104	110	1	115	115	205
Ga-Rasai	87	33	10	40	1	70	70	47	50	1	75	75	145

TABLE A.3-1 SUMMARY OF RESERVOIRS (*Total 3 Sheets*)

Reservoirs	Capacity Required		Height	Reservoir for Level A				Reservoir for Level B					
	Level B (m3)	Level A (m3)	G-Ground (m)	Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Cost (x1,000 R)	Addition (m3)	Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Add. Cost (x1,000 R)	Total Cost (x1,000 R)
Klipvoor East (Alternative-1)													
Regional Reservoir	*7,982*	*2,993*	*G*	*3,000*	*1*	*1,500*	*1,500*	*4,982*	*5000*	*1*	*1900*	*1,900*	*3,400*
Klipvoor East	7,982	2,993	G	3,000	1	1,500	1,500	4,982	5000	1	1900	1,900	3,400
Service Reservoir	*8,082*	*3,031*	*220*	*2,450*	*21*	*2,505*	*3,055*	*4,932*	*3390*	*22*	*2915*	*4,080*	*7,135*
Lebotlwane South	218	82	10	90	1	105	105	128	130	1	130	130	235
Tlholwe	136	51	10	60	1	85	85	76	80	1	95	95	180
Lebotlwane North	1,524	572	15	290	2	240	480	944	480	2	315	630	1,110
Mokobjane	142	53	10	60	1	85	85	82	90	1	105	105	190
Bollantlokwe	142	53	10	60	1	85	85	82	90	1	105	105	190
Slagboom	381	143	10	150	1	140	140	231	240	1	185	185	325
Sutelong	512	192	15	200	1	205	205	312	320	1	260	260	465
Ga-Hadebi	190	71	10	80	1	95	95	110	110	1	115	115	210
Modiane	44	17	10	20	1	50	50	24	30	1	60	60	110
Rantebeng/Dikeb	2,177	816	15	410	2	310	620	1,357	460	3	310	930	1,550
Makgavetlwane	708	266	15	270	1	230	230	438	440	1	310	310	540
Dikgophaneng	82	31	10	40	1	70	70	42	50	1	75	75	145
Rabosura	105	39	10	40	1	70	70	65	70	1	90	90	160
Ga-Moti	9	3	10	10	1	40	40	-1	0	0		0	40
Garantlapane	22	8	10	10	1	40	40	12	20	1	50	50	90
Botshabelo	142	53	10	60	1	85	85	82	90	1	105	105	190
Shakung	490	184	15	190	1	205	205	300	300	1	245	245	450
Buffelsdoorn/Moiletswane	840	315	15	320	1	260	260	520	260	2	230	460	720
Dipompong	218	82	10	90	1	105	105	128	130	1	130	130	235
Klipvoor East (Alternative-2)													
Regional Reservoir	*5,470*	*2,051*	*G*	*2,100*	*1*	*1,100*	*1,100*	*3,370*	*3400*	*1*	*1700*	*1,700*	*2,800*
Klipvoor East	5,470	2,051	G	2,100	1	1,100	1,100	3,370	3400	1	1700	1,700	2,800
Service Reservoir	*8,082*	*3,031*	*220*	*2,450*	*21*	*2,505*	*3,055*	*4,932*	*3390*	*22*	*2915*	*4,080*	*7,135*
Lebotlwane South	218	82	10	90	1	105	105	128	130	1	130	130	235
Tlholwe	136	51	10	60	1	85	85	76	80	1	95	95	180
Lebotlwane North	1,524	572	15	290	2	240	480	944	480	2	315	630	1,110
Mokobjane	142	53	10	60	1	85	85	82	90	1	105	105	190
Bollantlokwe	142	53	10	60	1	85	85	82	90	1	105	105	190
Slagboom	381	143	10	150	1	140	140	231	240	1	185	185	325
Sutelong	512	192	15	200	1	205	205	312	320	1	260	260	465
Ga-Hadebi	190	71	10	80	1	95	95	110	110	1	115	115	210
Modiane	44	17	10	20	1	50	50	24	30	1	60	60	110
Rantebeng/Dikeb	2,177	816	15	410	2	310	620	1,357	460	3	310	930	1,550
Makgavetlwane	708	266	15	270	1	230	230	438	440	1	310	310	540
Dikgophaneng	82	31	10	40	1	70	70	42	50	1	75	75	145
Rabosura	105	39	10	40	1	70	70	65	70	1	90	90	160
Ga-Moti	9	3	10	10	1	40	40	-1	0	0	0	0	40
Garantlapane	22	8	10	10	1	40	40	12	20	1	50	50	90
Botshabelo	142	53	10	60	1	85	85	82	90	1	105	105	190
Shakung	490	184	15	190	1	205	205	300	300	1	245	245	450
Buffelsdoorn/Moiletswane	840	315	15	320	1	260	260	520	260	2	230	460	720
Dipompong	218	82	10	90	1	105	105	128	130	1	130	130	235
Klipvoor East (Alternative-3)													
Regional Reservoir	*5,470*	*2,051*	*G*	*2,100*	*1*	*1,100*	*1,100*	*3,370*	*3400*	*1*	*1700*	*1,700*	*2,800*
Slagboom	5,470	2,051	G	2,100	1	1,100	1,100	3,370	3400	1	1700	1,700	2,800
Service Reservoir	*8,082*	*3,031*	*220*	*2,450*	*21*	*2,505*	*3,055*	*4,932*	*3390*	*22*	*2915*	*4,080*	*7,135*
Lebotlwane South	218	82	10	90	1	105	105	128	130	1	130	130	235
Tlholwe	136	51	10	60	1	85	85	76	80	1	95	95	180
Lebotlwane North	1,524	572	15	290	2	240	480	944	480	2	315	630	1,110
Mokobjane	142	53	10	60	1	85	85	82	90	1	105	105	190
Bollantlokwe	142	53	10	60	1	85	85	82	90	1	105	105	190
Slagboom	381	143	10	150	1	140	140	231	240	1	185	185	325
Sutelong	512	192	15	200	1	205	205	312	320	1	260	260	465
Ga-Hadebi	190	71	10	80	1	95	95	110	110	1	115	115	210
Modiane	44	17	10	20	1	50	50	24	30	1	60	60	110
Rantebeng/Dikeb	2,177	816	15	410	2	310	620	1,357	460	3	310	930	1,550
Makgavetlwane	708	266	15	270	1	230	230	438	440	1	310	310	540
Dikgophaneng	82	31	10	40	1	70	70	42	50	1	75	75	145
Rabosura	105	39	10	40	1	70	70	65	70	1	90	90	160
Ga-Moti	9	3	10	10	1	40	40	-1	0	0	0	0	40
Garantlapane	22	8	10	10	1	40	40	12	20	1	50	50	90
Botshabelo	142	53	10	60	1	85	85	82	90	1	105	105	190
Shakung	490	184	15	190	1	205	205	300	300	1	245	245	450
Buffelsdoorn/Moiletswane	840	315	15	320	1	260	260	520	260	2	230	460	720
Dipompong	218	82	10	90	1	105	105	128	130	1	130	130	235

TABLE A.3-1 SUMMARY OF RESERVOIRS (*Total 3 Sheets*)

Reservoirs	Capacity Required Level B (m3)	Capacity Required Level A (m3)	Height G=Ground (m)	Reservoir for Level A Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Cost (x1,000 R	Reservoir for Level B Addition (m3)	Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Add. Cost (x1,000 R)	Total Cost (x1,000 R)
Klipvoor East (Alternative-1)													
Regional Reservoir	*7,982*	*2,993*	*G*	*3,000*	*1*	*1,500*	*1,500*	*4,982*	*5000*	*1*	*1900*	*1,900*	*3,400*
Klipvoor East	7,982	2,993	G	3,000	1	1,500	1,500	4,982	5000	1	1900	1,900	3,400
Service Reservoir	*8,082*	*3,031*	*220*	*2,450*	*21*	*2,505*	*3,055*	*4,932*	*3390*	*22*	*2915*	*4,080*	*7,135*
Lebotlwane South	218	82	10	90	1	105	105	128	130	1	130	130	235
Tlholwe	136	51	10	60	1	85	85	76	80	1	95	95	180
Lebotlwane North	1,524	572	15	290	2	240	480	944	480	2	315	630	1,110
Mokobjane	142	53	10	60	1	85	85	82	90	1	105	105	190
Bollantlokwe	142	53	10	60	1	85	85	82	90	1	105	105	190
Slagboom	381	143	10	150	1	140	140	231	240	1	185	185	325
Sutelong	512	192	15	200	1	205	205	312	320	1	260	260	465
Ga-Hadebi	190	71	10	80	1	95	95	110	110	1	115	115	210
Modiane	44	17	10	20	1	50	50	24	30	1	60	60	110
Ranteberg/Dikeb	2,177	816	15	410	2	310	620	1,357	460	3	310	930	1,550
Makgavetlwane	708	266	15	270	1	230	230	438	440	1	310	310	540
Dikgophaneng	82	31	10	40	1	70	70	42	50	1	75	75	145
Rabosura	105	39	10	40	1	70	70	65	70	1	90	90	160
Ga-Moti	9	3	10	10	1	40	40	-1	0	0		0	40
Garantlapane	22	8	10	10	1	40	40	12	20	1	50	50	90
Botshabelo	142	53	10	60	1	85	85	82	90	1	105	105	190
Shakung	490	184	15	190	1	205	205	300	300	1	245	245	450
Buffelsdoorn/Moiletswane	840	315	15	320	1	260	260	520	260	2	230	460	720
Dipompong	218	82	10	90	1	105	105	128	130	1	130	130	235
Klipvoor East (Alternative-2)													
Regional Reservoir	*5,470*	*2,051*	*G*	*2,100*	*1*	*1,100*	*1,100*	*3,370*	*3400*	*1*	*1700*	*1,700*	*2,800*
Klipvoor East	5,470	2,051	G	2,100	1	1,100	1,100	3,370	3400	1	1700	1,700	2,800
Service Reservoir	*8,082*	*3,031*	*220*	*2,450*	*21*	*2,505*	*3,055*	*4,932*	*3390*	*22*	*2915*	*4,080*	*7,135*
Lebotlwane South	218	82	10	90	1	105	105	128	130	1	130	130	235
Tlholwe	136	51	10	60	1	85	85	76	80	1	95	95	180
Lebotlwane North	1,524	572	15	290	2	240	480	944	480	2	315	630	1,110
Mokobjane	142	53	10	60	1	85	85	82	90	1	105	105	190
Bollantlokwe	142	53	10	60	1	85	85	82	90	1	105	105	190
Slagboom	381	143	10	150	1	140	140	231	240	1	185	185	325
Sutelong	512	192	15	200	1	205	205	312	320	1	260	260	465
Ga-Hadebi	190	71	10	80	1	95	95	110	110	1	115	115	210
Modiane	44	17	10	20	1	50	50	24	30	1	60	60	110
Ranteberg/Dikeb	2,177	816	15	410	2	310	620	1,357	460	3	310	930	1,550
Makgavetlwane	708	266	15	270	1	230	230	438	440	1	310	310	540
Dikgophaneng	82	31	10	40	1	70	70	42	50	1	75	75	145
Rabosura	105	39	10	40	1	70	70	65	70	1	90	90	160
Ga-Moti	9	3	10	10	1	40	40	-1	0	0	0	0	40
Garantlapane	22	8	10	10	1	40	40	12	20	1	50	50	90
Botshabelo	142	53	10	60	1	85	85	82	90	1	105	105	190
Shakung	490	184	15	190	1	205	205	300	300	1	245	245	450
Buffelsdoorn/Moiletswane	840	315	15	320	1	260	260	520	260	2	230	460	720
Dipompong	218	82	10	90	1	105	105	128	130	1	130	130	235
Klipvoor East (Alternative-3)													
Regional Reservoir	*5,470*	*2,051*	*G*	*2,100*	*1*	*1,100*	*1,100*	*3,370*	*3400*	*1*	*1700*	*1,700*	*2,800*
Slagboom	5,470	2,051	G	2,100	1	1,100	1,100	3,370	3400	1	1700	1,700	2,800
Service Reservoir	*8,082*	*3,031*	*220*	*2,450*	*21*	*2,505*	*3,055*	*4,932*	*3390*	*22*	*2915*	*4,080*	*7,135*
Lebotlwane South	218	82	10	90	1	105	105	128	130	1	130	130	235
Tlholwe	136	51	10	60	1	85	85	76	80	1	95	95	180
Lebotlwane North	1,524	572	15	290	2	240	480	944	480	2	315	630	1,110
Mokobjane	142	53	10	60	1	85	85	82	90	1	105	105	190
Bollantlokwe	142	53	10	60	1	85	85	82	90	1	105	105	190
Slagboom	381	143	10	150	1	140	140	231	240	1	185	185	325
Sutelong	512	192	15	200	1	205	205	312	320	1	260	260	465
Ga-Hadebi	190	71	10	80	1	95	95	110	110	1	115	115	210
Modiane	44	17	10	20	1	50	50	24	30	1	60	60	110
Ranteberg/Dikeb	2,177	816	15	410	2	310	620	1,357	460	3	310	930	1,550
Makgavetlwane	708	266	15	270	1	230	230	438	440	1	310	310	540
Dikgophaneng	82	31	10	40	1	70	70	42	50	1	75	75	145
Rabosura	105	39	10	40	1	70	70	65	70	1	90	90	160
Ga-Moti	9	3	10	10	1	40	40	-1	0	0	0	0	40
Garantlapane	22	8	10	10	1	40	40	12	20	1	50	50	90
Botshabelo	142	53	10	60	1	85	85	82	90	1	105	105	190
Shakung	490	184	15	190	1	205	205	300	300	1	245	245	450
Buffelsdoorn/Moiletswane	840	315	15	320	1	260	260	520	260	2	230	460	720
Dipompong	218	82	10	90	1	105	105	128	130	1	130	130	235

TABLE A.3-1 SUMMARY OF RESERVOIRS (*Total 3 Sheets*)

Reservoirs	Capacity Required		Height	Reservoir for Level A				Reservoir for Level B					
	Level B (m3)	Level A (m3)	G=Ground (m)	Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Cost (x1,000 R)	Addition (m3)	Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Add. Cost (x1,000 R)	Total Cost (x1,000 R)
Moretele North (Alternative-1)													
Regional Reservoir	*2,512*	*942*	*G*	*1,000*	*1*	*800*	*800*	*1,512*	*1600*	*1*	*1000*	*1,000*	*1,800*
Slagboom	2,512	942	G	1,000	1	800	800	1,512	1600	1	1000	1,000	1,800
Service Reservoir	*5,024*	*1,883*	*115*	*1,670*	*10*	*1,520*	*1,710*	*3,094*	*2100*	*12*	*1750*	*2,520*	*4,230*
Transactie	331	124	10	130	1	130	130	201	210	1	175	175	305
Selepe	105	39	10	40	1	70	70	65	70	1	90	90	160
Ngobi	1,367	513	10	260	2	190	380	847	430	2	255	510	890
Swartboom	582	218	15	220	1	210	210	362	370	1	285	285	495
Dipetleloana	272	102	15	110	1	135	135	162	170	1	180	180	315
Moghitwaneng/Olverton	984	369	15	370	1	285	285	614	310	2	250	500	785
Makgapha	174	65	10	70	1	90	90	104	110	1	115	115	205
Renostervlei	163	61	15	70	1	110	110	93	100	1	135	135	245
Makekeng	1,045	392	15	400	1	300	300	645	330	2	265	530	830
Moretele North (Alt.-2 & 3)													
Regional Reservoir							*0*					*0*	*0*
N.A.													
Service Reservoir	*5,024*	*1,883*	*115*	*1,670*	*10*	*1,520*	*1,710*	*3,094*	*2100*	*12*	*1750*	*2,520*	*4,230*
Transactie	331	124	10	130	1	130	130	201	210	1	175	175	305
Selepe	105	39	10	40	1	70	70	65	70	1	90	90	160
Ngobi	1,367	513	10	260	2	190	380	847	430	2	255	510	890
Swartboom	582	218	15	220	1	210	210	362	370	1	285	285	495
Dipetleloana	272	102	15	110	1	135	135	162	170	1	180	180	315
Moghitwaneng/Olverton	984	369	15	370	1	285	285	614	310	2	250	500	785
Makgapha	174	65	10	70	1	90	90	104	110	1	115	115	205
Renostervlei	163	61	15	70	1	110	110	93	100	1	135	135	245
Makekeng	1,045	392	15	400	1	300	300	645	330	2	265	530	830

TABLE A.3-1 SUMMARY OF RESERVOIRS (Total 3 Sheets)

Reservoirs	Capacity Required Level B (m3)	Capacity Required Level A (m3)	Height G=Ground (m)	Reservoir for Level A Capacity (m3)	Reservoir for Level A Number (nos)	Reservoir for Level A Unit Cost (x1,000 R)	Reservoir for Level A Cost (x1,000 R)	Reservoir for Level B Addition (m3)	Reservoir for Level B Capacity (m3)	Reservoir for Level B Number (nos)	Reservoir for Level B Unit Cost (x1,000 R)	Reservoir for Level B Add. Cost (x1,000 R)	Reservoir for Level B Total Cost (x1,000 R)
Moretele North (Alternative-1)													
Regional Reservoir	*2,512*	*942*	*G*	*1,000*	*1*	*800*	*800*	*1,512*	*1600*	*1*	*1000*	*1,000*	*1,800*
Slagboom	2,512	942	G	1,000	1	800	800	1,512	1600	1	1000	1,000	1,800
Service Reservoir	*5,024*	*1,883*	*115*	*1,670*	*10*	*1,520*	*1,710*	*3,094*	*2100*	*12*	*1750*	*2,520*	*4,230*
Transactie	331	124	10	130	1	130	130	201	210	1	175	175	305
Selepe	105	39	10	40	1	70	70	65	70	1	90	90	160
Ngobi	1,367	513	10	260	2	190	380	847	430	2	255	510	890
Swartboom	582	218	15	220	1	210	210	362	370	1	285	285	495
Dipetleloana	272	102	15	110	1	135	135	162	170	1	180	180	315
Mogohlwaneng/Olverton	984	369	15	370	1	285	285	614	310	2	250	500	785
Makgapha	174	65	10	70	1	90	90	104	110	1	115	115	205
Renostervlei	163	61	15	70	1	110	110	93	100	1	135	135	245
Makekeng	1,045	392	15	400	1	300	300	645	330	2	265	530	830
Moretele North (Alt.-2 & 3)													
Regional Reservoir							*0*					*0*	*0*
N.A.													
Service Reservoir	*5,024*	*1,883*	*115*	*1,670*	*10*	*1,520*	*1,710*	*3,094*	*2100*	*12*	*1750*	*2,520*	*4,230*
Transactie	331	124	10	130	1	130	130	201	210	1	175	175	305
Selepe	105	39	10	40	1	70	70	65	70	1	90	90	160
Ngobi	1,367	513	10	260	2	190	380	847	430	2	255	510	890
Swartboom	582	218	15	220	1	210	210	362	370	1	285	285	495
Dipetleloana	272	102	15	110	1	135	135	162	170	1	180	180	315
Mogohlwaneng/Olverton	984	369	15	370	1	285	285	614	310	2	250	500	785
Makgapha	174	65	10	70	1	90	90	104	110	1	115	115	205
Renostervlei	163	61	15	70	1	110	110	93	100	1	135	135	245
Makekeng	1,045	392	15	400	1	300	300	645	330	2	265	530	830

TABLE A.3-2 SUMMARY OF BULK SUPPLY PIPELINES (*Total 5 Sheets*)

BULK SUPPLY PIPELINE	UNIT	LENGTH	UNIT COST x 1000 R	TOTAL COST x 1000 R
KLIPVOOR WEST(ALT.-1, ALT.-2 & ALT.-3)				
BEFORE KLIPVOOR REGIONAL RESERVOIR				
160 mm Dia. Steel incl. materials and construction	m	7,800	0.170	1,326
Sub-Total		7,800		1,326
AFTER KLIPVOOR REGIONAL RESERVOIR				
400 mm Dia. Steel incl. materials and construction	m	0	0.495	0
350 mm Dia. Steel incl. materials and construction	m	0	0.428	0
300 mm Dia. Steel incl. materials and construction	m	0	0.360	0
200 mm Dia. Steel incl. materials and construction	m	5,000	0.284	1,420
200 mm Dia. Steel incl. materials and construction	m	7,700	0.224	1,725
160 mm Dia. Steel incl. materials and construction	m	3,400	0.170	578
140 mm Dia. Steel incl. materials and construction	m	4,400	0.143	629
125 mm Dia. Steel incl. materials and construction	m	5,200	0.123	640
110 mm Dia. Steel incl. materials and construction	m	35,500	0.102	3,621
90 mm Dia. Steel incl. materials and construction	m	0	0.075	0
Sub-Total		61,200		8,613
Sub-Total of Klipvoor West (Alt.-1, Alt.-2 & Alt.-3)		***69,000***		***9,939***

TABLE A.3-2 SUMMARY OF BULK SUPPLY PIPELINES (*Total 5 Sheets*)

BULK SUPPLY PIPELINE	UNIT	LENGTH	UNIT COST x 1000 R	TOTAL COST x 1000 R
KLIPVOOR EAST (ALTERNATIVE-1)				
BEFORE KLIPVOOR EAST REGIONAL RESERVOIR				
400 mm Dia. Steel incl. materials and construction	m	7,600	0.495	3,762
Sub-Total		7,600		3,762
AFTER KLIPVOOR EAST REGIONAL RESERVOIR				
400 mm Dia. Steel incl. materials and construction	m	9,100	0.495	4,505
350 mm Dia. Steel incl. materials and construction	m	3,300	0.428	1,412
300 mm Dia. Steel incl. materials and construction	m	14,300	0.360	5,148
250 mm Dia. Steel incl. materials and construction	m	7,300	0.292	2,132
250 mm Dia. uPVC incl. materials and construction	m	4,200	0.220	924
200 mm Dia. Steel incl. materials and construction	m	9,200	0.224	2,061
200 mm Dia. uPVC incl. materials and construction	m		0.166	0
160 mm Dia. Steel incl. materials and construction	m	10,800	0.170	1,836
160 mm Dia. uPVC incl. materials and construction	m		0.120	0
140 mm Dia. Steel incl. materials and construction	m	6,700	0.143	958
140 mm Dia. uPVC incl. materials and construction	m	50	0.108	5
125 mm Dia. Steel incl. materials and construction	m	700	0.123	86
125 mm Dia. uPVC incl. materials and construction	m		0.086	0
110 mm Dia. Steel incl. materials and construction	m	11,300	0.102	1,153
110 mm Dia. uPVC incl. materials and construction	m	12,950	0.082	1,062
90 mm Dia. Steel incl. materials and construction	m	1,500	0.075	113
90 mm Dia. uPVC incl. materials and construction	m	13,650	0.066	901
Sub-Total		105,050		22,295
Sub-Total of Klipvoor East (Alternative-1)		***112,650***		***26,057***
KLIPVOOR EAST (ALTERNATIVE-2)				
BEFORE KLIPVOOR EAST REGIONAL RESERVOIR				
300 mm Dia. Steel incl. materials and construction	m	7,600	0.360	2,736
Sub-Total		7,600		2,736
AFTER KLIPVOOR EAST REGIONAL RESERVOIR				
400 mm Dia. Steel incl. materials and construction	m		0.495	0
350 mm Dia. Steel incl. materials and construction	m	9,100	0.428	3,895
300 mm Dia. Steel incl. materials and construction	m	9,500	0.360	3,420
250 mm Dia. Steel incl. materials and construction	m	7,300	0.292	2,132
250 mm Dia. uPVC incl. materials and construction	m	4,200	0.220	924
200 mm Dia. Steel incl. materials and construction	m	9,200	0.224	2,061
200 mm Dia. uPVC incl. materials and construction	m		0.166	0
160 mm Dia. Steel incl. materials and construction	m	10,800	0.170	1,836
160 mm Dia. uPVC incl. materials and construction	m		0.120	0
140 mm Dia. Steel incl. materials and construction	m	3,500	0.143	501
140 mm Dia. uPVC incl. materials and construction	m	6,050	0.108	653
125 mm Dia. Steel incl. materials and construction	m		0.123	0
125 mm Dia. uPVC incl. materials and construction	m	6,000	0.086	516
110 mm Dia. Steel incl. materials and construction	m		0.102	0
110 mm Dia. uPVC incl. materials and construction	m	24,250	0.082	1,989
90 mm Dia. Steel incl. materials and construction	m		0.075	0
90 mm Dia. uPVC incl. materials and construction	m	15,150	0.066	1,000
Sub-Total		105,050		18,926
Sub-Total of Klipvoor East (Alternative-2)		***112,650***		***21,662***

TABLE A.3-2 SUMMARY OF BULK SUPPLY PIPELINES (*Total 5 Sheets*)

BULK SUPPLY PIPELINE	UNIT	LENGTH	UNIT COST x 1000 R	TOTAL COST x 1000 R
KLIPVOOR EAST (ALTERNATIVE-3)				
BEFORE KLIPVOOR EAST REGIONAL RESERVOIR				
N.A.	m	0	0	0
Sub-Total		0		0
AFTER KLIPVOOR EAST REGIONAL RESERVOIR				
400 mm Dia. Steel incl. materials and construction	m	8,150	0.495	4,034
350 mm Dia. Steel incl. materials and construction	m		0.428	0
300 mm Dia. Steel incl. materials and construction	m	9,500	0.360	3,420
250 mm Dia. Steel incl. materials and construction	m	7,300	0.292	2,132
250 mm Dia. uPVC incl. materials and construction	m	4,200	0.220	924
200 mm Dia. Steel incl. materials and construction	m	9,200	0.224	2,061
200 mm Dia. uPVC incl. materials and construction	m		0.166	0
160 mm Dia. Steel incl. materials and construction	m	10,800	0.170	1,836
160 mm Dia. uPVC incl. materials and construction	m		0.120	0
140 mm Dia. Steel incl. materials and construction	m		0.143	0
140 mm Dia. uPVC incl. materials and construction	m	6,750	0.108	729
125 mm Dia. Steel incl. materials and construction	m		0.123	0
125 mm Dia. uPVC incl. materials and construction	m	8,000	0.086	688
110 mm Dia. Steel incl. materials and construction	m		0.102	0
110 mm Dia. uPVC incl. materials and construction	m	11,850	0.082	972
90 mm Dia. Steel incl. materials and construction	m		0.075	0
90 mm Dia. uPVC incl. materials and construction	m	20,300	0.066	1,340
Sub-Total		96,050		18,135
Sub-Total of Klipvoor East (Alternative-3)		***96,050***		***18,135***

TABLE A.3-2 SUMMARY OF BULK SUPPLY PIPELINES (*Total 5 Sheets*)

BULK SUPPLY PIPELINE	UNIT	LENGTH	UNIT COST x 1000 R	TOTAL COST x 1000 R
MORETELE NORTH (ALTERNATIVE-1)				
FROM KLIPDRIFT WTW TO OFF-TAKE POINT				
N.A.	m	0	0	0
Sub-Total		0		0
AFTER SLAGBOOM REGIONAL RESERVOIR				
400 mm Dia. Steel incl. materials and construction	m		0.495	0
350 mm Dia. Steel incl. materials and construction	m		0.428	0
300 mm Dia. Steel incl. materials and construction	m	9,900	0.360	3,564
250 mm Dia. Steel incl. materials and construction	m		0.292	0
250 mm Dia. uPVC incl. materials and construction	m	5,500	0.220	1,210
200 mm Dia. Steel incl. materials and construction	m		0.224	0
200 mm Dia. uPVC incl. materials and construction	m	6,000	0.166	996
160 mm Dia. Steel incl. materials and construction	m	900	0.170	153
160 mm Dia. uPVC incl. materials and construction	m	400	0.120	48
140 mm Dia. Steel incl. materials and construction	m		0.143	0
140 mm Dia. uPVC incl. materials and construction	m		0.108	0
125 mm Dia. Steel incl. materials and construction	m	5,500	0.123	677
125 mm Dia. uPVC incl. materials and construction	m		0.086	0
110 mm Dia. Steel incl. materials and construction	m		0.102	0
110 mm Dia. uPVC incl. materials and construction	m	5,850	0.082	480
90 mm Dia. Steel incl. materials and construction	m	5,100	0.075	383
90 mm Dia. uPVC incl. materials and construction	m	10,300	0.066	680
Sub-Total		49,450		8,190
Sub-Total of Moretele North (Alternative-1)		***49,450***		***8,190***
MORETELE NORTH (ALTERNATIVE-2)				
FROM KLIPDRIFT WTW TO OFF-TAKE POINT				
Use existing MW Nylstroom Pipeline	m	0	0	4,860
Sub-Total		0		4,860
AFTER OFF-TAKE POINT				
400 mm Dia. Steel incl. materials and construction	m		0.495	0
350 mm Dia. Steel incl. materials and construction	m		0.428	0
300 mm Dia. Steel incl. materials and construction	m		0.360	0
250 mm Dia. Steel incl. materials and construction	m	12,700	0.292	3,708
250 mm Dia. uPVC incl. materials and construction	m		0.220	0
200 mm Dia. Steel incl. materials and construction	m	7,400	0.224	1,658
200 mm Dia. uPVC incl. materials and construction	m		0.166	0
160 mm Dia. Steel incl. materials and construction	m		0.170	0
160 mm Dia. uPVC incl. materials and construction	m		0.120	0
140 mm Dia. Steel incl. materials and construction	m	7,600	0.143	1,087
140 mm Dia. uPVC incl. materials and construction	m		0.108	0
125 mm Dia. Steel incl. materials and construction	m		0.123	0
125 mm Dia. uPVC incl. materials and construction	m		0.086	0
110 mm Dia. Steel incl. materials and construction	m	800	0.102	82
110 mm Dia. uPVC incl. materials and construction	m		0.082	0
90 mm Dia. Steel incl. materials and construction	m	20,500	0.075	1,538
90 mm Dia. uPVC incl. materials and construction	m		0.066	0
Sub-Total		49,000		8,072
Sub-Total of Moretele North (Alternative-2)		***49,000***		***12,932***

TABLE A.3-2 SUMMARY OF BULK SUPPLY PIPELINES (*Total 5 Sheets*)

BULK SUPPLY PIPELINE	UNIT	LENGTH	UNIT COST x 1000 R	TOTAL COST x 1000 R
MORETELE NORTH (ALTERNATIVE-3)				
FROM KLIPDRIFT WTW TO OFF-TAKE POINT				
400 mm Dia. Steel incl. materials and construction	m	35,000	0.495	17,325
Sub-Total		35,000		17,325
AFTER OFF-TAKE POINT				
400 mm Dia. Steel incl. materials and construction	m	7,200	0.495	3,564
350 mm Dia. Steel incl. materials and construction	m	21,800	0.428	9,330
300 mm Dia. Steel incl. materials and construction	m	6,000	0.360	2,160
250 mm Dia. Steel incl. materials and construction	m		0.292	0
250 mm Dia. uPVC incl. materials and construction	m		0.220	0
200 mm Dia. Steel incl. materials and construction	m		0.224	0
200 mm Dia. uPVC incl. materials and construction	m		0.166	0
160 mm Dia. Steel incl. materials and construction	m		0.170	0
160 mm Dia. uPVC incl. materials and construction	m		0.120	0
140 mm Dia. Steel incl. materials and construction	m	400	0.143	57
140 mm Dia. uPVC incl. materials and construction	m		0.108	0
125 mm Dia. Steel incl. materials and construction	m		0.123	0
125 mm Dia. uPVC incl. materials and construction	m		0.086	0
110 mm Dia. Steel incl. materials and construction	m	800	0.102	82
110 mm Dia. uPVC incl. materials and construction	m		0.082	0
90 mm Dia. Steel incl. materials and construction	m	20,500	0.075	1,538
90 mm Dia. uPVC incl. materials and construction	m		0.066	0
Sub-Total		56,700		16,731
Sub-Total of Moretele North (Alternative-3)		***91,700***		***34,056***

TABLE A.3-3 SUMMARY OF BOOSTER PUMP STATIONS

LEVEL B	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
Klipvoor West											*166,580*
Ga-Tsogwe	1.512	0.091	80	2	1	3	0.045	11.0	33.0	58,303	166,580
Klipvoor East 1											*901,045*
Bolantlokwe	48.333	2.900	45	2	1	3	1.450	18.5	55.5	98,055	280,157
Sutelong	41.964	2.518	75	2	1	3	1.259	30.0	90.0	159,008	454,308
Makgavetlwane	13.437	0.806	70	2	1	3	0.403	11.0	33.0	58,303	166,580
Klipvoor East 2											*676,919*
Bolantlokwe	3.309	0.199	35	2	1	3	0.099	3.7	11.1	19,611	56,031
Sutelong	41.964	2.518	70	2	1	3	1.259	30.0	90.0	159,008	454,308
Makgavetlwane	13.437	0.806	70	2	1	3	0.403	11.0	33.0	58,303	166,580
Klipvoor East 3											*620,888*
Sutelong	41.964	2.518	75	2	1	3	1.259	30.0	90.0	159,008	454,308
Makgavetlwane	13.437	0.806	70	2	1	3	0.403	11.0	33.0	58,303	166,580
Moretele North 1											*454,308*
Slagboom	43.608	2.616	70	2	1	3	1.308	30.0	90.0	159,008	454,308

LEVEL A	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
Klipvoor West											*111,053*
Ga-Tsogwe	0.567	0.034	80	1	1	2	0.034	11.0	22.0	38,869	111,053
Klipvoor East 1											*600,696*
Bolantlokwe	18.125	1.087	45	1	1	2	1.087	18.5	37.0	65,370	186,771
Sutelong	15.737	0.944	75	1	1	2	0.944	30.0	60.0	106,005	302,872
Makgavetlwane	5.039	0.302	70	1	1	2	0.302	11.0	22.0	38,869	111,053
Klipvoor East 2											*451,279*
Bolantlokwe	1.241	0.074	35	1	1	2	0.074	3.7	7.4	13,074	37,354
Sutelong	15.737	0.944	70	1	1	2	0.944	30.0	60.0	106,005	302,872
Makgavetlwane	5.039	0.302	70	1	1	2	0.302	11.0	22.0	38,869	111,053
Klipvoor East 3											*413,925*
Sutelong	15.737	0.944	75	1	1	2	0.944	30.0	60.0	106,005	302,872
Makgavetlwane	5.039	0.302	70	1	1	2	0.302	11.0	22.0	38,869	111,053
Moretele North 1											*302,872*
Slagboom	16.353	0.981	70	1	1	2	0.981	30.0	60.0	106,005	302,872

TABLE A.3-3 SUMMARY OF BOOSTER PUMP STATIONS

Level B	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
Klipvoor West											*166,580*
Ga-Tsogwe	1.512	0.091	80	2	1	3	0.045	11.0	33.0	58,303	166,580
Klipvoor East 1											*901,045*
Bolantlokwe	48.333	2.900	45	2	1	3	1.450	18.5	55.5	98,055	280,157
Sutelong	41.964	2.518	75	2	1	3	1.259	30.0	90.0	159,008	454,308
Makgavetlwane	13.437	0.806	70	2	1	3	0.403	11.0	33.0	58,303	166,580
Klipvoor East 2											*676,919*
Bolantlokwe	3.309	0.199	35	2	1	3	0.099	3.7	11.1	19,611	56,031
Sutelong	41.964	2.518	70	2	1	3	1.259	30.0	90.0	159,008	454,308
Makgavetlwane	13.437	0.806	70	2	1	3	0.403	11.0	33.0	58,303	166,580
Klipvoor East 3											*620,888*
Sutelong	41.964	2.518	75	2	1	3	1.259	30.0	90.0	159,008	454,308
Makgavetlwane	13.437	0.806	70	2	1	3	0.403	11.0	33.0	58,303	166,580
Moretele North 1											*454,308*
Slagboom	43.608	2.616	70	2	1	3	1.308	30.0	90.0	159,008	454,308

Level A	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
Klipvoor West											*111,053*
Ga-Tsogwe	0.567	0.034	80	1	1	2	0.034	11.0	22.0	38,869	111,053
Klipvoor East 1											*600,696*
Bolantlokwe	18.125	1.087	45	1	1	2	1.087	18.5	37.0	65,370	186,771
Sutelong	15.737	0.944	75	1	1	2	0.944	30.0	60.0	106,005	302,872
Makgavetlwane	5.039	0.302	70	1	1	2	0.302	11.0	22.0	38,869	111,053
Klipvoor East 2											*451,279*
Bolantlokwe	1.241	0.074	35	1	1	2	0.074	3.7	7.4	13,074	37,354
Sutelong	15.737	0.944	70	1	1	2	0.944	30.0	60.0	106,005	302,872
Makgavetlwane	5.039	0.302	70	1	1	2	0.302	11.0	22.0	38,869	111,053
Klipvoor East 3											*413,925*
Sutelong	15.737	0.944	75	1	1	2	0.944	30.0	60.0	106,005	302,872
Makgavetlwane	5.039	0.302	70	1	1	2	0.302	11.0	22.0	38,869	111,053
Moretele North 1											*302,872*
Slagboom	16.353	0.981	70	1	1	2	0.981	30.0	60.0	106,005	302,872

TABLE A.3-4 SUMMARY OF INTAKE PUMP STATIONS

KLIPVOOR WTW

INTAKE PUMP STATION	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT			FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
				Operation	Stand-by	Total					
Alternative - 1, Level B											***454,308***
	167.540	10.052	20	2	1	3	5.026	30.0	90.0	159,008	454,308
Alternative - 2, Level B											***280,157***
	121.740	7.304	20	2	1	3	3.652	18.5	55.5	98,055	280,157
Alternative - 3, Level B											***83,290***
	22.020	1.321	20	2	1	3	0.661	5.5	16.5	29,151	83,290
Alternative - 1, Level A											***302,872***
	62.828	3.770	20	1	1	2	3.770	30.0	60.0	106,005	302,872

KLIPDRIFT WTW

INTAKE PUMP STATION	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT			FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
				Operation	Stand-by	Total					
Alternatives-2 & 3											***454,308***
Level B	208.333	12.500	20	2	1	3	6.250	30.0	90.0	159,008	454,308

TABLE A.3-4 SUMMARY OF INTAKE PUMP STATIONS

KLIPVOOR WTW

INTAKE PUMP STATION	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
Alternative - 1, Level B											***454,308***
	167.540	10.052	20	2	1	3	5.026	30.0	90.0	159.008	454.308
Alternative - 2, Level B											***280,157***
	121.740	7.304	20	2	1	3	3.652	18.5	55.5	98.055	280.157
Alternative - 3, Level B											***83,290***
	22.020	1.321	20	2	1	3	0.661	5.5	16.5	29.151	83.290
Alternative - 1, Level A											***302,872***
	62.828	3.770	20	1	1	2	3.770	30.0	60.0	106.005	302.872

KLIPDRIFT WTW

INTAKE PUMP STATION	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
Alternatives-2 & 3											***454,308***
Level B	208.333	12.500	20	2	1	3	6.250	30.0	90.0	159,008	454,308

TABLE A.3-5 SUMMARY OF RETICULATION PIPELINES (Level B)

Klipvoor Settlement	Alternative Name	Number of Household	Population	Water Demand AADD (l/day) Level A	Water Demand AADD (l/day) Level B	Area (ha)	Level A Length of Reticulation Pipe (m)	Level B Length of Reticulation Pipe (m)	Level B Proportion of Pipe Diameter (%) 63	75	90	110	125	140	160	200	Tot.	Level B Length of Pipeline for Each Diameter (m) 63	75	90	110	125	140	160	200	Tot.
1 Dipetloana		250	1,700	51,000	136,068	176.0	4,691	10,925	32.76	24.23	16.21	11.99	8.87	5.94			100.0	3,579	2,647	1,771	1,310	969	649	0	0	10,925
2 Makokong		960	6,528	195,840	522,501	283.5	7,461	14,866	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	4,311	3,419	2,527	1,635	1,189	892	595	297	14,866
3 Makgapha		160	1,088	32,640	87,084	102.0	2,784	8,213	37.69	27.88	20.63	13.80					100.0	3,095	2,290	1,694	1,133	0	0	0	0	8,213
4 Mogohlwaneng incl. Olverton		904	6,147	184,416	492,022	270.0	7,113	14,371	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	4,168	3,305	2,443	1,581	1,150	862	575	287	14,371
5 Renostervlei Tloonane		150	1,020	30,600	81,641	137.0	3,686	9,496	37.69	27.88	20.63	13.80					100.0	3,579	2,647	1,959	1,310	0	0	0	0	9,496
6 Selepe	Deputten	96	653	19,584	52,250	91.5	2,513	7,828	37.69	27.88	20.63	13.80					100.0	2,950	2,182	1,615	1,080	0	0	0	0	7,828
7 Ngobi		1,256	8,541	256,224	683,606	703.0	18,272	30,244	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	8,771	6,956	5,141	3,327	2,419	1,815	1,210	605	30,244
8 Swaartboom	Swartboom	535	3,638	109,140	291,186	103.5	2,822	8,268	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	2,398	1,902	1,406	909	661	496	331	165	8,268
9 Transaksie		304	2,067	62,016	165,459	371.5	9,729	18,092	32.76	24.23	16.21	11.99	8.87	5.94			100.0	5,927	4,384	2,933	2,169	1,605	1,075	0	0	18,092
Sub-Total of Moretele North		*4,615*	*31,382*	*941,460*	*2,511,815*	*2,238.0*	*59,070*	*122,303*										*38,778*	*29,733*	*21,489*	*14,456*	*7,994*	*5,789*	*2,710*	*1,355*	*122,303*
10 Ga-Tsogwe	Waterval	160	1,088	32,640	87,084	66.5	1,869	6,911	37.69	27.88	20.63	13.80					100.0	2,605	1,927	1,426	954	0	0	0	0	6,911
11 Fafung	Bultfontein	660	4,488	134,640	359,220	720.5	18,723	30,885	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	8,957	7,104	5,250	3,397	2,471	1,853	1,235	618	30,885
12 Ga-Rasai		160	1,088	32,640	87,084	129.5	3,492	9,221	37.69	27.88	20.63	13.80					100.0	0	371	1,902	1,272	0	0	0	0	3,546
13 Ga-Tsefoge	Tswee	255	1,734	52,020	138,789	74.5	2,075	7,205	32.76	24.23	16.21	11.99	8.87	5.94			100.0	2,360	1,746	1,168	864	639	428	0	0	7,205
14 Kgomo-Kgor	Dinaletsane	154	1,047	31,416	83,818	90.0	2,475	7,773	37.69	27.88	20.63	13.80					100.0	2,930	2,167	1,604	1,073	0	0	0	0	7,773
15 Legonyane		640	4,352	130,560	348,334	455.5	11,893	21,171	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	6,140	4,869	3,599	2,329	1,694	1,270	847	423	21,171
16 Sephai		190	1,292	38,760	103,412	180.5	4,807	11,090	36.04	24.11	17.83	13.19	8.83				100.0	3,997	2,674	1,977	1,463	979	0	0	0	11,090
Sub-Total of Klipvoor West		*2,219*	*15,089*	*452,676*	*1,207,740*	*1,717.0*	*45,334*	*94,257*										*26,988*	*20,857*	*16,927*	*11,352*	*5,783*	*3,551*	*2,082*	*1,041*	*88,581*
17 Bollantlokwe		260	1,768	53,040	141,511	166.5	4,446	10,577	32.76	24.23	16.21	11.99	8.87	5.94			100.0	3,465	2,563	1,715	1,268	938	628	0	0	10,577
18 Dikebu incl. Ranteberg		2,000	13,600	408,000	1,088,544	421.5	11,017	19,925	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	5,778	4,583	3,387	2,192	1,594	1,195	797	398	19,925
19 Lebotlwane North		2,800	19,040	571,200	1,523,962	351.0	9,201	17,340	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	5,029	3,988	2,948	1,907	1,387	1,040	694	347	17,340
20 Little	Lebotlwane South	400	2,720	81,600	217,709	99.5	2,719	8,121	29.43	23.12	17.10	11.44	8.46	6.26	4.19		100.0	2,390	1,878	1,389	929	687	508	340	0	8,121
21 Mokobyane	Mmukubyane	260	1,768	53,040	141,511	312.0	8,195	15,911	32.76	24.23	16.21	11.99	8.87	5.94			100.0	5,212	3,855	2,579	1,908	1,411	945	0	0	15,911
22 Rabosula		96	653	19,584	52,250	154.5	4,137	10,137	37.69	27.88	20.63	13.80					100.0	3,821	2,826	2,091	1,399	0	0	0	0	10,137
23 Suteiong Agricultural		940	6,392	191,760	511,616	354.5	9,291	17,469	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	5,066	4,018	2,970	1,922	1,397	1,048	699	349	17,469
24 Tlholwe	Flink	250	1,700	51,000	136,068	52.5	1,508	6,398	32.76	24.23	16.21	11.99	8.87	5.94			100.0	2,096	1,550	1,037	767	568	380	0	0	6,398
25 Dikgophaneng		75	510	15,300	40,820	123.0	3,325	8,983	44.75	33.10	22.15						100.0	4,020	2,973	1,990	0	0	0	0	0	8,983
26 Makgabetlwane		650	4,420	132,600	353,777	543.0	14,148	24,379	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	7,070	5,607	4,144	2,682	1,950	1,463	975	488	24,379
27 Moiletswane/Buffelsdoorn		772	5,250	157,488	420,178	309.5	8,131	15,819	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	4,588	3,638	2,689	1,740	1,266	949	633	316	15,819
28 Slagboom		350	2,380	71,400	190,495	44.5	1,302	6,105	29.43	23.12	17.10	11.44	8.46	6.26	4.19		100.0	1,797	1,411	1,044	698	516	382	256	0	6,105
29 Shakung		450	3,060	91,800	244,922	507.5	13,234	23,077	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	6,692	5,308	3,923	2,538	1,846	1,385	923	462	23,077
30 Ga-Hadebi		350	2,380	71,400	190,495	82.5	2,281	7,498	29.43	23.12	17.10	11.44	8.46	6.26	4.19		100.0	2,207	1,734	1,282	858	634	469	314	0	7,498
31 Modiane		40	272	8,160	21,771	40.0	1,186	5,940	44.75	33.10	22.15						100.0	2,658	1,966	1,316	0	0	0	0	0	5,940
32 Ga-Moti		8	54	1,632	4,354	20.5	684	5,225	44.75	33.10	22.15						100.0	2,338	1,730	1,157	0	0	0	0	0	5,225
33 Garantlapane		20	136	4,080	10,885	29.5	915	5,555	44.75	33.10	22.15						100.0	2,486	1,839	1,230	0	0	0	0	0	5,555
34 Botshabelo		130	884	26,520	70,755	139.5	3,750	9,587	37.69	27.88	20.63	13.80					100.0	3,614	2,673	1,978	1,323	0	0	0	0	9,587
35 Diponpong		200	1,360	40,800	108,854	137.0	3,686	9,496	36.04	24.11	17.83	13.19	8.83				100.0	3,422	2,289	1,693	1,252	838	0	0	0	9,496
Sub-Total of Klipvoor East		*10,051*	*68,347*	*2,050,404*	*5,470,478*	*3,888.5*	*103,156*	*227,543*										*73,748*	*56,479*	*40,563*	*23,384*	*15,034*	*10,394*	*5,631*	*2,360*	*227,543*
TOTAL		**16,885**	**114,818**	**3,444,540**	**9,190,033**	**7,844**	**207,560**	**444,102**										**139,514**	**107,019**	**78,978**	**49,191**	**28,811**	**19,734**	**10,423**	**4,756**	**438,427**

51	56	66	82	86	108	120	166	
								Average Unit Cost (R/m) : 55.15
Moretele North								
Klipvoor West								
Klipvoor East								

TABLE A.3-5 SUMMARY OF RETICULATION PIPELINES (Level B)

Klipvoor Settlement	Alternative Name	Number of Household	Population	Water Demand AADD (l/day) Level A	Level B	Area (ha)	Level A Length of Reticulation Pipe (m)	Level B Length of Reticulation Pipe (m)	Level B Proportion of Pipe Diameter (%) 63	75	90	110	125	140	160	200	Tot.	Level B Length of Pipeline for Each Diameter (m) 63	75	90	110	125	140	160	200	Tot.
1 Dipetloana		250	1,700	51,000	136,068	176.0	4,691	10,925	32.76	24.23	16.21	11.99	8.87	5.94			100.0	3,579	2,647	1,771	1,310	969	649	0	0	10,925
2 Makekeng		960	6,528	195,840	522,501	283.5	7,461	14,866	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	4,311	3,419	2,527	1,635	1,189	892	595	297	14,866
3 Makgapha		160	1,088	32,640	87,084	102.0	2,784	8,213	37.69	27.88	20.63	13.80					100.0	3,095	2,290	1,694	1,133	0	0	0	0	8,213
4 Mogohlwaneng incl. Olverton		904	6,147	184,416	492,022	270.0	7,113	14,371	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	4,166	3,305	2,443	1,581	1,150	862	575	287	14,371
5 Renostervlei Tloonane		150	1,020	30,600	81,641	137.0	3,686	9,496	37.69	27.88	20.63	13.80					100.0	3,579	2,647	1,959	1,310	0	0	0	0	9,496
6 Selepe	Deputten	96	653	19,584	52,250	91.5	2,513	7,828	37.69	27.88	20.63	13.80					100.0	2,950	2,182	1,615	1,080	0	0	0	0	7,828
7 Ngobi		1,256	8,541	256,224	683,606	703.0	18,272	30,244	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	8,771	6,956	5,161	3,327	2,419	1,815	1,210	605	30,244
8 Swaartboom	Swartboom	535	3,638	109,140	291,186	103.5	2,822	8,268	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	2,398	1,902	1,406	909	661	496	331	165	8,268
9 Transaksie		304	2,067	62,016	165,459	371.5	9,729	18,092	32.76	24.23	16.21	11.99	8.87	5.94			100.0	5,927	4,384	2,933	2,169	1,605	1,075	0	0	18,092
Sub-Total of Moretele North		*4,615*	*31,382*	*941,460*	*2,511,815*	*2,238.0*	*59,070*	*122,303*										*38,778*	*29,733*	*21,489*	*14,456*	*7,994*	*5,789*	*2,710*	*1,355*	*122,303*
10 Ga-Tsogwe	Waterval	160	1,088	32,640	87,084	66.5	1,869	6,911	37.69	27.88	20.63	13.80					100.0	2,605	1,927	1,426	954	0	0	0	0	6,911
11 Fafung	Bultfontein	660	4,488	134,640	359,220	720.5	18,723	30,885	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	8,957	7,104	5,250	3,397	2,471	1,853	1,235	618	30,885
12 Ga-Rasai		160	1,088	32,640	87,084	129.5	3,492	9,221	37.69	27.88	20.63	13.80					100.0	0	371	1,902	1,272	0	0	0	0	3,546
13 Ga-Tsefoge	Tswee	255	1,734	52,020	138,789	74.5	2,075	7,205	32.76	24.23	16.21	11.99	8.87	5.94			100.0	2,360	1,746	1,168	864	639	428	0	0	7,205
14 Kgomo-Kgor	Dinaletsane	154	1,047	31,416	83,818	90.0	2,475	7,773	37.69	27.88	20.63	13.80					100.0	2,930	2,167	1,604	1,073	0	0	0	0	7,773
15 Legonyane		640	4,352	130,560	348,334	455.5	11,893	21,171	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	6,140	4,869	3,599	2,329	1,694	1,270	847	423	21,171
16 Sephai		190	1,292	38,760	103,412	180.5	4,807	11,090	36.04	24.11	17.83	13.19	8.83				100.0	3,997	2,674	1,977	1,463	979	0	0	0	11,090
Sub-Total of Klipvoor West		*2,219*	*15,089*	*452,676*	*1,207,740*	*1,717.0*	*45,334*	*94,257*										*26,988*	*20,857*	*16,927*	*11,352*	*5,783*	*3,551*	*2,082*	*1,041*	*88,581*
17 Bollantlokwe		260	1,768	53,040	141,511	166.5	4,446	10,577	32.76	24.23	16.21	11.99	8.87	5.94			100.0	3,465	2,563	1,715	1,268	938	628	0	0	10,577
18 Dikebu incl. Ranteberg		2,000	13,600	408,000	1,088,544	421.5	11,017	19,925	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	5,778	4,583	3,387	2,192	1,594	1,195	797	398	19,925
19 Lebotlwane North		2,800	19,040	571,200	1,523,962	351.0	9,201	17,340	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	5,029	3,988	2,948	1,907	1,387	1,040	694	347	17,340
20 Little	Lebotlwane South	400	2,720	81,600	217,709	99.5	2,719	8,121	29.43	23.12	17.10	11.44	8.46	6.26	4.19		100.0	2,390	1,878	1,389	929	687	508	340	0	8,121
21 Mokobyane	Mmukubyane	260	1,768	53,040	141,511	312.0	8,195	15,911	32.76	24.23	16.21	11.99	8.87	5.94			100.0	5,212	3,855	2,579	1,908	1,411	945	0	0	15,911
22 Rabosula		96	653	19,584	52,250	154.5	4,137	10,137	37.69	27.88	20.63	13.80					100.0	3,821	2,826	2,091	1,399	0	0	0	0	10,137
23 Sutelong	Agricultural	940	6,392	191,760	511,616	354.5	9,291	17,469	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	5,066	4,018	2,970	1,922	1,397	1,048	699	349	17,469
24 Tlholwe	Rink	250	1,700	51,000	136,068	52.5	1,508	6,398	32.76	24.23	16.21	11.99	8.87	5.94			100.0	2,096	1,550	1,037	767	568	380	0	0	6,398
25 Dikgophaneng		75	510	15,300	40,820	123.0	3,325	8,983	44.75	33.10	22.15						100.0	4,020	2,973	1,990	0	0	0	0	0	8,983
26 Makgabetlwane		650	4,420	132,600	353,777	543.0	14,148	24,379	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	7,070	5,607	4,144	2,682	1,950	1,463	975	488	24,379
27 Moiletswane/Buffelsdoom		772	5,250	157,488	420,178	309.5	8,131	15,819	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	4,588	3,638	2,689	1,740	1,266	949	633	316	15,819
28 Slagboom		350	2,380	71,400	190,495	44.5	1,302	6,105	29.43	23.12	17.10	11.44	8.46	6.26	4.19		100.0	1,797	1,411	1,044	698	516	382	256	0	6,105
29 Shakung		450	3,060	91,800	244,922	507.5	13,234	23,077	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	6,692	5,308	3,923	2,538	1,846	1,365	923	462	23,077
30 Ga-Hadebi		350	2,380	71,400	190,495	82.5	2,281	7,498	29.43	23.12	17.10	11.44	8.46	6.26	4.19		100.0	2,207	1,734	1,282	858	634	469	314	0	7,498
31 Modiane		40	272	8,160	21,771	40.0	1,186	5,940	44.75	33.10	22.15						100.0	2,658	1,966	1,316	0	0	0	0	0	5,940
32 Ga-Moti		8	54	1,632	4,354	20.5	684	5,225	44.75	33.10	22.15						100.0	2,338	1,730	1,157	0	0	0	0	0	5,225
33 Garantlapane		20	136	4,080	10,885	29.5	915	5,555	44.75	33.10	22.15						100.0	2,486	1,839	1,230	0	0	0	0	0	5,555
34 Botshabelo		130	884	26,520	70,755	139.5	3,750	9,587	37.69	27.88	20.63	13.80					100.0	3,614	2,673	1,978	1,323	0	0	0	0	9,587
35 Diponpong		200	1,360	40,800	108,854	137.0	3,686	9,496	36.04	24.11	17.83	13.19	8.83				100.0	3,422	2,289	1,693	1,252	838	0	0	0	9,496
Sub-Total of Klipvoor East		*10,051*	*68,347*	*2,050,404*	*5,470,478*	*3,888.5*	*103,156*	*227,543*										*73,748*	*56,429*	*40,563*	*23,384*	*15,034*	*10,394*	*5,631*	*2,360*	*227,543*
TOTAL		16,885	114,818	3,444,540	9,190,033	7,844	207,560	444,102										139,514	107,019	78,978	49,191	28,811	19,734	10,423	4,756	438,427

51	56	66	82	86	108	120	166	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Average Unit Cost (R/m) : 66.15

Moretele North	1,977,474	1,665,030	1,418,256	1,185,357	687,461	525,184	295,154	224,926	8,109,091
Klipvoor West	1,378,394	1,168,011	1,117,151	930,847	497,324	383,344	249,870	172,827	5,898,967
Klipvoor East	3,761,159	3,160,048	2,677,142	1,917,471	1,292,929	1,122,342	675,671	391,759	14,998,722
								[illegible]

TABLE A.3-6 SUMMARY OF RETICULATION PIPELINES (Level A)

Klipvoor

Settlement	Alternative Name	Number of Household	Population	Water Demand AADD (l/day) Level A	Water Demand AADD (l/day) Level B	Area (ha)	Level A Length of Reticulation Pipe (m)	Level B Length of Reticulation Pipe (m)	Level A Proportion of Pipe Diameter (%) 63	75	90	110	125	140	160	200	Tot.	Level A Length of Pipeline for Each Diameter (m) 63	75	90	110	125	140	160	200	Tot.
1	Dipetloana	250	1,700	51,000	136,068	176.0	4,691	10,925	6.87	31.75	30.59	30.79					100.0	211	976	940	946	969	649	0	0	4,691
2	Makekeng	960	6,528	195,840	522,501	283.5	7,461	14,866	6.29	30.87	32.89	29.95					100.0	282	1,385	1,476	1,344	1,189	892	595	297	7,461
3	Makgapha	160	1,088	32,640	87,084	102.0	2,784	8,213	21.47	31.19	26.86	20.48					100.0	598	868	748	570	0	0	0	0	2,784
4	Mogohlwaneng incl. Olverton	904	6,147	184,416	492,022	270.0	7,113	14,371	6.29	30.87	32.89	29.95					100.0	267	1,309	1,390	1,270	1,150	862	575	287	7,113
5	Renostervlei Tloonane	150	1,020	30,600	81,641	137.0	3,686	9,496	21.47	31.19	26.86	20.48					100.0	791	1,150	990	755	0	0	0	0	3,686
6	Selepe Deputten	96	653	19,584	52,250	91.5	2,513	7,828	21.47	31.19	26.86	20.48					100.0	540	784	675	515	0	0	0	0	2,513
7	Ngobi	1,256	8,541	256,224	683,606	703.0	18,272	30,244	6.29	30.87	32.89	29.95					100.0	769	3,773	4,020	3,661	2,419	1,815	1,210	605	18,272
8	Swaartboom Swartboom	535	3,638	109,140	291,186	103.5	2,822	8,268	6.29	30.87	32.89	29.95					100.0	76	361	385	350	661	496	331	165	2,822
9	Transaksie	304	2,067	62,016	165,459	371.5	9,729	18,092	6.87	31.75	30.59	30.79					100.0	484	2,238	2,156	2,170	1,605	1,075	0	0	9,729
	Sub-Total of Moretele North	***4,615***	***31,382***	***941,460***	***2,511,815***	***2,238.0***	***59,070***	***122,303***										***4,015***	***12,843***	***12,784***	***11,581***	***7,994***	***5,789***	***2,710***	***1,355***	***59,070***
10	Ga-Tsogwe Waterval	160	1,088	32,640	87,084	66.5	1,869	6,911	21.47	31.19	26.86	20.48					100.0	401	583	502	383	0	0	0	0	1,869
11	Fafung Bultfontein	660	4,488	134,640	359,220	720.5	18,723	30,885	6.29	30.87	32.89	29.95					100.0	789	3,873	4,126	3,757	2,471	1,853	1,235	618	18,723
12	Ga-Rasai	160	1,088	32,640	87,084	129.5	3,492	9,221	21.47	31.19	26.86	20.48					100.0					0	0	0	0	
13	Ga-Tsofogo Tswee	255	1,734	52,020	138,789	74.5	2,075	7,205	6.87	31.75	30.59	30.79					100.0	69	320	308	310	639	428	0	0	2,075
14	Kgomo-Kgor Dinaletsane	154	1,047	31,416	83,818	90.0	2,475	7,773	21.47	31.19	26.86	20.48					100.0	531	772	665	507	0	0	0	0	2,475
15	Legonyane	640	4,352	130,560	348,334	455.5	11,893	21,171	6.29	30.87	32.89	29.95					100.0	482	2,364	2,519	2,294	1,694	1,270	847	423	11,893
16	Sephai	190	1,292	38,760	103,412	180.5	4,807	11,090	7.08	29.62	31.54	31.76					100.0	271	1,134	1,207	1,216	979	0	0	0	4,807
	Sub-Total of Klipvoor West	***2,219***	***15,089***	***452,676***	***1,207,740***	***1,717.0***	***45,334***	***94,257***										***2,544***	***9,046***	***9,328***	***8,467***	***5,783***	***3,551***	***2,082***	***1,041***	***41,841***
17	Bollantlokwe	260	1,768	53,040	141,511	166.5	4,446	10,577	6.87	31.75	30.59	30.79					100.0	198	914	881	887	938	628	0	0	4,446
18	Dikebu incl. Ranteberg	2,000	13,600	408,000	1,088,544	421.5	11,017	19,925	6.29	30.87	32.89	29.95					100.0	442	2,171	2,313	2,106	1,594	1,195	797	398	11,017
19	Lebotlwane North	2,800	19,040	571,200	1,523,962	351.0	9,201	17,340	6.29	30.87	32.89	29.95					100.0	361	1,770	1,885	1,717	1,387	1,040	694	347	9,201
20	Little Lebotlwane South	400	2,720	81,600	217,709	99.5	2,719	8,121	6.29	30.87	32.89	29.95					100.0	74	366	390	355	687	508	340	0	2,719
21	Mokobyane Mmukubyane	260	1,768	53,040	141,511	312.0	8,195	15,911	6.87	31.75	30.59	30.79					100.0	401	1,854	1,786	1,798	1,411	945	0	0	8,195
22	Rabosula	96	653	19,584	52,250	154.5	4,137	10,137	21.47	31.19	26.86	20.48					100.0	888	1,290	1,111	847	0	0	0	0	4,137
23	Sutelong Agricultural	940	6,392	191,760	511,616	354.5	9,291	17,469	6.29	30.87	32.89	29.95					100.0	365	1,790	1,907	1,736	1,397	1,048	699	349	9,291
24	Tlholwe Flink	250	1,700	51,000	136,068	52.5	1,508	6,398	6.87	31.75	30.59	30.79					100.0	38	178	171	172	568	380	0	0	1,508
25	Dikgophaneng	75	510	15,300	40,820	123.0	3,325	8,983	31.24	39.06	29.70						100.0	1,039	1,299	988	0	0	0	0	0	3,325
26	Makgabetlwane	650	4,420	132,600	353,777	543.0	14,148	24,379	6.29	30.87	32.89	29.95					100.0	583	2,862	3,050	2,777	1,950	1,463	975	488	14,148
27	Moiletswane/Buffelsdoorn	772	5,250	157,488	420,178	309.5	8,131	15,819	6.29	30.87	32.89	29.95					100.0	312	1,533	1,634	1,488	1,266	949	633	316	8,131
28	Slagboom	350	2,380	71,400	190,495	44.5	1,302	6,105	6.29	30.87	32.89	29.95					100.0	9	46	49	44	516	342	256	0	1,302
29	Shakung	450	3,060	91,800	244,922	507.5	13,234	23,077	6.29	30.87	32.89	29.95					100.0	542	2,660	2,834	2,581	1,846	1,385	923	462	13,234
30	Ga-Hadebi	350	2,380	71,400	190,495	82.5	2,281	7,498	6.29	30.87	32.89	29.95					100.0	54	267	284	259	634	469	314	0	2,281
31	Modiane	40	272	8,160	21,771	40.0	1,186	5,940	31.24	39.06	29.70						100.0	371	463	352	0	0	0	0	0	1,186
32	Ga-Moti	8	54	1,632	4,354	20.5	684	5,225	31.24	39.06	29.70						100.0	214	267	203	0	0	0	0	0	684
33	Garantlapane	20	136	4,080	10,885	29.5	915	5,555	31.24	39.06	29.70						100.0	286	358	272	0	0	0	0	0	915
34	Botshabelo	130	884	26,520	70,755	139.5	3,750	9,587	21.47	31.19	26.86	20.48					100.0	805	1,170	1,007	768	0	0	0	0	3,750
35	Diponpong	200	1,360	40,800	108,854	137.0	3,686	9,496	7.08	29.62	31.54	31.76					100.0	202	843	898	904	838	0	0	0	3,686
	Sub-Total of Klipvoor East	***10,051***	***68,347***	***2,050,404***	***5,470,478***	***3,888.5***	***103,156***	***227,543***										***7,185***	***22,101***	***22,016***	***18,440***	***15,034***	***10,394***	***5,631***	***2,360***	***103,156***
	TOTAL	**16,885**	**114,818**	**3,444,540**	**9,190,033**	**7,844**	**207,560**	**444,102**										**13,744**	**43,990**	**44,127**	**38,488**	**28,811**	**19,734**	**10,423**	**4,756**	**204,068**

51	56	66	82	86	108	120	166	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Average Unit Cost (R/m) : 77.83

Moretele North	204,777	719,235	843,739	949,823	687,484	625,312	325,200	224,930	4,580,201
Klipvoor West	129,729	506,568	615,630	694,256	497,328	383,508	749,840	172,806	3,749,716
Klipvoor East	366,420	1,237,646	1,453,024	1,512,053	1,292,924	1,122,552	675,720	391,780	8,052,139
									16,882,056

TABLE A.3-7 SUMMARY OF STANDPIPES (Level A & Level B)

Klipvoor Settlement	Alternative Name	Number of Household	Calculated Population	Water Demand AADD (l/day) Level A	Water Demand AADD (l/day) Level B	Area (ha)	No. of Standpipes Required Level A	No. of Standpipes Required Level B
1 Dipetloana		250	1,700	51,000	136,068	176.0	11	8
2 Makekeng		960	6,528	195,840	522,501	283.5	15	12
3 Makgapha		160	1,088	32,640	87,084	102.0	7	5
4 Mogohlwaneng incl. Olverton		904	6,147	184,416	492,022	270.0	15	12
5 Renostervlei	Tloonane	150	1,020	30,600	81,641	137.0	9	7
6 Selepe	Deputten	96	653	19,584	52,250	91.5	7	5
7 Ngobi		1,256	8,541	256,224	683,606	703.0	34	26
8 Swaartboom	Swartboom	535	3,638	109,140	291,186	103.5	7	5
9 Transaksie		304	2,067	62,016	165,459	371.5	19	15
Sub-Total of Moretele North		***4,615***	***31,382***	***941,460***	***2,511,815***	***2,238.0***	***124***	***95***
10 Ga-Tsogwe	Waterval	160	1,088	32,640	87,084	66.5	6	5
11 Fafung	Bultfontein	660	4,488	134,640	359,220	720.5	35	27
12 Ga-Rasai		160	1,088	32,640	87,084	129.5	0	0
13 Ga-Tsefoge	Tswee	255	1,734	52,020	138,789	74.5	6	5
14 Kgomo-Kgomo	Dinaletsane	154	1,047	31,416	83,818	90.0	7	5
15 Legonyane		640	4,352	130,560	348,334	455.5	23	18
16 Sephai		190	1,292	38,760	103,412	180.5	11	8
Sub-Total of Klipvoor West		***2,219***	***15,089***	***452,676***	***1,207,740***	***1,717.0***	***88***	***68***
17 Bollantlokwe		260	1,768	53,040	141,511	166.5	10	8
18 Dikebu incl. Ranteberg		2,000	13,600	408,000	1,088,544	421.5	22	17
19 Lebotlwane North		2,800	19,040	571,200	1,523,962	351.0	19	15
20 Little	Lebotlwane South	400	2,720	81,600	217,709	99.5	7	5
21 Mokobyane	Mmukubyane	260	1,768	53,040	141,511	312.0	17	13
22 Rabosula		96	653	19,584	52,250	154.5	10	8
23 Sutelong Agricultural		940	6,392	191,760	511,616	354.5	19	15
24 Tlhohwe	Flink	250	1,700	51,000	136,068	52.5	5	4
25 Dikgophaneng		75	510	15,300	40,820	123.0	8	6
26 Makgabetlwane		650	4,420	132,600	353,777	543.0	27	21
27 Moiletswane/Buffelsdoorn		772	5,250	157,488	420,178	309.5	17	13
28 Slagboom		350	2,380	71,400	190,495	44.5	5	4
29 Shakung		450	3,060	91,800	244,922	507.5	26	20
30 Ga-Hadebi		350	2,380	71,400	190,495	82.5	6	5
31 Modiane		40	272	8,160	21,771	40.0	4	3
32 Ga-Moti		8	54	1,632	4,354	20.5	4	3
33 Garantlapane		20	136	4,080	10,885	29.5	4	3
34 Botshabelo		130	884	26,520	70,755	139.5	9	7
35 Diponpong		200	1,360	40,800	108,854	137.0	9	7
Sub-Total of Klipvoor East		***10,051***	***68,347***	***2,050,404***	***5,470,478***	***3,888.5***	***228***	***177***
TOTAL		16,885	114,818	3,444,540	9,190,033	7,843.5	440	340
Average		482	3,281	98,415	262,572	224	13	10

Cost of Standpipe	Unit Cost	Quantity	Cost
Total			
Level A	1,600	440	704,000
Level B	1,600	340	544,000
Moretele North			
Level A	1,600	124	198,400
Level B	1,600	95	152,000
Klipvoor West			
Level A	1,600	88	140,800
Level B	1,600	68	108,800
Klipvoor East			
Level A	1,600	228	364,800
Level B	1,600	177	283,200

TABLE A.3-8 SUMMARY OF YARD CONNECTIONS (Level B)

Klipvoor Settlement	Alternative Name	Number of Household	Calculated Population	Water Demand AADD (l/day) Level A	Water Demand AADD (l/day) Level B	Area (ha)	No. of Yard Connection (nos)
1 Dipetloana		250	1,700	51,000	136,068	176.0	225
2 Makekeng		960	6,528	195,840	522,501	283.5	864
3 Makgapha		160	1,088	32,640	87,084	102.0	144
4 Mogohlwaneng incl. Olverton		904	6,147	184,416	492,022	270.0	814
5 Renostervlei	Tloonane	150	1,020	30,600	81,641	137.0	135
6 Selepe	Deputten	96	653	19,584	52,250	91.5	86
7 Ngobi		1,256	8,541	256,224	683,606	703.0	1,130
8 Swaartboom	Swartboom	535	3,638	109,140	291,186	103.5	482
9 Transaksie		304	2,067	62,016	165,459	371.5	274
Sub-Total for Moretele North		***4,615***	***31,382***	***941,460***	***2,511,815***	***2,238.0***	***4,154***
10 Ga-Tsogwe	Waterval	160	1,088	32,640	87,084	66.5	144
11 Fafung	Bultfontein	660	4,488	134,640	359,220	720.5	594
12 Ga-Rasai		160	1,088	32,640	87,084	129.5	144
13 Ga-Tsefoge	Tswee	255	1,734	52,020	138,789	74.5	230
14 Kgomo-Kgomo	Dinaletsane	154	1,047	31,416	83,818	90.0	139
15 Legonyane		640	4,352	130,560	348,334	455.5	576
16 Sephai		190	1,292	38,760	103,412	180.5	171
Sub-Total for Klipvoor West		***2,219***	***15,089***	***452,676***	***1,207,740***	***1,717.0***	***1,998***
17 Bollantlokwe		260	1,768	53,040	141,511	166.5	234
18 Dikebu incl. Ranteberg		2,000	13,600	408,000	1,088,544	421.5	1,800
19 Lebotlwane North		2,800	19,040	571,200	1,523,962	351.0	2,520
20 Little	Lebotlwane South	400	2,720	81,600	217,709	99.5	360
21 Mokobyane	Mmukubyane	260	1,768	53,040	141,511	312.0	234
22 Rabosula		96	653	19,584	52,250	154.5	86
23 Sutelong Agricultural		940	6,392	191,760	511,616	354.5	846
24 Tlholwe	Flink	250	1,700	51,000	136,068	52.5	225
25 Dikgophaneng		75	510	15,300	40,820	123.0	68
26 Makgabetlwane		650	4,420	132,600	353,777	543.0	585
27 Moiletswane/Buffelsdoorn		772	5,250	157,488	420,178	309.5	695
28 Slagboom		350	2,380	71,400	190,495	44.5	315
29 Shakung		450	3,060	91,800	244,922	507.5	405
30 Ga-Hadebi		350	2,380	71,400	190,495	82.5	315
31 Modiane		40	272	8,160	21,771	40.0	36
32 Ga-Moti		8	54	1,632	4,354	20.5	7
33 Garantlapane		20	136	4,080	10,885	29.5	18
34 Botshabelo		130	884	26,520	70,755	139.5	117
35 Diponpong		200	1,360	40,800	108,854	137.0	180
Sub-Total for Klipvoor East		***10,051***	***68,347***	***2,050,404***	***5,470,478***	***3,888.5***	***9,046***
TOTAL		**16,885**	**114,818**	**3,444,540**	**9,190,033**	**7,843.5**	**15,198**
Average		482	3,281	98,415	262,572	224	434

Cost of Yard Connection	Quantity	Unit Cost	Cost
Total	**15,198**	**1,050**	**15,957,900**
Moretele North	**4,154**	**1,050**	**4,361,700**
Klipvoor West	**1,998**	**1,050**	**2,097,900**
Klipvoor East	**9,046**	**1,050**	**9,498,300**

TABLE A.4-1 COMPARISON OF ENERGY REQIREMENTS

ITEM	Q (l/sec)	Q (m3/sec)	H (m)	QxH (m4/sec)
Klipvoor, Alternative - 1				
Raw Water				
Klipvoor West		0.168	21.000	3.518
Klipvoor East				0.000
Moretele North				0.000
WTW -> R.R.				
Klipvoor West		0.021	273.297	5.731
Klipvoor East		0.139	177.759	24.636
Moretele North				0.000
Booster Pump				
West 8	1.512	0.002	80.000	0.121
East 6	46.916	0.047	45.000	2.111
East 7	41.964	0.042	75.000	3.147
East 12	13.437	0.013	70.000	0.941
North 1	43.608	0.044	70.000	3.053
Total Energy (QxH)				**43.258**
except raw water				**39.739**
Klipvoor, Alternative - 2				
Raw Water				
Klipvoor West		0.122	21.000	2.557
Klipvoor East				0.000
Moretele North		0.046	21.000	0.962
WTW -> R.R.				
Klipvoor West		0.021	273.297	5.731
Klipvoor East		0.095	201.574	19.143
Moretele North		0.044	300.000	13.086
Booster Pump				
West 8	1.512	0.002	80.000	0.121
East 6	3.308	0.003	35.000	0.116
East 7	41.964	0.042	70.000	2.937
East 12	13.437	0.013	70.000	0.941
				0.000
Total Energy (QxH)				**45.594**
except raw water				**42.075**
Klipvoor, Alternative - 3				
Raw Water				
Klipvoor West		0.022	22.000	0.484
Klipvoor East				0.000
Moretele North		0.146	21.000	3.056
WTW -> R.R.				
Klipvoor West		0.021	273.297	5.731
Klipvoor East				0.000
Moretele North		0.139	300.000	41.577
Booster Pump				
West 8	1.512	0.002	80.000	0.121
				0.000
East 7	41.964	0.042	75.000	3.147
East 12	13.437	0.013	70.000	0.941
				0.000
Total Energy (QxH)				**55.057**
except raw water				**51.517**

A.5 COMPARISON OF COSTS FOR ALTERNATIVE TREATMENT WORKS AND REGIONAL RESERVOIR SITES

As a result of concerns expressed by the Parks Board of North West Province concerning the original proposal to locate the intake, water treatment works and one regional reservoir within the Borakalalo Nature Reserve, two alternative locations have been considered outside the Park to the north.

The three options considered are:

- Siting the treatment works close to the dam (Option 1)
- Locating the treatment works close to the Klipvoor East RR (Option 2)
- Locating the treatment works imeediately ouside the park towards the Klipvoor East RR (Option 3)

For all three cases a comparison of construction and operating costs has been prepared for the Case B Service Level. The costs relate only to the parts of the Feasibility Study scheme which are directly affected by the alternatives. Other costs are as shown in the Final Report.

The results of the analysis are summarised as shown:

Cost	Option 1	Option 2	Option 3
Construction Cost (R)	10,252,396	10,755,065	10,288,858
Annual Energy Cost (R)	293,734	328,914	316,740

It can be seen that the construction costs are similar but operating costs will be higher for the alternatives.

Figure A.5-1 : Option 1
Proposed Infrastructure at Klipvoor Dam

Figure A.5-2 : Option 2
Proposed Infrastructure at Klipvoor Dam

Figure A.5-3 : Option 3
Proposed Infrastructure at Klipvoor Dam

INFRASTRUCTURE SIZING - OPTION 1

Raw Water Pumps (consider Level B demand)

	Level B	
Water demand (AADD) x 1.05	9.65 Mld	(allow 5% for
SPDD (1.5 x AADD) x 1.05	0.168 m^3/s	treatment losses)
Required capacity (duty)	33.5 kW	
Provide 3 units of:	16.8 kW	(2 duty / 1 standby)

Raw Water Main (size for Level B demand)

	Level B	
Water demand (AADD)	9.650 Mld	(allow 5% for
SPDD (1.5 x AADD)x 1.05	0.168 m^3/s	treatment losses)

Weir level on Moretele River 960 m
WL in receiving well 980 m
Assume C = 130

Q (m^3/s)	D (m)	V (m/s)	I (m/m)	L (km)	HL (m)
0.168	0.450	1.054	0.0023	0.1	0.233
0.168	0.400	1.334	0.0041	0.1	0.414
0.168	0.350	1.742	0.0079	0.1	0.792
0.168	0.300	2.371	0.0168	0.1	1.676
0.168	0.250	3.415	0.0407	0.1	4.071
0.168	0.200	5.335	0.1205	0.1	12.055
0.168	0.160	8.336	0.3570	0.1	35.701
0.168	0.150	9.485	0.4887	0.1	48.871
0.168	0.140	10.888	0.6837	0.1	68.366
0.168	0.125	13.658	1.1866	0.1	118.662

Select 400 mm diameter
Pumping Head = 20.414 m

Klipvoor West Clear Water Pumps (consider Level B demand)

	Level B	
Water demand (AADD)	1.21 Mld	(allow 5% for
SPDD (1.5 x AADD)	0.021 m^3/s	treatment losses)
Required capacity (duty)	53.4 kW	
Provide 3 units of:	26.7 kW	(2 duty / 1 standby)

Bulk Supply Line to Klipvoor West Regional Reservoir (size for Level B demand)

Level B water demand (AADD)	1.208 Mld
Level B SPDD (1.5 x AADD)	0.021 m^3/s
Clear Water Tank BWL	970 m
Regional Reservoir TWL	1170 m

Q (m^3/s)	D (m)	V (m/s)	I (m/m)	L (km)	HL (m)
0.021	0.450	0.132	0.0000	7.8	0.389
0.021	0.400	0.167	0.0001	7.8	0.690
0.021	0.350	0.218	0.0002	7.8	1.322
0.021	0.300	0.297	0.0004	7.8	2.799
0.021	0.250	0.427	0.0009	7.8	6.796
0.021	0.200	0.668	0.0026	7.8	20.126
0.021	0.160	1.044	0.0076	7.8	59.603
0.021	0.150	1.187	0.0105	7.8	81.590
0.021	0.140	1.363	0.0146	7.8	114.136
0.021	0.125	1.710	0.0254	7.8	198.105

Select 160 mm diameter
Pumping Head = 259.603 m

Klipvoor East Clear Water Pumps (consider Level B demand)

	Level B	
Water demand (AADD)	7.98 Mld	(allow 5% for
SPDD (1.5 x AADD)	0.139 m^3/s	treatment losses)
Required capacity (duty)	229.9 kW	
Provide 3 units of:	114.9 kW	(2 duty / 1 standby)

Bulk Supply Line to Klipvoor East Regional Reservoir (size for Level B water demand)

Level B water demand (AADD)	7.983 Mld
Level B SPDD (1.5 x AADD)	0.139 m^3/s
Clear Water Tank BWL	970 m
Regional Reservoir TWL	1117 m

Q (m^3/s)	D (m)	V (m/s)	I (m/m)	L (km)	HL (m)
0.139	0.450	0.872	0.0016	7.6	12.477
0.139	0.400	1.103	0.0029	7.6	22.130
0.139	0.350	1.441	0.0056	7.6	42.379
0.139	0.300	1.962	0.0118	7.6	89.718
0.139	0.250	2.825	0.0287	7.6	217.839
0.139	0.200	4.414	0.0849	7.6	645.136
0.139	0.160	6.897	0.2514	7.6	1910.588
0.139	0.150	7.847	0.3441	7.6	2615.416
0.139	0.140	9.008	0.4814	7.6	3658.700
0.139	0.125	11.299	0.8356	7.6	6350.342

Select 400 mm diameter
Pumping Head = 169.130 m

Summary

Raw water main	400 mm	Length	0.1 km	h =	20.414 m
WTW to Klipvoor West RR	160 mm	Length	7.8 km	h =	259.603 m
WTW to Klipvoor East RR	400 mm	Length	7.6 km	h =	169.130 m

	Level A	Level B (additional)
Klipvoor West RR	460 m^3	800 m^3
Klipvoor East RR	3,000 m^3	5,000 m^3

Capital Costs

- Pipework

	Dia	Length	Rate	Cost
160mm steel	160	7,800	170	1,326,000
400mm steel	400	7,700	495	3,811,500

- Pumping Stations

	Pump Rating	No	Installed Capacity	Cost
Raw Water Pumping Station	16.8	3	50.3	253,927
Klipvoor W CWPS	26.7	3	80.1	404,262
Klipvoor E CWPS	114.9	3	344.8	736,707

- Service Reservoirs

		Capacity	Cost	
Service Reservoirs	Level A	460 m^3	300,000	
		3000 m^3	1,200,000	
	Level B	800 m^3	440,000	(additional)
		5000 m^3	1,780,000	(additional)

- Summary

Total	Level B	10,252,396

Energy Requirement - (Level B)

	Flow (m^3/s)	SPDD (Mld)	Head (H) (m)	SPDD x H (Mld.d)	Inst Power (kW) (1)	Power Use (kWh) (2)
Intake PS	0.168	14.474	20.414	295.5	33.536	36.031
WTW to Klipvoor West RR	0.021	1.812	259.603	470.4	53.390	57.3627
WTW to Klipvoor East RR	0.139	11.975	169.130	2025.3	229.866	246.969
Total					316.792	340.363

(1) Maximum flowrate plus 50% standby. 1 kW = Q (Mld) x h

(2) Power used at average rate assuming 0.73 efficiency and 0.85 power factor

	Inst Power (kW)	Duty Only (kW)	Energy Ch. (R/yr) (1)	Demand Ch (R/yr) (2)	Basic Ch (R/yr) (3)	Total Ch (R/yr)
Intake PS	50.304	33.5359	17,450	13,100	1,715	32,265
WTW to Klipvoor West RR	80.086	53.3904	27,781	20,856	1,715	50,352
WTW to Klipvoor East RR	344.799	229.866	119,609	89,791	1,715	211,116
Total						293,734

(1) Energy charge based on 5.94 c/kWh

(2) Demand charge based on R31.25 / kVA/month demand for 500V to 66kV and 0.96 power factor

(3) Basic charge based on R142.93 /month

INFRASTRUCTURE SIZING - OPTION 2

Raw Water Pumps (consider Level B demand)

	Level B	
Water demand (AADD) x 1.5	9.65 Mld	(allow 5% for
SPDD (1.5 x AADD) x 1.05	0.168 m^3/s	treatment losses)
Required capacity (duty)	315.2 kW	
Provide 3 units of:	157.6 kW	(2 duty / 1 standby)

Raw Water Main (size for Level B demand)

Level B water demand (AADD)	9.65 Mld	(allow 5% for
Level B SPDD (1.5 x AADD)x 1.05	0.168 m^3/s	treatment losses)
Weir level on Moretele River	960 m	
WL in receiving well	1120 m	
Assume C =	130	

Q (m^3/s)	D (m)	V (m/s)	I (m/m)	L (km)	HL (m)
0.168	0.450	1.054	0.0023	7.7	17.954
0.168	0.400	1.334	0.0041	7.7	31.845
0.168	0.350	1.742	0.0079	7.7	60.981
0.168	0.300	2.371	0.0168	7.7	129.100
0.168	0.250	3.415	0.0407	7.7	313.459
0.168	0.200	5.336	0.1206	7.7	928.318
0.168	0.160	8.337	0.3570	7.7	2749.238
0.168	0.150	9.485	0.4888	7.7	3763.450
0.168	0.140	10.889	0.6837	7.7	5264.682

Select 400 mm diameter
Pumping Head = 191.845 m

Clear Water Pumps (consider Level B demand)

	Level B	
Water demand (AADD)	9.19 Mld	(allow 5% for
SPDD (1.5 x AADD)	0.160 m^3/s	treatment losses)
Required capacity (duty)	11.5 kW	
Provide 3 units of:	5.8 kW	(2 duty / 1 standby)

Bulk Supply Line to Regional Reservoir (size for Level B water demand)

Level B water demand (AADD)	9.19 Mld
Level B SPDD (1.5 x AADD)	0.160 m^3/s
Clear Water Tank BWL	1110 m
Regional Reservoir TWL	1117 m

Q (m^3/s)	D (m)	V (m/s)	I (m/m)	L (km)	HL (m)
0.160	0.450	1.004	0.0021	0.1	0.213
0.160	0.400	1.270	0.0038	0.1	0.378
0.160	0.350	1.659	0.0072	0.1	0.724
0.160	0.300	2.258	0.0153	0.1	1.532
0.160	0.250	3.252	0.0372	0.1	3.719
0.160	0.200	5.081	0.1101	0.1	11.014
0.160	0.160	7.939	0.3262	0.1	32.620
0.160	0.150	9.033	0.4465	0.1	44.653
0.160	0.140	10.370	0.6247	0.1	62.465
0.160	0.125	13.008	1.0842	0.1	108.420

Select 400 mm diameter
Pumping Head = 7.378 m

Bulk Supply Line to Klipvoor West (size for Level B water demand)

Level B water demand (AADD)	1.208 Mld
Level B SPDD (1.5 x AADD)	0.021 m^3/s
Clear Water Tank BWL	1110 m
GL at foot of Mogosane Hills	1010 m
Regional Reservoir BWL	1170 m

Q (m^3/s)	D (m)	V (m/s)	I (m/m)	L (km)	HL (m)
0.021	0.450	0.132	0.0000	10.4	0.519
0.021	0.400	0.167	0.0001	10.4	0.921
0.021	0.350	0.218	0.0002	10.4	1.763
0.021	0.300	0.297	0.0004	10.4	3.732
0.021	0.250	0.427	0.0009	10.4	9.061
0.021	0.200	0.668	0.0026	10.4	26.834
0.021	0.160	1.044	0.0076	10.4	79.470
0.021	0.150	1.187	0.0105	10.4	108.787
0.021	0.140	1.363	0.0146	10.4	152.182
0.021	0.125	1.710	0.0254	10.4	264.140

Select 160 mm diameter
Residual Head = 1030.530 m
Required Head = 1170.000 m
Booster Pumping required = 139.470 m

Klipvoor West Booster Pumping Station (consider Level B demand)

	Level B	
Water demand (AADD)	1.21 Mld	(allow 5% for
SPDD (1.5 x AADD)	0.021 m^3/s	treatment losses)
Required capacity (duty)	28.7 kW	
Provide 3 units of:	14.3 kW	(2 duty / 1 standby)

Summary

Raw water main	400 mm	Length	7.7 km	h =	191.845 m
WTW to Klipvoor RR	400 mm	Length	0.1 km	h =	7.378 m
RR to Klipvoor West	160 mm	Length	10.4 km	h =	139.470 m

	Level A	Level B (additional)
RR	3500 m^3	5800 m^3

Capital Costs

- Pipework

	Dia	Length	Rate	Cost
160mm steel	160	10,400	170	1,768,000
400mm steel	400	7,800	495	3,861,000

- Pumping Stations

	Pump Rating	No	Installed Capacity	Cost
Raw Water Pumping Station	157.6	3	472.8	846,474
Clear Water Pumping Station	5.8	3	17.3	87,404
Klipvoor West BPS	14.3	3	43.0	217,187

- Service Reservoirs

		Capacity	Cost	
Service Reservoirs	Level A	3500 m^3	1,360,000	
	Level B	5800 m^3	2,000,000	(additional)
	Downstream SR Capacity (adjustment)		615,000	(additional)

- Summary

Total	Level B	10,755,065

Energy Requirement - (Level B)

	Flow (m^3/s)	SPDD (Mld)	Head (H) (m)	SPDD x H (Mld.d)	Inst Power (kW) (1)	Power Use (kW/h) (2)
Intake PS	0.168	14.475	191.845	2,777.0	315.184	338.634
WTW to RR	0.160	13.785	7.378	101.7	11.543	12.4022
Klipvoor West BPS	0.021	1.812	139.470	252.7	28.684	30.8178
Total					355.411	381.854

(1) Maximum flowrate plus 50% standby. 1 kW = Q (Mld) x h

(2) Power used at average rate assuming 0.73 efficiency and 0.85 power factor

	Inst Power (kW)	Duty Only (kW)	Energy Ch. (R/yr) (1)	Demand Ch (R/yr) (2)	Basic Ch (R/yr) (3)	Total Ch (R/yr)
Intake PS	472.776	315.184	164,004	123,119	1,715	288,838
WTW to Klipvoor West RR	17.315	11.5433	6,007	4,509	1,715	12,231
WTW to Klipvoor East RR	43.026	28.6837	14,925	11,205	1,715	27,845
Total						328,914

(1) Energy charge based on 5.94 c/kWh

(2) Demand charge based on R31.25 / kVA/month demand for 500V to 66kV and 0.96 power factor

(3) Basic charge based on R142.93 /month

INFRASTRUCTURE SIZING - OPTION 3

Raw Water Pumps (consider Level B demand)

	Level B	
Water demand (AADD) x 1.5	9.65 Mld	(allow 5% for
SPDD (1.5 x AADD) x 1.05	0.168 m^3/s	treatment losses)
Required capacity (duty)	176.4 kW	
Provide 3 units of:	88.2 kW	(2 duty / 1 standby)

Raw Water Main (size for Level B demand)

Level B water demand (AADD)	9.65 Mld	(allow 5% for
Level B SPDD (1.5 x AADD)x 1.05	0.168 m^3/s	treatment losses)
Weir level on Moretele River	960 m	
WL in receiving well	1050 m	
Assume C =	130	

Q (m^3/s)	D (m)	V (m/s)	I (m/m)	L (km)	HL (m)
0.168	0.450	1.054	0.0023	4.2	9.793
0.168	0.400	1.334	0.0041	4.2	17.370
0.168	0.350	1.742	0.0079	4.2	33.262
0.168	0.300	2.371	0.0168	4.2	70.418
0.168	0.250	3.415	0.0407	4.2	170.978
0.168	0.200	5.336	0.1206	4.2	506.355
0.168	0.160	8.337	0.3570	4.2	1499.584
0.168	0.150	9.485	0.4888	4.2	2052.791
0.168	0.140	10.889	0.6837	4.2	2871.645

Select 400 mm diameter
Pumping Head = 107.370 m

Klipvoor West Clear Water Pumps (consider Level B demand)

	Level B	
Water demand (AADD)	1.21 Mld	(allow 5% for
SPDD (1.5 x AADD)	0.021 m^3/s	treatment losses)
Required capacity (duty)	47.2 kW	
Provide 3 units of:	23.6 kW	(2 duty / 1 standby)

Bulk Supply Line to Klipvoor West Regional Reservoir (size for Level B demand)

Level B water demand (AADD)	1.208 Mld
Level B SPDD (1.5 x AADD)	0.021 m^3/s
Clear Water Tank BWL	1040 m
Residual head required	1170 m

Q (m^3/s)	D (m)	V (m/s)	I (m/m)	L (km)	HL (m)
0.021	0.450	0.132	0.0000	6.8	0.339
0.021	0.400	0.167	0.0001	6.8	0.602
0.021	0.350	0.218	0.0002	6.8	1.153
0.021	0.300	0.297	0.0004	6.8	2.440
0.021	0.250	0.427	0.0009	6.8	5.924
0.021	0.200	0.668	0.0026	6.8	17.545
0.021	0.160	1.044	0.0076	6.8	51.961
0.021	0.150	1.187	0.0105	6.8	71.130
0.021	0.140	1.363	0.0146	6.8	99.504
0.021	0.125	1.710	0.0254	6.8	172.707

Select 140 mm diameter
Pumping Head = 229.504 m

Klipvoor East Clear Water Pumps (consider Level B demand)

	Level B	
Water demand (AADD)	7.98 Mld	
SPDD (1.5 x AADD)	0.139 m^3/s	
Required capacity (duty)	118.4 kW	
Provide 3 units of:	59.2 kW	(2 duty / 1 standby)

Bulk Supply Line to Klipvoor East Regional Reservoir (size for Level B water demand)

Level B water demand (AADD)	7.98 Mld
Level B SPDD (1.5 x AADD)	0.139 m^3/s
Clear Water Tank BWL	1040 m
Regional Reservoir BWL	1117 m

Q (m^3/s)	D (m)	V (m/s)	I (m/m)	L (km)	HL (m)
0.139	0.450	0.872	0.0016	3.5	5.742
0.139	0.400	1.103	0.0029	3.5	10.185
0.139	0.350	1.441	0.0056	3.5	19.503
0.139	0.300	1.961	0.0118	3.5	41.289
0.139	0.250	2.824	0.0286	3.5	100.251
0.139	0.200	4.412	0.0848	3.5	296.896
0.139	0.160	6.894	0.2512	3.5	879.264
0.139	0.150	7.844	0.3439	3.5	1203.631
0.139	0.140	9.004	0.4811	3.5	1683.757
0.139	0.125	11.295	0.8350	3.5	2922.467

Select 400 mm diameter
Pumping Head = 87.185 m

Summary

Raw water main	400 mm	Length	4.2 km	h =	107.370 m
WTW to Klipvoor West RR	140 mm	Length	6.8 km	h =	229.504 m
WTW to Klipvoor East RR	400 mm	Length	3.5 km	h =	87.185 m

	Level A	Level B (additional)
Klipvoor West RR	460 m^3	800 m^3
Klipvoor East RR	3,000 m^3	5,000 m^3

Capital Costs

- Pipework

	Dia	Length	Rate	Cost
140mm steel	140	6,800	143	972,400
400mm steel	400	7,700	495	3,811,500

- Pumping Stations

	Pump Rating	No	Installed Capacity	Cost
Raw Water Pumping Station	88.2	3	264.6	655,698
Klipvoor W CWPS	23.6	3	70.8	357,391
Klipvoor E CWPS	59.2	3	177.7	896,869

- Service Reservoirs

		Capacity	Cost	
Service Reservoirs	Level A	3000 m^3	1,200,000	
	Level B	5000 m^3	1,780,000	(additional)
	Downstream SR Capacity (adjustment)		615,000	(additional)

- Summary

Total	Level B	10,288,858

Energy Requirement - (Level B)

	Flow (m^3/s)	SPDD (Mld)	Head (H) (m)	SPDD x H (Mld.d)	Inst Power (kW) (1)	Power Use (kW/h) (2)
Intake PS	0.168	14.475	107.370	1,554.2	176.399	189.524
WTW to Klipvoor West RR	0.021	1.812	229.504	415.9	47.200	50.712
WTW to Klipvoor East RR	0.139	11.970	87.185	1,043.6	118.449	127.261
Total					342.048	367.497

(1) Maximum flowrate plus 50% standby. 1 kW = Q (Mld) x h

(2) Power used at average rate assuming 0.73 efficiency and 0.85 power factor

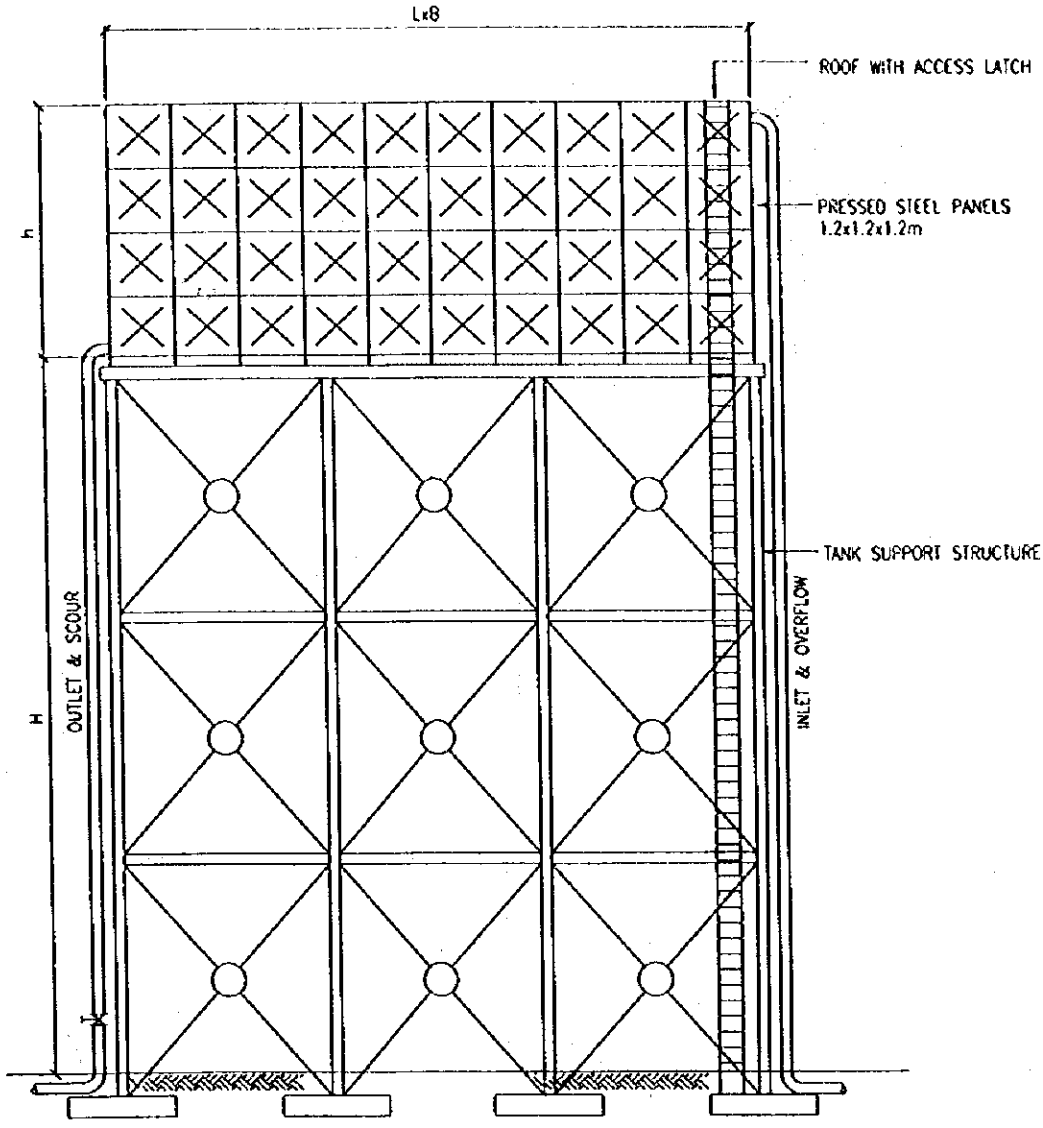
	Inst Power (kW)	Duty Only (kW)	Energy Ch. (R/yr) (1)	Demand Ch (R/yr) (2)	Basic Ch (R/yr) (3)	Total Ch (R/yr)
Intake PS	264.599	176.399	91,788	68,906	1,715	162,409
WTW to Klipvoor West RR	70.800	47.2002	24,560	18,438	1,715	44,713
WTW to Klipvoor East RR	177.673	118.449	61,634	46,269	1,715	109,618
Total						316,740

(1) Energy charge based on 5.94 c/kWh

(2) Demand charge based on R31.25 / kVA/month demand for 500V to 66kV and 0.96 power factor

(3) Basic charge based on R142.93 /month

FIGURE A.6-1
REGIONAL RESERVOIR



SIZE RANGE LxBxhxH(m)	CAPACITY Kl
2,4x2,4x1,2x3,0 TO 12,2x12,2x4,8x25	6,9 650

FIGURE A.6-2
SERVICE RESERVOIR

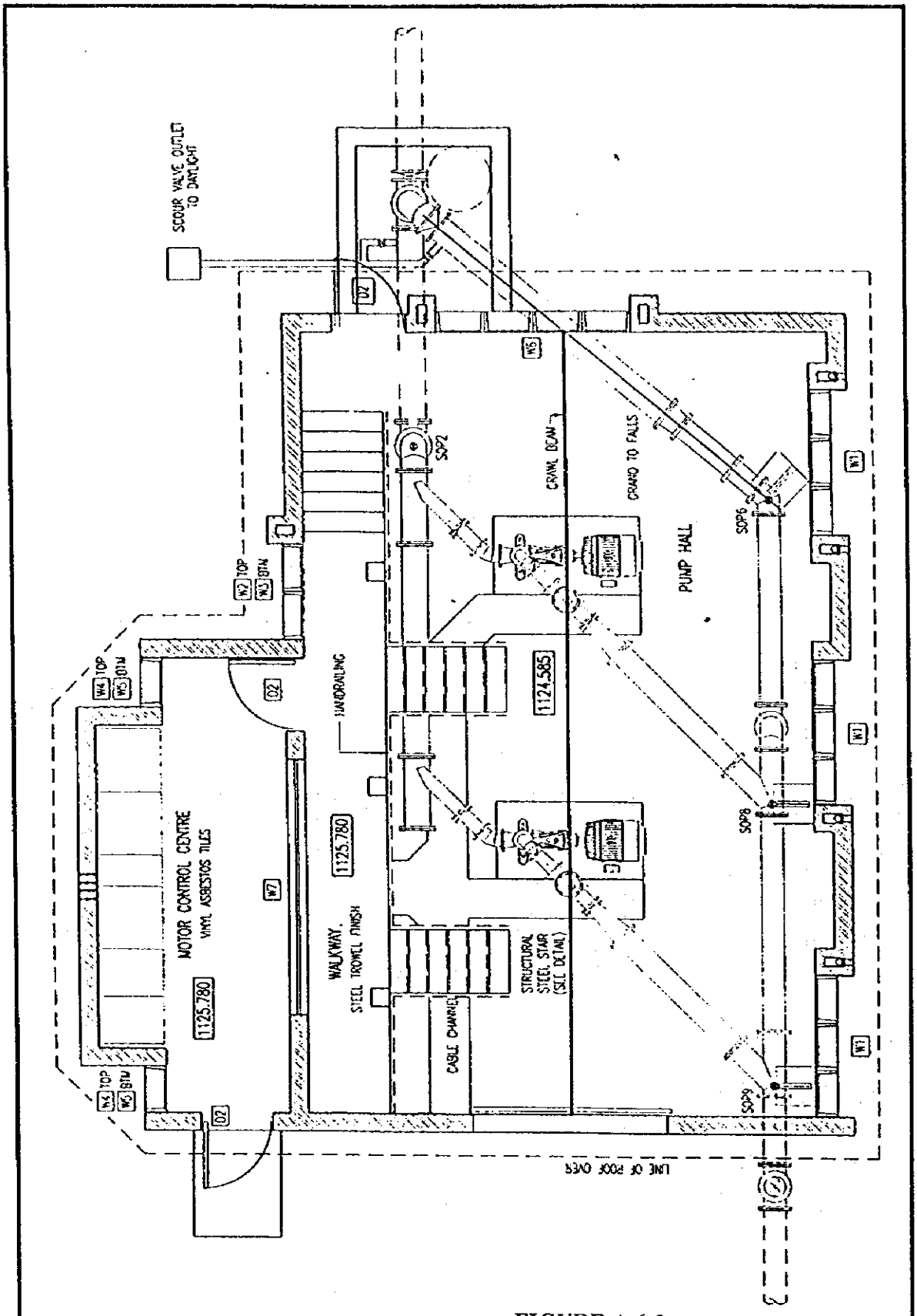


FIGURE A.6-3
PUMP STATION

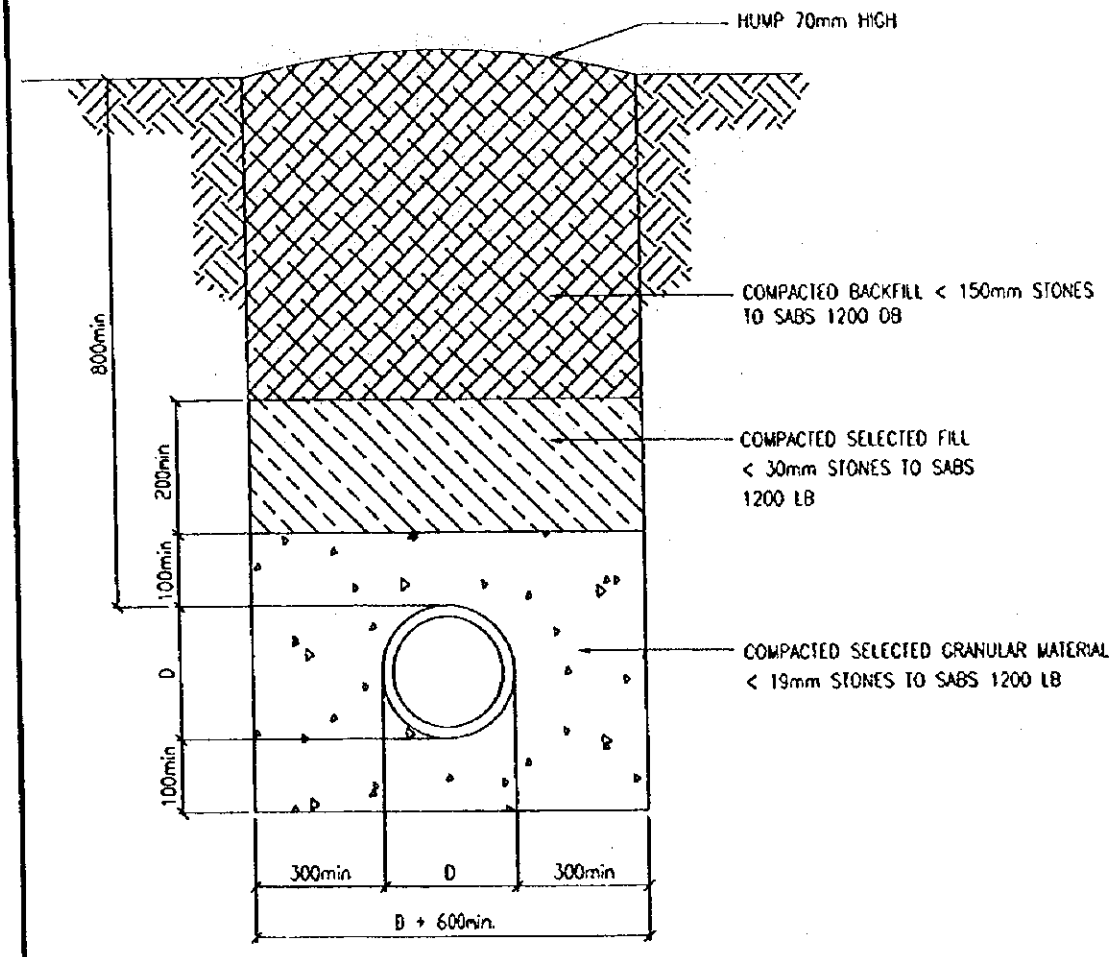
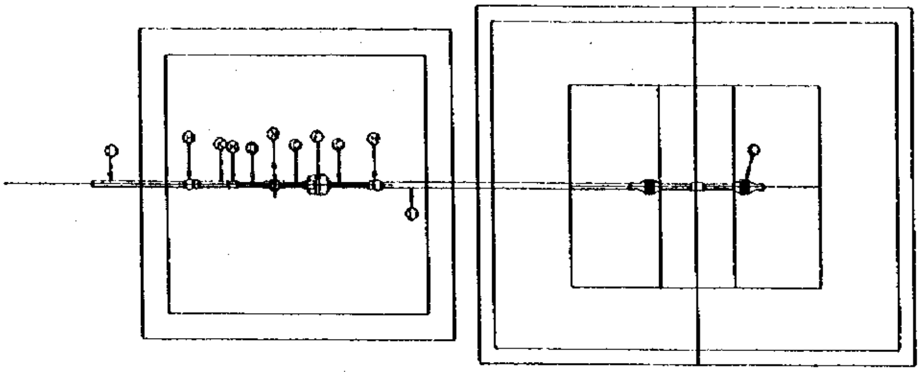
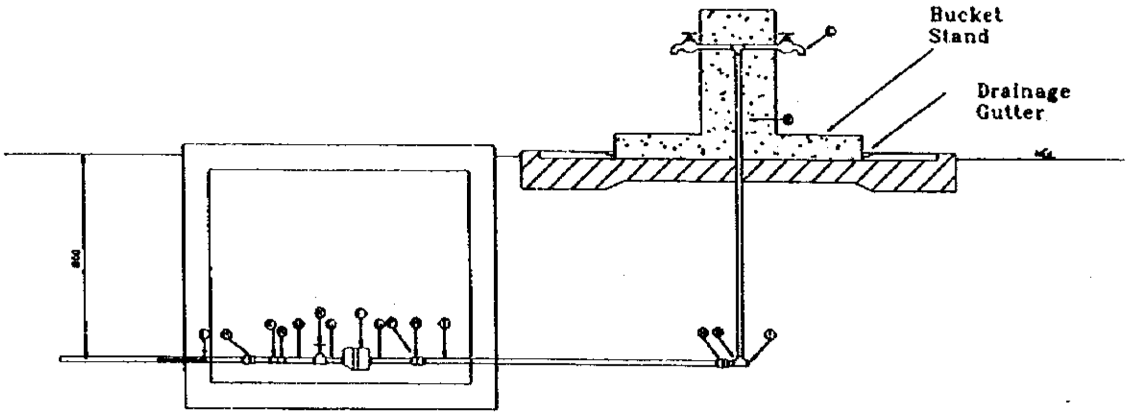


FIGURE A.6-4
PIPE TRENCH



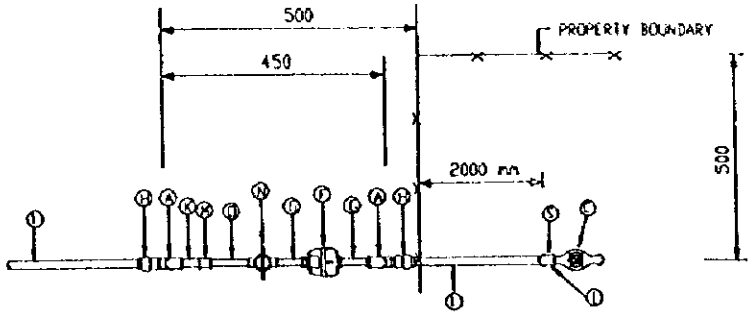
PLAN



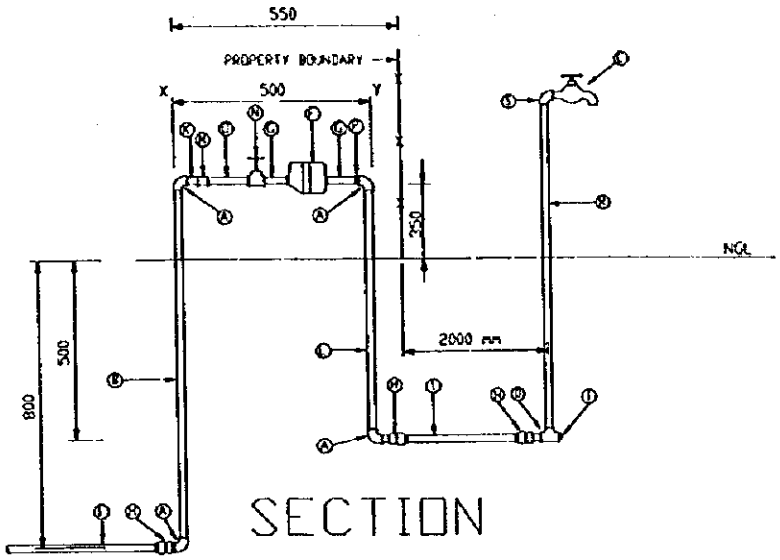
SECTION

	SINGLE ENF CONN (mm) SIZE	QTY	DESCRIPTION
A	20		90 DEG MALLEABLE CAST IRON (MCI) FEMALE ENDED ELBOW
B	20		GMS PIPE PIECE - L=1085mm
C	15		15mm ROUGH BRASS HOSE BIB TAP WITH 20mm OUTLET
D	20x15		MCI T-PIECE
F	15		KENT PSM SIZE 3 WATER METER
R	15		GMS PIPE PIECE - L=1000mm
H	20x3/4"		PLASSON MALE COMPRESSION ADAPTOR
I	20		20 mm MALLEABLE CAST IRON PLUG
J	20		HDPE PIPE, FITTINGS NOT INCLUDED (LENGTH TO BE DETERMINED ON SITE)
L	20		GMS PIPE PIECE - L=705mm
K	20		GMS PIPE PIECE L=50mm
M	20x15		GMS REDUCING SOCKET
N	15		15mm BOSSON BALL VALVE
O	15		GMS PIPE PIECE - LENGTH TO BE SUCH THAT DIMENSION XY= 500mm
P	15x20		GMS REDUCING BUSH
G	15		GMS 40mm TAILPIECE WITH UNION NUT
S	15		90 DEG MALLEABLE CAST IRON (MCI) FEMALE ENDED ELBOW

FIGURE A.6-5
STANDPIPE



PLAN



SECTION

	SINGLE ERF CONN (mm) SIZE	QTY	DESCRIPTION
A	20		90 DEG MALLEABLE CAST IRON (MCI) FEMALE ENDED ELBOW
B	20		GMS PIPE PIECE - L=1085mm
C	15		15mm ROUGH BRASS HOSE BIB TAP WITH 20mm OUTLET
D	20x15		MCI T-PIECE
F	15		KENT PSM SIZE 3 WATER METER
R	15		GMS PIPE PIECE - L=1000mm
H	20x3/4"		PLASSON MALE COMPRESSION ADAPTOR
I	20		20 mm MALLEABLE CAST IRON PLUG
J	20		HDPE PIPE, FITTINGS NOT INCLUDED (LENGTH TO BE DETERMINED ON SITE)
L	20		GMS PIPE PIECE - L=785mm
K	20		GMS PIPE PIECE L=50mm
M	20x15		GMS REDUCING SOCKET
N	15		15mm BOSSINI BALL VALVE
O	15		GMS PIPE PIECE - LENGTH TO BE SUCH THAT DIMENSION XY= 500mm
P	15x20		GMS REDUCING BUSH
G	15		GMS 40mm TAILPIECE WITH UNION NUT
S	15		90 DEG MALLEABLE CAST IRON (MCI) FEMALE ENDED ELBOW

FIGURE A.6-6
YARD CONNECTION