It is clear from the new quality tests listed in the table above that only Askham, Philandersbron and Rietfontein have water rated as Class II and higher.

Results from the DWAF funded Mier Municipality Drinking Water System Risk Assessment completed in October 2008 are as follows: The full report is attached in **Annexure C**:

Noenieput

Risk/health check score	-4.00	High Risk	Total Health Check Risk Levels
Individual Risks (Scores from -2 to +2)			
Source (Raw water)	-0.30	WARNING	8 to 14 Low Risk
Treatment	-1.00	WARNING	1 to 7 Medium Risk
Storage (Reservoirs)	-0.40	WARNING	-6 to 0 High Risk
Distribution Network	-0.60	WARNING	-14 to -7 Impossible
Households/Standpipes	-0.10	WARNING	
Laboratory	-1.00	WARNING	
Drinking-Water Quality	-0.60	WARNING	

Philandersbron

Risk/health check score	-0.70	High Risk	Total Health Check Risk Levels
Individual Risks (Scores from -2 to +2)			
Source (Raw water)	0.50		8 to 14 Low Risk
Treatment	-1.00	WARNING	1 to 7 Medium Risk
Storage (Reservoirs)	0.40		-6 to 0 High Risk
Distribution Network	0.00		-14 to -7 Impossible
Households/Standpipes	1.00		
Laboratory	-1.00	WARNING	
Drinking-Water Quality	-0.60	WARNING	

Rietfontein

Risk/health check score	0.20	Medium Risk	Total Health Check Risk Levels
Individual Risks (Scores from -2 to +2)			
Source (Raw water)	0.60		8 to 14 Low Risk
Treatment	-1.00	WARNING	1 to 7 Medium Risk
Storage (Reservoirs)	0.60		-6 to 0 High Risk
Distribution Network	0.60		-14 to -7 Impossible
Households/Standpipes	1.00		
Laboratory	-1.00	WARNING	
Drinking-Water Quality	-0.60	WARNING	

Loubos

Risk/health check score	-1.20	High Risk	Total Health Check Risk Levels
Individual Risks (Scores from -2 to +2)			
Source (Raw water)	0.20		8 to 14 Low Risk
Treatment	-1.00	WARNING	1 to 7 Medium Risk
Storage (Reservoirs)	0.20		-6 to 0 High Risk
Distribution Network	0.10		-14 to -7 Impossible
Households/Standpipes	0.90		
Laboratory	-1.00	WARNING	
Drinking-Water Quality	-0.60	WARNING	

Andriesvale

Risk/health check score	-4.10	High Risk	Total Health Check Risk Levels
Individual Risks (Scores from -2 to +2)			
Source (Raw water)	-0.50	WARNING	8 to 14 Low Risk
Treatment	-1.00	WARNING	1 to 7 Medium Risk
Storage (Reservoirs)	-0.90	WARNING	-6 to 0 High Risk
Distribution Network	-0.30	WARNING	-14 to -7 Impossible
Households/Standpipes	0.20		
Laboratory	-1.00	WARNING	
Drinking-Water Quality	-0.60	WARNING	

Askham

Risk/health check score	-0.80	High Risk	Total Health Check Risk Levels
Individual Risks (Scores from -2 to +2)			
Source (Raw water)	0.50		8 to 14 Low Risk
Treatment	-1.00	WARNING	1 to 7 Medium Risk
Storage (Reservoirs)	0.60		-6 to 0 High Risk
Distribution Network	-0.10	WARNING	-14 to -7 Impossible
Households/Standpipes	0.80		
Laboratory	-1.00	WARNING	
Drinking-Water Quality	-0.60	WARNING	

Groot & Klein Mier

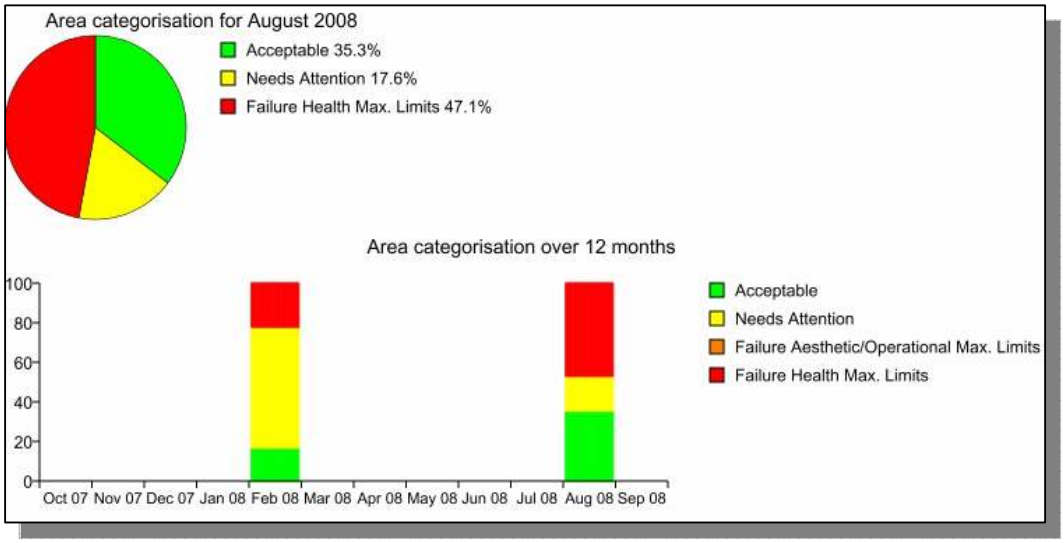
Risk/health check score	-0.70	High Risk	Total Health Check Risk Levels
Individual Risks (Scores from -2 to +2)			
Source (Raw water)	0.60		8 to 14 Low Risk
Treatment	-1.00	WARNING	1 to 7 Medium Risk
Storage (Reservoirs)	0.60		-6 to 0 High Risk
Distribution Network	-0.10	WARNING	-14 to -7 Impossible
Households/Standpipes	0.80		
Laboratory	-1.00	WARNING	
Drinking-Water Quality	-0.60	WARNING	

Welkom

Risk/health check score	-0.50	High Risk	Total Health Check Risk Levels
Individual Risks (Scores from -2 to +2)			
Source (Raw water)	0.50		8 to 14 Low Risk
Treatment	-1.00	WARNING	1 to 7 Medium Risk
Storage (Reservoirs)	0.50		-6 to 0 High Risk
Distribution Network	0.30		-14 to -7 Impossible
Households/Standpipes	0.80		
Laboratory	-1.00	WARNING	
Drinking-Water Quality	-0.60	WARNING	

It is clear from this assessment the quality of water is one of the contributing factors to the risk involved.

The graph below summarized the water quality situation.



5.4.3 Water quantity

Data on boreholes supplying water to the Mier towns are scruffy which makes this exercise very difficult. Water meters attached to the boreholes do not work or there are no by bass to make volumetrically measurements of the flow. Data from a survey done by SRK Consulting Engineers on boreholes in the Mier municipal area were used to compile the table below:

TOWN	NUMBER OF BOREHOLES	NUMBER OF OPERATIONAL BOREHOLES	NO. OF HOUSEHOLDS	NEW HOUSEHOLDS	INSTITUTIONS	DELIVERY IN kl/day	BOREHOLE DELIVERY ABILITY	PUMPS	WATER QUALITY
Askham	2	1	160	**100**	6	112	✓	2	Average
Groot Mier	11	2	100	**178**	3	70	×	2	Poor

Klein Mier	4	3	128	-	3	130	✓	3	Poor
Loubos	3	2	213	**138**	14	149	✓	2	
Philandersbron	6		208	-	7	146	×	5	Good
Rietfontein	2		484	**107**	16	339	✓	2	Good
Welkom	1	3	130	**103**	3	91	×	2	Good
TOTAL	29	11	1423	**626**	52	1037		18	

5.5 UNDERGROUND WATER : HUMAN SETTLEMENTS IN BOTSWANA

5.5.1 Current water supply systems to towns

Little information is available on the water supply systems in Botswana. The Struis-se-dam, Boksputs and Middleputs areas are 100% dependable on ground water from boreholes in their vicinity.

5.5.2 Water quality

According to the Botswana authorities the water quality is not suitable for long term human consumption.

5.5.3 Water quantity

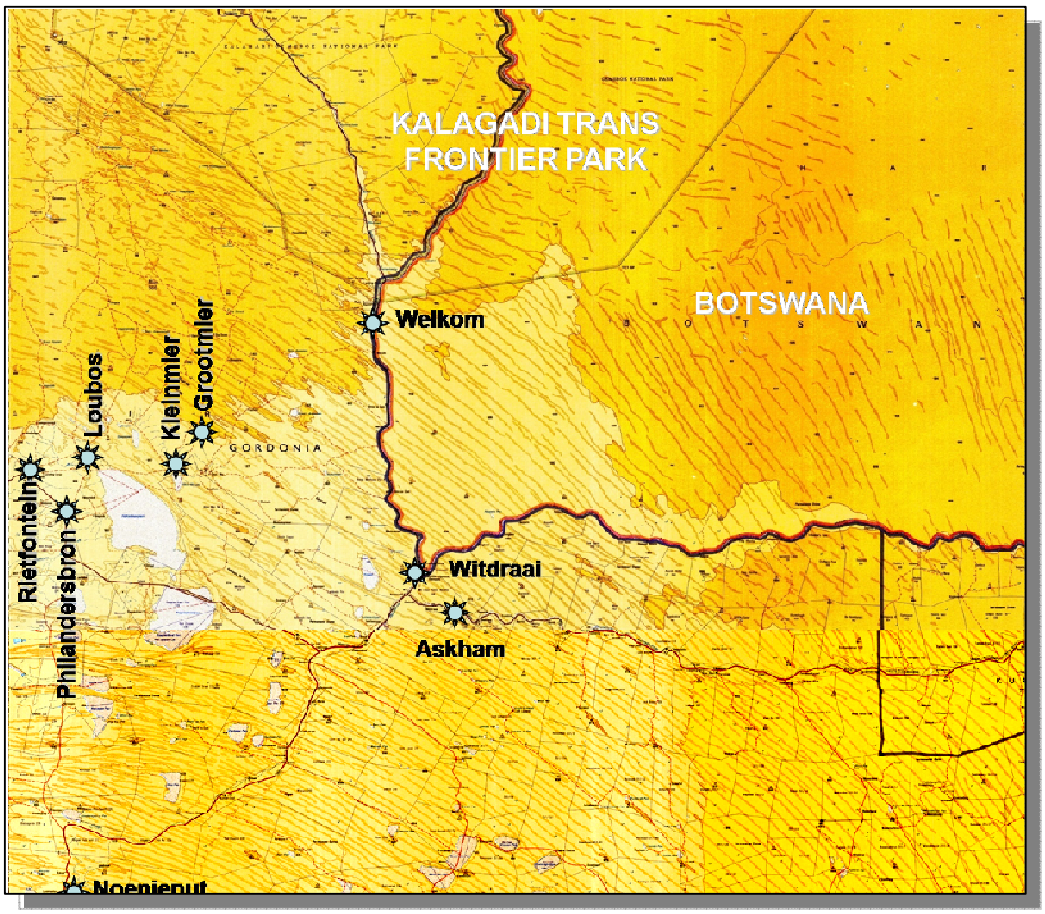
Southern Botswana towns struggle with water quantity.

6 USER PROFILE IN TARGET AREA

6.1 HUMAN SETTLEMENTS IN MIER MUNICIPAL AREA

6.1.1 Demographics

The map below (**MAP 14)** shows the towns that forms part of the Mier Municipal area.



MAP 14 – Towns in Mier Municipal area

6.1.2 Water demand

The water demand of towns in the Mier area is listed in the table below:

	GROWTH RATE	10%	360			
Village	**Total houses**	**Growth**	**Houses Qavg (l/s)**	**Summer PF**	**Q peak (l/s)**	**Q TOTAL**
Rietfontein	484	532	2.218	1.5	3.33	**3.56**
Loubos	213	234	0.976	1.5	1.46	**1.50**
Philandersbron	208	229	0.953	1.5	1.43	**1.49**
Klein Mier	128	141	0.587	1.5	0.88	**0.91**
Groot Mier	100	110	0.458	1.5	0.69	**0.72**
Askham	160	176	0.733	1.5	1.10	**1.21**
Noenieput	30	33	0.138	1.5	0.21	**0.22**
Andriesvale	SASI		0.000		-	**-**
Welkom	130	143	0.596	1.5	0.89	**0.93**
	GROWTH RATE	10%	200		**9.99**	**10.55**

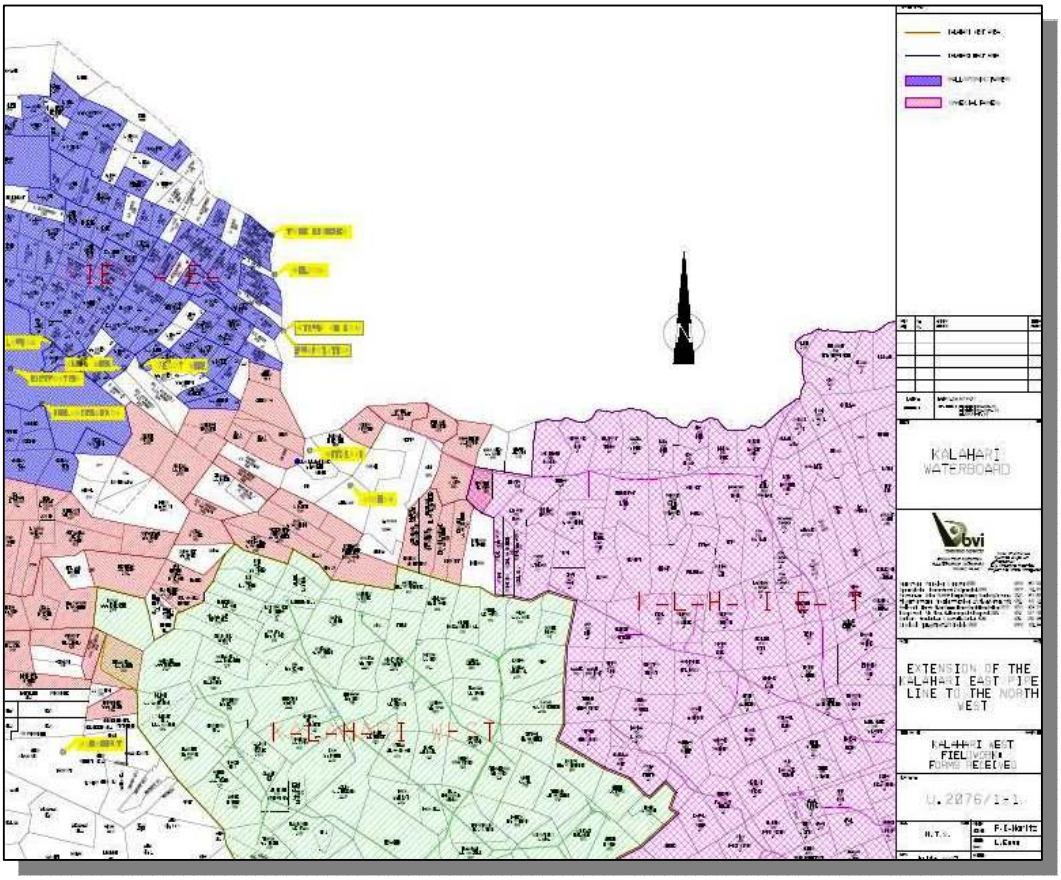
Village	**Businesses**	**Growth**	**Besiness Qavr (l/s)**	**Summer PF**	**Q peak (l/s)**
Rietfontein	14	15	0.036	1.5	0.05
Loubos	3	3	0.008	1.5	0.01
Philandersbron	5	6	0.013	1.5	0.02
Klein Mier	3	3	0.008	1.5	0.01
Groot Mier	6	7	0.015	1.5	0.02
Askham	10	11	0.026	1.5	0.04
Noenieput	4	4	0.010	1.5	0.02
Andriesvale	5		0.000		-
Welkom	4	4	0.010	1.5	0.02
	GROWTH RATE	10%	10		0.19

Village	**School**	**Growth**	**Schools Q avr**	**Summer PF**	**Qpeak (l/s)**
Rietfontein	964	1060	0.123	1.5	0.18
Loubos	137	151	0.017	1.5	0.03
Philandersbron	212	233	0.027	1.5	0.04
Klein Mier	3	81	0.009	1.5	0.01
Groot Mier	6	73	0.008	1.5	0.01
Askham	10	425	0.049	1.5	0.07
Noenieput	4	0	0.000	1.5	-
Andriesvale	5	0	0.000		-
Welkom	4	135	0.016	1.5	0.02
					0.37

6.2 AGRICULTURE

6.2.1 Small farms in Mier area

The blue colored area on the map below **(MAP 16)** shows the area where the small farms are situated in the Mier area.

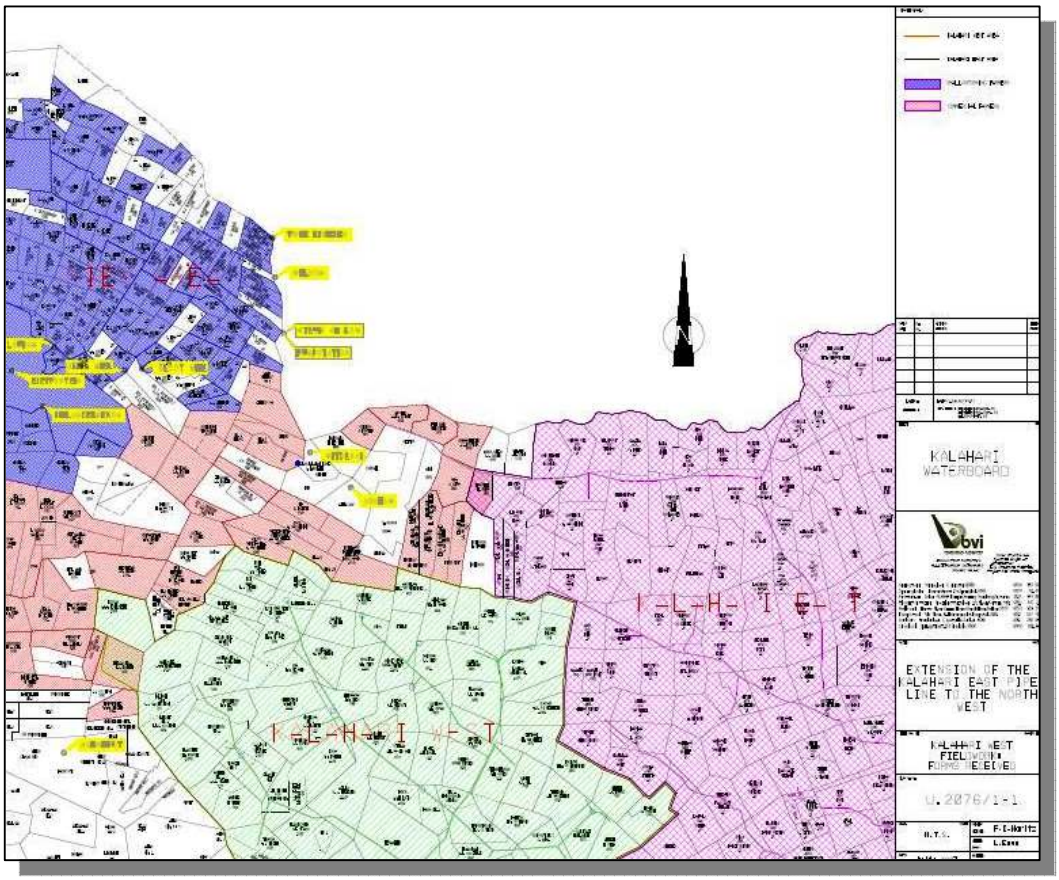


MAP 16 – Small farms in Mier area

SMALL FARMS	AREA (HECTARES)	FLOW RATE (l/s)
MA LINE	110057	3.31
MB LINE	92532	2.78
MC LINE	83282	2.51
MD LINE	54707	1.65
ME LINE	0	0.00
TOTAL	340578	10.24

6.2.2 Commercial farms

The pink colored area on the map below (**MAP 17)** shows the area where the commercial farms are situated in the Mier area.



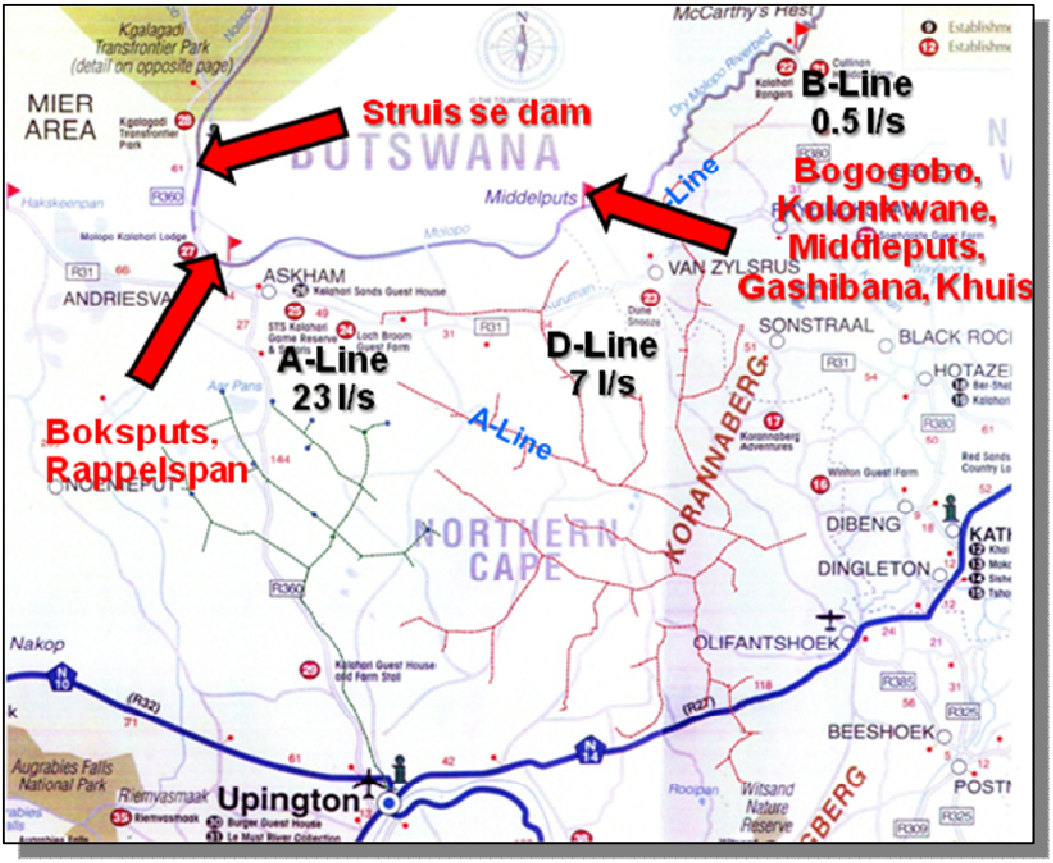
MAP 17 – Commercial farms in Mier area

COMMERCIAL FARMS	AREA (HECTARES)	FLOW RATE (l/s)
MA LINE	65143	2.42
MB LINE	0	0.00
MC LINE	0	0.00
MD LINE	31288	0.82
ME LINE	170239	5.10
TOTAL	266670	8.35

6.3 BOTSWANA TOWNS

6.3.1 Demographics

The map below **(MAP 18)** shows the locations of Botswana towns that can benefit from the extension of the Kalahari-East Water supply scheme:



MAP 18 – Botswana Towns

6.3.2 Water demand

As no population figures were provided by the Botswana Government the data is based on Houses in these areas counted from Google Earth satellite photos compiled in 2004. These data were checked against 2001 census population figures from Wikipedia in 2001. From this it is estimated that a household consists of 3.4 people per house, which is low. Because of a lack of reliable data further calculations were based on the sources discussed above.

The table below shows the water demand for each of the three areas Botswana areas.

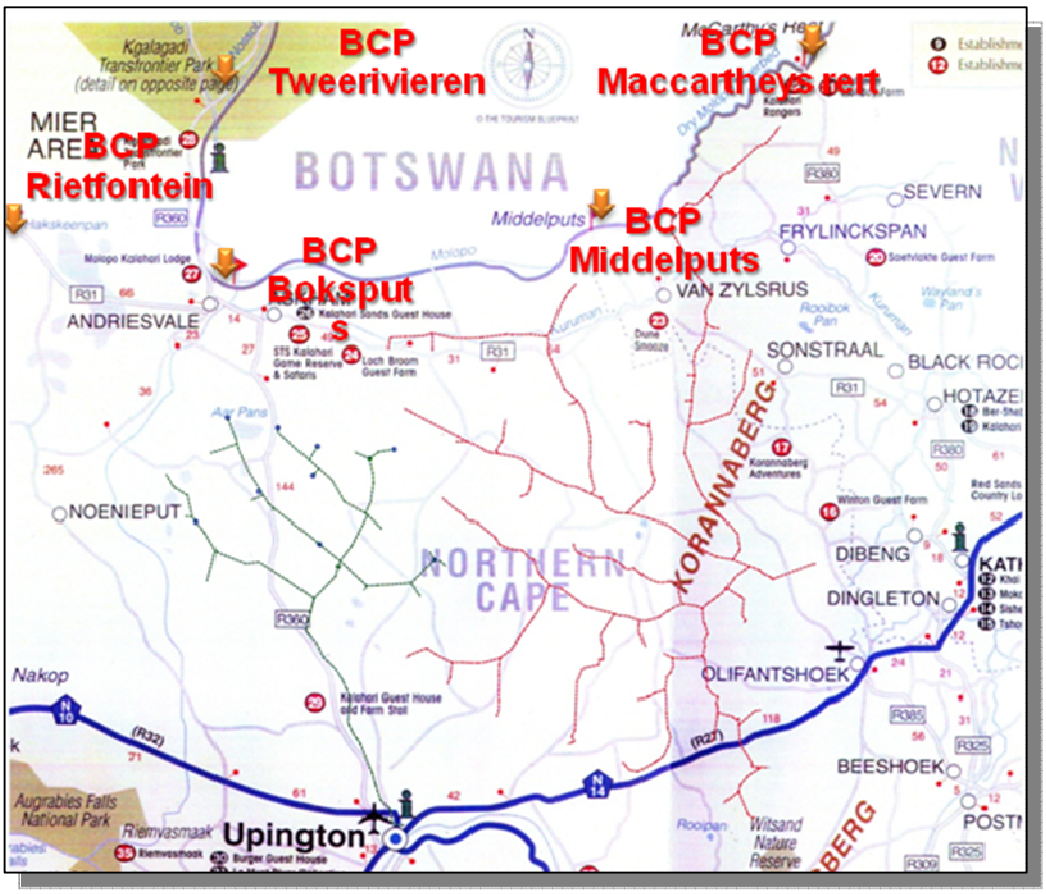
MIDDELPUTS AREA		GROWTH 2004-2010	AVERAGE DEMAND (l/house/day)	SUMMER PEAK FACTOR
		10%	360	1.5
TOWN	**HOUSES 2004**	**HOUSES 2010 (estimated)**	**Q average (l/s)**	**Q Peak (l/s)**
Bogogobo	125	138	0.573	0.86
Kolonkwane	207	228	0.949	1.42
Middleputs	301	331	1.380	2.07
Gashibana	156	172	0.715	1.07
Khuis	250	275	1.146	1.72
TOTAAL		1143	4.762	7.14

BOKSPUTS AREA		GROWTH 2004-2010	AVERAGE DEMAND (l/house/day)	SUMMER PEAK FACTOR
		10%	360	1.5
TOWN	**HOUSES 2004**	**HOUSES 2010 (estimated)**	**Q average (l/s)**	**Q Peak (l/s)**
Boksputs	282	310	1.293	1.94
Struis se dam	80	88	0.367	0.55
Paplespan	27	30	0.124	0.19
TOTAAL		428	1.783	2.67

6.4 BORDER CONTROL POSTS

6.4.1 Demographics

There are one Border Control Post between South Africa and Namibia and four between South Africa and Botswana in the targeted area. None of these Posts benefit currently from the Kalahari-East Water Supply Scheme. The map below **(MAP 19)** shows the locations of the Border Control Posts:



MAP 19 – Border Control Posts

6.4.2 Water demand

The water demand of personnel and people passing through were estimated conservatively as follows:

Border Control Post		AVERAGE DEMAND (l/person/day)	SUMMER PEAK FACTOR
		150	1.5
Description	**Persons**	**Q average (l/s)**	**Q Peak (l/s)**
Rietfontein	135	0.234	0.35
Tweerivieren	135	0.234	0.35
Boksputs	135	0.234	0.35
Middelputs	135	0.234	0.35
MacCartheys Rest	135	0.234	0.35
TOTAL			1.76

6.5 KALAHARI TRANS FRONTIER PARK

6.5.1 Water demand

The water demand for Twee Rivieren Rest Camp was compiled from figures obtained from officials from the Kalahari Trans Frontier Park self:

Twee Rivieren		AVERAGE DEMAND (l/person/day)	SUMMER PEAK FACTOR
		150	1.5
Description	**Persons**	**Q average (l/s)**	**Q Peek (l/s)**
Twee Rivieren	642	1.115	1.67

6.6 SUMMARY OF WATER USERS PROFILE IN TARGET AREA

The table blow shows extra water requirements at specific points of the Kalahari-East Water supply Scheme:

DESCRIPTION OF USER	VOLUME WATER NEEDED (l/s)
Commercial farms	8.35
Mier small farms	10.24
Mier towns	10.55
Mier area Border Control Posts	0.80
Kalahari Gemsbok Park	1.67
Borswana towns next to Mier mun area	2.67
TOTAL MIER AREA ***(END OF A-LINE)***	34.29
MacCartheys Rest Border Control Post	0.50
TOTAL MACCARTHEYS REST AREA ***(END OF B-LINE)***	0.50
Botswana towns in Middleputs area	7.14
Commercial farms	0.66
Van Zylsrus town	4.61
Middelputs Border Control Post	0.48
TOTAL MIDDELPUTS AREA ***(KHEIS CONNECTION TO D-LINE)***	12.89
TOTAL ADDITIONAL WATER DEMAND (Additional to the current 75l/s)	47.68

7 POSSIBLE WATER SOURCES THAT CAN BE UTILISED FOR POSSIBLE USERS IN TARGET AREA

7.1 KALAHARI-EAST WATER SYPPLY SYSTEM

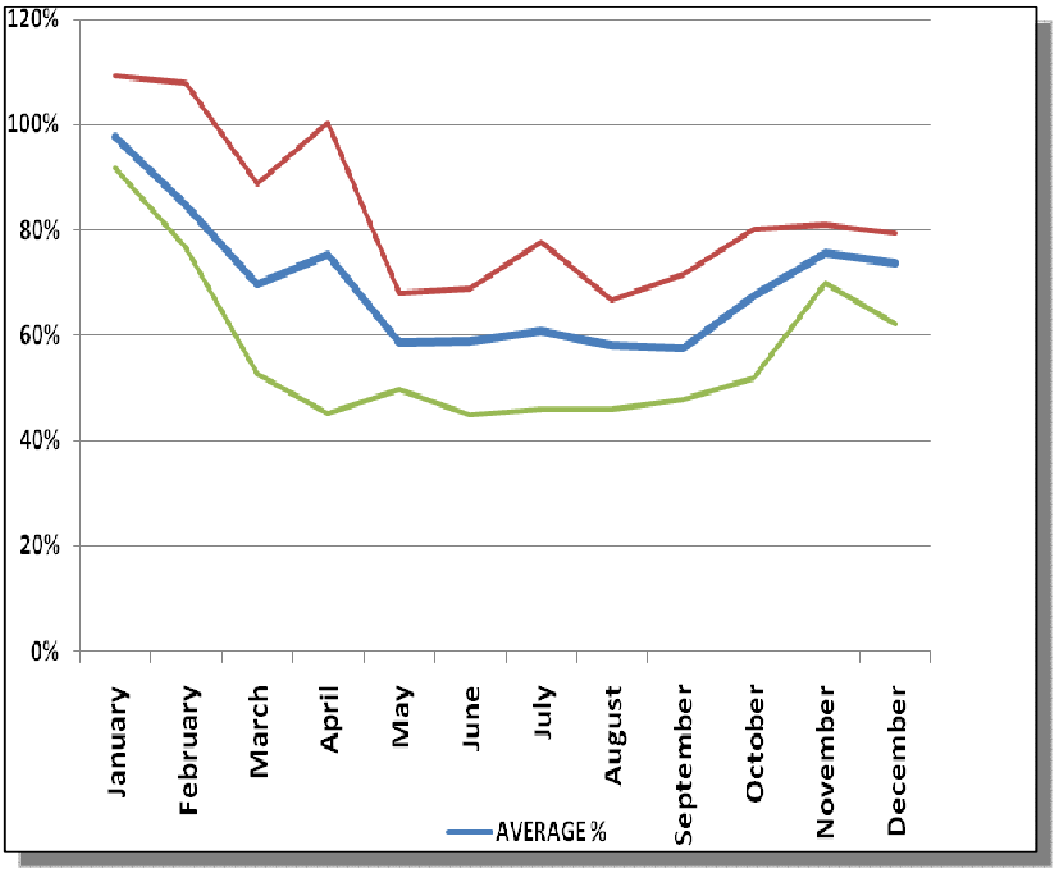
The Kalahari East Water Supply Scheme has a maximum capacity of 103l/s. The current utilization of the scheme is 75l/s. The table below shows where the additional water (up to the total capacity of the existing Supply Scheme) is available according to the original design of the scheme:

LINE ON KALAHARI-EAST WATER SUPPLY SCHEME	DESCRIPTION OF USER	VOLUME WATER NEEDED (l/s)	VOLUME WATER AVAILABLE (l/s)	SHORTAGE
A-Line	Commercial farms	7.52		
	Mier small farms	9.22		
	Mier towns	10.55		
	Mier area Border Control Posts	1.05		
	Kalahari Gemsbok Park	1.67		
	Borswana towns next to Mier mun area	2.67		
	TOTAL MIER AREA	32.69	26.00	**6.69**
B-Line	MacCartheys Rest Border Control Post	0.50		
	TOTAL MACCARTHEYS REST AREA	0.50	0.00	**0.50**
D Line	Botswana towns in Middleputs area	7.14		
	Commercial farms	0.66		
	Van Zylsrus town	4.61		
	Middelputs Border Control Post	0.35		
	TOTAL MIDDELPUTS AREA	12.76	2.00	**10.76**
	TOTAL	45.95	28.00	**17.95**

The Kalahari-East Water Supply Scheme will however be able to supply in the total additional demand for more than 9 months of the year. Utilization is over 85% of its total capacity only during the three warmest months of the year. The graph below shows utilization of the pipeline over the last This means that a flow of 18l/s need to be supplied

from other sources during the three warmest summer months of the year.

The monthly usages of the Kalahari-East Water Supply System over the last 8 years as a percentage of the maximum capacity (75l/ without 23l/s allocated to Mier) can be seen on the graph below:

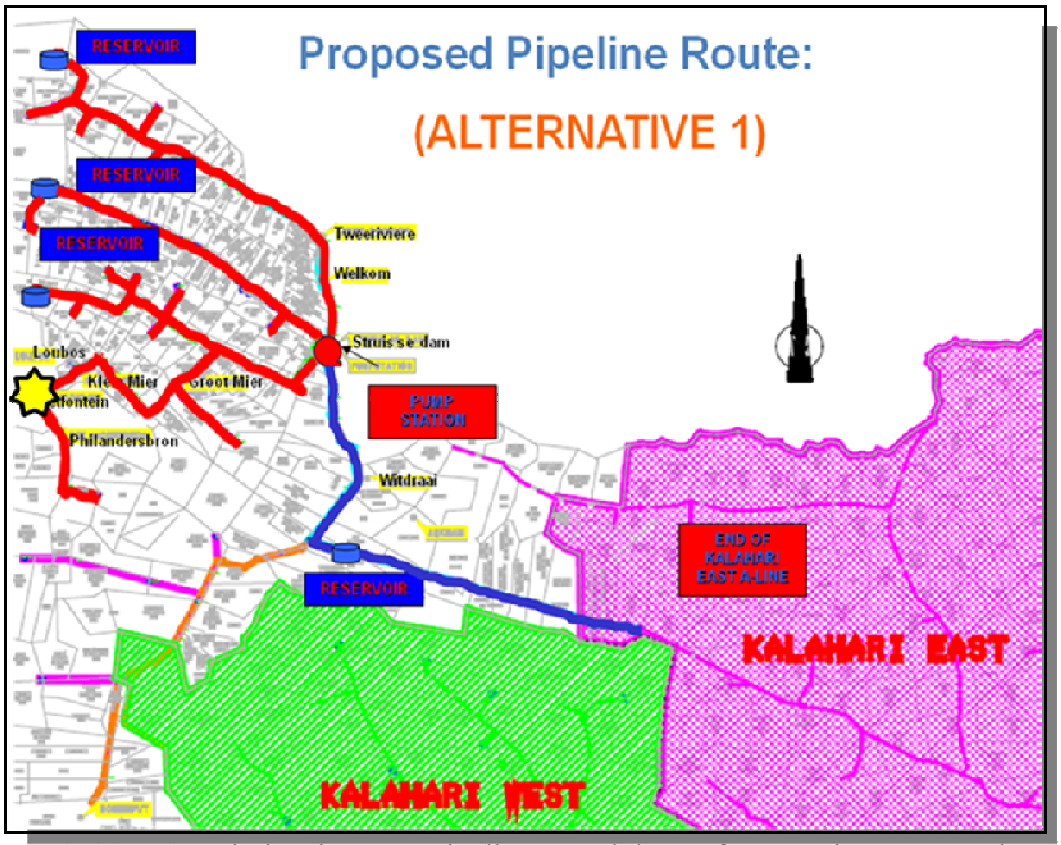


7.2 UNDERGROUND WATER SOURCES AS SUPPLEMENT

The only underground sources that can be utilized as a permanent supplement to the pipe line in during the summer in terms of quality and quantity is located in the area of Rietfontein. This area is recharged on a regular basis. Boreholes currently utilized for water supply to all the towns in the Mier area and in Botswana can however be used as a replenishment to the Kalahari-East water supply. Mixing of the borehole water with Kalahari-East pipeline water during these months will increase the quality of the borehole water currently used. Water can even be

mixed during colder months as well in order to save costs. This will ensure that underground water resources will be protected as

The capacity of the pipeline to the Rietfontein area needs to be increased in order to pump water back into the pipe system if the Kalahari-East Water Supply Scheme cannot meet the demand. The map below **(MAP 20)** explains the fact that the best water as supplement is available close to the end of the supply system.



MAP 20 – Boreholes location (yellow star) best for supplement to the Kalahari-East Water Supply Scheme

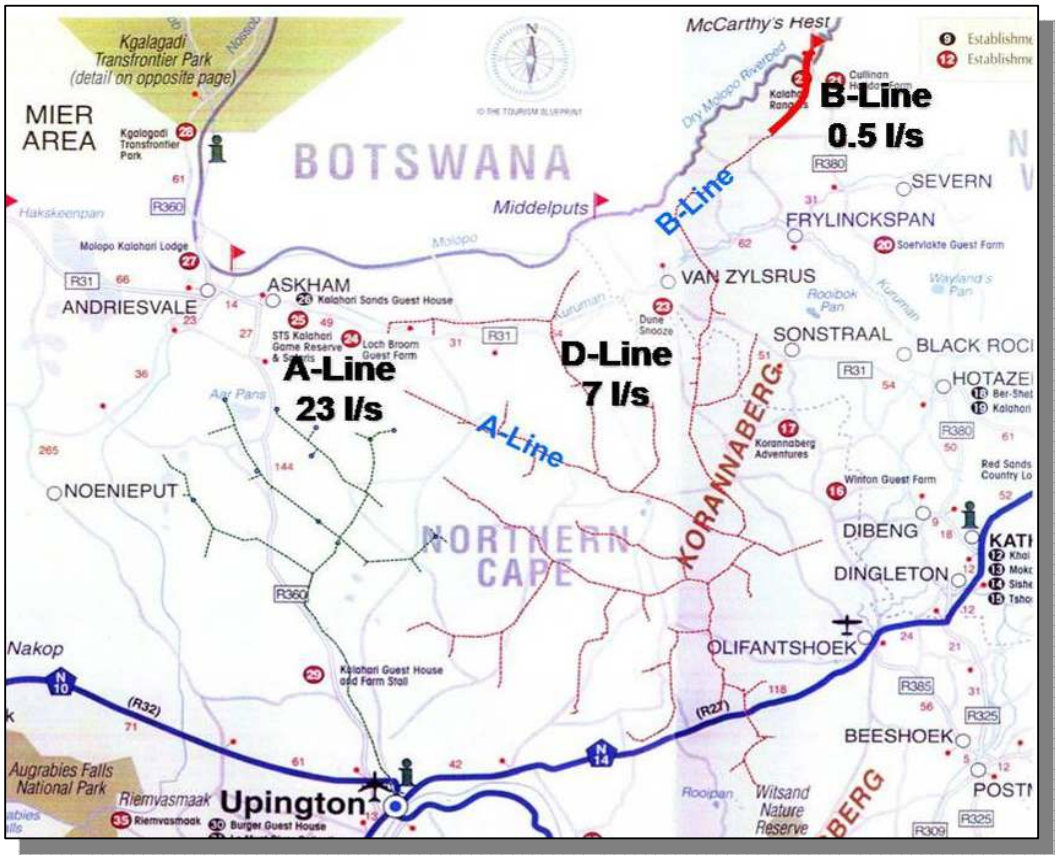
8 POSSIBLE WATER SUPPLY SYSTEM DETAILS FROM THE CURRENT KALAHARI-EAST WATER DISTRIBUTION SYSTEM

8.1 WATER SUPPLY SYSTEMS TO POTENCIAL USERS ADJACENT TO CURRENT KALAHARI EAST SUPPLY AREA

8.1.1 McCarthy's Rest Border Control Post

An investigation to provide water from the Kalahari-East water supply system to MacCartheys Rest border control post was completed recently by BVi Consulting Engineers for the Department of Public Works. A 24 hour flow of 0.5 l/s is needed for this purpose. It is possible to supply water at this rate to the border control post.

A 75mm diameter pipeline needs to be constructed from Cowen reservoir close to the end of the B- Line of the Kalahari-East water supply system over a distance of 18.2km to the MacCartheys Rest Border Control post as shown below. **(MAP 21)**



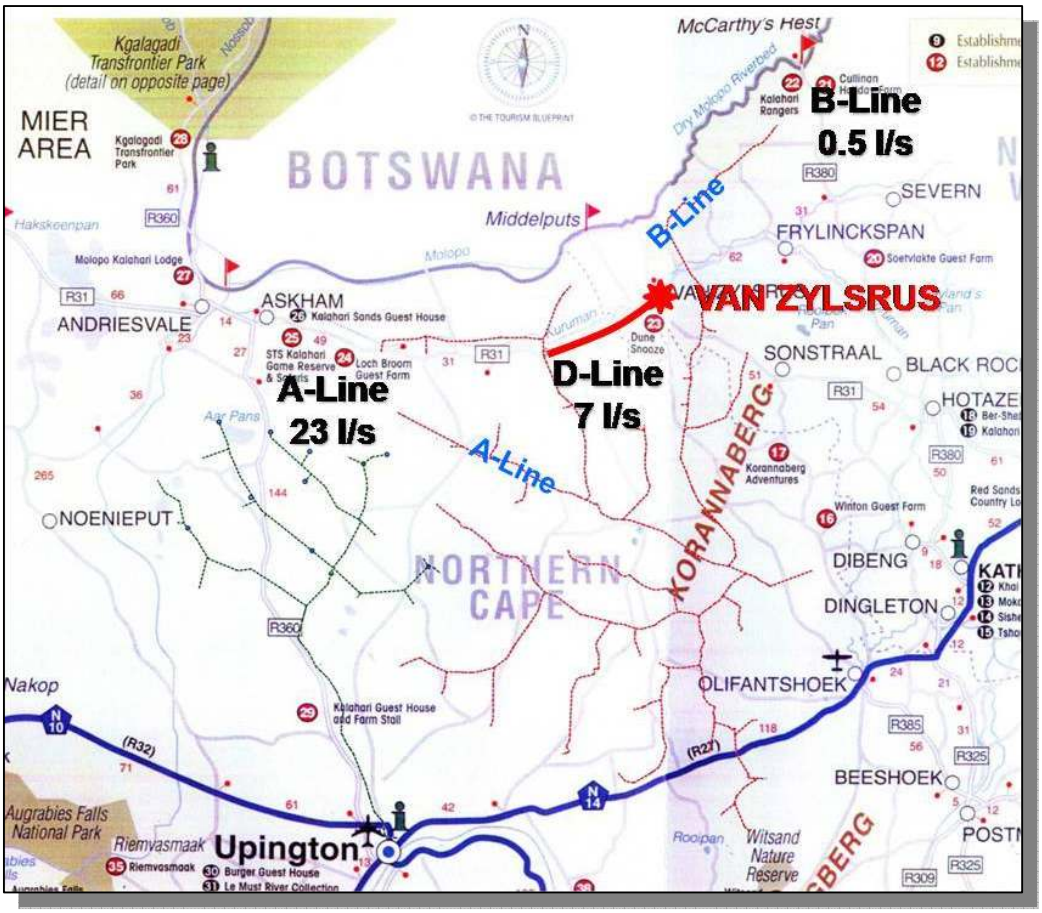
MAP 21 – Water supply pipeline to McCarthy's Rest

The cost of this pipeline is estimated at R3.5 million

8.1.2 Van Zylsrus

Van Zylsrus as a town needs 4.6l/s in order to satisfy their demand. The closest line on the Kalahari-East water supply system with this additional capacity is the D-Line.

A 200mm diameter pipeline needs to be constructed from Ch 49500 of the D-Line of the Kalahari-East Water Supply system over a distance of 30km to the Van Zylsrus as shown below.**(MAP 22)**

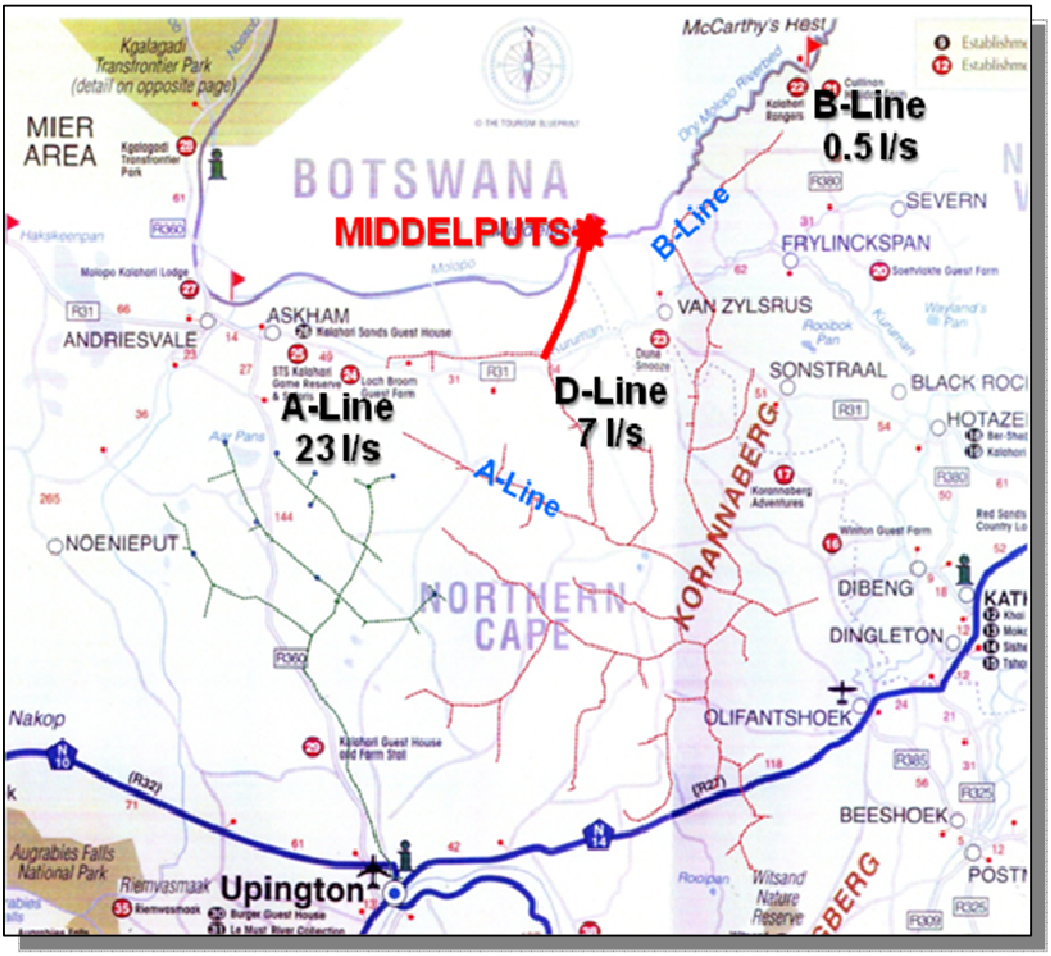


MAP 22 – Water supply pipeline to Van Zylsrus

The cost of this pipeline is estimated at R16m.

8.1.3 Middelputs Border Control Post and Human Settlements

The map below **(MAP 23)** shows the extraction point where water can be taken from the D-Line for the Middleputs area. The distance to border from this point is 20km. Water was abstracted from this point for construction of the Boksputs-Tsabong road at a rate of 7 l/s over the warm summer months.



MAP 23 – Water supply pipeline to Middleputs area

The cost of the pipeline for the Middleputs area is estimated at R10.6m.

8.2 WATER SUPPLY TO MIER AREA FROM END OF KALAHARI-EAST A-LINE

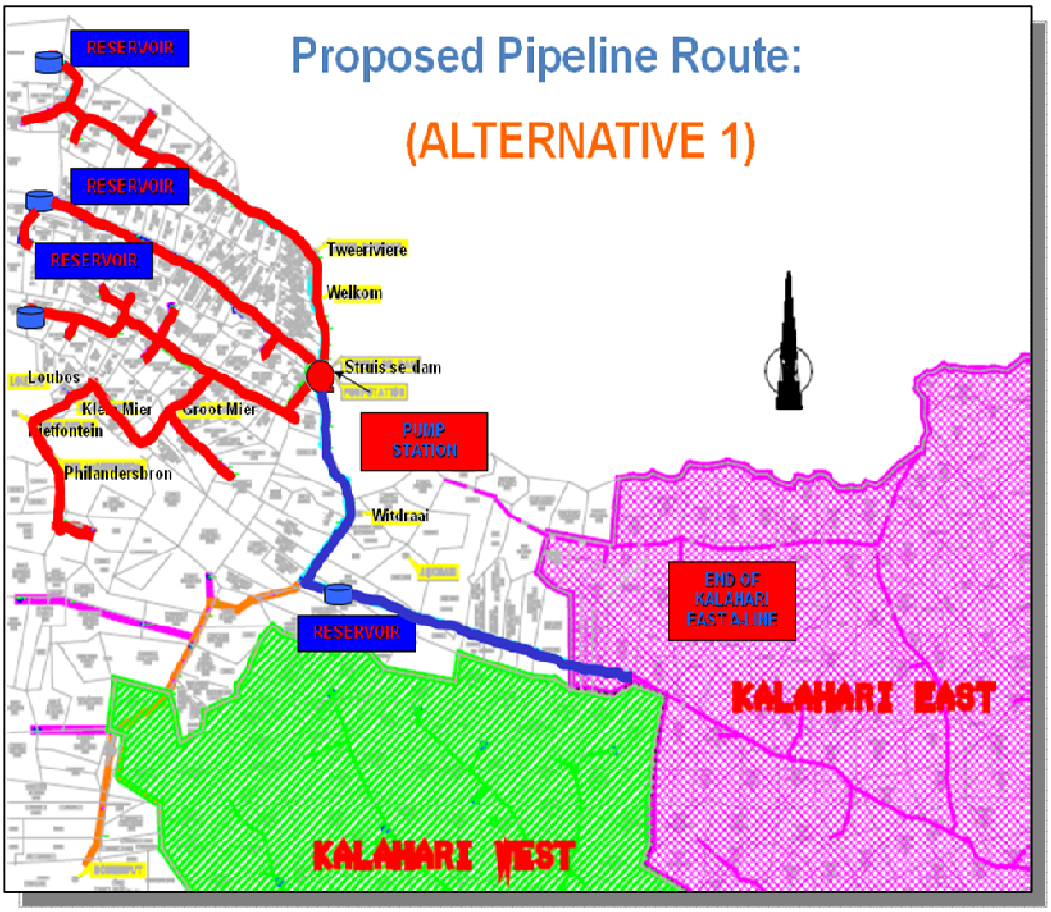
8.2.1 Description of alternative water supply systems investigated.

Two previous feasibility studies (BVi and Du Plessis and Burger) on water supply in the North-Western Kalahari and Mier area were studied in order to see what their design philosophy and the basis of their study was. This information was used to do a desktop study of the alternative water supply systems. This information was then discussed with all role players in order to determine if everything has been covered. The critical routes were then physically investigated and questionnaires sent to all farms in order to determine the need for pipeline water. After the questionnaires were returned the information was used to determine the final routes of the alternatives on the 1:50 000 maps of the area. The alternatives were then modeled with the help of computer programs.

The same design philosophy that applied to the Kalahari West and East rural water supply schemes were used to investigate the alternatives. The water supply systems will be designed to supply water at a constant flow rate over 24 hours to farms and other users. Current and future infrastructure also played a major role in determining of the routes and operation and maintenance aspects. Booster pump station/s, dependent on the availability of electricity and pipelines, were placed close to roads for easier operation and maintenance where possible. The placement of pipelines next to existing roads will also have less environmental impact.

Virtually all water to the whole Mier area must be pumped due to the fact that the highest point where water must be supplied is also the furthest to the North-West. This means that reservoirs must be erected at the highest points close to the end of supply lines so that water can be fed back into the system when the pump isn't in use or out of order.

The alternative that was the best economic option can be seen on the map below.**(MAP 24)**



MAP 24 – Layout of Alternative 1 Mier Pipelines

The cost estimation for this extension is R273.2 million which includes upgrading of boreholes as supplement to water supply in summer months.

8.3 OTHER WATER SUPPLY POSSIBILITIES INVESTIGATED

All possibilities in relation to water supply within limitations of the Kalahari-East water supply system capacity were investigated. The possibility to increase the capacity of the Kalahari-East water supply system's A and D lines were also investigated. Scenarios investigated included booster pumps and operating the pipelines at higher pressures. The results of this investigation were the capacity of the Kalahari East Water Supply Scheme cannot be increased beyond the supply of 103l/s without major costs in terms of duplicated, parallel and higher pressure class pipelines.

9 COST ESTIMATES

9.1 CONSTRUCTION COST ESTIMATES FOR USER CATEGORY AND AREAS

The cost for every category of user of the pipeline was calculated by dividing the usage of every pipe and other part of the water supply scheme between the possible users. The following table shows construction costs for different users as well as area totals.

AREA	USER	COST (R)	AREA TOTAL
Mier (End A-Line)	Commercial farms	60,200,000	
	Small Farms	125,600,000	
	SAN	1,100,000	
	Kalahari Gemsbok Park	9,900,000	
	Mier Towns	64,000,000	
	SA Border Control posts	3,100,000	
	Botswana	**6,500,000**	270,400,000
McCarthy's Rest (End of B-Line)	McCarthy's Rest Border Control Post	3,500,000	3,500,000
Van Zylsrus (D-Line CH 50,000)	Van Zylsrus	16,000,000	16,000,000
Middelputs (D-Line CH 58,000)	**Botswana (Middelputs Border Control Post and Human Settlements)**	**10,600,000**	16,000,000
TOTAL			**305,900,000**

COUNTRY	TOTAL
Botswana	**17,100,000**
South Africa	288,800,000
TOTAL	**305,900,000**

This table shows that there are substantial differences in terms of the cost implications for the different categories of users between the alternatives.

If a permanent connection is granted to Botswana the current value of the capital cost of the existing Kalahari-East Water Supply Scheme infrastructure as well as their percentage utilization must be calculated. The responsibility for this percentage of the capital cost of infrastructure provided by South Africa must form part of negotiations.

9.2 COST ESTIMATES LABOUR COMPONANTS

The local labour component of a standard pipeline contract is about 15% of the total construction cost. Materials and plant make up the rest of the cost. If the contract is executed in a standard way the total labour component will be in the order of R45 million or 70 000 person days.

If the contract is done under the Expanded Public Works program principles in terms of labour intensive construction the total labour component can be increased to more than R100 million or 1 200 000 person days. Large portions of the excavation for the pipelines can be done using labour intensive construction methods. This will however increase construction cost.

10 OPERATION AND MAINTENANCE COSTS

10.1 OPERATION AND MAINTANANCE COSTS OF WATER SUPPLY ON FARMS

The table below shows a calculation of what the operation and maintenance cost of a water supply scheme on a small farm amounts to under the following circumstances:

- One pump and diesel engine is used to supply the 3000 ha farm with water
- Life expectancy of the pump and diesel engine is 15 years
- The engine uses 5 liters of diesel every day.
- A vehicle with a value of R20 000 is used every day
- Distance to the pump is 10km
- 20% of the time of one labourer is dedicated to water related issues.

Description	Cost per annum
Pump : Price	R 2,194
Diesel engine : Price	R 4,389
Diesel engine : Services	R 1,645
Diesel engine : Diesel and oil	R 3,004
Vehicle : Price	R 6,582
Vehicle : Petrol	R 9,010
Vehicle : Services	R 823
Labourer : Time attending to water	R 3,160
Total	**R 30,808**
Water demand (kiloliter)	3,011
Cost per kilolitre	R 10.23

10.2 OPERATION AND MAINTANANCE COSTS OF CURRENT WATER SUPPLY TO HUMAN SETTLEMENTS

The estimated monthly Operation and Maintenance costs of water supply to the Mier towns are listed in the table below:

MIER TOWNS : MONTHLY COST WATER								
Towns	**Households Billed**	**Asset**	**4% of Asset**	**Wages**	**Electricity (ESCOM)**	**Total Monthly cost**	**Use per month (kl)**	**Estimated Current expenditure R/kl**
Rietfontein	679	2,665,680	8,886	8,367	1,814	19,066	1,370	13.91
Philandersbron	289	1,532,234	5,107	4,187	2,285	11,580	988	11.72
Loubos	286	413,460	1,378	5,166	1,523	8,067	2,372	3.40
Klein Mier	128	447,970	1,493	2,280	951	4,724	500	9.45
Groot Mier	106	309,920	1,033	2,280		8,037	2,452	3.28
Welkom	161	465,431	1,551	5,981	1,361	8,893	966	9.20
Askham	267	306,040	1,020	4,559		5,579	1,845	3.02
TOTAL	1,916	6,140,736	20,469	32,819	7,934	65,946	10,493	6.28

10.3 OPERATION AND MAINTENANCE COSTS OF KALAHARI-EAST AND KALAHARI WEST WATER SUPPLY SCHEMES

The operation and maintenance costs of the Kalahari East and West water supply schemes over the last years were:

KALAHARI-EAST WATER USERS EXPENDITURE ANALYSIS					
FINANCIAL YEAR	Cattle (GVE)	Quantity Delivered (kl)	Expenditure per year	Rate per kl (Users association)	Operational cost per kl
2002-2003	87,213	1,654,117	2,431,228	**1.35**	**1.47**
2003-2004	88,091	1,724,442	2,618,569	**1.48**	**1.52**
2004-2005	88,323	1,670,993	3,125,416	**1.60**	**1.87**
2005-2006	90,082	1,694,095	2,933,512	**1.75**	**1.73**
2006-2007	90,149	1,743,405	3,694,317	**1.90**	**2.12**
2007-2008	91,014	2,038,511	3,670,901	**2.05**	**1.80**

KALAHARI-WEST WATER USERS EXPENDITURE ANALYSIS					
FINANCIAL YEAR	Cattle (GVE)	Quantity Delivered (kl)	Expenditure per year	Rate per kl (Users association)	Operational cost per kl
2002-2003	33,232	538,269	1,704,304	**3.15**	**3.17**
2003-2004	33,232	532,007	2,125,989	**3.75**	**4.00**
2005-2006	33,281	507,636	2,291,725	**4.75**	**4.51**
2006-2007	33,554	537,833	2,639,395	**5.00**	**4.91**
2007-2008	33,554	559,587	3,196,722	**5.30**	**5.71**
2008-2009	33,539	471,775	4,527,989	**6.40**	**9.60**

10.4 ENVISAGED OPERATION AND MAINTENANCE COSTS ON NEW SYSTEM

The annual operation and maintenance cost was determined by using the Department of Water affairs and Forestry calculations. The amount of water sold by the Kalahari East over the last three years was used to determine the percentage of the maximum supply rate sold annually. This volume was used in the calculation of the unit cost of water of the alternatives.

Component	Alternative 1
Mechanical and electrical (4% of value)	119,120.00

Civil and structural (0.25% of value)	44,700.00
Pypelines (0.5% of value)	961,132.00
Vehicles	401,524.00
Salaries	468,000.00
Electricity for pump stations	166,790.00
Water purchases	1,394,710.80
Total	3,555,976.80
Volume of water sold	664,148.00
O & M Cost per kiloliter	5.35

10.5 COMPARISON OF OPERATION AND MAINTENACE COSTS

The operation and maintenance costs are compared in the table below:

Stock Farms	10.23
Kalahari-West water supply system	5.71
Kalahari-East water supply system	2.12
Human settlements in Mier	6.28
Extended Kalahari-East water supply system (2.12+5.35)	5.35

11 CAPITAL AND INTEREST REDEMPTION

Calculations were made to determine what portion of the project's capital cost is affordable by the beneficiaries as a loan. A period of 20 years was used as the amortization period at an interest rate of 10%. If 5% of the cost is taken up as a loan account the unit cost will be as follows:

Component	Alternative 1
Loan Account	R 13,414,101
Annual Payment	**R 1,575,614**
Volume of water sold	664,148
Cost per kiloliter : Interest and capital redemption	**R 2.37**

If the operation and maintenance cost is added to this cost the total unit cost will be:

Cost per kiloliter : Interest and capital redemption	R	2.37
Cost per kiloliter : O & M	R	5.35
Total unit cost of water	**R**	**7.72**

This unit cost is of the same magnitude as the current unit costs of Kalahari–East water.

The figures show that more than 90% of the capital needed must be funded by a grant.

Better stock production on the farms, as well as the fact that pipeline water will be cheaper, (if 90% of the capital cost is subsidized) will enable owners to pay for water supplied. The towns have a credit control policy in place as well as the equitable share for indigent people.

12 CONSTRUCTION PHASES

Implementation of the project can be done in phases over a couple of years. Cost estimates were made on a five year construction period completing the project in logical steps. Attached in ***Annexure I*** find a drawing indicating the logical construction phases. Phases 3, 4 and 5 can be switched around if necessary. The table below shows the cost of each phase (current values) as well as the costs every group of beneficiaries will be responsible for in terms of their advantage.

Phase	Description	Commercial farms (R million)	Small Farms (R million)	SAN (R million)	Kalahari Gemsbok Park (R million)	Towns (R million)	TOTAL (R million)
1	MA line up to the E line	16.3	22.1	4	3.5	14.3	60.2
2	MA line up to Twee Rivieren	1.9	28.8	1.3	9.8	13.2	55
3	MC+MD lines	8.5	26.5	0	0	26	61
4	MB and rest of the MA lines	0	58.8	0	0	0	58.8
5	ME line	34.7	0	0	0	0	34.7
	TOTAL	61.41	136.17	5.34	13.35	53.4	267
	Percentage	23%	51%	2%	5%	20%	**100%**

This shows that R200 million of the construction cost is needed for agriculture.

13 INSTITUTIONAL ARRANGEMENTS

There are two possibilities. The first is to incorporate the extension of the Kalahari-East pipeline system into the current Kalahari-East water users association in terms of administration as well as operation and maintenance. The second possibility is the founding of a new water users association that will administrate, operate and maintain the extended water supply system from die end on the Kalahari-East A-line

14 FUNDING

Possibilities of funding for the different categories of users are listed in the table below.

AREA	USER	COST (R)	AREA TOTAL
Mier (End A-Line)	Commercial farms	60,200,000	Dep. of Agriculture & farmers
	Small Farms	125,600,000	Dep. of Agriculture
	SAN	1,100,000	Mier Mun – (MIG+Bulk Infrastructure Grants)
	Kalahari Gemsbok Park	9,900,000	SAN Parks
	Mier Towns	64,000,000	Mier Mun – (MIG+Bulk Infrastructure Grants)
	SA Border Control posts	3,100,000	Dep. of Public Works
	Botswana	**6,500,000**	Botswana Government
McCarthy's Rest (End of B-Line)	McCarthy's Rest Border Control Post	3,500,000	Dep. of Public Works
Van Zylsrus (D-Line CH 50,000)	Van Zylsrus	16,000,000	Kalahari-DM – (MIG+Bulk Infrastructure Grants)
Middelputs (D-Line CH 58,000)	**Botswana (Middelputs Border Control Post and Human Settlements)**	**10,600,000**	Botswana Government
TOTAL		**305,900,000**	

Other possible role players in terms of funding are the Development Bank of Southern Africa as well as foreign donors.

15 CONCLUSION