KAMIESBERG MUNICIPALITY

PAULSHOEK

PROJECT NUMBER: S815/2012/01

PAULSHOEK GROUND WATER DESALINATION, BULK WATER, BOREHOLE DEVELOPMENT

TECHNICAL REPORT (REVISED)

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1. TECHNICAL REPORT

1.1 Introduction

This office was appointed by Kamiesberg Municipality to carry out investigations to access the current situation of water supply and demand in the Kamiesberg Municipal region. After completion of these investigations, reports must be compiled for the completion of a MIG-application to upgrade the current bulk water supply of the Kamiesberg Municipal District. The upgrading works will include, replacement of borehole equipment, fixing and upgrading of telemetric control equipment and the construction of reservoirs in the Kamiesberg Municipal District. All technical information provided and tabled in this report, will be applicable for the replacement of borehole equipment, the equipment of newly drilled boreholes, the construction of a reservoir and a purification plant and the installation of pipelines in Paulshoek.

1.2 Background

1.2.1 General

The village of Paulshoek is situated about 55 km from Kamieskroon on the N7 national road in the Northern Cape, about 65km from Springbok and 45km from Garies. Paulshoek is one of many small rural villages in the Kamiesberg region which is situated in the direction south-east from Kamieskroon. The average precipitation in Paulshoek is between 100 - 200mm per annum. The town relies on the use of groundwater for domestic purposes. It falls under the low income category and the people of Paulshoek are mostly dependant on work in nearby commercial farms and labour work in surrounding villages.

Paulshoek is situated about 1100m above sea level. The temperatures vary drastically between the summer and winter seasons (temperatures up to 40º in summer and down to 0º during winter times). This physical environment is typical of the Kamiesberg region and can closely relate to the Namaqualand region with prominent granite mountains.

1.2.2 Problem Statement

The increasing demand for proper housing in Paulshoek has led to an increased demand for drinking water. Currently water is pumped from a borehole, north-west from Paulshoek, but the supply is insufficient for the town. The water is pumped directly from the source into the reservoir (Plastic tanks). The water is only treated by the addition of chlorine at the reservoirs.

At present the Municipality is using 4 x 10 kℓ Green tanks as water storage reservoirs of which the capacity is insufficient. Other sources need to be considered to supply more water more frequently. The need for proper reservoirs, in addition to a purification plant and a reliable water supply source is currently extremely significant to the village.

1.2.3 Municipal Backlog

In accordance with the current demand, the Municipality is planning to develop plots for the building of houses in the near future. Information gathered from the Municipal office in Garies concludes that approximately 46 plots are in demand for Paulshoek. This expected increase in consumers will place additional pressure on the existing system.

1.3 Existing Services

1.3.1 The water supply system of Paulshoek consists of the following:

1.3.1.1 Existing Borehole (G45815)

Water is pumped from the Borehole for approximately 4.7km to the existing Municipal reservoir. The maximum amount of water possible is extracted from the borehole as it is currently the only equipped source that can be used. The supply available from this borehole is about 4147 kℓ per month or 138 kℓ per day.

According to the investigations undertaken by Toens & Partners cc in January 2002 the safe supply of the borehole is as follows:

Name of Borehole	**Safe Abstraction (24 hrs/day)**		
	24 hours (ℓ/s)	**kℓ/day**	**kℓ/month**
Borehole: G45815	1.6	138.24	4147.2

1.3.1.2 Available boreholes

During the period March 2001 to April 2001 six boreholes have been drilled by the Department of Water Affairs in the Kamiesberg region. In October 2001 AB Pumps was appointed to do controlled pump tests on three of the new boreholes at Paulshoek, namely G45815, G45816 and G45820 respectively. Borehole G45815 is currently being equipped to supply the town with water.

These boreholes are located on the western boundaries of the village. The boreholes are 5-6km from the current reservoirs in town. The boreholes were tested in 2001 and a report was compiled by Toens & Partners cc.

1.3.1.3 Available Supply from Boreholes

According to the report prepared by Toens & Partners cc in January 2002 the following information regarding the boreholes were compiled:

Borehole: Description				**Available Supply (24 hrs/day)**		
Name	**Brackish/ Fresh**	**Conductivity Ms/m**	**pH**	**Abstraction ℓ/s**	**Daily kℓ**	**Monthly kℓ**
Existing BH: G45815	Brackish	184	7.4	1.6	138.24	4 147.2
New BH: G45816	Fresh	144	7.5	0.4	34.56	1 036.8
New BH: G45820	Brackish	205	7.7	1.90	164.16	4 924.8
Total				3.9	336.96	10 108.8

Maximum Pumping Rate (12hrs/day)

Borehole	Maximum Abstraction(12hrs/day)		
	Abstraction ℓ/s	Daily kℓ	Monthly kℓ
Existing BH: G45815	2	87.6	2628
New BH: G45816	0.6	26	780
New BH: G45820	2.5	108	3285

1.3.1.4 Quality of Water from Boreholes

According to tests completed, the water standard is only compliant with SANS 241 class 2 water. Water of this quality is not suitable in the long term for human consumption.

The water from the existing borehole (G45815) has a low classification, due to the high fluoride, chloride contents as well as the conductivity. The other available boreholes G45816 and G45820 respectively have also been classified as low, due to similar reasons. The fluoride, chloride and conductivity of both water sources are high, making the water hazardous to drink. See Annexure D for Borehole test Results

1.3.2 Supply Pipelines from Boreholes

The water is currently pumped through a 40mm HDPE pipe from the borehole and has been in use for a long period. This pipeline is in a poor condition.

1.3.3 Storage Reservoirs and Capacities

Water is currently stored in 4 x 10kℓ green tanks which are constantly leaking and insufficient to supply the town with water during cases of emergency.

1.3.4 Distribution Networks

The existing water reticulation network consists of a variety of pipe types and classes and has not been properly installed. No proper network exists and

most of the house connections are informal connections to the network without any water meters.

1.4 POPULATION

According to information obtained from surveys by the local CDW, the resident figures are as follows:

Description of Items	Current 2012		Future 2032	
	Plots	Residents	Plots	Residents
1. Total plots	187	550	228	661
2. Calculated number	187	935	228	1140

The above figures are based on information provided by the Municipal offices in Garies. The village currently consist of occupied 141 plots with approximately 550 residents. The Municipal staff have indicated that a further ±46 plots are necessary to satisfy the future housing demand. Although the current resident figure has been determined at 4 people per plot, a figure of 5 people per plot will be used for design purposes. The population are estimated to be 1140 in 2032.

1.5 CURRENT CONSUMPTION

1.5.1 Water Balance 2011

Month (2011)	Abstraction (kℓ)
January	704
February	603
March	237
April	520
May	520
June	520
July	219
August	206
September	271
October	268
November	619
December	524
Total	4 691

1.5.2 Conclusion

From paragraph1.5.1 above, the following can be concluded:

- Water consumption during the summer from November to February is higher than in the winter months as expected. The figure of 520 kl for April, May and June is higher and very suspiciously the same over this three month period.
- The abstraction from the operational borehole can be calculated as follows:

Average Monthly Abstraction	:	391 kl per month
Average Daily Abstraction	:	13 kl per day
Maximum Daily Abstraction	:	23.5 kl per day
Maximum consumption per household	:	166 l per day

1.6 DESIGN GUIDELINES OF SYSTEMS

The following guidelines have been adapted in order to determine the demand:

- Total Plots 187
- Expected Population Growth 1%
- Number of residents per plot: 5
- Consumption per person per day (Household): 60ℓ
- Peak factor in summer peak consumption: 1,5
- Maximum time of interruption of supply: 48 hours
- Recovery of Desalination Plant 75%
- Conveyance Losses 10%

1.7 DETERMINING REQUIRED SUPPLY AND STORAGE CAPACITY

According to the current resident numbers and the expected demand for future plots and needs, the required supply and infrastructure are as follows:

1.7.1 Total Demand

The total demand per capita per day:

Total Demand = 60 ℓ x 1.5 x 1.1

= 99 ℓ/c/day

1.7.2 Purification Plant Capacity:

Description of Supply	2012(Calc)	2032
1. Resident figures	935	1 140
2. Total Demand (ℓ/person/day)	99	99
3. Daily consumption (kℓ/d)	92.57	112.86
4. Monthly demand (kℓ)	2 776.95	3 385.8
5. Monthly Demand before Treatment (kℓ)	3 702.6	4 514.4
6. Demand before Treatment/day(ℓ/s)	1.43	1.74
7. Available from boreholes / month (kℓ)	2628	2628
8. Available from boreholes /day(ℓ/s)	2	2
9. Shortage in Supply before Treatment	None	None
10. Capacity of Purification Plant Operated 8 hours (ℓ/s)	3.21	3.93
11. Capacity of Purification Plant Operated 12 hours (ℓ/s)	2.14	2.62
12. Capacity of Purification Plant Operated 24 hours (ℓ/s)	1.07	1.31

A purification plant operated 8 hours/day is recommended with a capacity of 14 kℓ/hour.

1.7.3 Storage Capacity

The storage capacity for a 48 hour period can be calculated as follows:

Year	Population	Consumption / day (kℓ)	Peak Consumption (kℓ/day)	Storage Capacity (kℓ)
2012	935	61.71	92.57	185.13
2032	1 140	75.24	112.86	225.72

A Steel Panel Reservoir with a capacity of about 228kℓ is recommended to solve the problem. This reservoir should, for the following 20 years, have sufficient storage capacity for the supply of water for 2 days.

1.7.4 Total Raw water Demand

The following raw water demand is estimated for a pumping period of approximately 12 hours/ day:

Description of Supply	2012	2032
Consumption / day (kℓ)	92.57	112.86
Total Raw Water Demand/ day (kℓ)	123.43	150.48
Total Raw Water Demand/per 12hours (ℓ/s)	2.86	3.48

1.7.5 Available Supply and System Shortcomings

According to the above calculations, the following can be concluded:

- The supply from the operational borehole namely G45815 is sufficient to supply the town with water according to tests conducted in 2002.
- This borehole must however be tested to confirm the quantity and quality of water supply. It must also be equipped with pumps that complies to the safe abstraction specifications of the borehole to ensure that the borehole is operated effectively.
- A standby borehole must be equipped next to the existing borehole to ensure constant supply of water during emergencies when the operational borehole is out of order.
- The reservoir capacities are not sufficient to store 48hours of water in the case of emergencies.
- The water network must be upgraded to reduce water losses and also to measure consumption effectively.
- The borehole water must be purified to supply water of acceptable standards to the residents.

1.8 PROPOSED WORKS

The proposed works is as follows:

- Equipment for existing operational borehole.
- Construction of 228 kℓ steel storage panel reservoir to supply the town with water in the case of emergencies.
- Installation of a 3.5km water reticulation network, consisting of uPVC pipes metered at all stands.
- Test operational borehole as well as other sources.

- Drill, Test and Equip standby borehole near the existing operational borehole.
- Construction of Water Treatment works to clean the water.
- Installation of Telemetric control system.

2. ESTIMATED PROJECT COSTS

Estimated costs are as follows:

2.1 DIRECT PROJECT COSTS

a. Equip existing and new borehole (2):	R 140 000-00
b. Construction of Reservoir including fences:	R 500 000-00
c. Bore and Test new Boreholes (1):	R 180 000-00
d. Construction of Reticulation network (3.5km):	R1 575 000-00
e. Construction of Water Treatment Plant and Evaporation ponds	R2 500 000-00
f. Telemetric Control System	R 200 000-00
g. Preliminary and General Costs	R 509 500-00
Sub Total	R5 604 500-00
h. Contingencies (10%)	R 560 450-00
i. Contract Price Adjustments and Increases (10%)	R 616 495-00
Sub Total	R6 781 445-00
Plus VAT (14%)	R 949 402-30
TOTAL	R7 730 847-30

2.2 INDIRECT PROJECT COSTS

a. PROFESSIONAL ENGINEERING FEES	R 777 120-20
b. REIMBURSEMENTS (SITE SUPERVISION, TRAVELLING COST, ETC.)	R 140 000-00
c. Sub Total	R 917 120-20
Plus14% VAT	R 128 396-83
TOTAL INDIRECT PROJECT COSTS	**R1 045 517-03**

2.3 TOTAL PROJECT COST

TOTAL DIRECT PROJECT COSTS	R 7 730 847-30
TOTAL INDIRECT PROJECT COSTS	R 1 045 517-03
TOTAL PROJECT COSTS	**R 8 776 364-33**

3. DATE OF COMPLETION AND CASHFLOW

According to the provisional work program, if work commence in July 2014, all should be completed by January 2015. The retention payment will be made in January 2016. No environmental impact study is necessary. Expected costs are as follows:

Month	Amount (R)	Balance
		R 8 776 634-33
Month of Approval +1	R 500 000-00	R 8 276 634-33
Month of Approval +2	R 500 000-00	R 7 776 634-33
Month of Approval +3	R 1 000 000-00	R 6 776 634-33
Month of Approval +4	R 2 500 000-00	R 4 276 634-33
Month of Approval +5	R 2 500 000-00	R 1 776 634-33
Month of Approval +6	R 1 337 546-11	R 438 818-22
Month of Approval +18	R 438 818-22	R 0-00

4. PROJECT MANAGEMENT

A project team will be appointed at the beginning of the project, consisting of representatives from Kamiesberg Municipality, the local community and Consulting Engineers. The duties of this committee will include the following:

4.1 Final approval of description of the planned works.

4.2 Approval of tender document.

4.3 Appointment of contractors.

4.4 Attendance of monthly site and project meetings.

4.5 Monitoring progress of project.

4.6 Involvement in completion, takeover and testing of system.

4.7 Evaluation of post installation care period, quarterly meetings and monitoring of system management by Municipal staff.

After the application has been approved, representatives of the District Municipality and the Department of Housing will join this project team

5. DRAFTING AND EVALUATION OF TENDER DOCUMENTS

The tender documents will be drafted according to the tender policy of the Kamiesberg Municipality. The accepted Targeted Procurement Conditions of the Municipality will also be used to evaluate the tenders and submit a recommendation to the Council regarding the appointment of the successful contractor.

6. PROJECT COMMENCEMENT DATE

All attempts will be made to have the project allocated to contractors within 2 months after approval of the Application for funds. With an expected construction time of 6 months, retention period of 12 months, the project should be completed 20 months after the approval of funds.

7. MAINTENANCE AND TRAINING

Due to the current problems being experienced, it is advised that the consulting engineers and contractors remain actively involved for 12 months after the completion of the project. During this time the following will take place:

7.1 Evaluation of the use of the system by Municipal staff.
7.2 Examination of pump hours, volume of water supplied and community consumption figures.
7.3 Drafting of water balance on a monthly basis.
7.4 Convening monitoring meetings on a quarterly basis and reporting to the Department of Housing, DWAF and Municipal Manager.

The aim of this involvement for the 12 months after completion is to extend the lifetime of the system by ensuring good training and effective control.
Training will be given to the supplier of the telemetric control system and will be done in accordance to their program and regulations.

8. GENERAL

This technical report was drawn up by BVi Consulting Engineers at the request of the Kamiesberg Municipality. We trust that you find the above in order and that you will contact our offices should you have any queries.

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BVi Consulting Engineers **Date**

9. ANNEXURES

9.1 Annexure A: Indigent Register
9.2 Annexure B: General Layout
9.3 Annexure C: Borehole Layout
9.4 Annexure D: Borehole Test results

Annexure A:
Indigent Register

Annexure B:
General Layout

Annexure C:
Borehole Layout

Annexure D:
Borehole Test Results