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REPORT ON ENGINEERING SERVICES FOR FEATHERBED NATURE RESERVE

PORTION 59 OF 216 UITZICHT, BRENTON, KNYSNA

10th APRIL 2026

CONTRACT:

Name:	FEATHERBED NATURE RESERVE
Erf number:	PTN 59 OF 216
Our reference:	16/20

CLIENT DETAILS:

TMBArchitects Pty Ltd
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Private Bag X31
Knysna, 6570

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DOCUMENT HISTORY:

Revision	Date:	Comments
0	18 October 2024	
1	10 April 2026	

REPORT ON ENGINEERING SERVICES FOR FEATHERBED NATURE RESERVE PORTION 59 OF 216 UITZICHT, BRENTON, KNYSNA

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A. Site development plan
B. Site development plan marked up with services
C. Borehole # 1 pumping test report
D. Borehole # 2 pumping test report
E. Borehole # 1 water quality test report (STILL WAITING FOR RESULTS)
F. Borehole # 2 water quality test report (STILL WAITING FOR RESULTS)
G. Sewage treatment plant report & proposal

1. Introduction

The Featherbed Nature Reserve on portion 59 of Uitzicht 216, currently operates as a facility for tourists offering a choice of 4 restaurants, lagoon cruises on board one of their boats, bus and walking tours in the Nature Reserve.

The owner intends to construct some new facilities including a new garage building, a managers' house, a conference centre with tourist accommodation and an entertainment facility for the owner and his guests.

This report on Services is required in terms of the environmental approval process.

The Reserve is situated on the Western Head at the entrance to the Knysna Estuary.

The Nature Reserve has a large jetty to facilitate loading and offloading of tourists and staff from their sailboat and ferries.

2. Access

Most guests access the Reserve on the Featherbed ferries or in private boats embarking and disembarking at the large jetty East of the Reserve. Most of the staff are also brought in by boat.

3. Access Road & Stormwater

Road Access is via the Brenton on Lake Road and a brick paved access road providing access to Western Heads properties, bordering on the West bank of the estuary.
The roads in the Reserve are concrete or brick paved roads. Disposal of Stormwater relies on the highly permeable sandy soil allowing stormwater to soak-away. Grassed berms guide stormwater from the roads into specially constructed detention ponds where stormwater is allowed to soak away.
Great care has to be taken however to avoid concentrating stormwater, as the dune sand is highly erodible when water flows over it. The existing stormwater disposal system seems to work well as there are very few signs of erosion on the reserve. A dedicated stormwater management plan has been requested to form part of the documentation required for the environmental approval process.

4. Facilities Creating a Demand on Services

4.1 Existing Main House & Proposed Entertainment Facility

The main house has 7 bedrooms for owner and guests. The entertainment facility for the owner and guests will have a squash court, swimming pool, gym, spa, steam room, bar, showers and toilets. This building will be approximately 900m² in extent.

4.2 Existing Restaurants

There are four restaurants on the Reserve:
Food Forest – 150 seats
Milkwood – 130 seats
Top Deck – 100 seats
Beach Bar – 90 seats

4.3 Tours

The Reserve can host 5 tours a day with a maximum of 75 people per tour = 375 people per day on tours to the reserve.

4.4 Proposed Garages, Staff Toilets & Facilities

The garages for the storage and maintenance of vehicles, machinery and boats used on the reserve will also house staff toilets, changing rooms and canteen facilities. The buildings will be approximately 714m² in extent.

4.5 Proposed Conference Facility

A conference facility with bar, restaurant and tourist accommodation will be constructed on the property. The size of this building will be approximately 615m² in extent.

4.6 Proposed Managers House

A Manager's House approximately 285m² in extent will be constructed close to the conference facility. The house will accommodate the Manager and his or her family.

4.7 Existing Staff Cottage

There is a small existing staff cottage constructed to the North of the sewage treatment works.

5. Potable Water

5.1 Water Demand for the Amenities in the Reserve

The Water demand is estimated using the Guideline for Human Settlement Planning and Design "The Red Book".

The Annual Average Daily Water Demand (AADD) is:

Existing Main House	2 000 litres per day
Proposed Entertainment facility	2 000 litres per day
Proposed Garages, Staff Toilets & Car Wash	1 000 litres per day
Proposed Conference Centre & Accommodation	2 500 litres per day
Proposed Managers House	700 litres per day
Existing Staff Cottage	600 litres per day
Existing Restaurants 470 seats at 69 – 90 litres per day	37 600 litres per day
Tours 375 people per day at say 50 litres per person per day	18 600 litres per day
TOTAL:	**65 500 litres per day**

5.2 Water Demand for Fire Fighting

This development does not, in my opinion, fall into one of the fire risk categories contemplated in the red book

Intuitively, I would advise some sort of firefighting capability provided by constructing two or three fire hydrants on the water reticulation in strategic positions. Fire-fighting could take place using lay flat hoses fed from the hydrants. Firefighting trucks could also fill up their tanks at these hydrants. The buildings on the property will be fitted with fire hose reels and fire extinguishers.

The lowest fire category in the Red book, requiring hydrants and water storage for firefighting purposes would be Low Risk Group 3, which calls for a fire flow of 350litres per minute and water storage for one hour of fire flow. I would recommend that the development aims at this capability.

5.3 Water Storage

In terms of the Red Book Guidelines, water storage must be provided to satisfy:

a) 2 Days of AADD = 2 x 65 000 litres = 130 000 litres

b) 1 Hour of fire flow = 60 min x 350 litres / min = 21 000 litres

Total reservoir storage = 151 000 litres

The developer needs to provide 151 000 litres of water storage on site, preferably roofed.

The development currently has six 10 000 litres of water storage = 60 000 litres of water storage.

5.4 Main Water Supply

There are two on-site boreholes situated close to the sewage treatment works and generator.

5.4.1 Borehole #1

Borehole #1 is situated on the level platform about 10m North of the existing generator. This borehole is 73m deep. The recommended max abstraction rate is 1.2 l/sec or 4320 l/hour.

Attached is the borehole test report for this borehole and a water quality test report for the water from the borehole.

5.4.2 Borehole #2

Borehole #2 is situated at the intersection of the road to the top of the reserve and the road to the sewage treatment plant. This borehole is 82 m deep. The recommended max abstraction rate of 1.0 l/sec or 3600 l/hour

Attached is the borehole test report for this borehole and a water quality test report for the water from this borehole.

The two boreholes will provide the AADD for the development of 65kilolitres per day in 8.2 hours of pumping at a combined rate of 7920 litres/hour litres per hour.

The water quality has been tested. Test results are attached. These are satisfactory. (Reports not yet received)

Water from the boreholes will be filtered & sterilized with chlorine or UV before being pumped into the reservoir.

5.5 Supplementary Water Supply

Rainwater from the roofs of the four proposed buildings will be harvested as part of the Stormwater Management Plan. The roof areas are:

Entertainment facility	approximately 902m²
Garages, Staff Toilets	approximately 714m²
Conference Centre	approximately 615m²
Managers House	approximately 285m²

Rainwater from the roofs of the entertainment centre and the garages and staff ablutions buildings will be collected in ten 10 000litre water tanks to be positioned alongside the garage building. Th harvested water will be pumped at a rate of 20 000 litres per hour through sand filters to a proposed 320 kilolitre water reservoir to be constructed close to the sewage treatment plant. Further, the rainwater from the roofs of the conference centre and Manager's house will be collected in four 10 000 litre tanks positioned adjacent to the Manger's house. This water will also be pumped at a rate of 20 000 litres per hour through sand filters to the 320 kilolitre roof water reservoir.

Water from this reservoir will be used when available, to ensure that the reservoir is empty when a new rainfall event starts.

5.6 Water Reticulation

Water is currently fed through a gravity reticulation system to the various buildings in the Reserve. The elevation of the water storage tanks provides adequate pressure in the reticulation.

The water reticulation should be expanded & improved as necessary to feed the two or three fire hydrants to be erected on the property, as well as the proposed new buildings.

6. Sewage Treatment & Disposal

6.1 Sewage Generated

In a development of this nature 95% of the water consumed ends up in the sewers.
Sewage generated: 95% of 64 400 litres = 61 750 litres per day.

6.2 Existing Sewer Reticulation

Sewage is collected in a reticulation of gravity sewers which collect sewage from all the buildings in the reserve (apart from the staff cottage which has its own septic tank and soak away system) and feeds into a 40 000litre septic tank situated adjacent to the restaurant building. Liquid effluent from the septic tank is pumped to the existing sewage treatment plant situated close to the generator and boreholes where it is treated.

6.3 Existing Sewage Treatment & Disposal

This septic tank(s) performs the anaerobic digestion function of the sewage treatment process. The outflow from the septic tank(s) is then pumped from a sump to the second part of the sewage treatment package plant which is situated higher up on the Reserve. This second part should perform further anaerobic digestion of the sewage before it enters the aerobic digestion section and clarifier. The clarified effluent should then be sterilized using UV light, ozone or chlorine before being pumped to a soak away area.

Inspection of this second part of the plant with sewage treatment experts revealed that the plant is not functioning properly and cannot function properly without major modifications. There is also no sterilization process available.

6.4 Proposed Sewage Treatment Process & Plant

6.4.1 Existing Septic Tank

Gravity sewers will convey sewage from the restaurants, Main House and Proposed Entertainment Facility to the existing 40 000-litre septic tank from where liquid effluent will be pumped to the sewage treatment plant.

6.4.2 Proposed Septic Tank

Gravity sewers will be laid to convey sewage from the proposed garages and staff ablutions, the conference centres and the Manager's house into an 8 500-litre septic tank to be constructed adjacent to the Manager's House. Liquid effluent from this septic tank will be pumped to the sewage treatment plant.

6.4.3 Proposed Sewage Treatment Plant

The existing sewage treatment plant (improved & extended) or a new sewage treatment plant, capable of treating 62 000-litres of sewage a day will be constructed on the site of the existing plant. In this new or improved / extended plant, sewage will be broken down in a combination of anaerobic and aerobic digestion processes in which specialized bacteria will break down and consume the solids.

A clarifier will then separate out sludge which will be returned to the aerobic digestor. Treated effluent from the clarifier will be sterilized using chlorine, ozone or UV light and will then be pumped to a soak-away tank from which it will soak away into the permeable in situ sand.

Periodic testing of the treated effluent must be carried out to ensure it meets minimum standards.

7. Refuse Removal

Refuse is collected in the Reserve and sorted into:

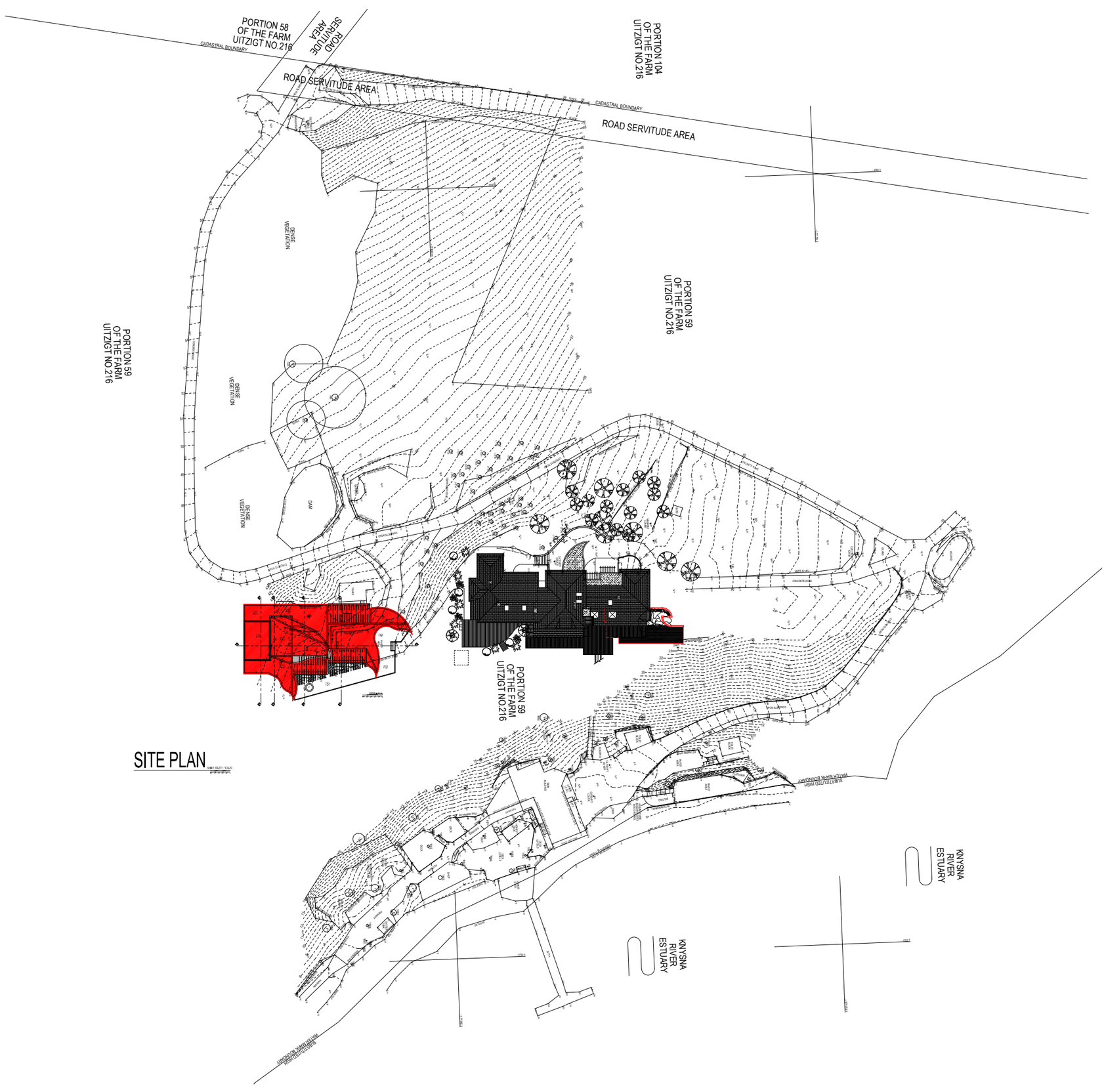
a) Refuse for the dump
b) Recycling material
c) Compostable material
d) Food waste suitable for use by pig farmers.

Refuse for the dump is transported to the Municipal solid waste transfer station from where it is carted to Mossel Bay where it is disposed of in landfill.

Recyclable material is carted to the recycling facility in the industrial area for recycling.

Compostable material is composted in the Reserve and the compost used for landscape gardening.

Food waste is carted to pig farms where it is consumed by pigs.



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No.	Revision Made	Date

PROJECT
POOL HOUSE & RECREATIONAL AREA

PROJECT SITE
PORTION 59 OF THE FARM
UITZIGT NO.216
Knysna

PROJECT NUMBER
15.07

PROJECT STAGE
COUNCIL SUBMISSION (Stage 4.1)

DRAWING TITLE
SITE PLAN

DRAWING NUMBER
15.07.S4-1.1-1

REVISION
.

SCALE
1:500 @ A1 1:1000 @ A3

DATE
19.04.2017

CLIENT
JOHN BENN

AUTHOR
Liphetolo Matlatsa

CHECKED
Tracey Mills-Brink

ENGINEER
Hofmeyr & Associates (Rein Hofmeyr)

FLOOR AREAS
New Area enclosed within walls:
New Pool House: 613,50 m²

New Foot Print
New Pool House: 656,90 m²

New Total Coverage: 656,90 m²
Site Area: 135 668,00 m²
Coverage %: 0,485 %

OWNER'S SIGNATURE

ARCHITECT'S SIGNATURE
Tracey Mills-Brink
PR.ARCH 5765

FOR OFFICE USE
C:\2017 TMBA\07 POOL HOUSE\180419 JOHN BENN

TMBA ARCHITECTS
PostNet Suite 330, Knysna, 6570 Cell: 082 922 6775 Email: tracey@traceymillsbrink.com

TN

SCALE 1:500

LEGEND:

- Existing Borehole
- Proposed Sewer Line
- Proposed Sewer Pump Line
- Septic Tank
- Proposed Stormwater Line
- Proposed Stormwater Pump Line.
- Rain Water Tanks
- Proposed Soak away.

Existing Slip way.

Proposed soak away
- overflow to be piped onto existing slip way to discharge without causing erosion.

Proposed Septic Tank (8500L)
- To service garage/ conference centre/ managers cottage
- Effluent to be pumped to existing sewer treatment plant

4No x 10000L Rainwater Tanks
- overflow into Soak away
- rainwater to be pumped up to proposed 320 kl reservoir.

Soak away

10No x 10000L Rainwater Tanks
- overflow into soak away.
- rainwater to be pumped up to proposed 320 kl reservoir

Existing Septic Tanks (4No x 10000L)

Existing Borehole #1

Existing Borehole #2

Existing Rain water Tanks (2No x 10000L).

Proposed sewer to tie into exising reticulation. from main house to the Septic tanks at the restaurant.

Proposed 151kl Reservoir for Domestic Water

Existing Sewer Treatment Plant.

Proposed 320kl Reservoir for Rainwater Storage.

CLIENT	FEATHERBED NATURE RESERVE.
PROJECT	FEATHERBED NATURE RESERVE
TITLE	PROSPOSED CIVIL SERVICES

SCALE	PAPER SIZE	DRAWING NO
NTS	A3	16-20-001

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NO	DESCRIPTION	DATE	SIGNED
0	PROPOSED CIVIL SERVICES	08/04/2026	RH

REVISIONS DETAILS

DATE APRIL 2026 | DESIGNED RH | DRAWN JV | CHECKED RH | REVISIONS 0

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GEOHYDROLOGICAL INVESTIGATION REPORT

BOREHOLE CAPICITY AND WATER QUALITY TESTING

For

FEATHERBED NATURE RESERVE BOREHOLE 01.

08th of April 2026

Report prepared by
Baron Vutoyi (Pri. Sci.Nat. 120060)
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Report reviewed by
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ACCEPTANCE LETTER

26th of March 2026
Corner of Rand & Bank Street
George Industrial
Western Cape, 6536

Attention: Sir / Madam
Ref: ***Geohydrological Report for Featherbed Nature Reserve Borehole 01.***

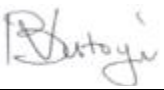
Arena Group is pleased to present our Geohydrological Investigation Report for Featherbed Nature Reserve Borehole 01. This report contains a summary of the results of Borehole Capacity Testing and Water Quality Testing fieldwork investigation which was conducted on the 26th of March 2026 till the 28th of March 2026 by Arena Group.

We trust that this report contains the information required and we thank you for the opportunity to assist you on this project. Copies of Geohydrological Investigation Report have been distributed as indicate in the table below:

Distribution List	*Date issued*	*Number of Copies*
Mr. B. Vutoyi	09/04/2026	1 Electronic and Hard Copy
Arena Group	09/04/2026	1 Electronic and Hard Copy
Featherbed Nature Reserve	09/04/2026	1 Electronic and Hard Copy

If you have any questions regarding the contents of this report, please call our office.

Yours Sincerely,



Baron Vutoyi
Geo hydrologist /Hydro Geologist (Pri. Sci. Nat Registered 120060)
Tel: 044 050 1151. **Cell:** +27 63 640 3546. **Email:** sales3@arenagroup.co.za

PROFILE OF THE CONSULTANT

GEO-HYDROLOGICAL CONSULTANT'S EXPERIENCE

- **Company** : Arena Group
- **Geo-Hydrological Consultant** : Baron Vutoyi
- **Telephone Number** :044 050 1151 / 086 999 0823
- **E-mail address** :sales3@arenagroup.co.za

QUALIFICATIONS

- B.Sc. (Honours) Environmental Sciences, NWU, 2014.
- B.Sc. (Honours) Information Technology, NWU, 2011.
- B.Sc. Statistics & Geology, UZ, 2004,

PROFESSIONAL REGISTRATION BOARDS

- SACNASP, Pri. Sci. Nat. 120060
- SAQA, NQF 7

KEY EXPERIENCES:

- Project management, coordinating & supervising the work of professional and technical staff, designing, implementation, monitoring, communicating with the client & subcontractors through regular meetings, emails etc. and composing of concise technical reports for projects;
- Undertake specialist input into Basic Assessments, Environmental Impact Assessments, Water Use Licenses, Planning geophysical surveys and interpretation of data (obtained from Magnetometers, Electromagnetics, Resistivity etc.), Design and construction of production boreholes and monitoring wells in varied geological environments, Planning and execution of drilling, geological logging/mapping, camera inspection, hydraulic tests and interpretation of data, Data analysis and interpretation of hydro geochemical data, Understanding and experienced with conceptual hydrogeological models, numerical flow models;
- Ability to work in a multi-disciplinary team and an environment which promotes a high safety culture.

1. INTRODUCTION

1.1. Background

Following the appointment of Arena Group by Featherbed Nature Reserve to conduct a borehole capacity and water quality testing to understand the aquifer yield and determine the correct pump to be installed. Four stages were conducted comprising of Step Testing, Constant Discharge Testing, Recovery Testing and Water Quality Testing to understand the sustainability / capacity of the borehole and hence make best possible recommendations for the borehole installation and usability. This study relied on expert knowledge and literature sources to assess and evaluate the current water resources and determine their productive capacity.

1.2. Location of the Borehole

A Google map showing the Featherbed Nature Reserve Borehole 01 location is presented below.

Figure 01: Google Earth Location of Featherbed Nature Reserve Borehole 01.

1.3. Geology of Featherbed Nature Reserve

The area and surrounding area of Featherbed Nature Reserve is underlain by rock formations of the Peninsula Formation, which form the base of the Table Mountain Group and the base of the Cape Supergroup. The Peninsula Formation is classified as *Ordovician* in age (± 480 Ma). The Peninsula Formation (although not visible within this area specifically) was deposited on top of tilted and folded rocks of the Malmsbury Group and granites of the Cape Granite Suite and that it comprises at least half of the Table Mountain Group and its thickness varies from 1800 – 2150 m. It is composed of a monotonous succession of medium to coarse-grained, thickly bedded, greenish grey sandstone which weathers whitish.

The deposition was mainly from the north into the fairly stable basin. With time and as more and more layers of rock formations were deposited on top, and due to pressure and heat, these beach sands were metamorphosed into sandstone and eventually into quartzites.

1.4. Hydrogeology

The regional aquifer directly underlying the Featherbed Nature Reserve Borehole 01 is classified by the Department of Water Affairs and Forestry (DWAF, 2002) as a fractured aquifer with an average yield potential of 0.1 – 0.5 L/s. A fractured aquifer describes an aquifer where groundwater only occurs in narrow fractures within the bedrock.

Based on the DWAF (2002) mapping of the regional groundwater quality, the electrical conductivity (EC), the majority of the area surrounding the Featherbed Nature Reserve Borehole 01 is approximately to be in the range of 0 -70 mS/m. This is considered to be “moderate to poor” quality for water with respect to drinking water standards. Both these classifications are based on regional datasets, and therefore only provide an indication of conditions to be expected.

2. AQUIFER SUSTAINABILITY TESTING FOR BOREHOLES

Featherbed Nature Reserve Borehole 01 was aquifer tested by Arena Group. The test data has been analysed and is discussed below. In short, aquifer testing entails the following:

2.1. Step Tests

The borehole is pumped at varying abstraction rates for periods of 60 minutes each and water levels are measured in the borehole at pre-determined intervals. A recorded sheet is attached in the appendix. The test effectively stresses the hole and gives an indication of its capable yield. The abstraction rate for the longer duration aquifer sustainability test is determined from the step test and its resultant data; hence a blow yield of the borehole has to be identified.

2.2. Constant Discharge Test

The Constant Discharge Test is usually carried for a period of approximately 24-hours and involves measuring the water levels in the borehole while pumping the water out and thus creating “drawdown” within the borehole. Drawdown is the difference between the measured Water Level at any time during the test and the position at which the Water Level would have been Static Water Level (SWL) if abstraction had not taken place. The main aim of the test is to lower the Water Level in the borehole to approximately 65% of the Available Drawdown and maintain the Water Level at this depth. The Constant Discharge Test is performed to assess the productivity of the aquifer according to its response to the abstraction of water. The response is analysed to provide information regarding the hydraulic properties of the groundwater and arrive at an optimum yield for the medium to long-term utilization of the borehole.

2.3. Recovery Readings

The rate at which the borehole recovers (WL rises) is also measured and recorded once the pump is switched off. This data is useful in determine the storage available to the borehole and the position of the main water strike(s).

3. AQUIFER TEST RESULTS FOR FEATHERBED NATURE RESERVE B/H 01.

The details of the aquifer test set-ups of Featherbed Nature Reserve Borehole 01 are presented below;

3.1. Step Testing Results

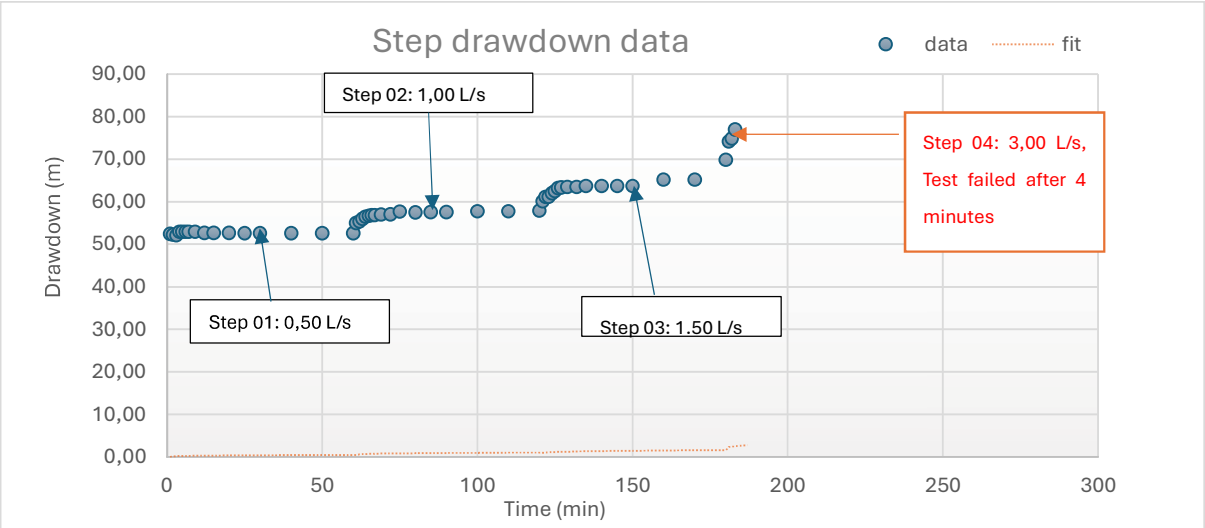
Table 1: Information of Featherbed Nature Reserve Borehole 01.

Borehole Name	*Coordinates*		*Borehole Information*	
Site Name	**Latitude**	**Longitude**	**B/H Depth (m)**	**SWL (m)**
Featherbed Nature Reserve	34° 4'26.56"S	23° 2'55.14"E	82.00	49.00

Table 2: Drawdown Data - Step Test of Featherbed Nature Reserve Borehole 01.

Steps	*L/s*	*Depth of Pump (m)*	*Dynamic Water Level (m)*	*Drawdown (m)*	*Percentage of Drawdown (m)*
Step 01	0,50	80,00	52,60	27,40	34,25
Step 02	1,00	80,00	57,90	22,10	27,63
Step 03	1,50	80,00	65,20	14,80	18,50
Step 04	3,00	80,00	77,00	3,00	3,75

Graph of Step Test Charge of the Borehole Vs Log – Time.



Graph 1: Graph of Step Drawdown Test of Featherbed Nature Reserve Borehole 01.

Analysis of the step-drawdown data indicated that the constant discharge test could be performed at a constant rate of 1.00 L/s for a period of twenty-four hours without failing.

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3.2. Constant discharge Test results

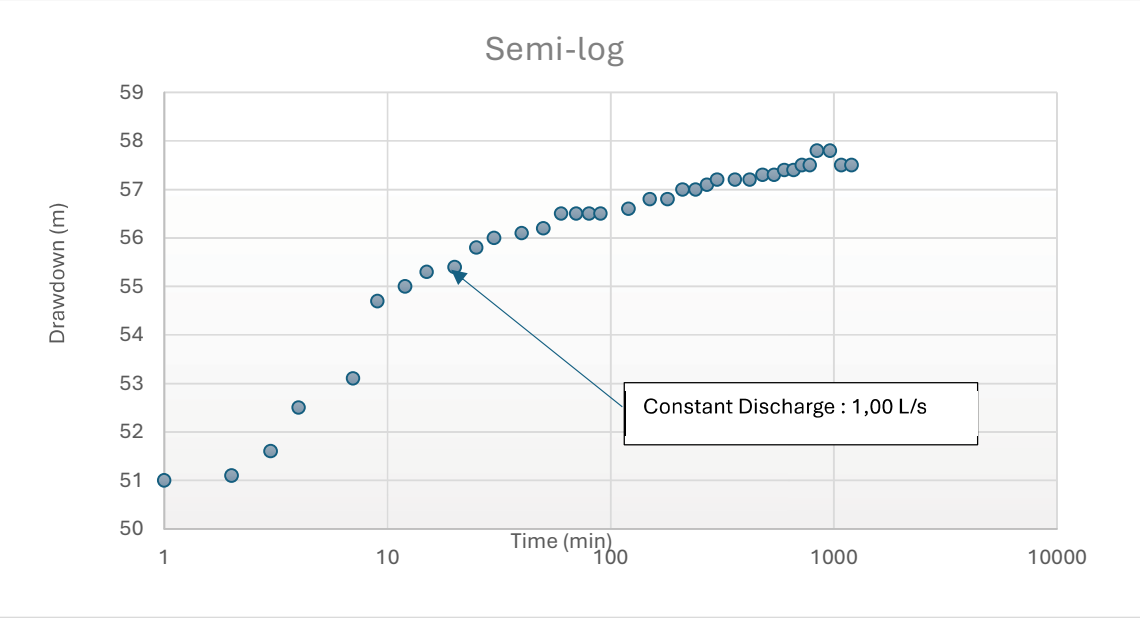
Table 3: Drawdown - Constant Discharge Test Borehole 01.

Constant Discharge	*Duration Hours*	*Depth of Pump (m)*	*Static Water level (m)*	*Available Drawdown (m)*	*Dynamic Water Level (m)*	*Available Drawdown (m)*	*%age of Available Drawdown*
1.00 L/s	24,00	80.00	49.00	31.00	57.40	22.60	95.48

ALL calculation done above the static water level used is 49.00 mbgl and available drawdown is 31.00 mbgl after pump installation.

Graph of Constant Discharge Test of the Borehole Vs Log – Time.

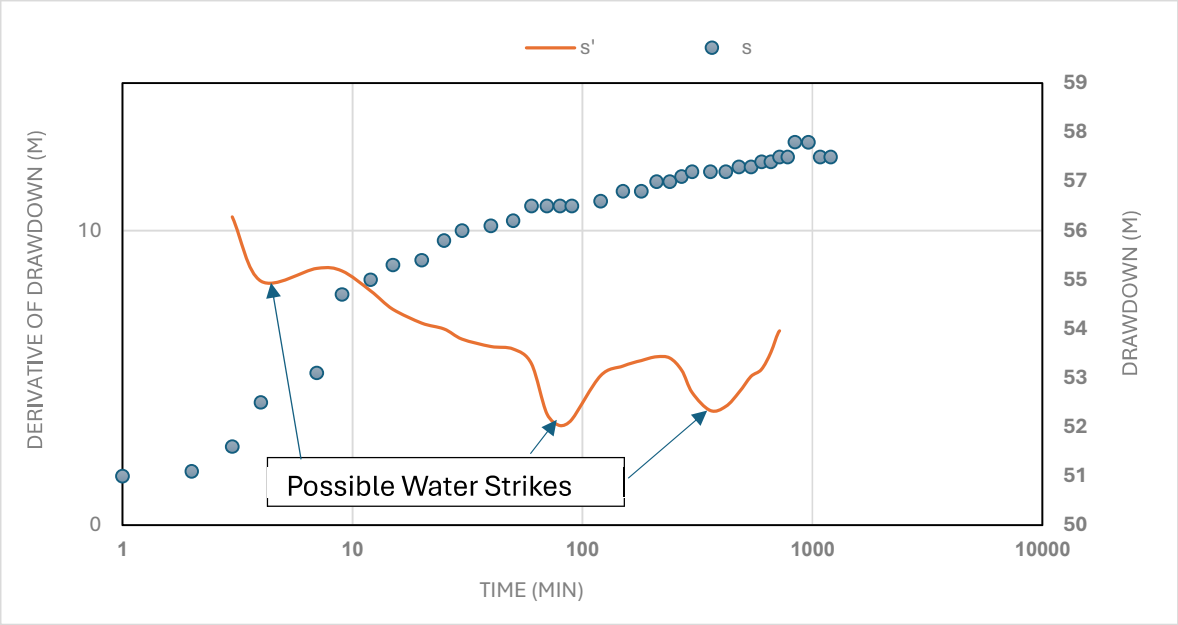
Graph 2 below presents a graphical summary of the Constant Discharge Test and possible depth of water strikes that exists in the borehole 01.



Graph 2: Graph of Constant Discharge test of Featherbed Nature Reserve Borehole 01.

The CDT was carried out for a period of a 24-hours at 1.00 L/s on average and achieved a maximum drawdown of 29.60 meters remained available which is 95.48 % of the available drawdown was available after constant discharge testing.

Derivative Plots And T- And S – Values Vs Log – Time



Graph 3: Graph of Derivative Plots And T- And S – Values Vs Log – Time

The graph above shows possible water strikes at 56.50 mbgl , 57.20 mbgl, and 51.60 mbgl.

3.3. Recovery testing results

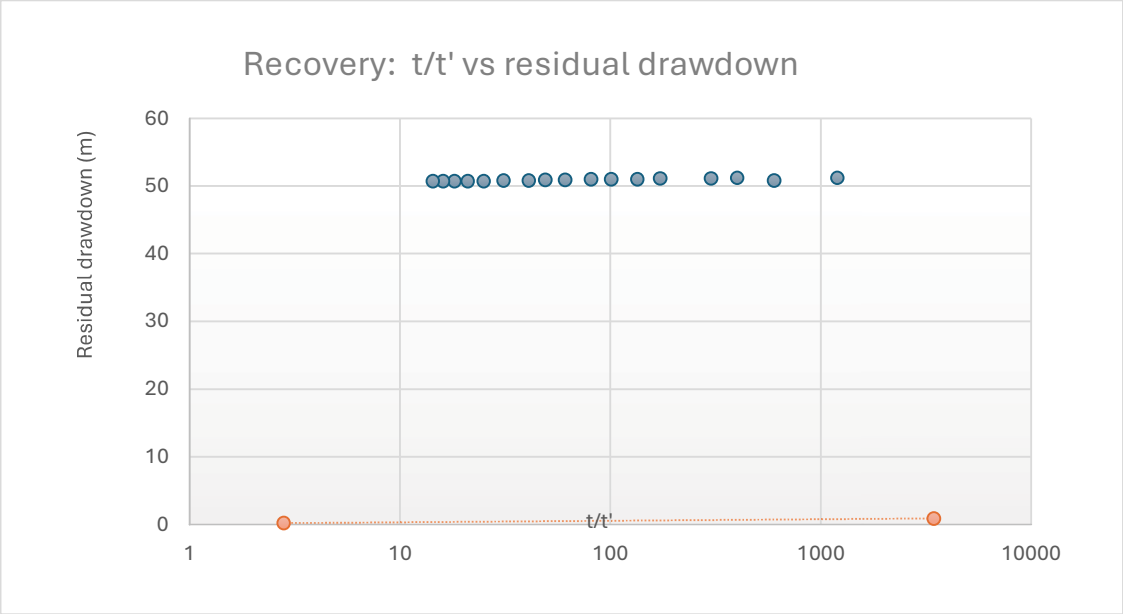
The recovery of the water level was monitored for both Step Test and CDT and is presented in the table below:

Table 4: Drawdown Data Recovery and Step Test Recovery of Featherbed Nature Reserve Borehole 01.

Test	Duration Minutes	Available Drawdown (m)	Static Water Level (m)	Dynamic Water Level (m)	Unrecovered	%age of recovered drawdown (m)
Step Test	90,00	31,00	49,00	50,20	1,20	96.45
Constant Test	90,00	30,30	49,70	57,40	1,00	99.26

The step test water level in the borehole recovered to 99.45 % of the static water level in 90 minutes after pumping stopped and in the constant discharge test the water level in the borehole recovered to 99.26 % after the pump was switched off in 90 minutes. In all the tests more than 65% of extracted water. This is an indication that the borehole recovers fast and has a good fracture network.

Graph of Recovery Test of the Borehole Vs Log – Time.



Graph 5: Graph of Recovery Test Vs Log – Time of Featherbed Nature Reserve Borehole 01.

It was observed that the borehole recoveries very fast. Within an hour the borehole had recovered more than 65 % of the drawdown water pumped during constant discharge.

4. WATER QUALITY ANALYSIS

4.1. Sampling procedure

Groundwater samples are ideally collected and sent to a SANAS Accredited Laboratory (Western Cape Laboratory) for potability analysis. The sample are taken according to the DWAF standards, at the end of the Constant Discharge Test in order to be representative of the water of a wider zone around the borehole.

4.2. Water quality

Water quality of domestic water, utilized for human consumption and food preparation, must be safe to use if the consumers' health is to be protected. For this reason, the "Quality of Domestic Water Supplies" (Second edition, 1998)" was set forward by the Department of Water Affairs and Forestry, Department of Health and the Water Research Commission in 1998. This document facilitates the evaluation of water on the basis of five water quality classes:

Table 5: Water Quality Analysis for Human Consumption,

CLASS	pH	TDS	EC	Total Hardness	Ca	Mg	Cl	NO2	Na	K	F
Class 0	5.00 - 9.50	<450	<70	0 -200	0.00 - 30.00	<100	<100	<6	<100	<25	<0.7
Class 1	4.50 - 5.00	450 - 1000	70 - 150	200 - 300	30 - 150	100 - 200	100 - 200	6.00 - 10	100 - 200	25 - 50	0.70 - 1.00
Class 2	4.00 - 4.50	1000 -2400	150 -370	300 - 400	150 - 300	200 - 400	200 - 600	10.00 - 20.00	200 - 400	50 - 100	1.00 - 1.50
Class 3	3.00 - 4.00	2400-3400	370 - 520	>400	>300	400 - 1200	600 - 1200	20 - 40.00	400 - 1000	100 - 500	1.50 - 3.50
Class 4	<3.00 ->11.00	>3400	>520			>1200	>1200	>40.00	>1000	>500	>3.50

Class 0 : ideal water quality, suitable for lifetime.
Class 1 : Good water quality, suitable for use, rare instances of negative effects
Class 2 : Marginal water quality-conditionally acceptable, Negative effects may occur in some cases to sensitive groups .
Class 3 : Poor water quality, Unsuitable for use without treatment. Chronic effects may occur.
Class 4 : Dangerous water quality, totally unsuitable ,for use. Acute effects may occur.

However, there was no water sample collected and sent to the Water Laboratory for Water Quality Testing and analysis of the result. It is advisable that water quality is done depending on the water use.

This data should be analysed by a qualified Hydrogeologist to ensure long term sustainable use the of the borehole. The legal compliance regarding the use of the groundwater also needs to be addressed with the Department of Water and Sanitation.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. RECOMMENDATIONS

Based on the aquifer test data, assessing of the pumping curves, location of the borehole relative to other boreholes and the recovery data, the following abstraction and installation recommendations has been made:

Table 6: Recommended Installation and Abstraction Rate for Featherbed Nature Reserve Borehole 01.	
Borehole Depth	82,00 mbgl
Borehole Pump Depth	80,00 L/s
Rest Water Level	49,7 mbgl
Borehole Pumping Rate	1,00 L/s
Borehole Pumping Duration	1 440 minutes
Borehole Recovery Duration	90 minutes
Transducer	Yes
Litres per Second	1,00 L/s
Litres per Minutes	60 L/Minute
Litres per Hour	3 600 L/Hour
Litres in 24 Hours	86 400 L/day
Critical Water Level	49,700 mbgl
Dynamic Water Level	57,40 mbgl

5.2. CONCLUSIONS

As of January 2018 the Department of Water and Sanitation released a Government Gazette stating that: “All water use sector groups and individuals taking water from any water resource (surface or groundwater) regardless of the authorization type, in the Berg, Olifants and Breede Gouritz Water Management Area, shall install electronic water recording, monitoring or measuring devices to enable monitoring of abstractions, storage and use of water by existing lawful users and establish links with any monitoring or management system as well as keep records of the water used.” Therefore, to facilitate monitoring and informed management of a borehole, it is highly recommended that a borehole be equipped with the following monitoring infrastructure and equipment:

- Installation of a 32 mm (inner diameter, class 10) observation pipe from the pump depth to the surface, closed at the bottom and slotted for the bottom 5 – 10 m. This

allows for a 'window' of access down the borehole which enables manual water level monitoring and can house an electronic water level logger.

- Installation of an electronic water level logger (for automated water level monitoring)
- Installation of a sampling tap (to monitor water quality) if required.
- Installation of a flow volume meter (to monitor abstraction rates and volumes)

6. REFERENCES

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APPENDIX A- BOREHOLE TEST RESULTS

FEATHERBED NATURE RESERVE BOREHOLE 01 TEST RESULTS

FORM 5F

BOREHOLE TEST RECORD SHEET- STEP TEST DISCHARGE & RECOVERY

Alt Borehole	None		**Province**	Western Cape	
Alt Borehole	None		**District**	Knysna Municipality	
Depth of Borehole	None		**Site Name**	Featherbed Nature Reserve	
			Date	26th of Mach 2026	

Borehole Depth	82.00 mbgl	**Datum Level Above Casing (m)**	0.90	**Pump Installed**	Submersible
Water Level	49.00 mbgl	**Casing Height (magl)**	0.00	**Contractor**	Arena Group
Depth of Pump	80.00 mbgl	**Diameter of the Pump (mm)**	160.00	**Pump Type**	DW15M

STEP TEST & RECOVERY

Discharge 1					**Discharge 2**					**Discharge 3**				
Date:		**Time**			**Date:**		**Time**					**Time**		
Time	**D/D**	**Yield**	**Time**	**Recovery**	**Time**	**D/D**	**Yield**	**Time**	**Recovery**	**Time**	**D/D**	**Yield**	**Time**	**Recovery**
mins	**m**	**L/s**	**mins**	**m**	**mins**	**m**	**L/s**	**mins**	**m**	**mins**	**m**	**L/s**	**mins**	**m**
1	52,50	**0.50**	**1**		**1**	55,00	**1.00**	**1**		**1**	60,10	1,50	**1**	**63.500**
2	52,30	**0.50**	**2**		**2**	55,40	**1.00**	**2**		**2**	61,20	1,50	**2**	**6.00**
3	52,10	**0.50**	**3**		**3**	56,00	**1.00**	**3**		**3**	61,20	1,50	**3**	**57.200**
4	53,00	**0.50**	**4**		**4**	56,50	**1.00**	**4**		**4**	62,00	1,50	**4**	**55.800**
5	53,00	**0.50**	**5**		**5**	56,70	**1.00**	**5**		**5**	62,50	1,50	**5**	**54.400**
6	53,00	**0.50**	**7**		**6**	56,90	**1.00**	**6**		**6**	63,20	1,50	**6**	**52.700**
7	53,00	**0.50**	**9**		**7**	56,90	**1.00**	**7**		**7**	63,40	1,50	**7**	**52.200**
9	53,00	**0.50**	**12**		**9**	57,00	**1.00**	**9**		**9**	63,50	1,50	**9**	**51.500**
12	52,70	**0.50**	**15**		**12**	57,10	**1.00**	**12**		**12**	63,50	1,50	**12**	**51.300**
15	52,70	**0.50**	**20**		**15**	57,70	**1.00**	**15**		**15**	63,70	1,50	**15**	**50.800**
20	52,70	**0.50**	**25**		**20**	57,50	**1.00**	**20**		**20**	63,70	1,50	**20**	**49.800**
25	52,60	**0.50**	**30**		**25**	57,60	**1.00**	**25**		**25**	63,70	1,50	**25**	**49.800**
30	52,60	**0.50**			**30**	57,60	**1.00**	**30**		**30**	63,70	1,50	**30**	**50.700**
40	52,60	**0.50**			**40**	57,80	**1.00**	**40**		**40**	65,20	1,50	**40**	**50.400**
50	52,60	**0.50**			**50**	57,80	**1.00**	**50**		**50**	65,20	1,50	**50**	**50.300**
60	52,60	**0.50**			**60**	57,90	**1.00**	**60**		**60**	69,9	1,50	**60**	**50.200**

FORM 5F

BOREHOLE TEST RECORD SHEET- STEP TEST DISCHARGE & RECOVERY

Alt Borehole	None	**Province**	Western Cape
Alt Borehole	None	**District**	Knysna Municipality
Depth of Borehole	None	**Site Name**	Featherbed Nature Reserve
		Date	26th of Mach 2026

Borehole Depth	82.00 mbgl	**Datum Level Above Casing (m)**	0.90	**Pump Installed**	Submersible
Water Level	49.00 mbgl	**Casing Height (magl)**	0.00	**Contractor**	Arena Group
Depth of Pump	80.00 mbgl	**Diameter of the Pump (mm)**	160.00	**Pump Type**	DW15M

Date:		**Time**			**Date:**		**Time**			**Date:**		**Time**		**50.200**
Time	**D/D**	**Yield**	**Time**	**Recovery**	**Time**	**D/D**	**Yield**	**Time**	**Recovery**	**Time**	**D/D**	**Yield**	**Time**	**Recovery**
mins	**m**	**L/s**	**mins**	**m**	**mins**	**m**	**L/s**	**mins**	**m**	**mins**	**m**	**L/s**	**mins**	**m**
1	74,2	3,00	**1**		**1**			**1**		**1**			**70**	**50.200**
2	74,9	3,00	**2**		**2**			**2**		**2**			**80**	**50.200**
3	77	3,00	**3**		**3**			**3**		**3**			**90**	**50.200**
4			**4**		**4**			**4**		**4**				
5			**5**		**5**			**5**		**5**				
6			**6**		**6**			**6**		**6**				
7			**7**		**7**			**7**		**7**				
9			**9**		**9**			**9**		**9**				
12			**12**		**12**			**12**		**12**				
15			**15**		**15**			**15**		**15**				
20			**20**		**20**			**20**		**20**				
25			**25**		**25**			**25**		**25**				
30			**30**		**30**			**30**		**30**				
40			**40**		**40**			**40**		**40**				
50			**50**		**50**			**50**		**50**				
60			**60**		**60**			**60**		**60**				
					pH									

FORM 5E

BOREHOLE TEST RECORD SHEET - CONSTANT DISCHARGE & RECOVERY

Project No	01	**Province**	Western Cape
Borehole No.	01	**Municipality**	Knysna
Borehole Depth	82.00 mbgl		34° 4'26.56"S
Water Level	49.00 mbgl	**Coordinates**	23° 2'55.14"E
Depth of Pump	80.00 mbgl	**Contractor**	Arena Group
Casing	0.00	**Operator**	Jacques Fivaz
Elevation	N/A	**Pump Type**	DW15M

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ArenaGroup Group of Companies

CONSTANT DISCHARGE & RECOVERY

Test Started			**Duration**		
Date	**26/03/206**	**Time**	**08H00**	**24.00**	**Hours**
Distance fom Observation Borehole			**Observation Borehole**	**None**	
Distance fom Pumping Hole Borehole			**None Applicable**	**Distance from Observation Borehole**	

CONSTANT DISCHARGE						RECOVERY				Observation Borehole			
Time	**Drawdown**	**Yield**	**Time**	**Drawdown**	**Yield**	**Time**	**Drawdown**	**Time**	**Drawdown**	**Time**	**D/D**	**Time**	**D/D**
mins	**m**	**L/S**	**mins**	**m**	**L/S**	**mins**	**m**	**mins**	**m**	**mins**	**m**	**mins**	**m**
1	51,00		780	57,50		1	51,20	780		**1**			
2	51,10		840	57,80		2	50,80	840		**2**			
3	51,60		960	57,80		3	51,20	960		**3**			
4	52,50		1080	57,50		4	51,10	1080		**4**			
7	53,10		1200	57,50		7	51,10	1200		**5**			
9	54,70		1440	57,50		9	51,00	1440		**7**			
12	55,00					12	51,00			**9**			
15	55,30					15	51,00			**12**			
20	55,40					20	50,90			**15**			
25	55,80					25	50,90			**20**			
30	56,00					30	50,80			**25**			
40	56,10					40	50,80			**30**			
50	56,20					50	50,70			**40**			
60	56,50					60	50,70			**50**			
70	56,50					70	50,70			**60**			
80	56,50					80	50,70			**70**			
90	56,50					90	50,70			**80**			
120	56,60					120				**90**			
150	56,80					150				**120**			
180	56,80					180				**150**			
210	57,00					210				**180**			
240	57,00					240				**210**			
270	57,10					270				**240**			
300	57,20					300				**270**			
360	57,20					360				**300**			
420	57,20					420				**360**			
480	57,30					480				420			
540	57,30					540				480			
600	57,40					600				540			
660	57,40					660				600			
720	57,50					720				660			

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GEOHYDROLOGICAL INVESTIGATION REPORT

BOREHOLE CAPICITY AND WATER QUALITY TESTING

For

FEATHERBED NATURE RESERVE BOREHOLE 02.

08th of April 2026

Report prepared by
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ACCEPTANCE LETTER

26th of March 2026
Corner of Rand & Bank Street
George Industrial
Western Cape, 6536

Attention: Sir / Madam
Ref: ***Geohydrological Report for Featherbed Nature Reserve Borehole 01.***

Arena Group is pleased to present our Geohydrological Investigation Report for Featherbed Nature Reserve 01. This report contains a summary of the results of Borehole Capacity Testing and Water Quality Testing fieldwork investigation which was conducted on the 29th of March 2026 till the 31st of March 2026 by Arena Group.

We trust that this report contains the information required and we thank you for the opportunity to assist you on this project. Copies of Geohydrological Investigation Report have been distributed as indicate in the table below:

Distribution List	***Date issued***	***Number of Copies***
Mr. B. Vutoyi	09/04/2026	1 Electronic and Hard Copy
Arena Group	09/04/2026	1 Electronic and Hard Copy
Featherbed Nature Reserve	09/04/2026	1 Electronic and Hard Copy

If you have any questions regarding the contents of this report, please call our office.

Yours Sincerely,

Baron Vutoyi
Geo hydrologist /Hydro Geologist (Pri. Sci. Nat Registered 120060)
Tel: 044 050 1151. **Cell:** +27 64 792 2504. **Email:** vutoyi2012@gmail.com

PROFILE OF THE CONSULTANT

GEO-HYDROLOGICAL CONSULTANT'S EXPERIENCE

- **Company** : Arena Group
- **Geo-Hydrological Consultant** : Baron Vutoyi
- **Telephone Number** :044 050 1151 / 086 999 0823
- **E-mail address** :sales3@arenagroup.co.za

QUALIFICATIONS

- B.Sc. (Honours) Environmental Sciences, NWU, 2014.
- B.Sc. (Honours) Information Technology, NWU, 2011.
- B.Sc. Statistics & Geology, UZ, 2004,

PROFESSIONAL REGISTRATION BOARDS

- SACNASP, Pri. Sci. Nat. 120060
- SAQA, NQF 7

KEY EXPERIENCES:

- Project management, coordinating & supervising the work of professional and technical staff, designing, implementation, monitoring, communicating with the client & subcontractors through regular meetings, emails etc. and composing of concise technical reports for projects;
- Undertake specialist input into Basic Assessments, Environmental Impact Assessments, Water Use Licenses, Planning geophysical surveys and interpretation of data (obtained from Magnetometers, Electromagnetics, Resistivity etc.), Design and construction of production boreholes and monitoring wells in varied geological environments, Planning and execution of drilling, geological logging/mapping, camera inspection, hydraulic tests and interpretation of data, Data analysis and interpretation of hydro geochemical data, Understanding and experienced with conceptual hydrogeological models, numerical flow models;
- Ability to work in a multi-disciplinary team and an environment which promotes a high safety culture.

1. INTRODUCTION

1.1. Background

Following the appointment of Arena Group by Featherbed Nature Reserve (Pty) Ltd to conduct a borehole capacity and water quality testing to understand the aquifer yield and determine the correct pump to be installed. Four stages were conducted comprising of Step Testing, Constant Discharge Testing, Recovery Testing and Water Quality Testing to understand the sustainability / capacity of the borehole and hence make best possible recommendations for the borehole installation and usability. This study relied on expert knowledge and literature sources to assess and evaluate the current water resources and determine their productive capacity.

1.2. Location of the Borehole

A Google map showing the Featherbed Nature Reserve Borehole 02 location is presented below.

Figure 01: Google Earth Location of Featherbed Nature Reserve Borehole 02.

1.3. Geology of Featherbed Nature Reserve

The area and surrounding area of Featherbed Nature Reserve is underlain by rock formations of the Peninsula Formation, which form the base of the Table Mountain Group and the base of the Cape Supergroup. The Peninsula Formation is classified as Ordovician in age (± 480 Ma). The Peninsula Formation (although not visible within this area specifically) was deposited on top of tilted and folded rocks of the Malmsbury Group and granites of the Cape Granite Suite and that it comprises at least half of the Table Mountain Group and its thickness varies from 1800 – 2150 m. It is composed of a monotonous succession of medium to coarse-grained, thickly bedded, greenish grey sandstone which weathers whitish.

The deposition was mainly from the north into the fairly stable basin. With time and as more and more layers of rock formations were deposited on top, and due to pressure and heat, these beach sands were metamorphosed into sandstone and eventually into quartzites.

1.4. Hydrogeology

The regional aquifer directly underlying the Featherbed Nature Reserve Borehole 02 is classified by the Department of Water Affairs and Forestry (DWAF, 2002) as a fractured aquifer with an average yield potential of 0.1 – 0.5 L/s. A fractured aquifer describes an aquifer where groundwater only occurs in narrow fractures within the bedrock.

Based on the DWAF (2002) mapping of the regional groundwater quality, the electrical conductivity (EC), the majority of the area surrounding the Featherbed Nature Reserve Borehole 02 is approximately to be in the range of 0 -70 mS/m. This is considered to be “moderate to poor” quality for water with respect to drinking water standards. Both these classifications are based on regional datasets, and therefore only provide an indication of conditions to be expected.

2. AQUIFER SUSTAINABILITY TESTING FOR BOREHOLES

Featherbed Nature Reserve Borehole 02 was aquifer tested by Arena Group. The test data has been analysed and is discussed below. In short, aquifer testing entails the following:

2.1. Step Tests

The borehole is pumped at varying abstraction rates for periods of 60 minutes each and water levels are measured in the borehole at pre-determined intervals. A recorded sheet is attached in the appendix. The test effectively stresses the hole and gives an indication of its capable yield. The abstraction rate for the longer duration aquifer sustainability test is determined from the step test and its resultant data; hence a blow yield of the borehole has to be identified.

2.2. Constant Discharge Test

The Constant Discharge Test is usually carried for a period of approximately 24-hours and involves measuring the water levels in the borehole while pumping the water out and thus creating “drawdown” within the borehole. Drawdown is the difference between the measured Water Level at any time during the test and the position at which the Water Level would have been Static Water Level (SWL) if abstraction had not taken place. The main aim of the test is to lower the Water Level in the borehole to approximately 65% of the Available Drawdown and maintain the Water Level at this depth. The Constant Discharge Test is performed to assess the productivity of the aquifer according to its response to the abstraction of water. The response is analysed to provide information regarding the hydraulic properties of the groundwater and arrive at an optimum yield for the medium to long-term utilization of the borehole.

2.3. Recovery Readings

The rate at which the borehole recovers (WL rises) is also measured and recorded once the pump is switched off. This data is useful in determine the storage available to the borehole and the position of the main water strike(s).

3. AQUIFER TEST RESULTS FOR FEATHERBED NATURE RESERVE B/H 02.

The details of the aquifer test set-ups of Featherbed Nature Reserve Borehole 02 are presented below;

3.1. Step Testing Results

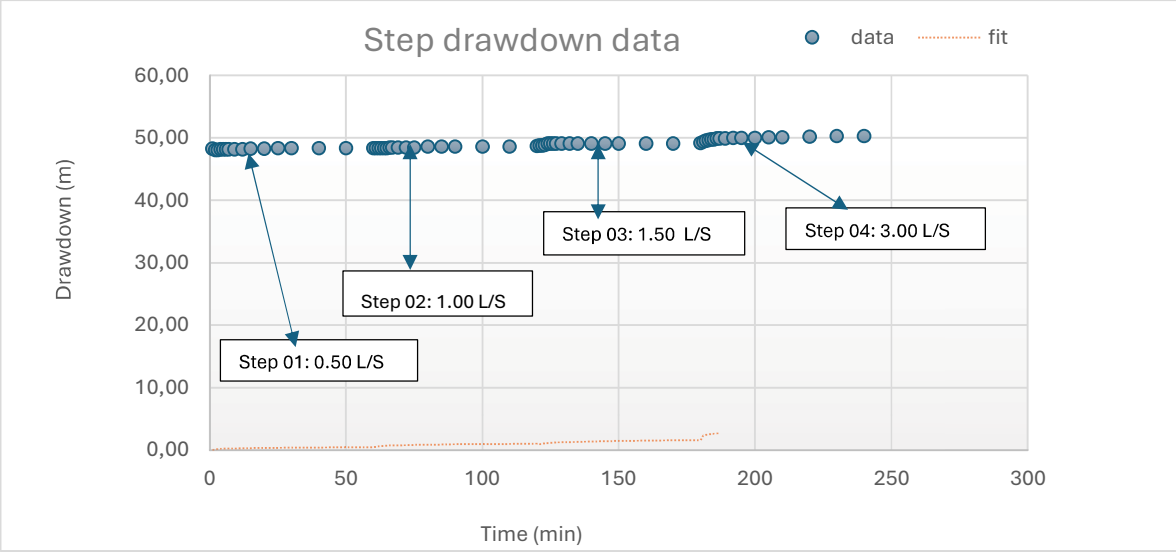
Table 1: Information of Featherbed Nature Reserve Borehole 02.

Borehole Name	*Coordinates*		*Borehole Information*	
Site Name	**Latitude**	**Longitude**	**B/H Depth (m)**	**SWL (m)**
Featherbed Nature Reserve	34° 4'27.23"S	23° 2'56.73"E	73.00	48.40

Table 2: Drawdown Data - Step Test of Featherbed Nature Reserve Borehole 02.

Steps	*L/s*	*Depth of Pump (m)*	*Dynamic Water Level (m)*	*Availble Drawdown (m)*	*Percentage of Drawdown (m)*
Step 01	0,50	70,00	48,40	21,60	30,86
Step 02	1,00	70,00	48,70	21,30	30,43
Step 03	1,50	70,00	49,20	20,80	29,71
Step 04	3,00	70,00	50,30	19,70	28,14

Graph of Step Test Charge of the Borehole Vs Log – Time.



Graph 1: Graph of Step Drawdown Test of Featherbed Nature Reserve Borehole (B/H 01).

Analysis of the step-drawdown data indicated that the constant discharge test could be performed at a constant rate of 1,200 L/s for a period of twenty-four hours without failing.

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3.2. Constant discharge Test results

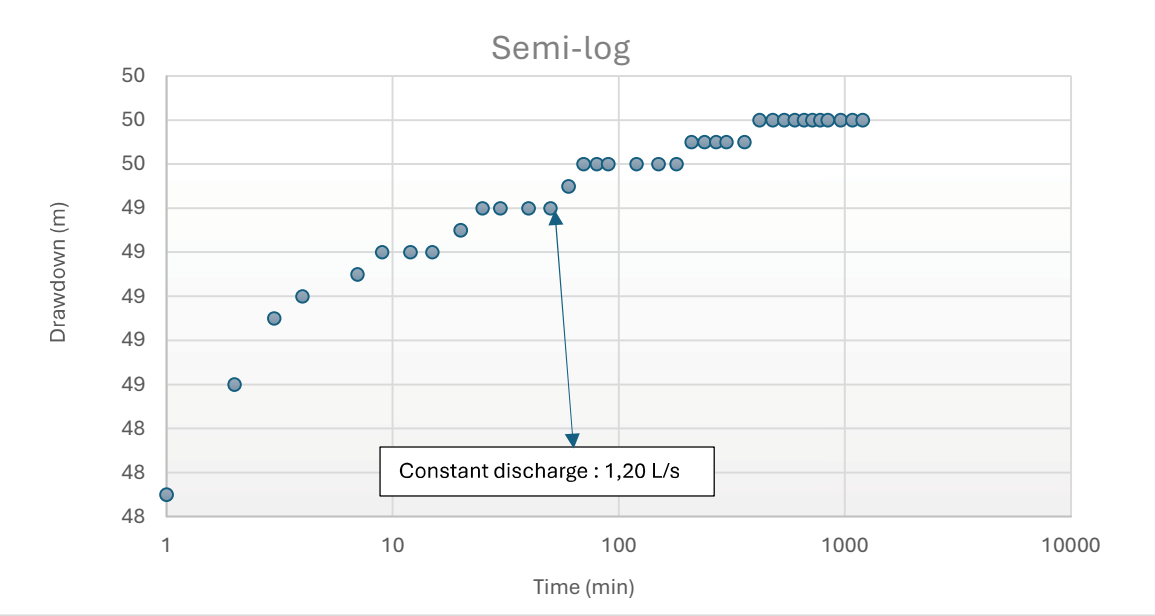
Table 3: Drawdown - Constant Discharge Test Featherbed Nature Reserve Borehole 02.

Constant Discharge	*Duration Hours*	*Depth of Pump (m)*	*Static Water level (m)*	*Available Drawdown (m)*	*Dynamic Water Level (m)*	*Available Drawdown (m)*	*%age of Available Drawdown*
1.20 L/s	24,00	70.00	48.40	21.60	49.70	20.30	93.98

ALL calculation done above the static water level used is 48.40 mbgl and available drawdown is 21.60 mbgl after pump installation.

Graph of Constant Discharge Test of the Borehole Vs Log – Time.

Graph 2 below presents a graphical summary of the Constant Discharge Test and possible depth of water strikes that exists in the borehole 02



Graph 2: Graph of Constant Discharge test of Featherbed Nature Reserve Borehole 02.

The CDT was carried out for a period of a 24-hours at 1.20 L/s on average and achieved a maximum drawdown of 20.30 meters remained available which is 93.98 % of the available drawdown was available after constant discharge testing.

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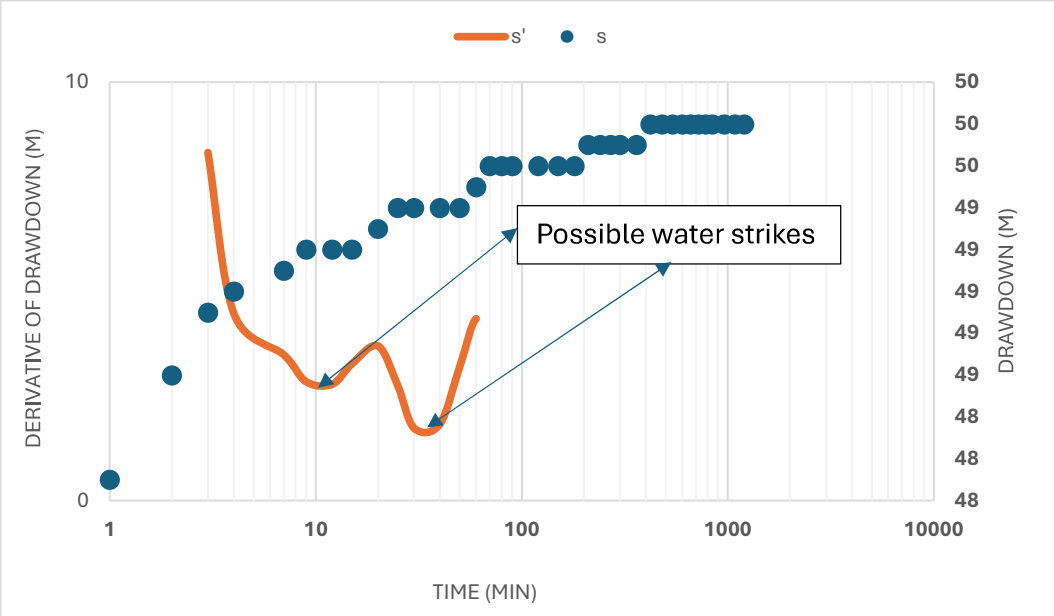
Derivative Plots And T- And S – Values Vs Log – Time



Graph 3: Graph of Derivative Plots And T- And S – Values Vs Log – Time

The possible water strikes were identified at depth of 49.20 mbgl and 49.40 mbgl.

3.3. Recovery testing results

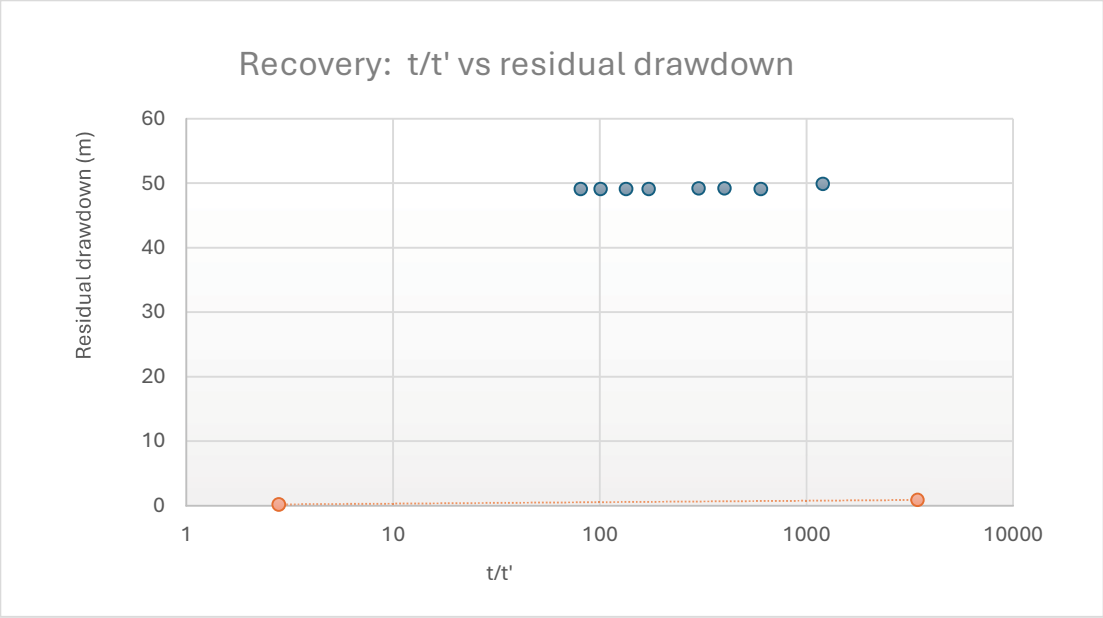
The recovery of the water level was monitored for both Step Test and CDT and is presented in the table below:

Table 4: Drawdown Data Recovery and Step Test Recovery of Featherbed Nature Reserve Borehole 02.

Test	Duration Minutes	Available Drawdown (m)	Static Water Level (m)	Dynamic Water Level (m)	Unrecovered	%age of recovered drawdown (m)
Step Test	160	21,6	48,4	48,8	0,4	98,14
Constant Test	15	21,2	48,8	49,1	0,3	98,58

The step test water level in the borehole recovered to 98.14 % of the static water level in 160 minutes after pumping stopped and in the constant discharge test the water level in the borehole recovered to 98.58 % after the pump was switched off in fifteen minutes. In all the tests more than 65% of extracted water. This is an indication that the borehole recovers fast and has a good fracture network.

Graph of Recovery Test of the Borehole Vs Log – Time.



Graph 3: Graph of Recovery Test Vs Log – Time of Featherbed Nature Reserve Borehole 02.

It was observed that the borehole recovers very fast. Within an hour the borehole had recovered more than 65 % of the drawdown water pumped during constant discharge.

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4. WATER QUALITY ANALYSIS

4.1. Sampling procedure

Groundwater samples are ideally collected and sent to a SANAS Accredited Laboratory (Western Cape Laboratory) for potability analysis. The sample are taken according to the DWAF standards, at the end of the Constant Discharge Test in order to be representative of the water of a wider zone around the borehole.

4.2. Water quality

Water quality of domestic water, utilized for human consumption and food preparation, must be safe to use if the consumers' health is to be protected. For this reason, the "Quality of Domestic Water Supplies" (Second edition, 1998)" was set forward by the Department of Water Affairs and Forestry, Department of Health and the Water Research Commission in 1998. This document facilitates the evaluation of water on the basis of five water quality classes:

Table 5: Water Quality Analysis for Human Consumption,

CLASS	pH	TDS	EC	Total Hardness	Ca	Mg	Cl	NO2	Na	K	F
Class 0	5.00 - 9.50	<450	<70	0 -200	0.00 - 30.00	<100	<100	<6	<100	<25	<0.7
Class 1	4.50 - 5.00	450 - 1000	70 - 150	200 - 300	30 - 150	100 - 200	100 - 200	6.00 - 10	100 - 200	25 - 50	0.70 - 1.00
Class 2	4.00 - 4.50	1000 -2400	150 -370	300 - 400	150 - 300	200 - 400	200 - 600	10.00 - 20.00	200 - 400	50 - 100	1.00 - 1.50
Class 3	3.00 - 4.00	2400-3400	370 - 520	>400	>300	400 - 1200	600 - 1200	20 - 40.00	400 - 1000	100 - 500	1.50 - 3.50
Class 4	<3.00 ->11.00	>3400	>520			>1200	>1200	>40.00	>1000	>500	>3.50

Class 0 : ideal water quality, suitable for lifetime.
Class 1 : Good water quality, suitable for use, rare instances of negative effects
Class 2 : Marginal water quality-conditionally acceptable, Negative effects may occur in some cases to sensitive groups .
Class 3 : Poor water quality, Unsuitable for use without treatment. Chronic effects may occur.
Class 4 : Dangerous water quality, totally unsuitable ,for use. Acute effects may occur.

However, there was no water sample collected and sent to the Water Laboratory for Water Quality Testing and analysis of the result. It is advisable that water quality is done depending on the water use.

This data should be analysed by a qualified Hydrogeologist to ensure long term sustainable use the of the borehole. The legal compliance regarding the use of the groundwater also needs to be addressed with the Department of Water and Sanitation.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. RECOMMENDATIONS

Based on the aquifer test data, assessing of the pumping curves, location of the borehole relative to other boreholes and the recovery data, the following abstraction and installation recommendations has been made:

Table 6: Recommended Installation and Abstraction Rate for Featherbed Nature Reserve Borehole 02.	
Borehole Depth	73,00 mbgl
Borehole Pump Depth	70,00 mbgl
Rest Water Level	48,40 mbgl
Borehole Pumping Rate	1,20 L/s
Borehole Pumping Duration	1 440 minutes
Borehole Recovery Duration	15 minutes
Transducer	Yes
Litres per Second	1,20 L/s
Litres per Minutes	72 L/s
Litres per Hour	4 320 L/Hour
Litres in 24 Hours	103 680 L/day
Critical Water Level	48,80 mbgl
Dynamic Water Level	47,70 mbgl

5.2. CONCLUSIONS

As of January 2018 the Department of Water and Sanitation released a Government Gazette stating that: “All water use sector groups and individuals taking water from any water resource (surface or groundwater) regardless of the authorization type, in the Berg, Olifants and Breede Gouritz Water Management Area, shall install electronic water recording, monitoring or measuring devices to enable monitoring of abstractions, storage and use of water by existing lawful users and establish links with any monitoring or management system as well as keep records of the water used.” Therefore, to facilitate monitoring and informed management of a borehole, it is highly recommended that a borehole be equipped with the following monitoring infrastructure and equipment:

- Installation of a 32 mm (inner diameter, class 10) observation pipe from the pump depth to the surface, closed at the bottom and slotted for the bottom 5 – 10 m. This

allows for a 'window' of access down the borehole which enables manual water level monitoring and can house an electronic water level logger.

- Installation of an electronic water level logger (for automated water level monitoring)
- Installation of a sampling tap (to monitor water quality) if required.
- Installation of a flow volume meter (to monitor abstraction rates and volumes)

6. REFERENCES

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APPENDIX A- BOREHOLE TEST RESULTS

FEATHERBED NATURE RESERVE BOREHOLE 02 TEST RESULTS

FORM 5F

BOREHOLE TEST RECORD SHEET- STEP TEST DISCHARGE & RECOVERY

Alt Borehole	None		**Province**	Western Cape	
Alt Borehole	None		**District**	Kysna Municipality	
Depth of Borehole	None		**Site Name**	Featherbed Nature Reserve	
			Date	28th of Mach 2026	
Borehole Depth	73.00 mbgl	**Datum Level Above Casing (m)**	0.90	**Pump Installed**	Submersible
Water Level	48.400 mbgl	**Casing Height (magl)**	0.00	**Contractor**	Arena Group
Depth of Pump	70.00 mbgl	**Diameter of the Pump (mm)**	160.00	**Pump Type**	DW15M

STEP TEST & RECOVERY

Discharge 1					Discharge 2					Discharge 3				
Date:		**Time**			**Date:**		**Time**					**Time**		
Time	**D/D**	**Yield**	**Time**	**Recovery**	**Time**	**D/D**	**Yield**	**Time**	**Recovery**	**Time**	**D/D**	**Yield**	**Time**	**Recovery**
mins	**m**	**L/s**	**mins**	**m**	**mins**	**m**	**L/s**	**mins**	**m**	**mins**	**m**	**L/s**	**mins**	**m**
1	48,30	**0.50**	**1**		**1**	48,40	**1.00**	**1**		**1**	48,80	1,50	**1**	**49.400**
2	48,10	**0.50**	**2**		**2**	48,40	**1.00**	**2**		**2**	48,80	1,50	**2**	**49.200**
3	48,10	**0.50**	**3**		**3**	48,40	**1.00**	**3**		**3**	48,90	1,50	**3**	**49.100**
4	48,20	**0.50**	**4**		**4**	48,40	**1.00**	**4**		**4**	49,10	1,50	**5**	**49.100**
5	48,20	**0.50**	**5**		**5**	48,40	**1.00**	**5**		**5**	49,10	1,50	**7**	**49.100**
6	48,20	**0.50**	**6**		**6**	48,50	**1.00**	**6**		**6**	49,10	1,50	**10**	**49.100**
7	48,20	**0.50**	**7**		**7**	48,50	**1.00**	**7**		**7**	49,10	1,50	**15**	**49.100**
9	48,20	**0.50**	**9**		**9**	48,50	**1.00**	**9**		**9**	49,10	1,50	**20**	**48.900**
12	48,20	**0.50**	**12**		**12**	48,50	**1.00**	**12**		**12**	49,10	1,50	**30**	**48.900**
15	48,30	**0.50**	**15**		**15**	48,50	**1.00**	**15**		**15**	49,10	1,50	**40**	**48.900**
20	48,30	**0.50**	**20**		**20**	48,60	**1.00**	**20**		**20**	49,10	1,50	**50**	**48.900**
25	48,40	**0.50**	**25**		**25**	48,60	**1.00**	**25**		**25**	49,10	1,50	**60**	**48.900**
30	48,40	**0.50**	**30**		**30**	48,60	**1.00**	**30**		**30**	49,10	1,50	**70**	**48.800**
40	48,40	**0.50**	**40**		**40**	48,60	**1.00**	**40**		**40**	49,10	1,50	**80**	**48.800**
50	48,40	**0.50**	**50**		**50**	48,60	**1.00**	**50**		**50**	49,10	1,50	**90**	**48.800**
60	48,40	**0.50**	**60**		**60**	48,70	**1.00**	**60**		**60**	49,20	1,50	**100**	**48.800**

FORM 5F

BOREHOLE TEST RECORD SHEET- STEP TEST DISCHARGE & RECOVERY

Alt Borehole	None	**Province**	Western Cape
Alt Borehole	None	**District**	Knysna Municipality
Depth of Borehole	None	**Site Name**	Featherbed Nature Reserve
		Date	28th of Mach 2026

Borehole Depth	73.00 mbgl	**Datum Level Above Casing (m)**	0.90	**Pump Installed**	Submersible
Water Level	48.400 mbgl	**Casing Height (magl)**	0.00	**Contractor**	Arena Group
Depth of Pump	70.00 mbgl	**Diameter of the Pump (mm)**	160.00	**Pump Type**	DW15M

Date:		**Time**			**Date:**		**Time**			**Date:**		**Time**		
Time	**D/D**	**Yield**	**Time**	**Recovery**	**Time**	**D/D**	**Yield**	**Time**	**Recovery**	**Time**	**D/D**	**Yield**	**Time**	**Recovery**
mins	**m**	**L/s**	**mins**	**m**	**mins**	**m**	**L/s**	**mins**	**m**	**mins**	**m**	**L/s**	**mins**	**M**
1	49,40	3,00	**1**		**1**			**1**		**1**			**120**	**48.800**
2	49,60	3,00	**2**		**2**			**2**		**2**			**150**	**48.800**
3	49,70	3,00	**3**		**3**			**3**		**3**			**180**	**48.800**
4	49,80	**3.00**	**4**		**4**			**4**		**4**				
5	49,80	**3.00**	**5**		**5**			**5**		**5**				
6	49,90	**3.00**	**6**		**6**			**6**		**6**				
7	49,90	**3.00**	**7**		**7**			**7**		**7**				
9	49,90	3,00	**9**		**9**			**9**		**9**				
12	50,00	3,00	**12**		**12**			**12**		**12**				
15	50,00	3,00	**15**		**15**			**15**		**15**				
20	50,00	**3.00**	**20**		**20**			**20**		**20**				
25	50,10	**3.00**	**25**		**25**			**25**		**25**				
30	50,10	**3.00**	**30**		**30**			**30**		**30**				
40	50,20	**3.00**	**40**		**40**			**40**		**40**				
50	50,30	**3.00**	**50**		**50**			**50**		**50**				
60	50,30	**3.00**	**60**		**60**			**60**		**60**				
					pH									

FORM 5E

BOREHOLE TEST RECORD SHEET - CONSTANT DISCHARGE & RECOVERY

Project No	01	**Province**	Western Cape
Borehole No.	02	**Municipality**	Knysna
Borehole Depth	73.00 mbgl		34° 4'26.62"S
Water Level	48.800 mbgl	**Coordinates**	23° 2'55.38"E
Depth of Pump	70.00 mbgl	**Contractor**	Arena Group
Casing	0.00	**Operator**	Jacques Fivaz
Elevation	N/A	**Pump Type**	DW15M

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ArenaGroup
Group of Companies

CONSTANT DISCHARGE & RECOVERY

Test Started			**Duration**		
Date	**28/03/206**	**Time**	**08H00**	**24.00**	**Hours**
Distance fom Observation Borehole			**Observation Borehole**		**None**
Distance fom Pumping Hole Borehole			**None Applicable**		**Distance from Observation Borehole**

CONSTANT DISCHARGE						RECOVERY				Observation Borehole			
Time	**Drawdown**	**Yield**	**Time**	**Drawdown**	**Yield**	**Time**	**Drawdown**	**Time**	**Drawdown**	**Time**	**D/D**	**Time**	**D/D**
mins	**m**	**L/S**	**mins**	**m**	**L/S**	**mins**	**m**	**mins**	**m**	**mins**	**m**	**mins**	**m**
1	48,10		780	49,80		1	51,20	780		**1**			
2	48,60		840	49,80		2	50,80	840		**2**			
3	48,90		960	49,80		3	51,20	960		**3**			
4	49,00		1080	49,80		4	51,10	1080		**4**			
7	49,10		1200	49,80		7	51,10	1200		**5**			
9	49,20		1440	49,80		9	51,00	1440		**7**			
12	49,20					12	51,00			**9**			
15	49,20					15	51,00			**12**			
20	49,30					20	50,90			**15**			
25	49,40					25	50,90			**20**			
30	49,40					30	50,80			**25**			
40	49,40					40	50,80			**30**			
50	49,40					50	50,70			**40**			
60	49,50					60	50,70			**50**			
70	49,60					70	50,70			**60**			
80	49,60					80	50,70			**70**			
90	49,60					90	50,70			**80**			
120	49,60					120				**90**			
150	49,60					150				**120**			
180	49,60				**4**	180				**150**			
210	49,70					210				**180**			
240	49,70					240				**210**			
270	49,70					270				**240**			
300	49,70					300				**270**			
360	49,70					360				**300**			
420	49,80					420				**360**			
480	49,80					480				420			
540	49,80					540				480			
600	49,80					600				540			
660	49,80					660				600			
720	49,80					720				660			

Certificate of Analysis

Client	Arena Group
Reference	Featherbed Borehole 1
Date of Certificate	07-Apr-26
Sample Type	Borehole

	Parameters	Test Methods	Borehole 1		SANS 241 Drinking Water Standard
*	pH	HANNA HI8424	6.97		5.0 - 9.5
*	Electrical Conductivity (mS/m)	WTW LF330	54		<150
*	Turbidity (NTU)	HACH 2100P	0.74		< 1.0
*	Colour	HACH Method 8225	2		< 20
*	Iron (mg/L as Fe)	HACH Method 8008	0.00		0.20
*	Aluminium (mg/L as Al)	HACH Method 8012	0.016		0.30
*	Total Hardness (mg/L as CaCO3	HACH Method 8226	98		<500
*	Calsium (mg/L as CaCO3)	HACH Method 8222	63		<150
*	Calsium as Ca	Calculated	25.3		< 150
*	Magnesium (mg/L as MgCO3)	HACH Method 8222	35		<70
*	Magnesium as Mg	Calculated	10.1		< 70
*	Total Dissolved Solids (mg/l)	Calculated	348		< 1200
*	Alkalinity (mg/ L)	Titrations	52		<500
*	Sulphate Mg/L)	Sulfaver 4 Method 8051	11		< 400
*	Manganese (Mn) (mg/ L)	HACH Method 8149 PAN Method	0.022		0.100
*	Chloride (mg/l)	Method 8225, Silver Nitrate Method, Buret Titration	73		< 300
*	Fluoride (mg/ L)	Hach Method SPADNS Method	0.16		< 1.0
*	Total Coliforms (Count/100ml)	Membrane filtration	600		0
*	E.Coli Count/100ml)	Membrane filtration	Nill		0

The values in red prevented the water to comply with the SANS 241 Drinking Water Standards.

Instrument calibration are done daily with appropriate standards

Laboratory Chemical Analysis Code: Western Cape Laboratory Services SABS Lab Code: B211

Instrument Calibration: Group 1 – 3 / Heavy Metals/Nutrients/Major Constituents

Certificate of Analysis

Client	Arena Group
Reference	Featherbed 2
Date of Certificate	13-Apr-26
Sample Type	Borehole

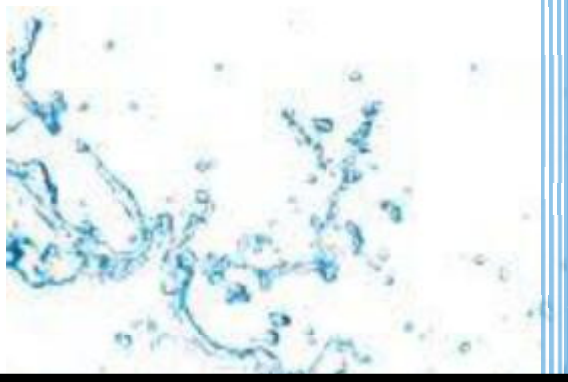
	Parameters	Test Methods	Borehole 2		SANS 241 Drinking Water Standard
*	pH	HANNA HI8424	7.32		5.0 - 9.5
*	Electrical Conductivity (mS/m)	WTW LF330	36		<150
*	Turbidity (NTU)	HACH 2100P	0.5		< 1.0
*	Colour	HACH Method 8225	0		< 20
*	Iron (mg/L as Fe)	HACH Method 8008	0.09		0.20
*	Aluminium (mg/L as Al)	HACH Method 8012	0.008		0.30
*	Total Hardness (mg/L as CaCO3	HACH Method 8226	74		<500
*	Calsium (mg/L as CaCO3)	HACH Method 8222	51		<150
*	Calsium as Ca	Calculated	20.4		< 150
*	Magnesium (mg/L as MgCO3)	HACH Method 8222	23		<70
*	Magnesium as Mg	Calculated	6.6		< 70
*	Total Dissolved Solids (mg/l)	Calculated	232		< 1200
*	Alkalinity (mg/ L)	Titrations	37		<500
*	Sulphate Mg/L)	Sulfaver 4 Method 8051	3		< 400
*	Manganese (Mn) (mg/ L)	HACH Method 8149 PAN Method	0.060		0.100
*	Chloride (mg/l)	Method 8225, Silver Nitrate Method, Buret Titration	68		< 300
*	Fluoride (mg/ L)	Hach Method SPADNS Method	0.41		< 1.0
*	Total Coliforms (Count/100ml)	Membrane filtration	400		0
*	E.Coli Count/100ml)	Membrane filtration	Nill		0

The values in red prevented the water to comply with the SANS 241 Drinking Water Standards.

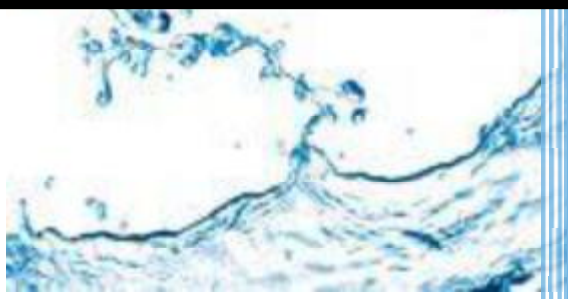
Instrument calibration are done daily with appropriate standards

Laboratory Chemical Analysis Code: Western Cape Laboratory Services SABS Lab Code: B211

Instrument Calibration: Group 1 – 3 / Heavy Metals/Nutrients/Major Constituents



PROPOSED MODULAR 65KL WASTEWATER TREATMENT PLANT FEATHERBED RESERVE – KNYSNA REF. BBAG60GL FB KL250326



Kevi Levin

CONTENTS:

Directors: K. Levin (Managing)

kevi@fluidco.africa – www.fluidco.africa – Tel: 069 035 5174 – Co. Reg. No: 2022/783422/07

SECTION 1. CLIENT DETAILS.

FEATHERBED RESERVE
Represented by Mr. Rein Hofmeyr of Hofmeyr Associates.

Directors: K. Levin (Managing)
kevi@fluidco.africa – www.fluidco.africa – Tel: 069 035 5174 – Co. Reg. No: 2022/783422/07

SECTION 2. INFO. PROVIDED AND SCOPE OF WORKS.

The client is in possession of an existing treatment plant, which is currently non-operational.

After inspection of the plant, and assessing its suitability for the treatment of effluent, we report back as follows:

1. The plant is not compliant in any way for treatment of sewage,
2. The capacity of current plant cannot handle the required load of 65m3/day as requested by the client,
3. The current tanks are not suited for this application, as they are water tanks, and not suited to a volatile substance such as domestic effluent. Fyrthermore the existing drilling on the tanks would make it very difficult to convert or modify them, even if they were suited to the application.
4. Effluent in any form requires specific Chemical Grade tanks,
5. The aeration system is in-operational, and rusted beyond repair,
6. It does not seem that there is any Pall Ring media in the aerobic tanks, which is critical to the chemical process,
7. There is no disinfection dosing capability on the tanks,
8. The effluent being discharged into the environment does not conform to legislative requirements and is hazardous to the environment.
9. Should any official inspect the plant, the client will be liable for legislative action.

We would thus propose that a new, built to purpose plant which will provide the required standard of effluent be installed, utilising as much of the current mechanical and electrical infra-structure as possible. This includes the current receiving tanks and transfer pump and pipeline at the restaurant area, as well as the discharge pump, and control panel, with necessary modifications.

Directors: K. Levin (Managing)
kevi@fluidco.africa – www.fluidco.africa – Tel: 069 035 5174 – Co. Reg. No: 2022/783422/07

The scope of works is as follows:

- **Inlet works**
  - Screening of raw sewage and collection of inorganic matter in an existing septic tank provided, before treatment process commences.
  - Able to handle peak flows.
  - The current transfer pump is to be utilised as is. This pump will transfer fluids from the initial septic phase to the buffer tank before the plant' phase to the plant.
- **Package Plant**
  - Able to biologically remove organic material, nitrogen, and phosphate.
  - Constructed out of durable H.D.P.E. Chemical Grade Tanks material
  - Meet effluent discharge standards – D.W.S. General Standards.
  - Provide specifications for operation and maintenance requirements.
  - Provide critical spares equipment list.
  - Provide operation and maintenance costing.
  - The appropriate sewage flow rate and discharge requirement are estimated at 65kl/day, as provided by the client.
  - Provide disinfection facilities to meet required effluent criteria.
  - Release treated wastewater into the environment. It is the client's responsibility to transfer the treated effluent to the discharge point required.

- **Costing**
  - Delivery and installation of complete packaged plant.
  - All capital cost involved in supplying packaged plant,
  - Provide costs of Maintenance.

  - .

Directors: K. Levin (Managing)
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SECTION 3. INFLUENT & TREATED EFFLUENT QUALITY.

This final effluent is guaranteed to be within General Limits as required from South African DWS.
All our plants are measured against below Parameters.

Influent Parameters assumed - max. allowed			
Determinant	**Unit**	**Typical domestic wastewater max. assumed**	
COD	mgO2/ℓ	700	
Suspended solids	mg/ℓ	350	
TKN	mg/ℓ	85	
Phosphate	mg/ℓ	13	
Ammonia	mg/ℓ	60	
Treated Effluent Parameters Required			
Determinant	**Unit**	**Value - General Limits**	**Value - Special Limits**
COD	mgO2/ℓ	75.0	30.0
Suspended solids	mg/ℓ	25.0	10.0
TKN	mg/ℓ	15.0	1.5
Phosphate	mg/ℓ	10.0	2.5
Ammonia	mg/ℓ	3.0	2.0

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SECTION 4. TECHNICAL CALCULATIONS

Plant Specific Calculations		
Q - Daily influent rate	m3/d	60
B.O.D.	mg/l	300
C.O.D.	mg/l	75.0
f = Oxygen equivalent factor		1
O_2 transfer efficiency (E):	%	25%
O_2 % in air:	%	21%
Density of air at STP -	kg/m^3	1.225
Oxygen requirement		
O^2 -calculated	kg/d	18
Assumed overall transfer efficiency	%	10
Required process air	kg/d	640
Duration of pumping	hr/d	8
Blower capacity	m3/hr	80
Blower duty and size		
Water Depth	kPa	30
Allow for losses	kPa	10
Total ΔP	kPa	40
Air Flow	m3/sec	0.022
Efficiency (Blower & Motor)	Watts	1.48
Required Blower Duty		80m3/hr/40kPa
Motor Size	Kw	2.2 allowing for margin and turndown
Retention duration applied:		
Daily Influent Rate:	m^3/day	60
Determinant	**hrs.**	**General Limits**
Hydraulic Retention time - Buffer	hrs.	4
Hydraulic Retention time - Anaerobic	hrs.	30
Hydraulic Retention time - Aerobic	hrs.	24
Hydraulic Retention time - Clarifier	hrs.	17
Hydraulic Retention time - Disinfection	hrs.	1
Calculated Chamber Capacities		
Buffer	m3	10
Anaerobic	m3	75
Aerobic	m3	60
Clarifier	m3	42.5
Disinfection	m3	2.5

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Chamber Capacities Rounded for Practicality		
Buffer	m3	10
Anaerobic incl. Buffer	m3	50
Aerobic	m3	60
Clarifier	m3	40
Disinfection	m3	2.5
Aeration Media Norms		
Type	mm	100mm Pall Ring Media
Surface Area	mm^2	71667.85
Mass	g	36.3
Surface area/m^3	m^2/m^3	200.39
Calculated Units	units/m^2	1960
Density	g/cm^3	1.24 min.
Void Ratio	%	91.79
Quantity required	item	117600

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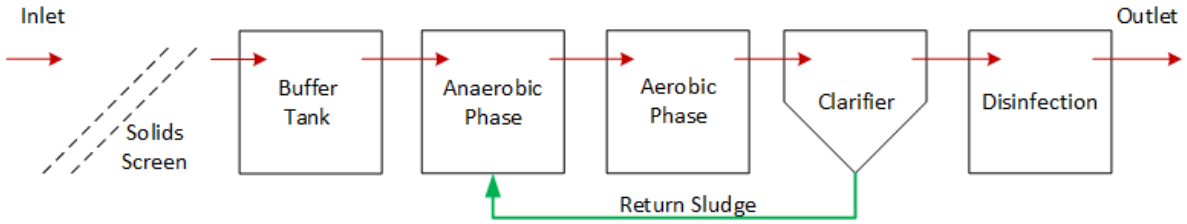
SECTION 5. PROCESS OVERVIEW & EQUIPMENT.



Anaerobic digestion tanks and Buffer (New tanks)

- The effluent will flow into an above-ground by pumping from the existing septic tanks,
- The anaerobic treatment processes take place in the absence of air (and thus molecular/free of oxygen) by those microorganisms (also called anaerobes) which do not require air (molecular/free oxygen) to assimilate organic impurities. The final products of organic assimilation in anaerobic treatment are methane and carbon dioxide gas and biomass.
- The anaerobic digestion also serves as separation of solids from liquids, a dual function which allows for settlement of solids and the other solids like oils, fats and greases will float to surface.
- The anaerobic digester also allows for anoxic conditions where nitrogen is removed.
- Hydraulic retention: 1 Day

Aerobic digestion or Bioreactors (New tanks)

- The Anaerobic phase will flow through to the Aerobic phase via gravity.
- The aerobic phase makes use of multiple lined tanks in series to serve as the aerobic digestion phase. Each tank will be fitted with diffusers supplied with air by blowers, which allows for high dissolved oxygen transfer into the effluent.
- Fixed film media to be installed in the tank to allow for bacterial growth at a rate of > 148m2/m3 of surface area
- Hydraulic retention: 1 Day

Clarifier or Re-activated sludge (RAS) tank (New tanks)

- There will be 2 Tanks that will serve as the clarifiers; and activated sludge will be pumped back to the buffer tank, creating a closed loop system.
- Settled sludge from the clarifier mainly consists of scoured bacteria that is returned to the anaerobic buffer tank which seeds the anaerobic digester.
- The RAS process improves the nitrification, stabilizes the primary sludge and ensures the sludge will always stay active, even during periods of low flow.
- Hydraulic retention: 0.6 Days

Disinfection Contact tank. (New Tank)

- There will be a Chlorine contact tank used for chlorine dosing.
- This tank will be discharged by the existing discharge pump and pipeline.

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SECTION 6. SIMILAR INSTALLATIONS

SECTION 7. MAINTENANCE REQUIREMENTS.

Daily Maintenance

- Should there be any inorganic build-up in the in-line screen it should be removed and disposed of in the appropriate manner, in-line with hazardous waste disposal legislation.
- Check that all mechanical Equipment is operational

Weekly Maintenance

- Check that all mechanical Equipment is operational.
- Check the timers to ensure that the timing has not changed due to electrical failure.
- Remove all non-organic material from septic tank.
- Open sludge drains valves to feed the Anaerobic tank.
- Add bacteria as per recommended dosage.

Monthly Maintenance

- ***Sampling*** – take feed sample and final treated effluent sample for SANAS accredited lab analysis.
- ***Manual Screen -*** Remove all non-organic material & agitate the accumulated organic material.
- ***Bioreactor pumps –*** Verify that pumps are clear of obstruction and grease mechanical components where required.
- ***Clarifier Pumps -*** Verify that the submersible pumps are clear of obstructions and in good running order.
- ***Chlorine Equipment -*** Measure & top up chlorine to design specifications
- ***Electrical -*** Check timers are set to correct intervals and test & ensure time is accurate.
- *Take water sample and submit to laboratory for analysis.*

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SECTION 8. OPERATING COSTS

Monthly Operating Cost		
ITEM	Description	Monthly Rate
1	Provision for replacement of critical equipment	R 1 000.00
2	Monthly Maintenance (Labour, travelling & Vehicles)	R 2 500.00
3	Monthly Maintenance (Plant Consumables)	R 3 890.00
4	Monthly Maintenance (Lab Analysis & Reports)	R 3 000.00
Total Excl. Vat		**R 10 390.00**

SECTION 9. ELECTRICAL REQUIREMENTS & FOOTPRINT.

- Exisitng power supply is required.
- Timers on Bioreactor & Disinfectant Pumps (24 hours with 15-minute interval settings)
- Earthing, lighting protection and earth matting has been excluded
- Feed cable provision and installation excluded
- If the plant is connected to a standby generator, we recommend that a soft Starter be installed in the control panel. This can be offered at an additional rate.
- With regards to the plant footprint, the new plant will fit into the available space.

SECTION 10. INSTALLATION.

- **FLUIDCO** will provide the following personnel for site installation and supervision:
  - 1 x Site Supervisor
  - 1 x Senior Technician
  - Unskilled labour as required
- There will always be at least 2 x representatives on site, the project engineer and project supervisor will conduct site visits during the installation.
- Price will include the following
  - All transport to and from site
  - All components,
  - All labour costs,
  - Start up chemicals,
  - Training and Handover,
  - Removal of old plant from site – this can be excluded as a cost saving if preferred,

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SECTION 11. DELIVERY & OFFLOADING

- Plant to be delivered to site
  - **FLUIDCO** will offload the plant and equipment

SECTION 12. HSEQ REQUIREMENTS.

- All PPE Included in proposal.
- No provision for a safety file is allowed for.
- Working at heights, excavation permits, and all other site-specific requirements is excluded
- All Contractors packs and the approval thereof and related labour and traveling cost are Excluded

SECTION 13. CUSTOMER RESPONSIBILITIES.

- Provision of suitable access for delivery and installation of plant.
- Secured Storage on site
- Safe access for all approved **FLUIDCO**L employees and contractors to the job site
- Piping, equipment or electrical to and from the defined battery limits (extraction and discharge lines)
- Security and Fire Protection systems as per local regulations
- Electrical supply from a mains breaker, with connection to our plant distribution board
- A representative to help coordinate activities that require support from the customer
- Environmental and discharge permits
- First fill of systems - we will require 100KL of clean water to fill tanks at startup.

SECTION 14. GUARANTEES.

- ***Mechanical Guarantee:*** All Mechanical & Electronic Equipment carries a 12-month OEM guarantee
- ***Structural Guarantee:*** A Structural guarantee of 8 years is offered on tanks, subject to correct upkeep.
- ***Process Guarantee:*** Final Effluent is guaranteed to be in line with DWS's General Standards requirements, subject to **FLUIDCO** conducting the maintenance of the plant.
- ***Start-up and commissioning:*** The plant will take between 2 – 8 weeks to reach the desired final effluent qualities
- **FLUIDCO**'s liability to the client shall in any event and under all circumstances be limited to the costs of remedying any defective workmanship, repairing any defective goods or replacing any defective goods not capable of repair.
- **FLUIDCO** shall under no circumstances whatsoever be liable for any loss of profit or any damages of whatsoever nature, direct or indirect, consequential or otherwise, suffered by the client or any other person or entity, whether or not caused by the negligence of **FLUIDCO**, its agents or employees.
- The Warranty is subject to the client's compliance to service procedures and maintaining the supplied equipment as prescribed and in accordance with **FLUIDCO**'s specifications and instructions. A separate maintenance service agreement may be negotiated separately based on further discussion.

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SECTION 15. INCLUSIONS TO THE OFFER.

- Complete design, manufacturing, testing and installation of biological WWTP.
- Delivery
- All Mechanical Equipment other than specified
- Installation
- Living out allowance for technical team
- Commissioning of plant onsite
- Operations manual with guarantee letter.

SECTION 16. EXCLUSIONS TO THE OFFER.

- Excavations, intermediate and hard rock excavations, groundwork and subsoil drainage
- Site Lighting, Earthing and earth matting, Lightning Protection, PLC Connection & telemetry
- Engineering drawings
- Pipe reticulation from plant for final water
- No allowance was made for retention or performance bonds.
- Any delays on site will be charged at R15 750.00 per day, excluding all lodging & traveling which will be billed at cost plus 15%.

SECTION 17. GENERAL TERMS & CONDITIONS.

- Full terms and conditions apply and may be obtained on request.
- All prices are excluding vat; prices will remain firm for a period of 30 days.
- This design and proposal are the intellectual property of **FLUIDCO**, this information cannot be used for tender purposes or basis for obtaining quotations without the written consent of **FLUIDCO.**
- **FLUIDCO** reserves the right to change technical aspects, designs, flow patterns, flow rates and equipment without prior notice to the client to ensure better performance and efficiency.
- Pricing submitted in this proposal are estimates only and will be confirmed after site visit and a clear understanding of your requirements by our engineering and design team

SECTION 18. LEAD TIMES.

Procurement of materials	: 4-6 Weeks
Workshop Fabrication and fitment	:1 - 2 Weeks
Delivery	: 5 Days
Installation	: 15 Working Days

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SECTION 19. PAYMENT TERMS.

- 60% On proposal acceptance
- 30% upon commencement of installation
- 10% upon commissioning and handover
- All payments are strictly 7 Days from invoice.
- Prices are nett, current and firm for 30 days.
- Prices are in ZAR at current exchange rates.

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SECTION 20. COST PROPOSAL

Code	Description	Total list	
V10000XXH	Vertical Chemical tank HD 10000 litre	R	3 060.00
V2200XH	Vertical Chemical Tank HD 2200 litre	R	178.50
ST8 4EVR	Rubber Tank Seal - 110mm	R	5 380.25
ST7 4EVR	Rubber Tank Seal - 50mm	R	6 648.23
PL Rosette 100mm Glof	Plastic rosette media - 100mm	R	514 080.00
DE22	InverEco pool pump, 1kW, 220V	R	12 416.59
SR7mm	Ski Rope 7mm per m.	R	471 750.00
T.A.L. 3 Core 2.5	3 Core Cable 100m x 2.5mm	R	2 113.95
040/00110	90° Elbow SW	R	7 356.24
046/0110	Tee SW	R	630.21
AGRICO110/12	110mm Upvc Class 12	R	26 775.00
037/0110	PVC Flange Adaptor 110mm	R	6 136.07
AGRICO50/12	50mm Upvc Class 12	R	3 761.25
040/0050	90° Elbow SW 50mm	R	875.93
046/0050	Tee SW 50mm	R	783.87
048/0050x0040x0040	Adaptor Male SW 50mm	R	290.70
044/0050	50mm Pipe Clip	R	462.06
043/0050x0040	50mm *1 1/2" Female Adaptor	R	404.94
017/0050	PVC Equal Cross 50mm	R	475.32
604/0050	Ball Valve S/U SW 50mm	R	2 515.32
054/0050x0040	50mm Black Tank Connector Heavy Duty	R	1 070.49
AGRICO50/12	50mm Upvc Class 12	R	8 274.75
040/0050	90° Elbow SW 50mm	R	875.93
046/0050	Tee SW 50mm	R	1 567.74
017/0050	PVC Equal Cross 50mm	R	950.64
036/0050*0032	PVC Tee Reducing	R	288.66
043/0032*0025	Adaptor Female SW	R	98.94
DIFF-250	25cm Rubber Diffuser	R	24 862.50
GHBH 003 34 2R4	Air blower, side channel (regenerative), 2.2 kW double-stage, 380 Volt, 3ph, three-phase, 150 m3/h max. air flow, -330 mbar max. vacuum, 440 mbar max. pressure	R	61 337.70
B Stone 5lph DOS Pump	Blackstone 5 L/h Chemical Dosing Pump	R	40 443.00
V500XXH - RT	Vertical Chemical Extra Heavy Duty Tank	R	10 608.00
LS50	Lamella Block	R	38 148.00
C Panel Mods	Control panel modifications - existing	R	38 250.00
RTU1026	BioZyme Sewer Gobbler 1E8 Liquid	R	6 107.25

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S. Hypo12-15%	BioZyme Sodium Hypochlorite	R	2 550.00
	Consumables	R	25 500.00
Sub-Total Componentry		R	1 327 028.01
5% Contingencies		R	66 351.40
Total Componentry		**R**	**1 393 379.41**
Labour - unskilled/hr	Labour - remove existing plant	R	24 097.50
Labour - Skilled/hr	Labour - remove existing plant	R	14 917.50
Director/hr	Labour	R	68 850.00
Labour - unskilled/hr	Labour - install new plant	R	24 097.50
Labour - Skilled/hr	Labour -install new plant	R	14 917.50
Director/hr	Labour	R	68 850.00
Transport	Transport of plant	R	31 875.00
Total Labour, Management and Travel		**R**	**247 605.00**
Total Componentry and Installation		**R**	**1 640 984.41**
10% Discount		**R**	**164 098.44**
Total Revised Price after Discount		**R**	**1 476 885.97**

Prices are nett, current, and exclude VAT. The discount is applicable if the proposal is accepted within 30 days of submission.

We trust that our proposal meets with your approval. Should you require more information, please do not hesitate to contact us.

Yours Sincerely,

Kevi Levin.

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