

CERTIFICATE OF ANALYSIS

ATTENTION: Discovery Water

DATE: 21 August 2009

1. **GENERAL:** Agterkliphoogte Borehole –

Sampled 17 August 2009

CONSTITUENT	Results expressed in mg/l as the ion or in mg/l as CaCO ₃ equivalents unless specifically stated	
	Borehole	Membrane Maximum Limits & Comments
Conductivity μ S/cm	3,990	
Total Dissolved Salts TDS @ 105 °C	2,673	
pH	7.98	
M-Alkalinity (HCO ₃ ⁻)	336	
Total Hardness (TDH as CaCO ₃)	938	High: Beware of % recovery
Iron (Fe) Total	0.16	Must be eliminated
Manganese (Mn) Total	BDL	Must be eliminated
Silica (Si as Si O ₂)	3.8	Must be reduced to < 1.0
Sodium (Na)	446	
Chloride (Cl)	472	
Sulphate (SO ₄)	108	Beware of high % recoveries
Flouride (F)	3.26	Beware of high % recoveries
Total Microbial Count (TMC) (Colonies per ml)	> 2000	Must be eliminated
Oscillatoria (Positive – Negative)	Positive	These are slime forming bacteria Must be eliminated.

RO – Physical & Organoleptic – Critical Analytical data		
Turbidity (NTU)	0.24	Reduce to preferably < 0.2-NT-units
Colour (Pt/Co Units)	22	Reduce to preferably < 20-Pt/Co-units
Dissolved Organic Carbon (DOC)	12.4	High for RO: Reduce < 5-mg/l
Scaling Index (SI) @ 20 °C	4.90	Severely Scaling
Fouling Index (FI) @ 20 °C	0.42	A fair potential to cause fouling
Total Suspended Solids (TSS)	0.15	Must be eliminated

TSS Particle Size Distribution Data		
Size Fraction (microns)	% SS	<ul style="list-style-type: none"> Point to fine filtration requirements. The recommendation from data generated is to select Ultra-Filtration equipment.
< 0.2	52.3	
0.2 – 10	19.4	
10 – 25	19.7	
> 25	8.6	

NA = Not Applicable	TNTC = Too Numerous To Count	TON = Threshold Odour Number
BDL = Below Detection Limit	μ g/l = Micrograms per litre	
Please Note: This report only relates to the actual water sample supplied and analysed. No responsibility can be accepted, related to the use of these results and recommendations provided.		

Agterkliphoogte Borehole – Continued

2. DISCUSSION:

Note: This laboratory makes use of the World Health Organisation (WHO) Quality Control (QC) standard to determine water quality and for comparative purposes. This standard is for us user-friendly and indicates clearly where improvements should be implemented to correspondingly improve the overall water quality.

- The salt content but essentially the overall mineral salt content is too high as suspected and as indicated on the label provided with the sample.
- The maximum recommended limit as stipulated within the WHO potable standard is +-500-mg/l and since this borehole showed up a TDS of +-2,600-mg/l one can say that it is in excess by a factor of 5 or in other words,
- The salt content is 5-times greater than what is considered acceptable.

This immediately means that a Reverse Osmosis (RO) system will be required to reduce the overall mineral salt content to the required extent and the analytical parameters from then onwards were all selected and determined to specifically help with what treatment train will be required to achieve this goal consistently and cost effectively.

From a desalination or Reverse Osmosis (RO) point of view:

- I. Reasonable to somewhat problematic water due to the fairly high SI, FI and the nature of the Suspended solids present.
- II. The Suspended Solids or particulate material is present as a stable suspended colloid, which essentially means that it consists of very small particles and that it will not settle out easily. This form of particulates is detrimental to RO membranes and will have to be securely eliminated to ensure fouling problems are not encountered.
- III. The positive results noted for Oscillatoria is similarly important and these organisms will have to be eliminated.
- IV. There are two main aspects which will determine the success of the application:
 - i. The pre-treatment train used must be able to reduce the Fouling Index to well below 0.25 which in turn simply signify that it will have to:
 - ◆ Eliminate all biological content.
 - ◆ Eliminate the suspended solids.
 - ◆ Eliminate the Iron no matter how insignificant or how little.
 - ◆ Reduce but preferably eliminate the Silica content.
 - ◆ Reduce the Turbidity to well below 0.2-NT-units.
 - ◆ Reduce Colour to well below 20-Pt/Co units.
 - ◆ Reduce the Dissolved Organic Carbon (DOC) content to well below 5-mg/l.
 - ii. The desalination step or system will additionally have to be controlled to prevent scaling reactions from inhibiting the process.

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- ◆ One may possibly have to make use of anti-scalants to specifically prevent scaling.
 - ◆ The RO % recovery will have to be limited to prevent aggravation of the scaling tendency noted.
 - ◆ One can consider the use of water softening equipment.

*** Any failure encountered in these two operating protocols (i) and (ii) will be detrimental to the RO membranes in use and will cause the system to fail.**

V. **Irrigation:** The Sodium Absorption Ratio (SAR) calculate out to a value of 9, which means that one will be able to use this water without any treatment, for irrigational purposes but note the following:

- Broad-leaf or all saline sensitive plants will generally suffer and will not be able to comfortably cope with this water.
- Lime should be added to the soil from time-to-time and this must be discussed with the local nursery or botanist, since this will be dependent on the type of soil, seasonal rainfall and type of plants under irrigation etc.
- If a lower TDS water source is available one will be able to improve the quality of the borehole water for irrigational use, via the addition of small volumes of the lower TDS water.
- Make use of an irrigation process, which will deliver the water to the root of the plant or onto the soil, as apposed to, onto the leaf or onto the plant itself.

2. RECOMMENDATIONS:

To produce potable water the following treatment train is considered the standard for these types of water sources:

Step-1. An Ultra-Filtration plant specifically set up and configured to:

⇒ Achieve the goals stipulated in the report.

Step-2. The Reverse Osmosis equipment sized and selected to produce the required quality and daily amount of water.