Transboundary Aquifer Information Sheet

**AF10 - Northern Kalahari/ Karoo Basin/ Eiseb Graben Aquifer**

### Geography
- Total area TBA (km²): 11 000
- No. countries sharing: 2
- Countries sharing: Botswana, Namibia
- Population: 5700
- Climate Zone: Semi-arid
- Rainfall (mm/yr): 440

### Hydrogeology
- Aquifer type: Multiple layered hydraulically connected
- Degree of confinement: Mostly unconfined, but some parts confined (mixed)
- Main Lithology: Mostly unconfined, but some parts confined (mixed)

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.
### TWAP Groundwater Indicators from Global Inventory

<table>
<thead>
<tr>
<th></th>
<th>Botswana</th>
<th>Namibia</th>
<th>TBA level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recharge (mm/y)</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Renewable groundwater per capita (m³/y/capita)</td>
<td></td>
<td>1130</td>
<td></td>
</tr>
<tr>
<td>Natural background groundwater quality (%)</td>
<td>80</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Human dependency on groundwater (%)</td>
<td>0</td>
<td>&gt;1</td>
<td></td>
</tr>
<tr>
<td>Groundwater depletion (mm/y)</td>
<td></td>
<td>&lt;1</td>
<td></td>
</tr>
<tr>
<td>Groundwater pollution (%)</td>
<td></td>
<td>&lt;5</td>
<td>B</td>
</tr>
<tr>
<td>Population density (Persons/km²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater development stress (%)</td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Transboundary legal framework (Scores)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transboundary institutional framework (Scores)</td>
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</tbody>
</table>

1. Recharge: This is the long term average recharge (in m³/yr) divided by the surface area (m²) of the complete country segment of the aquifer (i.e. not only the recharge area).
2. Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.
3. Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).
5. Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).
6. Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).

A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

### Key parameters table from Global Inventory

<table>
<thead>
<tr>
<th>Distance from ground surface to groundwater table (m)</th>
<th>Depth to top of aquifer formation (m)</th>
<th>Full vertical thickness of the aquifer system* (m)</th>
<th>Degree of confinement</th>
<th>Predominant aquifer lithology</th>
<th>Predominant type of porosity or voids</th>
<th>Secondary Porosity</th>
<th>Transmissivity (m²/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td></td>
<td></td>
<td></td>
<td>Aquifer Mostly unconfined, but some parts confined</td>
<td>Sedimentary rocks - Sandstone</td>
<td>Secondary porosity: Fractures</td>
<td>150</td>
</tr>
<tr>
<td>Namibia</td>
<td>150</td>
<td>120</td>
<td>380</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Including aquitards/aquicludes

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

### Aquifer description

**Aquifer geometry**

This aquifer is located largely within Kalahari sediments although deeper-seated Karoo sediments do also hold some potential for increased amounts of water over a wider area to the north of the
AF10 - Northern Kalahari/ Karoo Basin/ Eiseb Graben Aquifer

revised boundary but this is still uncertain. On that basis the area was reduced considerably within the proximity of a palaeo channel that contains abundant groundwater within a largely surrounding water scarce area. It is a 2-layered system. The aquifer is mostly unconfined, but some parts confined (mixed). The average depth of the rest water level is 153 m, and the average depth to the top of the aquifer is 120 m, while the thickness of the aquifer system is 380 m within Namibia.

Hydrogeological aspects
The predominant lithology is sedimentary rocks - sandstones that are overlain by unconsolidated sedimentary sands. It has a high primary porosity of fine/medium sedimentary deposits, with secondary porosity: fractures. The aquifer is further characterised by a high horizontal and vertical connectivity. The average transmissivity value on the Namibia side is 150 m²/d. Within Namibia the total groundwater volume is 3km³, while the average recharge, that is 100% through natural conditions, is 1.0 Mm³/yr over an area of about 9000 km². During extreme events the recharge rises to 12 Mm³/yr.

Linkages with other water systems
The major source of recharge is through surface water runoff into the aquifer area. The predominant discharge mechanism is through evapotranspiration.

Environmental aspects
Within Namibia around 20 % of the aquifer is not suitable for drinking purposes mainly due to high salinity within the superficial layers. No pollution has been identified. No shallow groundwater and groundwater-dependent ecosystems have been observed.

Socio-economic aspects
During 2010 the annual groundwater abstraction on the Namibian side was 0.1 Mm³ and this was mainly used for livestock purposes. These figures are based on expert judgement. There are no other sources of water in the aquifer area.

Legal and Institutional aspects
No formal agreement exists although a dedicated Transboundary Institution exists with limited mandate and capacity – the OKACOM commission. The National Institute within Namibia has a full mandate with limited capacity.

Emerging Issues
The management of this aquifer that is of a limited size and that shows good potential within a generally water scarce area, should be jointly undertaken by the 2 countries in order to maximize the quota that can be used on a sustainable basis.

Contributors to Global Inventory

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
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</tr>
</tbody>
</table>
Considerations and recommendations

Most data in the tables and text above have been provided by national and regional experts (listed above) or have been derived from the global WaterGAP model. See colophon for more information, including references to data from other sources.

Only 1 of the 2 TBA countries has provided information. Most aspects of the aquifer geometry and parameters have been addressed with consistent and realistic information, allowing most of the indicator estimates at a National level. Recharge is thought to exceed 1 mm/yr.

Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

Colophon

This Transboundary Aquifers information sheet has been produced as part of the Groundwater Component of the GEF Transboundary Water Assessment Programme (GEF TWAP). GEF TWAP is the first truly global comparative assessment of transboundary groundwater, lakes, rivers, large marine ecosystems and the open ocean. More information on TWAP can be found on: www.geftwap.org. The Groundwater component of TWAP carried out a global comparison of 199 transboundary aquifers and the groundwater systems of 41 Small Island Developing States. The data used to compile this transboundary aquifer information sheet has been made available by national and regional experts from countries involved in the TWAP Groundwater project. For aquifers larger than 20 000 km2 and which are not overlapping, additional data are available from modelling done by the Goethe University Frankfurt (Germany) as part of TWAP Groundwater. All data were compiled by UNESCO-IHP and the International Groundwater Resources Assessment Centre (IGRAC – UNESCO Category II Institute). Values given in the fact-sheet represent an approximate guide only and should not replace data obtained from recent local assessments. The editors of this information sheet are not responsible for the quality of the data.

For more information on TWAP Groundwater and for more data, please have a look at the TWAP Groundwater Information Management System which is accessible via www.twap.isarm.org or www.un-igrac.org.

Request:
If you have additional data or information about this transboundary aquifer that can improve the quality of this information sheet and the underlying database, please contact us via email at info@un-igrac.org. If appropriate, the information will be uploaded to the database of transboundary aquifers and will also be used in new versions of this information sheet.

References:
- Climate: Climate indicates the major climate zone which occurs in the aquifer area. If more than 1 climate zone is present the zone with the largest surface area was selected. Source climate data: ArcGIS Online (2015), Simplified World Climate zones. Owner: Mapping Our World GIS Education. Original map: National Geographic World Atlas for Young Explorers (1998).
- All other data: TWAP Groundwater (2015).

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