## AF12 - Eastern Kalahari Karoo Basin

### Geography
- Total area TBA (km\(^2\)): 34 000
- No. countries sharing: 2
- Countries sharing: Botswana, Zimbabwe
- Population: 240 000
- Climate Zone: Semi-arid
- Rainfall (mm/yr): 490

### Hydrogeology
- Aquifer type: Multi-layered system
- Degree of confinement: Mostly confined with some semi-confined parts
- Main Lithology: Sedimentary rocks – sandstones and shales; Crystalline rocks - basal

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**Legend**
- Transboundary aquifer
  - Confirmed aquifer boundary
  - Other aquifer(s)

**Others symbols**
- Rivers
- Lakes
- Political Borders
- TBA Location

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Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

No cross-section available
AF12 - Eastern Kalahari Karoo Basin

**TWAP Groundwater Indicators from Global Inventory**

<table>
<thead>
<tr>
<th></th>
<th>Recharge (mm/y)</th>
<th>Renewable groundwater per capita (m³/y/capita)</th>
<th>Natural background groundwater quality (%)</th>
<th>Human dependency on groundwater (%)</th>
<th>Groundwater depletion (mm/y)</th>
<th>Groundwater pollution (%)</th>
<th>Population density (Persons/km²)</th>
<th>Groundwater development stress (%)</th>
<th>Transboundary Legal Framework (Scores)</th>
<th>Transboundary Institutional Framework (Scores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E</td>
</tr>
<tr>
<td>TBA level</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E</td>
</tr>
</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).

(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.

(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).

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

**TWAP Groundwater Indicators from WaterGAP model**

<table>
<thead>
<tr>
<th></th>
<th>Recharge incl. recharge from irrigation (mm/y)</th>
<th>Renewable groundwater per capita</th>
<th>Human dependency on groundwater (%)</th>
<th>Groundwater development stress (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current state (m³/y/capita)</td>
<td>Projection 2030 (% change to current state)</td>
<td>Projection 2050 (% change to current state)</td>
<td>Current state (Persons/km²)</td>
</tr>
<tr>
<td>Botswana</td>
<td>29</td>
<td>7700</td>
<td>41</td>
<td>10</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>19</td>
<td>2400</td>
<td>23</td>
<td>-3</td>
</tr>
<tr>
<td>TBA level</td>
<td>23</td>
<td>3800</td>
<td>28</td>
<td>2</td>
</tr>
</tbody>
</table>

**Groundwater depletion (mm/y)**

<table>
<thead>
<tr>
<th></th>
<th>Current state (m³/y)</th>
<th>Projection 2030 (% change to current state)</th>
<th>Projection 2050 (% change to current state)</th>
<th>Current state (Persons/km²)</th>
<th>Projection 2030 (% point change to current state)</th>
<th>Projection 2050 (% point change to current state)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td>0</td>
<td>4</td>
<td>30</td>
<td>58</td>
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<td>0</td>
<td>8</td>
<td>40</td>
<td>63</td>
<td>&lt;1</td>
<td>0</td>
</tr>
<tr>
<td>TBA level</td>
<td>0</td>
<td>6</td>
<td>37</td>
<td>62</td>
<td>&lt;1</td>
<td>1</td>
</tr>
</tbody>
</table>
**AF12 - Eastern Kalahari Karoo Basin**

### Key parameters table from Global Inventory

<table>
<thead>
<tr>
<th></th>
<th>Botswana</th>
<th>Zimbabwe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from ground surface to groundwater table (m)</td>
<td>Whole aquifer confined</td>
<td>Sedimentary rocks – sandstones and shale</td>
</tr>
<tr>
<td>Depth to top of aquifer formation (m)</td>
<td>Low Primary porosity intergranular porosity</td>
<td>Secondary porosity: Fractures</td>
</tr>
<tr>
<td>Full vertical thickness of the aquifer system (m)</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Degree of confinement</td>
<td>Predominant aquifer lithology</td>
<td>Transmissivity (m²/d)</td>
</tr>
<tr>
<td>Predominant type of porosity (or voids)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary Porosity</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 is a multi-layered system that is mostly confined with some semi-confined aquifers. Data is not available on the aquifer geometry.

**Hydrogeological aspects**
The main lithology is sedimentary rocks - Karoo sandstones and shales, and crystalline rocks - basalts. It is characterized by some primary porosity with secondary porosity: fractures that have a high vertical connectivity. The TBA receives short seasonal rains and often experiences prolonged droughts. In the eastern areas transmissivity values of up to 200 m²/d are reported. Recharge has been estimated at 2.5 mm/yr in the Maitengwe River area, decreasing to 0.5 mm/yr in the thinner basalts.

**Linkages with other water systems**
The predominant source of recharge is from precipitation on the aquifer area and specifically in Botswana at the Ntane sub-outcrop area and through thin basalt cover along major drainage courses.

**Environmental aspects**
Data is not available on the environmental information. The groundwater quality is generally good but deteriorates towards the northwest in Botswana. There is a potential for cross border flow in the Karoo aquifer, and degradation on the one side can result in pollution on the other side of the border.

**Socio-economic aspects**
Data is not available with regard to the groundwater and fresh water abstraction within the system.

**Legal and Institutional aspects**
No agreement exists, nor is it under preparation. The National institutions are in place, but are not fully operational.

**Hotspots**
The hydraulic continuity and potential flow across the border, coupled with likely enhanced demand in the future, makes this TBA a priority for monitoring.
Contributors to Global Inventory

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Country</th>
<th>E-mail</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
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<td>Robert Mutepfa</td>
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<td><a href="mailto:mutepfar@yahoo.com">mutepfar@yahoo.com</a></td>
<td>Lead National Expert</td>
</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.

More information for this TBA should be obtained through the National Experts of the countries.

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).

Version: September 2015