Transboundary Aquifer Information Sheet

AF16 - Medium Zambesi Aquifer - Middle Zambezi Rift Upper Karoo Aquifer

**Geography**
- Total area TBA (km²): 9400
- No. countries sharing: 2
- Countries sharing: Zambia, Zimbabwe
- Population: 170,000
- Climate Zone: Tropical Dry
- Rainfall (mm/yr): 710

**Hydrogeology**
- Aquifer type: Single to multi-layered aquifer
- Degree of confinement: Mainly unconfined – confined in places
- Main Lithology: Sediments - sands and sedimentary rocks - sandstone

---

No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate
**Transboundary Aquifer Information Sheet**

**AF16 - Medium Zambesi Aquifer - Middle Zambezi Rift Upper Karoo Aquifer**

**TWAP Groundwater Indicators from Global Inventory**

<table>
<thead>
<tr>
<th>Country</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>Zambia</td>
<td>4</td>
<td>260</td>
<td>95</td>
<td>190</td>
<td>8</td>
<td>16 16</td>
<td>50</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td><strong>TBA level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>D</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.

**Key parameters table from Global Inventory**

<table>
<thead>
<tr>
<th>Country</th>
<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 (m³/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zambia</td>
<td>47</td>
<td>20</td>
<td>50</td>
<td>Whole Aquifer unconfined</td>
<td>Sedimentary rocks - Sandstone</td>
<td>High Primary porosity fine/ medium sedimentary deposits</td>
<td>Secondary porosity: Fractures</td>
<td>26</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td></td>
<td></td>
<td></td>
<td>Whole aquifer semi- confined</td>
<td>Sedimentary rocks - Sandstone</td>
<td>Low Primary porosity inter- granular porosity</td>
<td>Secondary porosity: Fractures</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.
Transboundary Aquifer Information Sheet

AF16 - Medium Zambesi Aquifer - Middle Zambezi Rift Upper Karoo Aquifer

Aquifer description

Aquifer geometry
The aquifer that varies between a single and a multiple layered system is largely semi-confined. The average depth to the water table in the Zambian side is 47 m. The average depth to the top of the aquifer is 20m and the average thickness of the aquifer system is 50 m (Zambia).

Hydrogeological aspects
The predominant lithology consists of lower and upper Karoo sandstones and siltstones that underlie basalts within the down-faulted Zambezi Rift graben. The Karoo strata are generally indurate rocks with low permeability and porosity; with groundwater only occurring in fractured and/ or in parts that are weathered to significant depths. The aquifers are characterized by a low to moderate primary intergranular porosity with secondary porosity fractures. It has a low to moderate horizontal and vertical connectivity. The average transmissivity value is 26 m²/d (Zambia). The total groundwater volume within the Zambian part of the Aquifer is 11 km³. The mean annual recharge is 21 Mm³/yr over an area of about 10 700 km² and this increases to around 37 Mm³/yr during extreme recharge events (Zambia). The long-term trend of the water level in Zambia shows significant signs of groundwater depletion at 1 km³/yr.

Linkages with other water systems
The predominant source of recharge, that is 100% through natural processes, is through Infiltration from surface water bodies. The predominant discharge mechanism is through groundwater flow into surrounding aquifers.

Environmental aspects
Within Zambia around 5% of the aquifer is not suitable for human consumption mainly due to high salinity and fluorides sometimes over significant parts of the aquifer. Anthropogenic groundwater pollution does affect around 10% of the aquifer within Zambia and this is mainly due to households, urban, and agricultural causes. The data is not available on shallow groundwater and on groundwater dependent ecosystems.

Socio-economic aspects
During 2010 the annual groundwater abstraction on the Zambian side was 10 Mm³/yr and this is an estimate based on expert judgment. The data is not available on the total fresh water abstraction within the TBA.

Legal and Institutional aspects
There is no TBA Agreement in place. The National Institution within Zambia is characterized by a full mandate with limited capacity, whereas within Zimbabwe it has limited capacity and mandate.

Emerging Issues
Any cross-border flow is likely to be very small and not a cause for management concerns by either state. Other common issues that need to be jointly managed should be reviewed between the countries and an agreement should be drafted. From the assessment of the aquifer there are signs of a high use relative to the mean annual recharge that occurs leading to groundwater depletion. This must be monitored.
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>
<td>Greg Christelis</td>
<td>CHR Water Consultants</td>
<td>Namibia</td>
<td><a href="mailto:gregchristelis@gmail.com">gregchristelis@gmail.com</a></td>
<td>Regional coordinator</td>
</tr>
<tr>
<td>Beatrice Kanyamula</td>
<td>Ministry of Mines Energy and Water Development</td>
<td>Zambia</td>
<td></td>
<td>Contributing national expert</td>
</tr>
<tr>
<td>Dr Howard MPAMBA</td>
<td>Ministry of Mines Energy and Water Development</td>
<td>Zambia</td>
<td></td>
<td>Contributing national expert</td>
</tr>
<tr>
<td>Andrew Kangomba</td>
<td>Ministry of Mines Energy and Water Development</td>
<td>Zambia</td>
<td><a href="mailto:kangomba@yahoo.com">kangomba@yahoo.com</a></td>
<td>Contributing national expert</td>
</tr>
<tr>
<td>Pasca Mwila</td>
<td>Ministry of Mines Energy and Water Development</td>
<td>Zambia</td>
<td></td>
<td>Contributing national expert</td>
</tr>
<tr>
<td>Simon Kangomba</td>
<td>Ministry of Mines Energy and Water Development</td>
<td>Zambia</td>
<td><a href="mailto:kangomba@yahoo.com">kangomba@yahoo.com</a></td>
<td>Lead National Expert</td>
</tr>
<tr>
<td>Robert Mutepfa</td>
<td>Ministry of Environment, Water and Climate</td>
<td>Zimbabwe</td>
<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.

Most of the information was provided by Zambia. The value provided for groundwater depletion should be reviewed. Most of the indicators could be calculated for the Zambian part.

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](http://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](http://www.twap.isarm.org) or [www.un-igrac.org](http://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:

- Population: Population has been calculated based on the aquifer map and grid information on population. Source population data: Center for International Earth Science Information Network - CIESIN - Columbia University, United States.
AF16 - Medium Zambesi Aquifer - Middle Zambezi Rift Upper Karoo Aquifer

- 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