GROUNDWATER AND EARTH SCIENCES
GEOSS
SOUTH AFRICA (Pty) Ltd

Unit 12, Technostell
9 Quantum Street, Technopark,
Stellenbosch, 7600
PO Box 12412, Die Boord,
7613, South Africa
Tel: +27 (0)21 880 1079
info@geoss.co.za
www.geoss.co.za

# A Guide to Compiling a Water Balance for a Geohydrological Report

## Background

Water is a critical resource, especially in areas facing scarcity and increasing demand, such as a semi-arid country like South Africa. Ensuring sustainable water management practices is crucial for both current needs and future growth. A key component of effective water management is implementing a comprehensive water balance, vital in Water Use Licence Applications (WULA) and Geohydrological Reports. In the context of South Africa's water scarcity, this guide is not just a set of instructions, but a powerful tool that empowers Applicants, enabling them to proactively provide a detailed water balance for a WULA-compliant Geohydrological Report. Your role in this process is significant, and this guide equips you to make a real difference in water management.

Once a WULA is approved, the application volume specified in the water balance must remain accurate for the license's duration. Any discrepancies in this volume can lead to serious repercussions. If a licensee exceeds the approved volume, an amendment application must be submitted on e-WULAAS (Electronic Water Use Licence Application and Authorisation System). This highlights the criticality of maintaining an accurate water balance. Inaccuracies cannot only result in non-compliance but also disrupt the WULA process, delaying the start of reporting and final submission to DWS. It's crucial to understand the potential risks of inaccuracies and the importance of this guide in helping you avoid them.

## Understanding the Water Balance

A water balance is a systematic method of accounting for the inflow, outflow, and storage of water on a property. It can be presented in a graphical form (**Figure A**) or as a table (**Table A**). DWS often prefers a tabulated water balance, so this guide will primarily focus on this format. It will provide step-by-step instructions and a mathematical formula for creating a water balance. The process involves a thorough evaluation of the property's water sources, the demand for various uses, and any losses on the premises. This guide will walk you through each step, from identifying water sources to calculating demand and losses, ensuring you have a comprehensive understanding of the process. If there are on-site losses, the water balance should detail any re-use of these losses (if applicable). If there is no reuse, and the effluent, wastewater, treated wastewater, or brine is discharged or disposed of, this should align with the water uses specified in Section 21 of the National Water Act (NWA) (Act 36 of 1998). Additional documentation may be necessary, such as an Effluent Discharge Permit from the local municipality or a Service Level Agreement (SLA).

The water balance provides the applicant and DWS with a clear understanding of how water is used for current and future activities. It is worth noting that for WULAs, only the recommended sustainable volume of the borehole can be applied for as per the yield test results. The yield test has to be done according to SANS 10299-4:2003 standards. The application volume must be detailed and motivated,

GROUNDWATER AND EARTH SCIENCES
GEOSS
SOUTH AFRICA (Pty) Ltd

Unit 12, Technostell
9 Quantum Street, Technopark,
Stellenbosch, 7600

PO Box 12412, Die Boord,
7613, South Africa

Tel: +27 (0)21 880 1079
info@geoss.co.za
www.geoss.co.za

i.e. correspond to what is required on a specific property. The water balance will show the current and future uses to ensure that the volume does not exceed the recommended sustainable supply from the borehole(s). A basic water balance template is shown in **Table A**.

GROUNDWATER AND EARTH SCIENCES
GEOSS
SOUTH AFRICA (Pty) Ltd

Unit 12, Technostell
9 Quantum Street, Technopark,
Stellenbosch, 7600
PO Box 12412, Die Boord,
7613, South Africa
Tel: +27 (0)21 880 1079
info@geoss.co.za
www.geoss.co.za

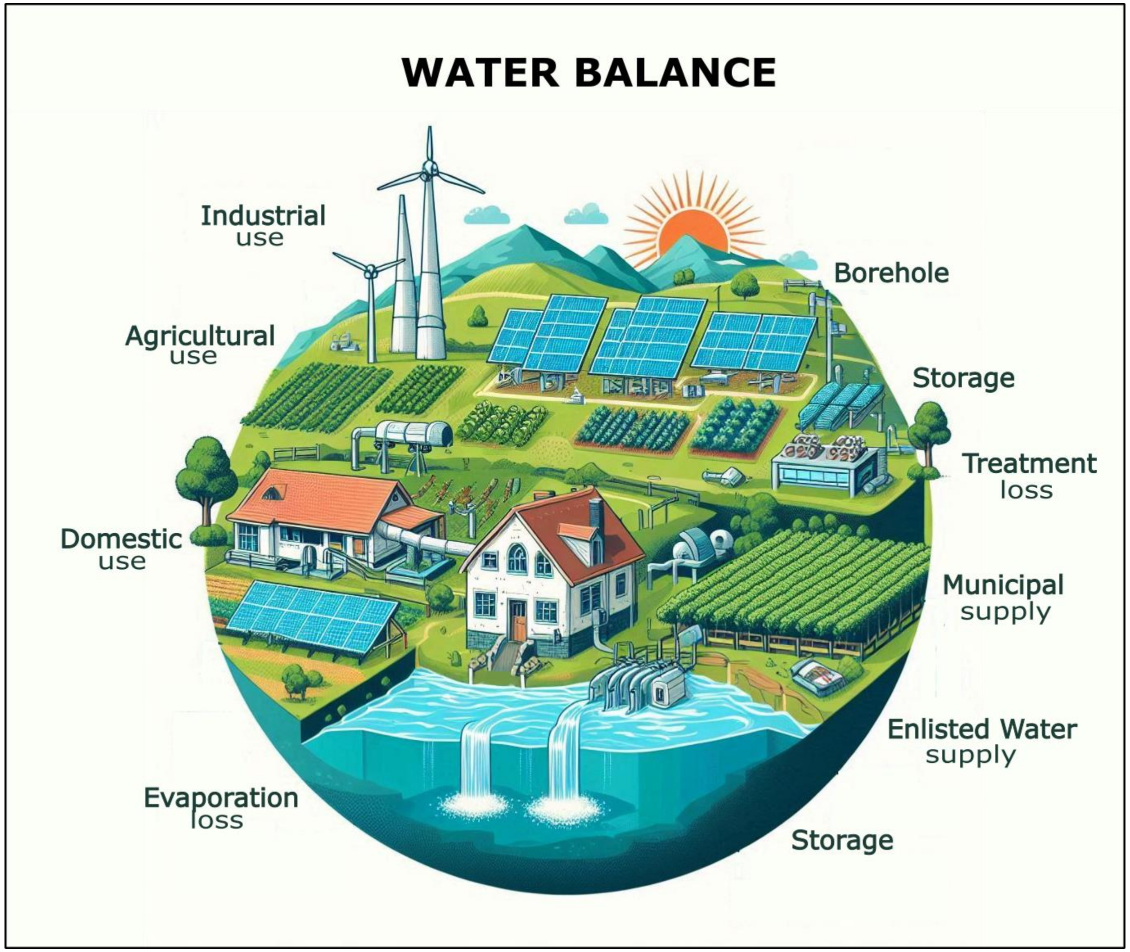


*Figure A: Graphical representation of a Water Balance*

*Table A: Tabulated representation of a Water Balance*

| Months | Requirement ($m^3$) | | | | | Loss ($m^3$) | | | Supply ($m^3$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Use (e.g., Agricultural, Industrial, Domestic) | | | Total Current Requirement ($m^3$/a) | Total Future Requirement ($m^3$/a) | Treatment Plant (RO, UV, UF, etc) | Evaporation | Total Loss ($m^3$/a) | Municipal Supply | Enlistment Water | Surface water Supply ($m^3$) | | Groundwater supply ($m^3$) | | Treated Effluent | Total Supply ($m^3$/a) |
| | Water Use (1) Requirement | Water Use (2) Requirement | Water Use (3) Requirement | | | | | | | | Dam | River | Borehole 1 | Borehole 2 | Treatment Plant specs | |
| **January** | | | | | | | | | | | | | | | | |
| **February** | | | | | | | | | | | | | | | | |
| **March** | | | | | | | | | | | | | | | | |
| **April** | | | | | | | | | | | | | | | | |
| **May** | | | | | | | | | | | | | | | | |
| **June** | | | | | | | | | | | | | | | | |
| **July** | | | | | | | | | | | | | | | | |
| **August** | | | | | | | | | | | | | | | | |
| **September** | | | | | | | | | | | | | | | | |
| **October** | | | | | | | | | | | | | | | | |
| **November** | | | | | | | | | | | | | | | | |
| **December** | | | | | | | | | | | | | | | | |
| **Total ($m^3$/a)** | | | | | X | | | Y | | | | | | | | Z |

Unit 12, Technostell
9 Quantum Street, Technopark,
Stellenbosch, 7600

PO Box 12412, Die Boord,
7613, South Africa

Tel: +27 (0)21 880 1079
info@geoss.co.za
www.geoss.co.za

## Components of a Water Balance

The water balance template, as illustrated above, is divided into three main sections: Losses, Requirements, and Supply. Depending on the property's storage, a fourth column may be included. However, the finer details that need refining lie within the first three columns.

## How to fill in the Water Balance

Below is a mathematical formula to assist in filling out the water balance table, ensuring that the total loss plus the total requirement equals the total volume of supply sources for the property:

$$Total\ Requirement + Total\ Loss = Total\ Volume$$
$$X + Y = Z$$

Where:

- X = Total Requirement is the sum of all monthly requirements
- Y = Total Loss is the sum of all monthly losses
- Z = Total Volume is the sum of all monthly supplies

This formula will help maintain the balance between water supply and water demand, including losses. Given the template from the document:

| **Months** | **Loss (m³)** | **Requirement (m³)** | **Supply (m³)** |
|---|---|---|---|
| January | Loss_Jan | Req_Jan | Sup_Jan |
| February | Loss_Feb | Req_Feb | Sup_Feb |
| ... | ... | ... | ... |
| Total | Loss_Total | Req_Total | Sup_Total |
| $\sum_{i=1}^{12} \square$ | $X_i$ | $Y_i$ | $Z_i$ |

Unit 12, Technostell
9 Quantum Street, Technopark,
Stellenbosch, 7600
PO Box 12412, Die Boord,
7613, South Africa
Tel: +27 (0)21 880 1079
info@geoss.co.za
www.geoss.co.za

## Detailed Breakdown of the General Components of a Water Balance

### Losses (m³):

- **Treatment Plant (RO, UV, UF, etc.):** Measures losses during water treatment processes such as reverse osmosis (RO), ultraviolet (UV) purification, and ultrafiltration (UF). The treatment specialist can also provide estimates (% or m3/d) during the planning phase.
- **Evaporation:** Accounts for water lost through evaporation from storage not closed off to the atmosphere.
- **Seepage:** Accounts for water lost through seepage from dams, depending on the type of dam and its design.
- **Additional Losses:** Any other site-specific planned losses that must be considered. Unplanned losses, such as leaks, could possibly occur. However, these will not form part of the WB, as with proper water management guidelines, the losses should be minimised and mitigated.

$$Total\ Loss = Treatment\ Plant\ Loss\ + Evaporation + Seepage + Additional\ Losses + Future\ Losses$$

### Requirements (m³):

- **Water Use (e.g., Industrial Use, Agricultural Use (i.e., Irrigation etc), Commercial, Domestic Use, etc.):** Details the water requirement for various uses on-site.
- **Total Current Requirement (m³/a):** Sum of all current water use requirements.
- **Total Future Requirement (m³/a):** Projected water needs for future expansion, with detailed motivation provided (if applicable).

Illustrating each use is highly recommended if the current and proposed future expansion water requirements can be broken down in detail. For example,

$$\begin{aligned} Current\ Requirement &= Industrial_{(wash\ bay)} + Industrial_{(product\ water)} \\ &+ Agricultural_{(vineyards\ (x\ ha)\ @micro_{spray})} + Agricultural_{(tomatoes\ (x\ ha)@drip\ irrigation)} \\ &+ Agricultural_{(landscaping\ (x\ ha)\ @irrigation_{system})} + Domestic_{Potable} \\ &+ Domestic_{nonpotable} + Commercial_{bottling} \end{aligned}$$

$$Future\ Requirement = Domestic_{expansion} + Industrial_{expansion} + Agricultural_{expansion}$$

$$Total\ Requirement = \ current\ requirement + future\ requirement$$

It is worth noting that if the groundwater is used for irrigation, the Geohydrological Report and WB will detail the crops being irrigated, the hectare (ha) size, the irrigation schedule and the method, as this will form part of the WULA.

Unit 12, Technostell
9 Quantum Street, Technopark,
Stellenbosch, 7600

PO Box 12412, Die Boord,
7613, South Africa

Tel: +27 (0)21 880 1079
info@geoss.co.za
www.geoss.co.za

**Supply (m³):**

- **Municipal Supply:** Water provided by the local municipality.
- **Enlistment Water:** Water from enlistment agreements like the Berg River Water Board or other water schemes.
- **Surface Water Supply (m³):** Water from surface sources such as dams and rivers.
- **Groundwater Supply (m³):** Water extracted from boreholes and other groundwater sources (e.g., springs).
- **Alternative Supply (m³):** Should there be treated water that becomes a new supply, the water balance must detail this in depth.

It is important to note that if abstracted groundwater is taken from a borehole or river and stored in the dam, then 'taking' from the resource is regarded as a Section 21 a water use and the 'storage' of the abstracted water in a dam/reservoir is regarded as a Section 21 b water use.

The total loss + total requirement must equal the total volume of the property. Future requirements, losses, and re-supplies (such as treated effluent) need to be considered.

## Key Questions Addressed by a Water Balance

A well-constructed water balance answers several critical questions essential for WULA compliance submission:

1. **Is there any existing authorisation on the property?** This adds to the water supply column in a water balance and can include any existing authorisation (Existing Lawful Use (ELU) & Verification and Validation (V&V)), enlisted water or water from irrigation boards.
2. **Will the surface water and/or groundwater supplement or replace the municipal supply?** The water balance must detail this if a combination of municipal, groundwater, and/or surface water is used on the property.
3. **What will the groundwater be used for on the properties?** This helps detail the water requirements, including domestic use (broken down into potable and non-potable columns), irrigation, agricultural, and industrial use. Broad descriptions should be broken down further; for example, industrial-winery versus industrial-wash bay water use volume. If treated wastewater is re-used for a specific purpose, this must be detailed in the water balance. Details about the quality of the treated effluent, the type of crops, the size of the area in hectares, the irrigation method, the irrigation system, and an irrigation layout plan all depend on the specific project. Future expansion must also be investigated, and proposed estimates must be shown in the water balance.
4. **Is any groundwater and/or surface water stored on the property?** If yes, please detail the storage method and volume (in m³). If groundwater is pumped to dams for irrigation, this must be detailed in the water balance. If groundwater is stored in a dam, evaporation losses must be documented. Should groundwater be stored in a closed reservoir or JoJo tanks, the volume must be shown to describe on-site activities and collective storage on the property. The Department of Water and Sanitation (DWS) does not classify the storage of abstracted water

Unit 12, Technostell
9 Quantum Street, Technopark,
Stellenbosch, 7600
PO Box 12412, Die Boord,
7613, South Africa
Tel: +27 (0)21 880 1079
info@geoss.co.za
www.geoss.co.za

in JoJo tanks as a Section 21(b) water use. However, they do require a comprehensive understanding of the water management on the property, including the processes of abstraction, storage, and distribution of water on the premises. The property's collective storage volume (excluding JoJo tanks) must be checked to ensure it is within the General Authorisation (GA) limit set by DWS. If not, it must form part of the integrated WULA and be detailed in the water balance.

5. **Is the surface water and/or groundwater being treated before use?** Please note the treatment process. Should any treated water be reused, this should be elaborated on. If groundwater is treated, e.g., through RO, the brine generated is considered a loss and must be shown in the water balance. If treated wastewater is reused, for example, irrigation or flushing toilets, it becomes another supply stream for a water requirement and must be clearly documented.
6. **Is the treated effluent discharged on-site or off-site?** The geohydrologist must comment on whether the property has an effluent permit or service level agreement (SLA) or needs one. For example, if brine is discharged to a municipal sewer system, septic tank or conservancy tank, the applicant must provide an SLA to DWS. Although the geohydrologist does not focus on these permits, the water balance will determine and confirm all water uses applicable for a WULA and possibly identify areas or scope that need refinement or implementation. Should the treated effluent be reused for on-site irrigation, additional information would be required. This includes details about the quality of the treated effluent, the type of crops, the crop rotation factor, the size of the area in hectares, the irrigation method, the irrigation system, and an irrigation layout plan, all depending on the specific project.

## Importance of a Water Balance in Geohydrological Reports

Incorporating a detailed water balance into geohydrological reports ensures a holistic view of water management. Here are key reasons why this is important:

1. **Compliance with Regulatory Standards** A water balance aligned with the SANS 10299-4:2003 standard, particularly the test pumping of water boreholes, ensures compliance with national regulations. This standard provides guidelines for testing borehole yields and sustainability, which are integral to determining reliable groundwater supplies. Only the recommended sustainable volume of the borehole can be applied for. The supply column in the water balance cannot exceed the yield test results. The geohydrological report needs the water balance and is written according to the procedural requirements as per GN 40713.
2. **Sustainable Water Management** By assessing the balance between water supply and demand, organisations can identify potential shortfalls or surpluses in water availability. This helps make informed decisions for sustainable water usage and future requirements.
3. **Identifying Inefficiencies** A detailed water balance highlights inefficiencies in the water management system, such as high evaporation losses or excessive water use in certain processes. Addressing these inefficiencies can lead to significant water savings and more efficient operations.
4. **Facilitating Future Planning** Understanding current and future water requirements is essential for strategic planning and development. A water balance provides the data necessary to plan

Unit 12, Technostell
9 Quantum Street, Technopark,
Stellenbosch, 7600

PO Box 12412, Die Boord,
7613, South Africa

Tel: +27 (0)21 880 1079
info@geoss.co.za
www.geoss.co.za

for expansions, ensuring that water resources will be sufficient to meet future needs without compromising the current supply.

## How GEOSS Incorporates the Water Balance in Reporting

Once the water balance is finalised, presented during a pre-application meeting, and all water uses confirmed by DWS, GEOSS will be able to commit to providing a comprehensive geohydrological report within a fixed timeline. This commitment ensures stakeholders receive timely, accurate information critical for decision-making and regulatory compliance.

## Conclusion

A water balance is an indispensable tool in preparing WULA-compliant geohydrological reports. It provides a detailed understanding of water supply, demand, and losses, ensuring sustainable and efficient water management practices for current and future requirements.

**Written by Abigail Oellermann (abi@geoss.co.za)**
**Date: 25 June 2024**

**CONTACT GEOSS Today**