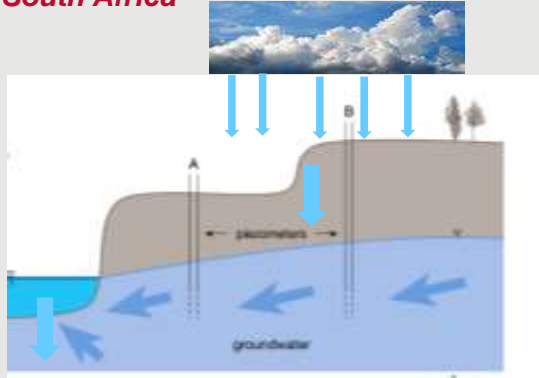


# Understanding groundwater recharge in the Limpopo River basin, Southern Africa: GRECHLIM

Tamiru Abiye: University of the Witwatersrand, South Africa

Karen Villholth, Manuel Magombeyi: International Water Management Institute, South Africa



Groundwater Recharge: complex natural process

**Vital role of groundwater in semi-arid region**



Groundwater for cattle



Groundwater for irrigation



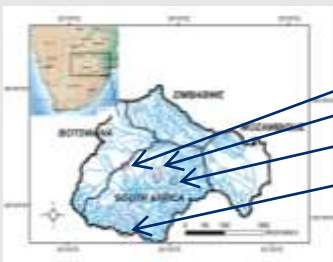
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Information for public

## Research Approach:



Ramotswa  
Dendron  
Letsitele  
Upper Crocodile

## Involvement of groundwater management (DWS) and users (Farmers)

- Collection of rainfall, groundwater, river water and spring,
- Aquifer characterization
- Water balance determination
- Recharge estimation
- Piezometer installation and monitoring
- Surface and ground water interaction monitoring
- PRMS modelling
- Groundwater vulnerability to pollution mapping

**Background**  
Groundwater resources are of increasing importance in being available to the rural areas of Southern Africa, particularly in South Africa in particular, in recent and early years. This means groundwater recharge is the most viable source of water for farming activities in such areas where surface water is scarce.

**Groundwater Recharge in the Limpopo River Basin (GRCHEUM)**  
The project will contribute to the understanding of groundwater recharge in the Limpopo River Basin (LRB) and its sub-basins, including the identification of recharge areas and the estimation of groundwater recharge rates.

**Study Areas:**  
The project is a three-year project, with investigations in a number of sub-basins in the Limpopo River Basin. The study areas include: Dendron, Letsitele, Ramotswa, Upper Crocodile, and Upper Crocodile.

**Project Coordinators:**  
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Tel: +27 11 251 2300

| Type of analysis                             | Type of source | # Of samples |
|--|----------------|--------------|
| $\delta^{18}\text{O}$ and $\delta^2\text{H}$ | Precipitation  | 257          |
|  | Borehole       | 52           |
|  | Surface water  | 47           |
| Tritium                                      | Spring         | 30           |
|  | Borehole       | 52           |
|  | Surface water  | 35           |
| $\delta^{13}\text{C}$ and $^{14}\text{C}$    | Spring         | 9            |
|  | Boreholes      | 14           |
| Chloride                                     | Springs        | 3            |
| Metal analysis                               | Spring         | 5            |
| Bacteria                                     | Boreholes      | 5            |
|  | Surface water  | 17           |
|  | Surface water  | 13           |



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## Key results:

- Capacity development: 1 PhD & 10 MSc students, 4 Researchers
- Experience sharing with the USGS experts
- Collaboration in sampling and drilling DWS & farmers



*Sampling*



Ramotswa training-Feb 2016



Groundwater recharge training- Nov 2016

## PG students

*Mr. Khahliso Leketa (PhD student)*  
*Mr. Simamkele Baqa (MSc student)*  
*Ms. Oudi Modisha (MSc student)*  
*Ms. Aqeelah Davis (MSc student)*  
*Ms. Silindile Zondi (MSc student)*  
*Ms. Paballo Moshupya (MSc student)*  
*Ms. Despina Tshipala (MSc student)*  
*Mr. Mulalo Netsianda (MSc student)*  
*Ms. Mashudu Mmbadi (MSc student)*  
*Mr. Sipho Nyebelele (MSc student)*  
*Mr. Justin Press (MSc student)*

## Recharge amount

- **BFS: 6.67%** of MAR (700mm/yr)
- **WTF: Recharge for individual boreholes 2.5% (17.5mm/yr.) to 39% (270mm/yr.).**  
Average is **15% (104mm/yr.)**
- **CMB: 2.2% and 2.8%** with the average as **2.5%**, Dolomites: **20.8% and 50%**.

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Tamiru Abiye: University of the Witwatersrand, South Africa

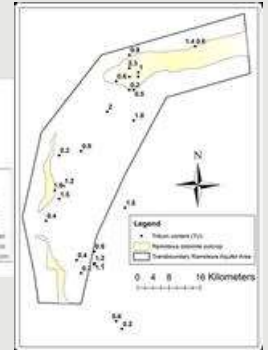
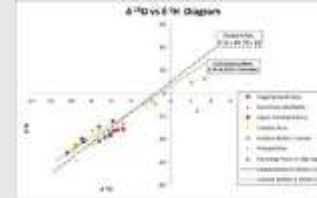
Karen Villholth, Manuel Magombeyi: International Water Management Institute, South Africa



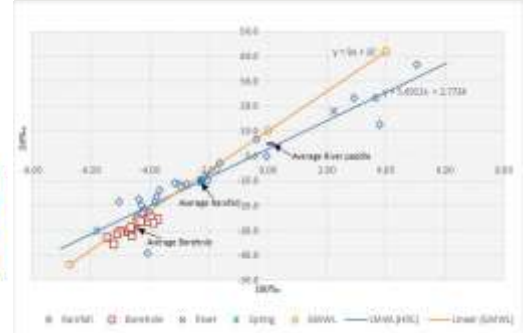
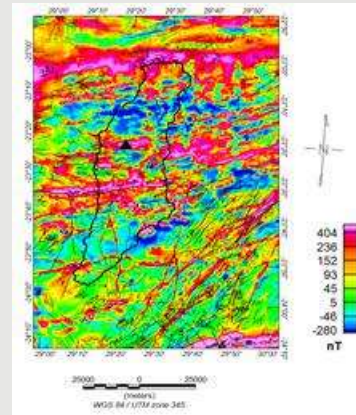
-Treated wastewater loaded river  
-Challenge for Baseflow separation  
-720 million m<sup>3</sup>/yr

Stream discharge measurement  
SW/GW interaction

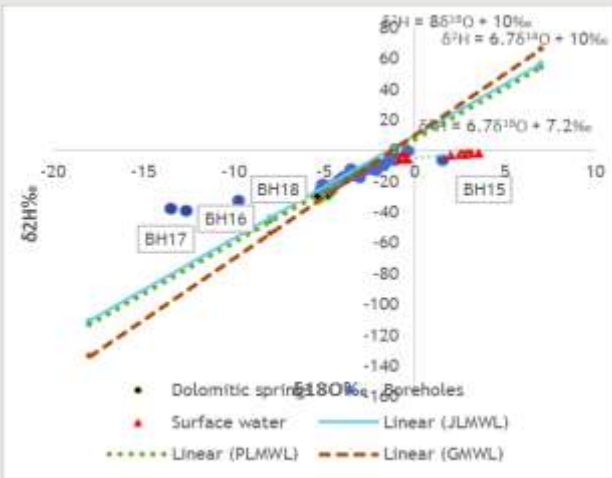
## Ramotswa



## Dendron



## Upper Crocodile



| BH No. | $\delta^{13}\text{C}$ (‰) | $^{14}\text{C}$ (pMC) | $\pm$ | MRT (Years) | Code | $^{14}\text{C}$ (pMC) | MRT (years) |
|--------|---------------------------|-----------------------|-------|-------------|------|-----------------------|-------------|
|        |                           |                       |       |             | D7   | 85.40±2.5             | 1304.73     |
|        |                           |                       |       |             | D8   | 93.40±2.6             | 564.46      |
| BH14   | -12.31                    | 104.4                 | ±2.7  | 0           | D12  | 84.30±2.5             | 1411.91     |
| BH16   | -17.35                    | 88.2                  | ±2.5  | 1038        | D15  | 102.30±2.6            | 0           |
| BH19   | -15.22                    | 95.7                  | ±2.6  | 363         | D16  | 110.30±2.7            | 0           |
| BH23   | -8.41                     | 84.4                  | ±2.5  | 1402        | D17  | 92.90±2.6             | 608.84      |
| BH24   | -15.38                    | 99.6                  | ±2.6  | 33          | D18  | 88.10±2.5             | 1047.41     |
| BH25   | -15.3                     | 95.1                  | ±2.6  | 415         | D20  | 87.70±2.5             | 1085.03     |
| SP1    | -6.05                     | 82.0                  | ±2.5  | 1641        |      |                       |             |
| SP2    | -5.64                     | 79.9                  | ±2.5  | 1855        |      |                       |             |



Recharge time: recent to millennia

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Next steps:

- Data analyses, interpretation and modelling, Manuscript preparation and publication, Students' research report preparation

How data and results impact stakeholder decisions and the development problem:

- Reveal actual groundwater recharge and control factors in order to estimate groundwater storage that is available for use; suggest feasible groundwater management techniques, increase awareness

Challenges you have faced in collecting meaningful data:

- Access to boreholes and springs, Meteorological data availability

