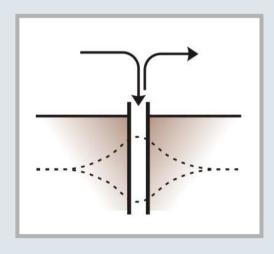
Artificial Recharge

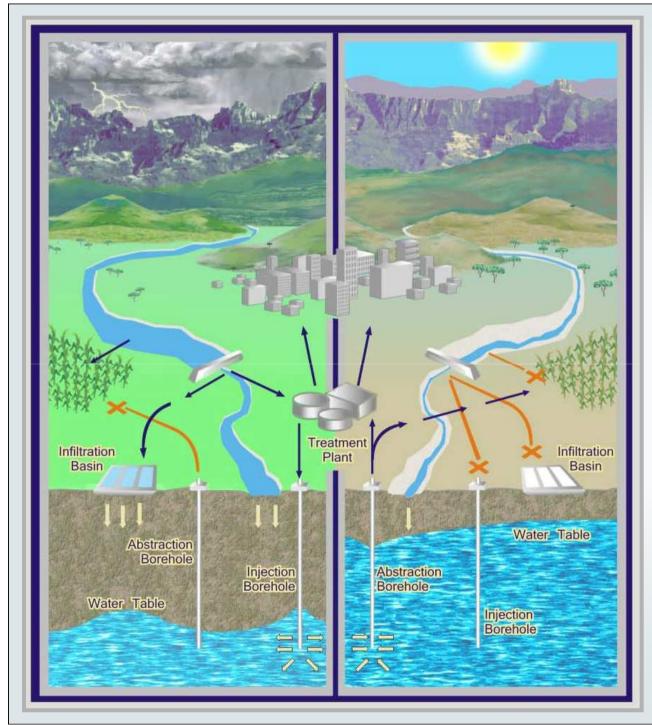
ARTIFICIAL GROUNDWATER RECHARGE: WATER STORAGE OPPORTUNITIES FOR SOUTH AFRICA



Dr Ricky Murray







The concept

Store water underground when available and recover it when needed

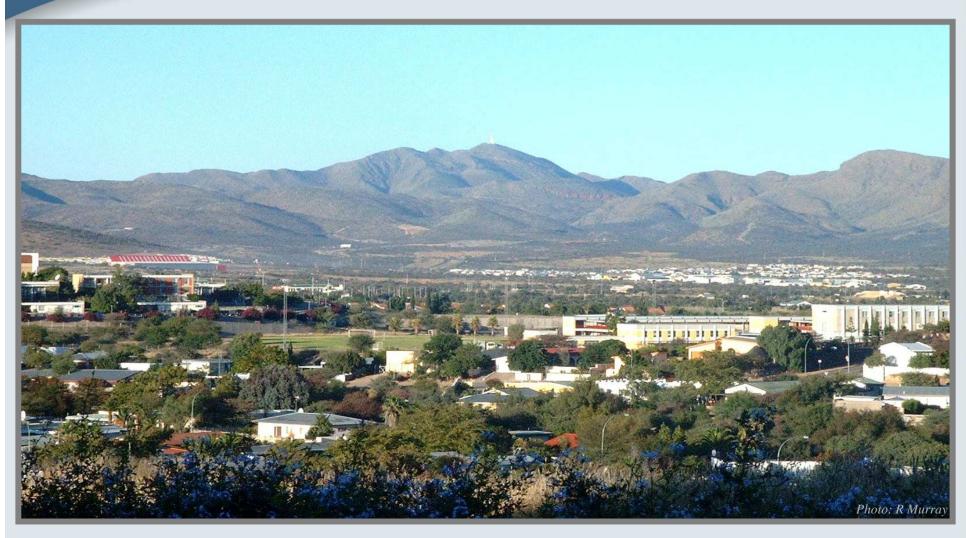
Left hand part of diagram: Water is diverted to infiltration basins and recharge boreholes while water is available and the aquifer is not pumped.

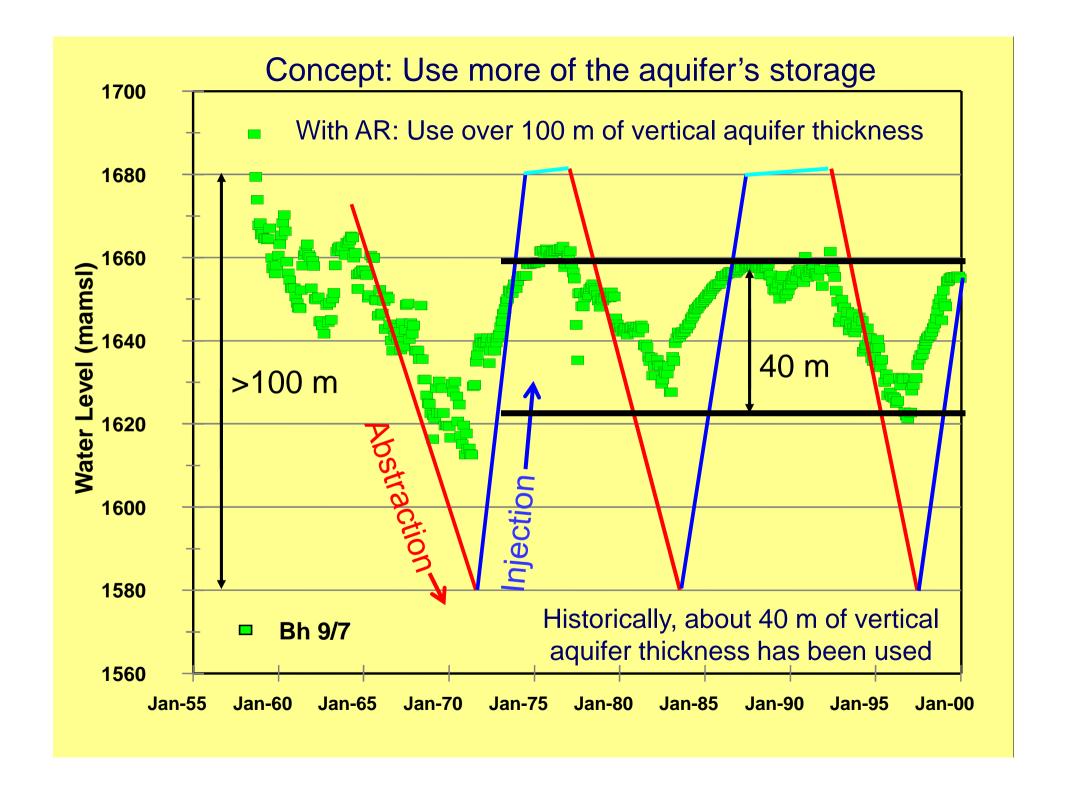
Right hand part of diagram:

Water is then abstracted when the aquifer is full. The recharge facilities are now rested.

Windhoek

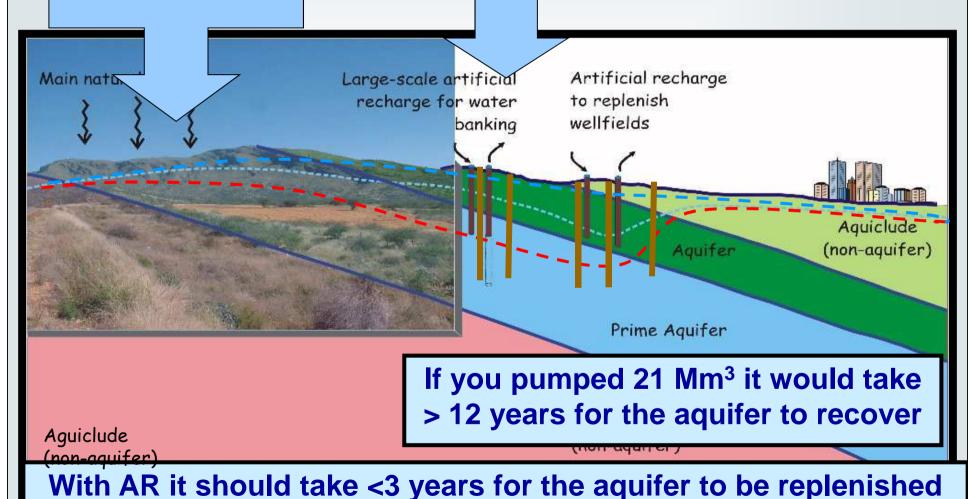
Large-scale water banking

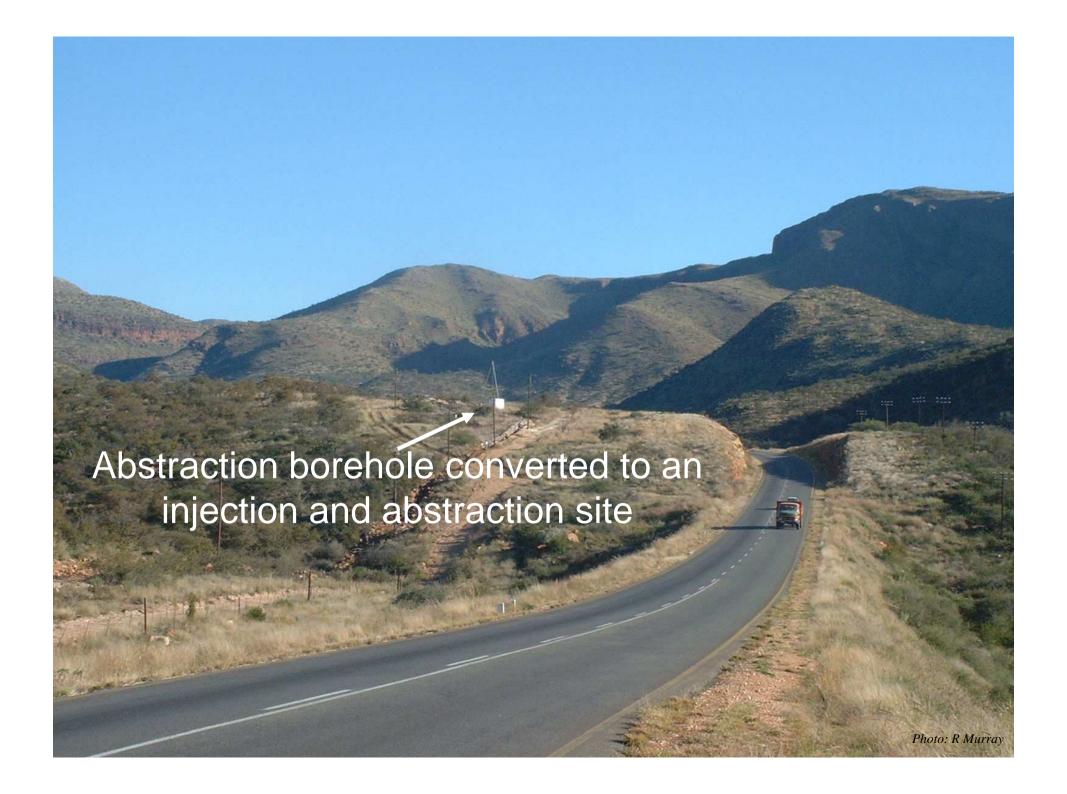




Natural recharge 1.7 Mm³/year (~ 8% of demand)

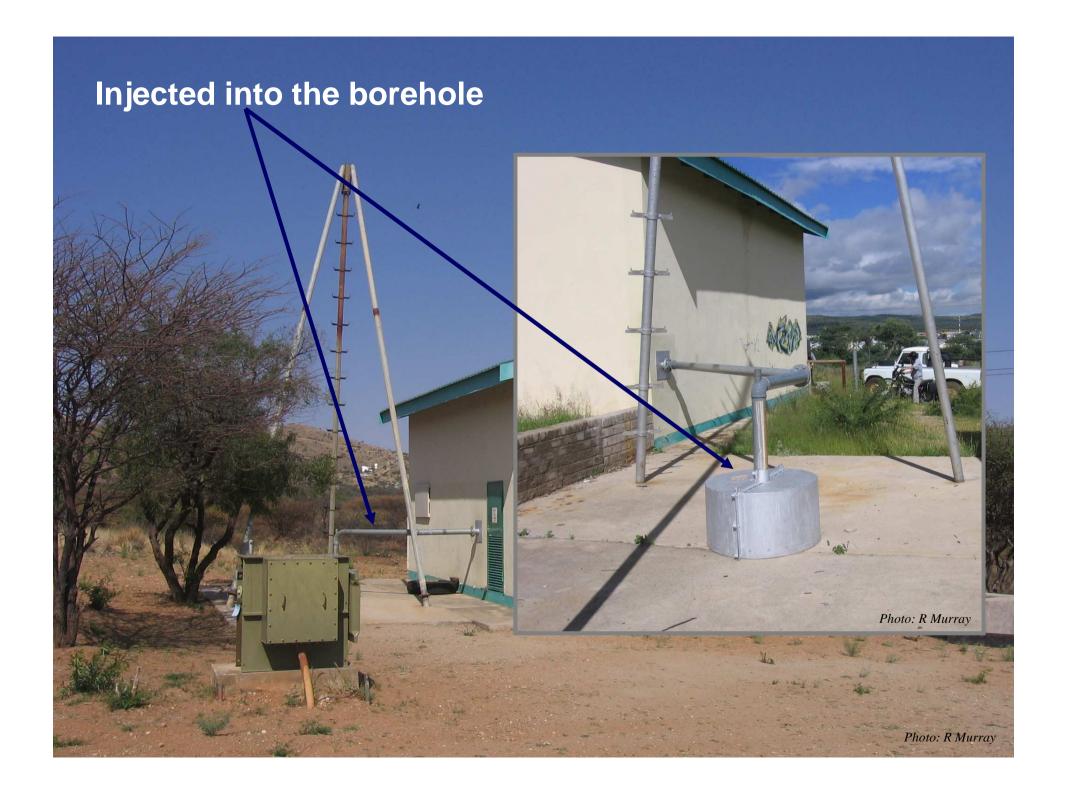
Artificial recharge 8 Mm³/year (~ 38% of demand) City's water use: ~ 21 Mm³/year



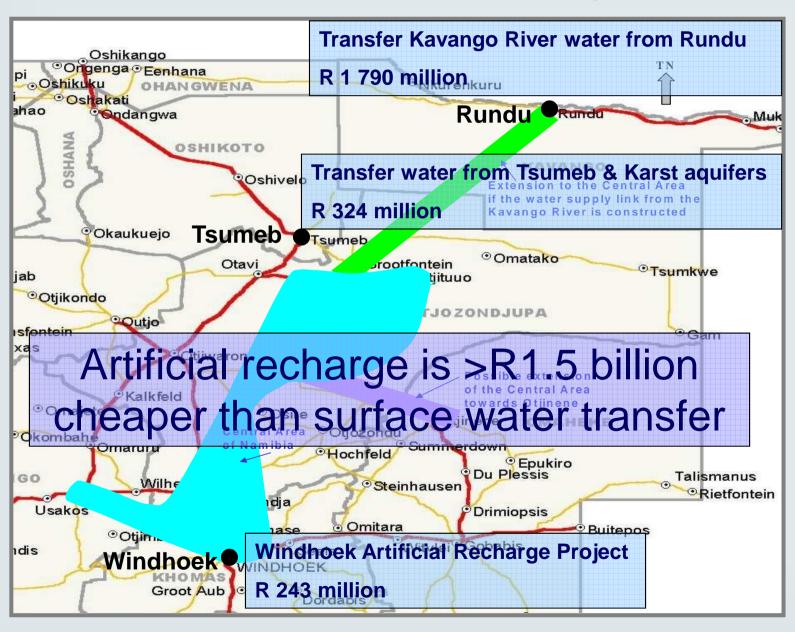








Capital cost of water supply options



Cost Comparison - 2007

Options costed in the same way taking capital and operational costs into account

Scheme	URV (R/m³)
Groundwater	1.74
Water Demand Management	1.70
Dams	5.75
Reclaimed water	7.00
Artificial recharge	9.80
Tsumeb & Karst III	24.70
Kavango River	206.80

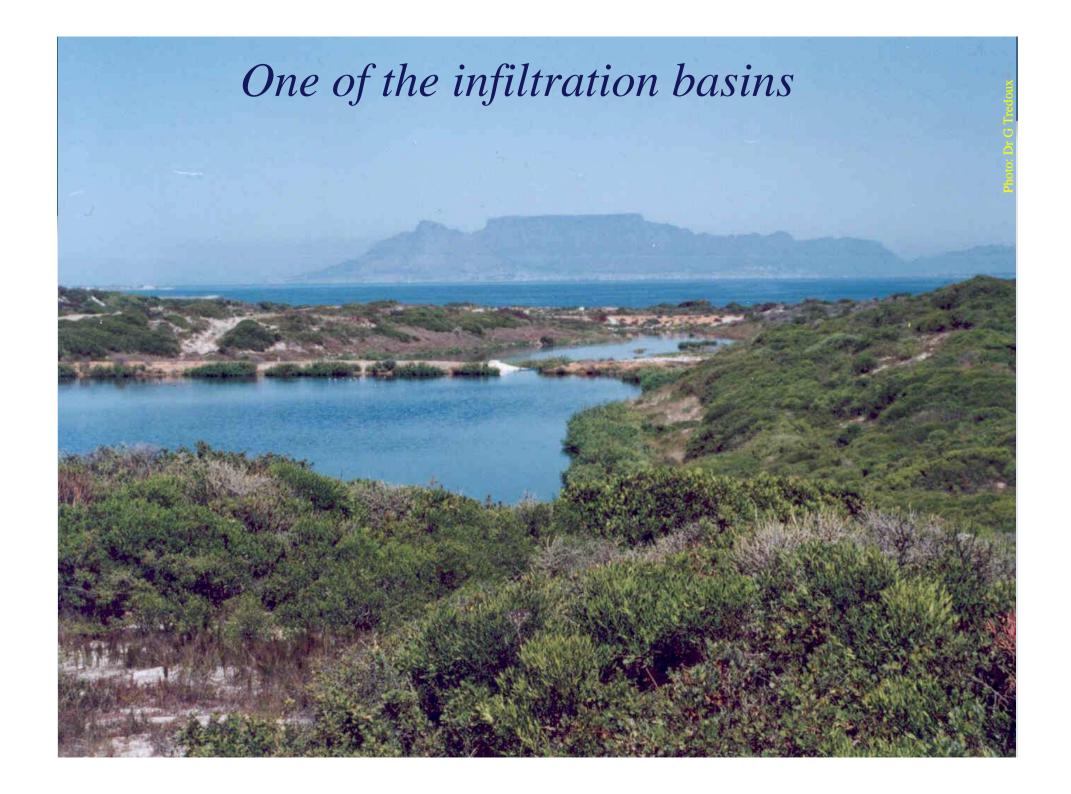
URV: Unit Reference Value

The AR scheme is 20 times cheaper than taking water from the Kavango River which flows into the Okavango Delta

Atlantis

Infiltration in dune sands







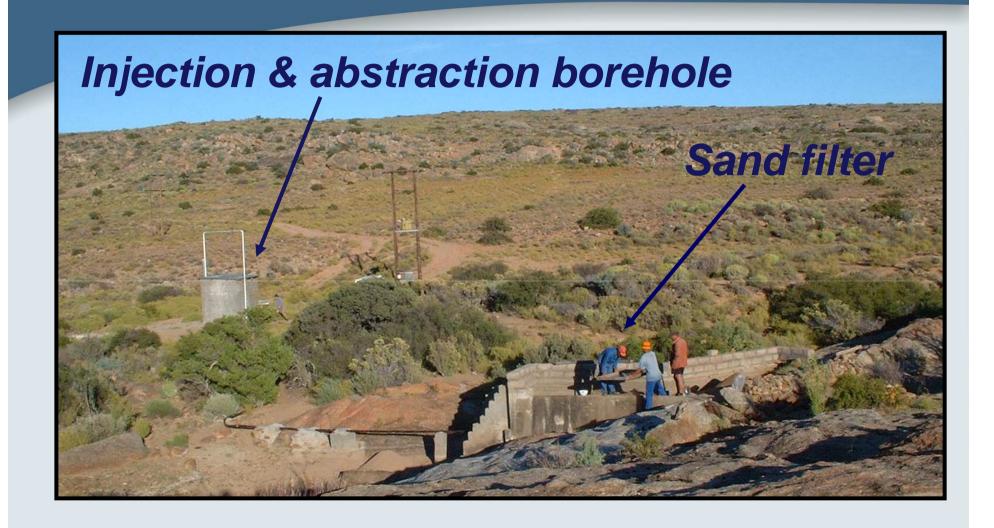
Karkams village

Opportunistic recharge when the river flows





- Borehole injection in fractured gneisses
- Injection rates of up to 1.4 L/s (5 m³/h)
- Sustainable yield of borehole doubled with artificial recharge

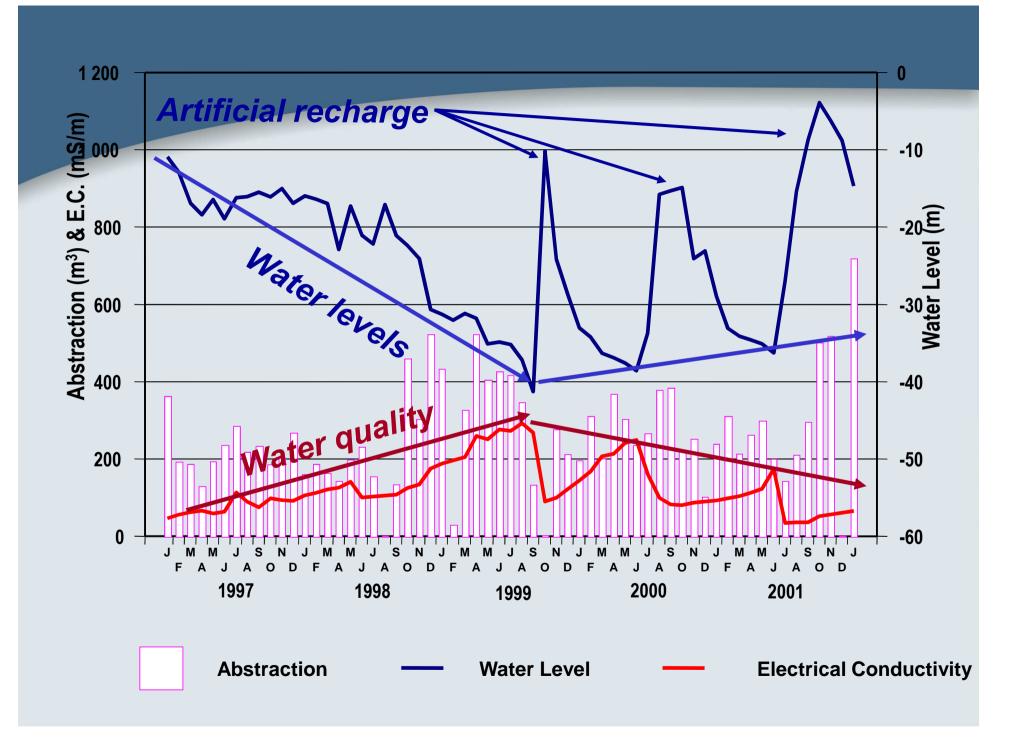


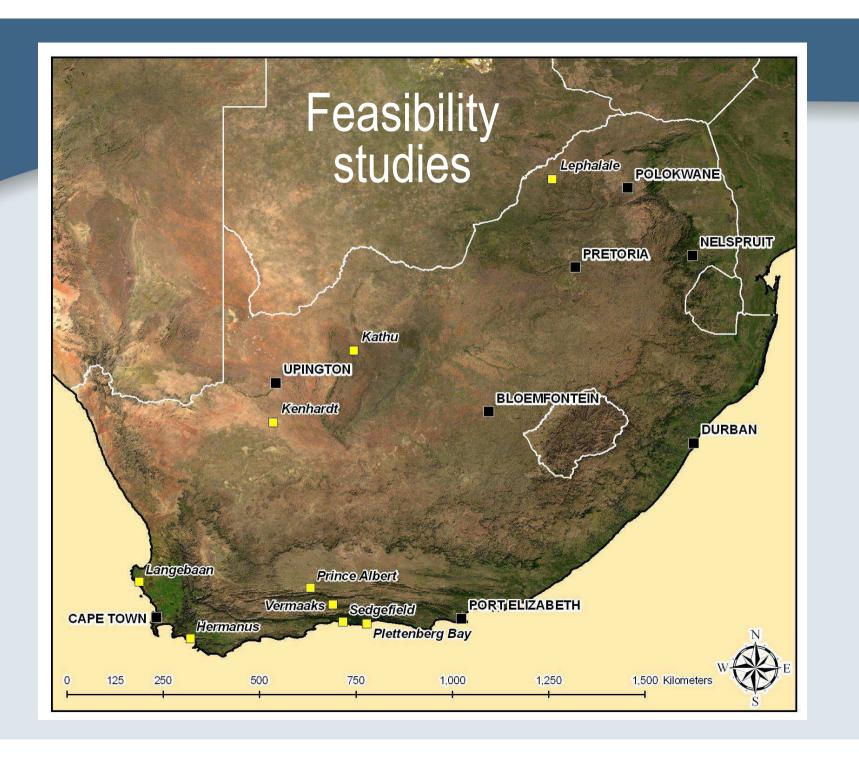






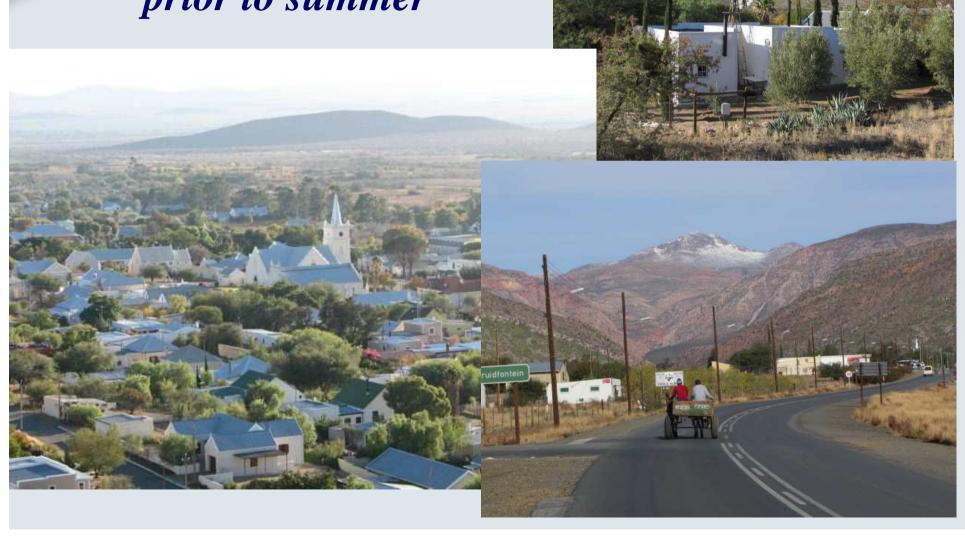




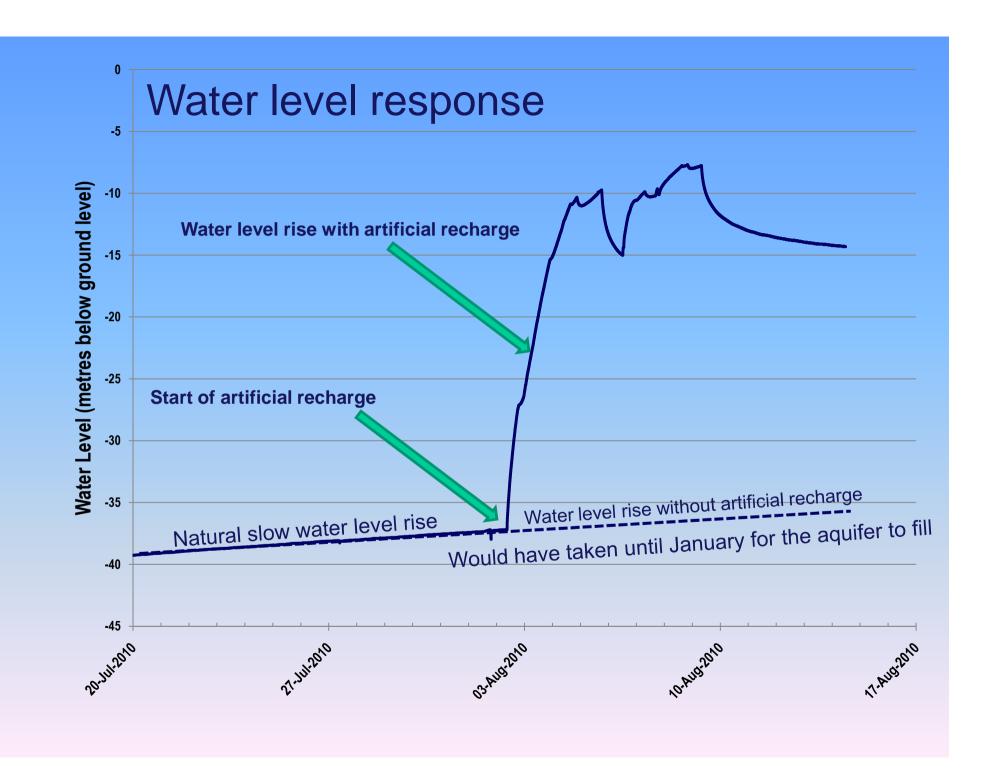


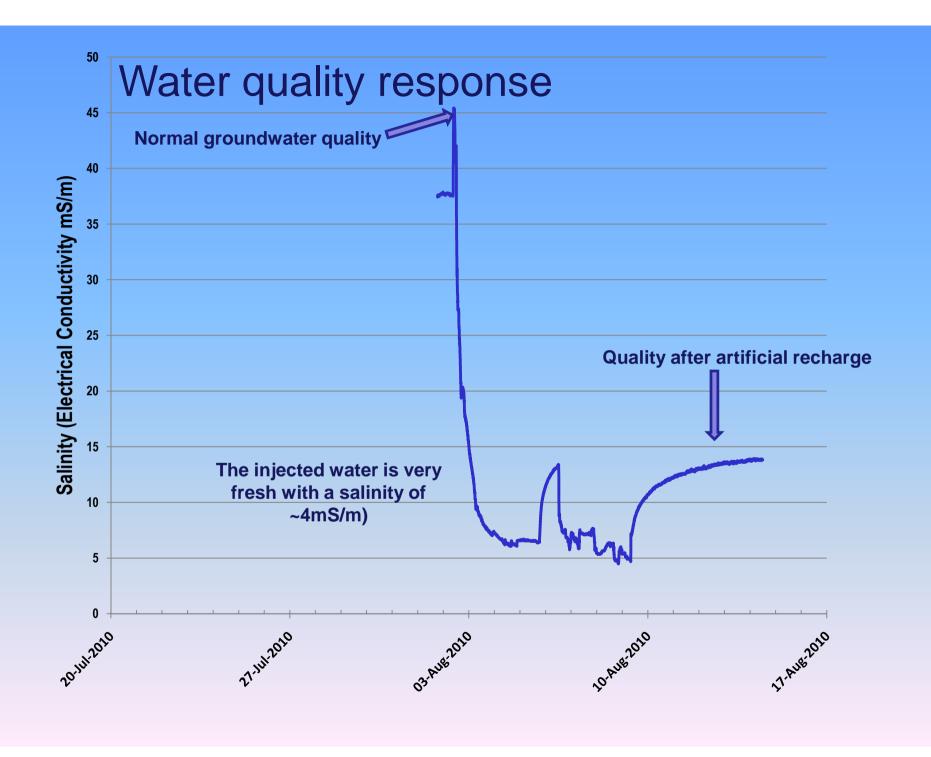


Ensuring the aquifer's full prior to summer









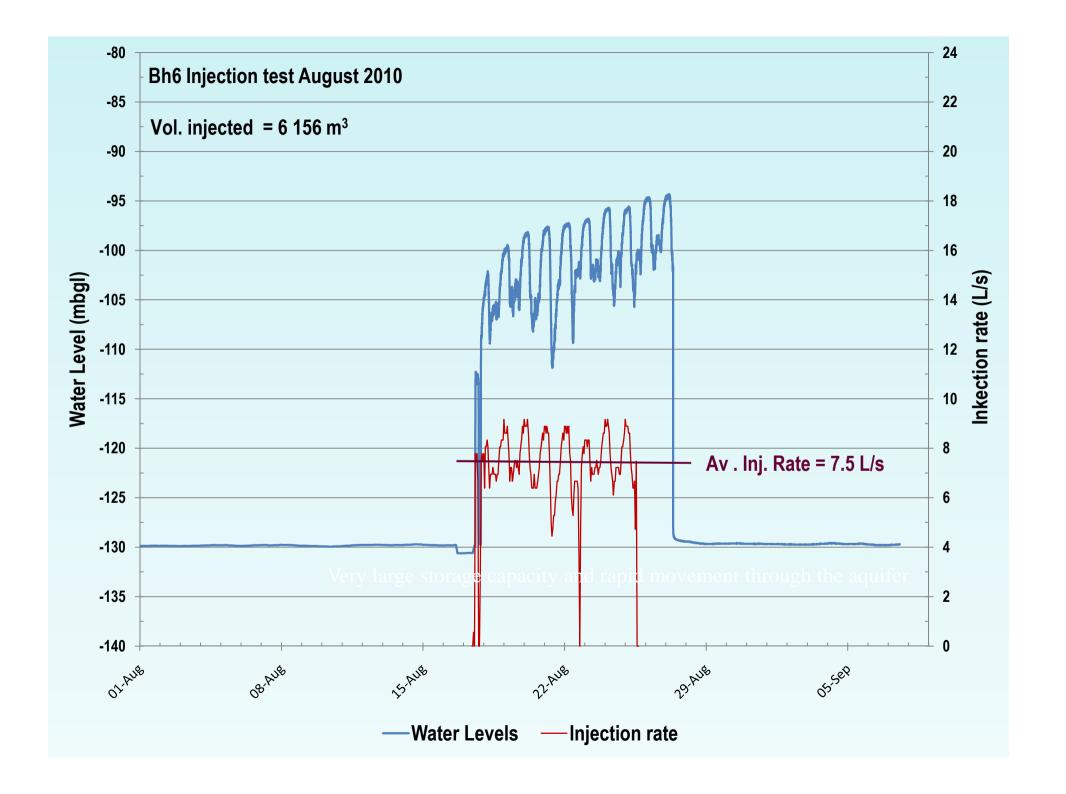
Prince Albert

- Demand: 2 MI/day over summer
 - 25 % from AR aquifer
 - 75 % from groundwater & (some) surface water
- Total supply from full AR aquifer: 100 MI
- ...or 50 days supply
- Makes sense to ensure its full before summer.
- Cost of AR:
 - Direct costs: R285 000 (construction)
 - Indirect costs: R427 000 (construction supervision, WUL, training, 1-year mentorship)
 - Total: R713 000 (excl VAT) or R7 130/MI or R7.13/kI

Plettenberg Bay





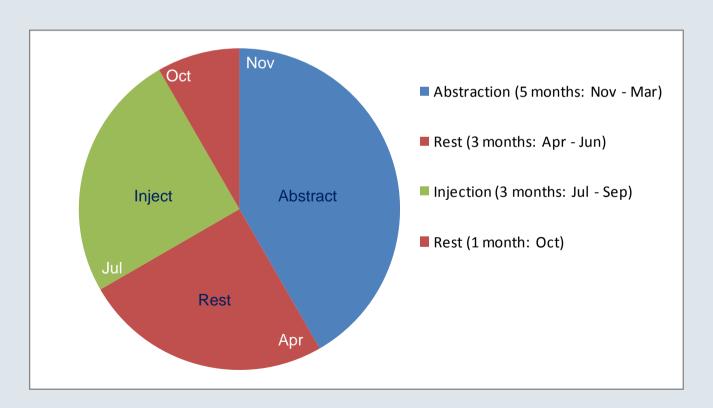


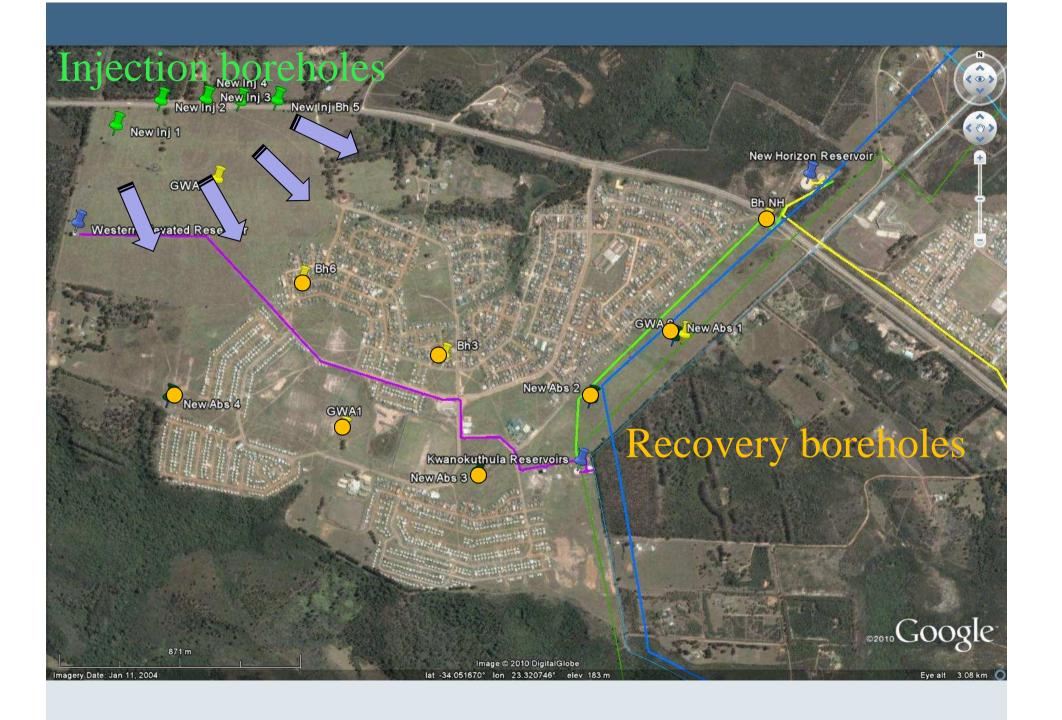
Target groundwater/artificial recharge capacity

Artificial recharge: 4.3 Ml/day over 3 months or 390 Ml

Abstraction:

5.8 MI/day over 5 months or 880 MI





Plettenberg Bay

- Summer demand: 12 13 MI/day [Peak Week Christmas New Year: 17-18Ml/day]
 - 6.9 MI/day from surface water (drought) [8.6 MI/day normal]
 - 3.4 MI/day from existing boreholes
 - 2.8 MI/day from Roodefontein Dam
 - 2.0 MI/day from desalination
 - 2.3 MI/day from AR over 5 peak demand months

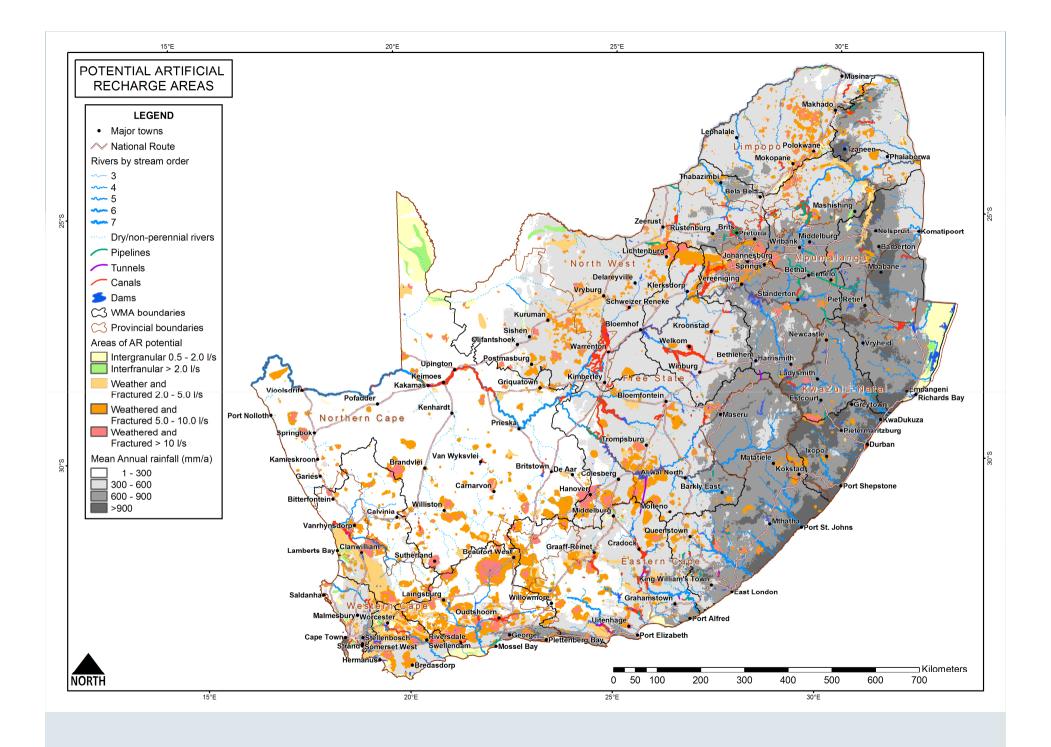
Total: 17.4 MI/day

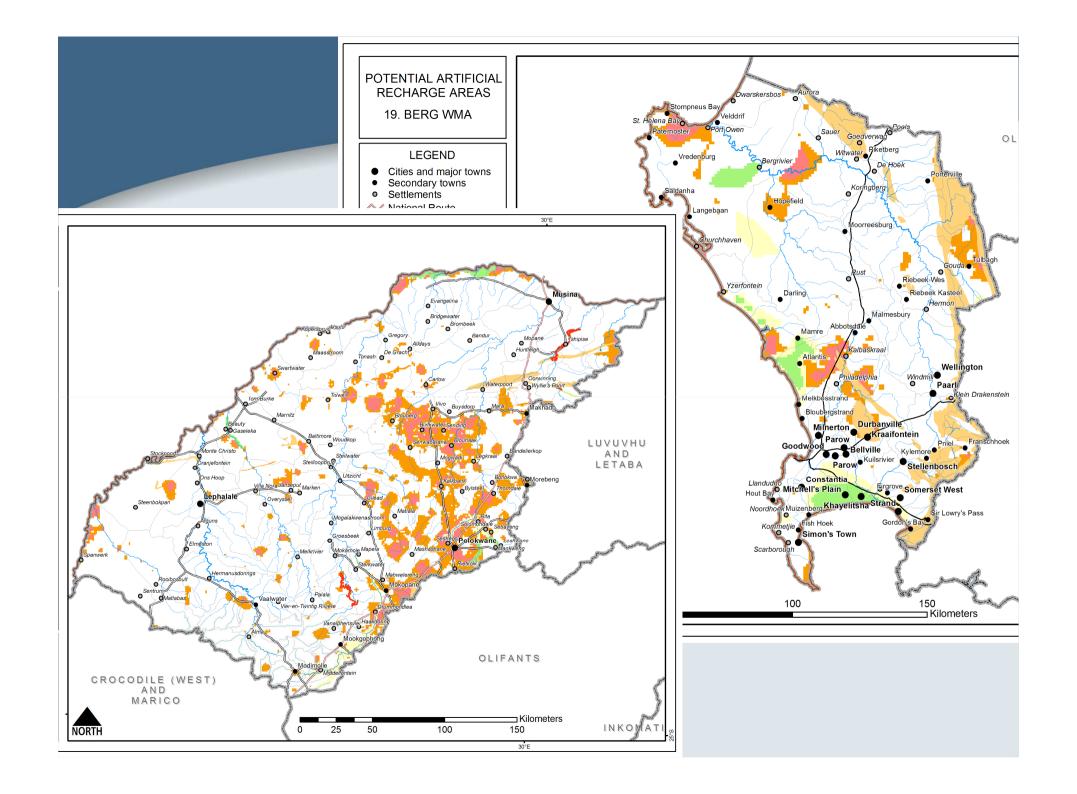
Capital cost of AR (incl VAT): R 12.6M

(R 5.4M for an AR scheme that delivers 1Ml per day)

- Desalination plant: ~R30M for a 2 MI/day plant (~R15M for a plant that delivers 1MI/day)
 - Off-channel storage dam: ~R80M

Potential Artificial Recharge Areas in South Africa

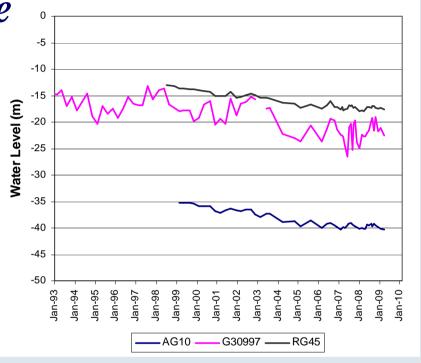


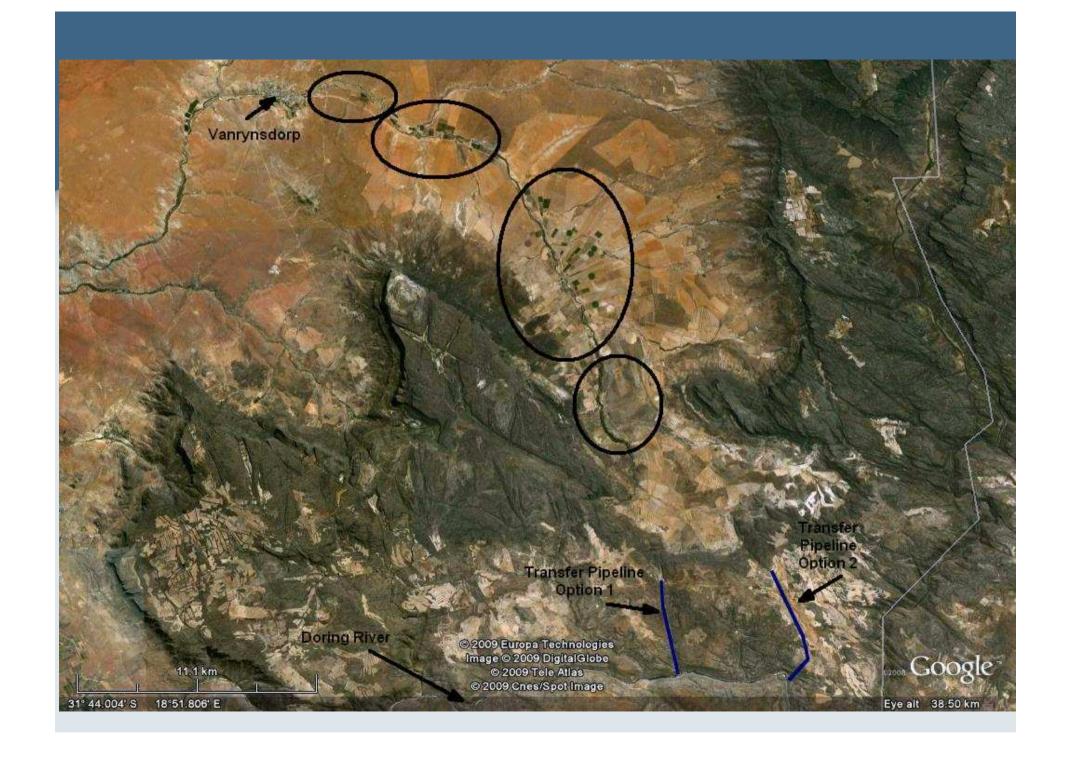


Vanrhynsdorp

Opportunities for large-scale irrigation in an arid area

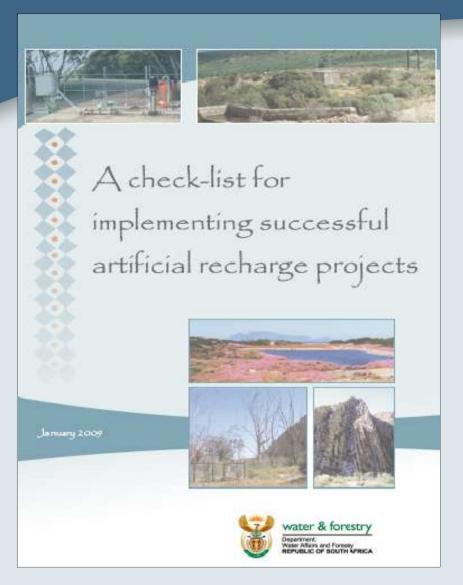
- High yielding Karst aquifer
- Declining water levels0.5 m/annum
- Deteriorating water quality
- Source water: Doring River
- Infiltration basins or recharge boreholes

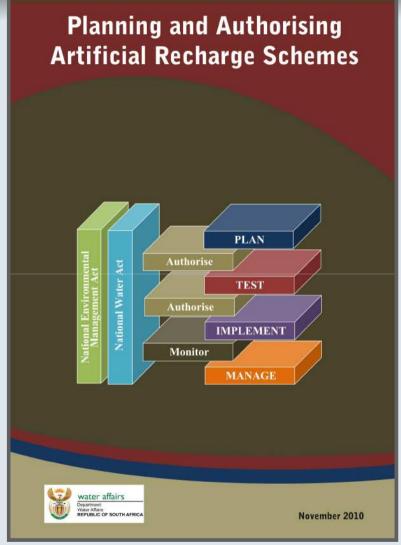




www.artificialrecharge.co.za







Artificial Recharge

The intentional banking and treating of water in aquifers

Prepared by:

Dr R Murray, Groundwater Africa for the Directorate: Water Resources Planning Systems Department of Water Affairs & Forestry



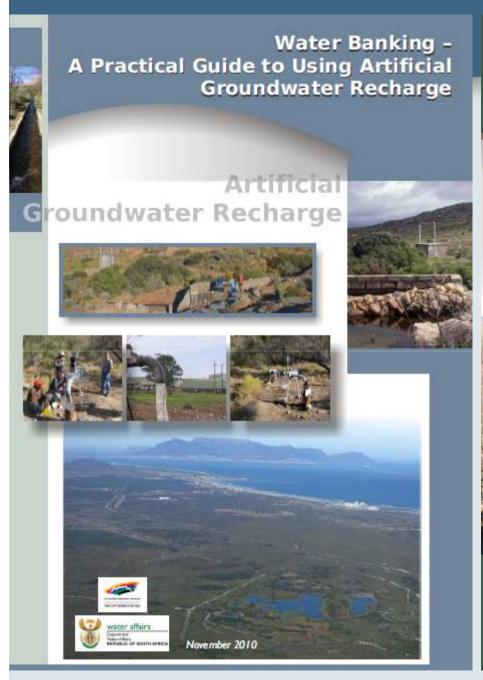




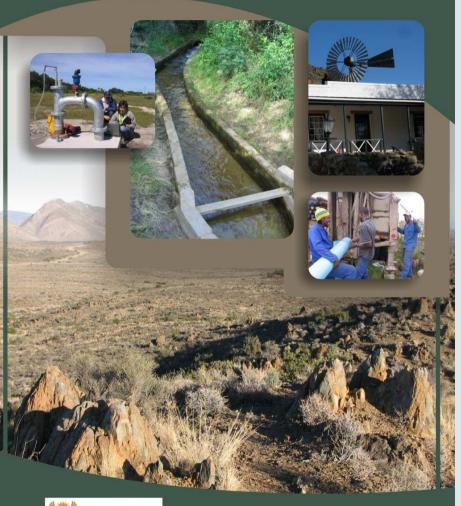
January 2009



The Atlantis Water Resource Management Scheme: 30 years of **Artificial Groundwater Recharge** August 2010



Potential Artificial Recharge Schemes: Planning for implementation





Conclusions

- It's the cheapest way to store water
- It's far cheaper than desalination

Why evaporate when you can infiltrate?

Acknowledgements

City of Windhoek
City of Cape Town (Atlantis)
Prince Albert Municipality
Bitou Municipality (Plettenberg Bay)
Department of Water Affairs
Water Research Commission



