

**8th Savanna Science Networking Meeting
8th-12th March 2010, Skukuza, KNP**

Wetland Hydrology in the Lowveld –

Lessons from the Sand River Headwaters



Riddell, ES. Lorentz, SA.

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**UNIVERSITY OF
KWAZULU-NATAL**



Wetland Rehabilitation

Tooth & McCarthy, 2007

Ellery et al., 2008



Headwater Wetland Hydrology

Southern Africa – dambos, vleis

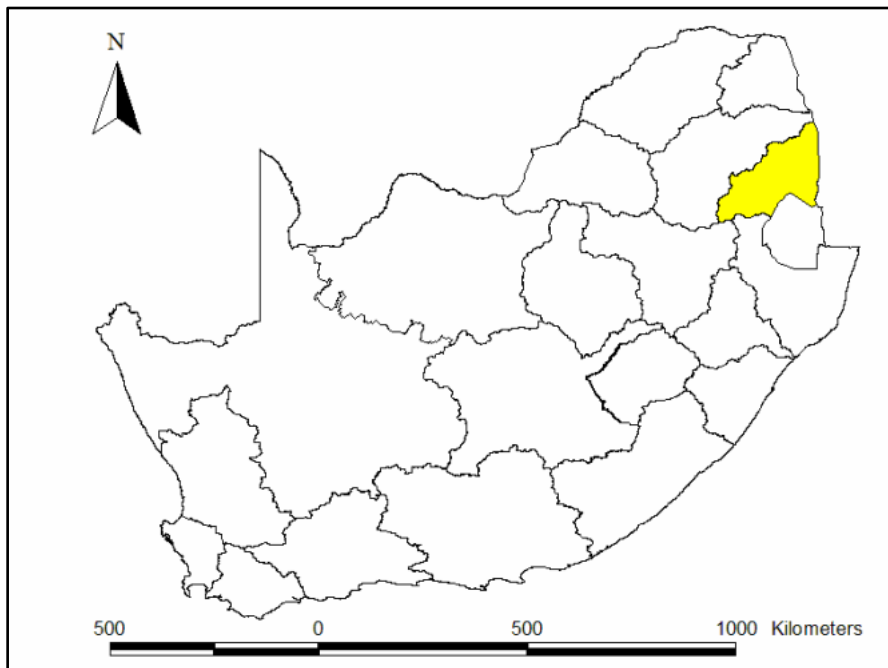
Balek & Perry (1976)

Bullock (1992)

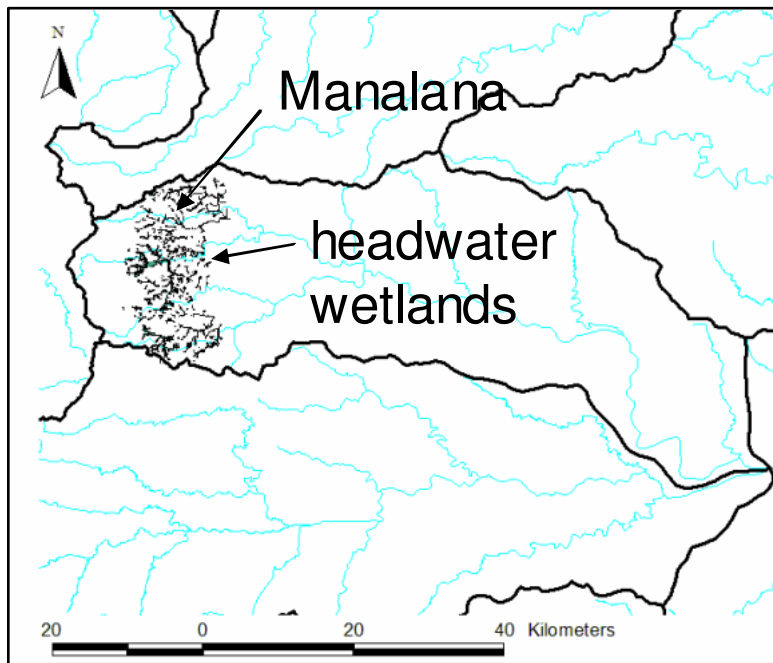
McCartney (2000)

Bullock & Acreman (2003)

Von der Heyden (2004)

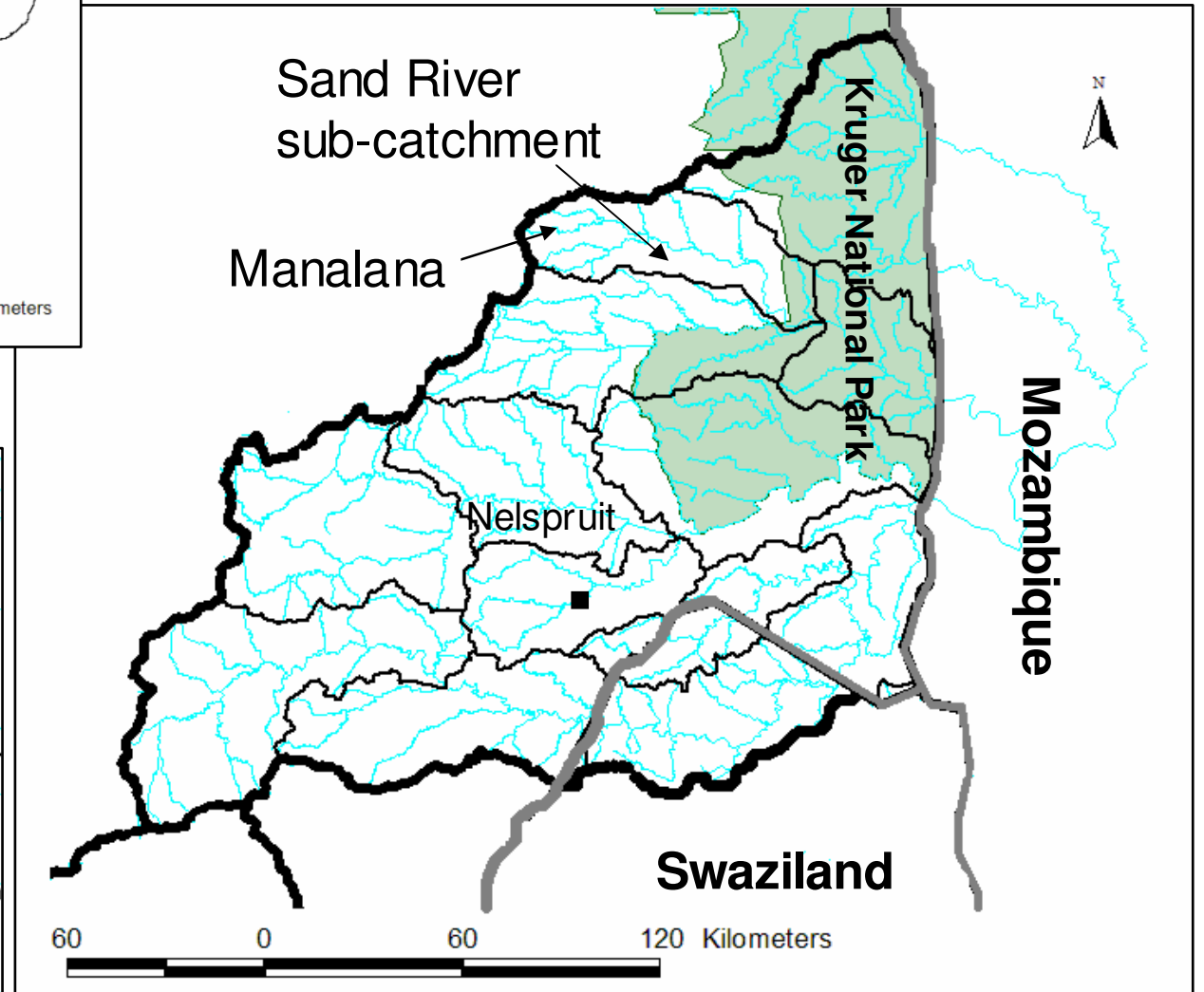


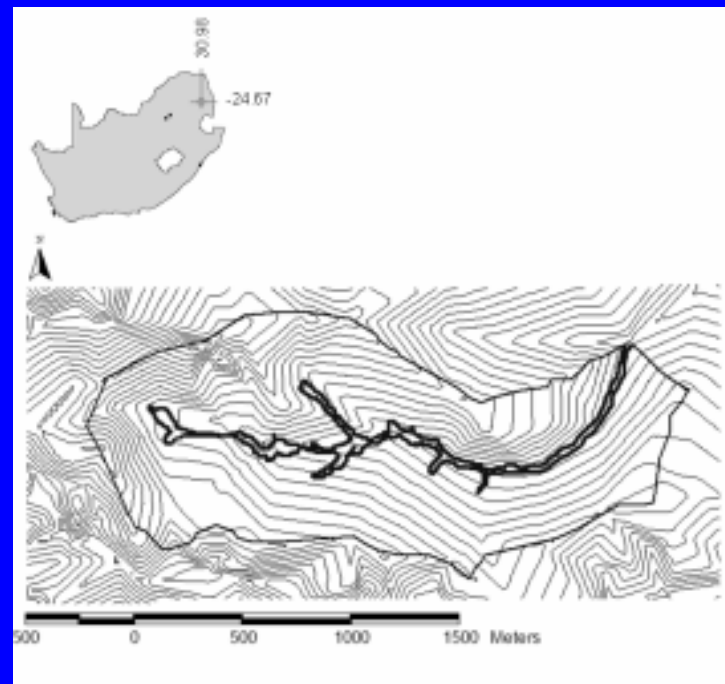
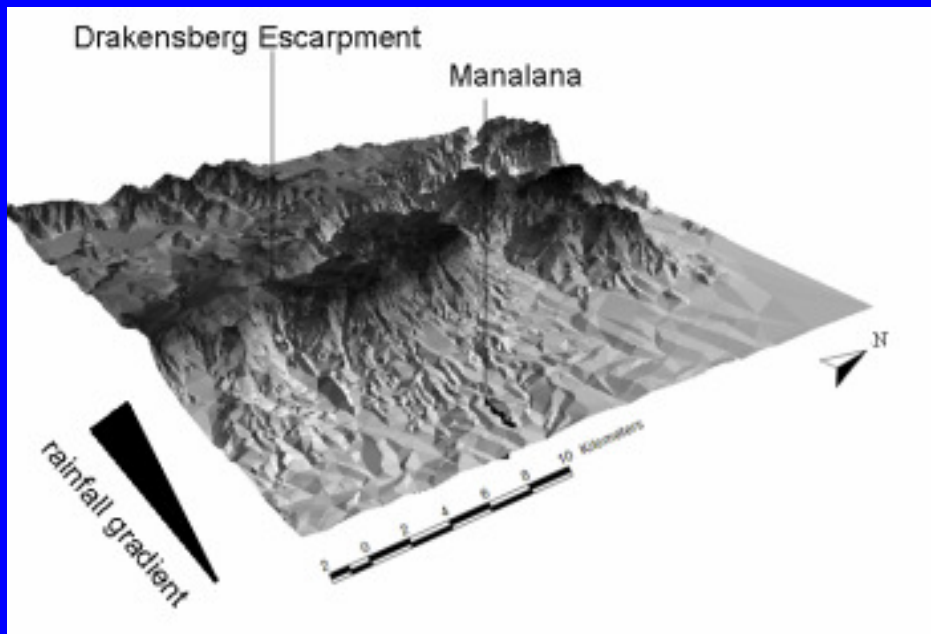
South Africa



Sand River

Incomati Basin





Headwater wetland – Sand River

Porphyritic Granite

Intense rainfall zone – escarpment

**Dense communal land-use
including valley bottom wetland
subsistence agriculture**



AWARD, 2005

Severe donga erosion



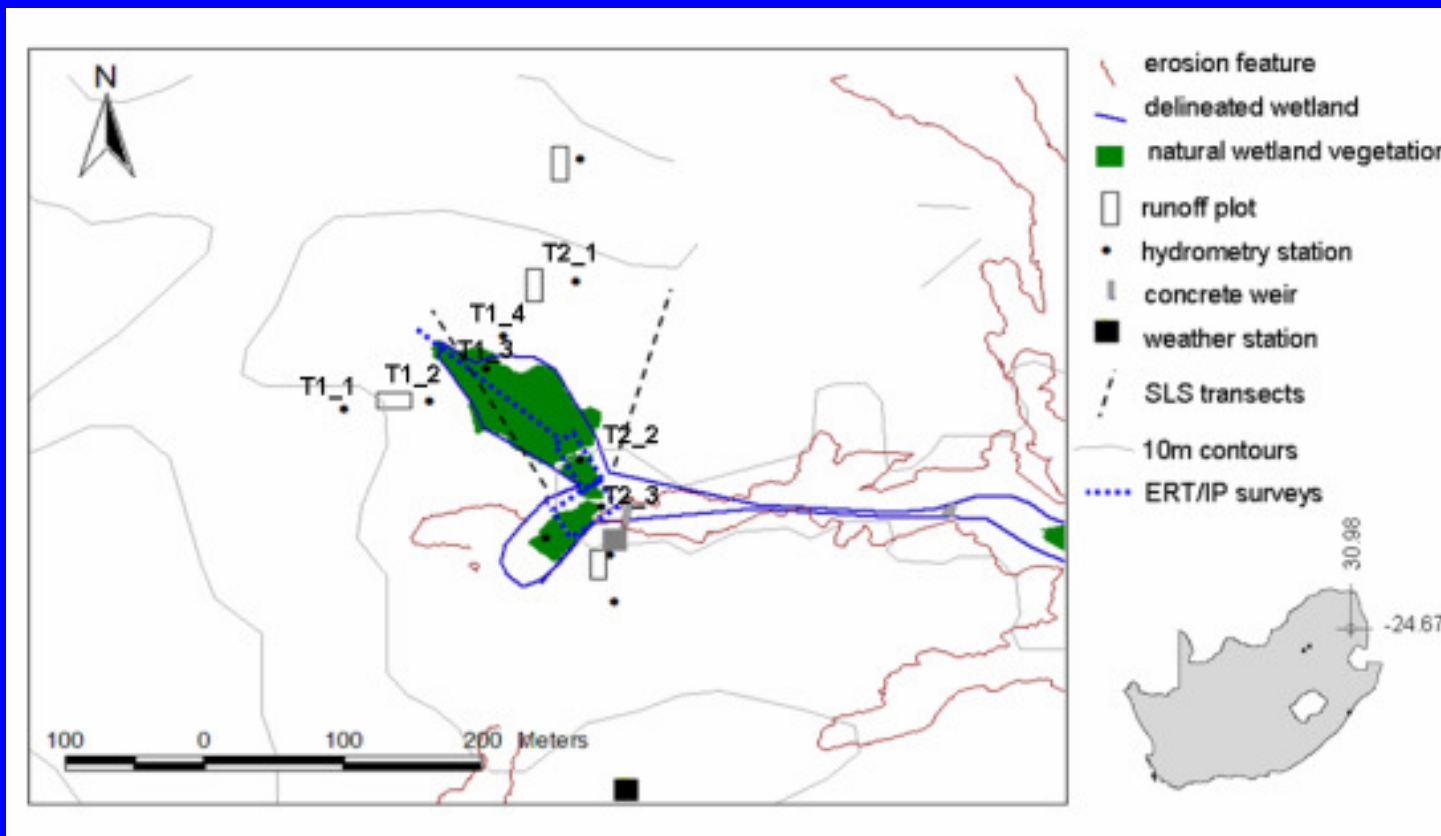
Main Objectives

Pre and Post Rehabilitation Responses

Hydro-Geomorphic Template

Wetland/Catchment Water Budget

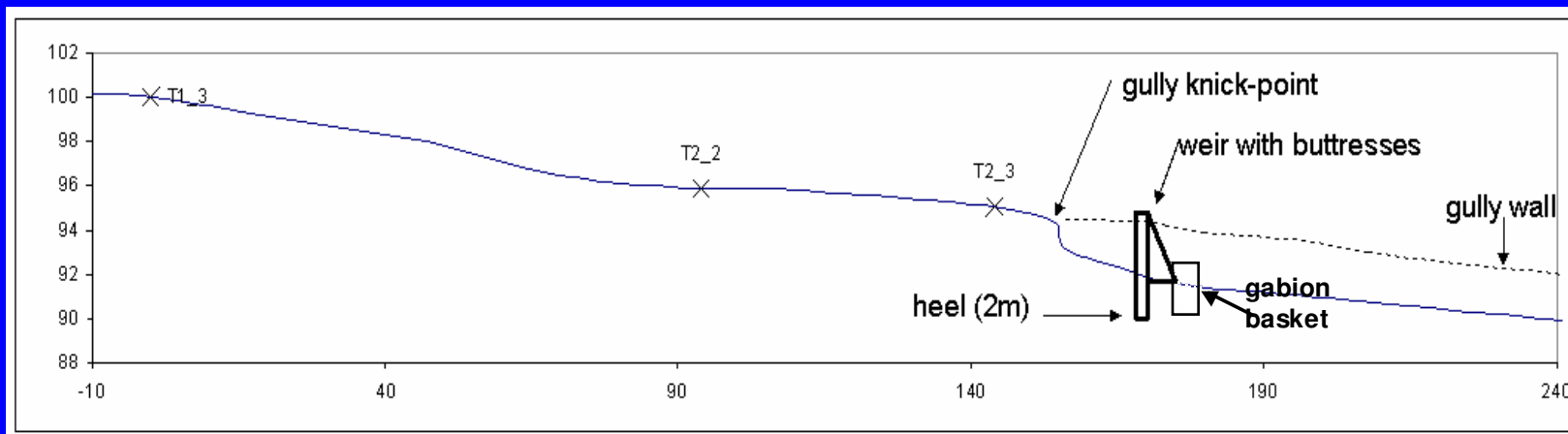
River Continuum – Hydro Response Units



**Hydrometry network
c.2005**

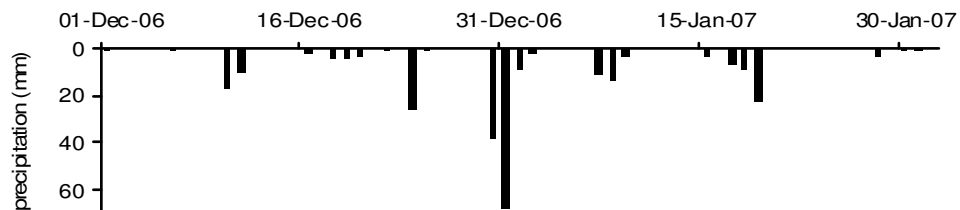
Geophysics

aET (CSIR) 2008-2009

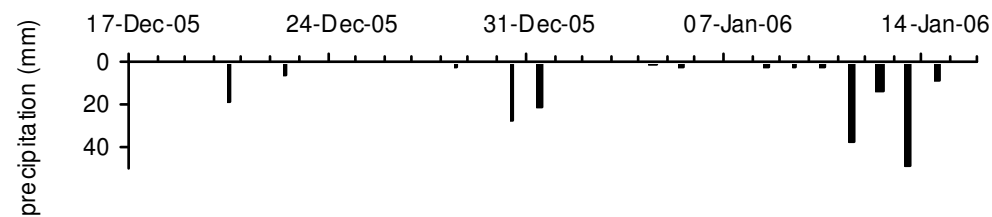
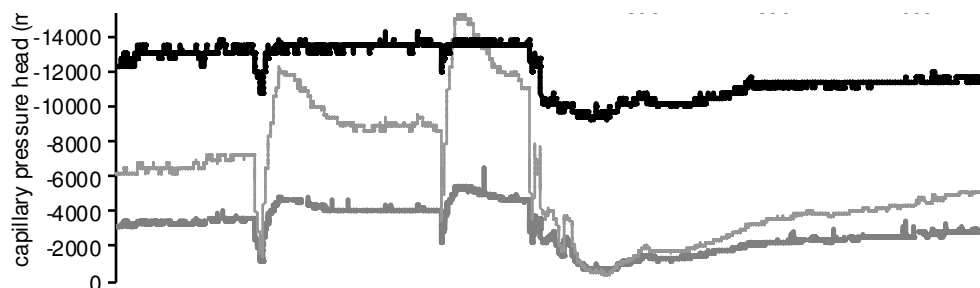


Rehabilitation commenced 2005 successful 2008

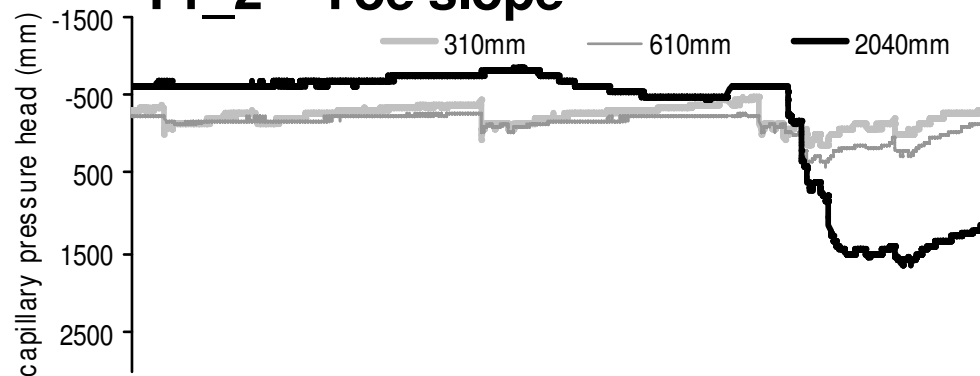
Hillslope-Wetland Responses



T1_1 Midslope - Granite

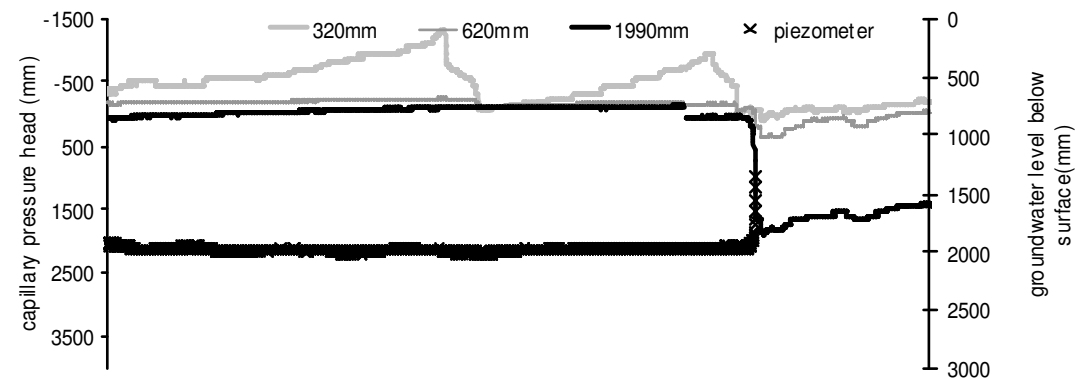


T1_2 - Toe slope

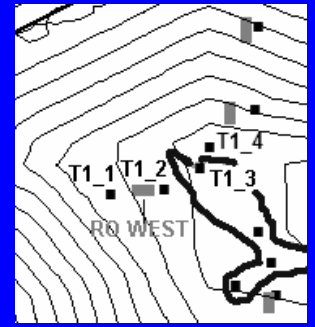


T2_1 Midslope - Dolerite

T1_3 Wetland



Soil Forms



mid-slope



SA: Glenrosa

WRB: Leptosols

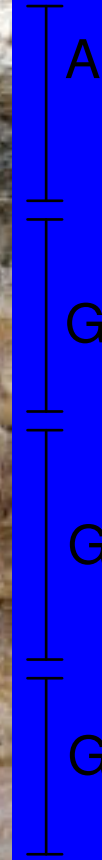
hillslope toe



Kroonstad

Planosol

wetland

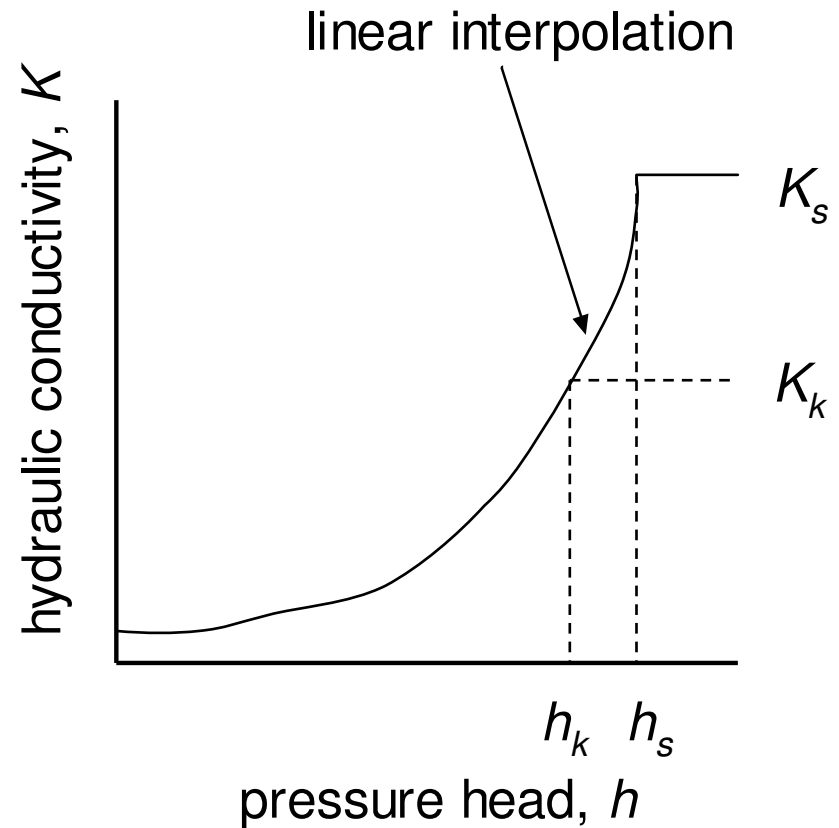
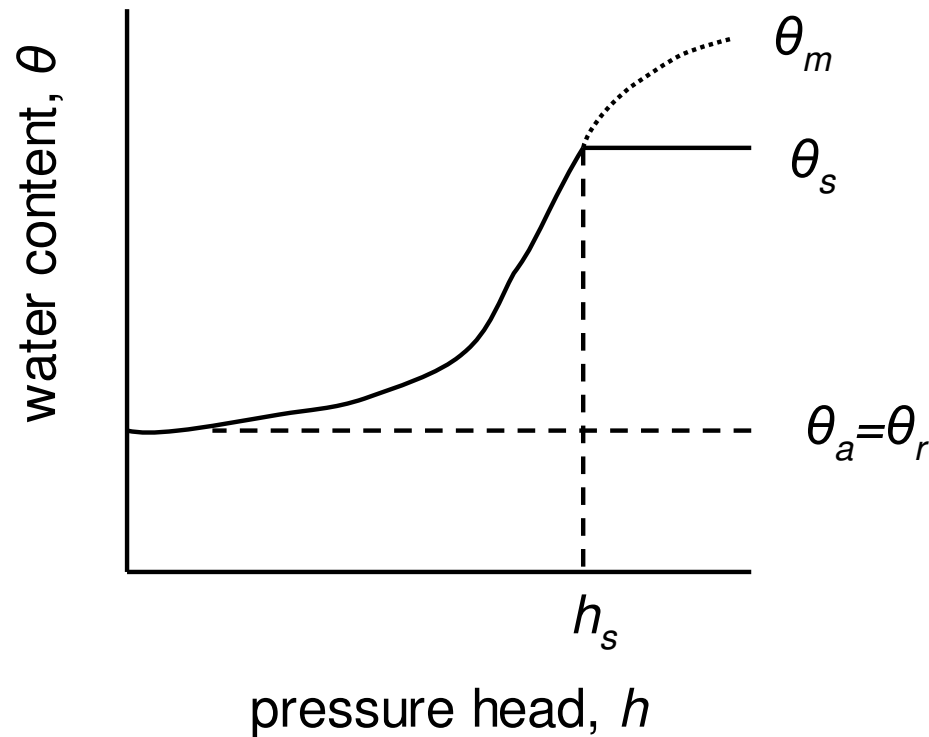


Katspruit

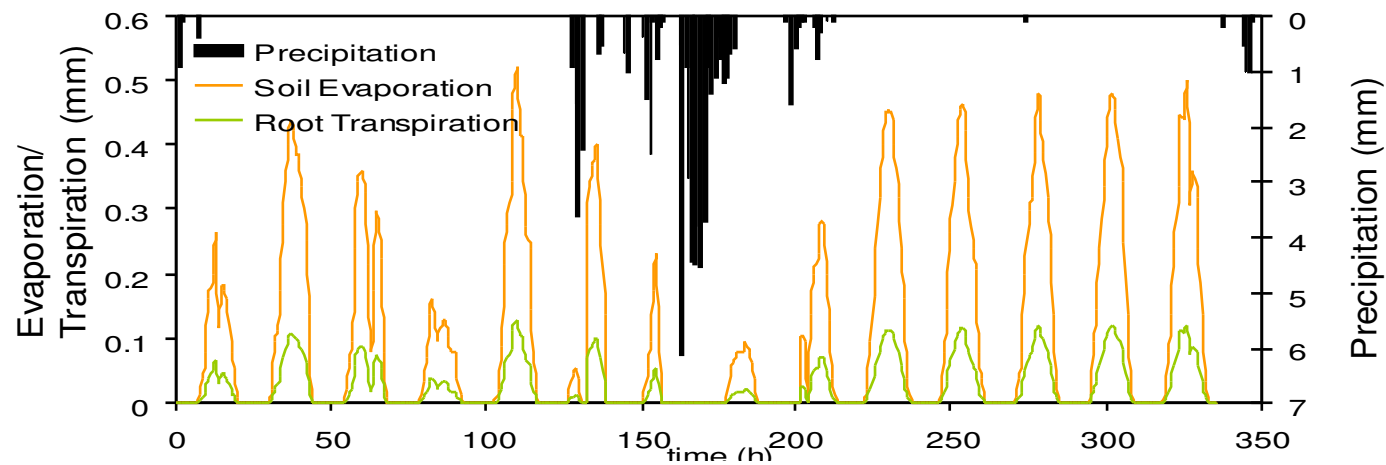
Gleysol

van Genuchten (1980) incl.
Vogel & Císlerová (1988)
 dual porosity function:

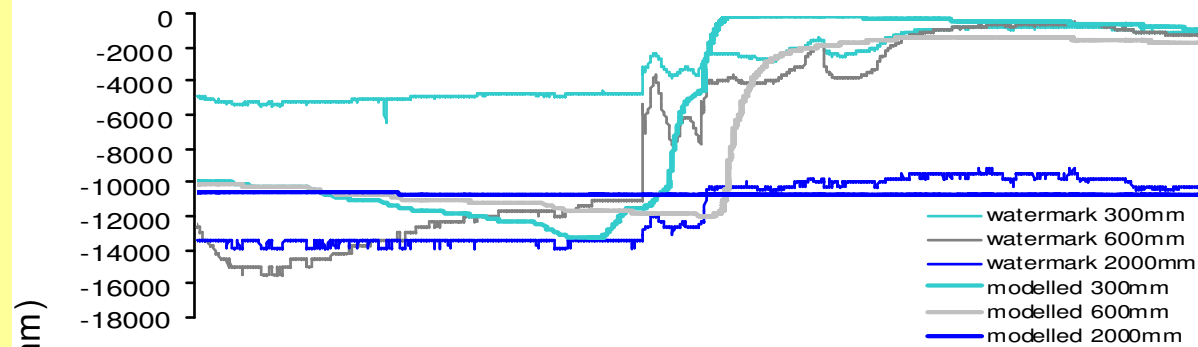
$$\begin{aligned}
 &K_s K_r(h) && h \leq h_k \\
 &K_k - \frac{h - h_k}{h_k} (K_s - K_k) && h_k < h < 0 \\
 &K_s && h \geq 0
 \end{aligned}$$



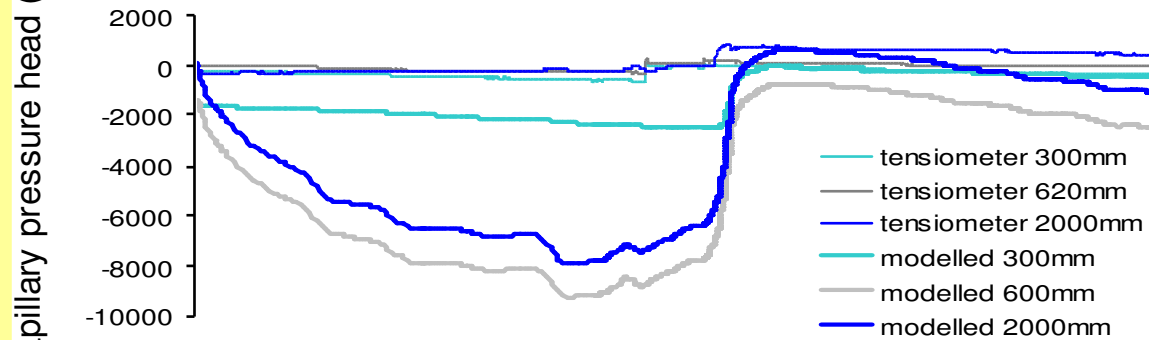
Simulation



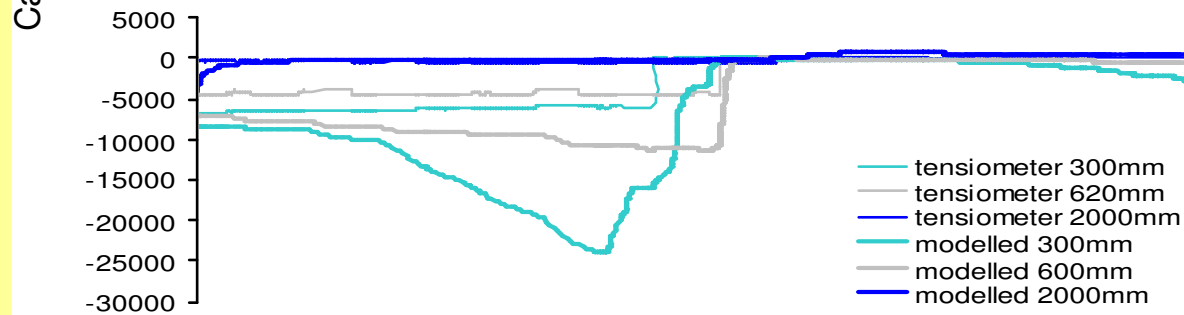
Mid-slope T1_1



Hillslope Toe T1_2



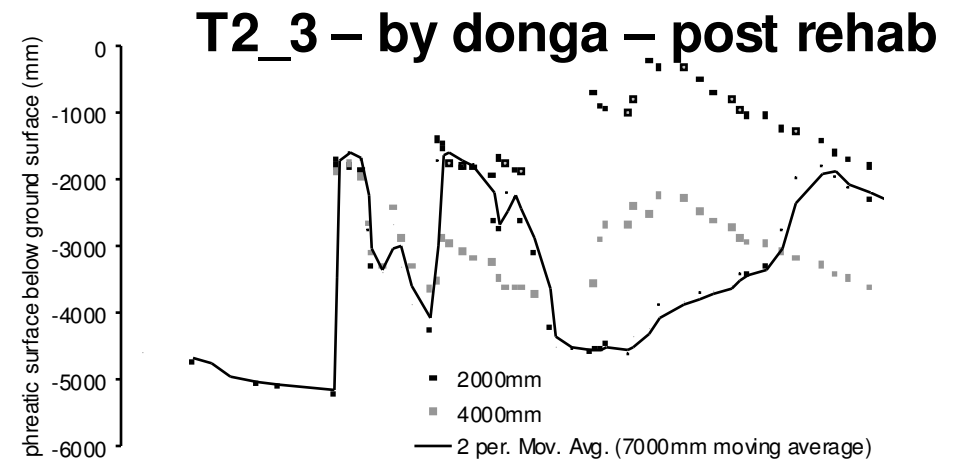
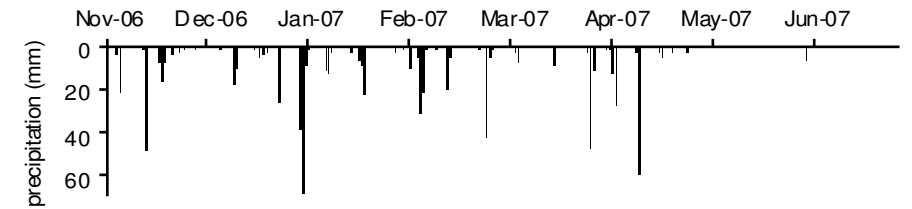
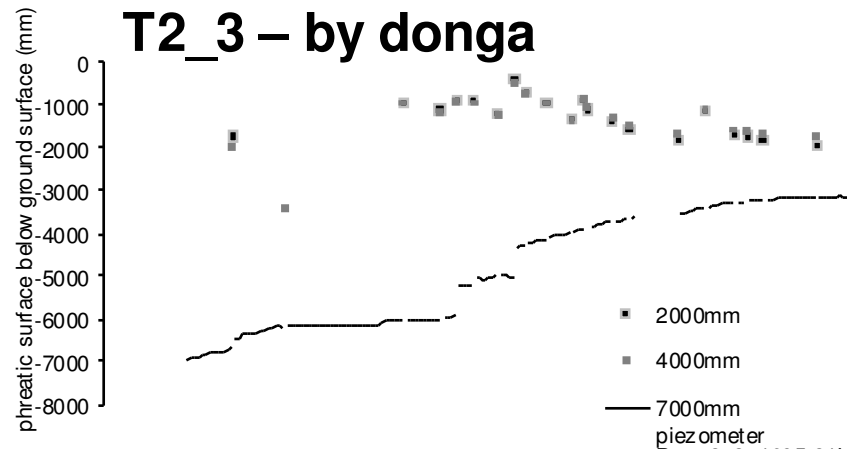
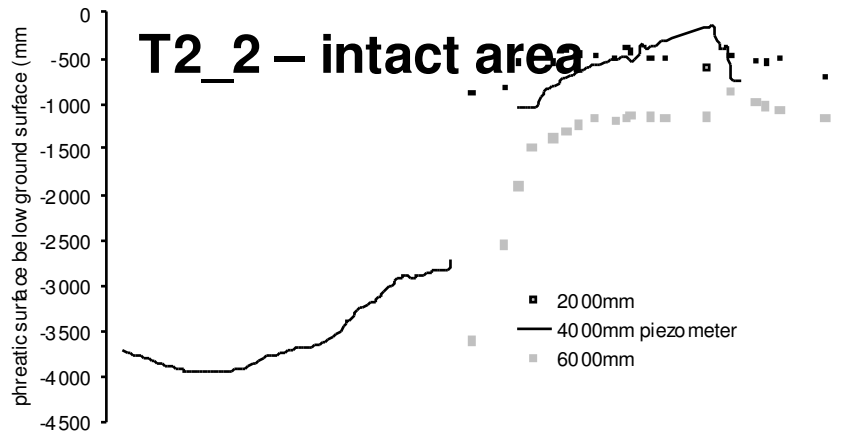
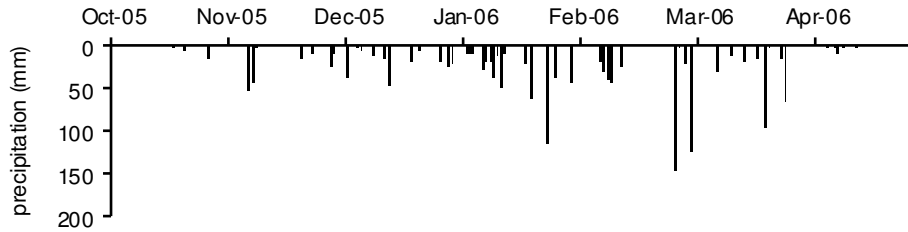
Valley bottom wetland T1_3



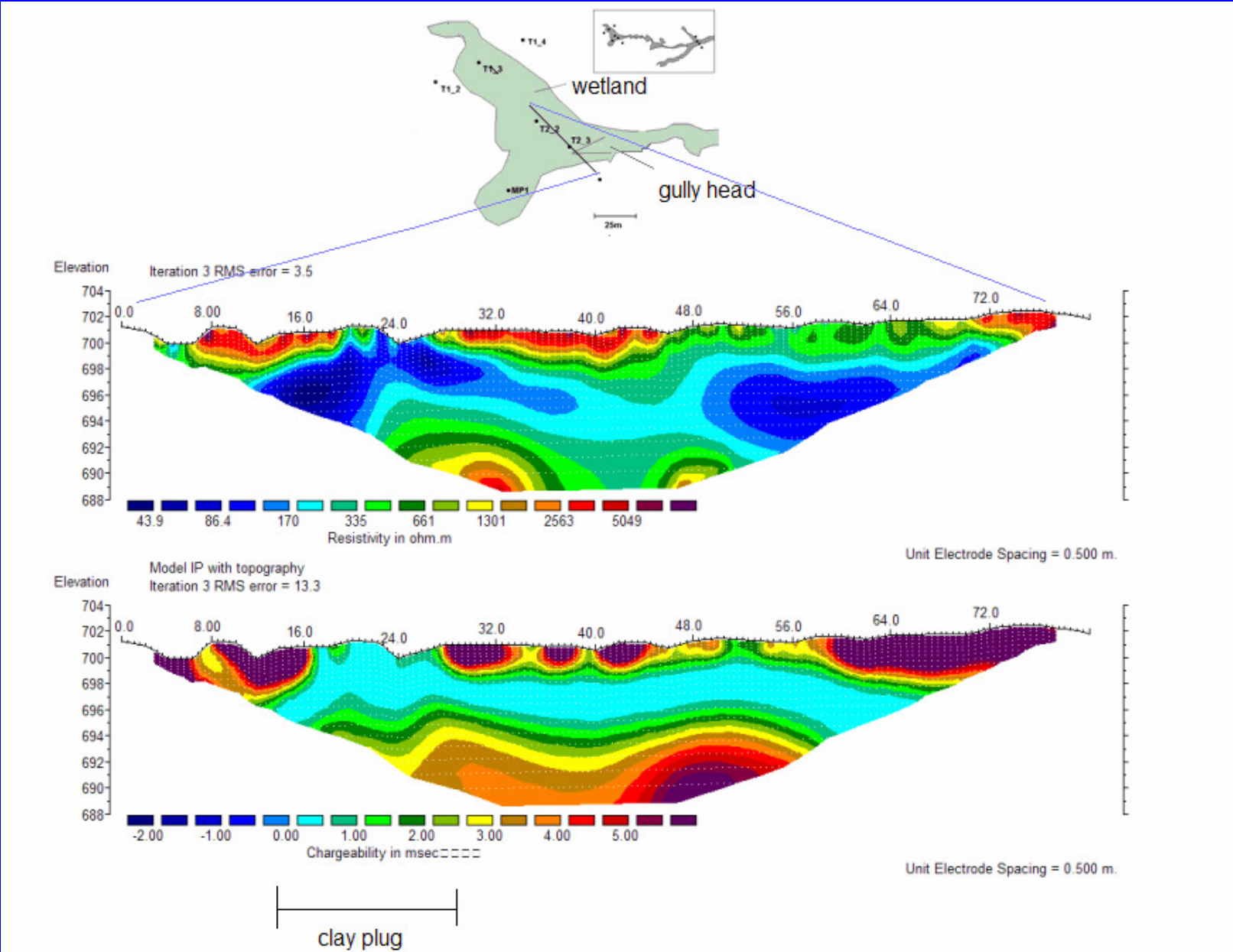
Hydrodynamic responses within wetland



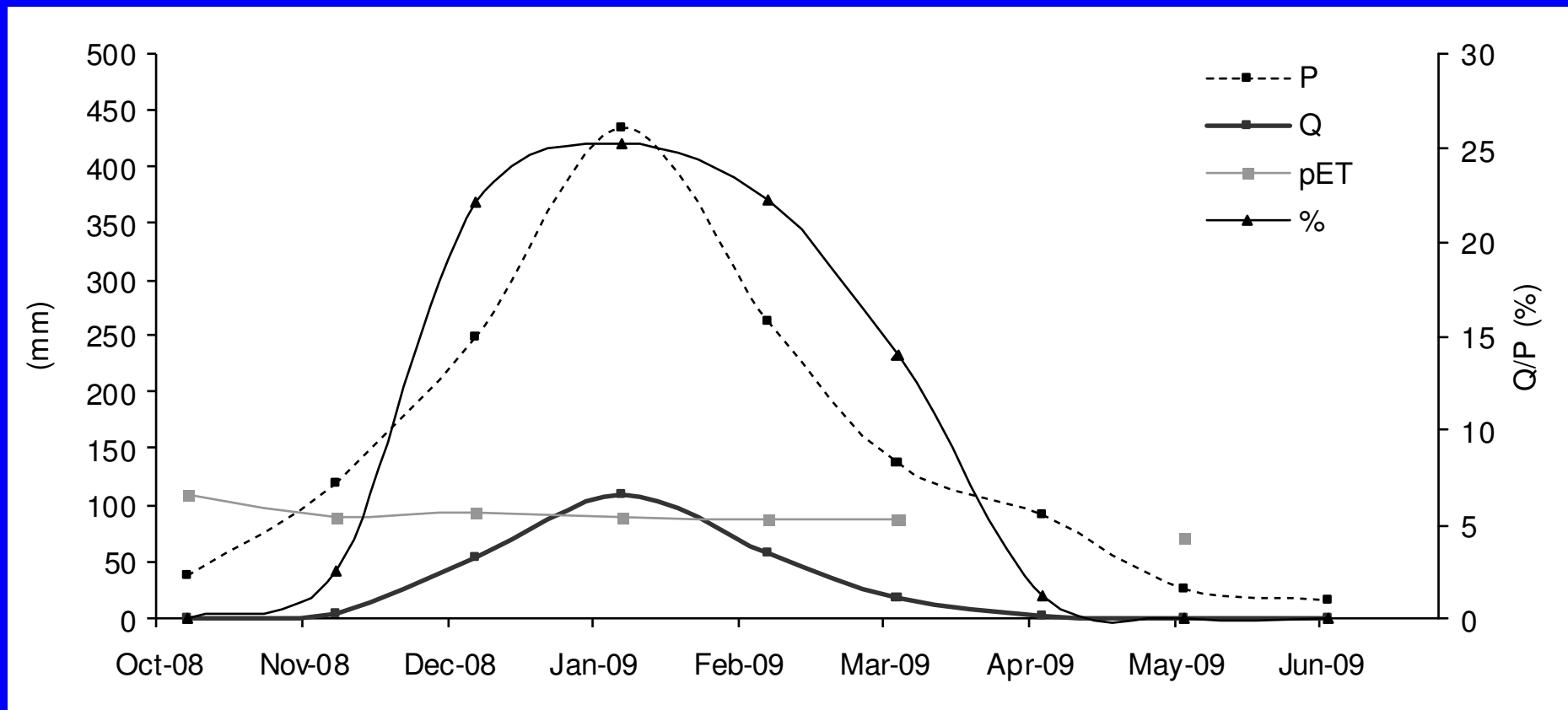
clay layers
(aquitards)



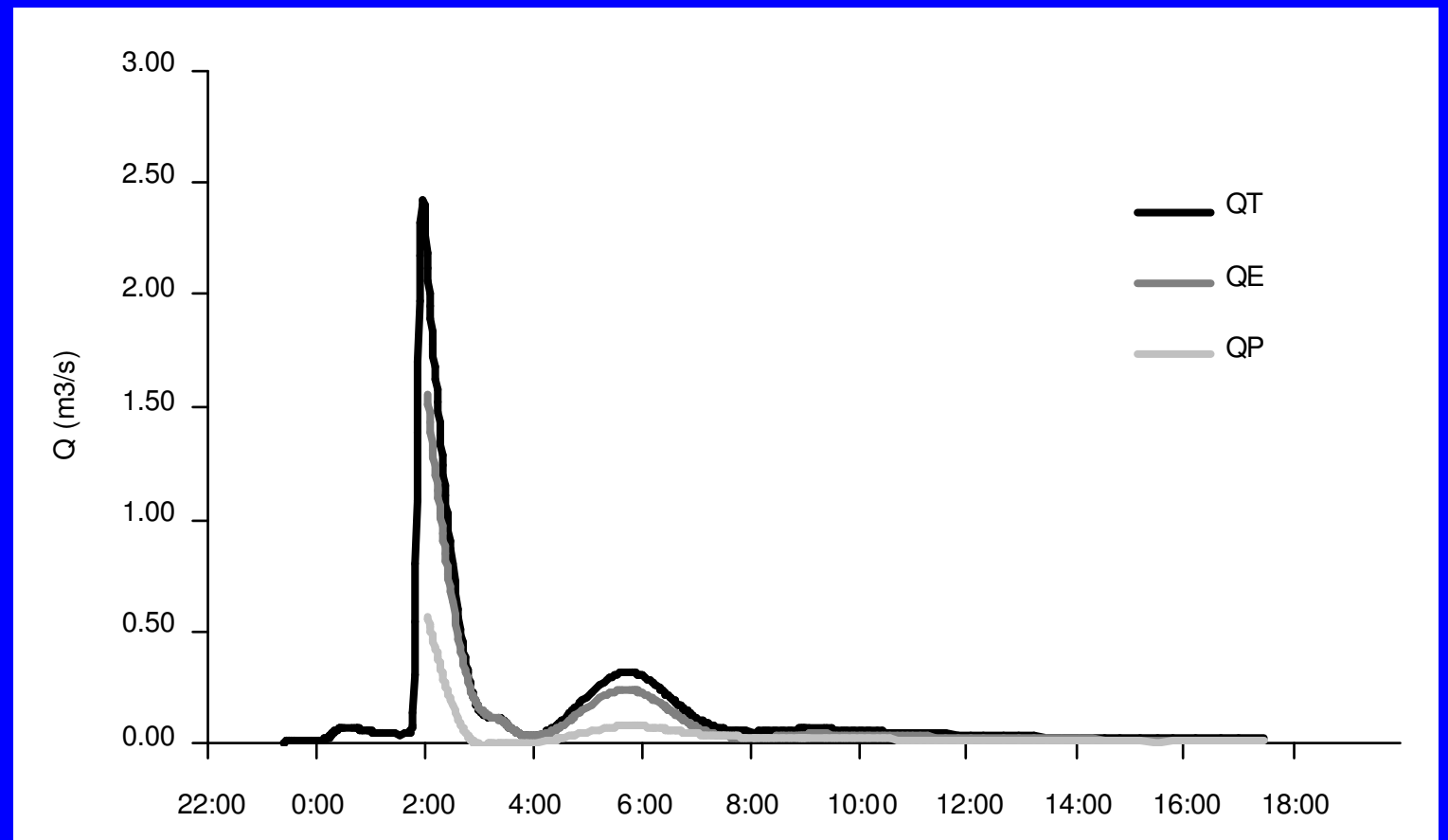
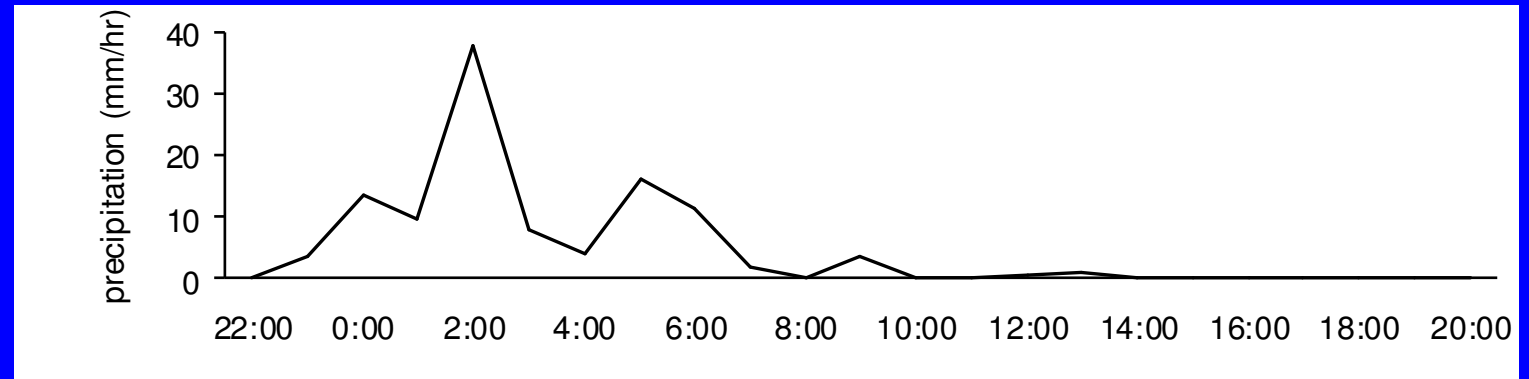
ERT & IP Geophysics Survey - HydroGeomorphology



Catchment Scale Water Budget



Hydrograph Separation – O¹⁸



28-29 Dec 2008

Daily Water Budget with aET



Winter 2008	Aug-29	Aug-30	Aug-31	Sept-01	Sept-02	Sept-03	
ET* interfluve (mm)	1.3	2.2		0.9	1.7	1.3	
ET* wetland (mm)	2.3	2.9	3.5	2.5	3.4	2.8	
rain interfluve (mm)	0	0	0	0	0	0	
rain wetland (mm)	0	0	0	0	0	0	
discharge (mm)	0	0	0	0	0	0	
ΔS (mm) interfluve	-1.30	-2.20		-0.90	-1.70	-1.30	
ΔS (mm) wetland	-2.30	-2.90	-3.50	-2.50	-3.40	-2.80	
Summer 2009	Jan-28	Jan-29	Jan-30	Jan-31	Feb-01	Feb-02	Feb-03
ET* interfluve (mm)	1.1	3.3	3.8		1.7	4.9	4.8
ET* wetland (mm)	1.2	3.9	4.4	2.7	2.2	5.1	5.1
rain interfluve (mm)	0.2	8.4	27.7	62.3	43.8	4.9	80.3
rain wetland (mm)	0.2	8.4	27.7	62.3	43.8	4.9	80.3
discharge (mm)	0.16	0.13	1.08	10.26	9.89	0.34	24.06
ΔS (mm) interfluve	-0.74	5.23	24.94		51.62	0.33	98.67
ΔS (mm) wetland	-0.99	4.50	23.34	59.98	41.97	-0.19	76.09

*Evapotranspiration quantified using Surface Layer Scintillometer (Everson *et al.*, 2009)
 ΔS change in storage

(dis)similarity with dambo model:

Increase of fines with depth

Deep substrate

Rapid water table rise – mechanism?

GW discharge from below?

Storm water attenuation?

Baseflow augmentation?

Management:

- **Sand River's headwater region has relatively uniform geology and climate**
- **Potential to extrapolate these findings to other sub-catchments**
- **model wetland sub-routines – low flows?**
- **consequences for rehabilitation?**

Thank you! Ke a Leboha!

Acknowledgements:

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