Workshop "Model Application for Wetlands Hydrology and Hydraulics"

1-3 April 2004, Bialystok, Poland

Ecohydrology of a groundwater-dependent Alder carr

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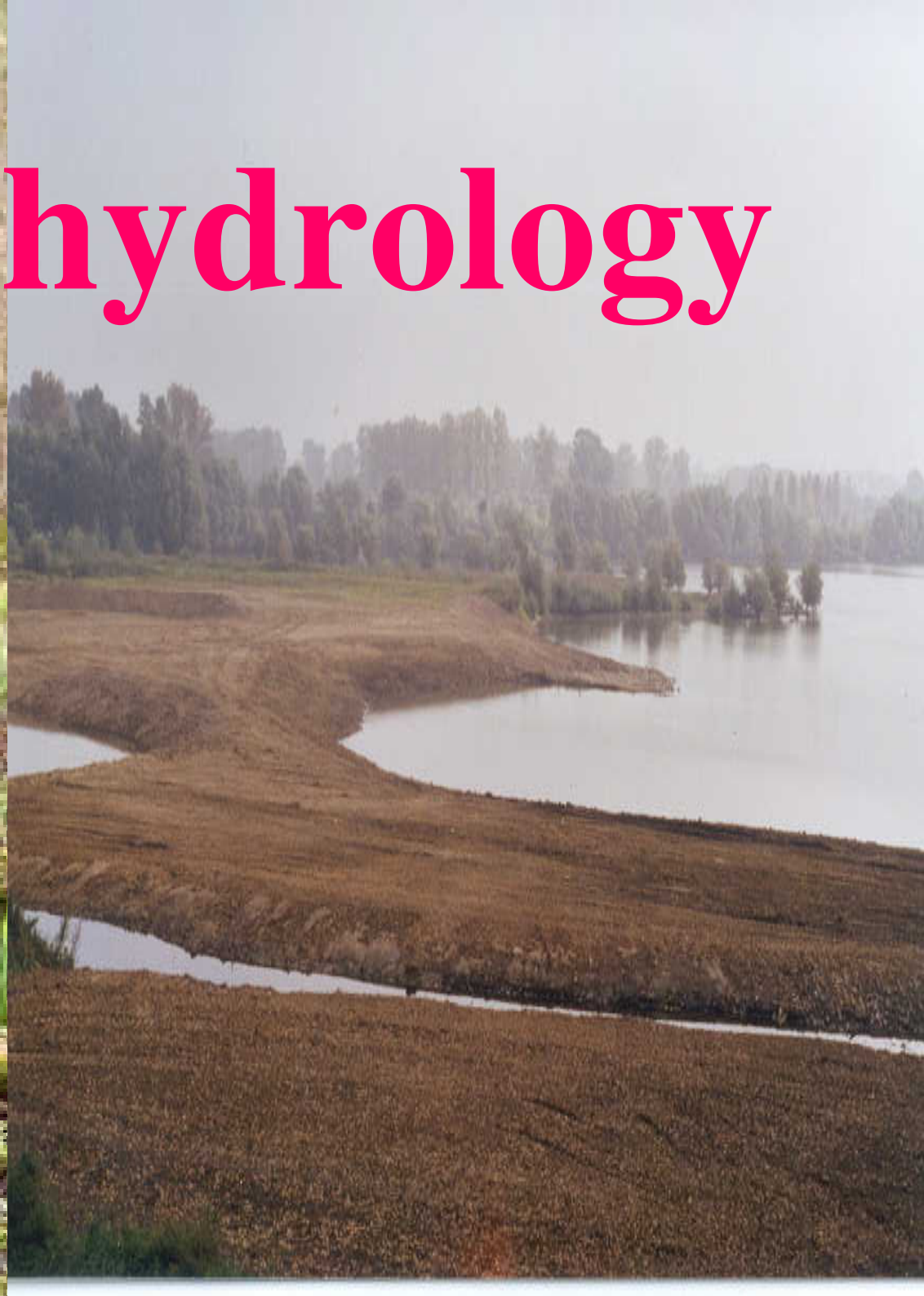
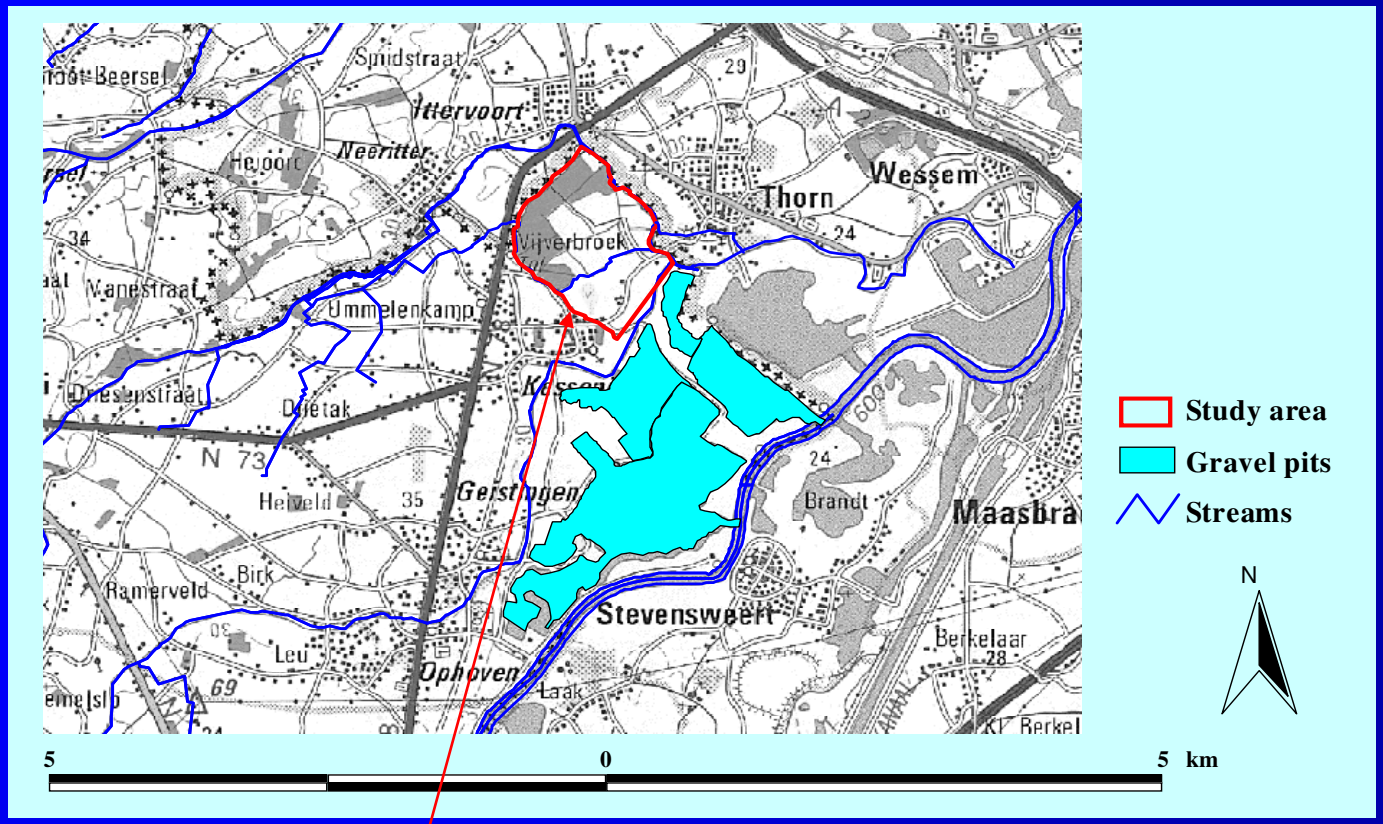
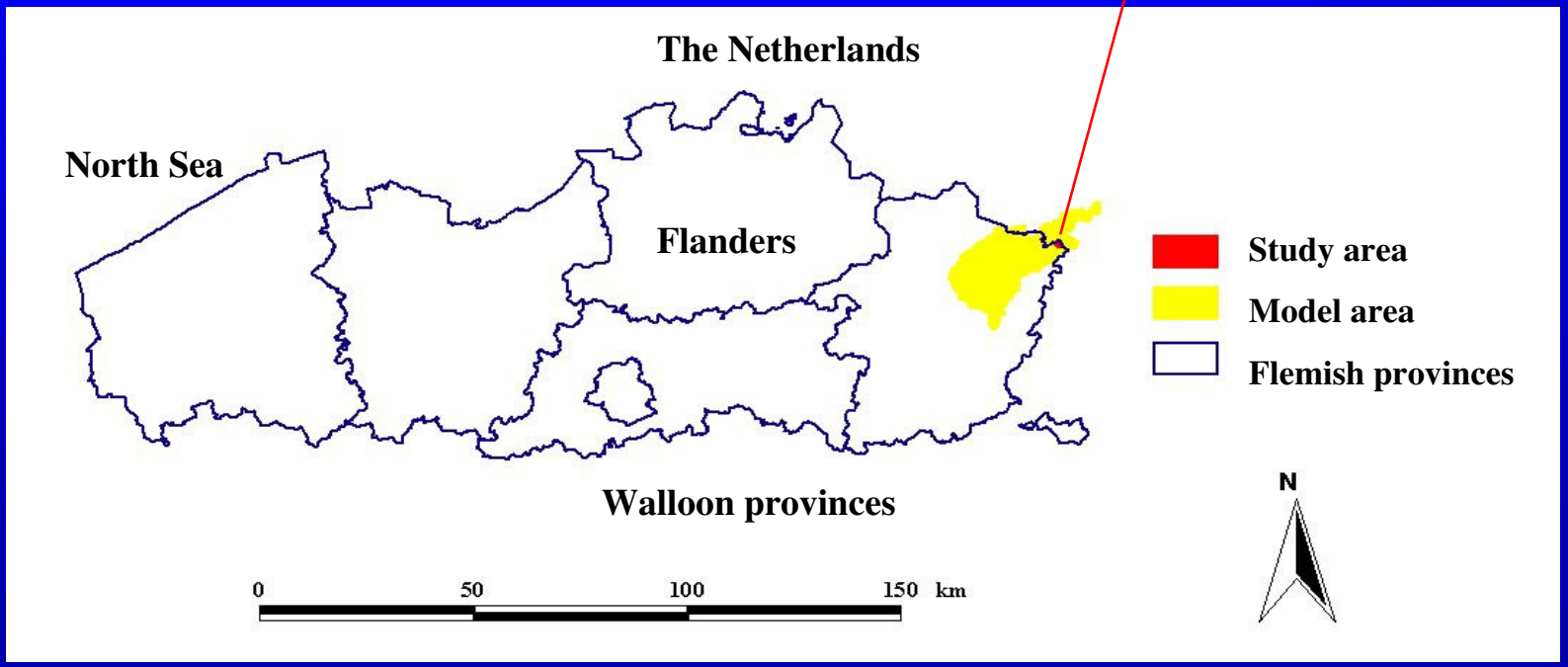
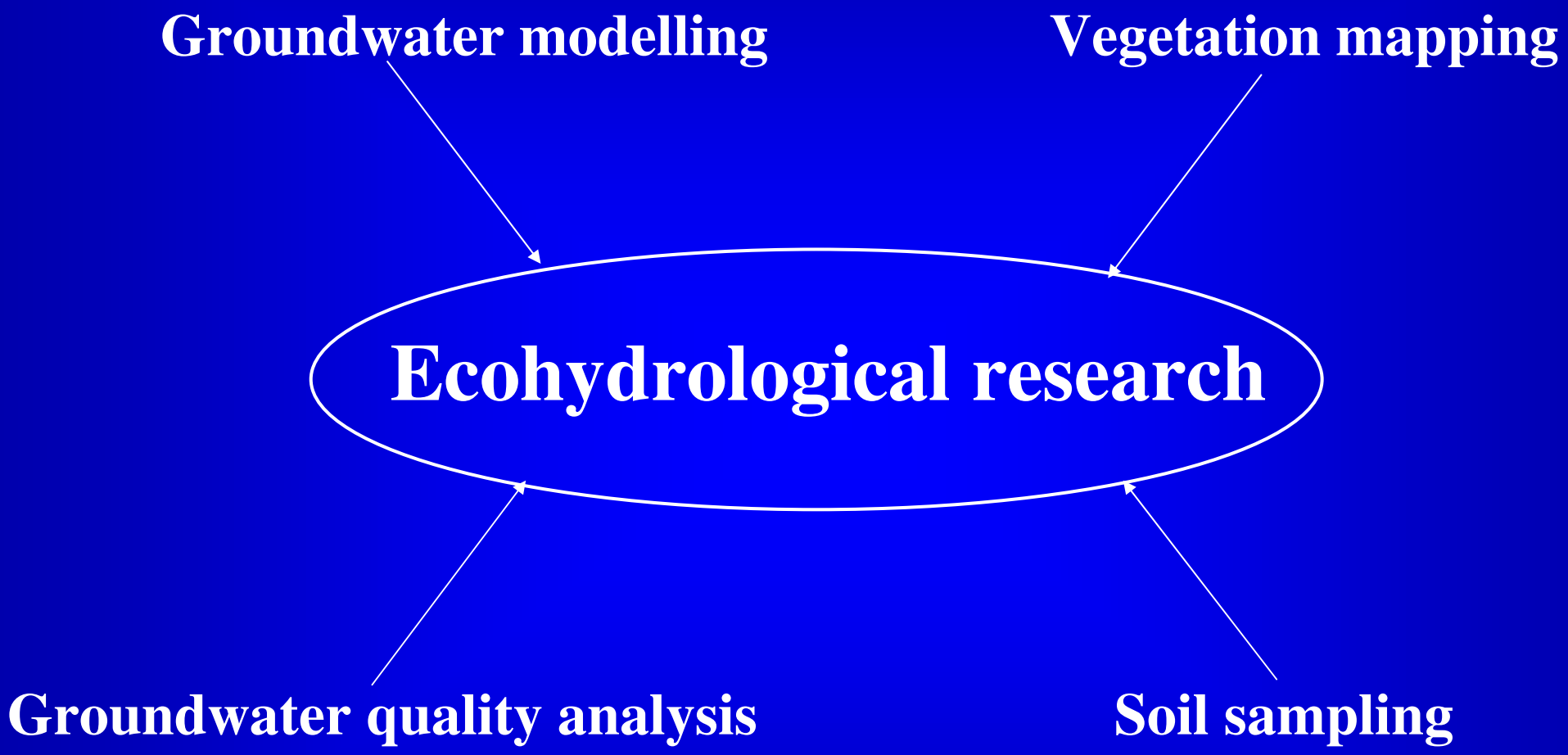
Ecohydrology



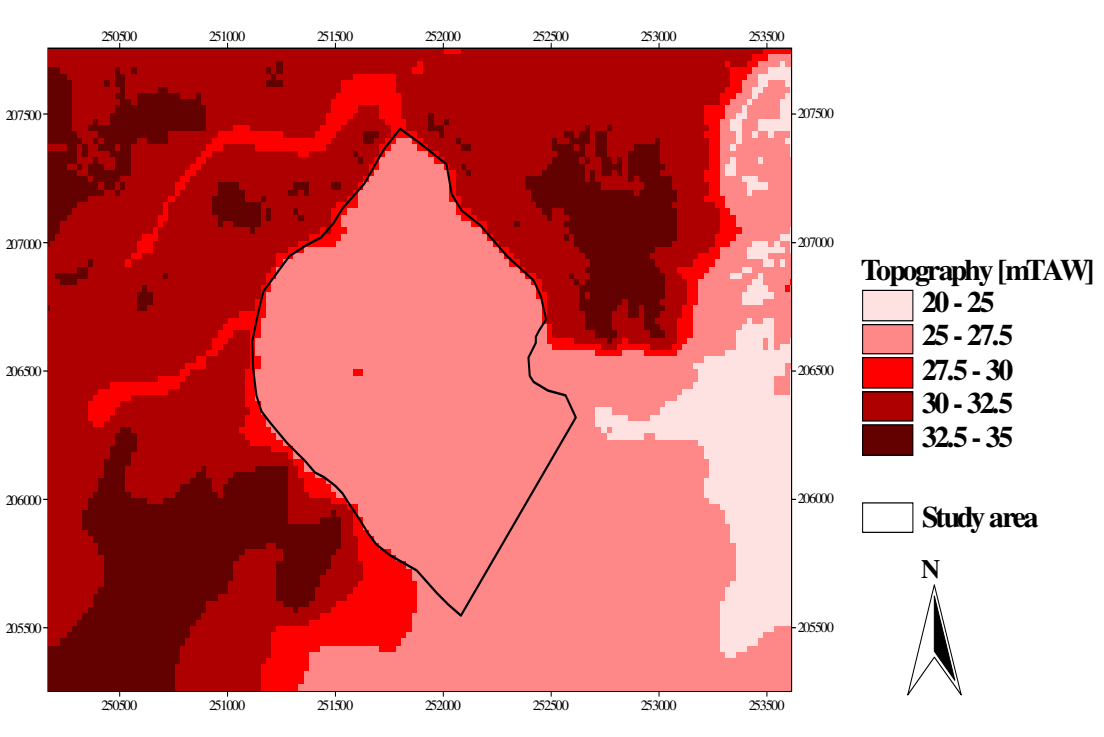
Study area
nature reserve "Vijverbroek"



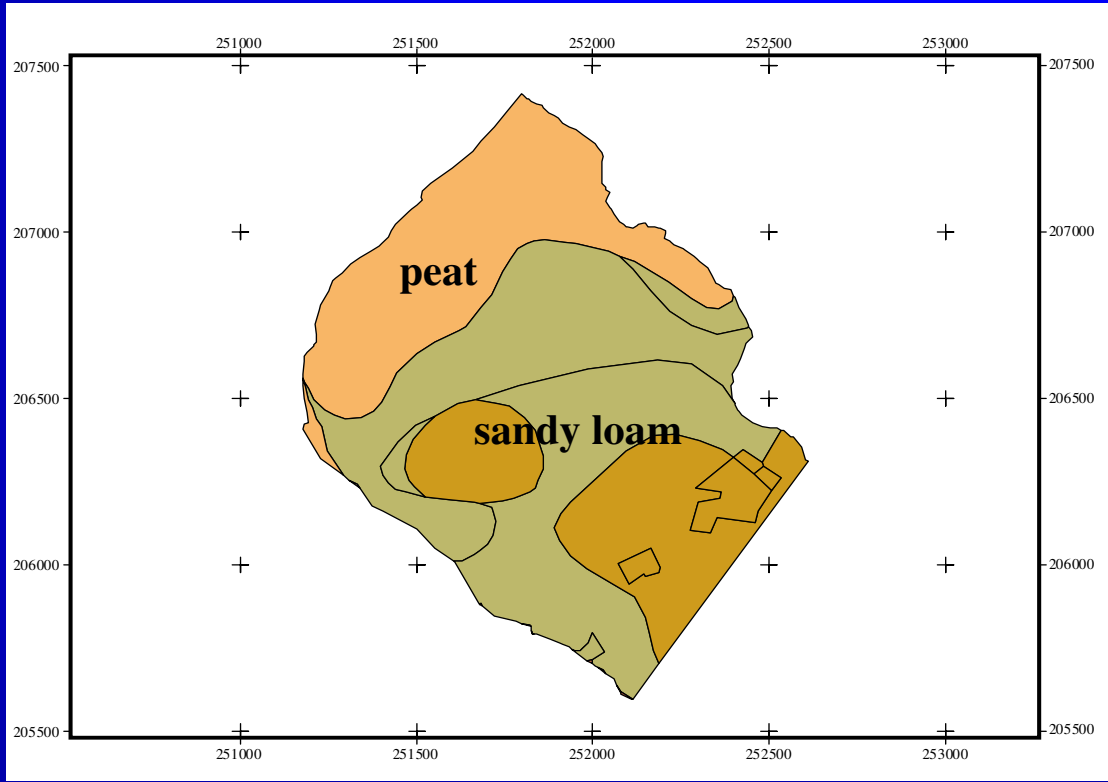



Groundwater modelling
Vegetation mapping
Ecohydrological research
Groundwater quality analysis
Soil sampling

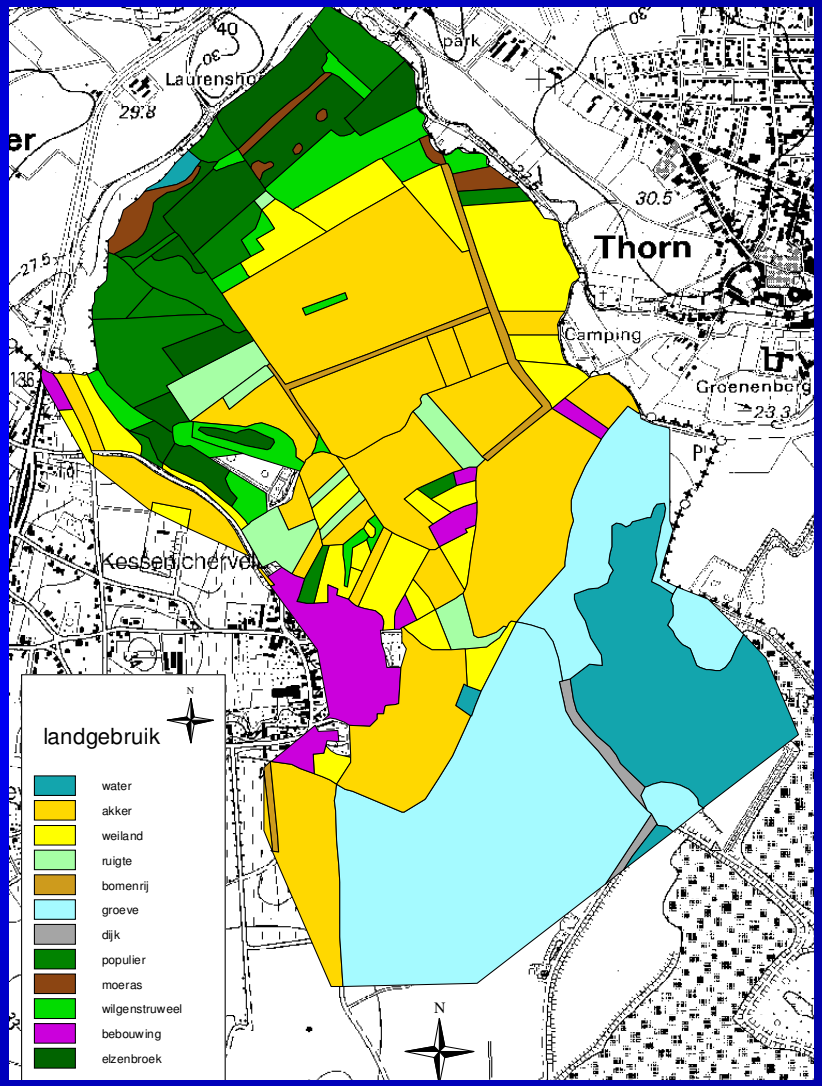
DEM



Soil



Landuse

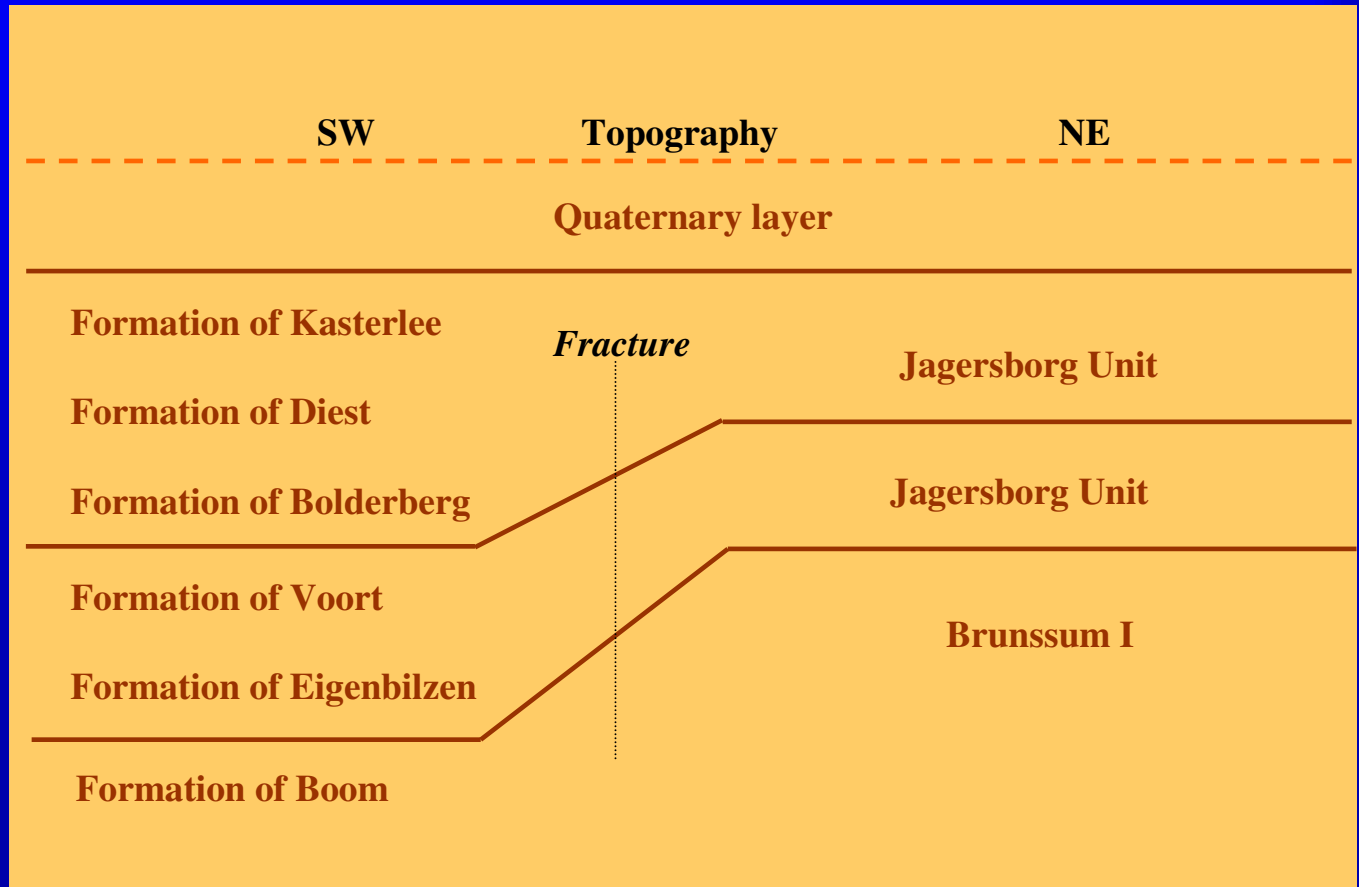


Groundwater modelling

- MODFLOW (Harbaugh & McDonald, 2000) & WetSpass (Batelaan & De Smedt, 2001)
- MODPATH (Pollock, 1994)

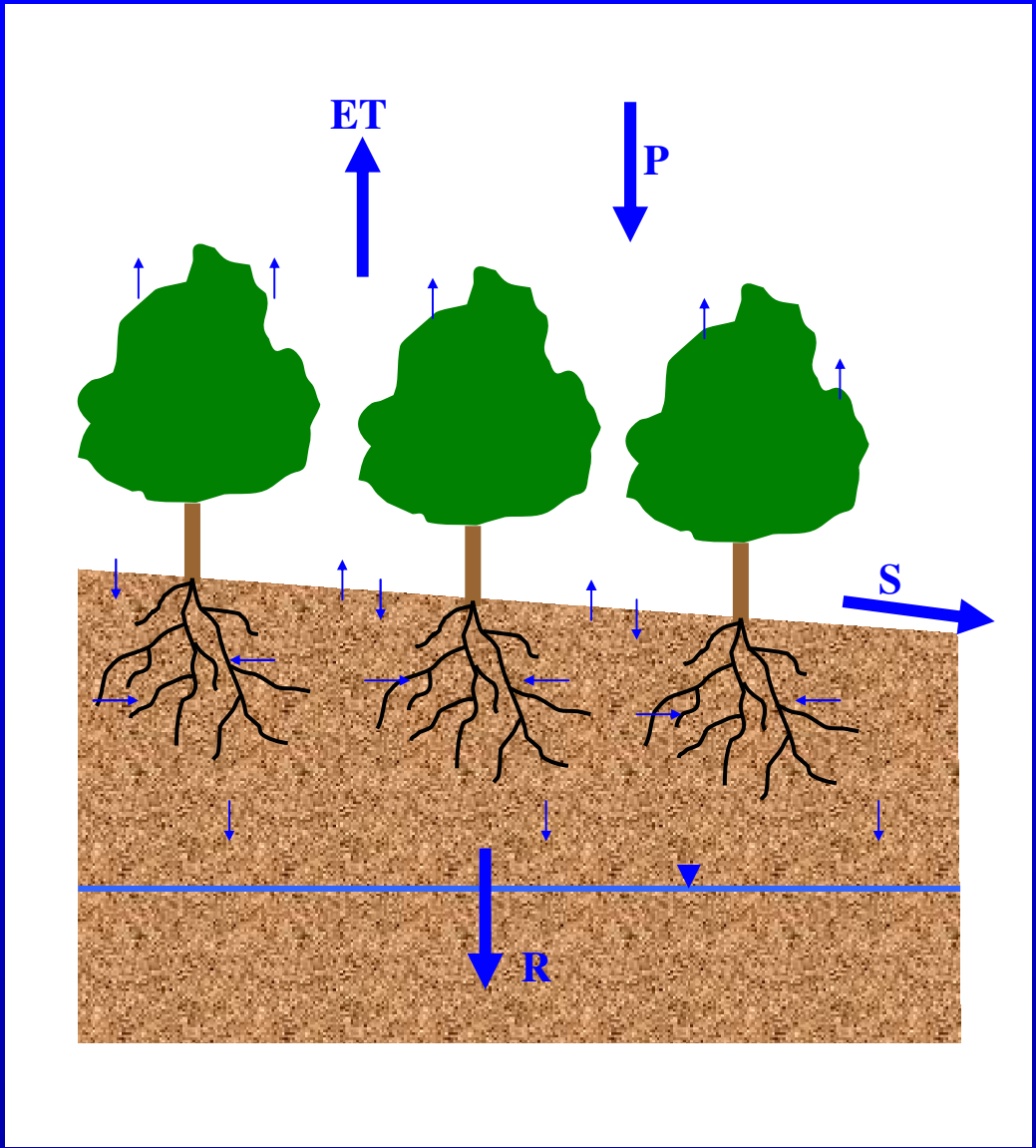
Model:

- 25 m x 25 m cells
- 3 layers



WetSpass model

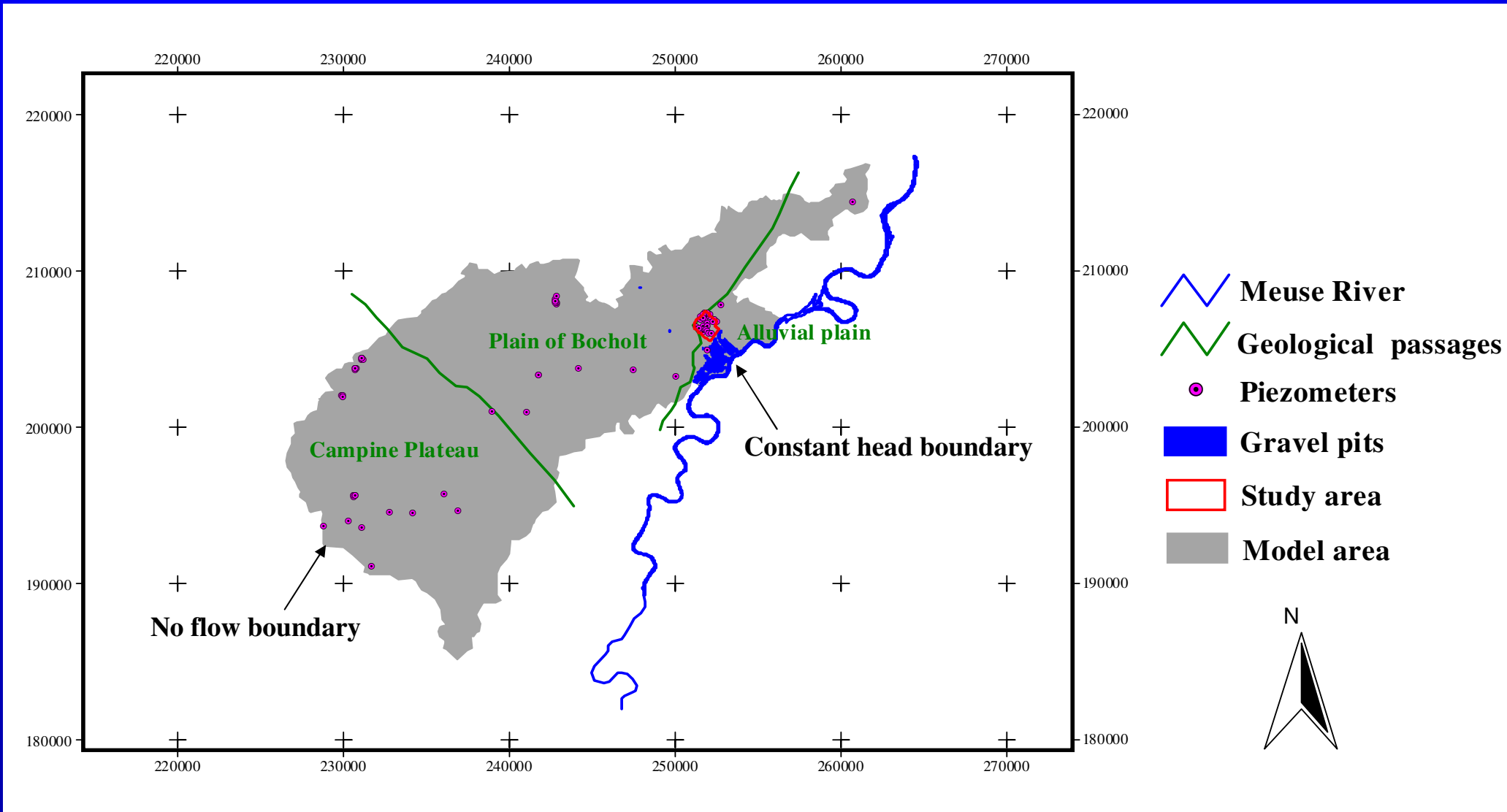
$$R = P - ET - S$$



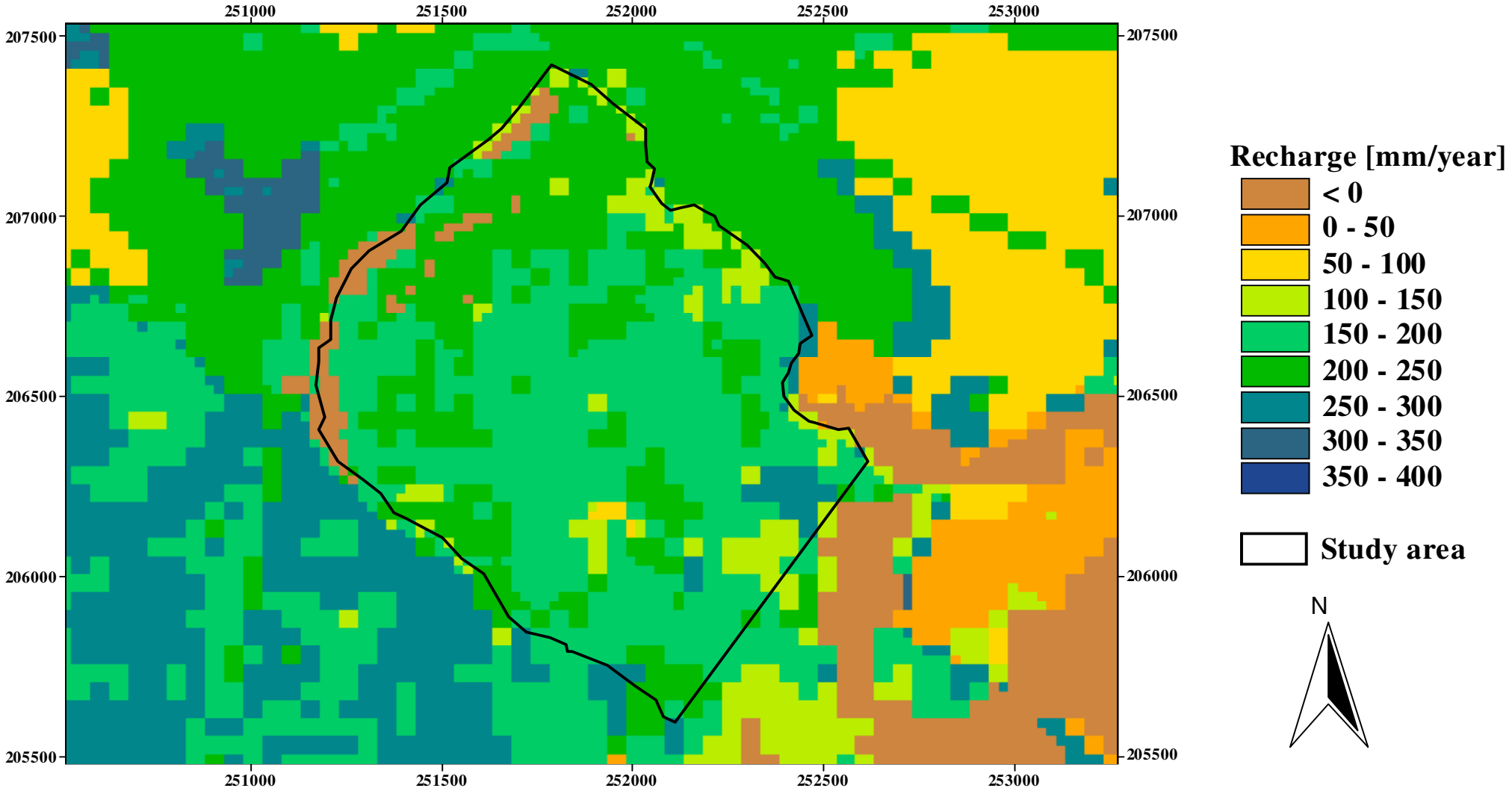
... overview simulations

Scenario → / Model type ↓	*Situation 2002*	*Situation 1995*	*Hypothetical Situation 1995*
Steady st.	- average gw.level/depth - discharge (location + flux) - flow time	- average gw.level/depth - discharge (location + flux)	- average gw.level/depth - discharge (location + flux)
Transient st.	- average gw.level/depth summer - average gw.level/depth winter	- average gw.level/depth summer - average gw.level/depth winter	

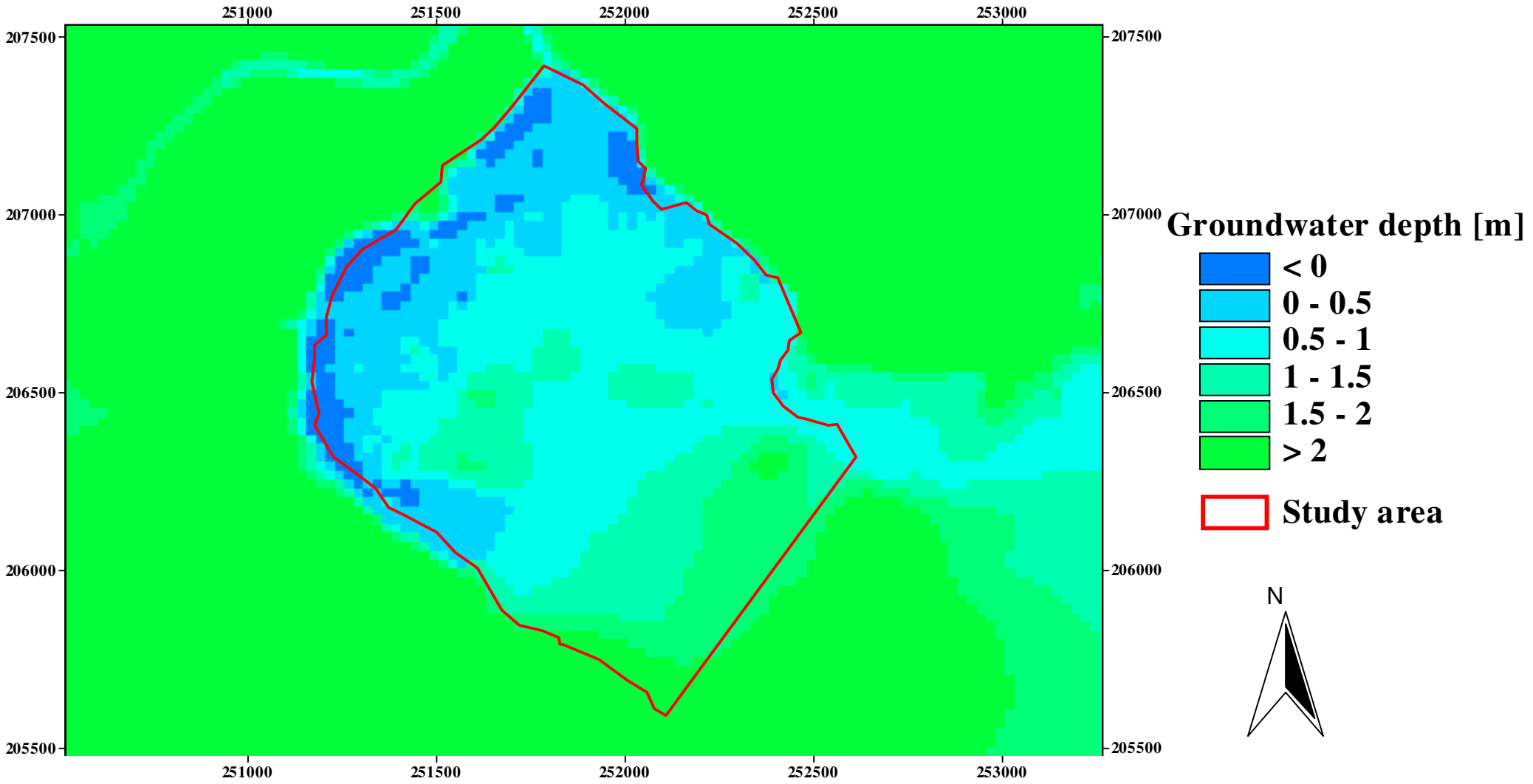
Model area


220000
230000
240000
250000
260000
270000
210000
200000
190000
180000
Plain of Bocholt
Alluvial plain
Campine Plateau
Constant head boundary
No flow boundary
Meuse River
Geological passages
Piezometers
Gravel pits
Study area
Model area
N

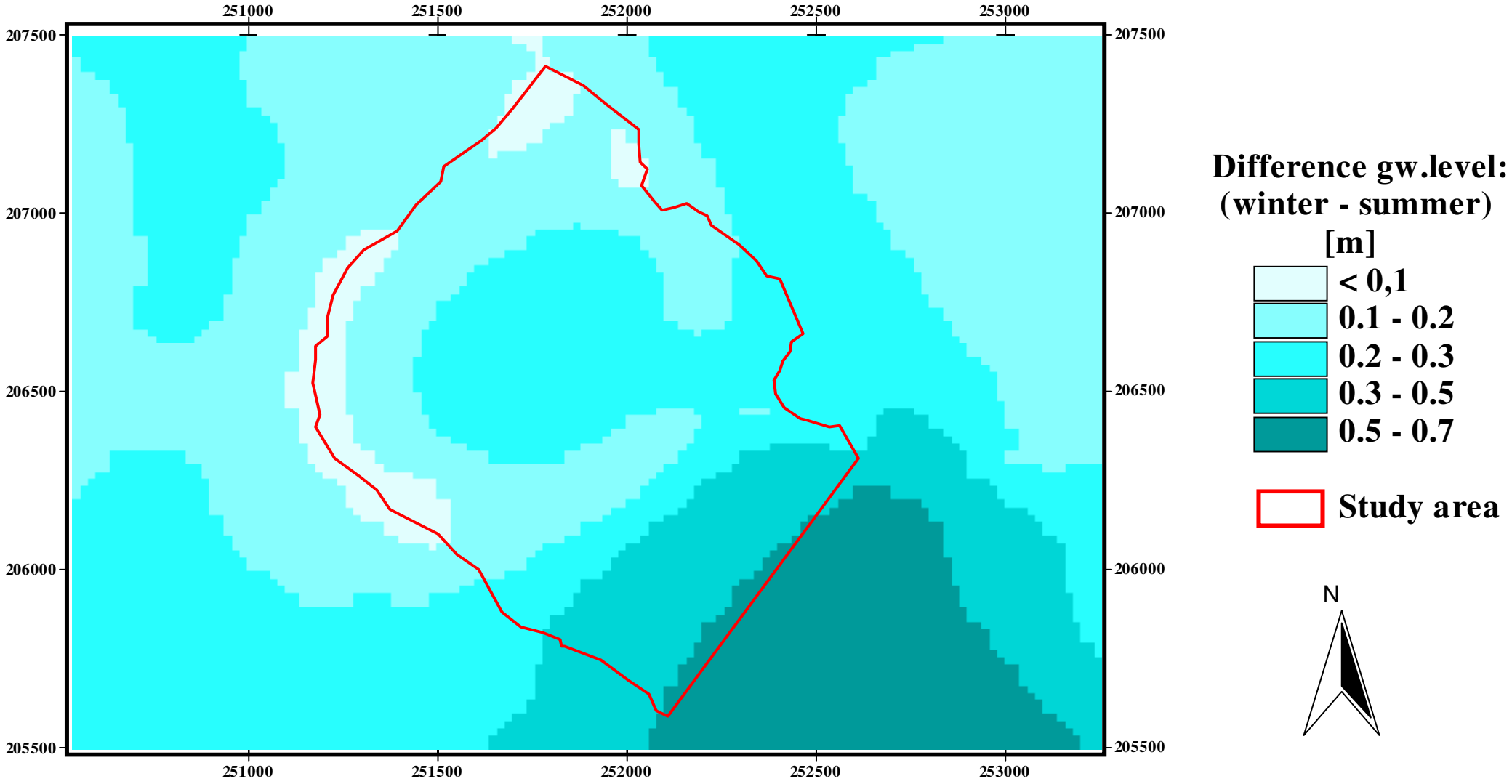
Yearly average groundwater recharge:
Situation 2002



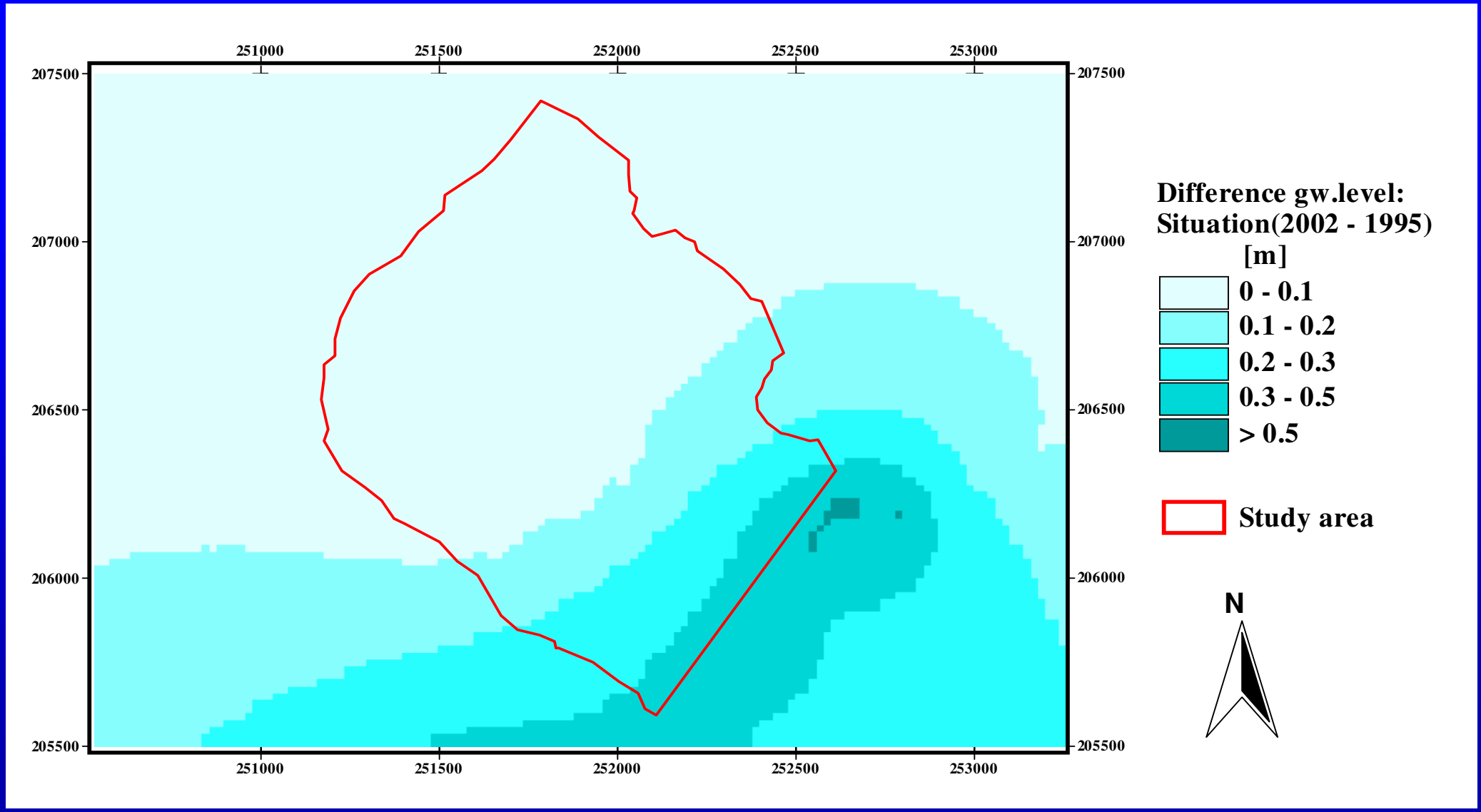
Yearly average groundwater depth:
Situation 2002



Situation 2002: (winter - summer)

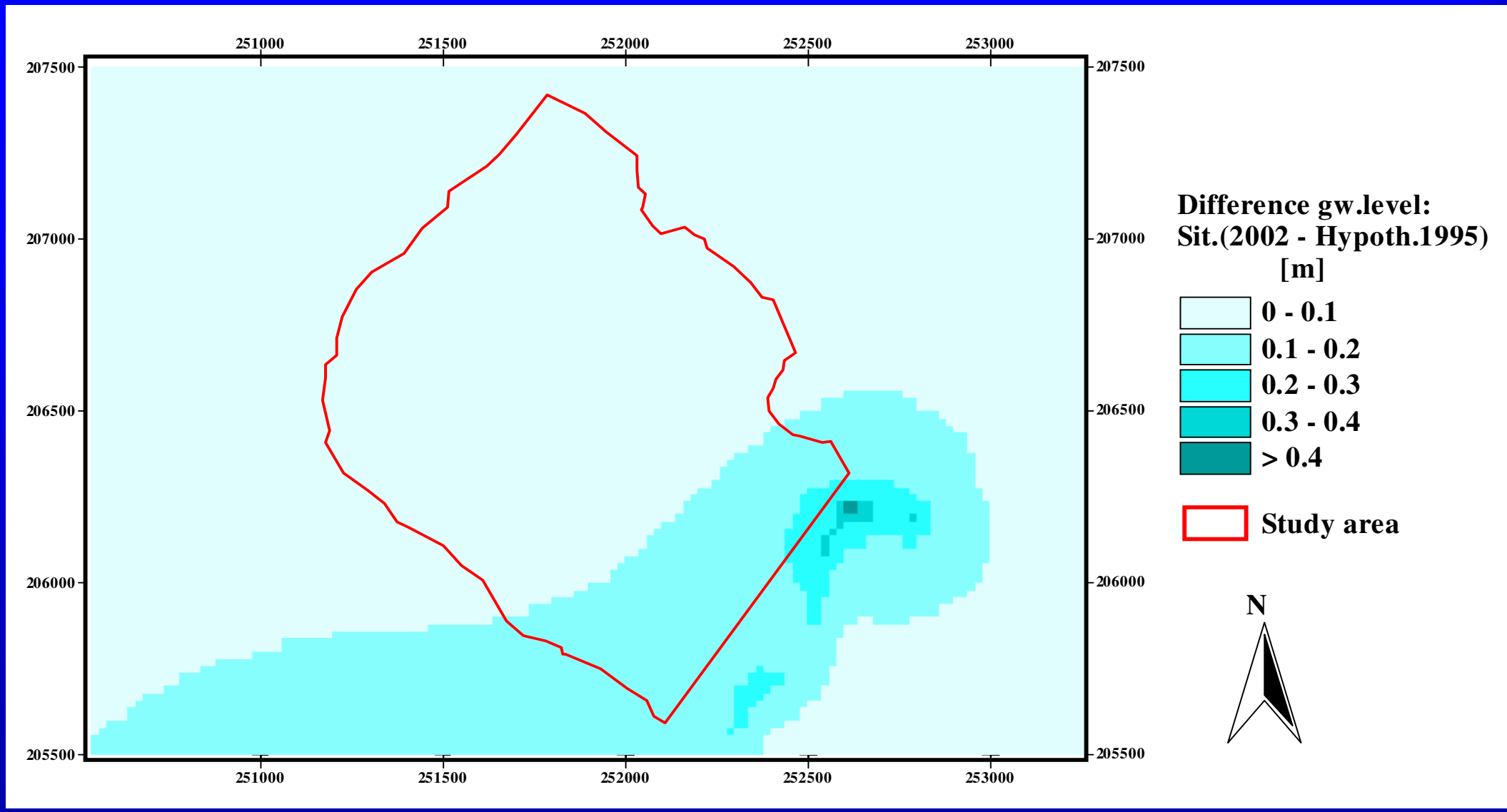


Situation(2002 - 1995)

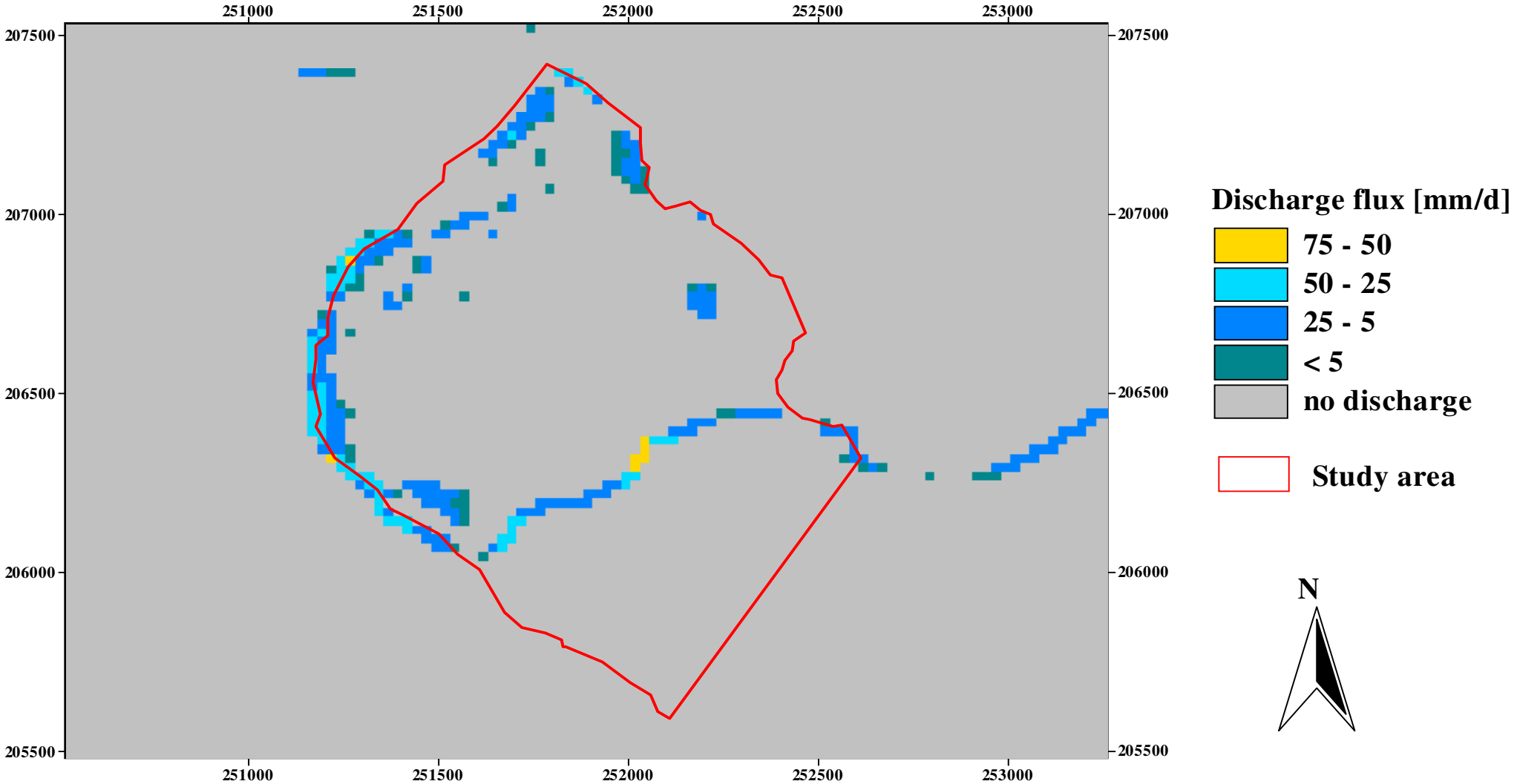


Yearly average groundwater level:

Situation(2002 – Hypoth.1995)

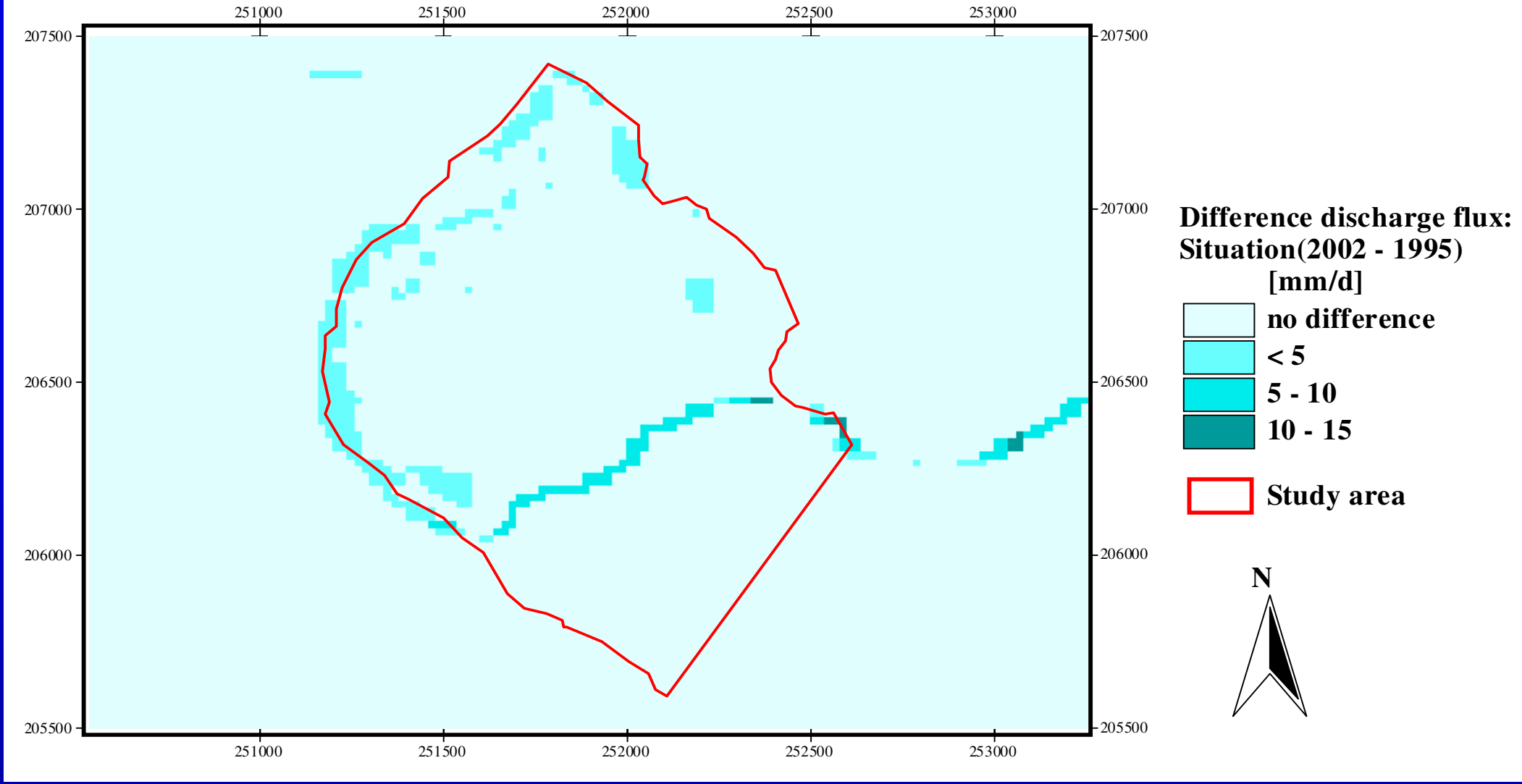


Yearly average discharge flux:
Situation 2002



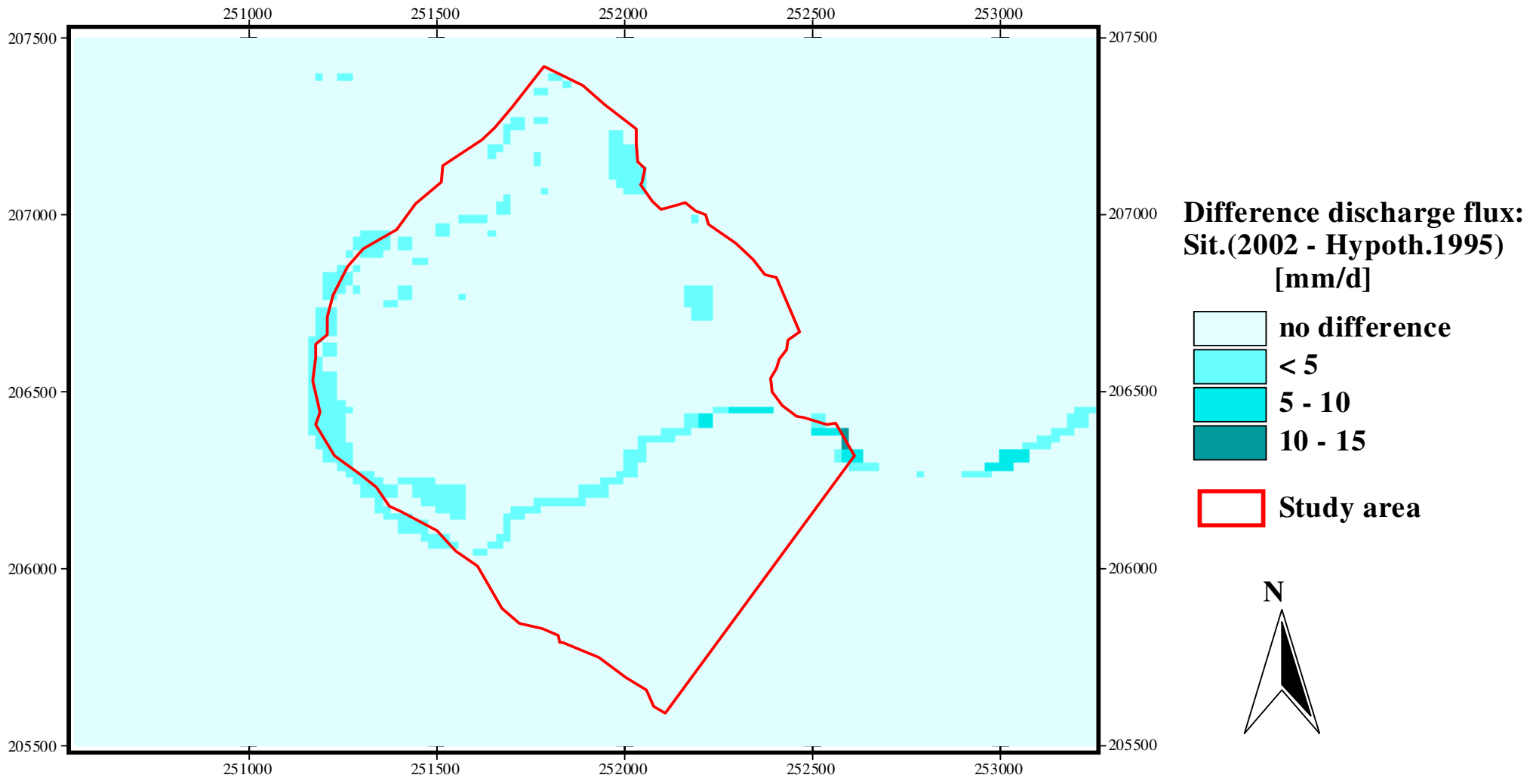
Yearly average discharge flux:

Situation(2002 – 1995)

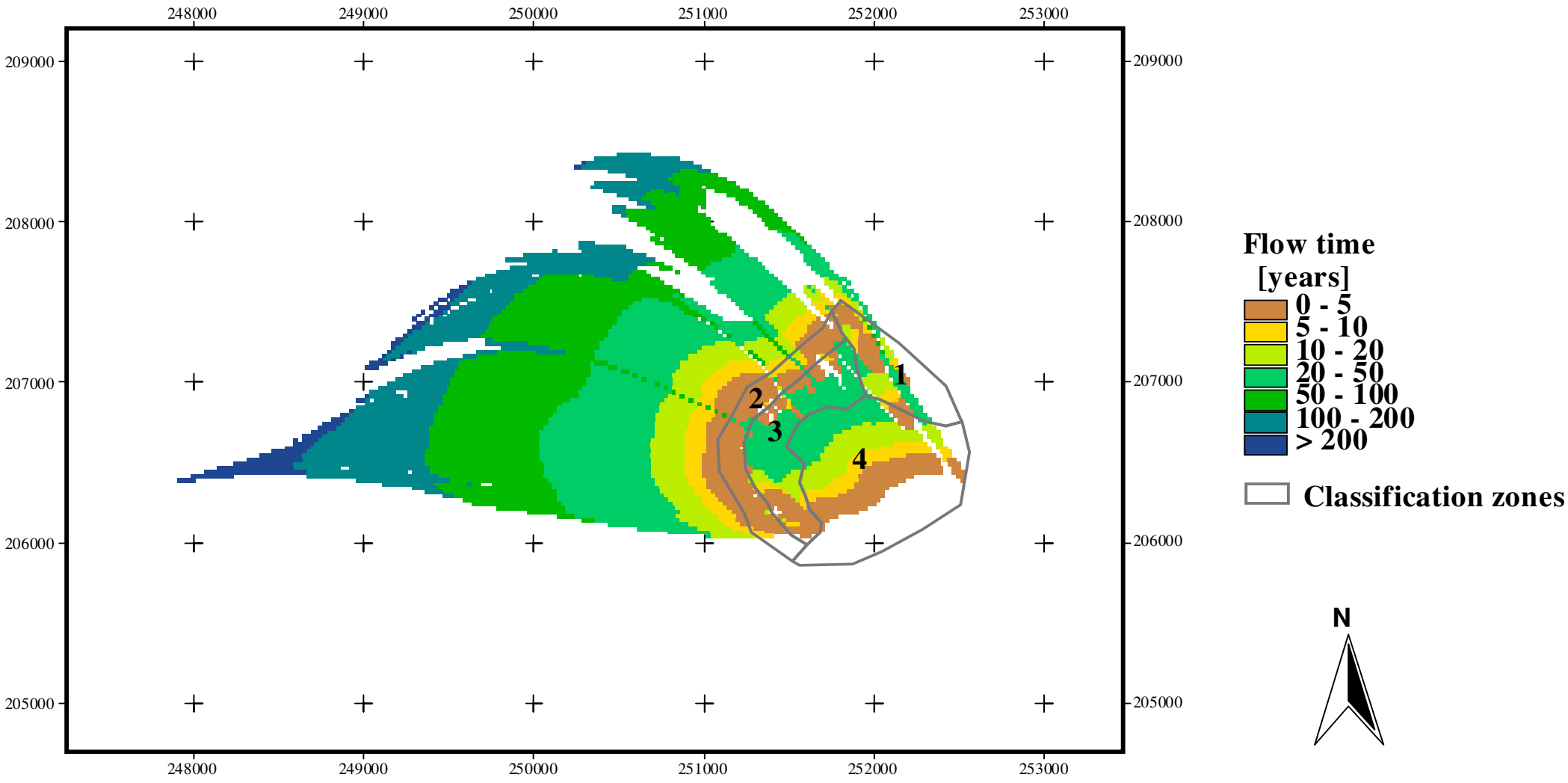


Yearly average discharge flux:

Situation(2002 – Hypoth.1995)



Recharge areas & flow times:
Situation 2002



Determination of controlling variables for vegetation using CCA (Canonical Correspondence Analysis)

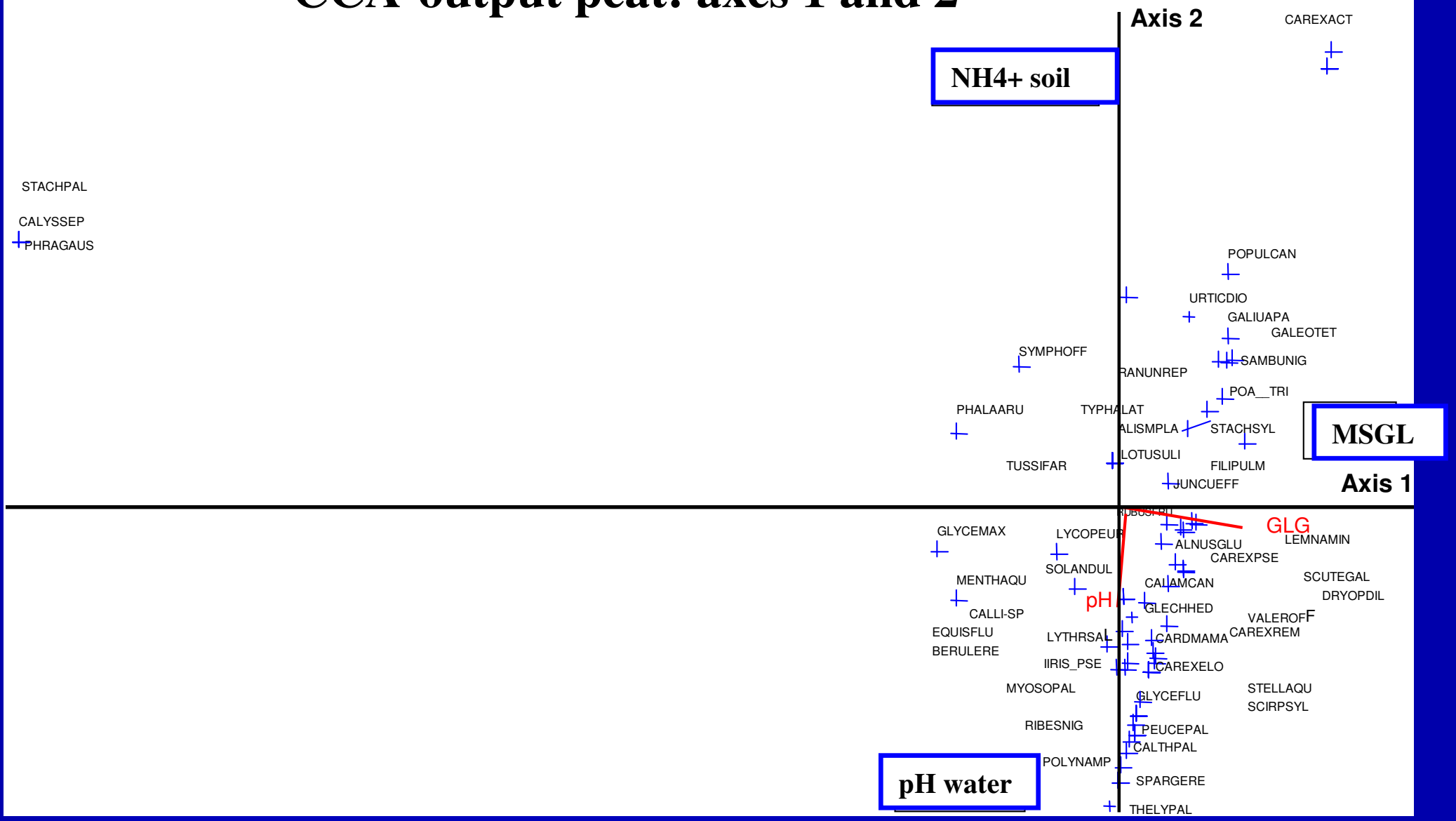
Variables considered:

- Groundwater quality (2002)
- Groundwater level: mean summer gw.level (MSGL)
- Soil nutrients: extraction/destruction

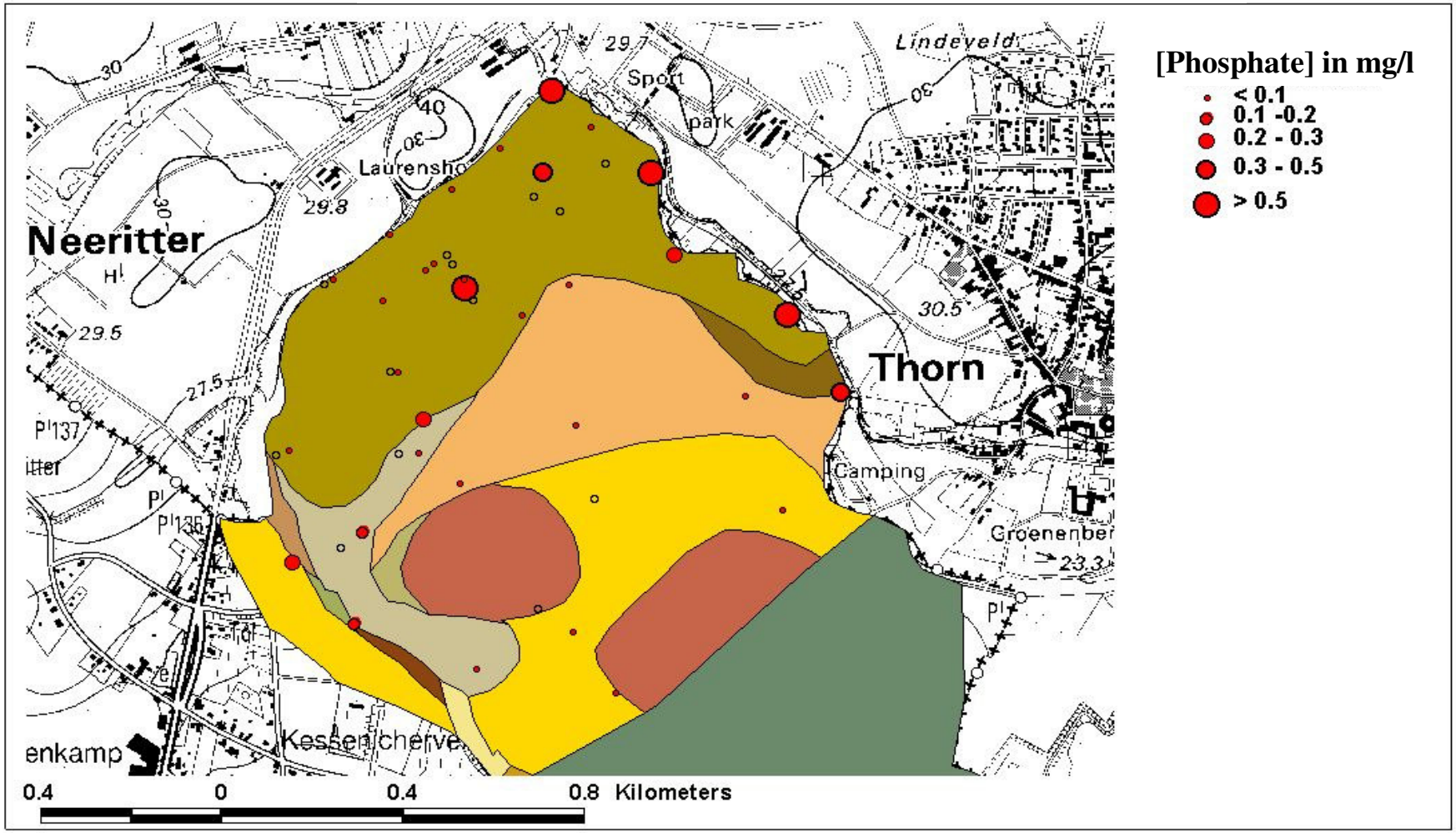
Findings: the controlling variables are:

- **MSGL**
- pH: impact rainwater + soil processes
- [phosphate]: external supply + soil processes

CCA-output peat: axes 1 and 2



[Phosphate] in groundwater

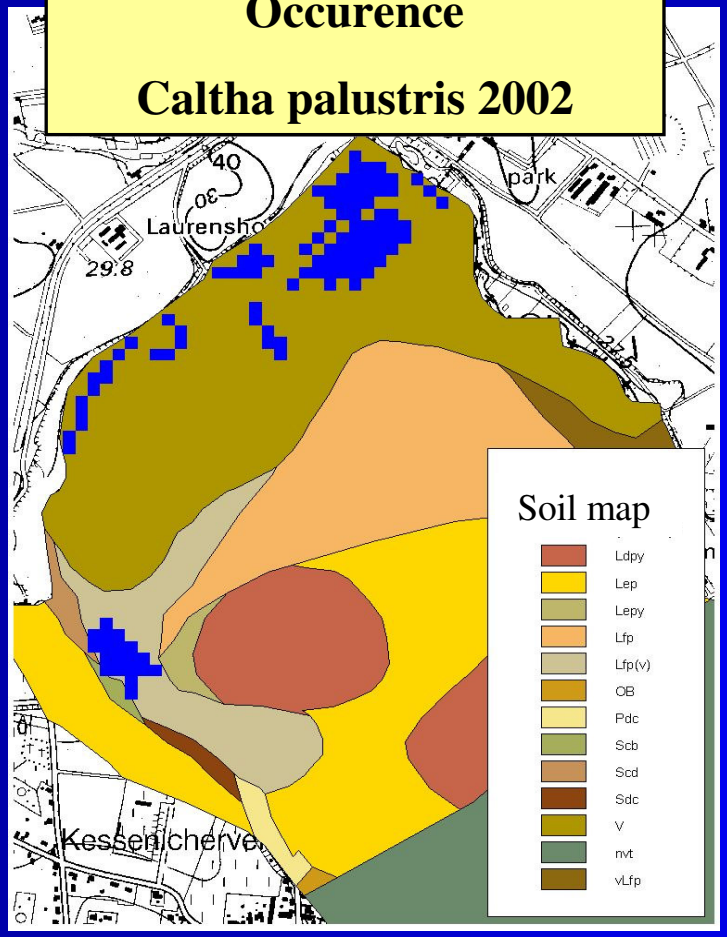


Vegetation (phreatophytes) “predictions”

- Based on results of groundwater model
- Delineation gw.depth-ranges pro species
  - Optimal range
  - Broad range
- Predictions based on these ranges
  - Simulation of *Situation 2002:* control
  - Simulation of *Situation 1995*

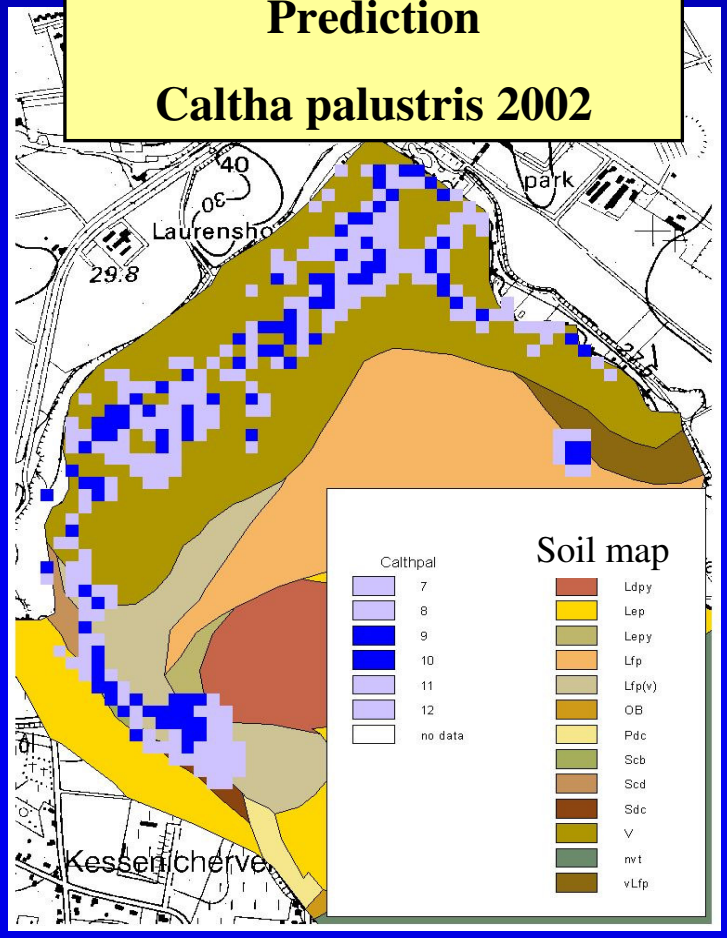
Occurence

Caltha palustris 2002



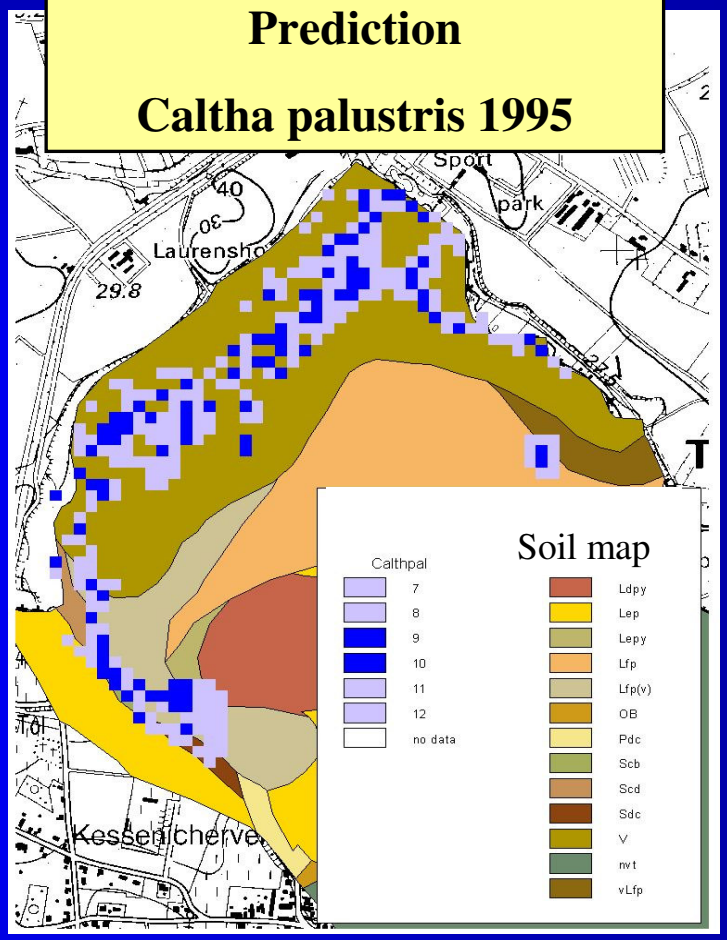
Prediction

Caltha palustris 2002



Prediction

Caltha palustris 1995



→ **Predictions**: not exact, however, indicative to trace the effects of restoration measures (here: filling up of gravel pits)

Conclusions

The methodology is useful:

- to obtain insight in groundwater systems:
  - gw.levels & depths
  - recharge & discharge area
- to obtain ecohydrological insight in wetlands:
  - influence of hydrological stresses (e.g. drainage depth)
  - prediction of vegetation/ nature potential