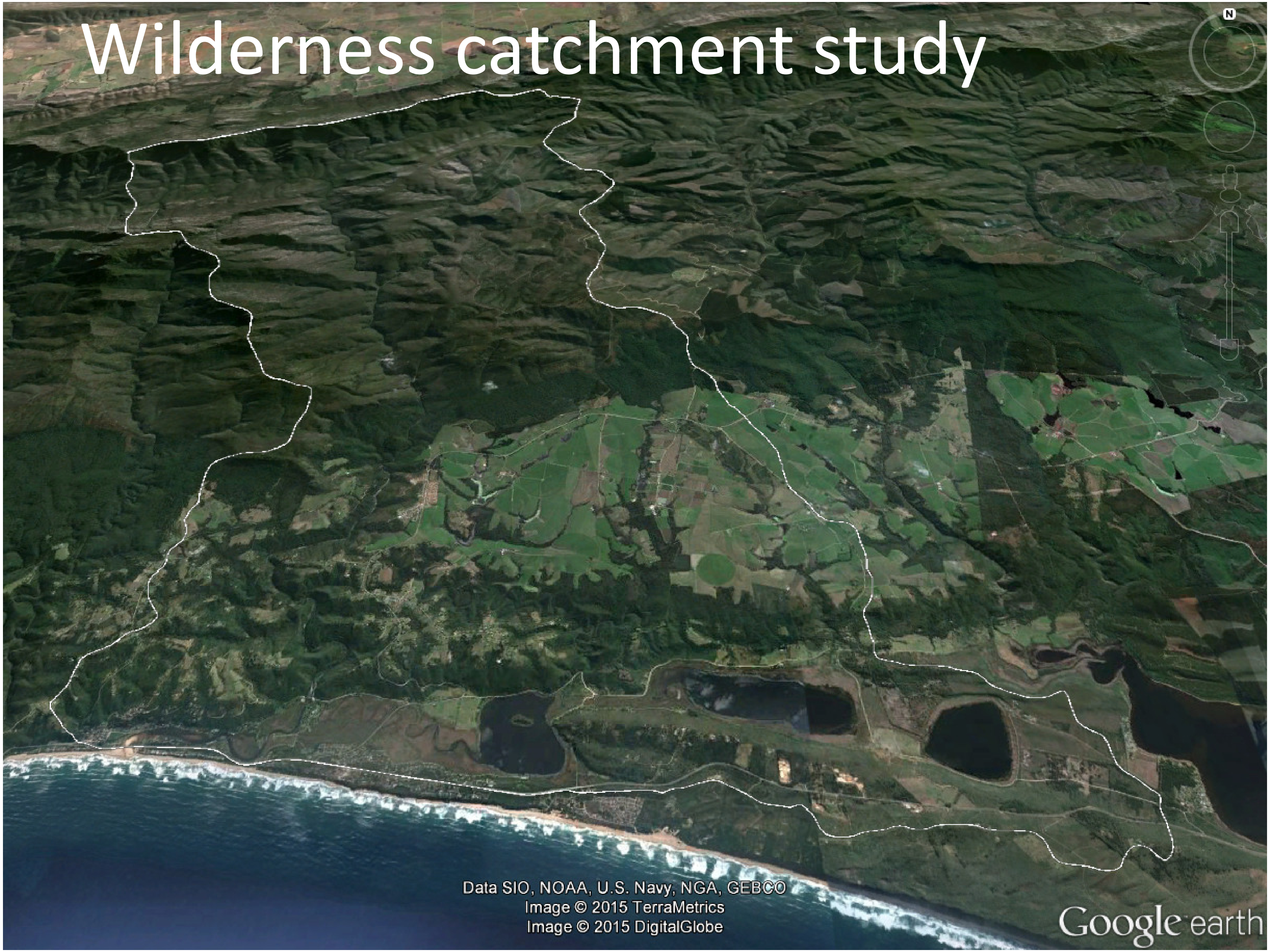
Modelling tools to support stakeholder co-learning

David Le Maitre with inputs from many colleagues
Natural Resources and the Environment, CSIR

Wilderness catchment study



Characterise the issue

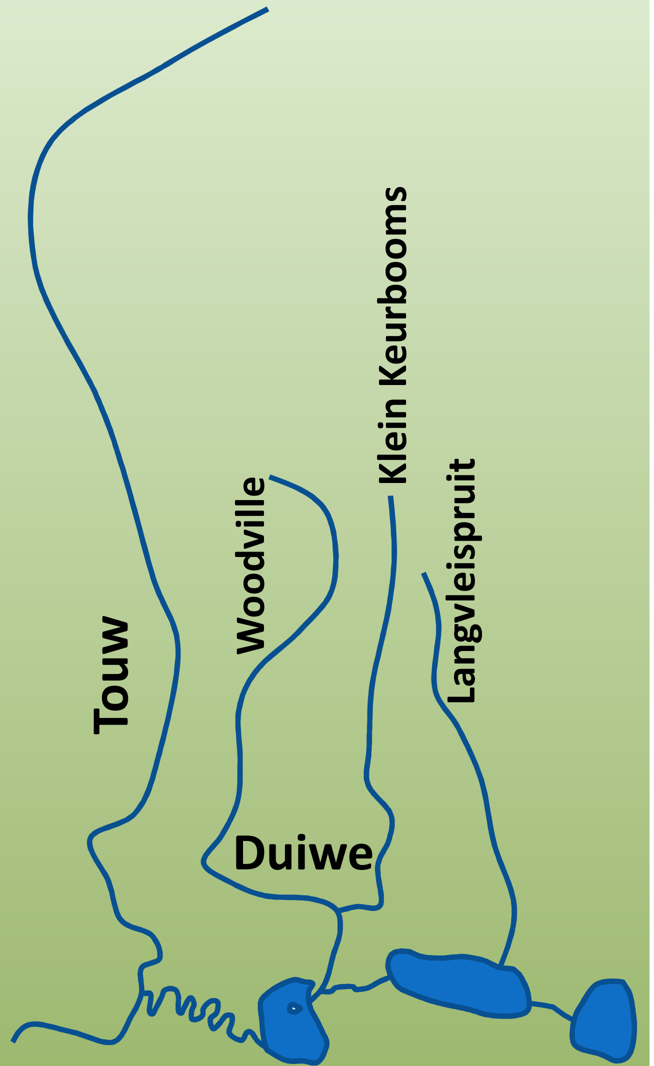
- Growing concerns about water quality
  - Periodic algal blooms in lakes
- Intensive agriculture
- Water consumption levels

Characterise the issue

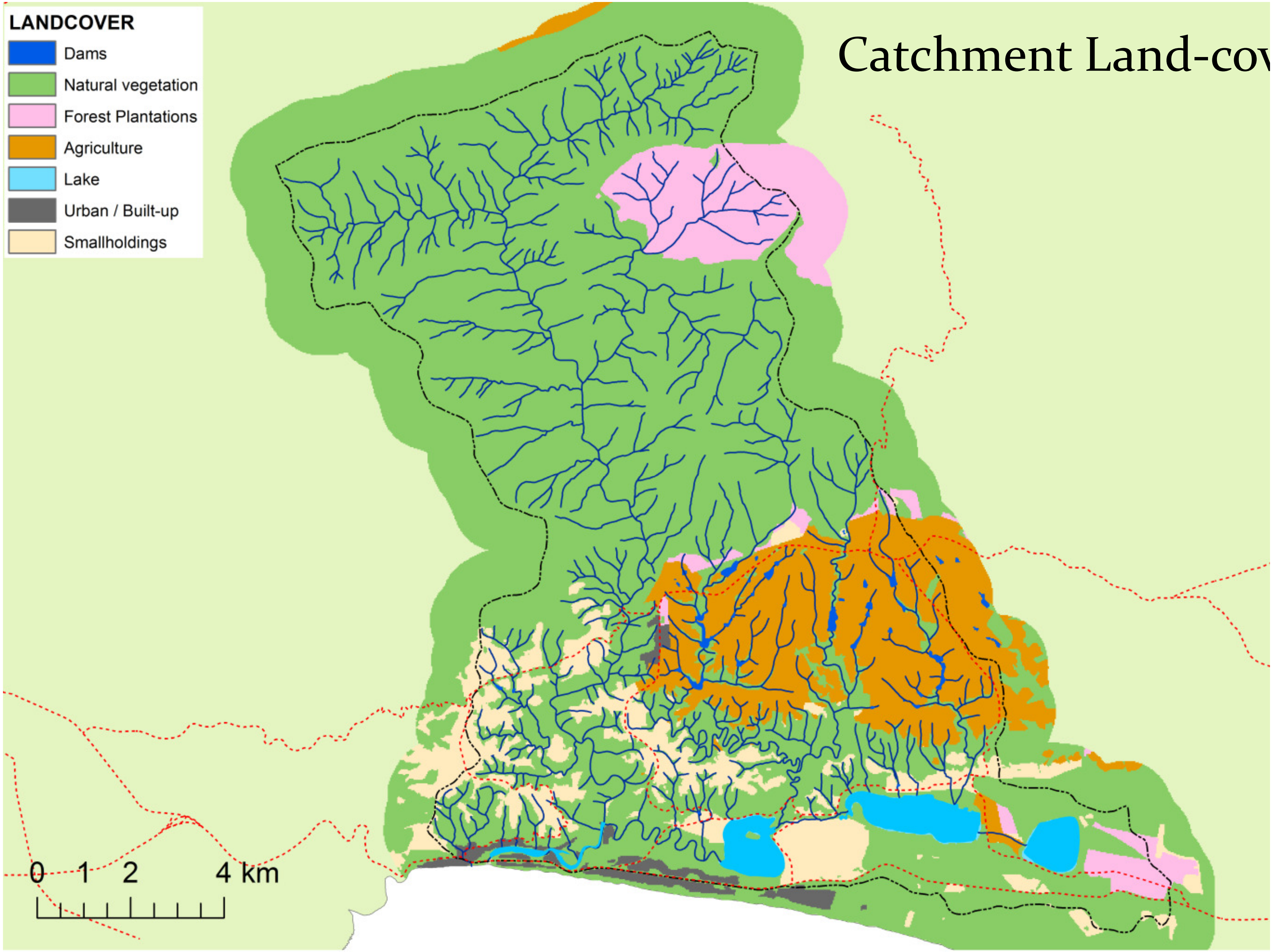
- Growing concerns about water quality
  - Periodic algal blooms in lakes
- Intensive agriculture
- Water consumption levels
- Is there a real problem?
- If so:
  - What are the causes?
  - Where are the sources?

Understand the system

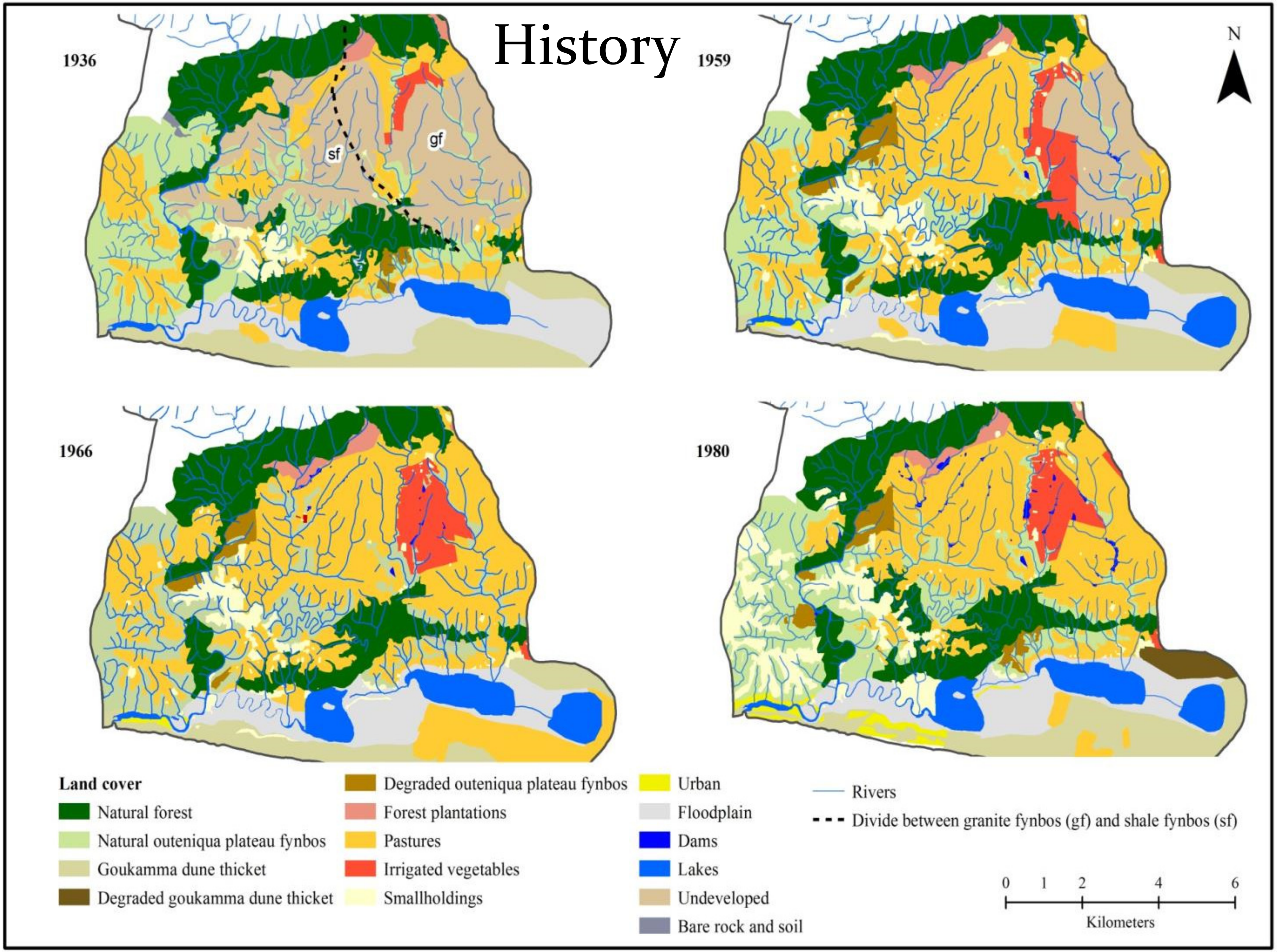
- Three river systems connected by lakes
  - Touw into estuary
  - Duiwe & Langvleispruit into lakes
- River flows
  - Originally 40% of rainfall
  - Evenly distributed across the year
- Blackwater – low nutrients and buffering capacity
- Estuary mouth managed



Catchment Land-cov



History

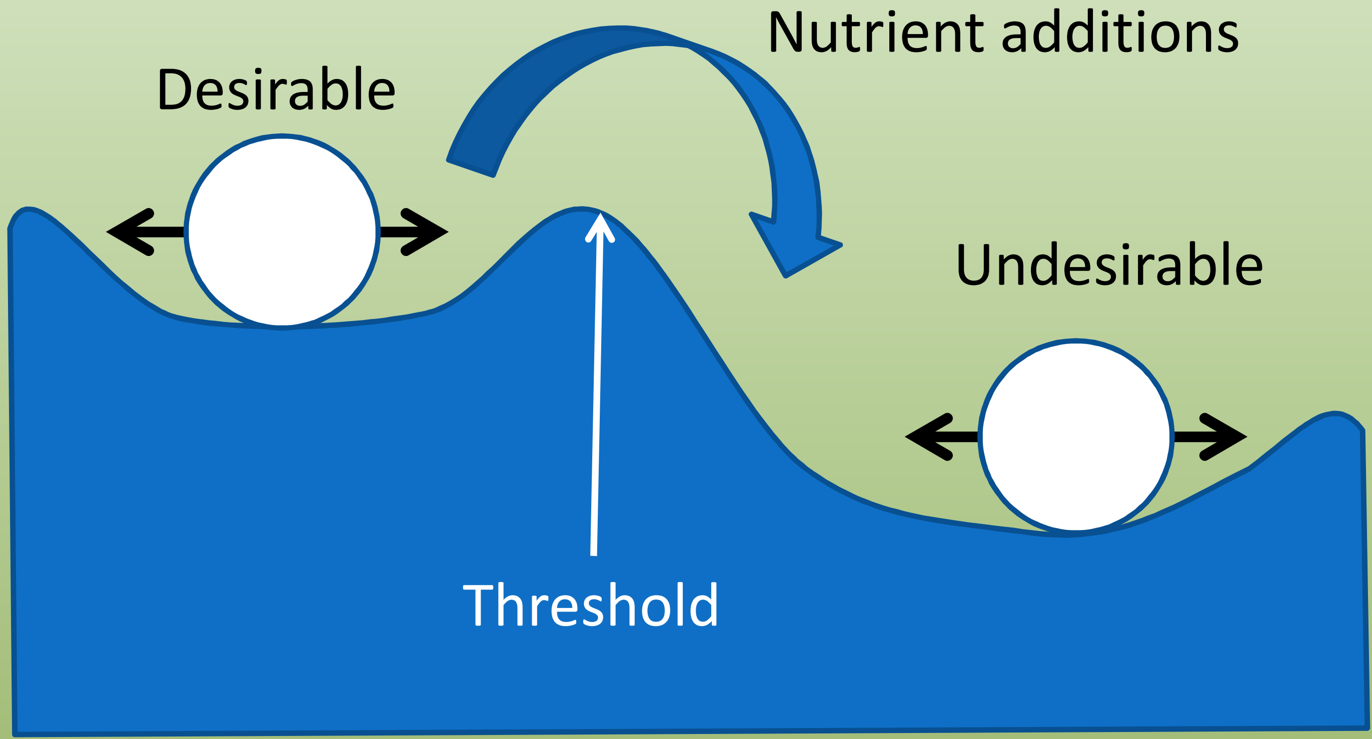

1936
sf
gf
1959
N
1966
1980
Land cover
Natural forest
Natural outeniqua plateau fynbos
Goukamma dune thicket
Degraded goukamma dune thicket
Degraded outeniqua plateau fynbos
Forest plantations
Pastures
Irrigated vegetables
Smallholdings
Urban
Floodplain
Dams
Lakes
Undeveloped
Bare rock and soil
Rivers
Divide between granite fynbos (gf) and shale fynbos (sf)
0 1 2 4 6
Kilometers

Identify causes and sources

- Using land in various ways requires different inputs:
  - How much fertiliser is added
  - What kinds of chemicals are applied for weeds and pests
  - How often the soil is cultivated (soil disturbance → loss)
- Examples:
  - Irrigated vegetables – typically lots of fertiliser, pesticides & intensive cultivation (high impact)
  - Natural pasture – some soil loss (moderate impact)
  - Natural – baseline levels (no impact)

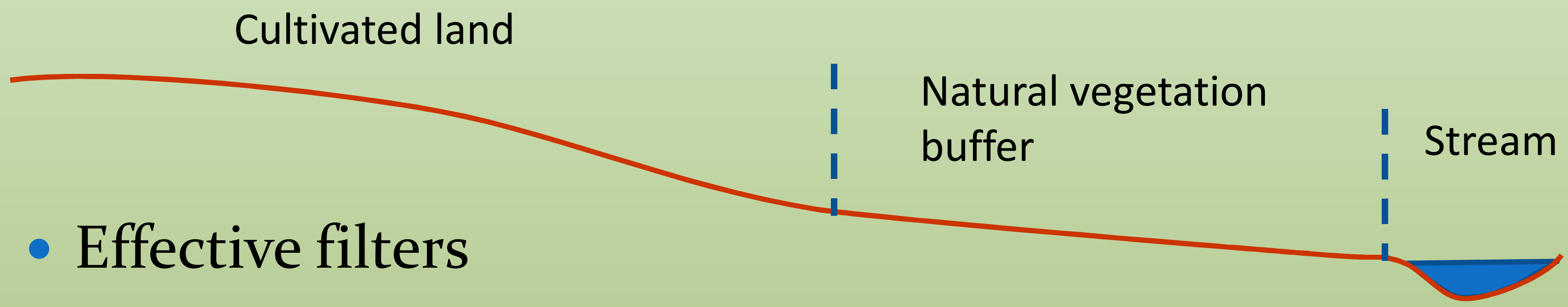
Identify undesirable consequences

- Changes can lead to thresholds

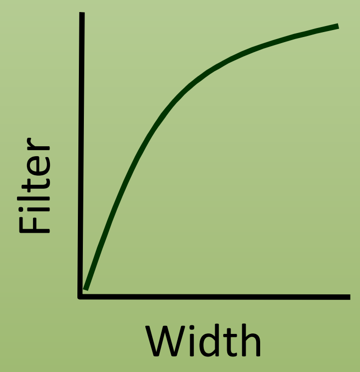


Identify mitigation options

- Natural river buffers and wetlands can reduce impacts



- Effective filters
  - Trapping soil
  - Absorbing nutrients & agro-chemicals
  - Regulating harmful microbes
- Filtering increases rapidly with width

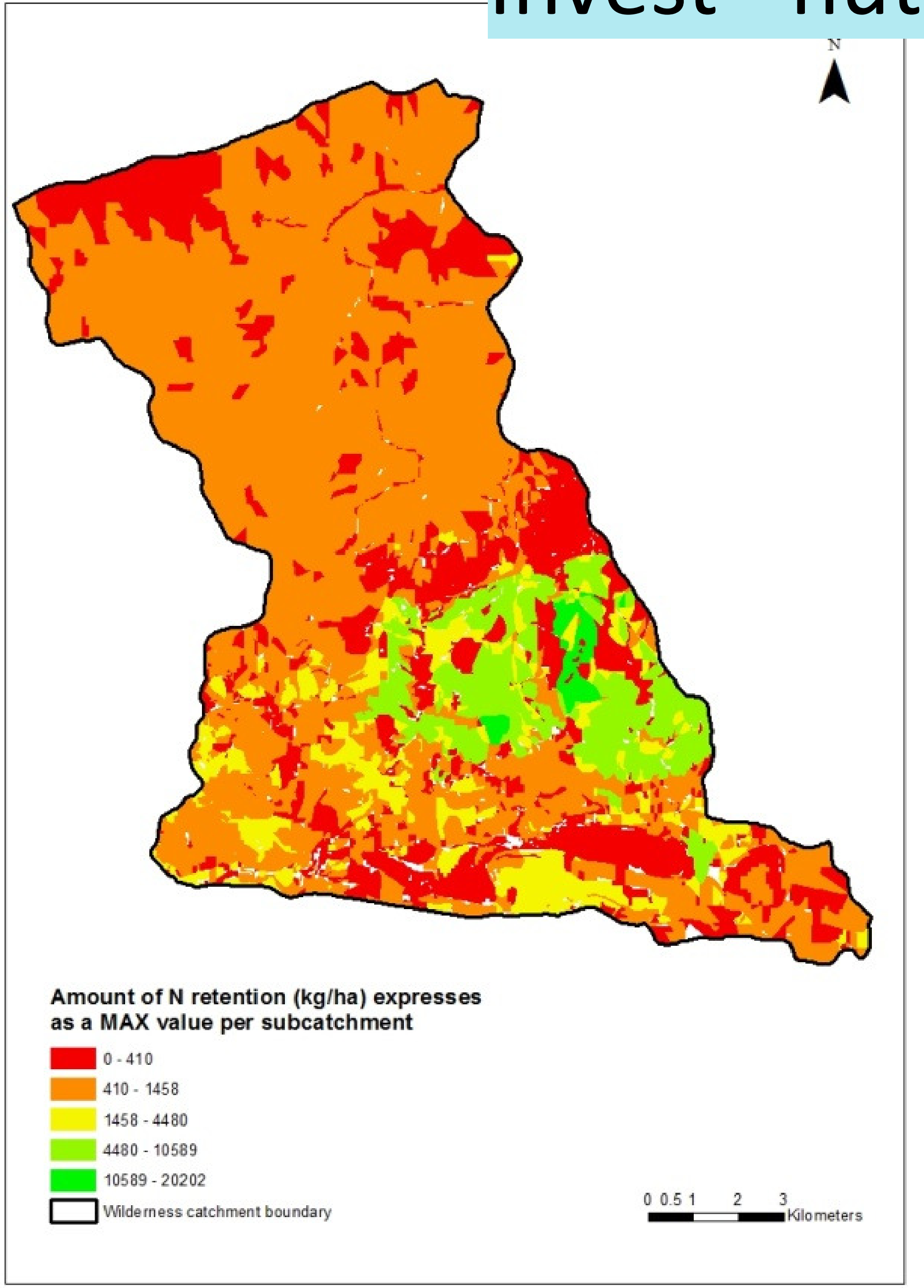


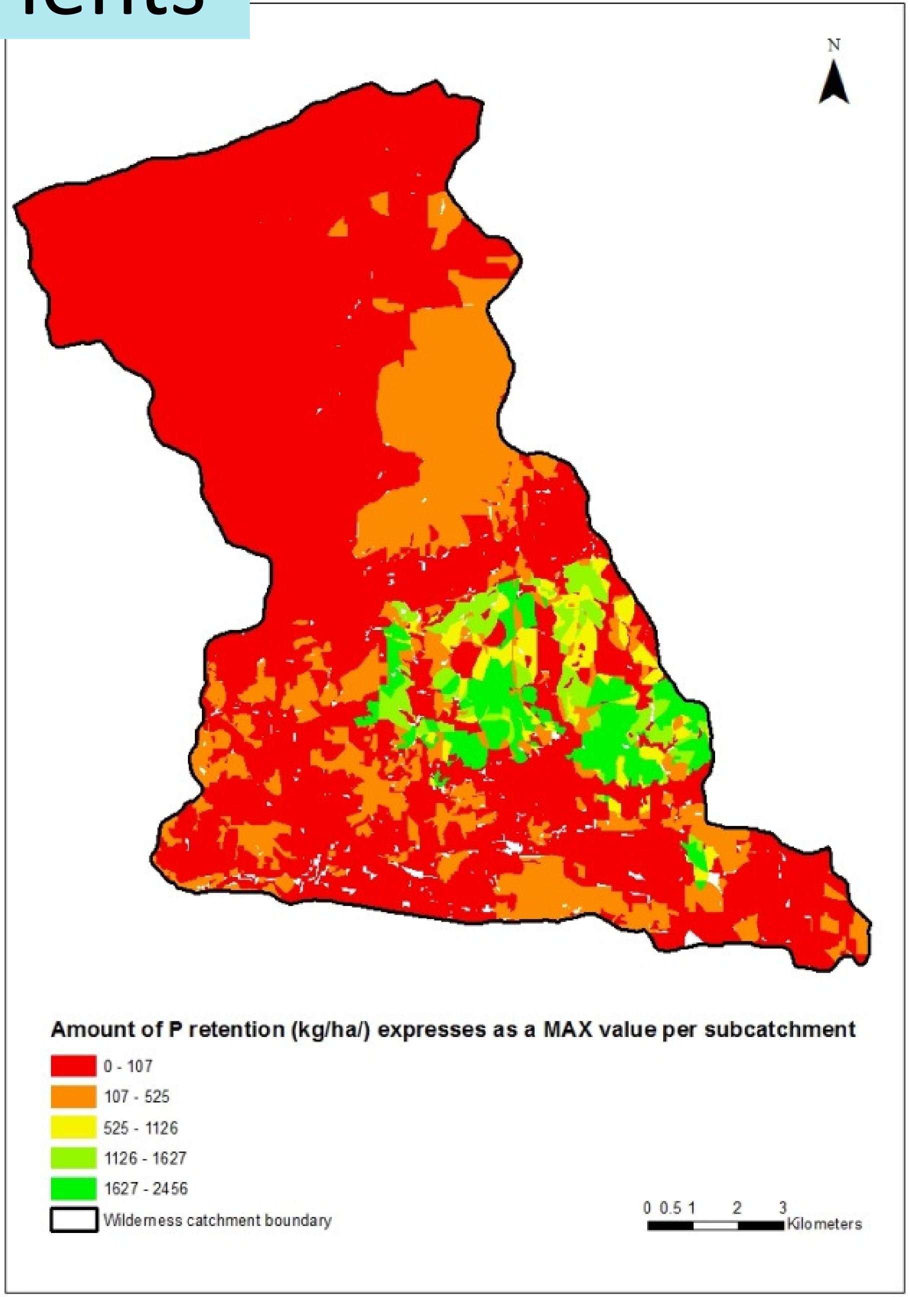
Design sampling and modelling

- Water quality sampling including algal indicators
  - Conductivity, nutrients, agrochemicals, microbes
- Water quality index:
  - Land cover / management based score
  - Nutrients, Agrochemicals, Sediments
  - -> Buffered river reach scores
- Invest modelling
  - Land cover -> impacts on ecosystem services
  - Water quality (nutrients, sediment)

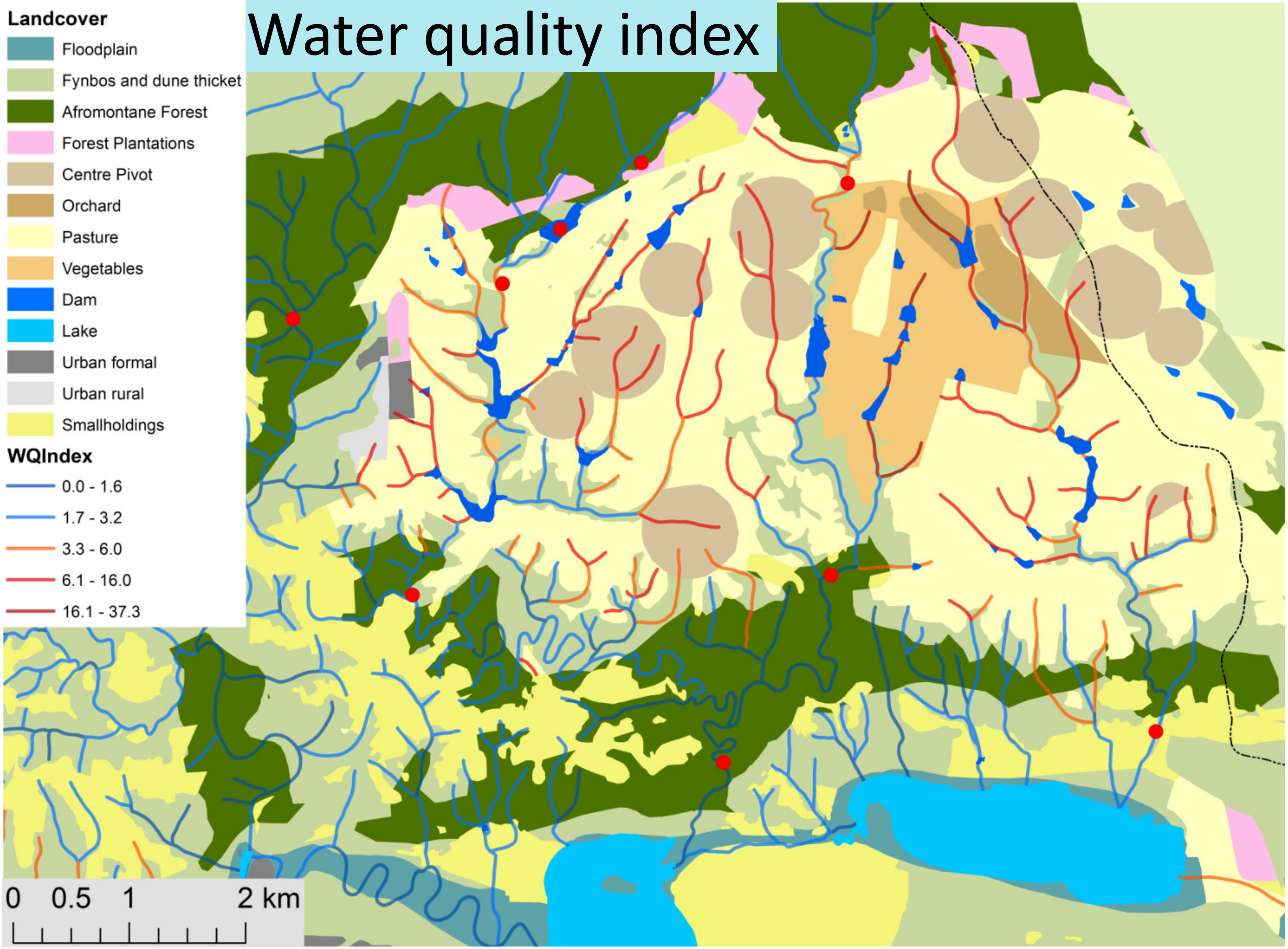
Sampling and modelling

Invest - nutrients

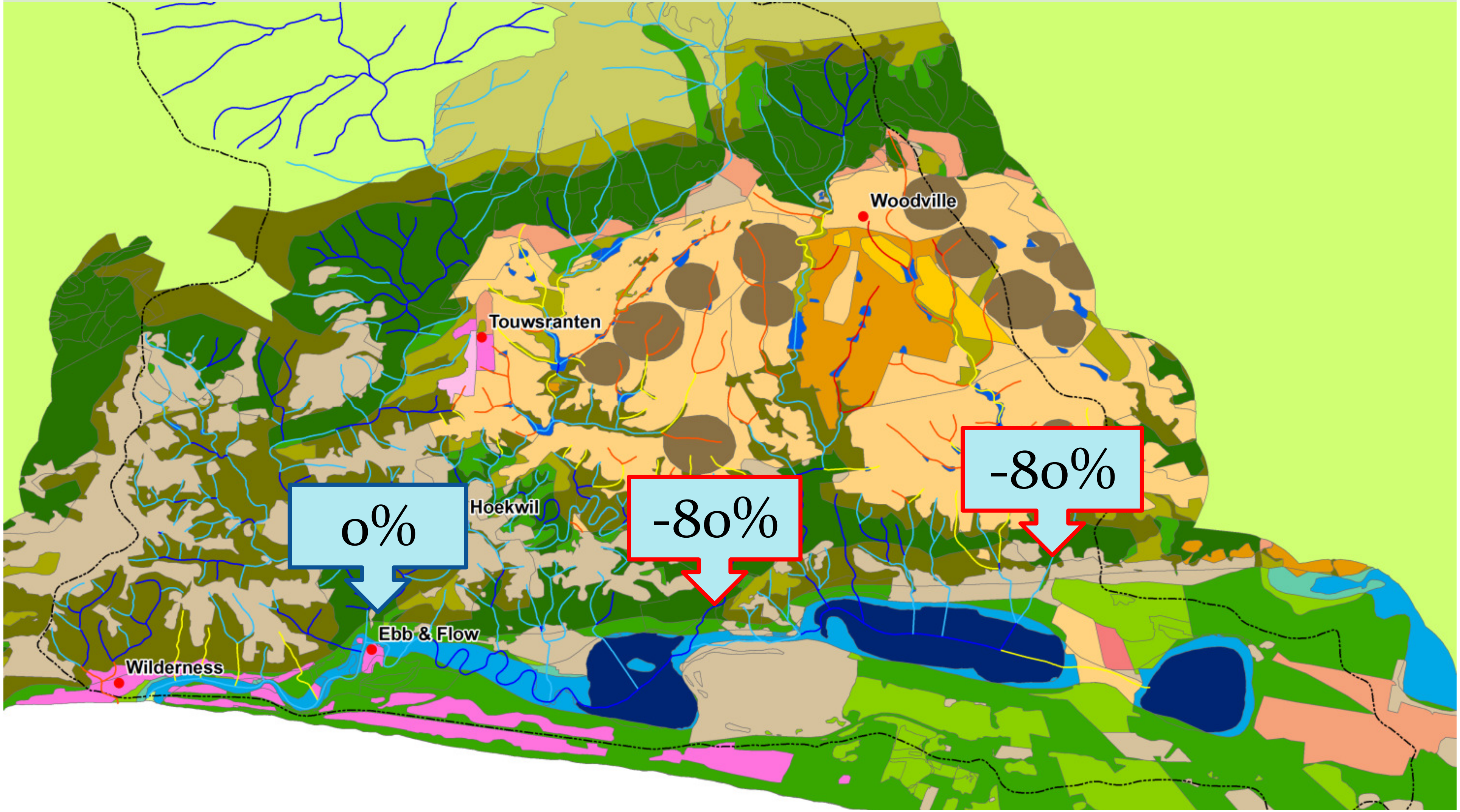




Water quality index



Importance of changed river flows



What we found

- Land-management practices have changed **flows** and **quality**
  - Worst affected river reaches are in farmed areas
  - Some evidence of reduction in inputs
  - Lakes are indicating potential problems
  - Farm dams are trapping pollutants
- Other impacts on lake system:
  - Changes in inflows - reduced ±80%
  - Substantial changes in lake flushing

Tailor your message carefully

What we found

- Land-management practices have changed flows and quality
  - Worst af[illegible]river reaches are in farmed areas
  - Some evid[illegible]nprovement
  - Lakes are indi[illegible]tential problems
  - Farm dams are tra[illegible]llutants
- Other impacts on lake[illegible]
  - Changes in flows - Duiwe/[illegible]spruit reduced ±80%
  - Substantial changes in lake flu[illegible]ing
- Be very aware of HOW you communicate
  - Understand your participants – make connections
  - Avoid scape-goats in the diagnosis
  - Include options for mitigation

In summary

- Characterise the issue
- Develop a conceptual understanding of the system
  - Causes, sources and consequences
- Identify mitigation options
- Design sampling and modelling
- Collate and synthesise your findings & options
- Understand your participants & connect (dialogue)
- In sharing your understanding the how is at least as important as the what


Thank you for listening
And to all my colleagues who contributed
to developing these insights

Afterthought

- Acceptance of scientific facts is not based solely on comprehension levels. It can be compromised whenever information confronts people's personal, religious, or political views, and whenever scientific facts provoke fear or make people feel that they have no control over a situation. The only recourse is to have genuine, respectful dialogues with people – Leshner 2015