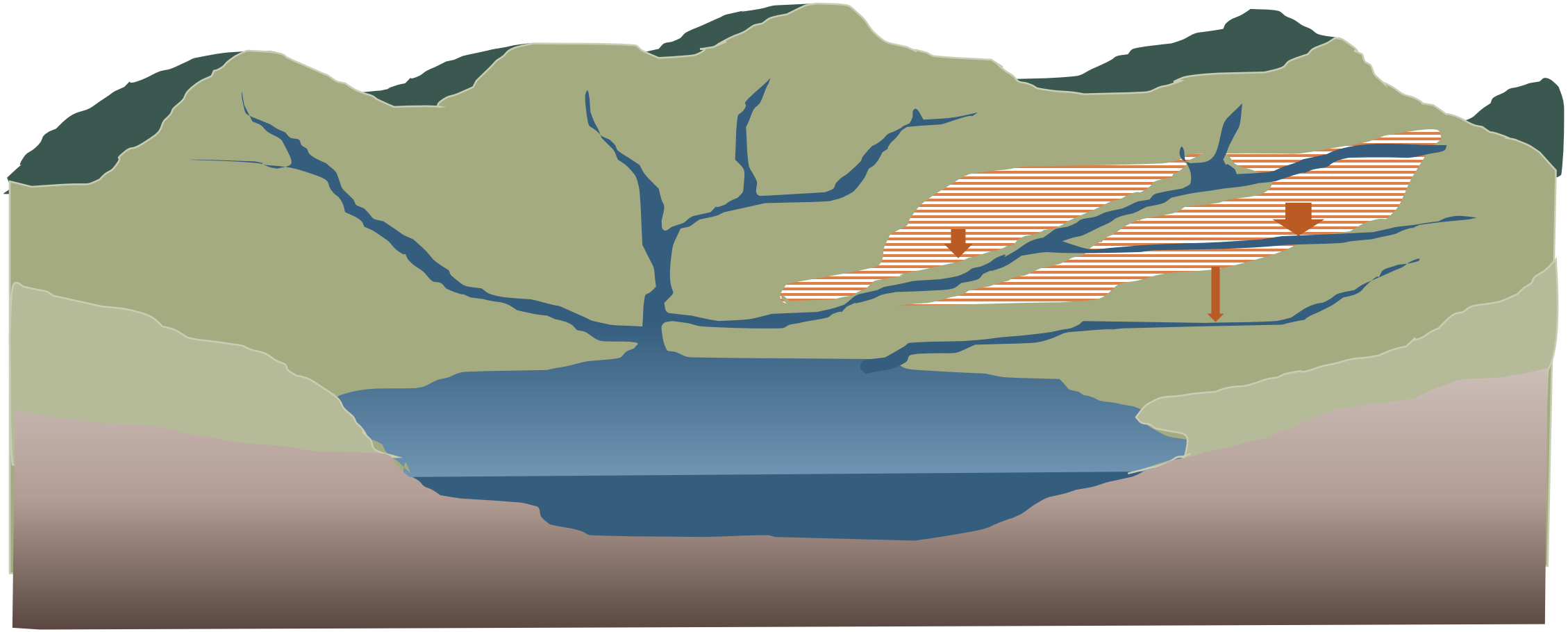
Erosion control & sediment retention



Jane Turpie University of Cape Town & Anchor Environmental Consultants

Service & Benefits

1. Limiting the area of degraded/transformed landscape that generates excess sediment

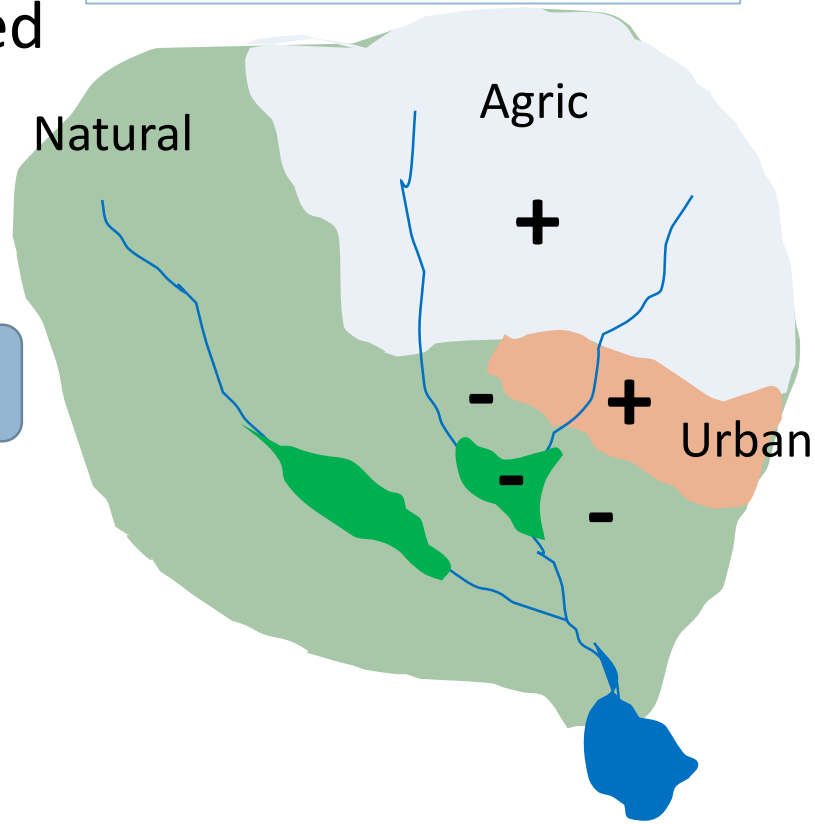
the passive service

1/disservice of degradation

2. Trapping some of the loads generated

the active service

+ = generates excess sediments
- = captures excess sediments



Downstream ecosystem/ reservoir/HEP station/canal/harbour

1. Reduced impacts on infrastructure

final service

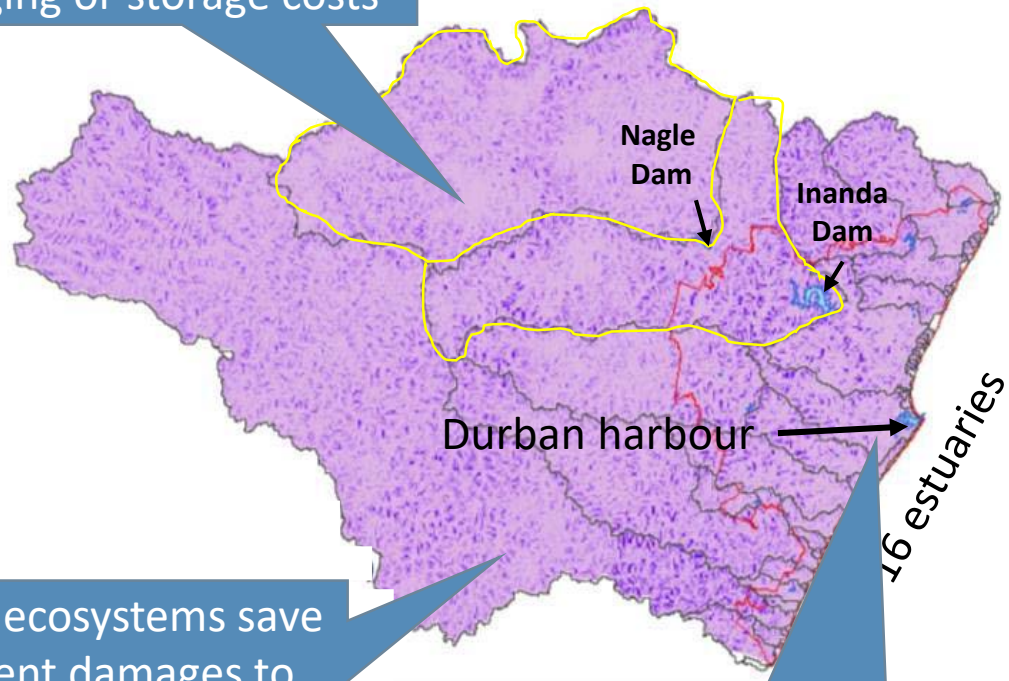
2. Reduced impacts on other downstream aquatic ecosystem services

intermediate service

Durban case study (eThekwini Municipality)

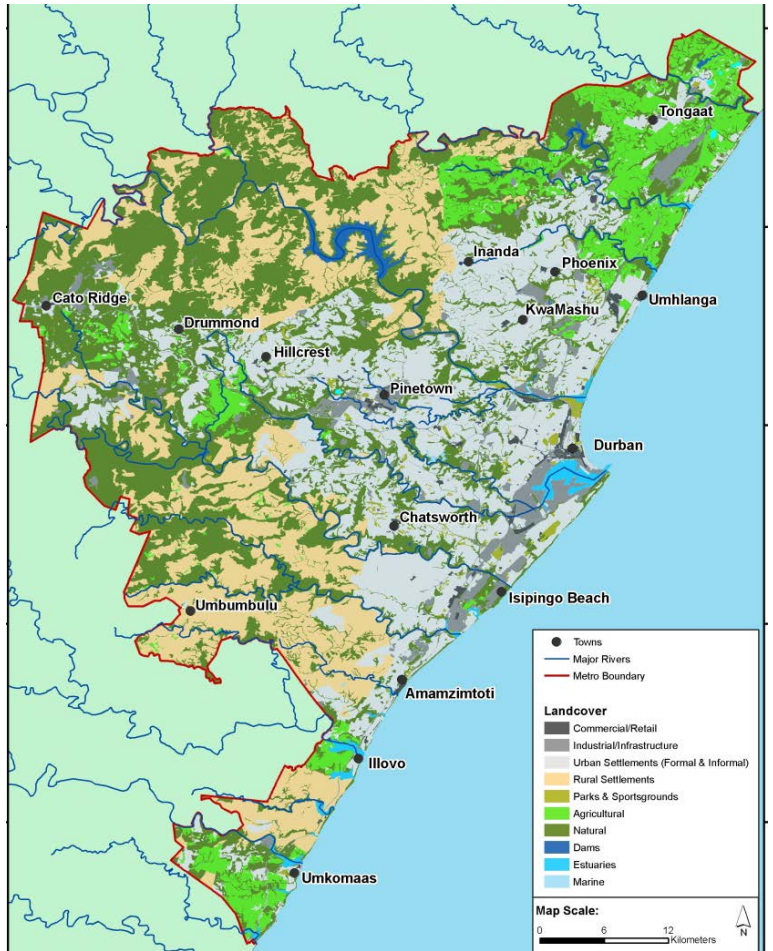
- Included active (sediment trapping) and passive (no LULC change) aspects;
- Included final (avoided dredge/storage costs) and intermediate (estuary ES) values

These ecosystems save on dredging or storage costs



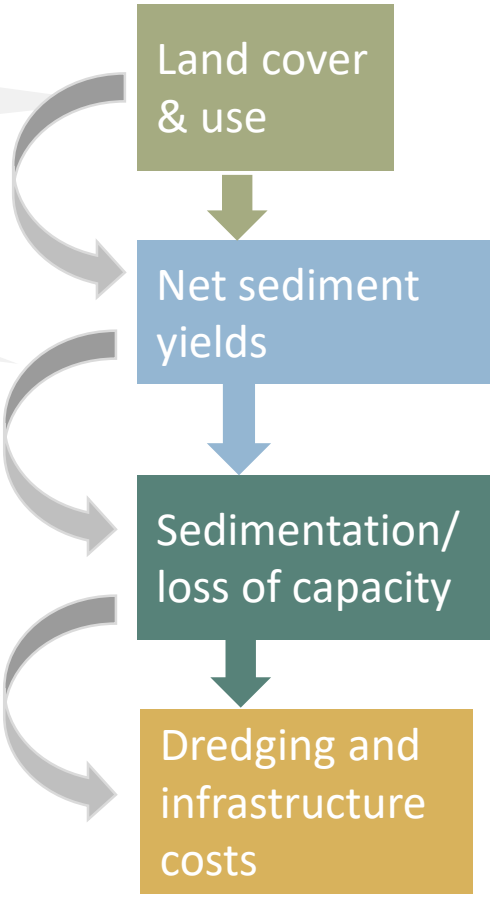
These ecosystems save prevent damages to downstream rivers and estuaries

These ecosystems save on harbour dredging costs

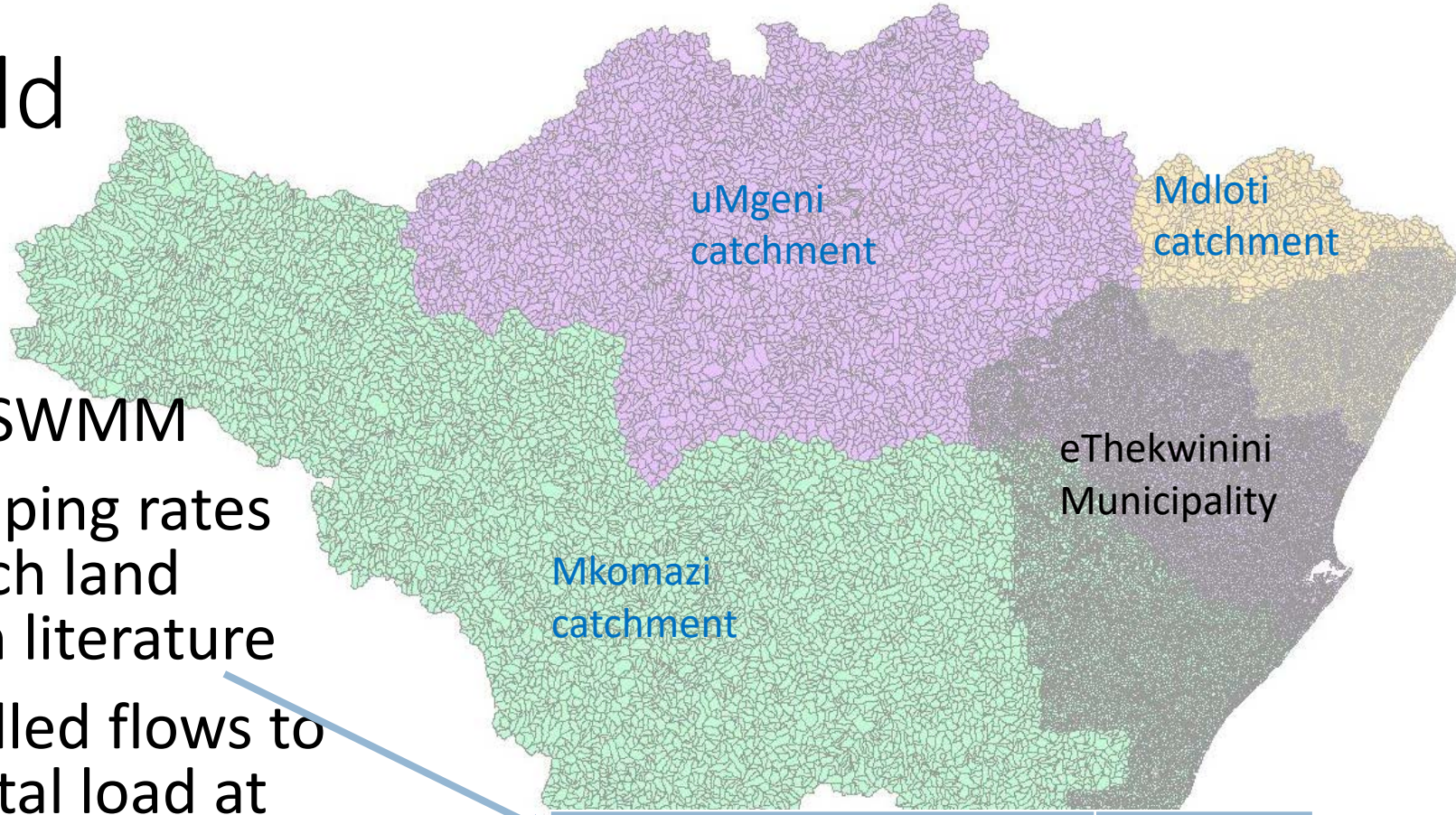


3-stage valuation process

- Model sediment yield
  - Difference in sediment load at each point of interest with and without service (tonnes/year)
- Estimate loss of reservoir capacity
  - with vs without service (m^3/year)
- Valuation (avoided costs approach)
  - Value avoided sedimentation at points of interest ($/year):
    - reservoir storage replacement costs
    - avoided harbour dredging costs
  - Map value to source areas ($/ha/year)
    - Based on physical model coefficients



Sediment yield



- Modelled using PC-SWMM
- Production and trapping rates of sediments for each land cover type based on literature
- Coupled with modelled flows to estimate TSS and total load at relevant points.
  - TSS adjusted by a factor of 1.25 to include bed load (Msadala *et al*. 2010, Rooseboom 1992)
- Calibrated with TSS data from >40 monitoring stations.

Event mean concs for 0.5y RP	TSS (mg/l)
Settlement - urban	100
Commercial / Retail / Institutional	166
Industrial / Road & Rail	166
Extractive / Utility	166
Farming / plantations & woodlots	201
Recreational open space	201
Settlement - rural	201
Natural vegetation (D'MOSS)	70
Settlement - informal	497

Defining the baseline (without service)

- Two scenarios were set up in the hydrological model:

1: removal of trapping capacity of natural habitats

quantifies the active service

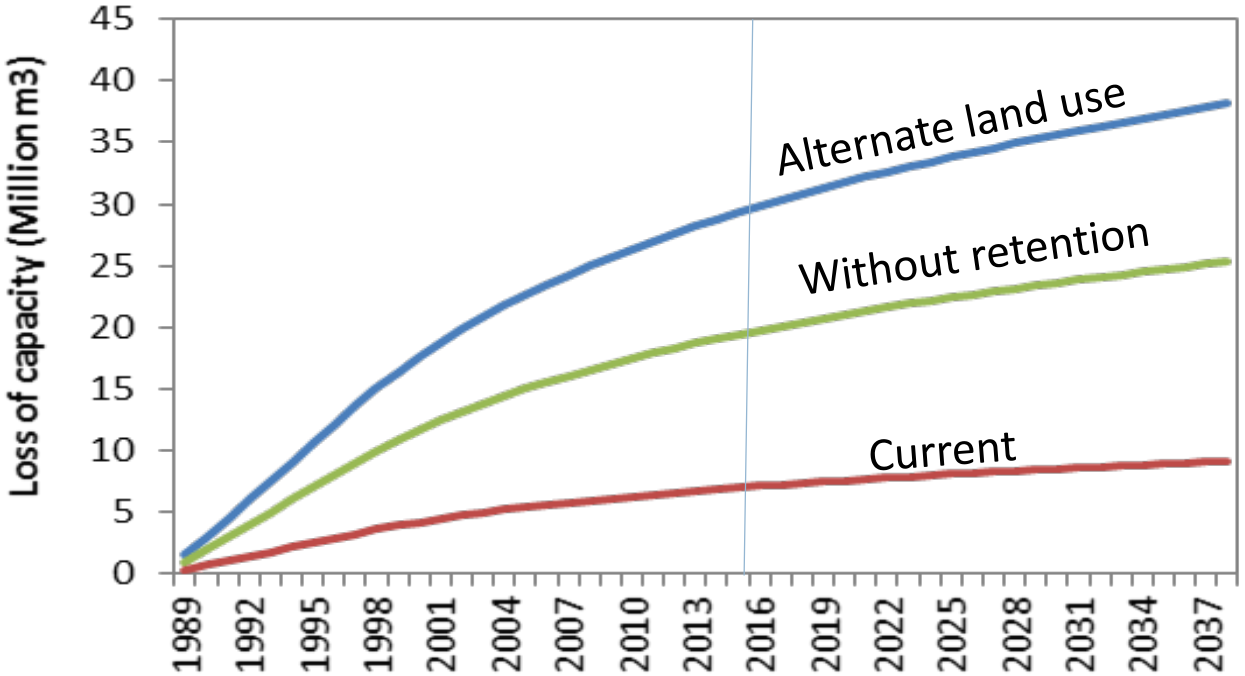
2: replacing natural habitats with dense rural settlement as a likely alternative land use

quantifies the active + passive services

- These provided lower and upper bound estimates of the magnitude of the service, depending on what is considered as the service

Impact on reservoir capacity

- Current rate of sedimentation estimated using average sediment yields, starting reservoir capacity and measured current (2015) capacity,
  - using Rooseboom (1975) model
- % change in rate of sedimentation under each scenario was taken from the PC-SWMM model.
- Calculated difference in loss of capacity over time based on the capital replacement costs of the dams (NPV)



	Avoided storage replacement cost NPV 20y from 2015, 6% (R millions)	
REs	Vs no retention	Vs transformed land use
Inanda	9.09	16.31
Hazelmere	3.01	16.33
Nungwane	0.15	0.38
TOTAL	12.25	33.02

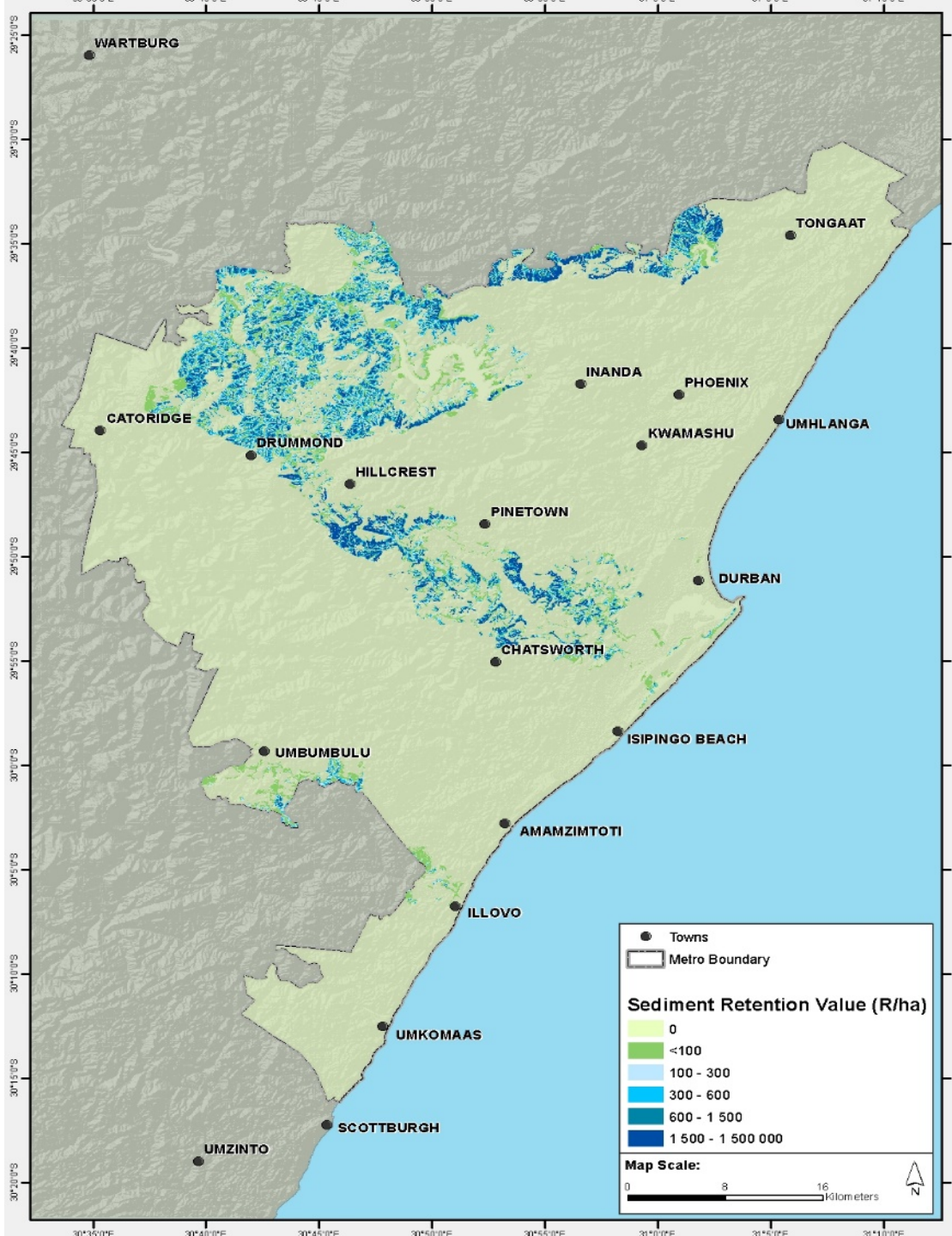
Impact on harbour

- % change in rate of sedimentation under each scenario taken from the PC-SWMM model
- Cost per m^3 was estimated using dredging data provided by Transnet

Durban Harbour	Average dredging cost (R/m^3)	Change in annual TSS load (m^3)	% change in annual TSS load	Annual dredging costs avoided (R millions)	NPV
Lower bound	229	4 511	195%	1.033	11.85
Upper bound	229	5 029	206%	1.152	13.21

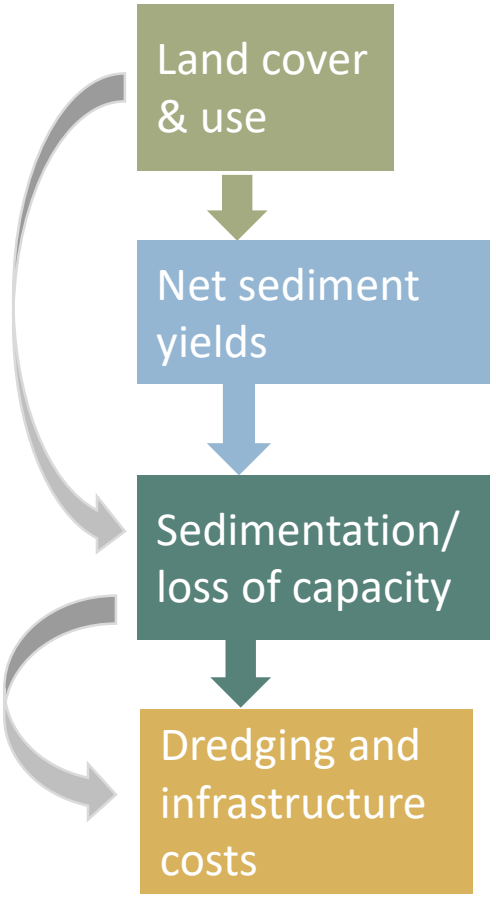
Mapping value

- Values were mapped back to the catchment areas based on the physical model of sediment retention
- Large range of uncertainty, mainly from physical modelling and service (baseline) definition



Discussion

- Models need better calibration with empirical estimates.
  - Now embarking on this in SA for physical aspect
- Two stage valuation probably best, since expenditures will be sporadic
  - empirical analysis of expenditure in relation to land cover would be difficult
- Rethink attribution of values to ecosystems
  - Rather attribute negative value to sources of erosion than positive value to natural land cover. Then:
    - Only the active service is mapped to the natural ecosystems
    - Externalities of production areas are internalised



- Thank you!