Identifying and testing adaptive management options to increase catchment resilience using a Bayesian Network

Kerr Adams[1,2], Christopher (Kit) A. J. Macleod[2], Marc J. Metzger[1], Nicola Melville[3], Rachel Helliwell[2], Jim Pritchard[3], Katie Edwards[4], and Miriam Glendell[2]

[1]University of Edinburgh, Scotland

[2]The James Hutton Institute, Scotland

[3]Scottish Environment Protection Agency, Scotland

[4]Scottish Water, Scotland

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Scottish Water
Trusted to serve Scotland

- Collaborate to better understand socio-ecological systems
- Future-focussed approach to decision making
- Identify sustainable and resilient outcomes.
- Use a capitals approach to consider wider value

Need to engage with layers of complexity and uncertainty:

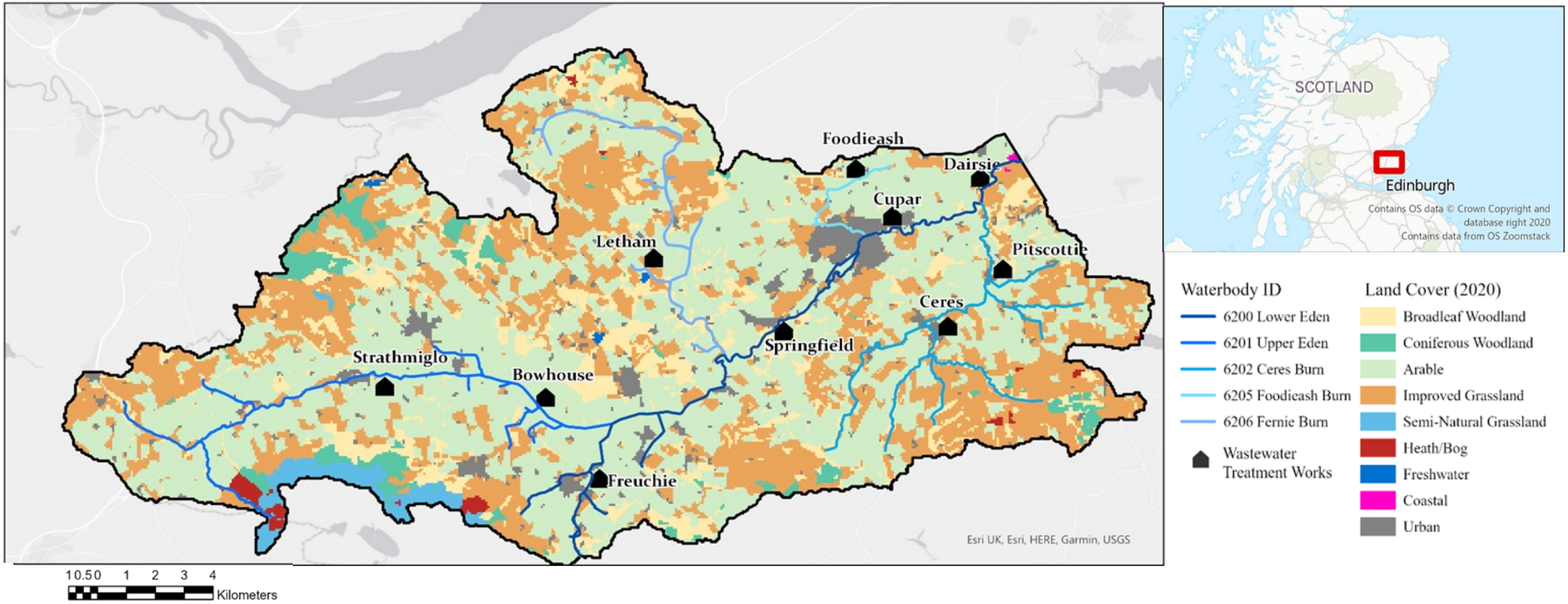
- Understand socio-ecological systems
- Measure cumulative impacts of future change
- Inform innovative & collaborative decisions

Research Question

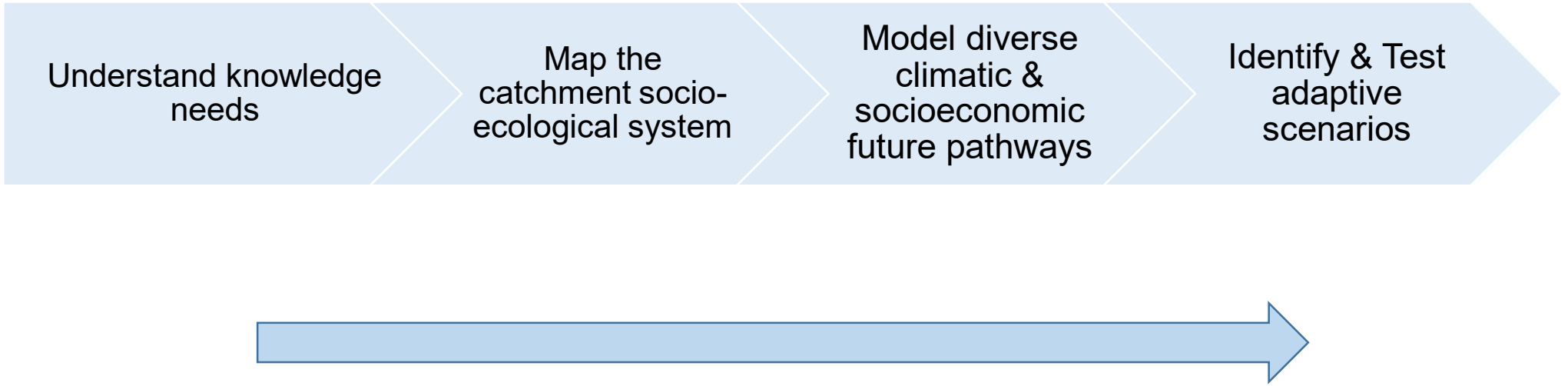
Can a Bayesian Network (BN) model support stakeholders in the **identification and testing of adaptive management options** that increase catchment system **resilience to the impacts of cumulative future change**?

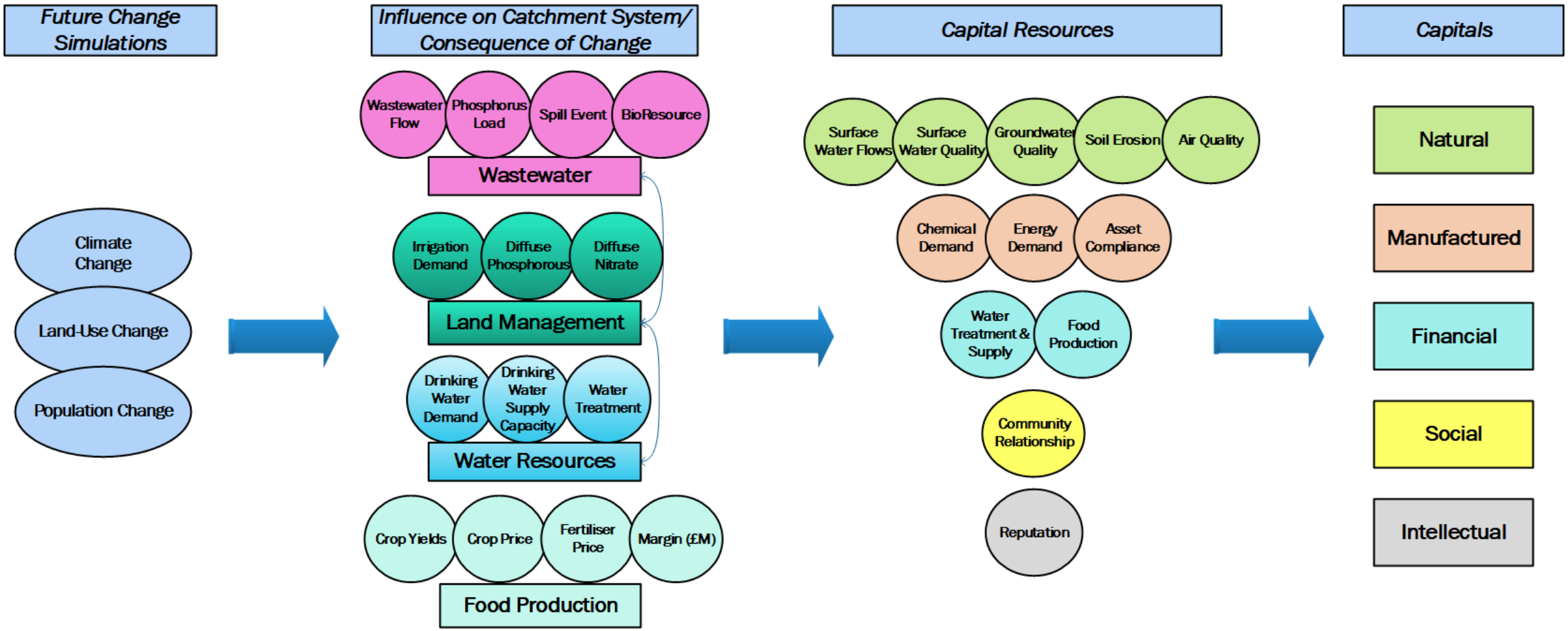
Applying continuous variables within the hybrid equation-based BN model structure.

The Eden Catchment



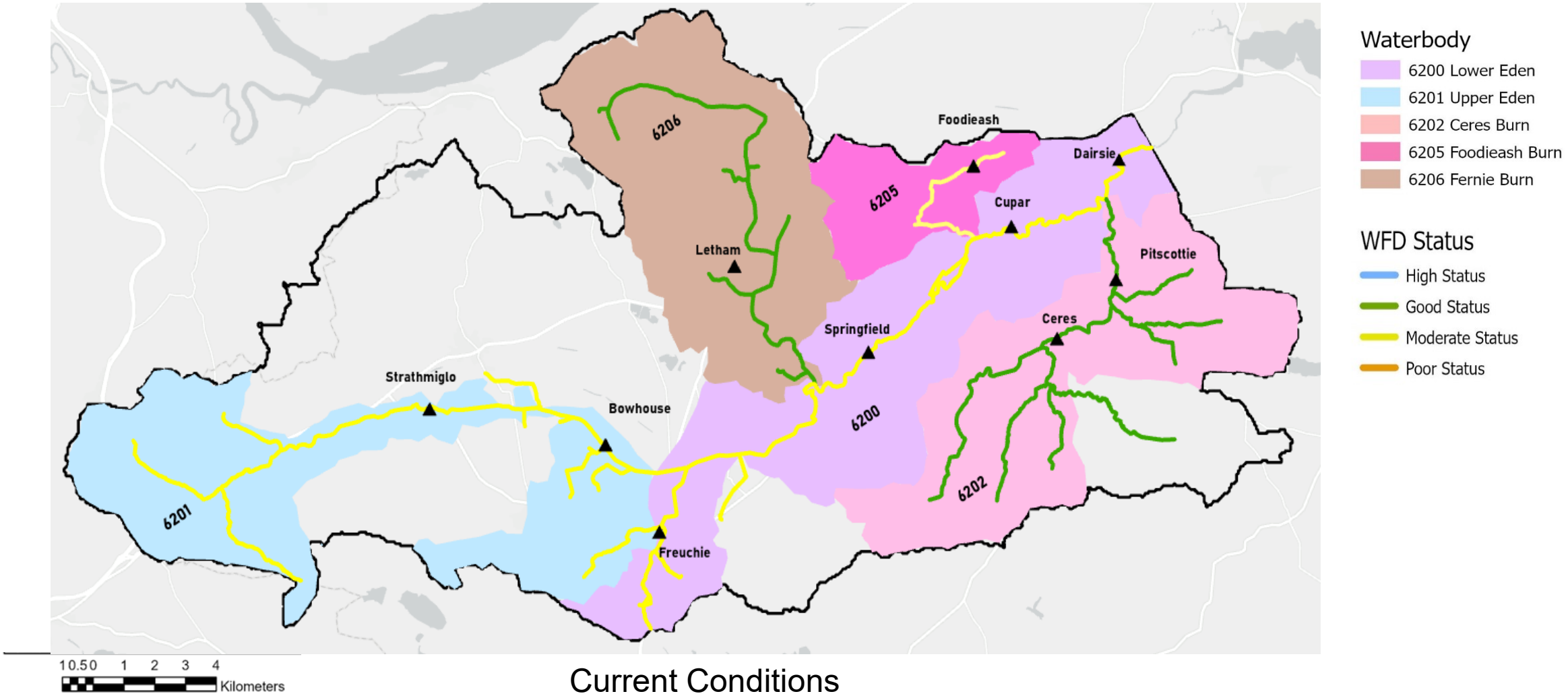
What **combination of management actions** across all sectors enables **good status to be achieved** whilst optimising **resource efficiency**, in the Eden catchment, **now and in the future?**


Understand knowledge needs
Map the catchment socio-ecological system
Model diverse climatic & socioeconomic future pathways
Identify & Test adaptive scenarios
Participatory methods


Future Change Simulations
Climate Change
Land-Use Change
Population Change
Influence on Catchment System/ Consequence of Change
Wastewater Flow
Phosphorus Load
Spill Event
BioResource
Wastewater
Irrigation Demand
Diffuse Phosphorous
Diffuse Nitrate
Land Management
Drinking Water Demand
Drinking Water Supply Capacity
Water Treatment
Water Resources
Crop Yields
Crop Price
Fertiliser Price
Margin (£M)
Food Production
Capital Resources
Surface Water Flows
Surface Water Quality
Groundwater Quality
Soil Erosion
Air Quality
Chemical Demand
Energy Demand
Asset Compliance
Water Treatment & Supply
Food Production
Community Relationship
Reputation
Capitals
Natural
Manufactured
Financial
Social
Intellectual

Resilience Outputs

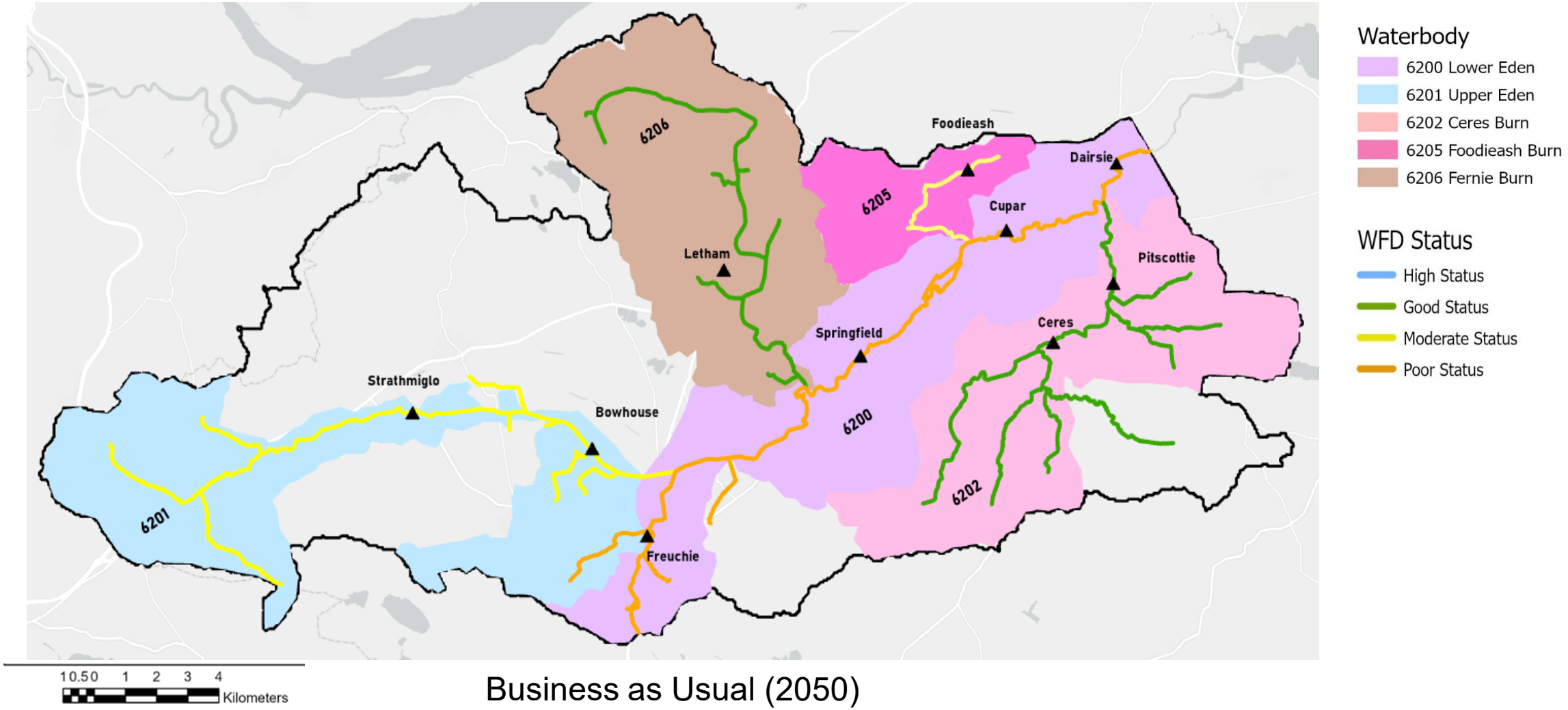
Surface Water Quality – Reactive Phosphorus concentrations (µg/l)



Current Conditions

Resilience Outputs

Surface Water Quality – Reactive Phosphorus concentrations (µg/l)



Business as Usual (2050)

Informing Collaborative Action

Scenario	Septic Tank Filters	Water Efficiency Campaign	Ferric Dosing	Nereda Treatment	Struvite Fertiliser	Wetland Treatment	40% Irrigation Reduction	Rural SUDS	Cover crops & Minimum tillage	Irrigation Lagoons
Standard	✓	✓	✓	✗	✗	✗	✓	✗	✗	✗
Nature Based Solutions	✓	✓	✗	✓	✗	✓	✗	✓	✓	✓
Best Available Technology	✓	✓	✗	✓	✗	✓	✓	✓	✗	✗
Resource Centre	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓

What **combination of management actions** across all sectors enables **good status to be achieved** whilst optimising **resource efficiency**, in the Eden catchment, **now and in the future?**

	Standard Scenario	Nature Based Solutions Scenario	Best Available Technology Scenario	Resource Centre Scenario
Good Status Achieved (Current)	✗	✓	✓	✓
Good Status Achieved (2050)	✗	✓	✓	✓

Conclusions

Bayesian Network model helped stakeholders engage with layers of complexity and uncertainty:

- Map socio-ecological systems
- Measure cumulative impacts of future change
- Test and inform identification of collaborative adaptive management options

Future research should investigate the application of a Dynamic Bayesian Network model to consider spatial and temporal scales for detailed assessment.