Towards an improved understanding and management of uncertainty in science investigations of environment policy options

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Land – water system
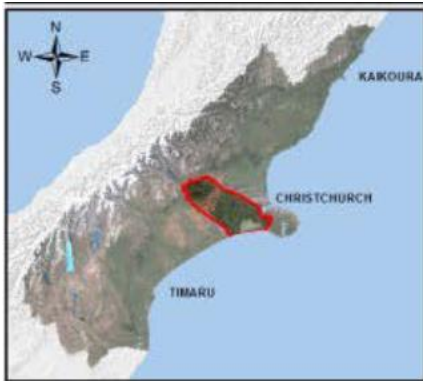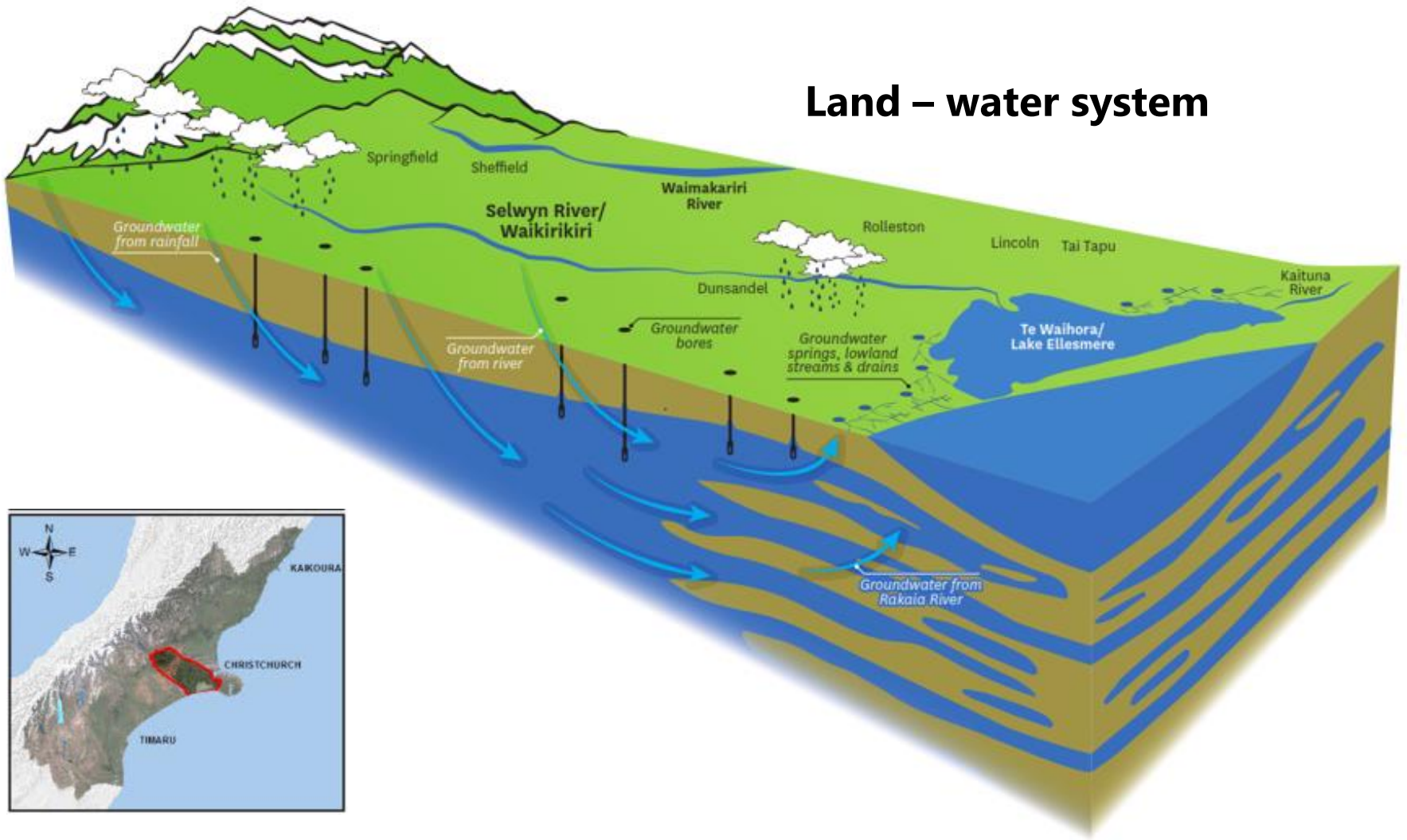
Community process to set nutrient limits
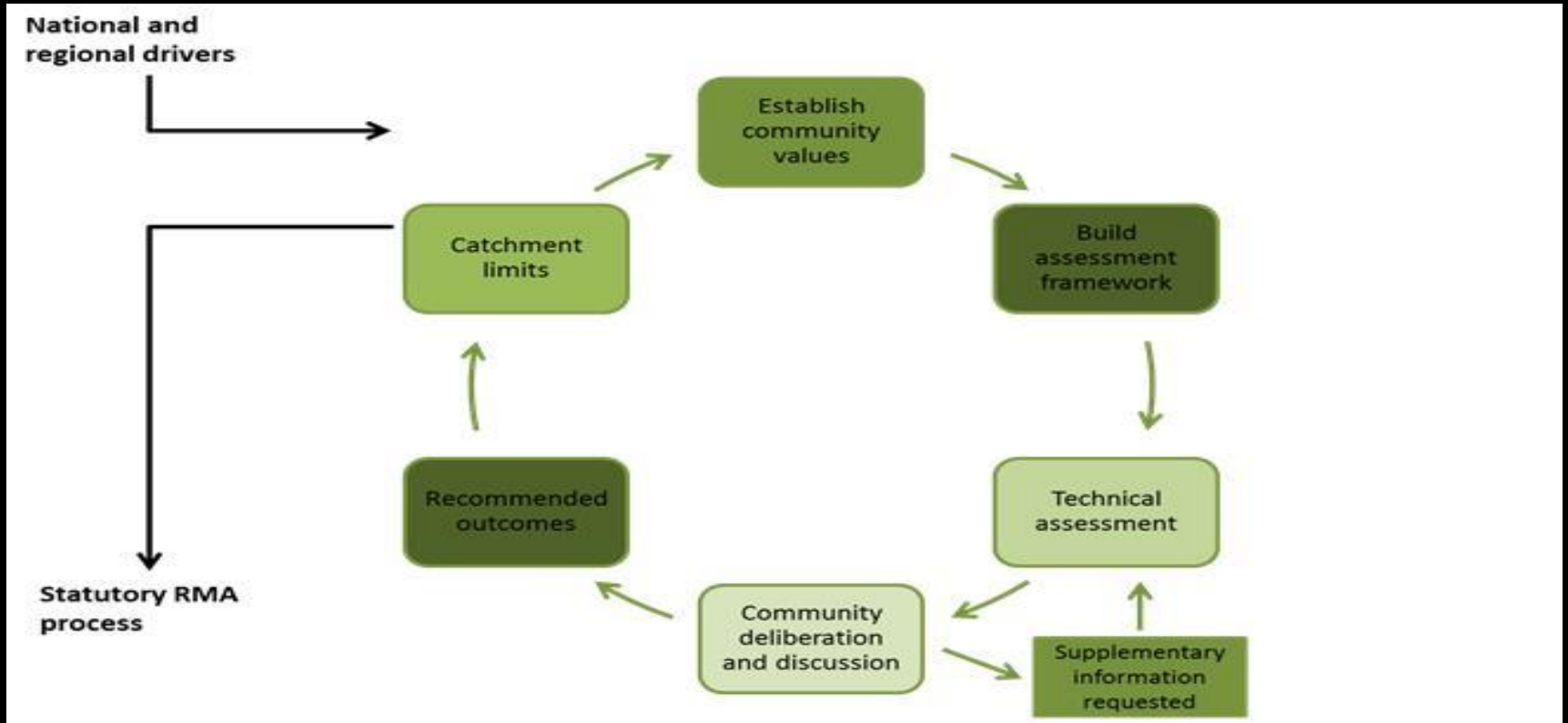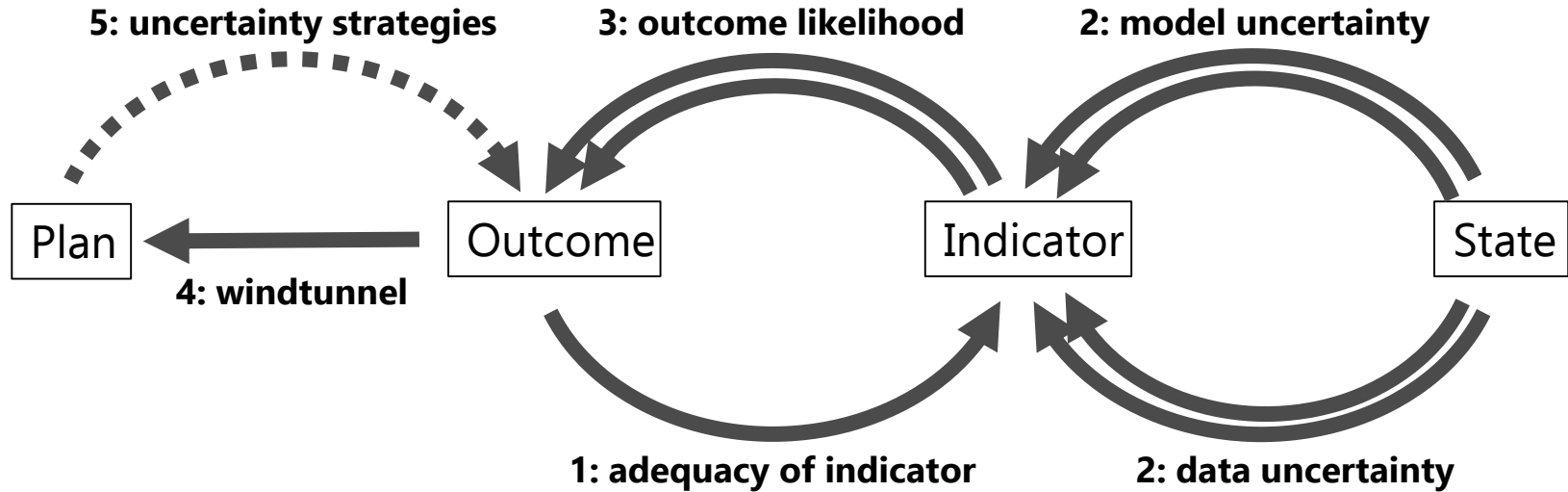
Design context

- Community decision-making
  - Compatible with the community defined decision making framework
  - Scope was broad and multi-faceted
  - Communication
- Participatory
- Transdisciplinary
  - Two ways of knowing (science and indigenous)
  - Multiple pre-existing models and assessment frameworks
  - Additional uncertainty (human, language)
- Time/resource constrained
  - Tight modelling/assessment timeframe
  - Single expert per discipline in the team

Design requirements

- Support the decision-making
- Practical
- Time limited (weeks)
- Broad consideration of multiple uncertainties

Five stages for understanding, communicating and managing uncertainty in a nutrient limit setting process

5: uncertainty strategies   **3: outcome likelihood**   **2: model uncertainty**

Plan ← Outcome   Indicator   State

4: windtunnel

1: adequacy of indicator   **2: data uncertainty**

Tools (boundary objects)

- Outcome likelihood matrices
- Influence diagram
- Indicator – Outcome Graphs (IOGs)
- SHELF expert elicitation

Outcome likelihood matrix

Priority outcomes	Current	Scenario 1	Scenario 2	Scenario 2 +	Scenario 3	Solutions Package
	Do the modelled outcomes for each scenario support the priority outcomes?					
Thriving communities and sustainable economies						
High quality and secure supplies of drinking water						
Wahi tapu and mahinga kai are respected, understood, protected and enhanced						
Healthy lowland streams						
Te Waihora is a healthy ecosystem						
Hill fed waterways support aquatic life and recreation						
Enhanced indigenous biodiversity across the Zone						

Outcome likelihood matrix

Priority outcomes	Current	Scenario 1	Scenario 2	Scenario 2 +	Scenario 3	Solutions Package
	Do the modelled outcomes for each scenario support the priority outcomes?					
Thriving communities and sustainable economies	About as likely as not	About as likely as not	Likely	Likely	Unlikely	Likely
High quality and secure supplies of drinking water	About as likely as not	Unlikely	Unlikely	About as likely as not	About as likely as not	Unlikely
Wahi tapu and mahinga kai are respected, understood, protected and enhanced	Very unlikely	Very unlikely	Very unlikely	About as likely as not	About as likely as not	About as likely as not
Healthy lowland streams	Unlikely	Very unlikely	Very unlikely	Unlikely	About as likely as not	Likely
Te Waihora is a healthy ecosystem	Unlikely	Unlikely	Unlikely	About as likely as not	Likely	Likely
Hill fed waterways support aquatic life and recreation	About as likely as not	About as likely as not	Likely	Likely	About as likely as not	Likely
Enhanced indigenous biodiversity across the Zone	Unlikely	Unlikely	Unlikely	About as likely as not	About as likely as not	Likely

Influence diagrams
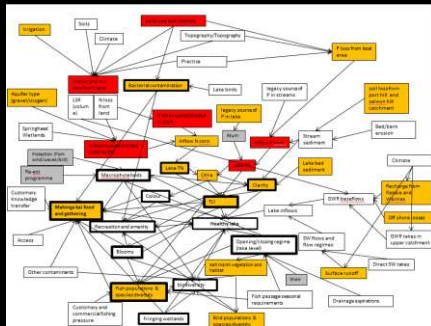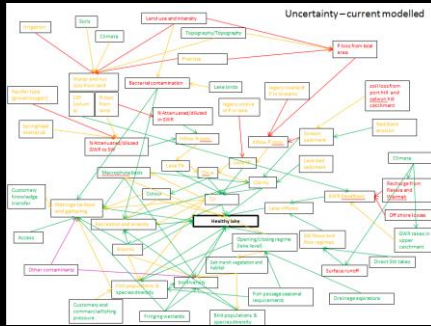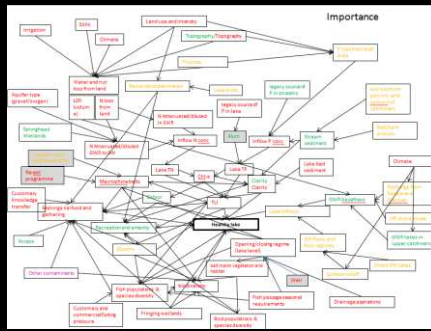
- Identify all the factors and causal relationships relevant to an outcome

- Integrates knowledge, builds common understanding

- Importance diagram

- Uncertainty diagram (data and model uncertainty)

- Priority = very important + very uncertain

- 3 x number of scenario + wind tunnel

- Useful in structuring the uncertainty analysis
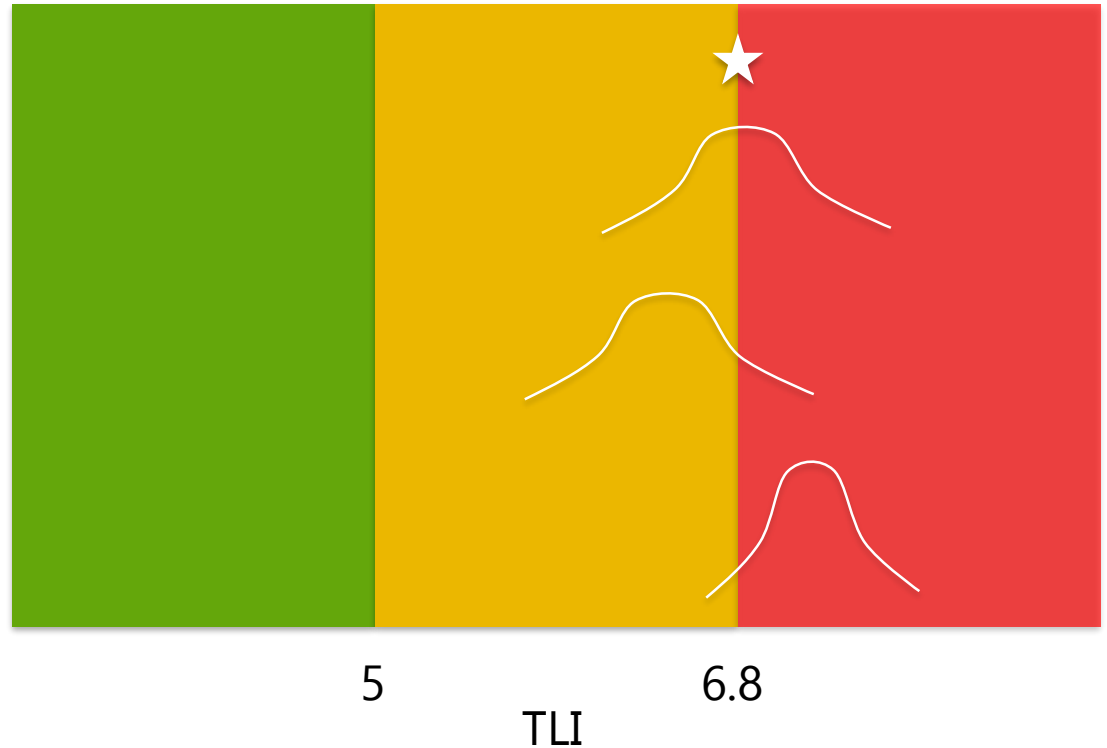
- Documentation

IOGs

Describe relationship between indicator and the desired outcome.

- Current state

- Current

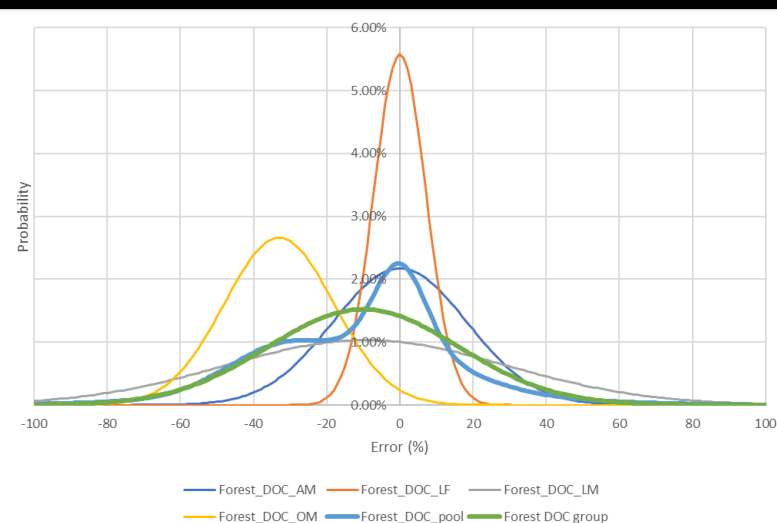- Solution Package
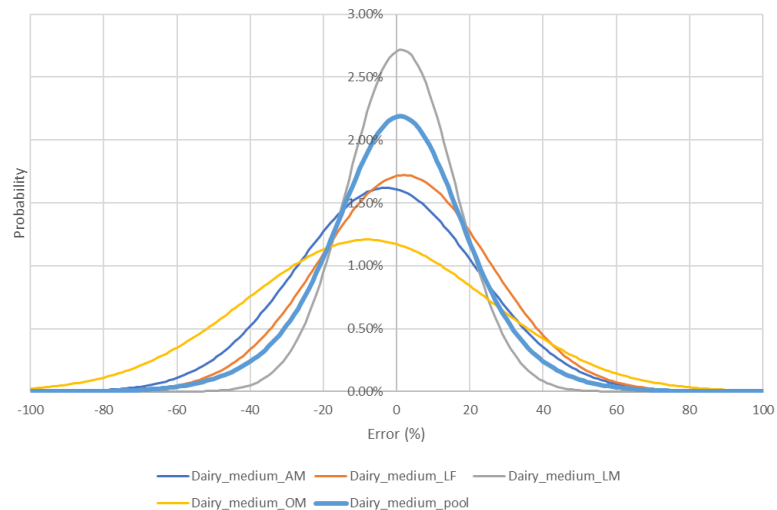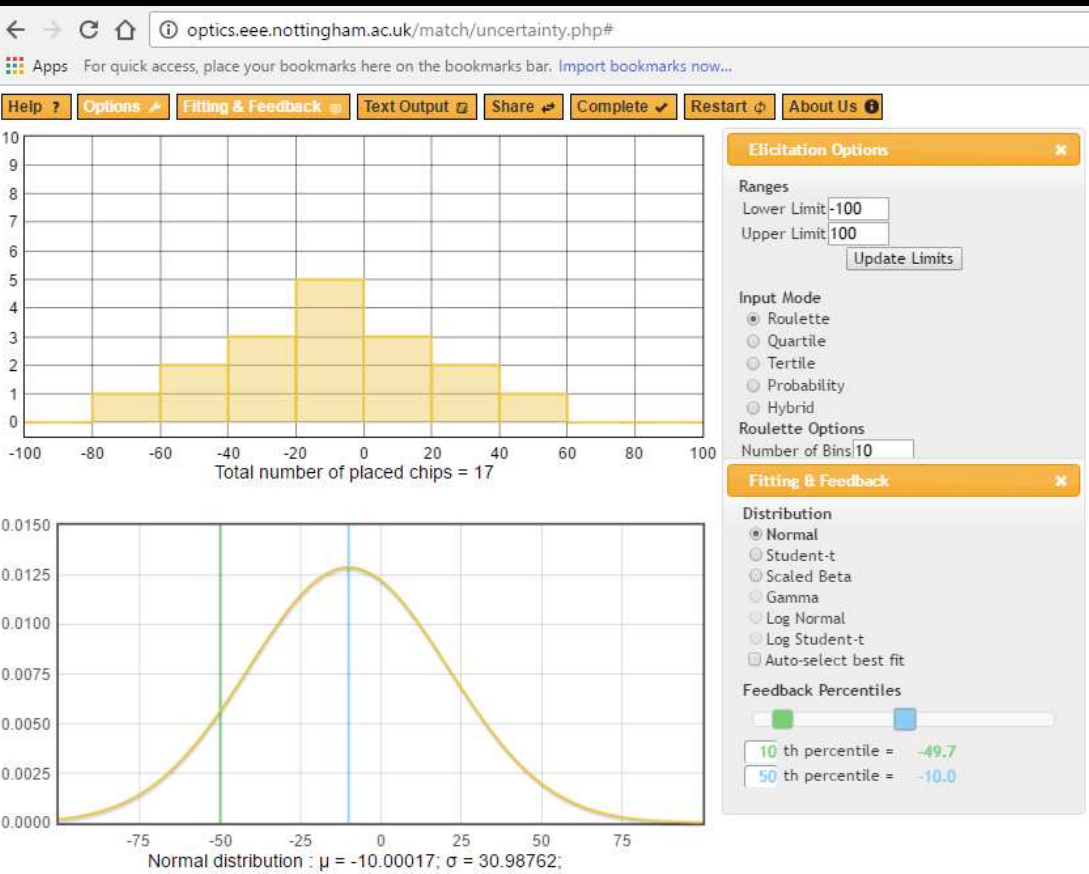
- Wind tunnel

Lake Trophic level index

TLI

5   6.8

IOGs

Risk of algal blooms

Surveillance	Alert	Action

Current Scenario

| 0 | 0.2 | 0.8 |

Solution Package

| 0 | 0.5 | 0.5 |

Wind tunnel

| 0 | 0.2 | 0.8 |

SHELF expert elicitation

Five stages for understanding, communicating and managing uncertainty in a nutrient limit setting process

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Outcome

Indicator

State

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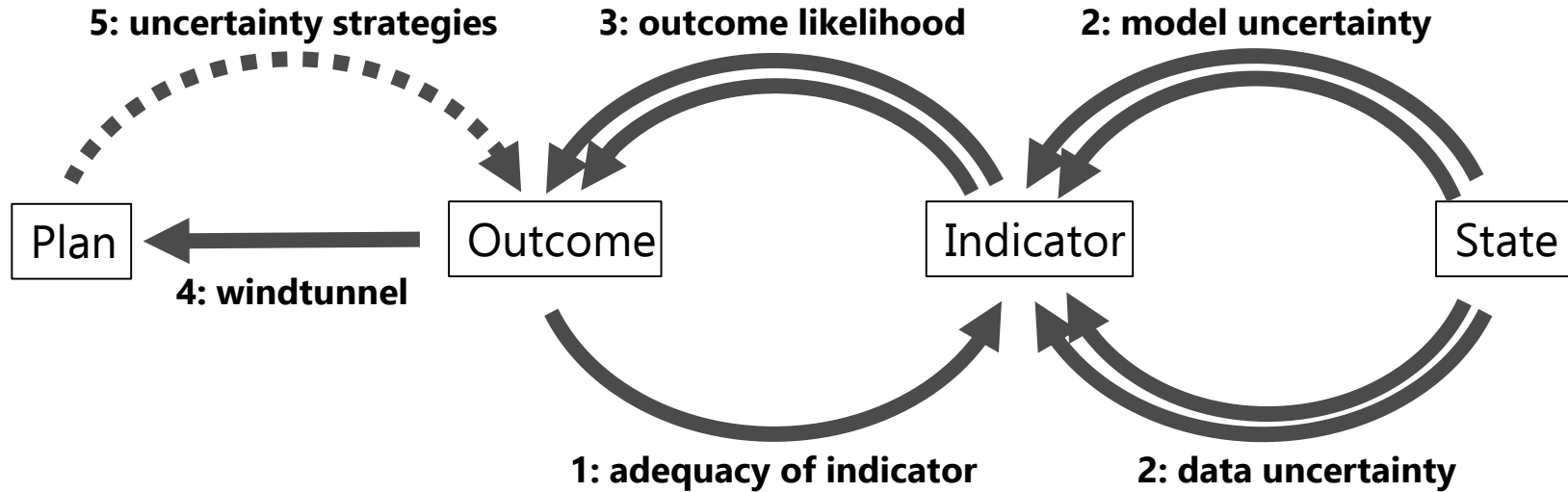
Conclusions

- ~150-200 hours of cumulative effort
- Qualitative approach (with some quantitative analysis where possible)
- Needs to be embedded throughout the technical support process
- Stronger focus on clearly articulated outcomes and robust indicators
- Better documentation of uncertainties by capturing expert knowledge
- Transparent
- Provides a forum for discussing how to manage the uncertainties

The process was practical, fitted the time/resource constraints, covered a wide range of sources of uncertainties, and it provided a rough estimate of uncertainty that could be readily explored in more depth as required