CECAN Webinar:

Developing Systems Approaches in the Water Sector

Tuesday 21st September 2021, 13:00 – 14:00 BST

Presenter: Brendan Bromwich, Principal Engineer, Asset Management and Investment Planning, Mott MacDonald

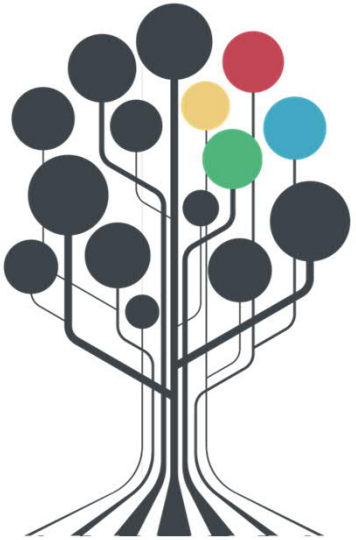
Welcome to our CECAN Webinar.

All participants are muted. Only the Presenters and CECAN Centre Manager can speak. The webinar will start at 13:00 BST.

Brendan will speak for around 45 minutes and will answer questions at the end.

Please submit your questions at any point during the webinar via the question box in the Zoom webinar control panel.

Today's webinar will be recorded and made available on the CECAN website.



E Mail: cecan@surrey.ac.uk

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Main messages

1. Understanding systems enables transformative rather than piecemeal interventions in the water sector

2. Mapping systems is often useful – if the approach is well targeted

3. Different organisations have different implicit assumptions about systems relating to handling uncertainty and risk.

4. These cultural preferences are significant in collaborating on systems and in designing system governance (organisational arrangements and policy).

Why think systems?

Failure of linear interventions – people want transformative results – not just projects

Resilience and adaptation – risk of failure rather than growth

Non-stationarity and complexity - known unknowns and unknown unknowns

More cost effective

Growing ambition – social outcomes of infrastructure

What does big data enable us to do?

Reaching out to other communities asking the same question from different vantage points

Policy change is driving systems thinking

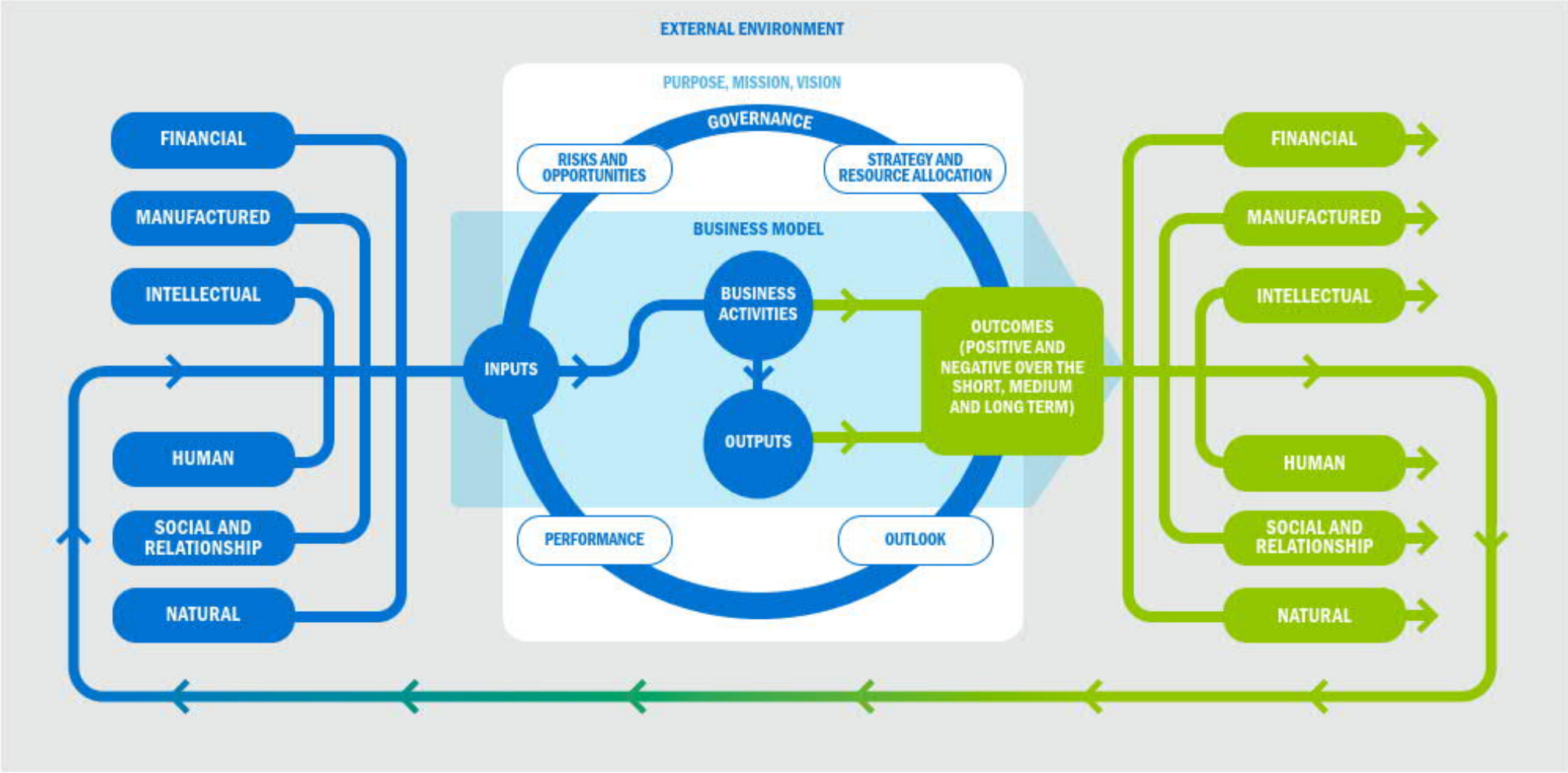
Defra: 25 Year Environmental Plan
The environment to be: *“mapped and managed more as a system”*

Defra: Enabling a Natural Capital Approach (ENCA)
Aims to: *“support systems-based thinking, identify new lines of inquiry linking previously disconnected spheres of operation or data, and support identification of priority areas of investment.”*

Ofwat: Resilience in the round
“deal with the causes of future threats, rather than just the symptoms, through adopting a stronger systems-based approach”

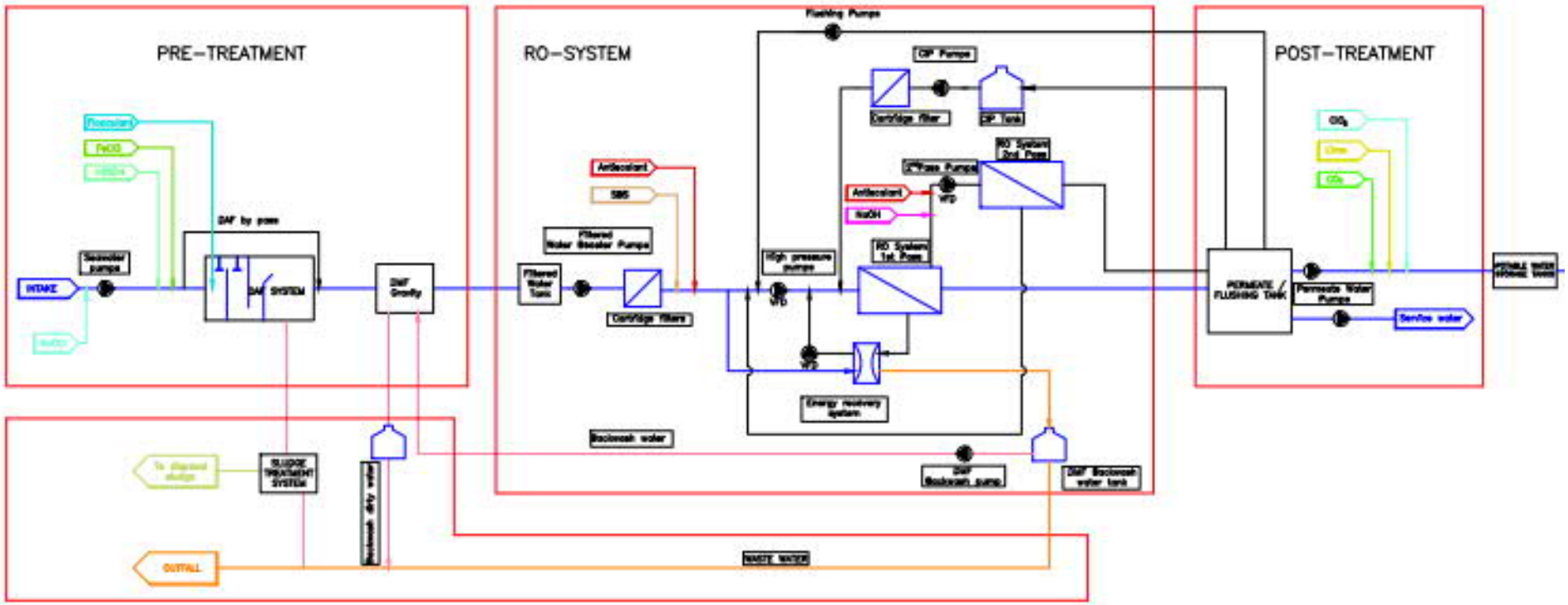
Multi-capital accounting, ENCA, Capitals coalition, 25 YEP, Digital, Project 13, TCFD…
Provide common languages, frameworks, platforms and metrics means of integrating systemic approaches.

Multi-capital accounting - IIRC



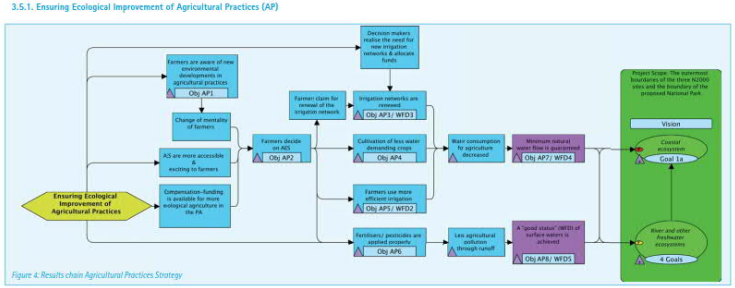
https://integratedreporting.org/

Process flow diagram – water treatment

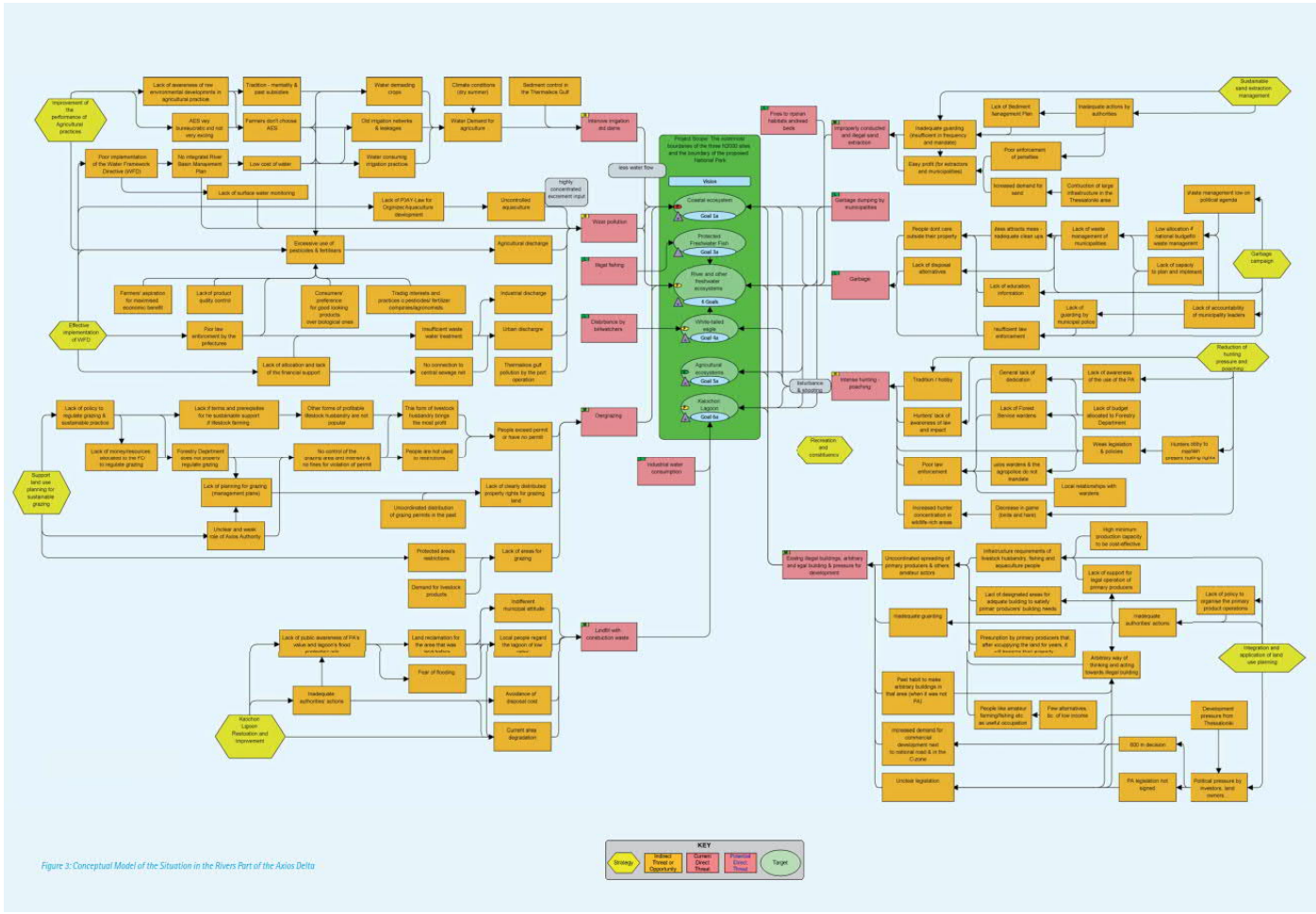


Axios Delta Strategic plan

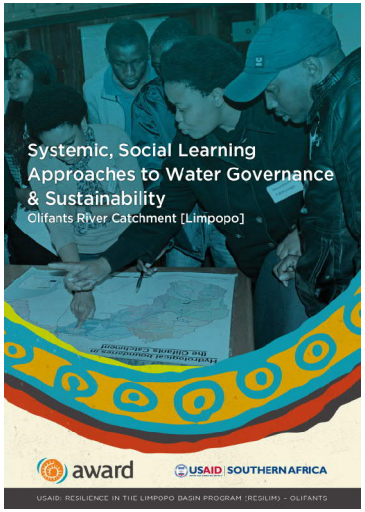
Conceptual model and results chain

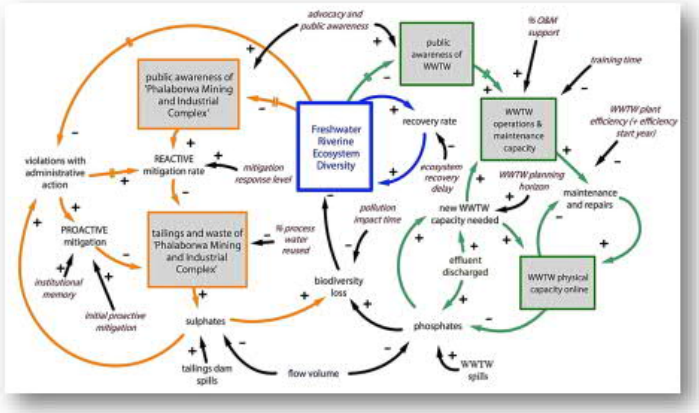


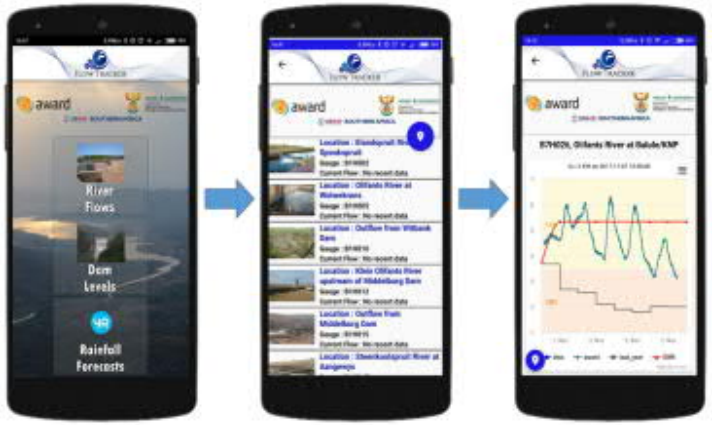
http://axiosdelta.gr/wp-content/uploads/2015/07/AxiosStrategicPlan.english-1.pdf

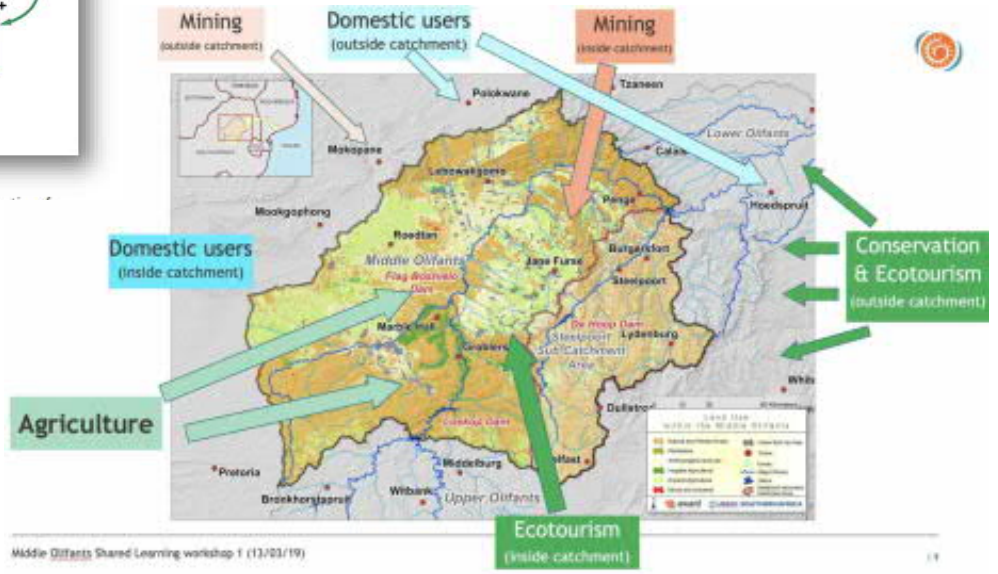


Olifants river catchment - Limpopo



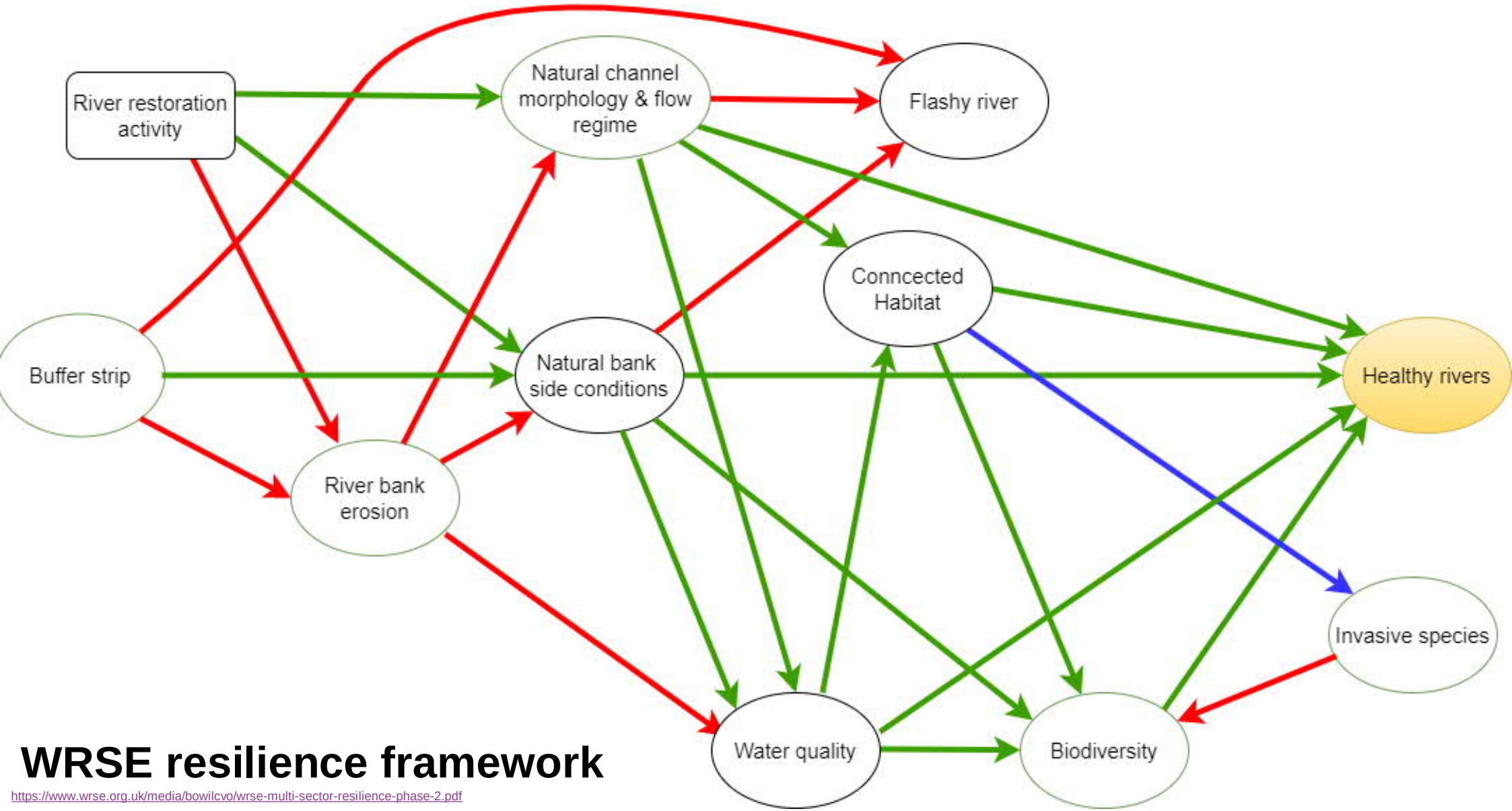






21 September 2021

http://award.org.za/wp/wp-content/uploads/2020/05/AWARD-BOOKLET-Systemic-Social-Learning-Approaches-to-Water-Governance-in-Olifants-Catchment-2020-v2.pdf



WRSE resilience framework

https://www.wrse.org.uk/media/bowilcvo/wrse-multi-sector-resilience-phase-2.pdf

Systems analysis for water resources

1

Participatory system mapping

2

Eden and **Medway** case studies

3

Proof of concept

4

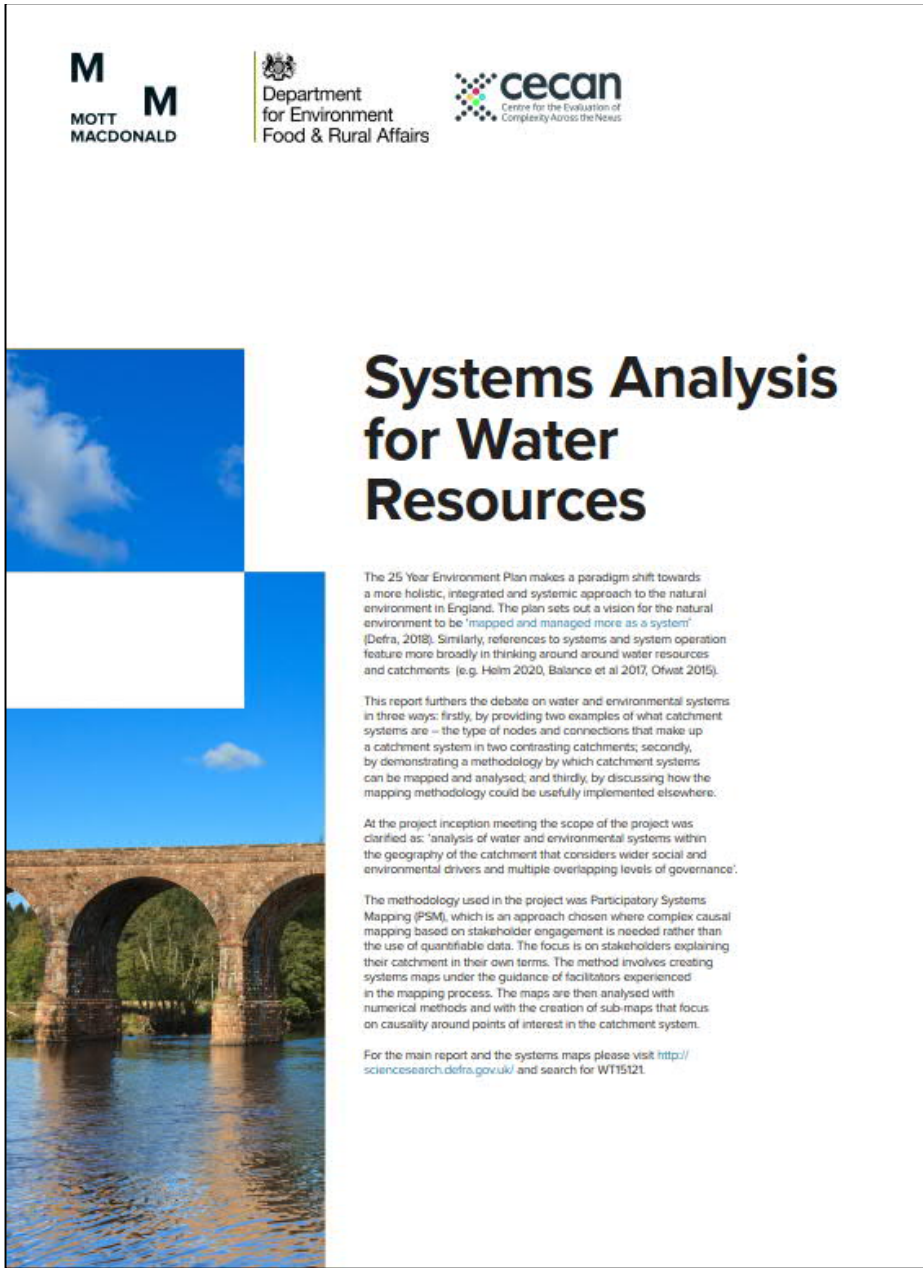
Identified **catchment system levers** and **outcomes**

5

Mapped hard and **soft systems**

6

A **replicable** method in modified form



http://randd.defra.gov.uk/ search for WT15121

PSM Process

Facilitators

Project host / combined group

Stakeholders

Progress on map

Wider constituency

Design & sensitisation

Initial design

Stakeholder engagement, sensitisation and consultation on design

Map production

Analysis

Workshop 1

Map production

Review and validate

Workshop 2

Map production

Produce submaps

Review and validate

Workshop 3

Map finalisation

Additional submaps

Review and validate

Liaison with stakeholder constituencies

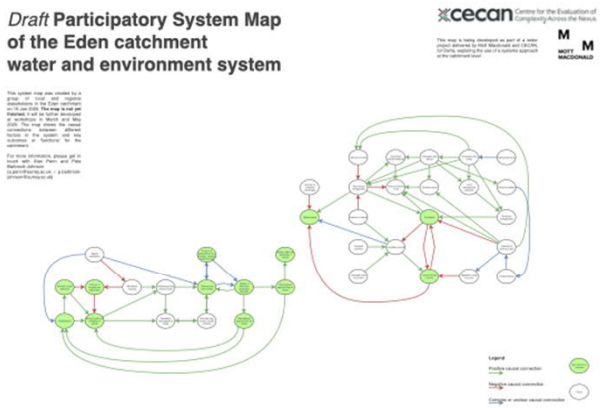
Dissemination

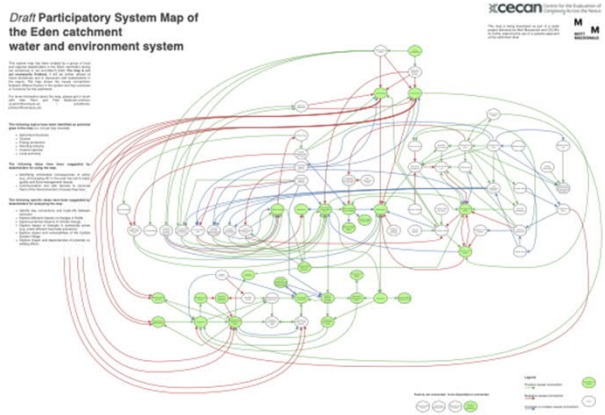
Dissemination of final maps and analysis

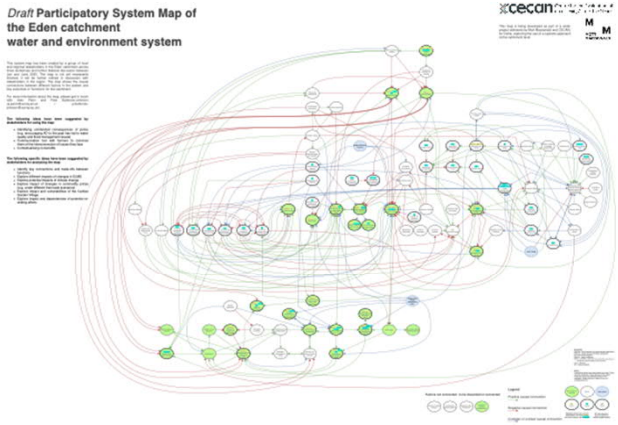
http://randd.defra.gov.uk/ search for WT15121

Mapping progress

Eden

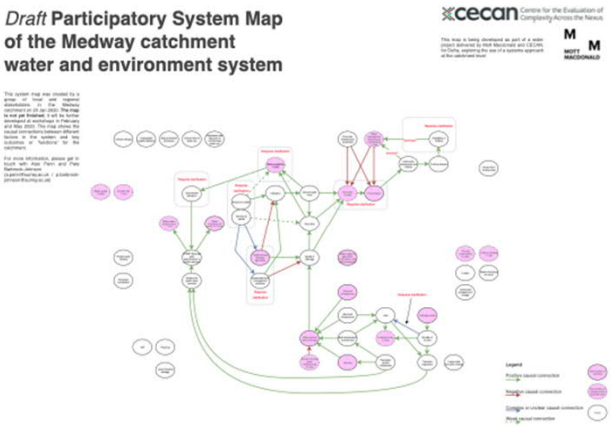


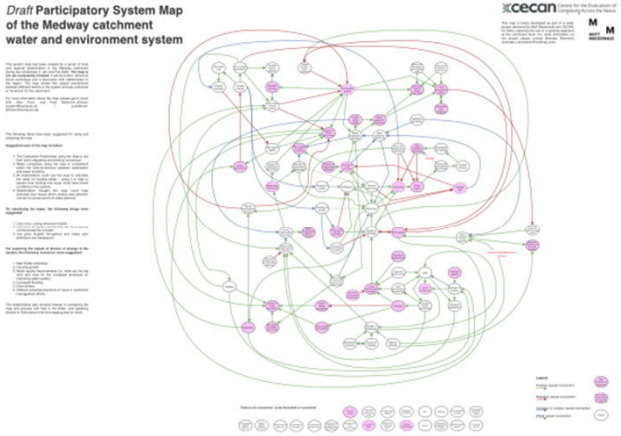


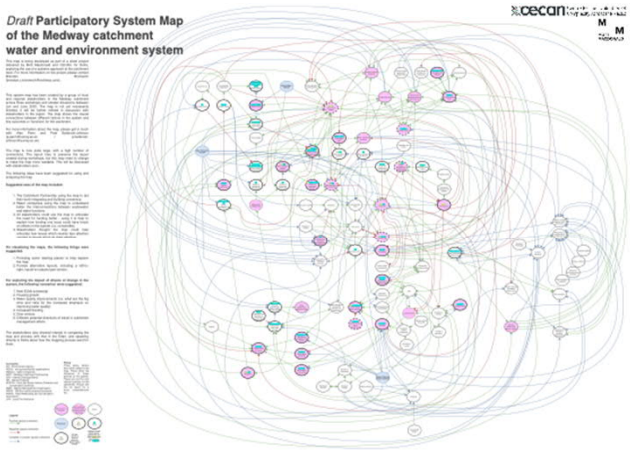


Workshop 1 | **Workshop 2** | **Workshop 3**

Medway







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http://randd.defra.gov.uk/ search for WT15121

What did the maps show?

Medway

- **Contrasting development pathways – transport and logistics or agriculture**
- Commonality or competition
- Agricultural intensification – will it harness other benefits that enable development synergies – such as flood control

Eden

- **What are the influences on farmer behaviour?**
- Tenancy and inheritance arrangements
- The significance of a trusted advisor

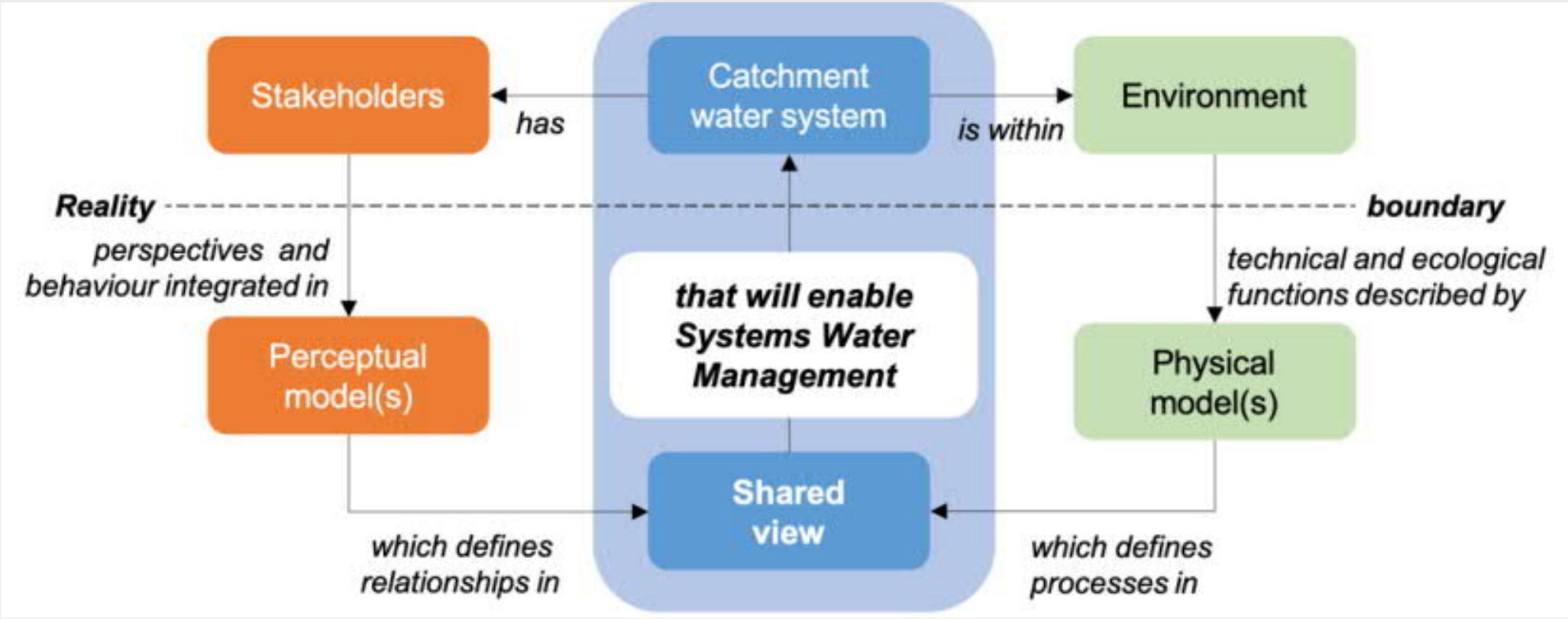
A difficult question arose…

When I talk about catchment systems with Highways England or Network Rail, I don’t feel I’m on a level playing field.

Participant – Eden workshops

Hard systems and soft systems

What information is admissible in system mapping? What is the role of “experts”?



Source: Systems water management for catchment scale processes – EA
https://www.gov.uk/government/publications/a-systems-based-approach-to-catchment-water-management

Understanding different system cultures

Hard and soft systems

Approach to systems	**Stakeholder perception / Community / egalitarian**	**Physical modelling/ Formal / bureaucratic**
Admissible data	Stakeholder perception	Engineering, science
Who validates information?	Stakeholders = “experts”	“Expert” or expert data
Example	PSM	Process flow diagram, ES Mapping
Implicit operator	Concerned parties	Formal arrangements authorities / experts
Implied control system	Collective action / collaborative effort	Infrastructure, rules-based, numerical risk assessment
Unknowns	Can accommodate uncertainty	Unknowns are calculated and assumptions defined
Example relevant to UK catchments	Catchment partnership	EA Asset performance team

Understanding different system cultures

A step towards deeper communication

Approach to systems	**Stakeholder perception / Community / egalitarian**	**Blended**	**Physical modelling/ Formal / bureaucratic**
Admissible data	Stakeholder perception	blended	Engineering, science
Who validates information?	Stakeholders = “experts”	Mixed	“Expert” or expert data
Example	PSM	PSM + ES Mapping	Process flow diagram
Implicit operator	Concerned parties	Combination	Formal arrangements authorities / experts
Implied control system	Collective action / collaborative effort	Combined approaches	Infrastructure, rules-based, numerical risk assessment
Unknowns	Can accommodate uncertainty	Mixed	Unknowns are calculated and assumptions defined
Example relevant to UK catchments	Catchment partnership	Flood partnership	EA Asset performance team

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KEY OBSERVATION

Organisational culture influences how you perceive and articulate a system

Flood partnership and catchment partnership

Contrasting organisational cultures and contributions to the management of catchment systems

Some of the benefits of the egalitarian convening organisation

- *It was positive that the host was a third sector organisation.* The personal qualities of the host were also mentioned like being a non-domineering person that manages to move the partnership along.
- There have been some successes on working together on small projects in the partnership. One … *potential area for partnership working was getting rid of invasive species – an issue that is non-political and everyone can agree that it's the right thing to do.*
- The partnership aims for collaborative working, meaning consensus building.

Some challenges of being egalitarian – and looking at the formal organisations (hierarchy/bureaucracy) to bring benefits of their approaches

- *Partners have ideas for what they would like to do but the mechanisms for making it happen are not there. This may be because the representatives on the partnership don't have the right level of seniority to make changes in their organisation.*
- Partnership plan isn't driving delivery. No action plan that states what the priorities are and who is delivering on them.

Looking across at the flood partnership and seeing some of the contrasting benefits that a more hierarchical/bureaucratic approach brings.

- *The strategic group in the flood partnership has a high level of personal commitment by senior representatives. Senior representatives at CEO's level, elected members and senior directors attend the strategic group.*
- *The flood partnership has a written published plan with clear responsibilities for who delivers what. Members have a specific role, are held accountable for delivering it and report back on activities in the strategic group.*

Comments that highlight the benefits of hybridity/complementarity

- *For organisations like the EA with a regulatory role, being in partnership with third sector organisations facilitated a different conversation with local communities and the public compared to what the EA could do by itself.*

Organisational culture is reflected in attitudes to hierarchy, collaboration, and handling unknowns: ie risk

Organisational culture influences what information is admissible in the representation of a system

Insights from theory

Embedded decision making

- People make choices that are informed by cultural perception, not just economic rationality
- Engineering problems tend to elements of larger problems or simplifications of complex problems – the articulation and definition of a simpler problem that can be solved.

Wicked and tame problems

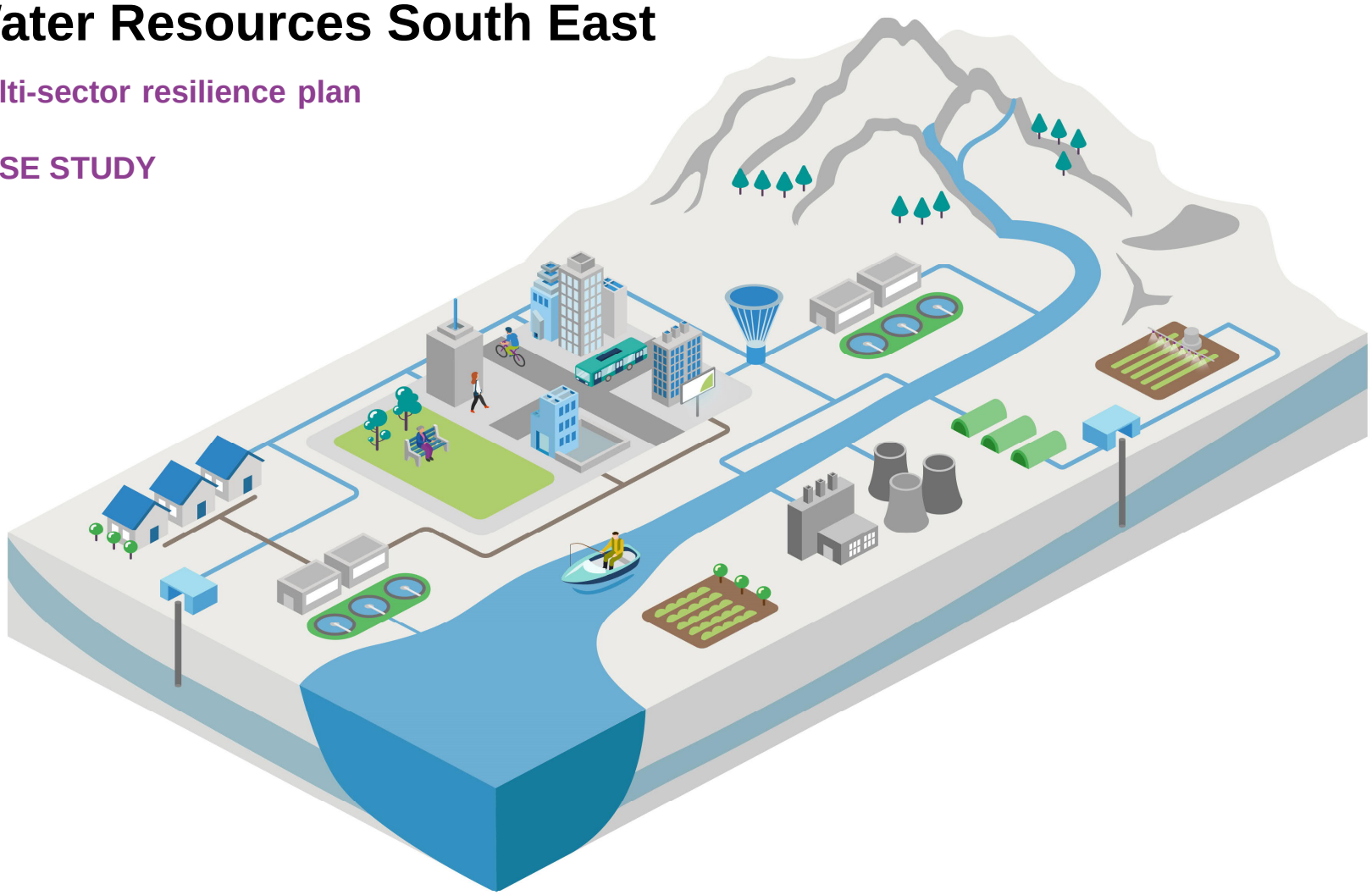
- There is no definitive formulation of a wicked problem and the search to identify a formulation is part of the problem;
- There is no clear point at which the problem is solved;
- There are no right or wrong solutions, merely better or worse approaches to handling wicked problems,
- An observer's perception of available options to provide a solution influences the way in which they choose to articulate the problem.

Rittel and Webber (1973) https://www.jstor.org/stable/4531523?origin=JSTOR-pdf

Water Resources South East

Multi-sector resilience plan

CASE STUDY

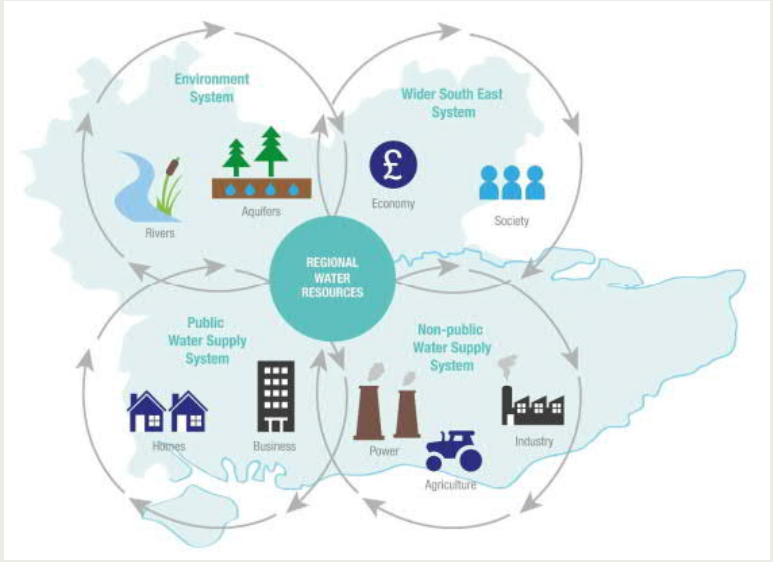


https://www.wrse.org.uk/media/bowilcvo/wrse-multi-sector-resilience-phase-2.pdf

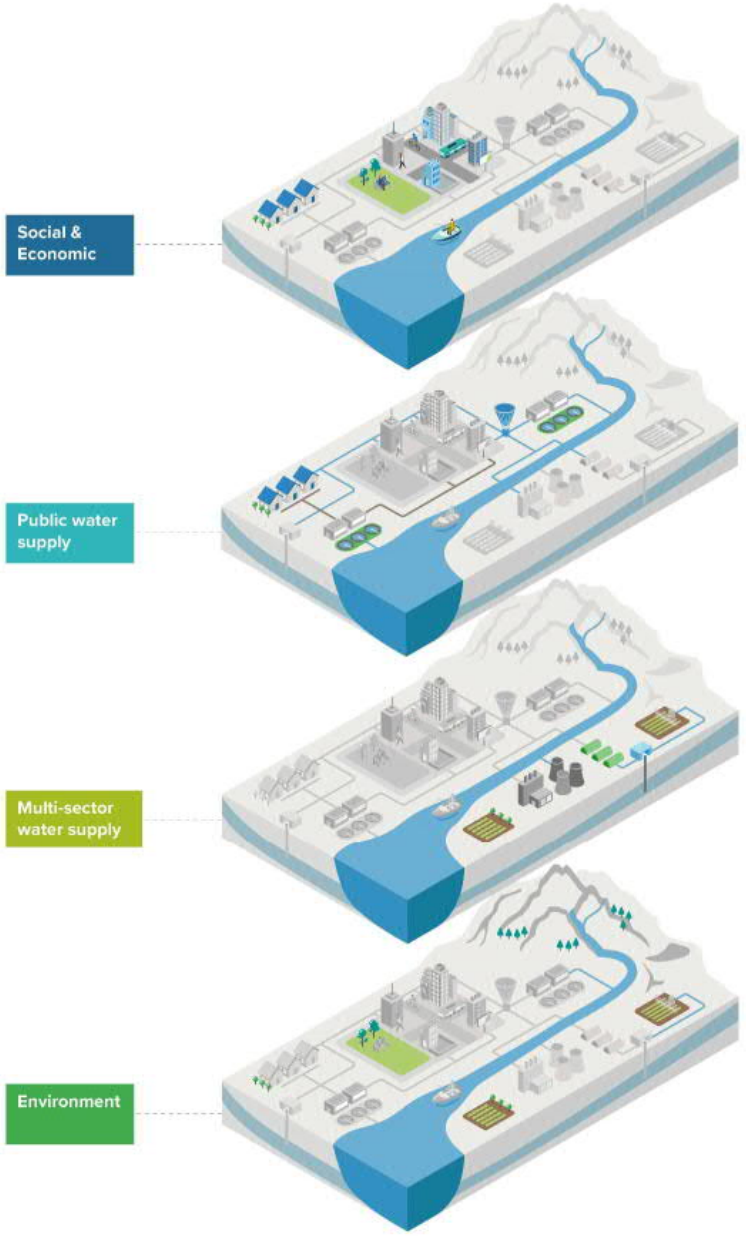
WRSE resilience framework

Responding to feedback on the draft framework

- A broadening of the scope away from the public water supply system (PWS) with more attention on the multi-sector elements of the programme.
- More focus on the environmental system given its role in underpinning water resources in the South East.
- Greater clarity around the systemic rationale for the resilience metrics.



Mott MacDonald



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WRSE Resilience Metric schedule

System attribute	RELIABILITY		ADAPTABILITY		EVOLVABILITY	
System Indices		UNCERTAINTY OF PERFORMANCE		TIMING AND WARNING OF EVENTS		FLEXIBILITY AND DIVERSITY OF OPTIONS
Metric	R1	Uncertainty of supply/demand benefit	A1	Expected time to failure (PWS)	E1	Scalability and modularity of interventions
Metric	R2	Breaches of flow and level proxy indicators	A2	Duration of enhanced drought restrictions		
System Indices		ABILITY TO PERSIST WITH PLANNED FUNCTIONS		ABILITY TO RESPOND TO AND RECOVER FROM UNEXPECTED FAILURES		DELIVERABILITY OF PLANNED CHANGES
Metric	R3	Risk of failure due to physical hazards	A3	Operational complexity and flexibility	E2	Intervention lead times
Metric	R4	Availability of additional headroom	A7	Customer relations support engagement with demand management	E3	Reliance on external bodies to deliver change
System Indices		RESILIENCE OF SUPPORTING SERVICES		SYSTEM CONNECTIVITY AND EASE OF SYSTEM RECOVERY		MONITORING AND MANAGEMENT OF CHANGE
Metric	R5	Catchment / raw water quality risks	A4	WRZ connectivity	E4	Flexibility of planning pathways
Metric	R6	Capacity of catchment services	A5	PWS system connectivity	E5	Collaborative landscape management
Metric	R7	Risk of failure of supporting service due to exceptional events	A6	Inter-catchment connectivity		
Metric	R8	Soil Health	**Metric applied to:** Public water supply; Multi-sector water supply; Environment			

https://www.wrse.org.uk/media/bowilcvo/wrse-multi-sector-resilience-phase-2.pdf

Resilient system attributes

1.

Reliability is an attribute that means the system can maintain its original function in face of shocks.

Flood defence around WTW

2.

Adaptability is an attribute that means the system can undertake a short-term modification of its function to withstand a shock.

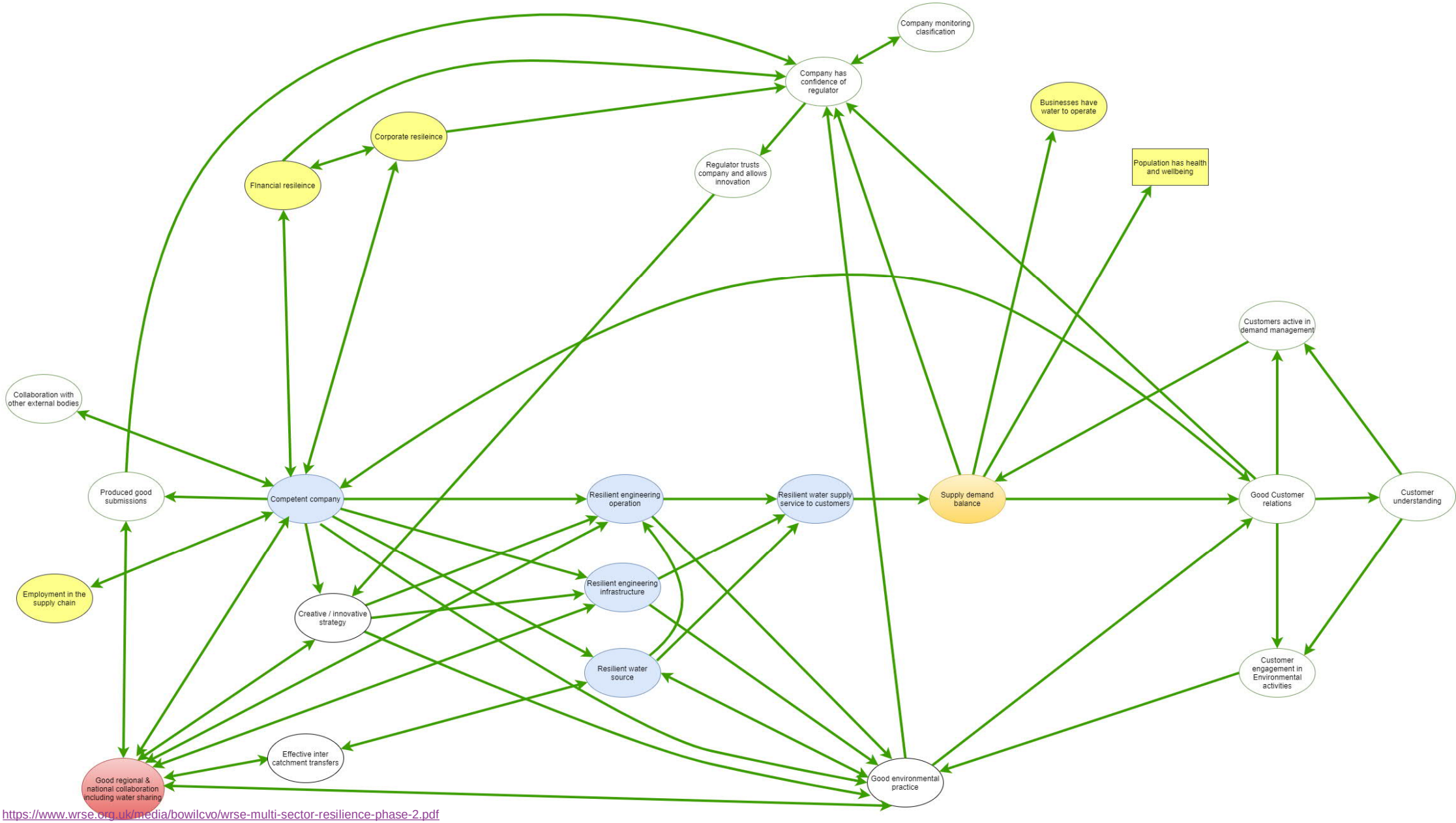
Customer drought management strategies

3.

Evolvability is an attribute that enables the system to modify its operation in face of one or more stresses or trends.

Pipelines designed to flow both ways

https://www.wrse.org.uk/media/bowilcvo/wrse-multi-sector-resilience-phase-2.pdf



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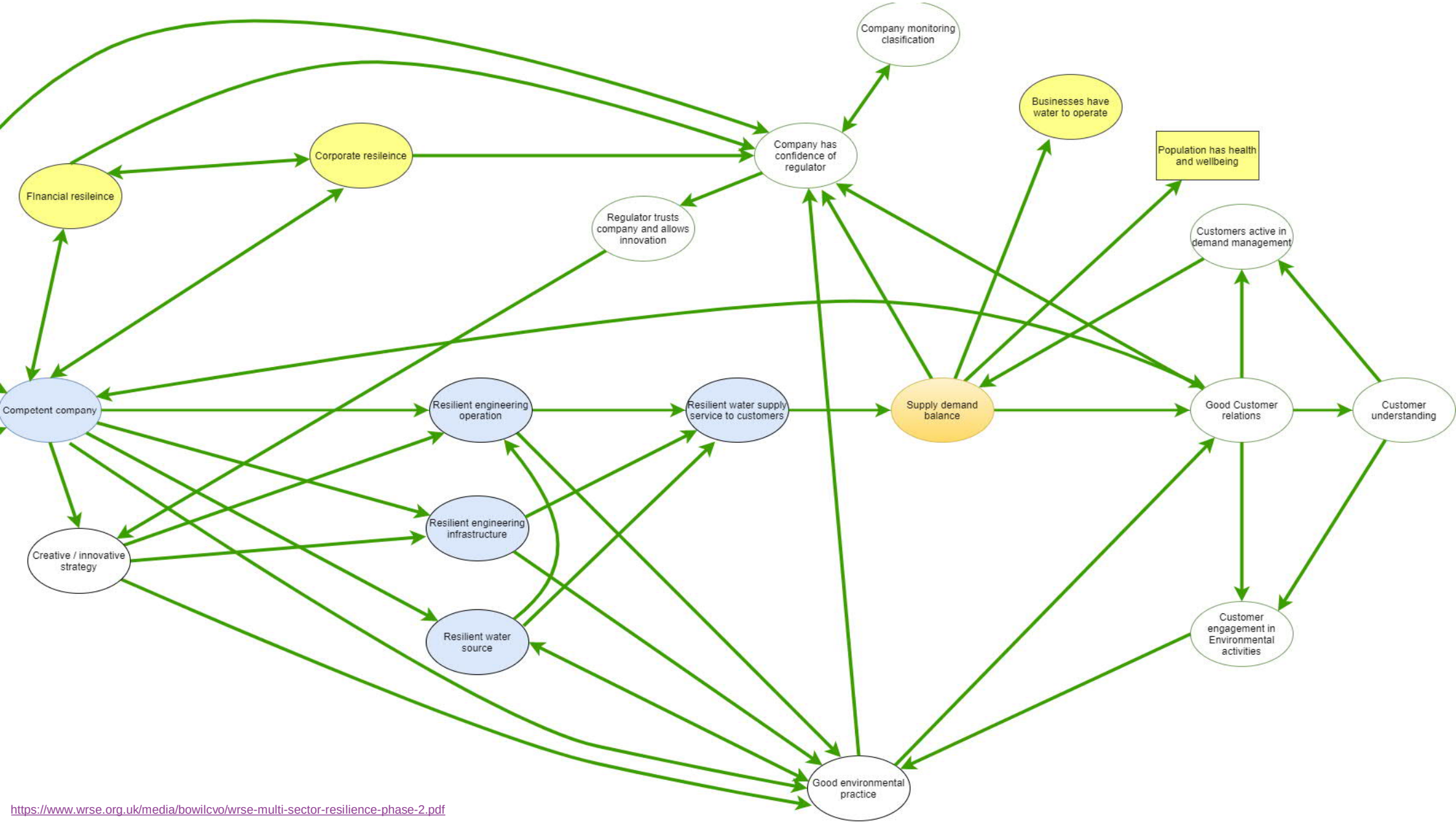


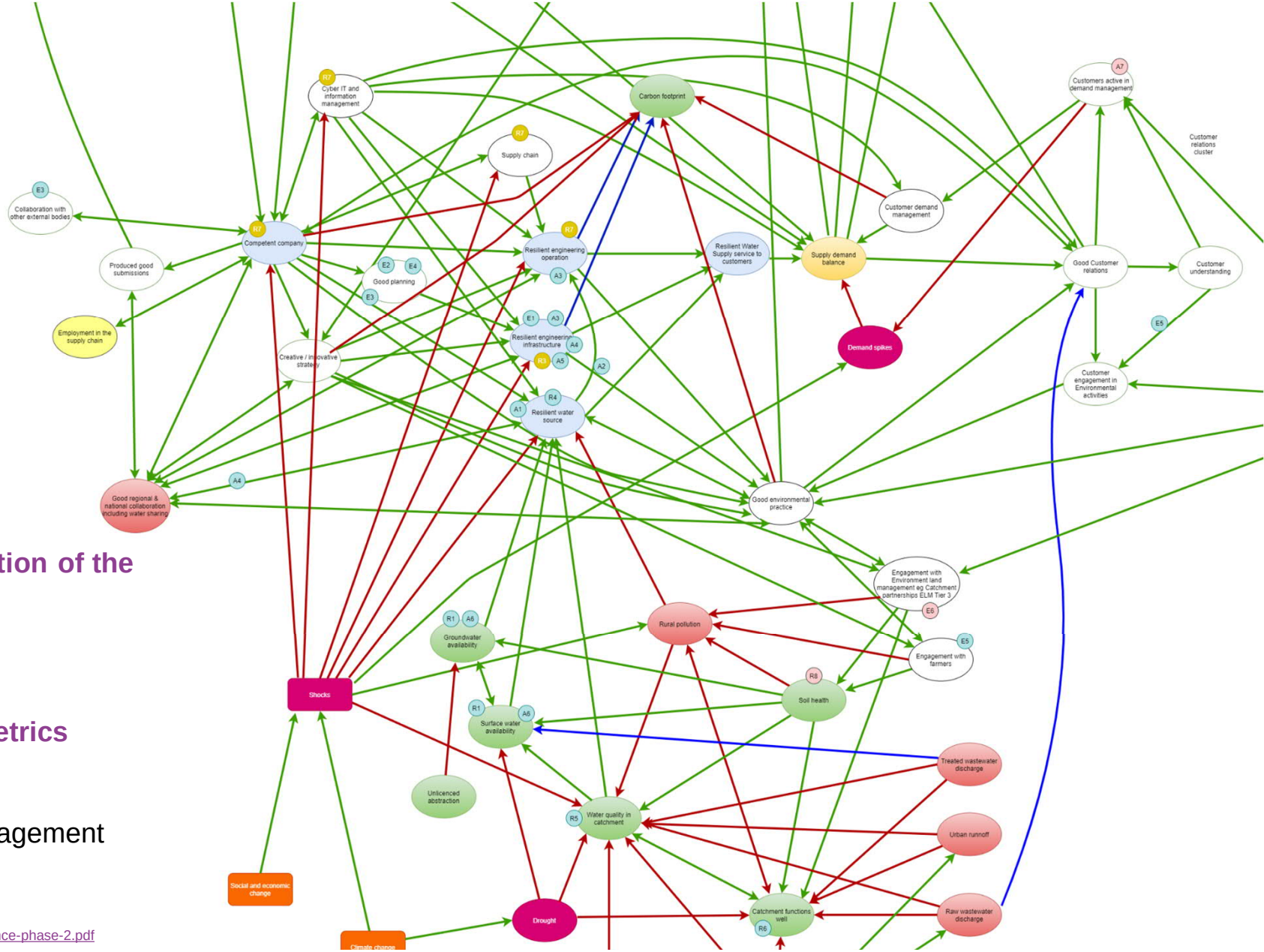
https://www.wrse.org.uk/media/bowilcvo/wrse-multi-sector-resilience-phase-2.pdf

Development and rationalisation of the framework

- Environmental aspects
- Shocks and trends

Addition and validation of metrics

- Customer engagement
- Soil Health
- Collaborative landscape management



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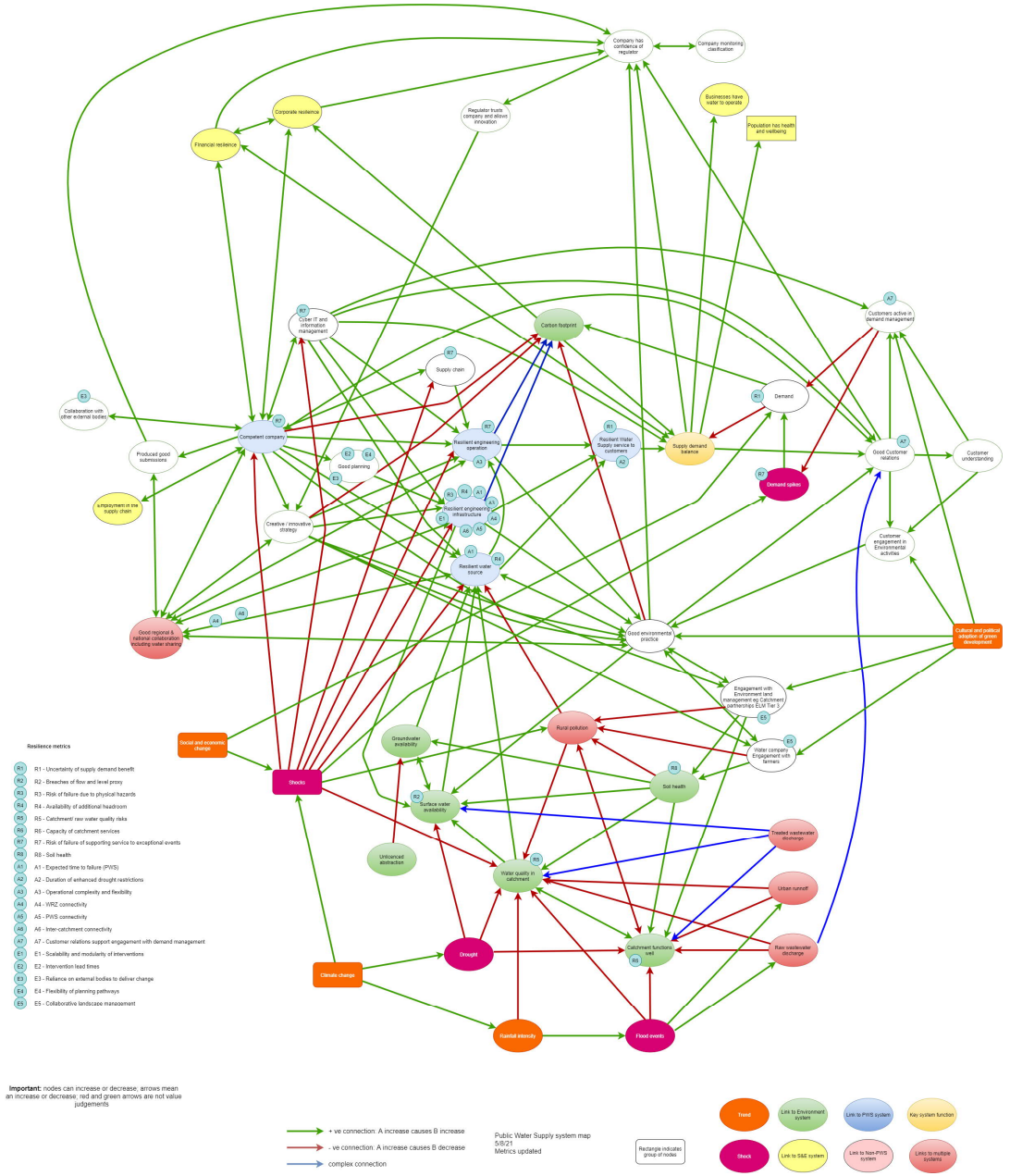
https://www.wrse.org.uk/media/bowilcvo/wrse-multi-sector-resilience-phase-2.pdf

Learning – what would we do differently?

- The rationale for the PSM has to be clear and robust
- Only undertake PSM if the team are all bought in
- PSM has real merit in validating schedules of metrics and understanding resilience
- System mapping sits well as part of broader suite of analytical tools and communication



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Potential applications of system mapping

1
Metrics
Validation & explanation
WRSE, NWG

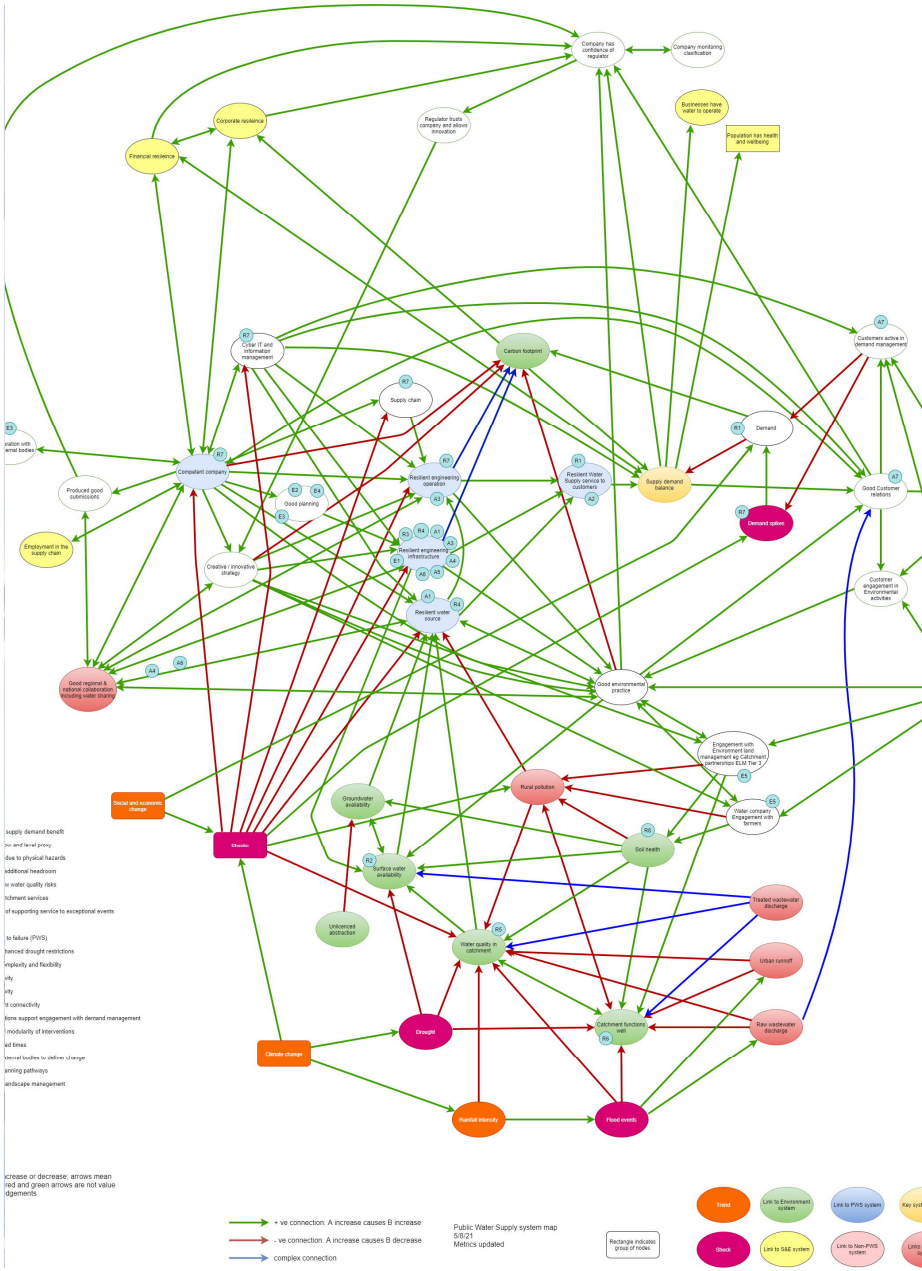
2
Intervention Identification
Fenland Reservoir, Wales Transition Lab

3
Co-benefit and attribution
NWG Innovation Festival
Blended finance,

4
Audit trail for complex analysis
Highways trade-offs

5
Framework development
OxCam Arc IWP
CReDO – digital twin development

6
Impact evaluation
NFM, landscape interventions etc



Cultural Theory / Plural Rationality

A framework for understanding organisational culture relating to risk and systems

WRSE: Multi-sector approaches to resilience

Power
- Need robust water tenure – trading introduces too much risk – willing to trade as vendor
- High capacity to evaluate risk and use this analysis to mobilise finance

Paper
- Need robust water due to steady process requirements

Rainfed farming
- High tolerance of variable outcomes – wheat production dropped by 40% between 2019 and 2020
- Trades on open market

Protected farming
- Low tolerance of crop failure due to long term contractual impacts and impacts on labour
- High interest in connection to PWS as a resilience strategy

Canals
- Clear strategy of 1 in 20 year service
- Diversifying revenue streams due to policy uncertainty over trust status

Golf
- A structural disconnect between careers of grounds staff and club management
- Need for cultural change – leisure association water charter July 2021

https://www.wrse.org.uk/media/bowilcvo/wrse-multi-sector-resilience-phase-2.pdf

A theoretical basis for categorising risk cultures in systems

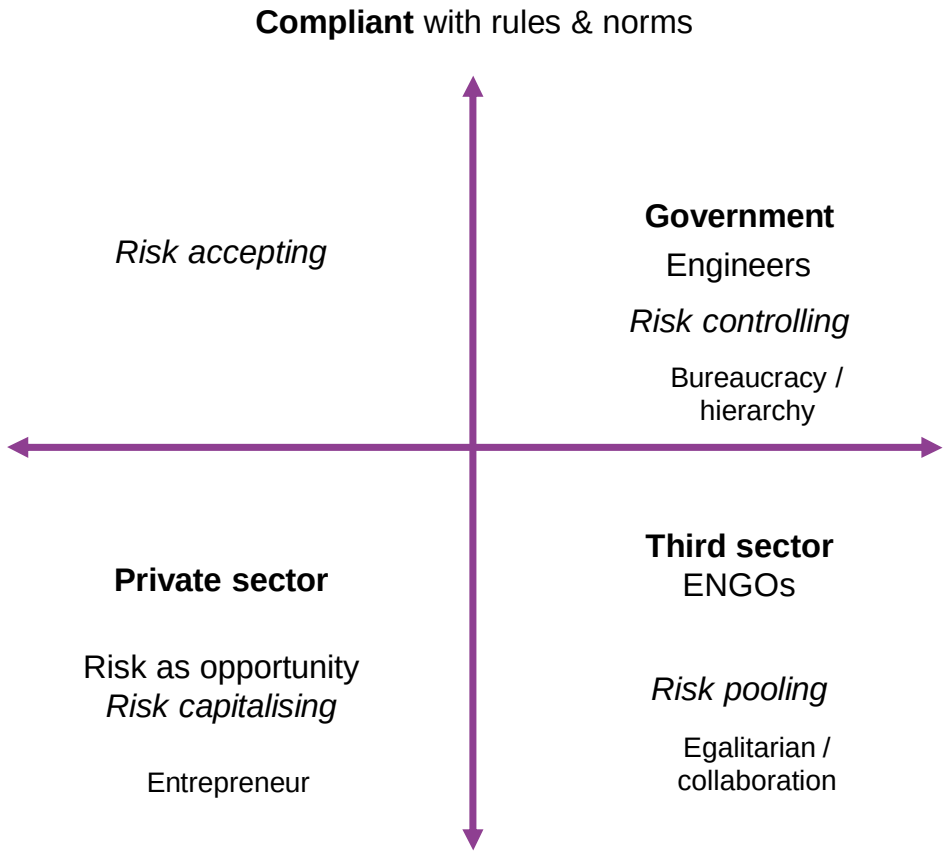
International Institute for Applied Systems Analysis

- Building bridges through scientific analysis during the cold war
- Identified challenges around systems and subjectivity
- Sought to establish a framework to understand subjectivity
- Michael Thompson applied Mary Douglas's grid group model
- Plural rationality / Cultural Theory

https://iiasa.ac.at/ Photo: IIASA

Grid – group model

Comparative strengths across government, private sector and third sectors



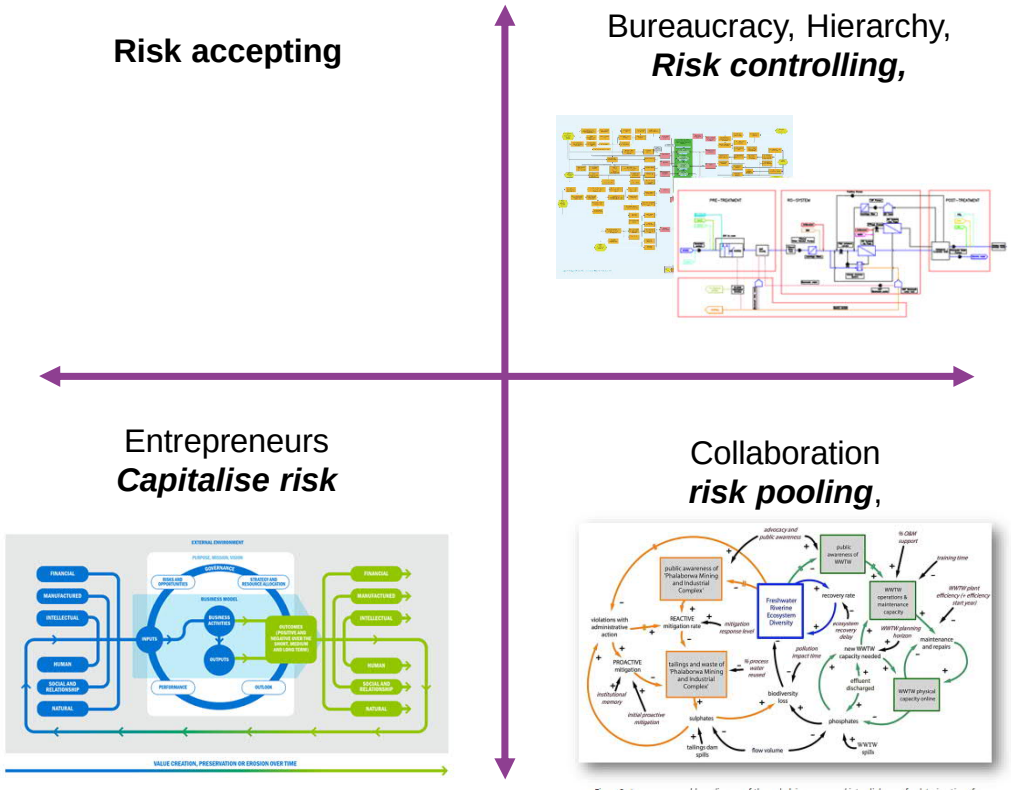
http://randd.defra.gov.uk/ search for WT15121 See appendix B of main report

Grid – group model

Different risk cultures are suited to different types of system

There is no one-size-fits-all – an “elegant solution”.

Theorists suggest that a constructive interplay between the approaches is needed



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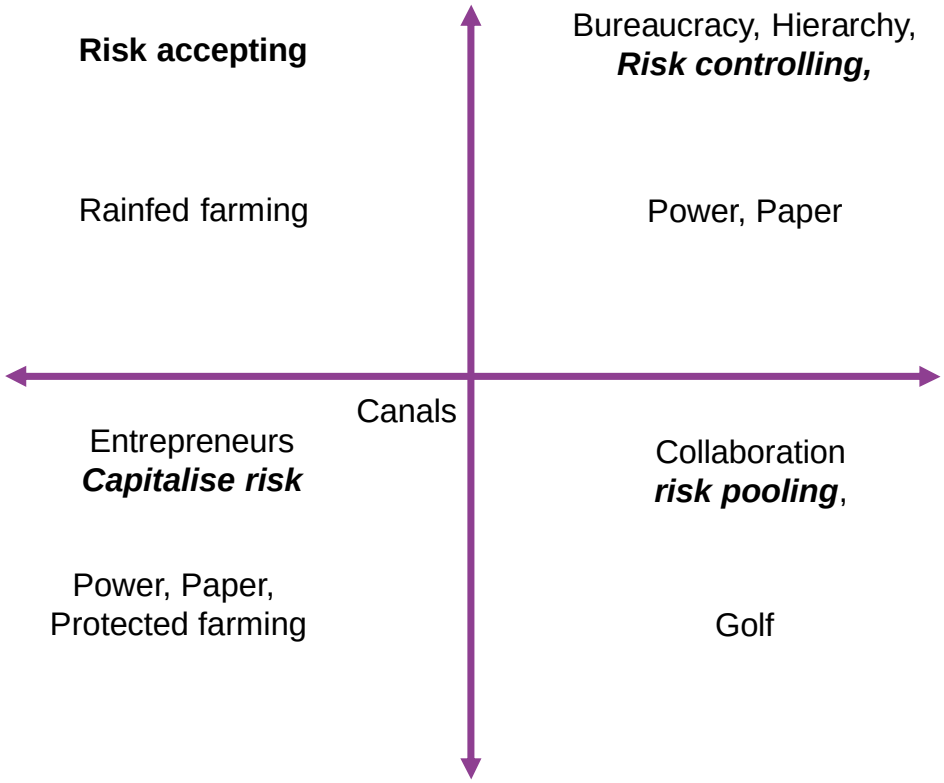


Complementary approaches at the catchment or landscape level

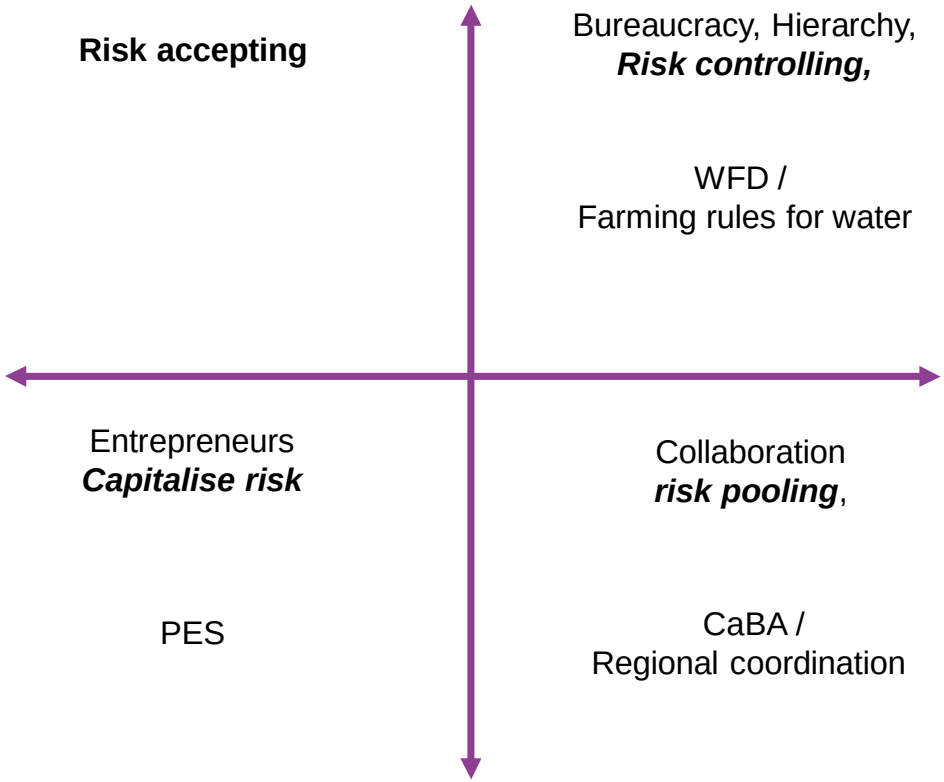
The Water Framework Directive and Farming rules for water are risk controlling strategies

CaBA is a risk pooling strategy – collective action

PES – Entrade classic

Blending approaches – LENs, Entrade market, Manchester Natural Capital, UU CaST

CaSO / France – scale matters



"Good governance is when .gov, .org and .com work well together for the benefit of society"
Tony Allan

http://randd.defra.gov.uk/ search for WT15121

A challenge for system operation

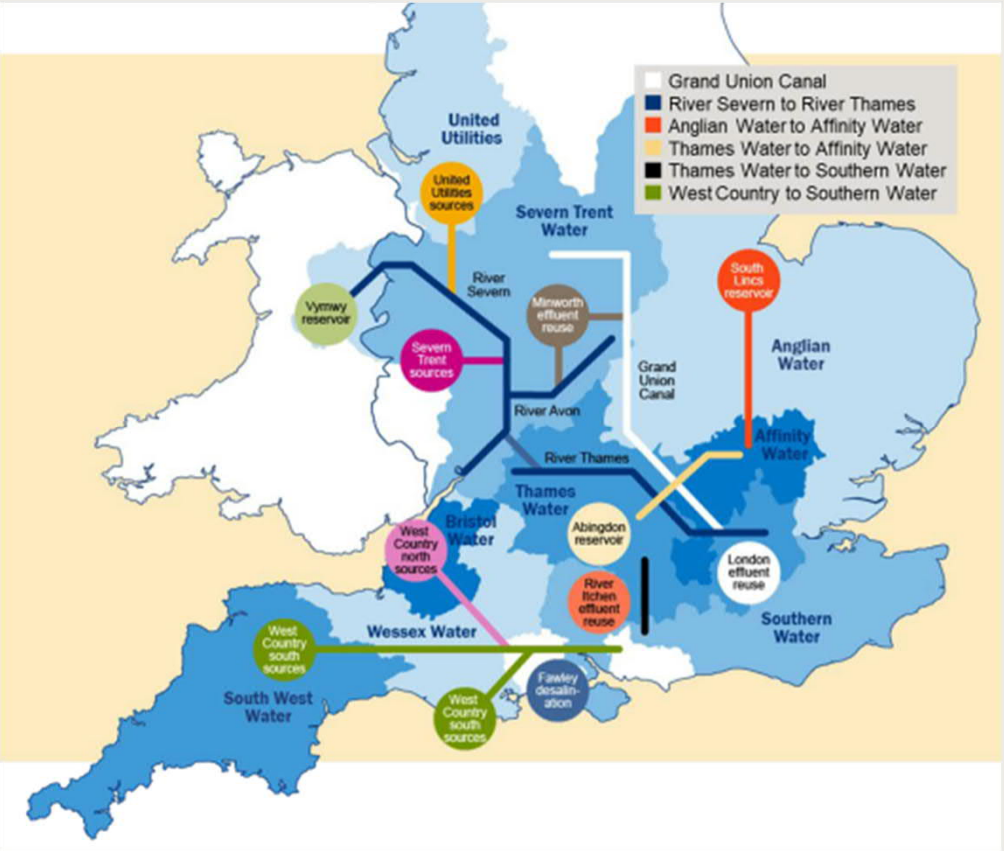
National level SROs
Definable systems – important challenges in coordination and pricing – lends itself to control

Regional coordination
Sitting between the two

Public water supply
Primarily engineering – also catchments and customers

Flooding and catchments
A range of approaches for multiple benefits, (e.g. Glasgow's smart canals)

Landscape & Natural capital – such as Greater Manchester Natural Capital Investment Fund; ELM

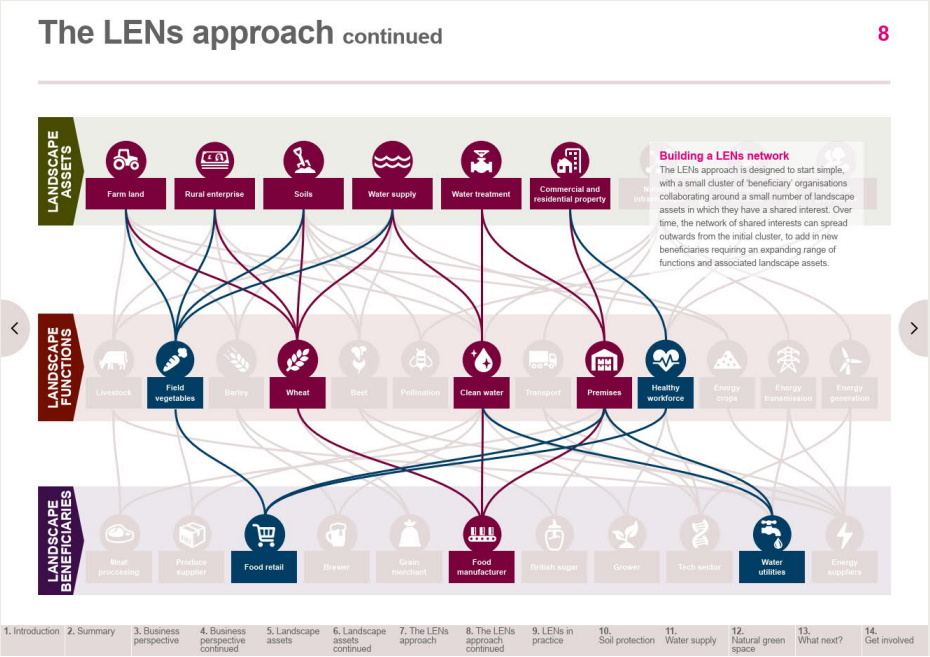


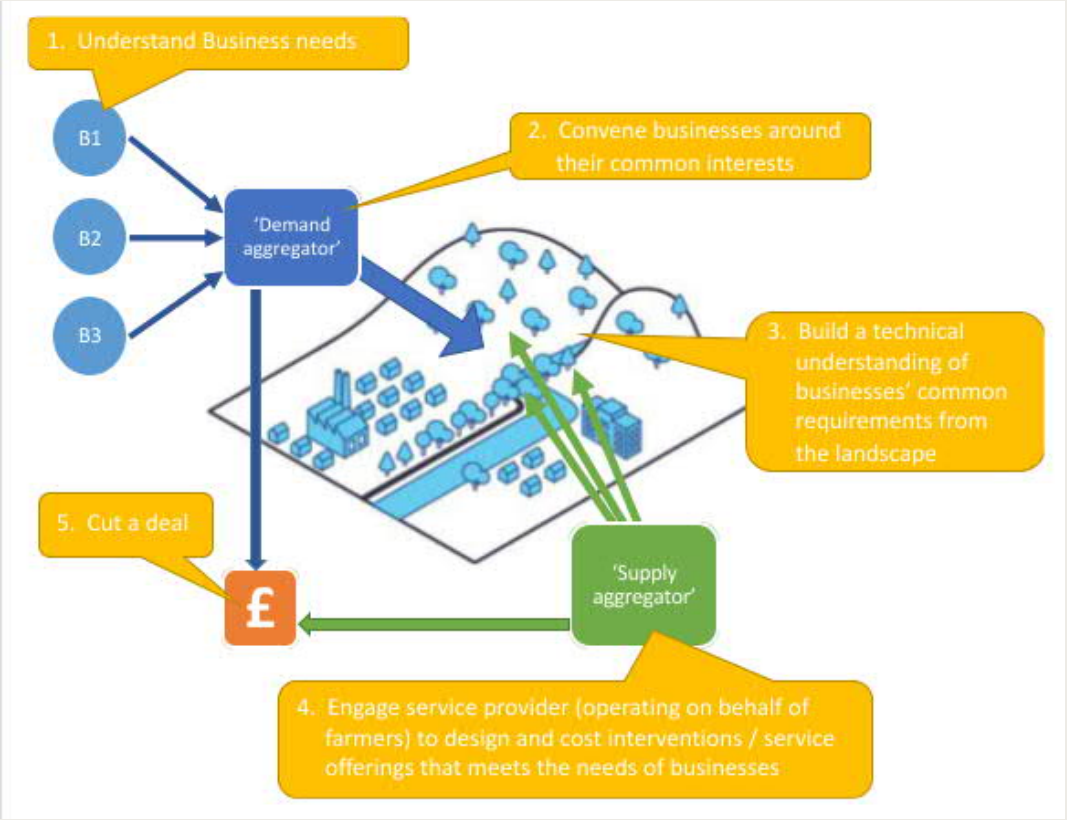
https://www.ofwat.gov.uk/wp-content/uploads/2019/12/PR19-final-determinations-Strategic-regional-water-resource-solutions-appendix.pdf

Landscape Enterprise Networks

Landscape enterprise networks

- Cumbria Lens – UU, Nestle, Iggesund
- Anglian Lens – Nestle, Affinity Water, Anglian Water Cambridge, Water, Northants CC
- Supply and demand aggregation





http://www.3keel.com/wp-content/uploads/2018/01/healthy-ecosystems-cumbria-lens.pdf

United Utilities Catchment system thinking - CaST

United Utilities have a range of ways they engage with catchments
Collaboration with Rivers Trust – hybridity
Contracts for activities or results? Who holds the risk?

River Petteril – phosphorous removal

- Funding outputs, rather than outcomes
- UU retain risk, but still preferable to WwTW solution
- Lower cost, lower carbon, more co-benefits
- Interface with farm water obligations?

River Wyre – a range of benefits

- SPV takes a loan
- Staged shift in risk
- Nine year project – half made on output and maintenance, then a transition to outcomes

Mott MacDonald

https://www.unitedutilities.com/corporate/responsibility/stakeholders/catchment-systems-thinking/understanding-cast/

Conclusions

System mapping is useful in some circumstances

- Consider it as a stakeholder process as much as an analytical process
- A library of approaches and mapping components will emerge – useful to keep these in the public domain (SYWM, WRSE, multi-capitals, NIC, PSM, TCFD)
- System thinking requires a cultural shift to engaging with the views, frameworks and biases of others

Understanding plurality in risk management provides a useful framework for governance of systems

- Understanding diversity in risk cultures will improve institutional design
- Understanding the cultural bias in the presentation of systems will facilitate collaboration between organisations

MOTT MACDONALD

Thank you