

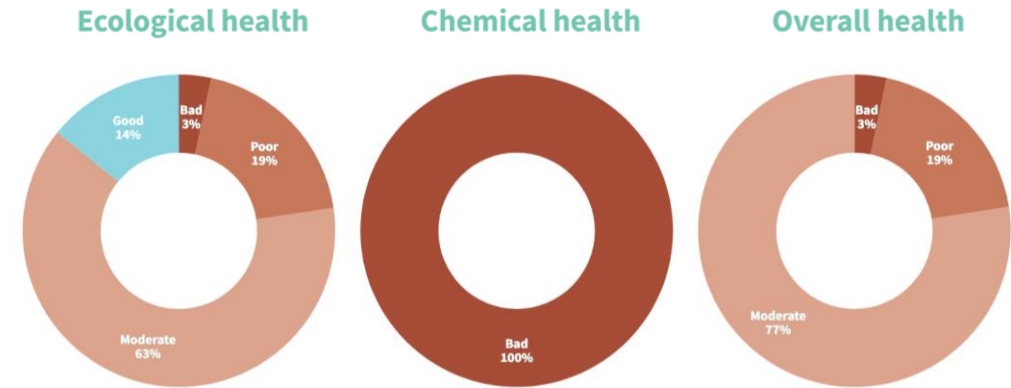
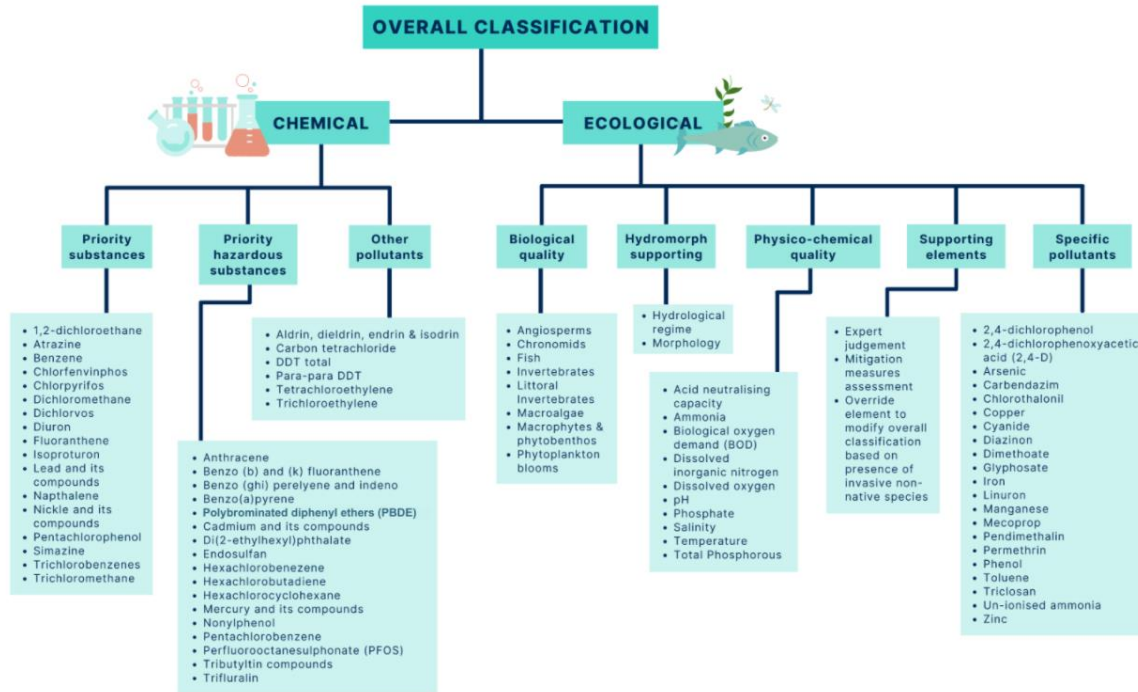
The potential for citizen science to improve catchment water quality across the UK.

Michelle Walker - The Rivers Trust

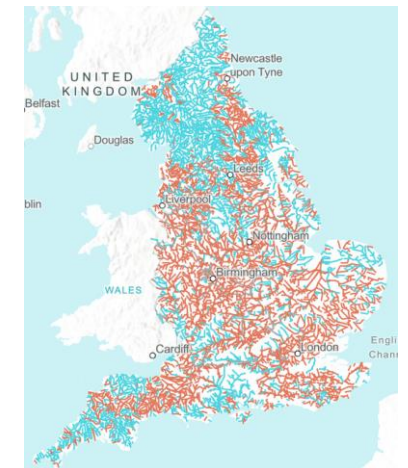
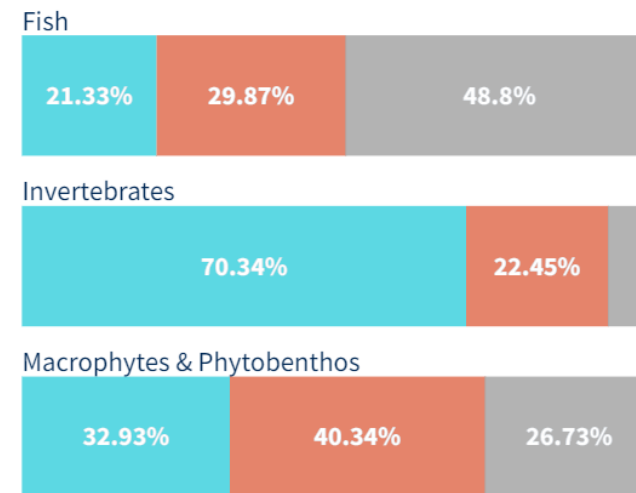
How can citizen science improve water quality?



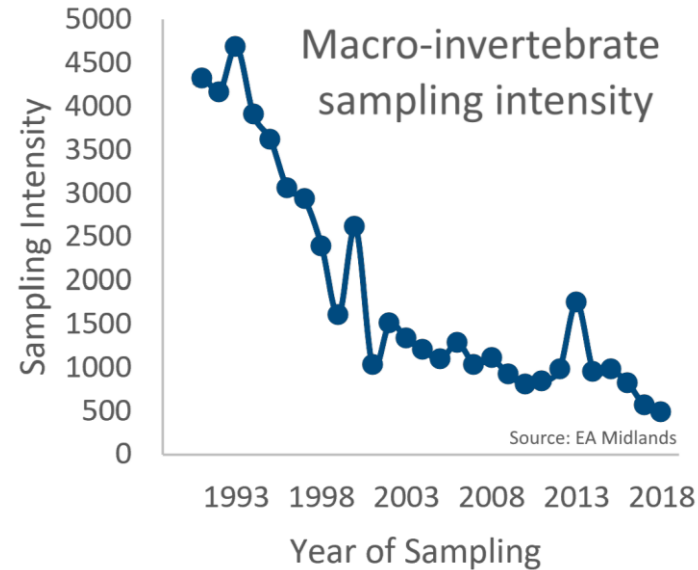
What are the water quality issues in catchments?



WFD status of rivers in England 2019



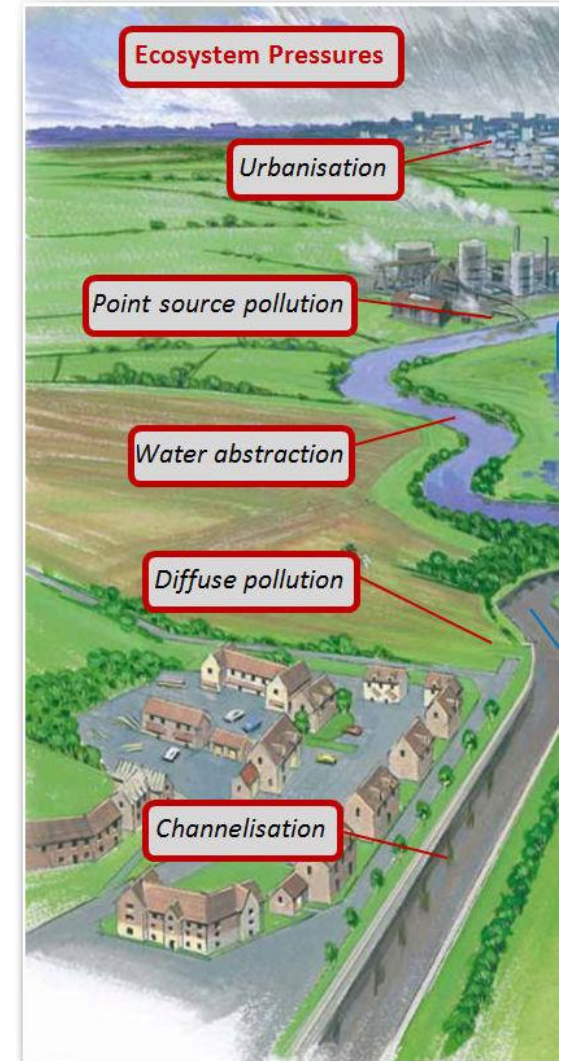
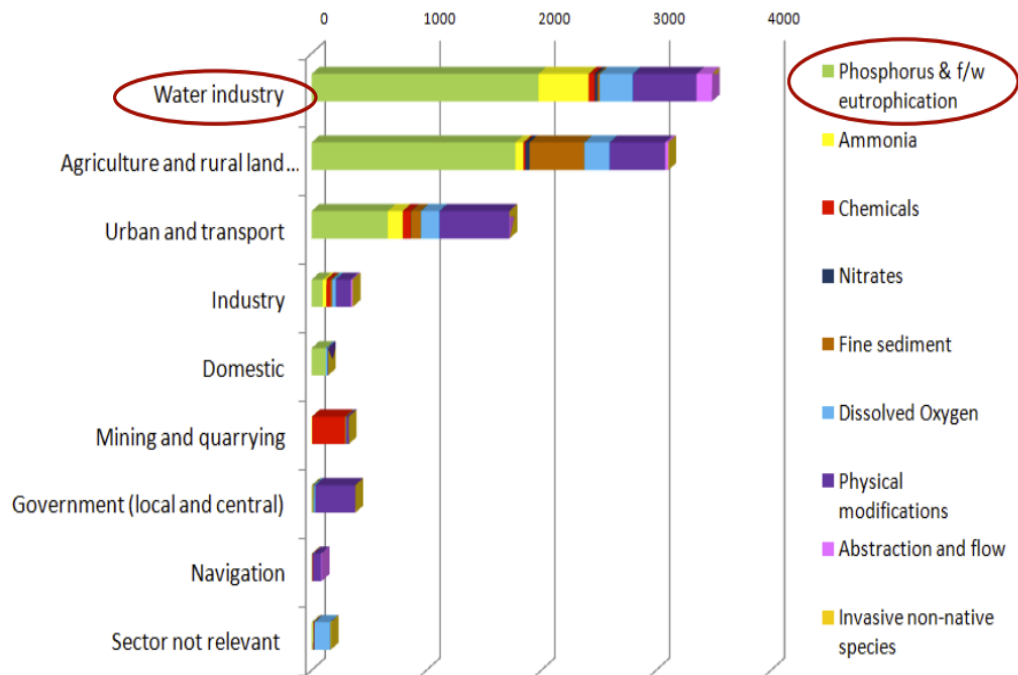
Mind the Evidence Gap



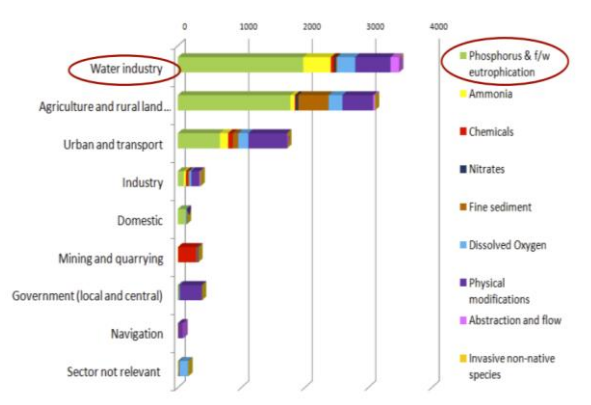
- Year on year cuts to government agency monitoring budgets leading to poor decisions and misdirection of resources
- Risk being unable to target work, measure effectiveness of investment or demonstrate progress against 25 Year Environment Plan

What are the causes of water quality issues?

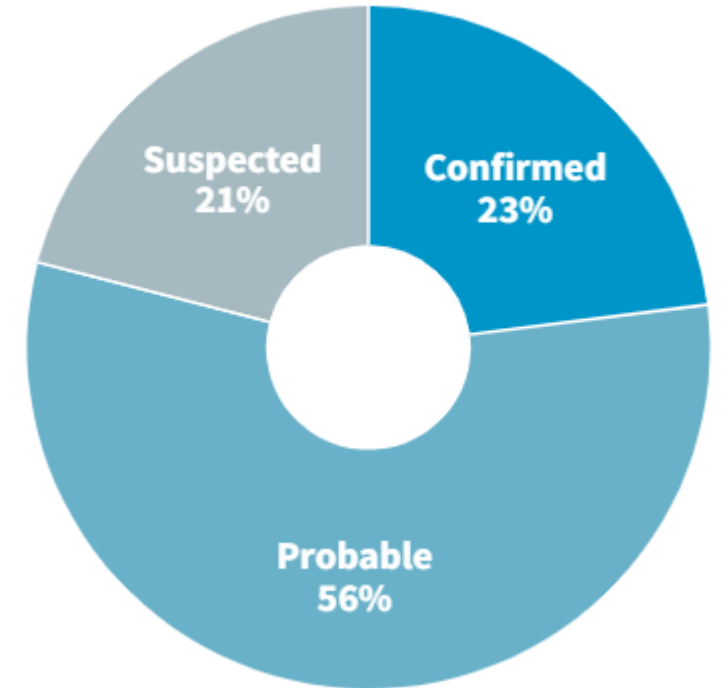
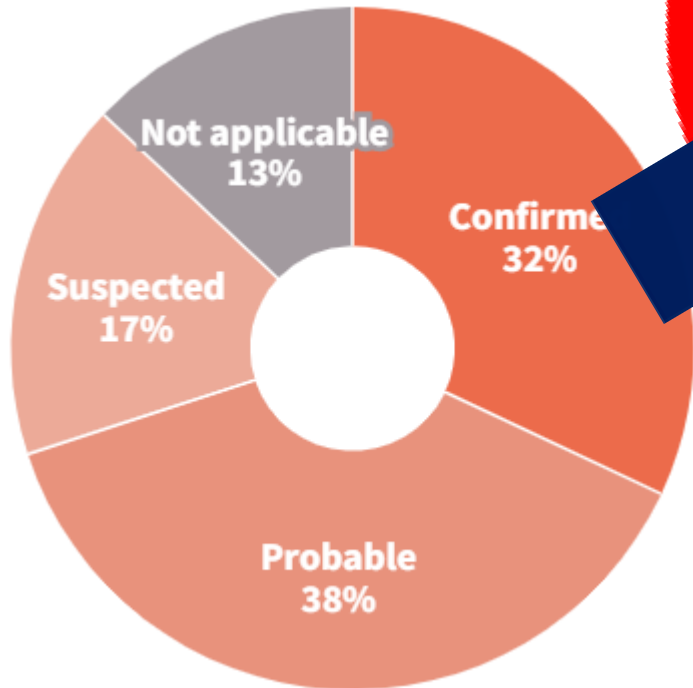
Summary of current reasons for not achieving WFD Good status




How certain are we about the causes?



Mind the evidence gap



How is water quality improvement achieved?



Regulation

- Legally enforceable controls, including product / source controls



Enforcement against illegal activity

- Punish / Remedy / Deter




Influencing sectors

- Incentives, Advice & guidance, Partnerships
- Encouraging ownership of problems & solutions
- Encouraging innovation



Influencing development planning and delivery

- land-use planning, and infrastructure associated with sectors such as water, energy, transport



Remediation programmes for legacy issues

- e.g. mining, contaminated land



How is water quality improvement achieved?



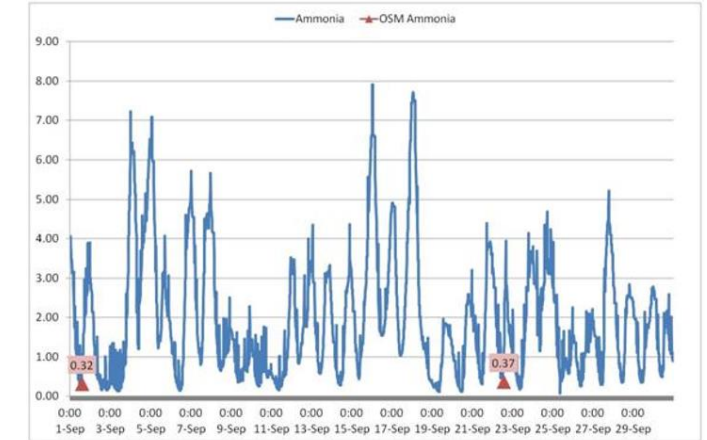
Regulation

- Legally enforceable controls, including permits / source controls

- Monitor compliance with permits
- Set limits on new permits /sites
- Justify greater action to control pollution
- Evaluate success of action to reduce pollution

Mind the evidence gap

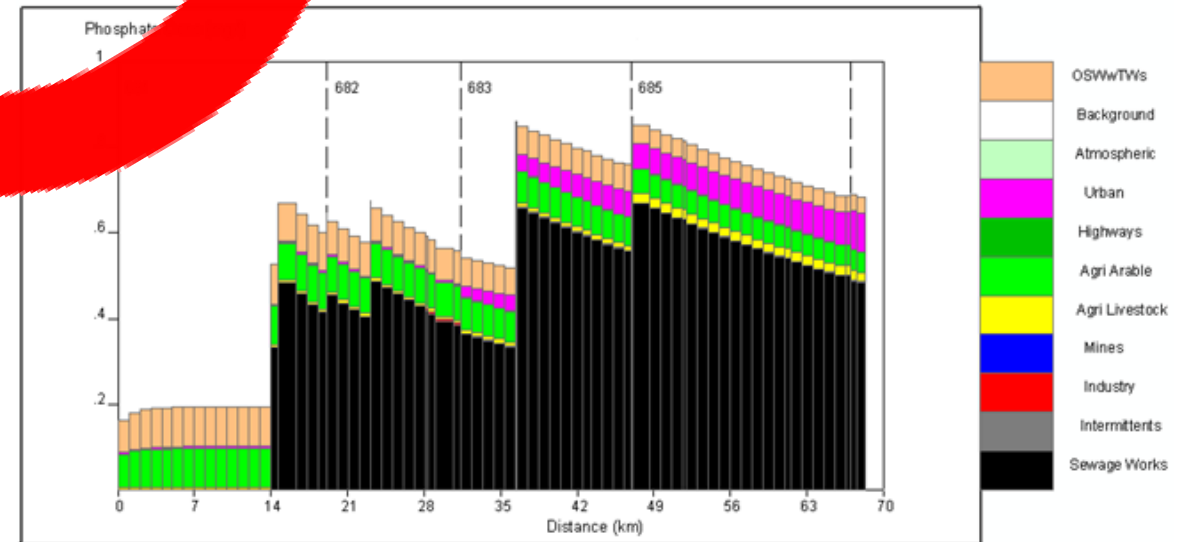
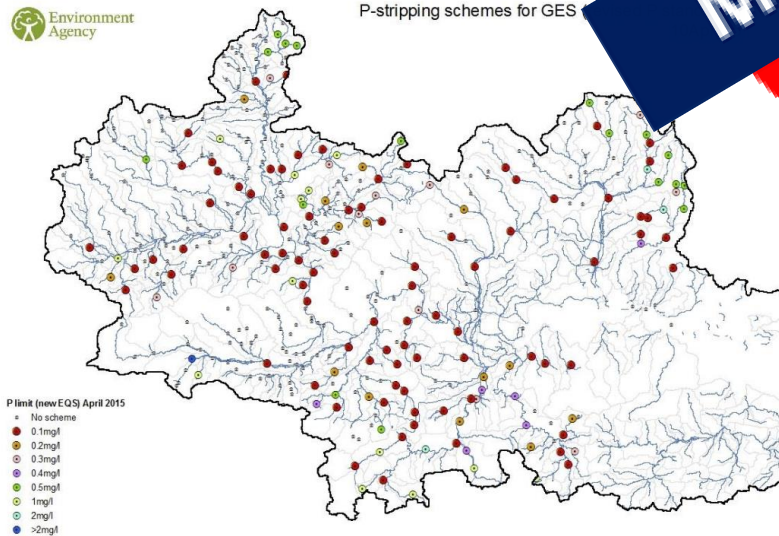
Figure 1. Ammonia concentration of STW effluent for one month, with compliance assessment samples superimposed



Optimising P permits needed across catchments



P-stripping schemes for GES



How is water quality improvement achieved?



Enforcement against illegal activity

- Punish / Remedy / Deter

- Identify and respond to incidents & illegal activity
- Identify and respond to regulatory compliance breaches

REPORT
POLLUTION

0800 80 70 60

Mind the evidence gap

Environment Agency budget cuts lead to drop in pollution prosecutions

News 14 Mar 2019 Abi Kay
Deep cuts to the Environment Agency (EA) budget have led to a drop in prosecutions for offences such as pollution, according to a legal expert.

Abi Kay
Abi took up the post of chief reporter at Farmers Guardian after a stint working for the NFU as part of its government affairs team.
[...Load More](#)



Water and Sewerage Companies Performance Assessment 2020

Environment Agency

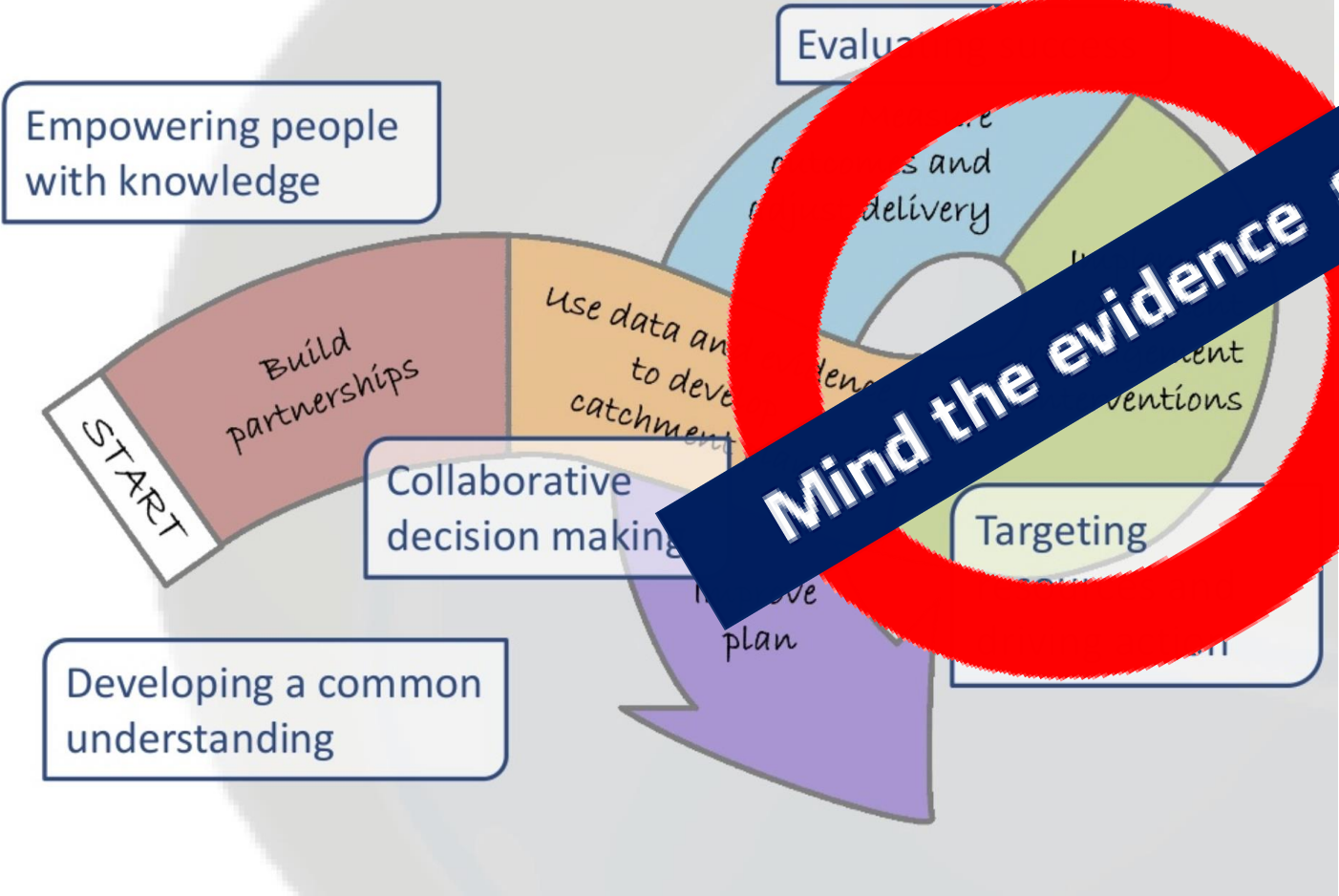
For more information on the data available in this report please visit: [water-and-sewerage-companies-in-england-and-wales-annual-performance-report-2020](#)

Company	Pollution incidents per 10,000km ² (actual)	Serious pollution incidents per 10,000km ² (actual)	Discharge compliance (%)	Self-reported pollution incidents (%)	WINEP ³ scheme delivery (%)	Security of supply index (SoSI)	Overall performance star rating (out of 4)
Anglian Water	24 (294)	1.0 (4)	99.3 (6)	73	100	99	★★★★☆
Northumbrian Water	24 (294)	1.0 (4)	99.4 (1)	81	100	100	★★★★★
Severn Trent Water ⁴	24 (294)	1.0 (4)	99.6 (3)	76	97.2	100	★★★★★
Southern Water	102 (400)	1.7 (3)	97.1 (10)	88	87.2	100	★★★☆☆
South West Water	131 (226)	1.7 (3)	99.0 (3)	74	100	99	★★★☆☆
Thames Water	27 (294)	1.2 (13)	99.7 (1)	63	98.0	100	★★★★☆
United Utilities	19 (143)	0 (0)	99.7 (1)	82	100	100	★★★★★
Wessex Water	25 (87)	1.2 (4)	99.1 (3)	85	100	100	★★★★★
Yorkshire Water	24 (125)	0.6 (3)	99.0 (3)	81	100	100	★★★★★
Sector Average (England)	33 (1718)	0.7 (39)	99.2 (31)	77	98.2	99.8	
Dŵr Cymru Welsh Water	21 (77)	0.3 (1)	99.7 (2)	80	100	100	★★★★★

Red Significantly worse than target
 Amber Slightly worse than target
 Green Better than target
 R A G Red, amber, green thresholds

CaBA – an Evidence-based Approach

Importance of data and evidence



Citizen Science Filling the Gap



Connecting the Culm

Collect Water Quality Data

Discover and Learn

Become a Citizen Scientist on the Culm

To find out how to join Westcountry CSI, visit connectingtheculm.com or join us for an online training event on



Spot testing



We have equipped our farm advisors with a set of instruments so they can carry out some testing in the field.

- Temperature
- Conductivity
- Dissolved solids
- Phosphate
- Turbidity
- Suspended sediment
- Colour



Data and Evidence team have additional instruments for dissolved oxygen, pH and fluorescence



Citizen Science Filling the Gap



TORRIDGE SCORECARD UP TO AND INC 20 OCTOBER 2016							
Site No.	River	Site	TDS	SED	PO4	TRYP	OVERALL
5	Iddesleigh Stream	D/S Pixton	14	15	11	15	13.8
4	Dolton Stream	Stony Bridge	11	6	15	13	11.3
3	R. Mere	Merton Mill	13	14	5	12	11.0
10	Pulworthy Brook	Runnon Moor Lane	12	11	4	14	10.3
7	Hole Brook	Monkokehampton	15	2	12	8	9.3
13	R. Waldon	Henscott Bridge	4	12	6	11	8.3
2	Woolleigh Brook	Kingscott	10	5	10	7	8.0
12	Whiteleigh Water	The Old Smithy	8	13	1	10	8.0
9	R. Lew	Holmes Farm, Lewer	7	7	8	9	7.8
11	Mussel Brook	Sheepwash	9	9	7	4	7.3
15	R. Torridge	Dolton New Bridge	3	10	9	6	7.0
14	R. Torridge	Gidcott Mill	5	8	3	5	5.3
6	R. Okement	Iddesleigh Bridge	2	3	13	2	5.0
8	R. Okement	New Bridge, Monkokehampton	1	1	14	1	4.3
1	R. Torridge	Rolle Rd, Torrington	6	4	2	3	3.8

Westcountry CSI Scorecard 2020 Abbey River, North Devon

River Health Scale

- A Excellent
- B Good
- C Fair
- D Poor
- E Very Poor

The overall score for the catchment is based on a year's data, collected at all sites in the **Abbey River** waterbody. It is calculated from the observations and water quality results attained during a Westcountry Citizen Science Investigation (CSI) survey. A waterbody has to have at least 12 samples taken over the year for it to qualify for a scorecard.

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ABBAY RIVER 2020

59%

Overall grade

Westcountry C.S.I.
Citizen Science Investigations

DS **Dissolved Solids** are measured using a handheld TDS meter. DS increase as a result of natural and anthropogenic inputs of things like chemicals, slurry, sewage or salts into the waterbody.

SS **Suspended Solids or Turbidity** is measured using a turbidity tube. SS increase as a result of increased soil erosion, mine discharge and road runoff. An increase in SS reduces water clarity, making it difficult for aquatic organisms to survive.

POL The **Pollution** score is calculated from the observations of pollution sources and evidence of recent pollution (e.g. litter or oil). These give an indication of the pollution pressures on that watercourse.

ECO The **Ecology** score is calculated from wildlife and problem plants spotted. Wildlife spotted near a river, indicates that the river is supporting a healthy food chain. Problem plants reduce this score as they can cause issues for the biodiversity of the watercourse by shading out other plant species.

PO₄ **Phosphate** (PO₄) is a vital nutrient for the healthy growth of all organisms and is found in natural and artificial fertilisers, sewage and industrial wastes. Natural levels are very low and thus any measurable phosphate observed is likely due to anthropogenic influences such as misconnections, farm runoff or industrial discharge. PO₄ is measured using strips which turn blue in the presence of phosphate.

Citizen Science Filling the Gap



Riverfly Monitoring Hub

- Welcome
- What is Riverfly?
- Why do we need Riverfly?
- The Riverfly Method
- The Hogsmill
- The Beverley Brook
- Join Riverfly!

Explore Riverfly data for the Hogsmill - a rare chalk stream in south London

Use the selectors below to view data for a specific site on certain dates.

Filter by site:
Middle Mill

Filter by date(s):

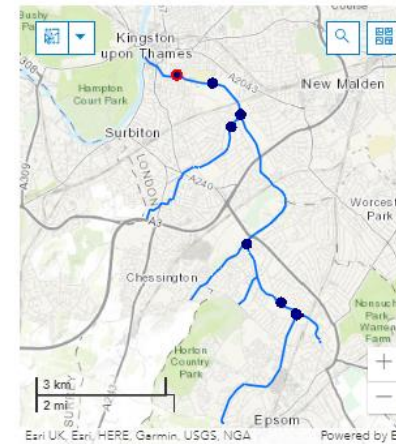
2021/11	2021/10	2021/09
2021/08	2021/07	2021/06
2021/05	2020/12	2020/11
2020/10	2020/09	2020/08
2020/07	2020/06	2020/05
2020/03	2020/02	2020/01
2019/12	2019/11	2019/10
2019/09	2019/08	2019/07
2019/06	2019/05	2019/04
2019/03	2019/02	2019/01
2018/12	2018/11	2018/10
2018/09	2018/08	2018/07
2018/06	2018/05	2018/04
2018/03	2018/02	2018/01
2017/12	2017/11	2017/10
2017/09	2017/08	2017/07
2017/06	2017/05	2017/04
2017/03	2017/02	2017/01
2016/12	2016/11	2016/10
2016/09	2016/08	2016/07
2016/06	2016/05	2016/04



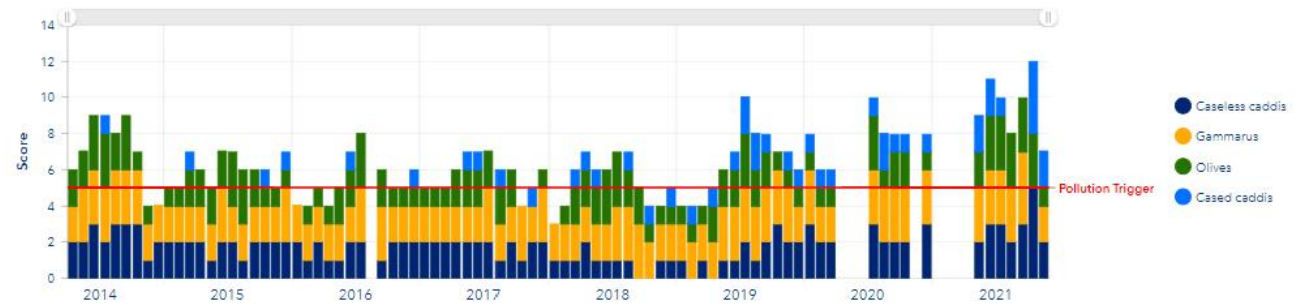
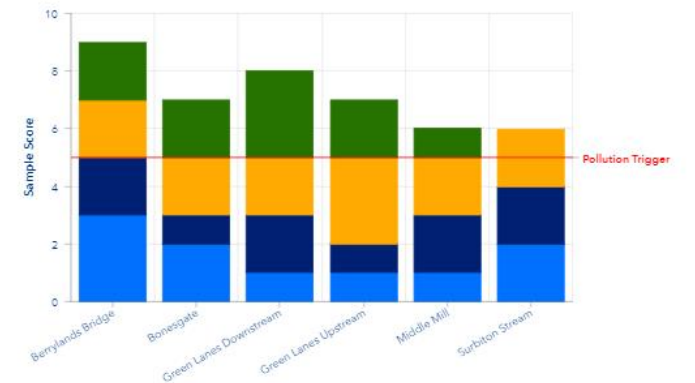
Number of surveys

82

for filtered selection



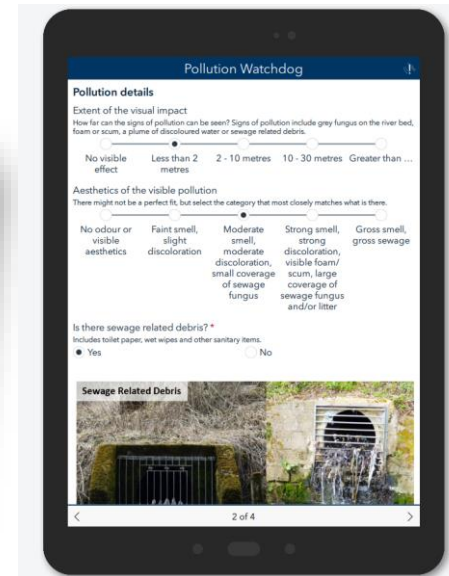
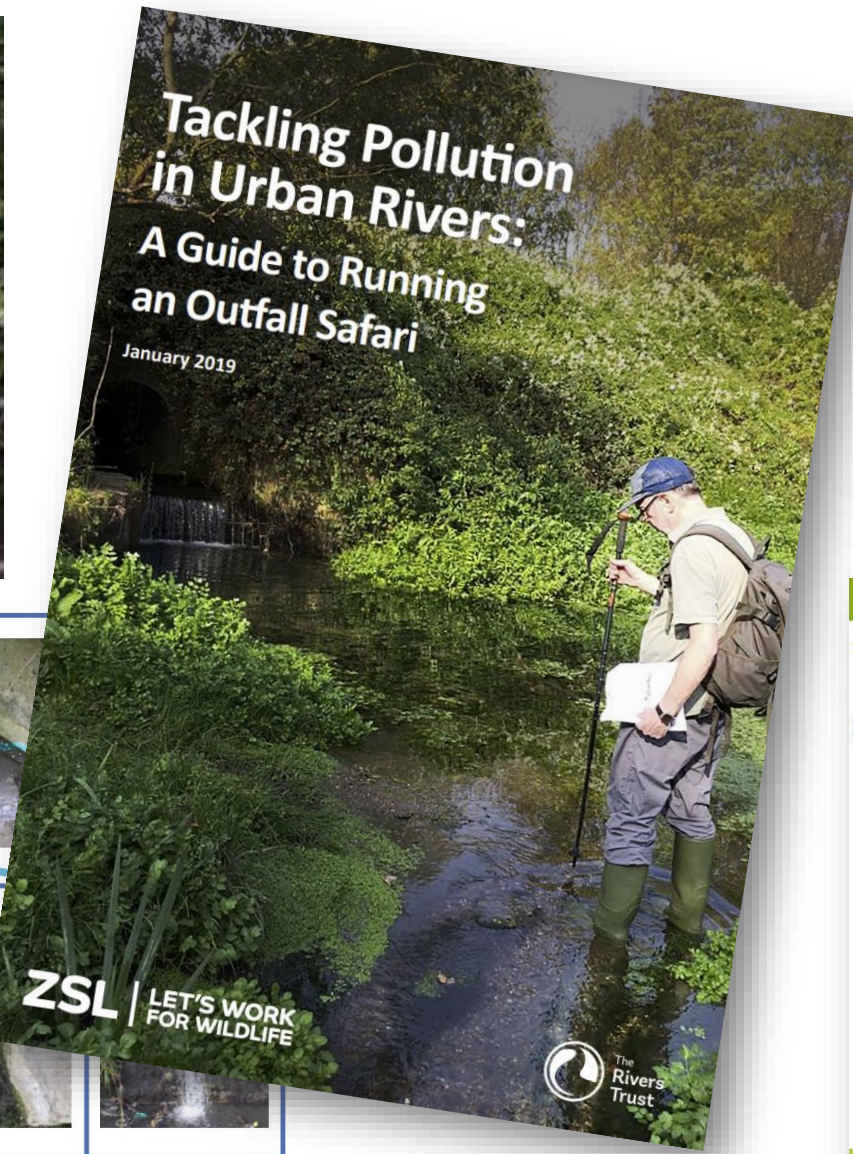
November Results



Use the slider above the graph to adjust the time period you'd like to view. Expand the graph using the button in the top right-hand corner.



Citizen Science Filling the Gap



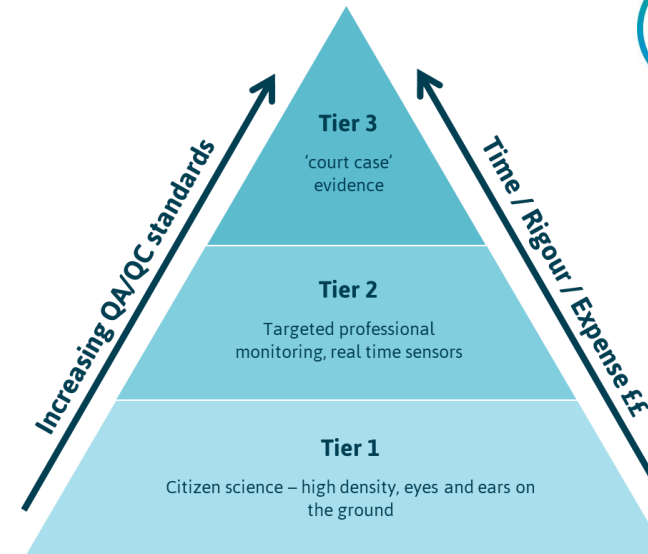
Citizen Science Filling the Gap



Regulation

- Legally enforceable controls, including product / source controls

- Monitor compliance with permits
- Set limits on new permits /sites
- Justify greater action to control pollution
- Evaluate success of action to reduce pollution



Weight of evidence

- Petteril project, Cumbria
- Evidence-based, risk-based collaborative approach
- Citizen science combined with state of the art monitoring
- Innovative sustainable solutions - natural capital approach, flexible permitting
- Wider benefits – nature-based solutions
- £300k monitoring resulted in £20m delivery efficiencies

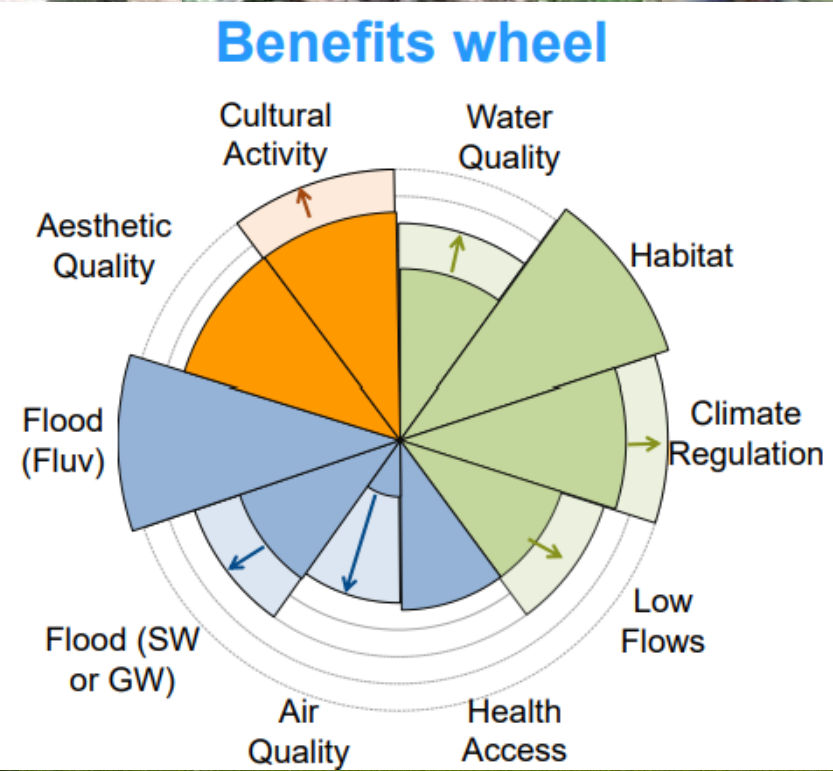
Evidence gathering

- Catchment investigations (sampling and monitoring)
- Modelling analysis
- CBA analysis
- Technical review
- Scenario planning

Catchment solutions

- Sustainable intervention
- Benefits to drinking and water quality targets
- Additional benefits (e.g.

Technologies



Mechanism

The purpose of trialling a natural capital investment approach is to test a model that would allow multiple beneficiaries to collectively pay back a significant upfront investment over time and within their institutional constraints.

These blended and bespoke deals will be based on flood performance, costs saved from a reduction in flood risk, costs avoided through a reduction in damage or maintenance of assets, or for delivery of additional benefits such as improved natural habitats, or opportunities to attract income from carbon capture.

Who will invest?

Beneficiaries 'buyers'

Who will provide these services?

Project partners

Triodos Bank

United Utilities

The co-operative insurance

Environment Agency

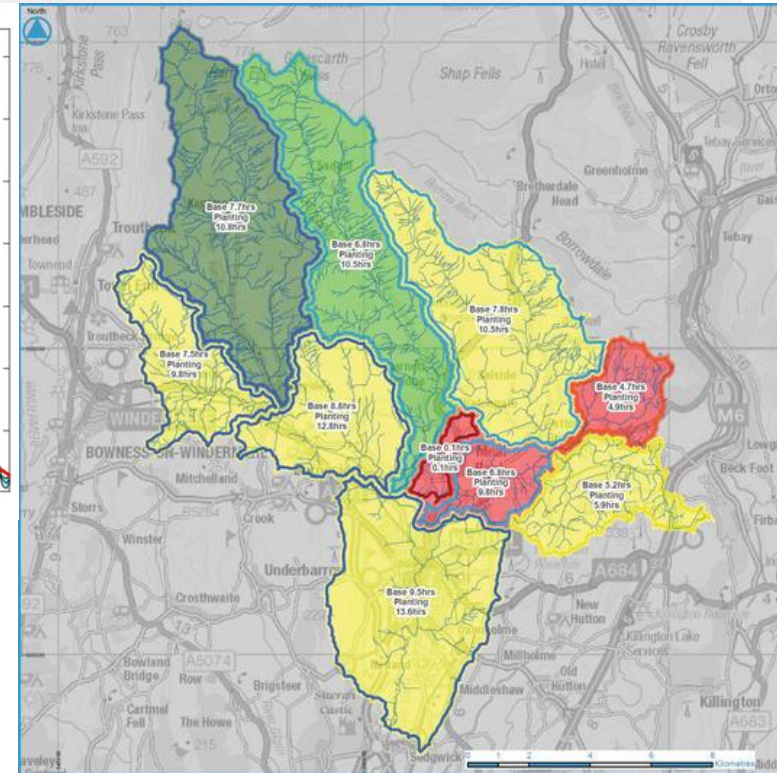
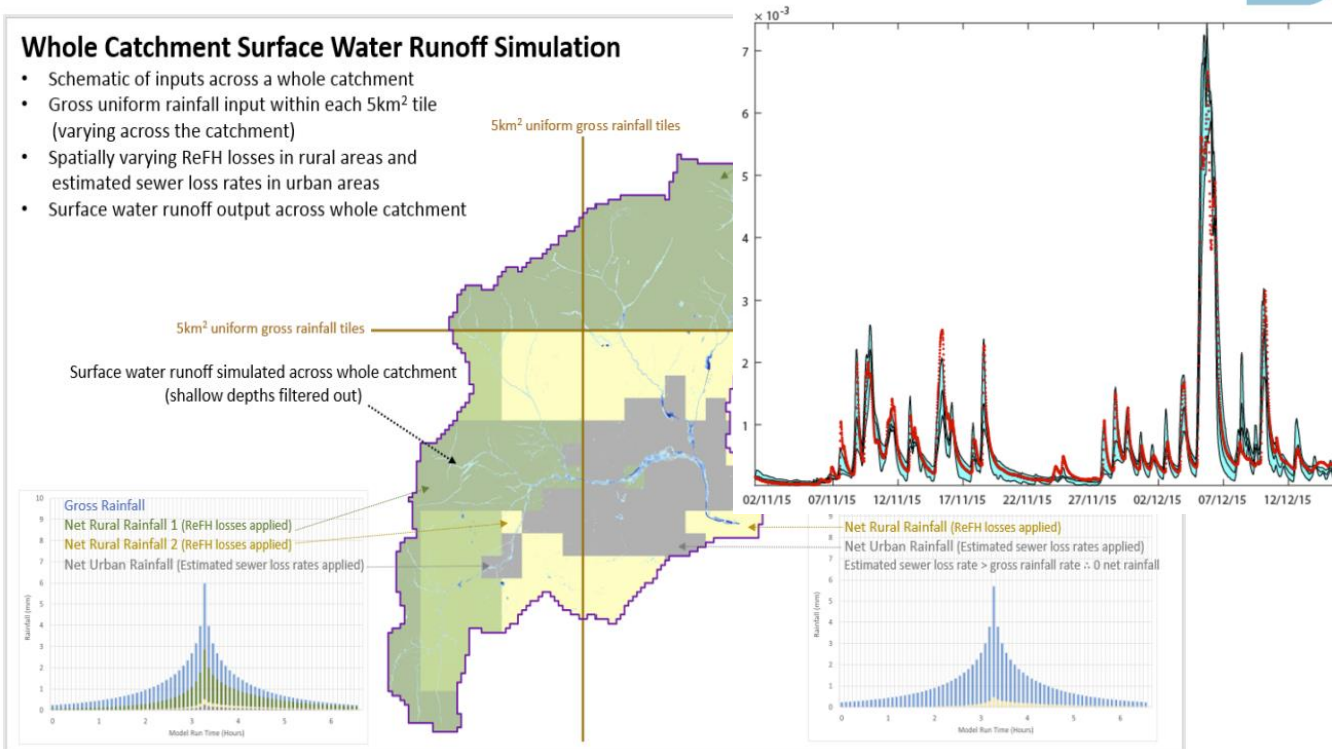


WYRE RIVERS TRUST
"from Bowland to Bay"

FLOODRE

Whole Catchment Surface Water Runoff Simulation

- Schematic of inputs across a whole catchment
- Gross uniform rainfall input within each 5km² tile (varying across the catchment)
- Spatially varying ReFH losses in rural areas and estimated sewer loss rates in urban areas
- Surface water runoff output across whole catchment



Kent Catchment

Working With Natural Processes Opportunity Mapping

Overview Map

Select layer to display from drop-down menu:
30-yr Return Period Planting Increased Roughness

Detailed River Network		Roughness Planting - A&P Percentage Peak Surface Runoff Attenuation (%)	
Blue	≤ 2	Red	≤ 1
Orange	> 2 and ≤ 5	Light Red	> 1 and ≤ 2
Yellow	> 5 and ≤ 10	Light Green	> 2 and ≤ 5
Light Green	> 10 and ≤ 20	Green	> 5 and ≤ 10
Dark Green	> 20 and ≤ 30	Dark Green	> 10 and ≤ 15
Dark Blue	> 30 and ≤ 40	Very Dark Green	> 15 and ≤ 25

Summary:
The catchment has been divided into sub-catchment analysis units based on the WFD waterbody catchments. The colour fill represents the area of each WNP opportunity within each unit. The outline represents the potential percentage attenuation monitored within each unit.
The simulated time of peak-surface runoff for each unit are annotated for baseline and WNP scenarios.
NOTE: Opportunity areas are summed within each unit whilst potential attenuation is representative of all upstream areas draining to unit outlet.
Opportunity locations are displayed on separate detailed maps accessed by clicking on a specific sub-catchment.

WYRE RIVERS TRUST
in partnership with
Environment Agency

JBA consulting

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Why isn't citizen science having more of an impact?

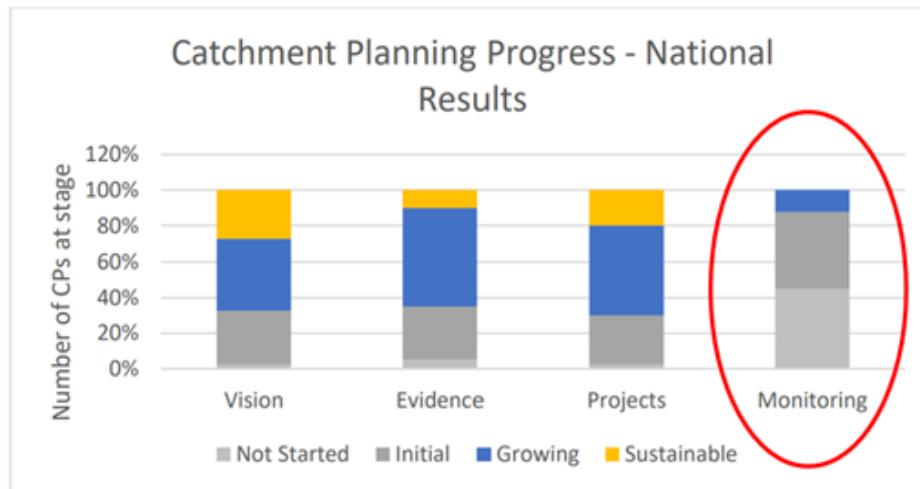
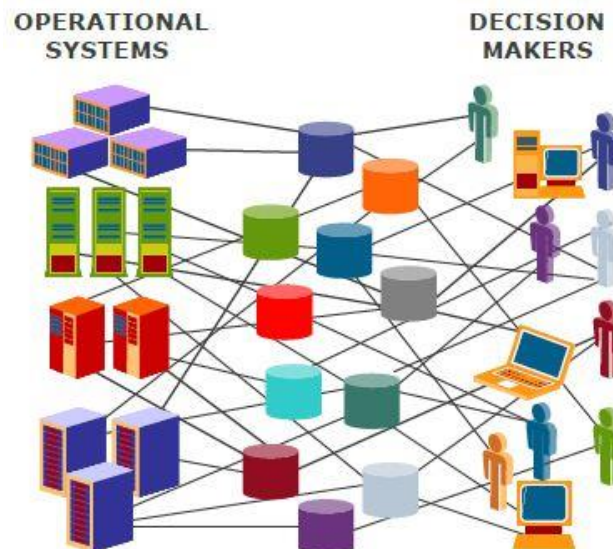
Barriers to greater impact:

Qu2. What are the barriers to using apps or shared data collection platforms? (Select all that apply)

- 16% A. Prefer to manage and control our own data
- 9% B. Lack of skills and training
- 19% C. Finance and budgeting
- 40% D. Too many apps and conflicting databases
- 4% E. Access to technology
- 12% F. Other



Source: 2019 Catchment Data & Evidence Forum



Source: 2018 CaBA Catchment Planning Review

Our Vision



Citizen science and community monitoring data are integrated into a **local collaborative evidence base** in every catchment.

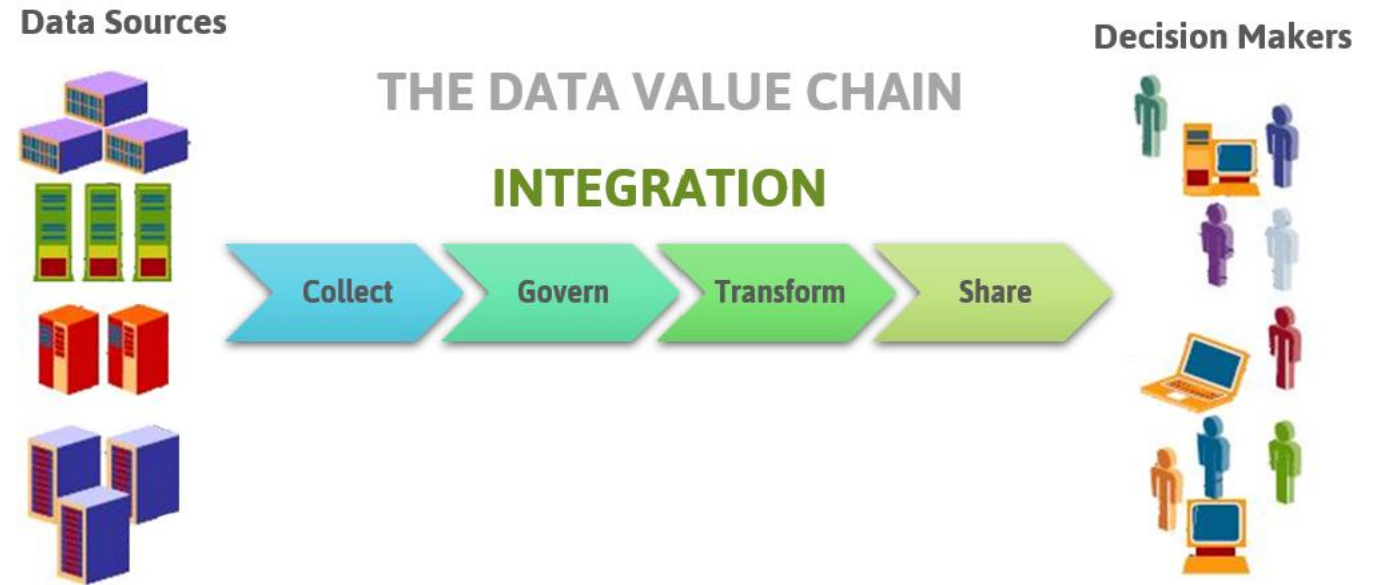
Catchment partnerships, communities and citizens are **empowered** to plan, gather, interrogate, interpret and share this evidence.

The evidence helps deliver **environmental improvements**.

The Catchment Monitoring Cooperative



- ✓ National governance and standardisation of citizen science
- ✓ Local funding
- ✓ Accredited training
- ✓ Data integration and visualisation
- ✓ Weight of evidence approaches

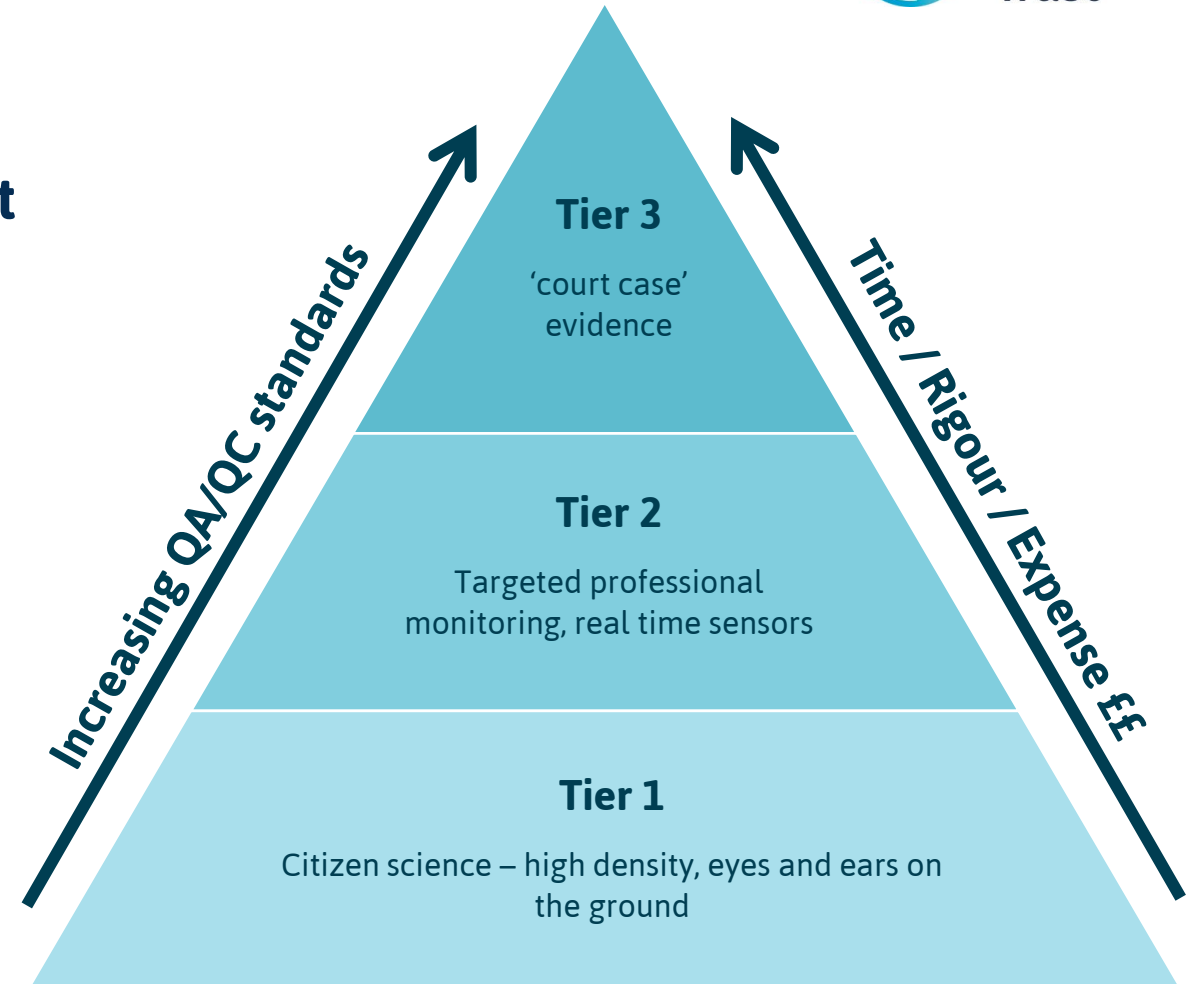


Tiered weight of evidence approach

Combine different tiers of data using **weight of evidence** approaches

Carefully planned and targeted to answer **specific** questions = greater **relevance**

Using data of **known quality** to underpin **appropriate** decisions



Consultation Responses



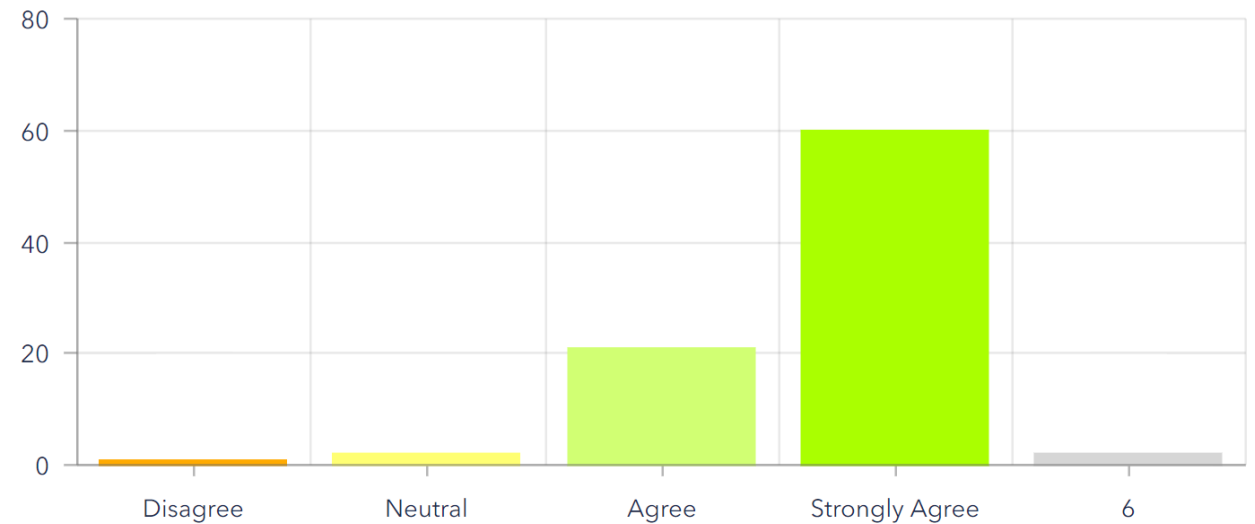
86

Reponses

37

CaBA hosts

To what extent do you agree or disagree with the with the overall aim of establishing a monitoring cooperative as set out in the proposal?



Benefits to water company customers & fit to Ofwat themes

1. Responding and adapting to climate change

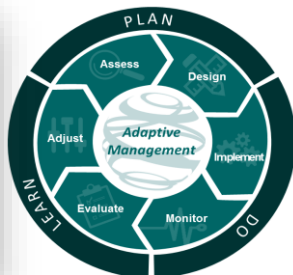
2. Restoring and improving the ecological status of our water environments

3. Understanding long-term operational resilience and infrastructure risks

4. Testing new ways of conducting core activities to deliver wider public value.

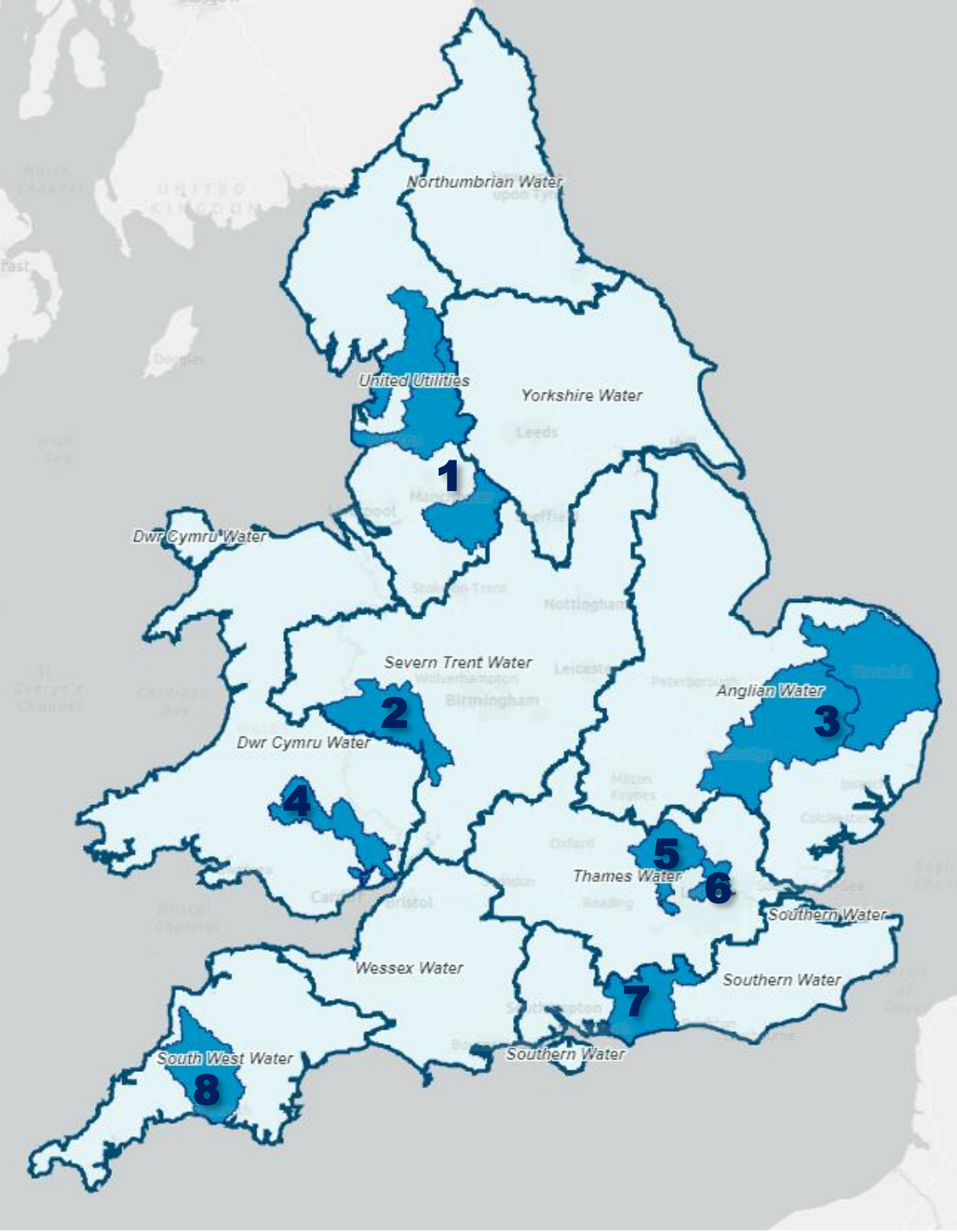
5. Exploring the opportunities associated with open data, stimulating innovation and collaboration

- Better open data
- Actionable insight
- Early warning
- Reputational benefits
- Innovative approaches
- Economic benefits
- Wider societal benefits



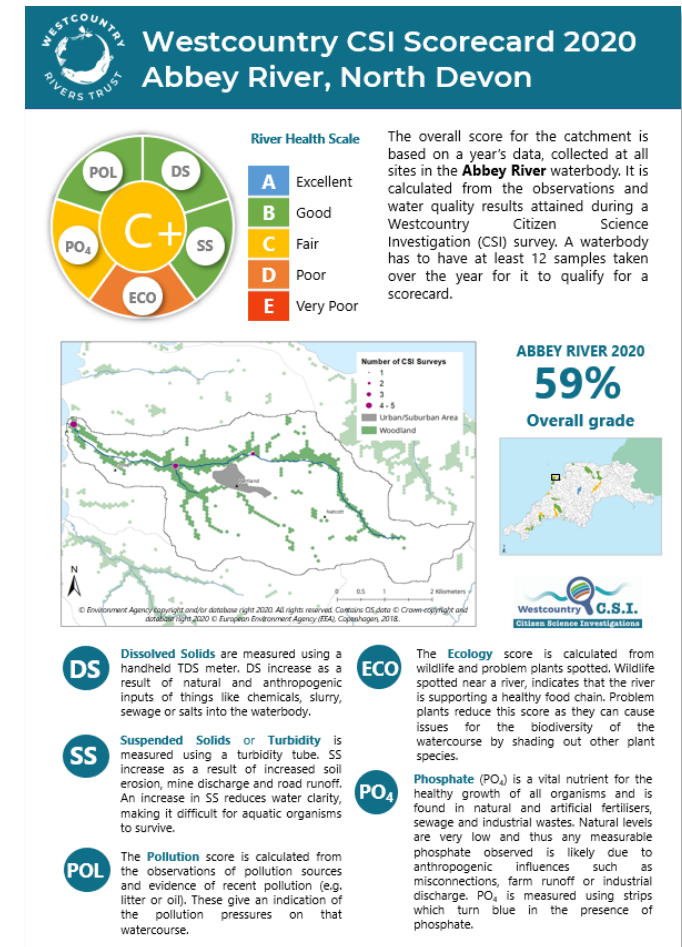
Catchment Systems Thinking Cooperative (CaSTCo) Demo Catchments:

1. **Upper Mersey (Lune, Ribble satellite demos) [Demo+](#)** United Utilities (Mersey RT, Ribble RT, Lune RT and Groundwork) *Strategic Fisheries Monitoring, multi benefits monitoring, Natural Course aligned*
2. **Teme [Demo](#)** Severn Trent Water (Severn RT) *Bathing Water Monitoring*
3. **Broads or CamEO (TBC) [Demo+](#)** Anglian Water (various Caba partnerships) *Landowner engagement & NBS*
4. **Usk [Demo+](#)** Dwr Cymru/Welsh Water (Wye & Usk Foundation) *Agriculture, landowner and community engagement, farmer self-monitoring*
5. **Chess [Demo](#)** Affinity Water (Colne CAN) *Chalk stream water resources and biodiversity*
6. **Salmon & Dollis Brooks [Demo](#)** Thames Water (Thames21) *Community engagement and modelling*
7. **Arun [Demo+](#)** Southern Water (Arun & Rother RT) *Soil monitoring and management*
8. **Tamar [Demo+](#)** South West Water (CREWW & Westcountry RT) *Diffuse water quality monitoring, asset decision support and community engagement*



Co-Design Standardised Methods

- Standard methods provides **data comparability** so can be integrated into state of environment reporting
- Cost-effective – **economies of scale** and not duplicating effort
- All partners **understand quality** so can analyse, interpret and have confidence to **act on evidence**
- Standard methods, tools and support for local groups **increases volunteer recruitment**
- Funders more likely to support local monitoring if can demonstrate **quality control** procedures



Data Platform Interoperability



Technical Innovation

- Low-cost sensor technology and IoT
- Machine learning / AI
- eDNA
- High spectral and temporal resolution earth observation
- Decision support tools



Power to the people

***“Tell me, I forget;
show me, I remember;
involve me, I understand.”***
Xun Kuang, Chinese philosopher



Governance structure



ofwat

OFWAT/Competition delivery team

Programme Sponsor



Jo Harrison
EP&I Director

Programme Manager



(To be appointed)

Programme Executives



Amina Aboobakar (*Commercial Director*)
Dave Johnson (*Technical Director*)

Steering Group

Oli Raud 	Jim Airton 	Michelle Walker (Steering Group Chair and Subject Matter Expert) 	Claire Neale 	Paul Gaskin
Tim Beech 	Alister Leggatt 		Debbie Wilkinson 	Clare Deasy
Granville Davies 	Vitty Danino 	Marc Naura 	Matt Fry 	Laurence Couldrick
Richard Smith 	Joe Pecorelli 	Izzy Bishop 	Louise Lavictoire 	

Work Package 1
Programme & governance establishment
WP Leader: Programme Manager (TBD)
The Rivers Trust

Work Package 2
Evaluation & sustainability
WP Leader: Amina Aboobakar
The Rivers Trust

Work Package 3
Method audit, selection and protocol co-design
WP Leader: Michelle Walker
The Rivers Trust

Work Package 4
Accredited training and upscaling
WP Leader: Dave Johnson
The Rivers Trust

Work Package 5
Catchment demonstration delivery
WP Leader: Project Manager (TBD)
The Rivers Trust

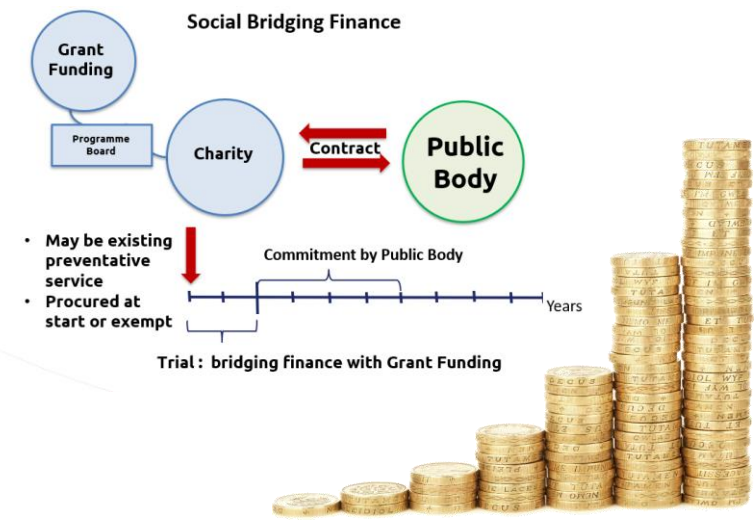
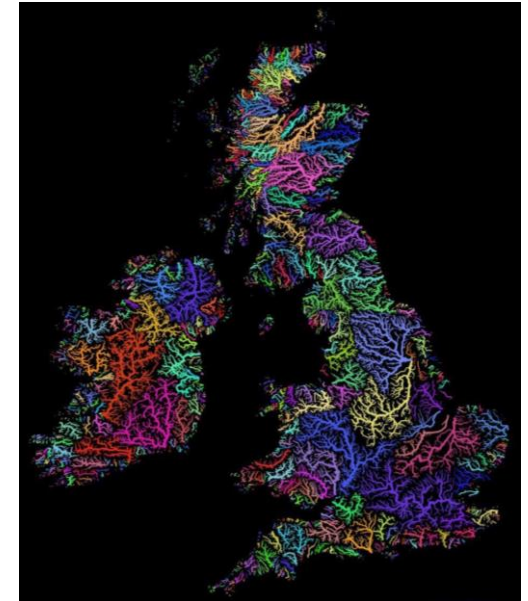
Work Package 6
Data management and visualisation
WP Leader: Michelle Walker
The Rivers Trust

Advisory members



The long-term CMC vision (Dear Santa I would like....)

- High density evidence base in every catchment underpinning nature based solutions
- Recognised brand developed collaboratively
- UK and Ireland shared framework
- Volunteer coordinators in every catchment
- Citizen scientists active in every waterbody
- Regional coordinators, demonstration and training hubs and equipment pools
- Green prescribing, skills and jobs, education
- Innovation, open data, creativity
- Govt, corporate, charitable and crowd funding = sustainable



“Never doubt that a small group of thoughtful, committed **citizens can change the world**; indeed, it’s the only thing that ever has.”

Margaret Mead

