UNIVERSITY OF BIRMINGHAM

VISUALISATIONS TO SUPPORT ENVIRONMENTAL JUSTICE-LED DECISION MAKING IN THE UK WATER SECTOR

by

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A thesis submitted to the University of Birmingham for the degree of
DOCTOR OF PHILOSOPHY

Department of Civil Engineering
School of Engineering
College of Engineering and Physical Sciences
University of Birmingham
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Volume 2 of 3

APPENDIX A: ETHICAL REVIEW FOR FOCUS GROUP

UNIVERSITY OF BIRMINGHAM

Ethical Review Form

Project details

Important Information

Please note that this form is only suitable for staff and postgraduate research students. If you are on a postgraduate taught course, your local school/college will review your work and you do not need to apply via the Research Ethics Review system.

If you need help whilst completing the form, FAQs and additional information can be found under the 'Help' section in the black bar at the top of the page. Some questions also have an 'i' on the top right, clicking this will bring up additional help text.

The form will automatically save when you click 'next'. Alternatively, you can click 'save' on the top left to manually save your progress.

Please note that this form is currently in a piloting phase. All applications may be subject to a quality assurance check and a member of the ethics team will be in touch with the lead researcher and/or applicant directly if an application raises any queries. If you would like to contact us directly please use aer-ethics@contacts.bham.ac.uk

Please note that programmes of work are currently being processed outside of the system. Please contact the ethics team directly if you wish to apply under a programme of work.

Is your project considered to be research?

A project is considered to be research if it is likely to result in research outputs (including, but not limited to, journal articles, conference papers, theses and online dissemination). Further indication of what might be considered to be research can be found at http://www.hra-decisiontools.org.uk/research/, but please be aware that if a service evaluation project will result in a research output (including theses) it will be considered to be research from a University perspective. If you are in any doubt as to whether your project should be considered as research, please contact the Research Ethics Team to discuss further.

- (•) Yes
- ( ) No

Is this a staff or a postgraduate research student project?

- ( ) Staff
- (•) Student (PGR only)
- ( ) Other (by special permission only)

Please confirm the college of the main PI/Supervisor

Engineering and Physical Sciences (EPS)

Please confirm which school within EPS the main PI/supervisor is from

Engineering

Please provide your student ID number

Project title and duration

Please give the full title of the research project

Visualisations to support environmental justice led decision making in the water industry

Please give a short title for the research project (e.g., an acronym or reduced title). You may use the same title as above if the character length allows

Visualisations to support environmental justice led decision making in the water industry

Please provide the anticipated start and end dates for the project

Please select the year before the month. Months which have already passed in the current year will not show.

Anticipated start date 01/08/2020

Anticipated End Date 01/07/2024

Contact Details For Researchers

Please note, then when entering details for University of Birmingham (UoB) staff/students/supervisors, you can click the 'assign role' button in blue at the top of each contact, selecting the correct role will automatically give that person the correct access/permissions to the current form. Please note that the form owner (i.e. who initially made the form) will automatically be given full access so, a role is not required for them.

Please provide details on any UoB PGR students involved in the project

First Name

Bryony

Surname

Bowman

Department

Civil Engineering

Email

Please enter the details on the UoB supervisors below

First Name

Christopher

Surname

Rogers

Department

Civil Engineering

Email

Please enter the details on the UoB supervisors below

First Name

Dexter

Surname

Hunt

Department

Civil Engineering

Email

Will there be any additonal co-investigators involved in the project **at UoB**?

- ○ Yes
- ◉ No

Are there any further external co-investigators you would like to add to the project? Please note that these individuals will not have access to the system but, you will be able to download the form as a PDF to share with them.

- ○ Yes
- ◉ No

Funder details

Please note that if the project will not proceed without a funding award, that ethics should not be submitted until the funding award is confirmed i.e., that the project will definitely go ahead (unless you have had prior permission from a member of the ethics team).

Is this project funded?

- ◉ Yes
- ○ No

Please state who is funding this project

EPSRC

Please state who is funding this project

United Utilities

If this project is going via Worktribe, please enter the Worktribe reference number for this project

Checklist

Please select which of the following your project will involve

- ☐ Research involving animals
- ☐ Research that needs to consider requirements under the Nagoya Protocol

  This includes uses of genetic material; plant, animal, microbial or other origin containing functional units of heredity which is of actual or potential value, or derivatives. The protocol does not apply to human genetic resources.

- ☐ Existing ethical approval from another institution in the UK or abroad, for a project that does not have NHS involvement
- ☐ Exsisting HRA approval and / or a favourable opinion from a NHS Research Ethics Committee

  This includes projects which have received sponsorship from UoB or other institutions within the UK. If it is planned that Sponsorship is provided by another institution, please select this option and provide details after sponsorship has been confirmed.

- ☐ Research which requires new application for HRA Approval and / or a favourable opinion from a NHS REC, with Sponsorship provided by UoB

  This includes research projects which will involve NHS patients, staff and services. This also includes projects where UoB will act as the National Co-ordinating Centre

- ☐ NHS Service Evaluation

  The University will review service evaluations where any of the data will be written up for a research output. If the service evaluation data will not be used for a research output then we do not require an ethical review.

- ☑ None of the above

  These projects will still be reviewed by the research ethics team

UREC Checklist

Please select all of the following which your study involves:

- ☑ Human Participants

Risks relating to participant involvement

- ☐ Potentially Vulnerable participants (including those aged under 16)

  Examples of vulnerable participants are children, people with learning difficulties, patients, people experiencing emotional distress or mental illness, people living in care or nursing homes, and people recruited through self-help groups, participants in a dependent or unequal relationship with the researcher(s) or research supervisor, or participants recruited because of their membership of groups which are vulnerable in relation to their identity (for instance, sexuality, gender or race)

- ☐ The co-operation or approval of a gatekeeper for initial access to the groups or individuals to be recruited

  For example, a gatekeeper would be considered someone who needs to give permission to access a

group (e.g., a head teacher, leader of a self-help group). If your supervisor is putting you in touch with a group of people or, you are using snowball sampling, this would not be considered use of a gatekeeper.

☐ Participants taking part in the study without their full knowledge and/or consent

e.g. covert observation of people in non-public places or any form of minor or major deception

Data collection risks

☐ Data collection/recruitment via the internet/social media without the consent of the data subjects
☐ The collection or use of obscene, illegal and/or offensive material

Including online content of this nature. This includes material which may prompt the University's duties under the government's Prevent strategy (see https://www.gov.uk/government/publications/prevent-duty-guidance/revised-prevent-duty-guidance-for-england-and-wales for further information)

☑ Visual recordings in which people can be identified

Risks relating to study design

☐ Physical or emotional harm, discomfort or stress
☐ Prolonged experiments or testing which is burdensome on the participant
☐ Financial or other inducements (other than reasonable expenses and compensation for time) for participants
☐ Sensitive or controversial topics or issues (e.g. topics which are politically, socially or culturally sensitive)
☐ Any breaking of security or other systems without the permission of the owners
☐ Potential risks or damage to the environment or society

Insurance/governance concerns

☐ Substances (including placebos, supplements, drugs) being administered to participants
☐ The collection of any form of human tissue NOT considered to be relevant material

(Relevant material being that which consists of or includes human cells, see https://www.hta.gov.uk/sites/default/files/Supplementary_list_of_materials_200811252407.pdf) including DNA.

☐ The project will fall within the exclusion of the Clinical Trial Legal Liability cover

Information on this is available at: https://intranet.birmingham.ac.uk/finance/insurance/liability/clinical-trials.aspx

Potential Conflict of Interest Risks

☐ Risks or potential controversy relating to the source of your funding

This may include politically or culturally sensitive funding sources

☐ Any potential conflicts of interest

e.g. staff of other organisations, students at school, members of self-help groups, or residents of a nursing home

☐ Any other ethical issues not covered in the above points that in the opinion of the applicant require further review

☐ None of the above

Project Details

Your answers up to this point have indicated that your project involves more than minimal risk, for this reason a full UoB ethical review is required. Please confirm that you are aware of this. Once this is confirmed, additional questions will be generated by the form.

◉ I understand that a full UoB ethical review is required

Please note that if you will be uploading any participant documents for this application that you will be required to use version controls. Information on version control can be found by clicking 'help' in the top banner of this webpage and then clicking FAQ.

Does your project contain any potentially disturbing materials which the reviewers should know about in advance (e.g. you will be uploading documents/videos etc. which may impact on reviewers well being)?

○ Yes
◉ No

Describe the purpose, background rationale for the proposed project, as well as the hypotheses/research questions to be examined and expected outcomes. This description should be in everyday language that is free from jargon - please explain any technical terms or discipline-specific phrases. Please do not provide extensive academic background material or references.

The project aims to generate visualisations to depict the relationships that each of society, ecology and the economy have with the surface water environment. The relationships held within these visualisations categorise the type of relationship and whether this is supportive or destructive to the objective of environmental justice and supported by a series of indices. The visualised relationships will be explored using foresight techniques to depict the diverse impacts of a range of futures to relationships across the surface water environment from the perspectives of ecology, society and the economy.

Please give a description of the research methodology that will be used. If more than one methodology or phase will be involved, please separate these out clearly and refer to them consistently throughout the rest of this form.

This part of the project forms the validation for baseline visualisation, this will consist of a structured discussion with a focus group including closed and open questions.

State the geographic locations where the project and all associated fieldwork will be carried out. If the project will involve travel to areas which may be considered unsafe, either in the UK or overseas, please ensure that the risks of this (or any other non-trivial health and safety risks associated with the research) are addressed by a documented health and safety risk assessment. The FCO guidance can be found at https://www.gov.uk/foreign-travel-advice

UK and other countries using web conferencing - zoom platform

Participants and Recruitment

Does the project involve human participants?

- (•) Yes
- ( ) No

Who will the participants be?

Describe the number of participants and important characteristics (such as age, gender, location, affiliation, level of fitness, intellectual ability etc.). Specify any inclusion/exclusion criteria to be used.

Group of 4-8 individuals with an interest in economics and sustainability.

How will the participants be recruited?

Please state clearly how the participants will be identified, approached and recruited. Include any relationship between the investigator(s) and participant(s) (e.g. instructor-student).

The proposed participants are part of a working group within Pivot Projects. Pivot Projects is a global voluntary collaboration which explores ideas which could lead to a pivot to a more sustainable society and identifies opportunities for action, the PGR for this project is a member of Pivot Projects. Members form working groups, one of which is economics and law and another is water and wastewater, it is proposed that these groups are approached to participate in a focus group or series of focus groups to act as validation of visualisations that have been developed through this research project.

Recruitment Documents

Will you be using any recruitment documents e.g. poster(s), advertisement(s) or letter(s), social media post(s)?

- ( ) Yes
- (•) No

Consent

You should start to consider the need to provide open access to your research data as early as possible, particularly whether you need to include consent for this in your participant documentation.

The UK Data Service provides advice on the legal and ethical issue to consider regarding data sharing and providing open access to data, including the need to obtain participant consent, at https://www.ukdataservice.ac.uk/manage-data/legal-ethical.aspx.

You can find more information about archiving and sharing your data at:
https://intranet.birmingham.ac.uk/as/libraryservices/library/research/rdm/Archiving-data/Archiving-and-sharing-data.aspx.

What process will be used to obtain consent?

Describe the process that the investigator(s) will be using to obtain valid consent. If consent is not to be obtained explain why. If the participants are under the age of 16 it would usually be necessary to obtain parental consent and the process for this should be described in full, including whether parental consent will be opt-in or opt-out.

Participants will be approached by the researcher and provided with an information sheet and consent form alongside a request for participation. The participants are part of a voluntary collaboration of which the researcher is also a part. The relevant sub-group of this collaboration will be contacted directly and snowball sampling methods used to ensure thorough representation. The consent form will be sent via email to the participants.

Please attach a copy any Participant Information Sheets (if applicable) which will be used.

Documents

Type	Document Name	File Name	Version Date	Version	Size
PIS	Participant Information Sheet	Participant Information Sheet.docx	10/05/2023	2	366.5 KB

Please attach a copy all the Consent Forms (if applicable) which will be used in the project. If consent will be gained in an alternative way (e.g. verbally) please provide a script for this or any other material that will be used in the consent process.

Documents

Type	Document Name	File Name	Version Date	Version	Size
Consent Form	Participant Consent Form	Participant Consent Form.docx	10/05/2023	2	365.6 KB

Deception

Will the participants be deceived in any way about the purpose of the study?

- ○ Yes
- ◉ No

Feedback

What, if any, feedback will be provided to participants?

Explain any feedback/ information that will be provided to the participants after participation in the research (e.g. a more complete description of the purpose of the research, or access to the results of the research). If no feedback will be provided, please explain why.

Follow up discussion of the results of the research and updates of progress including research outputs will be provided if participants are interested.

Withdrawal

What arrangements will be in place for participant withdrawal?

Describe how the participants will be informed of their right to withdraw from the project, explain any consequences for the participant of withdrawing from the study and indicate what will be done with the participant's data if they withdraw.

Participants are free to withdraw at any point up to 4 weeks after the focus group discussion. No reason is required for withdrawal. Any data collected up to this point will be deleted unless the participant agrees otherwise.

Please confirm the specific date/timescale to be used as the deadline for participant to withdraw their data and ensure that this is consistently stated across all participant documentation. This is considered preferable to allowing participants to 'withdraw data at any time' as presumably there will be a point beyond which it will not be possible to remove their data from the study (e.g. because analysis has started, the findings have been published, etc).

4 weeks after the focus group discussion.

Compensation

Will participants receive compensation for participation?

- ○ Yes
- ◉ No

Confidentiality/Anonymity

Participants will be anonymous if you will not be meeting participants face-to-face, or gaining any identifiable data (such as names, e-mail addresses, student ID's etc.)

If you have multiple participant groups, where each group has a different level of confidentiality/anonymity please provide clear details on this in the text box shown at the end of this page (the box will appear after a maximum of two selections have been made).

Will all participants be truly anonymous?

- ○ Yes
- ◉ No

Will all participants' data be treated as confidential?

- ◉ Yes
- ○ No

In what format will data be stored?

Will participants' data be stored in identifiable format, will it be anonymised or pseudo-anonymised (i.e. an assigned ID code or number will be used instead of the participant's name and a key will kept allowing the researcher to identify a participant's data)?

A recording of the focus group discussion will be held securely. A transcript will be generated from this recording and pseudo-anonymised. The focus group will be used to validate research visualisations and the documentation of this validation will be anonymised.

Storage, access and disposal of data

During the project, how and where will the data (both paper and electronic) be stored, what arrangements will be in place to keep it secure and who will have access to it?

Access to data collected will be restricted to the researcher. Anonymised data will be stored in the Research Data Store and personally identifiable information will be deleted following analysis.

After the project is complete, where do you intend to store your data at the end of the project (please select all which are relevant)?

- [x] University eData repository (https://edata.bham.ac.uk)
- [ ] An external repository
- [ ] Research Data Store (RDS) (https://intranet.birmingham.ac.uk/it/teams/infrastructure/research/bear/research-data-service/rds/research-data-store.aspx)
- [ ] Other

You can find more information about archiving and sharing your data, including your choice of data repository at: https://intranet.birmingham.ac.uk/as/libraryservices/library/research/rdm/Archiving-data/Archiving-and-sharing-data.aspx.

The University usually requires data to be retained in line with the data management policy https://intranet.birmingham.ac.uk/as/libraryservices/library/research/rdm/Policies/Research-Data-Management-Policy.aspx. Will you/your supervisor make arrangements for the data to be retained for in line with this?

- (•) Yes
- ( ) No

Do you intend to make your data openly accessible at the end of the project?

(please see https://intranet.birmingham.ac.uk/as/libraryservices/library/research/open-access/index.aspx for further information)

- ( ) Yes. A provision for open access will be put into place (please ensure a consent provision is in place for this)
- (•) No. Data will only be shared with current research team.
- ( ) Other e.g. embargoed for a period of time, data access committee to be set up etc

What arrangements will be in place for the secure disposal of data?

All copies of data related to a participant will be deleted if that participant withdraws. Their contribution to the transcript will be deleted, recordings of the focus group will not be used directly in research outputs.
Recording and personally identifiable data will be deleted from all locations following analysis and anonymisation of data collected.

Data Management Plans

Please note that these are live documents, the University Research Data Management Policy (https://intranet.birmingham.ac.uk/as/libraryservices/library/research/rdm/Policies/Research-Data-Management-Policy.aspx) requires that:

1. Funded research projects and unfunded research policies likely to generate data should be supported by a Data Management Plan (DMP)

2. Following completion of a project, Research Data should be made openly available (where appropriate), or made available for access and re-use under appropriate safeguards which take into account legitimate interests of research subjects and in accordance with the Data Protection Act. It should be kept for a minimum of 10 years.

You do not need to submit your DMP with your ethics application, but you must ensure that the information in your ethics application is consistent with the information in your DMP.

Additional Approvals

Are you aware of any other approvals required to carry out this research?

For example, DBS checks, local authority approvals etc.

- ○ Yes
- ◉ No

Risks and Benefits

Outline the potential significance and/or benefits of the research

The research will enable visualisation of relationships with the surface water system from a range of perspectives, in this case validated through use of a focus group. This aims to generate tools to enable justice-led decision making in the UK water industry providing benefits to people and the environment. Gathering consensus on visualisations and their completeness from a group of external experts will enable validation of the research outputs.

Outline any potential risks

Focus group will be conducted through an online meeting platform, passcode entry and waiting room will be selected to ensure confidentiality of the meeting.

The outlining of the risks in this section does not circumvent the need to carry out and document a detailed Health and Safety risk assessment where appropriate.

For projects of more than minimal H&S risk it is essential that a H&S risk assessment is carried out and signed off in accordance with the process in place within your School/College and you must provide a copy of this with your application. The risk may be non-trivial because of travel to, or working in, a potentially unsafe location, or because of the nature of research that will carried out there. It could also involve (irrespective of location) H&S risks to research participants, or other individuals not involved directly in the research.

Further information about the risk assessment process for research can be found at https://intranet.birmingham.ac.uk/hr/wellbeing/worksafe/policy/Research-Risk-Assessment-and-Mitigation-Plans-RAMPs.aspx.

Please note that travel to (or through) 'FCO Red zones' requires approval by the University's Research Travel Approval Panel, and will only be approved in exceptional circumstances where sufficient mitigation of risk can be demonstrated.

Does the research raise any ethical issues not dealt with elsewhere in this form?

- ○ Yes
- ◉ No

Do you wish to provide any other information about this research not already provided, or to seek the opinion of the Ethics Committee on any particular issue?

- ○ Yes
- ◉ No

Peer/Expert Review

Has your project received scientific peer review?

- ○ Yes
- ◉ No

Would you like to nominate an expert reviewer for your project?

- ○ Yes
- ◉ No

Supporting Documents

Please upload copies of any additional supporting documents such as questionnaires, interview topic guides, debrief materials etc.

Please note that you do not need to upload consent forms, information sheets or recruitment notices which were uploaded earlier in this form. To see a full list of documents already attached to the current form, please click the 'documents' button on the left hand side.

Documents

Type	Document Name	File Name	Version Date	Version	Size
UREC supporting document	Draft Interview Guide	Draft Interview Guide.docx	10/05/2023	1	17.4 KB

Declarations

By submitting this checklist, I declare that the questions have been answered truthfully and to the best of my knowledge and belief, and that I take full responsibility for these responses. I undertake to observe ethical principles throughout the research project and to report any changes that affect the ethics of the project to the University Ethical Review Committee for review. I have read and undertake to abide by the University's Code of Practice for Research (http://www.birmingham.ac.uk/Documents/university/legal/research.pdf)

(•) Yes

I understand that if my study involves more than minimal H&S risks, a H&S risk assessment must be carried out (see https://intranet.birmingham.ac.uk/hr/wellbeing/worksafe/policy/Research-Risk-Assessment-and-Mitigation-Plans-RAMPs.aspx). This includes risks due to the location of the research to be carried out (either in the UK or another location) or risks relating to travel. Further information about risks relating to overseas travel and working overseas can be obtained from the Foreign and Commonwealth Office (see https://www.gov.uk/foreign-travel-advice) and from RiskMonitor Traveller (see https://umal.co.uk/travel/pre-travel-advice/)

(•) Yes

I understand This form will be processed in accordance with the Data Protection Act 2018. Please see the University's Data Protection Policy at https://www.birmingham.ac.uk/Documents/university/legal/data-prot-policy.pdf for further information.

(•) Yes

Would you be happy for this application to be used anonymously in future training sessions with the committee and/or other applicants?

(•) Yes
( ) No

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Please note that once all signatures for the project have been gained, the project will automatically be submitted to the ethics team

If multiple signatures are required, the form will lock so no changes can be made. The form can be unlocked by anyone with access to edit the project. Please note that unlocking the form will invalidate all signatures.

Please confirm you are happy with the form as the **lead supervisor** on the project

Signed: This form was signed by Dexter Hunt [redacted] on 20/05/2023 11:12

Please confirm you are happy with the form as the **lead PGR student** on the project

Signed: This form was signed by Bryony Bowman [redacted] on 18/05/2023 12:53

UNIVERSITY OF BIRMINGHAM

Dear Christopher Rogers, Dexter Hunt, Bryony Bowman,

RE: Visualisations to support environmental justice led decision making in the water industry: testing

Application for Ethical Review: ERN_1814-Feb2024

Thank you for your application for ethical review for the above project, which was reviewed by the Science, Technology, Engineering and Mathematics Committee.

On behalf of the Committee, I confirm that this study now has ethical approval.

Any adverse events occurring during the study should be promptly brought to the Committee's attention by the Principal Investigator and may necessitate further ethical review.

Please ensure that the relevant requirements within the University's Code of Practice for Research and the information and guidance provided on the University's ethics webpages (available at https://intranet.birmingham.ac.uk/finance/accounting/Research-Support-Group/Research-Ethics/Links-and-Resources.aspx) are adhered to.

Please be aware that whilst Health and Safety (H&S) issues may be considered during the ethical review process, you are still required to follow the University's guidance on H&S and to ensure that H&S risk assessments have been carried out as appropriate. For further information about this, please contact your School H&S representative or the University's H&S Unit at healthandsafety@contacts.bham.ac.uk.

Kind regards,

The Co-Chairs of the Science, Technology, Engineering and Mathematics Committee

E-mail: ethics-queries@contacts.bham.ac.uk

APPENDIX B: TRANSCRIPTS FROM FOCUS GROUP DISCUSSIONS

Meeting held: 24th August 2023

Online meeting using zoom platform

Attendees:

Interviewer: Bryony Bowman

Member1 – Based in USA. Background in political science, involvement in Smart Cities and, more recently, disaster resilience.

Member2– Based in UK. Background in environmental science and computing, with involvement in conservation, innovation and smart cities.

Member3 – Based in USA. Career in advertising/ illustrator. Interests in economics, physics and using art as means to exploring these ideas.

Member4 – Based in Canada. Involved in smart cities and leads research, new technology and government relations for global organisation.

Member5 – Based in USA. Background in industrial engineering and organization psychology. Interested in the interface between the worker and work.

The below is a transcript of a meeting held between the attendees to discuss the relationships society has with the surface water environment from the perspective of economics. This

discussion was aided by viewing a draft version of the visualization created as a system map using Kumu. The transcript starts after introductions had been made.

Blue text – statements that can be used in the discussion of the basis for the research

Green text – statements that can be used in the discussion of social justice and the water environment and policy/economic frameworks that sits within.

Orange text – future possibilities

Speaker	Transcript
Interviewer	I'll run through a brief description of my research and where I've come from. And then we can start a discussion, I have some questions to work around but we can go with the flow lets see where it takes us. I'm looking at generating decision support tools. So, these are not going to make a decision, so it's not an input all your variables and the output would be the best thing to do in a given area or catchment. It's more to be able to visualize the relationships we have within a catchment and look at how these interact with each other. And also to look at that from different perspectives: environmental, societal and economic. This is all based on England and Wales as a primary focus, the reason for this is that is in a similar regulatory and policy framework. I'm interested in views from around the world but this is to be applied in England and Wales.

	Once I have an understanding of those relationships within a catchment it's then applying foresight techniques, so looking at extreme but plausible futures. How these would manifest at a global scale and then how they would manifest at a country and then at a local scale, and how those interactions that we have with the relationships we have within a river system. For example, if we get societal breakdown that means that some relationships become really strong whilst others become weak and what does that mean in terms of the river environment as a whole.
Member2	Just an observation on the whole visualization concept. In science all the major breakthroughs are when you get the telescope, the microscope, the MRI scan etc that do visualisations and you can see information in ways you've never seen before. So that's a fundamental kind of premise that your research is about. It's just a comment but does make sense.
Member5	I'm curious, I'm trying to bridge between this idea of visualization. We've done a lot of social network analysis in my world where we look at a social network and the strong and weak connections and hubs and outliers and spokes and so forth. So, I'm familiar with that visualization type as far as it goes, in the context of social justice and water and your background in sanitation I think you said. Which end of the water are you on? First of all, the front end where we all drink it, or the back end where we dispose of it.
Interviewer	The whole system. So at the moment, in the UK water system is kind of split, so the water companies are split with the water side and the wastewater side

	and the regulations are very different for those two things. There is an aspiration towards integrated water planning, that's not really coming through at the moment if I'm being completely honest, but there is a need within catchments to have a more holistic view. So, what I'm looking at is a river system, or I'm calling it a surface water system because I'm including lakes in there. And this includes the whole of that system from headwaters through to the estuary. It includes all of that and all our relationships within there. I am having to bound that system in some ways, so the soil environment is an external system as are groundwater and air quality. But I am looking at the relationships there are between those systems and the surface water system.
Member5	Where does social equity figure into this? And in an extreme case when we're in a pressure situation, how does that play out in a developed country like England. Where, you know you don't have these, I'm assuming, infrastructure gaps like we have in America where even though pretty developed we're a huge area and we have outlying regions that are very rural and undeveloped or underdeveloped. They get dissociated with the mainstream in infrastructure by big business interest sometimes and so the central valley ends up having towns where the groundwater is being taken up by agriculture and their taps now are not functioning. This is a problem here. But I'm trying to figure out what does that look like in England and you're concerned with and I'm trying to get my head round the problem state

Interviewer	Within England and Wales the abstraction licensing is governed by the environment agency and natural resources wales. So, they determine who can abstract water from where and what are the maximum limits. There is a degree of this competition you mention between whether water is used for industry, agriculture, energy production or domestic use. It's not as extreme as in America although I think in a few decades from now it could be in certain areas, particularly in the South East of England where there's big concerns around the availability of water in the future
Member1	The problem you've got is that administration boundaries almost never coincide with hydrological boundaries. Therefore, like it or not, and that's true of any country in the world. Therefore like it or not the multiple agencies have to collaborate which is not something they do naturally. It's the exact same problem that I see in disaster resilience where the resilience of a city is absolutely never in the hands of a single agency. And you've got multiple pieces of critical infrastructure that might be in the hands of different private sector organisations. You've got multiple government bodies. You've got multiple civil society bodies. You've got a huge concern for social equity in that. And actually with the problem you're looking at is not a million miles from resilience in the wider sense, anyway. You know. So a little parable about how it might work. And[Member2]'ll be familiar with this way back. When Ibm was doing Smartwater. we were piloting a Leak Detection technology in Sonoma County Water Agency, just north of where [Member5] is now. and we

	were working with Sonoma, which is a water wholesaler and a bunch of retail smaller water agencies that were the retailers for towns and places like Sonoma. Santa Rosa. I can't remember the other. And so on. We were working with those agencies to get them to collaborate on leak detection, which was to their mutual benefit, because this leak detection would have worked on the infrastructure that they all shared, and we were trying to work with them at the same time as they were suing each other over water rights. And interestingly, we found ourselves in the position of being the neutral broker. They talk to us where they wouldn't talk to each other. and eventually we hit a solution with them that they wouldn't share information with each other. They were just never going to do that. So we said, would you send the information to us? If we tell you what to send, would you send it on a schedule to us at the central Point? We'll aggregate it and give it back to everybody, and you'll all get back more than you gave. because we've done the aggregation. And we were copying a model that actually was applied first again by Ibm in Galway Bay, in the west of Ireland, where they had a similar issue, where nobody would talk to each other, and in that case it was the Marine Institute of Ireland, stepped in and said, This is damn stupid. Can we agree to share data? And then, at least we can. The politics proceeds on the basis of a shared basis of data. We can still disagree, but at least with disagreeing on the same data. And this, this is what we're trying to achieve with Sonoma. And that's how I proceeded. We got them to

	agree to supply the information. And it really got me thinking about the politics of information layouts. the politics of information. You could engineer a situation where everybody who provides information gets back more than they gave therefore it's worthwhile to do it. it can work but that's so rare is the thing, you know. That's the problem. Because other than that collaboration is, unless somebody's got legal mandate hanging over their heads, you know, like an anvil on a bit of rope or something. Collaboration like that's an unnatural night for an organization. They just don't.
Member5	So that's an example of a solution. Bryony, How does that bump up? Well, I think I'm starting to get a handle on the problem statement. because you did address that after I asked you the last time. But I guess I'm curious to know, like what [Member1] was just describing as an example of a solution around, you know, sharing information for the greater good, and it sort of generates a positive, not a feedback loop, but it's a win win, right? And so I guess that's an answer. But what's the question like, how does that? How does that feed into what you're trying to do, or, you know, connect to it at all.
Member1	Could I have a shot at? Articulate the problem statement we were solving. which is.and this might be what Bryony is after. It might be some, some, you know it it might not, but it might help. The problem we were solving was, how

	do you get organizations to collaborate around the management of a wider resource in the case of Sonoma County Water agency. It was a shared water infrastructure, but it could as easily be a watershed or some hydrologic system, an aquifer, let's say the Ogallala Aquifer in the Midwest and so on. Right? So it could easily easily be. That is, how do you get organizations to work across the boundaries between them without actually forcing them to dissolve the boundaries between them, because obviously, they can't suddenly become one organization. That's not gonna happen. How do you get them to work together. That's, you know, it's where politics meets information systems, if you will.
Interviewer	Yeah, yeah, there is an element of that. and is also the case that so within. Within the UK. That there is water pricing is almost a flat rate. and some people are metered. A proportion of the population have water meters, and so pay for the volume that they use. But it tends to be the more affluent people that have water meters and the less affluent people don't. And essentially they pay the flat rate. So the proportion of their income that is spent on water is very variable across the population. and for a proportion of the population that then tips them into water. Poverty. as defined by the UN. So even in a country as rich as England there are people in water poverty who can't afford to pay the water bills, and there isn't sufficient kind of social support to allow that.

Member2	Oh Bryony I've got story from Peterborough addresses exactly that that kind of thing. We were using Google earth to visualize the city data. So it was all about kind of smart cities understanding the system that you're in. And we looked at the water meter data which households had got water meters, which ones didn't. and we presented that information on a map. But then we flicked on and off the fuel, poverty, data. and there was an exact match that said, If you haven't got a water meter, you're very likely to be in fuel poverty. The conversation then ensued about well, if the water company could encourage people in those areas, specifically target them to take up water meters, that would reduce their income and get them out of fuel properties. Okay, a little bit. But it's that kind of thinking. And that was only possible because we were able to visualize 2 disparate sets of data on the same Google Earth map. And I think to some of [Member1]s points, the presenting the data on the wall enables people to collaborate around solving systemic problems as opposed to sitting across the table arguing, well, I'm doing this. You're doing that. Yours is one mine's right and nothing, no progress happens. By visualizing it you create this, the new space on the wall that enables people to understand how a system works and invent new solutions that often, like this one, cost nothing. Both parties gained. And then

	it just, it was a win win. So there's lots of systemic solutions like that that are hidden because you can't visualize what's going on.
Chat message: Member2: Water Meter Distribution in Peterborough https://youtu.be/aZMEJ9P-4w0	
Chat message: Member2: This is an energy distribution visualisation , however it could be a water usage visualisation https://youtu.be/6-I3Kv5YaAU	
Member5	No concept, I have no concept of a system like you're describing. I don't get a water system that doesn't have a meter at each user. We don't have that here
Member1	I tell you what, they do still have that in Sacremento, in places
Member4	It's like in Montreal, we don't. Nobody has meters up here. I think. You know, we're thinking about putting them in for some industrial institutional users. So the big ones. But aside from that, nobody has. I don't have a meter. It doesn't really matter. If you have a swimming pool and 4 cars to wash, you pay the exact same water tax, and part of that is because there's an abundance of well, relative abundance of fresh water, and the production cost is very low. It's like below, you know, below a cent per cubic meter kind of thing. So, putting in putting in water meters and monitoring them would actually be more expensive than whatever it is. You think you're gonna save in water? That also means that the infrastructure is very leaky. So, we had probably something like 50 per. Yeah. 50% non revenue water. Because of the amount of leakage cause, it was considered to be cheaper just to produce more water than it was to fix the infrastructure. Now that's gotten a little better, I think we're down to

	about 30%. But the reason that there is action taken there is because the leaks actually impacted telecom and electric infrastructure. And that's why they decided to fix it, not because they're losing money on water. It's a waste of water whatnot it's because it had some impact on things that actually did cost money.
Member1	So you've got a. You've got a situation where you're obliging people to collaborate over a resource that historically, has never been valued in line with this actual worth to mankind. The diamond water paradox. And yeah, absolutely. If water, let's say, was as valuable as oil. you can bet your ass there would have been more wars about it, and there would be more collaboration about it, cause it would be it would. It would be more worthwhile either the war or the collaboration, one or the other. Right? But it isn't. It's just this stuff that's there in the background. Everybody takes for granted. Nobody values it properly until it acquires some additional value, like telecoms systems that is knocking out. And the phone company gets pissed off and says, Hey, can we fix
Interviewer	Or until you have, year after year of droughts. And suddenly, it's impacting people's lives.
Member1	Yeah, that would be here. Yeah. The the worst thing that could have happened for water management in California was the wet winter we just had. because

	people will think the problem's fixed, and they'll go back to their old attitudes because we had the one of one of the wettest winters ever. During the drought people will start to take water management and non-revenue water and water rights and all that stuff seriously. And now I reckon they're probably gonna stop.
Interviewer	Well, we've got a lot of xeriscaping pride efforts in residential lawns here, but it tends toward the affluent just like solar. a lot of solar installations. But guess what it costs a lot of money to put that stuff up, and you get a Federal tax credit when you do it. Which again, the wealthy are smart about that stuff, and have the wherewithal to go after it. So they do it. But they're the people who can afford to do it. And yet it's a tip of the iceberg problem right? Because most people can't afford it.
Member1	And again, we see that with disaster, resilience over and over and over again, the people that live in the most dangerous places tend to have fewer resources. They are less able to make those homes and lives more resilient. In the first place, they got far fewer resources to recover. And that's true in the Bay area. What you think about the so called Flatlands in Hayward and San Leandro. Which are gonna be the places that get level when the Hayward fault goes. And it's true all over the world. That is probably true with water management in different places as well. You've got this equity issue shot right through the whole thing. You know, and it's as true, I think, of water

	management as it is of any other, any other good or service, you know, different people, you know, road pricing. It affects different social groups in different ways.
Member5	Bryony, what do you? What do you want from us, Bryony?
Interviewer	So I think it would be helpful if I showed you the visualizations that I've generated so far. and we start talking around them, and I've got some questions around them. Okay? So in terms of kind of data visualization. I'm looking at developing indicators and visualizing those on GIS. I'm not quite there yet, so I will show you at the moment my kumu maps. So these are very zoomed out, and the system maps that I'm looking at just to give you a bit of an idea. So this is from an environmental perspective. So what does the environment or the ecological systems? What do they need from a river system in order to function properly and to thrive. This is from a society point of view, and then this is from the economic point of view. These 2 [environmental and societal], I would say, are fairly straightforward. quite complex. But the relationships are causal. And there are that there's scientific research that backs them up and supports them and evidences those relationships. However, since those relationships from an economic point of

	view, because also, I'm looking into alternative futures. The economic policy framework could vary and could change. And that's why this is causing me more of a headache. Basically because. although we could look at or I could look at the policy economic structures that are in place at the moment. and what that leads to, what behaviours that leads to, what influences that has on a surface water system. and that then wouldn't they be translatable to an alternative future where a different economics framework was in place? Does that make sense?
Member1	So? Surely the art and science of this thing is finding alternative ways to value water while we wait for the law of supply and demand to boost the value of water itself. Which you will eventually. Just as an example, Bryony, wildfires right? A hydrated landscape is a hell of a lot more resilient to wildfires in a than a desiccated one and one that is in drought. Well, that has a value. And you know, that, could that reasonably be computed? The nature Conservancy recently did some work on ecological forest management practices and the potential impact in reducing wildfires. They did a case study just north of Tahoe and they found, you know, significant gains to the point where wildfire insurance would become feasible again when it was rapidly becoming impossible to get. That was about thinning undergrowth and all that kind of this but the same principle applies. If you hydrate the landscape, if you re establish surface water flows, riparian zones, and so on and so forth. One.

	You've got a lot fewer dead trees will become fuel. but also the hydrated areas themselves tend to act as fire breaks and there's a lot of a lot of empirical research to that. It's just that nobody has ever tied that together, and said well. If I reestablish this riparian zone, X percent less likely to have a wildfire that needs to translate into Y percent insurance premium reductions and over the over the long term, it will translate into Z percent loss of economic activity. You know, there's there's a whole bunch of calculations like that. And then, similarly, with drought. Water's not valuable, not valuable, not valuable, until all of a sudden it is. And you can see that the price of water rights is going up over a period of over a period of time, which sort of starts to reflect that. But there are other values as well like. If we stop pumping water out, the ground will reinflate their roads. So the central valley, you know, might actually start to come back up to the level it was when we first got to this country. Right now. It's about 14 feet below and everything keeps breaking. That has a value if you're preventing that from happening, although I guess it would break again if you repaired it to deal with it. It’s gonna break again when you lift it back up the 14 feet. But you know all kinds of additional values like that. You know. Another great example is the Salton Sea which is drying out, and these all the people who live around it face with a prospect of breathing alkali

	dust for the rest of their lives, which means the rest of their lives are going to be damn short. If you can re-establish the Salton Sea you know you've saved massively on healthcare costs, quite apart from the actuarial value of a human life. You've saved massively on their healthcare costs and you've re established what used to be a thriving tourism industry down there as well. So it's for me the art and the science of this thing, as I say, given the fundamental situation that water is undervalued, although that is changing, it still, is to look for all the additional values, all, all the co benefits, if you will.
Interviewer	So essentially looking at a multi capitals, approach so, looking at all those non monetizable or indirectly monetizable value that we could generate through water
Member1	Yes. yeah, yeah. I'm making that work exactly what you just described. Work requires information to be shared. which is, you know, where we came in? Yeah. And so
Interviewer	From a from a water industry point of view, that is an externality, that they don't have control over, or they have some degree of control over but not total control over. So, what I'm trying to show in these system maps is: what are the relationships if we are truly pushed by our government to a GDP economic growth. a very

	simplistic economic growth model How does that manifest in terms of the surface water system. And the alternative to that is a multi capital's approach. And the alternative to that is a donut economics or planetary boundaries approach.
Member1	I'm not sure that there is that much difference between the multi capitals approach and a simplistic economic approach cause. At some point those multi capitals are actually gonna get valued. And they are actually going into a basic equation, which is exactly what the European Union, for example, is going help another on all of the environmental directives in the US. As well. So eventually, that and the question is whether they'll converge fast enough to save us all.
Interviewer	I think that's it. So from my understanding of it. So if you, if you pursue a multicapital's approach, you could still be pursuing economic growth. it's how you define what that growth is, and how you calculate what growth is. That could still mean that in the short, to medium term. or in the medium term, you are exceeding planetary boundaries. And it's at what point does looking at multi capitals bring you within planetary boundaries?
Member1	Yes, so can we do it fast enough
Interviewer	Yeah, okay, good. I understand this excellent yeah. And so in terms of looking at foresight. Sorry, I'll close this. I don't think we need it.

Member1	No, this, I think is inspirational, actually leave it
Interviewer	So in terms of the futures analysis I'm looking at this is transposing us. And so not looking at trends. We don't have the data to be able to look at trends. I don't believe, across all of these systems. But it's transposing a sort of 80-100 years into the future, and saying, well, if we live in a future where x, y, and z are happening, then this is what happens to these system maps. These relationships are the ones that happen. These ones disappear and don't happen. and does that enable us to thrive as a society and as an environment or not. And then so there's 4 different alternative futures which are extreme, they're plausible, but they are extreme versions of a plausible future. So they extend between sort of market forces, driven approach, a very strong sustainability approach. And a Fortress World so you have the rich it in in some areas, and then the poor majority everywhere else in an environmental dystopia
Member1	Stratification you mean
Interviewer	What I'm trying to show with these system maps is kind of how all those alternative futures could manifest, and each of these system maps will be varied to look at those different options. The purpose of this meeting, we'll get there an hour into it, is to say all these system maps complete enough that we could look at different alternatives.

	Do they sufficiently represent the relationships from an economic perspective?
Member1	I'd say the instant reaction is, they're too complete. You've got too many variables there to tease out the major differences, I would have thought. but that's that's just an instant reaction
Member5	If they were, if they were complete. What does that mean to your research? And if they aren't complete, what does that mean to your research?
Interviewer	So, if it is a valid representation of the system then I can start playing around with the futures analysis. seeing how that changes these relationships and then test it. So you have a test catchment to test it within with a transdisciplinary groups that are active in that area to test it with it.
Member1	Something else you might want to think about. And this is just a completely orthogonal thought, are you familiar with the movement for the rights of nature?
Interviewer	Yes
Member1	Yeah, I mean, so just looking at that. That might be another scenario. You know that people. So they've done that with the Klamath River in California.

	Giving it its own legal voice. To exercise that voice for it, but it counts, you know, the they've been doing that in New Zealand and various places in Latin America. Chile, I believe for a while. I'm not sure how that would change some of the variables here, or is one of the scenarios, or one of the solutions, if you will, that What it would actually change? Will it actually drive the kind of choice that we need? I don't know. That's what seems to me it'd be worth investigating with it.
Member3	You know something. I was always kind of disgusted with Las Vegas. Nevada is just being just a Cadillac in a desert, and just totally ridiculous. But then I read an article a few years ago in the New Yorker, about how there was a push to privatize water in Las Vegas, and there was one woman on the municipal board who said, No, no, we can do this ourselves. And so they made a concerted effort to stop leakage and dissuade anybody from having lawns. And Las Vegas grew by 50%, but they use the same amount of water. and which is an astonishing achievement. And so instead, I went from disgust to actually admiring the municipality there that actually got their act together and did all these things that that made a huge difference.
Member1	If it's the woman the woman I'm thinking of, I can't remember her name. She was a singular force of nature. I've met her a few times. Anyway, she's retired now. But so yeah, yeah, yeah, you're exactly right. The problem, though the counter-argument of that is yeah. But like, Power's still running out..

Member5	So say, you don't really need Las Vegas. It's very impressive, but it's still a desert. There's not any water there. There aren't supposed to be people there.
Member2	Bryony, can. Can I make some suggestion about the visualization. So it might be that your aim is not to design or find solutions. but to create the environment which solutions can emerge
Interviewer	Yes, that's exactly it. The idea of all these visualizations and the research as a whole, as as a whole of body work is not to say. This is where we want to get to. And this is the pathway to get there. because there's lots of local differences that need to be applied. It is to provide the tools so that individuals in those local areas that that need to be involved in those conversations can have their views represented more equally So, within my work history. I've worked on projects where we had regulatory requirements and Water Framework Directive to provide X level of treatment across an area. And on going to that area and speaking to local stakeholders. they say, well, no, that's not the problem in this area. The problem is, the floods wiped out the soil around the rivers and people's homes. And that's what we want to invest in. We want to invest in flood resilience not in improving water quality. Being able to have those conversations more equally to bring those

	issues to the forefront where there may not be, as they engage local stakeholders and be able to to have a more holistic view over what should be done within a river catchment. So, not deciding what it should be but to be able to have a more holistic view of how it the problem should be articulated and then approached.
Member2	There might be an occasion with these visualizations. Say, well, this is how the system looks at the moment. And I've sent you some videos that we did of work in people. And then being able to say, well, imagine if this was in California, and they've got these problems and these resources and these water stores and these canals, this the system might behave completely differently. Because I think what you mentioned about future scenarios. Not only do I have to use the visualizations to solve today. But they've got to solve the equation for climate change, for energy use, for future pollution. So for, all the issues flooding and food security. and they they've got to have a way of saying, Well, if we did have a drought for 6 weeks then our system isn't resilient. Or if we did have rainfall of this intensity, then this is what would happen, and they can get a kind of future scenario out of the visualization that worries the heck out them.
Member5	I was going to just interject here that this is reminiscent of another pivot project effort

	that I was briefly working on called Democracy 2.0
Member1	Right
Member5	Bryony, you haven't really been hanging around pivot projects much, have you? Are you familiar with what I'm talking about?
Interviewer	No, I'm not. So. I was involved in the water pivot projects group. But yeah, because of young children, and it's not working on Friday. Not very aware of what else has been going on.
Member5	Okay, well, what? What's interesting to me? That's the side note is, there's a resemblance here, I think, in the social dynamic in respect of what D2.0 is working on, where they're basically trying to create a second UN charter for the United Nations. Yeah, it's very ambitious, and they have people from Parliament involved, and people who in are involved with the UN. And so they've got quite a powerful team working on this. But what they're basically observing is that even though the United Nations is meant to be a round table of equals to develop UN kind of policies that affect everybody. The fact remains that the wealthy countries and the powerful countries and the populated developed countries have a more equal say. And so. as a result. The people in the southern hemisphere of the world, you know, tend to get overlooked. you know, by and large, because the northern countries make the policies on things that affect the southern countries disproportionately, badly. For instance, right? And so

	the democracy 2.0 vision is a charter that would level that playing field up and give these minority (that's in inverted commas) countries an equal say at the table on the matters that affect them. Now it strikes me that what you're working on is a way of modeling the water situation in the UK or in Wales, where you're working. That would address some of that, Is that the social justice component of it in a way? And so, it could be a policy tool what you're building but you'd have to get buy in from both sides of the equation. The power brokers as well as the people who currently are kind of overlooked or don't have a seat at the table.
Chat message: Member4: https://www.cbc.ca/news/canada/montreal/water-meters-montreal-1.6941269	
Member1	You've got social equity on there [the system maps shared on screen], Bryony. Surely it's both a cause and an effect because I mean, we can talk about how social equity effects access to water unequally and we have been, and it does. But equally it was social equity, that, or lack of a lack thereof, that led to the situation that exists. In the first place. Populations are unequal because they're unequal. They have a hard time arguing for equality and winning that argument. You know. So what's playing out here is a very long running historic trend, in Europe over thousands of years, in the US over hundreds of years. And what you're seeing is just the continuation of life as usual. But as applied to water.

	You know the world has historically been a shitty place. It's still a shitty place, and is perpetuating itself through the through the water situation.
Interviewer	What a lovely view of the world
Member1	Oh, okay, it's a beautiful place as well. But you know what I mean. Yes,
Interviewer	Yes So are you looking at this bit over here [referring to system map on screen]
Member1	No, where you've got social equity further to the right of whether you've got. That's a cause as well as an effect. Right?
Interviewer	Yes, it is
Member4	So, you know, going back to your original question, and then this may be a little skipping over some other things, but so depending on who you present this to, or who uses it. I assume you wouldn't necessarily need or want to show everything like I can imagine some stakeholders would just be interested in part of it. Part of the challenge is always aligning the political and the administrative. And on the political side, I think they have patience for about, you know, 3 bubbles, and the administrators might, you know, be interested in more. So finding some way, I think you know. [Member1] alluded to the fact that there are a lot of variables there. I mean, I don't. I don't think they're necessarily too many, because the world's a complex place, but depending on who you need to explain it to you may need to simplify.

Member1	Right, that's my point, there's got to be a base map that's got in all in. I'm sorry I didn't mean to say, take this stuff out, I meant to say you'll need another level of abstraction before you start trying to take it to policy makers.
Interviewer	Absolutely. So, yeah, these are the base maps. Everything is meant to be there, and my plan, if it works, is that when these are then taken forward to a given catchment. So if they were used in, I don't know, the Windermere catchment. And someone or a group of people would work through them, in a collaborative workshop setting, and say, this is relevant, this isn't relevant. We'll turn these nodes off. We'll turn these nodes on And then we have a refined map that is representing that catchment. and then that is more able to be used as a tool to convince others. So, the idea is that these base maps are developed in a collaborative setting in order to generate the tools that are then used to influence policy, investment choices, etc., etc. Is that kind of what you're getting at?
Member1	Yes. I've got another comment to make but I see[Member2]'s got his hand up as well. But I have another comment to make in a minute that I've got to drop off.
Member2	I've been learning lately about the science of governance, and one of the principles they advocate is that almost every problem that society's got is a governance issue. And I think what you've got here is a kind of complete governance map.

	It might not all apply. but it's a start point from which you can say, well, which of the important nodes. What do we need to focus on? Where are the interventions in terms of governance policy? Collaboration? And I think that enables you to kind of boil down to the most important things in your catchment. Does that make sense?
Interviewer	Yes, Yes it does
Member1	Sorry. The point I was just gonna make before I have to drop one of the really interesting exercises, Bryony, you could do if you've got the energy in the time is to go through each one of the different entities on this map, and ask yourself how many of those can, or at least the arrows. I guess you say how many of those can be calibrated. How many of those could be measured? And how many of those can be in turn valued so that would work towards a numerical model of what's going on. There'll be some that you can't. There'll be some that might have effective proxies. I'm just doing a bit of work on the disaster resilience front at the moment, trying to come up with proxies for social connectedness. Social connectedness shows it has a huge influence on the outcome of disasters and there's a long literature, including incidentally, [Member3] in Chicago, the Chicago Heatwave, in 1995. The differential death rates that occurred across Chicago, and different areas were driven by the propensity of people to check in on one another, and the degree of social cohesiveness that existed in each of that area, and that was independent of economic status. By the way. There were a bunch of proxies you could come

	up with for it. Some of these things you're gonna need proxies for it as well. But how many of them can be quantified? How many of them in turn, you know, can be valued. and how much of a complete model would that then give you. That would be a fascinating twist I would think to your research as a side. You've bitten off a big enough task as it is, so don't change your scope.
Chat message:Member5: I like that one, [Member1]. Social Capital saves lives. Interesting.	
Interviewer	But I've got to stop at some point
Member1	Yeah, right? But if you had time that that would be really cool. folks, hey? It's great speaking with you. Great to meet [Member3] and [Member5]. [Member4] and[Member2] great to see you again. I actually have to drop. Bryony I'll be happy to stay involved with this as you take it forward, So, if you're looking for reviewers, or further brainstorms, or whatever. Happy to, alright?
Interviewer	That'd be great. Thanks a lot, [Member1]. Thanks for your time today. [Member1 left the call and discussion]
Member5	So, Bryony, have you looked at any kind of dynamic simulation of what you're working on as a way of trying to model it and see dynamic cause and effect over time.

Chat message:Member5: If you're interested in dynamic visualizations, this is one that a colleague of mine is working on in Africa for community exchange vouchers among rural village economies. Viz.sarafu.network	
Interviewer	I have thought about that, long and hard, and I have opted against dynamic modelling and simulations. The reason being that a lot of the data that you would need to hinge those simulations on is fragmented or doesn't exist universally or isn't trusted data. But also, when you're trying to start then simulating into the future our ability to predict. based on past trends is pretty bad. We might be able to go sort 5, 10 years into the future. But if we're looking at, so I look at water, infrastructure assets they may last 50 years. They may last a hundred years. We currently based on the data we've got and our ability to model that data, we can't simulate a hundred years into the future, with climate change as it is, with all the uncertainties we have within the water environment. We're just not able to model that far into the future with any degree of certainty.
Chat message: Member2 This might be worth developing further - A water metabolism. Not just a system diagram, but an understanding of how it works - especially under stress https://youtu.be/AUOWwx8XIUg	
Member2	I would agree with all of that. So, I think it's back to some of Dave Snowden's thinking [complexity science] that this isn't just a simple system that is complicated. So you've got to kind of analyze it to death and can predict, it is a complex adaptive system by nature and it is emergent.

	But it doesn't mean you can't study it and understand kind of what kinds of things might emerge, or, better still, create visualizations so that it can adapt before it gets too bad, because it knows how the system is behaving.
Member5	Yeah, right? If you played it out 50 times, you'd get 50 different end states with the same initial conditions. So and they would be predictive views. Yeah, and so predictive value is 0.
Member2	Yeah, that is, it's even if you've got something that you can just say, well, we've got all the signals that suggest it might be a drought coming up. Then that's quite useful. It doesn't have to be a prediction of a drought. It's just, we know, in a system like this drought conditions happen when these 3 things occur.
Interviewer	And that's why I've opted to look at foresight. So that's so sort of jumping, jumping into the future. So you could say that in in a given future climate breakdown has happened, and we know that floods are going to be more severe. We know that droughts are going to be more severe and more frequent? How does our existing infrastructure cope with those pressures as it stands now? So how do we make decisions now to become more resilient into this range of potential futures?
Member2	Yeah, I love the word foresight. It's good.
Member5	So really, this is a problem. Now, I'm I'm getting it. So it really is less in terms of this group of people you've assembled. This is not about water and water management. This is about

	decision, support tool creation. and design, and you know you led with that. And but now I I've got it. I'm a day late in a dollar short. But I get there eventually.
Interviewer	I have realized as well that because I come from a sort of chemistry microbiology background, I describe everything in those terms, and they don't make sense to other people.
Member2	The chemistry and biology term that I think might be quite useful is this, would metabolism because it. I think people don't look at the water system as a metabolism. It's just like you. blood circulation system. And and that analogy between a healthy organism that's got enough water to function and an environmental water system, I think would work quite well. Yeah.
Interviewer	yeah. right, I'm gonna go back to my prompts of what I wanted to ask you So, as part of the kumu maps that I have been looking at the system maps one of the branches, which I don't know if you saw it was around public services. and just as a question to start us off with, it is kind of how much do you agree that public services enable wealth or value creation, which in turn support a healthy and available workforce and environmental improvements that support resilience. It is quite a long question. So in essence, do you think that public services, so the provision of public services enable us to have a population that forms a healthy workforce.

Member3	yeah, you know, that's the goal. But whether or not that's perverted at some point or interrupted is the problem. But I think that is the best way to go and not to privatize something so public services should work, and we should put a lot of emphasis and resources behind to make sure that it works.
Member4	Yeah, I mean, it's difficult to argue against that statement, you know, even for hard, right conservative. There are you know, there are there. There's a patent office and that enables kind of innovation and growth. And that's a public service. And there are roads and highways which are public services. And so you know, the statement, does public services required for a you know, a healthy economy, I think most people would say, yes, I think the question is more, where does that end? And I think that's where the debate is. Where does the public service need to end? And where does the where is the private provision of the service either more innovative or efficient, or you know, whatever the argument is. and I think in water, that's where you have a huge diversity of answers to that question, you know, in some places like where I am, the entire chain is public, I mean, there's no, there's no private provider, there's no private distribution. There's no private sale, there's no private, not. There's nothing in water that is private, all public unless you buy bottled water, in which case that's private. But you know the rest of it's all public, and then in some other places it's much, you know. There's much more of a mix system. So I think maybe your diagram

	might help determine. You know where the you know what the impact is of having private or public and maybe part of it depends on whether you need innovation to get yourself out of a rut, or whether you need to fix an equity problem. And if you need to fix an equity problem. I'd argue well, there, you probably want to tend towards a public system. And if your problem has to do with the innovation. Then maybe the private systems, the best way to go. I mean, that's a huge generalization that may not apply everywhere. But that that might be an argument that some people would be comfortable with.
Member5	I wonder about looking at the counter case. The you know we all sort of intuitively understand the value of public systems and public works and infrastructure to some degree right. And it's just a matter of where on the spectrum, that is. But what if you took the extremes? If nothing were public. it was all privatized. What does that look like? How does that play out from a social equity perspective. And maybe there's a correlation with GINI coefficients and different nations and the level of public private infrastructure in those.
Interviewer	I think there's also a question there of what is what is private infrastructure and what is public infrastructure? So my my water company is a private water company. It's been privatized for most of my life. But having worked for that

	motor company almost everyone there their role was to deliver a public service, and that was the philosophy of the company. Yeah, I think there's there's 2 different sides to it on there. So there's privatized, like we think of a large corporate private organization. and there's privatized, and then but have a statutory remit. Which obviously is not working all that well in England at the moment. But the yeah. The kind of the philosophy of the company is rooted in public service, because all the people that weren't in them when they were public bodies still work in them when they were private bodies. So yeah, it's it's a blurred line , I think.
Member4	And there's the amount of regulation that they're under, which is also gonna have an impact. Right? You could have public opaque, and then you can have private, and then you can have regulated private, and the degree of transparency of you know how those that regulatory framework, or whatever guardrails are put in is gonna determine. You might have something that's notionally private, but is so regulated that maybe it's pretty close to being public.
Member3	We call those public utilities in the US. And and you know our electric company is one for sure, and it's regulated. And there's supposed to be transparency.

	And sometimes it's not. But ideally. It's supposed to be a blend of those 2 things, and it's supposed to be a virtuous combination. But, on the other hand, there was a case of Bolivia, where they tried to privatize the water system. And actually, people would go to people's if they were collecting water through a rain barrel when it rained. These guys would dump this stuff out because that belonged to the company and not to you. So as a private citizen. You couldn't even collect rain when people rebelled against this is what brought Evo Morales in and a leftist this government and kicked out the right. You know.
Member4	That was Suez. I think. Right. That's who is that had implemented that?
Member3	I think it was? Well, maybe they did, but it was Bolivia, for sure when this happened. So that's something to think of.
Chat message: Member4: https://thewalrus.ca/2008-10-online-exclusive-4/ Bolivia's water fight	
Member2	I do like [Member5]'s idea of looking at extremes of both public and private, because it it's never gonna be the kind of the extremes. But you need to understand the dynamics of that, and that story is great. The other way of looking at it might be in other sectors. So how does the Internet work public/private? How does transport work, railways, all that kind of thing? And that might give you some interesting lessons of kind of what can work, what

	hybrid models, what governance do you need to be able to do some of these things?
Member3	Well, so here's an interesting idea. Because if you take the Internet as an example? our digital exhaust is harvested, and monetized. What happens to the wastewater and the grey water that are is limited comes out of our houses. Is there a meter on that, or only a meter on the water coming in? So if the water going outward metered, then there would be a known contribution of each household. That could be kind of balanced somehow, or at least monitored and assessed.
Interviewer	Yeah. And also that enables you to look at the value, the potential value of wastewater or rainwater as a an alternative or resource. rather than considering it all the waste which, historically it has been.
Member5	It seems to me like this, this water meter set up, you guys, have I wonder whether that's enforced poverty, another vector for enforced poverty. You know. because if you're being charged a flat rate regardless of what you use. then not only are you disincentivized to use less. but more important. You have no ability to modulate how much you're paying, based on deciding you want to use less, or you're a family of one, not a family of 4, and inherently you do use less, or you don't water your lawn versus you do, or you don't have a lawn. I mean, there's so many variables. Well, you know, it's not

	in our economic interest to install a water meter at every property. So we're gonna charge some people a flat rate unless they pony up for the meter. It's like that, to me seems socially inequitable.
Interviewer	So within UK you can volunteer. and it is fitted free of charge. So it's fitted at a water company's charge. Cost them, and also most of the water companies have a policy that if within first year, 2 years, 3 years I can't remember what it is, and it probably varies. And if you don't save money on a water meter compared to what the flat rate would be. You revert to a flat rate, and they take out water meter. or they leave it in, and just don't charge you based on it. So there is that. But the take up has been unequal. So the take up of water meters has been largely by more affluent people. people who are in larger properties but are single occupants or couples, rather than large families living in small properties.
Member3	How much does the water meter cost cause I can't imagine that it costs a great deal of money. We just had ours replaced a few years ago. Our municipality wanted to get one that could be read digitally, you know, outside the house or something. So the guy put it in and took like a half an hour and was off the door. And it's not that big, so I can't imagine. It does seem like it's more of a cultural impediment for people with not a lot of resources than it is a financial one,

	especially if the company is gonna pay for it. So what are the what are the impediments that are keeping people of less resources from getting these water meters?
Interviewer	It is a lot of it is an assumption. So within. So there's been some studies done in different parts of the Uk. Mainly the south, east of England. where they've tried to work out why, there hasn't been uptake of metering, and it is a fear - people are saying, We're fearful that if you put a water meter on our suddenly my bill is going to go up to twice what it was previously. or something like that.
Member3	So those populations trust in Chicago. There was a issue about blood pressure and heart attacks among African Americans, and you know, on the South Side. So what they started to do where health workers were partnering up with barbershops, because that's where they knew that especially black males went for haircuts, and they trusted their barbers, and when the barbers learned about blood pressure, and how what an indicator that was! They started working together and built trust. So people were going in for, especially people in their forties, fiftys and sixties getting haircuts, they'd say, let's take your blood pressure to.
Member5	That’s awesome
Member3	It's working. So I think if you can find some common trust

	vehicles that people can latch onto. That may help that that situation and breed more trust.
Interviewer	Yeah, there's also the case of Ireland. Where the water payments had been through taxation and it had been a hidden cost. People were unaware how much they were paying, and then there was through European legislation they had to make it apparent how much people were paying. And there was a decision by the Irish Government that they were going to install universal meters across the whole of Ireland, and there were protests and there were legal cases sought, there was massive rebellion from the population that their free water was being taken away, and suddenly they were going to need to pay for it. And Irish water installed meters all over the place that already installed all the meters in order to and to enable fair payments, and the upshot has been that they don't have a water meter. They don't have water bills. They have an itemized part of their council tax. I think it's part of their Council tax bill, or similar sort of taxation Bill, which is for water. And if they are found to be an excessive water user that's investigated, and they may need to pay a premium. And but yeah, the distrust there from the government and the view that previously it was free where water's never free
Member2	unless you have a well. There is a digital exhaust thing that I found interesting from my online water meeting. I could tell who is in the shower in our house.

	whether it was me, my daughter, or my son. just because of the patterns you know, when they're in, how long they're in the shower. And for some people that's kind of scary as well.
Chat message: Member4: You still have to pay for the electricity to power the well pump	
Chat message:Member5: True - I'd guess that ends up being relatively minimal compared to what a water company would charge.	
Chat message: Member4: specially if you have solar panels!	
Member5	We don't have that here. Ours are still analog, they guesstimate and come out every quarter or so, and lift the cover on the sidewalk to read it, and then they adjust your bill accordingly, if it's up or down from what they guesstimated it on the previous couple of bills.
Member3	[Member1] brought up the heat wave in Chicago in 1995, I think, was just 5 days of extreme heat. We lost almost 800 people. Now, it wasn't water. That was the big issue. It was air conditioning, and those people in the poorer neighbourhoods died disproportionately, cause they didn't have air conditioning. Now we've made a lot of changes since then. Open, more cooling centers where necessary. But I don't know how that would correlate, because people have water in apartment buildings, no matter how bad it is generally people have water, but it's cooling that that is a problem. And we have these heat islands in our urban areas that are really causing more

	distress. So they're trying to plant more trees and everything. But there needs to be a lot more to just mitigate that heat that's coming down. So I don't know how that correlates into the more disaffiliated parts in the Southern England? Or does that relate at all? Is it heat or lack of water. That's the problem.
Interviewer	increasingly, it's both. So population, growth and industry in South East England, in particular, is leading to serious concerns over lack of water. and that if a serious drought were to occur, or there was a failure of infrastructure. London probably has hours of water storage. It is not in days or weeks. It's pretty low. There's action being taken to increase that resilience through transfers of water from rivers to rivers.
Chat message: Member4: Resilience - Montreal almost ran out of water during 1998 ice storm https://www.washingtonpost.com/wp-srv/inatl/longterm/canada/stories/montreal012598.htm	
Chat message: Member4: https://www.linkedin.com/posts/canadian-water-network_tech-for-nature-rbc-royal-bank-activity-7080266028508725248-PiWL/?trk=public_profile_like_view	
Member2	Yeah, just on that point. It was interesting. The Peterborough city they thought they'd got plenty of water because there is a big reservoir 10 miles away Rutland water.

	And they thought, Yeah, we're in a water stressed area but we've got one of the biggest reservoirs in Europe. And we pointed out that there's a big pipe from there to London. If there's a water stress problem, you're not going to get it. London's gonna get it so. And they didn't even know that they didn't get the water out of Rutland water. They got it out of the River Nene and the River Nene was feeding Rutland water. So the water metabolism that I sent to you explained that. And they had one water treatment works that fed the whole of the city and if that was out, that's it they're stuffed so that from a resilience point of view that was quite significant. Just one slightly different thing. I don't know if it's relevant in in this conversation about visualizing but every one talks about cold water. whereas hot water is one of the biggest problems the world's got just either heating or even chilled water and air conditioning and the amount of energy consumed by society heating water up. I did try and convince Thames water that there should be a hot water supplier. and manage on behalf of other people, measuring temperature and volume at point of source, and then managing kind of the total cost of producing hot water.

	But it just went over their head. It was too difficult. but I think that's part of the bigger system that it's not just cold water. Hot water is a big issue. Yeah, it's how we use water and and how that affects our lives.
Member5	Bryony, I'm curious whether anything thus far has helped. and as such, you know, is is. do you now have even. You know. Have you increased your clarity around how you can best leverage this brain trust you've assembled because I feel like you know, we've certainly been wandering off into a number of different paths, and each one is probably jarred loose a few nuggets that might be worth further pursuit. But you know, in the time remaining, I guess I'd be curious to know where you're up to.
Interviewer	Yeah. So it's certainly been useful. In terms of kind of refining the the system maps and and how they're going to be used. I'm gonna need to go through our conversation in quite a lot of detail and work out which bits to extract and how how to use them. But yeah, I'll be doing that over the next few weeks. I do have a couple more areas for us to cover. We have done quite well on covering what I plan to cover. A meandering chat is working We talked quite a bit about kind of the value of water. And I'd kind of be interested to hear your views about the value. We place some water how

	variable that is across geographies and across populations. But then, how that then impacts into ecosystems. Don't know if anyone's got any views on that
Member5	Ecosystems and the impact of water as in the value we place on water as in tying up wetlands
Interviewer	No as in the value we place on water and how that impacts ecosystems
Member4	The value – do you mean price?
Interviewer	Not necessarily. Yeah. So it could be price, or it could be our prioritization of water use. So are we prioritizing water use for economic gain for the production of high value goods? Or are we prioritizing our water use for domestic consumption and easing our life in a changing climate. So going back to that heating, and cooling of water, and how that impacts us during extreme events, and if we're prioritizing those things, does the ecosystem suffer, so does the ecosystem become water scarce
Member2	It's interesting that I'll see if I can dig out the paper. [Member1] and I have got a patent on the 3D water accounting. and what it tries to do is, is, say you not only need to know the quantity of water and the quality of water, which are kind of what people do at the moment. But what's the value of water use? So if you said, well, the value of water use going through an energy, you know,

	co-fired power station is X. Well, the quality coming out the other end is probably much the same, except it's a higher temperature. And so that's got a negative value that you need to account for. Whereas if it's going through a chemical, industrial complex. The temperature is the same, but the quality is horrendous, and the downstream effect, you can't use it for agriculture and all of those things, and I think a visualization of the transition of value, then stream would be quite interesting to say, Well, where do you lose value. Where do you gain value? If you, if you put water into agriculture, you gain a huge amount of economic value, and probably not lose too much nitrogen might be a problem. In terms of quality if it's managed well. But if you don't manage the nitrogen, you then lose that value because of the quality. So I think visualizing the value of water ups and downs as it transitions through different places could be quite interesting.
Chat message: Member2: You probably know about this https://www.waterfootprint.org/	
Member3	Well, in midwest they call us the Rust Belt, you know, because of our degraded industrial capabilities. But I always say. you can't have rust without waters, but we live in a water belt and not a rust belt, and so we have one of the greatest freshwater resources 15 min from my house, you know Lake Michigan, any other Great Lakes. And I was waiting for, sure enough, it happened like a

	couple of years ago, where somebody was saying, well, you know, out here out West we could use some of that Lake Michigan water. We should build a pipeline and start, you know, sucking that put that straw in there and start sucking it off, and I think no, no, no, you should never have built that place out there, knowing, that was great for the developer. But it's not good for people to live in. I don't know what's gonna happen in the future cause. Things are changing that I didn't that I did not see, you know, and these Canadian wildfires and stuff like that, and the jet stream just really bouncing up there. So I don't know what's gonna happen to the Great Lakes. But I do think that water is gonna be so important. And it's gonna be the critical thing that people will go, perhaps to war over from State to State. And that's a that's a dystopian future. But as far as the value of it. At some point it could come and become extremely critical.
Member4	if you look at the investments in technology. So this is just, you know, purely from an innovation technology standpoint. And where those have happened. those are generally happened in places like Israel and Australia have had, like major issues dealing with water and well and their rates of non-revenue water are like 3 or 4%, because they can't afford to lose any of it. And in places where maybe there's more of it, and we think it's abundant. Then, you know, there

	isn't so much investment that's put in. So maybe that's one way to think about for it, to try to measure how, you know, how important the resource is to figure out, well, how much investment are we putting in to make sure we don't waste any, regardless of whether there's a price on it or not, you know it might be free in those places. I don't know. And so I think that's, and certainly in those places, it's existential. You know, the relationship to water just as it is in California. I'm not sure what non revenue water is California, but I assume it has to be quite low.
Chat message: Member3: Water is transparent but its distribution is not.	
Member5	Well, oddly, the some of the biggest crops in the central valley are discretionary in terms of the utility or centrality of them in human nutrition. So you go into the central valley in the middle of a drought and see almond orchards. Well, almonds are one of the most water intensive crops you can grow. You've got avocado orchards. You've got cotton fields, you know. These are all enormously water, intensive crops. And you know, I read 75% of the water consumption in California is agriculture and industrial. And yet we, individual households, residential users, are being tasked with during the drought, cutting your water consumption by 25% or something, and

	quit watering your lawn, which I agree, watering your lawn is a waste, lawn is a dumb idea. But still, for some people this is a hardship, it affects their property value, they may not be able to afford to re landscape. You know, there's economic consequences at the household level there. and yet in terms of the savings that generates in the scheme of the total water consumption rate, it's tiny and the big users are meanwhile growing the world's almond crop and exporting it across the US, and I don't know how far outside the country it goes at a very affordable price like you can buy almonds relatively, inexpensively, and I love them. But it's a wasteful crop in terms of water and it's not necessary, So I think. But that's not the ecosystem, then, unless that is the ecosystem you're referring to Bryony. But to me the next level of that is. And so how does this affect bio-ecological systems? Is that where you're going? So, like there you'd look at thermal pollution from hydro and electric utilities on riverways and the ocean. You know they use sea water to cool reactors and guess where it goes in the ocean. And so you end up with these weird micro climates in the ocean around these plants that generate all kinds of interesting sea life, that it's not glowing green, but it ain't the same thing 500 yards away, or even a smaller scale where you've got
Interviewer	Or even at a smaller scale where you've got local degradation leading to fragmentation of the river system. So you might have a really good habitat in

	one area, but the fish can't get to it because they can't travel through the downstream areas which are degraded.
Member2	I do think this is where visualizing the environment data and the water use data at the same time gives that situation where people go: Ah, it's the almond groves that are using all the water. And my little bar graph on Google Earth just makes it obvious to everyone in the room. And that wisdom then goes well, we'll stop doing that, or we'll just buy all the almond places, it's far cheaper than installing a new water treatment plant or whatever.
Member3	Well, and I totally agree that we should pay for that luxury. And I gave up meat 30 years ago because of the stuff I was reading about, the waste it takes almost 1,800 gallons of water to produce one pound of beef that's 39 bathtubs filled up to the top for one pound of beef. I drive around here outside Chicago I see cornfield after cornfield after cornfield. 90% of that grain goes to feed animals. So, we have a very upside down system about using nature to produce out of whack proteins. I think that will have to be reassessed at some point comprehensively, so that people understand the choices they're making. They may have to may have to have a beef meter, you know, instead of a water meter for what they're eating, and how much water that thing uses.

Member5	Where does the water go, though? If they don't grow the corn? You know the water is a is a local resource, and difficult economically to ship. So, you end up with a situation where, hey? We got all this frigging water, you might as well use it for something.
Interviewer	You could grow other crops, couldn't you, which have greater value?
Member3	If Ukraine is not able to ship its grain to Africa. That's a survival problem for people over there. And you know, either we start shipping corn. But are they gonna need corn? Or do they really need wheat and other grains, you know?
Member5	Yeah, there, you're getting into macro economics and global food supply chains that are way over my pay grade, it's a mediating variable
Member4	maybe there's also just generally a question about transparency about where water is, you know, we're getting there with greenhouse gases, for instance. So we're trying to understand, you know, the where greenhouse gases are generated in your supply chain so you can get to some kind of you know, I'm not sure realistic is, but you know, net 0. So, somebody who's making a product knows well downstream, how many greenhouse gases is it generating? How many am I generating, making this product and upstream up in my supply chain? How much, you know, GHG has been emitted because of that. Now, if we could get some of that with water we might have a better understanding of the impact of, or the importance of water, or the value of water. So the people who buy a bag of almonds probably mostly don't know how much water goes into it same thing with the steak or the rest. Now, I don't

	know how much labeling would necessarily help, but if you start with the labeling, and then afterwards, once you have the labeling done, or at least an understanding of where it is then you can start talking about. Well, you know what is the value, then, that we're getting out of it. Maybe some things would come up where people would think, Well, that really doesn't make sense, is it? Really, you know, a hundred times more water for almonds than it is for lentils will. Maybe I'll eat more lentils and fewer almonds, or whatever it is, even if there's no specific cost or price attached to that right at the beginning, and then eventually, if you decide to put a price on water. At least, you have something to back you up. It shows well, here's why we think it's important to price it. Because look at the impact on and you can also, if there are some uses of water which are you know, essential. For some reason, then you know, at least you can make an accommodation for that. But until we have that level of transparency, it's gonna be really difficult, I think, for people to understand. I mean, imagine having a counter on your tap and on your toilet, and just so that you know how much each of those things consumes. We don't. We don't have that. We don't have that for electricity. Hi, there! But you know some people are starting to develop that in you know, in their electric. You know panels. So if we could, we could do the same thing as a society for water. Maybe that would help us, you know. Progressively.

Member5	I like it. I think you know, when you talk about food stuffs right here in the US. And I think in Canada they have it, too. Every single thing you buy that's packaged has the nutrition label on it. So I know how many grams of protein and carbohydrate and vitamins and salt, and all this stuff right, I know, on every single thing I buy per serving, and to me that's useful now was I'm trying to manage blood glucose. So I'm very tuned into this right now, but it occurs to me you could see doing the same thing with like a carbon footprint, and adding that to the label. I think it'd be challenging, in a way, for some things, because depending on how it was produced, or what part of the country it was produced in. I guess you just do an average. But, like different things, have different carbon footprints depending on whether they need more energy or less energy to make them, because it's more warmer or colder. Who knows what right?
Member4	But the difficulty, I think with water is that so? 1 one kilo of greenhouse gas emissions doesn't really matter where it happens. But if you're buying [Member5]atoes that were grown in Israel versus [Member5]atoes that were grown, you know, down the road where there's tons of water, then, you know, even though they may have the same water footprint, but doesn't really mean the same thing,
Member5	Because they didn't get transported around the world, and they didn't get transported around the world with a ship.

Member2	I've put a link to. What a free footprint.org, which is kind of the state of the art of all these things. So lots of people have thought about those intricacies, but it gives a lot of evidence down to the product level. So all of that information is there, it's kind of how to use that. And even we don't really know the details in there, and we've been playing in water for quite a while. So I would have thought a lot of people who well, the average member of the public has no idea.
Interviewer	And I think a lot what you're talking about goes back to the idea we put forward as part of the the water pivot paper we put together. So that idea of how do you account for virtual water? And how do you incorporate the damage you're causing at the point where you are using the water, how to incorporate that into the price of the product as you as it's then used around the world. And that's what builds that transparency of. Well, if we buy almonds from California that's got a massive impact. If we buy almonds from somewhere else. It has a lesser impact. So it it gives you more consumer choice. I think, but also it means that we are accounting for it, and what we were proposing was that there was then a mechanism to pay that back into those local ecosystems to rectify some of the damage caused.

Member2	It's interesting now with blockchain ledgers that for non financial information, you can do this sort of stuff. You could say those cucumbers have got a water footprint of X and put it in a ledger and chip it round the world. Do whatever you want, but you can track back to that particular package and prove that that one has got X amount of water footprint, so 10 years ago that was almost impossible. But now it's quite feasible to track anything and everything, and have that sort of trust factor in it.
Member5	I do know how much my toilet flush and shower uses. By the way, I do know we have a digital water meter add on. We have an analog meter, and we purchased our own digital strap on thing that has an app on my phone, and all I have to do is make sure nothing else is running, and then do a shower, or. you know, wash clothes and the washer, or whatever, and as long as there's no other water usage, we can see very, very precisely what that thing is doing with water. That's kind of useful.
Member3	That's excellent. And I hope that that starts to become more common you know, in California that makes total sense. But II think. accountability. You're cognizant of that. You probably take your shorter shower when you if you know there's a meter.
Member5	Yeah. And buy the water sense labeled. you know, we just remodeled a bathroom, and like, now we have really dual flush, low flow toilets, and low flow shower that gives you a really nice shower, even though it uses half the

	water of the other one we've got, you know. So it's like we are more conscious. And it does make a difference.
Member3	That sort of stuff, I think is so important. You know, it won't impact your day that much in your daily life, but it makes a huge difference as a community.
Interviewer	You led me nicely on to the final question I have. So if we look at our mixture of policy, technology and incentives in various forms and various mixtures of them each of those or a combination of them could reduce consumption of water. If consumption of water goes down the relative cost of each litre of water that we're using goes up because the majority of the costs associated with water production are infrastructure. Marginal cost. It's fixed cause we've got those assets. We have to employ those people. and to a certain extent to run them. We've got to use that amount chemicals to run them. We've got to use that amount power. And so the marginal cost is low. So. knowing all of this? How do you think that affects perception of sort of adoption of new practices? And how does it affect the adoption of them? Because if people are kind of banking on my water costs X. If I use 20% less, that means my bill goes down by 20%. Actually, the bill goes down by 10%. Or 5%. Does that mean that their behaviour then reverses?
Member5	The bill goes up, like on our water bill. 80% of the water bill is non water.

	20% of a hundred $120 is actually the number of gallons of water we used in a month. 80%. Of that $120 is not, it's fees. And because everybody did a great job of saving water. Guess what? We still have a plant. We still have 200 people running it. We still have infrastructure to distribute it. Just what you said. So that is really screwed up like that's shooting yourself in the foot screwed up.
Member2	That does assume the infrastructure costs remain the same. and they should, they should be innovating.
Interviewer	Yeah, there should be a way to bring down the sort of technological costs, the the chemical usage, the power use. But implementing that does cost money. So replacing those assets has a cost associated with it as well, if they're not at the end of life.
Member5	it's a pipe and a tank. and some chemicals, and a bunch of people
Member2	When we were working with Thames Water we were trying to say to them things like don't run your pumps 100% all of the time, just because it's easy for maintenance. actually manage your pumps digitally so you can wind them down use less power in a way that that isn't catastrophic to maintenance, and produces turbulence and all that. Another one was you know the turning on and off valves to do means apparently the knock on breaking because of the hammer effect is huge, just because someone's just quickly turned off a water supply. It's just burst a pipe kind of 100 yards down the road. So why don't you? Every time you turn a tap on and off. use the Internet of things on your

	power tool. and you log and register and understand how that affects the network which bits are fragile, which bits are not. Make sure that you turn it off slowly. and you could do that just with a micita power tool that's got a smartphone on the back and a GPS on the front, and it only terms the tap 3 turns per minute, or whatever is. But all of that thinking would enable you to manage your infrastructure much lower cost. And you're doing it with information. So can you visualize that information? So that you can reduce infrastructure costs?
Interviewer	I think I think you're right. There is there is a role for innovation within the water supplier to bring down those fixed costs. But I wonder if there's still a case that the fixed costs remain higher than people perceive them to be?
Member5	The biggest cost in our system is the people that run it. We've got I think it's 120 or 180 employees running on 3 shifts to keep the plant running. And they're it's quasi-public utility. So they have a public pension plan in place and underfunded pension liability. That's enormous. It's eating us all alive and getting worse because they've made these stupid assumptions about return that are simply unrealistic, and yet they keep it going. And so, consequently they, you know, collect the money in taxes to fund the pension. They invest the Pension fund. and then guess what? At the end of a year they do a reckoning and realize. Oh, gee! We didn't get 8.5% which we assumed would be the return on the investment funds. Gee, now, what? Well, I guess we'll just raise taxes or tack on another fee. and that all ends up on our bill. And so

	people are by far, I think, the biggest cost in this thing the actual labor, and I want to say they're unionized, but they may not be. But anyway, I don't know. I'm sure, as a consultant who worked in productivity improvement for most of my career. If I were to walk into the water utility and look at what's going on. I doubt I'd be able to take 50% of the head count out. I doubt it. I mean, I might be able to get 10% out. But then again, maybe not. You know it's been around a hundred years. It's not a new idea. I can't imagine. They're running fat. But it's a tough one. And and I think maybe it's I don't know if it's right tree to be barking up. I mean, we gotta have water. Hmm!
Member4	So there's a so I think, to answer your original question, Bryony. Yes, I think there probably is a perception that if the infrastructure is there, then if we reduce our consumption, then people's perception is that the infrastructure is kind of expensive, because as a percentage of what you're paying, it's gonna appear greater. So maybe there is a way to increase au[Member5]ation or efficiency, and sort of, you know, attack some of that at the margins. Maybe there's something to do there. But in order to do that you probably gonna have to invest upfront for the innovation that's required in order to do that which is probably challenging. If you're saying. well, we need to invest more in the infrastructure to au[Member5]ate it because people are using it less. Maybe the logics a little difficult, and the infrastructure's always been hard to invest in this, because partly because it's invisible. Right? maybe there are.

	And I have no idea. Are there other ways that we can repurpose or use the infrastructure. I really can't think of any off the top of my head. I mean, I know that some places like Iceland. you know, have water infrastructure that they use for heating, because they have all this geothermal water. I know Toronto uses pumps water from the lake for cooling, so in order to reduce the air conditioning they use the cold water from the bot[Member5] of Lake Ontario to cool the buildings. So you know, if there is some more creative ways to think about how you use the water infrastructure. How you rethink it maybe there's some other ways. I mean, look, we're gonna go through some major climate change issues that are probably gonna increase our reliance on air conditioning, which is probably not the best way to, you know, use electricity, and that contribute to Heat Island effect. So maybe there's something there I don't know. But maybe that's the kind of out of the box, thinking we need to get to in order to fix that. Yeah. Just came back from Switzerland. And interestingly, air conditioning is illegal over there. Alright. So illegal, I'm gonna say regulated. So you can't put in air conditioning just because you want to. You have to apply for it. And you have to have a good reason for it, like a medical reason. Otherwise you're not allowed to have air conditioning, the idea being, You know it was, we had a few days of 33, 34°C during the day, it cools down at night because of the mountains. But still it's you know, they're gonna have to deal with that. So

	you're allowed some kind of passive pooling technologies. But you're not allowed air conditioning.
Chat message: Member4: https://www.quora.com/Why-does-Switzerland-lack-air-conditioning	
Member5	Wow. That's crazy. I've never heard that before. I love that
Member3	I don't know if any of you have ever been to Granada Spain. But you know there they have these fountains all over the place, and you know they're spraying water. And this thing, this structure is ancient, you know, but it helped cool the environment, and made it a livable place. So maybe not the best use of water, but there are creative things that can be done. And if it's recycled, maybe that works. I don't know
Interviewer	A lot of our conversation as well as being about the value of water, and how we value water and populations historically undervaluing water, because it's cheap and readily available. If we're now talking about metering and reducing consumption and the driver for that, is it reducing our bills or the amount we pay for water? And is that counterproductive to us trying to increase the value people hold water under.
Member5	Say it again. One more time I was. I got the first half of it. But what's the second half?
Interviewer	So if we think that it would be useful for us to value water more highly across society does then paying less and less for it, because we're using less mean that subconsciously we are exacerbating societal undervaluing of water.

	I guess it comes down to, do people value the things that they can put money against. And if something is cheaper, is it valued less highly?
Member5	I think they only value it when they turn the tap on, and nothing comes out. As happened apparently in was it Cape Town or Joe Berg somewhere down there about 2 years ago people turned the tap on in the city, and nothing came out. That's a problem, you know. Well, suddenly you no longer take it for granted and value? whatever you can afford. You know it's like this is binary. It's a one or a 0, you know no water means no life. and we see this in the ancient ruins in the Mojave Desert. here in America, where these 5,000 year old settlements when they packed up and left, and they speculate it was due to water running out either that or a war that they lost with another tribe. But either way, I think the point is that you take it all for granted, because it's so ubiquitous and commonly available that you assume it's always gonna be there. And that's correct. We built our societies on the idea that there's water, and it's abundant and free and plentiful. But I don't know how you build a society… Okay, I do know how you build a society: go to Mars and build a settlement. You'll find out the true value of water versus say, almonds. screw almonds, I want water. Right? But there is none. Now you understand it's value. So again, go to the extreme and then work backwards from that and figure out, well, okay. how do you get to some midpoint where people understand it's that valuable. but still will pay

	whatever the freight is to have it, because it's also abundant. You know, it's a tricky paradox. I think
Member4	I'm sorry II gonna have to drop. So I'm just gonna say goodbye. Now I realize I have a 5 min late for another meeting. But no, no problem. Thanks, Bryony, if you need anything else, you know where to find.
Interviewer	Yeah, thanks very much,
Member3	One thing is, when I when I read about how much leakage there is, and water systems. I was pretty much pretty astonished, and how much waste is going on there, and it seems like that's one of the first things that should be addressed is stopping leaks because it's easy in a way to identify, but it's also critical that it gets fixed. And it might alleviate some of these other issues, you know.
Interviewer	Yeah. yeah, absolutely agree with that. Yeah, we shouldn't be taking a water resource, treating it to potable standard and then Letting it just and drift into the ground again. okay, I have taken up a lot of your time. Thank you very much for all of this conversation, I think we've had quite a thorough discussion. But if you think in reflection after this, if we've missed something, if there's something that you desperately wanted to raise and didn't get a chance to, or something comes to you in the middle of the night. then, yeah, please just drop me line. Let me know. I'll be working through this transcript and sort of

	digesting it. And I'll distribute it round as well. But thank you very much for your thoughts. And everything we've discussed that last couple of hours.
	Meeting ended

A second discussion took place with one individual who was not able to attend the focus group meeting due to availability. This transcript follows.

Meeting held: 1st November 2023

Online meeting using zoom platform

Attendees:

Interviewer: Bryony Bowman

Member6 – Sweden. Background as Managing Director of water purification company, now a local politician with interests in macro-economics

The below is a transcript of a discussion to discuss the relationships society has with the surface water environment from the perspective of economics. This discussion was aided by viewing a draft version of the visualization created as a system map using Kumu. The transcript starts after introductions had been made.

Blue text – statements that can be used in the discussion of the basis for the research

Green text – statements that can be used in the discussion of social justice and the water environment and policy/economic frameworks that sits within.

Orange text – future possibilities

Speaker	Transcript
[Transcript started after some introductions to the session]	
Member6	Are we talking here about the provision of drinking water? Or also water purification, water treatment?
Interviewer	This is focused on the whole system. This is everything. I used to work for a water company, mainly on the wastewater side. But this is definitely focused on the whole water system, I'll go on to this in a minute but it's actually focused on rivers, or surface waters including lakes etc. Looking at the natural water system how we interact with it abstracting water for consumption, drinking water, agriculture and industry, and then how we are returning that water back into the system. [sharing slides]
Member6	OK
Interviewer	So, these are the challenges being faced, but there is also an additional challenge to that is that silos exist both within the water industry and between sectors that interact with water. So within the UK water industry the price controls, how funding is allocated between water, wastewater and bioresources. Bioresources, or sludge is the solid stuff that remains after treatment, it has different names in different places and based on how polite you are being – I tend to call it sludge.

Member6	Right, yeah
Interviewer	So that is how the interventions, maintenance and management of each of those functions is separated within the UK water industry despite them being quite closely linked. Because of these silos holistic approaches are constrained, the water industry is very focused on end of pipe, our regulation is focused on end-of-pipe and there are limited opportunities to look at the system as a whole. That's what I'm trying to look at. But then, added to that, we've got to think about what is the objective of the industry and of the interventions we're trying to put in place. So there's the obvious public health duty of potable water and sanitation provision. But then there's an argument of how to that, is your goal for it to be achieved robustly? Is it for it to be resilient? Is it for it to be sustainable? Or should the aim be to achieve these with justice in mind? With just impacts?
Member6	Yeah, ok, got it.
Interviewer	And those are kind of seen as a hierarchy. A lot of the regulatory discussion within the UK is termed in resilience language. There is an element of sustainability added in there, there's not much in terms of justice.
Member6	Ok
Interviewer	So what I'm trying to do is to try to address some of those challenges and issues, is to build some tools that will support decision making. And these are tools, they are not an input/output model. So, you don't say what your

	problems are and it tells you what to do. I don't personally think that that's possible. I think it's too nuanced and too complex to be able to do that. So, what I'm trying to do is create a platform so that we can have more holistic and grown up discussions about what's actually going on and what needs to happen. That is being framed within a systems approach, using systems thinking and systems mapping. And it's looking at surface waters, so everything from headwater to estuary and all our interactions with water within that. A lot of systems in this pathway interact with each other. So there are soil systems, air quality systems etc. These are being addressed in terms of the interactions they have but the complexity of soil science is not being looked at. It's more saying soil management will impact water quality and water management will impact on soil health, but in terms of the details of soils for example, it's not going into that. The aim is to support cross-sectoral and cross-societal dialogue, to improve communications and create a common means to discuss these issues. So to do that I'm focusing on visualisations – these are abstract system maps and those system maps are intended to reflect multiple perspectives, those perspectives are from environmental, societal and economic viewpoints.
Member6	Yeah

Interviewer	Trying to create the tools to build confidence in the decisions that are being made and the investment choices were are making. So, in order to do that we need to have a view of what's going to happen into the future. Now there are various ways of doing that, some based on predictions, historic trends and how they could extrapolate into the future. But these methods are constrained, partly constrained by the data that's available. Environmental data generally, and especially in the UK is very fragmented, it can be fragmented through space and it can be fragmented through time. So there is a question over how reliable that data is. If you've got 50 samples from 1 point in a river system over the past 3 years it's not really going to tell you what's happening throughout the river system
Member6	They don't have comprehensive data mapping. We've got that in Sweden. I imagine most places
Interviewer	It used to be a lot better. The Environment Agencies budget was crippled in the last 10 years or so and the amount of data that's collected has decreased rapidly. It can be that within a river system you have data that's collected at the confluence of a number of tributaries, but then how do you tell from that what to do in each tributary in order to improve quality, because you've got one data point essentially. So, yeah, it's a big issue. There is a project that is started that I helped get the funding for which is to use citizen science to build a body of knowledge around rivers as cheaply as possible. Essentially so that can then inform the Environment Agency, water companies and

	landowners to then go and get more data in a certain area as the citizen science is reporting that this is potentially an issue.
Member6	Oh, I was involved in a citizen science EU project. It might have been the same one?
Interviewer	This is ongoing at the moment, funded through water companies and led by The Rivers Trust
Member6	Small world
Interviewer	Yes, water tends to be. The other disadvantage of using data driven, or prediction based approach is that we're at the point where we can't rely on historic trends to tell us what's going to happen in the next 5 to 10 years, or beyond that, because we're at a point of uncertainty. The alternative to using a prediction based approach is to use future scenarios. I'm guessing you're familiar with future scenarios?
Member6	Yeah
Interviewer	So, that's the route I'm taking, so that we can look at extremes in an 100 years from now view. Because the interventions that are put in place and their effects may not be seen for 20 or 30 years in terms of improving water quality in lakes and having that kind of long-term ecological impact and also impacts on groundwater systems can take decades to materialise and the assets themselves which are put in place may be there for 60 or 100 years so

	we need to be looking at what conditions they will need to operate in at the end of their asset life, not just at the beginning or half-way through.
Member6	Hmmm
Interviewer	Using the futures analysis will enable us to explore the potential impacts within the visualisations which are system maps. The final part of this is how can we measure those impacts? Because engineers and scientists like to have numbers to be able to quantify things. So, I'm proposing a series of indicators that reflect, based on the current data that's available, how well we are enabling our ability to thrive under a definition of environmental justice. These are data driven indicators, but because the data may not be believed, there may be different stakeholders involved that have different confidence levels regarding data. The proposal is to have those quantified indicators, but then have that qualified with local knowledge and alternative data sources and say, 'well this is the data, but how much do we trust that data? And is there something that we can do locally to improve our trust in that data?'
Member6	Yeah
Interviewer	So that's what I'm trying to achieve. You're making positive sounds so I'm hoping that this is making some form of sense?
Member6	Sure
Interviewer	Ok, good

	So, this is a very simplified version of the system maps. Each one takes a perspective so, environmental, social or economic. And I've looked at what does it mean for the system to thrive, with the system being the surface water system. From a economic point of view, does that mean we are able to show that we have prosperity across the nation, with affordable and equitable funding of water services which can be sustained into the future. If so, what are the influences on that. 4 key branches that influence that ability to thrive are policy and financing of water services, public services in general and then social equity. Each of these branches then expands out to look at the interactions within the surface water system that impacts our ability to thrive and the interactions are denoted as to whether they are enabling the ability to thrive, or the are limiting that ability. [signal was lost and some of this was repeated]
Member6	This is interesting because I was going down this route in pivot projects but I don't think anyone really saw that but me. I'll share that with you later, ok?
Interviewer	Great. Obviously you're familiar with future scenarios, this is more about developing those system maps and exploring, investigating or assessing how those relationships would change into the future. So it would be relationships which are supporting our ability to thrive, and then would they become strengthened or weakened in a potential future. That sort of thing. So what I'm hoping we can do is really have a look at this from an economics

	perspective. As I said, I have a water industry background as a chemist, or process engineer, so I don't have an economics background at all, I've been learning over the past year or so. So, what I'd like to do is look through the economic system map and get your views on that and see how well it aligns with other peoples views of economics related to water.
Member6	Yeah, yeah yeah sure
Interviewer	Because, am I imagining that you've got at least a partial economics background?
Member6	Yes, I was managing director of a water purification company and I was involved in an EU project looking at disinfection by-products. But I'm a pupil of Steve Keen. I've been on his course for a year now called Rebel Economics. So, I've been learning economics with him for a while. So I've got the micro simply because that's what you have to have as a managing director. But I got the macro from Steve Keen. So, yeah I think we can have a decent conversation about that perspective, sure yeah. Kate Raworth and everyone else, okay.
Interviewer	[Sharing screen of kumu map] This is the system map that I've developed. It is quite complicated to look at because it's trying to represent a lot of information. But there's these basic nodes, and then each of their relationships, if it's a solid line than its

	supporting the economy's ability to thrive and if it's a dashed line like these ones. then it is weakening that ability. I think there are few areas to talk through but the first one to start with is definitions. So that initial objective of the thriving economy in pursuit of environmental justice. Does that make sense to you?
Member6	No. Hmm. It probably does but there's a big difference in what thriving means actually. And most economists just won't go there. not even Steve Keen. you know. And I've had these conversations now for a year in his, nearly a year, in his seminars. So I think you need to be more specific in order that the system's thinking doesn't go wrong because it's not. It's not clear enough. Cause it's like, okay, let's put it this way. Economics is not really a science. it's more like a language. And so when you speak it. And the reason is because there's no underlying fundamental measurement that you're talking about. And because there's no underlying measurement like feet inches things like that economics becomes a practice that's based on a grammar. So these are like words, and the way the words are used is defined by the economics. What do you call it by the economics … I was going to say profession. But the economics practice? So they'll talk about economic growth and thriving. And this and that, but there's nothing underneath it that a scientist would recognize as being measurable.

	It's much it think it's more profitable or it's more effective in terms of research is to get down to something that everyone can accept. as you know. Yeah, that's right. That's good. That's good and in terms of society. I don't actually know what that is and I don't know if any economist has ever defined it. So you get into things like prosperity. a prosperous society. What do you mean by that? I mean, Britain's meant to be, you know, one of the largest economies, biggest economy most developed world. But it's got homeless people living on the streets. So it's like how you going to define that it's really difficult, Bryony, and like, I say, there's nothing, as far as I know, there's nothing in Macro that that you can put your finger on to put into a system map. Now, the reason I'm saying this is because we were working on this at Linköping University. We put in two applications to do? A system map based on World 3, which is limits to growth. And what we said we were going to do was we were going to add into that the economic side. Because this world 3 doesn't have an economic systems map. The only economic systems map that was available at that time was from Steve Keen. So I went through 6 months of applying in two rounds for funding for projects like that where water and that kind of you know thriving economy that we were going to try and be specific about. So, the way to handle this, I think, is to be very specific. A length of life. and unemployment, homelessness. etc. Yeah, very, very specific. But then you have to define that from the beginning.

Interviewer	I'm really glad you've said that, because that is the issue that I grappled with for a few months and reading several books around economic thought and the history of development of different thought practices within economics. Growth can mean different things to different people. Growth is often interpreted, or particularly by my government as monetary growth and increasing monetary value. But at the same time there's a lot more discussion around multicapitals. And then you've got a situation where you could have growth in terms of multiple capitals that doesn't equal Gdp growth. Or actually, how are you defining? GDP. Because if you change the definition of what's included in GDP. You could then have a more holistic view of the benefits to society that aren't just focused on money. And I tied myself up in knots thinking about all of this, and then tried to draw it and tied myself up in more knots.
Member6	Welcome to my world. I mean, you're not alone Bryony, you've got the whole weight of the systems thinking world hanging on your shoulders.
Interviewer	And so, and also because I think it would almost be easier if I took a more economics view of saying, this is what my world view is. This is how I want to define these things. And so how do I create systems that support that way of thinking which to my understanding is how a lot of economic thought has been developed.

Member6	They’re intellectually bankrupt the research on this has been done by Nietzsche and Bressler and they've written a lot about this. I can send you the They're two names that are very hard to write. Yeah, they've done a lot of research on this. And they're the ones that really pointed out that economics is 1) not based on anything that you could compare to science and 2) there's a misuse of power in economics, economics, or capital allows you to excess, to exert power in a way that's not just. So, I'll put it this way. And I mean Aristotle said this literally, Aristotle and Plato. If you go back to the times of them. They were warning about this. This has been intellectually with us a long time, which is why it's like a mess, almost like our generation or your generation is going have to deal with philosophically. Let's put it this way. And if I've got money, I can go out and buy a big hummer. and I can drive it around as much as I like. And that will produce a lot of carbon dioxide contribute to global warming. If I have a lot of money I can build an industrial cow facility or chicken facility and within the grey area of the law I can release nutrients into the surface water and I can do it because my money allows me to build that infrastructure. And so we've got to a point where it's the monetary system. This is where economics and nature clash because capital, financial capital, allows you to do things that draw down natural capital and it's unfair. Just I mean, what is

	it that says just because I have the money, I have the right to do that? It's a commons thing. And this goes back philosophically to John Locke because, John Locke said, if you own something, and then you produce something, then you own the products of that land or that machinery and that that gives you a right of property. And and this is very confused thinking because it takes away the idea of a of a commons. And you you're calling it justice. It's about donut economics as well. yeah. So it's quite interesting. Because in trying to solve a water problem. and it's like, it's like everything else. As a researcher. When you start pulling. You have a simple. it looks like it's a simple issue. I'll get water. You start pulling on it, and you start getting back to really, really difficult things that previous generations have just swept under the carpet. and then you're sitting there hanging. Do I pull this up or not? It's like, what do I really have to look at this. So I feel for you there. yeah. That's the problem with all systems, thinking, though. So, that's where the challenge is so in terms of economy, I think one of the one of the to me. One of the core things of this is to question just because you have the money. Does that give you the right to draw down natural capital? Does financial capital give you the right to draw down national capital and to shine a light on where that is actually happening. And in Sweden. we have eutrophication in surface water. And we also have problem of nitrification in some places. Now, if you go back to the causes.

	It's 50% agriculture, the way they do statistics, it's 50% agriculture and 50% water purification. So sorry waste water management. So you could say that the infrastructure, the economic activity. let's call it that of waste water purification is contributing to one quarter of the drawdown of the natural surface ecosystem. I imagine it's higher in England. Now.
Interviewer	No, it’s about that. As agricultural controls are mixed the diffuse pollution is high
Member6	Yeah, right? Right? Yeah, diffuse. Yeah. And point right? Yes. So that that's where we are and it is possible to show, what we've been looking at here is what we call economic insolvency. Sorry environmental insolvency. Because you match the cost of or you match the economics of that particular social activity. You match that with the potential cost of cleaning it up. And then you see that the capital in that is there, say, in the water industry is not enough to, It's not enough to invest in cleaning it up. So environmental insolvency, I think, is a way to connect economics and drawdown of natural capital. And you got ecosystem services there. I've got diagrams about this. I can share it with you, but to me that's the point I found of interaction where you're not comparing. You're not comparing chalk and cheese. apples and pears you're looking at one thing as comparative. And see. That's the point of what the Swedish Sustainable Economy foundation we're getting into. You don't need to value the environment at all. What you need to do is put a

	value on what it costs to not pollute it that's where you can get down to a specific investment figure. Does that make sense?
Interviewer	Yes it does. And that relates back to conversations we had in pivot projects around mechanisms to enhance the value with which water is perceived? So, looking at price discovery to find a point on which the cost to not harm is more amenable than harming it and then dealing with the impacts of harming the environment.
Member6	Yeah right Because it's also something you can set up as a goal. And you can start to have economic instruments. taxes, sanctions, tariffs, whatever that that get towards that goal. So you don't need to. You need to know where you want to end up. Then you just keep forcing the market system to comply to eat it up, and where competition will, the force of competition will help. I mean, let's take Sweden as an example which I know. All Swedish water is it's not privatized. It's the role of the municipalities. And I've got two sides on this, both because I've been working with water. And now I'm a local politician. So I sit with these people now and again in local council meetings. It costs I think about, let me see, 1,000 Swedish crowns per kilo of phosphor to remove. So that would be 100 pounds. However, the final Kilo. which you have to get out to reach emission standards cost 12,000. Well, when you

	match that to the fact that most farmers are paying. I think it's now €10 a kilo or even less for phosphor, and I don't have the latest prices for phosphorus to put on their land. You see that it's an amazing draw down of money. So that's another place to link economics and the cost of drawing down a an ecosystem service. That's the circular economy thinking.
Interviewer	Yeah. Absolutely
Member6	It costs 60,000. The Swedish crowns to deal with the damage to the Baltic Sea from excess phosphorus entering it. So you can see when you go down the line, and the guy placed €10 for his mineral phosphate. And then we pay. I'm not sure how much we pay. But I was working this out, and if talking about economics, this is fun. The price of fertilizer is about 25%. Of food costs at the shop right? But then you, as a consumer, you have to pay for your drainage and here it's about 3,000 crowns a year that we pay to be connected to the to the municipal supply and then we pay local taxes, which also pay for that. And then from our local, from our national taxes, we have to pay for restoration of the Baltic Sea. So the story of phosphorus is one of total economic insanity. But every time I've shown this and I've had presentations at this and stood up and said, Look, guys, this is insanity. People's eyes just glaze over because the industry can't pay the cost of changing the system. And there's and as you talking about these silos? When you're in the silos, no one can pay the cost of making the first change. So the recent the recent regulations here requiring really, really quite strict emission

	standards from waste water have actually increased our Gdp because the water companies are making a lot of money on it. because they're charging a lot to do this. I mean, that's why they go out and say, Look, guys, it costs 12,000 crowns a kilo. And then the obvious answer to that is like, well, we have to find that money. So we raised municipal rates whilst being insolvent environmentally. Yeah, I don't know if this is helping. There's one more thing I want to say which I've learnt from Steve Keen about decision making. and that I think this is really important to what you're trying to do. I think so, if you so if you start with let's say, start with a concern. Any concern. The first thing you get is the scientists. because the scientists will be looking at that, and they'll be using measurement systems. Tons carbon dioxide, terawatt hours of energy changes in weather! You know that sort of thing. That's the way scientists work. The scientists in a decision basis, scientists very rarely get to present that information directly to policy makers. what comes next is often that information is taken by social scientists and other science to look at human impacts. Then it's taken by people who know about business to look at investment and things like that. Then it goes through

	to economists. It's often the economist's job to put all that information together and to present it to policy makers. And because of this economists act as a gatekeeper to information coming to policy makers. now, hmm. The problem with doing this. And you're pointing out there, it is about economists will be using GDP and other measurements which aren't really based in anything like that the scientists, or even the social science have had, and even the business people. There's a big disconnect between macroeconomics and micro and an example of this gatekeeping is William Nordhouse. William Nordhouse was given a Nobel Prize for his work. Are you familiar with his work? In yeah. What dice and other ways of working out the environmental cost of global warming. Now. I think it was made fairly clear by James Hansen and all the others. 350 parts per 1 million and 1.5 degrees is a red line. We don't want to go above that now. That information, like Chinese whispers, came through to Nordhaus who said, No, 3.5 degrees of warming is optimal for economic growth and the economic risks are minimal. That information got put into, it was used by consultants economists, who were putting, giving, that information to insurance companies energy companies, and the rest of it. So when that information got through to say that, for example, the Bank of England it was oh, yeah, 3.5 degrees. Okay.

	And it was actually Steve Keen who brought that logic down in several academic papers. and one was commissioned, The last one was commissioned by an insurance company network. And what's happening now is, which I think is important, for your research is that insurance companies are backing down on the policies that they've created around global warming and are looking into the risks and that the risks are far higher than they originally thought. They'd been duped literally by economists. Now there is a good side of economists and why we all listen to them is because they have accounting. and they use the assets. liabilities, equity, model of accounting. So everything in economics is assets or liability. And it's that kind of bookkeeping that Steve Keen brought into systems modelling. So all of Steve Keen's models are based on assets, liability, equity. And that is intellectually robust. So what you need to do, I think. although it I don't, I guess you won't have enough time to do it. But what needs to happen is that you use the economists way of looking at the world. and you put assets against each other. So to give an example. One asset would be surface water. Yeah. and another asset would be the water purification system. And then you, one would be able to look at what's a liability. And what's an asset?

Interviewer	Yeah, that's really interesting way of thinking about it to kind of frame those different aspects.
Member6	Yes, so you could say. And human capital, too. because there's a difference if you take say, say, you've got the water purification system. No, let water distribution system. and you see it as a whole. So that's the whole supply chain. So it's from. When we did this with circuit economy, we did it from Raindrop to tap. so and then we said, what is the capacity of that? Well, that would be built Capital. I like using the word built capital rather than produce capital. What's the capacity of that build capital in terms of providing a reasonable daily amount to the whole of the population. And then the next question would be. and you've got it here performance you had it here somewhere. Well, let's call it performance. How well is that system performing? That's to say how much of that capacity is being enjoyed by everyone. Yeah. And so here you can. You can connect the built capital with the natural capital with the human capital. And that to me is justice.
Interviewer	Yeah, yeah, I think that that's yeah, really interesting. That might be a good way to depict it. Because part of the problem that I came across was this issue of

	how do you interpret as of economic world view? And you have this kind of policy choice. So is the policy choice to go down a growth objective? And is growth monetary growth? Or is it multi capital's growth? Or do you go down a planetary boundaries, constrained model of kind of Kate Raworths donut economics type approach. And it's almost this. So that's what I was trying to draw out. Here is what would be the impact of going down one route or the other route. And then, when we're looking at futures, because that decision is outside the influence of the people that are making the decisions in terms of the water systems, and so that is an externality, if you like, which is imposed on them. So in these future scenarios there'll be a future where financial economic GDP -based growth is the route that policymakers go down. And so it it's, how do you fit within that model as well as the potential future where a general economics model is preferred. And what would that mean? But I'm just wondering if, looking at it from an asset. Liability and risk point of view that can be demonstrated more clearly in terms of what impacts it has.
Member6	It could definitely be modelled. But then you have to get into going beyond system mapping. Because the next step is to do a stock and flow analysis.
Interviewer	Yeah, which I think would be the next step on, something that Peter Williams mentioned as well was about how the system maps could be developed in terms of an insurance type approach to say, Well if we can look at all of these interactions, we can put values against them. And then what? As your own

	incentive liabilities, what impact would that have in terms of risk? And how would you insure against it from a disaster and resilience point of view?
Member6	Yeah, because if you've got stock and flow system maps. then you can do scenario analysis of it. The top of this is, you need the systems researcher really to do it. So you need to grab that person and say, This is. it's just this is my mental model of the world. and then put it into stock and flow analysis systems map. And then you have parameters, and then you can go. What if? What if we do this? What if we do that? And then you'll be able to see the effects? But I would like to suggest another route. Simply because we're looking at decision making now, what we were suggesting in our first application was to use the decision room. Linköping University had a gigantic decision room. and what it was. It was a round room, and it was surrounded by screens, and each screen was connected to a powerful computer. And you had like. Have you read the Glass Bead game by Hermann Hesse by any chance? [BB – no I haven't] Okay. I was a long, long time since I read it. But it's like you have one guy who would be the you know. What do they call it the almost like a disk jockey, but a system jockey. So and so you'd bring the politicians into the room. And you say, Okay, well, this is the system. This is the way things are. And this is our analysis. So what are your ideas about policies? To get into, you know, what do you think is a good idea? And some of them will say, Well,

	I think it's a really good idea to do this this and that. Then, yeah, okay. So you then, like, slide the bar. press the button, and you see how that goes into the future. And then, you ask them another question and then they and then they might go. Well, maybe we could raise that and lower that. You go. Okay, right? And then. and it helps people explore their mental model of the world. So that's one thing one can do for decision making. But you're still not there, because you're still not presenting them with an assets, liabilities, equity, proposal, and how that will affect them. So what's been coming into decision making, in my world and that's like working with regions is to use the normative approach. Because when you're being normative you're always looking at something which is agreed by everyone, so to speak. I'll give an example of normative What scientists do with Normative is to say, if you want to da da da, then… and then it says the status of something should be over the Normative. So the status should be normative. And then you can say, today it is. And then you've got like a status over Normative. So a very simple example. If we want a stable climate. Then parts per million carbon dioxide should be 350. What it is today is, if you include methane, is 500. So today it's 500 over 350, which means we have an overshoot. which is a certain amount of percentage. Now, this puts figures on values. because what we've said is, if you want… then we should… And so it's framing this as if you want, then you should. and then you come to point of well, I don't want that. Well, what do you want then? So I think scientific

	framing using normatives is a good route to go down for decision makers. And believe me, I've been there. I mean, I've been sitting in council meetings, and all you have in front of you is a balance sheet. you know not assets liabilities, but a balance sheet. This is our income, this is our outgoings. This is what we should do and there's no discussion about 'if you want, then we should'. And I think that's the way to go personally. And can derive normatives from looking at the way systems work, systems, performance. you can say, Well, what's the performance of the current system? We have? We know the price of it because you know, the investment, and we know the running costs. What's its performance? Well, it has an effect on ecosystem services, and it has an effect on human capital. And then well, what is it we want? So what is it we want? Well, if we want a fully, just, an equitable society, then we should have. You know, everyone can afford their water bills. What's the situation now? What's the status now? And so then you show the gap? And the next question is, Well, what? What would be the system change or investment required? And then you can get into scenarios to approach that. Sorry I'm ranting.
Interviewer	no, no, it's it's all really interesting. And it relates a lot to some of my previous work, actually where and I'll share an anecdote with you. So I was working in an area in Cumbria and there was a requirement for phosphorus removal on this stretch of river 10 kilometers long. 1,000 people live there. spread over 10 treatment works. And so it's all very small. And when the asset managers

	went and said, Right, we've got this requirement. It's regulatory requirements of phosphorus removal. The local landowners and Natural England who were quite engaged as its a farming community and they said, Why are you putting in phosphorus removal? That's not the issue. The issue is that we just all got flooded and Carlisle got flooded because of this river. We want you to solve that problem. That's the problem that is valuable to us for you to solve, for you to remove a little bit of phosphorus and spend, it was projected in the millions, to solve this bit of phosphorus problem. No, that's not of value to us. That's not important. This river is actually Ok, in terms of what it's doing in its health and its ecology. It wasn't that bad. It wasn't that they saw it as a local water quality issue. They saw it as a flooding issue and with all of that backing, and with partnership support we managed to argue the case with the regulator, that what we wanted was a more lenient permit at the sites, in order to do something different that didn't involve chemicals but we would use the savings from that to do interventions through the catchment that would remove phosphorus from the catchment, but would also help slow the flow and alleviate flooding issues. And it's been a massive success. So it's come in at much lower cost. The farmers have had interventions on their sites in order to do simple things like fence off the river, so the cattle can't go into the river which has reduced phosphorus load, but it has also meant that the banks are more stable. They are more able to cope with high flows you're not getting

	the run off and the wash out and overall with seen a huge improvement in phosphorus in the catchment. Unfortunately, the environment agency don't really like it and because it's a bit too out the box and it's not just monitoring an end pipe system. So they're not that amenable to doing many more of them, which is really unfortunate.
Member6	Yeah, which is why you have to have a really good decision basis if you want then, it should. And to look at that gap that that it's the gap that is it's quantifiable.
Interviewer	And once you know what the gap is, you can work out ways to address it. Going back to water affordability. So water is seen as unaffordable by about 10% of the UK population, its seen as too high a cost. And there's a proportion of that of that 10% that then are able to get payment support from water companies, and they're able to get payment plans in place or exemptions because their income is low. But for the vast majority of the population Water Bill is not a high cost is a very low proportion of their household income. So actually, if you, if you did. Look at that gap, and you did look at it in an equity way. I can see the argument that for higher earners they would pay more in order to allow the people that can't afford it to be able to afford food instead, which, when it's that kind of decision that they're making on a household level. The people that can afford it really should pay

	more and it would be a marginal increase for them, which probably wouldn't be felt. That would make a massive difference to kind of the other end of society.
Member6	Yes, it comes down to values. Because if you say if you if you value this. then if that's what you want then this should be the status. Yes, it's I think it's a very productive way forward to bring science to decision makers.
Interviewer	I think it's also, how do you influence how people value things as well. which is, it comes into behavioural change and a whole load of other issues. But I have come across a lot of kind of attitude, of why should we pay for water? It falls from the sky -it's free. And not understanding that. Yes, it rains, but that rain water has to be managed. It has to be treated, it has to be made safe. It then needs to be transported to your home to come out of your tap and then everything that goes down. Your drain also needs to be dealt with and treated.
Member6	And that's right. And that's why, from raindrop to tap, because when we framed it here for the county we said, Look, if you're going because the county we're asking us, can we be more circular and we said, Yes, you have to look at what you as a county, are responsible for. And then we said, It's from Raindrop to tap. but the circular is from tap back to surface water. So that's the circularity of it.

	And then once you start to look at that as a system. You know what it costs. You know what it costs the ordinary person. And then you can start to put your sustainable values on it. So you could say, like, Well, if you want if you want surface water to be ecologically functioning then you shouldn't let out more than …. down into the rivers, or the rivers shouldn't have more than this in it. The thing is, when you start doing this, now this is probably the last thing I'll say I don't know as I think we're on the same page here. It's I've got the image of painting yourself into a corner. you know, like painting the floor was a good idea at the time and then making sure you get the edges right was a good idea, and then but suddenly you find yourself stuck in the middle of the room with no way out. And I mean, when you look at water you can ask Peter, yeah. Because it's like in the First World War. They invented chlorine to kill people, and then they realized that they had a large capacity for chlorine and no use for it. And so they started, saying, Well, I think we should purify drinking water with it and it's good, I mean, yes. Well, choleras bad, it works and everything. And then people say, Well, you've got to get the waters to the people. At that point the oil industry had created a pipe industry and the pipe industry wanted to sell more pipes. So the pipe industry size said, well, chlorinate it. Sweden got his first pipes 1912, I think. Yeah. The you know the full so it's piping to and piping from. and then it was like, Oh, no. this the

	water's starting to smell. It's terrible! And so that spewed a water purification industry and it's been like that ever since. And then it's like, Oh, you've got to have water closets. And yeah, oh, my God as all these industries and all these activities all around this gigantic piece of antiquity,
Interviewer	Like the cesspits and urban cesspits worked fine until we all had flushing toilets and then the volume of water was what they couldn't cope with. And then suddenly, they don't work anymore, and you've got a stinking river, and then then you've got to lay pipes, build sewers, in order to transport it away. And then you've got an issue where you transported it away.
Member6	So the investment needed to make that go circular is really quite huge. And that's the problem that England's going to face I think. It's bankrupt. It's not just in solvent, it's environmentally bankrupt. It's frayed. You've got to pussy foot around this now. But the same time as a scientist. When you take the scientific view, it's almost impossible to get that decision making basis under the eyes of the right decision makers. So I guess we have to hack at it very politely and very thoroughly.
Interviewer	Yeah, and just keep plodding away and trying to make the point.
Member6	Anyway, that was my feedback.

Interviewer	That's been incredibly useful. I've got a list of notes
Member6	I'll send you the stuff I've written. So it you should recognize some of it. yeah, you've got urbanization there. Yeah, I mean God. you know, you know, Aldous Huxley wrote, Brave New World. have you? Have you read it? You should see the film. Yeah, if you have a film night one evening. get your better half, and we must watch this film. But he wrote the book A Brave New World Revisited and in it, he wrote. I mean, Brave New World is a terrible vision of the future. It was written in 1935, just before the Second World War broke out, and he was so afraid of fascism. But he said that urbanization was one of the root causes of fascism and what he said was that humans aren't really constructed to live in large populations. He said humans and mammals, insects can live in huge populations. But mammals can't. And he said that what happens is that when you. when you put humans into cities like that. Then you start to force evolution. There's something in the human that that will make them go to insect level and examples of insects societies is, hierarchy, a very, very strong soldier class and use of chemicals to control. And that's what brave New world is. It's a vision of what that society is like. When humans are so stressed, they go back to insect behaviour. And it's frightening. It's absolutely frightening. And to think that we've got in Sweden, 85% live in urbanized environment. And in the world, it's 50.
Interviewer	But it's projected to go up to almost 70% by 2050. A massive, massive growth in urbanisation.

Member6	And I mean, it's like, yeah. And as you were saying, is, probably there's going to be another trend which is the opposite towards ruralization. But I honestly, I I've worked with this stuff for a long time but I don't have any answers. Honestly, I don't. What we're doing politically now is we're trying to put out fires, that's all we're doing climate fires. We've had one railway disappear because of excess rainfall. We've had one city drenched because of excess rainfall. We've had fires which have destroyed large percentage of forest and we've had droughts which have put farmers on the edge of bankruptcy. And I'm talking the last 5 years. Yeah. And so politically, it's like Paris?! forget it. It's like local politicians like how we going to prevent the dairy farmers from going out of business. and the poverty that comes with it because you get inflation and then you got all these people who are on the edge. And then suddenly, you get a poverty problem. So we're on the edge of a system collapse.
Interviewer	Yeah. I've read quite a few papers. Looking at, well, if water becomes more scarce, do we then change our agriculture to more high value crops. But then the impact of that is those high value crops may not support the local economy any more, and actually may not employ as many people. or may mean, that the local population needs to pay more for what used to be a local good that was cheaply provided. Because it's now imported from somewhere else. And actually, you're moving the environmental degradation to

	somewhere out of sight. And as soon as something's out of sight. People don't know about it any more, they don't care as much. and they don't act on it as much. So trying to make that more visible? and yeah, it's it seems to be a worrying trend in the literature that there's a lot of - let's look at the marginal costs, and look at the value and put a value against everything in order to say in this river basin. let's move away from this crop and have this crop instead, because we will make more money without looking at, well, what are the social consequences of that? And what are the environmental consequences of that. There's a whole big picture.
Member6	And it's now you're in good company with Dominic Cummings.
Interviewer	I don't think that sentence has ever been said.
Member6	Because when he was working at with Boris Johnson he published a paper. I mean, this guy is genius. Okay, evil genius, some people might say. Have you seen the film with Benedict Cumberbatch he did a film where he played Dominic Cummings. Oh, that was so brilliant!
Interviewer	I think I couldn't bring myself to watch it
Member6	Because it gives you an insight into decision making because he's good at this. So anyway, he wrote a blog, I'll see if I can find it. Saying that parliamentary processes was outdated and that the decision cabinet room should be covered with screens

	and they should have a full decision basis to work with. And that makes me think back to our decision room at Linköping University. These things exist, you know. And he was saying, You know, why don't? Why don't? Why doesn't politics use them? Very, very clear, very clear. So I mean, there are people that get this in different pockets around the landscape. Yeah, yeah. Yeah. Anyway, I think I've taken you as far as I can.
Interviewer	Can I just ask one very quick question? So when I was looking at financing of public water services, are trying to steer away from calling the water companies, because, although they are water companies currently in England and Wales. They may not be in the future. But whatever form it takes, it has to be financed in some way. And I could kind of block it into 3 main forms of financing. So private finance model which we currently have here. A public finance model which we had pre-1989 and a social enterprise model. Which is sort of, kind of, the case in Wales.
Member6	Really? Excellent
Interviewer	They are not for Profit Water Company, so they are a water company. But yeah, they are not for profit, and they reinvest into the community. They are also, not performing very well. But yeah, but because of their model, they have to get agreement from the community for everything that they do.

	Which does mean that affordability ranks quite highly in what investment they are able to undertake. And communities in Wales are not the most affluent across the country. So I think that kind of comes to bear.
Member6	But the okay, let me just stop you there It might be a mistake of history or of our human development but we think of everything as a company. Even co-operatives are organized as companies. Over here, the way this works, like I'm on the Council, right? So the Council decides. The Council has a planning monopoly and it also has a rubbish monopoly and a few other monopolies. But the society owns the water companies so the Council owns the water companies but they're still run as companies because it's very convenient because of the economist's good side, which is accounting. You know the balance sheet. What do we need to invest and what costs do we have? Etc. And then how we share those costs as part of the municipal fee. So there's nothing wrong with companies. Now in terms of financing. Where I think England's gone wrong is that there are two ways of financing a private company. One is shares. And when you issue shares, then you become a part owner and the other way of financing is loans. So a non-private company doesn't have the share root to go down. But, on the other hand privatized water companies have a problem because when they sell shares, people want things back from them.

Interviewer	I think across England, Wales, there's been a lack of regulation. There's been a lack of economic regulation and understanding of the implications of private finance.
Member6	Oh, yeah, absolutely.
Interviewer	And it was just a massive failure from the outset
Member6	Interestingly enough, Sweden has private schools. And the same has happened with the school system. So what happened with sewage in your case has happened here and what we've had here is that children have been given hard bread and water as lunch because these private education companies are actually saving money in order to give to their shareholders. Interestingly enough, the price of a share doesn't really give money to a company. A company can have a big share price or low share price. It's not going effect the money coming in or going out at all. It's like. But in fact, the privatized company is at the mercy of its shareholders. It’s not good. It's not a good thing. I mean, like, you know I was managing direct to a company. I know what it's like. I had to sit. stand in front of shareholders and look them in the eye. and some of them were pensioners, had put their savings into my business. which was failing. It's horrible. It's horrible. Yeah. So this the thing is that Society is the one that provides the basis for a thriving economy. It's society which takes the hit and also provides

	the customers and provides the workers. So I think what I'm saying is, I think we can use the idea of company as being the entity that that owns the system. But that it's the ownership that is really key. So how that performs?
Interviewer	And what I was finding, looking at kind of the movement of money or finance through these financing systems is that both private finance and public finance you get this kind of siphoning off of accumulated wealth which is taken out of the normal cycling within the economy. So either through, obviously the bad guys in England at the moment being seen as the companies and their investors and shareholders that accumulating the wealth. But similarly, if its public finance and its finance through government borrowing. governor, borrowing will still need to repay that interest on debt, and that that interest on Government debt was the reason that we privatized the water industry because the government at the time didn't want to pay that interest, and did not want to pay the increased interest that they would need to find for the mass investment that was needed in the industry at the time.
Member6	That's right, but that that is and economic misunderstanding
Interviewer	Which bit?

Member6	That you have to pay interest on Government debt that a government has to go into debt in order to create infrastructure. It doesn't. It doesn't at all. A government makes, because after Brexit Britain has its own sovereign money. If you were, if you were in EU, you're not allowed to create your own money. I mean, cause you literally that's what you, do you? You literally spend money into existence. The expert on this is Richard Murphy. He's a professor of tax and he can explain a lot of this stuff very simply. So I'll make a note to refer you to him. Yeah, because the reason government were borrowing is was because of EU rules. So now you're out of Brexit. You don't have to do that at all. There's no reason to have to do this And anyway. I mean, how? How did Britain get through the war? It issued war bonds. Wouldn't it be better if, I think it'd be better if people came in and said, Come on, I've got a water bond here you will. You have, an investment instrument in your local water company. What this bond does is give you a guaranteed price on water or guaranteed maximum price. That sort of thing. I mean, that's like getting the people involved in their own system. So it's what you've written there system-wise is true. but it doesn't have to be that way anymore.
Interviewer	Okay, no that's really interesting.

	Yeah. Okay? And then, in terms of the social enterprise was the one was the one. Well, the only one that I'd had. But where you've got this cycling. And essentially, the money remains circling within the economy, and it isn't siphoned off. But yeah, from what you're saying, then you can also kind of do that with public finance. If you are yeah, generating water bonds or something similar.
Member6	Yeah, yeah, I mean, there are a lot of there are a lot of solutions here. But I mean, while you've got Tories who are just, they're winging it. Basically, they don't really know how the system works. but they're winging it to for I don't know why, or whatever. They have a very poor view of how the economy works. Richard Murphy is. he writes in local, in newspapers slating, you know, the what people are saying is, it's wrong. It's wrong from a you know the way the economy works point of view. People assume that because you have a government, the only way to get money is to borrow. Absolutely not true of a sovereign country that has its own sovereign currency. There's no theoretical way that's true. The thing is, if you have a private company running the show. Then that is true. A private company can only get money through selling shares or through borrowing from private sources. whereas the government doesn't. So yeah. I agree.

Interviewer	Fantastic, that has been so useful. Thank you so much for spending one, nearly two hours discussing this with me. It's been, yeah, really useful, really interesting.

Call ended.

APPENDIX C: QUESTIONNAIRE AND SEMI-STRUCTURED INTERVIEW ETHICAL REVIEW

UNIVERSITY OF BIRMINGHAM

Ethical Review Form

Project details

Important Information

Please note that this form is only suitable for staff and postgraduate research students. If you are on a postgraduate taught course, your local school/college will review your work and you do not need to apply via the Research Ethics Review system.

If you need help whilst completing the form, FAQs and additional information can be found under the 'Help' section in the black bar at the top of the page. Some questions also have an 'i' on the top right, clicking this will bring up additional help text.

The form will automatically save when you click 'next'. Alternatively, you can click 'save' on the top left to manually save your progress.

Please note that this form is currently in a piloting phase. All applications may be subject to a quality assurance check and a member of the ethics team will be in touch with the lead researcher and/or applicant directly if an application raises any queries. If you would like to contact us directly please use aer-ethics@contacts.bham.ac.uk

Please note that programmes of work are currently being processed outside of the system. Please contact the ethics team directly if you wish to apply under a programme of work.

Is your project considered to be research?

A project is considered to be research if it is likely to result in research outputs (including, but not limited to, journal articles, conference papers, theses and online dissemination). Further indication of what might be considered to be research can be found at http://www.hra-decisiontools.org.uk/research/, but please be aware that if a service evaluation project will result in a research output (including theses) it will be considered to be research from a University perspective. If you are in any doubt as to whether your project should be considered as research, please contact the Research Ethics Team to discuss further.

- (•) Yes
- ( ) No

Is this a staff or a postgraduate research student project?

- ( ) Staff
- (•) Student (PGR only)
- ( ) Other (by special permission only)

Please confirm the college of the main PI/Supervisor

Engineering and Physical Sciences (EPS)

Please confirm which school within EPS the main PI/supervisor is from

Engineering

Please provide your student ID number

Project title and duration

Please give the full title of the research project

Visualisations to support environmental justice led decision making in the water industry

Please give a short title for the research project (e.g., an acronym or reduced title). You may use the same title as above if the character length allows

Visualisations to support environmental justice led decision making in the water industry: testing

Please provide the anticipated start and end dates for the project

Please select the year before the month. Months which have already passed in the current year will not show.

Anticipated start date	01/08/2020
Anticipated End Date	01/07/2024

Contact Details For Researchers

Please note, then when entering details for University of Birmingham (UoB) staff/students/supervisors, you can click the 'assign role' button in blue at the top of each contact, selecting the correct role will automatically give that person the correct access/permissions to the current form. Please note that the form owner (i.e. who initially made the form) will automatically be given full access so, a role is not required for them.

Please provide details on any UoB PGR students involved in the project

First Name

Bryony

Surname

Bowman

Department

Civil Engineering

Email

Please enter the details on the UoB supervisors below

First Name

Christopher

Surname

Rogers

Department

Civil Engineering

Email

Please enter the details on the UoB supervisors below

First Name

Dexter

Surname

Hunt

Department

Civil Engineering

Email

[redacted]

Will there be any additonal co-investigators involved in the project at UoB?

- ○ Yes
- ◉ No

Are there any further external co-investigators you would like to add to the project? Please note that these individuals will not have access to the system but, you will be able to download the form as a PDF to share with them.

- ○ Yes
- ◉ No

Funder details

Please note that if the project will not proceed without a funding award, that ethics should not be submitted until the funding award is confirmed i.e., that the project will definitely go ahead (unless you have had prior permission from a member of the ethics team).

Is this project funded?

- ◉ Yes
- ○ No

Please state who is funding this project

EPSRC

Please state who is funding this project

United Utilities

If this project is going via Worktribe, please enter the Worktribe reference number for this project

Checklist

Please select which of the following your project will involve

- ☐ Research involving animals
- ☐ Research that needs to consider requirements under the Nagoya Protocol

  This includes uses of genetic material; plant, animal, microbial or other origin containing functional units of heredity which is of actual or potential value, or derivatives. The protocol does not apply to human genetic resources.

- ☐ Existing ethical approval from another institution in the UK or abroad, for a project that does not have NHS involvement
- ☐ Exsisting HRA approval and / or a favourable opinion from a NHS Research Ethics Committee

  This includes projects which have received sponsorship from UoB or other institutions within the UK. If it is planned that Sponsorship is provided by another institution, please select this option and provide details after sponsorship has been confirmed.

- ☐ Research which requires new application for HRA Approval and / or a favourable opinion from a NHS REC, with Sponsorship provided by UoB

  This includes research projects which will involve NHS patients, staff and services. This also includes projects where UoB will act as the National Co-ordinating Centre

- ☐ NHS Service Evaluation

  The University will review service evaluations where any of the data will be written up for a research output. If the service evaluation data will not be used for a research output then we do not require an ethical review.

- ☑ None of the above

  These projects will still be reviewed by the research ethics team

UREC Checklist

Please select all of the following which your study involves:

- ☑ Human Participants

Risks relating to participant involvement

- ☐ Potentially Vulnerable participants (including those aged under 16)

  Examples of vulnerable participants are children, people with learning difficulties, patients, people experiencing emotional distress or mental illness, people living in care or nursing homes, and people recruited through self-help groups, participants in a dependent or unequal relationship with the researcher(s) or research supervisor, or participants recruited because of their membership of groups which are vulnerable in relation to their identity (for instance, sexuality, gender or race)

- ☐ The co-operation or approval of a gatekeeper for initial access to the groups or individuals to be recruited

  For example, a gatekeeper would be considered someone who needs to give permission to access a

group (e.g., a head teacher, leader of a self-help group). If your supervisor is putting you in touch with a group of people or, you are using snowball sampling, this would not be considered use of a gatekeeper.

☐ Participants taking part in the study without their full knowledge and/or consent

e.g. covert observation of people in non-public places or any form of minor or major deception

Data collection risks

☐ Data collection/recruitment via the internet/social media without the consent of the data subjects
☐ The collection or use of obscene, illegal and/or offensive material

Including online content of this nature. This includes material which may prompt the University's duties under the government's Prevent strategy (see https://www.gov.uk/government/publications/prevent-duty-guidance/revised-prevent-duty-guidance-for-england-and-wales for further information)

☑ Visual recordings in which people can be identified

Risks relating to study design

☐ Physical or emotional harm, discomfort or stress
☐ Prolonged experiments or testing which is burdensome on the participant
☐ Financial or other inducements (other than reasonable expenses and compensation for time) for participants
☐ Sensitive or controversial topics or issues (e.g. topics which are politically, socially or culturally sensitive)
☐ Any breaking of security or other systems without the permission of the owners
☐ Potential risks or damage to the environment or society

Insurance/governance concerns

☐ Substances (including placebos, supplements, drugs) being administered to participants
☐ The collection of any form of human tissue NOT considered to be relevant material

(Relevant material being that which consists of or includes human cells, see https://www.hta.gov.uk/sites/default/files/Supplementary_list_of_materials_200811252407.pdf) including DNA.

☐ The project will fall within the exclusion of the Clinical Trial Legal Liability cover

Information on this is available at: https://intranet.birmingham.ac.uk/finance/insurance/liability/clinical-trials.aspx

Potential Conflict of Interest Risks

☐ Risks or potential controversy relating to the source of your funding

This may include politically or culturally sensitive funding sources

☐ Any potential conflicts of interest

e.g. staff of other organisations, students at school, members of self-help groups, or residents of a nursing home

☐ Any other ethical issues not covered in the above points that in the opinion of the applicant require further review

☐ None of the above

Project Details

Your answers up to this point have indicated that your project involves more than minimal risk, for this reason a full UoB ethical review is required. Please confirm that you are aware of this. Once this is confirmed, additional questions will be generated by the form.

◉ I understand that a full UoB ethical review is required

Please note that if you will be uploading any participant documents for this application that you will be required to use version controls. Information on version control can be found by clicking 'help' in the top banner of this webpage and then clicking FAQ.

Does your project contain any potentially disturbing materials which the reviewers should know about in advance (e.g. you will be uploading documents/videos etc. which may impact on reviewers well being)?

○ Yes
◉ No

Describe the purpose, background rationale for the proposed project, as well as the hypotheses/research questions to be examined and expected outcomes. This description should be in everyday language that is free from jargon - please explain any technical terms or discipline-specific phrases. Please do not provide extensive academic background material or references.

The project aims to generate visualisations to depict the relationships that each of society, ecology and the economy have with the surface water environment. The relationships held within these visualisations categorise the type of relationship and whether this is supportive or destructive to the objective of environmental justice and supported by a series of indices. The visualised relationships will be explored using foresight techniques to depict the diverse impacts of a range of futures to relationships across the surface water environment from the perspectives of ecology, society and the economy.

Please give a description of the research methodology that will be used. If more than one methodology or phase will be involved, please separate these out clearly and refer to them consistently throughout the rest of this form.

This part of the project will test the visualisations, indicators and methods proposed for collaboration with cross-sectoral groups. This will consist of a questionnaire with options follow-up discussion.

A questionnaire will be used to collect views and opinions relating to understanding around reasons that interventions/improvements are needed across a river catchment. The questionnaire will be sent to participants across a range of organisations using a snowball approach where appropriate.
There is the option for a follow-up discussion after completion of the questionnaire to enable more in-depth conversation and exploration.

State the geographic locations where the project and all associated fieldwork will be carried out. If the project will involve travel to areas which may be considered unsafe, either in the UK or overseas, please ensure that the risks of this (or any other non-trivial health and safety risks associated with the research) are addressed by a documented health and safety risk assessment. The FCO guidance can be found at https://www.gov.uk/foreign-travel-advice

UK, online contact via web-link for questionnaire

Participants and Recruitment

Does the project involve human participants?

(•) Yes
( ) No

Who will the participants be?

Describe the number of participants and important characteristics (such as age, gender, location, affiliation, level of fitness, intellectual ability etc.). Specify any inclusion/exclusion criteria to be used.

Participants will be over 18s working in the UK water and environment sector (regulator, NGO, water company etc). A total of 5-15 individuals are expected to be involved.

How will the participants be recruited?

Please state clearly how the participants will be identified, approached and recruited. Include any relationship between the investigator(s) and participant(s) (e.g. instructor-student).

A partnership of water and environment sector organisations will be approached through the chair of the partnership as a case study group to test the findings of the research and develop outputs. United Utilities, one of the funding organisations of the research, is part of this partnership. The researcher also has an extensive network across the water sector (water company, consultancies, NGOs) which will be drawn upon to gain a rich understanding of views.

Recruitment Documents

Will you be using any recruitment documents e.g. poster(s), advertisement(s) or letter(s), social media post(s)?

( ) Yes
(•) No

Consent

You should start to consider the need to provide open access to your research data as early as possible, particularly whether you need to include consent for this in your participant documentation.

The UK Data Service provides advice on the legal and ethical issue to consider regarding data sharing and providing open access to data, including the need to obtain participant consent, at https://www.ukdataservice.ac.uk/manage-data/legal-ethical.aspx.

You can find more information about archiving and sharing your data at:
https://intranet.birmingham.ac.uk/as/libraryservices/library/research/rdm/Archiving-data/Archiving-and-sharing-data.aspx.

What process will be used to obtain consent?

Describe the process that the investigator(s) will be using to obtain valid consent. If consent is not to be obtained explain why. If the participants are under the age of 16 it would usually be necessary to obtain parental consent and the process for this should be described in full, including whether parental consent will be opt-in or opt-out.

Participants will be approached by the researcher and provided with an information sheet and consent form alongside a request for participation. The participants are part of an existing partnership of which the industrial sponsor (United Utilities) of this research is also a part. The lead for the partnership will be approached and snowball sampling methods used to ensure thorough representation, in particular for the first stage questionnaire. The consent form will be sent via email to the participants.

Please attach a copy any Participant Information Sheets (if applicable) which will be used.

Documents

Type	Document Name	File Name	Version Date	Version	Size
PIS	Questionnaire information sheet	Questionnaire information sheet.docx	19/12/2023	1.0	366.7 KB

Please attach a copy all the Consent Forms (if applicable) which will be used in the project. If consent will be gained in an alternative way (e.g. verbally) please provide a script for this or any other material that will be used in the consent process.

Documents

Type	Document Name	File Name	Version Date	Version	Size
Consent Form	Participant Consent Form	Participant Consent Form.docx	19/12/2023	1.0	365.5 KB

Deception

Will the participants be deceived in any way about the purpose of the study?

- ○ Yes
- ◉ No

Feedback

What, if any, feedback will be provided to participants?

Explain any feedback/ information that will be provided to the participants after participation in the research (e.g. a more complete description of the purpose of the research, or access to the results of the research). If no feedback will be provided, please explain why.

Optional follow-up discussion will be offered to all participants.

Withdrawal

What arrangements will be in place for participant withdrawal?

Describe how the participants will be informed of their right to withdraw from the project, explain any consequences for the participant of withdrawing from the study and indicate what will be done with the participant's data if they withdraw.

Participants are free to withdraw at any point up to 1 week after participation. No reason is required for withdrawal. Any data collected up to this point will be deleted unless the participant agrees otherwise.

Please confirm the specific date/timescale to be used as the deadline for participant to withdraw their data and ensure that this is consistently stated across all participant documentation. This is considered preferable to allowing participants to 'withdraw data at any time' as presumably there will be a point beyond which it will not be possible to remove their data from the study (e.g. because analysis has started, the findings have been published, etc).

1 week after participation

Compensation

Will participants receive compensation for participation?

- ○ Yes
- ◉ No

Confidentiality/Anonymity

Participants will be anonymous if you will not be meeting participants face-to-face, or gaining any identifiable data (such as names, e-mail addresses, student ID's etc.)

If you have multiple participant groups, where each group has a different level of confidentiality/anonymity please provide clear details on this in the text box shown at the end of this page (the box will appear after a maximum of two selections have been made).

Will all participants be truly anonymous?

- ○ Yes
- ◉ No

Will all participants' data be treated as confidential?

- ◉ Yes
- ○ No

In what format will data be stored?

Will participants' data be stored in identifiable format, will it be anonymised or pseudo-anonymised (i.e. an assigned ID code or number will be used instead of the participant's name and a key will kept allowing the researcher to identify a participant's data)?

Retuned questionnaires and discussions, contributions and feedback will be pseudo-anonymised using an assigned number with a key kept by the researcher. All participant data will be held securely.

Storage, access and disposal of data

During the project, how and where will the data (both paper and electronic) be stored, what arrangements will be in place to keep it secure and who will have access to it?

Access to data collected will be restricted to the researcher, direct (technical and strategic) outputs from the workshop will be available to participants. Anonymised data will be stored in on Microsoft 365 One Drive and personally identifiable information will be deleted following analysis.

After the project is complete, where do you intend to store your data at the end of the project (please select all which are relevant)?

- [x] University eData repository (https://edata.bham.ac.uk)
- [ ] An external repository
- [ ] Research Data Store (RDS) (https://intranet.birmingham.ac.uk/it/teams/infrastructure/research/bear/research-data-service/rds/research-data-store.aspx)
- [ ] Other

You can find more information about archiving and sharing your data, including your choice of data repository at: https://intranet.birmingham.ac.uk/as/libraryservices/library/research/rdm/Archiving-data/Archiving-and-sharing-data.aspx.

The University usually requires data to be retained in line with the data management policy https://intranet.birmingham.ac.uk/as/libraryservices/library/research/rdm/Policies/Research-Data-Management-Policy.aspx. Will you/your supervisor make arrangements for the data to be retained for in line with this?

- (•) Yes
- ( ) No

Do you intend to make your data openly accessible at the end of the project?

(please see https://intranet.birmingham.ac.uk/as/libraryservices/library/research/open-access/index.aspx for further information)

- ( ) Yes. A provision for open access will be put into place (please ensure a consent provision is in place for this)
- (•) No. Data will only be shared with current research team.
- ( ) Other e.g. embargoed for a period of time, data access committee to be set up etc

What arrangements will be in place for the secure disposal of data?

All copies of data related to a participant will be deleted if that participant withdraws. Their contribution to the transcript will be deleted, and recordings generated will not be used directly in research outputs.
Recording and personally identifiable data will be deleted from all locations following analysis and anonymisation of data collected.

Data Management Plans

Please note that these are live documents, the University Research Data Management Policy (https://intranet.birmingham.ac.uk/as/libraryservices/library/research/rdm/Policies/Research-Data-Management-Policy.aspx) requires that:

1. Funded research projects and unfunded research policies likely to generate data should be supported by a Data Management Plan (DMP)

2. Following completion of a project, Research Data should be made openly available (where appropriate), or made available for access and re-use under appropriate safeguards which take into account legitimate interests of research subjects and in accordance with the Data Protection Act. It should be kept for a minimum of 10 years.

You do not need to submit your DMP with your ethics application, but you must ensure that the information in your ethics application is consistent with the information in your DMP.

Additional Approvals

Are you aware of any other approvals required to carry out this research?

For example, DBS checks, local authority approvals etc.

- ○ Yes
- ◉ No

Risks and Benefits

Outline the potential significance and/or benefits of the research

The research will enable visualisation of relationships with the surface water system from a range of perspectives, in this case validated through use of a questionnaire. This aims to generate tools to enable justice-led decision making in the UK water industry providing benefits to people and the environment. Gathering viewpoints on the application of these tools will enable validation of the research outputs

Outline any potential risks

If follow-up discussion is requested this will be conducted remotely through an online meeting platform, passcode entry and waiting room will be selected to ensure confidentiality of the meeting.

The outlining of the risks in this section does not circumvent the need to carry out and document a detailed Health and Safety risk assessment where appropriate.

For projects of more than minimal H&S risk it is essential that a H&S risk assessment is carried out and signed off in accordance with the process in place within your School/College and you must provide a copy of this with your application. The risk may be non-trivial because of travel to, or working in, a potentially unsafe location, or because of the nature of research that will carried out there. It could also involve (irrespective of location) H&S risks to research participants, or other individuals not involved directly in the research.

Further information about the risk assessment process for research can be found at https://intranet.birmingham.ac.uk/hr/wellbeing/worksafe/policy/Research-Risk-Assessment-and-Mitigation-Plans-RAMPs.aspx.

Please note that travel to (or through) 'FCO Red zones' requires approval by the University's Research Travel Approval Panel, and will only be approved in exceptional circumstances where sufficient mitigation of risk can be demonstrated.

Does the research raise any ethical issues not dealt with elsewhere in this form?

- ○ Yes
- ◉ No

Do you wish to provide any other information about this research not already provided, or to seek the opinion of the Ethics Committee on any particular issue?

- ○ Yes
- ◉ No

Peer/Expert Review

Has your project received scientific peer review?

- ○ Yes
- ◉ No

Would you like to nominate an expert reviewer for your project?

- ○ Yes
- ◉ No

Supporting Documents

Please upload copies of any additional supporting documents such as questionnaires, interview topic guides, debrief materials etc.

Please note that you do not need to upload consent forms, information sheets or recruitment notices which were uploaded earlier in this form. To see a full list of documents already attached to the current form, please click the 'documents' button on the left hand side.

Documents

Type	Document Name	File Name	Version Date	Version	Size
UREC supporting document	Questionnaire	Questionnaire.docx	19/12/2023	1.0	18.1 KB

Declarations

By submitting this checklist, I declare that the questions have been answered truthfully and to the best of my knowledge and belief, and that I take full responsibility for these responses. I undertake to observe ethical principles throughout the research project and to report any changes that affect the ethics of the project to the University Ethical Review Committee for review. I have read and undertake to abide by the University's Code of Practice for Research (http://www.birmingham.ac.uk/Documents/university/legal/research.pdf)

(•) Yes

I understand that if my study involves more than minimal H&S risks, a H&S risk assessment must be carried out (see https://intranet.birmingham.ac.uk/hr/wellbeing/worksafe/policy/Research-Risk-Assessment-and-Mitigation-Plans-RAMPs.aspx). This includes risks due to the location of the research to be carried out (either in the UK or another location) or risks relating to travel. Further information about risks relating to overseas travel and working overseas can be obtained from the Foreign and Commonwealth Office (see https://www.gov.uk/foreign-travel-advice) and from RiskMonitor Traveller (see https://umal.co.uk/travel/pre-travel-advice/)

(•) Yes

I understand This form will be processed in accordance with the Data Protection Act 2018. Please see the University's Data Protection Policy at https://www.birmingham.ac.uk/Documents/university/legal/data-prot-policy.pdf for further information.

(•) Yes

Would you be happy for this application to be used anonymously in future training sessions with the committee and/or other applicants?

(•) Yes
( ) No

<

Please note that once all signatures for the project have been gained, the project will automatically be submitted to the ethics team

If multiple signatures are required, the form will lock so no changes can be made. The form can be unlocked by anyone with access to edit the project. Please note that unlocking the form will invalidate all signatures.

Please confirm you are happy with the form as the **lead supervisor** on the project

Signed: This form was signed by Dexter Hunt ([redacted] n 31/01/2024 15:02

Please confirm you are happy with the form as the **lead PGR student** on the project

Signed: This form was signed by Bryony Bowman [redacted] n 19/12/2023 14:21

UNIVERSITY OF BIRMINGHAM

Dear Christopher Rogers, Dexter Hunt, Bryony Bowman

RE: Visualisations to support environmental justice led decision making in the water industry

Application for Ethical Review: ERN_1105-May2023

Thank you for your application for ethical review for the above project, which was reviewed by the Science, Technology, Engineering and Mathematics Committee.

On behalf of the Committee, I confirm that this study now has ethical approval.

Any adverse events occurring during the study should be promptly brought to the Committee's attention by the Principal Investigator and may necessitate further ethical review.

Please ensure that the relevant requirements within the University's Code of Practice for Research and the information and guidance provided on the University's ethics webpages (available at https://intranet.birmingham.ac.uk/finance/accounting/Research-Support-Group/Research-Ethics/Links-and-Resources.aspx) are adhered to.

Please be aware that whilst Health and Safety (H&S) issues may be considered during the ethical review process, you are still required to follow the University's guidance on H&S and to ensure that H&S risk assessments have been carried out as appropriate. For further information about this, please contact your School H&S representative or the University's H&S Unit at healthandsafety@contacts.bham.ac.uk.

Kind regards,

The Co-Chairs of the Science, Technology, Engineering and Mathematics Committee

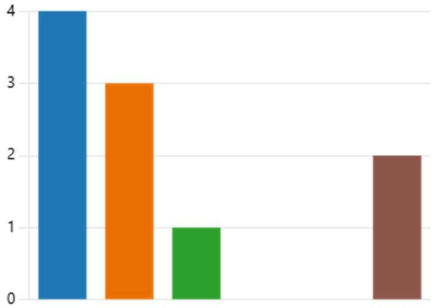
E-mail: ethics-queries@contacts.bham.ac.uk

APPENDIX D: QUESTIONNAIRE RESULTS IN FULL

Questionnaire: Decision making in the water sector 10 Responses

1. What sector most closely describes your organisation or those you represent?

Water company	4
NGO	3
Regulator	1
Land owner	0
Academia	0
Other	2

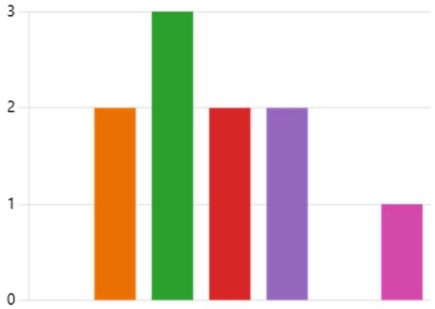


2. Are you currently involved in a partnership within the catchment whose purpose is to collaborate to define issues and action within that catchment?

Yes	6
No	4

3. What is your age bracket?

18-24	0
25-34	2
35-44	3
45-54	2
55-64	2
Above 64	0
Prefer not to say	1

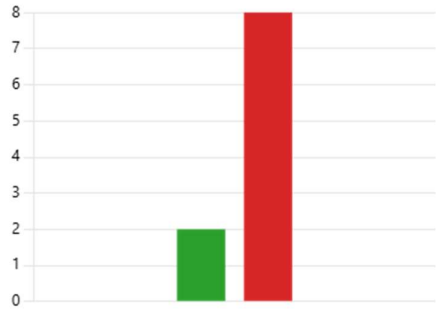


4. How would you describe your gender?

Female	4
Male	6
Non-binary	0
Prefer not to say	0

5. How would you describe your ethnicity?

Asian or Asian British	0
Black, Black British, Caribbean or...	0
Mixed or multiple ethnic groups	2
White	8
Other ethnic group – please defi...	0
Prefer not to say	0



6. Do you think that environmental pressures across the catchment are well understood and communicated?

Not at all	1
Occasionally	3
Sometimes	5
Frequently	1
Always	0

7. Do you think that social pressures across the catchment are well understood and communicated?

Not at all	2
Occasionally	6
Sometimes	1
Frequently	1
Always	0

8. Do you think that economic and affordability pressures across the catchment are well understood and communicated?

Not at all	3
Occasionally	4
Sometimes	2
Frequently	1
Always	0

9. How well do you think that identified issues are translated into action plans or interventions?

Not at all	2
Occasionally	1
Sometimes	5
Frequently	2
Always	0

10. Do you think your current partnership within this catchment (if you have one) has enabled greater communication and shared understanding of issues?

Yes	5
No	0
Maybe	1
Not in a partnership	4

11. Do current needs assessments focus on the now, or do they look into future requirements? (Select all that apply)

Now only	3
Near future (5-10 years)	6
Medium term future (25 years)	3
Far future (50-100 years)	0
Other – please define	0

12. What level of aspiration for the catchment do you think is most appropriate? (Select all that apply)

Reliability	4
Resilience	9
Sustainability	9
Justice	3
Other	3

13. Please provide ranking of aspirations selected in question 12 (most important to least important)

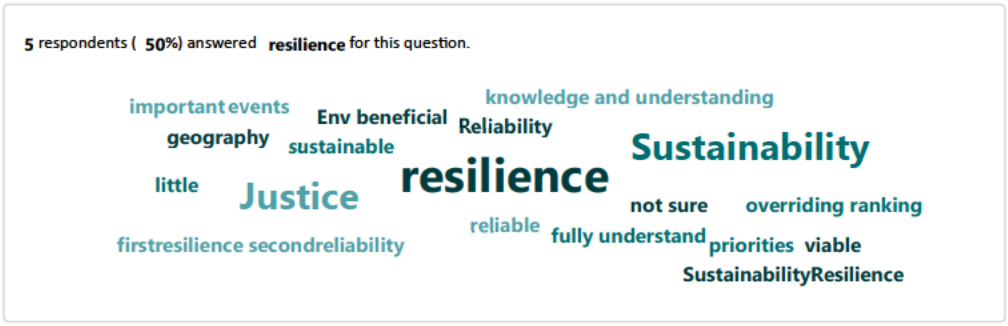
Latest Responses

10 Responses

Resilience Sustainability Justice Reliability

sustainability first resilience second reliability - not sure what you mean by t...

1) Env beneficial 2) Sustainable 3) Reliable 3) Resilience 4) Justice



14. Would analysing indicators collectively across themes (environmental, social, economic) enable your understanding of issues?

Yes	8
No	0
Maybe	2

15. Do you think qualitative or quantitative assessments are more appropriate?

Qualitative	0
Quantitative	2
Combination …	8
Not sure	0

16. Do you think the available data can be trusted?

Yes	2
No – I have concerns	4
Other	3

17. If Question 16 answer is other, please expand

Latest Responses

4

Responses

As above

depends on what data you mean. some env data is good enough. for assessi…

18. What do you think is the most appropriate approach to looking at future options? (Select all that apply)

Historic trends	8
Resilience	8
Sustainability	9
Justice	0
Other	1

19. Please provide ranking of approaches selected in Question 18 (most appropriate to least appropriate)

Latest Responses

8

Responses

Forecasting (based also on historic trends) Foresight

I answered other in Q18 - think collaborative approaches are needed for un...

1) Forecasting 2) Foresight 3) Historic trends

5 respondents (**63%**) answered **historic trends** for this question.

20. What level of visualisation would enable best use to be made of outputs? (Select all that apply)

Map-based info-graphic	8
Chart (ie radar plot)	2
System map	4
Not sure	3
Other	2

21. Which of these, or additional, indicators would enable analysis of the catchment or sub-catchment from an environmental viewpoint? (Select all that apply)

Ecological status	10
Chemical status	10
Renewable water	7
Physical modification	8
Other	3

22. Which of these, or additional, indicators would enable analysis of the catchment or sub-catchment from a societal viewpoint? (Select all that apply)

Potable water quality	5
Public health: pathogen	9
Human health index	8
Distance from blue-green inf.	7
Other	4

23. Which of these, or additional, indicators would enable analysis of the catchment or sub-catchment from an economic viewpoint? (Select all that apply)

Affordability: water price	8
Relative income level	9
Resource recovery - basic	6
Resource recovery - enhanced	7
Other	0

24. Many thanks for your time completing this questionnaire. Please indicate below if you would be interested in a follow-up discussion.

If you would please send an email to [redacted] and we can arrange a time.

Yes	9
No	1