

Long List - User Group	Long List – Theme	Long List - Specific question raised
Implementer	Measures selection and optimisation	What is the farmers role – what is the measure for each farmer to implement, when will the measure yield benefits, convince the measure will work, what level of uptake is required, what tools best achieve uptake of measures/buy-in?
Policy	Source Apportionment	Source apportionment and ecological impacts
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Another major gap to add to your list is regarding the pollution contribution via drain flow. We know a lot of pollutant transfer happens via drains but have very limited / no effective measures to address this. Ideally we would like a range of sensible practical mitigation measures for this pathway to use in addition to those we have to address things at source. For example: IN ditch wetlands, 3d buffers, end of field corner wetland . I am aware of work at Newcastle University at Nafferton farm on the use of in ditch systems with p stripping but don't have the detail of this
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	As the Environment Agency does not routinely monitor Drinking Water Protected Areas (DrWPAs) for bacterial contamination, we rely on water companies to monitor their supplies and alert us if they detect an issue. FIOs can cause pollution of drinking water sources and present a risk to human health
Policy	Source-Pathway-Receptor Evidence	Primary research into biological response (thresholds, resilience, recovery characteristics)
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	need to better understand the relationship between hydromorphological functioning and good ecological status
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Suitable end-points. Lack of evidence around ecological response and ecological benefit
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	A better link between chemical change and ecological change
Water industry	Source-Pathway-Receptor Evidence	Can the ecological benefits of measures be modelled to help identify where best to apply measures
Policy	Source Apportionment	How to move away from concentration based limits to ecological limits? How long could the ecology take to respond to improvements? How sensitive is the ecology to changes in the environment. How will climate change alter the baseline for "good" status?

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Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Bringing the evidence baseline for FIOs up to the standard of other pollutants
Water industry	Source-Pathway-Receptor Evidence	Can a consistent modelling approach be developed to look at sources of pesticides and their transport to receptors (e.g. surface water abstractions and boreholes).
Water industry	Source-Pathway-Receptor Evidence	Can high risk contaminant sources in specific environments be identified (influence of soil types, hydrology, rainfall, cropping patterns, farming practices such as tillage and under-drains, topographic features such as slope and proximity to water courses);
Water industry	Source-Pathway-Receptor Evidence	Can models be used to help decide where to invest in sampling and other evidence gathering?
Water industry	Evidence of outcome	Can models help to target measures and provide an estimate of the level of confidence that they will work – no point in investing customers money if uncertainty high
Water industry	Effectiveness of measures / mechanisms	Capture uncertainty in effectiveness of measures – understanding timescales of response and implications for economics
Policy	Effectiveness of measures / mechanisms	Catchment scale useful for optimising uptake – then upscale. What is the level of uptake required? And where?
Catchment Planner / regulator	Future pressures and extrapolation of impacts	Climate change impacts on river flow up to 2030–2050 are too uncertain to base any forecasts on impact on annual average concentrations in watercourses. The impact of forecast population change to 2030 needs further consideration although the current presence of ubiquitous chemicals from wastewater treatment works may mean that there will be little change to status
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Combinations of pressures – we need to understand more about the effects of pressures acting in combination on a water body (such as abstraction, barriers to fish migration and sediment).
Implementer	Contextualisation of the problem and solution	Conceptual model – persuasion there is a problem and why? Verification to support underlying beliefs. (Scored poorly)

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Policy	Decision support	Decision Support Tool – Multi-sector/pressure/response with (or that can link to) cost-benefit/cost-effectiveness for appraising policy options. Needs to be spatially explicit and incorporate social models/behaviour change. ‘Where do I get most bang for buck’ - Scenarios a. Criteria (including social and legal) need to be agreed up front for model acceptability b. Baseline and temporal contingencies (i.e. incorporation of external factors) are a critical component e.g. links to WFD no deterioration requirement c. Need buy-in from audience at different levels/scales – how? What does Good Ecological Status mean in terms of recreation? Investment in achieving moderate status is likely to have greater benefits than getting to good
Water industry	Source-Pathway-Receptor Evidence	Develop’ protocols for risk assessment and mapping
Catchment Planner / regulator	Measures selection and optimisation	Development of measures to control and mitigate the impacts of invasive species
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Evidence is not available on the effectiveness of specific measures on reducing pressure from ammonia and BOD. For example the impact of Catchment Sensitive Farming and Environmental Stewardship schemes on reduced pressure from sanitary pollutants
Catchment Planner / regulator	Effectiveness of measures / mechanisms	Flow regulation – we need to gather more evidence on the effectiveness of various mitigation measures for heavily modified river systems.
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	For all species we need more information on the pathways of introduction and ecological impacts
Policy	Future pressures and extrapolation of impacts	Future proofing – climate change and other impacts
Implementer	Evidence of outcome	How can we achieve final sign off by the regulators, but focus on benefits?
Water industry	Source-Pathway-Receptor Evidence	How do measures affect peaks?
Water industry	Model / data awareness, availability and application	How do we get repeatable outputs from models? Calibration, consistency, good practice, model development protocols, learning from other fields

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Catchment Planner / regulator	Evidence of outcome	Need to capture actual data on effectiveness of measures as this then reinforces model outputs when convincing farmers who often distrust models until verified by data.
Policy	Evidence of outcome	Trialling and demonstration with detailed monitoring before/after recommendations put in place in order to validate/refine modelled approaches. Accounting for uncontrollable variables when analysing results from trials into models – e.g. weather variations.
Implementer	Evidence of outcome	Data so that we can ground truth modelling output. This includes EA data but also data from local partnerships.
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Evidence of the problem – data from monitoring can be sparse or monitoring locations not ideally placed. • Insufficient evidence for the relative importance of different sources
Implementer	Source-Pathway-Receptor Evidence	need real data, not just modelled outputs
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	A national scale verification of point source locations (main concern would be water company assets)
Policy	Uncertainty, confidence and communication	How wrong would we be? Using different data sets e.g. agricultural census versus farm specific data or using real-time stream sensors versus grab samples not in terms of estimated load etc but in terms of the need and type of intervention
Catchment Planner / regulator	Effectiveness of measures / mechanisms	How effective is the current programme? How far will existing national policy get us and what more is needed?
Catchment Planner / regulator	Effectiveness of measures / mechanisms	What is the impact of existing national policy on a specific catchment?
Catchment Planner / regulator	Effectiveness of measures / mechanisms	Need to model not just the efficacy of measures but also a certain % uptake or “messiness” factor – assuming not everyone will do the measures, or do them right. Need to be able to play tunes on this in terms of scenarios of uptake and the outcome range it could result in. (sensitivity analysis)
Catchment Planner / regulator	Effectiveness of measures / mechanisms	Planning timeframe scenarios need to be modelled to show land management measures longevity for example – what will the effect be in 5 yrs compared with 25 years and this will help provide drivers for longer policy planning horizons as well as give farmers an idea of length of sign-up. Many measures are actually a culture shift rather than just specific actions for a discrete amount of time and then back to old ways

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Catchment Planner / regulator	Effectiveness of measures / mechanisms	Scenario modelling needs to let us understand how fast, how far and how effective we need to be – it may be a low level of action across the catchment or it may also be a high level of action in specific areas, e.g. source protection zones. Also need to be able to model what you can achieve for a specific amount of money.
Policy	Effectiveness of measures / mechanisms	With regards to NELMS we will need to be able to measure the impact of specific measures
Policy	Effectiveness of measures / mechanisms	potential efficacy of measures
Implementer	Effectiveness of measures / mechanisms	how we measure the benefits of say using buffer strips to contain ag diffuse or suds for urban diffuse on a catchment basis
Implementer	Effectiveness of measures / mechanisms	need data on where are we in terms of meeting baseline info; then on top of that other models look at incentivised
Implementer	Effectiveness of measures / mechanisms	need to understand the measures pick list and how far they will get us over and above the regulatory baseline e.g. CSF or agri-environment - how far will that get us towards GES?
Policy	Effectiveness of measures / mechanisms	Need to understand the relative impacts of different types of policy instrument e.g. regulations, voluntary measures, incentivised
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Data on catchment management actions is patchy and scheme-specific. You cannot recommend measures until you know exactly what is in place already
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Data on farm assets is also hard to obtain. CSF, EA, Rivers Trusts record actions taken by farmers but we don't readily record the quality of those installations or management
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	ELS/HLS/CSF/EA/Rivers Trusts all record information on farm visits. A data standard to allow this data to be combined would be useful
Policy	Effectiveness of measures / mechanisms	How effective is catchment management at improving water quality and maintaining water supply? Can we detect long term changes in raw water quality?
Policy	Environmental economics / socio-economics	Spatial differences in costs to farmers for instance is important
Catchment Planner / regulator	Environmental economics / socio-economics	the cost-effectiveness of diffuse pollution measures at a catchment rather than site scale

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Catchment Planner / regulator	Measures selection and optimisation	Insufficient grasp of the scale and nature of catchment interventions required – a clearer pathway to achieving the objective in any given catchment. Requires better predictive tools for assessing effectiveness of measures
Policy	Environmental economics / socio-economics	Cost benefit - will it work and how much is it going to cost?
Water industry	Environmental economics / socio-economics	Important to model costs of measures as well as impacts to feed into business planning (e.g. technical feasibility of measures, disproportionate costs)
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	how we relate nitrogen air pollution loads to in lake total N targets. So how much of that deposited in the catchment reaches a lake
Policy	Source Apportionment	How will climate change alter the baseline for “good” status?
Catchment Planner / regulator	Future pressures and extrapolation of impacts	Impact of the future on WQ – e.g. agricultural intensification and climate change – need to understand how this will affect multiple parameters N, P, Sediment.
Implementer	Source-Pathway-Receptor Evidence	Inaccurate records / insufficient means of recording structures, highways inputs, and INNS
Catchment Planner / regulator	Integration / focus / scaling	Need the ability to have multi objective models and integration but not lose the resolution of single focus where there may be a localised and specific issue.
Catchment Planner / regulator	Integration / focus / scaling	Integration of models across different water categories – especially important e.g. bathing waters and near shore issues where for example FIOs are an issue and the source (and controls) are further up the catchment.
Catchment Planner / regulator	Integration / focus / scaling	Tools should be tailored towards identifying synergies between policy areas
Policy	Integration / focus / scaling	Impact of spatial targeting of measures and having the evidence base available to justify spatial targeting

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Policy	Measures selection and optimisation	the potential trade-off in one outcome (e.g. biodiversity) when optimising for another, (say water quality). Are there datasets out there that could inform a model which seeks to quantify the level of synergy that could be delivered by options? And to what degree is the level of environmental outcome achieved compromised when trying to deliver multiple benefits through options? And does this relationship vary depending on different circumstances e.g. landscape/catchment type, farming system, scale of intervention? • For example, could ecological network and pollution pathway catchment models be integrated to quantify the level of synergy delivered and possibly seek to identify how to optimise for both?
Policy	Measures selection and optimisation	Need to understand the wider benefits – models / datasets need to do this either as a new dataset or by integration
Policy	Measures selection and optimisation	Biodiversity perspective – synergies between WQ and biodiversity needed ; targeting measures for multiple wins; catchment opportunity mapping (tailor A-E based on this where WQ is target rather than biodiversity – co delivery opportunities etc)
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Integrating hydrological routing with pollution modelling – hydrologists are hardly ever involved in developing pollution models, and environmental chemists are never involved in hydrological modelling. Since pollution pathways are so important this issue is critical for developing better models
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Integrating simulation of point and diffuse loads – we shouldn't have any more investment in models that only deal with one or other. We need models with equal resolution of both
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Models that try and do everything (at least in a useful way) can be too expensive or time-consuming to use. Modularising catchment and in-water models, which can then link up where necessary, is probably the best approach. Also, if you have a decent handle on the chemical dose- biological response/risk (e.g. through research models or observational/experimental research) then operationally you can focus on pollution load/concentration as the end-point
Policy	Source-Pathway-Receptor Evidence	Other pressures including urban and morphology will need to be included
Policy	Source Apportionment	Is good status achievable with all the other demands on the environment?
Catchment Planner / regulator	Uncertainty, confidence and communication	It is difficult to know the extent to which ongoing research will close evidence gaps

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Catchment Planner / regulator	Effectiveness of measures / mechanisms	It is not possible to assign the proportion of water company improvement that relates directly to reduced pressure from sanitary pollutants
Consultant	Source-Pathway-Receptor Evidence	key question for ecological impact – under what circumstances will higher P result in excessive growth – models need to be able to predict this and correlate with WFD compliance. Even in the total biomass growth it may matter a lot exactly which organisms are going barmy – e.g. toxic blue greens much more serious than some macrophytes – is this so??. what are the other factors??
Implementer	Measures selection and optimisation	Land management and use/what do we target? Triage phase. (Not being dealt with elsewhere)
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Land use and management change beyond agriculture e.g. forestry
Implementer	Source-Pathway-Receptor Evidence	Limited information about the true status of our Trac waters and marine waters, and their connections to the river ecosystem
Policy	Integration / focus / scaling	Link local and national models
Policy	Evidence of outcome	Link models to monitoring
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Links between P (in its different forms) and ecological responses are complex. This leads to uncertainty in deriving standards, and the need for a weight of evidence approach to confirming eutrophication.
Catchment Planner / regulator	Contextualisation of the problem and solution	Simple web based tools for viewing key GI datasets at catchment and sub catchment level
Catchment Planner / regulator	Contextualisation of the problem and solution	There is a distinct lack of easy to use and explain visualisation tools
Implementer	Contextualisation of the problem and solution	We've also shared a GIS project with pre-prepared legends, map templates and guidance notes: http://www.catchmentbasedapproach.org/images/PDFS/CaBAGISDataPackageGuidancev3.pdf
Implementer	Contextualisation of the problem and solution	Need Visualisation – pre-prepared GIS legends for model outputs – e.g. group layers showing PSYCHIC outputs with full descriptions of fields and attributes, and clear labels. Formatted for main GIS packages

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Catchment Planner / regulator	Evidence of outcome	Examples of how models have led to action and outcomes
Implementer	Model / data awareness, availability and application	access to reports e.g. UKWIR reports - for free.
Catchment Planner / regulator	Model / data awareness, availability and application	Getting away from data and product licensing and moving to open source code
Catchment Planner / regulator	Model / data awareness, availability and application	Access to information: data and models and IPR and capability - EA bottleneck
Implementer	Model / data awareness, availability and application	Need visibility of what's been used to make decisions on - core datasets on compliance, lidar, RPA etc - actual data not estimated data - all the bits of data that go into classification and coming up with a classification for example. Also, REASONS FOR FAILURE data
Implementer	Model / data awareness, availability and application	need to have access to SAGIS
Catchment Planner / regulator	Model / data awareness, availability and application	National databases to be more accessible for example the EA WIMS and WISKI databases
Catchment Planner / regulator	Model / data awareness, availability and application	the project would be best concentrating on access to the different models and any data needed to go into the models, but also any modelling runs/outputs, so that work does not need to be redone if the run has already been undertaken
Implementer	Model / data awareness, availability and application	Some Trusts have been involved in projects where modelling had been undertaken and have found limiting factors to include: insufficient funding to expand modelling beyond pilot areas, and lack of capacity to re-run models with updated data sets (absence of funding, or no access to the models / software

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Implementer	Model / data awareness, availability and application	Most of the models which rivers trusts have used most successfully to support decision-making, including ECM+, Scimap and Farmscoper are freely available, the input data are relatively easy to obtain and/or affordable and we have been able to work closely with the model developer to build and extend understanding, and to train lots of people in how to use the model. Free open source software and making training videos available online has helped a lot.
Implementer	Source-Pathway-Receptor Evidence	need access to fundamental data and information, not really models e.g. catchment walkover data etc compliance data from RPA.
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Make sure the existing models are updated with new data. As you know we had this problem with SAGIS using old Ag census and point source data, which makes it meaning less if you then wasn't to communicate and use the results to influence people on the ground as it is not credible
Implementer	Source-Pathway-Receptor Evidence	Access to / a better understanding of CSF modelling work would be good to show likely routes of erosion and areas susceptible to erosion, and to demonstrate these to wider stakeholders, landowners and others
Implementer	Uncertainty, confidence and communication	Need to understand what goes into SAGIS so the input datasets from PSYCHIC and also the flows datasets
Implementer	General points	need interim model outputs, not just the final model outputs
Catchment Planner / regulator	General points	I would not want the project to spend loads of time trying to integrate models together, as although this may be useful, I don't think there is any point until we have done the above first (improve access, improve documentation on models and make sure models are updated with most recent data e.g. ag census) and make the most of what we already have. I would have thought that the above would be plenty to try to tackle in your project, as I think that alone is quite a tall order from my experience
Water industry	Model / data awareness, availability and application	How do we make data (who does what, where, when) more readily available (and up to date e.g. from water companies). What about qualitative data?
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Measurements and predictions of nitrate loading to the environment, and the benefits of diffuse pollution control measures have a high level of uncertainty. We can measure nitrate concentrations in waters, but this doesn't necessarily help make the cause and effect link between sources and the effectiveness of measures

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Catchment Planner / regulator	Contextualisation of the problem and solution	Outputs of models need to be couched in a way that reaches individual stakeholders – e.g. for the farming industry the currency of discussion needs to be profitability, not necessarily Kg phosphate / year for example. Costs and benefits are difficult to measure and express in a common currency across sectors but if we're going to get shared ownership of the problem and solutions at a catchment level this needs to happen.
Catchment Planner / regulator	Contextualisation of the problem and solution	The ability to value the benefits in a way communities can fully understand, engage with and take on board
Policy	Contextualisation of the problem and solution	Need to contextualise issues: e.g. damage costs of N& P
Policy	Source-Pathway-Receptor Evidence	Morphology is a major pressure – can models help e.g. predict link to ecology?
Consultant	Decision support	Need more emphasis on the ability to model the solutions such as farmscoper or the SAGIS IT tool for optimisation and economic impacts on multi sector basis against WFD standards (however they are expressed). The ultimate aim of all of this will after all be to use models to find the optimal solutions, cost them and get them in an agreed programme of measures
Catchment Planner / regulator	Contextualisation of the problem and solution	Decision support tools (including models) which fit with stakeholder engagement processes (i.e. technical modelling needs to fit with engagement work – and not be separate) but also decision support tools that do not require vast amounts of monitoring data to use, and can factor in anecdotal evidence from stakeholders. Better integrated decision support tools, which can run on commonly available platform(s) and don't need specialist skills or resources
Policy	Decision support	Need to be able to combine model outputs into a decision making tool that visualises and communicates the weight of evidence used in decision making

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Catchment Planner / regulator	Decision support	Integrating the various separate decision making processes and different action schemes (e.g. point source control versus diffuse pollution, and water quantity with quality and flood risk). Some of these systems tend to be dominated by national, top down decision making processes (e.g. Water Industry Price Review process) where as others (e.g. river restoration schemes) are very bottom up. We need an integrated decision making framework that operates at the three main levels for water planning, national, River Basin District and Catchment. This framework is required as a first step at the policy level so we understand what it is we are trying to achieve. Once we understand this we can then develop appropriate decision support tools (including modelling).
Policy	Decision support	Decision support tools designed with cost benefit and societal decision making in mind - the inputs of which can be informed in part by modelling outputs
Catchment Planner / regulator	Environmental economics / socio-economics	Economics and social side of catchment planning of measures – how to approach the polluter pays principle and balance that across economics and social aspect of specific catchments where agriculture for example may be the heart of the catchments economy.
Catchment Planner / regulator	Environmental economics / socio-economics	Economics data is normally top-down coming from a national dataset, however when planning at a catchment level it is more appropriate to use local economics information and upscale; in this way, stakeholders can see that local level economic considerations are taken into account in catchment planning rather than standard-national level data.
Catchment Planner / regulator	Environmental economics / socio-economics	Scenario modelling of sector financial impacts – not just agricultural sector but all sectors contributing
Policy	Environmental economics / socio-economics	Above needing a focussed R&D effort with a clear end point in mind- that being societal choices informed by a better understanding of costs benefits and trade-offs
Policy	Decision support	Need stuff that helps make decisions – cost effectiveness and decision support
Catchment Planner / regulator	Inclusion of local catchment characteristics, objectives and data	We need a national level framework in terms of core datasets and models to use in catchment planning, but with the ability to combine local level data and thereby improve the weight of evidence to achieve local persuasion.

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Catchment Planner / regulator	Inclusion of local catchment characteristics, objectives and data	Need a way of factoring in local level knowledge e.g. behaviour of certain farmers when predicting the measures effectiveness (again, linked to the “messiness factor”
Catchment Planner / regulator	Inclusion of local catchment characteristics, objectives and data	Models need to be able to be adjusted in terms of input data to fit specific catchments – e.g. take account of actual numbers of cows, % dairy etc so that planning can happen on a catchment – specific basis rather than a “standard” farm type e.g. how FARMSCOOPER works
Catchment Planner / regulator	Inclusion of local catchment characteristics, objectives and data	Policy area priorities need to be set at a local scale – e.g. bankside grazing exclusion to protect water quality can jeopardise certain biodiversity objectives e.g. for vegetation management for damselfly. Local and site specific priorities need to be captured and considered when picking suitable measures
Implementer	Integration / focus / scaling	National level models can be inaccurate when applied at the local level, either as local datasets are more or less detailed than national sets
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	Insufficient detail on the spatial distribution of risks to be able to plan well targeted catchment interventions.
Consultant	Source-Pathway-Receptor Evidence	Need to be clear that problem is excessive biological activity not P conc per se. Therefore need to understand conditions leading to this. Account not just chemistry but residence times / temperature and light intensity – function of weather and shading. – any other factors?? E.g. seed populations coming from releases from ponds or canals of high residence then multiplying in river which was otherwise flushed clean.
Consultant	Source-Pathway-Receptor Evidence	On good status / moderate, regarding P will depend on UKTAG definitions of respective P concs for given settings. Also for P if not good status then may not really make a difference because P need to be below a threshold – I don't think this is a linear relationship so need to be clear about the nature of the thresholds of P and N or others on removing limits on the growth of different nuisance species – I assume there are ranges for different organisms
Catchment Planner / regulator	Future pressures and extrapolation of impacts	Potential effects of future trends such population growth, climate change; land use change, food security and nutrient supply need to be better quantified
Catchment Planner / regulator	Evidence of outcome	Sediment pressures are assessed by a link to biological element failures, we do not routinely monitor sediment run-off or in-river siltation, so there is limited collation of regional-to-national data available. This also relates to Natura 2000 sites

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Policy	Environmental economics / socio-economics	Social and economics important – optimising uptake
Policy	Environmental economics / socio-economics	Need to understand the social science side of why choose which policy mechanism and how those decisions affect uptake in different areas
Catchment Planner / regulator	Source Apportionment	Need a way of modelling not just sector responsible but activities within that sector. Activity -> behaviour -> response
Catchment Planner / regulator	Source Apportionment	Source apportionment – need this to be available and not just spatially distributed along the river but also temporally and how the apportionment changes under different flow and weather conditions. This is an important link because depending on the temporal response of the pollutant / sources, the selection of specific measures will be different.
Policy	Source Apportionment	Diffuse vs. point source contributions – the difficulties in source apportionment when there are still unknowns in the data: is the problem being overstated due to lack of data, is the data biased in any way?
Policy	Source Apportionment	Still don't fully understand the diffuse component of pollution – is everything from unknown (and potentially point sources) attributed to diffuse? What activities are causing diffuse pollution and how much can it be reduced to? What biogeochemical processes are going on in the whole system that might look like “diffuse” pollution?
Consultant	Source Apportionment	Important to consider the source apportionment between agricultural and agricultural sources because of the disproportionate impact of STW outputs which even if not as great as annual average are critical in low flows when they make up more of flow. Also effluent higher proportion of soluble P than runoff which the TP may have large part sediment attached and not as active. This could be more explicitly expressed – especially to draw on work of Mike Bowes of CEH
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	The temporal aspect of issues. A failure of an EQS in summer will need a different remedy to a failure in the winter, yet we use annual averages most of the time. Linked to this the frequency distributions of diffuse inputs could be better understood
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	A frequency-duration curve of modelled diffuse inputs or similar

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Policy	Source Apportionment	Source apportionment within the agricultural sector is needed
Catchment Planner / regulator	Contextualisation of the problem and solution	It's about convincing both farmers and Defra (or equivalent)
Policy	Contextualisation of the problem and solution	anything that is done needs to carry all the interested parties and we need the tools to explain and contextualise issues: Need to take an approach that uses the technology as a decision support and puts it into a context for consumption by non specialists
Policy	Contextualisation of the problem and solution	it's about benefits and options now – the number crunching needs to support a conversation couched in those terms
Policy	Contextualisation of the problem and solution	Decision support tools that can be used for combinations of measures that are transparent and accessible to all stakeholders and delivery partners
Policy	Contextualisation of the problem and solution	Decision support tools designed with stakeholders in mind
Implementer	Contextualisation of the problem and solution	need to be able to share data with stakeholders in a way that engages them
Implementer	Contextualisation of the problem and solution	need to visualise data and evidence of the problems and solutions and be able to show people on the fine scale e.g. river reach, field etc. - spatial resolution very important in local engagement and impact
Implementer	Contextualisation of the problem and solution	Sometimes getting the message across is more important than whether the model actually works or not
Catchment Planner / regulator	Contextualisation of the problem and solution	Better tools for explaining and visualising what we do know – i.e. that help the conversation with local stakeholders on what the problems are in a catchment and what the most cost-beneficial solutions might be
Catchment Planner / regulator	Effectiveness of measures / mechanisms	Catchment planners want tools to translate national policies at the local scale and to get local support
Catchment Planner / regulator	Evidence of outcome	Need a way of Justifying significant investment to achieve outcomes that are uncertain and won't be realised for several political cycles

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Catchment Planner / regulator	Uncertainty, confidence and communication	There are issues around confidence of models and underlying data and we need to be able to communicate confidence in a way that convinces stakeholders that the model may not be perfect, but it's good enough.
Catchment Planner / regulator	Uncertainty, confidence and communication	Tools need to be multifunctional to allow the wide array of catchment stakeholders to come together and engage, rather than sector specific. A shared understanding of the problem and a shared evidence base of the potential solutions for discussions to go ahead.
Implementer	Uncertainty, confidence and communication	it's about having the confidence in a model to be able to stand by it in the public eye.
Policy	Uncertainty, confidence and communication	Stakeholders need to be able to see what's gone into justifying a policy
Implementer	Uncertainty, confidence and communication	Confidence in how to interpret and combine datasets is a big barrier for non-specialists
Catchment Planner / regulator	Effectiveness of measures / mechanisms	The extent of the gap between where current measures will take us and WFD objectives is not well quantified, and a large programme of investigations is ongoing
Water industry	Source-Pathway-Receptor Evidence	the fate and behaviour of specific contaminants in the environment (use, timing and methods of application, leachability, persistence, biodegradation etc)
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	The limitations of the monitoring programme means that our understanding of the presence or otherwise of chemicals in the environment is patchy, especially for those that enter watercourses via diffuse routes
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	The majority of bathing waters and shellfish waters that have problems, have multiple diffuse sources of FIOs. The main evidence gap is identifying where the FIOs are coming from, which is very difficult as there are so many potential pathways and sources
Implementer	Source-Pathway-Receptor Evidence	the need for more work on septic tank locations and their contribution to water pollution, on highways inputs, and on sub-surface land drainage systems, both from a Water Quality perspective but also in relation to their contribution to flood peaks.
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	There are currently no formal nitrate standards for lakes and other freshwaters within the WFD although there are thresholds in the Defra/EA methodology for the Nitrates Directive

Long List - User Group	Long List – Theme	Long List - Specific question raised
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	There are currently significant gaps in our understanding of species/habitat/pressure relationships
Catchment Planner / regulator	Effectiveness of measures / mechanisms	There are currently significant gaps in our understanding of the costs and effectiveness of hydromorphological improvement measures
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	There are significant uncertainties in many cases regarding ecological responses to pressures and as a result to measures, both in terms of the magnitude and the time scales of response
Catchment Planner / regulator	Evidence of outcome	There are still concerns over whether sustainable ecological recovery will occur. Water quality improvements have not always resulted in a corresponding recovery in freshwater biological communities. This lack of improvement has been linked to land management and peaks in acidity during rainfall events
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	There is a great deal more we can and are doing to improve our understanding of the nature and impacts of hydromorphological pressures on aquatic ecosystems
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	There is limited evidence to clearly link the long term effects of activities that cause sanitary pollution to ammonia and BOD pressures on the water environment.
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	This information is being updated but the lack of data on the extent and nature of physical modification pressures is a cause of major uncertainty
Policy	Evidence of outcome	Time lags
Catchment Planner / regulator	Environmental economics / socio-economics	We are uncertain about the relative cost-effectiveness of measures to deal with many pressures. Uncertainties relate both to technical effectiveness and costs
Catchment Planner / regulator	Future pressures and extrapolation of impacts	We do not enough about how future trends of population and climate will affect pressures
Catchment Planner / regulator	Effectiveness of measures / mechanisms	We have little field data to verify the effectiveness of measures across wide scales such as catchments, and the contributions of different pathways can make a significant difference to load reductions.
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	We know that sediment pressure acts in combination with other pressures such as morphology, chemicals and nutrients. However we do not fully understand how these pressures combine to affect ecological status

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Catchment Planner / regulator	Environmental economics / socio-economics	We lack contemporary information on damage costs of eutrophication and a recent assessment of costs versus benefits of control options . The latter in particular are needed, along with improved apportionment and options appraisal tools, to inform national deliberations about measures and alternative objectives
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	We need more event based monitoring rather than more modelling This is especially true for ecological data, sediment and pathogens such as FIOs. With the new BW directive and tighter hygiene standards for Shellfisheries we need better coverage of FIO data and more event based FIO data, we only have these from academic research projects and detailed EA investigations. We need this sort of data u/s and d/s of mitigation measures at the farm and subcatchment scale.
Catchment Planner / regulator	Future pressures and extrapolation of impacts	We need to develop a better understanding of how recovery is being compounded by other stresses such as land use change and climate change
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	We need to know more about how our (generally pressure based) WFD biological tools are affected by invasive species. The UKTAG alien species group is attempting to collate available evidence (even where anecdotal) with the aim of commissioning more work and filling in gaps
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	We need to understand more about the role of, flow variability, in maintaining ecological integrity.
Catchment Planner / regulator	Source-Pathway-Receptor Evidence	We only have limited evidence about how pressures act in combination . As a result there are uncertainties regarding the effectiveness of measures in dealing with multiple pressures
Implementer	Measures selection and optimisation	What are the co-benefits – is there a tool to help persuade farmers to enact change?
Water industry	Future pressures and extrapolation of impacts	What are the implications of climate change and agricultural intensification for water quality?
Policy	Model / data awareness, availability and application	need a clear understanding of which models are available where and what they will tell us
Implementer	Model / data awareness, availability and application	Less IT spend and more spend on working with modellers and communications and support

Long List - User Group	Long List – Theme	Long List - Specific question raised
Implementer	Model / data awareness, availability and application	need a better background into the applicability of models and when to use them, when not to use them etc.
Catchment Planner / regulator	Model / data awareness, availability and application	need very good documentation to go along with the models and any outputs/data, for example metadata, good explanation of what was done, assumptions and limitations and for the models themselves good user guides and easy to use interfaces where needed
Implementer	Model / data awareness, availability and application	not sufficiently aware of what is already available
Implementer	Model / data awareness, availability and application	A general guide to existing models and the datasets they depend on would therefore be of benefit.
Implementer	Model / data awareness, availability and application	not knowing what models are out there
Implementer	Model / data awareness, availability and application	We've also produced or used guidance documents which are really important in flagging datasets and models which can be used – for example: http://www.catchmentbasedapproach.org/images/PDFS/WRT_ESS_Visualisation_Manual_v1-1-smaller.pdf
Implementer	Model / data awareness, availability and application	Need access to model developers and/or expertise
Implementer	Uncertainty, confidence and communication	would not feel confident defending the outputs of models due to a limited understanding of their use and limitations
Implementer	Uncertainty, confidence and communication	not understanding the outputs of a model and the limitations
Implementer	Uncertainty, confidence and communication	Understanding the information and model outputs is another big challenge particularly where outputs are shared without any explanation of the attributes or the best way to interpret and represent information
Catchment Planner / regulator	Uncertainty, confidence and communication	Confidence in model outputs and underlying data needs visibility

Long List - User Group	Long List – Theme	Long List - Specific question raised
Policy	Uncertainty, confidence and communication	Questions over the robustness of the various models used and their ability to replicate and predict real situations. Questions over the limitations in the data underpinning models such as spatial and temporal variations and how well these are expressed. Are all the models using the same data sets and are they based on enough data points for some of the extrapolations they are used for. Applicability of modelled/summarised/averaged data to individual locations – are they able to be used for site specific recommendations?
Implementer	Uncertainty, confidence and communication	Being clear on assumptions and limitations of the models so that they are used appropriately.
Implementer	Uncertainty, confidence and communication	not having the confidence in the predictions
Implementer	Model / data awareness, availability and application	What tools are available that map to elements of the problem – info in a repository is required?
Implementer	Model / data awareness, availability and application	Can we work with the modellers? Collaborative modelling – pair-wise working (e.g. ECM+ – farmers believed output as involved in process). Collaborate during learning phase and application.
Catchment Planner / regulator	Evidence of outcome	Monitoring data and visualisation just as important as modelling
Implementer	Integration / focus / scaling	Being able to drill down into the data from the model
Catchment Planner / regulator	Integration / focus / scaling	Ability to be able to draw down data specific to catchments
Catchment Planner / regulator	Integration / focus / scaling	Tools to enable simple analysis (e.g. of WQ time series plots, summary means etc) to be run at catchment and sub-catchment scale
Policy	Integration / focus / scaling	Need to be able to play tunes on scale
Water industry	Effectiveness of measures / mechanisms	Linking catchment management activities to deployable output for Water Co interventions
Policy	Effectiveness of measures / mechanisms	Understanding combined impact of multiple pressures, biological response, and the effectiveness of measures

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Policy	Environmental economics / socio-economics	The social side (levels of existing uptake, feasibility in convincing farmers to do it, and breakdown between different sectors) <ul style="list-style-type: none"> • The economics/costs – how much will it cost, will this vary between sectors • The benefits – for water quality, wider environmental and social benefits
Catchment Planner / regulator	Environmental economics / socio-economics	Identification of the economic benefits of a range of best farming practices
Catchment Planner / regulator	Environmental economics / socio-economics	Better grasp of the economic impacts on agriculture of raising environmental performance and reducing pollution.
Implementer	Environmental economics / socio-economics	we need to understand cost benefits and how these have been modelled by the EA
Policy	Environmental economics / socio-economics	Need ESS and natural capital - and standardisation of this as it's done differently everywhere
Catchment Planner / regulator	Environmental economics / socio-economics	Cost benefits need to be couched in terms of ranges rather than absolute.
Catchment Planner / regulator	Uncertainty, confidence and communication	Cost benefits need to be couched in terms of ranges rather than absolute.
Water industry	Effectiveness of measures / mechanisms	Pesticides are a key issue for water companies but models in this area are mainly looking at risk. Important to also look at impact of measures in relation to both surface and groundwater
Catchment Planner / regulator	Ecosystem Services	Use of ecosystem services to translate model outputs
Policy	Ecosystem Services	Costs and benefits of measures that incorporate a full range of Ecosystem Services
Catchment Planner / regulator	Ecosystem Services	Understanding the cost and benefits of measures, and the value of ecosystem services (multiple outcome approaches) relative to 'single issue' approaches is a key gap
Catchment Planner / regulator	Ecosystem Services	need an ecosystem services approach that can be understood and used by a broad range of stakeholders
Water industry	Uncertainty, confidence and communication	What are the uncertainties associated with modelling the impacts of different measures?

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Water industry	Environmental economics / socio-economics	Prioritisation of interventions and cost effectiveness of measures
Water industry	Source-Pathway-Receptor Evidence	What spatial scale should we be targeting for understanding processes and evaluating standards (don't look at water quality in isolation – bigger picture)
Policy	Effectiveness of measures / mechanisms	When will my policy be successful? How will we know it has been successful? Need outcome indicators to show direction of travel as well as modelled prediction. Need to understand why there are deviations from modelled prediction
Policy	Contextualisation of the problem and solution	· Morphology – links to ecological response and prediction of recovery. Confidence in current classification tool? Links to wider pressures?
Policy	Contextualisation of the problem and solution	· Missing Measures – effective process in place. What is missing? Links to source apportionment the identification of any additional (practical) cost-effective measures
Policy	Contextualisation of the problem and solution	· Impact of buffers on morphology – what is the relationship between buffer width and natural recovery ?
Policy	Contextualisation of the problem and solution	· Abstraction ponds – where and what size in relation to typology and cropping?
Regulator	Contextualisation of the problem and solution	· Morphology – MIMAS tool for classification. What confidence do we have in hazard data? What is the impact of river typology? Need tools to link to ecology and predict response.
Regulator	Contextualisation of the problem and solution	· Missing Measures - effective process in place. What is missing? Links to source apportionment the identification of any additional (practical) cost-effective measures
Regulator	Contextualisation of the problem and solution	· Coarse and fine sediment dynamics
Regulator	Contextualisation of the problem and solution	· Prediction of alkalinity for new P standards
Regulator	Effectiveness of measures / mechanisms	· Impact of measures eg low P animal feeds on P inputs to waters

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Regulator	Contextualisation of the problem and solution	· Urban diffuse pollution – toxics
Regulator	Effectiveness of measures / mechanisms	· Effectiveness of specific measure like Rural SuDS
Regulator	Model / data awareness, availability and application	· Data to validate and develop SAGIS
Regulator	Measures selection and optimisation	· Opportunity mapping to help target measures
Policy/Reg	Future pressures and extrapolation of impacts	· Do we have long term trends and forecasts for the quality of Scotland's drinking water sources? Do we understand the impact of climatic factors on them? Raw water deterioration- fact or fiction?
Policy/Reg	Effectiveness of measures / mechanisms	How can we mitigate changes in raw water quality in our catchments to minimise level of treatment required?
Industry	Effectiveness of measures / mechanisms	How effective is catchment management at improving water quality and maintaining water supply?
Industry	Effectiveness of measures / mechanisms	Do we have the monitoring data / modelling capabilities to evaluate this?
Industry	Effectiveness of measures / mechanisms	How do we know when is it more cost-effective to undertake catchment management or to improve the water treatment process?
Industry	Effectiveness of measures / mechanisms	How does this effectiveness vary with different water quality parameters and different measures?
Industry	Future pressures and extrapolation of impacts	Does this affect both short term and long term changes in water quality / water supply?
Industry	Effectiveness of measures / mechanisms	How can we ensure implementation of catchment management measures? What approach should be taken to achieve this, e.g. increased regulation / legislation, education?
Industry	Future pressures and extrapolation of impacts	Can we detect long term changes in raw water quality?

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Industry	Future pressures and extrapolation of impacts	Do we have sufficient baseline data to make this evaluation?
Industry	Future pressures and extrapolation of impacts	Is this changing on a temporal / spatial basis? – can we identify future risk areas?
Industry	Future pressures and extrapolation of impacts	Which water quality parameters are more susceptible to change?
Industry	Future pressures and extrapolation of impacts	How significant is this change?
Industry	Effectiveness of measures / mechanisms	If changes are taking place will the water still be treatable to provide a wholesome supply?
Industry	Effectiveness of measures / mechanisms	How best can we support and evaluate our systems model approach?
Industry	Future pressures and extrapolation of impacts	What are the potential impacts of climate change on drinking water quality?
Industry	Contextualisation of the problem and solution	Which water quality parameters are at greatest risk of changing?
Industry	Contextualisation of the problem and solution	Can we predict these impacts both temporally and spatially?
Industry	Effectiveness of measures / mechanisms	Can mitigation measures help reduce this? How successful are these measures?
Industry	Effectiveness of measures / mechanisms	How will these changes impact on the capability of the treatment process?
Industry	Future pressures and extrapolation of impacts	How does changing land use impact on drinking water sources, what are the primary concerns?
Industry	Future pressures and extrapolation of impacts	What will be the impact of agricultural intensification on drinking water quality? What is likely to be the key pressure(s) in the future?
Industry	Future pressures and extrapolation of impacts	What changes in land use pose the greatest risk to drinking water quality and supply e.g. windfarms, conversion to different crop types?

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Industry	Future pressures and extrapolation of impacts	How does this vary spatially?
Industry	General points	There is a need to establish better data sharing opportunities and for better links between data holders.
Regulator	Ecosystem Services	· Diffuse pollution and habitat connectivity/biodiversity
Regulator	Ecosystem Services	· Knowledge gaps around FWPM
Industry	General points	· Succinct outputs needed not alleged user friendly interfaces
Industry	General points	· Impacts of climate change on measures incl regulations
Implementer	General points	The data sets and the methodology used by the regulating bodies for designation should not be ignored in this process.
Implementer	General points	Providing a mechanism and outlining a methodology for easy access to data should be a priority
Implementer	General points	If the primary aim of this project is to succeed all data sets will need to conform to a clear and understood definition
Implementer	General points	With reference to my point on data sets one method of achieving this would be to establish, based on a regulatory data set, a real world “test” data set that can serve as a common link across the models chosen.
Implementer	General points	This approach will also help toward creating more realistic and transparent export coefficients which remain a necessary tool for linking mechanistic models to land management practices.
Implementer	Future pressures and extrapolation of impacts	1. As you know we can predict climatic trends, but this may not accurately reflect localised or extreme weather events which would increase risks to water quality. This uncertainty gives more of a focus on the need to increase farm resilience through adoption of a range of strategies which could minimise risks to water quality – so nutrient management, benchmarking and improvement in resource use (via farm carbon accounting), irrigation plans, floodplain management, farm resilience planning etc. would be key and have benefits for both the farm in terms of resource use, climate change mitigation and adaptation, plus the water environment.

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Implementer	Future pressures and extrapolation of impacts	1. This is a lot of data out there; the forum will be useful in highlighting the range of information, gaps and how you can add to this to make it more informative to land managers and their advisers. However as we have seen with nutrient management, adoption of these schemes and plans at the farm scale takes time; the ‘win-win’ approach is not always sufficient to drive demand from land mangers. The (uncertain) impacts of climate change will bring an added dimension of complexity to this.
Regulator	Contextualisation of the problem and solution	· Can we demonstrate the link between land use activity and ecological water quality on a catchment specific basis?
Regulator	Future pressures and extrapolation of impacts	· What is the evidence to suggest that the sustainable intensification of agriculture is achievable within the context of the targets of the WFD?
Regulator	Contextualisation of the problem and solution	· Should source apportionment of nutrients also be based on ecological impact rather than just contribution to loads?
Regulator	Effectiveness of measures / mechanisms	· On what basis should we prioritise catchments for the protection of aquatic ecosystems?
Regulator	Contextualisation of the problem and solution	· Can we disentangle the role of multiple stressors in constraining ecological recovery?
Regulator	Contextualisation of the problem and solution	· How can we target mitigation measures on a catchment/site specific basis?
Regulator	Effectiveness of measures / mechanisms	· How can we resolve the challenges between the need for the targeting of mitigation measures and the difficulties in implementing and administering a targeted approach?
Regulator	Effectiveness of measures / mechanisms	· How has the decline in advisory services impacted on aquatic ecosystems and our ability to protect/restore waterbodies?
Regulator	Future pressures and extrapolation of impacts	· How will climate change impact on the effectiveness of mitigation measures and the recovery of aquatic ecosystems?
Regulator	Contextualisation of the problem and solution	· Can we evaluate the resilience of aquatic ecosystems and the probability of recovery?

Long List - User Group	Long List – Theme	Long List - Specific question raised
Regulator	Contextualisation of the problem and solution	<ul style="list-style-type: none"> - How can uncertainty in ecological outcomes be incorporated in decision making processes?
Policy/science	Integration / focus / scaling	<ul style="list-style-type: none"> - Upscaling of sensitivity data from freshwater ecosystems for regional and national-scale assessments to understand the interactions between water temperature, water quality and water quantity on priority habitats and species and the regulation of water quality for the natural environment and human use. Most information is currently only available at site level.'
Policy/science	Future pressures and extrapolation of impacts	<ul style="list-style-type: none"> - Exploration of the role that the environment plays, in addition to climate, in determining raw water quality; how these things may change under future climate and environmental conditions and how water quality changes may be monitored is required. The associated consequences for water provision and on priority habitats and species need to be better understood.
Policy/science	Contextualisation of the problem and solution	<ul style="list-style-type: none"> - Exploration into the combined effects of climate change and the point or diffuse sources of pollutants that may lead to eutrophication and unwanted algal growth.
Policy/science	Contextualisation of the problem and solution	<ul style="list-style-type: none"> - Exploration into the relationship between current abstraction rates and implications for biodiversity under drought conditions and future climate change.

