SEVENTH FRAMEWORK PROGRAMME

THEME 6: Environment (including Climate Change)

Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems

Collaborative Project (large-scale integrating project)
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Contributors: **Kerry Waylen, Bill Slee, Rachel Helliwell, Iain Brown, Sue Morris, Kirsty Blackstock**

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PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
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Abstract

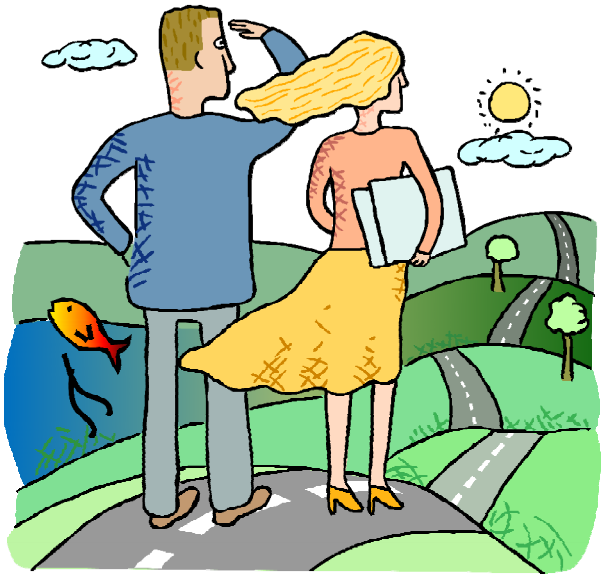
This document is the result of a workshop where policy-makers and scientists discussed future challenges to WFD implementation in Europe. The aim of the meeting was fourfold: (1) to develop links between scientists and policy-makers from across Europe, (2) to elicit ideas about how to develop science-policy links in future, (3) to introduce REFRESH and its scenarios to policy-makers, and discuss future challenges to managing the water environment, (4) to scope ideas about how to address those challenges (including information needs). Participants were regulators and policy-makers from six countries within Europe, together with REFRESH experts in scenario generation and modelling. Evaluation forms suggest that participants generally enjoyed meeting each other, learning about REFRESH, and discussing future challenges.

This discussion at the meeting focused firstly on the future changes and challenges to WFD implementation. Although climate change was unanimously agreed to be a key challenge (particularly due to extreme events), not all challenges arose from environmental change. Changes in other policies and societal changes could also influence WFD implementation. For example, a drive to reduce carbon emission by using hydropower could negatively affect water body classification. Compared to trends in environmental change, policy changes can seem relatively unpredictable.

It is important to note that not all changes are necessarily negative for the environment – for example, an increased shift to partnership working was seen as beneficial for encouraging the implementation of measures. Other changes can have positive or negative effects depending on how they are handled – for example, the effect of policy promoting bio-fuel crops could depend on the detail within that policy. This emphasises the need to assess impacts on a wide range of ecosystem services, the impact on different users, and to link with other policy sectors, both environmental and non-environmental (particularly energy and agriculture).

Four common issues were selected as the basis for discussion on how to tackle future challenges to WFD implementation; i) how to tackle the common pressure of diffuse pollution, ii) how to link policies, iii) how to 'do' partnership working and iv) how to handle uncertainty. Several overlapping strategies were proposed. Flexibility in management was desired, to allow adaptive management (learning from experience) and to allow trade-offs when other policies had conflicting objectives. Using the lens of ecosystem services may help to manage tradeoffs for multiple benefits. At the 'ground level', partnership working was seen as key for delivering measures, but only when solutions were truly co-constructed and when local-level stakeholders were properly resourced and supported. There are a number of uncertainties in management, and whilst science may be able to reduce some, uncertainty cannot always be removed. Considering worst-case scenarios may help to decide how to 'future proof' policies against the worst of future changes. This is important, since worries about the future are not yet leading to many concrete actions that allow 'future proofing'.

REFRESH Cross-European Policy workshop, London 16-17th March 2011



Kerry Waylen, Bill Slee, Rachel Helliwell, Iain Brown, Sue Morris and Kirsty Blackstock

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Contents

REFRESH

The James Hutton Institute

1) Summary

This document is the result of a workshop where policy-makers and scientists discussed future challenges to WFD implementation in Europe. The workshop was commissioned as part of a four-year FP7-funded project called 'REFRESH: Adaptive Strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems[1]. REFRESH aims to generate scientific understanding that will allow the identification of cost-effective measures that will protect freshwater ecosystems and biodiversity, taking into account future changes such as climate change. This information should assist in achieving sustainable management for 'good ecological status' (and associated commitments to protect water-dependent Natura 2000 sites).

The aim of the meeting was fourfold: (1) to develop links between scientists and policy-makers from across Europe, (2) to elicit ideas about how to develop science-policy links in future, (3) to introduce REFRESH and its scenarios to policy-makers, and discuss future challenges to managing the water environment, (4) to scope ideas about how to address those challenges (including information needs). Participants were regulators and policy-makers from six countries within Europe, together with REFRESH experts in scenario generation and modelling. Evaluation forms suggest that participants generally enjoyed meeting each other, learning about REFRESH, and discussing future challenges.

This discussion at the meeting focused firstly on the future changes and challenges to WFD implementation, as compared to present. Although climate change is unanimously agreed to be a key challenge (particularly due to extreme events), not all challenges arose from environmental change. Changes in other policies and societal changes could also influence WFD implementation. For example, a drive to reduce carbon emission by using hydropower could negatively affect water body classification, or rising food demand could cause intensification in land-use and hence more pollution. There was uncertainty in all areas of future change. Compared to trends in environmental change, changes and effects of policy changes were considered to be relatively unpredictable.

It is important to note that not all changes are necessarily negative for the environment – for example, an increased shift to partnership working was seen as beneficial for encouraging the implementation of measures, whilst social change causing rural land abandonment could also have positive implications for water (if not other landscape features). Other changes can have positive or negative effects depending on how they are handled – for example, the effect of a policy promoting bio-fuel crops could depend on the detail within that policy. This emphasises the need to assess impacts on a wide range of ecosystem services, the impact on different users, and to link with other policy sectors, both environmental and non-environmental (particularly energy and agricultural policies).

Four common issues were selected as the basis for discussion on how to tackle future challenges to WFD implementation; i) how to tackle the common pressure of diffuse pollution, ii) how to link policies, iii) how to 'do' partnership working and iv) how to handle uncertainty. Several overlapping strategies were proposed. Flexibility in management was requested, in order to allow adaptive management (learning from experience) and to allow trade-offs when links with other policies produced conflicting objectives. Using the lens of ecosystem services may help to manage tradeoffs for multiple benefits. At the 'ground level', partnership working was seen as key for delivering measures, but only when solutions were truly co-constructed and when local-level stakeholders were properly resourced and supported by national or regional agencies. There are a number of uncertainties in management, and whilst science may be able to reduce some, uncertainty cannot be removed for all decisions. Considering worst-case scenarios may help to decide how to 'future proof' policies against the worst of future changes. This is important, since worries about the future are not yet leading to many concrete actions that allow 'future proofing' of policies that safeguard the water environment.

[1] FP7 project number 244121 www.refresh.ucl.ac.uk/

Acronyms used in this document

DP	-	Diffuse Pollution
CIS	-	Common Implementation Strategy
FP7	-	Seventh Framework programme
HD	-	Habitats Directive
N2K	-	Natura 2000
NGO-	-	Non-Governmental Organisation
RBMP	-	River Basin Management Plan
WFD	-	Water Framework Directive
WISE	-	Water Information System for Europe

2) Introduction to the REFRESH project and this workshop

This document is the result of a workshop discussing future challenges to WFD implementation in Europe. It begins by introducing the REFRESH project, of which the workshop is part, then presents the issues discussed during the meeting, and finishes by summarising the key ideas and themes.

a) REFRESH research project

REFRESH: "Adaptive Strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems" is a four-year large-scale research project, funded by the European Union's Seventh Framework programme (FP7). It commenced in 2010.

The key objective of REFRESH is to develop a framework that will enable water managers to design cost-effective restoration programmes for freshwater ecosystems, in the context of future changes (including climate change), to achieve the objectives of the Water Framework Directive (WFD) and Habitats Directive (HD), to safeguard the future delivery of crucial ecosystem services. REFRESH will evaluate a series of specific adaptive measures that might be taken to minimise adverse consequences of climate change on freshwater ecosystems and biodiversity. This will be crucial for sustaining the flow of ecosystem services that water provides. REFRESH aims to generate scientific understanding that allows the identification of measures that sustain freshwater ecology and that are also cost-effective and 'future-proof'.

REFRESH begins by scoping measures, and identifying future scenarios of change (both climate-related and other interacting pressures) to expect by 2050. Then, experimental work packages explore how rivers, lakes and wetlands react to some of these changes in temperature, hydrology and pollution-loading. Integrated catchment modelling will attempt to link hydrological and chemical changes with ecological responses, in eight demonstration catchments in Europe (Figure 1). Finally, cost-effectiveness analysis will be used to identify what measures might be most useful, taking financial costs into account. The project is therefore interdisciplinary, bringing together scientists from 25 organisations across Europe with expertise in hydrology, hydrochemistry and ecology, aquatic modelling, economics and social science.

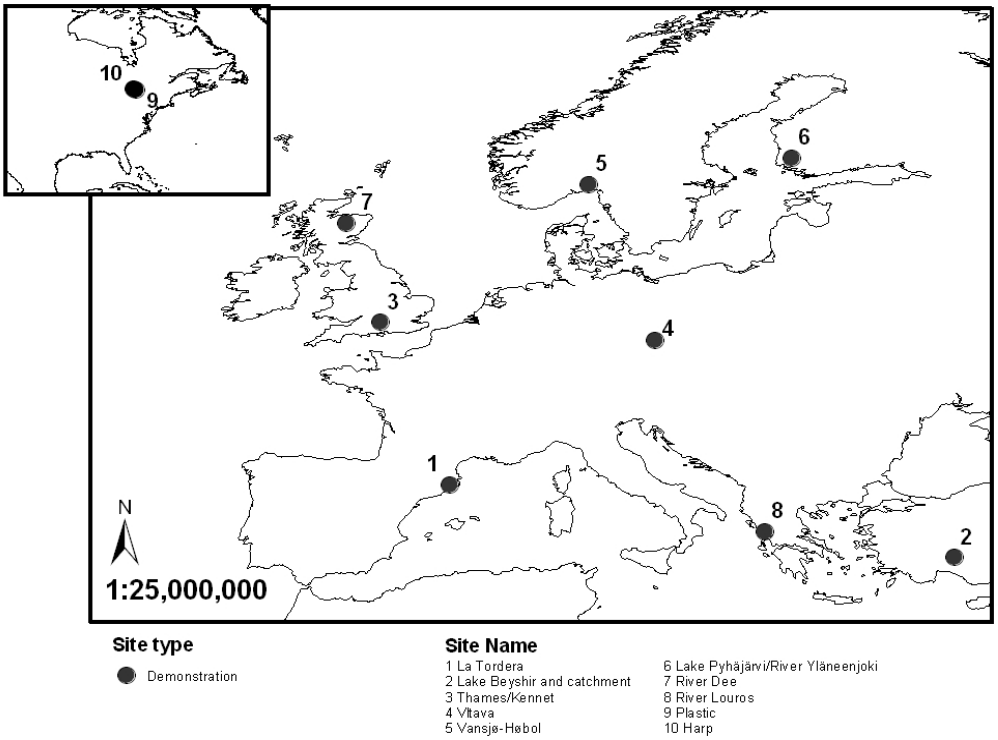

Figure 1 Demonstration catchment locations used in REFRESH.

More details and contacts about REFRESH are available from its website at www.refresh.ucl.ac.uk.

b) The objective of the workshop

There have been many calls for better links between the science and policy communities. This is true for all areas of science, including water management. There are some examples of good practice – for example, the development of a Common Implementation Strategy (CIS) for the WFD was seen as useful for connecting policy with expertise from several sectors[2] - but it is generally thought that the science-policy interface needs to improve. Within Europe, the European Commission and other organisations have already funded several initiatives to improve the science policy interface, most prominently the Water Information System for Europe (WISE)[3], as an aid to knowledge dissemination.

REFRESH builds on these efforts by attempting to integrate knowledge-exchange efforts throughout the project, and dedicating one of its seven work-packages to knowledge exchange. Its work is directly relevant to both water policy and to climate change policy, and also species and habitat protection, as water-dependent Natura 2000 (N2K) sites are also protected under WFD. A meeting was therefore scheduled early on within the life of the project, at the end of its first year.

Meeting at this time meant the focus of the workshop could not be disseminating project results. Rather, the aim was to initiate a dialogue between scientists and the policy community, giving both a chance for learning and reflection. The focus of the meeting was considering future challenges to WFD implementation (focusing on the goal of achieving sustainable management for Good Ecological Status of waters) and what changes and data needs would help to tackle those challenges. The only information formally presented from REFRESH scientists was the future scenarios of changes in climate, land-use, nitrogen deposition and water resource availability, and the future changes discussed at the meeting ranged more widely, and included policy and societal changes.

There were therefore four aims to the meeting:

1) to provide an opportunity for European policy-makers[4] to meet scientists and each other,

2) to elicit ideas about how best to make links between scientists and the policy community,

3) to introduce REFRESH to some members of the policy community, inform about scenarios of future change used in REFRESH, and discuss resulting challenges to WFD,

4) to scope ideas about knowledge gaps and future research that could assist the policy community.

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[2] For a discussion of issues and progress in developing a science-policy interface for water, including experience with CIS, see Quevauviller (2009), *Water System Science and Policy Interfacing*, Royal Society of Chemistry, Cambridge, UK. 430pp. ISBN 9781847558619 or Quevauviller, P. (2006). Science-Policy Interfacing in the Context of the WFD Implementation, *Journal of Soils and Sediments*, 6(4), 259-261. DOI: 10.1065/jss2006.10.189

[3] WISE is a partnership between the European Commission (DG Environment, Joint Research Centre and Eurostat) and the European Environment Agency. WISE is promoted as a "gateway to information on European water issues" and comprises a wide range of data and information collected by EU institutions http://water.europa.eu/

[4] We use a broad definition of policy-maker that includes those working in statutory or regulatory agencies, and those working at different levels (e.g. regional as well as national).

c) The workshop structure and agenda

The workshop involved about 20 policy-makers and regulators from six of the countries in Europe where REFRESH demonstration catchments are located. Both the WFD and REFRESH have regard to water-dependent sites under Natura 2000, so three participants were invited from each country, one with links to WFD implementation, one with links to Habitats Directive implementation, and one with links and knowledge of the particular catchment featured in REFRESH.

The final list of those attending did not include the Czech Republic or Norway, but did have someone from each of the other catchments in REFRESH. The following lists the countries and the number of representatives: Greece (1), Turkey (3), England (5*[5]), Scotland (3*), Spain, Catalonia (1), Finland (1). Representation related to WFD implementation but also to Natura 2000 goals. All attendees worked for public-funded bodies, but these ranged from national-level ministries, to statutory agencies and site-specific management bodies. Representatives from the European Commission (EC) and the European Environment Agency (EEA) were unable to attend but will receive this report and develop further links with the REFRESH project.

The meeting was facilitated by Professor Bill Slee (RS), Kerry Waylen (KW), Rachel Helliwell (RH), and Iain Brown (IB). All are researchers employed by The James Hutton Institute (TJHI), which was the Macaulay Land Use Research Institute (MLURI) at the time of the meeting. There were also REFRESH scientists present, with expertise in modelling and scenario generation.

The meeting spanned two half days, from 13:00 on 16th March until 12:00 on 17th March, at the Grange Langham Court Hotel in London. On day 1, after a short introduction, the afternoon was spent in discussion of WFD implementation and future challenges. This was followed by presentations about the future scenarios used in REFRESH. On the second day, the main activity was discussion, in carousel format, of how to address some of the key issues raised on the first day, and a presentation and discussion about making links between the policy community and scientists in REFRESH. The complete agenda is displayed on the following page.

[5] One participant from England attended only the first day. Two participants from Scotland each stayed only for one half day (so there were only two representatives from Scotland at any one time).

The workshop agenda:

Day 1	**16 March 2011**
13:00	Lunch and networking
14:00	Introduction to workshop and project
14:30	Implications of climate change for WFD delivery: current policy perspectives Discussion in 2 small groups – southern and northern Europe
16:00	Coffee break
16:30	Presentations on REFRESH scenarios and storylines
17:30	Break
18.30	Drinks and Dinner at 19.30
Day 2	**17 March 2011**
09:00	Summary of main issues raised to date
09:30	Workshop on main knowledge gaps and policy needs Carousel exercise – 4 small groups rotate around 4 issues.
10:30	Break
11:00	Connecting scenarios & policy processes – summarising carousel + further discussion
11:30	Discussing next steps and preferences for future engagement
12:00	Finish and lunch

The content of evaluation forms are all moderately or strongly favourable, and suggest that participants generally enjoyed meeting each other, learning about REFRESH and discussing future challenges.

3) Summary of discussion during the workshop

The topics discussed are synthesised below, following the order of the main workshop activities.

a) Current policy perspectives on WFD delivery and future challenges

The aim of the two small group meetings was to discuss and share thoughts and expectations on future changes and challenges to WFD implementation. Participants were divided into two groups according to geography, with a southern European group (Greece, Spain, Turkey) meeting separately from a northern European group (England, Scotland, Finland). As well as allowing some comparison between views and experiences in north and south, the smaller groups also allowed more opportunity for all individuals to contribute to discussion.

i) Southern Europe Group (Greece, Catalonia, Turkey) facilitated by KW and RH

Current situation

The contrast between Greece, Turkey and Catalonia (Spain) showed how differently WFD and N2K policies could be implemented in each country. None of the countries had yet finalised any River Basin Management Plans (RBMPs) under WFD. In Spain, each region is responsible for its own plan, and that in Catalonia was far ahead of other regions, having finished its consultation. N2K was managed separately. Turkey was not obliged to comply with the WFD but was planning to do something similar, more closely integrating it with habitat protection policies that are similar to N2K. Greece only started making plans for WFD two years ago, but by contrast the lagoon fed by the Louros (a REFRESH demonstration catchment) was already a N2K site with a management body.

Every country faced problems with human activities that caused diffuse pollution, mainly from agriculture but also from sewage. Water quantity not just water quality was a concern, and several hectares of lagoon area had already dried out in Greece. Water resources are needed for irrigation and domestic consumption. In some regions intensive tourism or industrial activity intensifies these pressures.

Future challenges

Climate change is a concern for all countries. For example, in Turkey, effects are predicted to include a 10-20% decline in precipitation by 2060, and a decrease in discharge of 40%. In Spain precipitation was thought to remain constant, but warmer temperatures would increase evapo-transpiration. Warmer temperatures, combined with less water availability could affect species distributions, and wetlands could dry out. Lagoons in Greece would face similar problems.

Future population changes were also thought key. In Greece there is land abandonment in some rural areas, reducing domestic and agricultural pressures on water (although not necessarily beneficial for some elements of biodiversity and hereogeneity of landscapes). However, in a Turkish pilot basin, the growth of tourism and towns, will probably cause increased water supply demands and exacerbate existing pressures. The construction of infrastructure such as roads can encourage tourism and the problems it brings.

Regardless of population, changing land-uses were thought important. In Greece, the building of dams for hydroelectricity could significantly affect morphology and water flows. However, not all changes are necessarily negative: in Turkey it is predicted that there will be a reduction in the amount of water used for irrigation, by adopting modern irrigation technologies. Other projects will have mixed effects: in Spain, the building of desalination plants may reduce water demand but create a problem of salt disposal.

Future needs
Although future changes were expected it was hard to think of any current measures designed to respond to these. The main need discussed was for programmes for education and to promote awareness of the need to conserve the water environment.

- **Education and awareness campaigns to promote long-term behaviour change.** During a drought in 2007-8, a campaign in Ankara during a drought resulted in resident reducing consumption by 25-30%, but the effect was short lived. This showed that campaigns could have temporary effects, and this needed to be overcome.
- **Communicate about ecological systems, not just actions required.** In all catchments there were various plans to engage with both children and adults. These schemes focused on communicating how ecological systems functioned and connected, and the benefits they provided. Some activities were already underway: for example, in La Tordera River Basin (N.E. Catalonia) since 2004 there has been an Environmental Education and Communication Programme that has taken science generated by the L'Observatori Project and 'translated' it for work with both children and adults.
- **Financial support.** In Greece there were no resources to implement a plan to reduce impacts from agriculture. Encouraging change requires long-term resourcing.
- **Transboundary working.** Many countries have river basins that span national borders. This situation can make it difficult to establish and implement catchment management. The WFD should stimulate cooperation and coordination with transboundary river basins to prepare RBMPs. However, in Turkey's experience to date this has not always occurred at the desired level (Lake Beyşehir catchment lies entirely within Turkey but 5 of Turkey's 25 river basins are transboundary, some shared with Middle East countries). However, pre-existing bilateral agreements with neighbours can help to promote activities for catchment management.

ii) Northern Europe Group (England, Scotland, Finland) facilitated by RS and IB

Current situation
At present there were major challenges to delivery of measures to achieve Good Ecological Status, even without considering future changes. For example, even with agricultural codes of practice there are still large parts of the UK and other countries where water quality will remain below desired levels: complying with codes of practice does not always mean achieving compliance with WFD.

Tackling diffuse pollution (DP) remains a big issue. The damage it causes depends on the type of water body, with shallow lakes cited as especially vulnerable. By contrast, point source pollution was perceived as having been remedied to a much greater extent.

The WFD was not seen as sufficiently integrated with N2K or other policies.

Future challenges
Climate change was seen as having widespread and multiple implications for WFD achievement, for example, causing flooding.

Future challenges may interact and reinforce each other. In 2009 the UK chief scientist outlined the possibility of a 'perfect storm'[6] a future scenario where challenges of food shortages, scarce water and insufficient energy resources would combine.

It was expected that unpredictable changes and challenges would occur in the coming years. Metaldehyde (a molluscicide) was used as an example: in the last 10 years this compound has been detected in drinking water sources, and treating the contaminated water imposes high costs[7].

[6]Slides and a paper describing Professor John Beddington's 'perfect storm' are available from http://www.bis.gov.uk/go-science/news/speeches/the-perfect-storm

Future needs

Various needs were discussed: they have been ordered into groups below, but many are related.

- **A need for an holistic approach e.g. linking policies.** It was argued that the WFD and N2K could not be looked at in isolation, although this often happened at present. There was also a need to take into account other water-related policies e.g. those relating to flooding, but beyond that there was a need to also link with land-use policies.
- **An ecosystem services approach is necessary**. Using the lens of ecosystem services could assist in considering and delivering multiple outputs. There may be positive synergistic effects: for example, delivery under one policy (e.g. planting buffer strips to reduce pollution) could well help delivery other benefits (e.g. trees growing on buffer strips could deliver carbon storage for climate change policies).
- **We must build resilience in water systems.** This is absolutely necessary to tackle any future 'perfect storm'. To do this, provisioning, regulating and cultural services should be understood as linked. Any single part of a system should not be viewed in isolation.
- **Linking with stakeholders, including better communication between all types of stakeholders.** Better communication is needed between policy, practitioners and research communities. Engagement must be stronger and more effective.
- **Governance needs to involve stakeholders.** New 'delivery models' are needed to ensure there is uptake of measures, to effectively implement plans. This requires stakeholders (at least those intended to deliver measures) to be involved in co-constructing solutions, rather than just being instructed how to behave.
- **Changing values to change behaviours.** Achieving a 'greener' future with better engaged citizens requires significant value shifts. Although there are some win-win practices which benefit both the implementer and the environment, quite often implementing a measure will incur a cost to someone. Sagoff's ideas of citizen values[8] may be relevant, but it is difficult to develop 'big society' ideas in an increasingly individualistic world.
- **Improving decision-making by using environmental economics to shape decisions**. We must value not only market goods but also un-marketed goods and 'bads'. The system must focus more on greater social efficiency
- **Handling uncertainty** Decisions need to be taken under conditions of uncertainty but economic logic may help in these situations. An example of uncertainty is identifying the correct reference conditions in heavily altered water bodies. Future changes are also uncertain.
- **Consider abandoning some catchments**. In some cases (particularly if there is intensifying farming), significant pressures may mean that need to abandon some catchments. Is this part of adaptive management?

North versus South?

In many ways there are not many differences between the southern and northern groups. In both regions there are many similar pressures to tackle, and there are also many shared worries about future changes. In both regions some effects of climate change are already evident. The northern group may have slightly better articulated worries about responses that might be needed to cope with future changes: this may reflect that the northern catchments were significantly ahead in WFD implementation versus the southern catchments represented in our workshop. However, neither group had yet made much concrete progress to cope with expected future changes or uncertainties. 'Future proofing' is a difficult concept to explain, and to operationalise.

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[7] The site http://www.water.org.uk/home/policy/positions/metaldehyde-briefing describes the UK Water industries' perspective on this emergent problem.

[8] www.ucl.ac.uk/~ucesswo/377-400%20Orr.pdf discusses 'citizen values' and Sagoff's arguments.

iii) Participants' perspectives on future challenges, post-workshop

After the workshop, participants were asked to select which future challenges they thought would particularly relevant for their region, and whether these would have positive or negative effects for WFD implementation. The list of options they chose from was derived from the ideas in discussions on day 1, although other options could be added.

The options expected to have significant negative effects broadly reflect the discussions on day 1, and extreme events were most often a concern. Some participants ranked the importance of the changes they thought likely: the negative effects of higher temperatures and growing human populations were, on average, ranked as the most important changes. In addition to the options selected on the form, other negative effects suggested were; a loss of biodiversity, secondary impacts of climate change, and summer droughts.

	Changes expected to have significant negative effects	
Potential future changes	Policy makers	Scientists
Environmental		
Higher temperatures and/or evapo-transpiration	11	3
More extreme events (e.g. droughts or heavy rain)	10	4
Decreased average rainfall	9	3
Policy		
Policies promoting hydropower	6	-
Policies promoting planting for biofuels	3	-
Decreasing subsidies for agriculture from the Common Agricultural Policy	3	1
More focus on managing for ecosystem services	1	-
More information available to inform policies for water-management	-	-
More integration of policies (e.g. WFD & HD, Floods Directive....)	-	-
Increased use of a catchment-level approach and partnership working, involving stakeholders	-	-
Societal		
Increasing human populations	9	4
Rising food demand / food prices	7	3
Decreasing human populations / land abandonment	2	-
Domestic (household) water-saving measures	1	-
Increasing public appreciation, and support for, biodiversity conservation	-	-

More optimistically, many policy and societal changes are thought to offer positive effects on WFD delivery. The use of information, together with integrated policies, were most often selected as a positive likely change. The few scientists' responses captured here suggest that there are no overt differences in opinion between scientists and policy-makers, in concern about future changes.

	Changes expected to have significant positive effects	
Potential future changes	Policy makers	Scientists
Environmental		
Higher temperatures and/or evapo-transpiration	2	-
More extreme events (e.g. droughts or heavy rain)	2	-
Decreased average rainfall	1	-
Policy		
Policies promoting hydropower	3	1
Policies promoting planting for biofuels	4	-
Decreasing subsidies for agriculture from CAP (Common Agricultural Policy)	7	2
More focus on managing for ecosystem services	10	3
More information available to inform policies for water-management	13	3
More integration of policies (e.g. WFD & HD, Floods Directive....)	13	3
Increased use of a catchment-level approach and partnership working, involving stakeholders	12	3
Societal		
Increasing human populations	1	-
Rising food demand / food prices	2	1
Decreasing human populations / land abandonment	6	1
Increasing public appreciation, and support for, biodiversity conservation	12	3
Domestic (household) water-saving measures	11	3

b) Responses to REFRESH scenarios

After discussing perspectives on current and future challenges, the REFRESH scientists delivered presentations delivered on four different aspects of future change used in the REFRESH project: climate (Dr Maria Shahgedanova), land-use (Dr Iain Brown), pollution deposition (Dr Rachel Helliwell) and Water Resource change (Dr Harm Duel)[9]. Printed copies of the presentations delivered at the meeting were enclosed in all participants' information packs. For additional copies of these presentations, please visit www.refresh.ucl.ac.uk or email kerry.waylen@hutton.ac.uk.

Participants did not express strong opinions or disagreement with the scenarios that they had been presented: the trends and details presented were in accordance with pre-existing ideas about general patterns of change to be expected in future. Following this discussion, there was some reflection on whether or not scenarios that looked far into the future should try to be predictive, given the uncertainties involved. It is easier to think about 2020 than to think about 2050. There are different kinds of scenario building e.g. exploratory scenarios are different to scenarios of what 'should' happen (normative scenarios). Scenarios should be useful – help us to build resilience – rather than encouraging fatalism.

[9] An overview of the four approaches, with links to more information about the methods used, is at http://refresh.ucl.ac.uk/Work_Programme_3

c) Brainstorming knowledge and policy needs to address challenges.

After identifying changes and challenges on day 1, the next step on day 2 was to discuss data needs and potential responses to these challenges. After reviewing the discussion on day 1, the facilitators picked out four challenges that seemed important and relevant to all participants. These challenges were written onto four separate flipcharts, and the meeting participants (both the policy participants and REFRESH scientists) were randomly divided into four groups. One group was assigned to each flipchart. The key questions asked of each group were: what knowledge would be needed? and what policy changes might be needed? in order to address the challenge. After about 20 minutes, each group moved around to the next board (this process is called a 'carousel'). This rotation was repeated until every group had visited every board and discussed every challenge.

i) Tackling diffuse pollution (facilitated by RH)

Diffuse pollution (DP) was defined as non-point source contamination, such as runoff from fields or toxic seepage from soil into groundwater, or pollutants in urban drainage waters. The main pollutants discussed in the group were nitrate, phosphorus and sediment. Although DP was acknowledged to come from both urban and rural sources, most discussion was focused on managing pollution in rural areas.

Research into causes of DP. Without sufficient scientific evidence of the main processes and mechanisms causing diffuse pollution, effective management options cannot be developed. A particular gap in the evidence is how to understand the magnitude of DP apportioned to different sources within a catchment. We also need to know now how effective current measures will be if climate changes. More research is required.

Improve communication Effective management depends on open communication channels between land-managers, regulators and policy-makers. We need to improve these communication channels, particularly with regard to best management practices, and catchment-sensitive farming.

Education and awareness raising. Scientific research and understanding should be disseminated to land-managers, using both national-level campaigns and more targeted approaches for specific problems at a catchment scale. Demonstrations of good agricultural practice at a farm level can be useful[10].

Financial incentives. Subsidies and other payments can be useful ways to encourage measures that reduce DP.

Roles for non-statutory bodies. In rural areas, if there are existing groups (e.g. within the UK the National Farmers Union) these could take a role, and responsibility in achieving DP reductions, rather than using regulation or interventions from statutory agencies. In the Scotland, the Diffuse Pollution Management Advisory Group[11] may be a useful model.

Specific measures useful for preventing and reducing DP:
Buffer zones /buffer strips. A range of widths may be needed according to purpose, terrain and other local environmental features. The UK minimum of two metres seems low compared to practice elsewhere (e.g. in Turkey).
Sustainable urban drainage (SUDs). Many existing urban drainage systems cause flooding or pollution problems: by contrast, sustainable drainage takes account of the quantity and quality of runoff, and the amenity value of surface water in the urban environment.

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[10] For example, http://www.lwec.org.uk/activities/demonstration-test-catchments

[11] Diffuse pollution management advisory group (DPMAG) is a partnership that focuses on improving Scotland's water environment by reducing rural diffuse pollution. http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag.aspx

Improve septic tank and slurry store management. Increased capacity to store slurry will also allow it to be dispersed only in favourable weather conditions and during growing seasons.
Target hotspots Change cropping systems /land-use – further research may be required.
Promote traditional and organic farming. Traditional agricultural practices, and organic farming methods, usually reduce DP risks. However, this may conflict with desires for intensified agriculture and ensuring food security.
Remove land from production. Land can either be left fallow or used for other purposes. However, even if this can be incentivised, this can conflict with food security priorities.
Rules based on best practice. A statutory baseline of "General Binding Rules" (GBRs), based on good practice, is useful for communicating and helping compliance with minimum standards of environmental care. Some countries' experience with existing codes and handbooks is useful for communicating best practice[12].

ii) Handling uncertainty (facilitated by RS)

Identify sources of uncertainty. Catchments are complex socio-ecological systems. Does uncertainty arise because we do not understand biophysical interactions? Or, does it arise because we do not know how to deliver effective institutions to manage change?[13]

Build resilience to cope with future changes. There needs to be a balanced focus on the present and the future. We should therefore act for the present whilst keeping 'one eye' on the future. Future uncertainties are so important that their effects must be considered now. To do this, there should be greater focus on the concept of resilience, trying to promote it and 'design it into' systems.

Identify 'critical thresholds' When water systems are shocked, the system may never return to its former state (an irreversible change). In this situation, it may not be easy or possible to return to reference conditions – should we accept the new state of the system?

Plan to accept some changes. There was discussion about what level of change was acceptable. It was perhaps impossible to return to reference conditions (although there was a lot of uncertainty about reference definitions). Discussion suggested that both large and very small changes could be acceptable. Is climate change so big that we just have to accept it? Are invasive species always bad, or can we accept some relatively harmless ones that may cause only small changes?

Accepting and identifying responsibility for handling uncertainty. Who should handle the uncertainty? Scientists argued that decision-making in the face of uncertainty is a political responsibility, but the policy-makers argued inadequacies in science were the cause of the uncertainty, so it was the responsibility of scientists to reduce it. Which bits of uncertainty is it important to reduce – uncertainty about trends, or about the probability and impact of extreme events?

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[12] UK examples discussed included the 'PEPFAA code' (Prevention of Environmental Pollution from Agricultural Activities) and the 'Farms Soils Plan': both are available from http://www.sepa.org.uk/land/agriculture/agricultural_guidance.aspx . Research into land-managers' views found a condensed version of PEPFAA (Do's and Don't guide) was particularly useful. http://www.scotland.gov.uk/Publications/2007/07/09152423/1

[13] See the work by Prof David Tàbara (Autonomous University of Barcelona) who argues that technological fixes are insufficient for reacting to climate change. In award-winning paper in 2009, (http://ec.europa.eu/research/sd/conference/2009/index_en.cfm?pg=winning-papers) he called for "Integrated Climate Governance" - a strategy of social and institutional innovation by individuals, communities and institutions, and integration of different forms of knowledge.

Using uncertainty to prompt action not inaction. Neither the public nor politicians like uncertainty. Care must be taken to avoid painting 'grim pictures' that cause only despair and thus inaction. Scientific models can and do accommodate uncertainty but scientists need to communicate about uncertainty more effectively. Also, it may be necessary to educate both the politicians and public 'young and old' about uncertainty: (a characteristic of post-normal science). A worst-case scenario, similar to the perfect storm (section 4a) should be presented as a spur to action, to motivate the pursuit of feasible projects that would contribute to reducing problems. This can be very useful in strategic planning (a practical example is a March 2011 planning exercise on flooding in London[14]).

REFRESH catchments could be used as a vehicle for exploring the unthinkable with water systems. Just what would happen in different REFRESH catchments, under the 'perfect storm' scenario? It was thought that these case studies be helpful for assisting strategic planning. There may be five key drivers of change to think about in these scenarios: demand for water, demand for food, climate change, population change, and global politics.

Learn from other sectors. Are there lessons to be learnt from other sectors (e.g. the financial sector?).

Implement adaptive management. There are likely to be some measures that are a good idea ('no regret' measures), regardless of what happens in future. As soon as they are known they should be implemented[15]. However, because of uncertainty we need to take risks with other measures. Some measures will fail: we need to expect and learn from these actions, but failure is never popular.

iii) How to 'do' partnership working to deliver measures (facilitated by KW)

Identify the 'partners'. The first step must be to ask who are the stakeholders that make up such partnerships. There is no prescriptive answer; the answer will vary according to the river basin in question. We should not make assumptions or stereotype who needs to be involve. Communities may be urban, not all farmers, they may not all agree. Scientists and possibly NGOs also need to be involved in partnerships. The term 'measure-holder' was invented, to mean the subset of stakeholders who are required to implement measures in practice.

Engagement not education. Once communities or partners are identified, outside agencies or policy-makers must try to understand their point of view, and their 'language'. The aim is to create dialogue, not simply to command people to implement prescribed measures. Ideally, measures should be co-constructed. The knowledge of local people can be useful, and sometimes help reduce uncertainties[16]. Ultimately, other stakeholders need to be involved in decision-making, whilst ideas should flow from bottom to top, as well as top to bottom.

Money matters. Money is needed to incentivise or enable some measures.

Devolve more than money. Both power and resources should be given to stakeholders. Capability includes capacity to carry out measures, sometimes this relates to very practical issues, such as

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[14] http://www.exercisewatermark.co.uk

[15] A compilation of existing measures that may be useful in a changing climate is contained in the "Review of published climate change adaptation and mitigation measures related to water". This report is deliverable 1.2 from REFRESH and should be available from www.refresh.ucl.ac.uk, or from the project leader m.kernan@ucl.ac.uk.

[16] In situations where 'facts are uncertain, values in dispute, stakes high and decisions urgent' the concept of 'post-normal science' (PNS) may be relevant. PNS is described at http://www.eoearth.org/article/Post-Normal_Science by Silvio Funtowicz and Jerome Ravetz.

providing training in particular skills. For farmers, integrating information about the environment into courses in agricultural colleges may be very useful for this.

Long term solutions cannot rely on monetary incentives. Many measures are voluntary – how can we incentivise these? In the long-term we need to motivate a sense 'ownership' of the water environment, for measures to be sustainable. Money is not sufficient, instead we need education; it needs to start when they are young, but also give consistent education to adults (particularly 'measure holders'). Some people already have this (e.g. in Turkey many already view water as an essential resource to be protected) but the idea needs to be promoted to others.

Maintain motivation. The scale of potential future problems can be dispiriting and encourage fatalism. Short-term funding for schemes can work against encouraging a long-term focus. To combat this, it is useful to start with interesting and/or achievable tasks. It can also be useful to engage with existing community groups or partnerships, which will be likely to have a sustained presence.

Higher-level bodies are important. A higher-level body and/or some kind of organised framework are needed to coordinate work, help build capacity, and keep everyone in touch with policies and strategies. They provide a focus on statutory requirements. Organisations must persist in the long-term and not be affected too much by political changes (capacity is easily lost but not regained). By comparison to politics, environmental problems are static and well-known. We must make a case for these institutions and communities/partners should appreciate them.

Multi-agency structures. Management will have to involve multiple agencies, not only vertically (i.e. agencies and local-level stakeholders) but horizontally (i.e. different organisations responsible for the environment). There is experience that can be learnt from e.g. in tackling diffuse pollution in Scotland (see footnote 11).

Learn from other experiences Lessons can be learnt from other processes that governments use to engage people, for example the UK development planning process[17].

iv) How to link WFD with other policies (facilitated by IB)

Multiple policies for multiple benefits Some elements of multiple benefits are already implicitly included within the WFD: for example, the emphasis on good ecological status should help to deliver good quality drinking water and bathing waters. However, linking policies with the WFD offers the possibility of managing water systems for multiple benefits.

Natura 2000 Water-dependent Natura 2000 (N2K) sites must be protected under the WFD, so the Habitats Directive as well as the Birds Directive are obvious links to make. (The Habitats Directive (HD) is of key importance to REFRESH because of its emphasis on eco-hydrological indicators of change.) However, to date the WFD and HD are often not sufficiently integrated, with one being treated as a bolt on to the other, or the policies being handled entirely separately.

Other relevant policy areas are: flood risk management (Floods Directive); agriculture (particularly Common Agricultural Policy (CAP) and Rural Development Programme); bathing; marine, shellfish and fisheries policies; climate change policies, urban regeneration, land use and spatial planning; energy. The ease of linking of policies will vary. At a high-level, environment and water are sometimes in the same government department, so it is easier for the policies to link. However, it is harder to link topics handled by different departments, for example water and energy. The three concepts of climate change, water[18] and ecosystem services could be helpful as cross-cutting themes

[17] http://www.planningportal.gov.uk/planning/

[18] The 2012 EU Blueprint for Water may offer an opportunity to establish water resources as a key cross-cutting policy issue. http://ec.europa.eu/environment/water/blueprint/index_en.htm

to identify links. (There may be even more focus on ecosystem services in future.)

Scale. The Floods Directive may be easily linked with the WFD, because of the shared focus on river basin management. Most other policies will work at a different scale e.g. development planning works is often bounded by population settlements: how should these be linked?

Identifying interconnecting and conflicting policy objectives. Linking with some policy areas will pose problems when objectives appear to conflict. For example energy policies that favour reducing greenhouse gas emissions can favour hydropower, but hydropower installations can involve significant morphological changes to rivers. Attempts to link should still be made: we must accept that some tradeoffs must be made, but in other cases some 'win-win' solutions may be available. For example, flood policy is a case where it could conflict with the WFD (if hard engineering solutions are installed to reduce flood risk) but where natural flood management could benefit both objectives. Even the WFD and N2K can conflict: there was a site where high densities of birds caused eutrophication of the water body. With climate change meaning species behaviour will likely change (e.g. changed migratory routes), these conflicts may become more frequent.

Flexible guidelines not rigid rules. Where there are conflicts between policy objectives trying to achieve multiple benefits, tradeoffs may have to made. Furthermore, given that systems will change in future (e.g. in response to climate change), the situations where conflicts can be expected will change. Therefore, rigid application of every rule in every situation is unlikely to be successful. Instead, some degree of flexibility in what benefits to deliver at each site is useful.

Lessons from other countries. Some countries have made clear progress on aspects of policy integration. For example, Finland is combining approaches to the WFD and the Marine Directive. This experience can be useful to other countries/river basins, although progress will inevitably reflect the different context and priorities in each country: for example, in the Netherlands flooding will be of particular importance.

Common incentives to link stakeholders Each policy area has a separate stakeholder group, and in some cases this can act as a barrier to integrating policy implementation. Voluntary schemes and incentives can be helpful as a common approach but success cannot be guaranteed.

Link priorities at a strategic level. In each country there are normally several agencies responsible for implementation of one or more different policies. These agencies should between them identify their key priorities. Then, all agencies could target achieving these priorities, above all else. Scientific knowledge can assist in understanding how systems and priorities are linked, and in ensuring that there is a clear rationale for the priorities. Interdisciplinary science can contribute integrated indicators to demonstrate key overlap areas.

Multi-level working groups. Where there are known to be areas of policy-overlap (e.g. flooding and water quality) the establishment of working groups may be useful. These working groups would be technical /scientific but could be informed by local/regional stakeholders to recognise key geographic distinctions. In turn, the working groups would inform high-level policy teams (i.e. those responsible for reporting progress to the European Commission). Mediators would be required to ensure smooth functioning and help resolve differences. A particular emphasis could be highlighting emerging issues (illustrated by worked examples) and identifying priority geographic areas.

v) Reflections on brainstorming

In many groups there were strong ideas about what was needed to address the challenges: these ideas and common themes are summarised in the last section of this document. Sometimes more questions are raised, rather than answers provided, but these help us to deconstruct the problems and identify future research needs. Specific requests for research are also summarised later. Different carousel discussions sometimes link with other: for example, the discussion on partnership working details some of the approaches useful for achieving the communication called for in the DP board.

d) Preferences for future knowledge exchange

'Knowledge exchange' aims for a two-way communication process between scientists and policy-makers. An aim of this meeting was to help build science-policy links but to identify ways of improving these links in future. This section is based both on discussion in the meeting, and preference elicited in a feedback form distributed at the end of the meeting.

Recommendations for making contacts with the policy community

- Link with existing networks, rather than 'reinventing the wheel' (e.g. EEA network of National Reference Centres, EIONET, within Thames catchment, "Science for a Better Thames")
- Start communicating early (e.g. REFRESH should raise awareness with policy makers now, not just at the end)
- Develop country-level links (e.g. connect Turkish scientists with Turkish policy-makers, since this is culturally comfortable and allows for the communication of more specific information)
- Strong European Commission involvement: commission representatives (including advisors, not just project officers) should attend as many as possible meetings connected with REFRESH). REFRESH and other projects should link with multiple relevant Directorate Generals e.g. DG Agriculture, DG Environment, DG Climate Change. Ideally, policy advisors should give presentations at meetings. This demonstrates their buy-in to the policy-community.
- Use different methods for different audiences (e.g. according to country, individual, level, role).
- Ensure there are sufficient resources for communication.

Participants' preferred methods of contact

The post-workshop evaluation form suggested 13 potential methods which could be used to disseminate information. Participants were asked to select all methods they thought would be useful for achieving engagement with policy-makers. These are listed below. No other methods were suggested.

Method	Number selecting (from 13 policy participants)
Short policy briefs	11
Presence at other events (i.e. conferences, meetings)	10
Personal meetings	10
Country-level meetings	9
Cross-national meetings	6
Project website	5
Articles in professional literature (e.g. society magazine)	5
Email lists	2
Academic papers	1
Blogs	0
Materials by post	0
Phone calls	0
Twitter/tweets	0

4) Key points from the workshop ('take home messages')

Changes that will pose challenges to future WFD implementation
Changes and challenges were discussed in the regional-group discussions on day 1, and also touched upon in the post-meeting evaluation form.

Throughout the meeting climate change was mentioned as a key future challenge. General trends in temperature and precipitation in the scenarios used by REFRESH were broadly as expected, but understanding the probability and size of extreme events may be as important, to predict droughts and floods. In comparison with environmental changes, policy changes (e.g. in agricultural policy, energy policy) are rather less predictable but can have equally significant implications for achieving good ecological status. For example, commitments to lower carbon emissions could lead to new hydropower plants, but these can significantly impact natural river functioning.

Trends in human population change (and corresponding water demands and pressures) vary between regions. However where there are growing populations, education and changing attitudes to the environment may help reduce water demand.

In the forms distributed after the meeting, participants were asked to select which future challenges they thought would particularly relevant for their region, with the list of options based on ideas suggested during the meeting.

Key responses to assist in achieving WFD in face of future challenges

- ***Develop links between policies at a strategic level***. Many policies have overlapping or conflicting objectives. To deliver multiple benefits at any site, and identify the preferred tradeoffs, links between policies must be made. (Given that many future challenges to WFD will come from changes in these other policies, this may also allow these changes to better predicted or influenced.) Corresponding links between responsible agencies are also needed, so key priorities are delivered between them. Focusing on cross-cutting themes (e.g. ecosystem services, climate change) and setting up small working groups can help to make these links practical.
- ***Partnership working***. Long-term sustainable action will only be achieved with the buy-in and empowerment of a variety of stakeholders, especially those expected to carry out measures. Genuine engagement and dialogue with carefully identified stakeholders, with co-construction of measures to take. Where responsibility and power is devolved to stakeholders, sufficient resources and capability must also be transferred.
- ***Educate for and expect uncertainties.*** Science may be able to reduce some areas of uncertainty, but not all. Policy-makers, politicians and the public need to be educated about uncertainty, and scientists must communicate it. Using worst-case scenarios can help to plan where there are uncertainties, as thinking about extremes (or a 'perfect storm') can help us to understand what responses may be needed, and also to motivate action now.
- ***Flexibility in management*** Given that we have uncertainties in our understanding of water systems, there are risks in taking action to manage them. Therefore, although it is politically unpopular, failures must be expected and learnt from. In addition, future changes may mean that measures that are appropriate now, may in future need to be modified, replaced or abandoned. Flexibility is also desired to allow site-specific decisions, either because reference conditions can no longer be achieved, or because considering other policies means a standard or goal should be modified (e.g. if high populations of protected bird species causes lake eutrophication, is better to allow this rather than cull the birds?)
- ***Share experiences***. In nearly every discussion, experience in different countries was compared, and useful case studies suggested. Not only does science need to inform policy, but policy communities in different countries (and even different sectors) have a lot to learn from each other.

Some outstanding questions and future research needs

These are selected from the discussions in the 'brainstorming' section of this document.

- How to use 'worst-case scenarios' to inspire action, rather than produce fatalism and apathy?
- How to sustain stakeholder engagement in partnership working?
- Will current measures be effective when climate change occurs?
- What does 'future proofing' really mean at the policy-level?
- How (and who) should reduce uncertainty in measures?
- What indicators should we use that are relevant to multiple policies?
- How to identify the magnitude of different sources of diffuse pollution, within a catchment?
- Can we use ecosystem
- How can we link policies that work at different scales? (e.g. WFD and energy policy)
- How should we manage ecosystems when individual policy objectives appear to conflict (e.g. if WFD and HD requirements in specific circumstances)?

Some of these research questions will be addressed by REFRESH (please see the next section for more information about future work in REFRESH). Other questions should influence future research agendas.

Specific ideas for improving science – policy links

- Short policy briefs are a popular method of communication.
- Use multiple methods of communication, and start early.
- Link with existing networks, meetings and sources of information but be aware that different networks suit different policy-audiences.
- Rather than science pushing information to the policy community, ask the policy community to take an active role: e.g. ask the commission to contribute at meetings.
- Develop country level links between policy and science.

A key point is that promoting links between the science and policy communities should not be an afterthought. Rather, it requires early and ongoing attention, resources, and commitment from both scientists and policy-makers.

5) Next steps

The outcomes of the workshop were presented at the annual REFRESH scientific workshop held 4 – 8th April 2011. In particular, the findings were presented to the rest of WP1 (adaptation, scenarios and stakeholder engagement) with regard to comments on scenarios; and discussed as part of the workshop that sought to use findings from WP1 to feed into the WP5 (modelling) and WP6 (cost-effective measures). Therefore, the workshop provided a very useful context for planning the modelling and cost-effectiveness work; plus REFRESH colleagues can contact participants if they wish to follow up any particular comment or issue.

The material was also presented to the WP7 (knowledge exchange) meeting, where people were very interested in the preferences expressed; and the general comments made about how to keep stakeholders involved. WP 7 intends to use the following processes to keep informed various audiences, including participants from this workshop:

- Continually updating the website (http://www.refresh.ucl.ac.uk/) with supporting materials (workshop reports including this one will be posted here; and best practice guidance is planned for publication 2011-12):
- Stakeholder engagement via regional workshops (UK, Scandinavia, Estonia, Turkey) in 2012-3;
- Synthesis reports on the catchments (2013-14)
- Policy implications as policy briefs (2013- 14).

The project leader agreed to modify some of the original suggestions to take account of the comments made during the London workshop.

The cross-European findings were similar to the outcomes of local level workshops held with stakeholders in the Louros (Greece) and Dee (Scotland) catchments, indicating that there is a common set of issues, challenges and questions facing stakeholders at local, national and international levels. However, there is always going to be a mismatch between the suite of issues raised by stakeholders and the ability of the REFRESH project to answer all the questions. Much of the science planned is focussed on improving the understanding of specific bio-physical processes, and some of the broader policy implications may be difficult to answer with this data. However, there are plenty of issues that the workshops raised which have helped inform plans for research from this year onwards.

As part of our commitment to sharing our findings with wider stakeholders and policy makers, we will report the outcomes of this workshop in the newsletter of the watershed and river basin management specialist group of the IWA (International Water Association). In addition, meeting participants are welcome to suggest other newsletters, websites or mailing list which might welcome a short report. Meeting participants are also welcome and encouraged to pass the report of this workshop on to colleagues and contacts who are interested in these topics.

If anyone reading this wishes to remain in contact with further work in REFRESH, they are encouraged to contact the project leader (and leader of WP7) Martin Kernan: mkernan@geog.ucl.ac.uk.

For further discussion on this report, please contact Kerry Waylen: Kerry.Waylen@hutton.ac.uk