

*Preliminary
Cost Effectiveness Analysis of the
Water Framework Directive*

Revised After Stakeholder Review

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Chapter 1

Introduction

Introduction

The pCEA forms part of the implementation process of the Water Framework Directive. It has been carried out by DEFRA with technical inputs from the Environment Agency (EA) and significant stakeholder involvement, starting in autumn 2006 and continuing until summer 2007. The pCEA aims to identify the most cost effective package of measures across sectors that will achieve the requirements of the WFD, taking into account the level of uncertainty associated with the different packages, their distributional and affordability implications and the potential for phasing implementation over the three river basin planning rounds, from 2009-2027.

The pCEA provides supporting evidence for Ministerial Guidance and guidance to the Environment Agency on delivery of the WFD for the first round of River Basin Management Planning and inputs into the revision of the overall WFD Impact Assessment.

The pCEA builds on the EA's Strategic Assessment report which constituted a first assessment of the work that would need to be done to meet WFD objectives.

Costs for Wales and England

Costs for the pCEA have been collected for Wales and England separately, where possible. In some areas, costs for Wales are being developed on a slightly different timescale from those for England and it has not been possible to integrate all input for agriculture, forestry and minewaters for Wales into this version of the pCEA synthesis report. Some chapters include information for Wales, which is the subject of ongoing review and refinement.

Revised Synthesis Report

The chapters in this report have been revised following stakeholder review. Draft chapters for key pressures were presented at the pCEA Stakeholder Workshop held in London in July 2007 and were made available for public review. This synthesis document brings together the revised chapters. It is available at <http://defraweb/environment/water/wfd/economics/research.htm>. The cost estimates given in this report will be improved and refined as further information becomes available in the course of the more local Cost Effectiveness Analysis at river basin level.

Key Findings

The pCEA makes a significant contribution to our understanding of the measures that are needed to meet WFD objectives and their associated costs. The participation of stakeholders in the sector working groups and in the review of the synthesis has helped to ensure the quality of the information included here. However, there is still uncertainty about several aspects of the cost estimations, which are noted in the individual chapters. In particular, there is uncertainty about the relationship between some water quality and quantity parameters and the ecological status of water bodies; and the related question of how far measures will need to be rolled out. These areas of uncertainty are being addressed by the Environment Agency and it will be necessary to update the cost estimates as information improves.

The chapters reveal that the overall costs of the WFD are potentially higher than estimated in the initial WFD Regulatory Impact Assessment <http://defraweb/corporate/regulat/ria/2004/wfd.pdf>. However, costs associated with some pressures may be lower than expected, depending on the way in which the Directive is interpreted.

A common theme emerging from the pCEA is the need for measures to improve information and reduce uncertainty. These measures may take a number of forms, such as research on the extent and apportionment of pressures which have not previously been monitored by the EA; the relationship between particular pressures and ecology, particularly for hydrological

and morphological pressures; investigations of pressures in specific sites; research on the effectiveness of measures, including the implementation of pilot projects. These measures may in themselves require significant expenditure and where, possible, pCEA authors have included these in the relevant chapters.

A second recurring theme is that of site-specificity. Given the wide range of conditions affecting water bodies in England & Wales, it is clear that the most cost effective package of measures will vary from place to place. The remit of the pCEA was to consider costs and effectiveness at the national level. As a result, authors made assumptions about the number of sites where implementation would be necessary and the average cost that would be incurred. Where possible, details of the range of costs have also been included in the chapters. The wide range of costs quoted for certain pressures, and the very high level of the upper cost estimates demonstrates the need for further more local cost effectiveness analysis. This will be taken forward by the Environment Agency in the context of the river basin planning process.

In many cases, particular measures are required to address specific pressures. However, the pCEA also identifies a number of cross-cutting measures which will address several pressures at the same time. These include catchment sensitive farming, which addresses agricultural diffuse pollution; General Binding Rules, voluntary measures and information and training measures directed at urban diffuse pollution; the roll-out of Sustainable Urban Drainage Systems approaches; and the integration of water considerations in the spatial planning process. There are particular challenges in assessing the cost effectiveness of these measures because of their cross-cutting and innovative nature, but should nevertheless be fully considered in the development of Programmes of Measures.

Taking the Analysis Forward

The findings of the pCEA are being used in conjunction with the analysis of benefits in the National Water Environment Benefits Survey to inform the revised overall Impact Assessment of the WFD and the Ministerial Guidance on the implementation of the WFD. The Ministerial Guidance will be subject to a full consultation and next steps will be informed by responses to this exercise.

Chapter 2

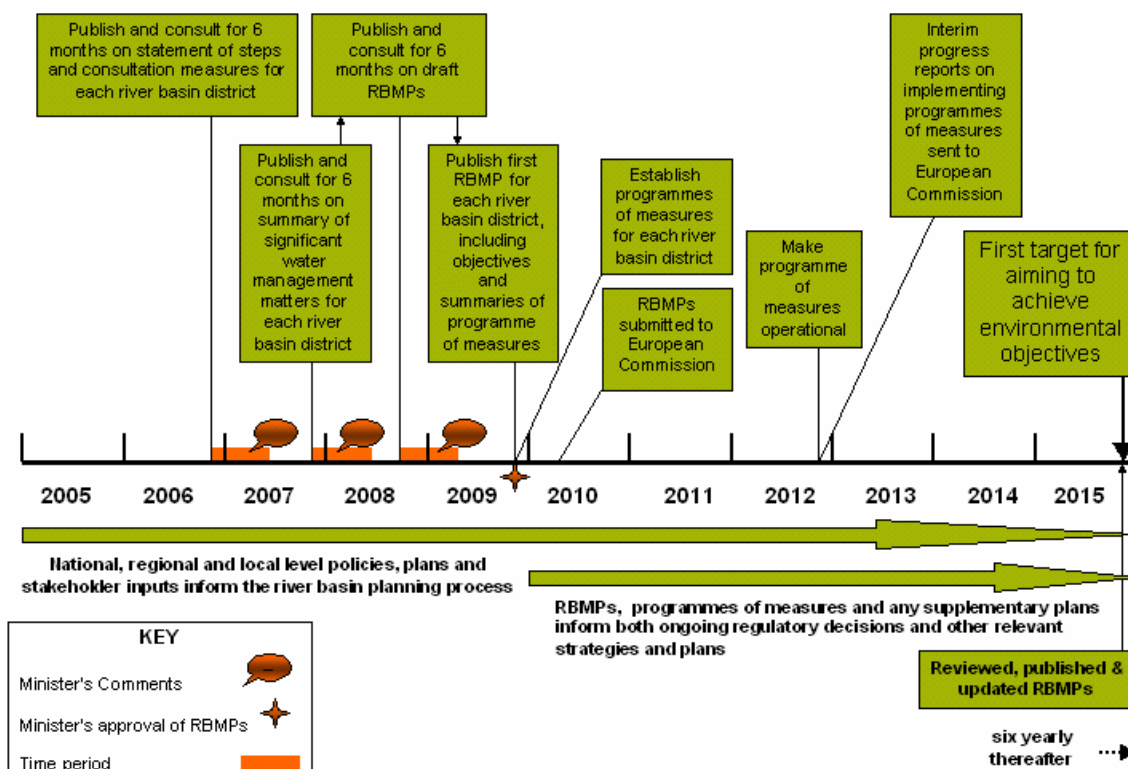
Policy Context

2.1 THE WATER FRAMEWORK DIRECTIVE AND DAUGHTER DIRECTIVES

The EU Water Framework Directive (WFD) will be the main vehicle for management of the water environment. It introduces a new, long term integrated river basin planning system which applies to all surface waters, groundwaters, estuaries and coastal waters and encompasses most existing water legislation.

The Directive brings in a common process and timetable for setting environmental objectives for each water body and taking action to meet them, which centres around production of a series of reports for each river basin district as shown in the timeline below.

Overview Timeline for First River Basin Management Plans



Defra and WAG issued joint guidance to the Environment Agency on river basin planning in September 2006¹.

River basin planning will drive significant improvements in integrated planning and efficiencies in delivery. It will be a key, central process which will highlight potential conflicts, synergies and interactions between activities taking place across the river basin district; and will enable the streamlining of different planning processes, timetables and stakeholder engagement arrangements.

2.2 KEY OBJECTIVES AND STANDARDS

Article 4 of the WFD establishes several types of objective for the water environment. The two key default objectives brought in by the WFD are

- to prevent deterioration in the status of water bodies and

¹ <http://defraweb/environment/water/wfd/index.htm>

- to aim to achieve ‘good status’ (both ecological and chemical) by 2015 in WFD water bodies.

There are also WFD daughter directives on groundwater and priority substances, which elaborate on the requirements under the WFD for groundwater and priority substances in surface water.

The groundwater directive

- sets out the criteria for good groundwater chemical status and for upward pollutant trends that must be reversed, and
- elaborates on the measures that must be introduced to prevent inputs of hazardous substances to groundwater and limit inputs of other pollutants to prevent deterioration or upward pollutant trends.

The directive on priority substances is still in negotiation but is likely to require Member States to

- set limits on concentrations in surface waters of 41 dangerous chemical substances that pose a particular risk to animal and plant life in the aquatic environment and to human health and
- cease or phase out discharges, emissions and losses of 11 substances within this list within an appropriate timetable that shall not exceed 20 years.

All EU Member States are using environmental quality standards to define these new WFD objectives, especially “good status”. The standards are set primarily by reference to the conditions necessary to support indigenous aquatic species. There is an “intercalibration” exercise to compare and agree upon standards across the EU. UK Technical Advisory Group is developing UK-wide WFD environmental quality standards, which the UK Administrations are consulting on and will incorporate into a classification scheme following the outcome of intercalibration. The assumptions which were made about standards for the purposes of doing the pCEA are explained in chapter 3 on methodology.

2.3 TIMING AND FLEXIBILITY

The WFD differs from other European directives in having greater flexibility than usual to set alternative, less stringent, objectives. These alternative objectives and defences are the only mechanism which the WFD provides for

- considering other environmental, social and economic priorities alongside priorities for the protection of the water environment and
- prioritising action over successive river basin planning cycles.

There are 4 types of alternative objective:

- an extended deadline (from 2015 to 2021 or 2027) [Article 4.4]
- a less stringent objective [Article 4.5]
- different objectives for heavily modified or artificial water bodies [Article 4.3] and
- different objectives where there are new modifications and new sustainable development activities [Article 4.7].

There are also 2 defences which may be used retrospectively to justify cases where an objective in a RBMP has not been met:

- a temporary deterioration in status [Article 4.6]
- new modifications or new sustainable human development activities [Article 4.7]

There are, however limits on the use of these alternative objectives and defences:

- Only some of the alternative objectives and defences can be used in relation to some of the objectives
- Alternative objectives and defences can only be used if certain conditions set out in the WFD are met. Different conditions apply for each alternative objective/defence,

but a key consideration – especially in the context of this report - is whether the measures required to meet the objective would be disproportionately costly.

- The alternative objectives and defences can only be used in relation to the standards and objectives arising from the WFD itself, not in relation to standards or objectives arising from other European legislation, unless the other legislation says so [NB draft priority substances legislation refers to Article 4 WFD].

2.4 INTER-RELATIONSHIP WITH OTHER DIRECTIVES (INCLUDING PROTECTED AREA OBJECTIVES)

As well as introducing some new requirements, the WFD incorporates some of the objectives and requirements of some other water related Directives so that they are also WFD requirements. In some cases a pre-existing Directive is repealed and its requirements become WFD requirements instead, but in other cases the other Directive remains (so we have a dual requirement to implement it – under the WFD and the Directive itself), as shown in the diagram below.

**Water Framework Directive
2000/60/EC**

WFD Daughter Directive on groundwater

WFD Daughter Directive on priority substances (in negotiation)

WFD Protected areas (ANNEX IV)

- To remain:**
- Bathing Water (76/160/EEC, as replaced by 2006/7/EC)
 - Drinking Water (80/778/EEC, as amended by 98/83/EC)
 - Urban Waste Water Treatment (91/271/EEC)
 - Nitrates (91/676/EEC)

- Other relevant Directives:**
- Integrated Pollution Prevention and Control (IPPC) (96/61/EC)**
 - Major Accidents (Seveso) (96/82/EC)
 - Environmental Impact Assessment (85/337/EEC)
 - Sewage Sludge (86/278/EEC)
 - Plant Protection Products (91/414/EEC)
 - Habitats (92/43/EEC)
 - Birds (79/409/EEC)

The above are WFD basic measures / to be included in programmes of measures (WFD Art. 10, Art. 11.3(a) & (d), Annex VI Part A)

Drinking water protected areas

Econ. significant aquatic species

Recreational water incl. bathing waters

Nutrient sensitive areas

Habitat or species, incl. N2K sites

- To be repealed:
forthwith**
- Dangerous Substances (76/464/EEC)* Note: Partly repealed forthwith and partly from 2013. There are transitional provisions.
- 2007**
- Surface Water for the abstraction of drinking water (75/440/EEC)
 - Exchange of info on quality of surface freshwater (77/795/EEC)
 - Surface water sampling/analys (79/869/EEC)
 - [Reporting (91/692/EEC)]
- 2013**
- Water for Shellfish (79/923/EEC)
 - Water for Freshwater Fish (78/659/EEC)
 - Groundwater (80/68/EEC)
 - [Dangerous substances related directives in Annex IX: Mercury Discharges, Cadmium Discharges, Mercury, Hexachlorocyclohexane Discharges and Dangerous Substances Discharges]

For each of these directives, the following sections describe the directive's purpose/objectives and the nature of its relationship with the WFD.

Directives which will be repealed and subsumed into the WFD:

1	Old groundwater directive
2	Dangerous substances directive
3	Freshwater fish directive
4	Shellfish directive
5	Surface water abstraction directive

1 Old Groundwater Directive

Purpose of Directive The old groundwater directive lists substances which should be prevented from entering, or prevented from polluting, groundwater. It requires a system of prior investigation, authorisation and requisite surveillance to be put in place.

Nature of relationship with WFD: The old Groundwater Directive will be repealed and replaced by WFD daughter directive on groundwater in 2013. The prevention of entry of List I substances and pollution by List IIs under the old Groundwater Directive will continue until 2013 and from then on groundwater will be managed under the WFD and its daughter directive.

2 Dangerous Substances Directive

Purpose of Directive The Dangerous Substances Directive prohibits the release of certain dangerous substances into the environment without prior authorisation.

Nature of relationship with WFD: The Dangerous Substances Directive (and its related directives listed in Annex ix of the WFD) will be repealed and replaced by WFD daughter directive on priority substances. Measures to meet the Dangerous Substances Directive will continue until it is repealed (in 2013) and from then on dangerous substances will be managed under the WFD and its daughter directive.

3 Freshwater Fish Directive

Purpose of Directive: The Freshwater Fish Directive requires Member States to protect designated waters from pollution that could be harmful to fish. It specifies environmental standards required to achieve the objectives for designated freshwater fish waters.

Nature of relationship with WFD: The Freshwater Fish Directive will be repealed in 2013. From then on management of these areas will be carried out under the WFD. The freshwater fish standards may be reviewed after the repeal of the Freshwater Fish Waters Directive in 2013 to the extent that they do not accord with the standards necessary for good ecological status (though in practice the standards will generally be the same). The designation of freshwater fish waters may be periodically reviewed after the repeal of the Freshwater Fish Waters Directive and new areas added or existing areas de-designated under the protected areas criteria for economically significant aquatic species.

4 Shellfish Waters Directive

Purpose of Directive: The Shellfish Waters Directive sets maximum pollution levels for certain substances in designated shellfish waters. Its objective is to support shellfish (bivalve and gastropod molluscs) life and growth, and thus contribute to the high quality of shellfish products directly edible by man.

Nature of relationship with WFD: The Shellfish Waters Directive will be repealed in 2013. From then on management of these areas will be carried out under the WFD. The shellfish standards may be reviewed after the repeal of the Shellfish Waters Directive in 2013 to the extent that they do not accord with the standards necessary for good ecological status. The designation of shellfish fish waters may be periodically reviewed after the repeal of the Shellfish Waters Directive and new areas added or existing areas de-designated under the protected areas criteria for economically significant aquatic species.

5 Surface Water Abstraction Directive

Purpose of Directives: The Surface Water Abstraction Directive sets quality objectives for the surface water sources from which drinking water is taken. It also sets out basic drinking water requirements.

Nature of relationship with WFD: The Surface Water Abstraction Directive will be repealed at the end of 2007, and similar provision will be carried out through the Drinking Water Directive and the designation and management of Drinking Water Protected Areas under the WFD. These areas are bodies of water used for the abstraction of water for human consumption which provide more than an average of 10 m³ a day in total or which serve more than 50 persons; and bodies of water intended for such level of use in the future. The relevant objective is aim to avoid deterioration in the quality of Drinking Water Protected Areas in order to reduce the level of purification treatment required in the production of drinking water. This will be carried out under the WFD. In addition, the Drinking Water Directive will continue to apply in relation to ensuring the quality of water at consumers' taps.

Directives which will remain in force alongside the WFD:

6	Drinking water directive
7	Bathing water directives
8	Nitrates directive
9	UWWT Directive
10	Habitats and Birds Directives

6 Drinking Water Directive

Purpose of Directives: The Drinking Water Directive sets standards for drinking water to protect public health and maintain the aesthetic quality of drinking water supplies.

Nature of relationship with WFD: The WFD introduces a new requirement to designate Drinking Water Protected Areas. These areas are bodies of water used for the abstraction of water for human consumption which provide more than an average of 10 m³ a day in total or which serve more than 50 persons; and bodies of water intended for such level of use in the future. In addition to the environmental objective set out above an objective in relation to Drinking Water Protected Areas is to ensure that, under the water treatment regime applied, the drinking water produced meets the requirements of the Drinking Water Directive. This duplicates the requirements of the Drinking Water Directive.

7 Bathing Water Directives

Purpose of Directive: The existing and new Bathing Water Directives set microbiological and physico-chemical standards to protect the health of bathers and maintain the aesthetic quality of designated bathing waters. From the end of 2014, the revised Bathing Water Directive introduces new objectives for designated bathing waters which

- require all bathing waters to achieve a classification of at least 'sufficient' by the end of 2015 (there are some exceptions to this), and
- require Member States to take such realistic and proportionate measures as they consider appropriate with a view to increasing the number of bathing waters classified as 'excellent' or 'good' (as defined in the Bathing Waters Directive).

Nature of relationship with WFD: Designated bathing waters are protected areas under WFD and it is thus a WFD requirement to put in place measures to meet the requirements of both bathing water directives and to meet the requirements of the new Bathing Water Directive by 2015.

8 Nitrates Directive

Purpose of Directive: The Nitrates Directive aims to reduce nitrate pollution of water that comes from farming, and prevent it in future. The Nitrate Directive requires Member States designate Nitrate Vulnerable Zones and to implement action programmes within them. It does not set a

deadline for achieving its objectives in Nitrate Vulnerable Zones but Member States are required to revise their action programmes if it becomes apparent that, unless revisions are made, the objectives of the Nitrates Directive will not be achieved.

Nature of relationship with WFD: Measures required under the Nitrates Directive (ie implementation of Action Programmes in Nitrate Vulnerable Zones) are 'basic measures' under WFD which must be included in programmes of measures. The Nitrates Directive requirements also continues to apply in their own right. Nitrate Vulnerable Zones become protected areas under WFD. Action to reduce Nitrates may also contribute to achievement of WFD phosphate, microbiological, and sediment objectives.

There are current reviews of the Nitrate Vulnerable Zone designations and of Nitrates Action Programme requirements. These are likely to result in the designation of more land and strengthening of Action Programme Measures.

9 UWWT Directive

Purpose of the Directive: to protect the environment by requiring:

- provision of systems for the collection and treatment of urban waste water from towns, villages and industrial premises;
- identification of environmentally sensitive areas and provision of more stringent treatment before discharge into those areas.

Compliance deadlines differ depending on the population or population equivalent served by the collecting systems and whether sensitive areas are involved. The last deadline in relation to collecting systems and treatment was 31 December 2005. Sensitive area designations are reviewed every four years; the outcome of the last review in 2005 is currently under consideration. Member states have 7 years from the date of designation of a sensitive area to put appropriate additional treatment requirements in place.

Nature of relationship with WFD: It is a WFD requirement to put in place measures to meet the requirements of the Urban Waste Water Treatment Directive. UWWTD sensitive areas become protected areas under WFD.

10 Habitats and Birds Directives

Purpose of the Directives: The Habitats Directive was introduced to protect or restore habitats for wild flora and fauna and the Birds Directive was introduced to protect and improve habitats for wild birds. Deterioration of the relevant natural habitat types and the habitats of species of Community importance as well as disturbance of those species as a result of impacts on the status of the water environment must be prevented.

Nature of relationship with WFD: The WFD applies to those areas designated under the Habitats and Birds Directives for the conservation of habitats or species directly depending on water.

The standards required to achieve the objective for a Natura Protected Area are the chemicophysical standards that are necessary to support the achievement of the conservation objectives that have been established for the designated area .

There is no deadline in the Natura Directives for making any environmental improvements necessary to achieve favourable conservation status for any habitat or species listed in those Directives. But the WFD introduces a 2015 deadline for achieving compliance with the standards and objectives of those water-dependent Natura sites which are covered by the WFD. The WFD provisions for extending deadlines can be used in relation to these water bodies where appropriate, provided that this achieve the same level of protection as existing Community legislation. The provisions for setting alternative objectives cannot be used to alter the conservation objectives of Natura Protected Areas..

2.5 INTER-RELATIONSHIP WITH NON-WFD POLICIES

Action taken as a result of other policies will also have an impact on the amount of action which needs to be taken to meet WFD objectives (particularly in regard to preventing deterioration).

Some other policies will assist with achieving WFD objectives, and others will conflict. There is information about these policy trends in the WRC report titled "Information on trends to improve the baseline scenarios." For example:

- **Greater urbanisation** Increased pressures for housing and other development, especially in the South East may lead to increased demand for water and more development near to water bodies, and hence to hydrological and physical pressures on water bodies. This will be mitigated through a range of measures, including spatial planning, measures to reduce water demand, uptake of Sustainable Urban Drainage Systems.
- **Changes in farming** Changes in the nature and scope of the farming industry and incentives for more environmentally sensitive farming, eg through Cross Compliance and Environmental Stewardship, may lead to reductions in diffuse and point source water pollution pressures from agriculture. These reductions may be further assisted by policies such as the CSF Delivery Initiative and additional water options in Environmental Stewardship, and the Pesticide Voluntary Initiative.
- **Greater use of waterways for freight and leisure** the Government favours increased use of waterways as an environmentally favourable form of transport. This is likely to lead to increases in seaborne trade, leisure craft and port and marina infrastructure, which may lead to increases in diffuse and point source pressures in water bodies. These may be mitigated through measures such as the marine consenting system, marine spatial planning and the European Marine Strategy Directive
- **Expansion of the strategic road network** Expansion of the road network to combat some of the most pressing infrastructure problems, as well as an expansion of local authority roads driven by urban growth may cause diffuse pollution and morphological pressures. These may be mitigated through measures such as development planning, improved highways drainage, increased use of "greener" vehicles.
- **More energy from renewable sources** The Energy Review launched in January 2006 committed the Government to a requirement that by 2010, 10% of UK electricity will be produced by renewable sources. Development of hydropower, and possibly also tidal power may lead to increased morphological pressures on water bodies. These may be mitigated through land and coastal planning controls.
- **Increase in flood events** The increasing likelihood of flood events as a result of climate change, may mean an increased need for flood defences and hence greater morphological pressures on water bodies. However, this should be mitigated by the catchment flood management approach set out in *Making space for water*.

The overall picture is very complicated with significant uncertainty. There is uncertainty about

- The scope and nature of relevant trends. It is difficult to say how great the trend will be, or how and when it will come about.
- What policies and other measures will be introduced to help alleviate the negative trends and improve the positive trends still further
- The level of uptake and timing of policies which will alleviate/improve the trends and how the various policies will interact

All of this makes it difficult to determine the resulting net trends and what the consequences will be in terms of achieving WFD objectives.

However, despite this uncertainty, the WRC study was able to draw some conclusions about pressure-activity relationships where the potential impact of trend data was high. They divide these into two groups depending on the level of confidence in the trend information.

Potential impact of trend data high Confidence in information on trends at least 'reasonable'	Potential impact of trend data is high Confidence in the information provided on trends low
Diffuse sources- Agriculture	Diffuse sources – Urbanization
Morphology - Flood defence	Point sources – Urbanization
Diffuse sources – Transport – acidification	Morphology – Urbanization
Navigation – Morphology	Abstraction and flow – Transport
Navigation – Alien species	Point, diffuse sources, abstraction and flow – Industry

[There is a third list of pressure-activity relationships where high local variation was highlighted, which are not relevant for the pCEA but will be relevant for the Regional Liaison Panels to consider during the river basin planning process.]

This policy trend information was taken into account by the pCEA working groups when producing their reports.

2.6 INTER-RELATIONSHIP WITH CLIMATE CHANGE OBJECTIVES

Whilst climate change is not mentioned explicitly in the text of the WFD does not directly take account of climate change, the consensus between EU Member States and the European Commission is that the WFD is capable of being used as a tool for climate change adaptation.

This is because the WFD has a built in review mechanisms and because it requires consideration of economic, social and environmental costs and benefits when deciding whether to take action.

Review mechanisms

- Climate change predictions and observed impact assessments can be factored into the 6 yearly review of River Basin Management Plans
- Future rounds of intercalibration (the EU harmonisation of the meaning of good ecological status) could potentially allow the actual impacts of current climate change to be taken into account in the reference condition of WFD waters. The reference condition (also known as 'high status') equates to what the water environment would look like without man made influences. The next round of intercalibration is envisaged around 2010-2012.
- Adaptation to drought and flooding events – which are predicted to increase in frequency, duration and intensity, should help forge win-win and no regret solutions eg. flood management strategies that deliver water quality and biodiversity benefits.
- WFD requires active public participation in the preparation of the RBMPs. This should help forge dialogue and consensus.

Cost and benefit considerations

- The WFD requires Member States to consider social, economic and environmental impacts when setting objectives and selecting measures to meet them. Climate change considerations can be factored into this economic analysis to promote solutions that help mitigate or adapt to climate change.
- The WFD can require consideration of, and help prevent or mitigate, the potential negative impacts of climate change mitigation measures eg. the insensitive siting or suboptimal design of hydropower or tidal power schemes or by ensuring the push for biofuels does not lead to an undue deterioration of water quality.
- An increased emphasis on catchment solutions should help decrease the need for energy intensive end of pipe solutions, to meet the more stringent water quality targets set by the WFD

Chapter 3

Methodology

Introduction

Information for the pCEA was collected through a number of sector groups, led by DEFRA with broad representation from stakeholders. The following groups were established: Water Industry, Agriculture, Industry, Navigation & Ports, Flood Defence & Planning, Non-Agricultural Diffuse, and Fisheries, Alien Species & Biodiversity Benefits.

A matrix of pressures and sectors was developed to ensure that all sector groups were addressing all pressures on water quality to which that sector contributes. The matrix was developed for the pCEA by the EA based on technical expertise and is presented in Figure 1.

Identifying the Environmental Gap

The first step for each group was to identify the gap between the expected situation in 2009 and the WFD objectives in terms of environmental quality. All groups were faced with considerable uncertainties in establishing the gap. These uncertainties included:

- Standards
- Designations
- Level of risk of failing to meet ecological objectives
- Underlying trends
- Non-WFD policy drivers
- Apportionment

Environmental standards for the WFD are being developed by UKTAG. Not all these standards had been set at the time that information was being collected for the pCEA. Groups were therefore asked to base costings on the first tranche of UKTAG standards and assumptions were developed for the second tranche of standards. Details of the assumptions are given in Figure 2. In addition, groups recognised the different nature of some of the WFD standards, notably the status of water resources and morphology as 'supporting standards' or triggers for investigation. These issues are discussed in more detail in the relevant pressure chapters.

Water-body specific standards were not available. As the pCEA is a national-level exercise, working groups were asked to estimate national averages or ranges as appropriate.

Information on the designation of water bodies as Heavily Modified Water Bodies was not available. Groups therefore developed costs on a unit basis where possible, e.g. cost of modifying an in-river structure, and applied different multipliers to these costs to provide a range of total costs that would encompass different possible designations of HMWBs. Other designations relating to the WFD Daughter Directives and related Directives are discussed in the Chapter on non-WFD policy drivers, below.

The Article 7 risk maps prepared by the Environment Agency were in the process of being updated during the period in which information was collected for the pCEA. Groups used the existing Article 7 maps and provided a range of costs to account for possible recharacterisation of areas. In the synthesis, it has been possible to use new information on risk characterisation to refine the cost estimates.

In addition to the uncertainty about existing risk levels, there is also uncertainty about how underlying trends will affect these pressures up to 2009, when the implementation of the WFD Programmes of Measures will begin. Groups based their assessments of the likely impact of trends on the 2006 DEFRA Report² Water Framework Directive (WFD) Economic Analysis: Information on trends to improve the baseline scenarios and provided their own commentary on the conclusions of this report.

² Water Framework Directive (WFD) Economic Analysis: Information on trends to improve the baseline scenarios August 2006, WRc Ref: DEFRA 7242

The extent of risks to meeting WFD 'internal objectives' will also depend on what is achieved under other policy drivers (including WFD 'external objectives' to meet requirements under the Daughter Directives and other related Directives). Groups developed cost estimates assuming a low reference case which included only measures that were currently agreed and funded. Issues relating to the likely achievement of WFD objectives as a result of these policy drivers is discussed in detail in Chapter 2 of this report.

There is ongoing uncertainty over the contribution of different sectors to particular pressures. Groups drew on various sources to inform their estimates including DEFRA research and the Environment Agency's Strategic Assessment. Details of the sources are given in the relevant pressures chapters. In order to manage this uncertainty, groups developed costs where possible based on estimated discharge quantities in standard units, rather than proportional reductions. This made it possible to reconsider apportionment assessments at the synthesis stage. Groups also provided costs for doing more and less than their 'share' in addressing a pressure.

Identifying Cost Effective Measures

Each group identified measures that their sector would need to implement in order to meet WFD objectives and collected information on the costs and expected impact of those measures, in order to identify which measures would be likely to be most cost effective. Groups also had to deal with uncertainty with regard to establishing costs and effectiveness. These included:

- Effectiveness of tried and tested measures on ecology
- Effectiveness of innovative measures on water quality and ecology
- Location-specific issues

WFD's ecology-based standards are fundamentally different from existing water quality standards. In many cases, our understanding of the impact of measures on ecological impacts is limited and further research will need to be conducted. The pCEA has drawn on ongoing efforts to model the impact of reductions in discharges of pollutants by different sectors on in-river pollutant concentrations of nutrients. The findings of the pCEA will need to be updated as this modelling work progresses.

A key purpose of the pCEA was to consider the effectiveness of innovative measures against tried and tested measures. For example, the NADWP group considered the implementation of General Binding Rules to reduce urban diffuse pollutants. Due to their innovative nature, there is no existing evidence base on which assessments of effectiveness can be based. Efforts were made to develop alternative estimates of effectiveness but were constrained by the availability of information on the impact on ecological status. In the chapters that follow, authors have sought to consider these innovative measures within these constraints.

The pCEA is a national level exercise seeking to identify national level measures needed to meet WFD objectives as well as national frameworks for measures that will be implemented at the local level. However, for many pressures, costs will be driven by location-specific attributes. Groups were therefore asked to establish a range of cost estimates that would encompass this local variation. These cost estimates will have to be refined in river basin plans and are likely to require further research and investigations. These issues are discussed in particular in the chapter on morphology pressures.

Local variation may be also relevant to effectiveness. For example, taking measures to address morphological pressures will not have a significant impact on ecology if water quality is poor in that location. It has not been possible in most cases to take this into account in the measures and cost estimates covered in the pCEA, but these issues are highlighted in the relevant chapters in the qualitative discussion. These kinds of interactions will need to be covered in greater depth as the river basin level.

There were considerable differences in the access of groups to financial and technical information but all were able to identify measures, drawing on expert advice where necessary. The sector reports have formed the basis of the synthesis process. Teams of DEFRA and EA authors have

drawn on these reports in order to write pressure-based chapters, which follow in Section 4 of this report.

Scenarios

The synthesis of the pCEA identifies alternative packages of measures or ‘scenarios’ to tackle pressures on ecological status. All the scenarios address ways of closing the gap between the low reference case and WFD requirements, but consider variations on two dimensions:

- The scope for phasing implementation based on considerations of affordability;
- The degree of certainty about achieving objectives that would be required.

In terms of phasing, authors were asked to develop packages of measures and associated costs for doing all technically feasible measures in the first round, and for phasing in measures across the three river basin planning rounds. For uncertainty, authors were asked to consider a low and high uncertainty threshold. A high threshold would imply that it would be acceptable to use more innovative measures and to rely to some extent on the contribution of underlying trends to meet objectives and technological developments to close the gap. A low threshold would imply a reliance on tried and tested measures and a degree of over-planning.

The synthesis also considers the distributional consequences of the different scenarios. Where it is possible to increase or decrease the contribution of sectors to tackling a pressure, alternative scenarios and funding mechanisms were identified. The main areas in which it was expected that this kind of balancing could occur were: nitrogen, phosphorus, ammonia, sediment and water resources.

Table 1 describes these dimensions and how measures would be expected to fit into them.

Table 1: pCEA Scenarios

	Uncertainty	
Phasing	No “higher certainty of achieving outcomes”	Yes “lower certainty of achieving outcomes”
No “do all technically feasible measures as soon as possible”	1 Include measures which will ensure that WFD objectives will be met by 2015. To include: - Only measures for implementation in RBMP1 - Only tried and tested measures - Some over-programming so that objectives can be met if effectiveness is lower than expected - No reliance on uncertain trends - Implications for affordability	3 To include: - Only measures for implementation in RBMP1 - Innovative measures - No over-programming to compensate from uncertainty about the effectiveness of measures - Some reliance on uncertain trends - Implications for affordability
Yes “do what is reasonable as soon as possible”	2 To include: - Tried and tested measures implemented over a longer time-scale (2009-2027), justified on the basis of affordability - Some over-programming so that objectives can be met if effectiveness is lower than expected - No reliance on uncertain trends	4 To include: - Innovative measures implemented over a longer time-scale (2009-2027), justified on the basis of affordability - Measures to reduce uncertainty (research, pilot programmes etc) in RBMP1 with implementation of innovative measures in 2015-2027. - No over-programming to compensate from uncertainty about the effectiveness of measures - Some reliance on uncertain trends

Due to the different nature of the measures and combinations of measures covered in relation to the different pressures, chapter authors have adapted the consolidation method. Where there is considerable uncertainty about the effectiveness of measures, authors focused on two scenarios –

phased and not phased. In cases where the apportionment of the pressure was not clear, authors presented partly disaggregated scenarios.

Aggregation of costs across pressures poses further challenges to ensure:

- Common assumptions are made in the estimation of costs across sectors, for example in relation to the inclusion of financing costs for the private sector;
- 'Cross-cutting measures' which address multiple pressures are not double-counted;
- Cross-cutting measures which are not likely to be cost effective in relation to a single pressure but may be cost effective when multiple pressures are considered are included in the analysis.

These issues were reviewed in depth in the preparation of the WFD revised overall Impact Assessment. The comparative sector costs presented in Chapter 5 draws on the cost estimations for the Impact Assessment. Further information on the methodology used for costings in the Impact Assessment is available from Defra.