Water for life and livelihoods

A consultation on the draft update to the river basin management plan

Part 3: Economic analysis

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Front cover: Blue dawn. Ullswater. © Dave Martin 2008

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1. Introduction

Water is essential for life. It allows the natural environment to flourish and businesses, agriculture and the economy to grow and prosper.

The water environment provides many benefits to society, from supplying drinking water and supporting fisheries to providing an essential resource for business and agriculture, transport routes and a source of recreation that promotes wellbeing.

It is critical that this precious resource is managed properly to ensure the needs of society, the economy and wildlife can be met and maintained in the long-term.

River basin management planning seeks to protect and enhance the benefits water gives to society, the environment and the economy. However, it is often necessary to consider trade-offs between these three 'beneficiaries' in which case river basin management planning seeks to find the right balance. To achieve this, a wide range of people and organisations who use the water environment or whose activities can adversely impact its uses are involved in the planning process with the results set out in river basin management plans.

River basin management plans were first published in December 2009. We (the Environment Agency) are now consulting on a draft update to those plans. There are three parts to this consultation:

- Part 1 'Summary and consultation questions' consists of 8 river basin district specific documents looking at the current state of the water environment, challenges faced and proposes objectives and measures that might apply. The consultation questions are in each of these documents
- Part 2 'River basin management planning overview and additional information' sets out the detail behind the decision making which has shaped the draft update to the river basin management plan
- Part 3 'Economic analysis' (this document) is to help the reader understand the potential implications for sector groupings of 5 future management scenarios

These documents, as well as other supporting information, can be found on the consultation web pages (www.gov.uk/government/consultations/update-to-the-draft-river-basin-management-plans).

This document (Part 3) describes the economic analysis, evidence, assumptions and scenarios that (following review of consultation responses) will be updated and used to develop the updated plans. An impact assessment will be produced and given to ministers alongside the updated river basin management plans in autumn 2015.

The economic analysis has been designed to inform stakeholders and promote debate about the environmental objectives and associated programmes of measures to be included in the updated plans. It uses a series of scenarios to describe the potential costs and benefits of implementing the Water Framework Directive's environmental objectives. Where relevant, it also provides information that may inform the use of the Water Framework Directive (WFD) exemptions including less stringent objectives.

Five scenarios for the future management of the water environment have been considered:

- **scenario 1** looks at what would happen if no further measures are taken
- **scenario 2** considers the effect of measures to prevent deterioration and to meet protected area objectives

Scenarios 3, 4 and 5 go further and consider measures to achieve improvements in water body status.

- **scenario 3** considers improvements in water body status using all measures which are technically feasible
- **scenario 4** considers improvements in water body status using all measures which are technically feasible where benefits justify costs. The assumptions behind this scenario have also been used to propose long-term objectives (2027 and potentially beyond) for individual water bodies, as set out in Parts 1 and 2 of the draft update to the river basin management plans.

In scenarios 1 to 4, costs and benefits are considered over the long term, to 2052.

- **scenario 5** is different. It is based on an illustrated level of national funding for the most relevant water management action programmes in the 6 year period to 2021, along with an assumption that voluntary action and targeting, mediated by catchment partnerships, will help optimise outcomes through additional local efforts. It therefore illustrates progress that could be made by 2021 towards the objectives proposed in the consultation (under scenario 4). The illustrative funding in scenario 5 is not a prediction of all funding and measures that will be available in the second cycle but it is linked to levels in action programmes currently being finalised. Final decisions, including the extent of measures to be taken forward over the period 2016 to 2021, will be made by the Secretary of State when considering the approval of the updated plans in 2015. Consultation responses will inform these decisions.

The consultation does not outline specific improvements to be achieved at the water body level by 2021. However, it does set out the potential scale of progress at a river basin level and asks for comments on how scenario 5 could be built on and developed to produce a preferred option for the updated river basin management plans and associated impact assessment.

The economic analysis presented here includes social cost benefit analysis that follows Treasury Green Book guidance.

There is an extended report that contains further details of the findings of the economic analysis, including method statements and references. This will be available from 17th October 2014, on the consultation web pages (http://ea.objective.co.uk/file/3078881)

The consultation questions and how to respond are contained in Part 1 of the consultation which you can access via the consultation web pages. Two of these questions refer specifically to this economic analysis.

The consultation questions relating to information provided within this document are:

Do you have any comments on the scenarios and how they have been produced?

How could scenario 5 be developed to present a preferred option for the impact assessment that will accompany the updated plans in autumn 2015?

2. Background and context

Summary of this section

This section provides a brief introduction to the management of the water environment. It describes why water is such an important resource and the policies (European and domestic) that shape how the water environment is managed in England. It explains the importance of economic analysis and its role in the consultation on updating the river basin management plans.

The WFD was adopted by the European Union in 2000 and the obligations relating to the process of river basin management planning are implemented for England and Wales in the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 and the Water Environment (Water Framework Directive) (Northumbria River Basin District) Regulations 2003.

The directive's purpose is to achieve sustainable water management by integrating various existing policies and regulations designed to protect the water environment in one legal framework. Economic analysis is a core requirement of the WFD and consideration of positive and negative consequences is an integral part of the planning process.

River basin management plans (the plans) are the principal statutory mechanism through which the WFD is implemented. The plans are developed by the Environment Agency in consultation with the public. The plans are ultimately approved by government ministers. The plans contain environmental objectives for all groundwaters and surface waters (including canals, estuaries and coastal waters) and summarise wide ranging programmes of measures needed to meet those objectives. River basin management plans for England and Wales were first published in 2009 and are reviewed and updated on a 6 yearly cycle. The Environment Agency is consulting on an update to the river basin management plans for the 9 river basin districts that fall wholly or partly in England.

The measures identified in river basin management plans are intended to:

- prevent the quality of the water environment deteriorating
- meet the environmental objectives of a range of legislation relating to 'protected areas', for example designated bathing waters and waters abstracted to supply drinking water
- improve as many water bodies as possible towards good status or good potential, within the limitations of natural conditions, technical feasibility and disproportionate cost
- promote the sustainable use of water
- mitigate the effects of floods and droughts

As well as integration of water management, the WFD also requires other environmental priorities, economic considerations and social issues to be taken into account when setting objectives.

Measures in the plans must also be consistent with government policy on better regulation, climate change, sustainable development, localism, efficient use of natural resources and the polluter pays principle. The WFD also allows for objectives in the plans to reflect distributional impacts, for instance impacts on vulnerable groups. This aligns with

government objectives of ensuring the WFD is implemented cost-effectively and essential services provided by the water companies remain affordable, including for low income households. The river basin management planning process therefore requires a range of policy priorities to be balanced and the needs and interests of different stakeholders taken into account.

The WFD allows costs and benefits to be considered when setting water body status objectives. Such considerations do not apply to protected area objectives or preventing deterioration (except when considering an Article 4.7 (new modification) exemption).

In developing the plans the Environment Agency aims to ensure public and private money is invested effectively and transparently for the greatest benefit to society as a whole.

This economic analysis is part of the consultation on the draft update to the river basin management plans and will help the reader understand the costs and benefits of achieving the proposed environmental objectives. It also illustrates the rate of progress that might be achieved towards the proposed objectives in the consultation under an assumed funding scenario.

In autumn 2015 the Environment Agency will submit proposals for updating the current river basin management plans to the Secretary of State. The proposals will be accompanied by an impact assessment designed to help the government decide whether to approve the updated plans.

This economic analysis includes 4 scenarios to illustrate the costs to society of addressing the issues from 4 sector groups along with the benefits of preventing deterioration, achieving protected area objectives and improving water bodies towards good status. A fifth scenario illustrates a possible initial 6 year funding profile for scenario 4. This scenario allocates costs to specific sectors.

Further information on how the WFD is implemented in England including environmental objectives and the use of exemptions can be found in Defra's guidance to the Environment Agency on river basin planning. The guidance can be found here. https://www.gov.uk/government/publications/river-basin-planning-guidance

3. Sector groups

Summary of this section

This section describes the sectors and their activities which can benefit from or have a negative impact on the quality of the water environment.

For the purpose of this economic analysis, the sectors whose activities benefit from or can impact on the quality of the water environment have been put in 4 groups.

1. Government: the public sector including central government and agencies, local councils

This sector group undertakes or sponsors a wide range of activities that contribute to achieving environmental objectives. The bulk of funding comes from the public purse. Activities on the ground are managed by various organisations and their partners to realise a range of environmental benefits. These are summarised in the table below along with the organisations involved.

This sector also includes a number of organisations with regulatory responsibilities for protecting the environment. This regulatory activity is funded through a mix of public funding and charging income from various environmental permits or permissions, based on the 'polluter pays' principle. This 'baseline' of regulation contributes significantly towards maintaining the economic benefits society gets from the water environment but does not form part of this economic analysis of river basin management plans.

Activities	Examples of environmental benefits	Principal delivery bodies
Managing flood risk	• Creating and restoring habitat • Improving biodiversity • Improving fish passage	Environment Agency (EA) Lead Local Flood Authorities
Managing surface water drainage	• Reducing pollution from road run-off • Sustainable surface water management • Improving biodiversity	Highways Agency Local councils
Restoring catchments	• Restored rivers • Controlling invasive non-native species (INNS)	Defra EA Local councils
Managing impacts on protected areas	• Cleaner bathing waters • Improving biodiversity • Protecting drinking water	EA Natural England Local councils
Local planning and development control	• Biodiversity and habitat improvement • Sustainable water management	Local councils
Addressing historic pollution	• Reducing abandoned mines pollution	Coal Authority EA

Activities	Examples of environmental benefits	Principal delivery bodies
Managing rural land	• Improving soil, nutrient and pesticide management	Defra Natural England EA
Managing land and assets in urban areas	• Creating and restoring habitat • Improving local environments • Reducing environmental impacts from the public estate	Local councils

2. Rural land management: including agriculture and forestry

The agriculture sector in England manages about 69% of the land and so has a very significant contribution to make towards sustainable management and protecting the quality of England's waters. Forestry covers only about 10% of land in England but has a significant role in improving the quality of the water environment.

The rural land management sector provides many benefits to society, including food, fibre and fuel production, tourism and recreation. In 2013, agriculture contributed £7.1bn (0.6%) of national Gross Value Added to England's economy, with forestry contributing a further £200m.

Agriculture and forestry management practices can work with natural processes to reduce flood risk. Slowing the flow of surface water and storing water on the flood plain during periods of high river flows can help reduce risk to people and property.

Some rural land management activities are polluting and reduce natural capital. Environment Agency investigations have shown that most pollution in rural environments results from farming activities. Other sources of pollution include roads, stables, golf courses, and household septic tanks. Individual sources of pollution are often small, but collectively can have a significant impact on the quality of surface water and groundwater.

Water abstracted by the sector can cause reduced river flows and low water levels that affect wetlands, impact ecology directly and can compound water quality impacts in rivers.

A large proportion of the land managed by this sector is associated with water bodies that need some degree of action to meet environmental objectives. Consequently, most rural land managers in England could take further steps to help meet these objectives and reduce their impact on the water environment. For example, agriculture is the second largest sector for water use in the country. Integrated catchment approaches and good farming practices would help to reduce the impact on river flows and groundwater levels.

Catchment Sensitive Farming (CSF) has brought about significant improvements in some catchments. From the first four years of CSF (2006 – 2010) pollution losses of phosphate, sediment and pesticides were reduced on average by between 5% and 10%.

Industry led campaigns such as the Campaign for the Farmed Environment and the pesticide Voluntary Initiative give advice to farmers resulting in action that helps reduce water pollution and improve biodiversity.

Sustainable farming is vital to maintain a high quality environment, a vibrant rural economy and increase food production to feed a growing population. By farming in an environmentally sensitive manner, farmers can help maintain the quality of drinking water, the cleanliness of beaches and healthier ecosystems. Improving farm productivity and protecting the environment are not contradictory objectives since most benefits are realised by reducing waste and improving cost efficiency.

3. Industry, services and infrastructure

A wide range of sectors are included in the 'industry, services and infrastructure' sector group. Some of the significant activities undertaken by this sector include:

- the power generation sector abstracts 24 billion litres of water for cooling every day and discharges a similar amount back into the environment
- the pulp and paper industry abstracts 0.5 billion litres a day and generates large volumes of contaminated effluent that requires treatment
- the food and drink sector also uses large amounts of water as a raw material and in the manufacturing process resulting in large amounts of effluent along with solid waste and sludge that are often spread on agricultural land
- management of solid waste from industry and households also has the potential to pollute groundwater and surface waters either as a result of discharges from landfills and treatment plants or as a result of recycling organic materials to land
- run-off from the country's transport infrastructure (road, rail and airports) can be contaminated resulting in pollution of both surface waters and groundwater
- pollution arising from urban areas which ultimately runs off into the water environment and causes up to 10% of water bodies to fail environmental objectives
- physical modifications made to water bodies to enable navigation and land drainage also have a significant impact on the quality of the water environment

Their activities have a broad range of positive and negative effects on the water environment which include:

- using water for processing or manufacturing goods
- discharging substances directly or indirectly into the water environment
- making use of water bodies for transport and recreation
- enhancing wildlife and habitat conservation

This sector is generally more economically independent of public spending and policy decisions driven by river basin management planning. However, organisations in this sector have a vital contribution to make to effective catchment management, for example in dealing with impacts of urban pollution on bathing and shellfish waters.

Most of the major sites operated by this sector are regulated through some form of environmental permit aimed at limiting negative impacts on the environment.

This sector grouping also contains the many national and local voluntary groups with an interest in protecting and improving the environment. Through partnership working or the management of their own land holdings, these groups have a significant and increasingly important role in the sustainable management of the water environment.

4. Water industry

The water industry provides water to households and businesses and treats the waste water they produce. Ten regional water and sewerage companies are responsible for supplying clean water and the treatment of sewage in England and Wales, nine of which operate primarily within England. There are an additional 9 regional companies that only supply clean water. These services are paid for by the water companies' customers through their water bills.

The water industry takes about 15 billion litres of water a day from rivers, canals, reservoirs, lakes, estuaries and groundwater. Too much abstraction for drinking water can reduce the amount of water available for other activities and sectors including agriculture, industry and recreation. Too much abstraction can also affect the wildlife and aesthetic quality of river environments. The Environment Agency regulates how much water is taken by all sectors, including the water industry, through abstraction licences.

Dirty water from households and businesses is collected via the sewerage system. Water and sewerage companies in England collect about 9 billion litres of sewage every day and treat it before releasing it to the environment. Sewage effluent contains a number of organic and inorganic contaminants along with bacteria and viruses. Discharge of effluent is strictly regulated.

Actions taken by the water industry have a significant influence on the quality of the environment and often result in wider benefits to society. For example:

- maintaining adequate river flows by taking less water from surface waters and groundwater at environmentally sensitive locations helps protect ecosystems and ensures that more water is available for dilution of sewage effluent
- removing more pollutants from wastewater helps protect ecosystems and supports the use of water for a wide range of purposes including drinking water supply, irrigation, water sports, angling, conservation, and wider aspects such as tourism and quality of life
- water companies own and manage tens of thousands of acres of land and do so in a way that ensures that the water that is taken from these catchments is of as good a quality as possible before it gets treated and supplied to households and businesses

Over the last 20 years, the water industry has, on behalf of its customers, invested £30 billion to reduce the damage its activities cause to the water environment. This has led to a steady improvement in the quality of the water environment. This investment equates to roughly £1,300 for every household.

The scale of water industry investment in environmental improvements depends in large part on the industry's ability to recover the costs through the prices it charges customers. These prices are governed by the economic regulator, Ofwat, through the 5-yearly 'periodic review' process. At the end of 2014 Ofwat will agree water company business plans and price controls for the period 2015 to 2020.

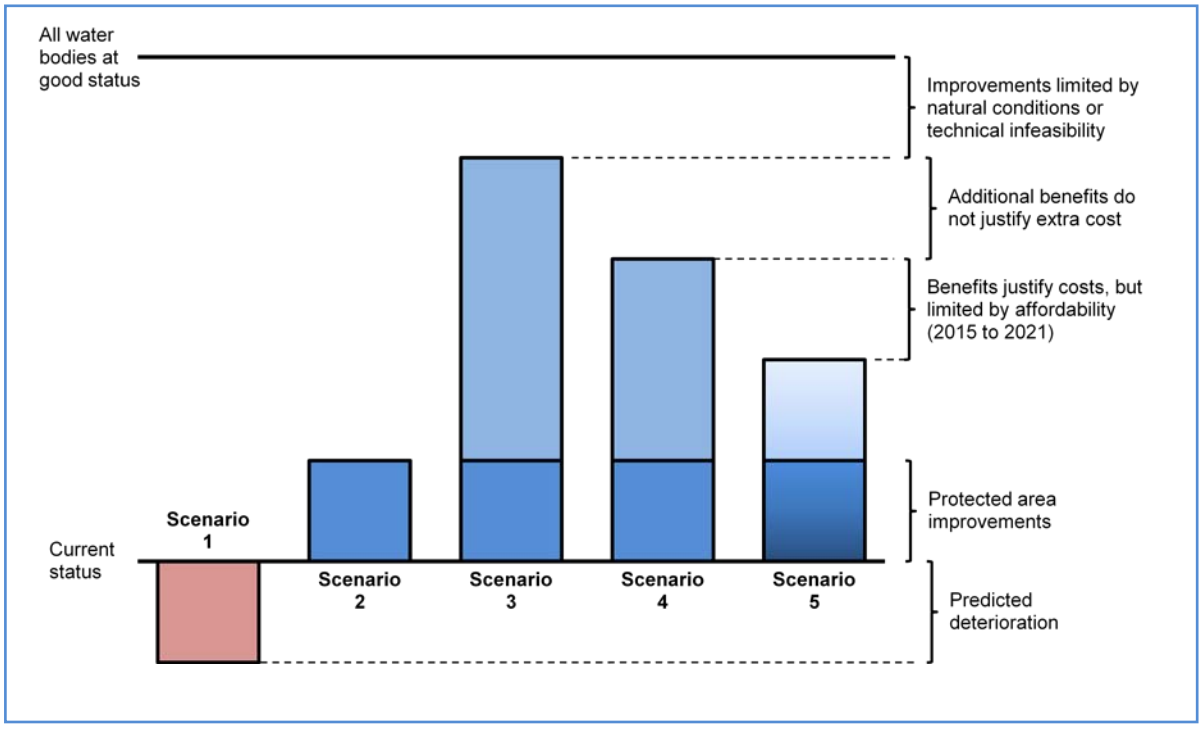
4. Future management scenarios

Summary of this section

This section describes the planning assumptions used to construct the five scenarios considered in the economic analysis.

Five scenarios have been developed. These would require different levels of investment by the four sector groups and result in different levels of environmental improvement. They have been developed and agreed with Defra to help explain the potential impacts from the draft updated river basin management plans and to help improve the evidence that will inform the Environment Agency's proposals for updated plans that will be considered by ministers. The proposals will be accompanied by an impact assessment with supporting evidence.

The scenarios are summarised in the diagram below.



Scenario 1: No new measures (2013 baseline)

This scenario illustrates the potential effect of not taking action to prevent deterioration. It considers the future impact of pursuing only those ongoing measures in current river basin management plans against a changing environmental baseline resulting from population growth, climate change and the impact of invasive non-native species. Under this scenario (an increase in environmental pressures against a static set of measures) deterioration in environmental quality is anticipated. Current measures would therefore fail to achieve many of the objectives set in current plans.

Scenario 2: Aim to prevent deterioration and achieve protected area objectives

Scenario 2 considers how the addition of new measures can help prevent deterioration in status and includes additional measures needed to achieve protected area objectives. Protected area objectives include those for:

- drinking water protected areas: surface water and groundwater
- economically significant species (shellfish waters)
- recreational waters (bathing waters)
- nutrient sensitive areas (urban waste water treatment directive)
- Natura 2000: water dependent special areas of conservation and special protection areas for wild birds

Scenario 3: Aim to prevent deterioration, achieve protected area objectives and all technically feasible improvements towards good status. No affordability constraint

In this scenario water bodies would be expected to achieve good status unless natural background conditions prevent it or there is no known technical solution to existing problems. Under this scenario less stringent objectives would be set for water bodies where exemptions for natural conditions and technical feasibility (no known technical solution) apply.

This scenario builds on scenario 2 by including all technically feasible measures needed to achieve good status by 2027. No measures are ruled out on the basis of cost, affordability constraints or available funding. As such, this scenario represents the outcome if there was no use of the disproportionate cost exemption.

Scenario 4: Aim to prevent deterioration, achieve protected area objectives and improvements in status where benefits exceed cost. No affordability constraint

This scenario builds on scenario 2 by including all technically feasible measures needed to achieve good status by 2027 where benefits justify costs. No measures are ruled out on the basis of affordability constraints or available funding.

Under this scenario less stringent objectives would be set for water bodies where exemptions for natural conditions and technical feasibility (no known technical solution) apply. Less stringent objectives would also be set where costs are not justified by benefits. Although the balance of costs and benefits would be taken into account in setting water body objectives, this scenario does not fully take account of all disproportionate cost considerations, for instance distributional impacts (affordability). This scenario represents the interpretation of disproportionate costs set out by Defra in its statutory guidance to the Environment Agency.

The proposed objectives in Part 1 of the consultation use the assumptions in scenario 4.

Scenario 5: Illustration of potential progress towards scenario 4 by 2021

Achieving all of these proposed objectives of scenario 4 in the short term is not feasible. Scenario 5 has therefore been produced to illustrate just one of the ways that achievement of the proposed objectives could be initially profiled. It illustrates the scale of actions and improvements that might be achieved between 2015 and 2021. It shows the effect of funding constraints on the rate of progress towards the objectives in scenario 4.

The scenario is based on an illustrative level of available national funding (up to and including 2021) related to the most directly relevant programmes and an assumed level of additional voluntary action through local efforts. It follows Defra guidance to consider the largest funding sources and use planning information that has been made public, or provided by others (for instance the water companies and National Farmers Union), or estimated by the Environment Agency.

The illustrative funding in scenario 5 is not a prediction of funding that will be available in the second cycle. Decisions, including the extent of measures to be taken forward over the period 2016 to 2021, will be made by the Secretary of State when considering the approval of the updated plans in 2015.

Under this scenario less stringent objectives would be set for water bodies where exemptions for natural conditions and technical feasibility (no known technical solution) apply. Less stringent objectives would also be set where costs are not justified by benefits. Where a water body objective cannot be achieved by 2021 (based on the assumed level of funding and taking into account natural recovery time) an objective with an extended deadline of 2027 would be set.

In practice, all the requirements of WFD Article 4.5 must be met before a less stringent objective is set. In addition, all the requirements of WFD Article 4.4 must be met before an objective with an extended deadline is set.

Assumptions were used to estimate the available funding for the different types of measures in scenario 5. These are summarised in the table below.

Sector group	Preliminary funding assumption
Government	Grant in aid funding at current level (including WFD catchment restoration fund) until 2016. For the purposes of this illustration, no assumption has been included on additional grant in aid funding for WFD from 2016 as this is the next government spending review period. Flood and Coastal Risk Management funding previously announced. Funding for environmental outcomes in draft Medium Term Plan. New Environmental Land Management Scheme and rural development grants and government sponsored advice. Most likely funding level and targeting criteria.
Rural land management	Current regulatory controls Current level of voluntary funding
Water industry	Programme level cost estimates in water company business plans submitted to Ofwat in December 2013 The final determination of prices will not be made by Ofwat until December 2014. Therefore these cost estimates, while the best available, have some uncertainty associated with them.
Industry, services, infrastructure (incl. eNGOs)	Current regulatory controls Current level of voluntary funding

The box below briefly describes 3 of the major programmes of measures considered under scenario 5.

Investment in flood and coastal risk management

A capital investment programme is being developed to maintain and improve flood and coastal erosion defence over the next 6 years to 2021. This will reduce the risks of flooding and erosion to people's homes and the economy. Many projects, while focused on protecting people and business (including farming business) will also protect valuable wildlife sites and contribute towards improving the status of water bodies and create new priority habitat. A smaller number of projects will have the primary purpose of protecting especially important wildlife sites. Where possible, when improving defences, the programme will also reduce any barriers to eel passage.

Investment in water supply and sewage treatment

Over the next 5 years (to 2020), the water industry will undertake a major investment programme to improve the water environment to help meet WFD objectives.

The investment will help to improve 50 bathing waters, 26 shellfish waters, 80 km^2 estuarine and coastal habitat and approximately 6,200 km of river length used for the supply of drinking water. In addition, 450 km of river will be maintained or improved for other protected areas, including Natura 2000 and nutrient sensitive areas (Urban Waste Water Treatment Directive). Water resource sustainability reductions will return 270 million litres of water a day to the environment by 2020. In addition, proposed investment will prevent deterioration and improve the status of many water bodies.

Implementing water company business plans will also make an important contribution to reducing the effects of sewer flooding and reducing pollution incidents.

These predictions are derived from information provided by water companies and in no way pre-empt the outcome of the 2014 Price Review or Ofwat's scrutiny role.

Investment in the rural environment

The new Common Agriculture Policy will benefit the rural economy in England by over £15 billion between 2014 and 2020. Farmers will receive over £11.5 billion in basic farm payments which will include conditions to improve water, through new soil standards to prevent soil erosion and providing wider environmental benefits through 'greening'. For example, buffer strips next to watercourses.

The Rural Development Programme will invest at least £3.5 billion to support the environment, the farming and forestry sectors and communities in rural areas. Around £2.2 billion is already committed to existing environmental stewardship and forestry agreements. There will be approximately £900 million for new agreements under the new environmental land management scheme (2015 - 2020). This new scheme will support changes to land management and land use to improve biodiversity outcomes with water and flood risk as an important focus. The scheme will also contribute to climate change adaptation and mitigation.

5. The appraisal process

Summary of this section

This section briefly describes the appraisal processes used to build the scenarios.

The scenarios have been constructed in different ways using information from a number of sources. This inevitably involves a number of assumptions. The appraisal methods and assumptions are described in more detail in the economic analysis extended report.

Information on costs of measures was obtained from a wide variety of sources including water company business plans, individual project appraisals, government published figures and the Environment Agency's own business plans.

The changes in benefits that have been monetised in this economic assessment mainly fall under the category of 'cultural and quality of life benefits'. This includes recreation, aesthetic value and existence value. Recreation includes all recreational uses of rivers, lakes and coastal areas, for example walking, and sports such as fishing, rowing and kayaking. People value water environments that look clean with varied wildlife: this is described as aesthetic value. People also derive value from knowing that such environments exist in a healthy state, irrespective of whether they use it; this is known as existence value.

The updated National Water Environment Benefits Survey was used as a principal source to value societal benefits of improving the water environment.

Scenarios 1 and 2 are based on nationally held information about programmes of measures, costs and benefits. These figures have then been broken down by river basin district and costs assigned to the 4 sector groups.

Scenarios 3 and 4 build on scenario 2 by including collated information from appraisals undertaken at catchment level. These appraisals considered the costs and benefits of 'bundles' of measures needed to improve and restore most of the catchments in England. The catchment scale economic appraisal process used to do this is described in Part 2 of this consultation and in the economic analysis extended report.

Scenario 5 is a potential short term funding profile for Scenario 4. It is not prescriptive and the costs and benefits of the catchment actions were not optimised. It is designed to illustrate the possible scale of water body improvements and economic benefits that could be achieved under certain funding levels.

National level funds and water industry river basin district level funds, were estimated for the 6 year period 2016 – 2021 (see annex B for more detail on water industry funding allocation). These were then allocated to the costs of measures on a catchment-by-catchment basis. From this allocation, bundles that could be fully funded, partially funded or not funded at all were identified. Funds were allocated to the relevant measures, with catchments with higher NPVs having priority for funds over catchments with lower NPVs. The assumed level of funding for the different types of measures was allocated first to measures to prevent deterioration and achieve protected areas objectives (that is measures

for scenario 2 were funded first), with the remaining funds allocated to measures to improve water body status. The illustration is optimistic in terms of water bodies improving because it is unlikely that funds would be allocated solely on the basis of best NPV outcomes.

Based on the proportion of costs that are funded in each catchment, the likely benefits in that catchment were estimated. For partially funded catchments a limited level of benefits were allocated that reflects the level of funding given to that catchment. The benefits that are assessed are the Net Present Value (NPV), Present Value (PV) Benefits, total number of water bodies improved, and water bodies improved to Good Status (ecological status or potential, groundwater status, and chemical status).

The cost of measures for scenarios 2, 3 and 4 has been broadly allocated to the sectors whose activities cause the problem (polluter pays). Scenario 5 shows the measures and improvements which, in this illustration, it is assumed sectors would fund based on the Defra guidance given in the table in Section 4.

The assessments relating to chemicals and chemical status used mainly nationally held information. This included information on the costs and effectiveness of sewage treatment (from the water industry's Chemicals Investigation Programme) and of product controls. Minewater impacts were obtained from appraisals undertaken at catchment level.

For chemical status, these substances are already highly regulated and the risk of 'real' deterioration in status is low, so no additional measures are required to prevent deterioration in surface waters and protected area objectives are not relevant for chemical status in surface waters. Therefore scenario 2 is not provided for chemical status in surface waters.

It has only been possible to assess the costs and benefits of achieving certain chemical standards and not the monetary benefit of improvements in chemical status as a whole. For this reason the costs of measures for chemical status are presented separately to those for achieving the other environmental objectives.

Due to recent changes in the WFD chemical standards, there is currently insufficient information for 4 chemicals (Brominateddiphenylethers, Fluoranthene, Mercury, and PAHs) to allow a reasonable estimate of compliance and the potential cost of any measures. Environmental monitoring is being carried out which should inform the update to the river basin management plans and associated impact assessment in 2015. Existing indications suggest that non-compliance could be widespread. If it is technically feasible to achieve compliance, this could lead to high costs in scenario 3.

6. Summary of results

Summary of this section

This section provides a summary of the results of the scenarios for England. Costs and benefits are summarised in monetary terms and as changes to wider benefits and uses of the water environment. Prediction estimates of how the scenarios would affect water body status are also provided.

The draft impact assessment results for each river basin district are also introduced.

6.1 Qualitative impacts by scenario and sector

All sections of society would benefit from the improvements to the water environment under scenarios 2 to 5:

- cleaner healthier rivers and lakes would benefit anglers, walkers, boaters and wildlife interest groups
- tourism and recreation businesses would benefit
- improved quality and quantity of freshwater in the environment would benefit businesses that abstract water for drinking water supply, agriculture, and manufacturing
- people's welfare would increase from knowing that the water environment exists in a healthy state, irrespective of whether they use it

One minor dis-benefit under scenarios 3 and 4 may be loss of cultural heritage from removal of weirs.

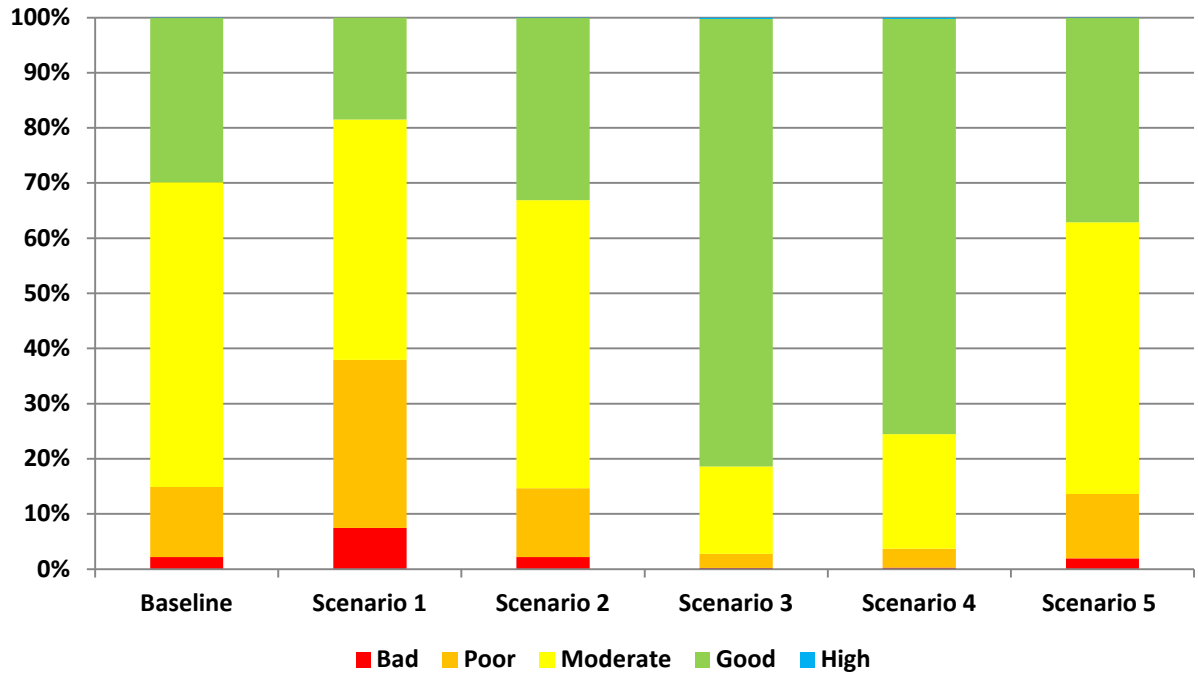
The changes to the wider benefits and uses predicted under the scenarios are shown in the table below.

If the change to a benefit or use is likely to be significant, two arrows are shown pointing up for a positive change (benefit) and down for a negative change (dis-benefit). If the change is likely to be noticeable but not significant, then one arrow is shown, again pointing up for benefits and down for dis-benefits. If there is likely to be no net change, a 'o' is shown.

Significant benefit	^^
Noticeable benefit	^
No net change	o
Noticeable disbenefit	v
Significant disbenefit	vv

Benefits and uses	Significance of change between baseline and scenario: Scenarios 1	2	3	4	5
Provisioning services					
Fresh water	v	^	^^	^^	^^
Food	o	o	^	o	o
Water for non-consumptive use	o	^	^	^	o
Regulating services					
Climate regulation and adaptation	v	v	^	^	o
Water regulation (including flood risk)	v	^	^^	^	^
Erosion regulation	vv	o	^^	^	^
Water purification and waste treatment	v	^	^^	^	^
Cultural services					
Cultural heritage	o	o	v	v	o
Recreation and tourism	v	^	^^	^	^
Aesthetic value	v	o	^^	^	o
Existence value	vv	^	^^	^	o
Supporting services					
Provision of habitat	vv	^	^^	^^	^

Predicted water body status for the scenarios is shown below. A baseline of 2013 interim classification is also shown. The predictions for scenarios 1 to 4 are for 2027. Scenario 5 is for 2021. They do not take into account ecological or groundwater recovery times.



An estimate of the percentage of water bodies at good or high status or potential for the scenarios is given in the table below.

	Baseline	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
% Water body	30	19	33	81	75	37
% Elements	80	Not available	Not available	97	95	Not available

Most of the measures in the current river basin management plans have been implemented. However, the benefits of these measures are not fully reflected in the 2013 interim classification results so an assumed baseline has been used that accounts for both future improvements and changes to classification processes.

Scenario 5 assumes that measures are targeted to a small number of catchments. In practice the ability to target measures in this way is limited. For instance, many of the measures in this scenario are voluntary, for example the take up of measures under the New Environmental Land Management Scheme and measures implemented by the voluntary sector. Because the ability to target all available measures towards a small number of catchments in limited, the number of additional water bodies that might be improved to good status under scenario 5 is optimistic.

6.2 Monetised impacts by scenario and sector

In England, businesses and the public sector jointly spend about £5 billion per year to protect the water environment. This includes;

- water industry operating costs to collect and treat sewage of approximately £3 billion
- industry and businesses investment of around £1 billion to mitigate their potential impact on the water environment and meet basic regulatory requirements
- £450 million by agriculture to meet basic regulatory requirements and further reduce impacts on the water environment. This includes payments under the Common Agricultural Policy and voluntary industry initiatives
- expenditure by government and the voluntary sectors to mitigate historic damage and provide water related benefits for people and wildlife

Against this background, scenario 1 considered the future impact (beyond 2015) of ongoing measures in current river basin management plans against a changing environmental baseline resulting from population growth, climate change and the impact of invasive non-native species.

Scenario 1 estimates that there would be a general deterioration in the status of 40% of water bodies across all surface water body categories by 2027. For surface water bodies, the percentage at good ecological status or potential would fall from 29% (2013) to 18% (2027). For groundwater, the percentage at good status would fall from 41% (2013) to 28% (2027). The main reasons for the predicted deterioration in surface waters are an increase in the physical modification of rivers and the spread of invasive non-native species. The increase in physical modification is driven by climate change and population growth resulting in the need for increased flood protection and land drainage, the spread of urban areas and more water storage (impoundments).

This deterioration would increase costs and reduce the value of the uses and benefits that society gains from the water environment. The loss of benefits is estimated to be £6.8bn (PV). This is likely to be an underestimate because it is based on willingness to pay values rather than willingness to accept compensation for loss, which research has shown is generally higher.

The estimated costs and benefits of scenarios 2, 3, 4 (over 37 years) and 5 (over 6 years) are given in tables below. These tables are for England.

Estimated costs and benefits: protected areas, ecological status, ecological potential, groundwater quantitative and qualitative status

£million

Sector group	**Scenario 2**[1] 37 year costs		**Scenario 3**[1] 37 year costs		**Scenario 4**[1] 37 year costs		**Scenario 5**[2] 6 year costs	
	Aim to prevent deterioration and achieve protected area objectives		Scenario 2 plus, improvements in status where technically feasible		Scenario 2 plus, improvements in status where benefits exceed cost		Illustration of possible 6 year funding profile for scenario 4	
	Total cost	Average annual cost	Total cost	Average annual cost	Total cost	Average annual cost	Total cost	Average annual cost
Government	450	10	2,700	70	2,300	60	600	100
Industry, services, and infrastructure	80	2	1,600	40	1,300	40	230	40
Rural land management	4,330[3]	120	6,800[3]	180	6,500[3]	180	90	15
Water industry	2,190	60	13,350[4]	360	5,900[4]	160	2370	390
Total costs [5] (undiscounted)	7,050	190	25,810	700	16,400	440	3290	550
Total PV costs	4,600		16,100		12,100		1,100	
Total PV benefits	10,900		21,100		20,600		2,400	
Net Present Value[5][6]	**+6,200**		**+5,000**		**+8,400**		**+1,300**	

Notes
Scenarios 3 and 4 are extensions of and therefore include the outcomes of scenario 2. They are not in addition to scenario 2.
[1] Scenarios 2-4 over 37 years (2015-2052). This is the appraisal period Defra has asked the Environment Agency to use for WFD analysis. This was 43 years in 2009 (the start of cycle 1), made up of the three 6 year cycles of the planning process, plus 25 years
[2] Scenario 5 costs and benefits are for 6 years only (2016 to 2021); the benefits are the scenario 4 estimates adjusted to show what's achievable in this period, using the proportion of assumed funding to total cost
[3] Costs of measures when implemented would include payments under the EU Common Agricultural

Estimated costs and benefits: protected areas, ecological status, ecological potential, groundwater quantitative and qualitative status £million
Policy (4) These are mid-point costs estimates. They have at least +/- 30% range reflecting the uncertainty of the estimates which should be considered when reading this information (5) Numbers may not sum to totals due to rounding. Totals include costs for unidentified sectors (6) Net Present Value - the benefits remaining after costs are deducted, discounted (3.5% for 30 years, then 3% for the last 7 years) over the appraisal period in order to compare future costs and benefits in today's terms

The second table, below, shows initial cost estimates for complying with chemical status requirements of the Environmental Quality Standards Directive. These are in addition to costs shown in the first table. Similar tables for each river basin district are presented in Part 1 of the consultation.

Estimated costs: chemical status £million			
Sector group	**Scenario 3**	**Scenario 4**	**Scenario 5**
	Improvements in status where technically feasible	Improvements in status where benefits exceed cost	Illustration of possible initial 6 year funding profile for scenario 4
	Total PV cost	Total PV cost	Total PV cost
Government(1)	120	110	20
Industry(2), services, and infrastructure(3)	Not quantified	Not quantified	Not quantified
Rural land management(4)	n/a	n/a	n/a
Water industry	1360	80	60
Total PV Costs(5)	**1,500**	**200**	**80**

Estimated costs: chemical status £million
Notes These are primarily Present Value costs from the Chemicals Investigation Programme (CIP). The PVs were calculated for a 20 year appraisal period using a discount rate of 3.5%. (1) Government includes investment in metal mine remediation (2) Investment by industry has not been quantified at this stage as this is largely driven by Industrial Emissions legislation, which is being implemented separately. (3) There is no specific allocation of investment on infrastructure to tackle urban diffuse pollution to chemicals as this is part of an ongoing Defra consultation on diffuse urban pollution (4) There is no estimate for rural land management. EQS compliance is generally not an issue for agricultural chemicals. The main driver relating to pesticides is protection of drinking water protected areas, this does not relate to priority chemicals. Risks to drinking water protected areas for other pesticides are covered in scenario 2 and consider measures currently available. (5) Numbers may not sum to totals due to rounding.

For scenarios 2, 3 and 4, the costs represent the expenditure that would be required to mitigate the damaging activities of the sector group. Costs for historic activities where there is no current responsible sector (for example abandoned mines) have been allocated to government. The costs in scenario 5 are the cash costs which, in this illustration, it is assumed sectors would fund.

6.3 River basin district differences

Annex A contains the sector costs by river basin district for scenarios 2, 3 and 4. The overall quality of the water environment varies significantly both between and within river basin districts. This variation largely results from geographic differences in the impacts of the main pressures on the water environment. The environmental objectives and programmes of measures set out in the draft update to the river basin management plans also reflect these differences and hence there are significant regional variations in the costs of the scenarios for the four sector groups.

7. General conclusions

Summary of this section

This section provides general conclusions from the economic analysis. It also provides a link to the consultation questions.

The scenarios are illustrative and not recommendations. The analysis has drawn on a large and diverse evidence base. By its very nature, the sort of complex analysis summarised here requires the use of assumptions and brings with it a degree of uncertainty. However, the results are of sufficient quality to inform this consultation. The analysis will be revised to inform the impact assessment that will be needed to justify the preferred option for the updated river basin management plans that the Environment Agency will submit to the Secretary of State next autumn.

The following general conclusions are intended to inform the debate and consultation responses.

- Scenario 1 would result in significant deterioration in the quality of the water environment and associated loss of benefits. It illustrates what could happen if the WFD requirement to prevent deterioration was not met. This is the only scenario expected to have an overall negative impact on society.
- Scenario 2 demonstrates that there are still significant additional costs to prevent future deterioration of current status and to achieve the objectives of the most important protected areas of water. There are also significant benefits leading to an overall NPV of around £6 billion if this scenario was implemented. To achieve protected area objectives (part of scenario 2), the cost of measures to resolve pressures arising from rural land management is higher than the cost of measures to resolve water industry issues. This difference reflects the fact that over the last 20 years the water industry has greatly reduced the impact of its activities on protected areas. As the water industry impacts have been reduced, the impacts of rural land management activities on protected areas have become more apparent and represent a greater proportion of the remaining problems.
- The best outcomes for the water environment would be achieved under scenario 3, but not necessarily the best overall wellbeing for society, estimated by the NPV. The additional cost to achieve outcomes over and above those under scenario 2 (improvements in water body status) would be greater than the additional benefits. The WFD does not require the achievement of water body objectives at disproportionate cost. This scenario may therefore go beyond the requirements of the WFD. Total costs of scenario 3 may also be underestimated. Some potentially large costs were excluded from the catchment scale appraisals because the actions would clearly have resulted in little additional benefit.
- Scenario 4 represents the economic analysis behind the draft objectives outlined in Part 1 of each river basin district's draft river basin management plan. The estimated benefit of achieving the proposed environmental objectives in these proposals is about £21 billion (PV). It would cost about £12 billion (PV). Under this scenario, around 75% of waters would reach good status or potential by 2027 (or later where natural recovery times are an issue). Around 95% of the individual elements measured across all water bodies would reach good.
- Scenario 5 is based on an illustrative level of funding and shows a possible initial 6 year funding profile for scenario 4. It would result in significant benefits that outweigh the

costs. It could result in modest (7%) increases in the numbers of water bodies at good status or potential by 2021. However, even this rate of progress could be optimistic, given the historical experience for ecological recovery and as noted on page 18, the inability to optimise investment from some funding streams to achieve more good status.

- A comparison of scenarios 3 and 4 shows that up to £4 billion (PV) of measures are not justified on the basis of the benefits being outweighed by costs. Many of these measures are those to reduce the impact of water industry activities, including further reductions in the amount of phosphorus and ammonia discharged from some sewage treatment works, and changes in the way water is abstracted for public water supply.
- Under scenario 5, the water industry (funded by their customers) would continue to make the largest investment and the fastest progress towards mitigating the damage their activities have on the water environment. Based on initial draft determinations published by Ofwat as part of its Price Review, it is likely that this level of water industry contribution could be absorbed within their overall investment programmes without increasing customer bills.
- The reported costs of measures to improve chemical status are relatively low. However, they might rise significantly as further evidence becomes available over the course of the consultation and next few years.

We would like to know your views on the evidence provided in the economic analysis. In particular, whether you think scenario 5 represents an appropriate level of environmental improvement to be achieved by 2021. If not, how could it be built on and developed to produce a preferred option for the updated river basin management plans and impact assessment?

We would like your opinion on the scenarios and evidence used in this economic analysis. See section 2.3 of Part 1: Summary and consultation questions.

Part 1 can be found on the consultation web pages here www.gov.uk/government/consultations/update-to-the-draft-river-basin-management-plans

Annex A – Estimated costs by river basin district

Scenario 2: Aim to prevent deterioration and achieve protected area objectives (£million)

River basin district	Government	Rural land management	Industry, services & other	Water industry	Overall Total
Anglian	90	860	20	350	1,320
Dee	1	6	0	0	6
Humber	50	440	8	80	570
North West	90	910	20	1,020	2,050
Northumbria	10	100	2	50	170
Severn	10	140	3	40	190
Solway Tweed	20	190	3	80	290
South East	20	220	4	140	380
South West	140	1,300	20	250	1,710
Thames	20	150	3	180	350
England total	**400**	**4,300**	**100**	**2,200**	**7,000**

Notes

Appraisal period is 37 years (2015-2052). This is the appraisal period Defra has asked the Environment Agency to use for WFD analysis. This was 43 years in 2009 (the start of cycle 1), made up of the three 6 year cycles of the planning process, plus 25 years.

Severn, Dee and Solway Tweed River Basin Districts are England only costs.

Numbers may not sum to totals due to rounding. RBD totals (>10m) are rounded to the nearest £10m, England totals (>100m) are rounded to the nearest £100m.

Scenario 3: Aim to prevent deterioration, achieve protected area objectives and all technically feasible improvements towards good status. No affordability constraint

(£ million)

River basin district	Government	Rural land management	Industry, services & other	Water industry	No sector identified	Overall Total
Anglian	460	960	180	2,580	100	4,280
Dee	<1	10	<1	5	0	15
Humber	410	770	300	2,390	110	3,980
North West	170	1,080	400	3,000	30	4,680
Northumbria	110	100	120	320	10	660
Severn	100	420	100	990	70	1,680
Solway Tweed	20	280	10	90	0	400
South East	250	270	20	760	40	1,340
South West	230	2,270	80	960	40	3,580
Thames	900	600	410	3,070	70	5,050
England total	**2,700**	**6,800**	**1,600**	**14,200**	**500**	**25,800**

Notes

Scenario 3 is an extension of and therefore includes the costs of scenario 2. Costs are not in addition to scenario 2.

Appraisal period is 37 years (2015-2052). This is the appraisal period Defra has asked the Environment Agency to use for WFD analysis. This was 43 years in 2009 (the start of cycle 1), made up of the three 6 year cycles of the planning process, plus 25 years.

Severn, Dee and Solway Tweed River Basin Districts are England only costs.

Cost of chemicals' measures that affect good ecological status are included

Water industry costs are mid-point estimates. They have at least +/- 30% range reflecting the uncertainty of the estimates which should be considered when reading this information.

Numbers may not sum to totals due to rounding. RBD totals (>10m) are rounded to the nearest £10m, England totals (>100m) are rounded to the nearest £100m.

Scenario 4: Aim to prevent deterioration, achieve protected area objectives and improvements in status where benefits exceed cost. No affordability constraint

(£million)

River basin district	Government	Rural land management	Industry, services & other	Water industry	No sector identified	Overall Total
Anglian	350	960	140	1,070	100	2,620
Dee	<1	10	<1	<1	0	10
Humber	200	690	210	570	70	1,740
North West	120	1,080	240	1,650	20	3,110
Northumbria	90	100	110	220	10	530
Severn	90	450	70	360	50	1,020
Solway Tweed	20	280	10	90	0	400
South East	250	270	20	380	40	960
South West	270	2,050	100	560	40	3,020
Thames	880	580	420	1,020	70	2,970
England total	**2,300**	**6,500**	**1,300**	**5,900**	**400**	**16,400**

Notes

Scenario 4 is an extension of and therefore includes the costs of scenario 2. Costs are not in addition to scenario 2.

Appraisal period is 37 years (2015-2052). This is the appraisal period Defra has asked the Environment Agency to use for WFD analysis. This was 43 years in 2009 (the start of cycle 1), made up of the three 6 year cycles of the planning process, plus 25 years.

Severn, Dee and Solway Tweed River Basin Districts are England only costs.

Cost of chemicals' measures that affect good ecological status are included

Water industry costs are mid-point estimates. They have at least +/- 30% range reflecting the uncertainty of the estimates which should be considered when reading this information.

Numbers may not sum to totals due to rounding. RBD totals (>10m) are rounded to the nearest £10m, England totals (>100m) are rounded to the nearest £100m.

Annex B – Water industry funding allocation assumptions

Water industry allocations for scenario 2 and scenario 5 are based on the estimated costs for NEP4 and 'managing uncertainty' in their December 2013 business plan submissions. These assumptions were used in the scenario 5 model.

Water industry funding allocation assumptions £m				
RBD	**NEP4 Allocation(1)(3)**	**'Managing uncertainty' amount available(2)(3)**	**'Managing uncertainty' allocation from model(4)**	**Scenario 5 modelled allocation(5)(6)**
Anglian	230	100	80	310
Dee	0	0	0	0
Humber	60	200	190	250
North West	640	260	260	900
Northumbria	30	10	10	40
Severn	20	90	50	70
Solway Tweed	30	5	5	40
South East	110	100	100	210
South West	150	90	90	240
Thames	70	220	230	300
TOTAL(6)	**1400**	**1100**	**1000**	**2400**

Note

(1) The water industry allocation for Scenario 2 has been based on the money allowance estimates included by water companies for NEP4 in their December 2013 business plan submissions.

(2) The water industry 'managing uncertainty' figures (rounded) are from water companies' December 2013 business plan submissions for 'managing uncertainty' (but not the detail of the measures they have included).

(3) These are mid-point costs estimates. They have at least +/- 30% range reflecting the uncertainty of the estimates which should be considered when reading this information

(4) These are the modelled output of the 'managing uncertainty' figures (part of Scenario 5 assumptions)

(5) The total water industry allocation for Scenario 5 is based on the NEP4 allocation plus the modelled allocation based on the 'managing uncertainty' estimates

(6) Scenario 5 outputs are 6 year funded amounts (£m)

(7) Figures rounded to nearest £10m unless under £10m. Totals rounded to £100m

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