Environment Agency

Water for life and livelihoods

Managing water for people, business, agriculture and the environment

We are the Environment Agency. We protect and improve the environment and make it a better place for people and wildlife.

We operate at the place where environmental change has its greatest impact on people's lives. We reduce the risks to people and properties from flooding; make sure there is enough water for people and wildlife; protect and improve air, land and water quality and apply the environmental standards within which industry can operate.

Acting to reduce climate change and helping people and wildlife adapt to its consequences are at the heart of all that we do.

We cannot do this alone. We work closely with a wide range of partners including government, business, local authorities, other agencies, civil society groups and the communities we serve.

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Welcome

Water is a vital resource

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 different 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 that the needs of society, the economy and wildlife can be met and maintained in the long-term.

In its assessment of the Environment Agency's work in regulating water abstraction the National Audit Office (National Audit Office, 2005) concluded that water is so important that its value to the economy is 'incalculable'.

We make a major contribution to managing water

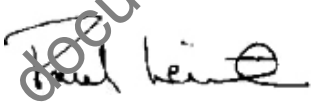
The Environment Agency has important roles in water management in England. We are committed to playing our part in protecting and improving waters and in making sure there is enough good quality water to meet the needs of people, businesses, agriculture and wildlife. We work with communities across the country in taking care of the water environment and developing local solutions.

In this publication we provide an overview of our contribution to water management. We explain the main features of the water environment and its current state. We take a look at some of the big challenges ahead and what needs to be done to tackle them. We explore our different roles and how these fit together, and how we work with others.

Our main aims

We have four main aims in our work in water management that support our contribution to sustainable development. We seek to:

- **protect and improve waters so they are clean and healthy**
- **reduce the risk of flooding**
- **ensure there is enough water for people, agriculture, business and the environment**
- **support sustainable growth**



Paul Leinster
Chief Executive

"Water is so important that its value to the economy is incalculable."

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"Water is the driving force in nature"

Leonardo da Vinci

Part I
The water environment: nature, state and challenges

1. The nature and state of the water environment

The water environment is a dynamic system, constantly changing as a result of natural forces and human activity. There have been some significant achievements in reversing the effects of centuries of industrial development and changes in land use, and restoring waters and wetlands.

What is the water environment?

The water environment comprises surface and underground waters, their surrounding landscapes, and the wildlife that depends on water and wetlands to thrive. Physical, chemical and biological components combine to determine the characteristics of the water environment, which vary widely across England and from headwaters to the sea.

The water environment can be viewed at different scales:

- ***River basins*** – that drain water from the land into the sea. These are divided into smaller drainage areas known as:
- ***Catchments*** - the main units used for water management planning. There are hundreds of individual catchments and sub-catchments. They may be large areas covering rivers, estuaries and coastal waters, or smaller tributaries of rivers. In each catchment there are networks of connected:
- ***Water bodies -*** including rivers, lakes, groundwaters, estuaries, coastal waters and wetlands.

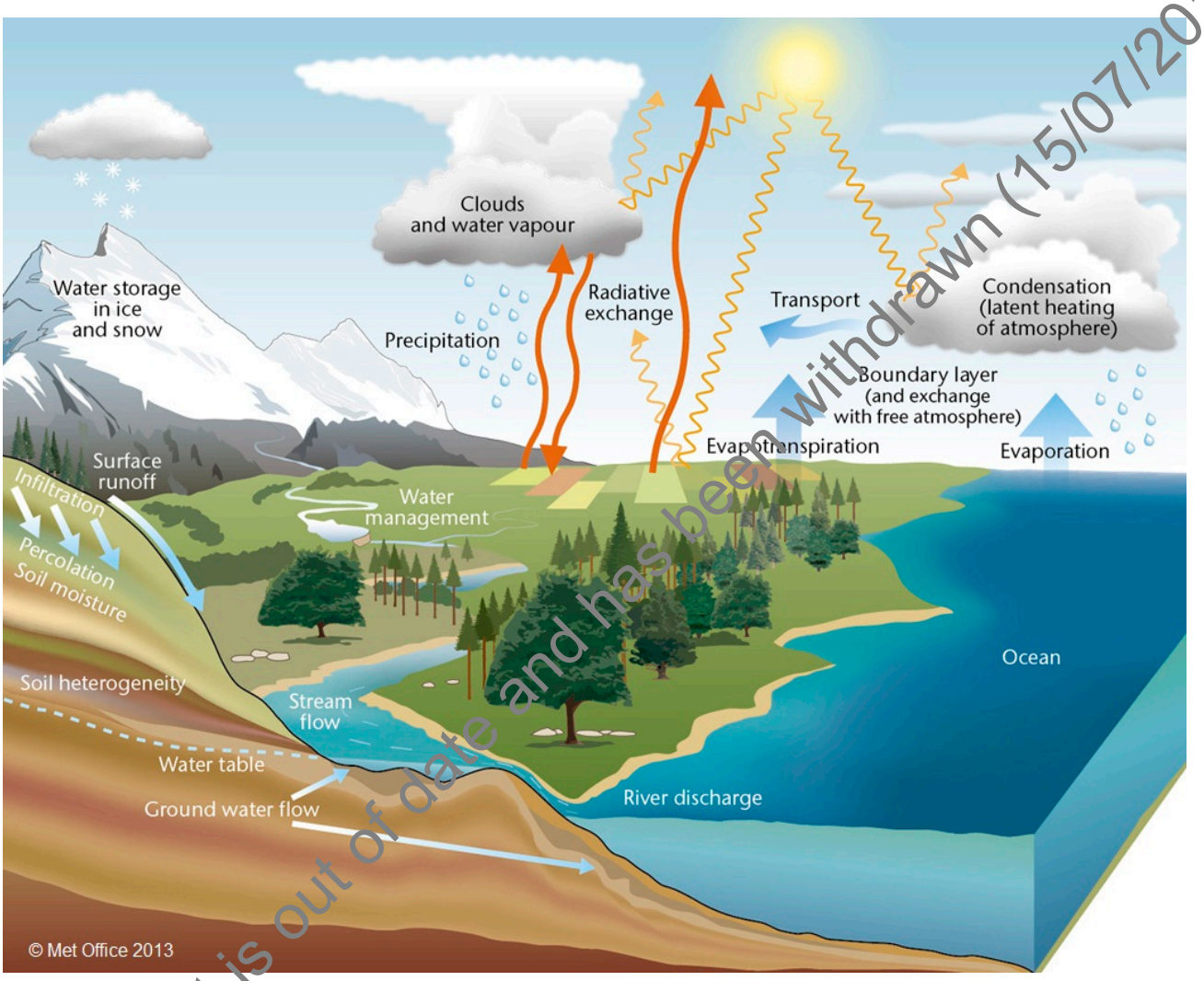
The water cycle

The water environment is a dynamic system, influenced by the constant cycling of water from one medium to another. The water cycle (also known as the 'hydrological cycle') is the journey water takes from the land to the atmosphere and back again.

The cycle purifies water, replenishes the land with freshwater, and transports minerals and nutrients. It shapes landscapes through erosion and sedimentation. It has an important role in heat exchange and in regulating the carbon cycle and local climates.

The natural water cycle has been changed in many places by society's use of water resources. Water supply and waste water disposal systems often take water from one area and return it to another. This can harm the environment if not properly managed.

Water management requires an understanding of the different processes in the water cycle and working with them to make sure that the uses of the water environment can be sustained.



The water cycle

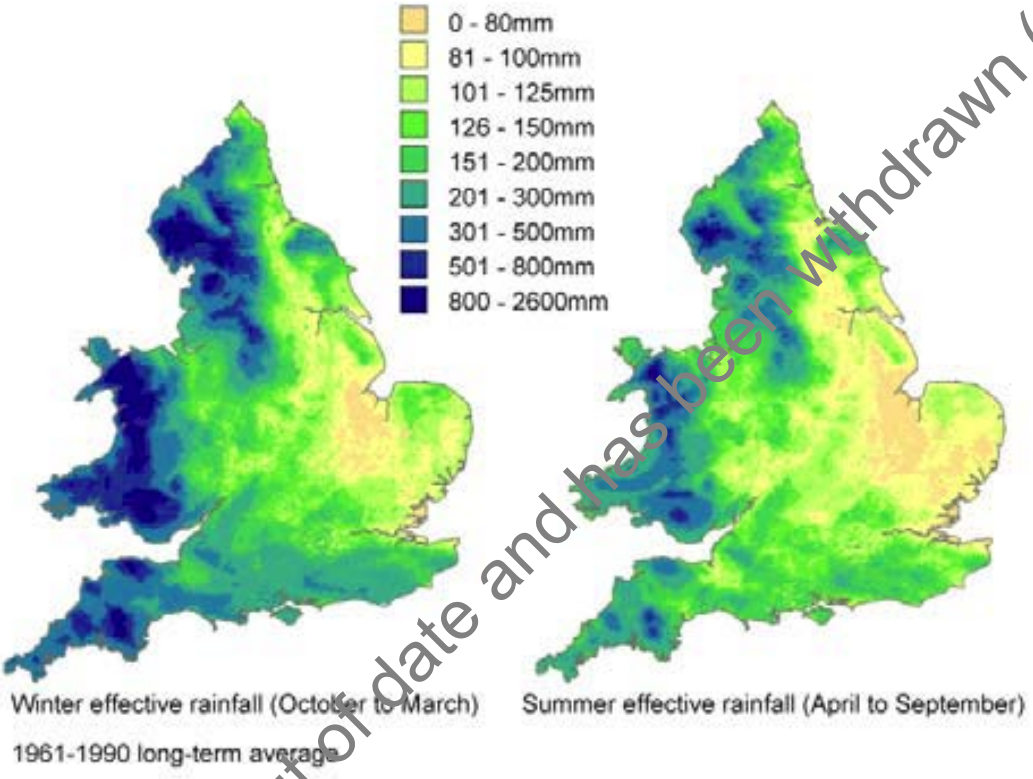
Did you know?

- Water covers nearly three-quarters of the Earth.
- Only 2.5% of the Earth's water is freshwater (mostly in ice-caps and groundwater).
- Less than 0.3% of all freshwater is in the rivers and lakes that are so important to society.

The natural forces that influence the water environment

Rainfall

Rainfall varies seasonally and across regions. It has a fundamental influence on water quantity and quality. The amount of rainfall reaching the water environment after losses to the atmosphere (often called ‘effective rainfall’), together with the number of people living in a catchment area determines the availability of water supply. The variability and intensity in rainfall present different challenges, particularly in managing the risks of flooding and in securing water supply during droughts. Heavy rainfall can also cause water pollution from sewerage systems and land drainage.



Seasonal long-term average rainfall

Flows

Rainfall, geology and the shape and slope of catchment areas determine river flows. These, in turn, influence the ecology of rivers and surrounding wetlands. The variation in flows determines the range of water habitats. River flows also influence the quality of water. The balance of oxygen in water that is so important in sustaining healthy ecosystems is fundamentally affected by river flows and temperatures. Faster-flowing, more turbulent river reaches usually have well-oxygenated water. Slower flowing, lowland rivers tend to have more marked changes in oxygen levels over a 24-hour cycle, with lower levels during the night when plants stop producing oxygen and the oxygen that has been produced is consumed by water life. Pollution can disrupt this natural cycle by creating a chemical and/or biological demand on the oxygen in water.

Geology

The underlying geology in river basins influences the nature and distribution of water bodies, such as the groundwaters that sit in permeable sandstone and limestone rocks. Geology also determines the natural chemistry of waters. Water in rivers flowing through upland areas over older, harder rocks is generally more acidic than in rivers in lowland catchment areas with younger, sedimentary rocks. The acidity (or alkalinity) of water also affects the availability and toxicity of natural and man-made chemicals.

Flooding

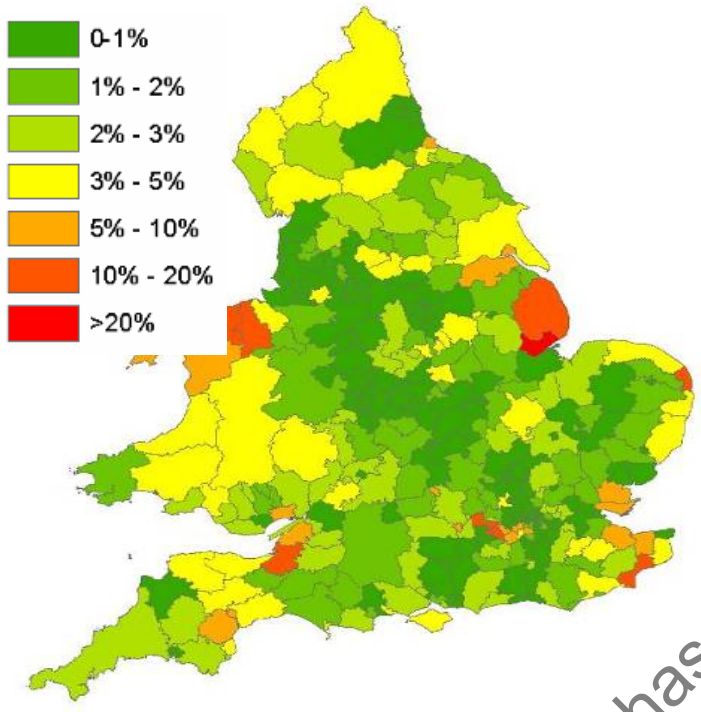
Flooding is a natural process where waters overflow into river floodplains and coastal areas during periods of heavy rainfall, high tides and storms. Rural and urban development has changed the natural drainage patterns in many catchments. Man-made drainage systems can also become overloaded and cause flooding. The risks of flooding need to be managed where it is likely that households and businesses could be damaged, public services disrupted, and people's lives endangered.

The most common forms of flooding are:

- **River flooding** occurs when a watercourse cannot cope with the water draining into it from the surrounding land. This can happen, for example, when heavy rain falls on an already waterlogged catchment.
- **Coastal flooding** results from a combination of high tides and stormy conditions. If low atmospheric pressure coincides with a high tide, a tidal surge may happen which can cause serious flooding.
- **Surface water flooding** happens when heavy rainfall overwhelms the drainage capacity of the local area. It is difficult to predict and pin-point exactly where it will occur, much more so than river or coastal flooding.
- **Sewer flooding** takes place when sewers are overwhelmed by heavy rainfall or when they become blocked. The likelihood of flooding depends on the capacity of the local sewerage system. Land and property can be flooded with water contaminated with raw sewage as a result. Rivers can also become polluted by sewer overflows.
- **Groundwater flooding** occurs when water levels in the ground rise above the land surface. It is most likely to occur in areas underlain by permeable rocks, called aquifers.

Our National Flood Risk Assessment (Environment Agency, 2009) shows that:

- 5.2 million (1 in 6) properties in England are at risk of flooding.
- 2.4 million properties are at risk of flooding from rivers and the sea.
- 34% of water and sewage pumping stations/treatment works are at significant risk of flooding.



Proportion of households with a significant likelihood of flooding

The risks of flooding are assessed at different levels, covering river basins, catchments and local areas. These assessments provide the basis for decisions on flood and coastal risk management and on the targeting of investment to reduce the risks of flooding.

Coastal erosion

Coastal erosion is a natural process that occurs when wave action breaks down sediments and rocks on shores and in cliffs and washes the material out to sea. The nature and shape of the coast has changed constantly over time as a consequence of geological processes and changes in sea level.

The rates of erosion vary around the coast, reflecting local geology. Softer, sedimentary rocks such as chalk and sandstone tend to erode more quickly than older, harder rocks. The rates of erosion are predicted to increase over this century as the climate changes, bringing more intense storms and rising sea levels.

Of the 4,500 km of coast in England, around 1,800 km is at risk of coastal erosion (about 340 km of which is currently defended). Approximately 700 properties are vulnerable to coastal erosion over the next 20 years and a further 2,000 may become vulnerable over the next 50 years (Environment Agency, 2012).

Coastal erosion and coastal flooding are often linked. One may lead to another, particularly where shorelines separating the sea from flat, low-lying land are eroding.

The risks of coastal erosion, now and into the future, have been assessed around the coastline. Shoreline Management Plans have been developed by Coastal Groups involving local authorities, the Environment Agency and others. The Plans set out actions for managing coastal processes, and support decisions on development in the vicinity of the coast, taking account of the needs of communities, agriculture, businesses and wildlife habitats.

Water habitats and wildlife

The UK National Ecosystem Assessment (UK NEA, 2011*)*, the first detailed overview of trends in the state of ecosystems over the last 60 years, reported that habitat losses in the water environment have been among the fastest in the UK. Many wetlands and floodplains have been lost or degraded.

Priority habitats (in the UK Biodiversity Action Plan), including chalk rivers and coastal saltmarshes continue to decline. Some species are still at risk, including plants such as stoneworts; invertebrate animals like the freshwater pearl mussel; fish such as the Allis and Twaite shads; and the water vole. Invasive, non-native plants, such as Himalayan balsam, have spread over the last decade, threatening river habitats and wildlife.

Numbers of some migratory fish, including the Atlantic salmon and eels, have been falling for many years and are of international concern. Around one third of important salmon rivers were classified as ‘at risk’ in 2011. The number of young eels migrating into rivers across Europe is less than 5% of pre-1980 levels. European targets have been set to reverse the decline in numbers.

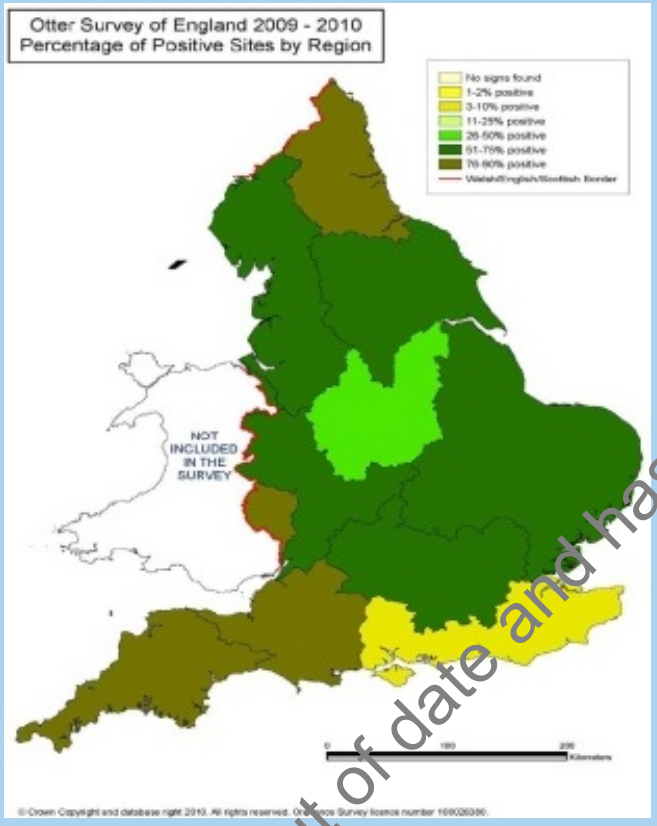
Loss and break up of habitats, rises in sea levels, water pollution from point and dispersed sources (‘diffuse pollution’) such as run-off from farm land and urban surfaces, unsustainable water abstraction, artificial structures that prevent fish from migrating, and the impact of invasive non-native species such as Himalayan Balsam, all continue to have a major impact on the biodiversity of water and wetlands.

But, despite these threats, efforts to regenerate waters have resulted in some impressive achievements:

- Atlantic salmon and brown trout have returned to rivers such as the Thames, Tyne, Wear and Mersey to breed for the first time in more than a century.
- After being virtually extinct in the early 1970s, the otter has made a dramatic return and is now present in every English county.

The return of the otter: a remarkable story of ecological recovery

As a predator feeding at the top of the food chain, the otter is an important indicator of the ecological quality of rivers and wetlands. The presence of the otter in English rivers has been monitored through national surveys since 1977. At that time, the otter was on the brink of extinction and was present at only 6% of the sites surveyed. Subsequent surveys showed a progressive return of otters across the country. In the most recent survey, carried out between 2009 and 2010 (Environment Agency, 2010), otters were found at nearly 60% of sites. Spreading from strongholds in Wales and south west and northern England, they have now returned to rivers in every English county.



The return of the otter is one of the major conservation success stories over the last 30 years. The main reason for its recovery has been the reduction in the levels of some persistent pesticides, but improvements in water quality, fish stocks and habitats have also played an important part.

Water quality

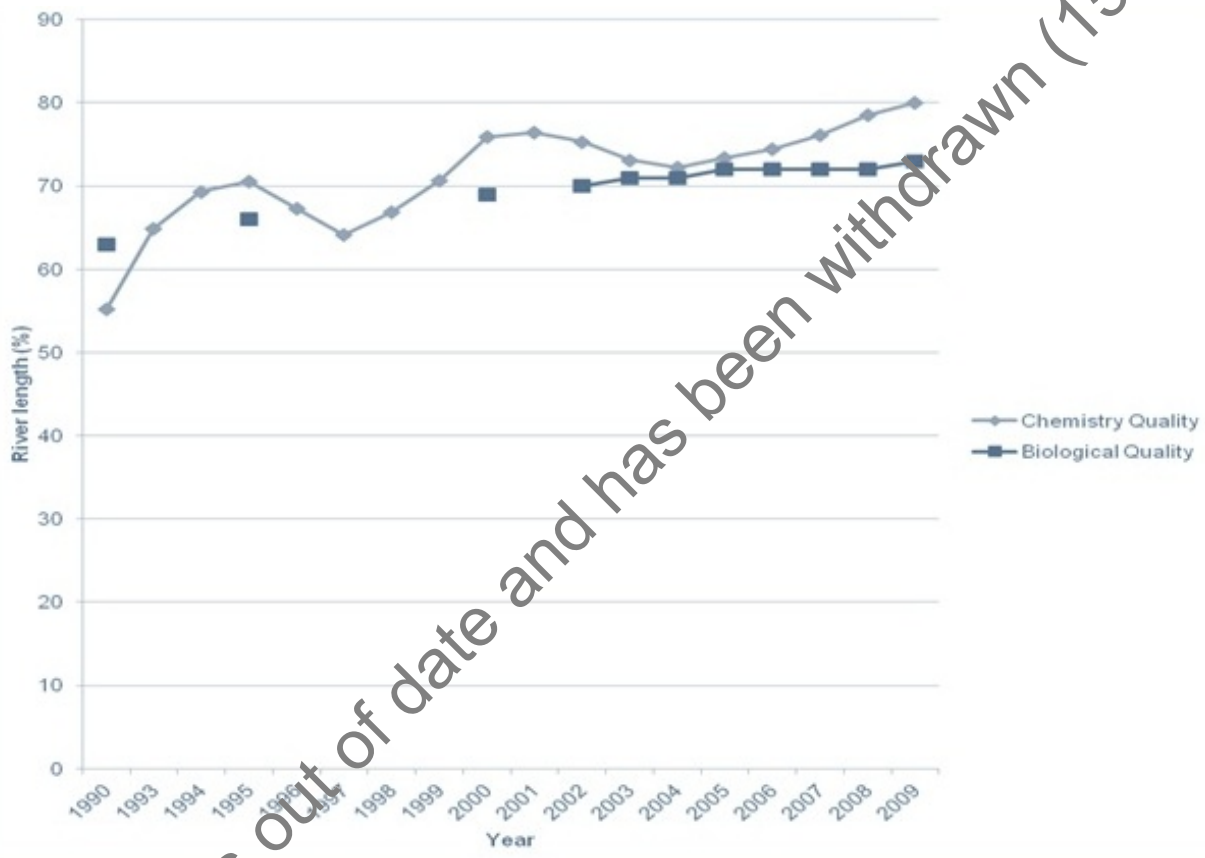
The Industrial Revolution started a long period of deterioration in water quality, and many waters, particularly those in urban areas, became seriously polluted. Expanding industry, urbanisation, and the introduction of sewerage systems all contributed to this decline. Changes in farming practices to grow food more intensively also had a major impact on water quality in the decades that followed the Second World War.

But, these trends have now been reversed in many parts of the country and, in places, there are significant improvements in the quality of rivers, lakes, estuaries and bathing waters.

This is as a result of:

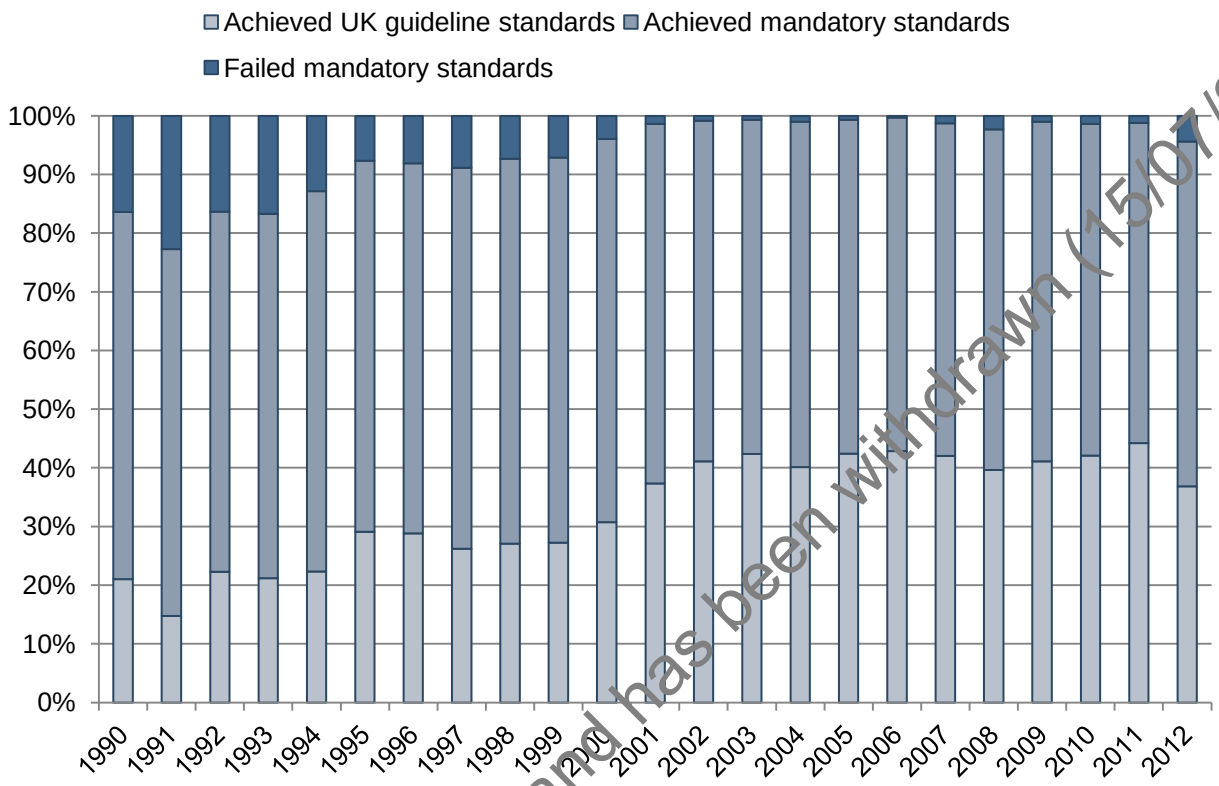
- Investment by the water industry to improve discharges from sewerage systems and wastewater treatment.
- Reductions in discharges from industrial processes and businesses.
- Campaigns to prevent pollution from farms and industry.
- Regulation to make sure that standards are met and action is taken against polluters.

A river monitoring and classification scheme, called the General Quality Assessment (GQA) scheme, has been used to assess changes in water quality over the last 20 years. In 1990, the chemical quality of 55% of monitored rivers was good or excellent. This had improved to 80% by 2009. For biological quality the improvement was from 63% to 73% over the same period.



The chemical and biological quality of rivers using the General Quality Assessment scheme

Water quality in coastal areas has also improved. In 1990, 79% of bathing waters met the required quality standards. By 2011, this had increased to 98%. In 2012 this fell back to 93%, mainly because of prolonged wet weather during the bathing season with pollution being washed from land into the sea. There has been an improvement in the quality of waters used for producing shellfish over the last decade.



The quality of bathing waters – achievement of Bathing Water Directive standards

There is a different picture for groundwater quality, as levels of pollutants including nitrate, pesticides and industrial chemicals are rising in some areas despite measures to prevent pollution. It can take a long time for chemicals to migrate into groundwaters, and, once there, they can take a long time to disperse. This is a significant problem where they are used as a source for drinking water because it is expensive to remove pollutants through treatment.

Since 2009 we have been monitoring waters using the classification schemes introduced by the Water Framework Directive. In 2009, 26 % of surface waters (including rivers, lakes, canals, estuaries and coastal waters) in England achieved good status or higher. This decreased slightly to 25 % in 2012. There were improvements in fisheries and phosphate indicators in rivers over this period, but there was a deterioration in dissolved oxygen levels, particularly in the south and east of the country which experienced prolonged periods of dry weather and low river flows.

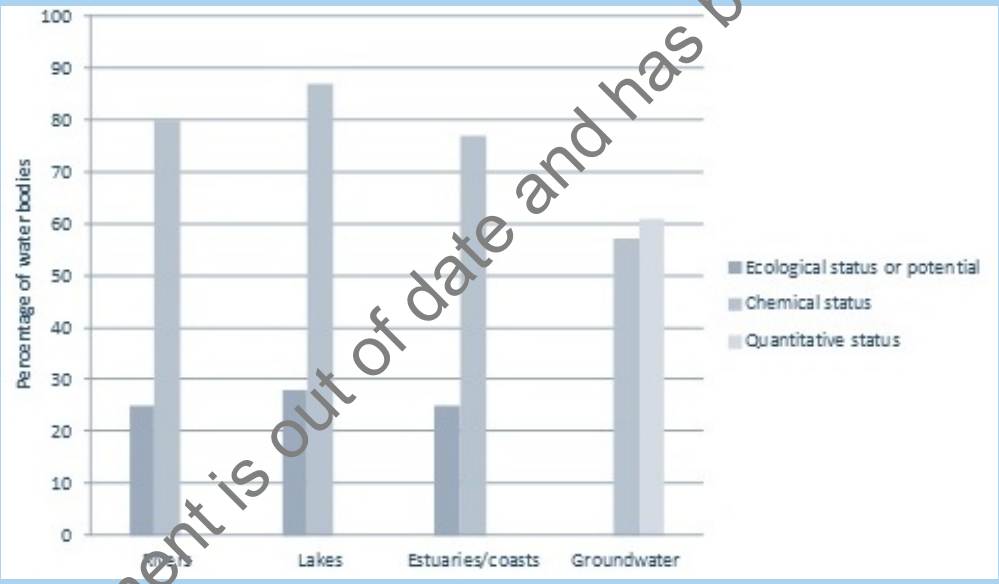
What is ‘good’ status?

The term ‘good’ status comes from the Water Framework Directive and is defined as a slight deviation from natural conditions. The main objective of the Directive is that all waters should achieve good status unless there are good reasons why this is not possible. Good status is defined through classification schemes, which have a range of different elements:

- *Biological:* algae and larger water plants; communities of small animals, known as invertebrates, such as insect larvae; fish.
- *Physical*: referred to as ‘hydromorphology’, which includes flows, and the shape and structure of water bodies.
- *Chemical:* natural chemical elements and specific pollutants, and priority hazardous substances.

Groundwater classification doesn’t have a biological component but has one relating to the quantity of water.

For some water bodies, reaching good status will not be achievable because the necessary improvements would be disproportionately costly and technically very difficult, or might create other risks such as flooding. In these cases, the aim for these water bodies is to achieve their best possible status.



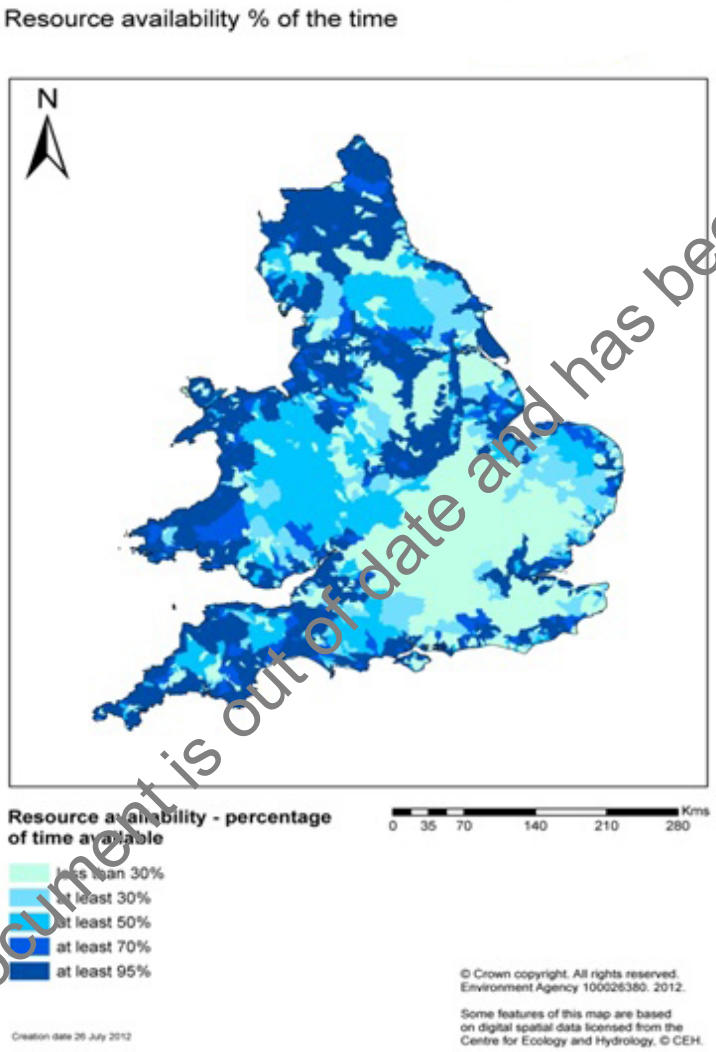
Waters achieving good ecological, chemical and quantitative status in 2012

Water availability

By assessing the state of water resources in each main catchment and the pressures on those resources, we have a good understanding of the availability of water across the country.

The total amount of fresh water taken from the environment has been declining over recent years. Between 2000 and 2009, it fell by more than a quarter. This is mainly due to industries using less water.

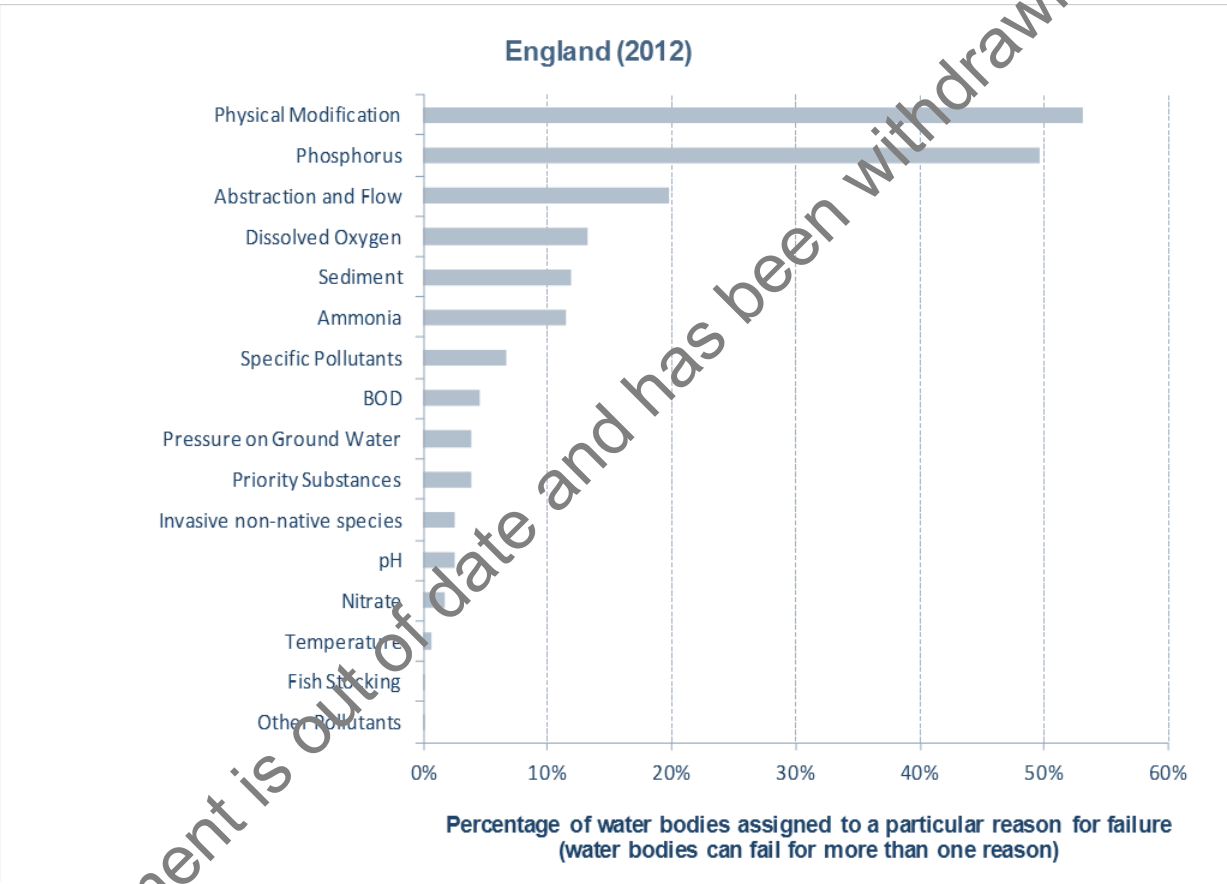
Despite this, water resources are under stress in parts of the country including the whole of the south and east of England and some areas in the Midlands. These are regions where the human population is already high and set to increase, and where the consumption of water per person is higher than in other parts of the country. The amount of water available per person in south east England is less than in some Mediterranean countries.



"The amount of water available per person in south east England is less than in some Mediterranean countries."

2. Challenges in protecting and improving waters

After carrying out thousands of investigations and bringing together information from many different sources there is now a much better understanding of the pressures on the water environment and of what needs to be done to achieve the necessary improvements. This will help us and others implement actions that will protect and improve waters.



Reasons why waters fail to achieve good status

Physical modification

Physical modification is the biggest single reason why waters fail to achieve good status, affecting more than half of waters across England.

Rivers, lakes, groundwaters, estuaries and coastal waters have been changed over centuries to create water supplies, drain land, regulate flows, reduce the risks of flooding, and open navigation routes. Engineering such as the construction of weirs and canals can change the size and shape

of water bodies and alter natural flows. It reduces the diversity of physical features and also the connections with surrounding flood plains and wetlands.

A national survey of river habitats (Environment Agency, 2010) showed that 43% of river channels have been altered and 8% of river banks have been reinforced. Removing trees has reduced shading of rivers in many parts of the country, particularly in upland areas. This, together with a changing climate, could increase the temperature of river water and have potentially damaging effects on water life.

We will continue to work in partnership with others to seek to achieve good status using a range of measures, which include:

- Restoring water levels and flows.
- Improving and re-creating habitats such as pools, riffles and meanders in rivers and restoring natural features in river banks and surrounding areas.
- Overcoming the physical barriers that have been created through engineering, for example by installing fish passes on weirs.
- Re-connecting water bodies that have become isolated within catchments.
- Promoting the use of, and payment for, different services provided by natural ecosystems, for example, using wetlands to help reduce the risks of flooding and remove pollutants from water.

Where waters have been heavily modified, it may not be practical or affordable to restore their natural features fully. In these cases, our main aim is for them to achieve their best ecological potential.

There are many examples of successful partnership projects and programmes in which we and others have developed innovative approaches and methods for restoring the natural functioning of water bodies. In many cases these have resulted in very significant benefits, not only to the wildlife and ecology of the waters themselves but also the quality of life in local communities.

"Physical modification is the biggest single reason why waters fail to achieve good status, affecting more than half of waters across England."

Sharing knowledge on river restoration in Europe- the 'RESTORE' partnership

Many different projects are taking place across Europe to restore degraded rivers towards a more natural state. River restoration can bring multiple benefits, including improved ecological quality, reduced flood risks, economic regeneration, and improved quality of life for local communities. The 'RESTORE' project is a partnership for sharing knowledge and promoting best practice on river restoration in Europe. It is funded through the European Community 'LIFE +' Programme.

The RESTORE database holds more than 200 case studies on river restoration from 19 countries and this is growing all the time. A new 'River Wiki' has been introduced to help share information and to encourage new examples to come forward. This provides a valuable and interactive online source of information to help share learning.

Unsustainable abstraction of water

Abstracting water can alter natural river flows, deplete groundwater levels and reduce the flows of water to springs, wetlands, and lakes. Water abstraction is the third most frequently cited reason why waters do not achieve good status.

The Restoring Sustainable Abstractions (RSA) programme is a major initiative in which we are taking action at around 250 sites across England to investigate and restore sustainable abstractions. About half of these concern abstractions for public water supply and around a third are related to agriculture.

Further investment needs to be targeted through the water companies' Water Resource Management Plans. These Plans take a long-term view of future water demand and set out measures to meet this demand and benefit the environment. Measures to reduce demand and to promote more efficient use of water are also needed in the agricultural sector. For example, the LEAF (Linking Environment and Farming) water management tool helps farmers to identify how they can reduce the amount of water they use, save money and protect water resources at the same time.

Restoring sustainable abstraction of water from the River Ehen

The River Ehen flows out of Ennerdale Lake in the Lake District. It is the single most important known pearl mussel habitat in England and, for this reason, it is designated as a Special Area of Conservation (SAC).

Outflow from Ennerdale to the River Ehen and freshwater Pearl Mussels (photo courtesy of Ian Killen)

Water has been abstracted from the site for over 100 years and the amount taken has increased over time. In the 1970s, a water abstraction scheme diverted a stream into Ennerdale Lake that previously flowed into the Ehen. This cut off the natural input of coarse sediment into the Ehen, affecting around a 4km reach of river and changing the natural flow and the structure of the river bed. This had an impact on the pearl mussels, which are very sensitive to habitat changes and need coarse sediments to break up and vary flows.

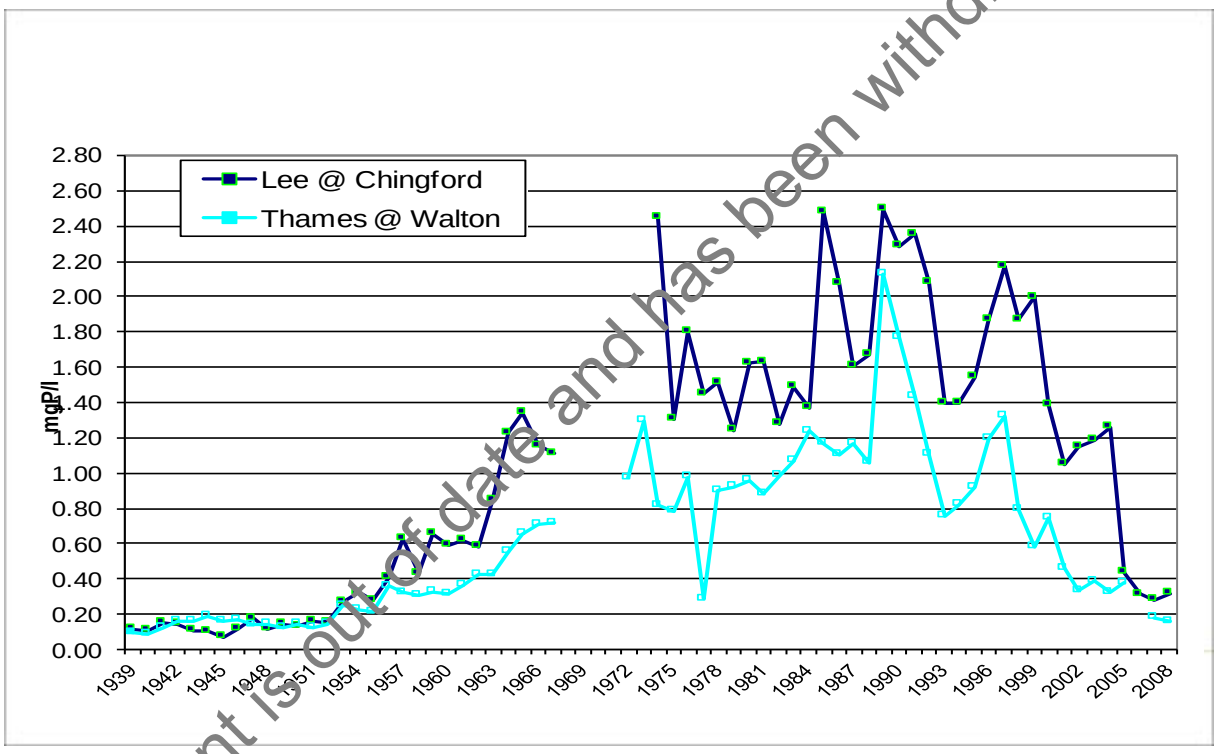
Working with the water company, United Utilities, we are taking action to change the abstraction licence conditions to make sure that the abstraction of water is sustainable and the natural processes in the river are restored. We are working with United Utilities on a project to re-connect the input of natural sediments into the river, which will help to rehabilitate the pearl mussels and support other water life such as Atlantic salmon.

Water pollution

Nutrients – phosphorus and nitrate

Phosphorus and nitrate are important plant nutrients. If concentrations in waters rise above natural levels, algae and other larger plants may start to grow excessively. This is called *eutrophication* and it can have serious effects on the ecological quality of waters and the costs of drinking water treatment.

Measures to control and prevent pollution have reduced the levels of phosphorus and nitrogen in rivers over the last two decades. Monitoring of nutrients through the GQA scheme showed that in 1990 there were high levels of phosphorus in 69% of rivers in England. By 2009, this had fallen to 50%. The length of river classified as high in nitrate fell from 36% to 29% over the same period. Long-term monitoring of phosphorus in some rivers, for example, the Thames and the Lee, shows that levels are returning to those recorded in the 1940s before they started to rise rapidly with increasing use of phosphorus, particularly in detergents and fertilizers.



Phosphate concentrations in the rivers Thames and Lee, 1939-2008

Despite these declining trends, 45% of monitored rivers and 83% of lakes in England have levels of phosphorus that exceed the agreed standards under the Water Framework Directive. The problem is greatest in lowland, high alkalinity rivers in central and south east England which tend to have higher population densities and slower-flowing rivers.

Nitrate is a relatively minor reason for waters failing to achieve good status overall, but it is a particular concern in groundwaters where levels are rising in some areas. It is also of concern in the marine environment where it affects the ecological status of some estuaries, harbours and coastal waters.

Sewage effluent and agriculture are the largest sources of phosphorus and nitrate, and are the most common reasons waters fail to meet standards.

Experience from restoration projects shows that it can take a long time for the ecology to recover, particularly where nutrients are locked into river bed and lake sediments from which they release slowly over time. There are examples of long-term successes, such as the ecological recovery of the Norfolk Broads, but it has taken over 30 years.

We are working with others to reduce nutrient levels in water. This involves a combination of national measures and action programmes in catchments. Further measures for tackling the issue at source are needed, for example, where phosphorus is used in detergents, food and drink products, water treatment, and fertilisers and feeds.

For agricultural sources, we are working with the farming industry on a range of measures, such as farm nutrient management plans including regular testing of soils; growing cover crops to reduce nutrient leaching; storing animal manure and slurry over the winter; calibrating fertiliser spreaders; changing land-use from intensively farmed arable land to less intensively managed grassland or woodland; and reducing animal stocking densities. The action programmes in designated Nitrate Vulnerable Zones (NVZs) are a key measure in reducing nitrate levels in water.

Sewage effluent and farm waste

Discharges from waste water treatment plants, sewerage systems and farm waste such as animal slurry can have a major impact on water quality. When they decompose they can lower oxygen levels in water, affecting fish and other species. They contain ammonia, which is toxic to fish and invertebrate animals. They also contain bacteria and other micro-organisms that can damage human health.

Dissolved oxygen and ammonia levels continue to be a significant reason for failure to achieve good status. Water contaminated with micro-organisms also presents problems in meeting the revised, more stringent, European water quality standards for bathing waters at some beaches and the standards for waters from which shellfish are harvested.

We continue to work with the water companies to help target investment to improve the quality of effluents from waste water treatment plants and to resolve unsatisfactory discharges from overflows from sewerage systems. We are also working with others to identify and rectify the problems caused by misconnections of household appliances into surface water drainage systems.

We are working with farmers to prevent pollution from farm waste, including identifying problems through catchment walkovers; better application of standards for storing and managing manure and silage, and farm drainage systems; and schemes to improve awareness and provide guidance to farmers, for example, through the Catchment Sensitive Farming approach. We are promoting actions that farmers can take that are relatively easy to implement and are effective in preventing pollution, including separating clean and dirty water systems, covering storage areas for slurry and silage, and avoiding spreading manures on land during wet weather.

Sediment from land run-off

Sediment transport and deposition are natural processes within catchments but can be disrupted through changes in the way land is used and managed. Sediment building up in rivers and lakes can damage their ecology, smothering habitats and affecting fish spawning sites. Sediment can transport chemicals, nutrients and bacteria. It can also clog and change the shape of river channels, causing an increased risk of flooding. At least 12% of waters – mainly rivers and lakes - fail to reach a good ecological status due to sediment problems.

Agriculture is the main cause of sediment problems. Most of these problems can be tackled through good soil management and conservation methods that benefit the farmer as well as the environment. Specific measures to reduce the run-off of sediments include planting tree belts, the use of grass buffer zones, sediment traps and field wetlands. Run-off of sediment from urban surfaces and roads is also a problem in some areas.

Run-off from construction sites is also a significant source of sediment problems and we continue to work with the construction industry to promote guidance on measures to prevent pollution from construction and demolition sites.

Chemicals

Some chemicals are of particular concern when released into the environment because they can be harmful to wildlife and human health. They include pesticides, metals, organic chemicals used in industries, and the by-products of combustion. They can enter waters from different sources, including sewage and industrial effluents; run-off from agricultural land, roads and urban surfaces; and deposition from the atmosphere.

Environmental Quality Standards (EQSs) are applied to priority chemicals as the basis for regulating discharges and in targeting action to prevent pollution. Waters fail to achieve good chemical status because of the presence of priority substances at levels that exceed their EQSs. Examples include the pesticide tributyltin and a group of chemicals known as polycyclic aromatic hydrocarbons (PAHs), which are found in coal, oil and tar deposits, and are produced as by-products of burning fuel. Metals such as cadmium are also of concern.

Changes being introduced to the regulation of chemicals are likely to have a significant effect on monitoring and compliance with standards. These include more surveillance monitoring to detect the wider impacts of diffuse sources of chemicals; tightening the EQSs for some chemicals; introducing new standards that relate to the accumulation of chemicals in fish and other aquatic animals and plants; and including new chemicals and EQSs on priority lists.

We are working with water companies, industry, mining companies, farmers, highways authorities and many others to better understand the sources, transport pathways, behaviour and effects of chemicals and to target actions to help prevent and control pollution.

3. An uncertain future

A growing population, increasing demand for water and a changing climate will place increasing pressures on the water environment and water infrastructure.

Global pressures

The United Nation's Global Environment Outlook (GEO 5) (UNEP, 2012) paints a picture of acute water stress in many regions of the world. Demands on water resources are increasing with a growing global population and changing lifestyles.

On average each person in the UK uses about 150 litres of tap water a day. If the amount of water used in the products and services that each person enjoys is included (often referred to as 'embedded water'), average water consumption is around 3400 litres every day.

About two-thirds of the embedded water used in the UK is imported in services and products from other countries. With increasing competition for water globally, there could be more pressure on the UK's own water resources in the future.

A growing population

There are around 53 million people living in England. The population of England is forecast to grow by nearly 10 million by 2035 and by 15 million by 2050. Much of this increase is likely to be concentrated in the south and east, areas that are already the most water stressed parts of the country.

A growing population will place more demand on water resources. Combined with other trends, including an increasing number of smaller households, some scenarios suggest an increase in water demand of around 5% by 2020 and as much as 35% by 2050 unless further water efficiency measures are adopted.

Extra demand for public supply could put a greater burden on existing infrastructure. It will place a greater emphasis on sharing existing supplies between regions more effectively. It could also result in increased discharges of wastewater which may cause more pollution.

A changing climate

Along with increasing demand from a growing population, a changing climate could also have a major impact on water availability.

The UK Climate Projections (UK CP09) suggest that, on average, the UK will experience rising temperatures and changes in seasonal rainfall patterns. Extreme weather events may become more common and more intense. There are different scenarios for how a changing climate could have different impacts across the country and through the seasons.

Higher temperatures could increase demand on resources, as more water is needed for irrigation, and in homes and gardens. Changes in rainfall and evaporation could affect natural river flows. Re-using water returned to rivers as treated effluent will become more important. Yields and supplies from reservoirs, groundwater and river intakes may become less reliable, and a more variable climate may make reservoir systems more vulnerable.

Lower flows also mean less capacity to dilute discharges to water and this could affect water quality. Groundwater could also be affected. A shorter recharge season would result in less groundwater support to rivers. Where groundwater is cleaner than the surface water, this would reduce the potential benefits of dilution.

River flows in some parts of the country could be as much as 80% lower by the 2050s.

The current projections also suggest that droughts are likely to happen more often. Water companies' water resource management plans will, therefore, need to deal with potentially longer lasting and more frequent droughts in the future to sustain water supplies and to limit environmental damage.

Lower river flows, higher temperatures and more sunlight, combined with increased concentrations of nutrients may increase algal growth (blooms) in rivers, lakes and reservoirs. This could increase the costs of treating water. The effects of a changing climate on wildlife habitats could mean that the distribution of native species will change. Fish such as Atlantic salmon and brown trout, which need cold water to thrive, may struggle to survive. Some native plants and animals could decline if invasive, non-native species spread. Increased sunlight will kill off bacteria more quickly.

Heavier rainfall may impact on water quality through runoff from agricultural land, urban surfaces and increased discharges from combined sewer overflows. It could also result in increased soil erosion and leaching of nutrients to groundwater. Rising water tables could increase groundwater flooding and the movement of pollutants.

More intense rainfall could increase the risk of flooding of properties and critical infrastructure such as water treatment works, pumping stations and power generating stations. Work by the water industry suggests that by 2080, storage of storm water to prevent properties flooding may need to double.

A changing climate is also likely to result in increased sea levels and coastal erosion. As well as posing a major risk to property, this may threaten sewerage infrastructure and transfer salt water into rivers and groundwater, affecting ecology, water supply and irrigation. Rising sea levels could also threaten important coastal habitats, destroying salt marshes and mudflats that are important refuges for migrating birds and other wildlife.

Climate change and rising sea levels: the Alkborough tidal defence scheme

More than 90,000 hectares of land and 300,000 properties rely on the system of flood defences around the Humber Estuary.

The £10 million Alkborough tidal defence scheme is a fundamental part of the Environment Agency's long-term strategy for managing flood risk on the Humber Estuary. The scheme increases the level of flood protection to an area stretching from the Humber Bridge to Goole on the tidal River Ouse and as far as Keadby Bridge on the tidal River Trent.

The scheme has been designed to reduce the impact of rising sea levels by creating storage areas for flood water during extreme tidal events. It also protects the internationally important nature conservation interest of the Humber by creating new wetland habitat, as well as providing a focus for education and recreational opportunities for local communities.

The future for water resources - the case for change

To support the Government's Water White Paper (HM Government, 2011), we carried out a major assessment of future water resource availability in England (Environment Agency, 2011). Using the best available evidence, the assessment sets out a number of scenarios, taking the possible impacts of a changing climate, population growth, demand changes and environmental requirements into account. The conclusions from this work are:

- The water environment will be different from that of today. Some species will be better suited to future conditions than others. This might mean that the requirements for future water ecosystems and the implications on the water available for abstraction will need to be reconsidered.
- The combined impacts of a changing climate and increases in population mean there could be less water available for people, businesses, agriculture and the environment than today.

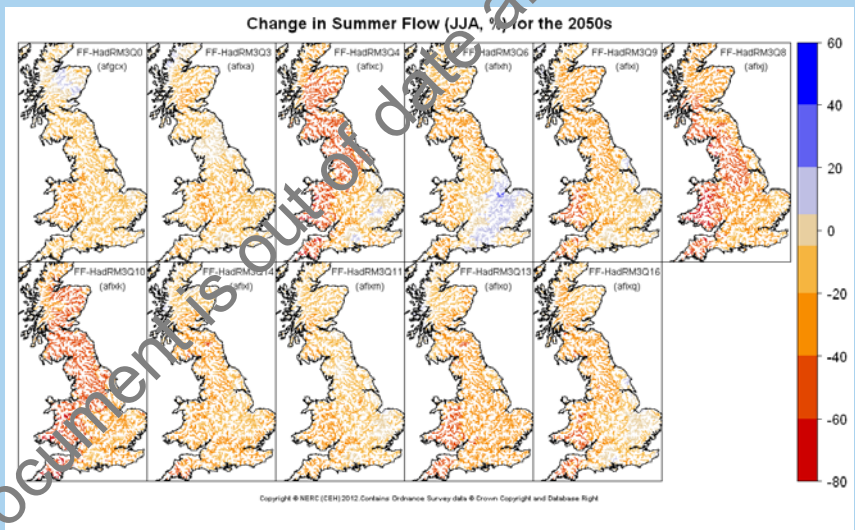
- Future water resource availability pressures will not be limited to the south and east of England. Under many of the scenarios the south west and northern England are likely to see significant unmet demand in the future.
- Over the longer term a changing climate could have a bigger impact on water resource availability than population growth. Unmet demand is more closely linked to changing climate scenarios than to the demand scenarios.
- Demand management will have an important role in the future, but increased demand and a changing climate could result in the need to develop significant new resources.
- The scale of the problem needs to be considered at a strategic and local level. The study shows that the river basin district analysis masks significant local problems.

Climate change and future river flows

Recent research has looked at scenarios for changes in river flows and groundwater levels based on the latest climate change projections (UKCP09) from the Met Office.

How the climate changes in future depends partly on the emissions of "greenhouse" gases. Here, we show results for a medium emissions scenario. Higher levels of emissions would probably lead to greater changes than those shown here.

We have used 11 different regional climate models to reflect the uncertainty in modelling the future climate. This gives us a range of possible changes. In summer, river flows predominantly show decreases in runoff across Britain, but range from an increase of 20% to a decrease of 80%. The largest decreases are mainly in the north and west of Britain. In spring and autumn, the picture of future changes is much more mixed. In winter, the picture is mainly one of increasing flows, but some scenarios show drier winters, reflecting uncertainty in rainfall projections.



These scenarios are important in informing the long-term planning of water resource management to ensure that water supplies remain resilient and the needs of the environment are met. Future work will include using the scenarios to look at possible impacts on water quality and on ecosystems that are sensitive to changes in flow. It will also look at whether the measures that we and our partners carry out will still be effective in the future.

An ageing infrastructure

The water and wastewater sectors provide important national infrastructure and much of this is ageing. For example, the average age of a London sewer is 63 years old. Wasting water through leakage from water distribution networks continues to be a major problem. At current rates, it would take about 800 years to repair or replace the whole network. This suggests that the rate of investment needs to increase to ensure the network can continue to operate in the long term.

To reduce the risks of flooding and to manage water levels an extensive network of structures – including sluices, weirs, floodgates and barriers - has to be maintained and kept in good working order. This requires significant investment.

Failing infrastructure can have major impacts on the environment and damage homes and businesses. Planning for the future needs to make sure that infrastructure can withstand the increasing pressures of a growing population and the impacts of a changing climate.

New housing and business developments are vital for economic growth, but it is important that local plans make sure that the water and wastewater infrastructure can meet the needs of the development and that the environment is not placed at risk. Greater extremes of weather and more frequent and intense flooding and droughts with a changing climate present real challenges to how water supply, wastewater and drainage systems work. Recent incidents involving the devastating impacts of surface water flooding have shown that some drainage networks are not able to cope with extreme rainfall. This situation seems likely to get worse if sewerage and surface water drainage systems are not upgraded.

More innovative approaches are needed to tackle these problems. Finding new ways of working with nature and taking advantage of 'green infrastructure' are important. For example, by incorporating natural drainage features, Sustainable Drainage Systems (SuDS) create new habitats for wildlife, filter pollutants, recharge groundwater and slow down water, reducing the risks of flooding.

Infrastructure can also play an important part in helping water to be used more efficiently. For example, multi-pipe systems that encourage rainwater and 'grey' water to be reused in homes and businesses will help to reduce the demand for water and also cut the costs and energy used for treating water and waste water. Such systems help to ensure that water is only treated to the standard necessary for a particular use.

What is water infrastructure?

Water: Water companies take groundwater and water from rivers and treat it to drinking water standard before pumping it through pipes to homes, businesses and other users. Sometimes it is stored in a reservoir before being treated and distributed.
Waste water: Homes and communities are drained by a system of sewers. Foul sewers carry sewage to sewage treatment works where it is treated to make it clean enough to be returned to rivers, groundwater or the sea. Surface water sewers carry water from roofs, roads and other surfaces directly into the water environment, usually without treatment. Sometimes both sewage and surface water are conveyed in a single 'combined' sewer.
Flooding: Sea walls, flood barriers, flood storage areas and other defences protect properties from coastal and river flooding.

Part II
Water management: our contribution

4. Our roles

As operator, regulator and adviser, we play a crucial role in protecting and improving the water environment. Guided by government policy and legislation, our work in managing water involves planning, taking action and monitoring.

Our water management functions

We are the lead organisation for water management and environmental regulation in England. Established under the 1995 Environmental Protection Act, our principal aim is to *protect or improve the environment, taken as a whole, to contribute towards achieving sustainable development*.

We work within a framework of government policy and legislation (Annex 1) that defines our powers and duties, and the environmental standards to which we work. Much of this is based on European wide requirements. Our main water management functions are:

- flood and coastal risk management
- water resources management
- water quality management including surface waters, groundwaters, bathing waters and shellfish waters
- biodiversity in waters and wetlands
- fisheries management
- angling
- navigation on some waterways

The principles that guide our work

There are several important principles that we apply to all our work. These guide our planning and operations, and support decision-making.

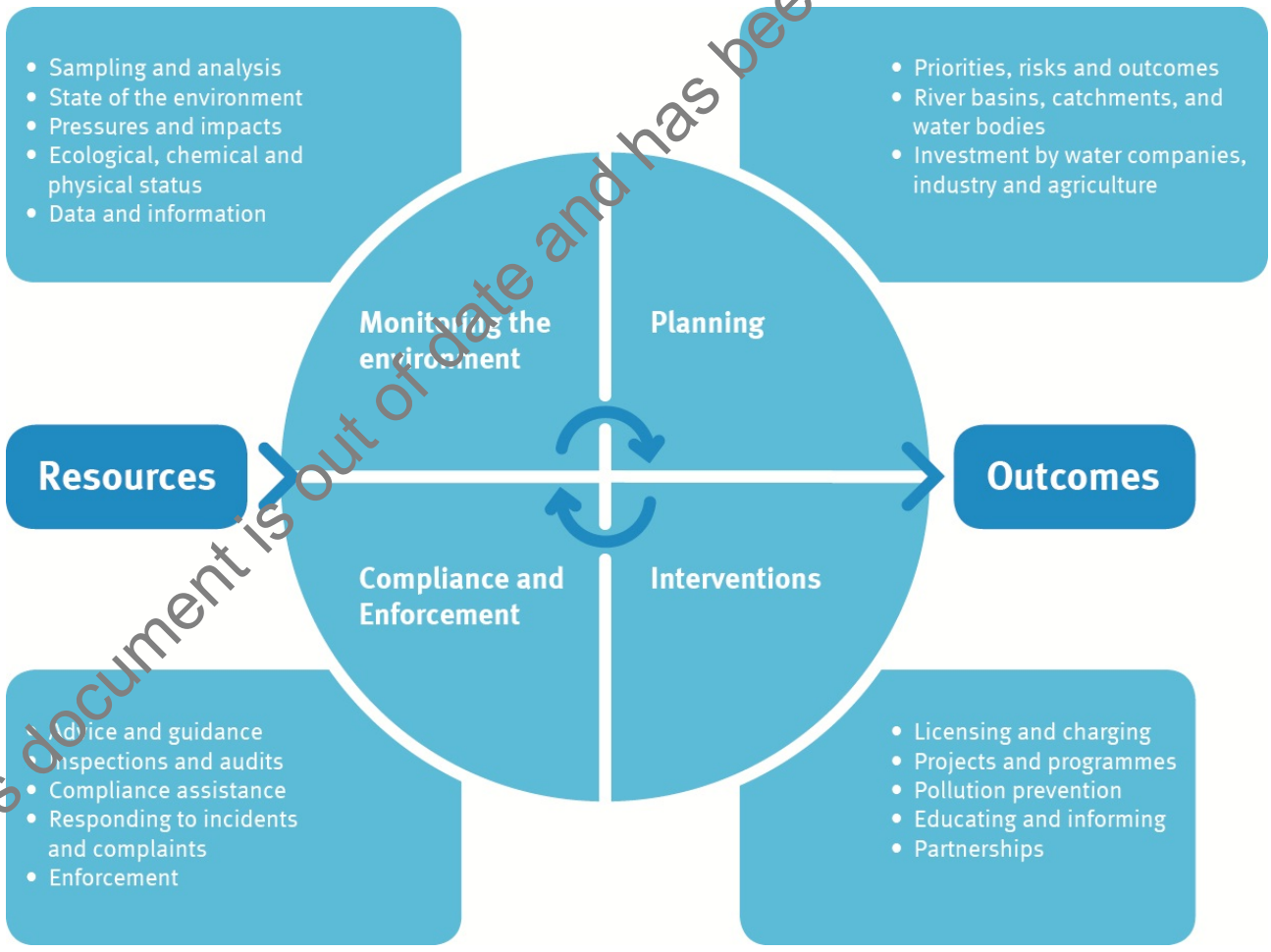
1. We focus on achieving *outcomes* and reducing *risks* for people and the environment.
2. We take an *integrated approach*. We work with the water cycle and bring together our different water management functions to provide a range of benefits for people and the environment.

3. We *work in partnership* to find solutions with others. We actively seek opportunities to work with other organisations and local communities.
4. The decisions we take and the work we do are based on firm *evidence*. We use data and information from our monitoring and modelling and other sources to support our work and to inform others.
5. We are *open and transparent*. We make information freely available.

Managing the water environment

Our work in managing the water environment involves targeting effort and resources to reduce risks and to provide the greatest benefits for people and wildlife. We bring together our different water management functions through an iterative cycle of activities which involves:

- Monitoring the environment to understand the state it is in and why.
- Planning the action needed to achieve agreed outcomes.
- Taking action and working with others to achieve these outcomes.
- Checking compliance with standards and permit conditions, and carrying out enforcement activities, if necessary, to make sure that the legal requirements are met.



The water management cycle

Strategic overview

We have important strategic overview roles in water management in which we coordinate our own work with those of other organisations. We are responsible for overseeing progress with national strategies and plans.

Through the National Flood and Coastal Erosion Risk Management (FCERM) Strategy (Environment Agency, 2011), we take a strategic overview of all flooding from rivers, the sea, surface water and groundwater.

We are the competent authority for implementing the Water Framework Directive, which involves working with many different partner organisations to develop and coordinate River Basin Management Plans.

We also oversee the management of water resources in England, looking at strategic options across the individual water company plans and taking a long-term view of water needs to make sure that supplies remain resilient.

The National Flood and Coastal Erosion Risk Management Strategy and the Environment Agency's strategic overview role

The National Flood and Coastal Erosion Risk Management (FCERM) Strategy has several key objectives, which are to:

- Understand flooding and coastal erosion risk.
- Prevent inappropriate development in areas at risk.
- Manage the likelihood of flood risk.
- Help people to manage their risk.
- Improve flood prediction, warning and post-flood recovery.

The Environment Agency is the lead organisation for flooding from main rivers, estuaries and the sea, and reservoirs. Other local flood authorities lead on flooding from surface water, groundwater and ordinary watercourses. There are also lead coastal erosion risk management authorities (including the Environment Agency for some parts of the coast).

Under The Flood and Water Management Act 2010 we must take a strategic overview of all flood and coastal erosion risk management in England. Some important activities in carrying out this role are:

- Setting the direction for FCERM through strategic plans (such as Catchment Flood Management Plans and Shoreline Management Plans).
- Providing the evidence and advice to inform government policy and to support other lead authorities in carrying out their responsibilities.
- Supporting collaboration, knowledge-building and sharing of good practice.
- Establishing and supporting Regional Flood and Coastal Committees and allocating funding.
- Monitoring and reporting on flood and coastal erosion risk management, including reporting on the implementation of the National FCERM Strategy.

Our role as operator

Flood and coastal risk management

Through our flood and coastal risk management work, we reduce the risks to people, property, businesses and infrastructure, and benefit the environment.

- Working with our partners, we manage flood defences and structures on over 23,000 miles of rivers including flood banks, pumping stations, locks and sluices. We also manage around 1000 miles of sea defences.
- We maintain existing flood defences and carry out around 145,000 inspections every year.
- Working in partnership with others, we commission the building of new flood risk management assets, investing around £260 million in capital programmes every year.
- Our work helps to support local economies. Reducing the risk of flooding helps regenerate communities by attracting people to live, work and invest there.
- Our information and advice helps reduce the impact of flooding on homes and businesses. More than one million properties are registered on Flood Warning Direct, which provides a free messaging service to give advance notice of flooding.
- We work with many different organisations through local resilience forums to prepare for and to manage major incidents. We investigate the causes of incidents and take enforcement action as appropriate.

Water resources

- We allocate water resources to sectors, including water companies, industry and farmers, making sure that there is enough water for homes, agriculture, businesses and the environment.
- We plan decades ahead so that society can respond to the changing pressures on water. We oversee the way that water companies plan so that supplies are secure and companies' environmental impacts are minimised.

Wildlife and fisheries

- We help to protect and improve nationally and internationally important wildlife sites and species.
- Each year we are involved in hundreds of partnership projects to create, protect and restore valuable habitats for wildlife.
- We work to reduce the spread and impact of non-native 'invasive species'.
- We maintain, improve and develop fisheries for salmon, trout, eels, lampreys, smelt and freshwater fish.
- We monitor and assess the health of fish and fisheries in rivers and lakes, and the numbers of migratory fish returning from the sea.
- We work closely with landowners and anglers to improve the economic and social value of fishing.

Navigation

- Our work provides a better and safer place for people to enjoy the environment. We work with others to promote the use of inland and coastal waters for recreation.

Our role as regulator

Our work as a regulator includes protecting and improving the environment and reducing risks to people and wildlife. National and European legislation provides the framework of environmental standards to which we work. These include requirements to improve waters for different uses, to protect wildlife, and to reduce pollution from sewage and industrial discharges, and from farming.

We monitor the water environment to assess the extent to which these standards are being achieved and carry out investigations to understand the reasons why, if they are not being achieved.

We set conditions within permits that operators have to meet to make sure the environmental standards will be met. These include permits for discharges, abstractions, impoundments, flood risk management assets, and fisheries management. We then check to ensure that operators are complying with the requirements and, if necessary, take enforcement action where there is failure to comply.

- We permit around 73,000 discharges to surface and groundwater.
- We work with different sectors to prevent pollution from diffuse sources, including run-off from farmland, roads and urban surfaces.
- We allocate around 20,000 licences to water companies, farmers and businesses to abstract water in a sustainable way.
- We reduce the risk of flooding through over 6,000 flood risk management consents.
- We consent movements of fish and issue authorisations for the fishing of particular species such as eels and crayfish.
- We issue over 1.25 million rod licences to anglers and 270 net licences for salmon and sea trout.
- We carry out surveillance and take enforcement action against illegal fishing activities.

We seek to ensure that our regulatory approach serves both society and businesses to bring about better outcomes for the environment. We target our effort and resources on those activities that pose the greatest risk to the environment and to human health. And we make sure that we minimise administrative burdens on businesses.

Our role as adviser

- We provide information and advice to national and local government to support policy and decision-making.
- We carry out the monitoring that is necessary for government to report to the European Commission on progress and compliance with European legislation.
- We also work with government departments to develop national strategies and guidance, for example, the National Flood and Coastal Erosion Risk Management Strategy was jointly produced by Defra and the Environment Agency.
- We provide advice to planning authorities to ensure that new development is appropriate and safe.
- We monitor the environment to assess how much water there is, how clean it is and to understand the state of water ecosystems.
- Every year we take over 170,000 samples at around 18,000 chemical and 7,000 ecological monitoring sites in rivers, lakes, groundwaters, estuaries, and coastal waters.
- We carry out around 1.85 million individual analyses each year in our laboratories.
- Every day around half a million flow, water level and rainfall measurements are generated from our hydrometry and telemetry networks.
- We make information freely available through our website and other media to inform people about the state of local environments.
- We work with others, including civil society organisations and volunteers to encourage them to get involved in protecting and improving the water environment through monitoring activities, and to improve the information available.
- We use the best available scientific evidence to assess new and emerging risks, for example the release of endocrine disrupting chemicals into water, and provide advice on what can be done to address these risks.
- We provide technical leadership in developing standards and guidelines, for example, through the UK Technical Advisory Group on the Water Framework Directive, and through other expert groups and networks at European and international level.

Working with others

We work with many different organisations and communities across the country, providing services to our customers and working in partnership on programmes and projects, and day-to-day operations.

Many of these organisations have important roles in water management themselves and we work closely with them where we have shared interests and objectives. These include:

- **Government departments -** responsible for setting national policy and standards. Our role is to provide information and advice in supporting the development of policy and legislation, and working with others to make sure it is properly implemented.

- **Other government agencies -** with regulatory and operational roles, including Natural England (natural environment and public access) and the Marine Management Organisation (planning and regulation in the marine environment). We work jointly with them to achieve more for the environment, to improve efficiency in our operations and to provide better customer services.

- **Other regulators -** responsible for different aspects of water regulation, including Ofwat (responsible for the economic regulation of the water companies and the Drinking Water Inspectorate (responsible for the regulation of drinking water quality). We work closely with them in the regulation of the water industry and in planning future investment.

- **Water companies -** responsible for providing water and wastewater services to customers. We work with them in regulating abstractions and discharges**,** providing guidance on water management plans, and targeting future investment in water infrastructure to meet environmental standards.

- **Business sectors -** benefiting from the many services provided by the water environment. We work with them as a regulator and adviser to help them improve environmental performance, prevent pollution, and use resources more efficiently.

- **Local authorities -** with many responsibilities in water management at the local level including spatial planning, infrastructure development, and public health. We work in partnership with them, providing information and guidance to support their management of bathing waters, and coastal erosion and flooding from surface water, small watercourses and groundwater. We provide information and advice on the environment for local plans.

- The **emergency services** and **health authorities.** We work with them through local resilience fora to plan for, and respond to, incidents and emergencies.

- **Local organisations and communities,** including Rivers Trusts, Wildlife Trusts, National Parks Authorities, Internal Drainage Boards and many others. We work in partnership to develop River Basin Management plans and take forward a catchment-based approach. We work together on projects to protect and restore water ecosystems. We involve civil society organisations in areas of work where we have mutual interests, benefiting from their skills and experience, for example in coordinating volunteers. We work with local communities to find out what they want to achieve, understand problems and concerns, and develop ideas and find solutions.

5. Planning and implementation

We take an integrated approach in managing the water environment. This involves bringing together our different functions and working with others at river basin, catchment, and local levels.

Why we need to take an integrated approach

The water cycle involves many different processes that interact. A change in one part of the cycle has consequences for another. By taking an integrated approach, which works with these processes, we can be most effective in achieving the necessary outcomes.

Through river basin and catchment plans we recognise the important interactions between land and water, and between water quantity and quality. For example, by working with natural processes, measures can be taken to increase the retention of water in catchments, which can, at the same time, reduce the risks of flooding, enhance the resources available for supply and prevent pollution.

We also need to take an integrated approach in contributing to sustainable development in our work, taking account of the needs of people, the environment and the economy. We use different techniques to help us do this, for example, in project and programme investment appraisals and in assessing the costs and benefits of particular activities and actions.

Planning for the future

Water management planning involves taking a long-term view. We need to anticipate possible changes in the future, such as the demands of a growing population and the impacts of a changing climate.

For example, the Environment Agency's Water Resources Strategy (Environment Agency, 2009) considers a range of scenarios to 2050. Planning to manage the risk of flooding and coastal erosion in the future involves looking ahead over the next 20, 50 and 100 years. Our long-term investment strategy for flood and coastal risk management (Environment Agency, 2009) looks ahead to 2035 and provides an indication of what investment will be needed to build and maintain new flood and coastal risk management defences to maintain current levels of protection.

Long-term planning provides the context for shorter-term planning cycles as 'stepping stones' towards the long-term goals. The Water Framework Directive, for example, requires a six-year cycle of planning towards the goal of all waters reaching their best potential for society by 2027. The water companies are required to look ahead 25 years in the management of water demand through five-yearly Water Resource Management Plans. They are required to produce asset management plans every five years, which provide the basis for the Periodic Review of water pricing. There would be benefits from better integration across these different plans and synchronising of the planning cycles through the River Basin Management Plans of the Water Framework Directive.

Planning for future flood and coastal risk management: a long-term investment strategy

The long-term investment strategy sets out the Environment Agency's evidence and views on the choices that the people of England face concerning the amount of investment needed to manage the risk of flooding and coastal erosion between 2010 and 2035.

The strategy describes:

- The present scale of flood and coastal erosion risk, and the achievements in managing it so far.
- An analysis of the investment needed to adapt to a changing climate and to manage the potential increased risk over the period 2010-2035.
- Ways to manage flood and coastal erosion risk more efficiently.
- An analysis of the benefits of investment, and the potential to broaden the sources of investment.

Priorities for protecting and improving waters

It is not practical to improve all waters to reach good status at the same time. It is often necessary to plan many years ahead to secure the investment needed to make the necessary improvements. Choices have to be made over where and over what period future investment should be made. Our main priorities in targeting future investment and action are:

- To protect and improve those waters designated as most important to society for:
  - drinking
  - nature conservation
  - bathing
  - commercial fishing
  - supply to industry and agriculture
- To protect the existing status of waters by preventing deterioration.
- To make improvements to waters that offer the best value to local communities with the aim of achieving good status.

Water industry investment and the National Environment Programme

When the water industry was privatised in 1989, the Water Services Regulatory Authority, Ofwat, introduced a five-yearly review of the prices that water companies can charge their customers, known as the ***Periodic Review***.

Water companies have to produce ***Asset Management Plans*** that set out the investment needed to meet customer service standards and environmental improvements.

The investment needed to meet national environmental obligations, including European standards, is coordinated through a ***National Environment Programme***. Since privatisation, water companies have invested more than £20 billion in environmental improvements, much of which has been driven by the standards of European Directives.

As the main environmental regulator in England, the Environment Agency plays a key role in the Periodic Review cycle. We work with the water industry to develop long-term solutions that better protect the water environment and secure wider benefits to society and the economy. We work with water companies to find innovative and sustainable solutions to the challenges they face. Through our evidence, information and advice we help to target the investment needed by the water industry to meet environmental requirements. In our role as environmental regulator, we then ensure that water companies meet their commitments through relevant permitting systems.

In the future planning of water industry investment we want to see:

- A resilient water industry that manages its infrastructure to reduce flood risk and meet the challenges of growth, development and a changing climate.
- No deterioration in the current quality of the environment, and catchments at or moving towards good ecological status or potential.
- A secure water supply with properly managed demands that ensures enough water for people, agriculture, business and the environment.
- Bathing and shellfish water quality and priority habitats protected and improved where required.

The Water Framework Directive

The European Water Framework Directive (WFD) provides the main framework for managing the water environment throughout Europe.

At its heart is an ecosystem approach that requires measures to be taken to promote the sustainable use of water and to protect and improve inland surface and groundwaters and coastal waters, with the aim of achieving good status. It recognises that interested groups need to work together to design and implement improvements.

A management plan must be developed for each river basin every six years. The plans are based on a detailed analysis of the effects of human activity on the water environment, and include programmes of measures to improve water bodies where necessary.

The main aims of the WFD are to:

- Improve the status and prevent further deterioration of water and wetland ecosystems.
- Encourage water to be used in a sustainable way.
- Reduce pollution of water, especially by priority hazardous pollutants.
- Protect groundwater resources and make sure groundwater pollution is progressively reduced.
- Achieve the water quality standards required in protected areas.

The Environment Agency is the competent authority for implementing the WFD in England.

River basin planning

The government has identified ten **River Basin Districts** in England. Some of these extend across national boundaries with Wales (the Severn and the Dee) and with Scotland (the Solway Tweed). These are the main units for implementing important European legislation, including the Water Framework and the Floods Directives.

River Basin Management Plans (RBMPs) provide an overview of how water will be managed and the objectives and actions for waters in each River Basin District.

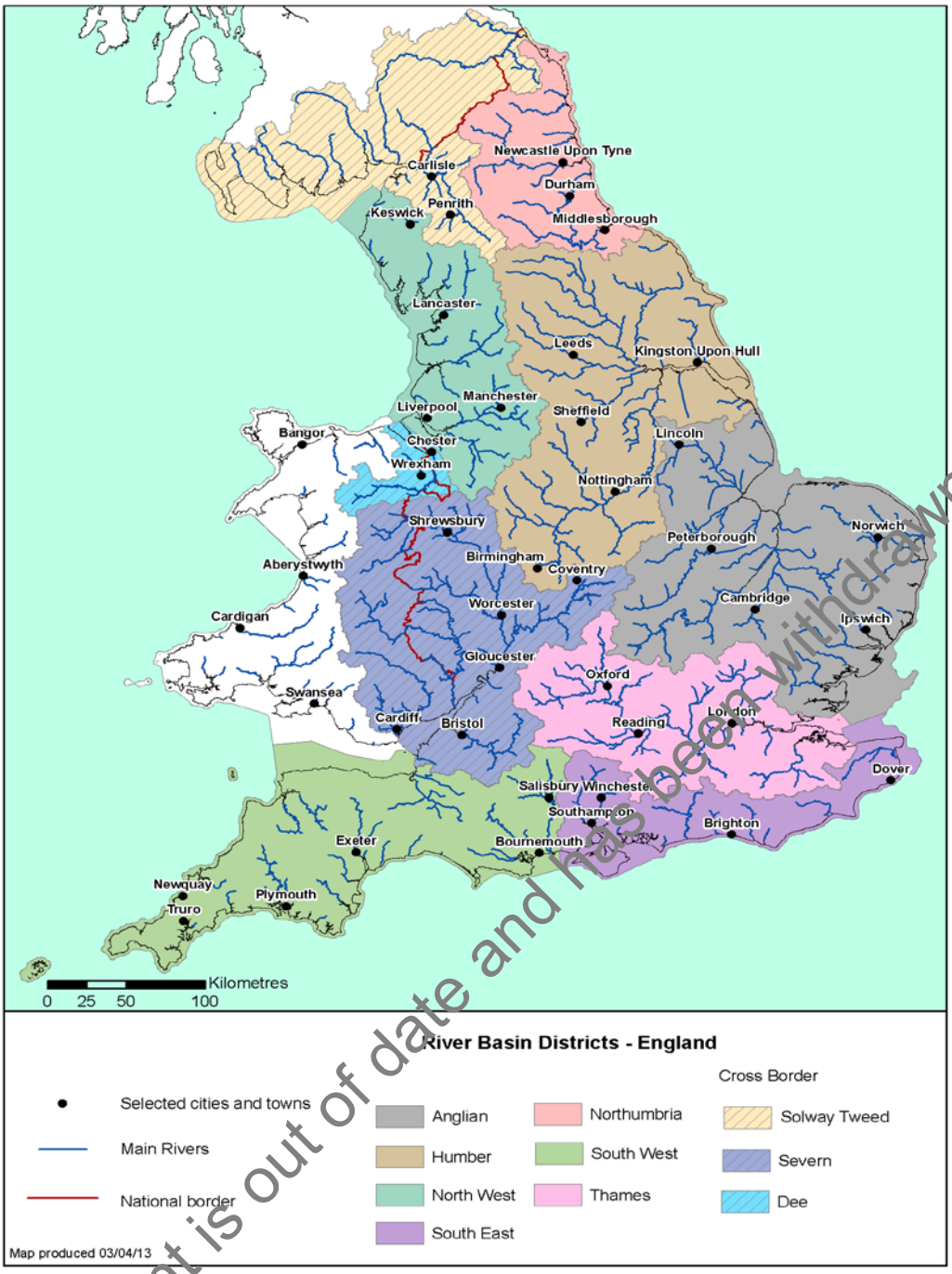
The RBMPs explain how decisions affecting the water environment are made. They also outline what society can do to create a healthy water environment for now and into the future. The RBMPs are important because they show businesses, water users and organisations what they need to do. They are not a full, detailed list of actions. Instead, they provide the basis for agreeing detailed work plans, making clear how they will be developed, achieved and monitored in a clear, fair and consistent way.

We published the first set of River Basin Management Plans in 2009. The plans will be reviewed and updated following consultation in December 2015.

River Basin District Liaison Panels include a range of organisations, which help to set the strategic overview for river basin plans and the actions required in key sectors. They:

- Provide evidence to help make decisions and monitor progress.
- Track progress in improving and protecting the water environment.
- Provide the focus for stakeholders to work together to develop the RBMP and to make sure the right people are involved in making decisions.

Annex 2 provides a description of the main water management plans that we and others use in river basin and catchment management.



River Basin Districts

Catchment planning

Each River Basin District is broken down into a number of catchments, which provide the focus for more detailed planning and working with others.

Different plans are in place for each of the main catchments and, in some cases, for sub-catchments. They provide the basis for planning actions and investment for specific functions such as water abstraction and flood and coastal risk management. We are the lead organisation in developing some plans, and provide information, advice and guidance to organisations that lead on others.

With our partners we are working towards a more integrated approach to catchment planning. We have an important role in providing common evidence and information for each catchment that supports the different plans and helps to identify the links between them. Drawing on this information base, the RBMPs will provide a catchment by catchment summary. They will provide signposts to and make the connections between the more detailed plans that apply in each catchment.

Catchment management planning has been applied successfully for many years in the UK. We are building on this experience to work towards a more inclusive approach where organisations and communities come together to agree what actions are needed locally and to build partnerships to fund and carry them out.

This ***catchment-based approach*** recognises the different strengths, knowledge and capacity that organisations and community groups can bring. It helps to make sure that local knowledge is used to drive local change by:

- Identifying and understanding issues within a particular catchment.
- Involving local groups in making decisions.
- Sharing evidence.
- Identifying priorities for action.
- Taking action in cost effective ways that protect and improve local resources.

A series of catchment pilots is being taken forward to test this approach, some led by the Environment Agency, and others led by a range of organisations including Rivers Trusts, Wildlife Trusts and water companies.

6. The benefits of our work

Our work in managing water provides a wide range of benefits to people, the economy and the environment.

Securing a safe supply of water now and for the future

The economy relies on a secure supply of water for many different uses such as supplying drinking water, producing food and drink, generating energy, and irrigating crops. Through our work in regulating water abstractions and discharges, and reducing pollution incidents we contribute to making sure there is enough safe water for water users and for the environment.

Protecting and improving waters

By protecting and improving waters, our work provides many benefits for water users and for wildlife.

Investment in improving water quality and protection from flooding helps to support local economies and communities. Our work in helping to restore previously degraded and contaminated rivers has been an important factor in the economic regeneration of cities and communities across the country.

Millions of people visit waters every year for recreation and relaxation, and benefit from improved water quality in activities such as angling, boating and water sports. Achieving water quality standards at beaches used for bathing underpins important tourist industries in coastal communities.

Improvements in the quality of surface and groundwaters also reduce the costs of treating water that is abstracted for public supply.

Through our work in managing the risks of flooding and coastal erosion we help to create and restore habitats that benefit wildlife. Our projects and programmes support the government's biodiversity objectives for water and wetland habitats and species. Working with different partners many projects have been successful in providing a range of benefits, which include reduced risks of flooding, improved water quality, greater retention of valuable water resources and the creation of new habitats.

Working with our partners we helped to create more than 3,400 hectares of new wetland and saltmarsh habitats between 2005 and 2012.

Restoring the Mayes Brook

Mayesbrook Park was a rundown 45-hectare park in the East London Borough of Barking and Dagenham. The Mayes Brook runs through the park for one mile before joining Barking Creek and then the River Thames. It was typical of many small urban tributaries. It had been canalised and set deep into a concrete channel as part of an old flood management system, which was decaying and needed replacing at a cost of several million pounds. The river was seriously polluted and virtually lifeless. It was fenced to prevent access.

In 2008, an innovative partnership of public, private and voluntary organisations was formed to restore the Mayes Brook and create a new floodplain along it for natural flood management. The partners drew up a 'Master Plan' for the restoration with local residents, and the first phase was completed in September 2011. One year later, many small fish are already being seen in the river.

The scheme will bring many benefits to local communities. It will help to reduce flood risk, bring recreation and educational opportunities and provide important habitats for wildlife. The social and health benefits of the restoration are expected to be significant, helping to improve the quality of life for residents and the wellbeing of local communities.

The overall economic benefits of the Mayesbrook Park restoration were assessed over 40 years. The lifetime benefits of the parkland and river restoration are roughly £27 million. The estimated costs of the whole Mayesbrook Park restoration scheme is just under £4 million (including the river restoration works), a lifetime benefit-to-cost ratio of approximately 7 to 1.

Mayes Brook before and after the first phase of restoration (completed in September 2011)

Protecting people, homes, businesses and infrastructure

The water environment provides many benefits to society and the economy. But it can also cause serious damage and disruption. The 2007 floods, for example, cost businesses, infrastructure providers and utilities more than £1.3bn. Our work in flood and coastal risk management helps

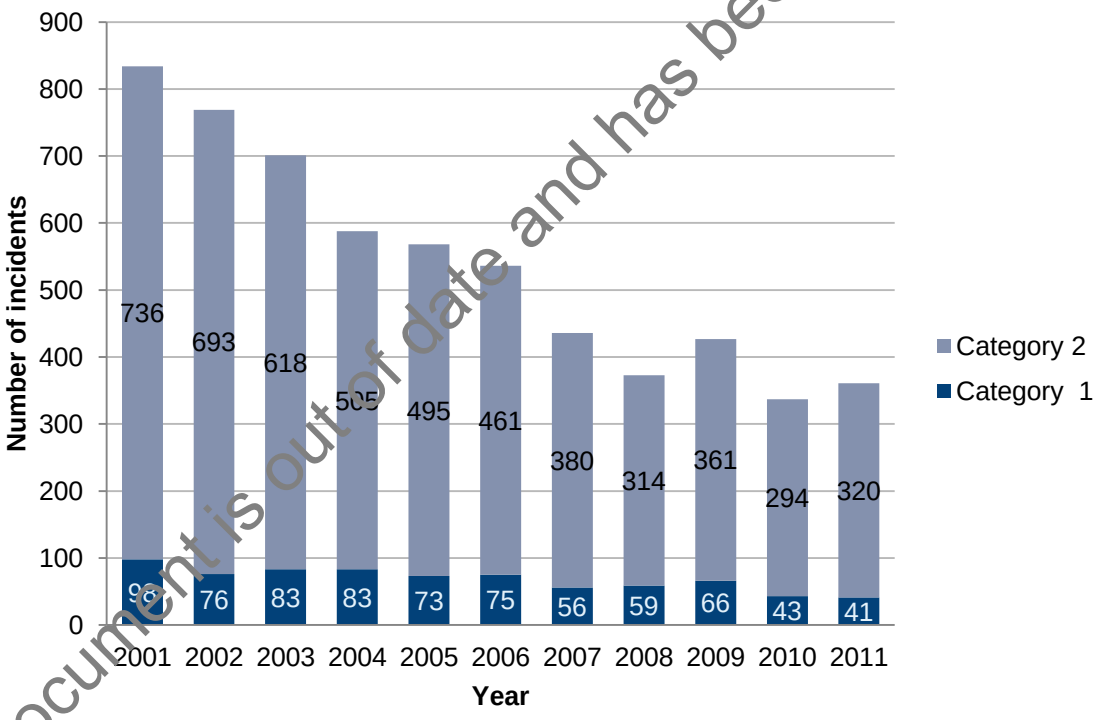
reduce the risks to people, properties and businesses. It helps reduce serious disruption to infrastructure such as roads and railways, and vital services such as water and electricity supply.

We aim to better protect at least 145,000 houses in the period 2011 to 2015 through a combination of flood and coastal defence schemes, flood forecasting and warning, and individual property protection. Investment in reducing the risks of flooding makes good economic sense by avoiding the much higher cost of repairing damage.

Between 2003/4 and 2011/12 investments in flood risk management reduced the likelihood of flooding to over 380,000 households.

Preventing the damaging effects of pollution

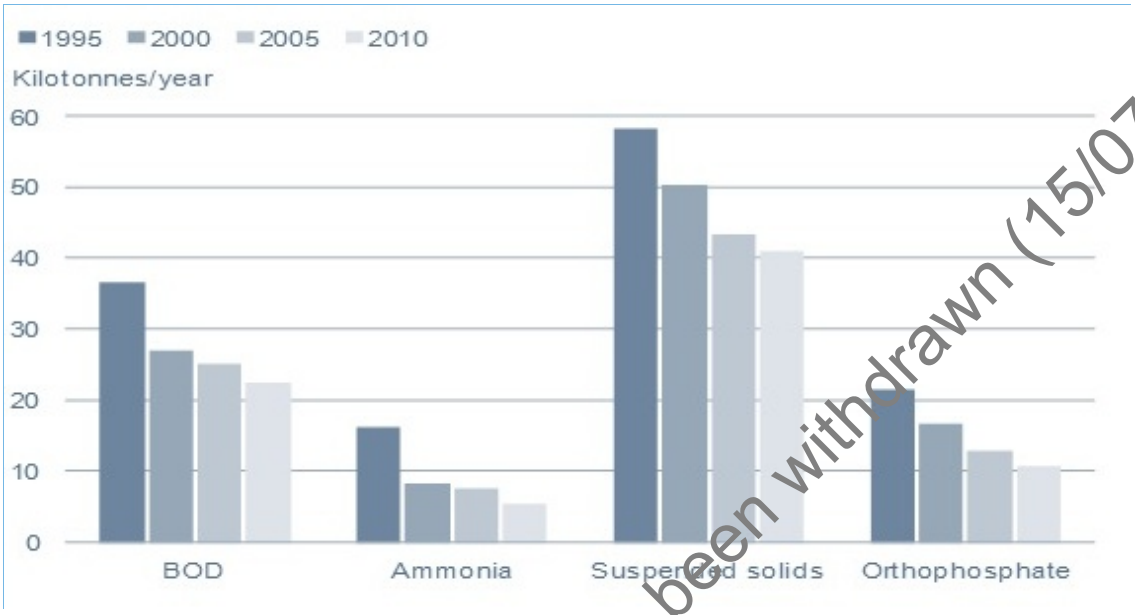
Pollution incidents can have devastating effects on wildlife and can endanger human health. Working with different business sectors on pollution prevention campaigns and taking enforcement action where necessary, the number of water pollution incidents has reduced in recent years. The number of serious incidents more than halved between 2001 and 2011.



Serious water pollution incidents

Between 2001 and 2011 the number of serious water pollution incidents reduced by more than 50 per cent.

Investment in sewage treatment and sewerage systems, and measures to manage manures and slurries on farms have led to a significant reduction in organic pollution in inland and coastal waters over the last twenty years. For example, the inputs of ammonia and phosphate from sewage effluent discharged into rivers more than halved over the period 1995 to 2010 resulting from investment by water companies.



Pollutant loads discharged to rivers from water company sewage treatment works

Improving efficiency in the use of water resources

Our work in promoting more efficient use of water is important because it reduces the demands on water resources, which are already under stress in many parts of the country. Using water more efficiently saves money for households and businesses. For example, we are leading a partnership with the seven water companies in the South East Region to facilitate sharing of water resources. Greater sharing could reduce the need for new infrastructure generating estimated savings of over £500 million by 2035 for water companies and their customers, including businesses. We are now working to develop similar groups in other areas, for example, East Anglia.

We also contribute to water efficiency by reducing the amount of water we use. Between 2005 and 2011 we reduced the total amount of water used in the Environment Agency by 31%.

Reducing the regulatory burden on businesses

Regulation is important in securing a safe supply of water and making sure that environmental standards are met. Our aim in implementing regulations is to minimise the administrative costs to businesses while still achieving the necessary results for people and the environment.

By taking a risk-based approach, we have removed approximately 23,000 low impact and low risk abstraction activities from licence control, out of the previously regulated total of about 43,000 licences, after Government deregulation in 2005. New abstractors below the deregulation threshold no longer need to apply for an abstraction licence and pay the application fee.

7. Our response to the challenges ahead

There has been great progress in improving the water environment over the last twenty years, but significant challenges remain. We have four main aims, which will provide the focus for our work in managing water.

Facing the challenges

There is still some way to go to restoring healthy waters. Further action and investment is also needed to make sure that systems and infrastructure are capable of supporting a growing population and are resilient to a changing climate.

Against the Water Framework Directive's target that all waters should achieve good status by 2027 currently only 25 per cent meet all the required standards. We will do all we can within our remit and with the funding available to ensure that waters that are already of good status remain in that condition and that those that need to be improved are on a pathway towards good status. We will continue to work with partner organisations and with communities across the country to achieve this.

For some water bodies, reaching good status is unlikely to be achieved within this timescale because the improvements would be disproportionately costly and technically very difficult, or might create other risks such as flooding. The aim for these waters will be to achieve their best possible status.

The ways we will work

To be successful in facing these challenges we will continue to focus on improving the ways in which we work with our customers and supporting the development and performance of our employees. This involves creating a work environment in which:

- We take a 'yes if' approach in all we do.
- We do more for people and the environment with every pound.
- We focus on outcomes not processes.
- We seek and embrace opportunities to work with others.
- We develop our people and benefit from diversity.

Our main aims

We have four main aims that will guide our work over the next few years. Together, these are part of the Environment Agency's principal aim to contribute towards achieving sustainable development.

1. Protect and improve waters so that they are clean and healthy.

We will:

- Find better ways of working with nature in managing water resources, reducing the risks of flooding and coastal erosion, preventing pollution and adapting to a changing climate.
- Develop and implement updated River Basin Management Plans.
- Develop the catchment- based approach with partners across all major catchments and coastal waters.
- Identify practical and affordable solutions to remove physical barriers to achieving good status.
- Work with others to address known sources of pollution.
- Restore sustainable abstractions.
- Better integrate the water company asset management planning cycle with River Basin Management Plans.
- Work with others to develop a more strategic approach to surface water management and sewerage planning. Help promote the benefits of sustainable drainage systems.
- Help to reduce the impact of damaging, non-native, invasive species.
- Maintain and restore favourable conservation status at protected sites and protect and improve priority habitats and species as our contribution to the objectives of the England Biodiversity Strategy.
- Work with others to bring about local environmental improvements, including Nature Improvement Areas and Local Nature Partnerships.
- Identify opportunities to work with volunteers and community groups.

2. Reduce the risks of flooding and coastal erosion.

We will:

- Develop our strategic overview role and demonstrate leadership in implementing the national flood and coastal erosion risk management strategy.
- Support local authorities with local flood resilience and resistance measures and play our part in multi-agency planning for and responding to major incidents.
- Improve evidence, information, and mapping and modelling tools to better understand the risks of flooding and coastal erosion.
- Promote awareness and advice on the need to avoid inappropriate development in areas at flood risk and the need to manage land to avoid increasing risks.
- Play our part in building, maintaining and improving flood risk and coastal erosion management infrastructure and systems.
- Assess the long-term investment needs of flood and coastal risk management.
- Continue to implement the partnership funding approach to increase and broaden the funding for flood risk management schemes.
- Make the public more aware of the risks of flooding and encourage householders, businesses and communities to take action to manage the risks.
- Improve our flood forecasting, monitoring and warning capability to support better incident management response and to help others act promptly to reduce risk.

3. Make sure there is enough water for people, agriculture, business and the environment.

We will:

- Develop a strategic, long-term view of the future water needs of key sectors including public supply, energy and agriculture. Assess options for managing the balance of supply and demand to make sure that water supplies remain resilient.
- Promote a better understanding of the value of water to society, the economy and the environment. Work with key sectors to raise awareness of the need to reduce demand and use water more efficiently.
- Support Defra in developing a more flexible water abstraction system to deal with unsustainable abstractions, a changing climate and a growing population, that takes account of water quality as well as water quantity.
- Ensure that water companies' resource management plans address security of supply and strike a balance between developing new resources and reducing demand.
- Promote greater interconnections in the water supply system.
- Take a strategic overview of the quality and capacity of water and wastewater infrastructure and promote more efficient and integrated approaches to managing the whole water cycle.
- Ensure that drought management plans take account of the impacts of a changing climate and more extreme weather.
- Work with other sectors to develop new water resources such as on-farm storage.
- Support innovation in water efficiency and water re-use, and ensure that water is only treated to the standard necessary for a particular use.

4. Support sustainable growth.

We will:

- Minimise the administrative burden of regulation on businesses.
- Facilitate innovation in business.
- Make it easier for businesses to access water, and remove barriers to trading of abstraction licences.
- Support local economies by helping to protect properties and businesses from the risks of flooding, and creating opportunities for regeneration and recreation.
- Develop a better understanding of the benefits that the water environment provides to society and the economy and how our work contributes to them.

Appendices

Appendix 1 European and national policy and legislation

Much of the policy relating to water management is driven by European Directives that have been introduced over the last 40 years. Some relate to the water quality required for different uses of water such as drinking water (EC, 1998), bathing waters (EC, 2006) and shellfisheries (EC, 2006). Some set the requirements to protect wildlife such as the Directives on habitats (EC, 1992), birds (EC, 2009) and fresh water fish (EC, 2006). Others concern the control of pollution from particular chemicals such as nitrates (EC, 1991) and hazardous substances (EC, 2006). There is also legislation that sets standards for the performance of sewerage systems and wastewater treatment (EC, 1991), and emissions from industrial processes (EC, 2010). These have been important in driving investment by water companies and others, and have led to major improvements in the water environment.

Over recent years there has been a move to introduce a more strategic approach to water management policy. The Water Framework Directive (WFD) (EC, 2000) provides a major overarching framework for river basin management, with the aim of promoting the sustainable use of water and achieving good status in inland surface and groundwaters, and coastal waters. The Floods Directive (EC, 2007) sets out a strategic approach to flood risk management planning. As competent authority, the Environment Agency has key roles in coordinating the implementation of these Directives in England. The Marine Strategy Directive (EC, 2008) provides a framework for achieving good environmental status in European seas. The European Commission has recently carried out a major review of water-related policy and legislation through its 'Water Blueprint' initiative (EC, 2012). Reforming the allocation of water resources and measures to improve water efficiency are key priority areas for future action.

The Department for the Environment, Food and Rural Affairs (Defra) is the main government department responsible for policy on water management in England. Defra has led the development of several policy initiatives that are important in shaping the future of water management in England. The Water White Paper sets out a vision for managing water in the future in which water is valued as a precious and finite resource. Key commitments include reforming the water abstraction system, and a new catchment-based approach to water quality and wider environmental issues.

The Natural Environment White Paper (HM Government, 2011) sets out the government's ambitions to protect and improve the natural environment, to support sustainable growth and to re-connect people with nature. The England Biodiversity Strategy (HM Government, 2011) describes how the government will implement EU and international commitments on biodiversity. Both of these policies introduce important changes, placing more emphasis on the need for an ecosystem approach in managing catchments and the waters that flow through them.

Appendix 2 Important water management plans

Plan	Purpose	Lead
River Basin		
River Basin Management Plans	To achieve good status for water bodies in River Basin Districts (RBDs).	Environment Agency
Flood Risk Management Plans	To manage the risks of flooding from main rivers, the sea, reservoirs and local flood risks. Based on RBDs.	Environment Agency; Lead Local Flood Authorities
Eel Management Plans	To ensure the long-term survival of eels. Based on RBDs.	Environment Agency
Water Company Area		
Water Resource Management Plans	To take a long-term view of future water demand and set out plans to meet this demand and benefit the environment.	Water companies
Drought plans	Water company plans set out actions to manage security of public water supply during a drought. Environment Agency plans address other aspects of drought management including environmental management and security of supply for other sectors.	Water companies; Environment Agency
National Environment Programme	Five-year programme of improvements in water company discharges and abstractions and measures to improve fish passage and screening agreed through the water company Asset Management Plans. Integrated with WRMPs and RBMPs.	Water companies; Environment Agency; Natural England; OFWAT
Catchment		
Catchment Abstraction Management Strategies	To assess water availability and determine abstraction management strategy through licensing.	Environment Agency
Catchment Flood Management Plans	To take a long-term view and manage the risks of inland flooding from river and tidal flooding.	Environment Agency
Sub-catchment		
Surface Water Management Plans	To provide a framework that allows different organisations to work together and understand the solutions to surface water flooding problems.	Local authorities
Shoreline Management Plans	To assess coastal flooding and erosion risks, identify actions for managing coastal processes and support decisions on sustainable development of the coast.	Coastal Local Authorities; Environment Agency
Water Level Management Plans	To manage water levels at sites of nature conservation importance.	Environment Agency; Internal Drainage Boards
Local Flood Risk Management Strategies	Strategy for local flood risk management in Lead Local Flood Authority areas.	Lead Local Flood Authorities
Multi-Agency Flood Plans	To plan for flooding emergencies together with Local Resilience Forums.	Environment Agency; Local authorities
Salmon and Sea Trout Action Plans	To set out actions that help to meet the objectives of the National Salmon Management Strategy at a local level.	Environment Agency

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