



# Managing flood and coastal erosion risks in England: 1 April 2011 to 31 March 2017

27 March 2018

We are the Environment Agency. We protect and improve the environment.

Acting to reduce the impacts of a changing climate on people and wildlife is at the heart of everything we do.

We reduce the risks to people, properties and businesses from flooding and coastal erosion.

We protect and improve the quality of water, making sure there is enough for people, businesses, agriculture and the environment. Our work helps to ensure people can enjoy the water environment through angling and navigation.

We look after land quality, promote sustainable land management and help protect and enhance wildlife habitats. And we work closely with businesses to help them comply with environmental regulations.

We can't do this alone. We work with government, local councils, businesses, civil society groups and communities to make our environment a better place for people and wildlife.

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# Foreword

5.2 million homes and businesses are at risk from flooding in England; 700 are at risk of coastal erosion over the next 20 years. It's the job of all Risk Management Authorities (RMAs) - the Environment Agency, local authorities, water companies and the internal drainage boards - working in partnership with others, to manage and reduce this risk.

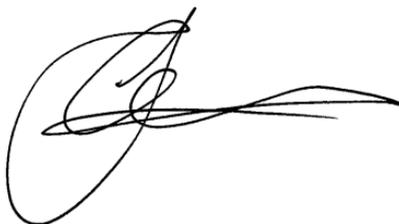
Since 2011 RMAs and partners have been working together to further improve their collective understanding of flood and coastal erosion risk, to plan and implement measures to manage that risk, and to help communities prepare for it.

Together we have extended our forward programme of works for both traditional and natural flood management schemes from one to 6 years. This helps RMAs plan more effectively and work with others to secure partnership funding. These changes, coupled with greater scrutiny of the programme by Regional Flood and Coastal Committees, have helped to get more schemes underway and ultimately ensure more homes are better protected. In the 6 years since 2011 we have collectively increased the protection provided to more than 270,000 homes. We have reduced risk to almost 10,000 kilometres of road and 500 kilometres of railway as well as over 400,000 hectares of agricultural land. We have also created or improved almost 11,000 hectares of habitat for wildlife.

Together we have significantly improved the nation's flood forecasting and warning services, reaching more people in more ways with more accurate information and advice. Over 1.3 million landline and mobile customers are now registered for a flood warning service. We have worked directly with the public to help us provide messages in ways which they better understand and can easily use. Across the RMA network we are working with the public in other ways too. Such as through developing locally-led flood action plans and in the ongoing development of our digital tools putting people at the heart of design.

The period has seen record-breaking extreme weather, rainfall and flooding. Many thousands of householders and businesses have experienced the devastating impact that flooding has on lives and livelihoods. RMAs have worked with the emergency services to continually evolve and improve how we respond to flooding. We have major incident plans in place and many more staff have been trained to respond to flooding. We have worked with communities to help them understand the actions they can take to reduce their own risk and the measures they can put in place to increase their properties' level of protection. The Environment Agency's ambitious asset management programme has ensured all assets damaged during the severe flooding in the winter of 2015 to 2016 had a restored standard of protection by October 2016.

We will never stop flooding and coastal erosion. And we need to plan for increasing pressures under a changing climate and a growing population. But by continuing to work together we can manage this, reducing the risk to communities and helping the country to be more resilient.



**John Curtin**  
**Executive Director of Flood and Coastal Risk Management**



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# 1. The risk of flooding and erosion

5.2 million homes and businesses in England are at risk from flooding. That risk comes from rivers, the sea, rising groundwater and overwhelmed drains and sewers. Some properties are at risk from more than one of these. However, during a significant flood event, we all have the potential to be affected by flooding as local services and utilities are disrupted. Over the period 2011 to 2017 we saw a number of major floods where that risk was a reality for many homes and businesses.

The Environment Agency estimates there are 2.7m properties at risk of river and coastal flooding, 3m properties at risk of surface water flooding and some 660,000 properties at risk from all sources: river, coastal and surface water.

In addition, between 122,000 and 290,000 properties are estimated to be in areas at risk of flooding from groundwater - this may include properties also in areas at risk of flooding from surface water.

The [national coastal erosion risk map](#) show us that approximately 700 properties in England are vulnerable to coastal erosion over the next 20 years. A further 2,000 may become vulnerable over the next 50 years. These estimates take account of the interventions proposed in [shoreline management plans](#) (SMPs). Without the interventions, these figures could increase to about 5,000 properties within 20 years and about 28,000 in 50 years.



**Flooding in Somerset during winter 2013 to 2014**

## Flooding between 2011 and 2017

In summer 2012, the lengthy period of drought the country had experienced came to an abrupt end. Prolonged and intense rainfall increased the risk of flooding from rivers and surface water for long periods. 7,900 properties were flooded across the country, particularly in the south west, including on the Somerset Levels and Moors.

The winter of 2013 to 2014 broke records. It started with a coastal surge and record sea levels on the many parts of the coast, followed by a conveyor belt of 12 storms working their way across the Atlantic Ocean. It became the wettest winter for 250 years and 11,000 properties were flooded. The total economic damages for England and Wales from the winter 2013 to 2014 floods were estimated to be approximately £1.3 billion.

Winter 2015 to 2016 also brought widespread flooding. 17,000 properties across the north of England were affected with named storms Desmond, Eva and Frank causing December 2015 to be the wettest month ever recorded (figure 1). The total economic damages for England were estimated to be a further £1.6 billion.

The impacts of these winters lasted long after the flood waters had receded. It takes time for communities to rebuild their lives and the implications can have a long-term impact on individual's mental well-being.

Autumn and winter 2015 brought successive bands of heavy rainfall, with significant flooding in Cumbria and northern England over Christmas and the new year period.



during 2015 to 2016 where flood risk across England was heightened



December 2015 is the wettest December in North West England since records started in 1910



the highest UK rainfall amount was recorded on 5 December 2015 in the Honister Pass



the highest amount of rainfall recorded in 48 hours was at Thirlmere in Cumbria

**Figure 1. Records set during winter 2015 to 2016**

January 2017 saw a significant tidal surge event. On 13 and 14 January communities along the east coast of England were warned to be prepared for large waves and potentially significant flooding. 17 severe flood warnings (meaning risk to life) were issued along the coast of East Anglia. The areas at greatest risk and most vulnerable were Great Yarmouth, Lowestoft and Jaywick. Evacuation procedures were put in place in those locations and rest centres were opened.

The actions taken by the Environment Agency and partners helped to minimise the impact on communities. Together they protected over 555,000 properties from flooding.

## Understanding risk

The risk of flooding is affected by a range of factors - natural, for example the weather and man-made, for example urban development and the presence of flood risk management schemes. Those who manage flood and coastal erosion risk are continually seeking to improve their understanding of risk and the way in which they communicate this to the public.

Information about the risk of flooding and coastal erosion has many uses, including:

- ensuring that investment in flood and coastal erosion schemes is proportionate to need and directed to where it achieves the best value
- informing developer and local planning authority decisions on future development and infrastructure
- helping emergency planners to prepare how they will respond to floods
- enabling people to understand and make decisions about the risk they face

The Environment Agency provides information showing the areas of England which are considered as being within the 'Extreme Flood Outline'. This is based upon the best information available and takes account of properties in areas with a 0.1% chance or higher chance of flooding in any year. Properties outside these areas may still be impacted by flooding if it affects services such as water and electricity supply or roads and railway infrastructure.

One of the biggest risks is around the changing patterns of rainfall predicted under climate change. After the floods of winter 2015 to 2016, the [National Flood Resilience Review \(NFRR\)](#) reviewed the Environment Agency's approach to modelling extreme floods using best available modelling to assess its sensitivity to potential changes in extreme rainfall. The NFRR report concluded that 'the Environment Agency Extreme Flood Outlines constitute a good representation of plausible severe river and tidal flooding'.

Coastal change, through erosion or permanent flooding of land, has always been a risk for those living and working by the sea. The coast is a particularly dynamic environment and coastal erosion risk is expressed differently from flood risk. Erosion is a process which causes land, and sometimes property, to be destroyed completely over time, while flood is a recurring risk which can happen time and again.

## Improving our understanding of risk

Since 2012, the number of properties the Environment Agency assesses as being at risk of flooding from rivers and the sea has increased from 2.5 to 2.7 million. Property at risk of flooding from surface water has reduced from 3.8 to 3.2 million and the number at risk from all sources has remained the same. These changes have primarily been driven by better understanding the risk as our models and data improve.

The way in which information on flood risk is shared with the public and partner organisations has also improved. The Environment Agency now offers more information to people about their flood risk and flood maps can now be downloaded free of charge.

There have been many recent advances in data and modelling methods. These include improving the details of topography, flood defence height, water level and climate data. We've also improved methods for calculating defence breaching, coastal overtopping and model certainty. Working in close partnership with Defra and the Cabinet Office, the Environment Agency made major improvements to the modelling and evidence base of the risk of widespread flooding in England to inform the Cabinet Office [national risk register of civil emergencies](#). The risk register allows central government, strategic emergency planners and responders to review strategic planning assumptions, emergency response and mutual aid capabilities.

## Communicating risk

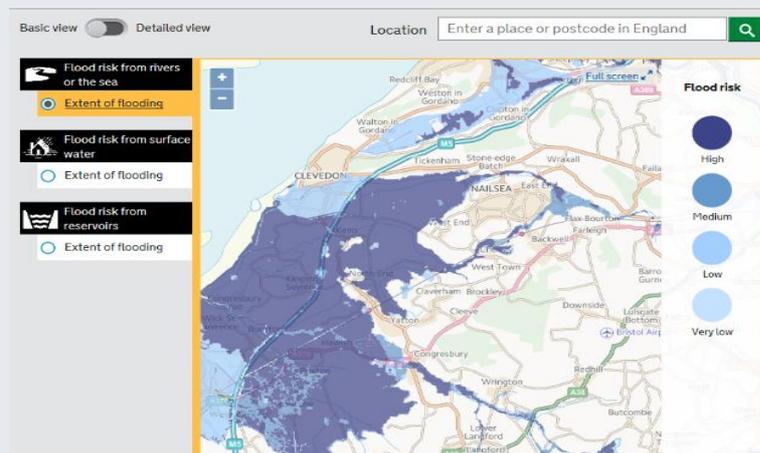
Many people and organisations need access to flood and coastal erosion risk information. It is important that this information is easily understandable and provides clear instruction on what action to take in the event of flooding. Since 2000 the Environment Agency has published its

[National Flood Risk Assessment](#) which is now the main source of information on flooding from rivers and the sea.

## Flood digital

The aim of the Environment Agency's flood digital work is to provide accessible services, clear information and greater interaction between professionals and the public about flooding. It puts users of services at the heart of how online digital services are identified and created. This 'user-centred design' means investing time to engage with the public, businesses and authorities to really understand what information they want and how they want to receive it. Open data is changing the way we all work. In 2016 to 2017, Environment Agency flood data feeds were used over 60 million times.

The Environment Agency's main user-facing service informs and warns members of the public about flood risk and managing flood incidents. Over 1.3 million people are on the Flood Warning Service. It also provides an online permitting service which helps customers to safely carry out works on or near water courses. And [river level information](#) is available online - 100,000 sessions were logged in a single day on Saturday 26 December 2015.



In July 2016, the Environment Agency launched its Long Term Flood Risk Information service. This provides flood risk information in various ways (using text, symbols and maps). It allows customers to check if they are at immediate or long-term risk of flooding. The improved information also describes actions people can take to

manage their own risk appropriate to the flood risk in their area. This followed significant research and public involvement through the [Sciencewise](#) programme. The Environment Agency regularly reviews and improves this service based on feedback.

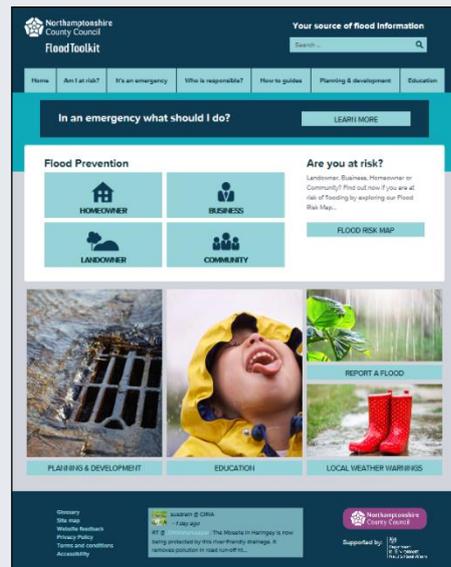
Other organisations also use the Environment Agency's flood risk information as a way to communicate with the public about flood risk and provide advice or help. This is particularly important for organisations that have responsibilities of their own in relation to flood and coastal erosion risk. Northamptonshire County Council's flood toolkit is an award-winning example of how bringing this kind of information together can help communities, individuals and businesses.

## Northamptonshire County Council Flood Toolkit

Northamptonshire County Council (NCC)'s [Flood Toolkit](#) helps communities, individuals, land owners, businesses and technical specialists understand what they can do about flood risk. Launched in March 2015, it provides one source for all flood information.

The toolkit enables users to access a range of information and services, including finding out if they are at risk of flooding, learning how to protect their property and who to contact in an emergency. There's also a flood aware schools pack. Since its launch, the toolkit has received an average of around 90 visits a day, providing information for users before, during and after flooding.

The toolkit is now helping communities beyond Northamptonshire through the development of toolkit elements for other authorities, including Oxfordshire. It has won awards from the Environment Agency, Association of Directors of Environment, Economy, Planning and Transport and the Royal Town Planning Institute for its innovative approach.



The Environment Agency has worked in partnership with local authorities to improve the quality and accessibility of coastal erosion data. The [national coastal erosion risk map](#) (NCERM), published on the Environment Agency website in 2012 uses local authority verified data and provides the first consistent assessment of coastal erosion risk around England. These maps (figure 2) show what is expected to happen where the shoreline management plan (SMP) policies are implemented and what is likely to happen if there is no active intervention along the coast. The Environment Agency worked with local authorities to update the [national coastal erosion risk map](#) between 2015 and 2017 and will continue to maintain this information in the future.



**Figure 2. Extract from the national coastal erosion risk map**

## Weather and flood forecasting

As well as understanding the long-term risk from flooding and coastal erosion, it is important to understand the short-term risk from the weather. The Flood Forecasting Centre (FFC) is a partnership between the Environment Agency and the Met Office that helps emergency responders across the country to do just that. The centre operates 24 hours a day, every day, and provides Emergency responders and Local Authorities in England and Wales with daily flood and coastal risk assessments.

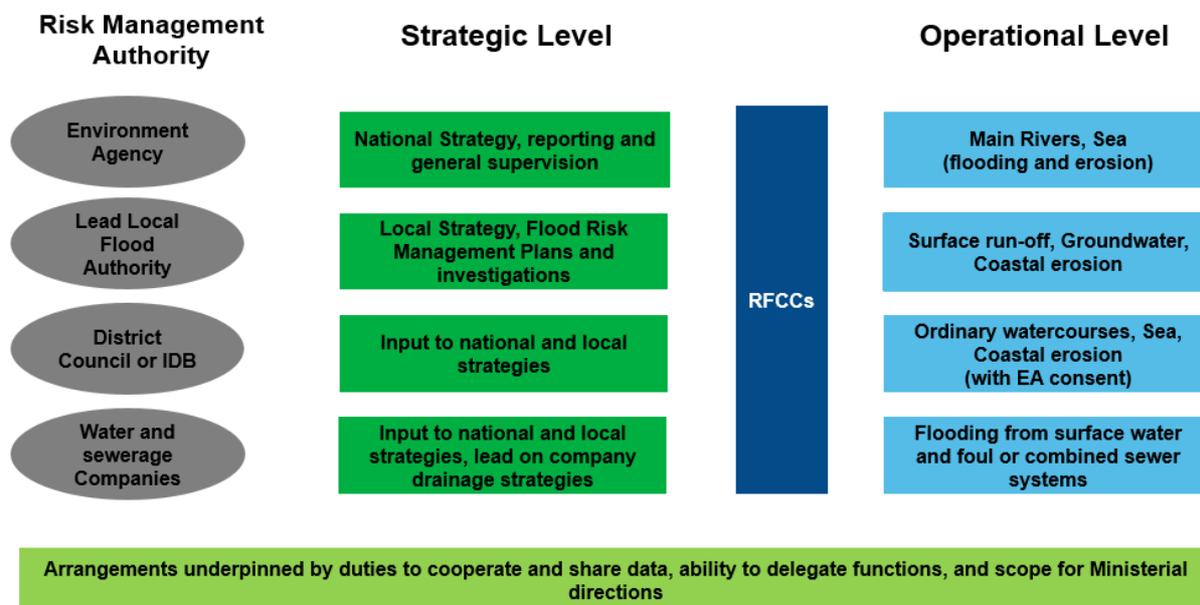
The centre produces a 5 day Flood Guidance Statement and tools for forecasting river, coastal, surface water and groundwater flood risk. The centre also provides training and training materials for flood responders.

The Environment Agency's National Modelling and Forecasting Service works alongside the FCC and plays a major role in mapping flood risk as well as in assuring flood defence models. The service maintains a network of river level, flow, coastal and rain gauges, these provide real-time data which feeds into national forecasting and alert systems.

This service also jointly funded the Met Office upgrade of all-weather radars. These upgrades improved resilience, accuracy and resolution of rainfall observations, and will further improve future forecasting capability.

## 2. Managing flood and coastal risk

The risk from flooding and coastal erosion cannot be totally removed, but it can be managed and the risk reduced. This takes planning across a range of organisations (figure 3), preparing emergency plans for when incidents cannot be avoided, and delivery of different types and sizes of schemes. Above all, it takes collaboration.



**Figure 3. FCRM roles and responsibilities in England**

### Who manages the risk?

It's the job and responsibility of all Risk Management Authorities (RMAs) - the Environment Agency, local councils or unitary authorities, water companies and internal drainage boards - to manage and reduce the risk from flooding and coastal erosion. Setting out these roles and partnerships was an important feature of the Environment Agency's 2011 FCERM Strategy. Collaboration and partnerships take work and an important part of the period 2011 to 2017 has been supporting groups and holding events that have helped to form, maintain and strengthen these.

Part of the statutory responsibility for developing and supporting partnership working sits with the Regional Flood and Coastal Committees (RFCCs). There are 12 committees covering England and they are made up primarily of elected members from lead local flood authorities (LLFAs) alongside representatives of other local interest groups. An independent government-appointed Chair leads each committee and helps to ensure collaboration between represented partners and wider organisations and communities in their region.

RFCCs are an important part of managing and delivering flood and coastal erosion risk management activities. They advise on and oversee the investment schemes for the areas they cover, support the development of funding for local priority projects and works, and bring together partners from across the public and private sectors to gain support and partnership funding for schemes.

The committees also scrutinise the Environment Agency's FCERM Programme of works each year before it is approved and published. In doing this they are able to ensure the needs of their region are properly reflected in decision making. As part of this the committees are responsible for consenting to and agreeing the amount of local levy which can be raised by the Environment Agency from LLFAs. The levy is used to fund FCERM activities within the RFCC's region and

supplements FCERM GIA funding. It is set annually and has totalled between £18 million and £33 million over the period.

### **Catterick flood storage reservoir**

The Catterick flood storage reservoir provides flood protection to 149 properties in the village of Catterick and protects the newly-constructed A1 motorway from flooding from Brough Beck. The project has been possible as a result of excellent partnership working between Yorkshire RFCC, Highways England, North Yorkshire County Council and a local levy contribution of £412k to supplement central government funding. Local levy funding unlocked other funding and made for more efficient construction schedules.



The Flood and Coast Conference is an important part of bringing those who manage flood and coastal erosion together. It provides an opportunity to share lessons, celebrate success, showcase innovations and discuss ways to meet future challenges. Attracting 1,700 delegates over 3 days, the event offers a combination of formal conference sessions and an exhibition space.



Partnership and collaboration is not limited to England or indeed the UK. Learning from and working with international partners is another important aspect which has evolved in the period 2011 to 2017. Memorandums of Understanding with key partners enable this type of work. The Environment Agency is working with the US Army Corps of Engineers to develop international guidelines for natural flood management and with the Australian Bureau of Meteorology to share best practice on warning and forecasting. It is also working closely with Rijkswaterstaat in the Netherlands to share the best of what each other does including hosting Dutch colleagues to observe and learn from flood incident response in England.

## Flood and Coastal Erosion Risk Management Research Programme

Defra, the Environment Agency, Welsh Government and Natural Resources Wales jointly oversee a programme of research to provide evidence, tools and techniques to managers, practitioners, RMAs and responders across England and Wales. Its aim is ensure that high-quality science is available to inform policy and practice. A group of representative practitioners and experts from academia help to identify research proposals and steer priorities to ensure we meet the needs of RMAs across England and Wales. This input is also critical in ensuring the programme looks far enough ahead to allow its output to help RMAs respond to future challenges.

Notable projects during the period 2011 to 2017 include:

- a revision of the industry-standard benefits assessment manual (the Multi-coloured Manual) which provides the data and techniques to all FCERM project business cases in the UK
- continued improvements to the National Flood Risk Assessment which is widely recognised as a world-leading capability
- the development of a probabilistic flood forecasting capability leading to less subjective forecasting and early identification of likely problem events
- new techniques for mapping all sources of flooding resulting in the improved flood map for surface water
- the development of an evidence base for natural flood risk management options

Delivery of specific projects remains an important part of the programme, but over the period 2011 to 2017 focus has shifted so more time is spent on translating research and bridging the gap between basic academic-led research and practitioner needs. As well as commissioning and managing research it also supports academic-led research partnerships with data and expertise. At the start of 2017, 33 active academic partnerships under the joint programme were attracting funding of £32 million from the UK Research Councils and European Commission.

## Collaborative flood and coastal risk management planning

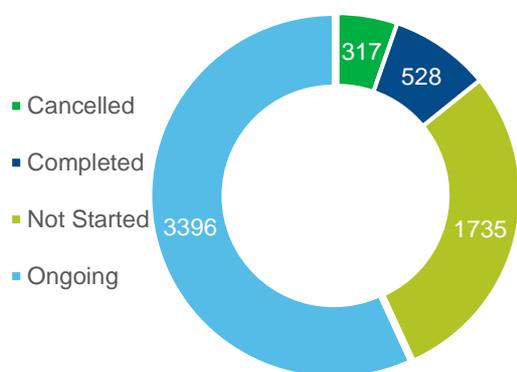
Reducing flood risk needs action from multiple organisations, government departments and the public. To make sure these actions work in harmony, we need to consider short and long-term plans at a national, strategic and local scale. Figure 4 summarises the main organisations working at each level. National plans set the vision for the future and explain the principles that need to be followed, strategic plans help to identify the reality of this for a catchment or area and local plans describe the action that is needed in a particular place.

National	Defra, Department for Communities and Local Government, Cabinet Office, HM Treasury, Department for Transport, Environment Agency, Highways England, National Infrastructure Commission
Strategic	Regional flood and coastal committees, lead local flood authorities, Environment Agency, Highways England, water and sewerage companies, Department for Communities and Local Government, local planning authorities
Local	Lead local flood authorities, local resilience forums, internal drainage boards, water and sewerage companies, reservoir owners and operators, third party owners, Environment Agency, coastal erosion risk management authorities, district councils, highways authorities, local planning authorities

**Figure 4. Organisations involved in planning at national, strategic and local levels**

The Environment Agency's 2011 [National Flood and Coastal Erosion Risk Management Strategy](#) sets the strategic picture for the sector. Its overall aim is to ensure that the risk of flooding and coastal erosion is properly managed by using the full range of options in a coordinated way. Alongside this, the Environment Agency's [long-term investment scenarios](#) (LTIS) study, published in 2014, is an economic assessment of future flood and coastal risk in England for the next 50 years. These two documents form the basis of all work on flood and coastal erosion risk management and are pivotal in securing investment for the future. Both are currently being updated in collaboration with partners.

Highways England's [Road Investment Strategy 2015 to 2020](#) sets out an ambition to revolutionise our roads and create a modern strategic road network that supports a modern Britain. As part of this, the [Environment Strategy](#) (April 2017) sets out how it intends to promote environmental improvements through the operation, improvement and maintenance of its roads. Highways England's work with partners helps to protect and improve the environment and develop and implement solutions to environmental challenges. The strategy promotes positive change and strives for the best possible environmental outcomes. It aims to deliver improved safety by reducing flood risk to communities adjacent to the road network and improving flood resilience.



[Flood Risk Management Plans](#) (FRMPs), first published in March 2016, set out how RMAs will work together and with communities to manage and reduce risk. They cover all sources of flooding over a 5 year period and look forward up to 100 years. This means measures will not begin until later in the period but may also be superseded over time and cancelled (figure 5).

**Figure 5. Progress so far of implementation of measures in FRMPs covering 2015 to 2021, as recorded during 2016 to 2017**

[Shoreline management plans](#) (SMPs) provide the long-term management framework for coastal flood and erosion risks. The 20 SMPs covering the English Coast were first produced between 1995 and 1999 and updated between 2006 and 2012. Coastal groups – partnerships between maritime local authorities, the Environment Agency and other key stakeholders - develop SMPs and work together to implement them.

SMPs identify a sustainable management approach for each stretch of coastline, assigning it one of 4 management policy options: no active intervention, hold the line, managed realignment or advance the line. These policies are applied across 3 planning horizons – 20 years, 50 years and 100 years. This has enabled coastal managers to share a thorough understanding of current and future risks on the coast and identify the most appropriate approaches for managing them.

The Environment Agency is working with coastal groups to plan a review of SMPs. The review will take place between 2018 and 2020 and will ensure that SMPs remain current, fit for purpose and use the best evidence available and to base decisions about how to manage the coast.

Lead Local Flood Authorities (LLFAs) are responsible for developing, maintaining and applying a Local Flood Risk Management Strategy for their areas and for maintaining a register of flood risk assets. Local strategies describe the flood risk in an area and set out the actions the LLFA plans to take to manage it. They are used to help prioritise investment decisions and provide a starting point for LLFAs to engage with their communities.

Each year, the Environment Agency collects information about the progress LLFAs are making in developing their local flood risk management strategies. 134 had published their strategies by 31 March 2017 with 18 yet to be completed. 15 of these were due to be complete within the first few months of 2017/18.

At the most local level most RMAs involve communities in planning for individual schemes which affect them and the risk they face. However communities have also started to get involved with broader levels of planning.

The floods during the winter of 2015 to 2016 led to widespread disruption and significant human impact. Over 17,000 homes and businesses were flooded in December 2015 alone: Cumbria, Lancashire, the north east and Yorkshire were worst affected.

Since the devastating flooding across large parts of the north of England in December 2015, the Environment Agency has worked with communities, government departments and partners to involve communities in planning for the future. [Community flood action plans](#), such as those in place in Cumbria, Calderdale, Mytholmroyd and York, set out how future flood risk will be managed and what action will be taken to protect communities. They provide an essential contribution to the flood and coastal erosion risk management planning landscape.



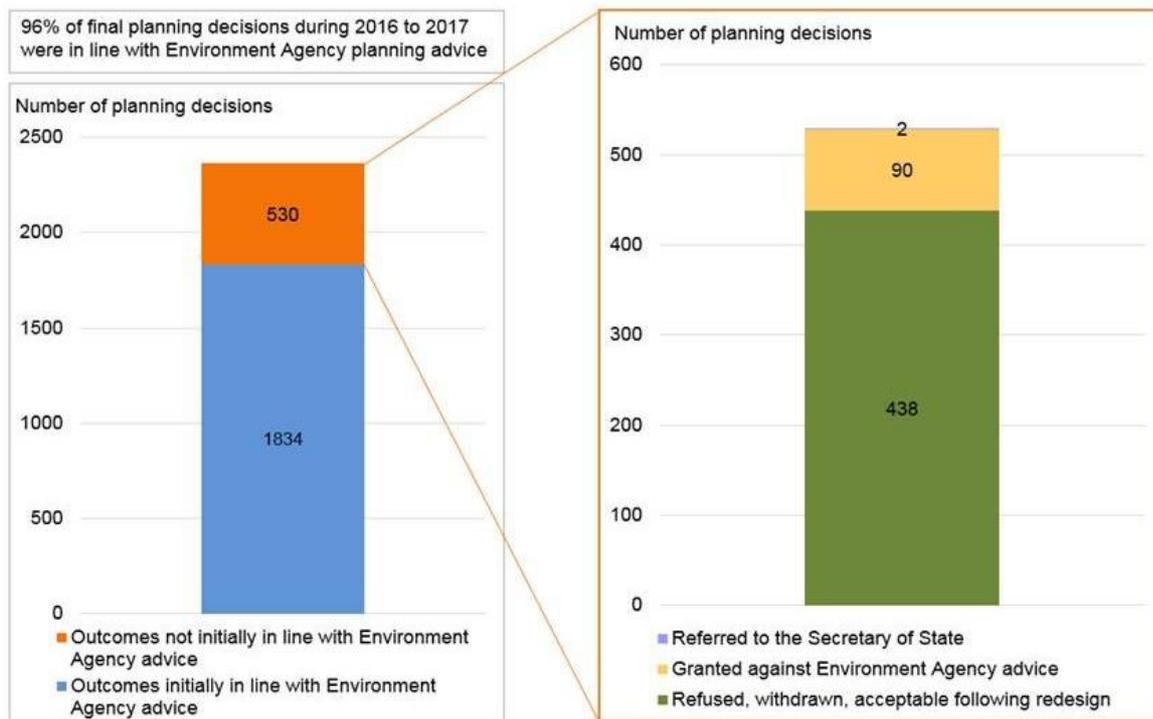
Communities and land-owners often have additional information about the local area which may otherwise not be available. They can help to identify and unlock solutions which might not otherwise be thought of or considered possible. And of course they are impacted by the actions in the plan so it is important that they have a voice.

## Property development and flood risk

The best option is always to prevent development in areas of flood risk. However, about 10% of England is at high flood risk, including large parts of central London, Hull and Portsmouth; which means this is not always possible. Where such development does occur the Environment Agency works with authorities and developers to ensure new build properties are designed to remain safe throughout their lifetime and have adequate protection from flooding through defences, property level resilience, flood warnings and evacuation strategies.

The proportion of new residential development constructed in flood risk areas remains below 9% per year. The Environment Agency is a statutory consultee on all planning applications for development (except minor development) in areas at risk of flooding from rivers or sea. It provides advice to help ensure any development in these areas is resilient to flooding and most authorities take on board this advice.

During 2016 to 2017, over 96% of residential units in planning decisions were in line with Environment Agency advice (figure 6) and over 94% of local authority-led development plans ensured the most vulnerable development allocations were located in areas at a lower risk of flooding.



**Figure 6. Outcomes of planning decisions in 2016 to 2017**

In April 2015, LLFAs became statutory consultees on major planning applications with surface water drainage implications; previously, the Environment Agency performed this role. Local planning authorities (LPAs) continue to consult the Environment Agency on proposed developments in locations where the Environment Agency has notified the LPA of critical drainage problems, as well as those areas where the risks from sea and river flooding are greatest.

In 2016, the Environment Agency updated its climate change advice for developers and local planning authorities, reflecting the variability in climate change impacts on flood risk across different river basin districts. This new approach allows for more resilient developments, better prepared for the impacts of climate change.

## Raising awareness of flood risk

Over the last 6 years the Environment Agency has targeted the 5.2 million households and businesses in England at risk of flooding with information and advice about how to prepare for, and respond to, flooding. The annual 'flood action campaign' is a key aspect of its work to warn and



inform. This helps protect lives and possessions during a flood, and reduces the overall cost to society. The campaign's primary objectives are to motivate people to check their flood risk, sign up for flood warnings and then know what actions to take when they receive them. Building public awareness of flood risk and encouraging

preparatory action reduces clean-up and recovery costs. It also helps reassure the public of the help available to at-risk communities, families and businesses to prepare for flooding.

Over the years, campaigns have gradually moved from traditional forms of communication to a largely online presence, following the government's 'digital by default' approach. Last year's campaign resulted in 30,800 visits to the campaign page on GOV.UK and 12,000 visits to check flood risk. Our tweets had a potential reach of over 36 million and #floodaware was used 7,200 times.

## Better incident response

As with managing flood and coastal erosion risk, a number of bodies are responsible for dealing with emergencies. Local resilience forums, Category 1 and 2 responders (the emergency services, local authorities, NHS bodies) respond to most emergencies with Category 2 organisations (the Health and Safety Executive, transport and utility companies) supporting as 'co-operating bodies'. The Environment Agency is a Category 1 responder and takes a lead on river and coastal risk, with LLFAs taking the lead for local risks from other sources.

The Environment Agency has developed a 5-year flood incident management plan which sets out objectives to increase the quality and availability of information so that people can better understand and respond to impending flooding. It has made significant progress towards implementing the plan already.

As well as having plans in place we also need trained staff in place to respond to flood incidents. RMAs have made good progress in improving their response capacity. The Environment Agency has 6,500 staff trained and ready to respond to incidents, including 500 flood support officers to give direct support to those in flood affected communities.

There's still more to do. The Environment Agency is further evolving the service it provides to make best use of forecast information. Sharing information with customers before flooding will give people time to prepare and take action. The agency is also committed to improving the quality and consistency of its service to communities at risk, working with them to increase their awareness and resilience, so they can do more to help themselves when flooding does occur.

Other Risk Management Authorities have also made considerable progress over the period 2011 to 2017. In their capacity as category 2 responders, water and sewerage companies have made a significant contribution to responding to incidents during the period. Highways England appointed a network resilience team and emergency planners in 2013 to build capacity and work with others during severe weather incidents. It also updates its severe weather plans across England annually.

## 3. Investing to manage risk

Better understanding of flood risk allows the identification and implementation of the appropriate actions to manage risk. Central to these is building and maintaining flood risk management schemes.

Since April 2011, government has invested £2.2 billion of capital on flood and coastal erosion risk management in England bringing a wide range of benefits (figure 7). Of this, £414 million was distributed to local councils and IDB's to deliver local flood and coastal defence schemes. Local levy, made up of contributions from local councils to the 12 RFCCs, forms a significant proportion of investment in local flood and coastal defence schemes. During this period, around £160 million of investment has come from local levy.



Figure 7. Benefits of the 6 year capital programme

Local authorities also receive funding from central government. Funding for their flood and coastal risk management functions, including LLFA duties and provision of surface water drainage advice, is delivered through the local government finance settlement. A breakdown of LLFA allocations is [published](#) but the funding is not ring-fenced and local authorities manage their budgets in line with local priorities. The annual breakdown of LLFA funding between 2011 and 2017 is published in the [Central Government Funding for Flood and Coastal Erosion Risk Management in England](#) report.

### Changes to investment and programming

The past 6 years have seen fundamental changes to investment in flood and coastal erosion risk management. The first of these was Defra's announcement in May 2011 of the new [flood and coastal erosion resilience partnership funding](#) approach. This new approach ensures that government funding is available for any scheme by linking it to better protected homes and economic benefits. The greater the benefit, the more government funding available. Where FCERM grant in aid is not sufficient to fund an entire scheme, it enables a conversation with the communities involved to look for alternative approaches to manage their flood risk. This may result

in the seeking out of funding from other sources to fill any shortfall. Actively seeking contributions from the beneficiaries of schemes has enabled government funding to go further and increase the number of schemes which can go ahead. Total partnership funding raised over the period is £190 million, 46% for schemes led by the Environment Agency-led projects and 54% for schemes led by other risk management authorities.

### Great Yarmouth tidal defences



12 km of flood defences in Great Yarmouth reduce the risk of tidal flooding from the tidal River Yare to over 6,000 homes and businesses. Most of the defences provide a good standard of protection but some of the steel piled quays supporting Environment Agency defences are corroded and in need of

repair.

The Environment Agency has developed a 5 phase programme over 50 years to 2061. The first phase was completed in December 2016. It involved a £28 million project to replace the 660 metres in the worst condition. Funded through the government programme for growth and acceleration and with Regional Flood and Coast Committee support through local levy and partnership funding, the project directly reduced the risk to 465 properties and achieved £2.2 million in efficiencies.

Phase 2 of the project trialled innovative technology known as a Limpet Dam – this temporary structure allowed engineers to inspect and repair the river wall in a dry environment that would otherwise be underwater. As a result, 80 metres of defences have been rejuvenated for only £715,000 rather than the estimated £2.4 million replacement costs. This stage of Phase 2 was completed in April 2017.

The second major change to investment was the move from an annual to a 6 year capital settlement (April 2015 to March 2021), announced in December 2014. Together these two changes are helping to deliver substantial benefits across society and the economy and on much more than just flood risk.

The 6 year settlement enables updates to the current rolling programme, rather than creating a new programme each year as part of the annual allocation of capital funding. The investment programme is already bringing improved protection to homes, businesses, infrastructure, agriculture and the natural environment. In the first 2 years since April 2015, 360 schemes have better protected 100,000 homes.

## Lincshore

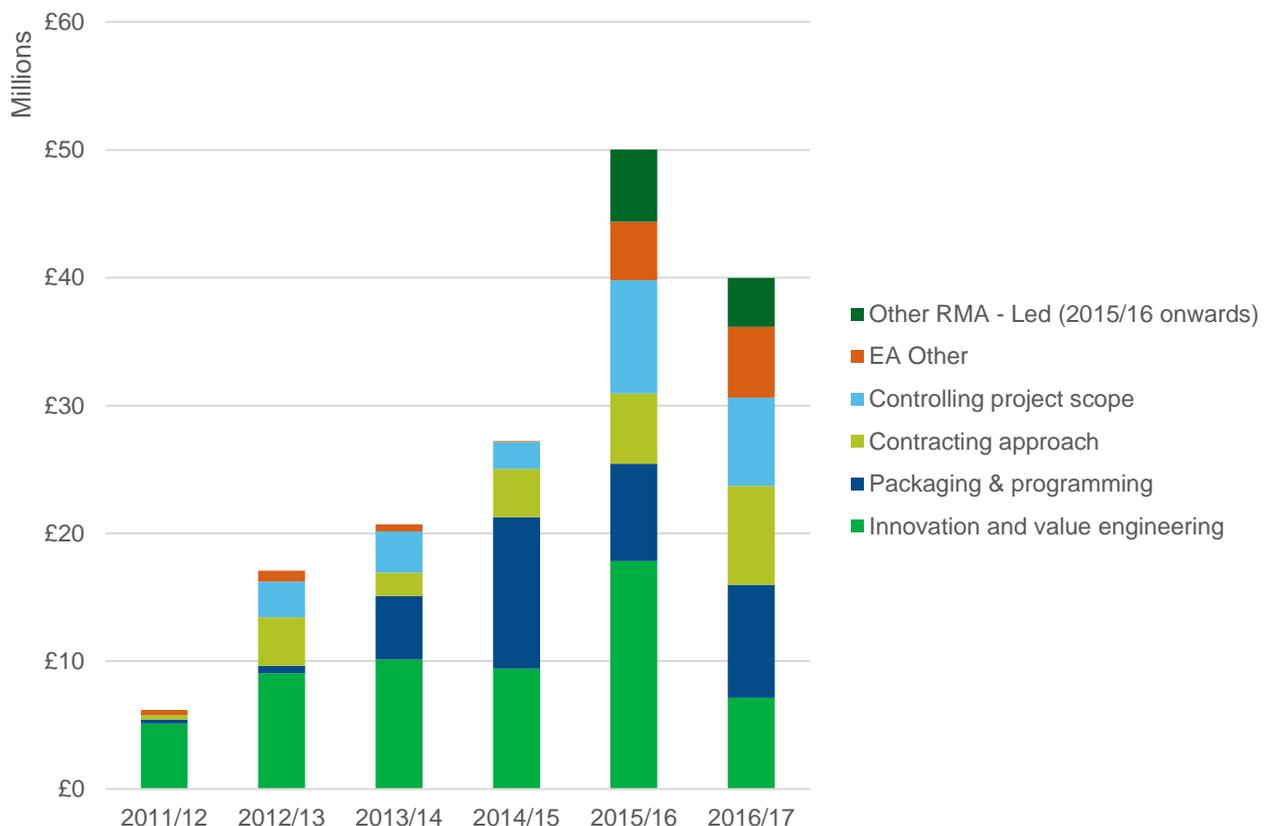


The Environment Agency's Lincshore scheme annually dredges sand from the sea bed and pumps it onto the beaches on the Lincolnshire coast, replacing levels lost to the sea during storms in winter. This coastal defence scheme first began in 1994 and protects 16,000 residential properties and 1,700 commercial/industrial properties.

Without it being replaced the beach would eventually erode to its underlying clay which would undermine the raised concrete flood defences along the coast. The most

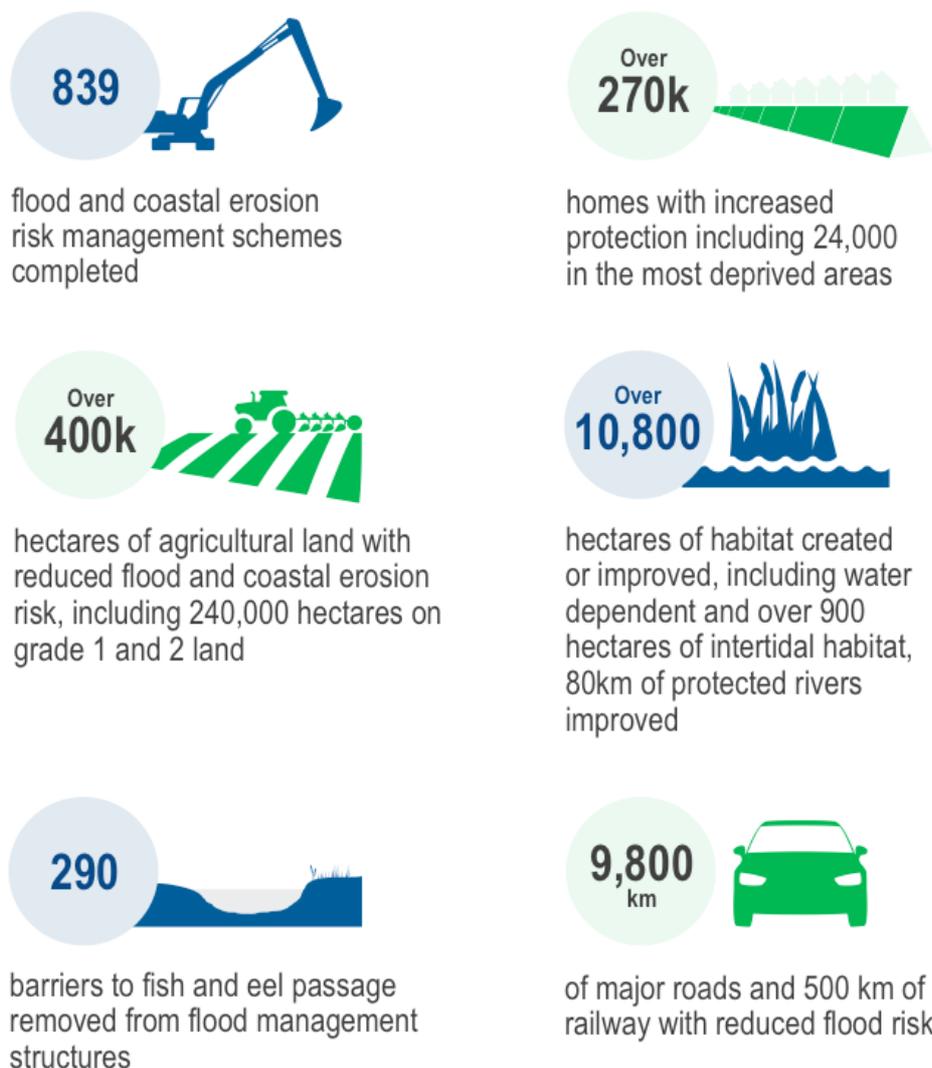
significant breaches of these coastal defences occurred in 1953. Extreme surge tide levels and severe wave action caused erosion and multiple breaching of the natural dunes along with wave overtopping of the hard defences. This in turn led to erosion of the rear of the defences, and their collapse leading to the loss of 43 lives and major property damage.

A condition of this longer term-investment was to demonstrate efficient delivery of the capital investment programme. Savings have been delivered through innovation, value engineering, longer-term planning and packaging of work. Efficiency savings from April 2011 to March 2017 totalled over £161 million (figure 8); these are verified quarterly by the Infrastructure and Projects Authority.



**Figure 8. Efficiencies achieved between 2011 and 2017**

Flood and coastal erosion risk management schemes completed during the reporting period by risk management authorities have made significant achievements (figure 9).



**Figure 9. Key achievements in flood and coastal erosion risk management between 2011 and 2017**

## Maintaining defences

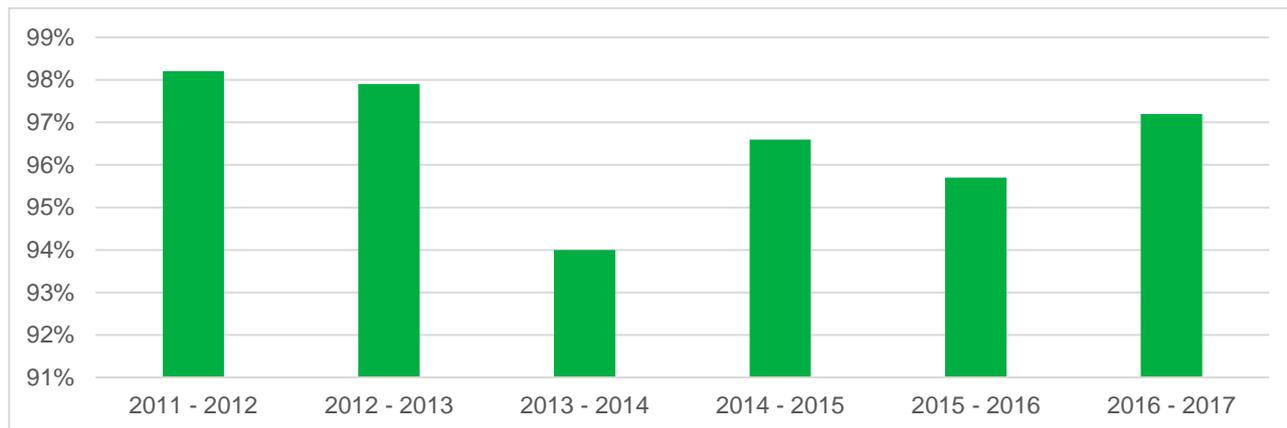
The Environment Agency manages and maintains around 7,000 km of defences on main rivers, around 1,000 km of coastal defences (such as sea walls), 17,000 structures (from the iconic Thames Barrier to individual pumping stations and flood gates) and operates permissive powers on 36,000 km of main rivers. Local authorities, internal drainage boards and private riparian owners are responsible for maintaining 2,400 km of defences and around 26,700 structures.

Routine maintenance of these assets prevents their deterioration and ensures they are operationally ready in the event of flooding. The Environment Agency monitors condition of assets on an ongoing basis to help target maintenance and investment.

The Environment Agency sets emissions targets for its flood risk management activities in an effort to reduce its carbon use. By initiatives such as making pumping stations more efficient,



installing energy efficient lighting, and improved heating and cooling systems in buildings, the Environment Agency has reduced carbon emissions by 33% during this period.



**Figure 10. Percentage of Environment Agency assets meeting target condition**

The condition of Environment Agency maintained assets has fluctuated across the last 6 years (figure 10), due to damage caused by significant flood events in 2013 to 2014 and 2015 to 2016, and by disruption to planned programmes of work as a result of flooding.

The Flood and Water Management Act 2010 requires all 152 lead local flood authorities to maintain, and make publicly available, a register of structures which may have an impact on flood risk in their areas. [Guidance](#) on this was published in March 2011. In annual reporting as at 31 March 2017 only the Isle of Wight Council reported it had yet to start work on its asset register.

## Natural flood management

Natural flood management (NFM) is about using or recreating natural landscape features to reduce the risk from flooding. It typically involves slowing or storing flood water. Examples range from big projects like restoring natural bends on artificially straightened rivers so water flows more slowly to creating natural blockages causing water to pond in upland areas. As well as reducing the risk of flooding, NFM can help create habitats for wildlife, improve water quality and even store carbon.

### Medmerry realignment scheme

This £28 million scheme in West Sussex was opened in November 2013 and involved the largest realignment of open coast ever in the UK. This allowed an area that was not previously exposed to flooding by the sea to become flooded by removing coastal protection.

The project has provided 7 km of new embankments, protecting almost 350 properties.



It has also created a large nature reserve at Medmerry and 183 hectares of intertidal habitat.

Further work has opened up new footpaths, cycleways and bridleways. The Royal Society for the Protection of Birds is now managing the wildlife habitats and access, and the Environment Agency is continuing to manage the flood risk management aspects

NFM is not new. The Environment Agency and other Risk Management Authorities include it in many of their schemes often in combination with more traditional flood defence walls. It's harder for us to be as confident in its effects as in hard engineering schemes but we've collected the evidence from NFM schemes across the country and [published it](#) to help everyone see where NFM might be an appropriate solution. In addition the Government has allocated £15m to the development of NFM.

### Morpeth Flood Alleviation Scheme



The scheme opened in August 2015, at a cost of £26m, (including £12m from Northumberland County Council). It includes one of the largest flood storage reservoirs the Environment Agency has ever built and reduces the risk of flooding to 1,000 homes and businesses in the area. The upstream dam and storage area on the Mitford Estate works by

storing up to 1.4 million cubic metres of water when river levels are high. Since the scheme started in 2013, new defences have been constructed in the town and existing ones improved. Morpeth is now protected from a flood with a 0.7% chance of happening in any given year or an event of a similar scale to the severe flooding that occurred in September 2008.

The work included making sure new flood defences fit with Morpeth's history and ensure the nationally important white clawed crayfish continues to thrive in the River Wansbeck. The scheme created 17 hectares of new habitat for local wildlife.

## Reservoir management

The Environment Agency is responsible for regulating the 1,810 third-party-owned large raised reservoirs in England. Since 2011, 76 new or existing reservoirs have been registered for the first time. The Environment Agency also operates 213 large raised reservoirs, mainly for flood risk management purposes and has constructed 24 new ones over the last 6 years.



**Birkby Nab Reservoir, Ripon, Yorkshire, completed in 2017**

Inspecting engineers make statutory periodic inspections of reservoirs, and identify any 'measures in the interests of safety' which may be needed. Reservoir owners or operators would be breaking the law if they did not carry out these measures within the time allowed.

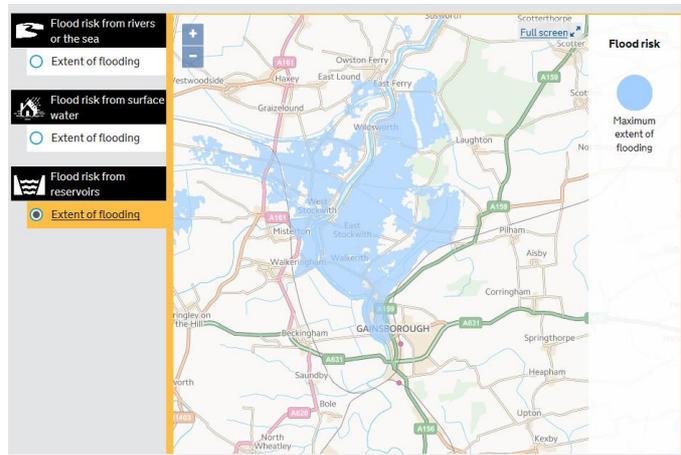
The Environment Agency has made concerted efforts to tackle non-compliance, working closely with owners and operators and offering advice and guidance to help them comply. Levels of compliance are monitored regularly, and consistently

show that more than 96% of the regulated reservoirs in England are compliant.

In 2013 the Flood and Water Management Act 2010 amended the Reservoirs Act 1975, requiring the Environment Agency to designate large raised reservoirs as high-risk where, in the event of an uncontrolled release of water from a reservoir, human life would be endangered. Only high-risk reservoirs will have to meet the full requirements of the Reservoirs Act in future. The Environment Agency has reviewed all large raised reservoirs to assess their level of risk; around 90% of them have been classified as 'high risk'.

The Environment Agency has published [maps](#) since 2010 showing areas at risk from flooding in the unlikely event of a reservoir failure during a given scenario known as a 'wet day scenario' (figure 11). These are for emergency planning purposes only.

In 2016 to 2017, only one incident at a dam or reservoir in England was reported, compared to an annual average of 7 reports prior to this. All reportable incidents are investigated so that lessons can be learned and shared.



**Figure 11. Extract from the reservoirs map, used for emergency planning purposes only**

# Looking ahead

Over the past 6 years RMAs and partners have adapted to shifting and growing pressures, learning lessons through collaboration and continuously seeking to evolve. However, the pressures we face will continue to grow. Our climate is changing, we are already seeing more extreme weather and the forthcoming UK Climate Impacts Programme (UKCIP18) scenarios will help us understand how this is linked to climate change. A growing population needs more houses which means there is more impetus to build in areas at flood risk and the associated urbanisation will increase the risk of surface water flooding.

The 25 Year Environment Plan, published in early 2018 sets out the government's ambition to protect and enhance England's natural landscape for now and the long-term. How we manage flood and coastal risk will be a key part of how the plan is implemented and RMAs are well positioned to take on the challenge. Collaboration between RMAs and their partners in managing all sources of flooding and coastal risk and at all spatial scales is essential if we are to achieve this and increase our country's resilience to such pressures.

The Environment Agency has recently begun work to review its strategy for flood and coastal erosion risk management. It is working in partnership with RMAs and a range of other partners to form a collective vision for the future of flood and coastal risk management. The aim of this coalition of partners is to identify the initial measures needed in order to achieve a shared vision and then to deliver it together.

Defra has recently announced its intention to review the Government's Policy Statement on flood and coastal erosion risk management. These documents will set the direction for policy and delivery of flood and coastal risk management in the future. But these are not the only forward looking pieces of work. The Environment Agency plans to deliver a new national flood risk assessment which will assess risks from surface water as well as rivers and the sea. It will provide partners and the public with more detailed information on flood depth and velocity and take the first steps towards modelling flooding from all sources. Alongside this it is also working to publish updated maps, expected by 2019, which will include modelling of different scenarios and information such as dam breach conditions, flood extent, depth, velocity and hazard for each reservoir.

The current 6 year capital investment programme ends in March 2021 and consideration is already being given to what a future programme may look like. This will be informed by the next Long Term Investment Scenarios (LTIS) analysis which will provide an updated view on the optimal amount to spend on flood risk management. The new analysis will build on the existing information and address a number of emerging questions and issues. These will include high range climate change scenarios, development controls, standards of protection, property level resistance and resilience, temporary community defences, natural flood management, and risks to infrastructure.

Alongside this, the Environment Agency is developing new techniques and skills to provide an increasingly efficient and professional flood incident service. By 2020 it plans to improve and replace its warning, forecasting and telemetry systems to provide greater efficiency, increase consistency as well as improved services for all.

As well as these visionary pieces of work all RMAs will continue working together and with partners to deliver £2.6bn of government investment by 2021, better protecting 300,000 homes from flooding and coastal erosion.

But most important of all, RMAs and their partners will continue to sustain and grow strong partnerships and collaborations - including with the communities affected. By doing this we will help ensure that increasing resilience to flood risk and improved coastal erosion management become the norm.

# Acknowledgements

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# Glossary

Defra - Department for Environment, Food and Rural Affairs

FAS - Flood Alleviation Scheme

FCERM - Flood and Coastal Erosion Risk Management

FCRM - Flood and Coastal Risk Management

FFC - Flood Forecasting Centre

FRMP - Flood Risk Management Plan

GIA - Grant in Aid

IDBs - Internal Drainage Boards

LLFA - Lead Local Flood Authorities

LPA - Local Planning Authority

LTIS - Long Term Investment Scenarios

NCERM - National Coastal Erosion Risk Map

NFRR - National Flood Resilience Review

NFM - Natural Flood Management

RFCC - Regional Flood and Coastal Committee

RMA - Risk Management Authorities

SMP - Shoreline Management Plan

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