

# Flood Risk Management in England

*Building flood resilience in a changing climate*

June 2020





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*Building flood resilience in a changing climate*

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## The Geneva Association

The Geneva Association was created in 1973 and is the only global association of insurance companies; our members are insurance and reinsurance Chief Executive Officers (CEOs). Based on rigorous research conducted in collaboration with our members, academic institutions and multilateral organisations, our mission is to identify and investigate key trends that are likely to shape or impact the insurance industry in the future, highlighting what is at stake for the industry; develop recommendations for the industry and for policymakers; provide a platform to our members, policymakers, academics, multilateral and non-governmental organisations to discuss these trends and recommendations; reach out to global opinion leaders and influential organisations to highlight the positive contributions of insurance to better understanding risks and to building resilient and prosperous economies and societies, and thus a more sustainable world.

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# 1. Executive summary

As the world responds to the COVID-19 crisis and governments prepare their economic stimulus plans, the potential compounding effects of weather-related extremes such as floods, tropical cyclones and wildfires could significantly challenge a country's emergency management capacities and slow down socio-economic recovery. This study is focused on building resilience to floods in a changing climate. It points to the need for a paradigm shift from reacting to crises towards a risk-based, anticipatory, holistic and all-of-society approach to managing the potential impacts of catastrophes.

Flooding is one of the most important physical climate risks in many countries, affecting households, communities, businesses and governments on a regular basis.

There are several kinds of floods:

- Fluvial floods (river floods)
- Pluvial floods (flash floods and surface water)
- Coastal floods (storm surge and coastal tidal flooding)

Each kind differs in terms of occurrence, potential damage and management measures.

Building resilience has become a priority for many countries around the world in recent years, due to the major socio-economic effects of flooding, including threats to human lives and livelihoods as well as direct and indirect economic impacts.

The costs associated with floods are growing in many places due to the combined impacts of

- Increasing concentrations of people and assets in areas of high flood risk linked to land use, urbanisation and development practices; and
- The increasing frequency and severity of weather-related events linked to climate change (e.g. changing storm and precipitation patterns and rising sea levels) (Intergovernmental Panel on Climate Change (IPCC) 2018).

Over the last decade, underpinned by three international framework agreements,<sup>1</sup> some governments have started to adopt a more proactive approach to disaster risk management (including for floods), engaging a variety of stakeholders (The Geneva Association 2016, 2017). Despite some progress, a number of hurdles remain related

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<sup>1</sup> The United Nations Hyogo Framework for Action (2005–2015), Sendai Framework for Disaster Reduction (2015–2030) and The Paris Agreement, which have been adopted by over 190 member states.

to policy and regulatory constraints, institutional and sectoral silos and capacities, conflicting and/or competing priorities and insufficient coordination within and across layers of government and with other key stakeholders, such as the private sector and non-governmental organisations (NGOs).

As part of its commitment to strengthening socio-economic resilience to extreme events and climate change, The Geneva Association has undertaken this study to take a deeper look at the evolution of flood risk management (FRM), particularly in light of the changing risk landscape. Specifically:

- This study offers a comprehensive review of FRM in three high-income countries with mature insurance markets: the U.S., England (a constituent country of the U.K., as defined by the Commonwealth) and Germany;
- Special attention is given to mapping the evolution of governance, institutional frameworks and the interplay of different components of FRM, including risk assessment, risk communication and awareness, risk reduction, risk prevention, risk financing, risk transfer (e.g. insurance and alternative risk transfer) and reconstruction measures;
- Trends and patterns are explored and key findings and recommendations for stakeholders aiming to improve FRM systems in any country are provided;
- The study did not set out to draw comparisons among the three countries, or to identify and promote best practices. In fact, a best practice in one country may not be so in another, as it cannot be isolated from the governance, institutional and cultural environments in which it was originally developed.

The methodology, overall findings and recommendations of the entire study are provided in The Geneva Association (2020a). Case studies for the U.S. and Germany are available in The Geneva Association (2020b) and (2020c), respectively.

This report provides a comprehensive review of FRM in England and highlights successes, lessons learned and continued challenges.

## Key findings

- **Flood risks:** Fluvial, coastal, pluvial and groundwater flooding occur regularly, causing damage and losses to communities, businesses and households. Climate change and socio-economic trends are expected to increase risk.
- **Flood events:** The 1952 coastal floods and 2007 summer floods across wide areas of the country stand out as key events that triggered shifts in perception and FRM responses. Winter floods in 2013/14, 2015/2016 and 2019 have led to calls for more investment and growing recognition of the need for an approach that focuses on both resilience and protection.
- **Institutional roles and responsibilities:** FRM entails a range of policies, interventions and activities, delivered by a variety of stakeholders. The approach to FRM is shaped by policy, legislation and other informal rule systems. The Department for Environment, Food and Rural Areas (DEFRA) has overall policy lead, and the Environment Agency (EA) is the main operational body.
- **Legislative action:** Several key pieces of legislation shape FRM governance, including the Civil Contingencies Act (2004), the Flood Risk Regulations (FRR) 2009 and the 2010 Flood and Water Management Act (FWMA). Regular lessons-learned reviews offer important insights, but recommendations are often not implemented.
- **Risk information and communication:** Risk information capability and data accuracy are strong and flood forecasting is highly developed in England, but the use of that information and level of general flood risk awareness remains low. Problems, stemming from different approaches to flood risk mapping and assessment in Scotland and England, cause challenges for stakeholders with cross-border perspectives, such as insurers for their risk management and underwriting purposes.
- **Alerts and early warnings:** Tools and innovative approaches for alerting stakeholders exist. Flood risk information is currently produced and communicated by the Flood Forecasting Centre (FFC), a partnership between the U.K. Met Office and the EA.



- **Emergency preparedness:** Flooding is treated as part of a broader 'emergency' civil protection policy as per the Civil Contingencies Act 2004. DEFRA maintains the National Flood Emergency Framework for England (HM Government 2016a) and Lead Local Flood Authorities (LLFAs) play a key role in emergency planning and recovery after a flood event.
- **Risk reduction:** The government is investing in FRM, but funding continues to pose a challenge, particularly at the local level. New funding types and sources are being tested across all levels of government.
- **Property-level protection:** Uptake remains low despite growing recognition of effectiveness. Some measures are funded by homeowners or developers and financial support in the form of grants is available.
- **Planning and land use:** The planning system recognises the need to consider flood risk when granting new permissions for development, but growing pressure on housing and land use creates challenges for those tasked with land zoning and local planning decisions. It has been pointed out that some aspects of the planning system, e.g. sustainable urban drainage, need updating to better align with FRM aims.
- **Risk finance:** Insurance, budgetary tools and funds such as the Bellwin scheme are the main sources of funding for recovery and reconstruction.<sup>2</sup>
- **Risk transfer and insurance:** Traditionally, the approach to FRM has been risk-based rather than solidarity-driven, with a strong reliance on insurance to finance losses. Insurance penetration levels are comparatively high, with cover provided by the private market, but concerns about affordability led to the creation of a subsidised pool solution known as Flood Re. However, the pool is only available to residential properties built before 2009.
- **Reconstruction:** Significant financial efforts, funded by insurance and public funds, support speedy recovery and reconstruction, but there is very limited evidence of 'building back better' and factoring resilience into reconstruction.
- **Multi-stakeholder engagement:** Integrated community-level risk management is still developing; however, specific roles and responsibilities are often unclear due to the many actors involved in FRM. Cross-sectoral collaboration exists, but more targeted incentives are necessary to engage all parts of society. The real estate, banking and investment sectors have not fully recognised the importance of flood risk and there is a systemic risk of over-reliance on the future availability of insurance.
- **Overall FRM approach:** There is clear evidence that FRM in England has shifted from hazard management, focusing on flood control measures such as flood defense and drainage systems, towards a much broader approach that embraces a range of tools and instruments and acknowledges that we cannot eliminate all risk. However, despite growing recognition of the need for wider resilience, there is still an over-reliance on structural flood protection. Improving the resilience of infrastructure, housing and land use and the implications of climate change are key challenges for FRM in England. Climate change considerations are integrated into FRM and long-term planning by the EA. The insurance industry and government have a track record of collaboration on FRM, but the new pool, Flood Re, was not designed to help build long-term flood resilience. Flood Re has now identified the need for a resilience strategy as part of its transition policy.

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<sup>2</sup> The Bellwin scheme (initiated in 1983) is funded by the central government and provides financial assistance for unexpected losses to local authority functions (Department for Communities and Local Government 2011). It covers uninsured losses inflicted by perils such as flooding, extreme weather and major fires, for example the cost of emergency procedures and repairs faced by local authorities (Alexander et al. 2016).

# The flood risk management system in England

## Response and reconstruction

- Emergency planning and recovery efforts are governed by the Civil Contingencies Act 2004, which lists local authorities, the EA and emergency services as Category 1 responders to emergencies, and sets out their duties in case of a flood.
- Reconstruction involves another set of actors, including loss adjusters, assessors and builders, with funding from private market insurance, the Bellwin scheme (and grants from national government and local authorities).
- No requirements for 'building back better', but guidelines are currently in development (insurance industry, government, reconstruction sector).

## Risk assessment and communication

- The EA is responsible for the delivery of flood risk maps & National Flood Risk Assessments (NaFRA).
- LLFAs identify flood areas, prepare hazard and risk maps and management strategies consistent with national strategy (maps focus on residential property and do not cover infrastructure, utilities and commercial assets).
- The insurance industry and Flood Re conduct regular assessments and have commercial models, often from private modelling firms, but there are some efforts to align the private and public sectors, particularly for incorporating flood defence information.
- Public flood risk maps can be accessed online and a variety of flood risk awareness games and art are offered by the insurance industry and government.
- The EA, Met Office, non-profit groups, insurers and academic institutes are involved in raising awareness.

## Risk governance

### National agencies

- The Department for Environment, Food and Rural Affairs (DEFRA) is responsible for flood protection and climate adaptation.
- The Ministry of Housing, Communities and Local Government (MHCLG, formerly Department for Communities and Local Government) oversees planning and building regulations.
- The Cabinet Office is responsible for civil protection and resilience.

### Legislation

- The 2010 Flood and Water Management Act (FWMA) merely requires a national flood management strategy to be developed by the Environment Agency (EA).
- The Flood Risk Regulations (FRR) 2009 and the FWMA identify six actors that constitute English Risk Management Authorities (RMAs):
  - the EA
  - Lead Local Flood Authorities (LLFAs) (Unitary Authorities or County Councils)
  - Internal Drainage Boards (IDBs) (where in existence)
  - District and Borough Councils
  - the Highways Agency
  - Water Companies.
- The Civil Contingencies Act of 2004 is another important piece of legislation, which made it a requirement for most designated responders to carry out risk assessments at the national and local levels.

## Risk prevention through planning and land use

- Effectiveness of the current planning system is unclear given pressure for new buildings and developments. Overall, continued building in high-risk zones.
- MHCLG sets planning policy through the National Planning Policy Framework and is responsible for its enforcement.
- Local governments have to apply a sequential test to steer development away from high- and medium-flood risk areas, which the EA can challenge.
- Regulations on planning and land use require Flood Risk Assessment reports for areas larger than one hectare in zones 1, 2 and 3.
- Effectiveness of these measures is not clear.



## Early warnings linked to emergency preparedness

- The National Flood Forecasting Centre (FFC) was launched as a partnership between the EA and U.K. Met Office.
- The EA introduced flood warning codes based on three levels, colour coding (amber to red) and symbols.
- The FFC produces alerts and warnings are disseminated via a variety of agencies.
- Broader 'emergency' civil protection policy as per the Civil Contingencies Act 2004 and DEFRA's National Flood Emergency Framework for England.
- The EA does a significant amount of awareness raising, including via Twitter.

## Risk transfer

- Traditionally the approach to FRM has been risk-based rather than solidarity-driven, with a strong focus on insurance as the predominant way to finance losses.
- There is very high insurance penetration for residential properties – coverage is part of the standard package – but exclusions can apply if high-risk.
- Flooding is covered under standard home insurance, banks require evidence for flood insurance for mortgage lending; SME flood cover is included under business insurance packages.
- Flood Re was introduced to deal with affordability and availability concerns. It is not risk-based, partly funded through private markets and voluntary. There are no incentives for risk reduction through premium discounts. Deductibles reflect risk levels and penetration rate is high; however, it assumes that until 2039, government, homeowners and other stakeholders will do their part to reduce flood risk, leading to no further public intervention in the flood insurance market.

## Risk reduction

- The main focus is on flood defences, more recently also considering property-level protection and temporary defences. Measures range from large-scale regional to household level with different funding mechanisms, for example:
  - Regional, such as Thames Barrier
  - Local (funding administered by the EA and MHCLG)
  - Property-level flood resilience (PFR) and property-level protection measures (PLPMs) from national and local government (uptake remains low)
- Estimated GBP 1.1 billion/year in savings from risk reduction investments.

## Risk financing for public assets

- When flooding occurs, by law, public authorities are only liable in cases of negligence. There is no right to compensation.
- Damage to public assets (such as council-owned buildings) may be funded in a variety of ways:
  - Local authorities take out insurance for their physical asset(s)
  - National budget reallocations (generally ad hoc)
  - Through central funds, such as the Bellwin scheme, or the agricultural flood recovery fund

## Other considerations for FRM

- Monitor, assess and provide ongoing feedback
  - Usually carried out through post-disaster audits
  - Occasional reviews
  - Committee on Climate Change (CCC) conducts reviews
- Incentivise risk-based decisions
  - Not evident
  - Uptake of grants/funds for disaster reduction is low
  - No incentives provided through Flood Re
- Multi-stakeholder coordination platforms
  - Cross-sectoral collaboration between the government (centralised, decentralised) and the private sector
  - A number of approaches to multi-stakeholder funding and implementation
  - Insurance industry engagement in resilience roundtables
- Educational, specialised and technical training programmes
  - Local examples, academia and trade groups
- Climate change considerations
  - More recently a greater focus on future risks
  - The first full assessment of future flood risk was carried out under the Foresight Initiative
  - Climate change considerations are integrated into FRM and long-term planning by the EA
  - CCC regularly reviews FRM progress

# Flood risk management in England: Pre-1950–2019

	pre-1950s	1950s	1960s	1970s
 <p>Approach to managing flood risk</p>	Focus on land drainage and civil defence			Shifting focus towards defence, increase in insurance coverage approach
 <p>Major flood events</p>	1952 Lynmouth Flood 1953 East Coast floods, which resulted in 308 deaths			
 <p>Major laws</p>	1949: Coast Protection Act			
 <p>Institutional changes and noteworthy developments</p>	1930: Catchment boards created 1948: River boards created	1953: Storm Tide Forecasting Service (STFS) was established and operated by the Met Office	1961: Gentleman's Agreement. Efforts by the government to increase usage of flood insurance led to a commitment from the insurance industry to provide affordable insurance against flooding, if requested to do so, for all private dwellings which were permanently occupied 1963: River Authorities created and made responsible for forecasting	The Building Societies Association make insurance coverage a prerequisite to obtaining mortgage financing, which leads to an increase in insurance penetration rates 1971: Separation of emergency planning and civil defence 1975: Regional Water Authorities created

Source: The Geneva Association



1980s	1990s	2000–2004
	Shift towards integrated coastal and fluvial flood risk management	Insurance industry calls for greater public investment Greater holistic/integrated emergency management and water approach Recognition of climate change impacts Discursive shift towards the success of local community partnerships The EA is empowered to plan for future flooding
1982 floods: USD 700 million overall losses USD 300 million insured losses	1998 floods: USD 460 million overall losses USD 230 million insured losses	2000: 10,000 homes in the U.K. flooded USD 2 billion overall losses USD 1.5 billion insured losses
		2004: Civil Contingencies Act Regional Flood Defence Committee Order (Southern, Wessex & Anglian)
1982: Thames Barrier 1980s: Water privatisation and creation of water companies 1983: Bellwin scheme. Local authority financial recovery 1985: Devolution as emergency planning guidelines released for local authorities	1996: The EA is responsible for flood warnings and national warning strategy established	2001: ABI Memorandum states that ABI member companies would only maintain insurance provision if there was greater investment in flood risk reduction measures by the government 2002: Statement of Principles on the Provision of Flood Insurance. Provided for flood coverage generally up to a risk level of 1:75 return period (1.3%) for households and small businesses as part of their building and/or contents cover 2002: National Flood Forum established 2004: Foresight Future Flooding Report (updated 2008). Report on how climate change will affect flooding in 30–100 years, aims to inform policy 2004: Making Space for Water. Strategy for joining up plans for water in the future, taking the water cycle as a whole

# Flood risk management in England: Pre-1950–2019



2005–2009

2010–2014



Approach to managing flood risk



Major flood events

2005 floods: USD 660 million overall losses  
USD 460 million insured losses

2007 floods: USD 8 billion overall losses  
USD 6 billion insured losses

2009 floods: USD 450 million overall losses  
USD 290 million insured losses

2013/2014 winter floods: USD 1.5 billion overall losses, USD 1.1 billion insured losses



Major laws

**2005: The Civil Contingencies Act 2004** (Contingency Planning) Regulations

**Regional Flood Defence Committee Order** (Yorkshire, Welsh, North West, Severn-Trent)

**2009: Flood Risk Regulations** (implements EC directives)

**2009: The Flood Defence** (Robertsbridge Works) Order

**2010: Flood and Water Management Act.** Granted the EA strategic overview of FRM and required it to develop a national strategy for flood and coastal risk management in England

**2010: The Flood Risk Management Functions Order**

**2010: The Flood Risk (Cross Border Areas) Regulations**

**2010: Planning Policy Statement 25 Supplement: Development and Coastal Change**

**2011: Localism Act**

**2014: Water Act and Regulations**



Institutional changes and noteworthy developments

**2005: Updated Statement of Principles.** Continues the SoP commitment to 2008

**2008: Revised Statement of Principles on the Provision of Flood Insurance.** Continues the SoP commitment to 2013, but does not apply to any new property built after 1 January 2009

**2009: Flood Forecasting Centre** (operated jointly by the Met Office/EA) launched, which provides a comprehensive, 24/7 forecasting service. The EA provides flood warnings based on these forecasts.

**2009: ABI guidance to assist developers** building flood resilient properties

**2009: Investing for future flood and coastal risk management in England**

**2008: Future Water.** Strategy on water as a resource and plans to 2030 for water supply demands

**2008: The Pitt Review.** Called for greater collaboration between various government departments, leading to the Flood and Water Management Act

**2010: National Flood and Coastal Erosion Risk Management Strategy for England.** Strategy document on what the authorities can do to manage flood and coastal erosion risk and consequences

**2011: Flood and Coastal Resilience Partnership Funding**

**2011: The Regional Flood and Coastal Committees (England and Wales) Regulations**

**2011: The Incidental Flooding and Coastal Erosion (England) Order 2011**

**2011: The Thames Regional Flood Defence Committee (Amendment) Order**

**2011: The Flood Risk Management Overview and Scrutiny Committee (England) Regulations**

**2012: National Planning Policy Framework and Technical Guidance.** Advises on the development and consolidation of planning guidance and its implementation, specifically in areas of flood risk





## 2. Introduction

### **Flood risk: A major physical climate risk and a growing global concern**

As an island nation with exposed coastlines, rivers and mountains, floods have played an important role in the history of the U.K. The four main types of flooding are

- Fluvial or riverine flooding: occurs when a river or stream overflows its banks
- Coastal flooding from tides and storm surge
- Pluvial (surface water) flooding: occurs when extreme rainfall saturates systems and the excess water cannot be absorbed
- Groundwater flooding: occurs when groundwater levels continue to rise above the standard level and eventually overflow

Fluvial flooding is currently the dominant cause of flood damage, accounting for around half of all annual flood losses (Committee on Climate Change Adaptation 2017).

In the U.K. there is no single body responsible for managing flood risk. FRM responsibility was delegated to the administrations in Scotland, Northern Ireland and Wales after devolution in the late 1990s.

Recognising these regional differences, this report focuses on the FRM system in England only. In England, flooding is widely recognised as the most common and costliest natural hazard (Committee on Climate Change 2016) and is listed as a major risk on England's National Risk Register (Cabinet Office 2015; Surminski 2018).

This report provides a comprehensive review of FRM in England, applying a holistic, multi-stakeholder, forward-looking framework for FRM (The Geneva Association, 2020a; Annex).

Section 3 provides an overview of flood risk in England. Section 4 discusses flood resilience as an emerging national issue. The development of FRM is described in section 5, and in section 6 the latest trend towards an all-of-society approach to flood resilience is discussed. Section 7 concludes.



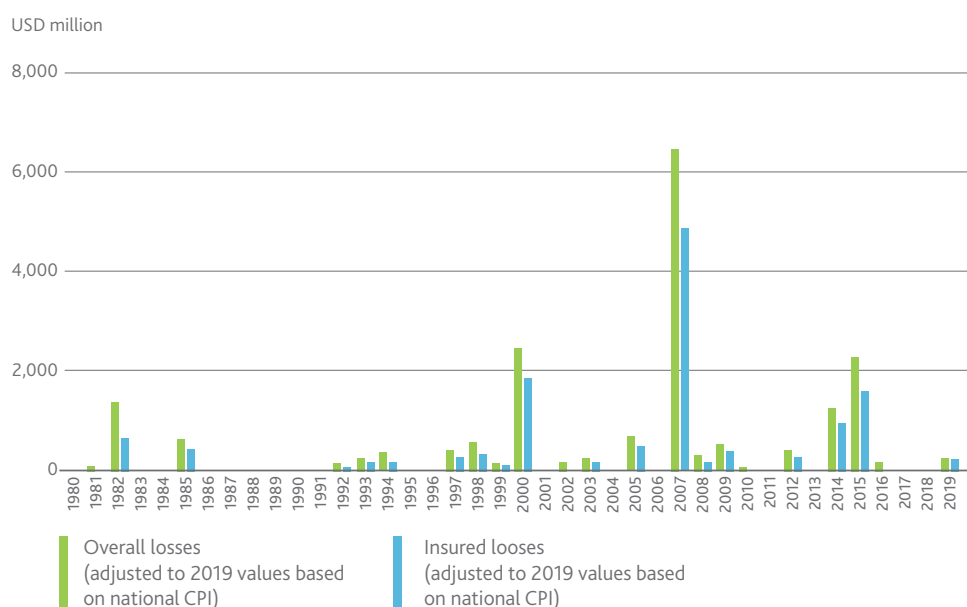


### 3. Drivers of flood risk in England

Damage and loss to homes, businesses and infrastructure and business interruption losses are the major impacts of flooding. Aggregated reported flood damages by year (total, insured) are depicted in Figure (1a). A more detailed breakdown of total and insured losses by event is provided in Figure (1b). The three most significant flood events of the last decade were the summer floods of 2007 and the winter floods of 2013/14 and 2015/16, causing more than USD 8.5 billion insured losses and more than USD 11.5 billion total damages (Figure 1b). The 2007 floods alone caused damage to 16,000 business premises and 68,000 residential properties, prompting GBP 4.4 billion in insurance claims (Cabinet Office 2008; J. Chatterton et al. 2010; Marsh et al. 2016). Smaller businesses are particularly vulnerable because of their constrained resources and geographically concentrated premises, customers and sales/supply networks (Surminski et al. 2018). On average, small businesses lose 50 working days after flood events and take six to nine weeks to resume operations (Crichton 2006; Kreibich et al. 2007).

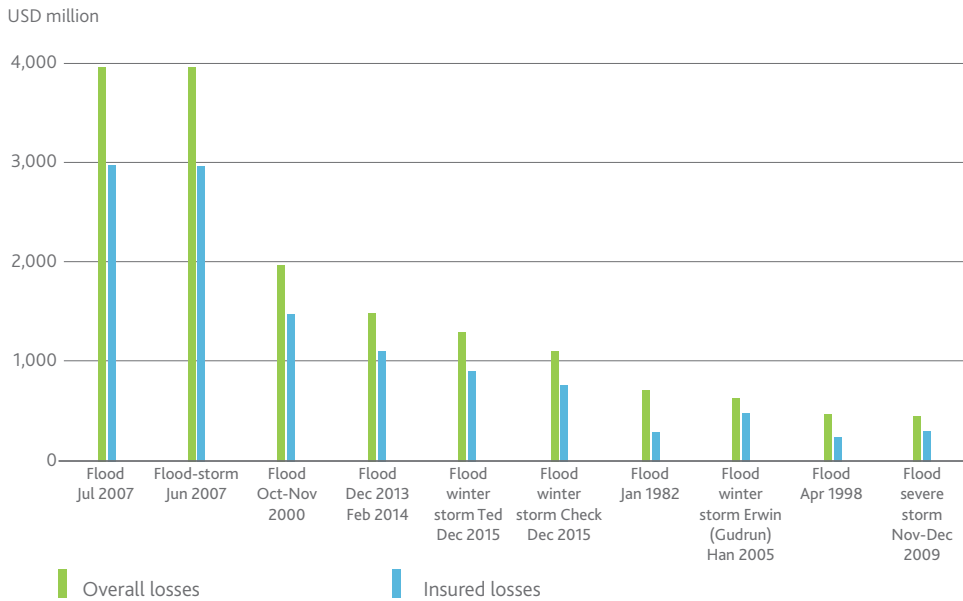
A recent review of the direct and indirect impacts of flooding by the EA shows the costs of flood-related damages: residential properties (GBP 1.5 billion during the 2007 floods), transport losses (GBP 341 million during the 2015/26 floods), health costs (GBP 340 million in 2007), to name a few (Environment Agency 2018). Additional impacts, such as personal financial losses, physiological impacts (Tapsell et al. 1999; Butler et al. 2016) and emotional stress (Ohl and Tapsell 2000; Tunstall et al. 2006; Lamond et al. 2015; Whittle et al. 2010), are not usually included in official statistics.

**Figure 1a: Aggregated reported flood damages by year (total and insured)**



Source: NatCatSERVICE Munich Re 2019

**Figure 1b. Damages from 10 major single high-impact events (total and insured)**



Source: NatCatSERVICE Munich Re 2019

### 3.1. Population growth and development

Around 6.4 million people in the U.K. currently live in flood-prone areas, 1.5 million of these in vulnerable or socially-deprived neighbourhoods. Over 50% of the population exposed to flooding is located in just 10 local authorities (Sayers et al. 2017). Population growth and development on floodplains, driven by shortage of land and rising demand for housing, are among the primary risk-enhancing factors. Of the 300,000 properties built in the most socially-vulnerable neighbourhoods during 2008–2014, nearly 14% were in areas prone to fluvial or coastal flooding (Sayers et al. 2017).

### 3.2. Climate change

Climate change is further exacerbating flood risk, with changes in precipitation (more sudden extreme rainfall events) and rising sea levels (Committee on Climate Change Adaptation 2017). Even limiting global mean temperature rises to 2°C would increase flood risk by the 2050s (40% increase in annual flood damage), while continuing towards a 4°C rise by the end of the century would result in significantly higher losses by the 2050s, especially if combined with high population growth (100% increase in annual flood damage) (Committee on Climate Change Adaptation 2017). The number of people living in flood-prone areas is estimated to increase to 10.8 million by the 2080s, assuming a plausible but more extreme scenario of high population growth and a 4°C increase in global temperature (Sayers et al. 2017).



## 4. Flood resilience in England: An emerging concern

FRM in England entails a range of policies, interventions and activities, delivered by a variety of stakeholders. The FRM approach is shaped by multiple 'rules', including policy, legislation and informal rule systems.

### 4.1. Roles and responsibilities of national agencies

Three national agencies have FRM responsibilities:

- DEFRA is responsible for flood protection and climate adaptation
- The Ministry of Housing, Communities and Local Government (MHCLG, formerly Department for Communities and Local Government) oversees planning and building regulations
- The Cabinet Office is responsible for civil protection and resilience.

The EA is the principal national FRM authority, with operational responsibility for managing fluvial and coastal flooding and defence infrastructure. It also provides advice on planning decisions related to flooding and plays an overall strategic role.<sup>3</sup>

### 4.2. Key legislation underpinning flood risk management in England

Traditionally, the approach to FRM has been risk-based rather than solidarity-driven, with a strong focus on insurance as the predominant way to finance losses. FRM is underpinned by various pieces of legislation. In general terms, 'there is no general right to be protected from flooding ... and no right to be protected to any particular standard where risk management action is taken' (Environment Agency 2011). The 2010 FWMA merely requires that a national flood management strategy be developed by the EA. According to the EA<sup>4</sup> 'it is not technically, economically or environmentally feasible to prevent flooding and coastal erosion altogether' (Environment Agency 2009). The EA follows an explicitly risk-based management approach to deciding whether, where and

<sup>3</sup> The EA is a non-departmental public body operating at arm's length from elected ministers but accountable to them for a series of New Public Management style outcome measures.

<sup>4</sup> <https://www.kcl.ac.uk/sspp/departments/geography/research/Research-Domains/Risk-and-Society/projects/howsafe/Making-space-for-failure-working-paper.pdf>

how much to protect the public from flooding given limited resources (Environment Agency 2011).

The FRR 2009 and the FWMA are key pieces of legislation underpinning FRM in England. The FRR 2009 transpose the EU Floods Directive, which requires certain steps to be taken to identify, map and manage high-flood risk areas, in English domestic law (Mehryar and Surminski 2020). This legislation identified the EA and LLFAs as competent authorities which have established a series of local FRM strategies (Alexander et al. 2016; Surminski and Thieken 2017). The FWMA granted the EA strategic overview of FRM and required that it develop a national strategy for flood and coastal risk management in England, which was released in 2011. The FWMA identifies six actors that constitute English Risk Management Authorities (RMAs):

- The EA
- LLFAs (Unitary Authorities or County Councils)
- Internal Drainage Boards (IDBs) (where in existence)
- District and Borough Councils
- Highways England
- Water companies.

Local Planning Authorities are responsible for strategic flood risk assessment and the creation of local plans (Alexander et al. 2016).

The Civil Contingencies Act of 2004 is another important piece of legislation, which requires that most designated responders carry out national and local risk assessments (Deeming 2017). Additionally, DEFRA's 2004 strategy report Making Space for Water identified shared governance of and responsibility for FRM as key (DEFRA 2004). This was a policy response to the failure of structural flood defence measures and proposed a shift towards resilience and adaptation to hazards. However, existing government funding still appears to favour structural and engineered flood defence projects that aim at protecting people and properties, while natural and societal interventions remain very limited.

### 4.3. The impact of flooding on critical infrastructure

The importance of improving the resilience and resistance of infrastructure to flooding following the 2007 floods, which had an unprecedented impact on critical infrastructure (in particular on water and electricity supplies), was emphasised in the Pitt Review.<sup>5</sup> However, a political preference for structural defences in subsequent years hindered progress. Things began to change during the winter of 2015/2016, when floods overwhelmed structural defences in northern England. The National Flood Resilience Review, commissioned and released in September 2016,<sup>6</sup> highlighted, amongst other things, the need to: protect key local infrastructure more effectively; improve incident response; and continue improving risk communication by the EA (HM Government 2016a; Surminski and Thieken 2017).

Constraints on funding, particularly at the local level, are a continual challenge, with public agencies testing innovative funding initiatives, including private sector funds and charges on new property developments. In addition, many local authorities face pressure on housing and land use. While the New National Planning Policy Framework (NPPF) provides clear requirements regarding new developments in high-risk areas, a lack of enforcement by planning authorities is a problem. At the same time, greater effort has gone into developing community preparedness and property-level resilience following the 2008 Pitt Review recommendation that flood risk reduction should be seen as a societal effort (Deeming 2017).

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5 The Pitt Review: Lessons learned from the 2007 floods, published on 25 June 2008, was prepared by Sir Michael Pitt following widespread flooding in England in June and July 2007. The 505-page report was commissioned by the Secretary of State for Environment, Food and Rural Affairs, the Secretary of State for Communities and Local Government and the Chancellor of the Duchy of Lancaster. It included a review of flood risk management, the resilience and vulnerability of critical infrastructure, the emergency response, emergency planning and the recovery phase. This was described by Pitt as 'one of the widest ranging policy reviews ever carried out in the UK'.

6 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/551137/national-flood-resilience-review.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/551137/national-flood-resilience-review.pdf)

#### 4.4. Climate change and future risks

More recently, there has been greater consideration of future risks. The first full assessment of future flood risk was carried out under the Foresight Initiative (Evans et al. 2006; Evans et al. 2008). The EA has also worked on long-term investment scenarios (LTIS) for flood and coastal erosion risk management, taking climate change and a growing population into account (Environment Agency 2009, 2014, 2019). Under the most extreme scenario, the study found more places where new investment is no longer cost-effective. It also recommended that property flood resilience and natural flood management measures be used in combination with conventional FRM, as the latter alone cannot reverse increases in risk due to climate change (Environment Agency 2019). An updated assessment of future flood risk is currently being prepared by Sayers et al. as part of the Third U.K. Climate Change Risk Assessment.

The Committee on Climate Change (CCC), created under the Climate Change Act, also advises on flood risk, with several reviews and publications exploring future flood risk implications and preparedness, including the U.K. Climate Change Risk Assessment

(ASC 2014; Committee on Climate Change 2019; Krebs 2013). The 2018 report by the CCC on coastal change in England (Committee on Climate Change 2018) outlined current and future risks for coastal areas and advocated closer integration of flood risk and coastal erosion management efforts, while also warning that it will not be economically efficient to protect all areas, requiring difficult social decisions and choices. This builds on earlier reports about expected rises in sea levels (50–100 cm) by the end of the century, which would approximately double the current length of coastal defences in England classed as vulnerable to failure (from 110 km to around 200 km; ~20% of the total length of coastal defences in England). One metre of sea level rise could lead to inundation of 2,000 km<sup>2</sup> of land in England in a 200-year tidal surge event (as in 1953 and 2013). Four hundred thousand properties would be at risk, seven times more than were impacted by the widespread flooding in 2007 (Committee on Climate Change Adaptation 2017).



*Flooding caused by Storm Dennis, 2017*



## 5. Flood risk management in England

FRM is a complex system involving many actors with different roles and responsibilities using a variety of measures and tools to address current and future risk. This section describes the current approach to FRM in England by considering past and current practice for key areas of FRM, including risk information/communication, early warnings/preparedness, corrective risk reduction, planning policy/land use, risk financing and insurance and reconstruction/recovery.

### 5.1. Flood risk information, communication and awareness

#### *National agencies*

Overall, the EA is responsible for the delivery of flood risk maps (Surminski 2018) and conducts flood risk assessments, such as the National Flood Risk Assessments (NaFRA). Its flood maps are currently modelled using the JFLOW software by JBA Risk Management (Surminski 2018), demonstrating an effort to align industry modelling and publicly available data (Clark 2017). The EA's flood maps have improved over time, usually following significant flooding events that triggered inquiries and reviews (Bye and Homer 1998; Pitt 2008). Concerns about surface water flooding, particularly following the 2007 floods, have culminated in the adoption of new surface water maps (Environment Agency 2013). Most of the maps are publicly available and updated quarterly. Following are some examples of publicly available flood risk maps and zones.

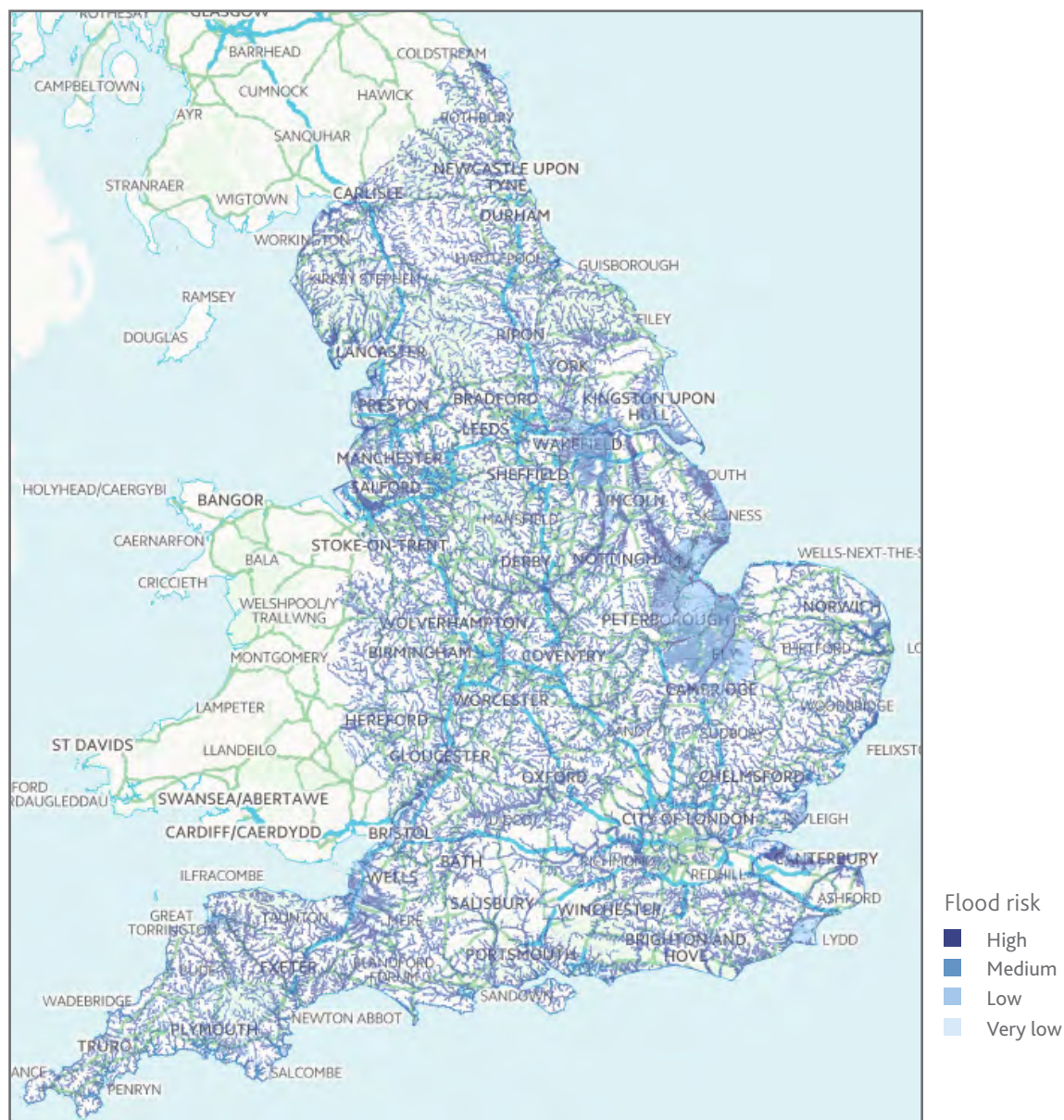


*Flooding caused by Storm Dennis, 2017*

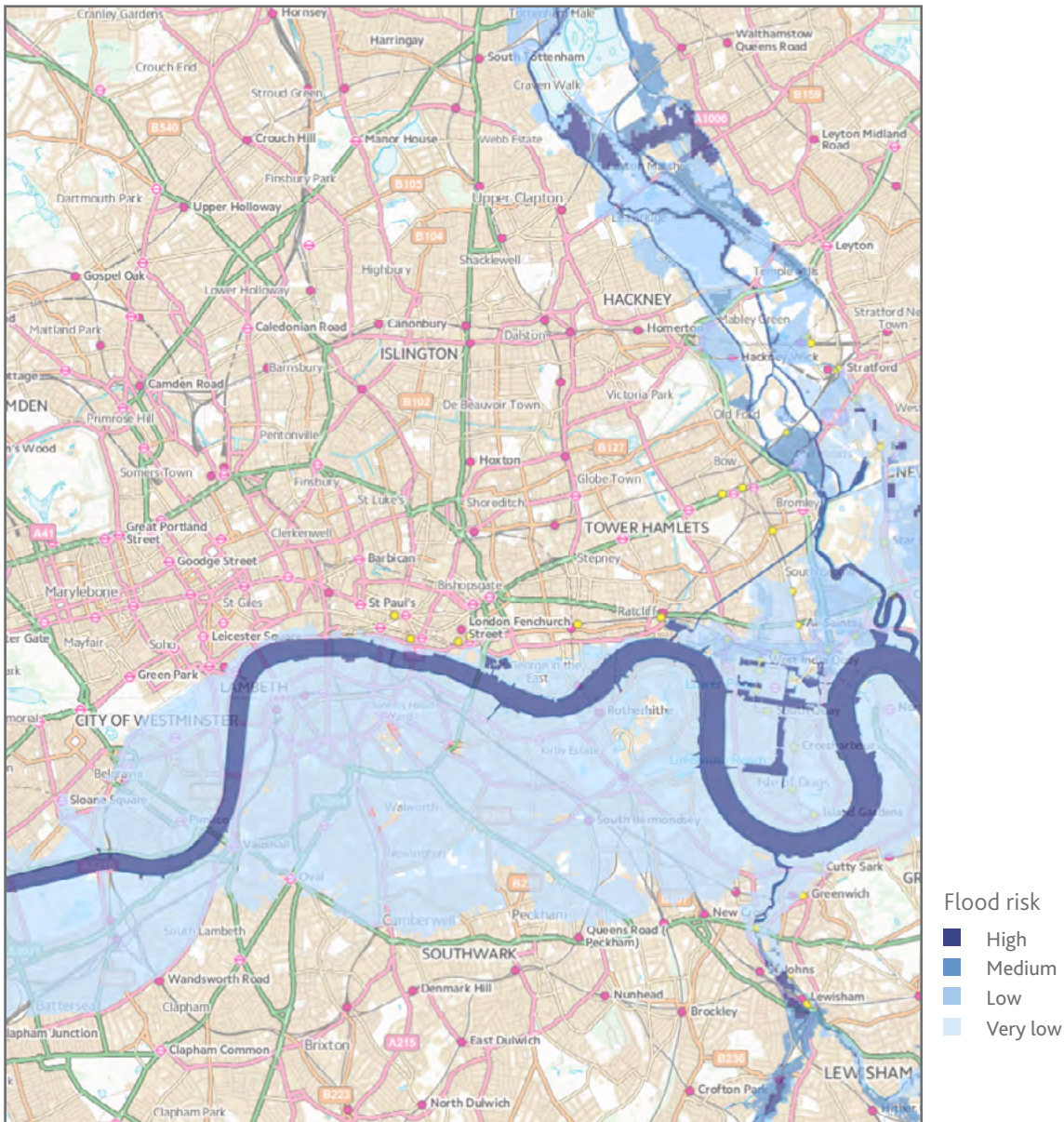
## Publicly available flood risk maps

Long-term flood risk maps for river, sea and surface flooding are publicly available at: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>. Examples are shown below.

**Map image 1: Flood risk from rivers or the sea (extent of flooding, England)**



Map image 2: Flood risk from rivers or the sea (extent of flooding, City of London)



Definition of different flood risk levels for rivers, sea or surface water:

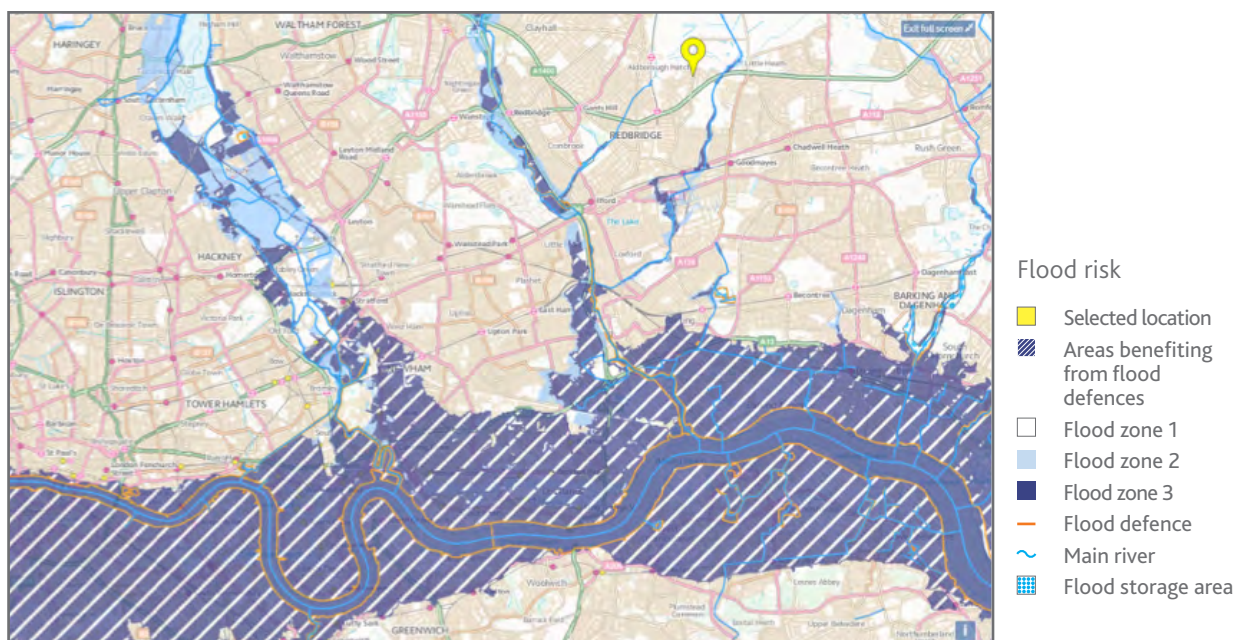
High, medium, low and very low risk mean that the annual chance of flooding for the area is greater than 3.3%, between 1% and 3.3%, between 0.1% and 1% and less than 0.1%, respectively. The effect of any flood defenses in the area is also taken into account.

Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.



The EA also produces flood risk maps with more details for development planning projects, which are publicly available at: <https://flood-map-for-planning.service.gov.uk/>. An example is shown below.

**Map image 3: Flood risk from rivers or the sea (extent of flooding, England)**



Flood zone definitions are set out in the National Planning Policy Guidance as follows:

- **Flood Zone 1:** land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)
- **Flood Zone 2:** land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1%–0.1%) or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5%–0.1%)
- **Flood Zone 3:** land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of sea flooding (>0.5%)

### Local authorities

At the local level, LLFAs are responsible for identifying areas prone to flooding, preparing hazard and risk maps and maintaining strategies for local FRM that are consistent with national strategy. In practice, however, LLFAs supply information and check that maps are consistent with local knowledge, whereas risk mapping is still carried out by the EA (Alexander et al. 2016).

Other authorities and organisations are also involved in flood risk communication. These include local authorities and voluntary organisations, such as the National Flood Forum. Much of this communication links or refers to EA information and services such as Floodline and flood maps.

Despite efforts to integrate different data sources, challenges remain, particularly with regards to mapping vulnerabilities, estimating economic impacts and factoring in the effectiveness of FRM measures, especially from nature-based and green infrastructure based measures. With regards to urban drainage, there is a need to integrate information from across multiple sources, including water utilities (sewers, manholes), local authorities (gullies) and transportation authorities (road gullies). Furthermore, the impact of climate change on disaster event volatility is generally not included in these models due to its uncertain nature (Committee on Climate Change 2016).

For many urban areas maps focus on risk to residential property and do not cover infrastructure, utilities and commercial assets and the interconnected risk. The wider

systemic impacts can be severe and continue to be felt long after residential properties have been reinstated. The Data and Analytics Facility for National Infrastructure (DAFNI) and other projects are working to improve risk modelling for better strategic planning in the face of climate change.<sup>7</sup> This is particularly important for coastal areas where much of the energy infrastructure is located. This has been highlighted by the National Infrastructure Commission, calling for better coordination across agencies and public/private infrastructure providers (National Infrastructure Commission 2019).

### *Insurance sector*

The insurance industry and Flood Re use a combination of in-house models, commercial CAT modellers (The Geneva Association 2018) and government data (such as EA and NAFRA ordnance surveys) to measure their exposure, diversify their portfolios and gain regulatory approval.

In the past, flood risk was determined using postcodes. However, due to advances in satellite radar and improvements in LIDAR data collection, detailed household-level data can now be accessed by commercial suppliers of insurance with resolutions of up to one metre globally (Rumford, forthcoming). The Association of British Insurers has also developed a close relationship with the EA to expedite the improvement of data available to insurers and the general public (Surminski 2009).

Recent initiatives attempt to align public data and industry modelling, particularly for incorporating flood defence information. Several datasets from mapping programmes have been made freely available, such as airborne floodplain and coastal LIDAR data. However, challenges associated with flood mapping and data sharing remain. Data still needs to be transformed into a regular format and should preferably be pooled by a central body in order to save on time and costs. For example, The London Market Target Operating Model (LM TOM) involves the creation of a central data repository and deals with challenges associated with data capture and access. Private initiatives have also arisen, such as Oasis Hub.

### *Raising awareness through games and the arts*

Several online games have also been produced in the past 10 years that focus on flood risk communication. It is unclear from the available literature how successful these games have been in helping to communicate FRM policies and ideas to their intended audiences. Examples include FloodRanger, an educational game about managing flood

defences along rivers aimed at flood defence practitioners, local authorities, insurers, universities and schools; and FloodSim, a free online game that helps raise public awareness of issues around flood policy and provides feedback to insurers and policy makers on public attitudes towards different flood protection options. The latter was funded by Aviva as part of its corporate responsibility strategy. Flood information events have also been used to increase flood awareness, such as the Thames Barrier flood exhibition in 2011, the week-long photography exhibition by FloodSmart in 2013, and different activities by the Living with Water Initiative to raise awareness and prepare communities for the impact of flood events.<sup>8</sup>

## **5.2. Early warnings and emergency preparedness**

Early warnings and emergency preparation to save lives and protect assets are key aspects of England's diversified FRM strategy. Flooding is treated as part of the broader emergency civil protection policy laid out in the Civil Contingencies Act 2004. DEFRA also maintains the National Flood Emergency Framework for England (HM Government 2016a).

Following the 2007 floods the Pitt Review called for greater collaboration between the various government departments involved in FRM to improve warning services (Pitt 2008). On 1 April 2009, the EA launched the FFC to eradicate regional differences in flood forecasting (Alexander et al. 2016) and to set up an integrated flood risk monitoring platform which allows simulations linking meteorology, hydrology and flooding (HM Government 2016b). The FFC was established in partnership with the Met Office to allow for better prediction of the scale and timing of flooding events and better monitoring (Pilling et al. 2016), combining meteorology and hydrology expertise to provide a comprehensive, 24/7 forecasting service for flood risk. These organisations are major components of the flood risk communication system.

Flood warnings have been part of FRM strategy for a long time, with studies in the 1970s exploring the economic benefits of warnings and the system's performance (Chatterton and Farrell 1977; Chatterton et al. 1979; Penning-Rowsell et al. 1978; Penning-Rowsell et al. 1983; Penning-Rowsell et al. 2013; Parker and Tunstall 1991; Drobot and Parker 2007; Parker et al. 2007; Penning-Rowsell and Parker 1987; Penning-Rowsell and Green 2000; Parker 2017). Improvements were made in terms of timing and combining warnings with measures individuals can take in response. The FFC brings together expertise

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7 <https://www.dafni.ac.uk/>

8 <https://livingwithwater.co.uk/projects>

from meteorological and hydrological sciences and uses information provided by the Met Office to give a single forecast of flood risk. The FFC is responsible for communicating five-day Flood Guidance Statements to emergency responders. In 2011, the government decided that these forecasts should also be available to members of the public and a three-day Flood Guidance Statement (or Three Day Flood Risk Forecast) is now published for members of the public on the EA's website.<sup>9</sup> Using information provided by the FCC, the EA also provides a flood information service,<sup>10</sup> which allows homeowners to check their five-day flood risk (ranging from unlikely to high risk) and monitor nearby river/sea levels.

To improve usability, the EA introduced new and clearer flood warning codes in England: flood watch, flood warning and severe flood warning.<sup>10</sup> Colour coding (amber to red) and symbols (e.g. a triangle within which the outline of a house is submerged) are used to increase the accessibility of this type of information (Parker 2017). Recently, these flood alerts have also been made available as Twitter feeds, making England the first country in the world to formally use social media in this context.

Organisations and individuals can also seek flood risk information from the EA's website, social media channels and by registering to receive warnings from Floodline Warnings Direct (FWD).

Other recent investments in technology have increased monitoring and communication of flood alerts.<sup>11</sup> The EA has also invested in improved response kit, including 40 km of temporary flood barriers, 250 high volume pumps and four incident response vehicles.<sup>12</sup>

### Flood risk alerts and warnings

Flood risk information is currently produced and communicated by the FFC. Communication of flood warnings involves many other organisations and members of the public (Table 1). The EA also runs regular local awareness campaigns for communities at risk of flooding (e.g. in autumn in anticipation of winter flooding, (HM Government 2016a)).

**Table 1: Flood risk information providers and users in England**

Provider	Description	User
Environment Agency	Flood risk maps (rivers, surface water and reservoirs)	Publicly available. Used by planners, homeowners, modellers, local authorities
Environment Agency, JBA	Flood alerts/ floodline warnings	Publicly available via email, direct calls, fax and SMS. Used by households, businesses, the media (TV, radio), EA, national flood forum
Environment Agency	Five-day flood risk information	Publicly available
Flood Forecasting Centre (Met Office, The Environment Agency)	Flood forecasts	Publicly available
Met Office	U.K. weather warnings	Publicly available
National Tidal and Sea Level Facility	Real-time tide height data, coastal flood forecasts	Policy makers, planners, coastal engineers, National Farmers' Union (NFU)
Environment Agency	River level information (Shootherill GaugeMap)	Publicly available
Commercial modellers, insurers	Flood risk maps and probabilistic flood models	Insurers, brokers
Local flood wardens (volunteers from local communities)	Face-to-face and personal flood warning communication	Local communities with less access to technology, e.g. older people

Source: The Geneva Association

<sup>9</sup> Responsibility was transferred from the police to the EA when it was created in 1996.

<sup>10</sup> <https://flood-warning-information.service.gov.uk/warnings>

<sup>11</sup> Examples include upgraded publicly available river level monitoring services via postcode search (<https://flood-warning-information.service.gov.uk/river-and-sea-levels>) and an improved weather radar network from the Met Office. For more information see: <https://www.metoffice.gov.uk/public/weather/observation/rainfall-radar#?map=Rainfall&fcTime=1560378000&zoom=5&lon=-4.00&lat=55.01>

<sup>12</sup> <https://environmentagency.blog.gov.uk/2017/06/27/flood-risk-management-10-years-on-a-journey-of-high-and-low-tech-improvements/>



Figure 2 differentiates between central government and other funding sources. The latter includes partnership funding raised by other RMAs; internal drainage board funding raised from drainage charges and special levies; local authority funding from the Settlement Funding Assessment (SFA), spent on flood or coastal erosion risk management (DEFRA 2019); and funding secured from infrastructure providers (e.g. water companies), other central government sources (such as Highways England), local businesses and individuals. In addition, grants and loans are provided by Local Enterprise Partnerships (LEPs). These are regional organisations that facilitate the allocation of grants and loans provided by the central government for projects or businesses that enable economic growth and job creation by reducing flood risk to areas of land or operations. LEPs also invest in FRM projects that support these outcomes, for example in the east coast towns of Ipswich, Great Yarmouth and Lowestoft (over GBP 20 million in grants and loans).

This illustrates the large number of funding sources and mechanisms through which money is disbursed. Table 2 shows the historic development of central government and EA expenditure. Local authority funds, funding raised by other RMAs and internal drainage board funding raised from drainage charges and special levies are not shown (DEFRA 2019). An increase in funding is seen over time. Some innovative forms of funding are currently being explored by the water industry. In 2017, Anglian Water became the first European utility company to issue a sterling green bond. The GBP 250 million bond will mature in August 2025 and offers a 1.625% return to investors. The money raised is intended to finance a range of activities, including water abstraction projects, drought and flood resilience schemes and water recycling projects. So far, Anglian Water has spent GBP 276 million on schemes funded by the green bond, including a wetland restoration project in Norfolk (<https://www.anglianwater.co.uk/about-us/our-strategies-and-plans/2020-2025/>).

**Table 2: Central government and EA expenditure (GBP million)**  
Real terms figures reflect 2019/20 prices

Financial year	Total central government	EA local levy	EA funding from other sources	Total	Total real terms
2005/06	508.7	19.7	41.6	570.0	743.3
2006/07	506.9	26.1	34.5	567.5	718.6
2007/08	499.8	17.0	25.8	542.6	670.5
2008/09	567.6	33.2	22.1	622.9	749.4
2009/10	633.1	38.0	18.5	689.6	818.1
2010/11	670.1	30.9	17.1	718.1	836.3
2011/12	572.9	33.7	16.9	623.5	716.7
2012/13	576.3	20.2	27.2	623.7	702.8
2013/14	606.2	29.1	39.4	674.7	746.6
2014/15	802.6	24.1	42.9	869.6	950.0
2015/16	710.8	18.2	55.8	784.8	850.6
2016/17	794.9	27.1	55.0	877.0	929.3
2017/18	777.0	29.3	49.8	856.1	889.2
2018/19	792.4	35.5	42.8	870.7	888.1

Source: DEFRA 2019

### *Funding property-level risk reduction measures*

PFR measures and PLPMs tend to be funded by homeowners or developers. Generally, PFR and PLPMs have a high cost–benefit ratio, potentially reducing property damage by around 75% and decreasing financial impacts, insurance claims and disruption to business, schooling, communities, family life and mental health (DEFRA 2019).

Uptake of PFR and PLPMs, however, remains low. Some property owners in England have received support from local and national governments through grant schemes for investment in PLPMs. For several years, post-flood grant schemes have been a feature of the government's response to extreme floods. For example, the Property Resilience Grant Scheme (PRGS), operated by the national government and administered at the district level, provided grants of up to GBP 5,000 for the adoption of PLPMs following flooding in late 2015/early 2016 (Priestley and Uberoi 2017).

Although efforts to promote PFR have had some success, usage in refurbishment and post-flood reinstatement is limited: 6% of high-risk households, 39% of flooded households and 15% of flooded businesses (Harries 2013; Bhattacharya-Mis and Lamond 2014). Even the offer of full public grants often fails to engage businesses and homeowners due to the hassle involved, lack of awareness or fear of 'blighting' a property with clearly visible PFR measures (from comments made to the authors during consultations with stakeholders). DEFRA, local authorities (LAs) and the EA are therefore trying to promote PFR and increase the uptake of PFR grants. The DEFRA PFR Roundtable, a cross-industry and cross-sector alliance, has a five-year plan and the EA focuses on more effective national campaigns to promote PFR. One of the drawbacks of PLPM projects is that they do not address risks to the wider community or disruption linked to flooding as they only benefit individual properties. In addition, with the current rate of investment in subsidy schemes it would take 400 years to introduce PFR to the 120,000 properties for which risk reduction measures would be cost-effective (Committee on Climate Change 2015).

## **5.4. Risk prevention through planning policy and land use**

In England, the MHCLG sets planning policy through the NPPF and is responsible for its enforcement (HM Government 2016a; Surminski and Thieken 2017). Overall, the planning system has become more risk-based (Cowling et al. 2017). Rather than adopting a ban on building in floodplains, governments have introduced measures aimed at reconciling the need to avoid creating new risks with the rising demand for new housing.

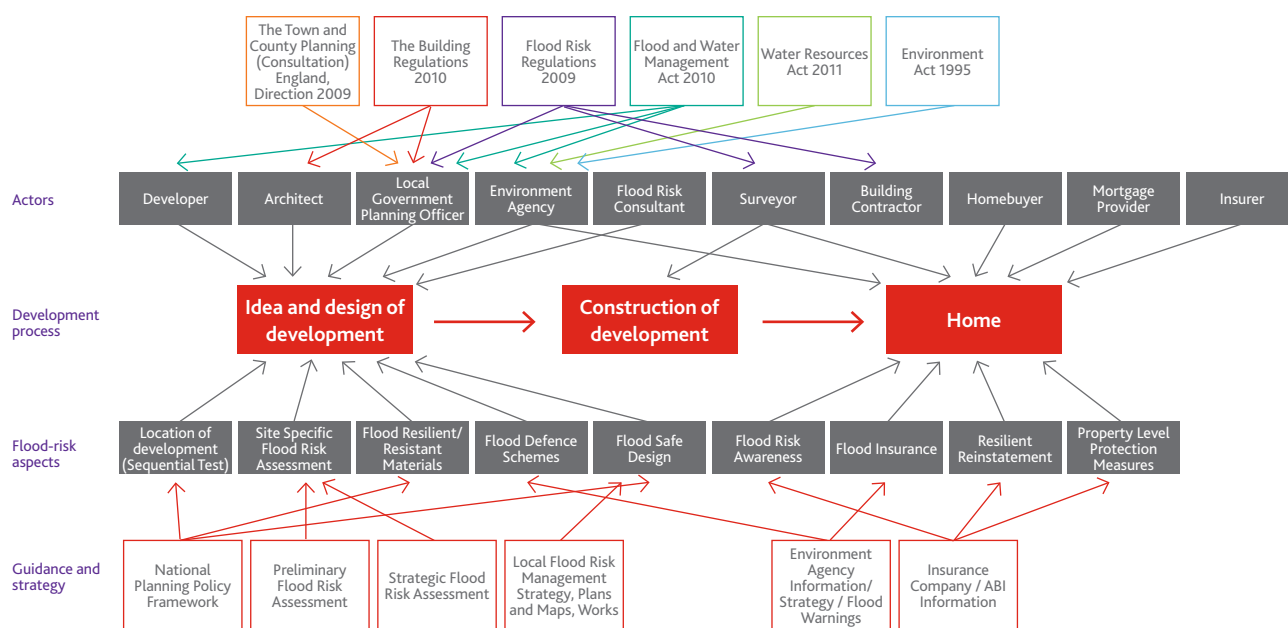
Importantly, a whole range of laws and policies set out when and how flood risk should be taken into account during the different stages of planning, designing and building properties. Figure 3 gives an overview of key actors involved in this process.

### *Development in medium- and high-risk areas*

Local governments have to apply a sequential test to steer development away from high- and medium-risk areas. Planning decisions can be challenged by the EA; however, exceptions for development in high-risk zones are possible if no other alternatives exist and wider societal interest can be proven (Cowling et al. 2017; Porter and Demeritt 2012; Department for Communities and Local Government 2012). It must be demonstrated that:

- The development would provide wider sustainability benefits to the community that outweigh the flood risk;
- The development will be safe for its lifetime, taking the vulnerability of its users into account, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

**Figure 3: Factors that influence the planning, design and building processes**



Source: Crick et al. 2016

Both conditions must be met to gain approval. Moreover, the development plans should demonstrate that:

- Within the site, the most vulnerable development is located in the area of lowest flood risk, unless there are overriding reasons for selecting a different location;
- The development is appropriately flood resistant and resilient;
- It incorporates sustainable drainage systems (see Box 1), unless there is clear evidence that this would be inappropriate;
- Any residual risk can be safely managed;
- Safe access and escape routes are included, where appropriate, as part of an agreed emergency plan (Ministry of Housing, Communities and Local Government 2019).

### Flood risk assessment report

Planning and land use regulations require flood risk assessment reports to be completed for proposed development sites larger than one hectare in flood zone 1 and for any developments in flood zones 2 and 3 (see page 23 for a description of flood zones). Impermeable surfaces should be kept to a minimum. Developers can verify whether a flood risk assessment must be carried out by consulting publicly available flood maps. For large sites, flood modelling might be required to quantify the risk of flooding and consider risk reduction measures. In addition, developers can adopt standards such as BREEAM to increase sustainable design standards (e.g. by including flood risk and surface water management strategies) (BREEAM 2018). Sustainable urban drainage is one example of a specific requirement that can be incorporated into the planning process (Box 1).

### Box 1: Sustainable urban drainage

New developments can cause an increase in surface water run-off and therefore impact watercourses and sewer systems. Long-term environmental and social factors are taken into account during the decision making process for sustainable drainage systems. In April 2015, new planning guidance came into effect to drive the delivery of sustainable urban drainage systems (SuDS). Notably, it states that SuDS are to be provided in developments of 10 or more dwellings; planning authorities must ensure that arrangements are made for future maintenance of SuDS over the lifetime of a development; and that LLFAs are to be made statutory consultees on planning applications for surface water management. Furthermore, in March 2015, DEFRA introduced non-statutory technical standards for sustainable drainage systems to be used alongside the Planning Practice Guidance and NPPF with regards to discharge rates in greenfield developments. However, this guidance does not address all of the proposals for sustainable drainage systems set out in the Pitt Review and the FWMA 2010.

## Effectiveness of the current planning regime

The effectiveness of the current planning regime is unclear, as highlighted regularly by the CCC. Ongoing research by the Grantham Research Institute shows that of the 120,000 new homes built in high-risk flood zones in England and Wales over the last decade, a disproportionately higher number are found in deprived and struggling neighbourhoods; many more new homes could also end up in high-risk flood zones over their lifetime as a result of climate change (Surminski and Roezer 2020). Development on floodplains is still permitted; 12% of new residential developments between 2001 and 2014 were situated in floodplains, 25% of which were in medium- or high-risk areas (Committee on Climate Change 2015). Furthermore, the annual rate of development is higher than average in high-risk areas in floodplains (Committee on Climate Change 2015; Crick et al. 2016). In its 2019 progress report the CCC argued that the planning system needs to be updated to ensure better alignment with the aims of the FWMA; specifically, 'The National Planning Policy Framework (NPPF) and planning practice guidance (PPG) should be updated to ensure that Sustainable Drainage Systems (SuDS) installations maximise their impact in terms of flood risk reduction and their co-benefits. This could be done by aligning the NPPF and PPG with the aims of Schedule 3 of the FWMA (2010)' (Committee on Climate Change 2019).

A forthcoming study (Roezer and Surminski) uses a new detailed data set combining information from Ordnance Survey (OS) and the Office for National Statistics (ONS) to analyse the location of new business premises built between 2008 and 2018 in England and Wales with regards to their flood risk. Analysis of temporal, spatial and sectoral trends of at-risk business premises shows that without further action, flood risk might significantly increase by the middle of the century.<sup>16</sup>

## 5.5. Disaster risk financing measures within government budgets

The law states that public authorities are only liable after a flooding event in cases of negligence. There is no right to compensation as common law holds victims responsible for their own losses. As such, there is an expectation that private losses should be covered by insurance. However, financial relief may be available to households and small businesses after an event (e.g. local council tax, business-rate relief, a farming recovery fund and charitable donations) in cases of non-insurance and underinsurance or to help with immediate funding needs.

## Financing public sector losses

Recovery and repair of damaged public assets (such as council-owned buildings) may be funded by:

- Insurance (e.g. local authorities take out insurance for their physical assets)
- National budget reallocations (generally ad hoc)
- Central funds such as the Bellwin scheme or the agricultural flood recovery fund.

The Bellwin scheme (initiated in 1983) is funded by the central government and provides financial assistance for unexpected losses to local authority functions (Department for Communities and Local Government 2011). It covers uninsured losses inflicted by events such as flooding, extreme weather and major fires, for example the cost of emergency procedures and repairs faced by local authorities (Alexander et al. 2016).

The Local Government Association reported that the 2015/16 floods cost local authorities more than GBP 250 million, with Cumbria (GBP 175 million), Calderdale (GBP 33 million), Northumberland (GBP 24 million) and Lancashire (GBP 5 million) the worst hit (LGA 2016). The majority of these costs related to road damages (Environment Agency 2018). However, a detailed breakdown of costs and funding mechanisms by local authority is not currently available.

## Financing damages or loss to public infrastructure

Information on funding sources and instruments for public infrastructure is also lacking. In a recent report, the EA concluded that an exact breakdown of flood-related costs for transport and utilities is not available (Environment Agency 2018). The report indicates that some damages are insured, but an overview of the extent of cover is not provided (Environment Agency 2018).<sup>17</sup> In recent years, some infrastructure repair costs have been covered by the EU Solidarity Fund.<sup>18</sup>

Government funds cover some agricultural losses. Following the 2015/16 floods, the central government established a GBP 10 million agricultural flood recovery fund to support costs incurred by farmers; by early September 2016 approximately GBP 1 million in reimbursements had been paid to flood-hit farmers for completed repairs (Environment Agency 2018), while applications exceeding GBP 9 million had been approved by the Rural Payments Agency (Environment Agency 2018).

16 <http://www.lse.ac.uk/GranthamInstitute/news/flood-risk-is-rising-and-so-must-our-resilience-to-it/>

17 Quote from the report: 'It is assumed that Network Rail's capital costs and that of utility companies will be covered by insurance to a greater or lesser extent'.

18 In 2007 and following the 2015/16 floods, the U.K. Government received GBP 51.3 million from the EU to help repair uninsured public assets. In 2007, the U.K. Government received GBP 142 million from the EU Solidarity Fund.



## 5.6. Flood insurance and other risk transfer solutions

Flood insurance is long-established and widely-used in England (and across the whole of the U.K.), with estimated penetration rates of 95% to 98% for homeowners (Flood Re 2016a). High insurance penetration rates for building insurance can mainly be attributed to the fact that flood insurance is bundled into standard home insurance policies and banks require evidence of such cover before granting a mortgage. Cover rates for home contents are lower at around 75%,<sup>19</sup> while uptake from those renting their homes is around 50% (Flood Re 2016a).

### History of flood insurance and the Statement of Principles

Insurance is provided entirely by the private market but in close cooperation with the government. This goes back to the 1961 Gentleman's Agreement, which was adopted after serious flooding in the 1950s revealed that only a small number of homes had flood insurance (Penning-Rowse et al. 2014). To avoid nationalisation of flood insurance, the insurance industry agreed to make flood insurance available as part of standard home insurance cover. This arrangement was replaced by a Statement(s) of Principles following major flooding across the country in 2000.

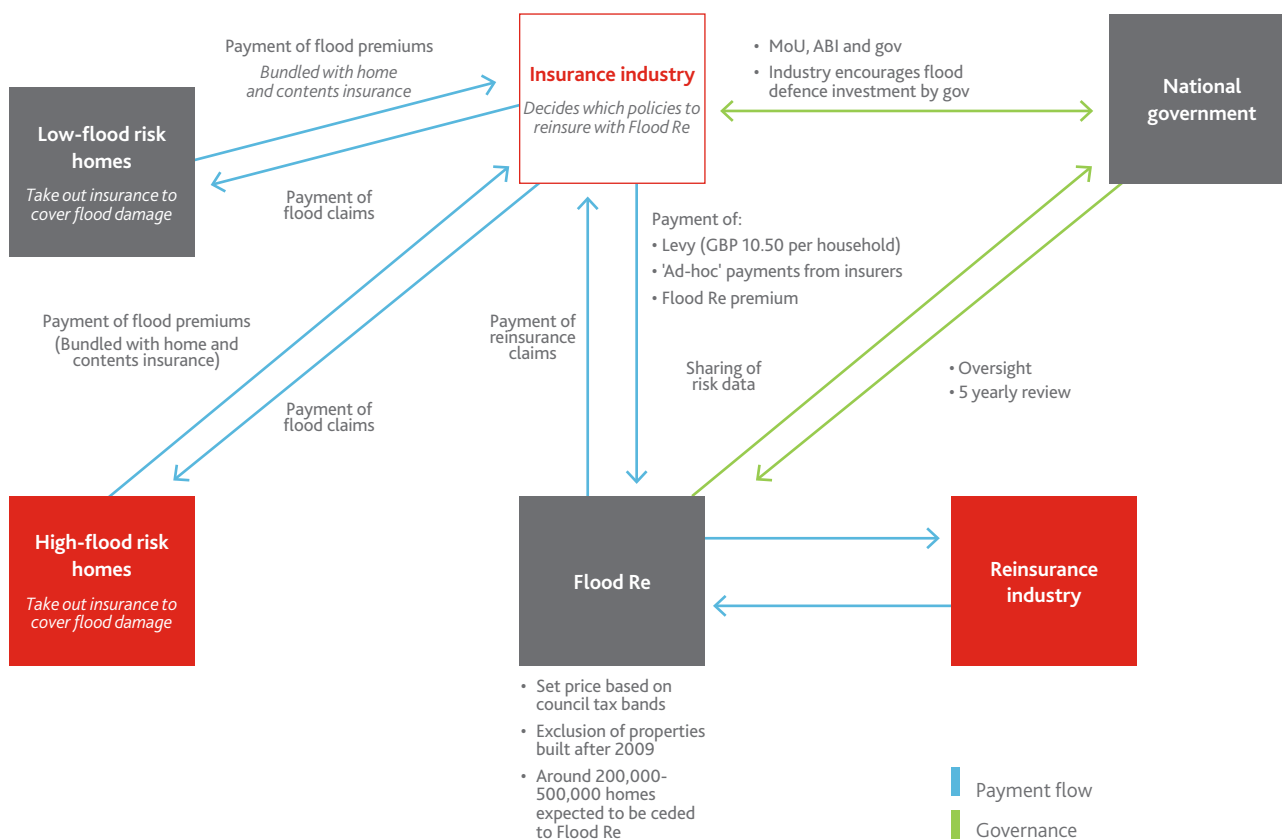
subsequent iterations (2002, 2005 and 2008) set out the varying commitments of the insurance industry to provide flood insurance coverage and of the government to continue investing in flood protection, improving the planning system and sharing flood risk information (Surminski and Eldridge 2014). The Statement(s) of Principles was generally successful in securing high flood insurance penetration rates and increasing government action on FRM; however, it was always considered a temporary solution.

### Flood Re

The 2007 floods and subsequent discussions about affordability and availability of cover prompted negotiations between the government and the insurance sector in 2010. Eventually, the Statement of Principles was replaced by Flood Re.

Flood Re is a non-profit reinsurance pool owned and operated by the insurance industry, established through the Water Act 2014 and launched in April 2016. It is intended as a transitional measure, running until 2039, when it is supposed to make way for risk-reflective pricing (Surminski and Thieken 2017). A schematic overview showing the key responsibilities and financial flows of Flood Re is provided in Figure 4.

Figure 4: Structure and mode of operation of Flood Re



Source: Crick et al. 2016

19 <https://www.abi.org.uk/news/news-articles/2019/01/cost-of-home-contents-insurance-falls-to-a-record-low-yet-one-in-four-uk-households-are-uninsured/>

Flood Re sets out to promote the availability and affordability of flood insurance to those who own and live in residential properties in areas at risk of flooding. It is a reinsurance scheme that is available to insurers, while individual customers continue to buy their insurance from and have their claims settled via insurers or insurance brokers. The set-up costs (around GBP 20 million) were paid by insurance companies, who also pay a GBP 180 million levy on their home insurance business to Flood Re. In addition, Flood Re receives a premium for each policy reinsured.

The Flood Re pool is an addition to the standard home insurance market rather than a replacement and is expected to encourage private carriers to write affordable flood insurance policies for high-risk properties. It does this by offering insurers a low-cost option of offsetting the costs of property insurance claims for flood damage (BMI Research 2016). The pool is directly accountable to parliament by law and is overseen by the Secretary of State; however, unlike many other pools and disaster insurance schemes, the government has no direct financial liability. Nonetheless, it is expected that the government would provide an emergency bailout if Flood Re were to fail.

Flood Re is only applicable to residential properties built before 2009, an important condition incorporated to discourage risky new developments (Surminski and Eldridge 2014). However, this raises questions about future insurance provision for newly built properties and small and medium enterprises (SMEs). Industry and government continue to monitor the situation and may revisit plans to expand or replicate Flood Re in the future.<sup>20</sup>

Flood Re is present as an 'innovative way to ensure the availability and affordability of flood insurance, without placing unsustainable costs on wider policyholders and the taxpayer' (DEFRA 2013). Funded through a levy on all home insurance policies, Flood Re premiums are based on council tax bands rather than risk-based. This is in response to concerns about affordability of insurance in high-risk areas, where high premiums and high excesses can cause difficulties for homeowners (Flood Re 2016a; Oliver 2016). The primary motivation of Flood Re is to temporarily protect these homeowners from risk-based pricing.

Table 3: Overview of insurance in England	
Risk-based?	Mixed. Flood Re is not risk-based, the private market is partly risk-based
Mandatory or voluntary?	Voluntary. Banks require evidence of flood insurance cover before granting a mortgage
Public, private or a combination?	Private market plus publicly governed Flood Re pool
Policyholder programmes	Flood damage is covered under standard home insurance (bundled). Flood Re pool is available for residential buildings built before 2009. SME cover is available as part of business insurance packages
Incentivising risk reduction	Very little evidence. Flood Re provides no incentives. Some insurers encourage property-level resilience, but premium discounts are rare. Deductibles reflect risk levels In 2020 Flood Re announced plans to support property-level flood resilience
Market penetration and coverage	Penetration rates are very high: between 95% and 98% (estimated) for building insurance; 75% for contents insurance; 50% for tenants Information on flood insurance uptake by businesses is limited. Insurance is available but there are concerns about affordability in high-risk areas (commercial properties are not covered by Flood Re) Local authorities use insurance to protect their own assets, cover includes flooding
Insurance-backed securitisation	Limited

Source: DEFRA 2019

20 In 2016 the British Insurance Broking Association (BIBA) had developed a specific scheme to help SMEs find flood insurance cover. For more information see: <https://www.biba.org.uk/press-releases/new-insurance-scheme-biba-businesses-risk-flood/>

The Flood Re pool is built on the assumption that the government, homeowners and other stakeholders will play their part in risk reduction, meaning public intervention in the flood insurance market would no longer be required. However, given rising risk levels, this would require greater investment in risk reduction.

Flood Re's Memorandum of Understanding requires that the government invest in flood defences, although the conditions are not as clear-cut as those set out in the Statement of Principles (Environmental Audit Committee 2016). Therefore, the sustainability of flood insurance is uncertain. This was highlighted by the Prudential Regulation Authority (PRA) in its first ever climate change report (Prudential Regulation Authority 2015). The report cited an analysis of the widening gap between technical risk-based prices and subsidised Flood Re premiums (Crick et al. 2016). The government committed to GBP 2.3 billion spending on flood defences until 2021 under the Memorandum of Understanding (Flood Re 2016b); however, it is sceptical whether the targets will be achieved (Environmental Audit Committee 2016). More recently, Flood Re has highlighted the need for more incentives and better collaboration between stakeholders to address increasing risk levels and set out how this can feature as part of its transition strategy (Flood Re 2019).

Flood Re's ability to encourage the uptake of risk reduction measures is limited; however, there are some encouraging signs. In 2020, Flood Re announced its support of policy holders' resilience efforts (<https://www.floodre.co.uk/flood-re-plans-to-make-britain-more-resilient-to-flooding/>). Experts emphasise the following as key challenges for flood insurance going forward: insurance provision for SMEs and newly built properties; ensuring affordability in the face of increasing risks; wider societal resilience and engagement; and establishment of risk-based pricing in Flood Re's lifetime (Surminski and Thieken 2017; Surminski 2018).

## 5.7. Post-flood response, recovery and reconstruction

### *Response and recovery*

Emergency planning and recovery efforts are governed by the Civil Contingencies Act 2004, which lists local authorities, the EA and emergency services as Category 1 responders to emergencies and sets out their duties in case of a flood. This was strengthened by the government's National Flood Emergency Framework in 2014. It brings together information, guidance and policies as a resource for those involved in emergency planning and flood response.

LLFAs play a lead role in emergency planning and recovery. As Category 1 responders, local authorities must have flood response plans for controlling or reducing the impact of an emergency. According to the Civil Contingencies Act, Category 1 responders' post-flood responsibilities include: assisting with business continuity, providing support and advice to individuals, management of public health issues, coordination of the recovery process, dealing with environmental and health issues (e.g. contamination and pollution) and managing local transport and traffic networks.

Local Resilience Forums (LRFs) bring together Category 1 and 2 responders within a local police area with a focus on planning for incidents. In case of a flood emergency, a system of control levels is used to manage the incident.<sup>21</sup>

Planning for the recovery phase of disasters and emergencies has improved following evolution of the 2007 National Recovery Guidance and the 2008 Recovery Plan Guidance Template (HM Government 2016a). However, it is still a challenging task and one which involves many more stakeholders than the response phase (Deeming 2017).<sup>22</sup>

### *Reconstruction*

Reconstruction involves another set of actors, including loss adjusters, assessors and builders, and is funded by private insurance, the Bellwin scheme (described earlier) and grants from the national government and local authorities. Reconstruction is driven by the need for speedy repairs and replacements and so resilience and the concept of 'building back better' are often not considered (Surminski and Eldridge 2014).

21 The three control levels are: (i) Bronze Operational, at which the management of 'hands-on' work is undertaken at the incident site or impacted areas; (ii) Silver Tactical, introduced to provide overall management of the response; (iii) Gold Strategic, local decision makers and groups establish the framework within which operational and tactical managers work in responding to and recovering from emergencies. For more information see: <https://www.local.gov.uk/topics/severe-weather/flooding/emergency-planning/emergency-planning>

22 Voluntary services provide practical and emotional support to those affected, support transportation and communications and provide telephone helpline support (Civil Contingency Act, 2004). One example is the National Flood Forum, which provides support and advice to communities and individuals that have been flooded or are at risk of flooding.

The PFR Action Plan outlines steps that would help increase property-level resilience during reconstruction and recovery: providing an advisory service to support households and local authorities to effectively use property-level resilience grants; collaboration with the EA to prepare for future flood events; and reviewing previous flood recovery schemes and sharing local authorities' previous experiences to help flood victims make their properties more resilient (DEFRA 2016). This would require collaboration between many stakeholders, including local authorities, claims surveyors, insurers, builders and homeowners. Indeed, some insurers are encouraging homeowners to install cost-neutral, resilient repairs following a flood claim and it is expected that a new Code of Practice, developed under the DEFRA Property Level Flood Resilience Roundtable, will help to raise the profile of these measures.<sup>23</sup>

Some local authorities have started to allow more flexible use of funds received through repair and renew grants. After the 2013/14 floods, some local councils allowed community members to combine their individual GBP 5,000 repair and renew grants towards community flood defences, rather than simply protecting their individual premises (from comments made to the authors during earlier consultations with stakeholders).<sup>24</sup>



***Flooding caused by Storm Dennis, 2017***

23 <https://www.floodguidance.co.uk/wp-content/uploads/2018/05/2017-PFR-End-of-Year-Report.pdf> and [https://www.ciria.org/Research/Projects\\_underway2/Code\\_of\\_Practice\\_and\\_guidance\\_for\\_property\\_flood\\_resilience\\_.aspx](https://www.ciria.org/Research/Projects_underway2/Code_of_Practice_and_guidance_for_property_flood_resilience_.aspx)

24 [https://www.cii.co.uk/media/6175205/coordination\\_of\\_flood\\_response.pdf](https://www.cii.co.uk/media/6175205/coordination_of_flood_response.pdf)



## 6. Towards an all-of-society approach to flood risk management

Managing flood risk is a multi-faceted challenge that involves many stakeholders. Clearly defined roles and responsibilities, effective collaborations and an understanding of the different motivations and incentives behind the actions of stakeholders are therefore important.

### 6.1. Cross-sectoral collaboration

There has been evidence of a shift towards a multi-sectoral approach to FRM, with a mix of government- (central and local) and private sector-led activities involving a growing number of actors, strategies and instruments in play. However, key stakeholders, such as flood risk managers in local authorities, also argue that there are missed opportunities and that national aims and objectives are difficult to implement, particularly in times of fiscal austerity.<sup>25</sup> This is driven in part by shifting national-level responsibilities to local authorities who, in the face of tight public budgets, must explore new avenues for FRM collaboration and funding (Alexander et al. 2016).

There have been efforts to clarify and simplify ownership and responsibilities through formal processes, such as the FWMA (2010), which aimed at implementing some of the recommendations from the Pitt Review (2007) and greater institutional clarity.<sup>26</sup>

Formal ways of expressing opinions and engaging in policy discourse are offered through public consultations run by the government or agencies. The most recent example is the EA's consultation on its draft strategy, which aims to create a nation resilient to flooding and coastal change by 2100.<sup>27</sup> The consultation was held in the summer of 2019 and the EA plans to publish its new strategy in spring 2020.

#### *Multi-stakeholder funding and implementation of flood risk management*

A number of approaches exist; a few are highlighted below.

Partnership funding has the potential to increase defences and risk reduction by diversifying funding sources and creating risk-sharing arrangements among the public

<sup>25</sup> Based on consultations with stakeholders for this project.

<sup>26</sup> An example involved water companies, identified as one of the main authorities for FRM in the FMWA 2010, with operational-level responsibilities. However, their role in FRM is constrained by investment priorities set by the regulator Ofwat, with FRM being only of limited importance (from interviews).

<sup>27</sup> <https://consult.environment-agency.gov.uk/fcrm/national-strategy-public/>

and private sectors and civil society; however, this will only succeed with sufficient incentives or regulatory pressure. Some critics argue that these schemes incentivise local councils to grant planning permissions in high-risk areas in order to secure private sector funding for FRM.<sup>28</sup> The private sector is under no obligation to contribute and it is up to the LLFA to present a business case for voluntary contributions, which in some cases is the main challenge in attracting private funding. This is the case for coastal flooding in particular, for which FRM infrastructure costs and the density of business assets are higher, meaning that partnership funding gaps are typically greater. According to some local authorities, partnership funding has been successful in enabling the delivery of more projects by spreading government funding more widely, enabling projects that deliver broader social, economic and environmental outcomes. However, this also means that those most able to secure the money will benefit most from FRM projects. Authorities without the resources to acquire additional funding, sufficient capital reserves or local political support will remain at risk.<sup>29</sup>

Local resilience forums were established by the Civil Contingencies Act (Contingency Planning) Regulations 2005 to help facilitate integrated emergency management between different responders and secure broader community engagement in FRM. However, resource constraints (financial, staff, skills) in LLFAs and the EA tend to restrict their public engagement activities (Alexander et al. 2016). Other civil society-led initiatives, such as the National Flood Forum or local flood action groups, tend to fill these gaps, but participation is often limited to areas that have very recently been impacted by floods. The Zurich Flood Resilience Alliance,<sup>30</sup> itself an example of cross-sectoral collaboration, is currently working with communities in England to introduce a participatory-based approach to measuring and enhancing flood resilience. Through the Flood Resilience Measurement Tool, a wide range of local stakeholders come together to identify their priorities and resilience needs, establishing a snapshot of current local-level strengths and weaknesses that can then be addressed by targeted interventions.

The organisation Business in the Community has started to focus on the resilience efforts of businesses, offering tools and methods to increase understanding and preparedness through ex-ante action as part of its Business Emergency Resilience Group.<sup>31</sup> Local authorities have the mandate to provide advice and assistance in relation to business continuity management (BCM) when emergencies such as extreme flooding occurs (HM Government 2012). The

British Standards Institution adopted core international standards for businesses in order to support BCM. Although large businesses show a healthy uptake of BCM, SME adoption is relatively slower (Federation of Small Business (FSB) 2015), with the latter tending to struggle with implementing resilience strategies. Government data suggest that 4,897 businesses, including farms, were affected by the 2013/14 winter storms (HM Government 2016c). Furthermore, businesses tend to carry out mitigation actions only after a flooding event rather than proactively. FRM might provide some SMEs with an opportunity to develop services or take on a community support role by encouraging similar practices among their network partners, within their local community and across supply chains. However, operating a business from a tenanted property can hinder flood risk reduction as support of the landlord is required (FSB 2015).

Building back better is a collaborative concept that has been stepped up recently. The PFR Action Plan (DEFRA 2016) sets out ways for people to protect their homes from floods. DEFRA's Resilience Roundtable project was subsequently created to facilitate collaboration between the spatial and land use planning and building damage restoration sectors, including the insurance industry, to identify and mitigate risks. This project has five main focuses: testing and promoting resilience among local and wider communities and SMEs; embedding resilience in small businesses; launching a new website and engaging with EA marketing campaigns; developing and monitoring standards, certifications and skills; and encouraging behavioural changes and better communication among central and local governments, industries and at-risk communities. Guidance and a code of practice on resilient repairs are planned for later this year.<sup>32</sup>

### *Private sector engagement*

The insurance industry is actively involved in the Resilience Roundtables. Collaboration with different stakeholders is well established, most prominently through the public-private partnership on risk transfer, but also in areas such as risk information and communication, data sharing, risk reduction and investment. However, the highly competitive nature of the private market can make this difficult. For example, insurers have expressed concerns about the release of their claims data, which they consider to be commercially sensitive. This highlights the challenges associated with information sharing between insurers and the government (Surminski and Eldridge 2014).

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28 Based on consultations with stakeholders for this project.

29 Based on consultations with stakeholders for this project.

30 <https://floodresilience.net/>

31 <https://www.bitc.org.uk/campaigns-programmes/communities-place/business-emergency-resilience-group>

32 Based on consultations with stakeholders for this project.

Flood Re has pledged to share its flood risk data with different stakeholders. Over the course of its operation, the pool will have a map of high-risk homes, a clearer picture of which of these homes are flooded, the cost of claims and a breakdown of these costs (Flood Re 2016b). While it remains unclear how this information will be shared in the future, Flood Re is considering how it can be utilised to smooth the transition to risk-reflective pricing (Flood Re 2016b). For example, the data could allow the government to calibrate measures for managing flood risk in different areas by providing the information necessary for a more thorough analysis of the effectiveness of different risk reduction measures (Surminski 2017). It will also provide the information required by the government for deciding where and how to build new properties. More generally, sharing data may also help the shift towards a longer-term focus by helping to identify common concerns. To date, this has not been tested as there have not been any significant floods since the inception of Flood Re in 2016.

There are also opportunities for Flood Re to collaborate with insurers to support risk reduction, for example by making recommendations on resilient repairs, through information sharing and awareness raising or government lobbying for FRM. Flood Re could also help to address key underlying barriers to risk reduction. Insurers do not necessarily value all kinds of risk-reducing behaviour. For example, engineered defences are perceived as the gold standard for reducing vulnerability, whilst non-engineered measures such as warning systems are perceived as ineffective (DEFRA 2016). Data and knowledge sharing can help to improve understanding of broader resilience measures and lead to cross-sectoral collaboration (Surminski 2017).

The relatively high level of insurance penetration has also meant that for some sectors, flood risk is not considered a priority. This is the case with mortgage providers (Crick et al. 2016); however, there appears to be a growing interest in undertaking insurance-style flood risk assessments.<sup>33</sup>

Risk reduction also seems to have played a relatively limited role in the strategies and business models of property developers (Taylor et al. 2012; Taylor and Harman 2016; Handmer 2008). Importantly, flood risk does not remain with developers but instead rests with homeowners, who then use flood insurance to transfer this risk, either voluntarily or as required through their mortgage provider. However, Flood Re is not available for properties built after 2009, and there are signs that mortgage providers may start to consider flood risk in

their valuations (comments made to the authors during earlier consultations with stakeholders). This could have implications on how buyers and property developers consider flood risk.

There are also some indications that investors are starting to take flood risk into account. When investing in commercial properties, about 90% of investors conduct flood risk assessments when they deem it necessary. However, they typically do not carry out ongoing assessments after acquisition of the property, unless a flood occurs. Furthermore, investors often incorrectly assume that risk levels do not change over time and can be reluctant to address this problem. As a result, risks imposed by climate change, the impact of other developments and catchment flood risks are not monitored over time (Pottinger and Tanton 2014).

## 6.2. Behaviour, perceptions and incentives

FRM involves difficult decisions about the level of protection provided to certain areas, the possibility of managed retreat from some coastal areas and increasing risks associated with climate change. Societal perceptions and expectations of who owns the risks and who should take action are therefore important for increasing flood resilience. Public understanding, awareness and recognition of alternative actions are important – as highlighted by narratives such as DEFRA's living with water initiative in the mid-2000s. Recent communications on winning the war against flooding (Owen Paterson in a DEFRA strategy publication) seem counter-productive as they present FRM as a finite aim rather than a continuous process with a long-term, forward-looking approach. Perceptions and perspectives matter, particularly when behavioural changes and long-term action is required, but incentive structures appear to be lacking.

Despite campaigns, financial incentives (resilience grants) and high cost-benefit ratios, PLPM uptake and the rate of behavioural change remain slow (Bichard and Kazmierczak 2012; DEFRA 2016). Recent studies indicate that property owners: lack risk awareness; do not accept risk; view floods as one-off events; and consider flood protection to be the responsibility of the authorities (DEFRA 2016; Surminski and Thieken 2017; Joseph et al. 2015). The extent and efficacy of government support at household level remains an area of debate (Cowling et al. 2017).

33 A study conducted by Vivid Economics for the Cambridge Institute for Sustainability Leadership (CISL 2019) offers real estate investors and lenders a means of understanding the potential physical risks of climate change on their portfolios and shows the importance of resilience and adaptation measures.

The role of insurers in incentivising risk reduction is a topic that has received significant attention. Several studies have highlighted the need for insurers in the U.K. to support physical risk reduction (for example, de Ruyter et al. 2017; EC 2017; Hudson et al. 2019; Surminski 2018). A survey of 400 homeowners shows that insurers have been ineffective in encouraging their policyholders to adopt flood mitigation measures (Lamond et al. 2009). The adoption of PLPMs is difficult to assess so insurers do not necessarily see this as a basis for lowering premiums (Ball et al. 2013).

It has been shown that public sector flood protection creates a feeling of safety, reducing risk perception and investment in risk reduction measures (Hanger et al. 2018).<sup>34</sup> However, the study also found no support for moral hazard in insured households in England. Households with flood insurance were somewhat more likely to have risk reduction measures in place. As flood premiums are bundled with other home insurance costs, insurers do not usually differentiate or disclose to their customers the percentage relating to flood insurance. This affects the ability of policyholders to understand their own personal risk and possibly the likelihood of them undertaking their own risk reduction efforts. However, insurers do promote risk reduction measures (Box 2).

When Flood Re was launched it became clear that it would not provide new incentives for flood risk reduction, which was identified as a missed opportunity (Surminski 2018; Surminski and Eldridge 2014, 2015). The exclusion of newly built properties (post-2009) sent a signal to property developers and buyers about the importance of building insurable properties (Association of British Insurers 2009). However, there is evidence that the cost of risk is becoming less of a concern than the lack of affordable housing, which has led to the easing of planning rules (Committee on Climate Change 2015). Flood Re has recognised its lack of levers for risk reduction as a key issue (Flood Re Transition Plan 2016, 2018) and is now exploring options to better promote and strengthen risk reduction. The study on incentivising household action on flooding (Oakley 2018) sponsored by Flood Re acknowledges that Flood Re premium thresholds are likely to make too small an impact on too few households to drive large-scale change towards property-level resilience. Instead, it is suggested that Flood Re should form collaborations to develop and implement a package of incentive measures for flood resilience and resistance that can be adapted over the next 20 years. Flood Re has also made recommendations to DEFRA on how to enhance its role in risk reduction<sup>35</sup> and sponsored a broader study into this issue, investigating behavioural drivers and barriers in the uptake of risk reduction measures.<sup>36</sup>

## Box 2: How can I prepare my home if it is in a high-risk flood area?

Ways to minimise the potential impacts of flooding before higher-risk winter months:

- **Write a flood plan:** Put together a community flood plan that details where to go and what to do before and after a flood. Also consider writing a household plan.
- **Move valuables:** Use waterproof bags to store valuables, move anything you can upstairs and raise immovable items off the floor. Remember that although insurance policies can replace damaged items, some precious items are irreplaceable.
- **Prevent water invasion:** Use removable barriers and temporary seals for doors, windows and air vents.
- **Fit one-way valves:** Install valves on toilets and pipes on to prevent sewage backing up.

Source: *The Geneva Association*

34 For example, a significant number of homeowners whose properties are protected by public measures, such as flood dams, feel safer and thus tend to invest less in PLPMs.

35 <https://www.floodre.co.uk/flood-re-plans-to-make-britain-more-resilient-to-flooding/>

36 [https://www.floodre.co.uk/wp-content/uploads/SMF-Incentivising-household-action-on-flooding\\_web.pdf](https://www.floodre.co.uk/wp-content/uploads/SMF-Incentivising-household-action-on-flooding_web.pdf)





## 7. Conclusions: Successes, continued challenges and lessons learned

In England, fluvial, coastal, pluvial and groundwater flooding occur regularly, causing damage and losses to communities, businesses and households. Population growth and development on floodplains and coastlines, driven by shortage of land and increasing demands for housing, are among the primary risk-enhancing factors. Climate change is further exacerbating flood risk, with changes in precipitation (more sudden extreme rainfall) and rising sea levels.

Flood risk maps are provided by a variety of stakeholders, predominantly the EA, local authorities and the insurance sector. Beyond data and models, the insurance industry plays an important role in increasing risk awareness through innovative approaches using games and the arts.

Influenced by a series of flood events and subsequent 'lessons learned' reviews, the FRM approach in England has undergone a significant shift from hazard management towards a broader strategy that involves a range of actors. Overall, FRM is transitioning toward a focus on flood resilience, acknowledging future risks and the importance of risk reduction and prevention. There are signs of a move towards a more holistic, wider community-focused approach and away from reliance on purely structural solutions. However, funding constraints, fragmented roles and responsibilities and a lack of targeted incentives threaten progress. Unnecessary risk creation linked to local developments and climate change is a key challenge – regularly recognised and highlighted in reviews and lessons-learned exercises – and implementation of measures to increase current and future resilience remains limited and slow.

Traditionally, the approach to FRM has been risk-based rather than solidarity-driven, with a strong focus on insurance as the predominant way to finance losses. The MHCLG sets planning policy through the National Policy Framework and is responsible for its enforcement. Rather than banning development in floodplains, measures aimed at reconciling the need to avoid risk creation with the increasing demand for new housing have been introduced. Furthermore, a whole range of laws and policies define when and how flood risk should be taken into account during the different stages of planning, designing and building properties (e.g. conditions for development in medium- and high-risk areas, requirements for flood risk assessment reports, etc.). However, the effectiveness of these developments is currently unclear.

The insurance industry and government have a good track record of collaboration on FRM, but the new pool, Flood Re, is not designed to help build long-term flood resilience. Importantly, Flood Re is intended as a transitional measure and will only run until 2039 when it is supposed to make way for risk-reflective pricing. Overall, Flood Re sets out to promote the availability and affordability of flood insurance

to those who own and live in residential properties in areas at risk of flooding. The Flood Re pool is an addition to the standard home insurance market rather than a replacement and is expected to encourage private carriers to write affordable flood insurance policies for high-risk properties. Moreover, Flood Re only applies to residential properties built before 2009, an important condition intended to discourage new developments in at-risk areas. It has been presented by the insurance industry and government as an innovative way to ensure the availability and affordability of flood insurance, without placing unsustainable costs on policyholders and the taxpayer. Funded through a levy on all home insurance policies, the premiums are based on council tax bands rather than the level of risk.

The Flood Re pool is built on the assumption that the government, homeowners and other stakeholders will play their part to reduce flood risk, meaning public intervention in the flood insurance market would no longer be required after 2039. However, realistically, given rising risk levels, this would require more investment in risk reduction. Flood Re’s Memorandum of Understanding requires that the government invest in flood defences, although the conditions are not as clear-cut as those set out in the Statement of Principles. Flood Re has limited levers to incentivise risk reduction measures.

Overall, there is scope for insurers to shape future investments, design and planning and to promote ‘building back better’ (as advocated by Flood Re), but this will require stronger incentives and better communication about the benefits and limitations of insurance. The Property Level Flood Resilience Roundtable is a good example of cross-sectoral collaboration, but agreeing on guidelines, standards and codes of practice can take time; furthermore, their implementation will require awareness-raising and new incentive structures to increase uptake. The real estate, banking and investment sectors are starting to recognise the importance of FRM but have not yet found a mechanism that ensures a return on their investment (Cambridge Institute for Sustainability Leadership 2019). Projects such as the Climate Bonds Initiative’s Resilience Investment Principles can help to address this (Climate Bonds Initiative 2019), and other ideas are currently being sought.

Discussions with experts, a roundtable event and a literature review conducted for this study revealed a set of perceived strengths and weaknesses of the current FRM system in England. These are highlighted in Table 4.

**Table 4: Strengths and weaknesses of the flood risk management system in England**

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• High insurance penetration and private sector involvement in risk transfer</li> <li>• Introduction of Flood Re to address affordability concerns</li> <li>• Risk information capability and accuracy of data</li> <li>• Move to a more holistic approach (for example SuDS, Making Space for Water)</li> <li>• Climate change considerations integrated into FRM and long-term planning by the EA</li> <li>• Regular reviews and assessments across different stakeholders, creating opportunities for participation and wider contribution (for example public consultations)</li> <li>• Cross-sectoral collaboration</li> </ul>	<ul style="list-style-type: none"> <li>• Flood Re not designed to help build long-term flood resilience</li> <li>• Insurance industry engagement could be better – some companies are very active in FRM, but not across the board</li> <li>• Banking and investment sector does not recognise the importance of flood risk. Over-reliance on future availability of insurance. More communication and collaboration needed</li> <li>• Real estate sector recognising the importance of flood risk very slowly</li> <li>• Decision-makers often struggle to assess and define different investment options and appraise broader resilience benefits</li> <li>• Lack of incentive for the private sector to engage in FRM</li> <li>• Behavioural change require more targeted incentives</li> <li>• Over-reliance on structural flood protection, integrated community-level risk management still only emerging</li> <li>• Funding challenges for local authorities. Coastal flooding projects no longer fully funded by the government (since 2015)</li> <li>• Aim is currently to ‘control’ risk – should work towards maintaining an acceptable level of risk and increasing resilience</li> <li>• Systemic cost of interruptions, e.g. energy, roads, neither well understood nor communicated to stakeholders</li> <li>• Difficult to quantify risks and impacts, particularly for individual business sectors where data is often commercially sensitive</li> </ul>

Source: The Geneva Association

While post-flood reviews and lessons-learned reports offer useful insights, it is often unclear how their recommendations have been implemented and how successful they have been. This is particularly relevant for strengthening the business case for FRM. Increasing collaboration on the communication of resilience benefits could also help improve planning and decision-making, where flooding remains a 'wicked problem' (Rittel and Webber 1973) and is often caught in a trade-off with urgent short-term priorities of local authorities.

Recognition of the wider social implications of rising risks and the broader societal benefits of resilience are important. This has so far received relatively little attention, but there are growing concerns that flood risk will become a dividing issue, with implications for social justice and fairness. Specifically, 'Cities in relative economic decline, coastal areas and dispersed rural communities experience levels of flood disadvantage above the U.K. average, suggesting flood risk could undermine economic growth in areas that need it most' (Sayers et al. 2017). The use of indicators and risk information from different stakeholders could help present FRM as a tool for economic regeneration, inclusive growth and development that can help to avoid the creation of more vulnerable communities. This could generate greater political support and buy-in and provide a new, more positive narrative for FRM.

Measuring and monitoring progress in FRM is challenging but important for prioritising and justifying investments for improving the system. In England this is not centralised. For example, the EA and the CCC deliver regular reports on the current and future impacts of flooding. In addition to government-led reviews, other assessments of FRM, such as Post-Event Review Capability (PERC) reports, enable post-disaster learning as a means of identifying gaps and entry points for building system-wide resilience (Zurich Flood Resilience Alliance 2015). These processes need to be leveraged more systematically to enable proactive improvements to the system. Other examples include reports and reviews from the insurance industry, such as a recent study into the added value of flood defences.<sup>37</sup>

Overall, FRM still tends to be reactive, focusing on problems that occurred during a flood event rather than anticipating future risks. While the mindset

of those tasked with FRM appears to be changing, funding constraints and available officer resources across all RMA's make implementation difficult. In the wake of rising concerns about climate change and coastal change there has been a greater effort to include longer-term elements in FRM planning. This is underpinned by the National Adaptation Programme, which the government was required to produce under the Climate Change Act, in which a range of objectives (following the ASC 2017) requiring a holistic approach are identified.

The approach to FRM has become much more holistic, as seen with the growing recognition of Natural Flood Management (NFM) measures and the concept of integrated catchment management since 2015/16 (Deeming 2017). Efforts to connect different types of risks and pressures within risk assessments also point towards a more all-encompassing perspective.<sup>38</sup> However, building resilience does not only mean increasing current and future protection but also reducing the creation of new risks. As such, flooding must be considered as a multi-faceted phenomenon that can only be tackled through a broad array of measures which extend beyond the domain of engineers, hydrologists and statisticians (Merz et al. 2014). It also requires clear recognition of the challenges arising from climate change, in terms of preparing for rising risk levels and dealing with the impacts. This is particularly relevant for coastal communities, where relocation of at-risk properties will be unavoidable. Currently, there is no clear funding mechanism for this as standard FRM funding (flood defence grants) cannot be used to move people or properties away from high-risk areas as the latter is considered a 'private benefit' (from interviews with stakeholders for this project). Local authorities in Norfolk and Yorkshire have developed planning and funding mechanisms to enable relocation of people and property in a 'managed realignment' of the coast in the face of coastal erosion. A similar approach could be used for tidal flooding.

37 <https://www.abi.org.uk/news/news-articles/2019/06/inland-flood-defences-save-the-uk-1.1-billion-a-year/>

38 The recently published Draft National Flood and Coastal Erosion Risk Management Strategy for England presents the EA's clear vision for a holistic and anticipatory approach to FRM in England. Turning this vision into reality will require significant funding, cross-sectoral collaboration and hard political choices. Aligning incentives, ensuring that risk trends are understood and that support for resilience measures is available are essential.

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# Annex: Questions used for mapping and analysing the evolution of flood risk management

## 1. What is the evolution of flood risk in the country?

- a. What are the types of flood risk, who is at risk and why?
- b. What are the underpinning causes of flood risk?
- c. What are the socio-economic impacts?
- d. Is flood risk growing? What are the drivers of rising flood risk in the country?
- e. Has addressing financial and social risks associated with floods become a national concern for people, businesses and the government? In what ways?

## 2. Is reliable flood risk information available and accessible to support decision-making?

- a. What are the underpinning data sources for flood risk analysis (hazard, exposure and vulnerability)?
- b. Are there official flood risk maps and are they publicly available? What types of information are being developed? What are the strengths and weaknesses of the official flood risk maps? How often they are updated?
- c. Are there other sources of flood risk information? Who is processing and providing flood risk information? What types of information is being developed? To whom is this information provided? How is this information provided to target stakeholders?
- d. Is flood risk information provided to target stakeholders? E.g. people, businesses, community organisations, different government agencies, local government and utilities? Are these maps decision-relevant?
- e. Has the level (e.g. high, medium, low) been identified in different regions? Is this

information used to zone the regions according to the level of risk? What are the fundamental assumptions?

- f. Are there targeted risk communication programmes? If yes, who provides them?
- g. What are the benefits, challenges and concerns associated with available risk information and the way it is being provided?
- h. What is the level of flood risk awareness in the country among different stakeholders? Is risk information impacting decisions (e.g. by people, businesses and government)?
- i. Are there any mechanisms for monitoring, assessing and incorporating the changing risk landscape (hazards, exposures, and vulnerability) in the risk maps? Are the underpinning causes of the changing risk landscape investigated and monitored (e.g. climate change, development patterns and practices?) What are the main challenges and concerns?

## 3. How is FRM governed in the country, and how is it evolving? How are different stakeholders engaged in the system?

- a. Who are the key stakeholders with official responsibility to manage floods and their impacts?
  - i. Who has official responsibility for FRM in the country? Is this reflected in national to local legislative processes (e.g. government at national, state and local levels, the insurance sector, banking and mortgage lenders, public utilities, the media, NGOs and other community-based orgs, homeowners)? What are their roles?
  - ii. Who is responsible for addressing the needs and challenges faced by the most vulnerable groups of the population?

- iii. What is the perception of homeowners, businesses and other stakeholders in terms of who is responsible? Does the existing system require that homeowners and business owners manage their own flood risks? Please describe.
- 4. What is the approach to risk reduction (existing risks) and risk prevention (new risks), particularly in relation to rising risks associated with climate change and other socio-economic drivers?**
- a. Is FRM considered an integral element of socio-economic planning, budgeting and development in the country? Is FRM an integral element of climate adaptation policies and decisions, as opposed to being a stand-alone objective?
  - b. Have (or are) disaster risk reduction and risk prevention plans been (or being) developed, implemented and supported/enforced by public policy and regulatory frameworks (at all levels of government)?
    - i. Who is responsible for the development and implementation of these measures? Are the interlinkages of these measures considered part of the overall development and risk management strategy? Or are they implemented in isolation?
    - ii. Is there a dedicated budget supporting these plans? How is the budget allocated between levels of government?
    - iii. Are there incentive mechanisms to promote and enable the implementation of risk reduction and risk prevention by different stakeholders (homeowners, businesses, community-based organisations, local, state and federal governments, public and private utilities, etc.)?
    - iv. Is there a process for monitoring and evaluating the impacts of these measures to improve them over time (what level, by whom, how)? For example, monitoring the impact of retrofitting for residential homes, businesses, government assets, infrastructure (public or privately owned) and communities; or the impact of floods on homes and buildings built based on new building code standards versus old ones?
- 5. Are early warning systems and emergency preparedness in place and if so, how is this helping to reduce risks (reducing loss of life, livelihoods and economic damage)?**
- a. Who is responsible for developing and issuing the alerts and warnings? Are these warnings accessible, understood and responded to by different stakeholders?
  - b. Who is responsible for ensuring alerts and warnings are linked to emergency preparedness on the ground?
  - c. What is the receptivity of the general public, businesses and communities to these warnings?
  - d. Are warnings leading to increased risk awareness, reduction of property damage and expedited response to and recovery from flooding?
  - e. What types of actions are being taken by government (at all levels), businesses, communities and people, based on warnings, to reduce risk?
- 6. Are those that are directly impacted by floods incorporating risk financing and contingency planning in their budgets and plans to increase financial resilience and expedite their ability to respond to floods (e.g. government (all levels), businesses, people)?**
- a. Is the government taking a strategic approach to its financial protection by combining financial instruments? E.g. prioritising cheaper sources of funding, ensuring that the most expensive instruments are used only in exceptional circumstances, using pre-planned budgetary instruments, contingent financing and risk transfer measures (e.g. risk pools) and insuring public assets?
  - b. How has post-disaster aid funding been approached and appropriated?
  - c. Does the country remain reactive (focused on post-disaster response and recovery) or is it strategically considering the need to build resilience to reduce current risks and prevent new risks? Describe in more detail with examples.
  - d. Have post-disaster aid programmes undergone any reforms or modifications to incentivise and/or enable risk reduction and prevention and help with the expansion of insurance for the protection of people, businesses and government?

- e. Does the government arrange for any contingency plans to protect its budget to ensure access to cheaper funds in case of disasters?

**7. Is there an active flood insurance market in the country? Is the value proposition of the insurance sector leveraged in building flood resilience in the country? Is the value proposition of the insurance sector understood by governments, businesses and people?**

- a. What is the status of insurance in the country? Is it provided as a national government service, through the private insurance market or as a combination (public-private partnerships, PPPs)?
- b. What is the nature of the insurance programmes (insurance pools, integral part of home insurance or separate insurance products)? Is the insurance delivery:
  - i. Risk-based?
  - ii. Mandatory versus voluntary?
  - iii. Incentivising risk reduction through reduced premiums or other mechanisms (please describe)?
  - iv. Aimed at residents, SMEs, businesses, government?
  - v. Market-based or enabled through policies and regulatory frameworks (if so, how)?
- c. Is there insurance-backed securitisation of CAT and green bonds?
- d. What is market penetration and coverage?
- e. Is the insurance programme sustainable?
- f. What is the receptivity of government in engaging with the insurance sector?
- g. Is the insurance industry proactively engaged with government and other stakeholders to address strengthening of flood resilience? Please describe.
  - i. Is the insurance industry engaged with government in reviewing flood risks to residents, business, government, and infrastructure and identifying innovative market-based solutions?
  - ii. Is the insurance industry developing innovative risk transfer measures (with or without collaboration with the government)?

Are these solutions available, accessible and affordable and are they being used by those at risk to distribute or pool the residual economic risks?

- iii. Are insurance solutions (by industry, government or both) incentivising behavioural change (e.g. insurance solutions available to residents, SMEs, etc.)?

- h. Are the government (at all levels) and/or the insurance industry engaged with customers and businesses to educate about risks, preventive mechanisms and the benefits of insurance?

**8. Following a disaster, are there systematic mechanisms to revisit, re-evaluate and decide on reconstruction plans and decisions?**

- a. Are there formal mechanisms and legislation in place to enforce the need to build back smarter (e.g. build back using updated building codes, relocate and do not build at all if the region(s) has been identified as a high-risk zone)?
- b. Are there efforts to reconsider land zoning in high-risk regions that experience recurrent risks? Are there any government plans for buyouts and relocation from high-risk zones? Have these programmes and their impact been assessed?

**9. Are there monitoring and review processes in place for assessing/measuring the impact of risk communication, risk reduction, risk prevention, risk financing and risk transfer decisions and for providing feedback to improve the different components of FRM in the country?**

**10. Overall:**

- a. Is the FRM approach transitioning toward a greater focus on flood resiliency? E.g. is the approach focused not only on reducing current risks but also prevention of future risks linked to factors such as climate change?
- b. Is the approach characterised as fragmented (i.e. engaging many organisations with different but disconnected roles and initiatives) or is it evolving towards a holistic all-of-society approach (leveraging all components of the system)?
- c. Is there any evidence of cultural/behavioural change towards active management and reduction of risk (e.g. people, businesses, communities and all levels of government)? Is it linked to the level of risk? Are there incentives for this change?





As the world deals with the COVID-19 pandemic crisis, potential compounding effects of weather-related extremes such as floods, tropical cyclones and wildfires could significantly challenge a country's emergency management capacities and slow down its socio-economic recovery. Floods are among the most concerning and costly weather-related events globally. Part of a major study on the evolution of flood risk management (FRM) in five mature economies, this report takes an in-depth look at the FRM system in England – governance, institutional frameworks and stakeholder engagement – against an analysis of the changing risk landscape.

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