

Buckinghamshire County Council

Local Flood Risk Management Strategy



Prepared by: Strategic Flood Management Team

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Glossary

Term	Definition
Act (or The Act)	The Act refers to the Flood & Water Management Act 2010
AEP	Annual Exceedance Probability. A flood or rainfall event with a 1 in 100 (1%) chance of being exceeded in any year has an AEP of 1/100 or 1%.
AVDC	Aylesbury Vale District Council
AW	Anglian Water
BCC	Buckinghamshire County Council
BSFMG	The Buckinghamshire Strategic Flood Management Group was formed in 2009 to co-ordinate work amongst relevant stakeholders and Partners.
CDC	Chiltern District Council
CTC	Chesham Town Council
CFMP / Catchment Flood Management Plan	Catchment Flood Management Plans are produced by the Environment Agency to give an overview of the flood risk in the two primary catchments in BCC's area: Great Ouse and Thames.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency, which has a Strategic overview role for flood and coastal erosion risk management and permissive powers for the management of Main Rivers
Flood	The temporary inundation by water of property or land not normally covered with water
Flood & Water Management Act 2010 (FWMA)	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which (partly) is to clarify the legislative framework for managing local flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a river.
Groundwater flooding	Occurs when water levels in the ground rise above the natural surface. Areas underlain by permeable strata (e.g. Chalk) are particularly susceptible.
IDB	Internal Drainage Board. Applicable to only one area in Buckinghamshire for which the Buckingham and River Ouzel Internal Drainage Board has flood risk management responsibilities.
Integrated Catchment Management	A management approach that recognises the need to integrate all environmental, economic and social issues within (or related to) a river basin into an overall management philosophy, process and strategy or plan. Its aim is to provide the greatest sustainable benefits to a population.
LLFA / Lead Local Flood Authority	Local Authority responsible for taking the lead on local flood risk management
Local Flood Risk	Flooding from sources other than Main Rivers, which principally concerns surface runoff, groundwater and Ordinary Watercourses. BCC has a responsibility under the Flood & Water Management Act to manage flooding from these sources.
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers.
Multiple Benefits	As well as reducing the risks to people and property, flood risk management can bring economic, environmental and social benefits.

Term	Definition
Ordinary Watercourses	All watercourses that are not designated Main River, and which are the responsibility of local authorities or IDBs
Partner	A person or organisation with responsibility relating to flood risk management for the decision or actions that need to be taken.
PFRA / Preliminary Flood Risk Review	A report produced by BCC in response to the Flood Risk Regulations 2009 which summarises local flood risk across BCC's area and provides a number of detailed maps recording local flood incidents
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Riparian Owner	A person that owns land adjoining a watercourse.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
RMA / Risk Management Authorities	Organisations that have a key role in flood and coastal erosion risk management as defined by the Flood & Water Management Act 2010. These are BCC (the Lead Local Flood Authority and Highways Authority), District Councils, Environment Agency, Buckingham and River Ouzel Internal Drainage Board, Anglian Water and Thames Water
SBDC	South Bucks District Council
SFRA	Strategic Flood Risk Assessment. These are produced by each District to give an assessment of flood risk from all sources and its implications for land use planning.
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations; includes the public and communities.
Strategy	Under the Flood & Water Management Act 2010, BCC have a duty to develop, maintain, apply and monitor a strategy for local flood risk management
Sustainability	In the context of this Strategy, the risk of flooding must be reduced now, but in a way which does not compromise the interconnected needs of the economy, society and environment in the future.
SuDS / Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Surface water/runoff	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer. The term 'surface water' is used generically to refer to water on the surface and is often associated with periods of intense rainfall.
Swale	A shallow vegetated channel designed to conduct and retain water, but also may permit infiltration. The vegetation filters particulate matter.
SWMP	Surface Water Management Plan
TW	Thames Water Utilities Ltd
uFMfSW	Updated Flood Map for Surface Water
UKCP09	The UK Climate Projections provide climate information designed to help those needing to plan how they will adapt to a changing climate. The data is focussed on the UK.
WDC	Wycombe District Council

1 Introduction

1.1 Why has this strategy been produced?

This document updates the Buckinghamshire County Council (BCC) Local Flood Risk Strategy 2013-17. It has been updated earlier than anticipated following the flooding incidents during winter 2013/14 and in light of legislative changes. In September 2015, the Department for Communities and Local Government (DCLG) and the Department for Environment, Food and Rural Affairs (Defra) updated measures to strengthen existing planning policy relating to Sustainable Drainage Systems (SuDS).

This strategy has been produced to comply with the first of the statutory duties of Buckinghamshire County Council (BCC) as Lead Local Flood Authority as stipulated by the Flood and Water Management Act 2010 and as lead Risk Management Authority (RMA) (additional duties are included throughout this document and are summarised in the following box).

“BCC has a duty to develop, maintain, apply and monitor a strategy for local flood risk management in its area.”

This Strategy has been produced for a number of reasons:

- In a review of natural hazards across Europe in the decade to 2009¹, floods, along with storms, were the most damaging form of disaster in terms of economic losses. The UK is registered as having the highest economic losses from flooding within Europe. A major contribution to these losses results from flooding from watercourses other than Main River or Sea.
- In England, in 2009, around 5.2 million, or 1 in 6 residential and commercial properties were identified as being in areas at risk of flooding from rivers, the sea or surface water. Furthermore, 1.7 million properties have been identified as being at risk of flooding from groundwater².
- Buckinghamshire has suffered the consequences of flooding in recent years. Flooding of homes, businesses, agricultural land as well as roads, public services and the wider environment has occurred from rivers, smaller watercourses, intense rainfall, groundwater and sewers
- Flooding from the Main Rivers in Buckinghamshire continues to be managed by the Environment Agency (EA)³ using their permissive powers. However, to provide

¹ European Environment Agency (2010) Mapping the impacts of natural hazards and technological accidents in Europe: An overview of the last decade. EEA Technical Report No 13/2010

² Jacobs (2004) Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23) Final Report Volume 1 of 2 May 2004. Report for Defra

³ The Environment Agency also continues to manage the risk of flooding from the sea although this is not relevant to Buckinghamshire and is not mentioned further. Similarly, the Flood & Water Management Act

better and more comprehensive management of flood risk, the Flood & Water Management Act 2010⁴ has assigned new responsibilities to local authorities

- There is a need to update flood and coastal erosion risk management to reflect current approaches and organisational structures
- Consideration of how to adapt to climate change is an important strategic issue. Climate change is predicted to increase flood risk through changing patterns of rainfall and flood flows in rivers, and increased risks from surface runoff

Set in this wider context of flood management, addressing flood risk in Buckinghamshire must be tackled strategically and must remain up to date to reflect changes in understanding and legislation.

To comply with both the statutory duties for Flood Management and the policy relating to SUDS, the vision in creating this strategy was to better understand and manage the risk of local flooding using sustainable, cost-effective and coordinated approaches for the benefit of Buckinghamshire's communities and environment.

This Local Flood Risk Management Strategy uses a number of principles to demonstrate the ways in which BCC will manage flood risk in the county and a series of case studies to illustrate the ongoing work with which BCC is involved with. This approach falls in line with other flood risk management policy to group actions and provide a logical framework within which to pursue holistic management.

also covers responsibilities for managing coastal erosion. Again, this are not mentioned further as it is not relevant for Buckinghamshire.

⁴ <http://www.legislation.gov.uk/ukpga/2010/29/contents>

Statutory Duties and Powers

The Flood and Water Management Act (FWMA) 2010 sets out a number of requirements for the Buckinghamshire County Council as the Lead Local Flood Authority.

Partnership Working (FWMA Part 1 Section 2.13)

BCC has a statutory duty to cooperate with other authorities, including data sharing. This ensures efficiency in how flood risk can be managed.

Enforcement (FWMA Part 1 Section 2.15)

When works have been carried out on watercourses without consent, BCC have the power to enforce and serve notice under the Land Drainage Act 1991. Unconsented actions often stem from a lack of understanding of riparian ownership responsibilities (see section 7.1).

Flood Investigations (FWMA Part 1 Section 3.19)

BCC have a duty to formally investigate flood events that meet certain criteria, as set out in the strategy (section 4.5). These Section 19 Flood Investigation Reports enable a greater understanding of the locations where flooding has happened, which in turn ensures the methods laid out in this strategy are relevant.

Asset Register (FWMA Part 1 Section 3.21)

BCC has a duty to produce a register of structures that are likely to have a significant effect on flood risk (section 4.6). Documentation of these structures helps to ensure greater co-ordination of information between partners, regulatory bodies and the public.

Consenting (FWMA Schedule 1 Section 6)

Under the Land Drainage Act 1991, the erection or alteration of any feature that may affect the flow of an ordinary watercourse requires local authority consent. BCC processes applications for consent in order to carefully manage flood risk.

Sustainable Drainage Systems (SuDS) (Schedule 3)

BCC has a duty to promote SuDS and has the authority to approve, or otherwise, sustainable drainage proposals associated with any major development that will affect surface water runoff above certain thresholds. In April 2015, BCC became a statutory consultee with regards to the drainage part of planning applications for Major Development (section 5.4).

1.2 Who is involved with Flood Risk Management in Buckinghamshire?

Buckinghamshire County Council (BCC) and the district councils (Aylesbury Vale, Chiltern, South Bucks and Wycombe) now work in partnership with the Environment Agency (EA), water companies (Anglian Water, Thames Water and Affinity Water⁵), the Buckingham and River Ouzel Internal Drainage Board (IDB) and others to manage various aspects of flood risk. BCC, as the lead partner, is designated as the Lead Local Flood Authority (LLFA).

Figure 1 displays a map of the main political and organisational boundaries. This partnership of organisations has responsibility for managing flooding which arises from 'local' sources. Local sources are defined as: surface water, ordinary watercourses and groundwater flooding. The inset in figure 1 displays the different EA areas covered in Buckinghamshire.

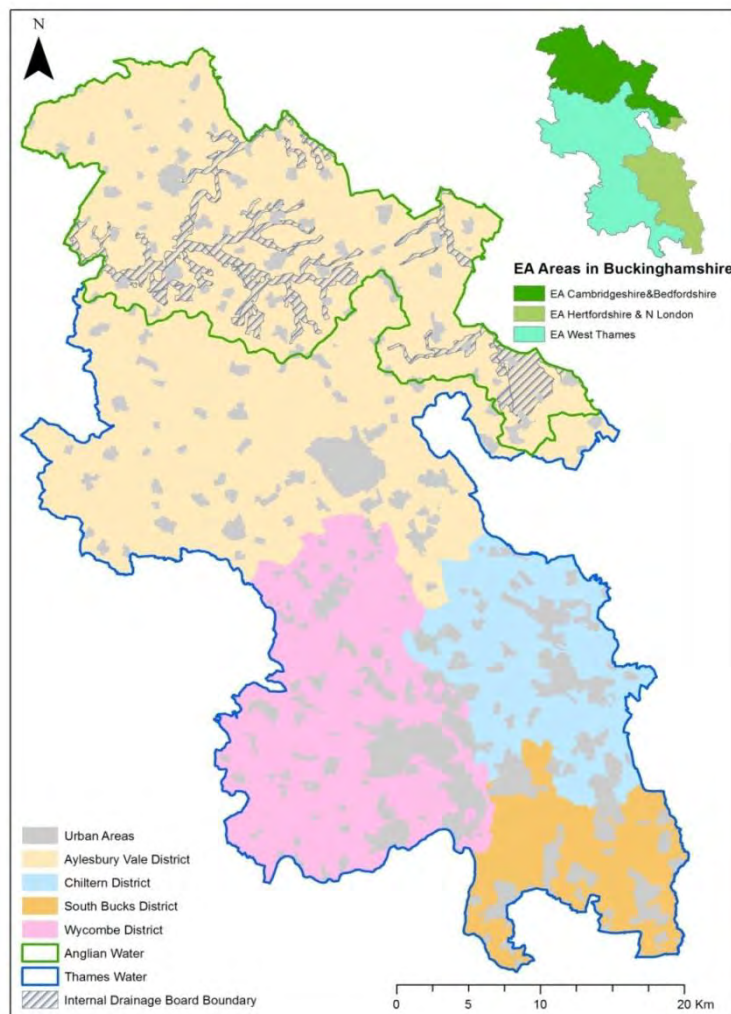


Figure 1: BCC's administrative area for management of local flood risk

⁵ Anglian Water (water and sewerage), Thames Water (water and sewerage) and Affinity Water (water only)

2 Understanding flood risk in Buckinghamshire

2.1 What is flood risk?

A flood is formally defined within the Flood and Water Management Act, 2010, as occurring “where land not normally covered by water becomes covered by water”.

Flood risk is defined as the combination of the **probability** of a flood occurring and the scale of **consequences** should that flooding occur. There can be various contributory factors and sources of flood risk, as outlined in Sections 2.3 below.

The **probability** (or likelihood) of flooding is described as the chance that a location will flood in any given year. For example, if a location is described as having a 2% chance of flooding, this can also be expressed as:

- A 1 in 50 chance of flooding in that location in any given year; or
- Odds of 49 to 1 against that location being flooded in any given year.

However, this does not mean that a location will flood on a 50 year cycle.

The **consequences** of flooding are the economic, social, environmental or cultural impacts on a **receptor**. Receptors are properties, people, infrastructure assets and environmentally or culturally significant sites which may suffer harm should flooding occur.

2.2 Factors contributing to flooding

Flooding is a natural phenomenon, the adverse consequences of which can be exacerbated by poor management of the landscape and the environment.

Flooding is generally driven by natural weather events such as:

- Heavy rainfall and thunderstorms over a short period
- Prolonged, extensive rainfall
- Snow melt

It is predicted that climate change will result in an increase in short, intense rainfall events and an increase in overall winter rainfall in the UK, with a resultant increase in flood risk through greater surface runoff rates and flood flows in rivers.

Flood risk can also result from, or be exacerbated by, other factors including:

- Insufficient capacity in drainage systems
- Inadequate maintenance of watercourses
- Inappropriate development in floodplains
- Building on land in a way that prevents rainfall from draining away naturally, such as roads and car parks that are impermeable to water
- Unsustainable land management activities

- Deforestation can reduce interception of precipitation by trees and therefore increases surface runoff
- Intensive grazing and heavy farm machinery can increase soil compaction and reduce infiltration, leading to greater surface water runoff and soil erosion. Sediment-laden runoff entering rivers reduces their capacity to transport water
- Straightening of watercourse channels increases the flow rate, increasing sediment transport and potentially accentuating flood peaks downstream

2.3 Sources of flood risk

Flooding in a particular location can be caused by the complex interaction of a number of different sources. Whilst someone suffering the impacts of flooding is unlikely to be concerned about the particular causes, better management and identification of appropriate responses require these interactions to be easily understood. This section summarises the characteristics of flooding (Table 1) which are managed by BCC, other Risk Management Authorities and partners. The roles of the RMAs are covered in detail later in Section 6.5.

Table 1 : Sources, characteristics and managing authorities of flooding

Source of flood risk	Characteristics of flooding	Managing Authority
Main River (Fluvial)	Watercourses designated as Main River are the responsibility of the Environment Agency. "Fluvial" flooding refers to flooding from both Main Rivers and Ordinary Watercourses. Main River flooding typically results when the river banks are overtopped. In many instances, overtopping river banks is not a significant problem if the flood plains are in a natural state without buildings or infrastructure.	Environment Agency
Ordinary Watercourses (Fluvial)	All watercourses that convey a flow and that are not designated Main River, are referred to as "Ordinary Watercourses" and are the responsibility of local authorities or Internal Drainage Boards. Flooding from Ordinary Watercourses (typically smaller than Main Rivers) is essentially flooding from a river, stream or canal – often referred to as fluvial flooding. It can be a particular problem even though the catchment areas may be small. Urban watercourses are often culverted over long sections and the entrances to these culverts, even though screened, can often be flooding 'hotspots'. Debris, both natural and man-made often accumulates in urban	Buckinghamshire County Council Internal Drainage Boards

Source of flood risk	Characteristics of flooding	Managing Authority
	<p>watercourses which not only constricts the watercourse but can accumulate at culvert screens and cause bottlenecks or blockages. Whilst these characteristics are typical, it should not be assumed that all Main Rivers are large and all Ordinary Watercourses are small – the distinction between the two relates only to the responsibility for managing these watercourses.</p>	
Surface water	<p>Flooding occurs when the capacity of local drainage (both natural and man-made) is overwhelmed by intense rainfall and so the water cannot enter the drainage system, resulting in ponding, sometimes to a significant depth. Such ponding, often in low spots in the ground surface can occur rapidly and be a particular risk to underground assets. Flooding can also occur on sloped surfaces from surface water that has not yet reached the surface water drainage system. Where slopes are steep, high velocities along roads and streets can also be a hazard to pedestrians and traffic.</p>	Buckinghamshire County Council
Groundwater	<p>Water which is below the surface of the ground and found below the water table. Groundwater can be close to the surface or at significant depth, but the risk of groundwater flooding is highest where the water is held in permeable rocks, called aquifers, and where the water table is relatively close to the ground surface. A rise in the water table may lead to “groundwater emergence” at the surface. The Chalk of The Chilterns form extensive aquifers. Raising of groundwater levels to cause flooding can take long periods of above average rainfall which may happen infrequently but, once raised, levels can remain high for weeks or months and cause severe damage and disruption.</p>	Buckinghamshire County Council
Sewer	<p>Can occur when sewers are overwhelmed by heavy rainfall, seepage of groundwater or when they become blocked. The likelihood of flooding depends on the characteristics of the local sewerage system and the local hydrology. Land and property can be flooded with water contaminated with raw sewage as a result of sewer flooding. Rivers can also become polluted by sewer overflows.</p>	Anglian Water Thames Water

Source of flood risk	Characteristics of flooding	Managing Authority
Reservoirs	Reservoirs are artificially created ponds or lakes typically formed by either damming a river (on line) or raised (off line). Reservoirs retaining more than 25,000m ³ are regulated under the Flood and Water Management Act 2010 (FWMA). The likelihood of flooding from reservoirs is rare, however overtopping of the dam crest or embankment can happen when the spillway is too small or becomes blocked. Flood risk is increased if the overspill is unable to cope with excess volumes of water. If the flow is too large or overtopping lasts too long, water can erode the surface of the embankment which can lead to the unintended release of large volumes of water at high velocity. However under the FWMA new arrangements for reservoir safety, based on risk rather than the size of the reservoir mean that risks are carefully managed.	Environment Agency
Canals	Canals are artificially created waterways which were historically used for freighting. The likelihood of flooding is dependent on their hydrological inputs. Canals in the UK are supplied by groundwater or river abstraction or by direct inflow. Water levels are usually controlled by weirs or sluices. Uncontrolled loss of water from the canal can result from overtopping or breaching.	Canal and River Trust/ Local Authority

The scale of fluvial and surface water flood risk in Buckinghamshire is set out in Table 2 but it is noted that there are additional sources of flood risk beyond these.

Table 2: Distribution of properties at risk of flooding in Buckinghamshire

District	Number of properties at risk of surface water flooding (in a 1 in 100 year event)	Number of properties at risk of fluvial flooding (in a 1 in 100 year event)
Aylesbury Vale	617	2733
Chiltern	1629	784
South Bucks	229	1474
Wycombe	1870	3040
Total	4345	8031

Figures have been calculated using GIS by intersecting the Risk of Flooding from Surface Water and Risk of Flooding from Rivers and Sea maps with the National Receptors Dataset. As the datasets are independent, there may be properties at risk from both surface water and fluvial flooding and therefore counted in both datasets.

2.4 Areas with similar flood risk

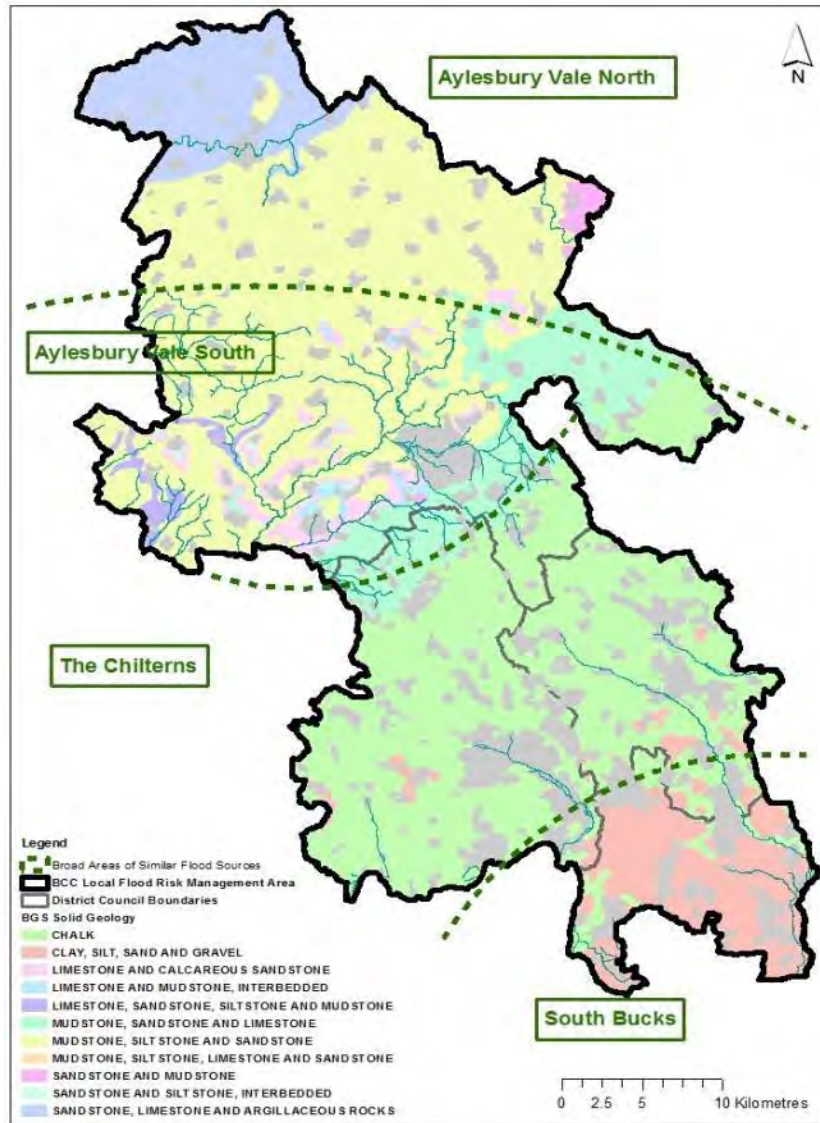


Figure 2: Broad grouping of areas with similar flood risk

Buckinghamshire is at risk of flooding from a number of sources, which are often interlinked. Whilst this strategy concentrates on flooding from local sources; Ordinary Watercourses, surface water and groundwater (see Table 1), BCC takes a holistic approach to flood risk management at the catchment scale (see Section 8) allowing the integration of compound risks from Main Rivers and sewer flooding. Figure 2 and Table 3 provide an overview of the risks within each region of Buckinghamshire. BCC will produce a more detailed risk assessment that shall inform a prioritisation of the local areas at greatest risk of flooding. Further details of this work are outlined in Section 4.2.

Region	Major Watercourses	Geography	Hazards
Aylesbury Vale North	River Great Ouse River Ray Numerous Smaller Watercourses	Flat Terrain Underlying Limestone	Groundwater-Flooding Fluvial Flash-Flooding
Aylesbury Vale South	River Thames Numerous Smaller Watercourses	Underlying combination of limestone, chalk, clay and alluvium	Groundwater Flooding Surface- Runoff
The Chilterns (Wycombe and Chiltern Districts)	River Thames, River Wye, River Chess, River Misbourne	Underlying Chalk	Groundwater Flooding Overtopping of watercourses
South Buckinghamshire	River Misbourne River Colne	Underlying Clay	Groundwater Flooding Surface Runoff

Table 3: Descriptions of local flood risk across Buckinghamshire

2.5 Timeline of recent key flood events in Buckinghamshire

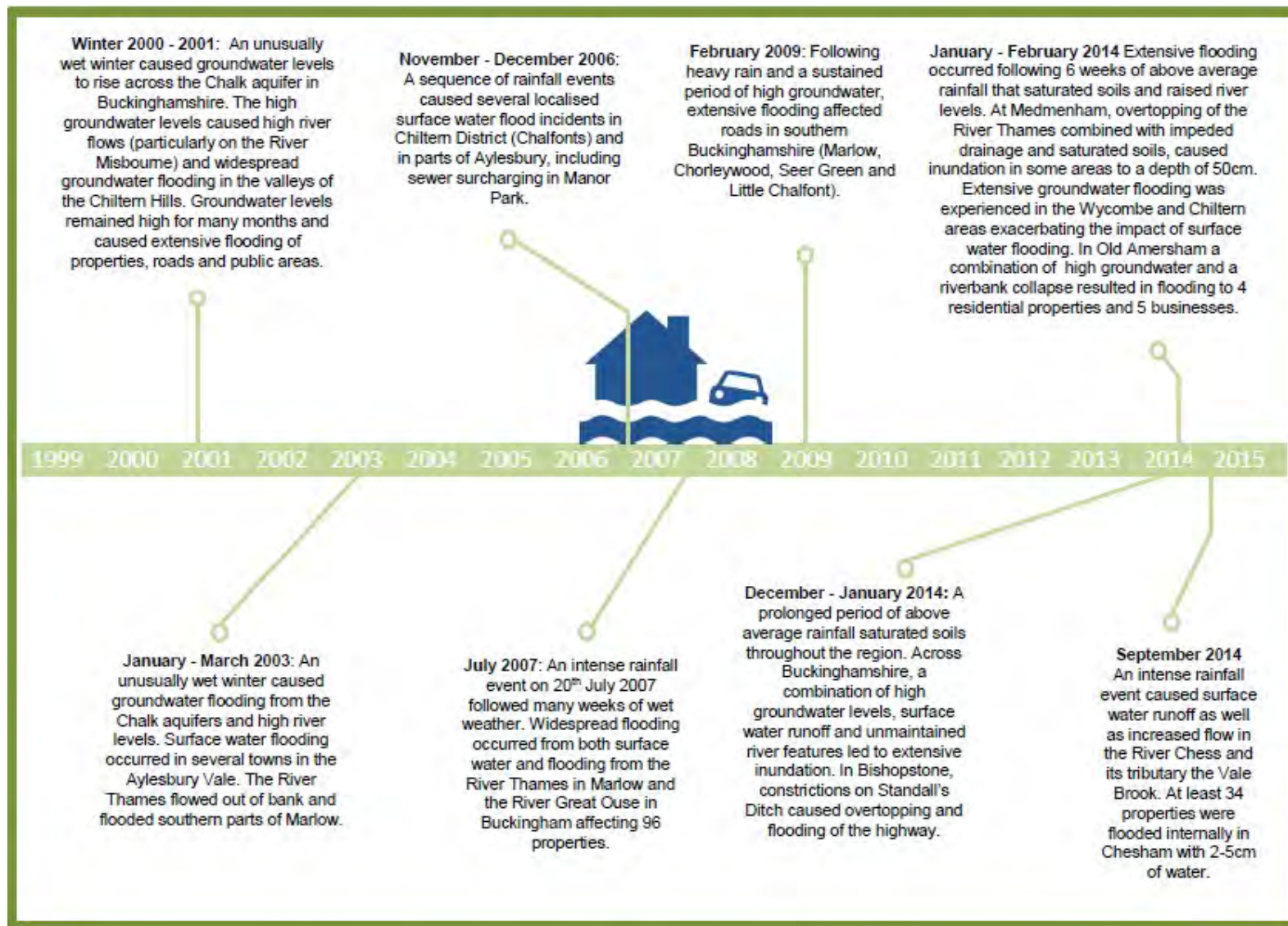


Figure 3: Timeline of recent key flood events

Case Study: Groundwater flooding in Buckinghamshire

Extensive groundwater flooding occurred in the unconfined Chalk aquifers that make up the Berkshire Downs and Chilterns in the winter of 2012/13 following a year of above average rainfall (148% of the long term average in the Thames region). Major disruption was caused as a result of flooding of properties, roads, agricultural land and the overwhelming of sewers.

Groundwater levels receded over the summer of 2013, reaching the seasonal average by early autumn. However, an exceptional period of heavy rainfall followed. Between October 2013 and February 2014, 230% of the long term average rainfall fell on Buckinghamshire and areas of Berkshire. This is estimated to have a probability of occurring of less than 1% in any year.

This brought exceptional runoff rates and fluvial flooding, which was soon followed by groundwater flooding from the Chalk. Whilst the extent of flooding was variable across the county, groundwater levels were so high that all areas that flooded in winter 2012/13 flooded again in the winter of 2013/14.

As groundwater levels rose, the area experienced an increase in spring flows followed by flows in normally dry valleys. This resulted in widespread disruption in the Bishopstone, Chalfont and Aylesbury areas with groundwater flooding contributing to inundation of over 80 residential homes and numerous businesses.



Groundwater flooding in Chalfont. Photograph taken from Section 19 Flood Investigation Report – Chalfont St Peter, January-March 2014

2.6 Collating flood risk data and mapping

Information on local flood risk can be found in a number of sources including the following. Key findings are summarised in this section and relevant recommendations have been brought forward into the accompanying action plan.

- **BCC Preliminary Flood Risk Assessment (PFRA; May 2011):** Summarises local flood risk across BCC's area and provides a number of detailed maps recording local flood incidents. Every Lead Local Flood Authority (LLFA) is required to produce and update this report every six years in response to the Flood Risk Regulations 2009.
- **Surface Water Management Plans (SWMPs):** Plans produced by a partnership of organisations, usually led by the LLFA, which identify sustainable responses to manage local flooding and contain Action Plans that provide an evidence base for future decisions. Plans were published for Chesham and High Wycombe in November 2011 and the first phase of the SWMPs for Buckingham and Marlow completed in 2013.
- **EA Catchment Flood Management Plans:** The Great Ouse and Thames CFMPs give an overview of the flood risk in the catchments and set out the EA's preferred plan for sustainable flood risk management over the next 50 to 100 years. These are due to be superseded by the EA's **Flood Risk Management Plans (FRMP)**, which are due to be published in 2017. The BCC area will be covered by the Anglian FRMP and the Thames FRMP.
- **Strategic Flood Risk Assessments (SFRAs):** These are produced by each District to give an assessment of flood risk from all sources and its implications for land use planning. SFRAs have been produced by Aylesbury Vale District Council (AVDC) in 2012, Chesham District Council (CDC) in 2013, South Bucks District Council (SBDC) in 2008 and Wycombe District Council (WDC) in 2008.
- **Section 19 Flood Investigation Reports**
These are produced by BCC following flood events that meet certain criteria (outlined in section 4.5.1).
- **Asset Register**
This is a register, produced by BCC, of structures or features with identification or risk to flooding (outlined in section 4.6).

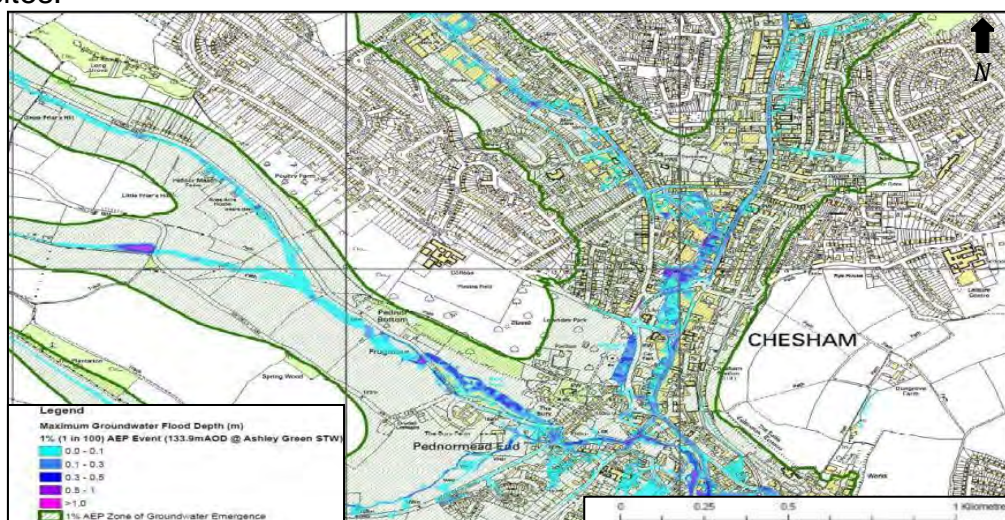
National mapping of areas which could be at risk of local flooding, known as the [Risk of Flooding from Surface Water](#) has been produced by the Environment Agency and adopted by BCC as that which best represents local conditions. The mapping gives an indication of the areas which may be susceptible to flooding caused by intense rainfall, high groundwater levels and out of bank flow in watercourses which are not Main River. However the focus of these maps is surface water and it does not fully represent flooding from ordinary watercourses or groundwater.

This mapping⁶ estimates that there are 4,335 properties across the four Districts within Buckinghamshire which could be at risk of local flooding in an event with a 1 in 100 (1 %) annual chance of occurring (Table 2). The primary concentration of these properties is predicted to be in Aylesbury, Buckingham, High Wycombe, Amersham/Chesham and Marlow.

Unlike fluvial or surface water flooding, the Environment Agency adopted groundwater flood maps (developed following the 2000/2001 flood events) have a limited value to LLFAs. These maps are only indicative and typically provide less information on depth or geographical extent of water at the ground surface.

A recent study has produced much more detailed groundwater flood risk maps for key high risk locations in Buckinghamshire (Figure 4), showing flood depth and extents for various events of different probabilities⁷. These mapping techniques offer more detailed information to LLFAs and may be incorporated into future flood risk assessments. Similar maps to the one below can be seen on the [BCC website](#).

It is not only people and properties which the national mapping identifies as being at risk of local flooding. There are also a number of environmentally designated sites. A small proportion of one Special Area of Conservation (SAC) is identified as being at risk, as well as a number of Sites of Special Scientific Interest (SSSI) which are likely to be at risk of flooding both from local sources and Main Rivers. A number of Scheduled Monuments may be at risk and both Chesham and Amersham have a significant number of listed buildings. Given the number and density of listed buildings at risk, particularly in Amersham and Chesham, there is an appreciable risk of surface water flooding to cultural heritage sites.



This map shows the outer emergence zone around Chesham within which groundwater levels can be expected to rise to within 2m of the ground surface in a 1% event. The base map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings.

Figure 4: Groundwater flood map for Chesham

⁶ Risk of Flooding from Surface Water and Risk of Flooding from Rivers and Sea.

⁷ Morris.S.E, Cobby. D, Zaidman. M and Fisher. K, 2015 'Modelling and mapping groundwater flooding at the ground surface in chalk catchments', *Journal of Flood Risk Management*, CIWEM.

2.7 Looking forward - update of PFRA - Flood Risk Regulations (2009)

The Flood Risk Regulations 2009 (FRR) implement the EU Floods Directive in England. They provide a framework for managing flood risk over a 6 year cycle, comprising:

- preliminary flood risk assessment (PFRA)
- identification of areas of potential significant risk, referred to as flood risk areas (FRAs)
- mapping of flood hazards and risk and
- Flood Risk Management Plans (FRMPs), setting out measures and actions to reduce the risk

The FRR state that each of the above four elements must be reviewed, and updated where necessary, at least every 6 years. Each LLFA completed a PFRA and identified FRAs for local flood risk, primarily surface water runoff, groundwater and ordinary watercourses, in 2011. The first review is required in 2017.

Further information which is useful to this Strategy may well be identified in the Preliminary Flood Risk Assessment (PFRA) due in 2017. This information is likely to be identification of potential significant risk referred to as Flood Risk Areas (FRAs). These areas will be added to the information in Appendix B when they become available.

3 Principles of this Local Flood Risk Management Strategy

This document, the Local Flood Risk Management Strategy sets out the following principles which, in priority order, demonstrate the ways in which BCC's Strategic Flood Management Team will manage local flood risk. The principles focus on effective and innovative approaches whilst also ensuring that BCC adhere to their statutory duties which are outlined under the relevant principles throughout the document.

It should be noted that these principles also fall in line with the overarching focus of the [Strategic Objectives](#) set out by Buckinghamshire County Council. These guide the activities and delivery of all of the services of the organisation, which range from education to social care to strategic planning. At the national level BCC seek to influence the content of new planning legislation, guidance and other material prepared by Central Government and its agencies. A key challenge is in how to balance the need for new development in Buckinghamshire with the protection and enhancement of its environment and quality of life.

Principle 1. Improve understanding of flood risk across Buckinghamshire to inform strategic and prioritised local flood risk management

Principle 2. Provide support to local planning authorities to minimise future development in flood risk areas, increase resistance and resilient building design and seek to use development to reduce flood risk elsewhere

Principle 3. Lead and work together with partners to manage the existing "local" flood risk

Principle 4. Engage with the public and local communities to improve awareness of flood risk and ensure work is guided and informed by local knowledge and successes are shared with everyone

Principle 5. Pursue integrated flood management approaches across the whole event life cycle

Principle 6. Seek funding from a variety of sources to support flood risk management activities and implement projects

Principle 7. Recognise the pressures and opportunities that a changing climate presents and take action to mitigate threats and exploit opportunities wherever possible

Principle 8. Provide support and information to our partners who undertake emergency flood management

In addition to BCC's Strategic Objectives, Table 4 shows how each of the principles fit within the wider context of the [National Flood and Coastal Erosion Risk Management Strategy](#) on flood management.

National Strategy Objective	Guiding Principles of the EA National FCERM Strategy	Buckinghamshire Local Flood Risk Management Strategy Principles
<p>Understanding the risks of flooding and coastal erosion, working together to put in place long term plans to manage these risks and making sure that the other plans take account of them.</p>	Sustainability	Recognise the pressures and opportunities that a changing climate presents and take action to mitigate threats and exploit opportunities wherever possible (Principle 7)
	Proportionate, risk-based approaches	Improve understanding of flood risk across Buckinghamshire to inform strategic and prioritised local flood risk management (Principle 1)
<p>Avoiding inappropriate development in areas of flood and coastal erosion risk and being careful to manage land elsewhere to avoid increasing risks.</p>		Provide support to local planning authorities to minimise future development in flood risk areas, increase resistance and resilient building design and seek to use development to reduce flood risk elsewhere (Principle 2)
<p>Building, maintaining and improving flood and coastal erosion management infrastructure and systems to reduce the likelihood of harm to people and damage to the economy, environment and society.</p>	Catchment and coastal "cell" based approach	Pursue integrated flood management approaches across the whole event life cycle (Principle 5)
	Multiple benefits	
	Beneficiaries should be encouraged to invest in risk management	Seek funding from a variety of sources to support flood risk management activities and implement projects (Principle 6)
	Community focus and partnership working	Lead and work together with partners to manage the existing "local" flood risk (Principle 3)
<p>Increasing public awareness of the risk that remains and engaging with people at risk to make their property more resilient.</p>		Engage with the public and local communities to improve awareness of flood risk and ensure work is guided and informed by local knowledge and successes are shared with everyone (Principle 4)
<p>Improving the detection, forecasting and issue of warnings of flooding, planning for and co-ordinating a rapid response to flood emergencies and promoting faster recovery from flooding.</p>		Provide support and information to our partners who undertake emergency flood management (Principle 8)

Table 4: Comparison of BCC Principles against EA National Strategy Objectives

4 Strategic management

Principle 1. Improve understanding of flood risk across Buckinghamshire to inform strategic and prioritised local flood risk management

BCC recognises that coordinating maintenance and flood risk management activity between different authorities within catchments is important to ensure that flood risks are being managed in a holistic and cost-effective way. This is overseen by the Buckinghamshire Strategic Flood Management Group (BSFMG).

The impacts of flooding are not the same throughout the county. As noted in the [National FCERM Strategy](#), it is not technically, economically or environmentally possible to prevent flooding altogether. BCC shall therefore take a risk-based management approach to prioritise areas and communities that are at greatest risk of flooding and target resources where they will provide the greatest positive effect. This prioritisation will evolve over time as BCC's understanding of flood risk is developed and refined.

By recording flood events and assessing vulnerabilities, BCC will build a better picture of flood events and improve the efficiency of future management practices. These activities shall include maintaining an asset register to inform delivery of the best and most suitable solutions for communities and local infrastructure.

These points shall be expanded upon in the following sections.

4.1 Buckinghamshire Strategic Flood Management Group

BCC has a dedicated Strategic Flood Management Team, who coordinate all "local" flood risk management activities. BCC recognises that much of the local knowledge and technical expertise necessary to improve management of local flooding lies with the District Councils, EA, water companies, IDB and other Partner organisations. Involvement of these and other organisations will also provide benefits for the natural and social environment, as well as the cultural heritage of Buckinghamshire.

To coordinate work amongst the Risk Management Authorities (RMAs) and other Partners, the Buckinghamshire Strategic Flood Management Group (BSFMG) was formed in 2009. The group is chaired by the BCC Cabinet Member for Planning and Environment and comprises County members as appropriate, District Council members and other partner organisations as shown in Figure 5. The terms of reference for the BSFMG (Appendix A) focus on setting strategic direction, coordinating activities across the County and decision making for effective risk management. To maintain effective links to carry out these decisions a Technical Working Group has been set up to oversee operational activities such as flood investigations and implementation of this Strategy.

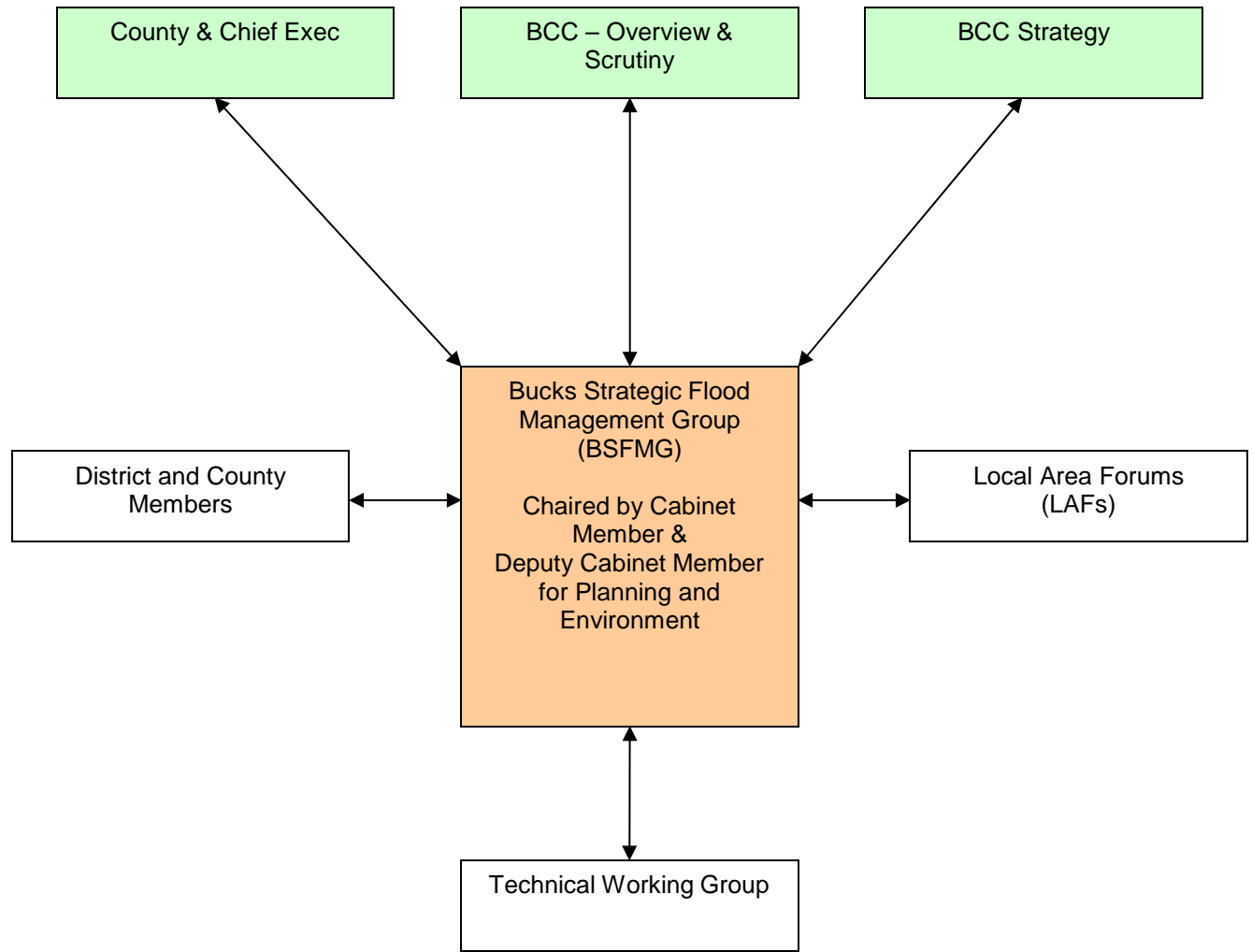
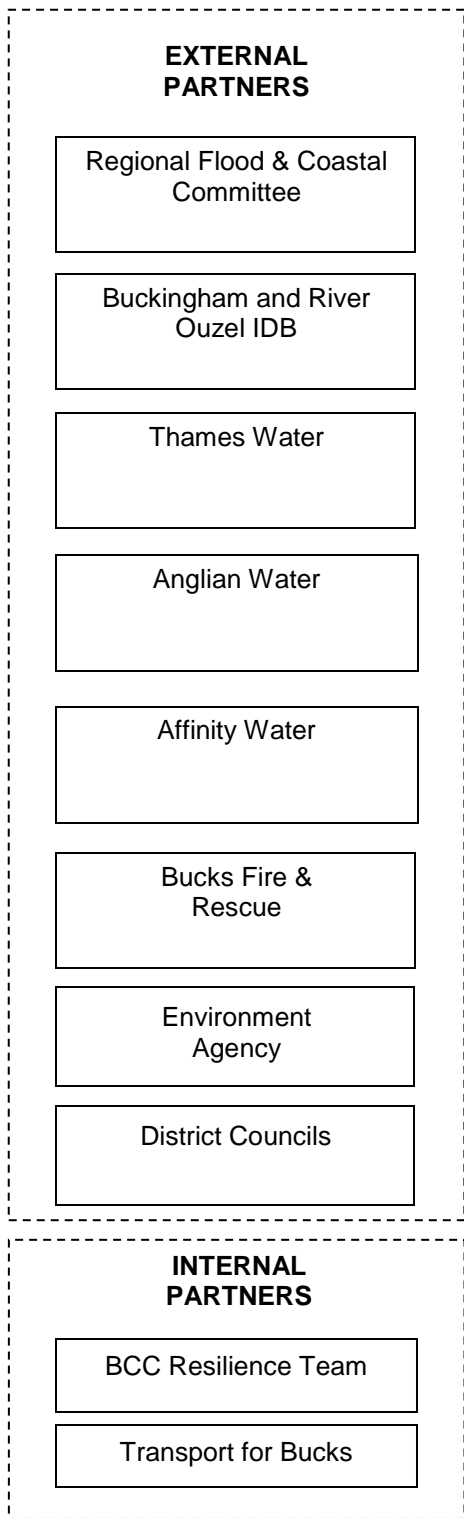


Figure 5: Buckinghamshire Strategic Flood Management Group Organisation

4.2 Risk based assessment

BCC has begun work to produce a local flood risk assessment of the areas and communities across Buckinghamshire to enable prioritisation of the local areas at greatest risk of flooding (see Appendix B). This will provide an evidence base for BCC to target flood management funds and measures where they will have the greatest benefit.

A high level screening of the settlements most at risk across the county has been undertaken as an initial step in this process, based on the numbers of properties within mapped flood outlines for surface water flooding and fluvial flooding separately within each settlement (Appendix B).

The intention during the lifespan of this strategy is to provide a more detailed risk based assessment at a finer spatial scale to better understand the distribution of local flood risk across the county and identify and prioritise ‘hot spots’ of flood risk that may require priority action or further detailed investigation. The methods and outputs will be GIS-based and highly visual, helping to communicate flood risk to non-technical decision-makers, partners and interested groups. The process shall be designed to support options appraisal and provide evidence for investment decisions. The outputs of the risk assessment and prioritisation will inform ongoing flood risk management.

The local flood risk assessment methodology shall be based on that proposed in the EA document [“Framework and tools for local flood risk assessment: project report SC070059/R3”](#). It will consider both the likelihood of flooding, as well as the economic, social, environmental and cultural “consequences” of flooding that “receptors” will suffer should flooding occur.

The likelihood component of the assessment will utilise the probabilities of flooding indicated within existing flood mapping datasets (such as the Flood Map for Planning, the updated Flood Map for Surface Water (uFMfSW) and groundwater flood maps).

The consequence component of the assessment shall employ the existing National Receptor Database. This provides a useful repository of data on receptors, including buildings, critical infrastructure and services layers, which flooding can cause potential harm to in terms of the aforementioned consequences.

The assessment process shall be iterative and will be updated through the life span of the Strategy as BCC understanding develops. Appendix B will hold the updated information.

4.3 Effective local flood risk management plans - SWMPs

Surface Water Management Plans (SWMPs) identify sustainable responses to manage local flooding and contain action plans that provide an evidence base for future decisions. Based on national mapping, SWMPs were developed in high risk locations in response to a [government review](#) in 2007 by Sir Michael Pitt, following which Defra funding was allocated to help local authorities coordinate flood risk management.

SWMPs are not required in all locations, however based on Defra guidance they should be prioritised in areas where;

- There is the greatest risk of surface water flooding
- Where partnership working is considered essential to both understand and address surface water flooding concerns
- There is evidence of surface water flooding history (Section 19 Flood Investigation Reports)
- Where a development presents a challenge to existing drainage capabilities
- Where the operation of a local drainage system is known to be complicated by interactions between river, groundwater, sewer or canal systems.

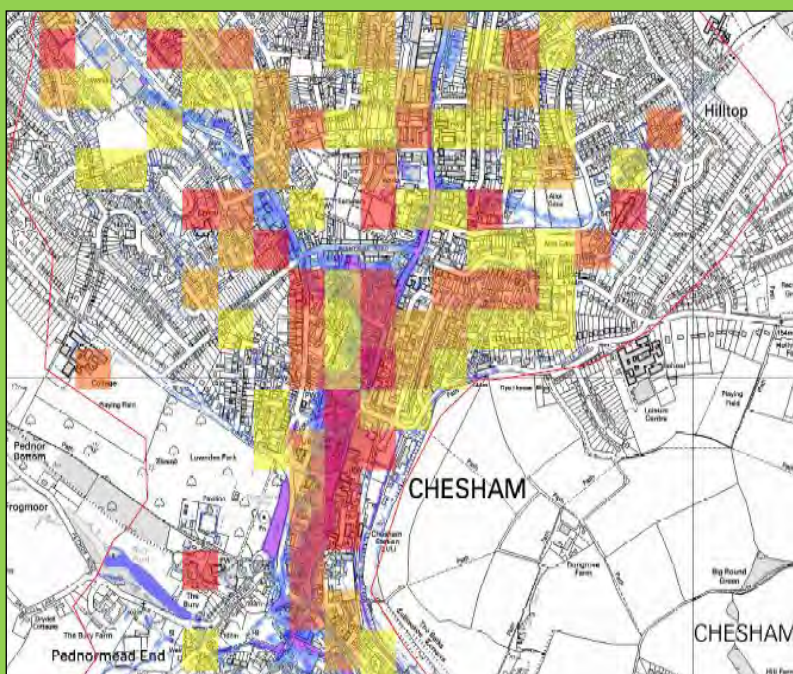
The case study below provides some further detail on SWMPs undertaken to date in Buckinghamshire.

Chesham and High Wycombe SWMPs

Chesham and High Wycombe were identified as particularly susceptible to local flooding and SWMPs have been prepared using funding from Defra. The SWMP studies have resulted in benefits including the following:

- Strengthening of Partnership working between BCC, the District councils, the Environment Agency, Thames Water and other stakeholders.
- An improved understanding of the local flood risks from different sources, including maps showing predicted flood depth and velocity in different scenarios, including consideration of climate change.
- A first appreciation of the cost of damage which could be caused by local flooding: for those residential properties at risk of flooding in the 1% annual probability event (a 1 in 100 chance of flooding in any year) the average cost of the flooding is estimated to be around £50,000 per property in Chesham and £35,000 per property in High Wycombe.
- An understanding that the Vale Brook culvert, which performs an important urban drainage function in Chesham, can only drain the rainfall up to the 3.33% annual probability event (1 in 30 chance of flooding in any given year).
- The Environment Agency has undertaken some emergency repairs to the Vale Brook culvert in the town centre and has developed a strategy for managing the remainder as funding permits.
- Development of a number of options to improve management of local flooding, both through changes to policy and practice, as well as location-specific actions including individual property protection, control of runoff close to source and design of urban environments to make space for water.
- Successful applications to the Environment Agency for funding to further develop and implement a number of these options.
- Successful delivery of surface water flood risk management schemes at Fuller's Hill and The Spinney in Chesham.
- Provided the evidence which contributed to a successful Defra Pathfinder application and delivery of various community flood resilience projects in Chesham.

An SWMP has also been undertaken in Buckingham and an SWMP is currently underway in Marlow.



This figure extracted (from the Chesham SWMP) shows the concentration of economic damages in Chesham from surface water flooding. The red squares show the highest damages, and the yellow the least. This approach assists in prioritising development and options to minimise these damages.

4.4 Proactive and reactive flood risk management

The risk of flooding can never be completely eliminated, however BCC can prepare by considering emergency responses to flood events and proactively planning with the resilience and operational teams. This preparedness can help to reduce the consequences of flooding.

There are three primary plans which set out the multi-agency response to floods in Buckinghamshire:

- Multi-agency Tactical Flood Plan for the River Thames
- Multi-agency Tactical Flood Plan for the River Great Ouse
- Thames Valley Local Resilience Forum Multi-Agency Flood Plan

These are primarily focussed on responding to fluvial flooding, and are activated either upon receipt of information by the Environment Agency or an otherwise undeclared flooding emergency which requires a response.

The plans set out the command structures and actions undertaken by the different responders (see Section 11). Whilst forecasting and warning for fluvial flooding is well established, predicting surface water flooding and groundwater flooding caused by intense rainfall, increased precipitation and prolonged above-average rainfall is more problematic. The box below outlines the flood warning information currently available for local flood sources which, if deemed significant in terms of the potential impacts in Buckinghamshire, could trigger a multi-agency plan response.

Flood forecasting and flood warning

The Flood Forecasting Centre (FFC) is a partnership between the Environment Agency and the Met Office, combining meteorology and hydrology expertise into a specialised hydrometeorology service. The FFC forecasts for all natural forms of flooding - river, surface water, tidal/coastal and groundwater. A daily Flood Guidance Statement provides information for Category 1 and 2 responders to help them with their emergency planning and resourcing decisions. It presents an overview of the flood risk for England and Wales across five days and identifies possible severe weather, which could cause flooding and significant disruption to normal life.

The Environment Agency provides a free flood warning service, called Floodline Warnings Direct, which provide advance notice of when flooding from rivers and the sea is likely to happen and time to prepare. In some parts of England it can issue warnings when flooding from groundwater is possible.

4.5 Recording flooding which has happened

Under the FWMA, BCC has become responsible for recording flooding arising from local sources. BCC produced a Preliminary Flood Risk Assessment in 2011 which collates all the records of local flooding across the county. This document is due to be reviewed in 2016.

Information on larger flood events will come from BCC's own investigations through the statutory responsibility under Section 19 of FWMA (2010) (recent events are also summarised in Appendix B). BCC will also centrally collate all reports of flooding and will investigate those which require a formal flood investigation based on the definition for a Section 19 Flood Investigation Report (detailed below), to build a comprehensive picture and gather evidence to improve local management. Aside from the Section 19 Flood Investigation Reports, the information on properties flooded will be managed according to the existing data protection [policy](#) and will not be published.

4.5.1 Flood Investigation Reports

When a flood event occurs, the focus during and immediately afterwards will be on the best possible management of the situation. However under Section 19 of the FWMA, BCC has the statutory requirement to investigate significant flood events. These are published as [Section 19 Flood Investigations Reports](#) on the BCC website. The aim of a Flood Investigation Report is to understand the cause of the flooding, the mechanisms and the responses to it. This information can then be used to inform proactive flood risk management.

To ensure best use of available resources, BCC will work with its partners to investigate flood events which, according to the best available information and taking into account local factors, are likely to meet the guidelines provided in the following box. These will be reviewed by the Bucks Strategic Flood Management Group at least once a year. Following a Flood Investigation, BCC will recommend actions for relevant parties.

Significant flood events to be investigated under Section 19 of the Flood and Water Management Act

- Internal flooding (including to basements) to five or more residential properties within an area of 1km²
- Internal flooding of two or more business premises within an area of 1km²
- Internal flooding (including to basements) of at least one property for one week or longer
- Flooding of one or more critical infrastructure assets, which could include hospitals, health centres, clinics, surgeries, colleges, schools, day nurseries, nursing homes, emergency services (police, fire, ambulance) stations, utilities and substations
- Any flooding event that a risk management authority deems significant but does not meet the agreed thresholds should be assessed at the next strategic flood management group for consideration

Case Study: Flood Investigations

After the flooding in Buckinghamshire in the winter of 2013/14 a number of areas across Buckinghamshire were identified as meeting the criteria for a formal statutory Flood investigation under Section 19 of the Flood and Water Management Act (2010).

These flood investigations included information on the flooding: what happened and why; and who was responsible for its management. The intention behind them is to provide information to the different authorities: County and District Council; Environment Agency; Water Companies; and Emergency Services in addition to residents and businesses impacted and the general public.

The reports include a section on recommendations to be undertaken by a wide range of organisations and individuals which would help to manage and alleviate the flooding in the future. These reports have provided a resource for better understanding of flooding, evidence for helping to bid for monies to help manage flooding and to guide planners on areas where development might cause concern.



Case Study: Monks Risborough February 2014

The flood event in Monks Risborough occurred after a prolonged period of above average rainfall which caused groundwater levels in the underlying aquifer to rise to unusually high levels and the surrounding land to become saturated. Subsequent rainfall caused flooding where the flow was unable to pass through restricted culverts and drains. Three sources of flooding were identified;

- Groundwater Flooding
- Surface Water Flooding
- Sewerage Flooding

Groundwater

Groundwater levels in the aquifer were exceptionally high during January and February 2014 and soils were fully saturated as a consequence of the many weeks of wet weather. Groundwater rose to the surface through both widespread seepage and through springs.

Surface Water Flooding

Heavy rainfall in early February was unable to infiltrate into the already saturated soil and flowed over the surface along with the emerging groundwater.

Flooding intensified as the flow exceeded the capacity of the local drainage system failed to take all of the water. At the culvert beneath the railway at Monks Risborough Railway Station excess water was unable to pass beneath the railway and flowed down Crowbrook Road.

At Mill Lane and Crowbrook Road water levels came close to causing internal flooding of residential properties. At least one property lost power supply as a consequence of the flooding where depths of between 3" (0.07m) and 5" (0.13m) were reported by the residents.

Sewerage Flooding

It is likely that sewers were overwhelmed by excess waters in the system. This caused a number of residents to report that floodwater was seen to be contaminated with sewage. Furthermore residents also reported surcharging of the sewer in the field between Kingsmead and the railway, leading to the public potentially coming into contact with contamination during clean-up.



Image taken from Mill Lane, Monks Risborough S19 Flood Investigation Report

4.6 Flood asset register

Many natural and manmade structures and features exist which can affect the routing of flood waters. Some of these structures or features may have been specifically constructed for the purposes of managing water flow and reducing flooding (e.g. culverts, sluices and flood embankments). Others may have been built for a completely different purpose (e.g. garden walls, railway embankments) but may also affect the route of overland flow and ultimately the location of flooding.

Designation of structures or features of the environment to be included as flood assets is made in accordance with the provisions of Schedule 1 of the Flood and Water Management Act 2010. Under Section 21, BCC has a statutory duty to produce a register of all structures that are likely to have a significant effect on flood risk.

BCC have committed to the following actions:

- To establish a record of these structures which contains information about each structure or feature listed in the register such as ownership and state of repair
- To establish and maintain a register of structures or features with an identification or risk to flooding, which act to reduce flooding and which can be designated as fulfilling this purpose
- To ensure that the register of structures will be made available for public inspection, however will retain information on specific ownership under data protection responsibilities

The compilation of an asset register and record will help to ensure greater co-ordination of information between partners, regulatory bodies and the public. Holding this information at County level aims to avoid situations where ambiguity exists over which organisation has responsibility for flood risk management assets or functions. More information on the asset register, including a map of the assets in the area can be found at the [BCC website](#).

5 Sustainable development

Principle 2. Provide support to local planning authorities to minimise future development in flood risk areas, increase resistance and resilient building design and seek to use development to reduce flood risk elsewhere

One of the key aims of this Strategy is to improve the quality of development in the county and encourage more water-sensitive design. This can be achieved by enhancing 'green infrastructure' such as sustainable drainage systems which mimic natural processes to maximise the use of the natural landscape to store or slow flood waters.

The following sections outline the general approaches that will be taken to improve the management of local flood risk. These approaches are consistent with improving sustainability and will be implemented in line with the Environment Agency National Strategy. Note that the production of this strategy has also been informed by a Strategic Environmental Assessment (SEA) ([Appendix D](#)).

The SEA has sought to ensure that any policies or actions adopted through the Strategy for managing flood risk take into account the environment, social and socio-economic and health concerns and take advantage of opportunities for wider benefits at the same time.

5.1 Sustainable approaches to improved flood risk management

Within each of the principles of this Flood Risk Management Strategy, the following approaches will fundamentally underpin improved and sustainable local flood risk management as shown in Figure 6.

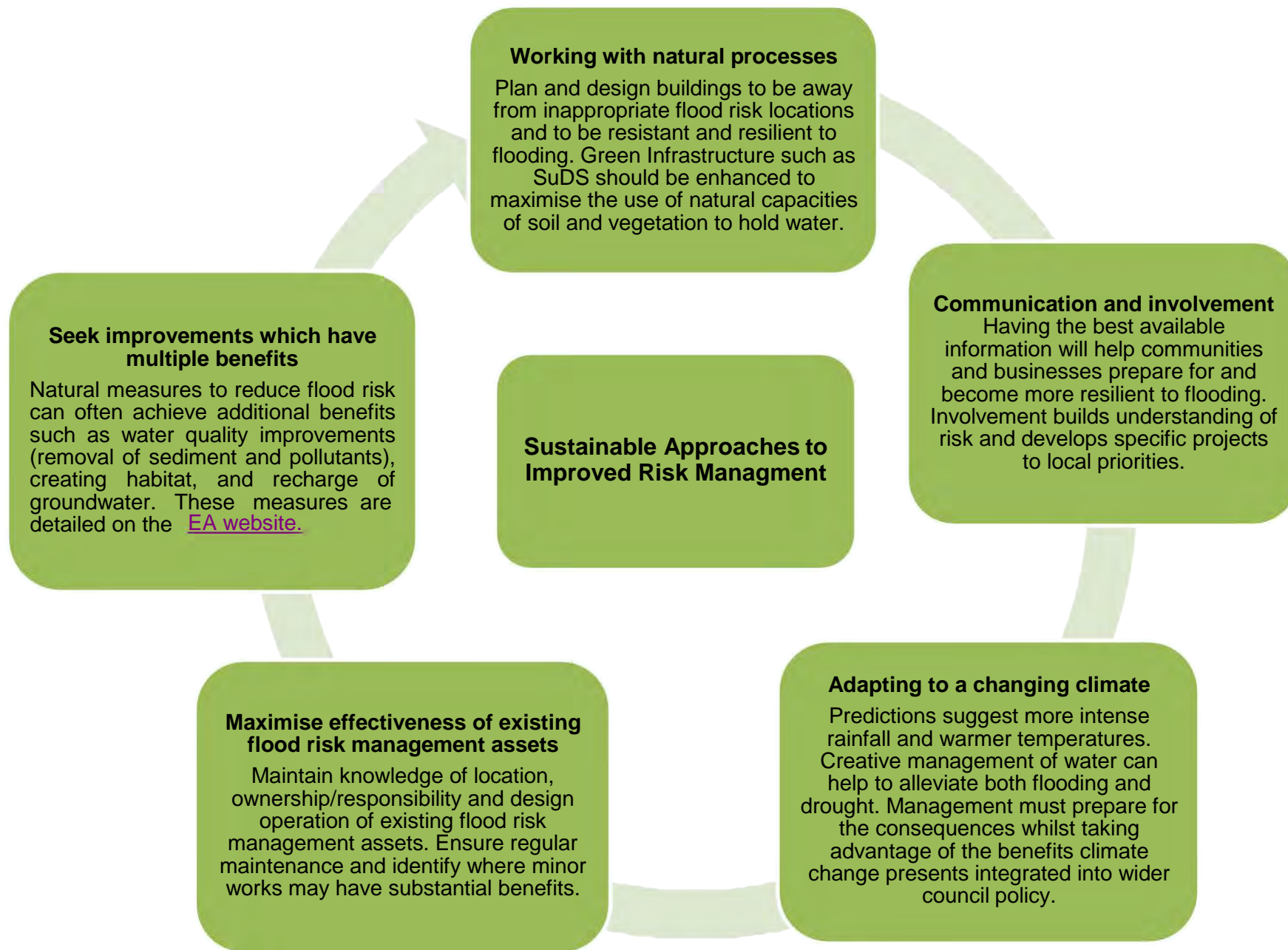


Figure 6: Sustainable approaches to improved risk management

5.2 Planning developments for flood management

BCC recognises that development is planned in the county. The BCC FRM team will therefore advise the LPAs of opportunities to manage existing flood risk as outlined below, to reduce the likelihood of flooding.

- **New developments used to manage existing flood risk.** New developments adjacent to an area at risk of surface water flooding could provide additional attenuation within their site to reduce the flood risk, thereby benefitting the wider community.
- **Modernisation and retrofitting of existing developments.** Often existing sites have old drainage systems which are not designed with an allowance for climate change. Modernisation of brownfield sites can be designed to reduce flood risk both in the surrounding area and wider catchment. Development of the site presents the opportunity to provide new drainage or SuDS to increase water storage and reduce surface runoff. This can also benefit the wider area by improving water quality, biodiversity and amenity.

Effective land use planning is paramount in facilitating sustainable development to minimise flood risk. With the projected population increases in Buckinghamshire, new development has the potential to increase flood risk in the surrounding area, yet also has the potential opportunity for managing current and future flood risk through innovative design. A strategic approach is needed to utilise the opportunities presented.

The [National Planning Policy Framework](#) (NPPF) sets out that unless there are mitigating factors, new development will not generally increase flood risk either specifically in the area of the development or overall.

As documented in this Strategy, records of incidents of flooding will be collected more effectively in the future. This information, combined with the latest available flood risk mapping will be made available to the local planning authorities (LPA) to incorporate into their Strategic Flood Risk Assessments (SFRA) updates such that new development can be located appropriately so as not to increase flood risk.

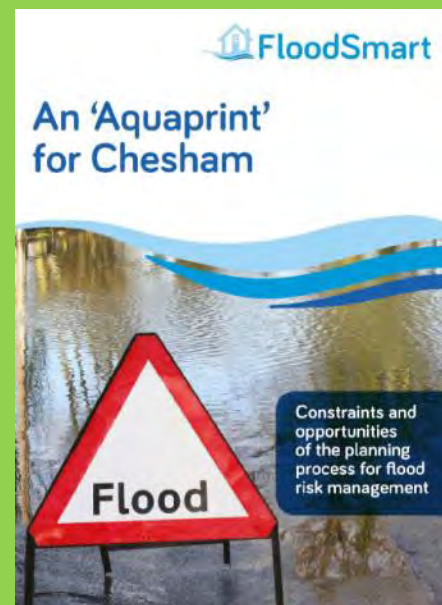
BCC will work closely with District Councils during the planning process to ensure a coordinated and effective approach to deliver the requirements of the NPPF and any locally specific policies. The case study on Aquaprint gives details of a recent project by BCC to investigate the constraints and opportunities within the planning process for flood risk management.

Case Study: Constraints and opportunities of the planning process for flood risk management – an ‘Aquaprint’ for Chesham

Between 2013 and 2015, BCC ran a project looking at innovative and community-led solutions to flooding in Chesham called Flood Smart (see Section 7.2 for further details). Among many other activities, the project looked at the planning process, in particular at the constraints and opportunities this process presents for flood risk management. This work found that multiple planning policies can potentially influence the installation of flood alleviation schemes. The report, entitled “Aquaprint”, presented a number of conclusions, including:

- Where flood alleviation schemes enable the use of a site to remain largely unchanged, the planning system does not generally form a significant barrier to the management of flooding, as long as such schemes are carefully designed.
- Flood risk from other sources such as surface water could be more prominently recognised through clear local policy, as national policy tends to focus on flooding from larger rivers.
- Some things can significantly impact the likelihood of a flood alleviation scheme being implemented, and should be addressed early on. These include land use and ownership as well as the proximity to properties and utilities infrastructure.
- Most flood alleviation schemes would require planning permission, although permitted development rights can sometimes be used.
- Green Belt and AONB designations do not appear to be a barrier to the development of flood alleviation schemes, as long as they are sympathetically designed. Such schemes can even contribute positively to these designations.
- To make a flood alleviation scheme financially viable, change of use or redevelopment of the site to a higher value use may be required. This could result in conflict with existing planning policy but could also offer an opportunity to improve the long term viability of sites for existing uses.
- Flood alleviation schemes can bring significant additional public benefits, for instance improvements to local landscaping, improvements to amenity for neighbouring properties, reductions in the amount of pollution entering watercourses from flood events.

The Aquaprint report can be downloaded from [BCC's Website](#)



Another method by which sustainable development can be achieved is through planning obligations⁸. These are mechanisms which make a potential development acceptable in planning terms that would otherwise have been unacceptable, and are commonly used to bring developments in line with the objectives of sustainable development. Planning obligations may be offered as either a financial payment to fund work needed to ensure sustainability or flood protection, or where the developer builds or provides the matters necessary to fulfil the obligation. However in order to regulate obligations they must be

- Necessary to make the development acceptable in planning terms
- Directly related to the development; and
- Fairly and reasonably related in scale and kind to the development

5.3 SuDS

Sustainable drainage is achieved by employing a series of different drainage techniques which reduce flow rates and volumes, minimise pollution and so reduce the impact of the water emanating from a development.

Sustainable Drainage Systems (SuDS) aim to mimic the way in which rainfall drains in natural systems, typically by reducing the rate and volume of surface water runoff through infiltration or storage. Their management should be approached sequentially using a number of techniques in series to alter the flow and quality characteristics of the runoff. As shown in Figure 7 below, SuDS management should begin with source control, employing techniques such as living roofs in order to reduce the flow of runoff from the site. Only if the water cannot be managed on site should it be conveyed elsewhere and in each case efforts to slow flows should be employed to reduce flood risk.

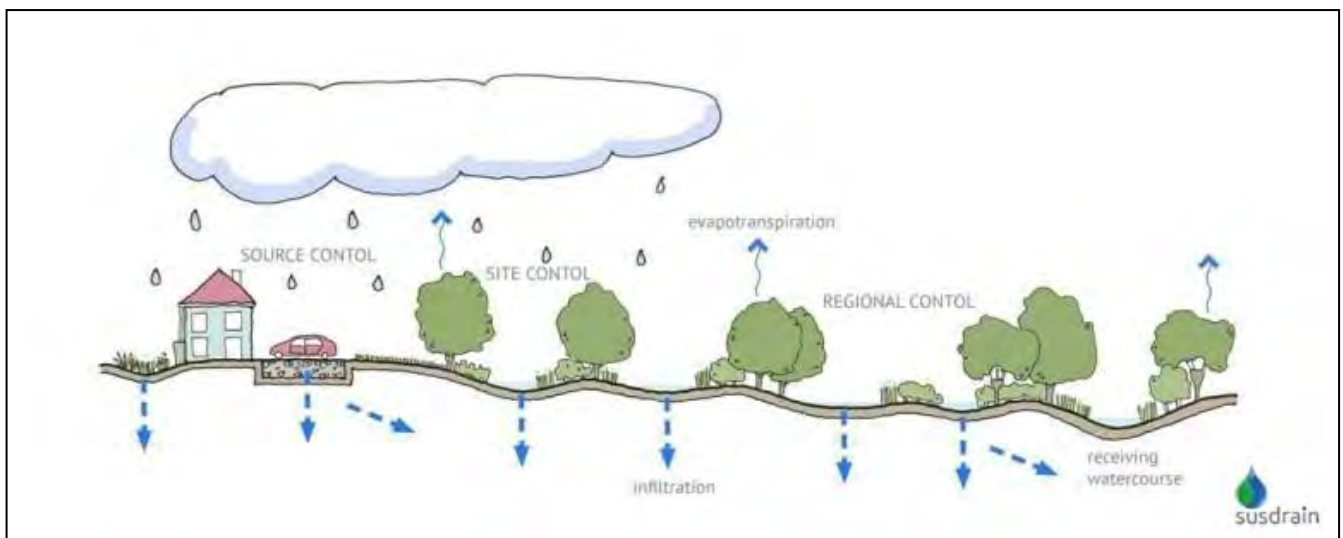


Figure 7: The SuDS management train (Source: CIRIA)


⁸ Section 106 of the Town and Country Planning Act 1990, commonly known as Section 106 agreements.

In addition to reducing surface runoff, SuDS can provide some natural removal of pollutants and sediments, promote aquifer recharge and enhance biodiversity. Guidance on SuDS in the UK is documented as a comprehensive guide under the [CIRIA SuDS Manual](#).

To remain in line with an integrated catchment approach, SuDS should be designed to add aesthetic value and offer attractive natural amenities for the local community. This is particularly desirable in developed urban areas where surface runoff can cause flooding, and where receiving water bodies may be sensitive habitats.

There are numerous ways that SuDS can be incorporated into a development; however, options should be considered both hierarchically from most to least sustainable and sequentially from source control to regional control. The main components of SuDS and their level of sustainability are described in Table 5 and the following case study describes the advantages and disadvantages of using pervious surfaces as one method of water management.

Table 5: Summary of sustainable drainage techniques and wider benefits (Source: EA)

Most Sustainable	SuDS Technique	Flood Reduction	Water Quality Improvement	Landscape & Wildlife Benefit
	Living Roofs	✓	✓	✓
	Basins and Ponds -Constructed Wetlands -Balancing Ponds -Detention Basins -Retention Ponds	✓	✓	✓
	Filter Strips and Swales	✓	✓	✓
	Infiltration devices -Soakaways -Infiltration Trenches and Basins	✓	✓	✓
	Permeable Surfaces and Filter Drains -Gravelled Areas -Solid Paving Blocks -Porous Paving	✓	✓	
	Tanked Systems -Over-sized Pipes/Tanks -Storm Cells	✓		
	Least Sustainable			

Buckinghamshire County Council recognises that by incorporating SuDS into both new developments and existing redevelopment there is the opportunity to;

- Manage runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding
- Protect or enhance water quality (reducing pollution from runoff)
- Protect natural flow regimes in watercourses
- Provide an attractive habitat for wildlife in urban watercourses
- Provide opportunities for evapotranspiration from vegetation and surface water
- Encourage natural groundwater/aquifer recharge (where appropriate)
- Create better places to live, work and play
- Offer a cost effective and affordable drainage solution

Buckinghamshire County Council has also produced a Developer Pack which offers guidance on planning submissions in relation to surface water, this can be found on [BCC's website](#).

Case Study: Pervious surfaces

Pervious surfaces can be either porous or permeable. The important distinction between the two is:

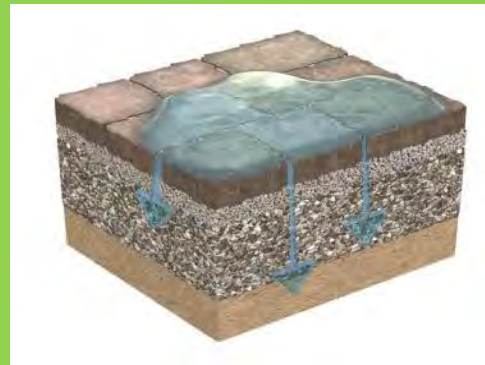
- Porous surfacing infiltrates water across the entire surface (gravel, grass protection grids, porous tarmac)
- Permeable surfacing is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration through the pattern of voids (block pavements, void structured concrete etc.)

Advantages

- Suitable for pedestrian and/or vehicular traffic
- Allows rainwater to infiltrate through the surface and into underlying layers
- Water can be temporarily stored before infiltration to the ground
- Can provide good water quality treatment
- Reduced peak flows to watercourses reducing the risk of flooding downstream
- Can be used in high density developments with a range of surface finishes
- Reduced need for deep excavations for drainage - significant cost benefits
- Lined systems can be used where infiltration is not desirable
- Allows dual use of space, so no additional land take
- Removes need for gully pots and manholes
- Eliminates surface ponding and surface ice
- Reduced effects of pollution in runoff on the environment

Disadvantages

- Can't be used where large sediment loads may be carried onto the surface
- Risk of long-term clogging and weed growth if poorly maintained



5.4 Sustainable drainage responsibilities

Recognising the pressures of future climate change, government has specified that developers must incorporate ways to manage the impacts of increased volumes of surface runoff.

As a Statutory Consultee, BCC promote Sustainable Drainage Systems (SuDS) as an alternative to the conventional ways of managing flood risk in accordance with the National Planning Policy Framework (Paragraph 103)⁹.

From 6th April 2015, it became compulsory for local planning policies and decisions on planning applications, which relate to major development¹⁰, to ensure that sustainable drainage systems for the management of runoff are put in place, unless demonstrated to be inappropriate. The changes to SuDS responsibilities are summarised in the [House of Commons Written Statement \(HCWS161\)](#) issued by the Secretary of State for Communities and Local Government dated 18 December 2014.



Implementation of a water storage basin as part of a sustainable drainage system, in Berryfields, Aylesbury.

BCC advises the District Councils (as Local Planning Authorities) on whether proposed drainage schemes comply with the relevant technical standards and policies through comments and if required, conditions in response to planning. BCC has the authority to approve, or otherwise, sustainable drainage proposals associated with any major development (10 dwellings or more, or equivalent non-residential or mixed development) that will affect surface water runoff exceeding prescribed thresholds.

It is vital that the proposed drainage systems, once constructed, are suitably maintained to ensure both efficiency and longevity. BCC ask all developers to provide a whole life maintenance and management plan which details how this will be accomplished, however, responsibility for considering future maintenance ultimately lies with the developer. BCC will secure the future maintenance of SuDS through an appropriately worded planning condition and/or planning obligation (such as a Section 106 agreement) whichever is considered to be the most appropriate in order to meet the requirements set out in the House of Commons Written Statement (HCWS161).

Whilst the LLFA will be involved in steering a developer towards a SuDS design, it remains the responsibility of the developer to manage the design of the SuDS asset. As BCC is not the Local Planning Authority (LPA), close liaison and partnership working with the LPAs will be necessary to ensure that prospective developers receive the appropriate steer and guidance. The case study below describes how this can be achieved through the use of a SuDS Developer Pack.

⁹ Paragraph 103 of the [National Planning Policy Framework](#) 2012.

¹⁰ Schedule 4 of the [Town and Country Planning \(Development Management Procedure\) \(England\) Order 2015](#).

SuDS Developer Pack

The Developer Pack (2015) forms part of Buckinghamshire County Council's guidance to inform developers of current policy and requirements for major development applications which we review as part of our statutory consultee duties.

We seek to encourage developers to move away from conventional drainage towards creating drainage systems that mimic natural processes; managing rainfall close to where it falls. The document aims to raise awareness of the numerous SuDS features that can be utilised on a development to manage water quantity and quality as well as enhance amenity and biodiversity.

The Developer Pack seeks to improve understanding of the SuDS Approval Process, one of the ways in which this is achieved is by setting out the information required for a SuDS Strategy for different types of applications. In addition, we promote early engagement with developers in the planning process, known as pre-application discussions, to ensure the most effective drainage strategy can be achieved.

We aim to review the Developer Pack on an annual basis or more regularly if required to include the most recent policy, legislation and guidance.



Attenuation pond at Berryfields, Aylesbury

6 Partnership working

Principle 3. Lead and work together with partners to manage the existing “local” flood risk.

BCC has a statutory duty to “*cooperate with other authorities, including data sharing*”. Working in partnership across BCC teams as well as with elected members, external risk management authorities and neighbouring authorities will ensure that truly integrated and effective management of local flood risk is achieved (see [Appendix D](#) for more detail).

Partnerships within the development and implementation of local strategies will enable better sharing of information and expertise, which in turn will ensure both the efficiency and accuracy of how flood risk can be managed, as seen in the Aston Clinton case study.

A coordinated response across different RMAs promotes efficiency and sharing of specialist and local knowledge. Furthermore, links across administrative boundaries ensure a catchment based approach with clear distribution of responsibility ensuring an effective response to flood management.

Within Buckinghamshire, BCC extend this partnership working to asset management to ensure continued maintenance and management of existing assets in order to reduce unnecessary risk from degradation and to avoid resource expenditure involved in emergency repairs.

6.1 Overall structure for partnership working

Coordination is led by BCC and involves a number of other organisations as summarised in Figure 8.

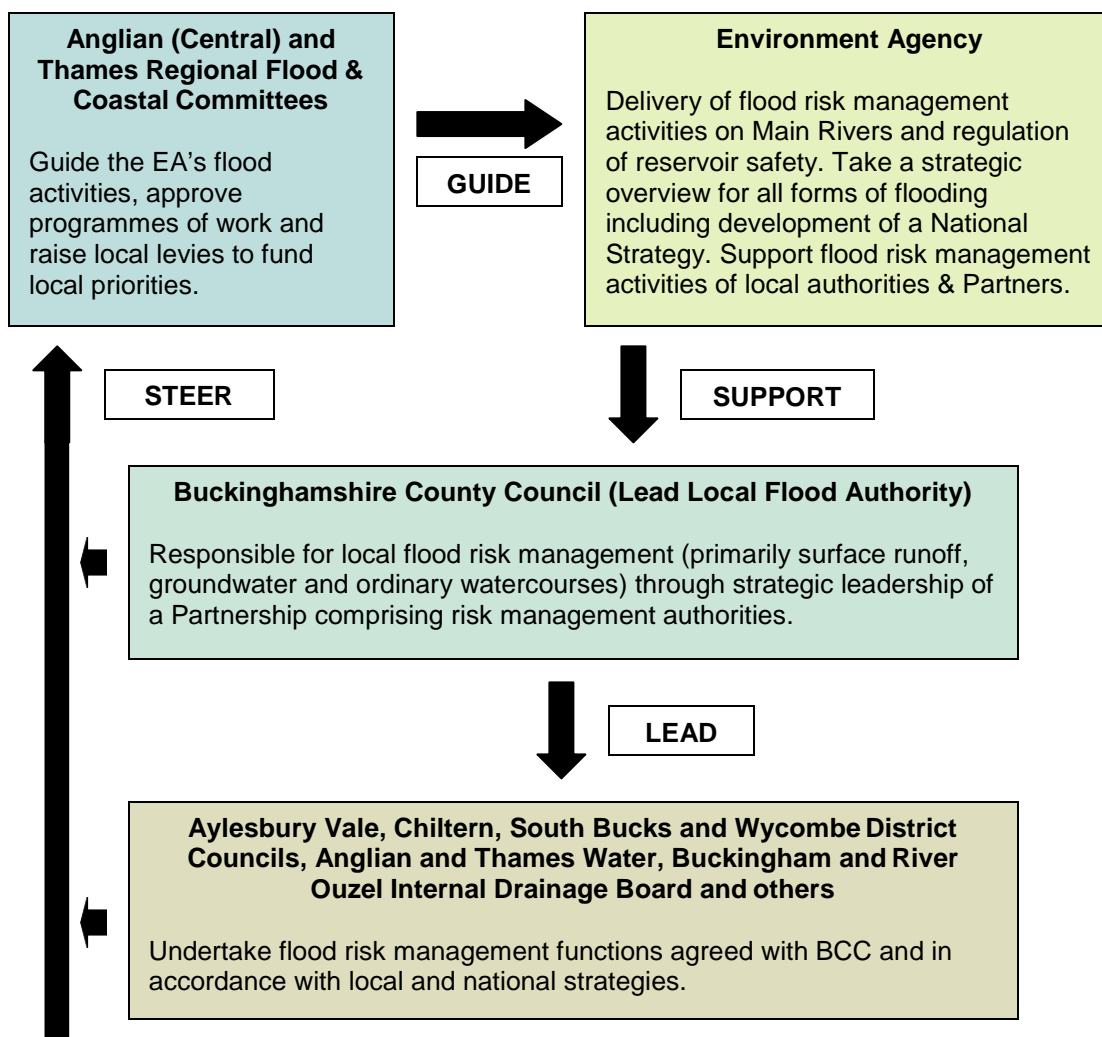


Figure 8: Summary of relationships between various Partner organisations

The Regional Flood and Coastal Committees (RFCCs) comprise members appointed by the EA and LLFAs with relevant experience to:

- Ensure there are coherent plans for identifying, communicating and managing flood risks across catchments
- Promote efficient, targeted and risk-based investment in flood risk management that optimises value for money and benefits for local communities
- Provide a link between the EA, LLFAs, other Risk Management Authorities, and other relevant bodies to improve mutual understanding of flood risks in their areas.

6.2 Internal partners

Liaising with internal partners is also key in providing a focussed and efficient response to flood risk and happens across multiple levels. Strategic management requires the political support from members at all levels; from MPs to provide political momentum for projects and funding, and advocacy from parish councils and local politicians which provide invaluable information on local risks or issues.

- District Members
Attend Buckinghamshire Strategic Flood Management Group meetings as well as liaise with parish members on flood risk management through community forums. This helps to transfer information between local communities and managing authorities
- Transport for Buckinghamshire
Deliver BCC's highways services including managing flood risk and drainage issues on highways and local roads, for example, through routine highway gully maintenance and emergency support when flooding occurs, such as emergency road closures or diversions
- Resilience Team
As part of their wider resilience responsibilities, the resilience team have a responsibility to respond to a flooding emergency and coordinate the strategic response of the emergency services, including Category 1 and 2 responders.

BCC's Strategic Flood Management Team also work internally with;

- Planning and Enforcement
- Strategic Planning
- Ecologists
- Archaeologists
- Community Liaison Team
- Education
- Growth and Development Strategy
- Highways
- Transport

6.3 Risk Management Authorities within Buckinghamshire

In addition to these 'core' RMAs and internal partners, organisations including the following are likely to have important contributions to more integrated management of flood risk:

- Buckinghamshire and Milton Keynes Local Nature Partnership
- Canal and River Trust
- Chilterns Conservation Board
- English Heritage
- Highways Agency

- Thames Valley Local Resilience Forum¹¹
- National Farmers Union
- National Trust
- Natural England
- Network Rail
- Parish and Town Councils

6.4 Links across administrative boundaries

Water catchments often span political boundaries and truly integrated flood risk management will only be possible through working with neighbouring authorities. These authorities' areas may contain a source of water flowing out of BCC's area or BCC may receive water flowing in from neighbouring counties. BCC shares borders with the following LLFAs: Bedfordshire, Hertfordshire, LB Hillingdon, Milton Keynes, Northamptonshire, Oxfordshire, Slough, Windsor & Maidenhead and Wokingham¹².

6.5 Roles and responsibilities of the RMAs

Involving the various RMAs in coordinated management of local flood risk endeavours to make the best use of existing arrangements and resources. Each of the RMAs has a responsibility to act in a manner consistent with the EA National Strategy, cooperate with other RMAs and to investigate floods when directed by BCC. Table 6 summarises some of the roles of these groups.

¹¹ Note that the TVLRF covers all of Buckinghamshire, including the Great Ouse catchment

¹² Note that Windsor & Maidenhead and Wokingham have northern boundaries which follow the River Thames and so will be less relevant for the cooperative management of local flood risk

Risk Management Authorities in Buckinghamshire	Flood Risk Management Roles and Responsibilities		Powers	Duties
Buckinghamshire County Council	Lead Local Flood Authority Strategic and coordination role. Decision-making responsibility for whether works on Ordinary Watercourses by third parties that may affect water flow can take place.	Manage Local Flood Risk From: Surface Water Groundwater Ordinary Watercourses	<ul style="list-style-type: none"> • Powers to request information from any person in connection with the authority's flood and coastal erosion risk management functions • Power to undertake works to manage flood risk from surface runoff or groundwater; • Power to designate and register structures and features that affect flooding; 	<ul style="list-style-type: none"> • Strategic leadership of local risk management authorities • Coordination of local flood risk management • Development, maintenance, application and monitoring of a strategy for local flood risk management • Duty to investigate and publish reports on flooding incidents (S19 Flood Investigation Reports) • Duty to maintain a register of structures or features which have a significant effect on flood risk • Duty to exercise flood or coastal erosion risk management functions in a manner consistent with the national and local strategies • Duty to aim to contribute towards the achievement of sustainable development • Discretionary enforcement powers on owners of private watercourses to undertake maintenance to reduce flood risk • Decision making responsibility for whether third party works on ordinary watercourses by third parties that may affect water flow can take place • Statutory Consultee on land drainage aspects of Major Planning Applications including advice on the suitability of Sustainable Drainage Systems.
Buckinghamshire County Council	Highways Authority	Manage Flood Risk From: Surface Water originating on the highways		<ul style="list-style-type: none"> • To maintain a strategy for managing highway infrastructure such as gullies, culverts and other assets to ensure effective drainage of the highway • Routine highway gulley emptying and emergency clearance of highway gullies and drainage when flooding occurs.
District Councils: Aylesbury Vale Chiltern District South Buckinghamshire Wycombe	Land Drainage Authority	Manage Flood Risk from Ordinary Watercourses	<ul style="list-style-type: none"> • Power to carry out flood risk management work which will benefit management of surface runoff, groundwater or ordinary watercourses. • Power to do works on ordinary watercourses and, with the Environment Agency's consent, the sea. • Power to implement and maintain flood defences on ordinary watercourses. 	<ul style="list-style-type: none"> • Inspect watercourses on District Council land and undertake necessary maintenance. • Assist in flooding incidents and contribute to any multi-agency response. • Consultee on land drainage aspects of planning applications including advice on the suitability of Sustainable Drainage Systems and their adoption • Work with the EA and IDB advising Parish Councils on watercourse maintenance and improvements with the encouragement of community action groups. • Designation of structures or features which affect flood risk which are not already designated or owned by another Risk Management Authority
Environment Agency	Strategic overview of all sources of flooding. Also responsible for flood risk management activities on Main rivers		<ul style="list-style-type: none"> • Powers to request information from any person in connection with the Environment Agency's flood and coastal erosion risk management functions. • Power to designate structures and features that affect flooding or coastal erosion. • Power to undertake works and surveys in relation to flooding from Main River and the sea 	<ul style="list-style-type: none"> • To develop long-term approaches to Flood and Coastal Erosion Risk Management (FCERM). This includes working with others to prepare and carry out sustainable Catchment Flood Management Plans (CFMPs). • Provide evidence and advice to support others including national flood and coastal erosion risk information, data and tools to help other risk management authorities and inform government policy, and advice on planning and development issues. • Monitoring and reporting on flood and coastal erosion risk management. This includes reporting on how the national FCERM strategy is having an impact across the country. • Work with others to share knowledge of best practise.

Risk Management Authorities in Buckinghamshire	Flood Risk Management Roles and Responsibilities		Powers	Duties
Internal Drainage Boards	Land Drainage Authority	Manage Flood Risk From: Ordinary Watercourses	<ul style="list-style-type: none"> Power to designate structures and features that affect flooding or coastal erosion; Powers to cause flooding and erosion for nature conservation and cultural heritage reasons, and people's enjoyment of these Power to do works on ordinary watercourses flooding within their boundary and, with the Environment Agency's consent, the sea. 	<ul style="list-style-type: none"> Duty to exercise their functions in a manner consistent with local and national strategies Duty to be subject to scrutiny from lead local flood authorities' democratic processes Ability to work in consortia with other IDBs Statutory consultees to the SuDS approving body on sustainable drainage that impacts land drainage
Water companies: Anglian Water Thames Water	Responsible for operating and maintaining the condition of sewerage systems, encompassing foul water, surface water and combined systems, in order to reduce sewer flooding.	Manage Risks From: Sewerage Flooding	<ul style="list-style-type: none"> Provide, improve, extend and maintain a system of public sewers and works for the purpose of effectually draining its area (including management of flood risk from sewers) Adopt private sewers and lateral drains which communicate with public sewers Maintain a register of properties at risk of hydraulic or operational flooding 	<ul style="list-style-type: none"> Act in a manner which is consistent with the Environment Agency National Strategy and guidance and have regard to the Buckinghamshire Local Strategy and guidance Co-operate with other Risk Management Authorities, which may include the sharing of information
Affinity Water	Responsible for operating and maintaining condition of drinking water system		<ul style="list-style-type: none"> Maintain a register of properties at risk of hydraulic or operational flooding 	<ul style="list-style-type: none"> Act in a manner which is consistent with the Environment Agency National Strategy and guidance and have regard to the Buckinghamshire Local Strategy and guidance Co-operate with other Risk Management Authorities, which may include the sharing of information
Parish Council	Flooded communities have a role to play in being prepared for flooding and to report flood incidents to the local authorities to assist with flood investigations and sharing local knowledge for progressing flood improvements. Parish and Town Councils also have a role in producing neighbourhood plans, including the assessment of flood risk of potential development sites. They can also produce Community Action Plans or Emergency Plans where appropriate with the assistance of Local Authorities and the Environment Agency. Parish and Town Councils have powers under Section 260 of the Public Health Act 1936 to enforce the maintenance of ponds and ditches where these are causing a nuisance to others.			
Riparian Land Owners	Responsible for maintaining watercourses as riparian land owners. Responsible for the drainage of their land and in doing so, not to cause problems for neighbours. A person owning lower-level land has a duty to accept natural land drainage water (that is, spring water, groundwater or surface water runoff) from adjacent land at a higher level. However, they also have the right to prevent such water causing damage to their own land and the right to pass on water naturally to lower ground without causing a nuisance. BCC have prepared guidance for Riparian Owners which summarises responsibilities seen in section 7.			

Table 6: Roles and Responsibilities of the RMAs

6.6 Flood Action Groups

BCC also work in partnership with local community groups. [Flood Action Groups](#) are a local voice for communities on flood-related issues. By working with organisations such as local authorities, the Environment Agency and the water companies, some Groups have been successful in making a difference to flood risk and the impact of flooding on local communities, as shown in the example below of the Chesham Water Group.

Action Groups can aid RMAs by;

- Raising concerns over issues or infrastructure they feel is not working effectively
- Getting involved in discussions on future flood risk management in their community
- Creating a wider awareness of flood risk areas
- Organising flood watchers throughout the community

Case Study: Improving Chesham's water environment in partnership: the Chesham Water Group is created

Created in June 2015, the Chesham Water Group provides a strategic overview of everything happening in Chesham relating to droughts, water quality, habitat conservation and flooding. Indeed, these problems often overlap, and the Group wanted to make sure opportunities for multiple benefits are taken advantage of and that activities focusing mainly on one aspect don't negatively affect another.

Over the years, various community groups, agencies and water companies have been doing excellent work in Chesham, often in partnership with each other. We wanted to build on this joint work and strengthen it. We also wanted to carry on some of the great things that happened as part of BCC's FloodSmart project (see Section 7.2 for more details).

Membership so far includes: Affinity Water, Buckinghamshire County Council (including Transport for Buckinghamshire), Chesham Flood Action Group, Chesham Town Council, Chilterns Conservation Board, Chiltern District Council, Environment Agency, River Chess Association and Thames Water. A published article showcasing the groups work can be found overleaf.

Improving Chesham's water environment in partnership: The Chesham Water Group is created...

The various community groups, agencies and water companies that work on water-related issues in Chesham have come together and created the Chesham Water Group. Through this Group, we plan to work in better partnership with each other and to deliver real benefits for Chesham's water environment and its residents.

There's been a lot of work going on in Chesham in the past few years in relation to water: not only water quality but also droughts, habitat conservation and flooding.

Various community groups, agencies and water companies have been doing excellent work, often in partnership with each other.

We wanted to build on this joint work and strengthen it. We also wanted to carry on some of the great things that happened as part of FloodSmart, a partnership project that was managed by Buckinghamshire County Council (2013-2015).

flooding. Indeed, these problems often overlap, and we want to make sure opportunities for multiple benefits are taken advantage of and that activities focusing mainly on one aspect don't negatively affect another.

The Group will help us all work

in partnership, ensuring we work closely together on relevant projects and are kept aware of each other's work.

Members of the group so far are: Affinity Water, Buckinghamshire County Council (including Transport for Bucks), the Chesham Flood Action Group, Chesham Town Council, the Chilterns Conservation Board, Chiltern District Council, the

Environment Agency, the River Chess Association and Thames Water. That list will remain open to change.

We plan to meet every three months and to remain in touch between meetings, for example through the working groups that

help manage particular projects in more detail.

Keep your eye out for regular updates about the Chesham Water Group in Your Chesham, and visit our page on the ColneCAN website: <http://bit.ly/1DWYrKL> (hosted by www.colnecan.org.uk)



Healthy flows in the River Chess around Waterside, August 2014. Photo: Environment Agency



The River Chess running dry around Waterside, June 2012. Photo: Environment Agency

That's why we created the Chesham Water Group in June 2015.

The Chesham Water Group will provide a strategic overview of all the things happening in Chesham relating to droughts, water quality and

The voices of

Where has Volunteering taken you? That's the question being asked for the launch of Buckinghamshire's Volunteer Voices appeal.

Community Impact Bucks (CIB), the region's Volunteer Centre, are campaigning to change outdated perceptions around volunteering and showcase some of the exciting and life-enhancing opportunities on offer to local people.

Volunteers are being offered the chance to win a

CIB IMPACT

6.7 Engaging with partners

The responsibilities of the RMAs require a collaborative approach to the sharing of information, the use of data and the coordination of resources. Effective and regular communication (e.g. through the Bucks Strategic Flood Management Group (BSFMG) Appendix A) is key to ensuring success.

Memorandums of Understanding between BCC and each of the Districts and the water companies will be developed to clarify how data sharing, investigations and works are to be collaboratively managed. These will be reviewed as part of the regular review of the Strategy, or as warranted by significant changes. Close cooperation, including through joint communication using established channels where possible, will be integral to providing a clear and consistent message to the public or other stakeholders. It is recognised that some data which partners hold is extremely sensitive and the extent of sharing information and the best ways of sharing that information will be agreed via the memorandums of understanding.

Strong relationships between the Districts and County Council and other Partners who are represented in the BSFMG have developed over many years and will continue to be developed. These relationships make the practicalities of sharing information between organisations more straightforward, although they are not a substitute for the proper licensing and policies which protect confidentiality and commercial interests. In the majority of cases, appropriate sharing of information relevant to enable any RMA to improve its management of local flood risk will proceed using agreed procedures.

Key information and data will be held centrally where it is of importance or relevance across BCC's area. This information will be made available to relevant RMAs to view as necessary. Information pertaining to local issues will continue to be held by Parish, Town and District Councils or other RMAs as appropriate. A standardised approach to the collection of data will be based on priority and need in accordance with a risk-based approach.

The following case study highlights the positive results which can be delivered through partnership working.

Case Study: Partnership working to achieve Aston Clinton river restoration project

During the winter of 2013/14 there was flooding in Aston Clinton Park, partly as a result of a collapsed culvert. The opportunity was taken to create a new stretch of open watercourse which would bypass the collapsed culvert.

The project aimed to benefit the environment, reduce flood risk and be more cost efficient than replacing the very old culvert. The project involved many different stakeholders including; the Environment Agency, tenant farmer and District and Parish Councils. The stakeholders had different interests in the project and therefore different priorities for the outcomes. These different priorities resulted in many challenges along the way but the priorities of the different groups helped to shape the project and the end result is something all stakeholders are happy with and proud of.



6.8 Accountability

BCC understands that actions taken to improve management of flood risk do not lie with a single group, and as Figure 9 demonstrates, different organisations and the public all have a role to play.

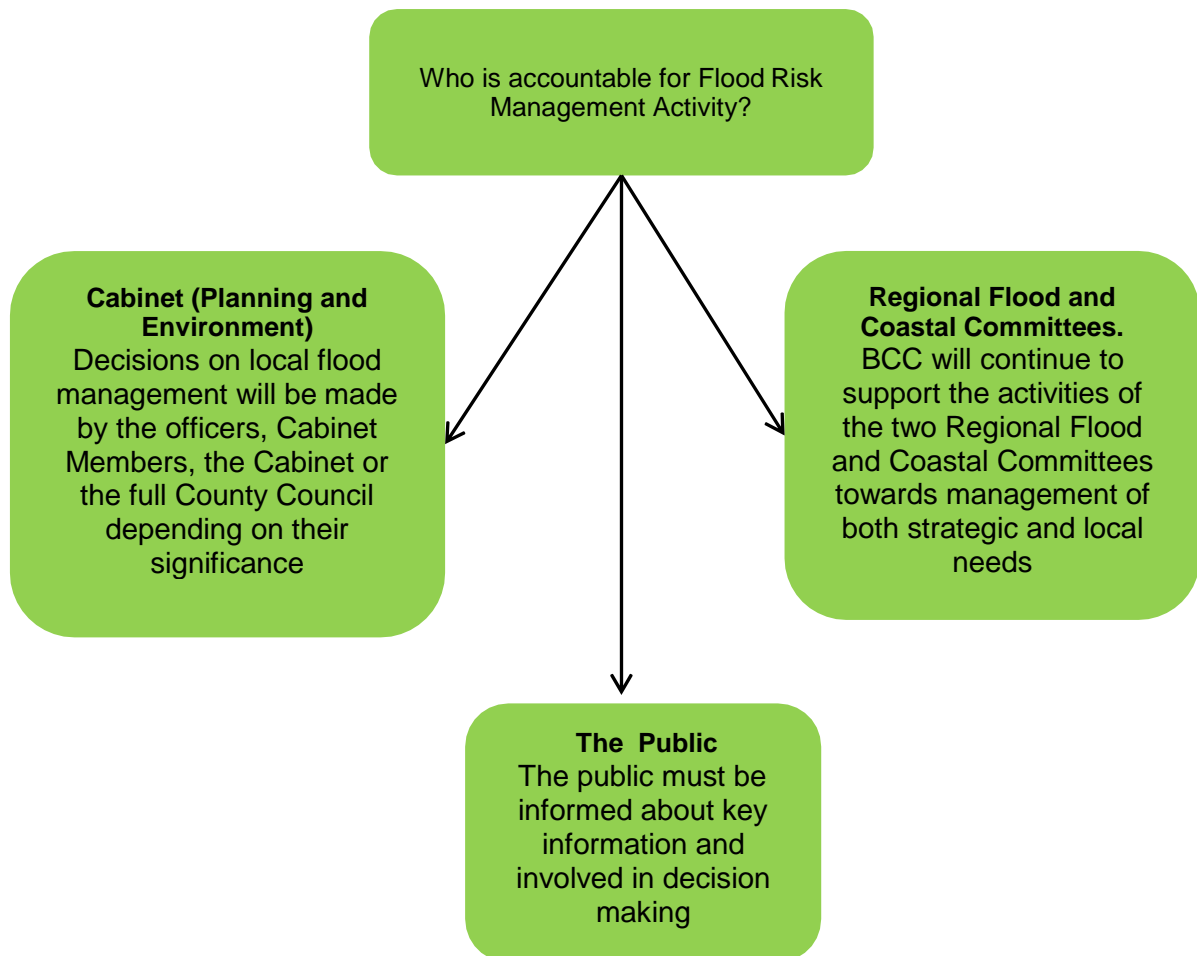


Figure 9: Accountability for flood risk management

7 Public engagement and communication

Principle 4. Engage with the public and local communities to improve awareness of flood risk and ensure work is guided and informed by local knowledge and successes are shared with everyone.

Engagement with the public is key to raise awareness of flood risk and promote sustainable practices. Communities are the ultimate beneficiaries of improved flood risk management and should be at the heart of local flood risk management activities.

Implementing this strategy to enable the long term management of local flood risk will require cooperative working and sharing of information between Partners. Such cooperation is critical to realise the many possible integrated benefits across a range of public, private and voluntary sector interests. It is recognised that there are many complex issues to be considered ranging from understanding the risk from different sources, to what to do in the event of a flood, to how to get the best flood warning information.

BCC and its Partners therefore seek to provide transparency on how local flood risk is managed. BCC will involve the public directly and through elected member groups as it addresses technical and operational priorities within its area.

The need for public engagement and communication was identified in the [Pitt Review 2007](#), which states;

“We firmly believe that the public interest is best served by closer cooperation and a presumption that information will be shared. We must be open, honest and direct about risk, including with the public. We must move from a culture of ‘need to know’ to one of ‘need to share’”.

7.1 Involving the public

BCC is committed to engaging with the public on matters relating to the management of local flood risk. This will empower communities to effectively increase their own resilience and have a say in which management approaches are of highest local importance and which are likely to work best locally. Views will also be sought through consultations on regional matters where this will enhance information gathering, local decision making and management of risk. Examples of what has previously been done and will continue include:

- An address¹³, phone number (0845 3708090 or 01296 486630), email address (floodmanagement@buckscc.gov.uk) and set of [web pages](#) to contact the Flood Management team
- Web-based consultations on the draft Surface Water Management Plans and Preliminary Flood Risk Assessments
- Involvement of elected members and representatives of residents or other local groups in workshops for the Surface Water Management Plans
- Consultations and local displays to publicise the developing understanding of flood risk
- Letters targeted at property owners who should be aware of particular conclusions and recommendations
- Door to door visits for detailed discussions to follow up on letters

Whilst the local authority takes lead responsibility in managing local flood risk, the public also have a duty to take some responsibility. Engagement with the public and close coordination helps to achieve this by educating communities in how they can contribute to risk management practices, as indicated in the following case studies.

¹³ Flood Management, County Hall, Aylesbury, Bucks HP20 1UY

Actions we can all take to better manage flooding

There are a number of actions which we can all do, and some which we are responsible for, to protect ourselves, our property and our communities from flooding:

- **Emergency Services**

The emergency services are there to protect life - the responsibility for the protection of property lies with the property owner. There are a number of measures which can be taken to make your property more resistant (stop water entering) and resilient (better prepared to recover) to flooding. Information can be found at the National Flood Forum's independent [Blue Pages directory](#).

- **Are You Ready?**

Take steps to prepare for a flood as recommended in the '[Are you ready](#)' leaflet. These include registering for the EA Floodline Warnings Direct service if flooding from rivers may be involved, keeping a 'grab bag' of essential items ready and having a plan to turn off electricity, gas and water supplies.

- **Reporting Incidents**

Reporting incidents of flooding to BCC via the Highways on Call Report a Problem page (0845 3708090 or 01296 486630) helps build evidence for action to be taken – water companies cannot take action in response to flooding related to sewers unless they have evidence direct from the property owner that flooding has occurred. Report flooding via the [BCC website](#).

- **Urban Creep**

The combined effect of many people paving over their front gardens can increase the amount of surface runoff which adds to the risk of flooding. Since 1 October 2008, planning permission is required if more than five square metres of a new or replacement driveway is to be covered with traditional, impermeable materials that do not provide for the water to run to a permeable area. See the '[Guidance on the permeable surfacing of front gardens](#)' leaflet:

- **Riparian Ownership**

If you own land adjoining a watercourse then you are a riparian owner and you have a responsibility to pass on flow without obstruction or pollution, including maintaining the banks of the channel and any vegetation so they remain clear of debris. See the Environment Agency leaflet '[Living on the Edge](#)' and [BCCs Riparian Owners leaflet](#) below.

- **Sewerage**

If your property is served by separate surface water and foul sewers, you have a responsibility to fix any pipes which may be wrongly connected. For example, dirty water from sinks, baths, showers, appliances and the toilet should go to the foul sewer to be treated, otherwise watercourses can be polluted. Gutters and gulleys collecting rainwater should connect to the surface water sewer – if these are wrongly connected to the foul sewer then flooding from the foul sewer can result. See the advice by [Thames Water](#).

More information regarding who to contact can be found in the BCC leaflet on [roles and responsibilities in the event of flooding](#).

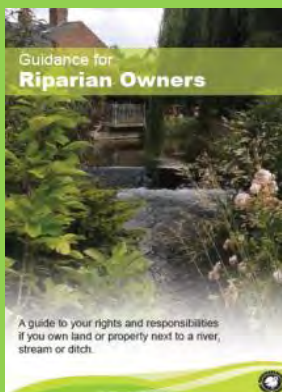
Case Study: Bishopstone Vegetation Management

In the winter of 2013/14 Bishopstone suffered from flooding causing the road to be closed for a considerable amount of time and at least two properties to flood internally. Buckinghamshire County Council investigated the flood event and produced a Flood Investigation Report in compliance with Section 19 of the Flood and Water Management Act 2010.

The report included some recommendations for various Risk Management Authorities which, if carried out, would reduce the likelihood of a repeat event. One of the recommendations was for the local community to learn how to manage the vegetation in their local river to avoid any blockages in the future. This led to the Bishopstone Vegetation Management day where the local community joined up with Buckinghamshire County Council, Transport for Buckinghamshire and the Environment Agency in August 2014 to spend a day clearing vegetation and debris from Standall's Ditch. Fun was had by all while learning methods to help prevent flooding in Bishopstone.



Riparian Ownership



By law, the erection or alteration of any feature that may affect the flow of an ordinary watercourse requires local authority consent. BCC processes applications for consent in order to carefully manage flood risk. When works have been carried out on watercourses without consent, BCC have the power to serve notice and enforce remediation. Many flood investigations and enforcement cases around Buckinghamshire stem from riparian owners not knowing or understanding their rights and responsibilities.

To educate and with a long term goal of reducing the number of new enforcement cases we deal with; the Strategic Flood Management Team put together an informative leaflet which explains the most important rights and responsibilities riparian owners should be aware of.

When contacting riparian owners with regards to enforcement cases, we include this leaflet in the first instance. It has also been distributed at events (e.g. Bucks County Show) and to all Parish Councils in Buckinghamshire.

7.2 Local Business

The impact on flooding to local business can be severe both in terms of the immediate impact on the damage from flooding and also the impact on the local economy. The problem for businesses can be exasperated by the fact that flood damage is not always included as standard in business insurance. New flood insurance for businesses available from the British Insurance Brokers Association has been available from December 2016 and it is possible for businesses to insure the excess element of their policy <https://floodexcess.com>. Help and advice is available for business from the [Know Your Flood Risk website](#).

7.3 Involvement of the voluntary sector

A key characteristic of Buckinghamshire is the strength of the communities and the vibrancy of the voluntary sector. Two of the priorities in the [BCC Corporate Plan](#) are to support the Voluntary and Community sector to deliver services and build on community strengths to find local solutions. In addition to the activities highlighted in the 'Actions we can all take' box, there are a number of activities which could be undertaken by local communities, supported by the councils, the Environment Agency and others, that could make local communities less vulnerable to the consequences of flooding. These include:

- **Reporting flood events:** This can be the vital first step to any action being taken. When the flood event may involve the sewer system, the relevant water company must be informed by the person affected for any further action to be taken. Incidents can be reported through the [BCC website](#), but this should not be used in an emergency situation.
- **Flood wardens:** Volunteer flood wardens provide an important point of contact in a local community. They can provide a focus for raising awareness of issues and for assistance during flood events.
- **Maintenance of watercourses:** Working with the Environment Agency, Internal Drainage Board and Councils, clearing watercourses and trash screens of obstructions can greatly improve their capacity to convey high flows.
- **Designing local solutions:** The Councils, Environment Agency and others are committed to involving local representatives in decision making about flood risk management.

As part of the involvement with the voluntary sector, BCC undertook an exciting community engagement project called "FloodSmart" between 2013 and 2015, detailed in the case study overleaf.

Case Study: FloodSmart - Helping Chesham get wise to flooding

[The FloodSmart project](#) (2013-2015) was part of the Department for Environment, Food and Rural Affairs' (Defra) Flood Resilience Community Pathfinder Scheme. This initiative supported thirteen areas around the UK to find innovative and community-led ways of preventing and responding to flooding. FloodSmart was a partnership project involving Buckinghamshire County Council, which managed the project, the National Flood Forum, the Environment Agency, Chiltern District Council and Chesham Town Council.

Among the highlights of the project were:

- Forming the Chesham Flood Action Group of local residents.
- Awareness-raising with residents, businesses and schools.
- Increasing understanding of flood risk and how to reduce it.
- Improving knowledge of the town's highway drainage.
- Realising the opportunities and constraints of the planning system.
- Encouraging residents to reduce rainwater runoff from their properties.
- Working in close partnership between the agencies involved in the project.



“The Chesham Flood Action Group (CFLAG) acts as a representative voice for their community on flood-related issues (Photo credit: E. Hutchinson).”

8 Flood Management approaches

Principle 5. Pursue integrated flood management approaches across the whole event life cycle

Water is not restricted by administrative or political boundaries and therefore it is essential to consider the impacts of any activity on the wider area and in the wider context. Whilst structural engineering solutions may reduce flood risk in the local area they may cause other negative effects such as disconnection of the river from the floodplain, faster downstream time to flood peak, physical disruption of natural processes and adverse ecological impacts. Limited resources can restrict the use of hard flood defences and other engineered solutions (such as flood walls) because they are expensive to construct, and require ongoing maintenance meaning that projects in areas at risk of flooding may not be funded if the assets and properties at risk do not offset the costs.

These factors have increased interest in 'natural', lower-cost, catchment and sub-catchment scale approaches for flood risk management, innovative in both design and nature. It is this innovation which is required to help combat the pressures of climate change (as identified in section 10), as well as other land use pressures, to ensure an effective approach to flood risk management.

8.1 Natural and integrated catchment management

Natural Flood Management (NFM) is the alteration, restoration, or use of landscape features to reduce flood risk. It is based on the concept that changing land use can alter the way that land reacts to rainfall. By encouraging water to stay on, or to be absorbed by the ground surface, can reduce peak runoff that may affect downstream areas.

Slowing runoff in a rapidly responding catchment is likely to reduce the peak water levels and reduce the rate of erosion and sediment transport; an issue potentially problematic for the longevity or maintenance of drainage systems as well as having a detrimental impact on the environment, particularly on river habitats. Natural water retention measures aim to safeguard and enhance the water storage potential of landscape, soil, and aquifers, by restoring ecosystems, natural features and characteristics of water courses and using natural processes.

Buckinghamshire County Council are working at a number of locations across the county (Chesham, Saunderton, Hughenden Valley, Monks Risborough and Bishopstone) to identify where these techniques could be used to manage flood risk in a natural and effective manner (as shown in Figure 10). The Pednornead End Flood Project, seen in the case study below, is another example where innovative and natural management techniques can be considered to manage surface water flood risk.

To fully understand impacts on the wider water-cycle, local sources of flood risk will not only be investigated where they occur, but will be managed within the wider context of the catchment scale.

As part of a holistic approach, management of flood risk should also consider and attempt to address wider issues. As identified by the BCC FloodSmart Aquaprint report (2014), opportunities should be sought in association with schemes to ensure wider public benefits are recognised such as through the improvement to local ecology, landscaping or public facilities. This is an effective way of working towards “good ecological status” for water bodies, as required by the EU Water Framework Directive.

The BSFMG will continue to work with all relevant Partners to seek sustainable and coordinated land management. The Buckinghamshire Rural Strategy and Biodiversity Action plans promote a sustainable partnership to landscape conservation, enhancement and management. The latest of these plans, [Buckinghamshire and Milton Keynes Biodiversity Action Plan: Forward to 2020](#), can be found on the Buckinghamshire Partnership [website](#).

Coordination in line with existing plans will ensure flood risk is managed in the most suitable way for the catchment as a whole. An example of sustainable landscape conservation is given in the Aston Clinton Case Study (Section 6.7) where the formation of a new open channel has created a more natural and ecologically beneficial watercourse. Countryside Stewardship schemes administered by Natural England can aid sustainable management as they provide funding to farmers and other land managers to deliver effective environmental management of their land. Furthermore, opportunities within the [Woodlands for Water](#) initiative to work with the Forestry Commission on natural flood management via planting and use of woodland may be possible. Through these schemes, there may be opportunities to work with landowners/farmers and Natural England to implement actions that provide a range of positive outcomes, including adaptation to climate change and management of diffuse pollution, erosion, water quality and quantity.

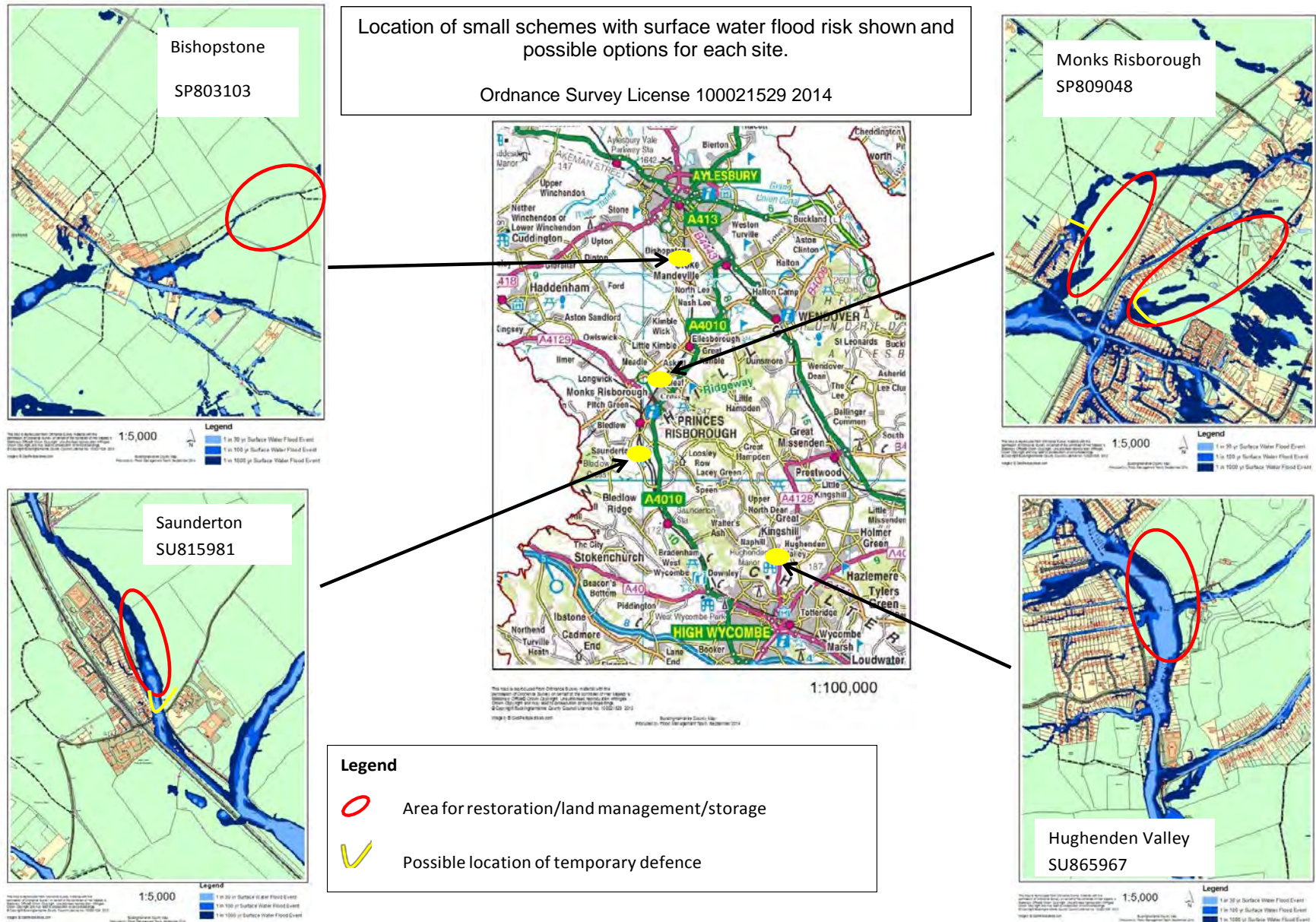


Figure 10: Site locations for integrated catchment management schemes

Case Study: Pednormead End flood project

Recent flooding of several properties in Pednormead End (in February and September 2014), followed by a site investigation and detailed modelling, indicate that there is a risk of surface water flooding to a number of properties in Pednormead End, Chesham.

Modelling in the SWMP suggests that flood depths at properties in Pednormead End, could be approximately 0.15m in the 3.33% (1 in 30) AEP event, 0.3m in the 1% (1 in 100) AEP event through to more than 0.3m in the 0.1% (1 in 1000) AEP event. It is thought that during heavy rainfall events, and particularly when the soil is saturated and groundwater levels in the underlying Chalk are high, local surface water can increase flood risk.

The project was a feasibility study by Buckinghamshire County Council, local land owners and Transport for Buckinghamshire to investigate the effectiveness of different options on the River Chess. These included property level protection and upstream attenuation for fluvial and surface water considering the contribution that groundwater makes to the flows.

The options likely to be considered are to use in-stream measures to reconnect channel and floodplain by making the channel less incised and using and enhancing the natural floodplain storage for use in more frequent flood events.

The measures could include:

- placing in-stream woody debris
- raising the stream bed
- encouraging riffles
- re-profiling of the banks
- Use of swales with accompanying reed beds to re-route surface water runoff from the Missenden Road

Funding for this project has been provided by the Flood Defence Grant in Aid (FDGiA)



8.2 Temporary flood defences

A temporary flood defence protection system is formed by removable flood protection products that are wholly installed immediately prior to a flood event and removed completely when water levels have receded.

The number of temporary flood defence products available is steadily increasing, and with this product innovation come significant potential to use temporary systems to protect properties, businesses, critical infrastructure and other vulnerable assets against flooding. This is at a time when the frequency and severity of flooding across Buckinghamshire appears to be increasing, underpinning the need to consider climate change projections and effective resilience and adaptation measures.

Temporary flood defences can be considered in situations where permanent flood defences are planned but not yet constructed, as well as where a permanent flood protection scheme may not be economically or otherwise viable. Defra's strategy for managing flood risk in England as outlined in *Making Space for Water* calls for a portfolio of measures for managing flood risk and includes the use of temporary defences.

Temporary systems can be designed for site specific use however, as they do not require pre-installation, they are not tied to a particular location and therefore offer more versatility and potential for multiple uses within incident response scenarios.

The use of temporary flood defences in combination with permanent defences or natural flood management supports an integrated and effective response to management strategies and resilience to flooding. With specific regard to surface water flooding as a result of short duration intense rainfall events, one of the key limitations is the flood warning time and the ability to respond quickly to install the defences. Nevertheless, in certain locations they do offer an effective flood risk management solution.

Temporary defences are often considered to be [sandbags](#), however whilst these can be useful in directing flows around property, they offer little protection from other sources of flooding such as sewerage or groundwater flooding, and can be difficult to lay to create a fully effective barrier. Determining the quantity of sandbags needed and their location prior to an event is particularly difficult and, as they may retain pollutants from flood waters, careful disposal is required. The box below details the current agreement between the five authorities in Buckinghamshire regarding sandbags and is taken from the multi-agency flood plan.

Local Authority sandbag agreement

Initial response to reports of flooding:

- Private property owners (or landlords) have a responsibility to protect their own property.
- TfB will respond to flooding caused by flooding on the road network.
- District Councils will respond initially in the event of imminent internal flooding of residential / live in properties where they have been contacted.
- County Council will support District Councils under mutual aid arrangements – authorised as required.
- All will work together with the emergency services as part of a multi-agency emergency response.

Note:

- No Council will undertake pumping from private properties.
- FRS may pump from private properties.
- No Council is responsible for sewage related flooding and / or the clear up from it. This is the responsibility of the Water Companies on main sewers.
- Links to local sandbag distributors can be found on the District Council website

As appropriate, BCC recommends the use of financial protection ([insurance](#)), retrofitting (raising plug sockets or favouring wooden floors as oppose to carpets), flood gates, and raising awareness with flood plans. More information can be found on [BCC's website](#).

The case study overleaf highlights BCC's experience with temporary flood defences.

Case Study: Temporary flood defences

Experience during the February 2014 floods in the Thames Valley demonstrated that rapid deployment of temporary flood defences can effectively be used as part of an emergency response to major flooding.

BCC were keen to look at the possibility of using temporary defences to protect from smaller watercourses, surface water flood risk and groundwater flooding.

A study to investigate innovative thinking in considering the types of temporary defence measure that could be effective for such applications was undertaken. This has led to the purchase of some temporary flood defences and pumps for the Willows in Aylesbury and for Broad Street in Chesham.



Logistic plans are being developed for the Willows and Broad Street and the use of temporary defences are being considered for other locations in the County

9 Funding

Principle 6. Seek funding from a variety of sources to support flood risk management activities and implement projects

The cost of damage to property as a result of a flood can typically be between £10,000 and £50,000 depending on the flood depth and duration¹⁴. Indeed, groundwater flooding can result in substantially higher costs than for other forms of flooding as a result of its longer duration¹⁵. Where cost effective, flood management schemes can be implemented to reduce this potential damage from reoccurring in future. Additional funding from national, regional and local sources will be identified and pursued to support flood risk management activities. A partnership funding approach will be prioritised, both to improve the likelihood of a successful application and also to foster buy-in and involvement among those involved.

9.1 Available resources

Central Government currently provides an annual formula grant to BCC which is apportioned in accordance to local priority. BCC recognises flood risk as an important issue and therefore supports the Strategic Flood Management team with work towards fulfilling the commitment to viable, sustainable and coordinated management of local flood risk and will provide reasonable justification to secure internally the available Defra grant.

The total funding available from Defra is £36 million a year, however this is split between all 152 Lead Local Flood Authorities. The split is related to the level of local flood risk, with a minimum annual fund of £110,000 given to all LLFAs and up to £750,000 a year for those at highest risk. BCC's area ranks 22nd out of the 152 LLFA areas and currently receives a proportional share of the available funding.

The available funding within BCC will be split as follows

- To implement the general actions identified throughout this strategy
- To support and use the best available expertise to deliver the responsibilities set out in this strategy
- To support a dedicated Strategic Flood Management Team responsible for coordinating all local flood risk management activities

Close partnership working with organisations having expertise will enable BCC and its Partners to develop best practice and grow capacity in an efficient manner.

¹⁴ Environment Agency (2009) Flooding in England: A National Assessment of Flood Risk. Available from: <http://publications.environment-agency.gov.uk/PDF/GEHO0609BQDS-E-E.pdf>

¹⁵ Green, C., Wilson T., Masterson, T. and Boothby, N. (2006) An Assessment of the Additional Flood Losses associated with Groundwater Flooding: A report to Hampshire County Council and Winchester City Council. Flood Hazard Research Centre, September 2006.

9.2 Seeking additional resources

The annual government grant to BCC will not be sufficient to undertake all actions identified as necessary. Therefore, the BSFMG remains committed to sourcing additional funding to support its activities. A key element to secure funding is robust evidence of past flooding.

9.2.1 National funding

The Central Government funding allocation method for flood risk management projects has recently changed to encourage communities to invest in locally-appropriate measures which protect them. Instead of meeting the full costs of a limited number of projects, the new approach could make central government money available for any viable scheme. Central funding for a scheme will relate directly to the number of households protected, the damages being prevented, plus other benefits a scheme would deliver, for example creation of habitat. Grants for surface water management and property-level protection are available alongside funding for managing other risks (e.g. from Main River).

If a proposed scheme does not qualify for full central funding, contributions from local Partners are required to meet the full costs of the scheme (see Figure 11). This gives each community more of a say in which schemes are taken forward to protect them. However, it does mean that local contributions may be required for any scheme to progress. If required, local contributions would be sought from those who are likely to benefit from the proposed scheme.

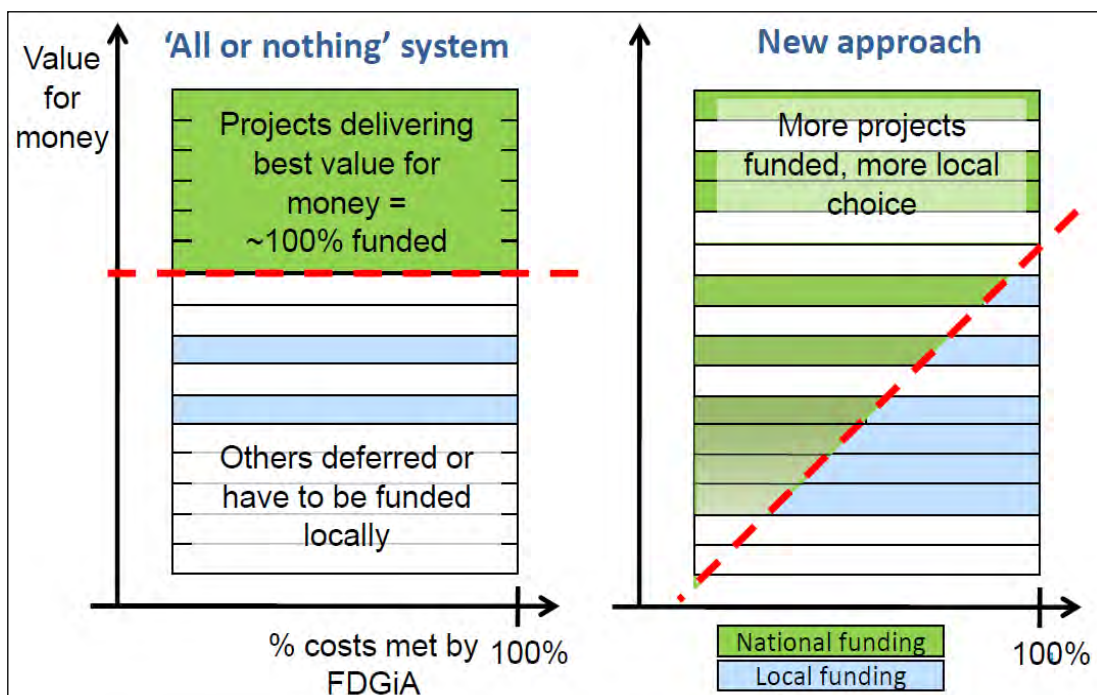


Figure 11: Comparison of the new and previous funding principles Reproduced courtesy of D.Johns, Head of Funding, Insurances and Outcomes, Defra

Schemes which are likely to attract the most central funding are those which:

- Protect a large number of households, especially in deprived areas where the impacts of flooding are significant and there are a high frequency of flood events
- Achieve other benefits such as protecting businesses, agricultural activity and national and local infrastructure, across the whole life of the scheme
- Provide environmental benefits needed to maintain healthy ecosystems as well as offset any habitats lost when a scheme is built

Other national sources (e.g. government and National Lottery funded regeneration grants) may also be considered.

In addition to conventional Central Government funding, the Defra Small Schemes Pathfinder project seeks to tackle some of the constraints involved in funding flood management of small disparate communities.

Case Study: Helping small communities access flood alleviation funding

Accessing flood defence funding from central government typically entails calculating the cost/benefit of a scheme, which itself is linked to the number of properties such a scheme would protect from flooding. As a result, funding is often disproportionately allocated to more densely populated areas. In February 2015, Defra announced a Pathfinder programme looking to address this problem. The “Small Schemes” Pathfinder encourages schemes that serve smaller, disparate communities to be packaged together, to make the appraisal process more efficient and make it was easier for them to enter the government capital investment programme.

Buckinghamshire County Council bid for funding under this Pathfinder programme. Our bid was one of six projects to be funded out of 23 applications. Work on the project started in August 2015, focusing on four Buckinghamshire communities at risk of flooding which were affected during the flooding of Winter 2013/4. For each of the communities, the project will look to combine the following innovative approaches: upstream natural flood management (see Section 8.1) with techniques for storing water and slowing runoff from farm or open land; temporary flood defences (see Section 8.2); building resilience and ownership at the community level (see Section 7).

Exploring funding from sources at a National scale could be key to identifying partnership funding opportunities. These funding sources could be from Department for Transport, where flood schemes are associated with road drainage and from other sources such as National Lottery, Heritage funding, EU LIFE funding to name a few.

9.2.2 Regional funding

BCC is represented on the Thames and Anglian (Central) Regional Flood and Coastal Committees (see Section 6). Funding is raised by the RFCCs by way of a levy on the Lead Local Flood Authorities in their areas and payments are supported by grants from central

Government. The RFCCs are responsible for making decisions on how the levy is spent. The local levy can be used to support locally important flood risk management projects that are not considered to be national priorities and hence do not attract full central government funding. This funding programme is known as Flood and Coastal Erosion Management (FCERM).

Table 7 displays information on four (FCERM) projects for which BCC's Strategic Flood Management Team have successfully obtained funding. They refer to projects that contain an indicative allocation of FCERM grant in aid funding within the 2015 to 2021 period.

In the financial year 2012/13, BCC provided £414k to the Thames and Anglian (Central) RFCCs. This has been used to support upstream works which provide improved protection for Buckinghamshire and to support local works e.g. schemes recommended in the Chesham SWMP. Contributions from private beneficiaries (e.g. Trusts and utility companies) may also be considered. Funding opportunities may exist within water company budgets, such as the Thames Water Twenty 4 Twenty funding set to support the development of SuDS.

9.2.3 Local funding

Local funding for flood management schemes can be obtained from the developer, typically by way of Planning Obligations (POs) or the Community Infrastructure Levy (CIL).

Planning obligations are mechanisms which make a potential development acceptable by bringing it in line with the objectives of sustainable development. As developers may offer a financial payment to complete any work, POs could be utilised to fund flood management schemes in two ways;

- To fund flood management schemes specifically related to an individual development project
- Through pooling so that several development schemes provide the funding for one flood management scheme that serves a wider area¹⁶

CIL is a planning charge that came into force in 2010¹⁷ which allows local authorities to raise funds from developers¹⁸ through a levy. These funds are designed to cover the cost of new public facilities required as a result of the development.

The rates charged are set out by the Council. The Council has the power to charge differential rates on different developments providing they can be justified by reference to the economic viability of the development. Whilst the levy is not to be used to remedy pre-existing deficiencies in infrastructure it can be used to increase the capacity of existing infrastructure or to repair that which is necessary to support the development. Other local sources (e.g. Business Rate Supplements) may also be considered.

¹⁶ Note that pooled funds cannot be sought from development schemes below certain thresholds.

¹⁷ Under the Community Infrastructure Levy Regulations 2010

¹⁸ On developments that increase net floor space

Local Enterprise Partnerships (LEPs) central government initiative to promote and rebalance economic growth between different regions. They are business-led partnerships between the private sector and local authorities established with the purpose of steering growth strategically in local communities. The Strategic Flood Management team will work with LEPs locally to encourage and promote flood management opportunities within the growth and development within Buckinghamshire.

Table 7: Programme of FCERM projects

Project Name	Project Stage¹⁹	Regional Flood and Coastal Committee (RFCC)	Constituency of Project Location	Location	Estimated Total Project Cost	Households with a better level of flood protection	Economic Benefits (Net Present Value, £k)	Estimated earliest construction start
Sands (High Wycombe) Surface Water Flood Risk Management	<i>Development Programme²⁰</i>	<i>Thames</i>	<i>Wycombe Co Constituency</i>	<i>Sands, High Wycombe</i>	<i>255.0</i>	<i>20</i>	<i>361.8</i>	<i>2016-2018</i>
Hughenden Road and Coates Lane, High Wycombe Surface Water Management	<i>Development Programme</i>	<i>Thames</i>	<i>Wycombe Co Constituency</i>	<i>Hughenden Road and Coates Lane, High Wycombe</i>	<i>40.0</i>	<i>10</i>	<i>193.6</i>	<i>2016-2018</i>
Pednormead End, Brushwood Road and Harding Road Surface Water Flood Alleviation Scheme	<i>Development Programme</i>	<i>Thames</i>	<i>Chesham and Amersham Co Constituency</i>	<i>Pednormead End, Brushwood Road and Harding Road, Chesham</i>	<i>150.0</i>	<i>35</i>	<i>583.4</i>	<i>2016-2018</i>
Marlow Surface Water Drainage	<i>Pipeline Programme²¹</i>	<i>Thames</i>	<i>Beaconsfield Co Constituency</i>	<i>Marlow, Buckinghamshire</i>	<i>1,050.0</i>	<i>-</i>	<i>2032.3</i>	<i>2018-2021</i>

¹⁹ The different project stages reflect increasing levels of certainty around the development and delivery of individual schemes. The visibility that this provides will enable the construction industry to better support the Environment Agency and its partners in identifying where additional efficiencies or delivery improvements could be introduced.

²⁰ Projects in development with full funding packages agreed, expected to start construction in future years, subject to approval of a full business case and/or securing other funding contributions.

²¹ Pipeline programme classifies project proposals that are likely to qualify for some government funding before 2021 and have been given an indicative allocation. However they have not yet identified sufficient contributions and/or do not have a sufficiently well-developed case to enter the development programme at this stage.

10 Climate change adaptation

Principle 7. Recognise the pressures and opportunities that a changing climate presents and take action to mitigate threats and exploit opportunities wherever possible

Adaptation to climate change will be a central consideration in the management of local flood risk. Over the past century around the UK, winter rain has increased with more intense wet spells²². Seasonal rainfall is highly variable but overall the broad picture in terms of anticipated climate change impacts on rainfall is a decrease in total summer rainfall, but with more intense rainfall events, and an increase in winter rainfall. Although some of these changes might reflect natural variation, the broad trends already observed are in accordance with projections from climate models.

By ensuring that local flooding and future climate changes are considered in planning policy and activities, BCC aim to minimise the adverse impacts of climate change whilst also taking advantage of opportunities that may arise.

Actions which BCC will take to deliver these opportunities include:

- Maintaining an awareness of the latest scientific advice and guidance on climate change, particularly with regard to winter rainfall totals and short intense downpours
- Making best use of this guidance in any decision making related to flood risk management and ensuring related functions with the County Council are involved in these decisions
- Seeking creative solutions to flooding issues which lead to overall better water management
- Maximise the performance of existing drainage and flood risk infrastructure

Effective adaptation to climate change will require coordination with a number of stakeholder groups covering both the Risk Management Authorities and the local community.

²²[DEFRA, 2009 Adapting to Climate Change: UK Climate Projections](#)

The Willows – Community Flood Alleviation Project

Climate change projections indicate rainfall intensity is likely to increase which will cause the areas at risk of flooding in Buckinghamshire to change over time. Adapting to this will help to minimise the impacts of climate change. Temporary flood defences offer an innovative short term solution to this issue by providing a manoeuvrable barrier that can be quickly put together to protect property and easily redeployed in other locations as necessary. BCC's Strategic Flood Management Team have gained experience in the use of temporary flood defences by supporting a recent community led project in Aylesbury.

On the 7th February 2014, 79 properties flooded internally on the Willows estate in Aylesbury, Buckinghamshire. The flood occurred as a result of above average prolonged heavy rainfall leading to saturated ground and a combination of surface water and fluvial flooding from the nearby Stoke Brook.

BCC supported local residents to purchase over 700m of temporary flood barriers and ten pumps. These defences provide cost-efficient measures that will benefit the whole community and can be deployed quickly.

Temporary flood defences offer flexibility in their set-up and location and therefore form an important part of an adaptation plan which allows BCC to manage changing flood risk as the climate evolves.



BCC Strategic Flood Management Team deploy a length of the flood barrier at The Willows

11 Emergency management

Principle 8. Provide support and information to our partners who undertake emergency flood management

11.1 Responding to a flood event

Flood risk management can be divided into mitigation and response. BCC's Strategic Flood Management Team, and this strategy, focus on mitigation to minimise the likelihood and consequences of flooding. However, under the Civil Contingencies Act 2004, BCC's Resilience Team have a responsibility to respond to a flooding emergency and coordinate the strategic response of the emergency services, including Category 1 and 2 responders.

The emergency services have a responsibility to protect life - the responsibility for the protection of property is the responsibility of the property owner. There are a number of measures which can be taken to make property more resistant and resilient to flooding which have been noted in section 8.2.

Category 1 responders are those organisations at the core of emergency response ('blue light services'). Category 2 responders are cooperating bodies who, while less likely to be involved in the heart of planning work, will be heavily involved in incidents that involve their sector.

Table 8: Examples of category 1 and 2 responders

Category 1	Category 2
Thames Valley Police	Utility Companies (Anglian, Thames and Affinity Water)
Buckinghamshire Fire and Rescue	Internal Drainage Board
South Central Ambulance Service	Transport Operators
Environment Agency	
Buckinghamshire County Council (Resilience Team and Transport for Buckinghamshire)	
District Councils	

Flood warnings and rainfall forecasts following the initial event, provided by the Met Office, must be taken into account by Category 1 responders.

Before, during and after an event, the BCC Strategic Flood Management Team will offer support to flood incident response authorities, by providing information, undertaking statutory investigations of flood events and helping to develop flood resilience plans.

The key roles and responsibilities for responders during and after an emergency are presented in Figure 12. The scale of response by each organisation is proportionate to the scale of the emergency. These responsibilities are not influenced by the source of flooding (Main River, Ordinary Watercourse, surface runoff, groundwater, sewer etc.) and remain unchanged by the Flood and Water Management Act and this Strategy. The aim of the BCC Resilience Team remains to create a resilient Buckinghamshire by ensuring that BCC is able to respond swiftly

and proportionately to an emergency in the community as part of an integrated emergency response, whilst continuing to deliver key services and a more resilient community.



Local Authorities (BCC Resilience Team, Transport for Buckinghamshire and District Councils)

- Coordinate emergency support within their own functions
- Deal with emergencies on 'non main rivers'
- Coordinate emergency support from the voluntary sector
- Liaise with central and regional government departments
- Liaise with essential service providers
- Open rest centres
- Manage the local transport and traffic networks
- Mobilise trained emergency social workers
- Provide emergency assistance
- Deal with environmental health issues, such as contamination and pollution
- Coordinate the recovery process
- Manage public health issues
- Provide advice and management of public health
- Provide support and advice to individuals
- Assist with business continuity

Police Force

- Save life
- Coordination and communication between emergency services and organisations providing support
- Coordinate the preparation and dissemination

Fire and Rescue Service

- Save life rescuing people and animals
- Carry out other specialist work, including flood rescue services
- Where appropriate, assist people where the use of fire service personnel and equipment is relevant

Ambulance Service

- Save life
- Provide treatment, stabilisation and care at the scene

Utility Providers

- Attend emergencies relating to their services e.g. water companies attend all reports of sewer flooding
- Assess and manage risk of service failure
- Assist with recovery process, that is, water utilities manage public health considerations

Internal Drainage Board

- Operate strategic assets to reduce flood risk in partnership with other RMAs and the public

Voluntary services

- Support rest centres
- Provide practical and emotional support to those affected
- Support transport and communications
- Provide administration
- Provide telephone helpline support

Environment Agency

- Issue Flood Warnings and ensure systems display current flooding information
- Provide information to the public on what they can do before, during and after a flood event
- Monitor river levels and flows
- Work with professional Partners and stakeholders and respond to requests for flooding information and updates
- Receive and record details of flooding and related information
- Operate water level control structures within its jurisdiction and in line with permissive powers
- Flood event data collection
- Arrange and take part in flood event exercises
- Respond to pollution incidents and advise on disposal
- Assist with the recovery process, for example, by advising on the disposal of silt,

Figure 12: Roles and responsibilities of emergency responders during and after a flood event

12 Review of this strategy

Progress of BCC's work towards flood risk management will be monitored in the BSFMC meetings which are scheduled three times a year.

Review of the Strategy is planned for April 2022, to coordinate with the same six year cycle as required to update the Preliminary Flood Risk Assessment. This will enable the review of flood risk to be reflected in BCC's updated approach to flood risk management.

Appendix A

Terms of Reference of the BSFMG

- **Longevity and Coordination**
To ensure a long-term approach to flood management in Buckinghamshire ensuring clear accountability and co-ordination between all relevant parties as appropriate.
- **Development and Ownership**
To develop and own the overarching strategy for flood risk management in Buckinghamshire.
- **Leadership**
To provide leadership and accountability to ensure effective delivery of the Flood & Water Management Act within Buckinghamshire.
- **Guidance**
To provide high level guidance in order to prioritise and co-ordinate local investment in flood management assets, maintenance and improvement works.
- **Coordinated Discussion**
To be the central point where all flooding issues in Buckinghamshire can be discussed by all agencies involved and appropriate action agreed and then taken.
- **Information Sharing**
To share information, taking into account Data Protection issues, to facilitate the management of flood risk and to enable BCC, RMAs and other relevant organisations to fulfil their functions in relation to flood risk management.
- **Public Relations**
To endeavour to provide advance warning of public statement messages to be communicated by Partners in Buckinghamshire in relation to flooding issues and to consider whether they could be produced as a partnership.
- **Relevance and Responsibilities**
To review the Terms of Reference for the group on an annual basis in order to update and or amend as necessary taking into account legislation and new responsibilities.
- **Future Strategic Development**
To provide strategic direction on the development of future Surface Water Management Plans and revisions to the Preliminary Flood Risk Assessment.

Appendix B

Priority locations in Buckinghamshire based on risk of flooding

Table 9: The top ten most at-risk settlements within the county in terms of number of properties at risk from surface water flooding (1 in 100yr) as an output from risk based assessment work. Where flood management measures have either been started or are planned to address these risks are outlined.

Location	Known flood area or Section 19 done	Surface water management plan	Surface water Flood project underway or in place	Flood project under discussion
High Wycombe	Yes	Yes	Yes money available for 2016 onwards	Yes
Chesham	Yes Section 19	Yes	Yes projects ongoing	Yes further work being explored
Burnham	?	No	No	
Aylesbury	Yes Section 19	No	Yes at Willows	Yes further work at Willows
Marlow	Yes Section 19	Yes	Yes feasibility	Surface water options being explored
Amersham	Yes Section 19	No	No	Not currently
Wooburn	Yes Section 19	No	No	Not currently
Great Missenden	?	No	No	Not currently
Farnham Royal	?	No	No	Not currently
Wendover	No	No	No	Not currently
Chalfont St Peter	Yes Section 19	No	No	Not currently
Denham	No	No	No	Not currently
Beaconsfield	No	No	No	Not currently

Table 9: Areas with the greatest risk from fluvial flooding (flood zone 3) based on number of properties at risk

Location	Known flood area or Section 19	Surface water management plan	Fluvial Flood project underway or in place	Flood project under discussion
Aylesbury	Yes Section 19	Yes	Yes at Willows	Yes further work at Willows being explored
Marlow	Yes Section 19	Yes	Yes Flood Scheme starting 2016/17	N/A
Wooburn	Yes Section 19	No	No	Not currently
Wendover	No	No	No	Not currently
Amersham	Yes Section 19	No	No	Not currently
Chesham	Yes Section 19	Yes	Yes	Ongoing discussions of options
Chalfont St Peter	Yes Section 19	No	No	Not currently
Denham	?	No	No	Not currently
High Wycombe	Yes	Yes	Plans to open up River Wye	Ongoing discussions
Medmenham	Yes Section 19	No	No	Ongoing discussions
Risboroughs	Yes Section 19	No	No	Options being explored
Buckingham	Yes	Yes	No	Not currently
Great Missenden	?	No	No	Not currently
Chalfont St Giles	Yes	No	No	Not currently
Burnham	?	No	No	Not currently

Appendix C

Table 10: Summary of Section 19 Flood Investigation Reports (alphabetical)

Date	Location	Flood Event	What Happened
December 2013 – February 2014	Bishopstone, Aylesbury	Above average rainfall caused excess runoff that exceeded the capacity of local watercourses and the highway drainage system.	<ul style="list-style-type: none"> The main river, Standall's Ditch, was breached where it makes a ninety degree turn to follow the highway as it enters Bishopstone. The water that flowed out of the river at this point used the highway as a second flow path, making its way into the village and to its lowest point. Severe floods caused at least two properties in Bishopstone to flood internally The only road through Bishopstone was impassable. The highway was closed both on 24th December and 7th February by Transport for Bucks and the road closures stayed in place for two to three days after each event
March – April 2014	Chalfont St Giles	Groundwater flooding. The high water level within the Chalk aquifer lead to the flooding of the Affinity Water public water supply pumping station and the BT telephone exchange which were both located in Chalfont St Giles	<ul style="list-style-type: none"> Over pumping of the water from the BT telephone exchange lead to disruption for the village as it flooded the high street and forced the carpark to close The main street in the village was reduced to one direction of traffic which had an economic impact on the small business within the village.
January – March 2014	Chalfont St Peter	Groundwater infiltrated into the sewer network. This was not a result of design failure, but rather because the sewer network is not sealed to prevent ingress of water	<ul style="list-style-type: none"> Chalfont St Peter Parish Council reported manholes overflowing with sewage-laden water to Thames Water. This caused sewage-laden water to enter the George pub on the High Street. Internal flooding was also experienced in Greyhound Inn Road closure for at least 10 hours. A culvert flow restriction in the village caused the River Misbourne to back up, which may have caused a backup of the surface water drainage network.
September 2014	Chesham	An intense rainfall event caused surface water runoff as well as increased flow in the River Chess and its tributary the Vale Brook. The increased flow exceeded the capacity of some structures, including the Vale Brook culvert	<ul style="list-style-type: none"> Although the most intense rainfall was relatively short-lived, at least 34 properties were flooded internally in Chesham. 5 residential properties and 29 businesses with 2-5cm of water
February 2014	Gerrards Cross	The flood on 7th February 2014 occurred after a long period (over 6 weeks) of above average rainfall that saturated the catchment. Excess runoff began to fill the road drainage system and in the early hours on 7th February, intense rainfall caused surface water runoff that exceeded the capacity of the local drainage system.	<ul style="list-style-type: none"> Heavy rainfall overwhelmed the drainage system which was exacerbated by the heavily silted ditches on both sides of Fulmer Lane. This resulted in the surface water not flowing along the Fulmer Lane ditches and instead it flowed down the embankment and onto the M25 causing lane closures.
December 2013 – January 2014	Hedgerley Lane, Beaconsfield	Groundwater Flooding. The closure of Pyebush Lane pumping station prompted Thames Water to use tankers to manage flows, as is normal operating procedure. However, groundwater infiltration in to Thames Water pipes overwhelmed capacity. Water surcharged out of manholes on Hedgerley Lane, causing a flood of contaminated water. Resultantly the road was impassable via vehicles and on foot	<ul style="list-style-type: none"> High groundwater levels meant Thames Water had to use tankers to manage the flows at the pumping station however capacity of these tankers was quickly exceeded due to groundwater and surface water infiltration. This led to a foul sewer on Hedgerley Lane to surcharge and flood. Closure of Hedgerley Lane due to flooding 20-30cm inches of water
February 2014	B4443 Stoke Mandeville	The flood on 7th February 2014 occurred after a long period (over 6 weeks) of above average rainfall leading to a saturated catchment. Excess runoff filled the road drainage system and in the early hours on 7th February, further rainfall led exceedance of the drainage system.	<ul style="list-style-type: none"> The heavy rainfall overwhelmed the drainage system which was exacerbated by a number of blockages within the drainage system. This lead to the flooding of Lower Road on several occasions during the winter and flooding of a residential property internally in early February Flood caused road closure for 40 hours.

Date	Location	Flood Event	What Happened
February 2015	Monks Risborough	The flood event in Monks Risborough occurred after a prolonged period of above average rainfall which caused groundwater levels in the underlying aquifer to rise to unusually high levels and the surrounding land to become saturated. Subsequent rainfall caused flooding where the flow was unable to pass through restricted culverts and drains	<ul style="list-style-type: none"> • Groundwater levels in the aquifer were exceptionally high during January and February 2014 and soils were fully saturated as a consequence of the many weeks of wet weather. Groundwater rose to the surface through both widespread seepage and through springs • Heavy rainfall in early February was unable to infiltrate into the already saturated soil and flowed over the surface along with the emerging groundwater. There was insufficient capacity in the local drainage network to take all the water • The lack of capacity in the road drainage under the Mill Road railway bridge prevented flood water draining away and resulted in extensive flooding reported as 'knee deep' • Surface water runoff from surrounding farmland caused internal flooding (to at least the height of floorboards), flooding to gardens and flooding to both Kingsmead and Mill Lane roads. • Runoff and groundwater flowed off the Molins sports ground and flooded towards the south into the rear gardens and garages of properties in Mill Lane (east of the railway) and Crowbrook Road. • In both areas water levels came close to causing internal flooding of residential properties. At least one property lost power supply as a consequence of the flooding. Flood depths in February 2014 of between 3" (0.07m) and 5" (0.13m)
October 2014	Old Amersham	The flood event in Old Amersham occurred after a prolonged period of above average rainfall which, combined with exceptionally high groundwater levels, raised river levels. In addition, a culvert flow restriction in the town caused the River Misbourne to back up, while the blockage of a drainage asset caused a secondary flow down the High Street. A riverbank collapse also caused property flooding	<ul style="list-style-type: none"> • The large volumes of surface water in addition to the high river levels meant that the capacity of the River Misbourne and highway drainage was exceeded • The internal property flooding resulted from the malfunctioning of a flap valve installed to drain surface water from the High Street to the River Misbourne. This was lodged open with rubble. • As river levels were high, water which had backed up was not able to re-join the River Misbourne until it reached the gullies near Church Street on the north side of the High Street. In the process, the High Street was flooded both along the road and above the kerb line. • The most severe flooding event occurred overnight between 06 and 07 February 2014, with several properties along the High Street continuing to be flooded internally for several days as a result of culvert flow restrictions. • A section of the riverbank downstream of the Jaguar garage (near the A355) collapsed on 07 February 2014, causing water to back up and flood the Jaguar garage workshop • In total, the flooding caused at least 4 residential properties and 5 business premises to flood internally
December 2013-February 2014	The Orchards, Wexham	The flood event at The Orchards Residential Park occurred after a prolonged period of above average rainfall which caused the groundwater levels to rise and an increased volume of surface water. The private combined drainage system was overwhelmed with surface water and groundwater causing localised flooding at low points. The event posed serious environmental and public health risks due to standing contaminated flood water	<ul style="list-style-type: none"> • Due to the saturated catchment, when large amounts of rainfall fell on the area, water ran off the fields and hard standing surfaces and entered the combined drainage system, it is likely the system would have already been inundated with groundwater. • Due to the large volumes entering the combined system, it backed up and came out of the gully's causing contaminated flood water to pond in areas around the residential park. • It was likely the groundwater levels were also high and therefore would have been infiltrating in to the combined sewer, causing a reduced capacity
February 2014	The Willows, Aylesbury	The flood on 7th February 2014 occurred after a long period (over 6 weeks) of above average rainfall leading to a saturated catchment and the Stoke Brook and Sedrup Ditch close to capacity. Further rainfall in the early hours on 7th February 2014 exceeded the capacity of the surface water drains and the water courses	<ul style="list-style-type: none"> • The flooding began during the early hours of the morning of 7th February 2014 and resulted in 80 properties flooding internally • Due to the high water levels in the river the surface water was not able to drain down gullies and connecting pipes and may have backed up through the gullies from the river. • The debris and fly tipping in the river would have increased levels in the river and therefore the flooding. • Any blockage or constriction due to the culvert size at the A418 culvert would have increased water levels in the river and increased the flooding

Date	Location	Flood Event	What Happened
February 2014	New Denham	The flood event in February 2014 occurred after a prolonged period of above average rainfall which caused the surrounding land to become saturated and an increased volume of surface water to flow into the highway drainage and watercourses. The River Colne was very high during this time and overtopping resulted in flooding in the area around Oxford Road	<ul style="list-style-type: none"> • There was internal flooding to at least 4 properties and the businesses • Sandbagging of doors and garages was observed along Willow Avenue, Willow Crescent West, Poplar Road and Alder Road • The water level at the gauge board on the western channel of the gauging station was noted as 32.90m AoD
February 2014	Wooburn Green	The flood event in February 2014 occurred after a prolonged period of above average rainfall which caused the surrounding land to become saturated.	<ul style="list-style-type: none"> • A blocked culvert reduced the flow capacity. • As the flow was unable to pass freely down the channel the river broke its banks upstream • The field between the river and the houses was filled with water up to waist deep and the horses had to be removed from the field for their safety. • Residents were able to remove their cars to a safe location and water had to be pumped out from the front gardens.
January and February 2014	Medmenham	The flood events in January and February 2014 occurred after a prolonged period of above average rainfall which caused the surrounding land to become saturated. The River Thames was flowing very high for a long period of time with peaks in January and February 2014. The River Thames flooded Ferry Lane, and some roads and houses in the village. The highways and field drains were unable to discharge due to the high levels in the River Thames	<ul style="list-style-type: none"> • Water depth on Ferry Lane was up to 80cm and the west to east flow across Ferry lane • A number of properties had access to pumps, however water levels in homes reached between 5 and 18 inches outside homes and 1 to 2 inches inside. • Roads varied in inundation between 30cm, 50cm and 100cm on average.
January and February 2014	Bourne End	The flood event in Bourne End occurred after a prolonged period of above average rainfall which caused water levels in the River Thames to peak, overtop the banks and flow to the low lying areas of Bourne End. The drainage system in the centre of town was overwhelmed by the volume of surface water runoff and subsequently resulted in further flooding to the area.	<ul style="list-style-type: none"> • Flooding from surface water overwhelmed the road drainage network at Cores End Road and Wharf Lane which was suspected to be exacerbated by a number of blockages throughout the system. • Hedsor Road, Riversdale and Ferry Lane were inundated by water from the Thames resulting in restricted access to a number of the surrounding properties. • Whilst only two properties were reported as being flooded internally in the Riversdale area, there were a number of other properties in the vicinity that would have also been affected by floodwaters.
January and February 2014	Marlow	The flood event in Marlow occurred after a prolonged period of above average rainfall which caused groundwater levels in the underlying aquifer to rise to unusually high levels and the surrounding land to become saturated. Subsequent rainfall, along with groundwater emergence, caused flooding where surface water drainage pumps were overwhelmed and a culvert on an ordinary watercourse had insufficient capacity for the flow. Water levels in the River Thames peaked twice, overtopping the banks and flooding low lying areas of Marlow. The sewer system became overwhelmed from groundwater infiltration and caused flooding.	<ul style="list-style-type: none"> • The ground in and around Marlow was saturated due to above-average prolonged rainfall and unusually high groundwater levels; • Groundwater emerged and flooded low lying areas; • Surface water drainage systems that rely on infiltration were unable to function due to the high groundwater levels; • Surface water drainage systems that are supported by permanent pumps failed when the pumps were unable to cope with the volume of water; • Where the surface water is piped to the Newt Ditch flooding occurred when the Newt Ditch was overwhelmed. The capacity of Newt Ditch may have been reduced by sediment at the time of the flood; • Infiltration into the foul sewers caused surcharging and flooding. Reduced capacity in the sewers led to some areas being unable to use the sewer system; • Those areas of Marlow close to the River Thames were flooded directly when water levels rose above the river bank. The flood on the River Thames was estimated to be a 5% AEP event.

Appendix D

Strategic Environmental Assessment and Habitats Regulation Assessment

The production of this Strategy has been informed by undertaking a Strategic Environmental Assessment (SEA) as part of the development process, which was determined to be a requirement under the EC SEA Directive (2001/42/EC), implemented in England through the Environmental Assessment of Plans and Programmes Regulations (SI 1633 2004).

The SEA assessment has sought to ensure that any policies or actions adopted through the Strategy for managing flood risk take into account the environment, social and socio-economic and health concerns and take advantage of opportunities for wider benefits at the same time. The SEA process has run concurrently with the development of the LFRMS and has been applied in two stages:

- **Scoping:** which established the data and information considered adequate to enable the later assessment stage; and
- **Assessment:** which identified the likely significant effects of the alternatives (or “options”), and of the draft Strategy, and makes recommendations to change or improve it (where appropriate)

During the first stage of the SEA process a Scoping Report was produced and has been consulted on. All comments received have been addressed and the response documented in the SEA Environmental Report, which provides our assessment of the impact of the Strategy options on communities and the environment.

The SEA assessment concludes that the proposed aims and policies within this Strategy are generally positive in terms of their likely environmental impact, given that the primary strategic focus of the Strategy is to protect the built and natural environment.

As a County-wide Strategy, it has been developed to provide an overarching framework for action. As such, it does not contain detail on local measures and options. Therefore, the SEA assessment cannot determine potential environmental impacts beyond the likely consequences of the wider objectives for flood risk management.

However, future flood risk management works will need to be reconciled with wider land use, economic, biodiversity and landscape objectives and where potential negative effects may arise, mitigation should be provided through Strategy measures which specifically aim to protect the environment. A detailed assessment of the cumulative impacts of the County-wide actions is ideally suited when it is known what option is adopted for each action, following consultation.

To maintain a necessary future perspective on environmental impacts associated with this Strategy, the SEA assessment further identifies the need to incorporate environmental monitoring as part of the overall approach to monitoring achievement of the Strategy actions. A

range of indicators have been suggested for this purpose, highlighting the need for appropriate future assessment where significant or uncertain effects are identified.

The SEA assessment has also addressed the requirements of Habitats Regulation Assessment (HRA) under the Conservation of Habitats and Species Regulations 2010. The HRA considers the potential effects of a development plan on the biodiversity of designated European Sites, including Special Protection Areas (SPA) and Special Areas of Conservation (SAC).

The HRA concluded that, whilst there are relevant sites that could potentially be affected through implementation of flood risk management actions (through changes to the water environment or by engineering works to create flood management infrastructure), no further Habitats Risk Assessment is required at this stage as it has been demonstrated that no likely significant effects will occur because of the Strategy. However this conclusion does not remove the need for later Habitats Regulations Assessment of any other plans, projects, or permissions associated with, or arising out of, the measures identified as a result of the Strategy.

Appendix E

Linking with other strategies

One of the key aspects of viable and sustainable approaches to management of local flood risk is effective coordination across all Council and Partner strategies and activities with clear communication and involvement of the public. By linking with other strategies the following can be achieved:

- Management of flood risk through the cumulative benefit of a number of smaller schemes
- Identification of opportunities for 'piggy-backing' schemes, resulting in cost savings, efficiencies and potentially larger schemes deemed uneconomic
- Incremental adaptation to the potential impacts of climate change through creative water management
- Raising and maintenance of awareness which will develop expertise

For these reasons, this Strategy has been developed in full consultation with the key delivery Partners and with existing priorities in mind.