

Lune Catchment Flood Management Plan

Summary Report December 2009



managing
flood risk

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Introduction



I am pleased to introduce our summary of the Lune Catchment Flood Management Plan (CFMP). This CFMP gives an overview of the flood risk in the Lune catchment and sets out our preferred plan for sustainable flood risk management over the next 50 to 100 years.

The Lune CFMP is one of 77 CFMPs for England and Wales. Through the CFMPs, we have assessed inland flood risk across all of England and Wales for the first time. The CFMP considers all types of inland flooding, from rivers, groundwater, surface water and tidal flooding, but not flooding directly from the sea (coastal flooding), which is covered by Shoreline Management Plans (SMPs). Our coverage of surface and groundwater is however limited due to a lack of available information.

The role of CFMPs is to establish flood risk management policies which will deliver sustainable flood risk management for the long term. This is essential if we are to make the right investment decisions for the future and to help prepare ourselves effectively for the impact of climate change. We will use CFMPs to help us target our limited resources where the risks are greatest.

This CFMP identifies flood risk management policies to assist all key decision makers in the catchment. It was produced through a wide consultation and appraisal process, however it is only the first step towards an integrated approach to Flood Risk Management. As we all work together to achieve our objectives, we must monitor and listen to each others progress, discuss what has been achieved and consider where we may need to review parts of the CFMP.

In the Lune catchment the main source of flooding is tidal, approximately 2,200 properties are potentially at tidal flood risk from a 0.5% annual probability event (APE), although most of these properties benefit from

flood defences. There are approximately 500 properties at risk of flooding from rivers (fluvial flooding). By 2100, we estimate there will be 700 properties at risk of fluvial flooding due to the effects of climate change. Tidal flood risk is currently being reassessed as part of the production of Shoreline Management Plans (SMP2s) expected in 2010. Other sources of flooding, including surface water flooding, sewer flooding and groundwater flooding, occur on a lesser scale.

We cannot reduce flood risk on our own, we will therefore work closely with all our partners to improve the co-ordination of flood risk activities and agree the most effective way to management flood risk in the future. To develop this plan and ensure social, economic and environmental issues were taken into account we worked with, and consulted many organisations. These include DEFRA, Natural England, Lancaster City Council, United Utilities, Lancashire Wildlife Trust.

This is a summary of the main CFMP document, if you need to see the full document an electronic version can be obtained by emailing enquiries@environment-agency.gov.uk or alternatively paper copies can be viewed at any of our offices in North West Region.

A handwritten signature in black ink, appearing to read 'Tony Dean'.

Tony Dean
Regional Director

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The purpose of a CFMP in managing flood risk

CFMPs help us to understand the scale and extent of flooding now and in the future, and set policies for managing flood risk within the catchment. CFMPs should be used to inform planning and decision making by key stakeholders such as:

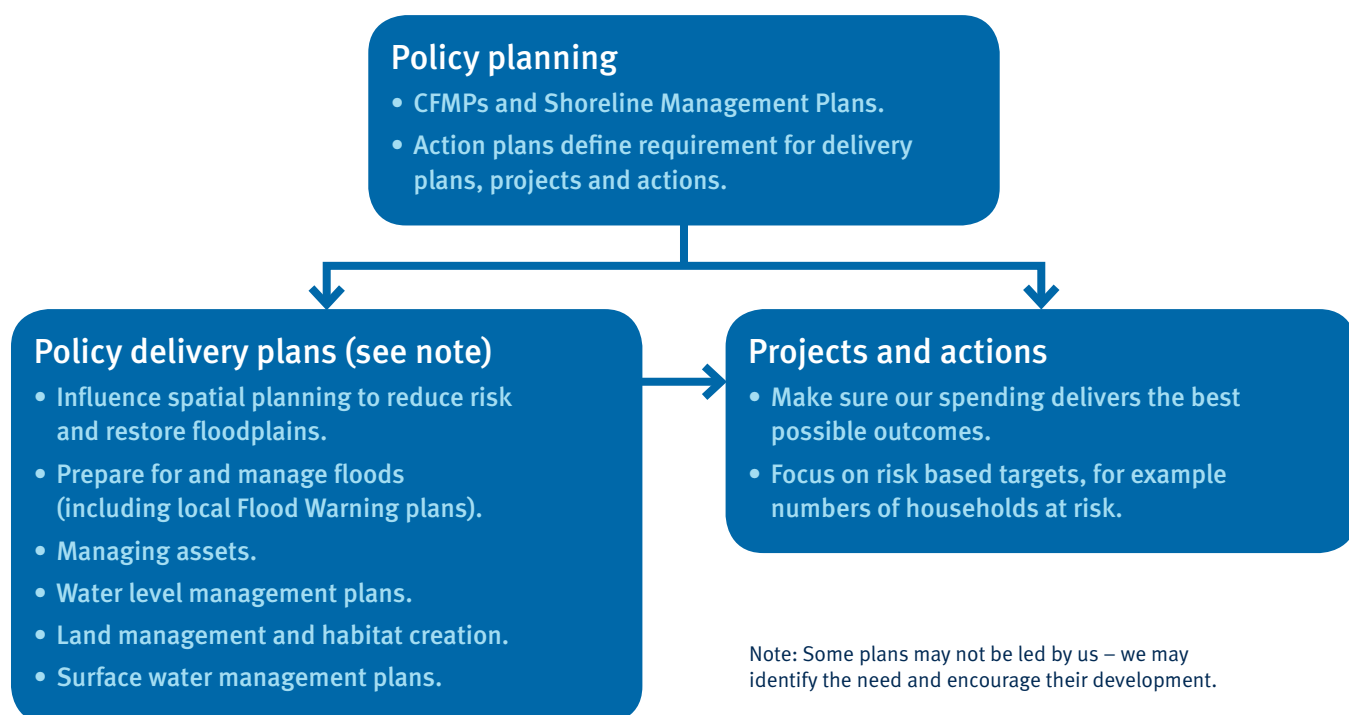
- The Environment Agency, who will use the plan to guide decisions on investment in further plans, projects or actions.
- Regional planning bodies and local authorities who can use the plan to inform spatial planning activities and emergency planning.

- Internal Drainage Board, water companies and other utilities to help plan their activities in the wider context of the catchment.
- Transportation planners.
- Landowners, farmers and land managers who manage and operate land for agriculture, conservation and amenity purposes.
- The public and businesses to enhance their understanding of flood risk and how it will be managed.

CFMPs aim to promote more sustainable approaches to managing flood risk. The policies identified in the CFMP will be delivered through a combination of different approaches. Together with our partners, we will implement these approaches through a range of delivery plans, projects and actions.

The relationship between the CFMP, delivery plans, strategies, projects and actions is shown in figure 1.

Figure 1 The relationship between CFMPs, delivery plans, projects and actions



Catchment overview

It is useful to draw out some general characteristics that are most important in our management of flood risk. The Lune is a rural catchment in the North West covering 1,300km². It extends from the Howgill Fells in the north, the Yorkshire Dales in the east and to Bowland Forest/Cockerham Moss in the south. The western boundary is Morecambe Bay.

The catchment is made up of steep slopes to the north and west, but there is flatter terrain to the east and south, along the Rivers Keer, Conder, Cocker, Pilling Water and the lower reaches of the River Lune. These watercourses are shown opposite.

By far the largest river in the catchment is the River Lune. This is a natural, relatively steep watercourse in its upper reaches and tributaries, with narrow floodplains and fast flowing watercourses. The main

tributaries include the Rawthey, Greta and Wenning. These are all similar to the upper Lune: rural, natural, narrow floodplains and fast flowing. The topography and soils have discouraged both urban development and intensive agricultural production. The middle reaches of the Lune consist of flat, wide floodplains covering better quality farmland (but still mainly grazing), with little urban development. Significant urban settlement only occurs in the downstream reaches in Lancaster. Much of this lower reach is dominated by tidal action. The River Conder and River Keer have similarities; both drain directly into the Irish Sea and the flatter topography and better soils have allowed good grazing and some arable production. Some urban development has occurred, notably at Carnforth and Galgate. Further south, Pilling Water and the River Cocker catchments include the best

agricultural land in the Lune CFMP area. However, in order to realise the soil productivity it has been necessary to introduce relatively intensive land drainage techniques.

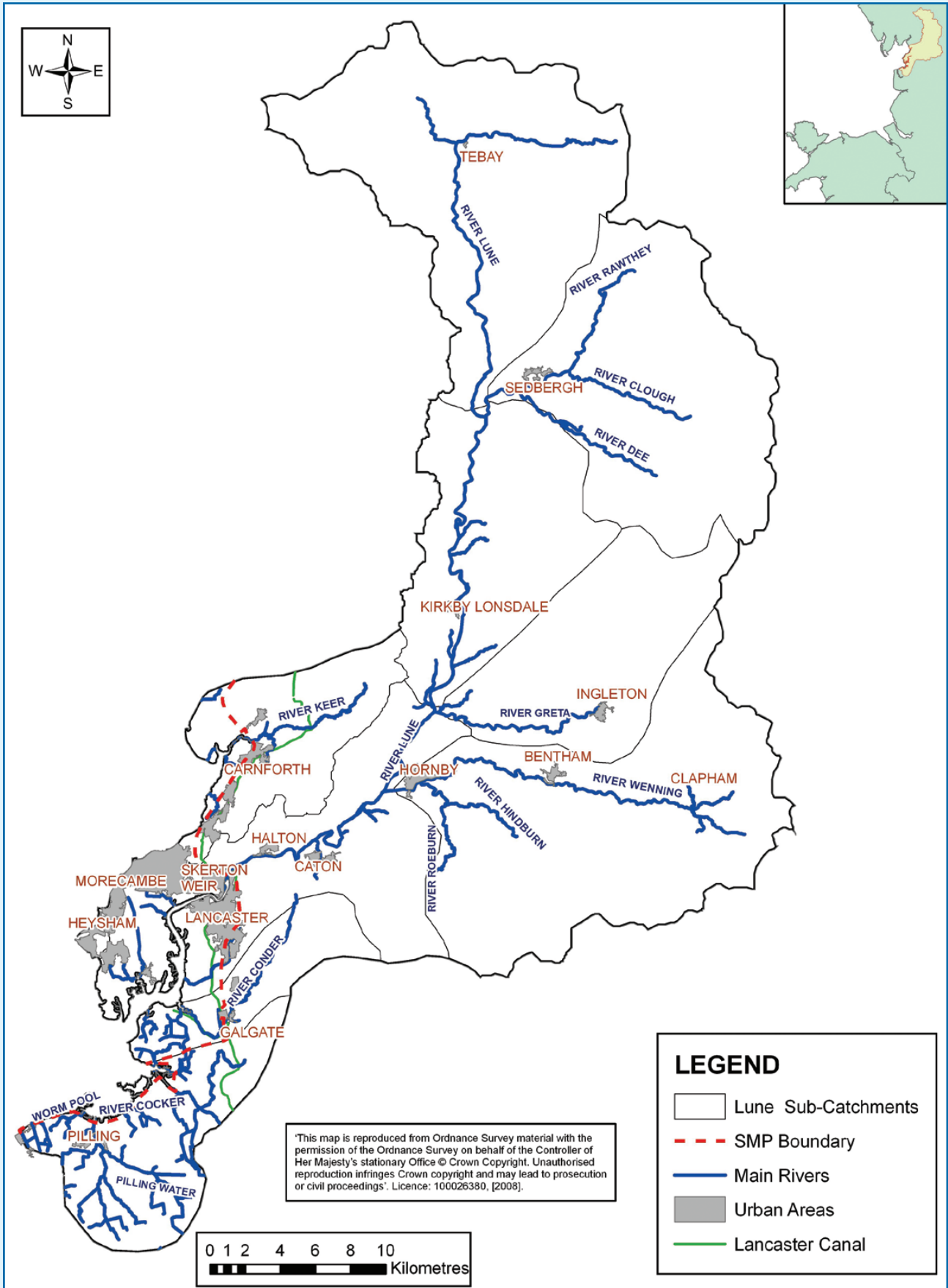
There are 10 European and over 50 nationally designated environmental sites existing within the catchment. The main flood risk to people and property is at these locations and is from the sea.

A number of national and European designated sites (4 SSSIs and 2 areas of outstanding natural beauty are within the 1% flood zone) exist within the catchment. Depending on the location and nature of the designation, flooding can have a mixture of impacts. One particularly important area is the Morecambe Bay SAC/SPA/Ramsar site. The potential impact on this protected site of some of the actions arising out of this CFMP will need to be carefully examined before implementation.



↑ Lune at Kirby Lonsdale

Map 1 Lune CFMP – main features



Current and future flood risk

Overview of the current flood risk

Flood risk has two components: the chance (probability) of a particular flood and the impact (or consequence) that the flood would have if it happened. The probability of a flood relates to the likelihood of a flood of that size occurring within a one year period, it is expressed as a percentage. For example, a 1% flood has a 1% chance or probability of occurring in any one year, and a 0.5% flood has a 0.5% chance or probability of occurring in any one year. The flood risks quoted in this report are those that take account of flood defences already in place.

Historical flood events within the catchment come from both tidal and fluvial sources. Morecambe Bay has suffered extensive tidal flooding several times in the past as a result of tidal / wave overtopping. Records show the most severe of these flood events occurred in November 1977, when 1300 properties were damaged, and in February 1990 when extensive flooding of properties and agricultural land occurred. The most notable fluvial flood events include several incidents along the River Lune through the nineteenth Century and into the early twentieth Century. The most recent flood events include tidal flooding from the River Lune of the Luneside Industrial Estate in 2002 and fluvial flooding from the River Conder at Galgate and Lancaster University in August 2004.

The main sources of flooding in the

Lune catchment are as follows:

- The Lune CFMP area has four principal sub-catchments each of which drains separately into the Irish Sea. These are the River Lune and its tributaries, River Keer, River Conder and the Pilling Water sub-catchments. On the Lune sub-catchment there is flood hazard to people along the River Wenning due to high river velocities and potentially deep flooding that could affect Clapham, High and Low Bentham, Wennington, Wray (serious flooding in 1968) and Hornby. River Rawthey and tributaries put isolated properties and some small communities at risk. Halton in the lower Lune sub-catchment has significant potential risk to people and property. Other fluvial flood risk “hotspots” include Galgate in the Conder sub-catchment, and Carnforth in the River Keer sub-catchment.
- Tidal flooding is caused by storm surge and wave action in times of high astronomical tides. The main urban areas influenced by direct tidal flooding are Lancaster, Morecambe and Heysham. The lower reaches of the River Keer, River Conder (including Thurnham Moss) and Pilling Water are also influenced by tides. There is widespread tidal flood risk at the downstream end of the Conder near Glasson. The tidal floodplain is continuous through Thurnham Moss to the Pilling area to the south. On the Keer, and particularly in the Pilling Water / Cocker area, there is significant fluvial flood risk and drainage issues combined with tidal interaction.
- Surface water flooding is caused by water collecting or flowing over the surface before soaking into the ground or entering a watercourse. It can also occur when smaller watercourses flood. This type of flooding can occur throughout the catchment but usually only causes a low level of risk. There are unsubstantiated reports of localised surface water flooding in areas of Halton, Ingleton, High Bentham, Orton, Warton, Carnforth, Galgate and Sedbergh.
- Sewer flooding is usually caused by an inadequate sewer capacity or blockages within the network. There are reports of localised sewer flooding in Carnforth, Lancaster, Heysham, Preesall and Pilling, but little detail on the actual cause of these events. United Utilities have an ongoing programme of work to maintain and improve public sewers.
- Groundwater flooding is not considered to be a significant source of flooding in the Lune catchment even though 250,000 properties lie on a major aquifer. It is thought highly unlikely that groundwater levels will rise

enough to produce a flooding problem. Verbal reports of underfloor or groundwater flooding in isolated properties in Warton, Millhead and Hornby appear to affect individual properties rather than the wider area.

What is at risk?

Using some detailed and broad-scale modelling we identified 500 properties in the catchment have a 1% chance of flooding in any one year from rivers (1% annual probability). There is also fluvial flood risk to a large area of agricultural land, particularly in the Pilling Water and River Cocker catchment. There are six environmentally designated sites including the North Pennine Dales Meadows SAC and three other SSSIs at risk in a 1% APE. There are seven scheduled ancient monuments including Hornby Bridge and three roman forts within the 1% annual probability flood extent, some of which could be adversely affected by a flood. The main source of flooding is tidal, approximately 2,200 properties are potentially at tidal flood risk from a 0.5% annual probability event (APE), although most of these properties benefit from flood defences. Tidal flooding will be addressed by the next Shoreline Management Plan due to be completed in summer 2010.

Where is the risk?

A number of high risk areas or flooding hotspots exist such as at Ingleton, Clapham, High and Low Bentham, Hornby, Carnforth, Lancaster (near Skerton Weir) and Scotforth. There are typically 50 to 100 properties at risk from a 1% APE at each location.

There is flood hazard to people along the River Wenning and River Rathay sub-catchments due to potentially high river velocities and depth of flooding, areas affected are Clapham, High and Low Bentham and Hornby. Existing raised fluvial

flood defences benefit 150 hectares of agricultural land and 170 properties in a number of urban areas such as at Carnforth, Hornby, Galgate and an industrial estate upstream of Skerton Weir along the River Lune. The map overleaf illustrates where the properties are at risk of flooding in a 1% annual probability event.

We recognise the potential risk from surface water and sewer flooding. Further studies, following on from the CFMP, will be undertaken to quantify this potential risk.

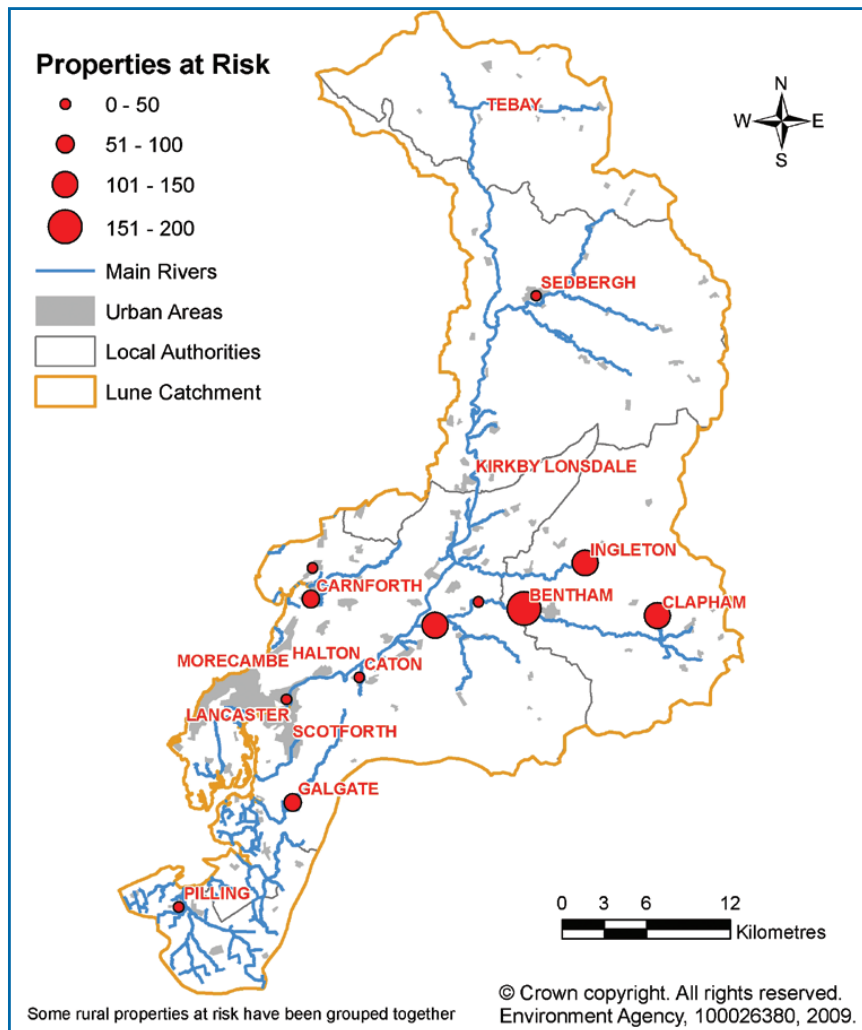
Table 1. Locations of Towns and Villages with 25 or more properties at risk in a 1% annual probability river flood

Number of properties at risk	Locations
Over 500	None
151 to 500	In the Borough of Craven and in the Borough of Lancaster City
51 to 150	None
25 to 50	In the Borough of South Lakeland at Rawthey and in the Borough of Wyre at Pilling

Table 2. Critical infrastructure at risk:

2 schools, 8 sewage treatment works and 2 electricity sub-stations

Map 2 Risk to property across catchment for the 1% annual probability fluvial event



How we currently manage the risk in the catchment

The Lune catchment has benefited from engineering schemes put in place over the last 50 years or more. These include:

- The construction of embankments along the Rivers Wenning and Rawthay.
- New tidal defences at Glasson, Morecambe, Heysham and Lancaster.
- Raised defences put in place in Galgate to protect 55 properties and agricultural land.

In addition to these engineering schemes, other flood risk management activities are carried out in the catchment. These include activities, which help to reduce the probability of flooding, and those that address the consequences of flooding.

Activities that reduce the probability of flooding include:

- Maintaining and improving existing flood defences, structures and watercourses, the catchment has nearly 10 km of raised defences on its rivers; maintained

by the EA. There are over 14 km of tidal defences. We spend over £220,000 every year on maintenance of these and other assets in the catchment.

- Identifying and promoting new flood alleviation schemes where appropriate, such as the Lower Lune Flood Risk Management Strategy and the work ongoing at Millhouses in the Upper Lune.
- Enforcement and maintenance where riparian owners carry out work detrimental to flood risk.

The impact of climate change and future flood risk

- Working with local authorities to influence the location, layout and design of new and redeveloped property and ensuring that only appropriate development is allowed on the floodplain through the application of Planning Policy Statement 25 (PPS25).

Activities that reduce the consequences of flooding include:

- Flood risk mapping, understanding where flooding is likely to occur.
- Operation of floodline and flood warning services to 7 areas and 3,300 properties in the Lune Catchment, five of the areas are directly associated with fluvial flooding.
- Providing flood incident management and response.
- Promoting awareness of flooding so that organisations, communities and individuals are aware of the risk and are prepared in case they need to take action in time of flood.
- Promoting resilience and resistance measures for those properties already in the floodplain.

In the future, flooding will be influenced by climate change, changes in land use (for example urban development) and rural land management. In the Lune catchment, sensitivity testing revealed that climate change has the greatest impact on flood risk, with land management change, and urbanisation having a smaller effect. Whilst we do not know exactly what will happen in the future the key trends are:

- More frequent and intense storms causing more widespread flooding from drainage systems and some rivers.
- Wetter winters increasing the likelihood of large-scale flooding.

The future scenarios used in the Lune CFMP were:

- A 20% increase in peak flow in all watercourses. The predicted increase in flow can affect the frequency, timing, scale of flooding and the flood levels.
- A total sea level rise of 800 mm by the year 2100.

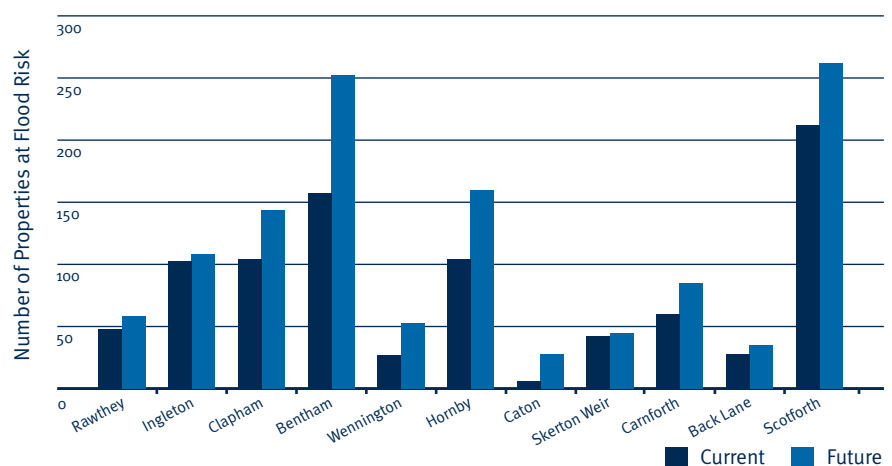
- Change in rural land use- increasing run-off by 10%.

We estimate that by 2100 approximately 700 properties will be at risk of fluvial flooding. This is a 40% increase compared to the current number of properties at fluvial flood risk across the catchment. This catchment is sensitive to climate change, by 2100, fluvial flood depths are typically expected to rise by 0.5m. We estimate a rise of 0.8m at Carnforth, and approximately 0.5m at Lancaster, High and Low Bentham, Hornby and Galgate. The increase in tidal flood depths is estimated to be approximately 1m, a very significant change.

No additional environmental or heritage sites are in the future 1% annual probability flood extent but the flood depth and extent of flooding is expected to increase slightly.

Figure 2 shows the difference between current and future flood risk for a 1% annual probability event at key areas in the catchment taking into account defences where they exist.

Figure 2 Current and future (2100) flood risk to property from a 1% annual probability river flood, taking into account current flood defences.



Future direction for flood risk management

Approaches in each sub-area

We have divided the Lune CFMP area into nine distinct sub-areas that have similar physical characteristics, sources of flooding and levels of risk. These sub-areas will allow us and the key stakeholders to promote flood risk management approaches, policies and actions that are most appropriate in that area to deliver the various Government and regional strategies, in particular the Making Space for Water strategy. In the face of increasing risk, it often is not sustainable to keep building

and raising defences. This is why we have to look catchment wide at how we direct effort and resources to ensure sustainable solutions. We have assessed what will be the most sustainable approach to managing flood risk in each sub-area. This is presented in the following sections and they outline:

- The key issues in that area.
- The vision and preferred policy.
- The proposed actions to implement the policy.

This document does set out our policies for managing flood risk, recognising the constraints that do exist. Our future direction for managing flood risk is expressed by applying one of our six standard policy options to that sub area. To select the most appropriate policy, the plan has considered how social, economic and environmental objectives are affected by flood risk management activities under each policy option. The six policy options are explained on page 11.

Map 3 Sub-areas

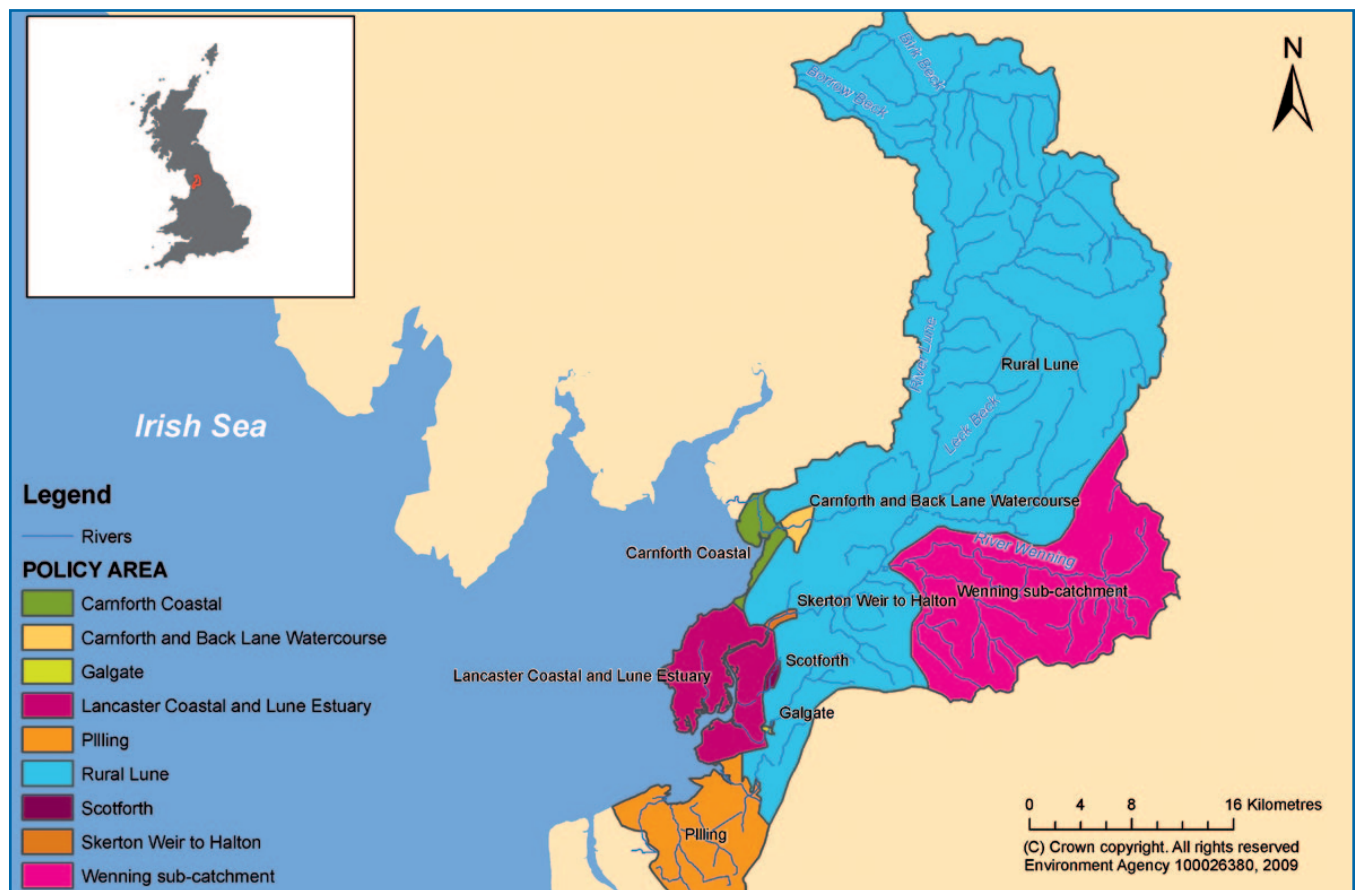


Table 3 Policy options

→ Policy 1

Areas of little or no flood risk where we will continue to monitor and advise

This policy will tend to be applied in those areas where there are very few properties at risk of flooding. It reflects a commitment to work with the natural flood processes as far as possible.

→ Policy 2

Areas of low to moderate flood risk where we can generally reduce existing flood risk management actions

This policy will tend to be applied where the overall level of risk to people and property is low to moderate. It may no longer be value for money to focus on continuing current levels of maintenance of existing defences if we can use resources to reduce risk where there are more people at higher risk. We would therefore review the flood risk management actions being taken so that they are proportionate to the level of risk.

→ Policy 3

Areas of low to moderate flood risk where we are generally managing existing flood risk effectively

This policy will tend to be applied where the risks are currently appropriately managed and where the risk of flooding is not expected to increase significantly in the future. However, we keep our approach under review, looking for improvements and responding to new challenges or information as they emerge. We may review our approach to managing flood defences and other flood risk management actions, to ensure that we are managing efficiently and taking the best approach to managing flood risk in the longer term.

→ Policy 4

Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change

This policy will tend to be applied where the risks are currently deemed to be appropriately-managed, but where the risk of flooding is expected to significantly rise in the future. In this case we would need to do more in the future to contain what would otherwise be increasing risk. Taking further action to reduce risk will require further appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options.

→ Policy 5

Areas of moderate to high flood risk where we can generally take further action to reduce flood risk

This policy will tend to be applied to those areas where the case for further action to reduce flood risk is most compelling, for example where there are many people at high risk, or where changes in the environment have already increased risk. Taking further action to reduce risk will require additional appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options.

→ Policy 6

Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits

This policy will tend to be applied where there may be opportunities in some locations to reduce flood risk locally or more widely in a catchment by storing water or managing run-off. The policy has been applied to an area (where the potential to apply the policy exists), but would only be implemented in specific locations within the area, after more detailed appraisal and consultation.

Rural Lune

Our key partners are:

Eden District Council

South Lakeland District Council

Craven District Council

Lancaster City Council

Natural England

United Utilities

The issues in this sub-area

This sub-area includes all rural areas of the River Lune catchment except for locations with concentrated flood risk. Relatively few, and generally isolated, properties are at risk from flooding. There are no significant flood defences in the sub-area. In total, approximately 110 properties are at risk from the 1% APE, increasing to approximately 130 properties by 2100. The main problem location is at Ingleton where approximately 50 properties are currently at flood risk. Flood depths here are currently a metre or less but will increase by 0.5m on average by 2100. Other vulnerable locations identified as being at risk include campsites, a particular hazard as they are located in a fast responding catchment with high flow speeds in flood events. The critical infrastructure at risk includes three electricity sub-stations, eight sewage treatment works and the Lune water intake structure at Halton. Existing flood risk is not thought to have a significant adverse impact on the important environmental sites within the sub-area.

The vision and preferred policy

Policy option 4: Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.

Our vision is for the catchment to continue to function in a natural way, with little intervention, such as flood defences and maintenance programmes. However, low cost but highly valuable actions focussing on risk to people should continue to help sustain the low flood risk in this sub-area.

The key messages

- Although this area is rural with relatively low flood risk, there is high risk in Ingleton that needs further investigation, especially with regard to future flood risk.
- Promote the natural functioning of the rivers and protect the floodplain from inappropriate development.
- Consider a range of flood risk management measures to improve or sustain the level of risk into the future, particularly in providing advice to those at risk on flood resistance/resilience, emergency planning and flood warning.

Proposed actions to implement the preferred policy

The essential actions to achieve our policy aim are listed below:

- Encourage and assist the Regional Assembly and local planning authorities to produce Regional and Strategic Flood Risk Assessments to inform future development and minimise flood risk from all sources.
- Undertake a pre-feasibility study for a new flood defence scheme in Ingleton. This will look at the options of reducing flood risk and damages to Ingleton. An environmental study will be carried out to assess the impact on any species or habitats as a result of new defences.
- Consider expanding current emergency planning and flood warning services for hotspots and campsites in Ingleton, Caton and Rawthey Valley. Promote self-help approaches.
- Assess flood risk for flood risk to critical infrastructure eg, sewage treatment works and work with operators to establish a programme of work to remedy any shortfalls.



↑ Rural Lune

Carnforth and Back Lane Watercourse

Our key partners are:

Lancaster City Council

Lancashire County Council

Landowners

Natural England

The issues in this sub-area

This sub-area includes the urbanised reach of the River Keer and Back Lane watercourse. This includes Carnforth, Millhead and Warton. The Keer is tidally influenced and so there is both tidal and fluvial flood risk.

Approximately 90 properties are at risk from the 1% APE, mostly residential. This rises to 135 by 2100 when tidal flood risk is included, but much less if only fluvial flood risk is examined. Twenty five of these properties benefit from 1km of flood defences. Property at risk includes a school and a large leisure development at Pine Lake. Critical infrastructure includes several railway lines, the A6 road and a sewage works in Warton.

Flood depths are typically less than 1m. By 2100, fluvial flood depths are typically expected to increase by only 0.1m, but tidal flood depth increases will be nearer 1m. The frequency of tidal flooding will also increase.

The vision and preferred policy

Policy option 6: Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood

risk reduction or environmental benefits.

Our vision is to reduce the overall flood risk to Carnforth and Warton in accordance with the principles of "Making Space for Water". Fluvial flood storage may be viable on the Back Lane watercourse and when renewal of the existing defences on the Keer is required, this may best be achieved on an alignment set well back from the existing watercourse. Providing flood defence to Pine Lake is unlikely to be appropriate and so other flood management approaches will be required.

The key messages

- Increase in tidal flood risk will be a significant issue in the long term and changes to tidal flood defences will be needed, although not immediately.
- The floodplain is our most important asset in managing flood risk. We want to safeguard the floodplain from inappropriate development, and where possible set back existing defences to allow a more natural system to operate.
- We will examine flood risk management options where possible. This includes a study to look into the options on the Back Lane watercourse.

Proposed actions to implement the preferred policy

The essential actions to achieve our policy aim are listed below:

- In the long term (2020 onwards), investigate the feasibility of setting-back defences from the River Keer to the village of Warton. Agricultural land currently behind the defences could be allowed to flood and given over to habitat restoration.
- Seek to remove and re-locate high risk properties (chalets and caravans) at Pine Lake.
- Undertake a study and evaluate the flood risk management options along Back Lane Watercourse.



↑ River Keer at Millhead

Carnforth Coastal

Our key partners are:

Lancaster City Council

United Utilities

The issues in this sub-area

The only significant source of flood risk in this sub-area is associated with coastal processes and as a result, the relevant SMP will be used to determine flood risk management policy for this sub-area. There is no risk of fluvial flooding in the sub-area and there are no fluvial flood defences. This sub-area includes the tidal sections of the River Keer and the adjacent open coastline and hinterland.

Development includes part of Carnforth and a few isolated properties along the coast. There are two sewage works in the sub-area. Current tidal flood levels are forecast to increase by 0.8m by 2100.

The vision and preferred policy

Policy option 3: Areas of low to moderate flood risk where we are generally managing existing flood risk effectively.

The policy recommended here relates to fluvial flood risk only, which is not a significant issue. Therefore, our vision for this unit is to continue our current policy of no active intervention with regard to fluvial flood risk and rely on the SMP for direction with regard to managing tidal flood risk and coastal erosion. We will continue our current development control activities to discourage inappropriate development in the floodplain.

The key messages

- Coastal processes dominate here and the SMP process is the appropriate way to consider management of tidal flood risk.

Proposed actions to implement the preferred policy

The essential actions to achieve our policy aim are listed below:

- All fluvial main river lengths inspected regularly for blockages or other problems and these problems dealt with so as not to increase fluvial flood risk.
- In conjunction with local planning authorities, any proposed works likely to affect fluvial flood risk shall be evaluated and any likely increase in risk from these works minimised or eliminated.



↑ Carnforth coastline

Lancaster Coastal and Lune Estuary

Our key partners are:

Lancaster City Council

United Utilities

The issues in this sub-area

The only significant source of flood risk in this sub-area is associated with coastal processes and as a result the relevant SMP will be used to determine flood risk management policy for this sub-area. There is no risk of fluvial flooding in the sub-area and there are no fluvial flood defences. This policy unit incorporates all of the coastal towns of Morecambe and Heysham, the village of Overton and most of Lancaster. Although tidal flooding occurs only occasionally, there is extensive tidal flood risk throughout the area (see figure opposite), and flood levels are forecast to increase by 0.8m by 2100 due to sea level rise.

Critical infrastructure works in the sub-area include Heysham Nuclear Power Station, two electricity substations and two sewage works. Numerous other important assets and infrastructure are present in the large urban areas at tidal flood risk.

The vision and preferred policy

Policy option 3: Areas of low to moderate flood risk where we are generally managing existing flood risk effectively.

The policy recommended here relates to fluvial flood risk only, which is not a significant issue. Therefore, our vision for this unit is to continue our current policy of no active intervention with regard to fluvial flood risk and rely on the SMP for direction with regard to managing tidal flood risk and coastal erosion.

The key messages

- Coastal processes dominate here and the SMP process is the appropriate way to consider management of tidal flood risk.
- Continue to resist inappropriate development in areas of flood risk.

Proposed actions to implement the preferred policy

The essential actions to achieve our policy aim are listed below:

- All fluvial Main River lengths inspected regularly for blockages or other problems and these problems dealt with so as not to increase fluvial flood risk.
- In conjunction with local planning authorities, any proposed works likely to affect fluvial flood risk shall be evaluated and any likely increase in risk from these works minimised or eliminated.



↑ Lune Estuary, Lancaster

Skerton Weir to Halton

Our key partners are:

Lancaster City Council

Lancashire County Council

Local landowners

The issues in this sub-area

This sub-area includes the downstream fluvial reach of the River Lune, between Halton and Skerton Weir in Lancaster. Halton is a village on the north bank, and there is an industrial estate and hotel on the south bank near Skerton Weir. The industrial estate is protected by 2.5km of flood defence, but this only provides a relatively low standard of protection. Unfortunately, improvement to this defence is difficult to implement, most notably because of the need to ensure that flood risk to residential property on the opposite bank is not increased. There are 28 properties currently at risk in a 1% APE rising to 32 by 2100 taking into account climate change. Typical current flood depths in the industrial estate are up to 2m and climate change will result in a 0.4m increase in this by 2100, with the defences overtopping twice as often. An investigation is needed into the options to reduce present and future flood risk in the Lansil Industrial Estate.

No critical infrastructure is thought to be at risk of flooding and there are no significant natural environment issues within this sub-area.

The vision and preferred policy

Policy option 6: Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.

There are a large number of residential and industrial properties at risk of flooding downstream of this sub-area, and therefore land that is not designated as environmental may be restored to floodplain in the area to manage excess water in flood conditions. Our vision for this area is to restore, where possible, the River Lune floodplain so that the risk and impacts of flooding are reduced.

The key messages

- An investigation into the flood risk management options in Lansil Industrial Estate is needed to prevent repeated future flooding.
- The investigation should consider all options including the gradual removal of development on the floodplain. Until then, improvements in flood awareness, warning and flood resistance/resilience will be pursued.

Proposed actions to implement the preferred policy

The essential actions to achieve our policy aim are listed below:

- Complete a feasibility study examining the flood risk management options for this sub-area and base long-term flood risk management on its findings.
- Encourage the use of flood resilience/resistance measures for vulnerable properties by providing information and advice (as per recommendation 15 of the Pitt Review) and explore funding opportunities. This is a short to medium term measure, applying until, and if, any scheme to reduce flood risk is implemented.
- Expand current flood warning service and promote self-help approach, taking into account the impact of climate change.



↑ The Lune at Skerton Weir - Photo courtesy of the North West England and North Wales Coastal Group.

Scotforth

Our key partners are:

Lancaster City Council

Lancashire County Council

Natural England

The issues in this sub-area

This sub-area consists of the urban suburb of Lancaster which is drained by Burrow Beck. Although flooding is not a frequent problem, we estimate that approximately 110 properties are presently at risk from the 1% APE, rising to approximately 140 properties by 2100. Most property at risk is residential, although part of a school is also at flood risk. Average flood depths are currently less than a metre but are predicted to increase by 0.5m by 2100. Burrow Beck suffers from some of the usual problems of watercourses in urban areas; it is relatively artificial in some reaches, is subject to littering and there are numerous bridge crossings and culverts that could cause flood risk. However, good development control has meant that there are few reported flooding problems and there is adequate space for flood water along the downstream reaches. We currently carry out relatively little flood risk management activity and there are no flood defences.

The vision and preferred policy

Policy option 6: Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.

Our vision for the unit is to protect and restore as much of the natural floodplain as possible in order to provide flood storage, prevent inappropriate development and reduce flooding, whilst providing environmental benefits.

The key messages

- The floodplain is our most important asset in managing flood risk. We want to safeguard the natural floodplain from inappropriate development.
- Effective development control and application of sustainable drainage approaches within the catchment are important.

Proposed actions to implement the preferred policy

The essential actions to achieve our policy aim are listed below:

- Review the conclusions and recommendations from our recently completed detailed modelling study on Burrow Beck.
- Seek to maximise the potential use of open space to allow them to flood in extreme events for the benefit of developed locations. Habitat creation may be possible as part of this scheme.



↑ Burrow Beck

Galgate

Our key partners are:

Lancaster City Council

Lancashire County Council

Natural England

United Utilities

The issues in this sub-area

The small residential settlement of Galgate is located south of Lancaster on the River Conder and Whitley Beck. Approximately 40 properties are at risk from the 1% APE, rising to nearer 70 properties by 2100. A police station is also exposed to flood risk. Many of the properties at risk are protected by 1km of flood wall along the Conder, although the visual impact, condition and low standard of protection provided by the defence are a concern. Average depth of flooding in this sub-area is around 1m and this is expected to increase by 0.5m by 2100. This represents a significant potential hazard to life during both now and in future flood events. Road bridges and a culvert can increase flood risk and require regular maintenance.

The vision and preferred policy

Policy option 4: Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.

Our vision is to maintain the distinct visual character of Galgate while sustaining the existing level of flood risk into the future. This may be achieved by the reconstruction of the flood wall or inclusion of other measures such as upstream flood storage and improved flood warning and emergency planning.

The key messages

- The existing flood risk management measures at Galgate require improvement. However, the economic justification for improvements will need to be established and may not be sufficient to attract funding. Also, significant reduction in flood risk to Galgate may not be possible without damaging its visual amenity.
- Managing residual flood risk through flood warning, awareness and emergency planning will be important.

Proposed actions to implement the preferred policy

The essential actions to achieve our policy aim are listed below:

- Review, through a feasibility study, the flood risk management options to protect properties from the River Conder in Galgate. Visual, economic and environmental impacts of the new scheme should be assessed. Habitat creation may be possible as part of this scheme.
- Examine possible locations along the Conder for new flood storage areas to benefit Galgate. The environmental impacts of the creation of new habitat, or restoration of lost/degraded habitat, should be considered as part of the study.
- A sewer owned by United Utilities passes over Whitely Beck and it is possible for flood debris to wedge against the sewer pipe, increasing flood risk to properties. We will work with United Utilities to find a solution to this problem.
- Create a new flood warning area and promote self-help approach.



↑ Galgate

Pilling

Our key partners are:

Wyre Borough Council

Natural England

Landowners

The issues in this sub-area

This is a largely rural, flat and low lying sub-area. Most of the sub-area is below the 20% annual probability tide level. Watercourses and ditches drain the land and allow good quality grazing and arable production. Pilling Water and the River Cocker drain to the Irish Sea via flapped tidal outfalls and a pumping station. We maintain 150km of watercourses in the sub-area. Although there is potential for extensive fluvial flooding, this would be shallow and low hazard. Tidal flood risk is much more hazardous and we maintain 14km of tidal defences to reduce risk and allow agricultural production. There are villages but many properties are either farms or in rural hamlets.

Only 25 properties are currently at risk from fluvial flooding rising to 30 by 2100 due to climate change, whereas over 1,000 are potentially at risk from an extreme tidal event. However, due to our defences, there are currently no properties at tidal flood risk from a 0.5% annual probability tidal event. Due to sea level rise, we expect typical future flood depths to increase by 0.8m by 2100, leaving 1300 properties at risk from a 0.5% event by 2100. In future, our tidal defences will also be subject to much more frequent overtopping and breaches unless improvements are made.

Critical infrastructure at risk includes a sewage treatment works and two electricity sub-stations.

The vision and preferred policy

Policy option 6: Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.

Our vision is that the current agricultural land use within the sub-area should be supported, but this will be challenging given the potential impact of climate change. We expect that the best way to manage additional river flows and higher sea levels will be to allow more space for flood water. This will involve increased wetting and change in land use of a small proportion of the sub-area in order to sustain the remainder. We believe that this represents a balanced and sustainable way forward.

The key messages

- Most current land use will continue to be supported.
- We will need to work with landowners to identify areas that can be set aside to help manage the expected impacts of climate change. This will apply to storing river floodwater and possibly also to our sea defences, but the SMP process will consider the latter.

Proposed actions to implement the preferred policy

The essential actions to achieve our policy aim are listed below:

- Examine locations behind the sea defences for possible new flood storage areas. This should include a study of the viability and environmental impact (including habitat creation) of any identified storage areas.
- The recommended policy for the sea defences in the SMP2 document should be reviewed when it is available. At an appropriate date, examine the possibility of setting back the new defences to make them more sustainable and create habitats.
- Investigate the viability of producing an emergency plan for the Pilling catchment. Evacuation plans for large public buildings (such as schools) should be included.



↑ Pilling

Wenning sub-catchment

Our key partners are:

Lancaster City Council

Lancashire County Council

Craven District Council

Local community

The issues in this sub-area

The River Wenning is a rural tributary of the Lune draining from the western slopes of the Yorkshire Dales. There are a few small villages in the catchment where properties are at flood risk: Hornby, High Bentham, Clapham and Wennington. The nature of flood risk is particularly hazardous due to the fast responding and flowing rivers. There are a total of 140 properties at risk in the sub-area from a 1% APE. Of these, 80 are protected by raised defences in Hornby. Critical infrastructure at risk includes three sewage works near High Bentham, Low Bentham and Hornby. The average depth of flooding to properties is typically less than a metre but is expected to increase by 0.5m by 2100 and the total number of properties at risk increase to 220.

The vision and preferred policy

Policy option 5: Areas of moderate to high flood risk where we can generally take further action to reduce flood risk.

The villages within the catchment of the River Wenning are currently at risk of flooding. Given the potential for loss of life and property damage we need to take appropriate action to minimise this risk.

The key messages

- Flood risk causes serious hazard due to the speed of flood water through this sub-area. This needs to be addressed.
- Investment in new flood defences may not be appropriate given the investment already made in flood defences at Hornby and that the limited numbers of remaining properties at risk are spread over several locations.
- Homeowners will need to be better informed and prepared for flood events.

Proposed actions to implement the preferred policy

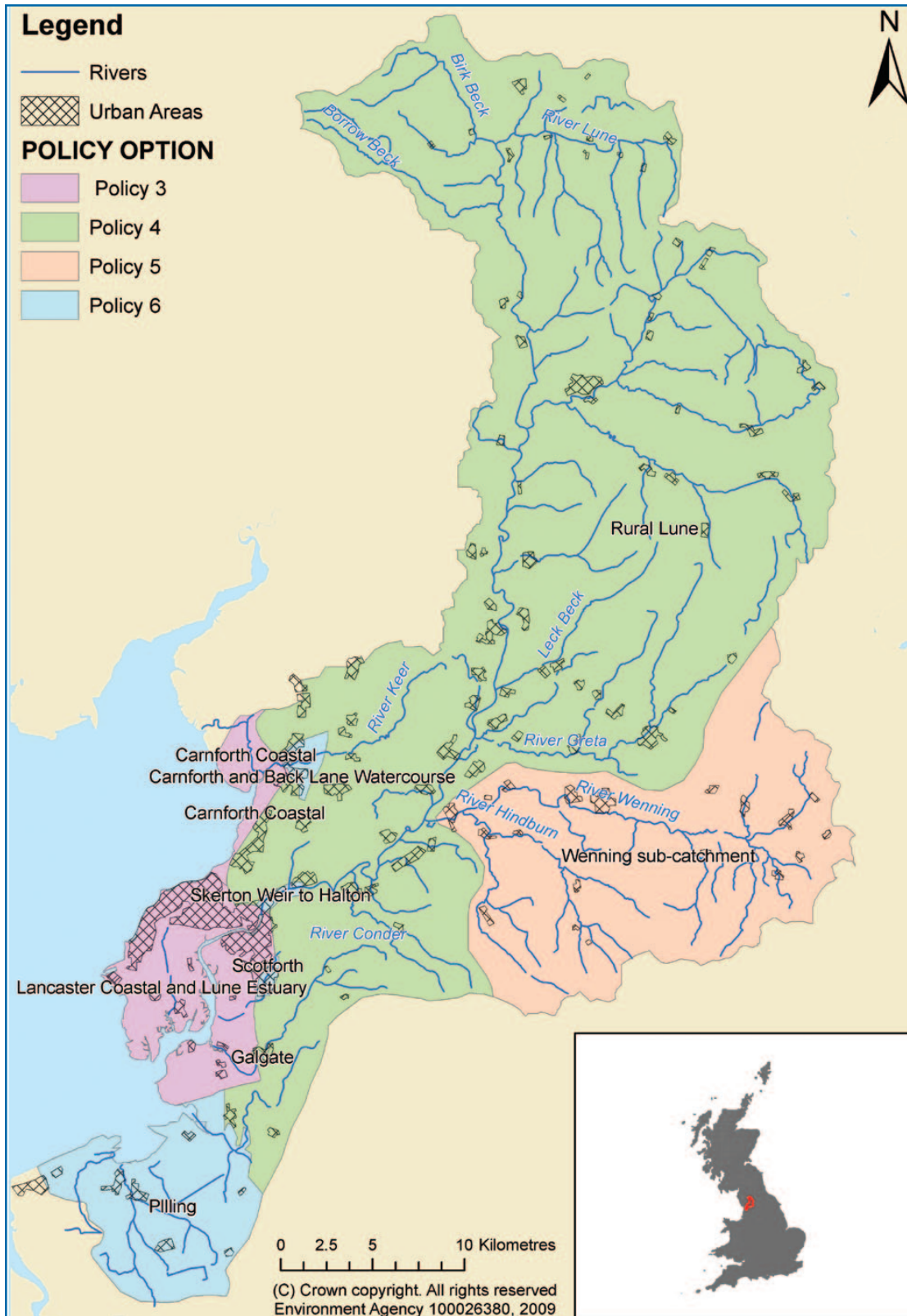
The essential actions to achieve our policy aim are listed below:

- Review the existing detailed modelling and extend if required. Carry out a strategic review of flood risk and flood management in the Wenning catchment with the aim of reducing the increased risk caused by climate change.
- Influence the development control process to steer inappropriate new and replacement property away from floodplain areas. Any development that, exceptionally, must go ahead needs to ensure it has raised floor levels, is resilient to flooding and has safe access/evacuation routes (such as the school at Low Bentham).
- Consider expanding the current flood warning service to Low Bentham, undertaking education and awareness programmes and improving emergency plans.



↑ River Wenning at Low Bentham

Map of CFMP policies



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