



Asiantaeth yr
Amgylchedd Cymru
Environment
Agency Wales

North West Wales Catchment Flood Management Plan

Summary Report January 2010



managing
flood risk

We are Environment Agency Wales. It's our job to look after your environment and make it **a better place** – for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

Environment Agency Wales. Out there, making your environment a better place.

Published by:

Environment Agency Wales

Cambria House

29 Newport Road

Cardiff CF24 0TP

Tel: 0870 8506506

Email: enquiries@environment-agency.gov.uk

www.environment-agency.gov.uk

© Environment Agency Wales

All rights reserved. This document may be reproduced with prior permission of the Environment Agency.

January 2010

Front cover image: Afon Ddu, Llanfairfechan

Introduction



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

The North West Wales 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 catchments. 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.

The North West Wales CFMP area has a long history of flooding and flood risk. Historic records show that flooding is typically due to flash flood events following prolonged periods of rainfall. Flooding tends to be localised and often heavy rainfall experienced in one

part of the catchment is not experienced elsewhere, for example in the Prysor valley in July 2001. Over the last 50 years, numerous engineering schemes have been constructed, to manage the flood risk in conjunction with other management responses, for example, the Abererch scheme on the Afon Erch, east of Pwllheli and the Afon Adda scheme in Bangor.

We have worked with others to produce this CFMP, including: local authorities, water companies, environmental groups, land owners and land managers. Whilst there is broad support for this plan, local authorities have raised concerns about limited resources, prioritisation and the potential impact on current development and regeneration proposals. Also, land managers have raised concerns about how flood risk is managed in rural areas. 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 manage flood risk in the future.

This is a summary of the main CFMP document. If you need to see the full document, an electronic version may be obtained by emailing enquiries@environment-agency.gov.uk.

A handwritten signature in blue ink that reads "Chris Mills".

Chris Mills
Director Wales

Contents

The purpose of a CFMP in managing flood risk	3	4 Pwllheli	17
Catchment overview	4	5 Snowdonia	18
Current and future flood risk	6	6 Porthmadog	19
Future direction for flood risk management	12	7 Coastal Lowlands	20
Sub-areas		8 Dolgellau	21
1 Anglesey	14	9 Upper Dyfi and Upper Wnion	22
2 Bangor and Caernarfon	15	10 Llanfairfechan	23
3 Lleyn Peninsula	16	11 Borth	24
		Map of CFMP policies	26



Image: View of the Seiont from Caernarfon Castle

© iStockphoto.com/JonTarrant

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 catchments. CFMPs should be used to inform planning and decision making by key partners such as:

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

- internal drainage boards, water companies and other utility companies to help plan their activities in the wider context of the catchment;
- transportation planners; who can use the plan to inform their activities;
- land owners, 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.

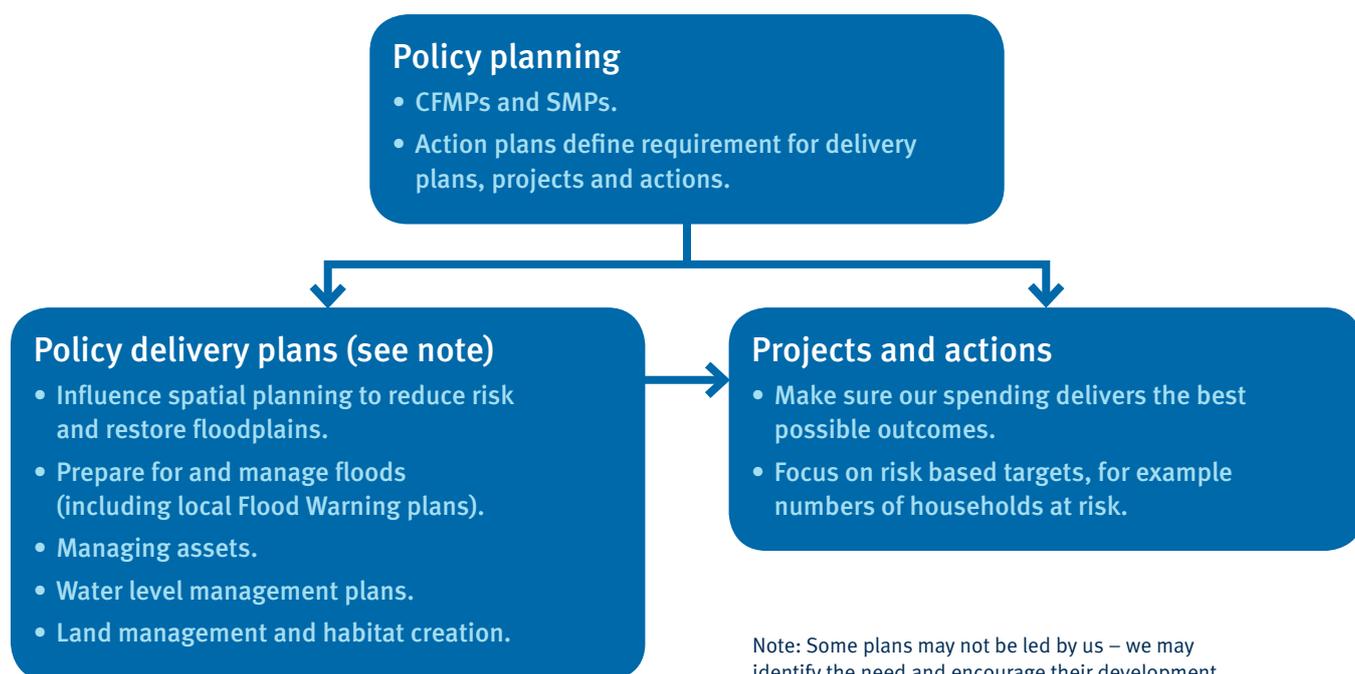
CFMPs aim to promote more sustainable approaches to managing flood risk.

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 CFMPs, delivery plans, projects and actions is shown in figure 1.

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



Catchment overview

The North West Wales CFMP covers an area of approximately 3,400 km². It extends from Anglesey and the North Wales coast in the north, to Borth in the south, and includes approximately 103,000 properties. Map 1 shows the location and extent of the CFMP area.

The area is predominantly rural with only one per cent being urbanised. The rest is either farmland or open countryside. The river catchments vary in character from steep, fast flowing, rapidly responding catchments in the mountainous

areas of Snowdonia, to gently sloping, slower responding catchments on Anglesey and the Llyn Peninsula.

A significant proportion of the population live in coastal towns and villages such as Bangor, Caernarfon, Pwllheli, Porthmadog, Fairbourne, and Borth. Inland, the population is dispersed between larger villages and towns such as Dolgellau, Llangefni and Blaenau Ffestiniog, interspersed with numerous scattered hamlets and individual properties.

The economy of the area is largely reliant on tourism and farming. Industrial development is limited apart from pockets of light industry in mainly coastal towns. Slate quarrying in Bethesda and Blaenau Ffestiniog produces slate products for internal and export markets.

This CFMP has significant links with energy production and includes both a working and decommissioned nuclear power station and a number of larger scale hydro-electric schemes.

The CFMP area is of high environmental, landscape and historical interest, with 15 per cent of the area designated for its nature conservation, 83 per cent of the area designated for its landscape value and 34 per cent designated for historical interest. The majority of the CFMP area lies within the Snowdonia National Park and the Anglesey and Llyn Peninsula Areas of Outstanding Natural Beauty.

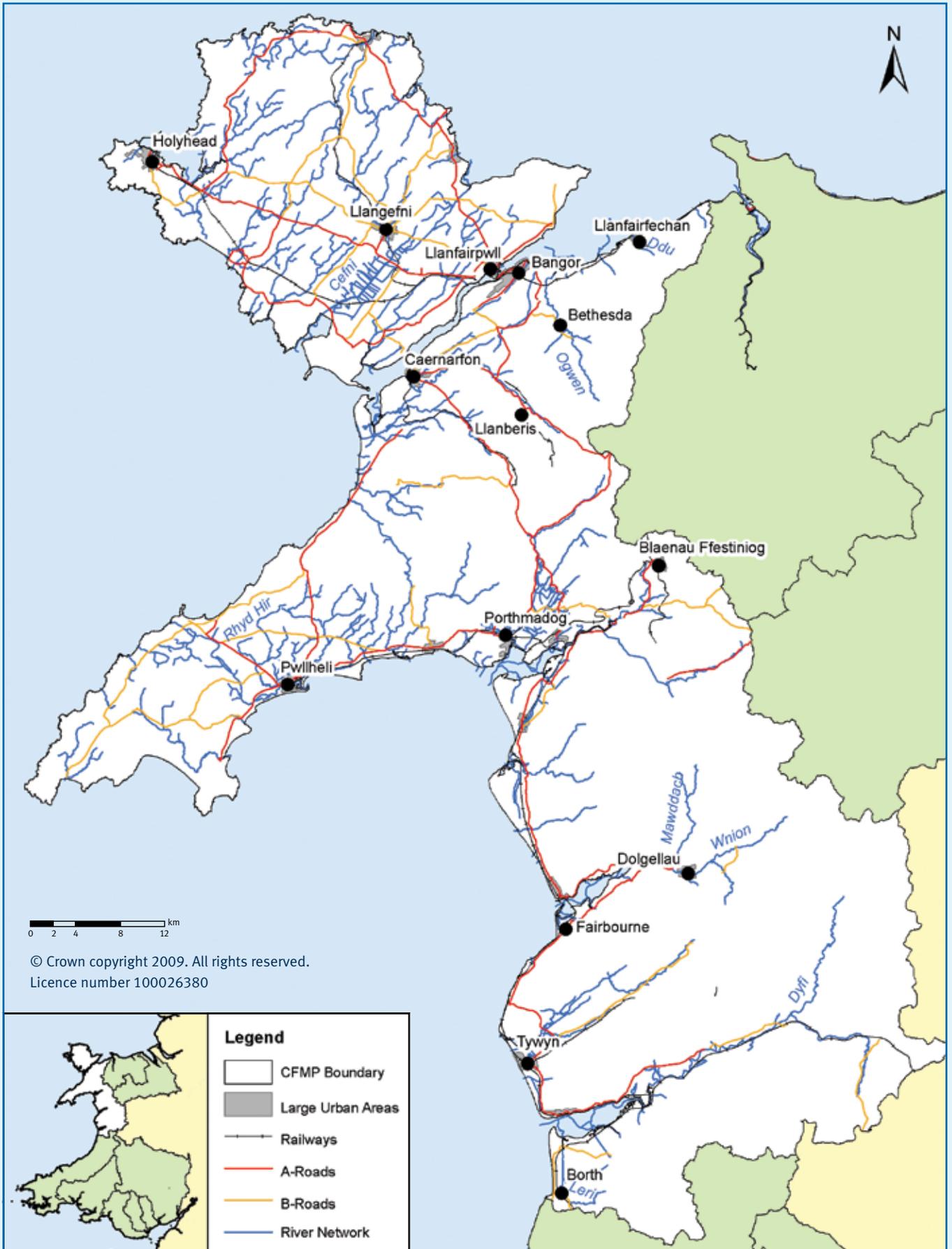
There are 277 international designated sites, over 200 Sites of Special Scientific Interest, three World Heritage Sites and 17 Historic Landscape Areas within this CFMP. Of particular note is the Cors Fochno (Borth Bog) which is the most intact lowland raised bog in Europe. The national, European and international importance of this site is reflected in its multiple environmental designations.

“We must learn from the past so that present and future flood risk management addresses the consequences of flooding.”



↑ River Dyfi Bridge, summer 1963

Map 1. Location and extent of the North West Wales CFMP area



Current and future flood risk

Overview of the current flood risk

Flood risk is the combination of two components; the likelihood (or probability) of a particular flood event occurring and the consequence (or impact) that the flood event would have if it occurred.

The probability of a flood event is the likelihood of a flood of that size occurring within a one year period. It is described as an annual exceedance probability (AEP) and is expressed as a percentage. For example, a 1% AEP flood event has a one per cent chance or 0.01 probability of occurring in any one year.

Unless otherwise stated, numbers in this report are based on the 1% AEP river flood event. More extreme events can occur at any time. The likelihood of an extreme event occurring is small, although the consequences are potentially very serious, particularly where defences could be overtopped.

The CFMP area has a long history of flooding. The most recent flooding to affect this area includes; widespread severe flooding in October and November 2000 affecting the whole CFMP area and an isolated storm in July 2001, which caused the worst flooding to the Mawddach Valley in living memory.

The sources of flood risk are:

- **river flooding** is the dominant source of flooding and occurs throughout the catchment.

The steep slopes of the mountainous areas result in rapid run-off and quick responses to heavy rainfall. Based on local knowledge and anecdotal evidence some of the locations that have experienced flash flooding include: Beaumaris, Caernarfon, Llanberis and Llanfairfechan;

- **tidally influenced river flooding** on rivers presents a particular risk in Pwllheli, Bangor, Llanfairfechan, Porthmadog, Fairbourne, Tywyn and Borth;
- **surface water flooding** is experienced at varying locations catchment wide. Locations have been identified based on limited and anecdotal evidence and include Bangor, Caernarfon and Pwllheli;
- **sewer flooding** has occurred in Llangefni, Pwllheli, Bangor, Caernarfon, Porthmadog, Dolgellau and Machynlleth. Our evidence of this type of flooding is not comprehensive and will require further work with our partner organisations to reveal the level of actual risk from this source of flooding;
- **groundwater flooding** is not considered to be significant source of flooding across the catchment although there may be local issues.

What is at risk?

CFMPs assess how flood risk is likely to change in the next 100 years. They do this at a strategic level and not at a detailed, local level.

We used computer models to simulate river flows and produce indicative numbers of properties, infrastructure and environmental features at risk. These models take in to account the benefit of current flood defences. Where applicable, tidal influences on river flows have also been modelled. Where models are not available we have based our flood risk estimates on our Flood Maps, which do not include flood defences. Numbers produced are sufficient for the purposes of the CFMP only.

It is estimated that a 1% AEP river flood event, could place approximately 4,500 properties at flood risk if the event occurred across the whole CFMP area.

Flooding has some impact on infrastructure across the whole area, for example, in Bangor and Porthmadog where there are a number of electricity sub-stations, a police station and a fire station at risk.

It is difficult to assess the impact of flooding on environmental features with certainty. Of the 277 environmentally important sites in North West Wales, 172 are affected by flooding from a 1% AEP flood event. Depending on the nature of the environmental

feature, flooding may have a negative or positive impact. For example, flooding may create or enhance a habitat in some areas e.g. a new flood storage wetland, or have the potential to cause physical damage to the historic environment e.g. listed buildings and scheduled monuments.

Where is the risk?

To assess flood risk at a strategic level we have identified a number of key locations where we have carried out a more detailed analysis of flood risk. These are presented in Table 1 and Map 2. This is not an exhaustive list of locations. Flood risk in all other areas has been considered in the development of the CFMP.

Almost a third of all properties at risk in North West Wales CFMP are found in Borth, Porthmadog and Llanfairfechan, which are all to some extent affected by tidally influenced river flooding. The communities of Pwllheli, Llanfairfechan, Fairbourne and Blaenau Ffestiniog show potentially a significant sensitivity to a higher 0.1% AEP flood event.

We recognise there is potential risk from surface water and groundwater flooding in some areas of the CFMP, however there is limited information currently available.

Table 2 lists some of the infrastructure currently at risk.

Table 1. Key locations currently at risk in a 1% AEP flood event

Number of properties at risk	Locations
> 1,000	None
500 to 1,000	Borth (tidal)
100 to 500	Bethesda, Llanberis, Llanfairfechan, Porthmadog, Abergynolwyn, Caernarfon, Fairbourne
50 to 100	Bangor, Dolgellau, Tywyn
25 to 50	Llanfairpwll, Pwllheli, Machynlleth

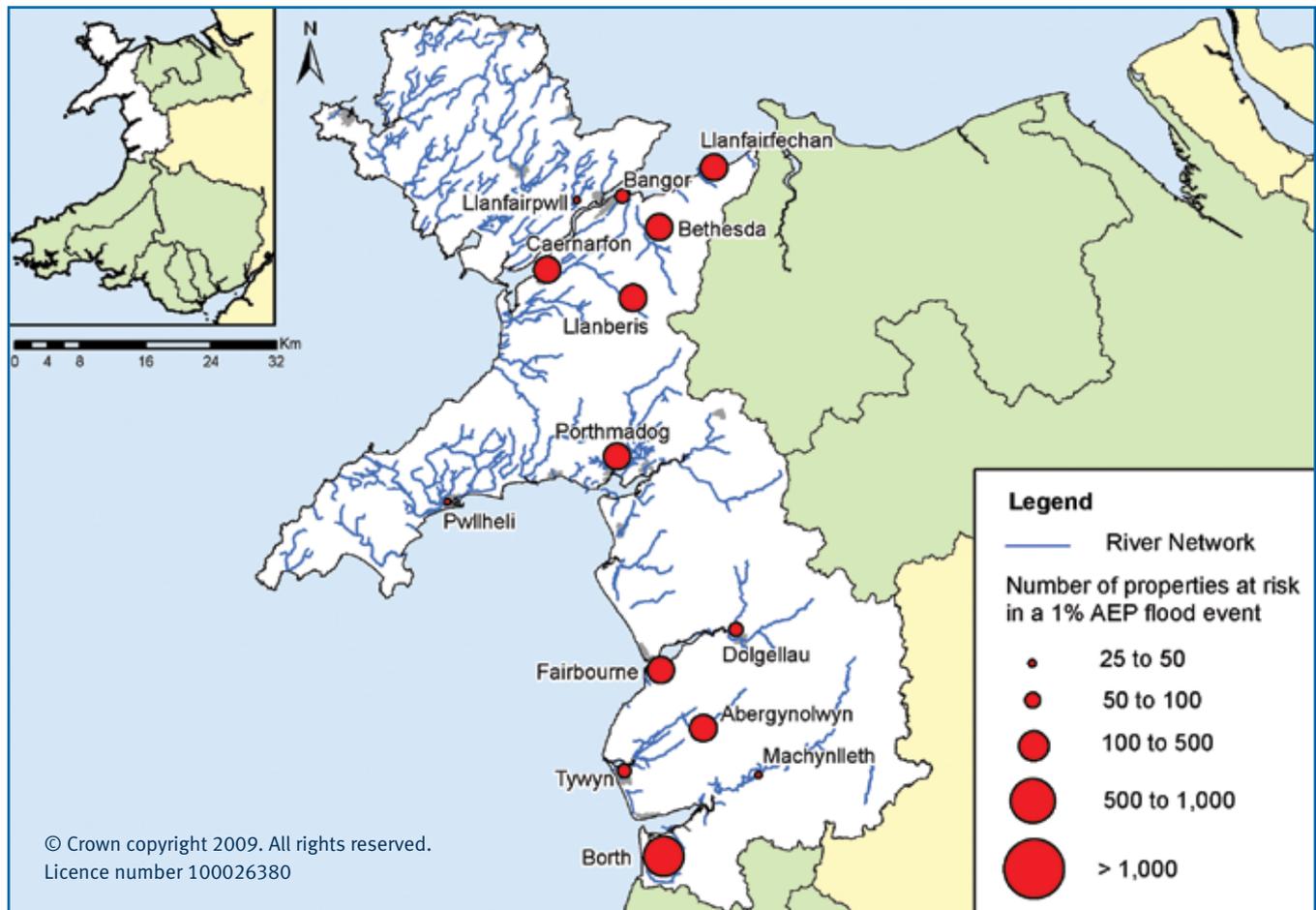
Table 2. Infrastructure currently at risk in a 1% AEP flood event

17 electricity power or sub-stations
9 emergency response centres
23 sewage / water treatment works
1 telephone exchange building
66 kilometres of main road



↑ Fairbourne behind the defences

Map 2. Number of properties currently at risk in a 1% AEP flood event



How we currently manage the risk in the catchment

We can split the work we do to manage flood risk into two types:

- work which helps us to reduce the likelihood of a flood occurring, and
- work which helps us to deal with the consequences of flooding.

In the past, we have focussed on reducing the likelihood of flooding by building flood defences. Other measures have been used but not as a primary response to flood risk. It is now widely recognised that managing flood risk to provide safe and sustainable communities will require more emphasis on the

management of the consequences of flooding. This will include:

- promoting awareness of flooding so that organisations, communities and individuals are aware of the risk and are better prepared to take action in time of flood;
- providing flood warning services to those at risk, to enable them to take action;
- improved incident and emergency response by the emergency services and by those at risk from flooding;

- encouraging land use planning to take account of flood risk in determining the location, layout and design of new development;
- flood proofing properties and infrastructure to improve the resilience (reducing the damage from flood water) and the resistance (keeping water out) to avoid harm.

In this CFMP area, current flood risk management is mainly reliant on flood warning, development control and local defences at communities, for example Pwllheli, Porthmadog and Dolgellau.

Some of the ways in which we currently manage risk in the catchment include:

- **flood risk mapping and data management** (understanding the risks now and in the future);

Flood risk mapping is fundamental to understanding flood risk and managing it effectively.

A number of flood risk mapping studies have recently been undertaken in order to better understand flood risk and improve the quality of our Flood Maps. For example, we have recently made improvements to the Afon Adda and the Dyffryn Ardudwy Flood Maps.

- **strategic planning and development control** (managing future risk and adapting to climate change);

CFMPs and SMPs are an important part of strategic planning allowing us to look at a range of strategic measures. These include looking for opportunities to reduce run-off through better rural land management and restoration of floodplains through redevelopment of properties and infrastructure.

- **asset management and maintenance** (managing current risk);

We build, operate and maintain flood defences. The recently completed Afon Adda Flood Alleviation Scheme is one example where existing flood alleviation measures have been improved and upgraded to manage the current flood risk.

Numerous sections of river have been engineered to protect people and property

from flooding. Once constructed, these defences need to be maintained, such as those on the; Afon Cefni in Llangefni and those on the Afon Mawddach up to Llanelltyd and Afon Wnion incorporating Dolgellau.

There are nine Internal Drainage Districts (IDDs) in this area. These districts were established many years ago when flood defences and land drainage measures were required for particularly low lying areas of land. The IDD's vary from mainly agricultural areas such as Llanfrothen and Tywyn to those with significant urban areas such as the Mawddach and Glaslyn. The management of these areas is currently under review.

Maintenance procedures differ from catchment to catchment. In recent years maintenance works have reduced on many rivers in this CFMP area due to a changing focus from land drainage to risk management. The work we carry out includes: blockage and debris removal

from watercourses, asset inspection, management of flood storage areas and inspection and cleaning of grids and trash screens.

- **flood forecasting and warning** (flood event management);

We use the latest technology to monitor rainfall, river levels, tides and sea conditions and use this information to produce flood warnings. Communities such as Dolgellau (at risk of river flooding) and Fairbourne (at risk from coastal flooding) directly benefit from these services.

- **flood incident management** (responding to flooding events);

Emergency response to flood events is mainly co-ordinated through Civil Contingency arrangements and Local Resilience Forums.

Our role is to advise our partners through these arrangements. We support and participate in emergency response exercises.



↑ Malltraeth Marsh IDD, Afon Cefni, Anglesey

The impact of climate change and future flood risk

Future flood risk will be influenced by climate change, changes in land use (for example urban development) and rural land use management. Sensitivity testing identified that the main driver of change to future flood risk is climate change.

The following scenario was used to analyse future flood risk:

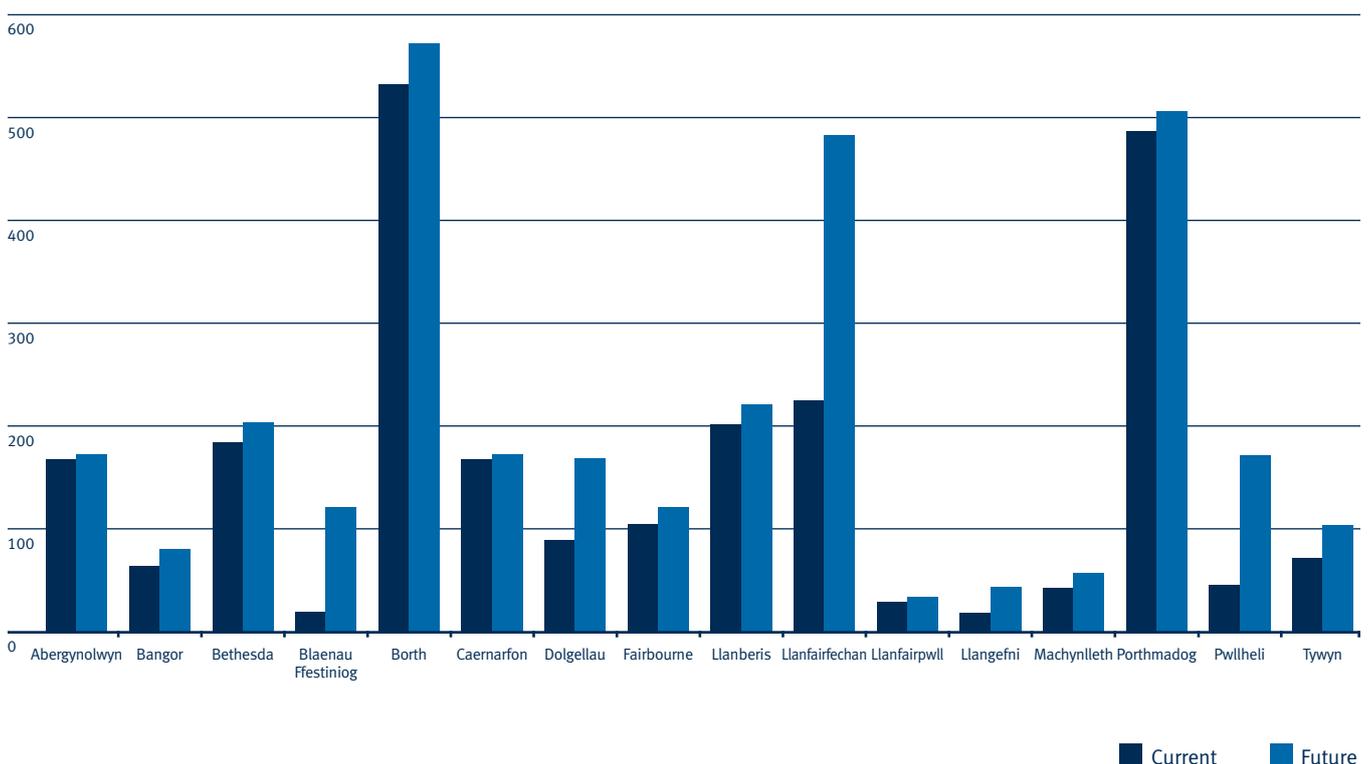
- 20 per cent increase in peak river flows in all watercourses;
- a total sea level rise of one metre by the year 2100.

Assuming the current level of flood risk management continues, we estimate that by 2100 the number of properties at risk from the 1% AEP flood event will increase, from approximately 4,500 to around 5,400 unless actions are taken to manage the increasing risks.

Figure 2 shows the difference between current and future flood risks from a 1% AEP flood event, assuming current management activities. The most significant increases in future risk occur in Llanfairfechan, Pwllheli, Dolgellau and Blaenau Ffestiniog.

Table 3 provides a summary of key locations at risk in the future. Future increase in flood risk tends to be largest in towns located near the mouth of rivers, or where the tidal influence travels inland up an estuary. This is where the effects of sea level rise and increased rainfall combine, resulting in more frequent, deeper and more extensive flooding in the future. The locations where this is likely to occur include Llanfairfechan, Pwllheli, Porthmadog, Borth and Tywyn in particular. There are also notable increases in the risk from rivers flooding in locations such as Llanfairfechan, Dolgellau, Blaenau Ffestiniog and Llangefni.

Figure 2. Current and future (2100) numbers of properties at risk from a 1% AEP flood event



In general the area of environmental sites affected by flooding in the future will increase. There is likely to be a 13 per cent increase in the area of environmental sites affected by flooding in the future. The specific impact upon sites is presently unknown. Detailed site specific assessments would be required to quantify this risk.

Flood risk to infrastructure will increase in the future. Table 4 shows the anticipated number of infrastructure affected in the future.

Table 3. Key locations at risk in a future (2100) 1% AEP flood event

Number of properties at risk	Locations
> 1,000	None
500 to 1,000	Borth (tidal), Porthmadog
100 to 500	Pwllheli, Bethesda, Caernarfon, Llanberis, Llanfairfechan, Abergynolwyn, Blaenau Ffestiniog, Dolgellau, Fairbourne, Tywyn
50 to 100	Bangor, Machynlleth
25 to 50	Llanfairpwll, Llangefni

Table 4. Infrastructure at risk in the future (2100) 1% AEP flood event

22 electricity power stations or sub-stations
12 emergency response centres
24 sewage / water treatment works
4 telephone exchange buildings
75 kilometres of main road
3 railway stations



↑ View of the Seiont from Caernarfon Castle

Future direction for flood risk management

Approaches in each sub-area

We have divided the North West Wales catchments into 11 distinct sub-areas which have similar physical characteristics, sources of flooding and level of risk. These sub-areas are presented in Map 3 below. We have identified the most appropriate approach to managing flood risk for each of the sub-areas and allocated one of six generic flood risk management policies. These are shown in Map 3 and Table 5.

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. Policy analysis and selection is based on flood risk across the entire CFMP area and not just the key locations referred to earlier.

Map 3. Sub-areas in the North West Wales CFMP

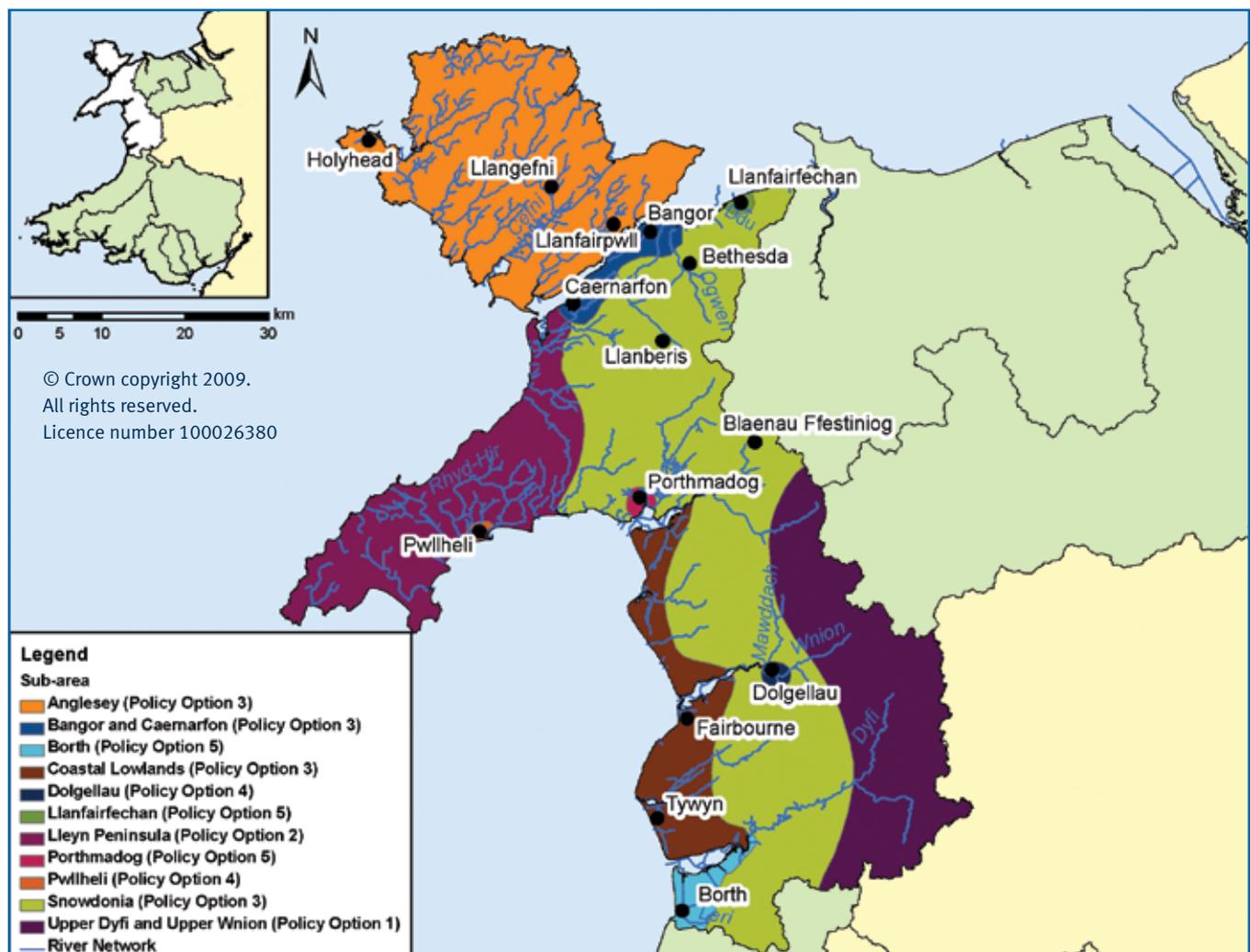


Table 5. Policy options

→ 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.

Anglesey

Our key partners are:

Isle of Anglesey County Council

Local communities

Landowners and managers

Countryside Council for Wales (CCW)

Emergency Services

Malltraeth Marsh IDD

Approximately 520 properties are currently at risk from the 1% AEP flood event, increasing to around 580 in the future.

Property and infrastructure are at risk in a number of small towns and villages including Amlwch, Llangefni, Beaumaris and Menai Bridge. The A5 and A55 Trunk roads are also at flood risk.

- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.

Actions to implement the policy include:

Review and rationalise our current actions to ensure they are appropriate and targeted to locations of greatest risk.

Encourage and support our partners to produce local long term plans to manage all sources of flooding, particularly at Llangefni, Llanfairpwll, Benllech and Amlwch.

Review the current flood risk management actions in the Malltraeth Marsh IDD area where expenditure at present is disproportionate to the flood risk.

Encourage and support an assessment by partners of potential flood risk from reservoirs on Anglesey.

Engage and advise the local community to encourage people at risk to take action to help themselves.

Encourage and support studies by partners to identify surface water and sewer flooding issues and management options.

Investigate potential for extending the present Flood Warning Project for Anglesey to Llangefni, Llanfairpwll, Benllech and Amlwch.

The issues in this sub-area

This area covers Anglesey including all the river catchments draining the island. The area is mostly rural and includes the towns of Llangefni, Holyhead and Amlwch. The natural floodplain of the lower Afon Cefni is land reclaimed from the sea and contains the Malltraeth Marsh IDD.

Across the island there is localised river flooding and some evidence of surface water and sewer flooding. Tidally influenced flooding of Malltraeth Marsh from the Afon Cefni can be extensive.

The vision and preferred policy

Policy Option 3 – areas of low to moderate flood risk where we are generally managing existing flood risk effectively.

Our vision is to ensure our actions are appropriate and proportionate to the risks, now and in the future.

We will continue to maintain our defences, but it may not be justifiable to replace them or to increase their height in the future. Our vision also includes:

- increased emphasis on actions to manage the consequences of flooding;



↑ Tidally influenced Afon Cefni at Pont Marie Powell

Bangor and Caernarfon

Our key partners are:

Gwynedd Council

Local communities

Dŵr Cymru Welsh Water

Emergency Services

The issues in this sub-area

This area includes the coastal belt to the south of the Menai Strait, including Bangor and Caernarfon, and extending inland to Pentir, Llanddeiniolen and Bethel.

Localised run-off with rapid onset of river flooding can occur in both Bangor and Caernarfon. The Afon Adda through Bangor and the Afon Cadnant through Caernarfon are engineered and culverted for large sections.

There is tidally influenced river flooding on the Afon Adda, Afon Cadnant and Afon Seiont. There is historic sewer and surface water flooding in Bangor and Caernarfon. Approximately 230 properties are currently at risk from the 1% AEP flood event, increasing to around 250 in the future. Properties and infrastructure are affected in Bangor and Caernarfon.

Flood risk in Bangor and Caernarfon is the result of a complex interaction of flooding sources. Extreme flood events could occur at any time and could have very serious consequences.

The vision and preferred policy

Policy Option 3 – areas of low to moderate flood risk where we are generally managing existing flood risk effectively.

Our vision is to ensure our actions are appropriate and proportionate to the risks, now and in the future.

Further work is required to better understand this risk. In the short term, we will continue with existing activities whilst we improve our knowledge of the flooding mechanisms. This will allow us to identify the most appropriate mix of actions to manage risk into the future. Our vision also includes:

- increased emphasis on actions to manage the consequences of flooding;
- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.

Actions to implement the policy include:

Encourage and support partners to carry out studies to develop a more detailed understanding of the flood risk from all sources in Bangor and Caernarfon. Climate change and tidal flooding should be included.

On completion of the above studies, review and rationalise our current actions to ensure they are appropriate and targeted to locations of greatest risk.

Encourage and support our partners to produce local long term plans to manage all sources of flooding. These should consider the future options and investment needs of the culvert systems.

Engage and advise the local community to encourage people at risk to take action to help themselves.



↑ Afon Adda flood storage area

Lleyn Peninsula

Our key partners are:

Gwynedd Council

Local communities

Landowners and managers

CCW

The issues in this sub-area

This area covers the Lleyn Peninsula to the borders of Snowdonia National Park in the east. The main towns and villages include Aberdaron, Abererch, Abersoch, Chwilog, Nefyn Criccieth and Llannor. The peninsula is mainly rural with scattered settlements and areas of locally important agricultural land. Most of the peninsula is designated as being environmentally important.



↑ Afon Rhyd Hir near Boduan

Approximately 320 properties are currently at risk from the 1% AEP flood event, increasing to around 370 in the future.

Flooding is characterised by localised areas of river and surface water flooding. The Rivers Soch and Rhyd Hir are influenced by tidal levels. The current flood risk is generally low and is not expected to increase significantly in the future, relative to other locations.

This is a large geographical area of dispersed properties and communities and therefore flood risk. Flood risk management activity is currently disproportionately high relative to the broad level of risk.

The vision and preferred policy

Policy Option 2 – areas of low to moderate flood risk where we can generally reduce existing flood risk management actions.

Our vision is to reduce the overall level of flood risk management activity over time. We will follow a risk based approach to rationalise our current activities and target our actions and limited resources to locations of greatest risk.

It may not be justifiable to continue to maintain our defences, to replace them or to increase their height in the future. Our vision also includes:

- increased emphasis on actions to manage the consequences of flooding;
- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.

Actions to implement the policy include:

Work with partners to determine how the policy of reducing actions is most appropriately communicated and implemented.

Support opportunities to store water or manage run-off to provide flood risk and environmental benefits, e.g. in the upper catchments.

Engage and advise the local communities to encourage people at risk to take action to help themselves.

Work with partners to investigate options for river restoration on the Afon Erch where increasing attenuation of floodwaters could contribute to flood alleviation downstream.

Encourage and support studies by partners to identify surface water and sewer flooding issues and management options.

Pwllheli

Our key partners are:

Gwynedd Council

Local communities

Dŵr Cymru Welsh Water

CCW

Emergency Services

Infrastructure owners and operators

The issues in this sub-area

This area covers the town of Pwllheli on the south coast of the Llyn Peninsula.

The area is mostly flat and low-lying and is vulnerable to tidally influenced flooding. Tidal influence on the outfall of the Afon Rhyd Hir and Afon Penrhos can restrict river outflows and result in overtopping



↑ Pwllheli with flooding from the Afon Penrhos

upstream. Pwllheli has a high number of historical sewer flooding incidents and surface water flooding is a problem.

Approximately 40 properties are currently at risk from the 1% AEP flood event, increasing to around 170 in the future. The main A499 trunk road is at risk of flooding. Significant flood risk management measures are already in place to manage river and tidal flooding.

In the future, sea level rise and expected increased storminess and wave action could potentially significantly increase the risk of flooding from the sea.

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.

We will continue to maintain our defences, but it may not be justifiable to increase their height in the future. We will seek a broader range of integrated actions to manage both current and future flood risks.

The outcome we seek is a complementary set of flood risk management actions by all partners at a local community level. These will include:

- increased emphasis on actions to manage the consequences of flooding from all sources;
- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.

Actions to implement the policy include:

Encourage and support our partners to produce local long term plans to manage all sources of flooding at Pwllheli. These plans should include an assessment of the consequences of flooding, including from overtopping of defences, and actions to manage these. They should consider future options and investment needs for defences, emergency planning and response, and development control issues.

Work with partners to investigate river restoration options on the Afon Rhyd Hir where increasing attenuation of floodwaters could contribute to flood alleviation at Pwllheli.

Investigate options to improve flood warning from the Afon Rhyd Hir.

Engage and advise the local community to encourage people at risk to take action to help themselves.

Flood risk management actions will inform and be informed by the West of Wales SMP review, currently being undertaken.

Snowdonia

Our key partners are:

Gwynedd Council

Powys County Council

Local communities

Snowdonia National Park Authority

Landowners and managers

CCW

Emergency services

Run-off from the mountains, causes localised surface water and rapid response flooding from rivers and streams. This affects towns and villages in the foothills, such as Llanberis, Waunfawr, Machynlleth and Bethesda. Snowmelt in winter can contribute to flooding. Localised sewer flooding is present.

Approximately 1,570 properties are currently at risk from the 1% AEP flood event, increasing to around 1,780 in the future.

Our vision also includes improved management of run off in the upper catchment areas to reduce flood risks downstream.

Actions to implement the policy include:

Review and rationalise our current actions to ensure they are appropriate and targeted to locations of greatest risk.

Encourage and support our partners to produce local long term plans to manage all sources of flooding, particularly at Llanberis, Bethesda, Blaenau Ffestiniog, Machynlleth and Abergynolwyn. These plans should include an assessment of the consequences of flooding, including from overtopping of defences, and actions to manage these. They should consider future options and investment needs for defences, emergency planning and response, and development control issues.

Engage and advise the local community to encourage people at risk to take action to help themselves.

Seek opportunities to store water or manage run-off to provide flood risk management and wider environmental benefits.

Encourage and support opportunities for land use and management change, which assist in achieving flood risk management and wider benefits.

The issues in this sub-area

This area includes most of Snowdonia National Park. The main communities include Llanberis, Bethesda, Blaenau Ffestiniog, Machynlleth and Abergynolwyn. The topography is dominated by the Snowdonia mountain range. Settlements are generally small and scattered across the area.

The vision and preferred policy

Policy Option 3 – areas of low to moderate flood risk where we are generally managing existing flood risk effectively.

Our vision is to ensure our actions are appropriate and proportionate to the risks, now and in the future.

We will continue to maintain our defences, but it may not be justifiable to replace them or to increase their height in the future. Our vision also includes:

- increased emphasis on actions to manage the consequences of flooding;
- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.



↑ Afon Mawddach flood debris

Porthmadog

Our key partners are:

Gwynedd Council

Local communities

Dŵr Cymru Welsh Water

CCW

Emergency Services

Glaslyn and Pencyflog IDD

The issues in this sub-area

This area covers the urban coastal area of Porthmadog and includes part of the tidally influenced Afon Glaslyn and the Afon Cyt. This area also includes part of the Glaslyn and Pencyflog IDD.

Flooding takes the form of tidally influenced river flooding, tide locking of the Cyt outfall, tidal flooding in coastal areas on the River Glaslyn and surface water and sewer flooding.

Approximately 480 properties are currently at risk from the 1% AEP river flood event, increasing to around 500 in the future. Properties and infrastructure in Porthmadog are all at risk from flooding.

Porthmadog is dependent on defences to prevent regular inundation from the sea. This is a heavily managed area, with a complex interaction of defences, flood sources and environmental features. In the future, sea level rise, increased storminess and potential additional development would considerably increase the flood risks.

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.

We will continue to maintain our defences, but it may not be justifiable or acceptable to increase their height in the future.

The outcome we seek is a complementary set of flood risk management actions by all partners at a local community level. These will include:

- increased emphasis on actions to manage the consequences of flooding from all sources;
- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.

Actions to implement the policy include:

Encourage and support our partners to produce local long term plans to manage all sources of flooding at Porthmadog. These plans should include an assessment of the consequences of flooding, including from overtopping of defences, and actions to manage these. They should consider future options and investment needs for defences, emergency planning and response, and development control issues.

Investigate options for installing demountable or temporary defences through Porthmadog to reduce the likelihood of flooding.

Engage and advise the local community to encourage people at risk to take action to help themselves.

Flood risk management actions will inform and be informed by the West of Wales SMP review, currently being undertaken.



↑ Porthmadog Harbour, Glaslyn Estuary, Llyn Bach and the Portmadog Cob sea defence

Coastal Lowlands

Our key partners are:

Gwynedd Council

Local communities

Landowners and managers

Dŵr Cymru Welsh Water

CCW

Network Rail

Emergency services

IDDs

The issues in this sub-area

This mostly rural area extends from the Afon Dwryd estuary in the North, along the low lying coastal strip as far as the outskirts of Borth (Sub-area 11). It includes the towns of Fairbourne, Tywyn and Barmouth. The area includes five IDD's.

Tidally influenced river flooding is a risk from the Afon Dyfi, Afon Dysynni, in Fairbourne, the Afon Henddol, and in the town of Tywyn.



↑ Coastal Lowlands viewed from Llyn Peninsula

The onset of flooding is rapid in Fairbourne, Llanbedr and Tal-y-Bont. Surface water flooding is more predominant in the mid-section of the area due to run-off from the mountains. Sewer flooding is a local issue in some of the urban areas.

Approximately 280 properties are currently at risk from the 1% AEP flood event, increasing to around 300 in the future. Property and infrastructure in the urban areas along the coast are at risk of flooding. Caravan parks and camping sites on the coast are also at risk. Flood risk management activity is currently disproportionately high, relative to the overall level of risk. This is partly due to the maintenance activity in the IDD areas.

Future risk to coastal communities, such as Fairbourne and Tywyn and coastal caravan and campsites, is expected to increase due to sea level rise and increased storminess and wave action.

The vision and preferred policy

Policy Option 3 – areas of low to moderate flood risk where we are generally managing existing flood risk effectively.

Our vision is to ensure our actions are appropriate and proportionate to the risks, now and in the future.

We will continue to maintain our defences, but it may not be justifiable to replace them or to

increase their height in the future. Our vision also includes:

- increased emphasis on actions to manage the consequences of flooding;
- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.

Actions to implement the policy include:

Review and rationalise our current actions to ensure they are appropriate and targeted to locations of greatest risk.

Encourage and support our partners to produce local long term plans to manage all sources of flooding, particularly at Tywyn and Fairbourne. These plans should include an assessment of the consequences of flooding, including from overtopping of defences, and actions to manage these. They should consider future options and investment needs for defences, emergency planning and response, and development control issues.

Review and rationalise the current flood risk management actions in the IDD areas.

Engage and advise local communities to encourage people at risk to take action to help themselves.

Flood risk management actions will inform and be informed by the West of Wales SMP review, currently being undertaken.

Dolgellau

Our key partners are:

Gwynedd Council

Local communities

Snowdonia National Park Authority

Dŵr Cymru Welsh Water

Emergency services

The issues in this sub-area

This area covers the town of Dolgellau located within the Afon Wnion Valley. Dolgellau is exposed to flooding from the Afon Wnion and Afon Arran. Rapid onset of river flooding is likely in this steep catchment. Surface water and sewer flooding have occurred in the town.

Flood defences currently reduce the likelihood of flooding to the town. The protection provided by the



↑ Sediment accumulation at Pont Fawr Dolgellau

defences is affected by sediment accumulation in the river channel. The likelihood of flooding is currently managed through frequent channel maintenance, at a high cost. Climate change will potentially have a significant impact on the flood risk.

Approximately 90 properties are at risk from the 1% AEP flood event, increasing to around 170 in the future. Property and infrastructure including the A470 North to South Wales trunk road and A49 are at risk from flooding.

Extreme flood events could occur at any time, either now or in the future. These have a low likelihood of occurrence but could have serious consequences.

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.

Defences will continue to have a dominant role in reducing the likelihood of flooding, but we will seek a broader range of integrated actions to manage the flood risks.

Our vision is to put in place an integrated, long term approach to flood risk management which places less reliance on frequent channel maintenance. Our vision also includes:

- increased emphasis on actions to manage the consequences of flooding;
- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.

Actions to implement the policy include:

Encourage and support our partners to produce local long term plans to manage all sources of flooding at Dolgellau. These plans should include an assessment of the consequences of flooding, including from overtopping of defences, and actions to manage these. They should consider channel maintenance issues, future options and investment needs for defences, emergency planning and response, and development control issues.

Encourage and support studies by partners to identify surface water and sewer flooding issues and management options.

Engage and advise the local community to encourage people at risk to take action to help themselves.

Investigate options to improve flood warning on the Afon Wnion to respond to climate change.

Upper Dyfi and Upper Wnion

Our key partners are:

Local Authorities and communities

National Park Authority

Landowners and managers

CCW

The issues in this sub-area

This area covers the upland section of the Afon Dyfi, Afon Wnion and Afon Prysor catchments. The area is rural with only a few small settlements and other dispersed properties.

There is little flood risk to property or infrastructure. Approximately 160 properties are at risk from the 1% AEP flood event in the present and future.

The risk is generally low and is dispersed amongst individual properties and hamlets. In the future climate change is expected to have little impact on the overall level of flood risk.

There is some potential that land management changes could result in both flood risk management and wider environmental benefits either locally or downstream, for example in areas of Snowdonia and Dolgellau.

The vision and preferred policy

Policy Option 1 – areas of little or no flood risk where we will continue to monitor and advise.

A flood warning service appropriate to this rural area is currently provided. We do not currently carry out any other planned flood risk management activities. Our vision is to continue with this approach into the future and not to carry out any significant planned flood risk management activity.

We would review this policy if future monitoring suggests that it is inappropriate.

Actions to implement the policy include:

We will continue to monitor and advise.

We will review our policy if monitoring suggests it is inappropriate.

We would encourage and support land use and management changes by others, where these deliver flood risk management and wider environmental benefits.



↑ Llyn Trawsfynydd with a view towards the distant Upper Dyfi

Llanfairfechan

Our key partners are:

Conwy County Borough Council

Local communities

Dŵr Cymru Welsh Water

Emergency services

The current scale of flood risk is high and additional risk will result if unmanaged, due to climate change.

Extreme flood events could occur at any time, either now or in the future. These have a low likelihood of occurrence but could have serious consequences.

- a reduction in constrictions to river flows over time;
- reduced reliance on in-channel maintenance to manage the flood risk over time;
- increased emphasis on actions to manage the consequences of flooding from all sources;
- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.

The issues in this sub-area

The Afon Ddu passes through Llanfairfechan, following a narrow steep valley down from the foothills of Snowdonia and into the sea. The coastal border is characterised by flat topography. This portion of the river is affected by the tide.

Approximately 220 properties are currently at risk from the 1% AEP river flood event, increasing to around 480 in the future. Flooding from the river can be rapid, deep and fast flowing. Surface water and sewer issues have contributed to the flooding of properties in the past.

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.

Managing the likelihood of current flooding is particularly dependent on the maintenance of the main channel flow capacity and the locally engineered river banks. The outcome we seek is a complementary set of flood risk management actions by all partners at a local community level. These will include:

Actions to implement the policy include:

Encourage and support our partners to produce local long term plans to manage all sources of flooding at Llanfairfechan. These plans should include an assessment of the consequences of flooding, including from overtopping of defences, and actions to manage these. They should consider future options and investment needs for defences, channel maintenance, emergency planning and response, and development control issues.

Engage and advise the local community to encourage people at risk to take action to help themselves.

Flood risk management actions will inform and be informed by the West of Wales SMP review, currently being undertaken.

Investigate potential options for introducing a flood warning area.



↑ Afon Ddu at Llanfairfechan

Borth

Our key partners are:

Ceredigion County Council

Local communities

Dŵr Cymru Welsh Water

CCW

Network Rail

Emergency services

The issues in this sub-area

This includes the coastal area between Borth and the Dyfi estuary and includes Borth town and the Cors Fochno Special Area of Conservation and Ramsar site.

Approximately 530 properties are currently at risk from the 1% AEP flood event, increasing to around 570 in the future. Caravan parks, camping sites, the railway line and Cors Fochno are also at risk of flooding.

Raised defences on the Afon Leri are predominantly made of earth, are extensive and if overtopped are likely to breach. These have breached in the past. We are considering the future options for these defences, in the context of the broader risks and issues of Borth and Cors Fochno.

This area has a complex interaction of defences, flood sources and environmental features. In the future, sea level rise and increased storminess will considerably increase the flood risks.

- increased emphasis on actions to manage the consequences of flooding from all sources;
- increased community and individual awareness of their flood risks and adoption of actions both can take to help themselves.

Actions to implement the policy include:

Encourage and support our partners to produce a local long term plan to manage all sources of flooding at Borth. This plan should include an assessment of the consequences of flooding, including from overtopping of defences, and actions to manage these. It should consider future options and investment needs for the Afon Leri defences, impacts on Cors Fochno, emergency planning and response, and development control issues.

Engage and advise the local community to encourage people at risk to take action to help themselves.

Flood risk management actions must be informed by the findings of the West of Wales SMP review, currently being undertaken.

Investigate potential options for introducing a flood warning area to Borth.

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.

We will continue to maintain our defences, but it may not be justifiable or acceptable to replace them, or increase their height in the future.

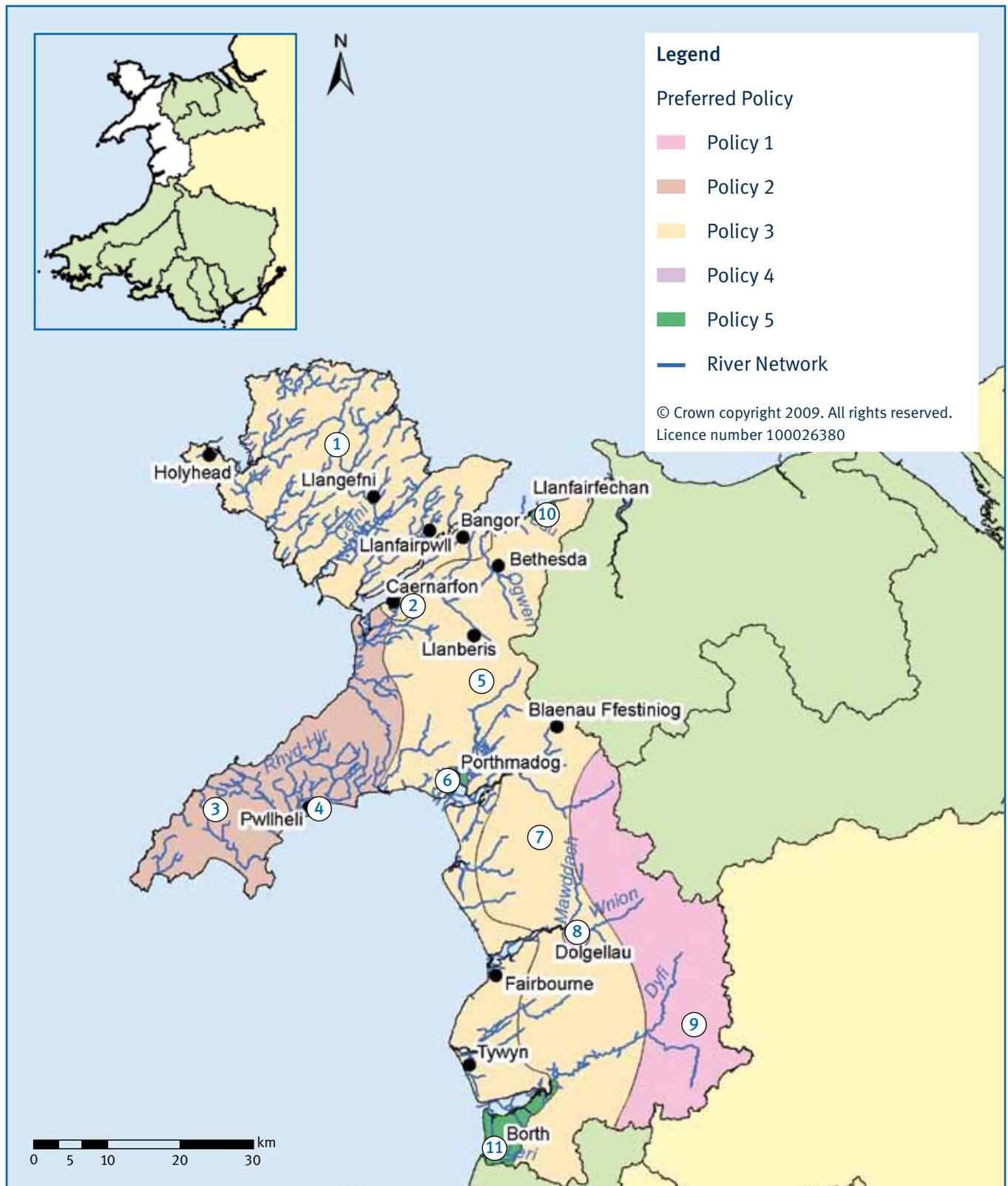
The outcome we seek is a complementary set of flood risk management actions by all partners at a local community level. These will include:



↑ Collapsed flood defence near Borth

This page is intentionally left blank.

Map of CFMP policies



■ Sub-area 1 – Anglesey

Flood risk is fairly low for the present and future. Where risk increases in the future this will be managed by reprioritising current flood risk management activities.

■ Sub-area 2 – Bangor and Caernarfon

Flood risk is low to medium for the present and future. Bangor and Caernarfon are at risk from a number of flood mechanisms and further assessment is required to understand future flood risk.

■ Sub-area 3 – Lleyn Peninsula

Flood risk is comparatively low and is not expected to rise significantly in the future. Through adopting different land drainage, management practices we would expect to be able to reduce reliance and expenditure on hard defences.

■ Sub-area 4 – Pwllheli

Pwllheli is at risk from a number of flood mechanisms and this risk will increase in the future. Sea level rise will have a significant impact on tidally influenced flooding here and we will require an integrated approach to manage the increase in risk.

■ Sub-area 5 – Snowdonia

Flood risk is fairly low for the present and future. This is a large area with some variation in levels of flood risk across its expanse. Where risk increases in the future in specific localities, this will be managed by reprioritising current flood risk management activities.

■ Sub-area 6 – Porthmadog

The current flood risk is high and climate change will increase the risk posed from both fluvial and tidal flooding mechanisms in the future. This community is vulnerable due to its coastal low lying location and management of flooding here requires an integrated approach to sustain and enhance the present management approach.

■ Sub-area 7 – Coastal Lowlands

Future flood risk from non tidally influenced sources alone are unlikely to increase significantly. Because this area is low lying, tidal influence is widespread and the combined mechanisms of flooding complex. Some specific risks will require addressing.

■ Sub-area 8 – Dolgellau

The present flood risk in Dolgellau is assessed as low to medium given regular and sustained levels of channel maintenance. Future flood risk due to climate change potentially increases the risk significantly. We will take action to address these issues.

■ Sub-area 9 – Upper Dyfi and Upper Wnion

Flood risk to property and infrastructure is low, now and in the future. As long as no inappropriate development takes place in the floodplain, management of flood risk here will require only the minimum application of resources.

■ Sub-area 10 – Llanfairfechan

Current and future flood risk is potentially high from flashy fluvial events. Climate change is likely to increase the flood risk to this community due to both increased river flows and higher tide levels. Present and future actions will be required to manage the flood risk at an appropriate level.

■ Sub-area 11 – Borth

The potential flood risk to property, infrastructure and the Cors Fochno designated site from tidally influenced flooding both now and in the future is significant. Further action will be required to reduce this risk, both now and in the future.

**Would you like to find out more about us,
or about your environment?**

Then call us on

08708 506 506* (Mon-Fri 8-6)

email

enquiries@environment-agency.gov.uk

or visit our website

www.environment-agency.gov.uk

incident hotline 0800 80 70 60 (24hrs)

floodline 0845 988 1188

*** Approximate call costs: 8p plus 6p per minute (standard landline).
Please note charges will vary across telephone providers.**



Environment first: Are you viewing this on-screen? Please consider the environment and only print if absolutely necessary. If you're reading a paper copy, please don't forget to reuse and recycle if possible.