22. UNITED KINGDOM

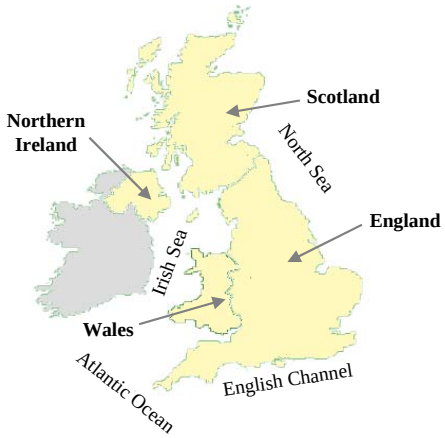
This country fiche provides a comprehensive overview and assessment of climate change adaptation in the United Kingdom. After detailing the vulnerability of the United Kingdom's coastal zones, the responsibility and financing for coastal protection is explained. Next, the fiche presents the relevant research activities, the coastal defence, risk reduction and adaptation plans available in the United Kingdom as well as the current and future protection and adaptation expenditure[1]. The persons contacted and sources of information are listed at the end.

22.1. VULNERABILITY OF UK'S COASTAL ZONES TO CLIMATE CHANGE

The UK has the longest coastline of Europe, measuring 17 381 km and is surrounded by the Atlantic Ocean, the North Sea, the English Channel and the Irish Sea. The country is divided into four devolved administrations: England, Wales, Scotland and Northern Ireland. *Figure 22-1* provides an overview of these 4 administrations and the main physical and socio-economic indicators of the coastal zones of the UK.

[1] All expenditures in British Pound were converted to Euro using the average exchange rate between 1999-2008 of 0.672617.

Figure 22-1: Administrations of the UK and an overview of the main physical and socio-economic indicators of the coastal zones



Physical and socio-economic indicators	*Atlantic Ocean*	*North Sea*
Sea Level Rise	High	High
Coastline length	17 381 km	
10 km coastal zone below 5 metres elevation	10-15%	
Coastline subject to erosion	3009 km (16%)	
GDP in 50 km zone (€ million)	1 090 342 (69%)	
Population in 50 km zone	46 565 867 (78%)	

Source: Policy Research based on EEA, 2006, The changing faces of Europe's coastal areas (for Sea Level Rise and 10 km coastal zone below 5 metres elevation); European Commission (Eurosion study), 2004, Living with coastal erosion in Europe: Sediment and space for sustainability (for coastline length and coastline subject to erosion); Eurostat 2004 (for GDP and population in 50 km zone)

The following paragraphs discuss the main climate change risks for the coastal zones of the UK. Erosion and increased severity of storm events pose the greatest threat, especially in England and Wales.

a/ Flooding and erosion

The coastline of the UK is characterised by erosion patterns, alternated with stable segments and areas subject to accretion. Hence, Sea Level Rise (SLR) and increased storminess have different implications depending on the nature of the coast and the current regime of erosion, stability or accretion.

The erosion-accretion pattern is mainly due to the coastal management strategies used in the mid-20th century which did not consider long-term impacts of hard engineering defence works. Hard coastal defences aimed to stop erosion in one place often disrupt the natural sediment drift and lead to an exacerbation of erosion somewhere else. This is especially prevalent around the south and east of England.

Wales is not as vulnerable to coastal erosion as *England*, as most of the coast is hard cliff, but it is vulnerable to SLR. The greatest threat is the over-topping of current sea defences. The current expectation in Wales is a 1 m SLR over the next 100 years. The most vulnerable coastal areas include the low-lying coastal area in northern Wales which is highly populated as well as the southern coastline where large communities are at risk from flooding due to SLR and increased storminess.

Most of the *Scottish coast* is not vulnerable to erosion or tidal flooding as many areas experience an isostatic land uplift. Nevertheless, an increase in the number and severity of storms could pose a potential threat as a large proportion of the Scottish population lives in close proximity to the sea.

Also in *Northern Ireland* coastal erosion is currently not perceived as a major problem due to the nature of the coastal geology and the water currents. The vulnerability of the region to flooding is currently being evaluated.

b/ Freshwater shortage

In general the UK will not suffer from the same water stress as the southern areas of Europe. Nevertheless, changes to annual precipitation patterns, an increase of rainfall in winter and a decrease in summer, may affect surface and groundwater recharge across the UK and generate the need for adaptation.

In this regard, the Environment Agency in England commissioned a study on *'The potential cost of climate change adaptation for the water industry'* in 2007. The report states that the assumed flow reductions due to climate change compared to the current water quality status would generate an incremental cost in present value terms of € 178 million to € 550 million.

c/ Loss of coastal eco-systems

The UK has many coastal wetlands of high ecological value which are often located in front of hard coastal defences. With a rise in sea level, hold the line policies for areas of economic importance may lead to 'coastal squeeze' as protection measures in combination with accelerated SLR will reduce buffer areas in front of the defences. This may affect RAMSAR sites[2], Special Protected Areas[3] and a wide variety of sand dune systems as well as salt marsh habitats.

Implementation of the Water Framework Directive[4] and the Habitats Directive[5] in the UK aims to ensure that habitat relocation associated with coastal squeeze and development is anticipated in coastal planning. Furthermore, Shoreline Management Plans need to include strategic environmental assessments to guarantee that environmental considerations are taken into account.

---

2 RAMSAR sites are areas taken-up in the 'List of Wetlands of International Importance' in respect of the Convention on Wetlands signed in Ramsar, Iran in 1971; the sites include amongst others swamps and marshes, lakes and rivers, wet grasslands and peatlands, oases, estuaries, deltas and tidal flats, near-shore marine areas, mangroves and coral reefs.

3 Special Protected Areas are strictly protected sites classified in accordance with the EU Birds Directive of 1979.

4 Directive 2000/60/EC of 23 October 2000 on establishing a framework in the field of water policy.

5 Council Directive 92/43/EEC of 21 May 1992 on nature conservation.

The report '*England Biodiversity Strategy – Towards adaptation to climate change'*, published by Defra[6] in 2007, recommends that policy and management should allow eco-systems to respond and adapt naturally.

22.2. RESPONSIBILITY AND FINANCING FOR COASTAL PROTECTION AND CLIMATE ADAPTATION

In the UK, the government has no legal obligation to provide flood and sea defences but a range of permissive powers do exist within the different administrations. Responsibilities for defending the coast have been divided furthermore into two categories:

- Coastal protection: coastal erosion or inundation leading to permanent occupation of the land by the sea;
- Sea defence: temporary sea or tidal flooding incidents.

Table 22-1 provides an overview of the responsible bodies within the different UK administrations: England, Wales, Scotland and Northern Ireland. No overall funding mechanisms for climate adaptation in coastal zones are at hand. UK administrations deal with this independently.

Table 22-1: Responsible bodies of the 4 administrations

Administration	*Responsible bodies*		
	Policy	*Planning and implementation*	*Funding*
England	Department for the Environment, Food and Rural affairs (Defra)	Environment Agency, local authorities	*Capital projects*: Environment Agency, local authorities *Maintenance*: Environment Agency, local authorities, private landowners
Wales	Welsh Assembly Government (WAG)	Environment Agency, local authorities	*Capital projects*: WAG, local authorities *Maintenance*: Environment Agency, local authorities, private landowners
Scotland	Scottish Government (SG)	Local authorities	*Before 2008*: 80% funded by SG *As of 2008*: Local authorities, private landowners
Northern Ireland	Northern Ireland Executive	Rivers Agency	Local authorities, private landowners

[6] Defra is the Department for the Environment, Food and Rural Affairs of the government of England.

The *Department for Environment, Food and Rural Affairs (Defra)* has overall policy responsibility for flood and coastal erosion in England. The Environment Agency and local authorities[7] on the other hand, have full responsibility to build and design their defences[8] with guidance provided by Defra. *Regional Flood Defence Committees* (RFDCs) also play a role by overseeing the maintenance or improvement of sea and tidal defences as well as issues related to coastal erosion.

As to funding, Defra funds most of the Environment Agency flood management activities and provides grant aid to local authorities to support investments in capital infrastructure projects. These capital costs are funded on a 'project by project' basis from a central fund and are scored against national priorities to assess their suitability for funding. Local authorities are responsible for the maintenance cost and funds come from local authority budgets distributed by the Department of Communities and Local Government. The Environment Agency will cover the maintenance cost of the defence structures that fall under their respective responsibility.

The *Welsh Assembly Government (WAG)* provides a similar role in Wales as Defra does in England having the policy responsibility for flood and coastal defences. The local authorities provide protection from coastal erosion and contribute to flood protection, while the *Environment Agency* contributes to tidal or sea flood defence. Local authorities use their own funds for maintenance but also apply to WAG for the capital expense of schemes which are funded on a project-by-project basis. The Environment Agency receives financial support from WAG for defences as well as capital tidal or sea flood measures. As in England, there are Regional Flood Defence Committees, known as *Welsh Regional Flood Defence Committees.* They are supported by Local Flood Defence Committees responsible for determining the programme of maintenance and capital works carried out by the Environment Agency.

The *Scottish Government (SG)* is responsible for overseeing coastal protection and flooding policy in Scotland. Local authorities[9] carry out their own coastal protection works, subject to the approval of the SG. In the past, the SG has funded up to 80% of the capital building cost, but as of 2008 the local authorities have to fund all of their own work. As in the rest of the UK, coastal protection works are done under permissive powers and on private land, it is the owner's responsibility to manage and prevent erosion. Any proposed coastal defence work always requires the consent of the relevant local authority before implementation.

In Northern Ireland, the *Rivers Agency,* within the Department of Agriculture and Rural Development of Northern Ireland, provides and maintains sea defences[10]. A main difference between Northern

7 Maritime District Councils; 88 in England.

8 The Environment Agency and local authorities have permissive responsibilities for sea defences and coastal protection under the Coast Protection Act 1949, the Land Drainage Act 1991 and the Water Resources Act 1991.

9 Empowered via the Coastal Protection Act 1949.

10 These powers are granted under the Drainage Order 1973; there is no legislation that specifically relates to coastal erosion.

Ireland and the rest of the UK is that the local authorities do not have direct responsibility for coastal protection from flooding or erosion other than that the 'Bateman formula'[11] can be applied. According to this interdepartmental agreement, coastal protection works that are deemed necessary are carried out by the department or authority responsible for the asset at risk. When the need arises, the River Agency will undertake essential works which do not fall under the responsibility of other authorities.

22.3. RESEARCH TO THE UK'S VULNERABILITY TO CLIMATE CHANGE AND CLIMATE CHANGE SCENARIOS

In the UK, *the UK Climate Impacts Programme (UKCIP)* is the main research framework for climate change scenarios, mainly funded by Defra. In addition, Defra and the Environment Agency have a joint fund for flood and coastal erosion risk management research and development.

The UKCIP, set up in 1997, produces and regularly updates climate change scenarios[12] and analyses their impact for different sectors (e.g. coastal zones). The most recent scenarios were issued in 2002 (UKCIP-02) and new predictions are due at the end of 2008 (UKCIP-08). The UKCIP-02 scenarios are based on the four different IPCC emissions scenarios and for each scenario, the predicted change in future climate for the UK is calculated for three time-periods (2011-2040, 2041-2070 and 2071-2080). The last UKCIP update for coastal areas was made in February 2007.

The UKCIP predictions on climate change are adapted by Defra as guidance for shoreline management planning. In addition to SLR, Defra provides predictions on offshore wind speeds and extreme wave heights which need to be taken into consideration within any modifications to coastal and flood defences. Guidelines set out by Defra regarding SLR and related climate change issues will be updated following the UKCIP-08.

UKCIP is mainly funded by Defra. Defra provided € 5.2 million from 2005 to 2010. However, very little is focused on coastal areas as most of this theme is covered by the Hadley Centre and other partners (e.g. the Tyndall Climate Change Centre) and funded by the joint Defra/Environment Agency's Fund. Under this fund, it is estimated that 10-20% or € 0.4 to 1 million per year is dedicated to the coastal zones.

[11] The Bateman formula is a historic agreement detailing the procedure for executing essential coastal protection works.
[12] The climate change scenarios are based on the Hadley Centre's Regional Climate Model.

22.4. COASTAL DEFENCE, RISK REDUCTION AND ADAPTATION PLANS IN RELATION TO CLIMATE CHANGE

Although the responsibility for coastal defence is decentralised in the UK, policy initiatives relating to climate change adaptation of the different administrations are steered by overall UK guidelines and strategies. At operational level, the different administrations implement coastal protection and sea defence projects in line with generally agreed Shoreline Management Plans. In addition, dedicated strategies and measures are undertaken to protect hot-spot London.

22.4.1. INITIATIVES AT POLICY LEVEL

In the UK, there is no over-aching national plan or coastal defence policy. Nevertheless national policy initiatives exist such as the Climate Change Act 2008, the Marine Bill and the strategy document 'Safeguarding our seas'. Furthermore, the different administrations outline strategies and documents independently with regard to climate change and adaptation.

The Climate Change Act 2008[13] makes the UK the first country in the world to have a legally binding long-term framework to cut carbon emissions while at the same time creating a framework to adapt to climate change. As to adaptation, the act commits the UK government to carry out a UK Climate Change Risk Assessment. This assessment will inform all UK administrations about the risks of climate change and help them to set priorities for adaptation programmes. To complement the Climate Change Risk Assessment, the government is also planning to undertake an overall cost-benefit analysis of adaptation.

In addition, the UK has drafted a *Marine Bill*[14] highlighting climate change as a major threat to marine and coastal environments. The document should assist in adapting marine spatial planning to climate change.

The other piece of work that encompasses the UK as a whole is the '*Safeguarding our seas*'[15] strategy document which was drafted with the support of Defra, the Scottish Government as well as the Welsh Assembly Group. The strategy advises that climate change adaptation is considered in all coastal and flood defence plans.

Beyond this, coastal planning is generally the remit of the UK's devolved administrations which develop strategies and documents independently to deal with current and future risks. *Table 22-2* and

[13] The Climate Change Bill finished its passage through parliament on 18th November 2008, and was enacted by Royal Assent on 26th November; source: http://www.defra.gov.uk/environment/climatechange/uk/legislation.
[14] http://www.defra.gov.uk/marine/legislation/index.htm.
[15] Defra, 2002, Safeguarding our seas.

Table 22-3 provide an overview of the most important policy documents of each of the devolved administrations.

Table 22-2: Key policy documents of England and Wales

	England		*Wales*
Title	Making Space for Water Strategy	Future Water Strategy	Environment Strategy and Action Plan
Period	2004-onwards	2008-2030	2006-2026
Content	25 separate projects dealing with issues such as a holistic approach to managing flood and erosion, increasing resilience to flooding and achieving sustainable development	Encompasses all aspects of water management in England up to 2030; sets out a vision for flood and coastal risk including embedding risks in spatial planning and increasing public understanding	Highlights the risk of climate change to coastal flooding and erosion and sets out actions to identify and implement risk reduction measures

Table 22-3: Key policy documents of Scotland and Northern Ireland

	Scotland		*Northern Ireland*
Title	Seas the Opportunity Strategic Framework	Scotland Climate Change Adaptation Strategy	ICZM Strategy
Period	2005-onwards	1st consultation phase ended in October 2008, 2nd consultation phase will start in 2009	2006-2026
Content	Outlines the long term sustainability plan for maritime industries; recognises the impacts of climate change on the coast and seas and the need to understand impacts to be able to adapt	Identifies effective options to help reduce Scotland's vulnerability to the consequences of climate change and provides guidance to decision-makers	Highlights strategic issues for discussion concerning the coast including impacts of climate change and what approach should be taken (hard versus soft)

22.4.2. INITIATIVES AT OPERATIONAL LEVEL

At the operational level, Shoreline Management Plans set out the general policy to be followed when designing coastal protection measures. England and Wales are the most advanced, providing specific planning guidelines as well as dedicated funding opportunities for climate adaptation through the 'Adaptation Toolkit' and the latest proposal of Wales to the EU Convergence Programme.

a/ Shoreline Management Plans and Individual Schemes

The implementation of coastal protection and sea defence measures in the UK starts with the development of Shoreline Management Plans. These plans are not developed for a specific region or

county but cover a specific part of the UK coastline based on the natural boundaries of the coast. For the coastal segments covered, each Shoreline Management Plan provides guidelines on the main strategy option to be followed: hold the line, advance the line, managed re-alignment or no active intervention. In a second step, and in line with the respective Shoreline Management Plan, Individual Schemes are developed, detailing the exact measures to be undertaken along each coastal segment or even sub-segment.

Shoreline Management Plans (SMPs) are developed by dedicated Coastal Groups or Coastal Partnerships which are mainly composed of local authorities. Individual Schemes are presented to their local authorities for approval by whoever is responsible for the specific segment or sub-segment of the coast (e.g. private landowners or county councils). In England and Wales, local authorities in their turn put forward bids for funding to the central government, which are attributed against national priorities.

Table 22-4 provides an overview of the SMPs developed in the different UK administrations. The plans do not include additional or separate actions to account for 'climate change adaptation' but take into account predictions on Sea Level Rise (SLR) and storminess from UKCIP. Plans are valid for a period of approximately 10 years[16]. In addition cost-benefit analyses are considered within England's SMPs and are a feature of the guidelines provided on planning policy by Defra. A cost-benefit analysis is undertaken to decide on the most suitable management options for the shoreline.

Table 22-4: UK Shoreline Management Plans

<table>
<tr><th></th><th>England and Wales</th><th>Scotland</th><th>Northern Ireland</th></tr>
<tr><td>Who produces the plans?</td><td>7 Coastal Groups</td><td>7 Coastal Partnerships</td><td rowspan="6">No past or current plans, future plans may be developed under the EU Flood Directive</td></tr>
<tr><td>No of SMPs</td><td>36</td><td>3</td></tr>
<tr><td>Verification</td><td>Guidance by Defra (for Wales WAG is also involved)</td><td>Guidance by Scottish government (based on Defra guidelines)</td></tr>
<tr><td>Protection level</td><td>Max 1:300</td><td>Not defined</td></tr>
<tr><td>Climate change scenarios used</td><td colspan="2">Scenarios produced by the UKCIP, based on IPCC scenarios
Predictions on offshore wind speeds and extreme wave heights provided by Defra</td></tr>
<tr><td>Protection against</td><td>Flooding & erosion</td><td>Flooding & erosion</td></tr>
</table>

In considering the entire process from developing Shoreline Management Plans to the implementation of concrete protection measures, England and Wales set the example.

[16] Due to the introduction of the Water Framework Directive the duration of the SMPs might also be reorganised to coincide with the 6 (or 12) yearly deadlines of the Directive.

In 1998, so called first generation Shoreline Management Plans were created for 36 stretches along the coasts of *England and Wales* by dedicated Coastal Groups. A strategic review by Defra rationalised the Coastal Groups into 8 regions in 2006 and provided guidelines for second generation Shoreline Management Plans (26 in total) due to be completed by 2010 for England and 2011 for Wales. In contrast to the first generation of plans, the second ones will be reviewed by the Environment Agency to ensure uniformity in the documents and will develop a 25-year investment strategy into them. Furthermore, the Environment Agency will work closely together with the local authorities to produce work plans and timetables. This new generation of plans takes more account of nature protection issues and will have stronger links with regional development plans. To date, three 2nd generation plans have been completed already.

In *Scotland*, only three Shoreline Management Plans have been prepared to date for some parts of the Scottish coast. These were developed 5 to 6 years ago in a bid to secure funds from the Scottish government for coastal protection works. Their development was based on the Defra guidelines produced for the 1st generation plans.

In *Northern Ireland*, no Shoreline Management Plans are developed to date. Ad-hoc measures are undertaken to protect the coastline against flooding and erosion.

b/ Dedicated climate change initiatives in England and Wales

England and Wales also set the example with respect to climate change initiatives.

Defra is developing a climate change adaptation toolkit to assist communities where coastal defences are no longer appropriate. This toolkit includes the possibility for giving communities financial support if managed retreat is the required option[17]. Up to € 42 million has been allocated for this over the period 2008-2011[18]. The adaptation tool kit will put climate change at its core and look at ways to reduce damages caused by floods and coastal erosion.

Wales has recently submitted a proposal to the EU Convergence Programme for € 90 million to carry out a number of climate change adaptation projects. These projects should mainly assist in broadening the current approach to address flood-risk and will propose improvements to current flood defences, primarily within coastal regions.

[17] An example is the 'Roll back' approach which allows caravan parks to 'roll back' as the land slips into the sea.
[18] The total budget is distributed as follows: € 2.9 million in 2008, € 11.9 million in 2009 and € 26.8 million in 2010.

22.4.3. HOT-SPOT LONDON

In August 2008, the Mayor of London published the preliminary *'London Climate Change Adaptation Strategy'*. The strategy outlines the potential climate change effects for the city of London and prioritises the actions needed to prepare London for the impacts of climate change and extreme weather events. Subjects covered include flood-risk, drought, heat waves, environment, health, infrastructure and economy. The strategy is currently open for consultation with the Greater London Authority. A revised version will be published for public consultation in the course of 2009.

From an operational point of view, the most famous example of a structure designed to manage the threat of extreme weather in the UK is the *Thames Barrier Structure*. The Thames estuary is particularly vulnerable to tidal flooding due to the high population density and GDP at risk. Moreover, it is estimated that 75% of UK property lies within the Thames tidal floodplain. Flood-risk increases as a result of SLR, increased rainfall and tidal ranges as well as more frequent and intense storm events. In addition, the south-eastern tip of the British Isles is gradually 'sinking'. Previous investment into flood protection took place in the 1970s and 1980s. The Thames Barrier Structure was constructed in 1984 at a cost of € 795 million and is a key part of this defence designed to provide protection until 2030.

The *Thames Estuary 2100* project of the Environment Agency aims to develop a longer term tidal flood-risk management plan for the Thames estuary. Using the latest climate change scenarios and models, and taking account of future SLR, the final plan will recommend what flood-risk management measures will be required as well as where and when they will be needed.

The Thames Estuary 2100 plan will contain a short, medium and long term action plan and will be developed in such a way that it can be adapted to further accelerations in SLR or more intense storm surges. Based on current climate change predictions for the Thames at the end of the century (94 cm increase above maximum water levels of today), flood management could continue utilising existing assets (flood defences and barriers) with some renewal and replacement in areas until around 2070. Longer term options that are currently being considered include:

- *Hard measures*: adapting the Thames Barrier, deepening the channel, rural storage of water, flood walls & embankments, development of an Outer Estuary Barrier and narrowing the river;
- *Soft measures*: management re-alignment, land use management, and adapted spatial planning and building regulations.

The Thames Estuary 2100 plan will be delivered to the government early 2010, following public consultation in Spring 2009.

22.5. PAST, PRESENT AND FUTURE ADAPTATION EXPENDITURE

In 2008 the UK has spent close to € 104 million to protect the coastal zones against flooding and erosion. This amount includes the maintenance, capital as well as indirect expenditure of the four devolved administrations. The majority of this amount, € 87 million, comes from England.

The annual coastal protection expenditure is expected to rise in the future with the implementation of the Thames Estuary 2100 plan. Although the plan has not been finalised yet, it will provide the basis for future government spending on flood management. The implementation cost set out in the plan will be included in the long-term investment strategy which the Environment Agency develops to prioritise and direct future investment. The investment recommendations presented in the preliminary version are:

- Between 2010 and 2035: close to € 1.49 billion
- Between 2035 and 2075: close to € 4.46 billion
- Towards 2100: estimates range between € 2.97 billion and € 29.73 billion due to the uncertainty in the options and actions required.

In total, the UK will have spent almost € 2.1 billion to protect its coasts from flooding and erosion over the period 1998-2015. Detailed information on the current and future protection and adaptation expenditure can be found in *Table 22-5*.

Table 22-5: Expenditure to protect against coastal flooding and erosion *(in € million)*[19]

Year	CAPITAL & MAINTENANCE EXPENDITURE				INDIRECT EXPENDITURE*****		HOT-SPOT PROTECTION	**TOTAL**
	*Northern Ireland**	*Scotland***	*Wales****	*England *****	*Wales*	*England*	*Thames******	
1998	1.20	0.74	7.33	45.51	0.30	1.19		56.27
1999	1.20	0.74	5.12	47.13				54.20
2000	2.51	0.74	4.96	48.94				57.16
2001	1.75	0.74	5.01	53.58				61.09
2002	1.04	0.74	4.89	62.47				69.15
2003	0.30	0.74	4.71	66.47				72.22
2004	0.40	0.74	5.98	72.23				79.35
2005	0.23	0.74	7.67	87.84				96.47
2006	0.25	0.74	6.98	86.50	0.30	1.19	5.94	101.90
2007	0.27	0.74	3.22	88.03	0.30	1.19	5.94	99.69
2008	0.53	0.74	8.03	87.18	0.30	1.19	5.94	103.91
2009	1.50	0.74	8.03	88.09	0.30	1.19	5.94	105.79
2010	0.96	0.74	8.03	100.95			59.47	170.15
2011	0.67	0.74	8.03	108.02			59.47	176.93
2012	0.78	0.74	8.03	115.58			59.47	184.59
2013	0.62	0.74	8.03	123.67			59.47	192.53
2014	0.44	0.74	8.03	132.32			59.47	201.00
2015	0.41	0.74	8.03	141.59			59.47	210.24
TOTAL	15.08	13.38	120.10	1556.08	1.49	5.95	380.58	**2092.65**
	1704.64				7.43			

* *Expenditure provided by the Irish Government*

** *Expenditure calculated by Policy Research based on the information that Edinburgh County Council spends € 148 000 per year on coastal protection and the estimation that 5 major coastal cities will be protected*

*** *Proxy provided by the Welsh Assembly Government and Welsh Environment Agency; Expenditure for 2009-2015 based on stakeholders' estimation that 15% of the total government budget for flood risk management will be dedicated to the coast*

**** *Proxy based on stakeholders' estimation that 10% of the total government budget for flood risk management is dedicated to the coast; for the years 2011-2015 expenditure is calculated based on the average increase in the expenditure in the previous years*

***** *Indirect expenditure includes the drafting of the first generation Shoreline Management Plans in the period 1995-1999 and the second generation Shoreline Management Plans in the period 2006-2009*

****** *Between 2006-2009, about € 23.76 million has been spent to draft the Thames Estuary 2100 plan; between 2010-2035, about € 1487.5 million is expected to be spent to upgrade the Thames Barrier; proxies provided by Environment Agency and equally divided by Policy Research over the period concerned*

[19] Exchange rate used (average exchange rate 1999-2008): 1 € = 0.672617.

22.6. PERSONS CONTACTED AND SOURCES OF INFORMATION USED

22.6.1. PERSONS CONTACTED

Name	*Organisation*
Aucott, Kathy	Environment Agency, Thames Barrier
Crossman, Matt	Defra - Capital Planning
Curtis, Bryan	Worthing County Council - Chair of Coastal Group Chairs
Dyke, Phil	National Trust NI
Fairgrieve, Rhona	Scotland Coastal Forum
Hamilton, Alan	Environment NI - Northern Ireland Coastal & Marine Forum
Hutchison, Jim	Environment Agency
Jones, Peter	Welsh Assembly Government
Martin, Jim	NI Rivers Agency
Rees, Sue	Natural England
Rennie, Alison	Defra - Sustainable Flood & Coastal Department, inc. Adaptation
Seaman, David	Scottish Government - Flooding Policy Unit
Steeds, Sarah	Defra - Institution reform & strategic approach to coastal risks

22.6.2. SOURCES OF INFORMATION USED

- Baxter J.M., Boyd I.L., Cox M., Cunningham L., Holmes P. and Moffat C.F. (Editors), 2008, *Scotland's Seas: towards understanding their State*, Aberdeen, Fisheries Research Services *(consulted in library)*
- De la Veigert A. C., Nicholls R. S. J., 2008, *Potential implications of sea-level rise for Great Britain*
- Department for the Environment (DoE), 2006, *An integrated coastal zone management strategy for Northern Ireland 2006-2026*
- Defra, 2000, *Flood and coastal defence project appraisal guidance economic appraisal: a procedural guide for operating authorities*

- Defra, 2001, *National appraisal of assets at risk from flooding and coastal erosion including the potential impact of climate change, final report*, Report produced by Halcrow Group Ltd, HR Wallingford and John Chatterton Associates
- Defra, 2002, *Safeguarding our seas*
- Defra, 2006, *Flood and coastal defence appraisal guidance FCDPAG3 economic appraisal supplementary note to operating authorities: climate change impacts*
- Defra, 2007, *England biodiversity strategy – towards adaptation to climate change*, Final report to Defra for contract CR0327
- Defra, 2008a, *Adapting to coastal change: supporting communities that may be affected by coastal erosion & flooding*
- Defra, 2008b, *Defra departmental report, Chapter 2: tackling climate change*
- Environment Agency, 2003, *Coastlines: an Environment Agency Anglian region publication*, Issue 1 April 2003
- Flood Management Division, 2004, *National assessment of defence needs and costs for flood and coastal erosion management*
- Glasgow City Council, 2003, *Flood prevention and land (Scotland) drainage act 1997 – 2003 statutory report*
- Hughes R. G., Paramor O. A. C., 2004, *On the loss of saltmarshes in south-east England and methods for their restoration*, Journal of applied ecology 41 p. 440-448
- ICF International & RPA, 2007, *The potential costs of climate change adaptation for the water industry*
- Klein R. J. T. and Nicholls R. J., 1999, *Assessment of coastal vulnerability to climate change*, Ambio 28 (2), p. 182-187 *(consulted in library)*
- Marine Climate Change impacts Partnership, 2008, *Marine climate change impacts – annual report card 2007-2008*
- National Trust Northern Ireland (NTNI), 2008, *Shifting shores: living with a changing coastline*
- Nicholls R.J. and Mimura N., 1998, *Regional issues raised by sea-level rise and their policy implications*, Climatic research vol. 11 p.5-18
- Runcie R. and Fairgrieve I., 1996, *A case study for the Marblethorpe to Skegness first phase beach nourishment*, in: Fleming C.A., *Coastal Management: putting policy into practice*, Thomas Telford *(consulted in library)*
- RYA, 2008, *Shoreline, flood & coastal defence management plans: environmental briefing 05/01*
- Scotland & Northern Ireland Forum for Environmental Research (SNIFFER), 2007, *Preparing for a changing climate in Northern Ireland*
- Scottish Executive, 2005, *Seas the opportunity*
- Scottish Government, 2007, *Recommendations of the advisory group on marine & coastal strategy: a follow up to seas the opportunity: a strategy for the long term sustainability of Scotland's coasts & seas*
- Smith A., 2000, *The Weather: The truth about the health of our Plane*, London: The Random House Group Ltd *(consulted in library)*

- UK Climate Impacts Programme (UKCIP), 2002, *Climate Change scenarios for the United Kingdom: The UKCIP02 briefing report*
- UK Climate Impacts Programme (UKCIP), 2005, *Measuring progress: preparing for climate change through the UK climate impacts programme*
- UK Climate Impacts Programme (UKCIP), 2007, *Updates to regional net sea-level change estimates for Great Britain*
- www.defra.gov.uk/environ/fcd/policy/strategy/sd4/default.htm, Making space for water
- www.defra.gov.uk/environ/fcd/policy/mtp/2007/ea.htm, Comprehensive spending review (Defra)
- www.ngfl-cymru.org.uk/cc-future-climate-in-wales.htm, Climate change in Wales
- www.scotland.gov.uk/consultations/planning/spp7-04.asp, Scottish planning policy
- www.scotland.gov.uk/Publications/2006/03/30091039/22, Scotland's climate change programme
- www.scotland.gov.uk/Publications/2004/07/19639/40169, A strategy for Scotland's coast and inshore waters
- www.sailcoast.eu/index.shtml, Sail project
- www.ukbap.org.uk/GenPageText.aspx?id=52, UK biodiversity action plan