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Management of third party flood risk assets and the Habitats Directive

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Background

There are 423 internationally important wildlife sites in England and Wales designated under the EU Habitats and Birds Directives and/or the Ramsar Convention (European Sites). Of these, 268 are to a lesser or greater extent within Flood Zones 2[1] & 3[2]. These must be protected and as a nation, we must take appropriate steps to prevent the sites from deteriorating. This legal requirement is reflected in Government policy. This says that there should be no question of the sites being allowed to deteriorate and that steps should be taken to protect them *in situ* where it is sustainable to do so. Where this is not possible, then we should recreate the designated interest in more sustainable locations.

The Environment Agency owns and/or manages over 33,400km of flood risk assets. Many of these are associated with European Sites. In many cases, the site would deteriorate without the assets and we are committed to managing them to protect the site. However, a large number of flood risk assets are owned or maintained by a private individual or organisation (third party). But the obligation arising from the Habitats Directive cannot be passed from Government to third parties, not at least without proper support and assistance.

So the aim of this project was to make a first estimate of:

i. the extent of third party owned and maintained assets in England and Wales,
ii. how many third party managed assets are required to protect European Sites, the nature of the assets, the standard of protection and their residual life,
iii. the costs of maintaining the assets required for the protection of European Sites,
iv. how many of the assets required may be having an adverse effect on site interest features,
v. the costs of providing the required habitat mitigation/ compensation should management of flood risk assets stop.

Once we know this, we can then make decisions about the best way to facilitate the management needed. This work makes no assumptions about who might be best placed to facilitate the asset management needed, or how.

It must be stressed that this work is a first attempt to work out the scale of the potential third party asset management needed. Inevitably, a number of assumptions had to be made. Also, it is constrained by the availability and

[1] Flood zone 2 identifies areas at risk of flooding from rivers between a 1 in 100 and a 1 in 1,000 chance of flooding in any year and for coastal areas between a 1 in 200 and a 1 in 1000 chance of flooding in any year

[2] Flood zone 3 indicates the areas of land with a 1 in 100 chance (or greater) of flooding each year from rivers and a 1 in 200 chance (or greater) of flooding each year from the sea

accuracy of data. For example, the accuracy of the National Flood and Coastal Defence Database continues to be improved. No doubt, the estimated costs of maintaining third party assets for nature conservation reasons can be refined (for example, the costs for habitat replacement are probably maximum estimates), and the costs model developed allows for the underling assumptions to be updated as new information becomes available. Overall, the estimates of costs represent a useful first indication of the possible costs involved.

Summary results

The overall cost of managing all third party assets linked to European Sites over the next 100 years is estimated to be £11.5 billion (lower estimate £2.6 billion: upper estimate - £35.3 billion). Including a factor to account for sea level rise, this increases the estimated cost to £12.9 billion.

These results equate to the following potential annual costs of managing third party assets associated with European Sites: assets within sites - in tidal floodplain = £21.8 million, in fluvial floodplain = £26.3 million; assets outside sites – in tidal floodplain = £24.1 million, in fluvial floodplain = £35.4 million.

In comparison, overall the Environment Agency currently spends in the region of £800 million a year on flood risk management.

Summary of asset management costs associated with European Sites	
Approximate number of assets listed in NFCDD	200,000 (88,300 km)
Number of assets managed by 3rd parties	122,600 (45,800km) (59%)
Number of assets managed by the Environment Agency	60,700 (33,400km) (29%)
Number of 3rd party assets lying within European Sites	6000
Number of 3rd party assets lying within 1km of European Sites	15,000
Number of European Sites in England with 3rd party assets	167
Number of European Sites in Wales with 3rd party assets	66
Present Value cost of managing 3rd party assets linked to European Sites over the next 100 years	£11.5 billion (between £2.6 and £35.3 billion)
Accounting for sea level rise, cost of managing 3rd party assets linked to European Sites over the next 100 years	£12.9 billion
Cost of managing 3rd party assets which lie within European Sites over the next 100 years	£4.9 billion (approx 46% are tidal defences)
Cost of managing 3rd party assets which lie outside European Sites over the next 100 years	£6.6 billion (approx 37% are tidal defences)

It should be noted that more than half the assets that have been associated with European Sites lie up to 1km away from the sites. These are likely to be less important (in some cases irrelevant) to the conservation management of the sites.

Some flood risk assets currently protecting European Site interest may at the same time be having a negative impact on other sites (for example, a seawall defending a coastal reedbed may be causing intertidal habitat loss due to coastal squeeze). Government policy is to protect sites *in situ* where it is sustainable to do so, and to recreate them elsewhere if it is not. The costs model can be used to estimate the potential costs of relocating sites which might not be considered sustainable as their continued protection by third party assets is causing damage to other sites.

Summary of habitat creation costs associated with third party assets relating to European Sites	
Number of European Sites in Flood Zone 2 and 3	192 in England & 76 in Wales
Number of European Sites linked to 3rd party assets which appear to be adversely affected by flood risk assets	35 (England & Wales)
Cost of replacing habitats that are linked to third party assets	£4 billion (minimum £0.88 billion)
Cost of replacing habitats that are linked to third party assets within sites	Approx £1.3 billion
Proportion of habitat relocation costs associated with intertidal habitats	>50%

Assumptions and uncertainties in estimating costs

The costs model calculator provides a first estimate of the likely future costs of third party asset management and habitat replacement involved in managing risk assets to secure the favourable condition of European Sites. As is the nature of such costing exercises, a number of assumptions were made. These include the following:

a) It was assumed that the current standard of protection provided by each asset is appropriate for the international site(s) to which it is linked. Whilst at some sites the standard of protection will be better than that required, at other sites the standard will be insufficient to meet conservation requirements. Natural England advise that for fluvial sites in particular, current standards of protection are likely to be significantly greater than that needed to secure favourable condition of the site.

b) A generic percentage uplift of 75% was applied to the management costs of all coastal asset types to account for changes in sea level rise. This was based on the assumption that accommodating climate change is likely to require an increase in costs of managing flood risk assets of between 10% and 20% over and above that required to meet indicative standards under present day conditions and a 35% to 85% overall increase in costs to meet indicative standards over the next 50 years.

c) In order to generate costs for habitat replacement it was assumed that the third party assets that are linked to the SSSI units are responsible for causing any detrimental effects.

The costs of relocating selected habitats associated with third party assets within sites		
	Tidal	Fluvial
Acid grassland - lowland		£1,018,214
Acid grassland - upland	£125,653	£295,215
Bogs - lowland	£1,530,062	£1,579,685
Bogs - upland		£56,907,698
Broadleaved mixed and yew woodland - lowland	£4,961,363	£11,393,160
Broadleaved mixed and yew woodland - upland	£1,877,995	£16,459,525
Calcareous grassland - lowland		£498,877
Calcareous grassland - upland		
Conifer		
Dwarf shrub heath - lowland	£79,934	£4,208,704
Dwarf shrub heath - upland	£4,908,002	£8,023,013
Fen marsh & swamp - lowland	£18,702,736	£6,433,759
Fen marsh & swamp - upland		
Improved grassland	£583,177	£2,538,219
Littoral sediment	£843,237,263	£16,061,125
Neutral grassland - lowland	£44,326,945	£22,353,488
Neutral grassland - upland		£492,278
Rivers and streams	£2,534,254	£36,496,745
Standing open water & canals	£23,576,317	£51,749,535
Supralittoral sediment	£39,722,214	

d) The costs of recreating habitats were taken from a range of sources. Uplift was applied to reflect 2008 prices. In addition to the replacement costs, it was assumed that land cost £6,672 per hectare (based on previous studies adjusted to 2008 process).

e) Habitat replacement costs do not include ongoing management costs, species relocation or dealing with habitat that is being replaced.

In addition to these assumptions, there are a number of key uncertainties in the quality and extent of input data. So there is potential for the costs to vary. To account for this, these uncertainties have been quantified to identify the likely effect that this may have on the total cost of asset management or habitat replacement. The uncertainties are:

a) The National Flooding and Coastal Defence Database (NFCDD) could over-estimate the number of assets maintained by third parties by up to 50%. So costs of managing assets by third parties could be 50% less.

b) A standard average height for each asset type was assumed for asset replacement costs as there was no consistent asset height data in the NFCDD. It is possible that a higher than expected proportion of assets have a height that is lower than the average in the unit cost database, so the costs may be overestimated by up to 20%.

c) Asset replacement costs in the cost calculator may need to increase by 60% to account for any optimism bias in the costs included in the unit costs database.

d) The number of third party assets indirectly linked to sites is likely to be overestimated because the only criterion used was whether the assets were within 1km of the site boundary. As there was no information on flood flow patterns and intervening landscape features between assets and sites, some assets may be included that actually have no effect on site condition. In fact, very few third party assets outside sites may affect the habitats within the sites. So the costs of managing assets that are indirectly linked to sites could be overestimated by up to 100%. As the cost of managing third party assets that are indirectly linked to international constitutes 43% of the total cost of managing assets that are both directly and indirectly linked to international sites, the total asset management costs may be overestimated by up to 43%.

e) Asset repair costs are based on a percentage of the replacement cost. So asset repair costs may need to increase by 60% to account for optimism bias in the unit cost database, from which the replacement costs are derived.

f) The potential delay in intervention by overrating the condition of assets would cause the overall asset management costs to be underestimated by around 20%.

g) The area of habitat to be replaced could be overestimated by up to 40% as the methodology calculates replacement costs for the whole SSSI unit linked to a third party asset.

h) Third parties assets may be linked to unfavourable SSSI units but impacts are actually caused by other asset managers rather than third party. So habitat replacement costs could be over estimated by as much as 20%

The overall highest and lowest possible costs for both asset management and habitat replacement have then been derived based upon the cumulative effects of the uncertainties upon the cost estimates.

Summary of uncertainties and quantified effects				
Cause	Cost may need to increase by factor of:	Cost may need to decrease by factor of:	Cumulative error increase	Cumulative error decrease
Number of assets maintained by 3rd parties	0.00	0.50	1.00	0.50
Height of assets used for costing	0.00	0.20	1.00	0.40
Unit cost of asset replacement	0.60	0.00	1.60	0.40
No. of assets indirectly linked to sites	0.00	0.43	1.60	0.23
Unit cost of asset repair	0.60	0.00	2.56	0.23
Year of intervention	0.20	0.00	3.07	0.23
Total error factor (asset management costs)			**3.07**	**0.23**
Number of assets maintained by 3rd parties	0.00	0.50	1.00	0.70
Area of habitat to be replaced	0.00	0.40	1.00	0.28
Number of assets detrimentally affecting sites	0.00	0.20	1.00	0.22
Total error factor (habitat replacement costs)			**1.00**	**0.22**
Note: orange shading denotes cells in the cost calculator that can be altered by the user				

1.0 Introduction

1.1 Background to the study

Most major estuaries and large inland water bodies in England and Wales are internationally important wildlife sites under the European Habitats Directive[3] and Birds Directive[4] or Ramsar Convention[5]. The UK Government has committed to take appropriate steps to prevent these sites from deteriorating. Flood management assets may be required, maintained and operated to prevent inappropriate flooding, but they can in some cases both have an adverse impact on internationally important sites (e.g. through coastal squeeze). Where assets are owned and/or maintained by us, the Environment Agency, these issues are well understood and this is usually the case where responsibilities lie with other competent authorities. However, the management of flood risk assets is often less clear where:

- the asset is owned and managed by a third party (defined in section 1.3 below);
- we currently manage the asset but choose to withdraw, thus passing responsibility for future management to a third party.

As a result, where management of third party owned/maintained assets is required to meet the obligations under the Habitats and Bird Directives, there is a risk that Government collectively could fail to meet its legal obligations should the third party landowner not carry out the required flood management activities.

One way to avoid this would be for Government (and therefore us) to take on the management of third party owned assets having an impact on or required for the protection of designated sites. However, it is unclear:

- how many assets are owned and/or maintained by third parties,
- how many need to be maintained to protect sites, and;
- how many that are maintained, might have an adverse effect (e.g. through coastal squeeze) which would need to be addressed.

It is probable that this issue is not countrywide, rather that there are particular areas where this is a problem (e.g. along the southern coast). This information is required to establish the cost of taking on responsibility for third party owned/maintained assets in these situations and consequently to develop an informed position on this option.

1.2 Study aim and objectives

The aim of this study was to establish what third party owned and managed flood assets in England and Wales are required for the protection and management of internationally important sites, which may have an adverse

[3] Council **Directive** 92/43/EEC on Conservation of natural **habitats** and wild fauna and flora
[4] Council **Directive** 79/409/EEC on the conservation of wild **birds**
[5] Convention on Wetlands of International Importance, 1971

impact on these sites, and how much their management and/or mitigation of impacts would cost.

In summary, the key objectives for the study were to:

i. Establish the extent of third party owned and maintained assets in England and Wales,

ii. Establish how many third party managed assets are required to protect European designated sites and Ramsar Sites, the nature of the assets, the standard of protection and their residual life,

iii. Establish the costs of taking on responsibility for maintaining third party maintained assets required for the protection of internationally important sites,

iv. Establish how many of the third party managed assets required to protect internationally important will have an adverse effect on the site interest features,

v. Establish the costs of providing the required habitat mitigation/ compensation should management of flood risk assets be ceased.

1.3 Definitions

The Environment Agency defines 'third party' assets as any flood risk asset that is:

- part of a flood risk management system that reduces flood risk from main river or the sea; and,
- has not been improved or maintained by the Environment Agency and/or other competent authorities since 1930.

Competent authorities are defined in Regulation 6 of the Habitats Regulations[6] (as amended) as 'any Minister, government department, public or statutory undertaker, public body of any description or person holding a public office. The expression also includes any person exercising any function of a competent authority in the United Kingdom'.

1.4 Study Team

A steering group was formed for the study. Its principal tasks were to i) decide what baseline data should be used, ii) approve the methodology to be used in the costing exercise, and iii) agree how assumptions and uncertainties are to be incorporated into the study.

The study steering group was made up of individuals with the following specialisms:

[6] The Conservation (Natural Habitats, &c.) Regulations 1994

- Environment Agency - asset management policy advisors
- Environment Agency - asset management process advisors
- Environment Agency – Flood Risk Management policy advisors
- Natural England - coastal and fluvial policy advisors
- Black and Veatch – economics specialists
- Black and Veatch – Environmental specialists
- Black and Veatch – Information solutions specialists

In addition, policy advisors from the Countryside Council for Wales were passed relevant information for review and comment during implementation of the study.

1.5 Layout of the report

The remaining sections of this report are laid out as follows:

Section 2 summarises the approach used to identify internationally designated sites that are protected by third party managed flood risk assets.

Section 3 describes the methodology used to identify the cost of maintaining relevant third party flood risk assets, and the costs of providing habitat compensation should management cease.

Section 4 describes the limitations and assumptions of the assessment, and how these have been dealt with.

Section 5 presents the costs of asset management and habitat compensation, as defined by the approach described in section 2.

Section 6 provides a summary of the outcomes of the study.

The outputs of the costing exercise are supported by a cost database. This contains all of the calculations involved in estimating the costs of asset management and habitat compensation. It also allows some of the cost assumptions to be altered and the costs recalculated. Site information can also be updated should the characteristics of the site alter in the future, for example if the condition of a site was to turn from favourable to unfavourable.

2.0 Sites protected by third party flood risk assets

2.1 Identifying Relevant International Sites

Sites protected by international designations included in this study are Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) protected under the Birds Directive and Habitats Directive, as well as wetlands of international importance (Ramsar Sites). In addition, Sites of Community Importance (SCIs) which are yet to be formally designated as internationally important by UK government have been included. Candidate SACs that have not yet been submitted to the European Commission for consideration as SACs have not been included.

Geographical Information System (GIS) datasets for these international designations are available through Natural England and the Countryside Council for Wales (CCW) for England and Wales respectively. These GIS datasets were reviewed to identify all sites designated for nature conservation with at least one of the above designations and those sites with a combination of designations. In total, there are 423 internationally important sites in England and Wales, of which 318 are designated as SACs, four are designated candidate SACs, 97 are designated as SPAs and 76 are classified as Ramsar sites.

The starting point has been to determine those internationally designated sites that may have some linkage with fluvial or coastal floodplains, and therefore may rely on or are affected by flood risk assets to support their interest features. The boundaries of the international sites were overlaid with the latest Environment Agency Flood Map (dated August 2007) for both fluvial and tidal areas, to identify sites within the flood zones. Flood zone 2 identifies areas at risk of flooding from rivers between a 1 in 100 and a 1 in 1,000 chance of flooding in any year and for coastal areas between a 1 in 200 and a 1 in 1000 chance of flooding in any year. Flood zone 3 indicates the areas of land with a 1 in 100 chance (or greater) of flooding each year from rivers and a 1 in 200 chance (or greater) of flooding each year from the sea.

This process of overlaying and intersecting all of the boundaries of internationally important sites and flood zones identified a total of 192 internationally important sites within flood zones 2 and 3 in England and 76 in Wales. These sites are listed in Appendix A and shown in Figure 2.1.

Table 2.1 identifies the division of international designations between sites and between the types of floodplain. In total, 133 sites were found to be located solely within the fluvial floodplain, 26 sites were solely within the tidal floodplain, and 109 were located within both fluvial and coastal floodplain areas.

Table 2.1: Numbers of International sites in Fluvial and Tidal Floodplains in Flood zones 2 and 3

Country	No.of International Sites in flood zones	Designations Present	No. of Sites by Designation	Fluvial	Tidal	Both
England	192	SAC only	104	69	10	25
		SPA only	6	3	1	2
		RAMSAR only	3	2	0	1
		SAC & SPA	16	8	1	7
		SAC & RAMSAR	8	7	1	0
		SPA & RAMSAR	25	3	4	18
		All	30	2	0	28
Wales	76	SAC only	49	32	3	14
		SPA only	3	0	3	0
		RAMSAR only	0	0	0	0
		SAC & SPA	13	4	3	6
		SAC & RAMSAR	8	3	0	5
		SPA & RAMSAR	1	0	0	1
		All	2	0	0	2
Total	**268**		**268**	**133**	**26**	**109**

The vast majority of internationally designated sites are also designated as Sites of Special Scientific Interest (SSSI). Nevertheless, some international designations extend offshore beyond the tidal and fluvial flood zones and are not covered by SSSI designations; these are shown in Figure 2.2. In consultation with Natural England, it was decided that parts of offshore international sites that were not covered by SSSIs were to be excluded from the study, as they were unlikely to contain flood risk assets.

For internationally designated sites in England, the Natural England ENSIS database was also interrogated, to identify the habitats present within each site and the current condition of the habitats. This database is routinely updated by Natural England officers responsible for the conservation of particular international sites.

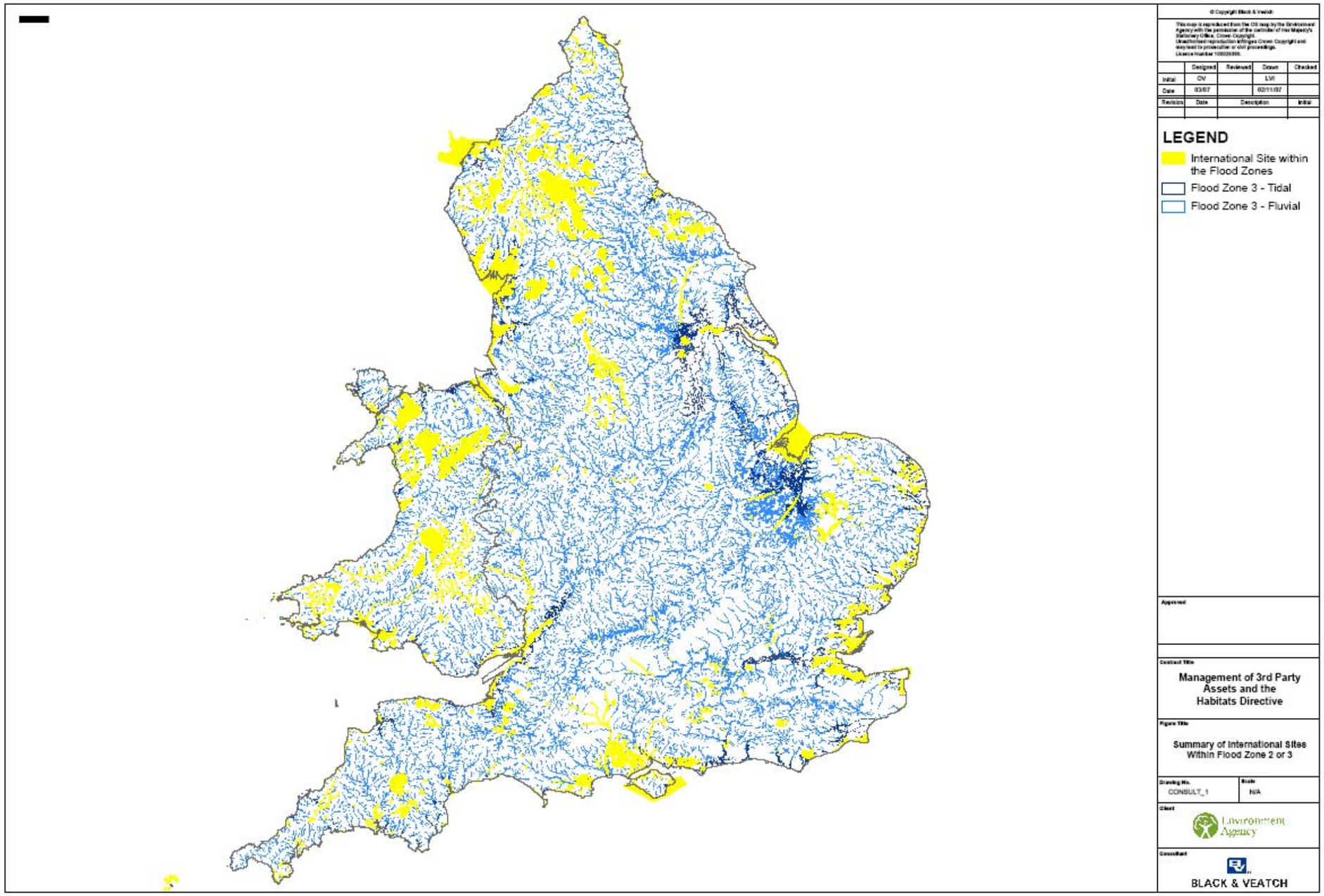

Figure 2.1: Internationally Important Sites within Flood zones 3 and 2

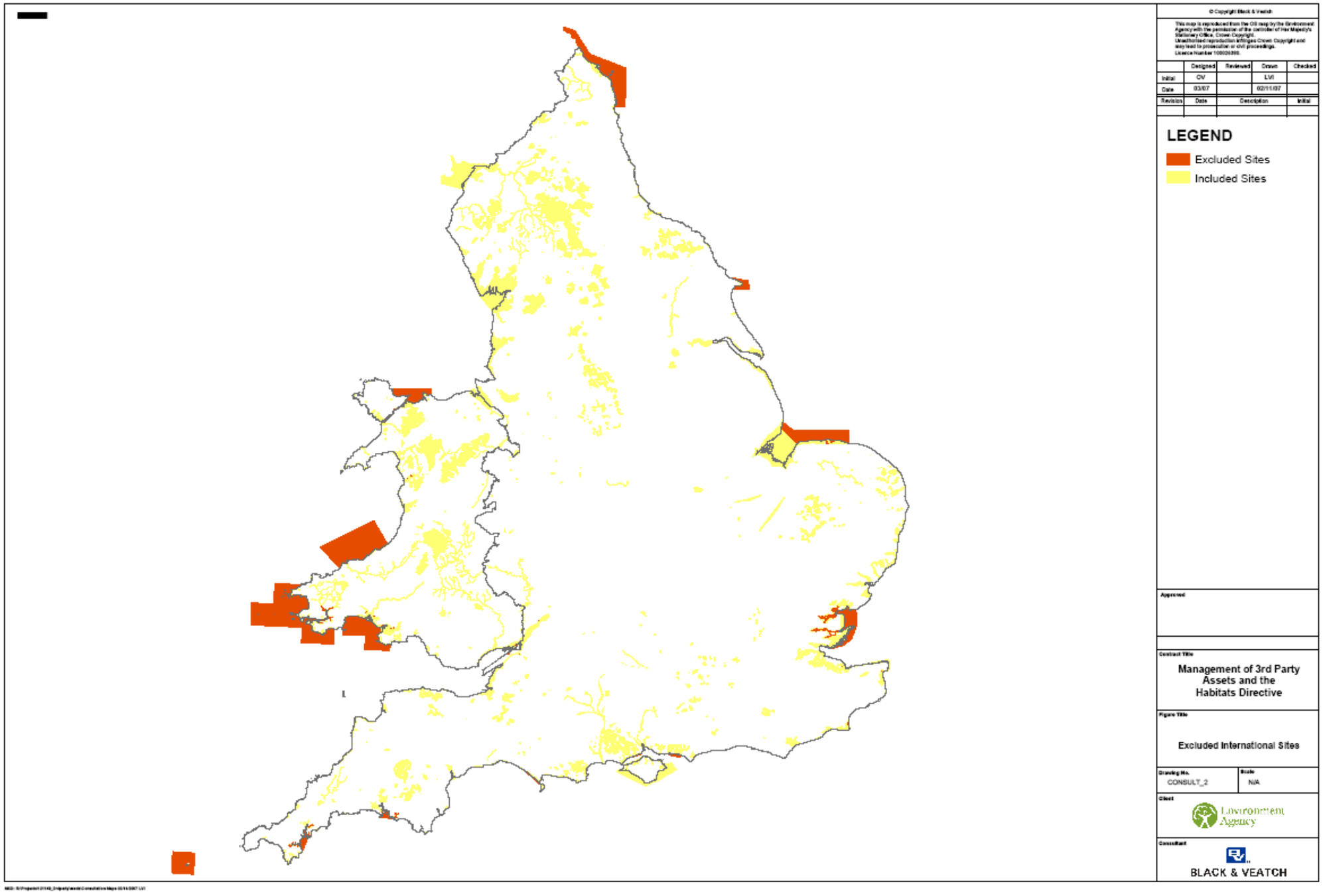

Figure 2.2: Parts of Internationally Important Sites excluded from the Study where these do not include SSSIs

2.2 Identifying Third Party Flood Risk Assets

Our National Fluvial and Coastal Defence Database (NFCDD) is the principal source of information on flood risk assets in England and Wales. NFCDD contains records for over 200,000 segments of flood asset in England and Wales. Each asset is uniquely identified by a reference number. The database is comprised of both fluvial and coastal assets. The database also contains comprehensive data on the condition, length, type and construction of these asset segments.

NFCDD indicates the type of organisation responsible for maintenance of the asset, split into four categories, being:

- Environment Agency,
- Local authority
- Internal Drainage Board
- Private

The division of maintenance between organisations, for all assets on NFCDD is shown in Table 2.2.

Table 2.2: Maintainers of assets on NFCDD

Maintainer	Total No. of Assets	% of Assets	Total Length in km
Private	122636	~60%	45832
Environment Agency	60729	~30%	33472
Local Authority	16929	~8%	3023
Internal Drainage Board	2453	~1%	675
Total	**207834**		**88314**

As this study focuses on third party assets that are not maintained by competent authorities, those maintained by the Environment Agency, Local Authorities and Internal Drainage Boards on NFCDD have been excluded. In addition, the 'private' maintainer category on NFCDD not only includes assets that are maintained by private individuals and private organisations, but also assets that are maintained by competent authorities other than the Environment Agency, Local Authorities and Internal Drainage Boards. Examples of competent authorities in this category include Network Rail, Ministry of Defence and water companies. This is explained diagrammatically in Figure 2.3.

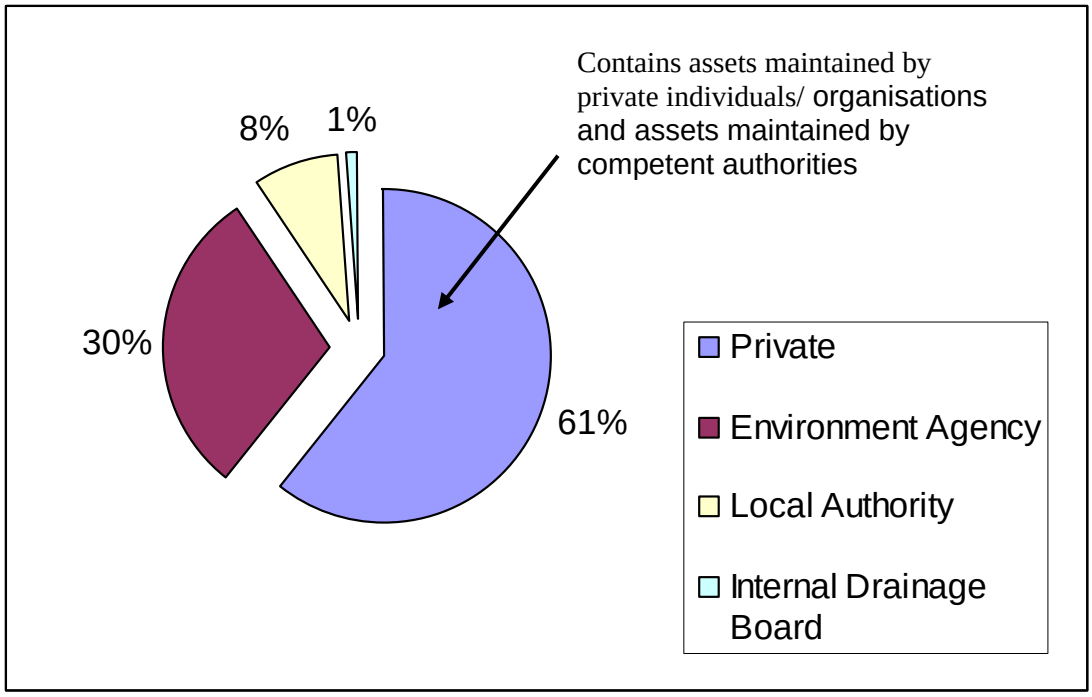

Figure 2.3: Division of Asset Management Responsibility on NFCDD

In order to identify which assets within the 'private' maintainer category were maintained by competent authorities, it was necessary to review the NFCDD asset ownership data, with the assumption that the owner would also maintain the asset. Where owners were identified as being competent authorities, these were excluded from the third party assets being considered in the study. Ownership data was not commonly listed in NFCDD for individual assets; however, where it was listed it was possible to exclude 192 assets owned by competent authorities from the private maintainer dataset.

2.3 Linking Third Party Flood Risk Assets to Internationally Important Sites

The study linked assets to habitats in international sites either directly or indirectly using the following methodology. To begin, GIS data on locations of third party assets were overlaid with locations of international sites within floodplains. Assets within, or partially within a SSSI unit in an international site in flood zone 2 or 3 were directly linked to that unit. Assets outside international sites in floodplains, but within 1km of the site were linked to the nearest SSSI unit in the international site. In addition, where an asset is within one international site (and directly linked to this), but also within 1km of other international sites in the floodplain, it is indirectly linked to the nearest SSSI unit in each of the other international sites within 1km; this approach was adopted in discussion with Natural England to ensure that assets that have potential to effect international sites (but lie outside their boundaries) are picked up in the assessment of costs. The approach to linking sites and assets is shown diagrammatically in Figure 2.4.

This method allows each asset to be linked (either directly or indirectly) to a particular SSSI unit, and therefore a particular habitat as each SSSI unit has a

dominant habitat associated with it. The dominant habitat will be one of the 30 habitats listed on ENSIS, which are listed in Table 3.3. Assets in Wales were linked to entire international sites rather than to SSSI units, as digital SSSI unit data was not available at the time of study.

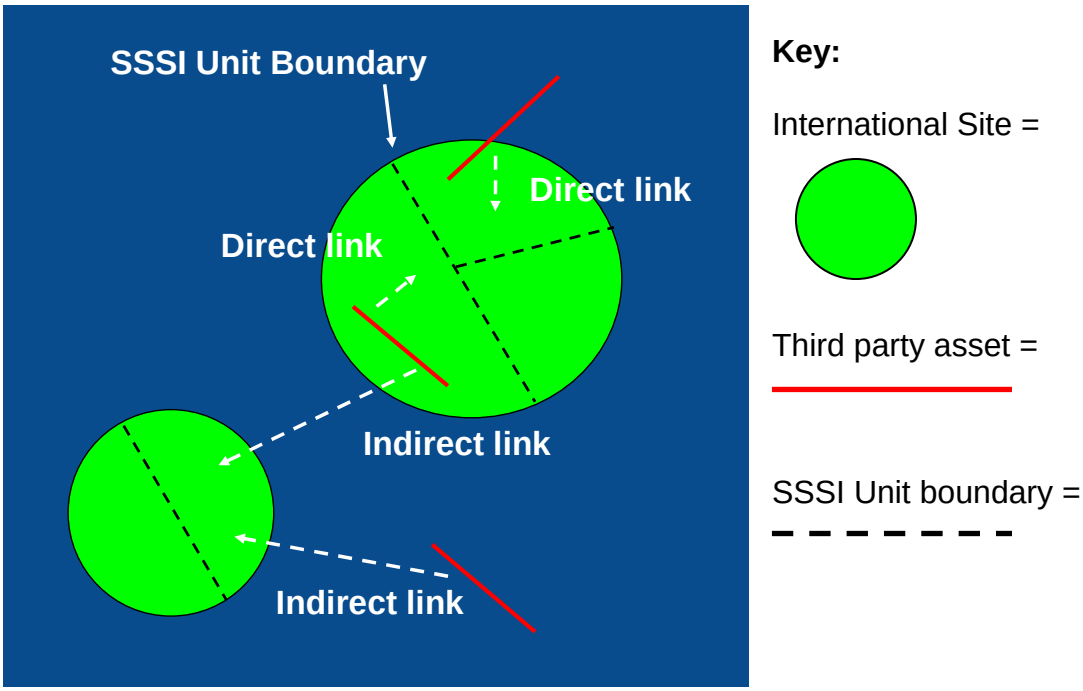

Figure 2.4: Asset and Site Linkage

The process of linking assets to habitats in international sites in floodplains resulted in the following outputs:

- ~6000 third party assets are directly linked to SSSI units in international sites
- ~15000 third party assets are indirectly linked to SSSI units in international sites
- The total length of third party assets linked to international sites is 12,981km.
- SSSI units in 167 internationally important English sites are directly or indirectly linked to third party assets.
- SSSI units in 66 internationally important Welsh sites are directly or indirectly linked to third party assets.
- Only four international sites in England and Wales were found to have only direct links to third party assets, these being Coedwigoedd Dyffryn Elwy / Elwy Valley Woods, Dunraven Bay, East Hampshire Hangers and Flamborough Head.
- A further 58 sites were found to have only indirect links to third party assets,
- 169 sites were found to be both indirectly and directly linked to third party assets.

All 30 ENSIS habitat types in English sites were found to be linked to third party assets, the most common being littoral sediment and neutral grassland - lowland.

2.4 Extent of Areas Adversely Affected by Third Party Assets

The Natural England website 'Nature on the Map' and ENSIS database were interrogated to determine which sites in unfavourable condition are detrimentally affected by flood risk management. All SSSI units where the status was designated as unfavourable recovering, unfavourable no change and unfavourable declining were researched using Natural England's SSSI unit condition data in order to determine reasons for the unfavourable status. Key words/ phases relating to asset effects (for example coastal squeeze, inland flood assets, inappropriate weirs, dams and other structures etc) were searched for within the datasets.

Detrimental effects from flood risk management were caused by a variety of reasons, for example sea walls preventing natural coastal processes, saltmarsh erosion due to coastal squeeze against sea assets and sea assets preventing dune systems from being mobile. The assessment found that a total of 243 SSSI units in 35 international sites in floodplains in England and Wales were detrimentally affected by flood risk management and were also linked to third party assets. The sites and number of affected SSSI units are shown in Table 2.3.

In order to generate costs for habitat replacement (discussed in section 3) the study has assumed that the third party assets that are linked to the SSSI units are responsible for causing the detrimental effects. It is acknowledged that detrimental effects could equally be caused by assets managed by competent authorities in the vicinity; the implications of this assumption are discussed further in section 4.

Table 2.3: Internationally designated sites detrimentally affected by flood risk management and linked to third party assets

General Site Name	No. SSSI Units Detrimentally Affected by FRM and linked to 3rd Party assets	Site Flood Zone	Flood Zone Type	Site Designation Type	Site EA Region
Benfleet and Southend Marshes	3	Tidal	2 & 3	SPA and Ramsar	Anglian
Chesil & The Fleet	1	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	South West
Chichester and Langstone Harbours	7	Fluvial & Tidal	2 & 3	SPA, SAC and Ramsar	Southern
Deben Estuary	10	Fluvial & Tidal	2 & 3	SPA and Ramsar	Anglian
Dorset Heaths	2	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	South West
Duddon Estuary	4	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	North West
Duddon Mosses	1	Fluvial & Tidal	2 & 3	SAC	North West

General Site Name	No. SSSI Units Detrimentally Affected by FRM and linked to 3rd Party assets	Site Flood Zone	Flood Zone Type	Site Designation Type	Site EA Region
Dungeness to Pett Level	9	Fluvial & Tidal	2 & 3	SPA and SAC	Southern
Essex Estuaries	67	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	Anglian
Exe Estuary	14	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	South West
Hamford Water	2	Tidal	2 & 3	SPA and Ramsar	Anglian
Humber Estuary	22	Fluvial & Tidal	2 & 3	SPA and Ramsar	North East
Kennet & Lambourn Floodplain	1	Fluvial	2 & 3	SAC	Thames
Kennet Valley Alderwoods	1	Fluvial	2 & 3	SAC	Thames
Marazion Marsh	1	Fluvial & Tidal	2 & 3	SPA	South West
Medway Estuary & Marshes	3	Fluvial & Tidal	2 & 3	SPA and Ramsar	Southern
Minsmere-Walberswick	3	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	Anglian
North Pennine Dales Meadows	1	Fluvial	2 & 3	SAC	North West
Pevensey Levels	5	Fluvial & Tidal	2 & 3	Ramsar	Southern
Portsmouth Harbour	1	Fluvial & Tidal	2 & 3	SPA and Ramsar	Southern
River Derwent	5	Fluvial & Tidal	2 & 3	SPA and SAC	North East
River Derwent & Bassenthwaite Lake	8	Fluvial & Tidal	2 & 3	SAC	North West
River Eden	9	Fluvial & Tidal	2 & 3	SPA and SAC	North West
River Itchen	1	Fluvial & Tidal	2 & 3	SAC	Southern
River Kent	7	Fluvial	2 & 3	SAC	North West
River Lambourn	2	Fluvial	2 & 3	SAC	Thames
River Wensum	6	Fluvial	2 & 3	SAC	Anglian
Severn Estuary	13	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	South West
Solent & Southampton Water	17	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	Southern
Solway Firth	2	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	North West
Somerset Levels & Moors	1	Fluvial & Tidal	2 & 3	SPA and Ramsar	South West
Stour and Orwell Estuaries	13	Fluvial & Tidal	2 & 3	SPA and Ramsar	Anglian
Thames Estuary & Marshes	1	Fluvial & Tidal	2 & 3	SPA and Ramsar	Southern
The Broads	1	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	Anglian
The Wash & North Norfolk Coast	1	Fluvial & Tidal	2 & 3	SPA, SAC & Ramsar	Anglian

2.5 Case Studies

The outputs of the GIS processing to link assets and habitats have been presented in diagrammatic form for four internationally designated areas, namely; Chichester and Langstone Harbours, North York Moors, Hamford Water and several international sites in north Wales. These are shown in Figures 2.5 to 2.8.

The information presented in the figures can be interpreted as follows:

- Coloured areas show different habitat types (i.e SSSI units) within international sites.
- Hashed areas are SSSIs in unfavourable condition due to flood risk management activities and that are also linked to third party flood risk assets. The flood risk management reasons for unfavourable conditions are marked on the figures where relevant.
- Different coloured lines indicate different asset types
- The black dotted line is a 1km buffer beyond which assets are not considered to have links to the site.

Chichester and Langstone Harbours – these estuarine areas are part of the Solent international site in our southern region, and are designated as an SAC, SPA and Ramsar site. The largest habitat type in the harbours is littoral sediment. Certain SSSI unit habitats of littoral sediment and natural grassland are currently in unfavourable condition due to flood assets. Natural channels are marked in yellow and are common within the harbours.

North York Moors – this fluvial site is designated as an SPA and SAC. A large third party maintained natural channel runs through parts of the site, so is partly linked directly (where it rns within the site) and partly linked indirectly (where it runs outside the site but within 1km). The predominant habitat is drawf shrub heath – upland.

International sites in north Wales - a series of small internationally important sites lie on the north Wales coast and the Ilse of Anglesea. The majority of flood risk management assets in these sites are natural channels or sea assets. As discussed previously, it is not possible to identify areas of these sites that are detrimentally affected by flood risk management assets, as this information is not currently available for Wales.

Hamford Water – this coastal site in our anglian region is designated as an SPA and Ramsar site. The predominant habitat within the site is littoral sediment. Several SSSI units that have third party assets within or in close proximity to them are affected by coastal squeeze. Nevertheless, the majority of these SSSI units also contain assets maintained by competent authorities, which are also expected to be contributing to coastal squeeze.

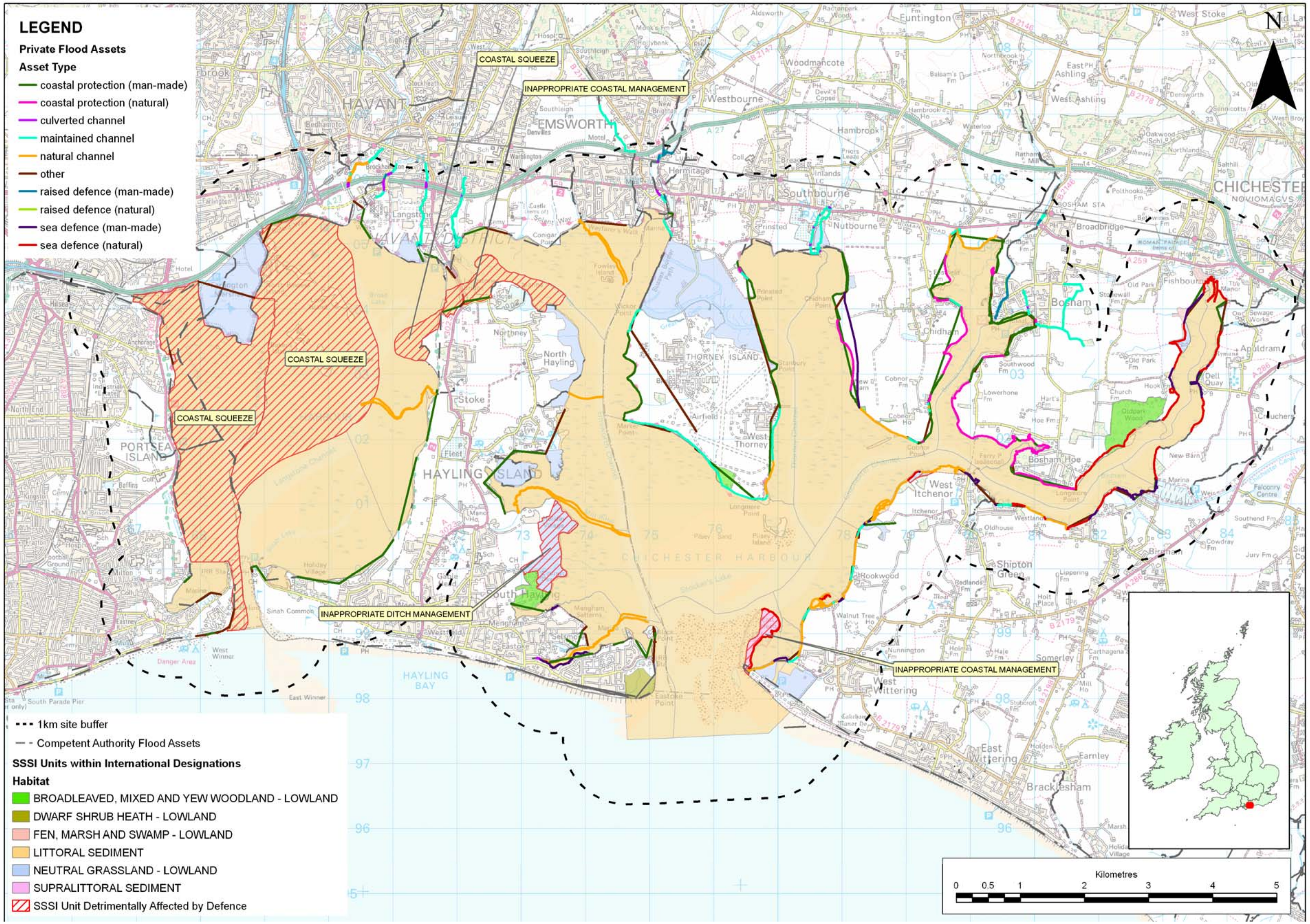

Figure 2.5: Chichester and Langstone Harbours

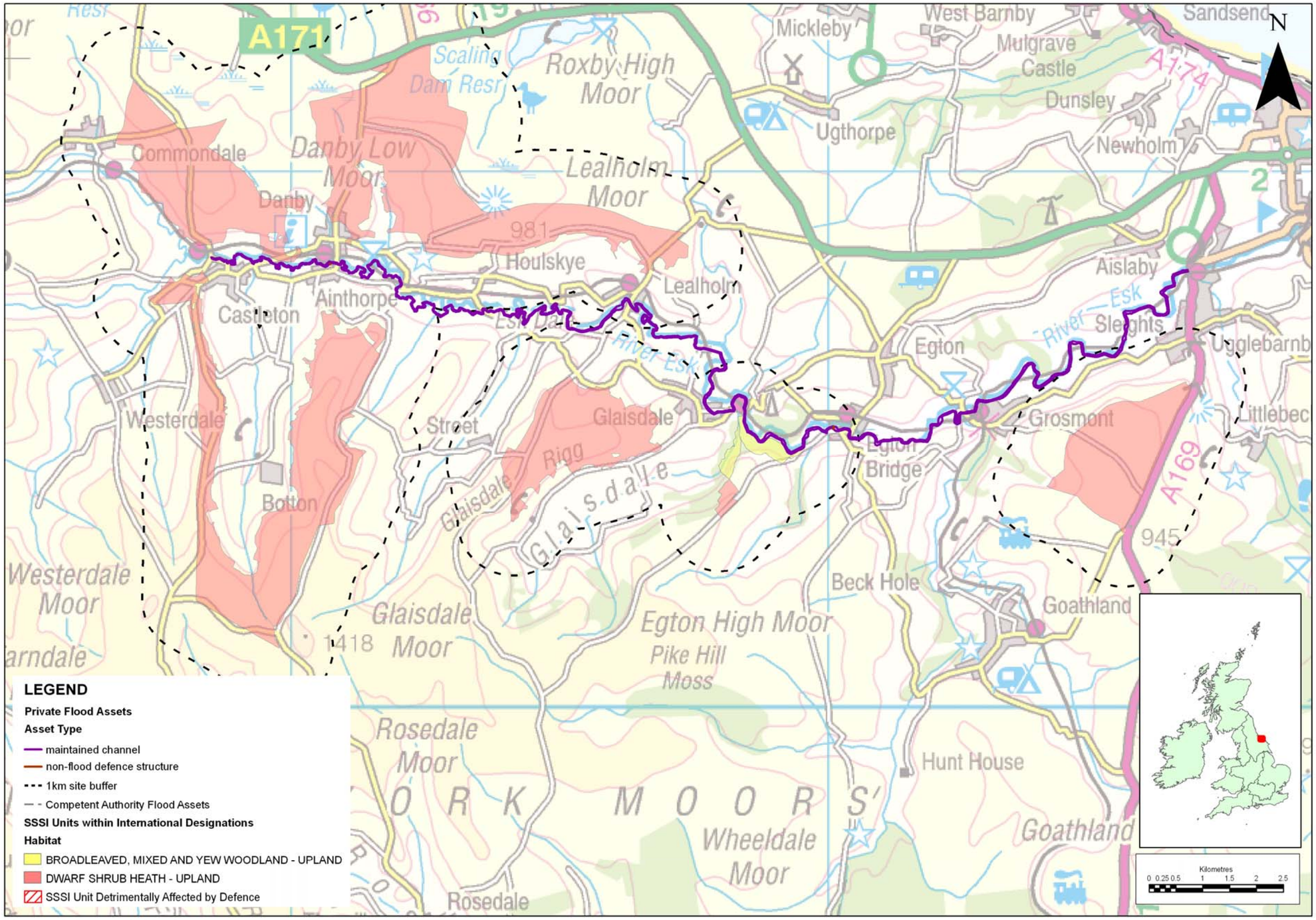

Figure 2.6: North York Moors

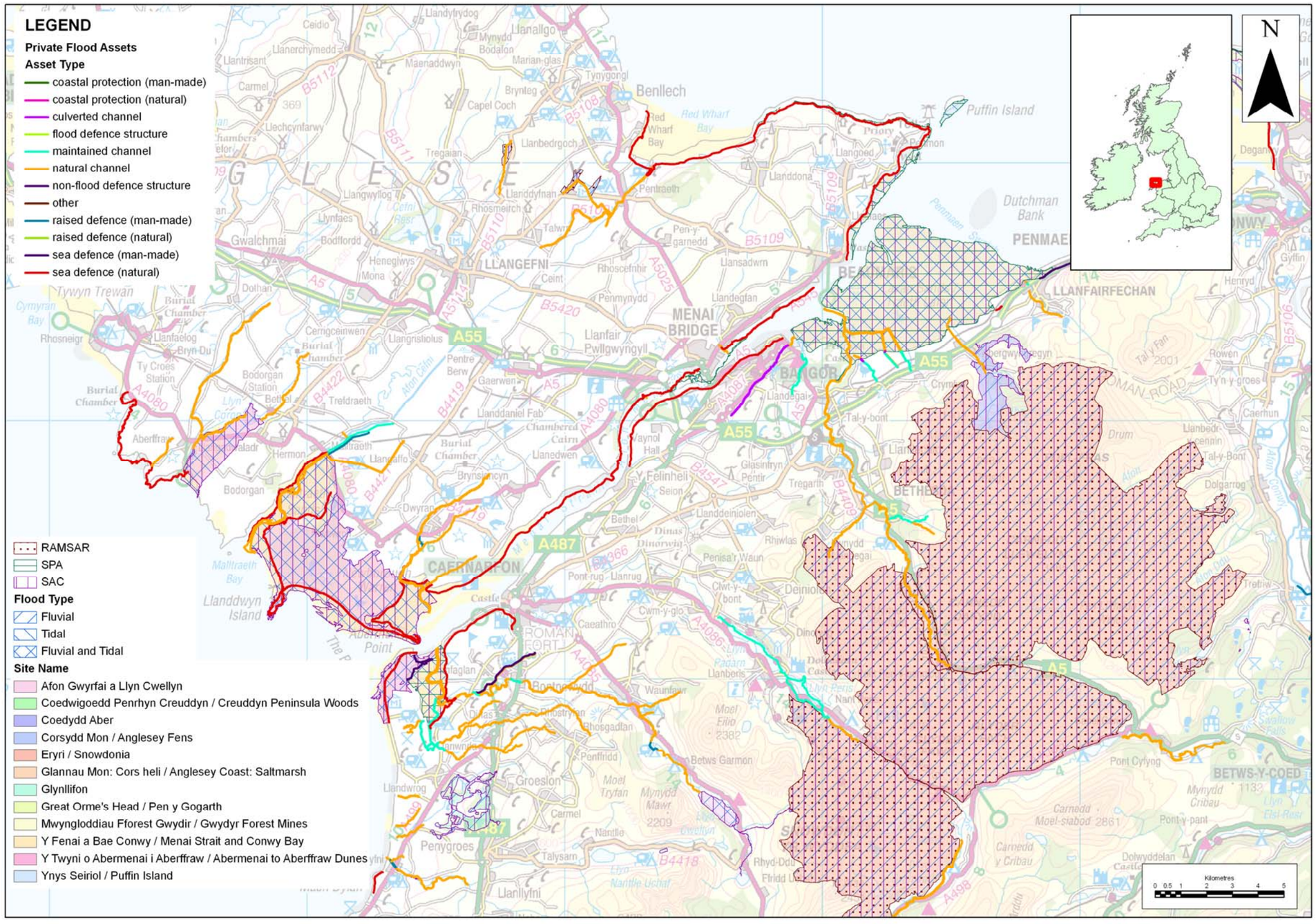

Figure 2.7: International Sites in North Wales

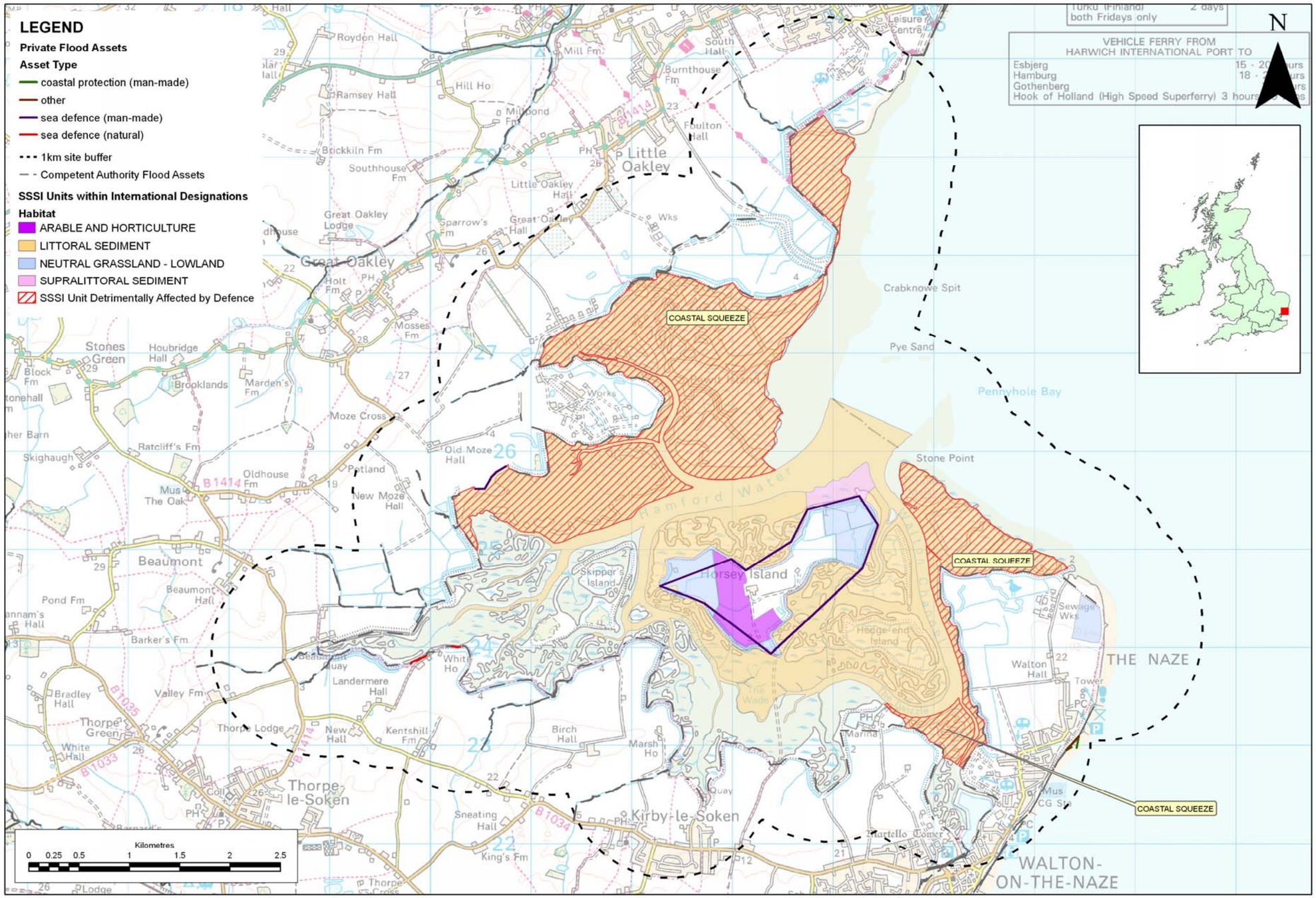

Figure 2.8: Hamford Water

3.0 Methodology to identify asset management costs and habitat replacement costs

3.1 Introduction

We have undertaken an asset management costing exercise to determine the cost of managing all flood risk assets affecting internationally important sites over a 100 year period. In addition, we have also calculated the cost of replacing habitats in internationally designated sites.

To determine the management costs of third party assets affecting internationally important sites, as well as the costs of habitat replacement, we have developed an Excel based tool that we have called the 'Cost Calculator.' Sections 3.2 and 3.3 below detail the input data, assumptions and workings of the Cost Calculator.

Due to the high level nature of this study, there are several uncertainties in the costs of asset management and habitat replacement. These uncertainties are described in section 4.

3.2 Methodology for Asset Management Costing

3.2.1 Guidance & Previous Studies Used

To ensure we have adopted a consistent approach in our methodology for asset management costing we have drawn from a range of existing studies and data sources where possible. This includes the following:

- Our National Flood and Coastal Defence Database (NFCDD) has been used as the prime source of data to identify the characteristics of the third party assets which may affect international sites.
- The Defra study into the 'National Evaluation of the Costs of Meeting Coastal Environmental Requirements (NEOCOMER) (Defra, 2006), has been referred to, to ensure consistency of approach were possible and to identify potential habitat replacement costs.
- Our Unit Cost Database has been used to generate costs for management of the third party assets.
- Our regional System Asset Management Plans (SAMPs) and previous flood risk management strategies (in particular the Thames Tidal Embayments Strategy) have been reviewed to develop the appropriate methodology for costing of third party assets over the 100 year timeframe.

3.2.2 National Flood and Coastal Defence Database (NFCDD)

As described above, the NFCDD database was used to identify characteristics of the third party assets affecting internationally important sites.

The 'Asset Type' dataset in NFCDD was used to determine the relevant types of third party assets. The dataset contains 13 different asset types, against which each of the ~200,000 assets on NFCDD have been assigned, these are listed below and in Table 3.2.

- Coastal protection (man-made)
- Coastal protection (natural)
- Culverted channel
- Flood asset structure
- Maintained channel
- Natural channel
- Non-flood asset structure
- Raised coastal asset (man-made)
- Raised coastal asset (natural)
- Raised asset (man-made)
- Raised asset (natural)
- Sea asset (man-made)
- Sea asset (natural)

The following asset attributes in Table 3.1 were extracted from NFCDD for all of the third party assets that are directly or indirectly linked to international sites in floodplains; a total of ~21000 assets as discussed in section 2.3. This information was used to inform the costing exercise.

Table 3.1: Asset Attributes

NFCDD	Description of Attribute
ASSET_REF	Unique code to identify asset
ALT_ASSET_REF	Alternative code to identify asset
MAINTAINER	Organisation responsible for maintenance of the asset
ASSET_PROT_TYPE	Type of flooding asset defends against
ASSET_TYPE	Description of asset e.g. bridge, weir, etc.
DESCRIPTION	Description of asset
DESIGN_STANDARD	Design standard of defence defined as a return period in years
ACTUAL UCL	Current height of upstream crest level (mAOD)
ACTUAL DCL	Current height of downstream crest level (mAOD)
DESIGN_UCL	Upstream crest level defence was designed to (mAOD)
DESIGN_DCL	Downstream crest level defence was designed to (mAOD)
LENGTH	Length of asset (m)
OVERALL_COND	Overall condition of the asset based on the latest inspection
RESIDUAL_LIFE	Estimated residual life of an asset e.g. 0, <2, <5
WORST_COND	Condition code of the asset element in the worst condition at the latest inspection

3.2.3 Asset Management Costs

To generate the 100 year cost of managing all the assets affecting international sites we have considered the following:

1) The Required Standard of Protection – this is discussed in section 3.2.4.

2) Management intervention. This will be required when the condition of an asset deteriorates to a certain level - discussed in sections 3.2.5 and 3.2.6.

3) An asset will require costs per unit length for:
- Inspection - £2 per metre as shown in Table 3.2,
- Maintenance – discussed below,
- Refurbishment – discussed below,
- Replacement – discussed below.

4) A standard cost will be applied for:
- Mobilisation for asset refurbishment - £100k as shown in Table 3.2,
- Mobilisation for asset replacement - £200k as shown in Table 3.2.

Replacement Costs

We have used our Unit Cost Database to estimate the cost of replacing Assets. The costs were inflated from the March 2006 base date using the DTI "Public Works Non-Roads" cost index as given in the guidance for the Unit Cost Database.

The costs provided for in the Unit Cost Database are for a range of asset types. These types do not exactly match those described in the NFCDD data field 'Asset Type'. We have therefore made assumptions on which asset type from NFCDD most closely matches an asset type from the Unit Cost database. These assumptions are shown in Appendix D.

A key assumption is that the cost of asset replacement is related to the type and length of the asset. We recognise that asset height is a significant variable in the management cost of assets. Unfortunately only around 35% of the assets listed on NFCDD are assigned a height. The steering group therefore decided to assume a standard average height for each asset type and therefore base the costs solely on asset type and asset length. The implications on the costs of using a standard asset height are discussed in section 4.

Appendix D details how we have used the Unit Cost database to generate costs for each of the asset types from NFCDD. Users of the cost calculator have the ability to change these replacement costs if they choose.

Refurbishment Costs

Refurbishment costs are not given in the Unit Cost Database. The steering group therefore agreed to use an appropriate percentage of the capital replacement cost for each asset type. The percentage of the capital replacement cost assigned to refurbishment was calculated through review of application of the technique in our Flood Risk Management Strategies. Following this review, it was deemed that appropriate percentages were 46.5% for 'hard' engineered assets, and 39.5% for soft (as shown in Table 3.2). Users of the cost calculator have the ability to change these percentages if they choose.

Maintenance Costs

Maintenance costs for each asset were assigned in a similar way to refurbishment costs. Maintenance costs were assumed to be 1% of capital replacement costs per annum (as shown in Table 3.2). This was considered to be a suitable percentage as it reflects the percentage used in the 2007 NEOCOMER study of asset management costs for coastal sites, discussed in section 3.2.1. As with replacement and refurbishment costs, users of the cost calculator have the ability to change these percentages if they choose.

Table 3.2: Asset Replacement, Repair and Maintenance Costs and Intervention Assumptions

Asset Type	Maintenance		Refurbishment				Replacement (to CG 1)	Climate Change
	Maintenance cost as % of replacement	Cost (£/metre)	Refurbishment cost as % of replacement	Cost (£/metre)	CG refurbished to	Max. no. of repair cycles	Cost (£/metre)	% uplift in intervention cost
Coastal protection (man-made)	1	104	46.5	482	3	4	1,037	75
Coastal protection (natural)	1	5	39.5	18	3	4	45	75
Culverted channel	1	152	46.5	707	3	4	1,520	0
Flood asset structure	1	605	46.5	2,813	3	4	6,050	0
Maintained channel	1	5	39.5	18	2	4	45	0
Natural channel	1	2	39.5	9	2	4	23	0
Non-flood asset structure	1	605	46.5	2,813	3	4	6,050	0
Other	1	153	46.5	710	3	4	1,526	0
Raised coastal asset (man-made)	1	104	46.5	482	3	4	1,037	75
Raised coastal asset (natural)	1	5	39.5	18	3	4	45	75
Raised asset (man-made)	1	153	46.5	710	3	4	1,526	0
Raised asset (natural)	1	5	39.5	18	3	4	45	0
Sea asset (man-made)	1	55	46.5	257	3	4	552	75
Sea asset (natural)	1	5	39.5	18	3	4	45	75

Inspection costs per metre	£2.00	
Repair mobilisation cost	£100,000	(lump sum)
Replacement mobilisation cost	£200,000	(lump sum)

Note: Cells shaded orange can be altered by the user of the cost calculator to influence the asset management costs.

3.2.4 Standard of Protection

A key assumption of the asset management costing exercise is that the current Standard of Protection provided by each asset is appropriate for the international site(s) to which it is linked.

Information on the required standard of protection to meet conservation requirement at individual sites (and within sites) is not readily available. The steering group recognises that at certain sites the standard of protection is at or above the required standard of protection to maintain the conservation interests, as identified in a Natural England Reserch report on standards of protection for designated sites (Natural England 2006). Nevertheless, at other sites the standard of protection is insufficient to meet conservation requirements. Therefore, it was considered that the most pragmatic approach to the costing exercise would be to assume that it is appropriate to continue managing each asset to its existing standard of protection.

In order to judge whether standards of protection should be reduced or increased for individual assets in particular sites, investigations would be required to a level of detail beyond the scope of this study.

3.2.5 Deterioration Curves

We have used deterioration curves to represent how the condition of all asset types change over time. Using these curves gives us greater certainty on when investment for each individual asset is required. To ensure consistency of approach, the deterioration curves used in this assessment reflect those developed for Defra's National Assessment of Defence Needs and Costs (Risk Assessment for Strategic Planning) [NADNAC (RASP)], 2004. This document provides guidance on determining asset deterioration and the use of condition grade deterioration curves.

The deterioration profiles are based on the Condition Grade (or CG) of an asset. We use CGs to report on the visual condition of our flood risk assets. CGs are assigned to every asset to reflect its remaining operational life. There are five grades applied to asset condition, ranging from assets in excellent condition which are grade 1 to assets in very poor condition which are grade 5. This enables the management of assets to be undertaken in a timely and systematic manner which avoids deterioration to an extent where urgent intervention is required.

We have matched the asset types contained in NFCDD with an appropriate asset deterioration curve. The full list of deterioration curves for each asset type are presented in Appendix C.

3.2.6 Intervention Strategies

We have used the deterioration curves to make high level assumptions as to when assets will reach a point requiring refurbishment or replacement and thus when money should be invested for each asset. These assumptions are

described below. It should be noted that many of these assumptions can easily be altered by a user of the Cost Calculator.

When does an intervention occur?

- All costs are based on pro-active intervention (i.e. no assets are allowed to fail and the risk of failure is zero for CG 1-4).
- If the initial Condition Grade of an asset is CG 4 or CG5 the first intervention is a replacement in Year 0.
- For all other assets at CG 1 to CG 3, intervention over and above any normal maintenance work occurs when assets reach Condition Grade 4. This intervention is either a refurbishment or a replacement.

What are the different interventions?

- By default we have determined that the first intervention for each asset will be a refurbishment. We recognise that this may not be appropriate for all assets and may lead to an underestimate of total costs. This is accounted for in section 4. We have built in a function to the cost calculator that allows a user to override the 'refurbish first' assumption for any given asset.
- By default, a refurbishment will consist of the works that are required to improve the asset to CG 3, except for channel asset types where this has been set to CG 2. These assumptions can be altered by the user within the Cost Calculator.
- Refurbishment can only be undertaken a specified number of times for each asset type, after which a replacement of the asset is required. The number of refurbishments prior to replacement can be altered by the user in the cost calculator (the maximum number being 4 refurbishments). The preset number of refurbishments for each asset prior to replacement is shown in Table 3.2.
- A Replacement will improve an asset to CG1.

For each asset type, the cost calculator uses these assumptions and the deterioration curves to determine the timing of the next intervention. The cost calculator then uses a formula to determine whether this intervention is a 'refurbishment' or a 'replacement'. This is done over a series of potential interventions until 100 years has lapsed.

Using this method, the timing and nature of each intervention for each individual asset is known. From this, we can build up the total management costs for each asset.

3.2.7 Discounting

As mentioned, the asset management costs have been calculated over a 100-year appraisal period. Over the 100-year appraisal period the following discount factors have been incorporated into the cost calculator.

- Year 0 to year 29 = 3.5%
- Year 30 to year 74 = 3.0%
- Year 75 to year 99 = 2.0%

Present value has been used as the method of discounting the asset management costs. This is the simplest and most commonly used discounting method available. Present Value is defined as "*the value of a stream of benefits or costs when discounted back to the present time*". It can be thought of as the sum of money that needs to be spent today to meet all future costs as they arise throughout the life cycle of a scheme or structure.

3.2.8 Duplicate Assets

Approximately 2000 assets are directly linked to one international site (i.e are located within one), but are also indirectly linked to another international site (i.e lie within 1km of another international site). The cost calculator identifies whether an asset is a 'repeat' (i.e directly and indirectly linked), so that whilst the management cost of these assets may be included more than once when calculating costs of managing assets associated with particular international sites, the total costs of asset management do not double count these.

3.2.9 Incorporation of Climate Change

The effects of climate change upon sea level rise and fluvial flows have been considered in developing the costs of asset management.

The latest Defra guidance on the costing of climate change within flood risk management works identifies that sea level rise will vary regionally and will also increase over time (Defra 2006a). The annual rate of sea level rise is predicted to double in about 50 years time. The Defra guidance does not require that increases in fluvial flows be taken into account as the evidence for increases in fluvial flows as a result of climate change is weak. Natural England has also advised that fluvial sites are not very sensitive to the actual standard of protection. The steering group therefore decided to include costs for the potential effects of sea level rise within the cost calculator, but not the effects of changes in fluvial flows.

Due to the high level nature of this study, and the need to keep the cost calculator to a usable size limit, a generic percentage uplift of 75% was applied to the management costs of all coastal asset types to account for changes in sea level rise (as shown in Table 3.2). The value of 75% was based upon the findings of a Defra 2001 study on the 'National Appraisal of Assets at Risk from Flooding and Coastal Erosion'. The study identified the following:

- Accommodating climate change is likely to require an increase in costs of managing flood risk assets of between 10% and 20% over and above that required to meet indicative standards under present day conditions.
- A 35% to 85% overall increase in costs may be required to meet indicative standards of protection over the next 50 years.

Based on these findings and the knowledge of the steering group members of the inclusion of climate change for Flood Risk Management Strategies, it was felt that a value of 75% was a suitable uplift value to incorporate to coastal asset management costs for the 100-year appraisal period.

The effect of climate change upon asset management costs has been kept separate in the cost calculator, so that the user can identify the effect of this upon the base costs. It is also possible for users to amend the % uplift in the future if future information becomes available.

3.3 Methodology for Habitat Replacement Costing

3.3.1 Habitat Replacability

The first task in costing of habitat replacement was to determine whether it would actually be possible to replace habitats. The steering group agreed that only three of the 30 habitats on ENSIS could not be replaced; these being earth heritage, inland rock and littoral rock. Each of the ENSIS habitats is listed in Table 3.3 below, along with an indication of whether they can be replaced. Note that each SSSI unit is assigned to one of the 30 habitats on ENSIS.

Table 3.3: ENSIS Habitats and whether that can be replaced

Main Habitat	Replaceable?
Acid Grassland - Lowland	Yes
Acid Grassland - Upland	Yes
Arable And Horticulture	Yes
Bogs - Lowland	Yes
Bogs - Upland	Yes
Boundary And Linear Features	Yes
Bracken	Yes
Broadleaved, Mixed And Yew Woodland - Lowland	Yes
Broadleaved, Mixed And Yew Woodland - Upland	Yes
Built Up Areas And Gardens	Yes
Calcareous Grassland - Lowland	Yes
Calcareous Grassland - Upland	Yes
Coniferous Woodland	Yes
Dwarf Shrub Heath - Lowland	Yes

Main Habitat	Replaceable?
Dwarf Shrub Heath - Upland	Yes
Earth Heritage	No
Fen, Marsh And Swamp - Lowland	Yes
Fen, Marsh And Swamp - Upland	Yes
Improved Grassland	Yes
Inland Rock	No
Inshore Sublittoral Sediment - Coastal Lagoons	Yes
Littoral Rock	No
Littoral Sediment	Yes
Montane Habitats	Yes
Neutral Grassland - Lowland	Yes
Neutral Grassland - Upland	Yes
Rivers And Streams	Yes
Standing Open Water And Canals	Yes
Supralittoral Rock	Yes
Supralittoral Sediment	Yes

3.3.2 Habitat Replacement Costs

The next task was to determine suitable costs for replacing each habitat type. Previous studies of habitat costing were referred to. Where possible, the costs from the NEOCOMER study were used to maintain consistency. Where this was not possible, alterative data sources were used. Appendix B, Table B2 lists the data sources used.

The replacement costs are based on a cost per hectare. Uplift to the costs of habitat replacement used in previous studies was applied to reflect 2008 prices. The habitat replacement costs are shown in Appendix B, Table B1.

In addition to the costs of habitat replacement, a separate land purchase cost of £6,672ha was added to each replacement cost. This value is based upon the land purchase cost from the NEOCOMER study, with a 2008 uplift applied.

The cost calculator has been set up to multiply the cost of replacing one hectare of the ENSIS habitat in each SSSI unit (plus the cost of land purchase per hectare) by the size of each SSSI unit. The cost calculator has been designed so that the user can modify the habitat replacement costs and land purchase costs if necessary.

Note that the habitat replacement costs provided in this study do not include for ongoing management of replacement habitat, or for dealing with the habitat that is being replaced. There are also no costs included for relocating fauna species as part of the habitat replacement. This should be considered if making comparisons with the costs of asset management.

4.0 Limitations of the Cost Calculator

4.1 Introduction

It is acknowledged that whilst the cost calculator provides an indication of the likely future costs of third party asset management and habitat replacement, uncertainties in the quality and extent of input data mean that there is potential for the costs to vary. To account for this, each uncertainty has been quantified to identify the likely effect that this may have on the total cost of asset management or habitat replacement. For each uncertainty that may influence costs, a percentage increase and / or decrease in the total costs has been identified.

Each key uncertainty is discussed below, along with a justification for the potential effect upon the overall costs. It is considered that the level of uncertainty assigned to each of the below issues is the current best estimate based upon available data.

The overall highest and lowest possible costs for both asset management and habitat replacement have then been derived based upon the cumulative effects of the uncertainties upon the cost estimates. The uncertainties and quantified effects on the asset management costs and habitat replacement costs are summarised in Tables 4.1 and 4.2 respectively.

It may be possible to though further study to reduce these uncertainties and to consider the combined effects of certain uncertainties. Therefore, the cost calculator has been designed to allow the user to alter the level of uncertainty given to each issue.

4.2 Uncertainties in asset management costing

Number of assets maintained by third parties

It is likely that NFCDD overestimates the number of assets that are included in the 'private' maintainer category. As discussed in section 2, the private maintainer category is known to contain certain assets that are owned by competent authorities. Where ownership is recorded in the database, it has been possible to exclude a total of 193 assets from the costing exercise, but it possible that the number of third party assets is lower than recorded in the database. The study steering group has estimated that the total third party asset management costs could be over-estimated by up to 50%.

Height of assets used in costing

As discussed in section 3, as only a selection of assets were assigned a height in NFCDD it was agreed to adopt the average asset height from the unit cost database for structural asset types in the costing exercise. It is likely that the majority of assets will have a height that is lower than the average in the unit cost database, so there is a possibility that this will cause the costs to be overestimated by up to 20%.

Unit cost of asset replacement

It is predicted that asset replacement costs in the cost calculator may need to increase by 60% to account for any optimism bias in the costs that are included in the unit cost database.

Number of third party assets indirectly linked to sites

The number of third party assets indirectly linked to internationally important sites is likely to be overestimated because the only filter used was whether the assets were within 1km of the site boundary. A lack of input data on flood flow patterns and intervening landscape features between assets and sites meant that is was not possible to discount assets within 1km of sites that have no effect upon the condition of the site itself.

It may be that very few third party assets outside sites affect the habitats within the sites, causing the costs for managing assets that are indirectly linked to sites to be overestimated by up to 100%. As the cost of managing third party assets that are indirectly linked to international constitutes 43% of the total cost of managing assets that are both directly and indirectly linked to international sites (discussed further in section 5.2), the total asset management costs may be overestimated by up to 43%.

Unit cost of asset repair

As the repair costs are based on a percentage of the replacement cost, it is predicted that asset repair costs may need to increase by 60% to account for optimism bias in the unit cost database, from which the replacement costs are derived.

Year of intervention

The deterioration curves in the cost calculator assume that assets are at the start of the condition grade to which they have been assigned. It is possible that in reality assets are close to deteriorating to the next grade down (e.g. 1 to 2). The steering group has therefore assumed that the potential delay in intervention through overrating the condition of assets would cause the overall asset management costs to be 20% underestimated.

In total, the combined effect of uncertainties to decrease the total asset management cost means that the lowest possible cost is 0.23 times the cost predicted in the cost calculator. Conversely the combined effect of uncertainties to increase the total asset management cost means that the highest possible cost is 3.07 times the cost predicted in the cost calculator.

Table 4.1: Quantified effects of uncertainties upon Asset Management Costs

Cause	Cost may need to increase by factor of:	Cost may need to decrease by factor of:	Cumulative error increase	Cumulative error decrease	Justification
Number of assets maintained by third parties	0.00	0.50	1.00	0.50	NFCDD overestimates number of assets in third party ownership
Height of assets used for costing	0.00	0.20	1.00	0.40	Medium height used from EA cost database
Unit cost of asset replacement	0.60	0.00	1.60	0.40	Standard EA optimism bias
No. of assets indirectly linked to sites	0.00	0.43	1.60	0.23	1km buffer to indirectly link sites to assets likely over-estimates number of relevant assets
Unit cost of asset repair	0.60	0.00	2.56	0.23	Standard EA optimism bias
Year of intervention	0.20	0.00	3.07	0.23	Rate of asset deterioration may be underestimated in early years
Total error factor			**3.07**	**0.23**	-

Note: orange shading denotes cells in the cost calculator that can be altered by the user.

4.3 Uncertainties in Habitat Replacement Costing

Number of assets maintained by third parties

The steering group has determined that NFCDD may overestimate the number of assets that are included in the 'private' maintainer category by up to 50%. Therefore it could be possible that 50% of third party assets linked to habitats are actually managed by competent authorities, who would have a duty to continue asset management rather than replace habitat.

Area of habitat to be replaced

The steering group has estimated that the area of habitat to be replaced could be overestimated by up to 40%. The methodology calculates replacement costs for the whole of a SSSI unit linked to a third party asset, whereas only a part of the habitat within the unit may be affected by the asset. For example, certain coastal sites have large SSSI units of littoral sediment that are likely to only be partially affected by assets in the unit.

Number of assets detrimentally affecting sites

The methodology assumes that where third party assets are linked either directly or indirectly to SSSI units detrimentally affected by flood risk management, that these assets are causing the detriment. Whilst assets managed by third parties may be linked to unfavourable SSSI units, it may be that detrimental effects are actually caused by assets managed by competent authorities (including the Environment Agency) within these SSSIs, rather than third party assets. The steering group has estimated that this assumption may cause the habitat replacement costs to be overestimated by up to 20%.

In total, the combined effect of uncertainties to decrease the total habitat replacement cost means that the lowest possible cost of replacing habitats in internationally designated sites that are linked to third party assets is 0.22 times of the cost predicted in the cost calculator. It is not anticipated that the habitat replacement costs in the calculator are underestimated.

Table 4.2: Uncertainties and quantified effects on Habitat Replacement Costs

Cause	Cost may need to increase by factor of:	Cost may need to decrease by factor of:	Cumulative error increase	Cumulative error decrease	Justification
Number of assets maintained by non-EA parties	0.00	0.50	1.00	0.70	NFCDD overestimates number of assets in third party ownership
Area of habitat to be replaced	0.00	0.40	1.00	0.28	Assumption that whole SSSI-unit will need to be replaced overestimates replacement requirement
Number of assets detrimentally affecting sites	0.00	0.20	1.00	0.22	Precautionary attribution of site damage to assets that are third party maintained
Total error factor			**1.00**	**0.22**	-

Note: orange shading denotes cells in the cost calculator that can be altered by the user.

5.0 Costs of Asset Management and Habitat Replacement

5.1 Introduction

The information in this section has been extracted from the cost calculator using the cost data, assumptions and levels of uncertainty identified in the previous sections. Users can integrate the results further within the cost calculator, using pivot tables to extract information for particular international sites or asset types for example.

5.2 Third Party Asset Costs Summary

The overall Present Value management cost of all third party assets linked to international sites over the next 100 years is £11.5 Billion (with an upper cost limit of £35.3 Billion and a lower limit of £2.6 Billion to account for uncertainty). Nevertheless, there are several factors that will affect this overall cost. The breakdown of the costs is provided in Table 5.1.

The inclusion of a factor to account for sea level rise resulting from climate change increases the value to £12.9 Billion (with an upper limit of £39.6 Billion and a lower limit of £3.0 Billion to account for uncertainty).

Slightly under half of the asset management costs (£4.9 Billion) relate to assets that are directly linked to sites (i.e lie within them), whilst the remaining costs (£6.6 Billion) relate to assets that are indirectly linked to sites (i.e lie outside them but within 1km in the floodplain) and therefore may not be as important for conservation of sites.

Approximately half of the third party asset management costs linked to international sites (£6.2 Billion) are associated with assets in fluvial floodplain areas, whilst the remainder of the costs are associated with tidal floodplain areas (£4.6 Billion) or areas where the floodplain type has not been defined (£753,118,000). In addition, the vast majority of assets lie within Flood Zones 2 and 3 (which are vulnerable to floods with return periods of between 1:1 and 1:000) with a total cost of £10.3 Billion. Whilst a small number lie of assets only within Flood Zone 2 (which is vulnerable to floods with return periods of between 1:100 and 1:000) or in areas where the flood zone has not been defined, with total costs of £320,483,000 and £772,166,000 respectively.

As shown in Table 5.1, approximately £826 million of the asset management costs relate to assets that are associated with habitats that are currently in an unfavourable condition due to flood risk management. The Environment Agency regions with the highest asset management costs in habitats detrimentally affected by flood risk management are the north west and anglian.

Table 5.1: Summary of Costs for Management of Third Party Assets Affecting International Sites

Factor affecting costs	Breakdown	Baseline cost (£)	Uncertainty	
			Lower Cost Limit (£)	Upper Cost Limit (£)
Overall PV Cost	-	11,500,000,000	2,645,000,000	35,305,000,000
Climate Change	Overall PV Cost with Climate Change	12,900,000,000	2,967,000,000	39,603,000,000
Asset/ Site linkage	Assets directly linked to site	4,937,588,744	1,135,645,411	15,158,397,444
	Assets indirectly linked to site	6,571,739,993	1,511,500,198	20,175,241,779
Floodplain	Fluvial	6,163,593,805	1,417,626,575	18,922,232,981
	Tidal	4,592,617,228	1,056,301,962	14099334890
	Not Defined	753,117,704	173,217,072	2,312,071,351
Flood zone	FZ2	320,482,596	73,710,997	983881569.7
	FZ2 & FZ3	10,329,959,820	2,375,890,759	31,712,976,647
	Not Defined	772,165,953	177,598,169	2,370,549,476
Habitat in unfavourable condition due to flood risk management		£826,398,049	£190,071,551	£2,537,042,010

The costs for management of all third party assets affecting international sites are presented graphically by Environment Agency region in Figures 5.1 to 5.3. The north west, south west and Wales Environment Agency regions have the highest management costs. Figure 5.3 identifies that the asset type with the highest costs in most Environment Agency regions is 'natural channels', although in the anglian and north west regions the highest costs are for coastal assets.

The costs relating to management of third party assets that are directly linked to international sites only (i.e. excluding costs of assets that are indirectly linked) are presented graphically by Environment Agency region in Figures 5.4 to 5.6. The Wales and south west Environment Agency regions have the highest management costs for assets directly affecting sites.

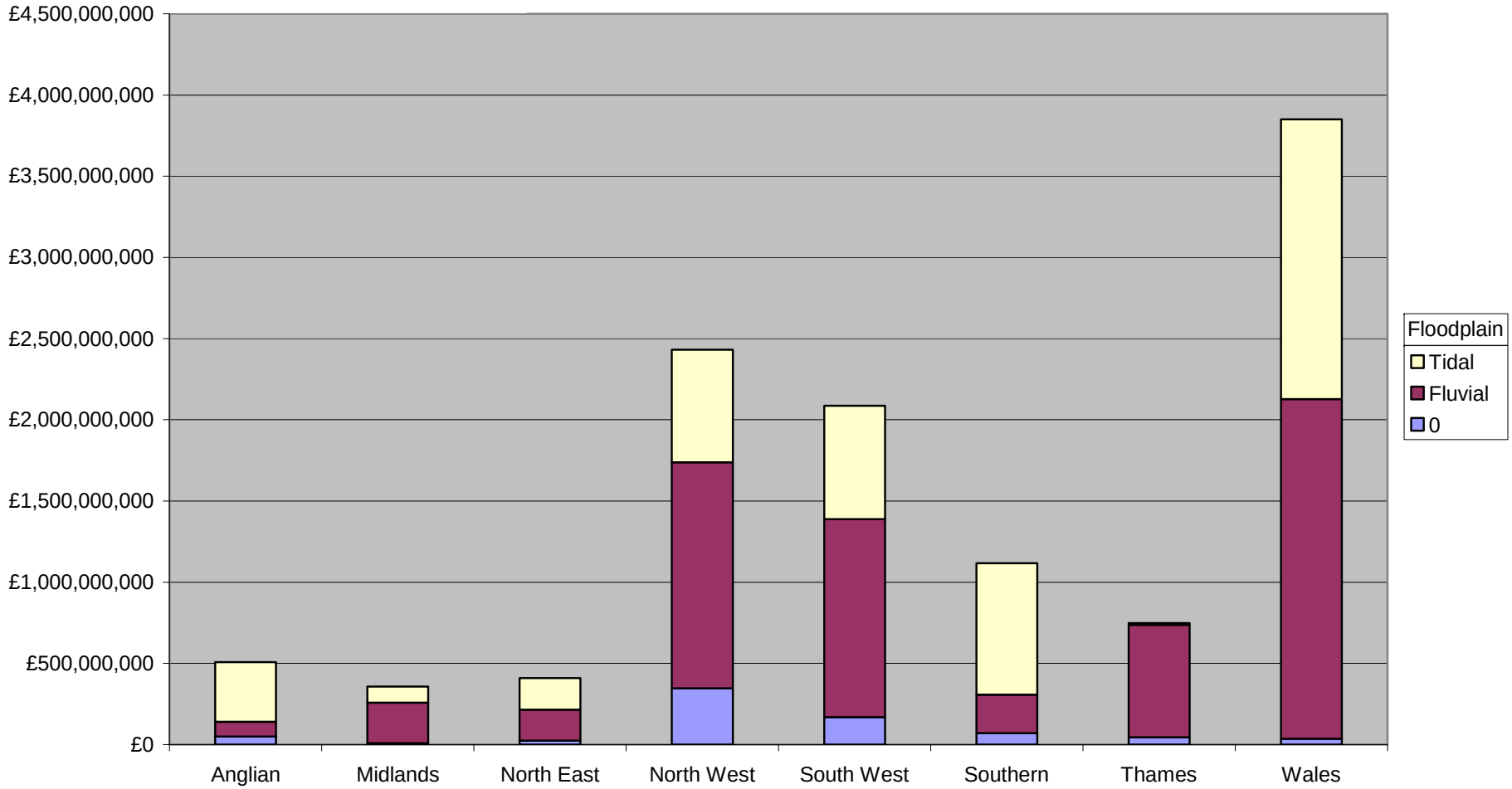

Figure 5.1: Breakdown of Costs for Management of all Third Party Assets affecting International Sites, by Environment Agency Region and Floodplain Type
Note: 0 indicates where floodplain was not defined.

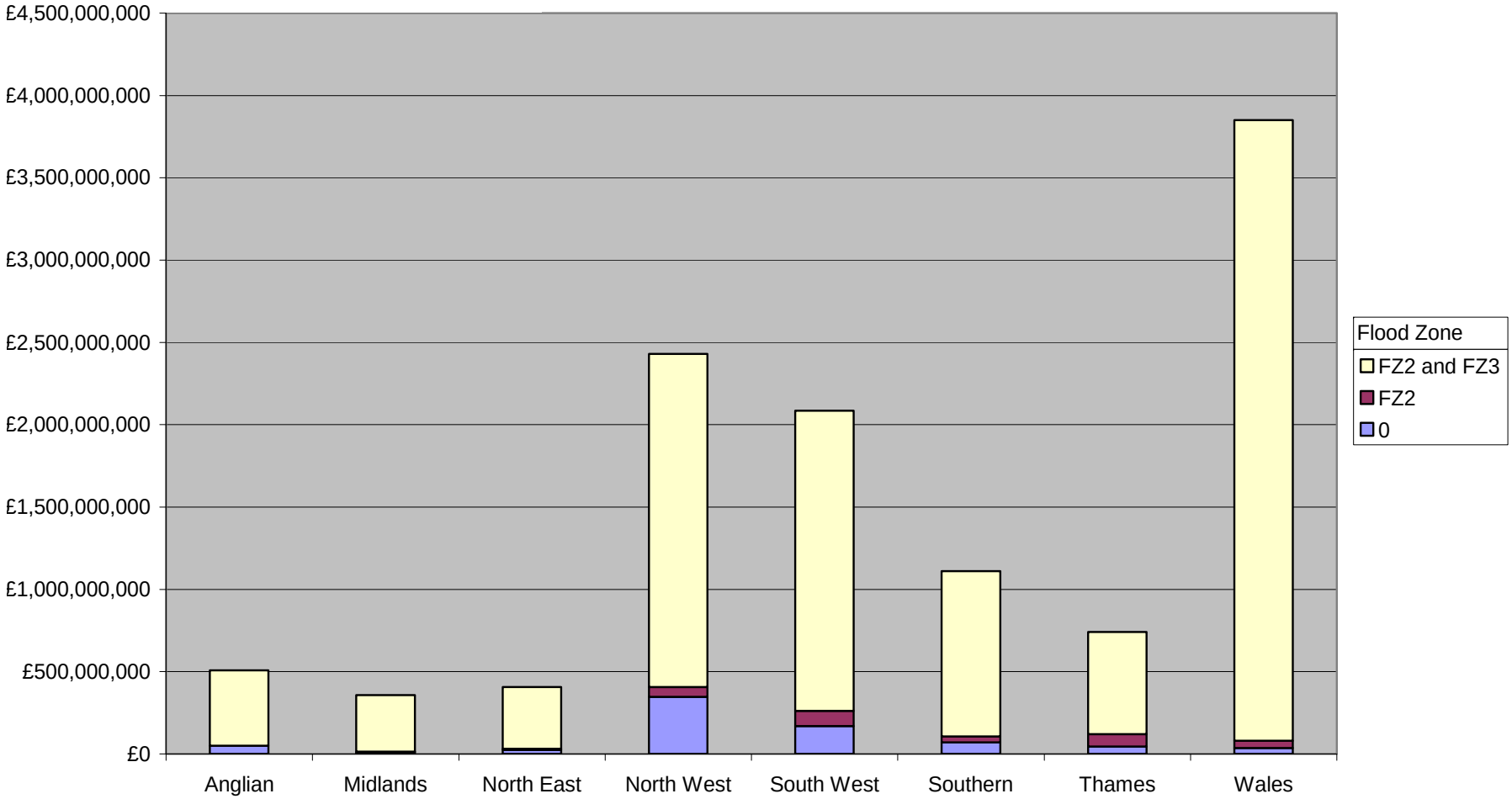

Figure 5.2: Breakdown of Costs for Management of all Third Party Assets affecting International Sites, by Environment Agency Region and Flood zone

Note: 0 indicates where flood zone was not defined.

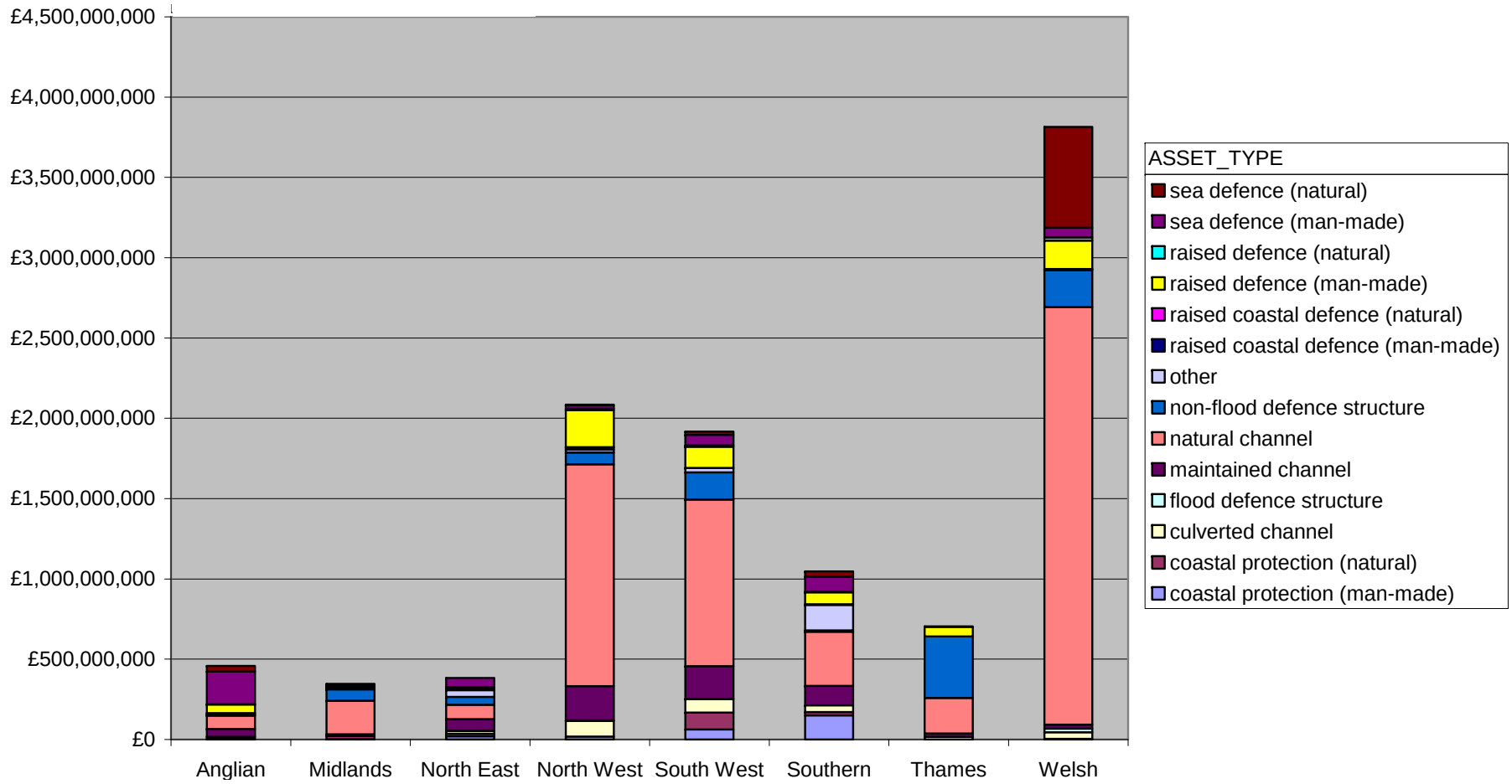

Figure 5.3: Breakdown of Costs for Management of all Third Party Assets affecting International Sites, by Environment Agency Region and by Asset Type

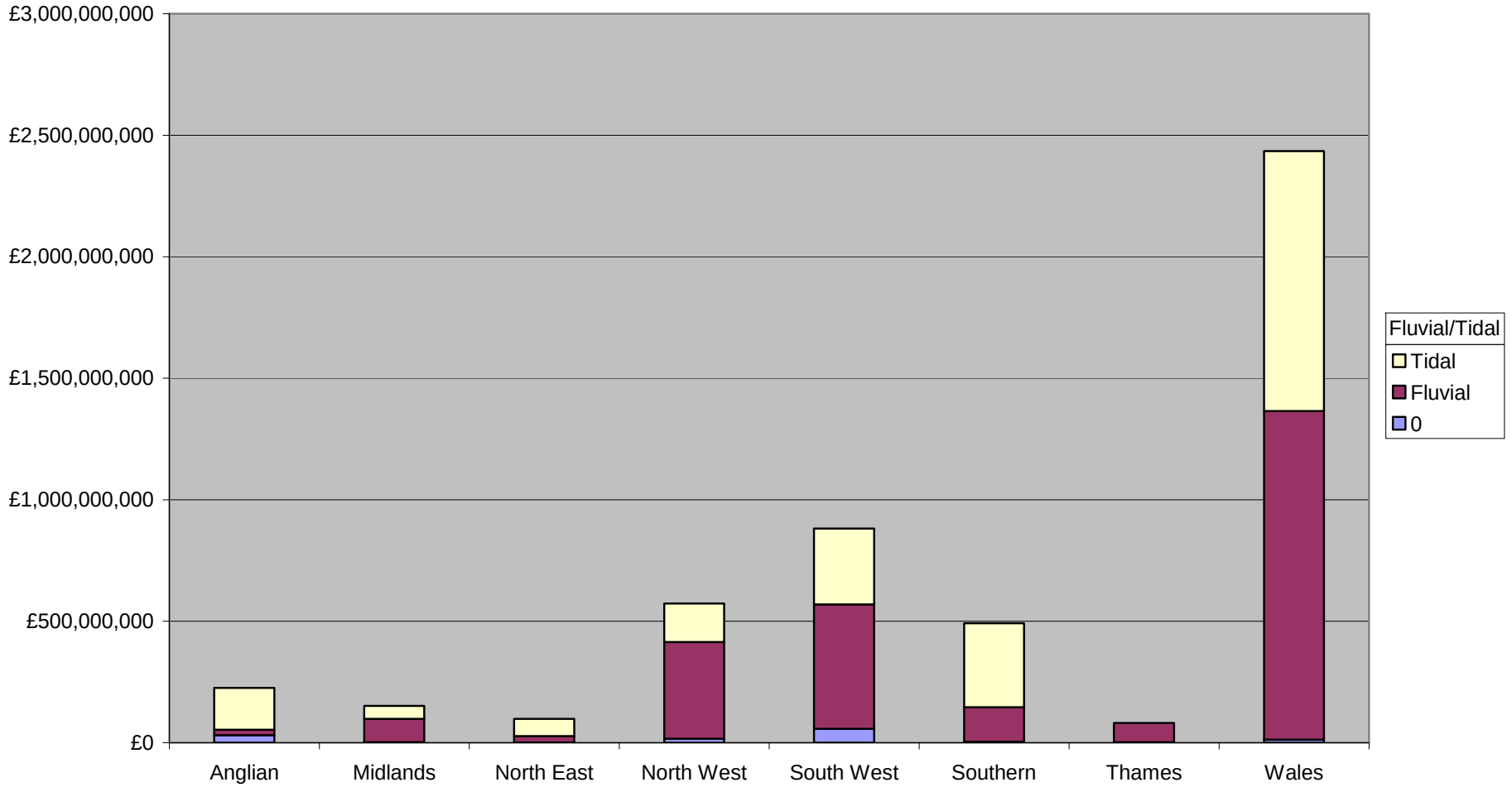

Figure 5.4: Breakdown of Costs for Management of Third Party Assets directly affecting International Sites, by Environment Agency Region and Floodplain Type
Note: 0 indicates where floodplain was not defined.

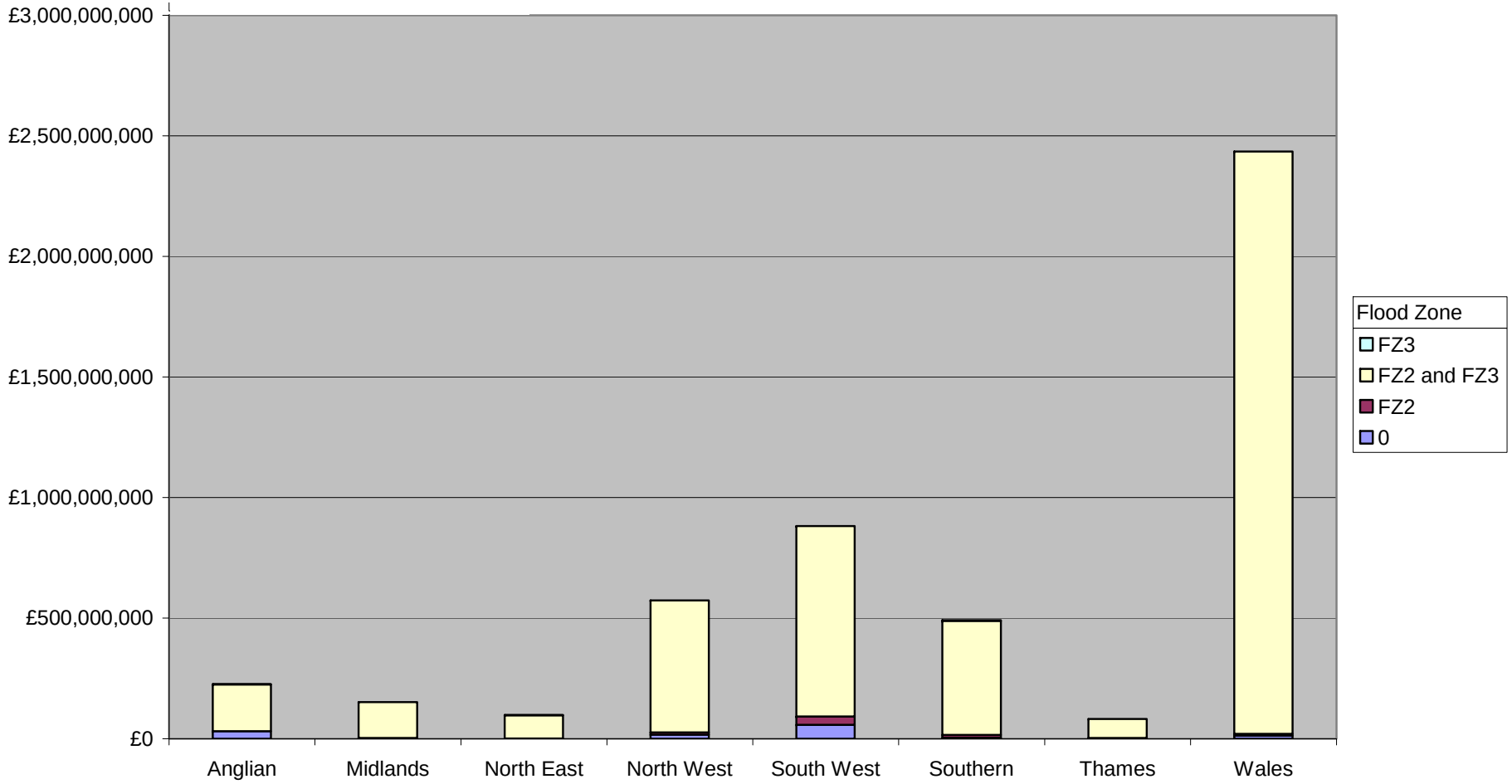

Figure 5.5: Breakdown of Costs for Management of Third Party Assets directly affecting International Sites, by Environment Agency Region and Flood zone
Note: 0 indicates where flood zone was not defined.

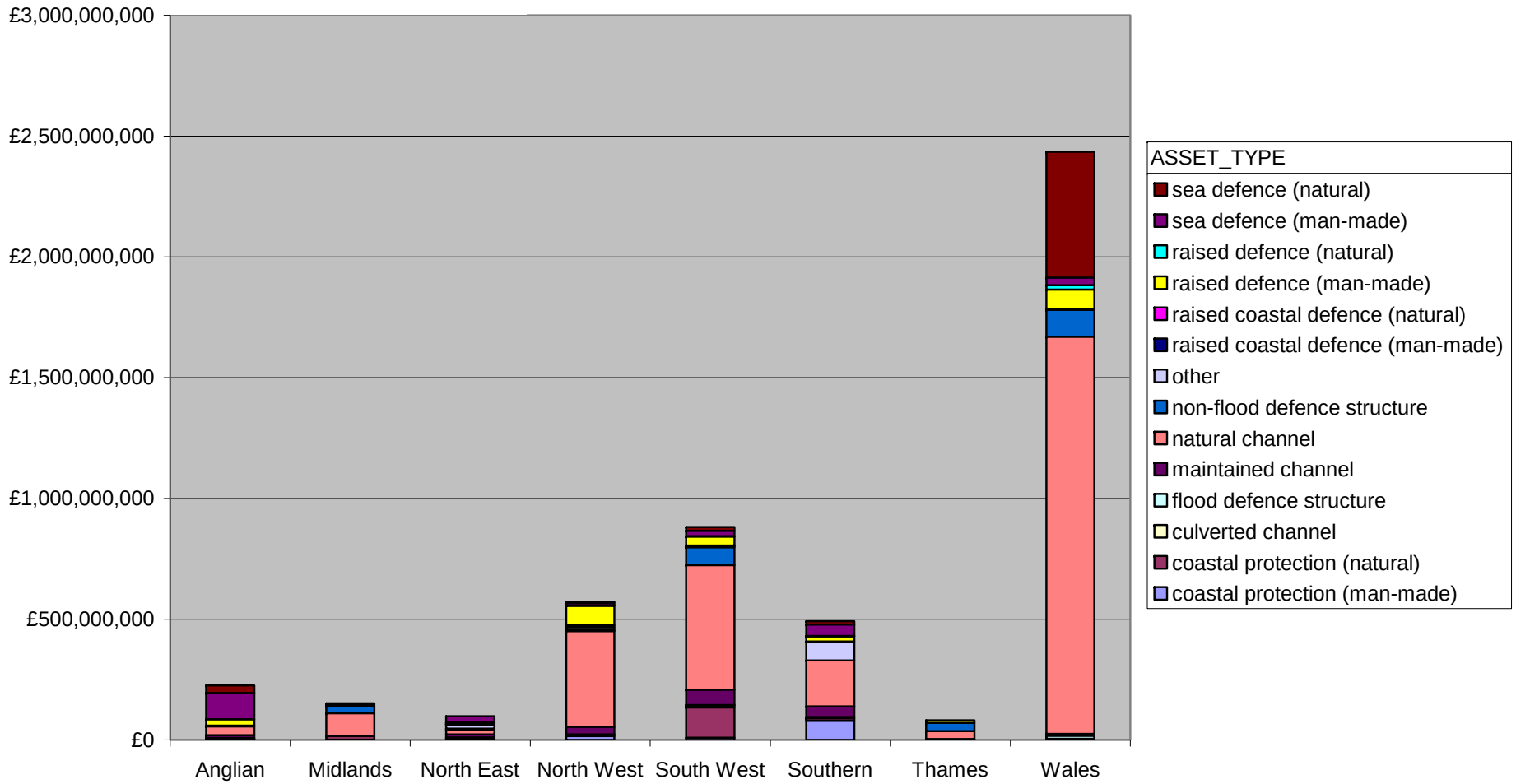

Figure 5.6: Breakdown of Costs for Management of Third Party Assets directly affecting International Sites, by Environment Agency Region and by Asset Type

5.3 Habitat Replacement Costs Summary

The overall Present Value cost for replacement of habitats that are linked to third party managed assets is £4 Billion (with a lower cost limit of £882,200,000 to account for uncertainty). As with the asset management costs, there are several factors that will affect this overall habitat replacement cost. The breakdown of the costs is provided in Table 5.2.

The costs for replacement of habitats that are affected by third party managed assets are presented graphically by Environment Agency region in Figures 5.4 to 5.8. The north west, southern and anglian regions have the highest habitat replacement costs.

About one third of the habitat replacement costs (£1,331,513,000) relate to replacement of habitats that are directly linked to assets, as shown in Figure 5.7. The remaining costs (£2,674,693,000) relate to habitats in sites that are indirectly linked to assets and therefore may not be as vulnerable to changes in management of these assets.

Approximately one quarter of the habitat replacement costs (£1,004,665,000) are associated with sites in fluvial floodplain areas, whilst the remainder of the costs are associated with habitats in tidal floodplain areas (£2,584,544,000) or areas where the floodplain type has not been defined (£416,997,000) (Figure 5.8). In addition, the vast majority of costs associated with habitat replacement are for sites within Flood Zones 2 and 3 (which are vulnerable to floods with return periods of between 1:1 and 1:000) with a total cost of £3,466,804,214. A small number of sites lie only within Flood Zone 2 (which is vulnerable to floods with return periods of between 1:100 and 1:000) or in areas where the flood zone has not been defined, with total costs of £116,999,000 and £422,404,000 respectively.

The habitat type with the largest replacement costs is littoral sediment, which accounts for over half of the total replacement costs. There are also large replacement costs associated with river and stream habitats, as shown in Figure 5.9.

Of the total habitat replacement costs, approximately half of the costs are associated with habitats in favourable condition (£2,241,409,000) and half are associated with habitats in unfavourable condition (£1,764,797,000). This is shown diagrammatically in Figure 5.10.

As shown in Figure 5.11, approximately £400 million of the habitat replacement costs for habitats linked to third party assets are associated with habitats that are currently in an unfavourable condition due to flood risk management. The Environment Agency regions with habitats particularly affected by flood risk management are anglian and southern.

The costs for replacement of habitats that are directly linked to third party assets only (i.e. the assets lie within them) are presented graphically in

relation to floodplain type, habitat type, favourable condition and whether the habitat is in unfavourable condition due to flood defences in Figures 5.12 to 5.15 respectively.

The distribution of costs of habitat replacement that relate to directly linked third party managed assets broadly reflect those relating to both directly and indirectly linked assets. The Environment Agency region with the largest replacement costs associated with habitats directly linked to third party assets is the north west. Nevertheless, the the anglian and southern regions have the highest habitat replacement costs for habitats that are directly linked to third party assets and are in unfavourable condition due to flood risk management.

Table 5.2: Summary of Costs for Replacement of Habitats that are Linked to Third Party Assets

Factor affecting costs	Breakdown	Baseline cost (£)	Uncertainty	
			Lower Cost Limit (£)	Upper Cost Limit (£)
Overall PV Cost	-	4,010,000,000	882,200,000	4,010,000,000
Asset/ Site linkage	Assets directly linked to site	1,331,513,412	292,932,951	1,331,513,412
	Assets indirectly linked to site	2,674,692,994	588,432,459	2,674,692,994
Floodplain	Fluvial	1,004,664,592	221,026,210	1,004,664,592
	Tidal	2,584,544,357	568,599,759	2,584,544,357
	Not Defined	416,997,458	91,739,441	416,997,458
Flood zone	FZ2	116,998,679	25,739,709	116,998,679
	FZ2 & FZ3	3,466,804,214	762,696,927	3,466,804,214
	Not Defined	422,403,514	92,928,773	422,403,514
Condition	Favourable	2,241,409,217	493,110,028	2,241,409,217
	Unfavourable	1,764,797,190	388,255,382	1,764,797,190

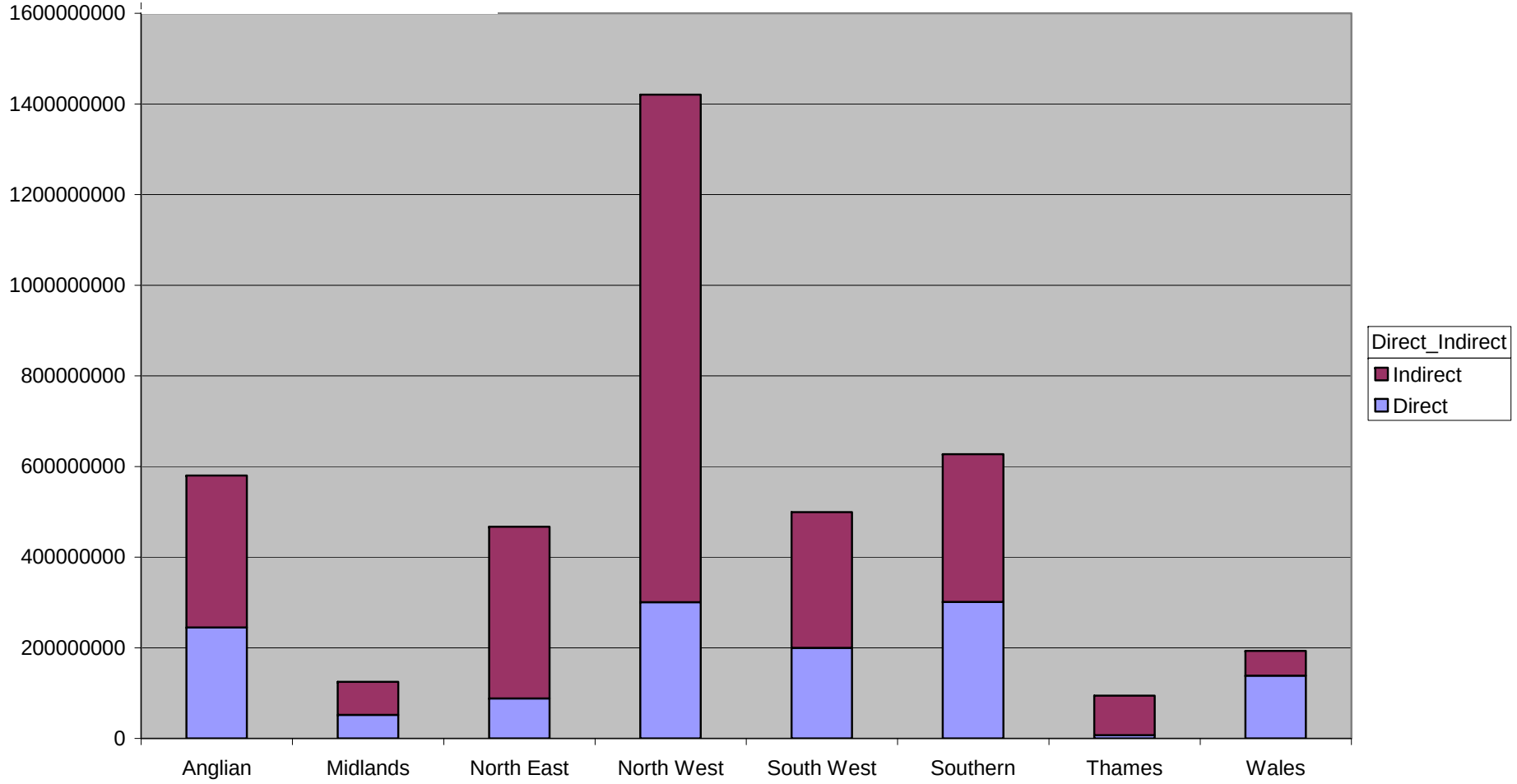

Figure 5.7: Breakdown of Costs for Replacement of Internationally Designated Habitats that are linked to Assets Managed by Third Parties by Environment Agency Region and by direct and indirect linkages

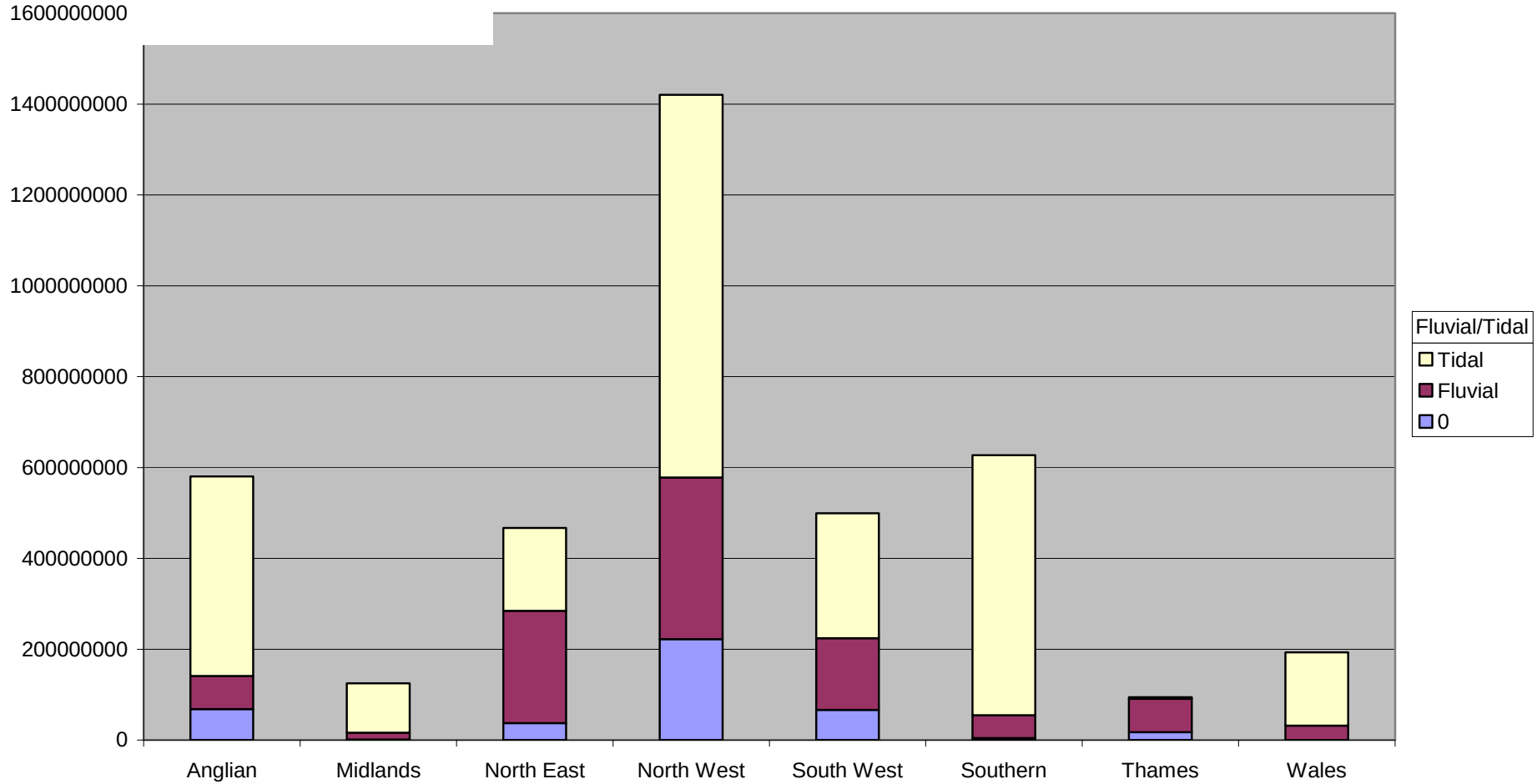

Figure 5.8: Breakdown of Costs for Replacement of Internationally Designated Habitats that are linked to Assets Managed by Third Parties - by Environment Agency region and by floodplain type
Note: 0 indicates where floodplain was not defined.

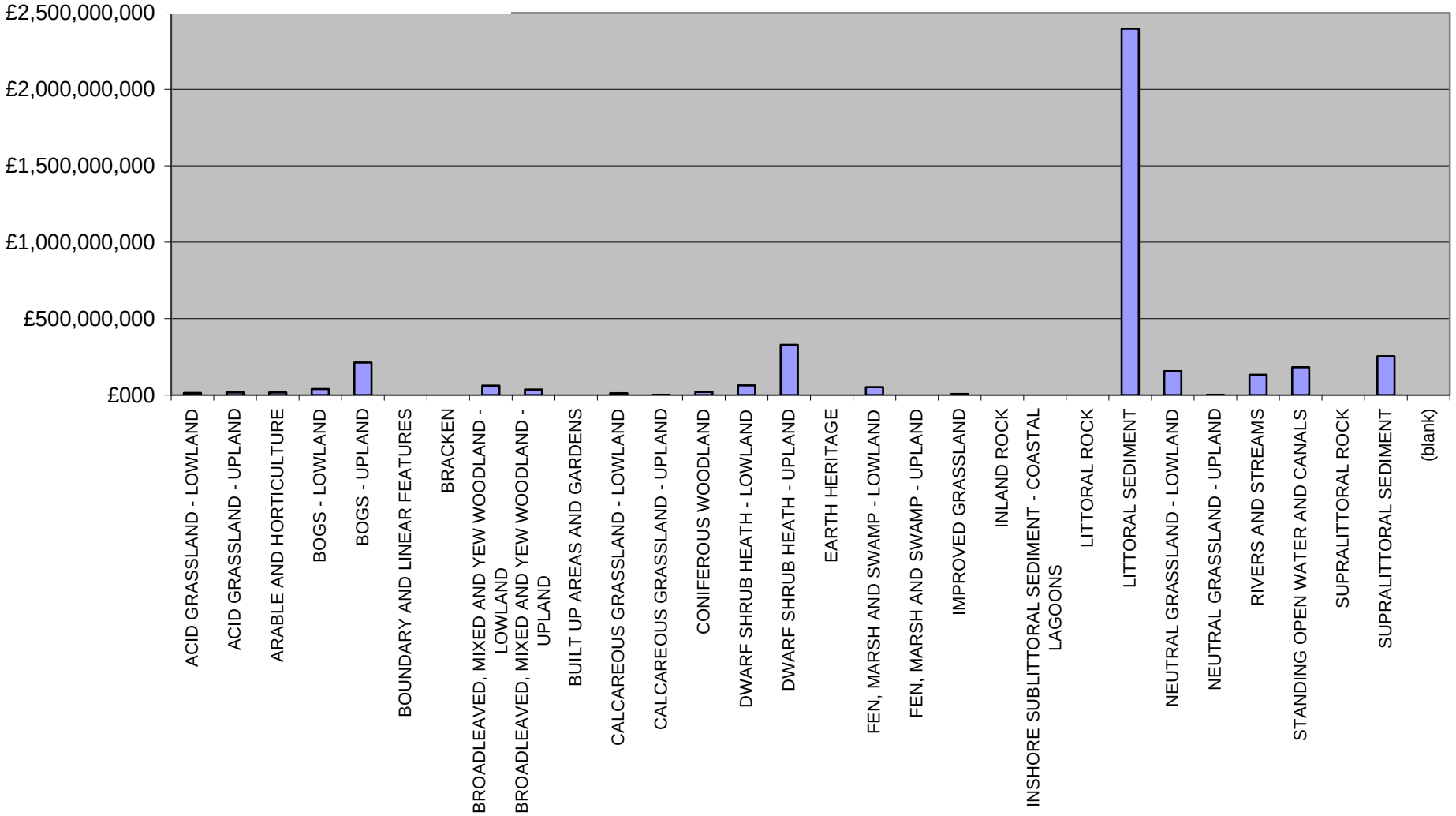

Figure 5.9: Breakdown of Costs for Replacement of Different Internationally Designated Habitat Types that are linked to Assets Managed by Third Parties

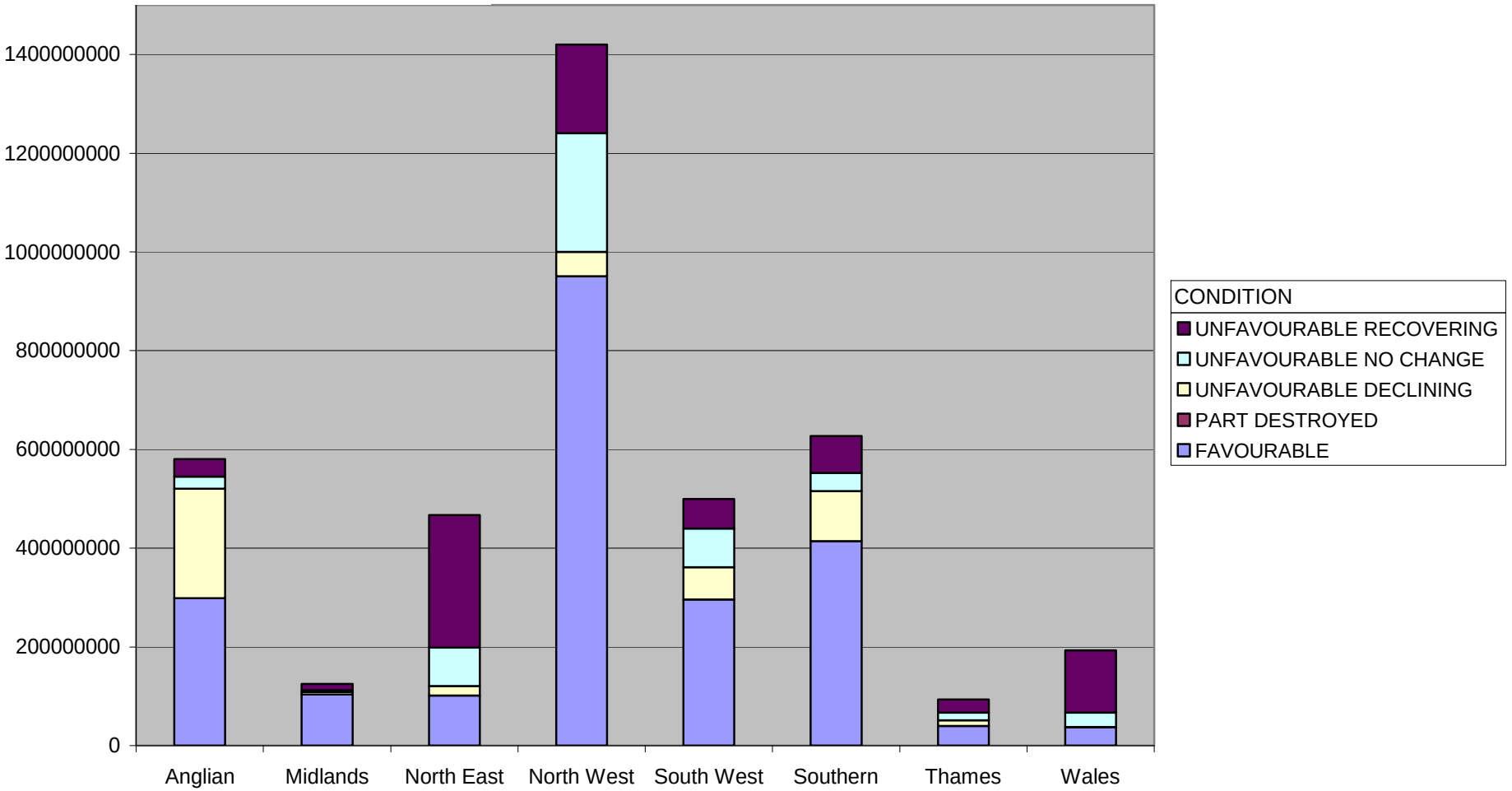

Figure 5.10: Breakdown of Costs for Replacement of Habitats that are linked to Assets Managed by Third Parties - by Environment Agency Region and by Habitat Condition

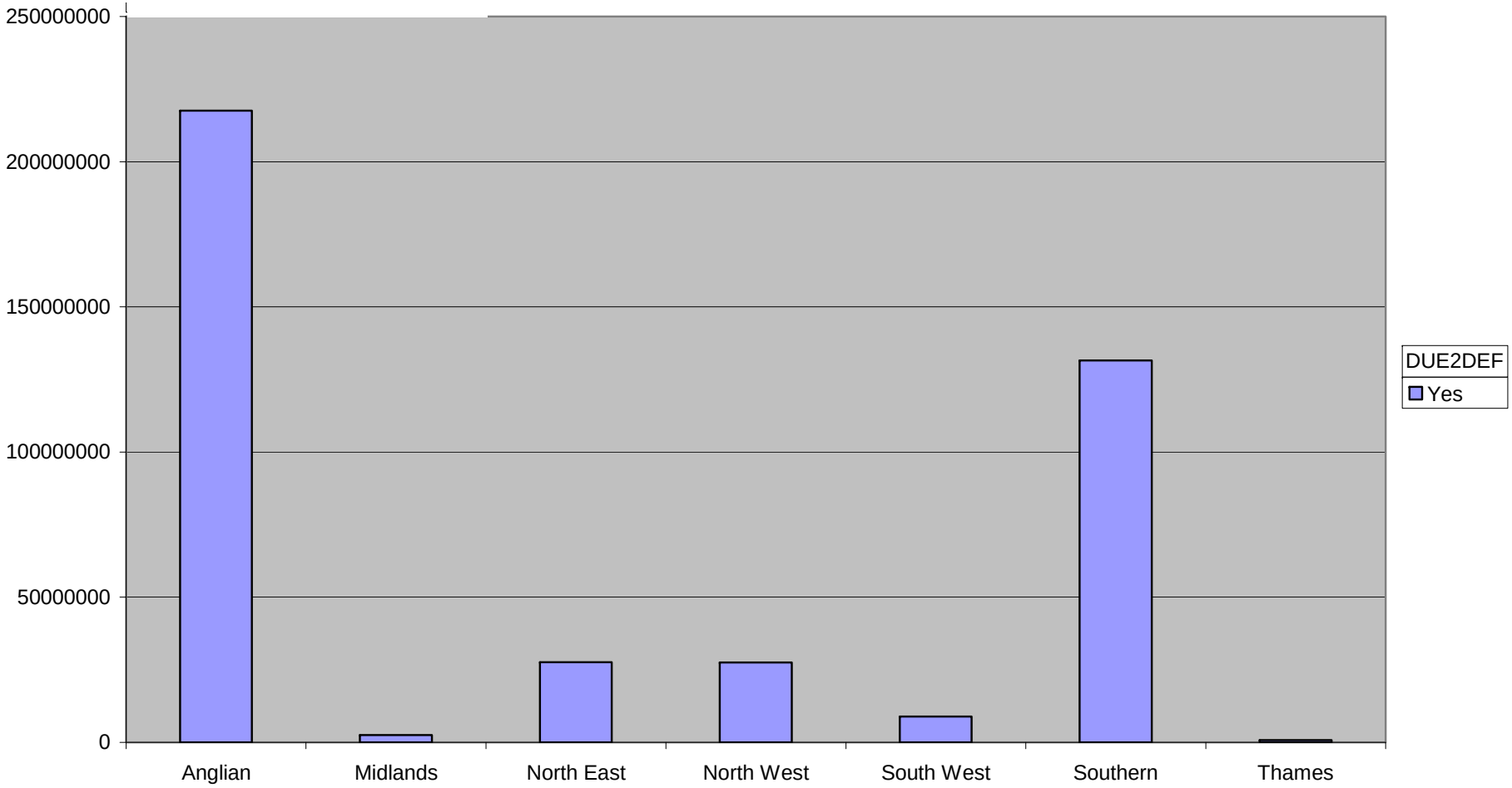

Figure 5.11: Breakdown of Costs for Replacement of Habitats in Unfavourable Condition and linked to Assets Managed by Third Parties, where the Unfavourable Condition is caused by Flood Risk Management

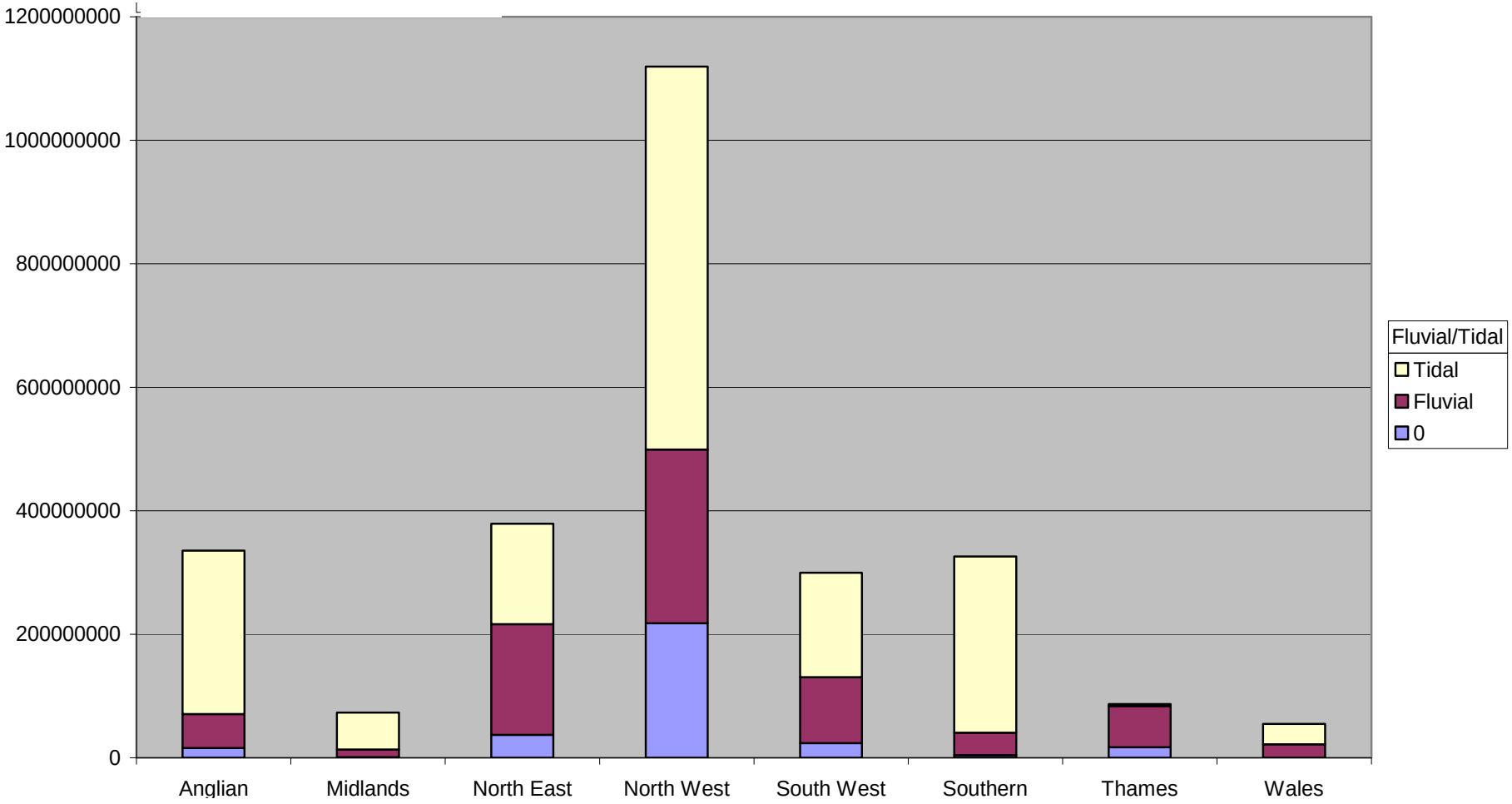

Figure 5.12: Breakdown of Costs for Replacement of Internationally Designated Habitats that are Directly Linked to Assets Managed by Third Parties - by Environment Agency region and by floodplain type
Note: 0 indicates where floodplain was not defined.

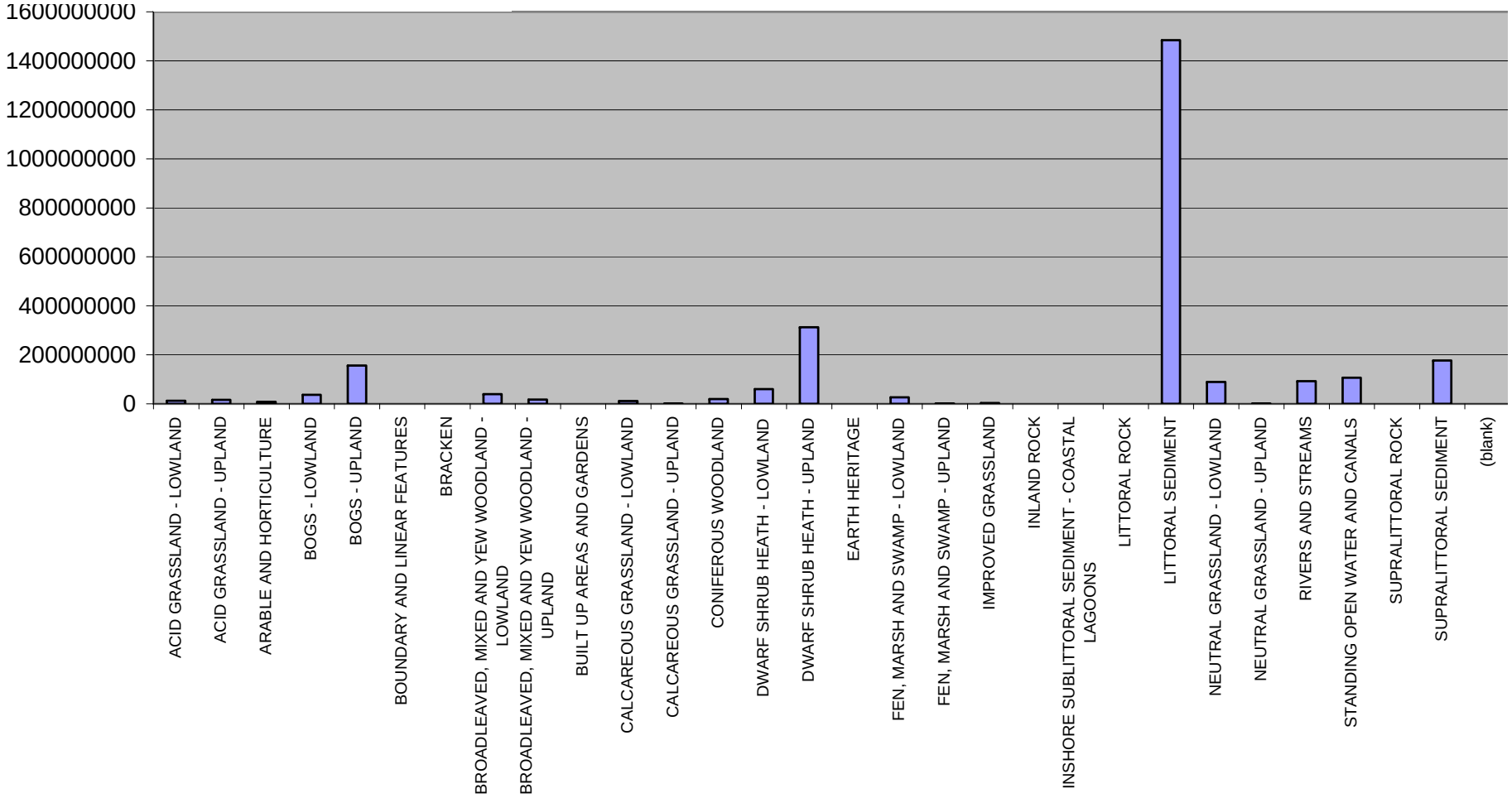

Figure 5.13: Breakdown of Costs for Replacement of Different Internationally Designated Habitat Types that are Directly linked to Assets Managed by Third Parties

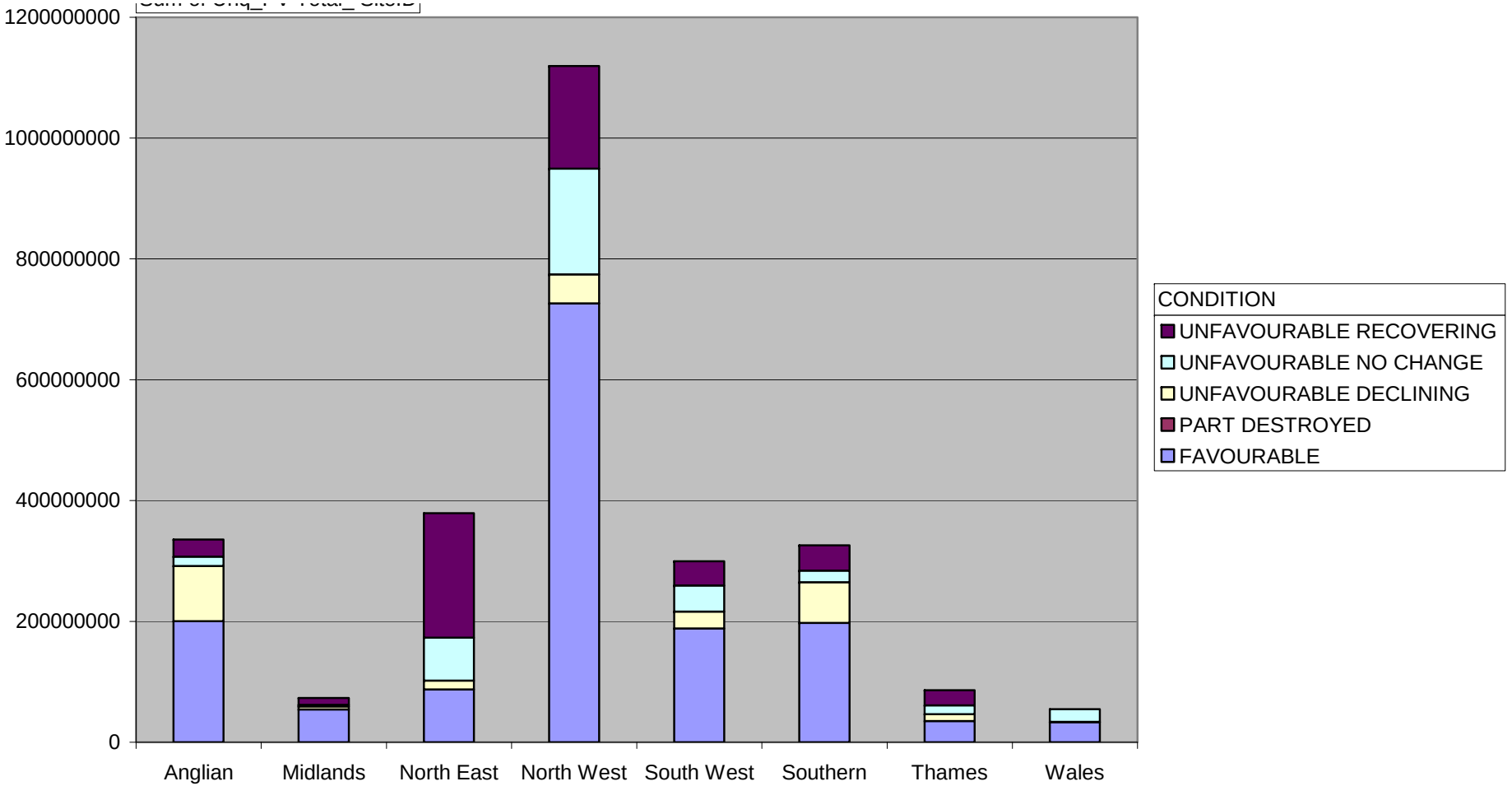

Figure 5.14: Breakdown of Costs for Replacement of Habitats that are Directly Linked to Assets Managed by Third Parties - by Environment Agency Region and by Habitat Condition

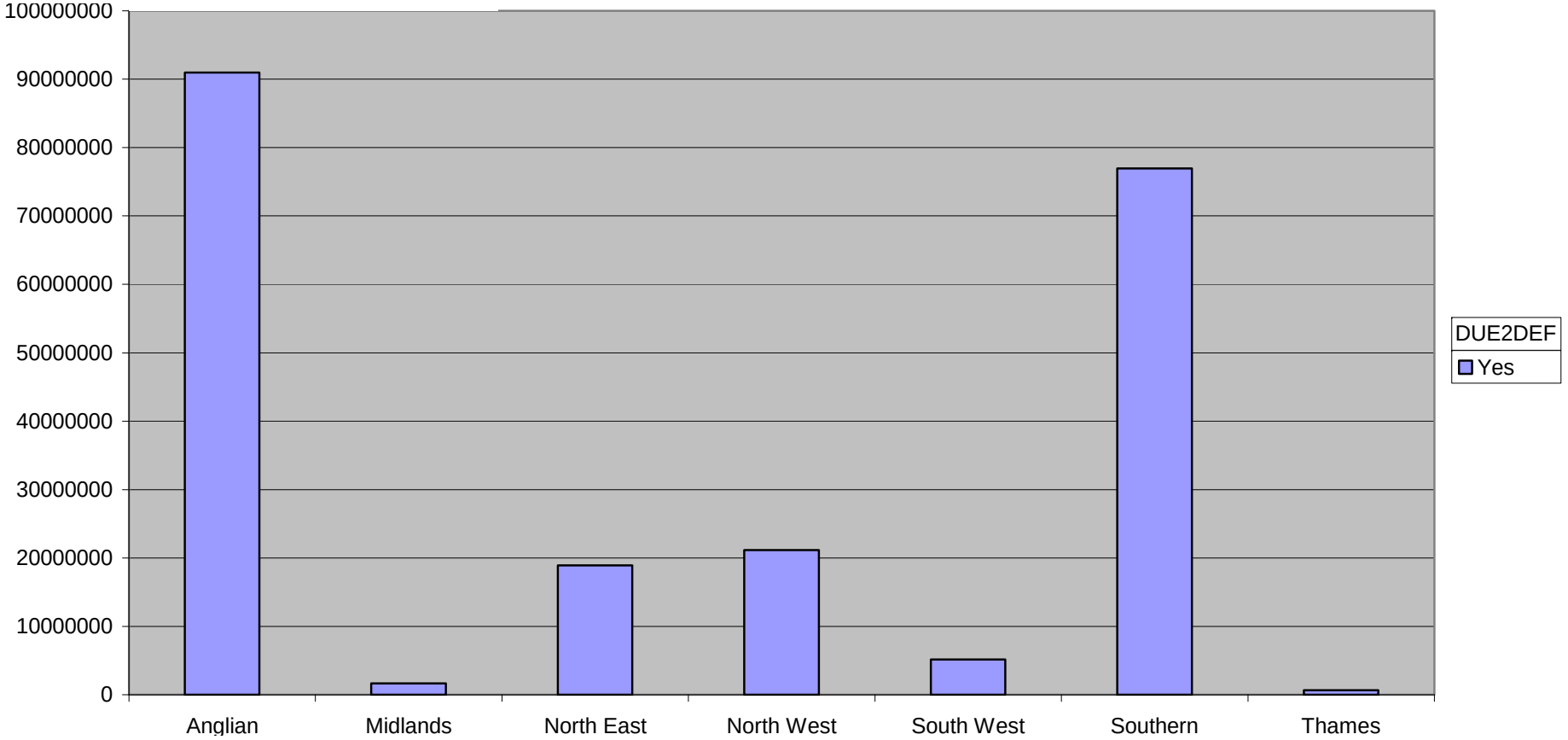

Figure 5.15: Breakdown of Costs for Replacement of Habitats in Unfavourable Condition and Directly Linked to Assets Managed by Third Parties, where the Unfavourable Condition is caused by Flood Risk Management

6.0 Summary

The study has identified high level indicative costs for the future management of third party flood risk assets affecting internationally important sites over the next 100 years. The study has also identified the costs of replacing habitats in international sites that are affected by these third party flood risk assets.

The overall cost of managing all third party assets linked to European Sites over the next 100 years is estimated to be £11.5 billion (lower estimate £2.6 billion: upper estimate - £35.3 billion). Including a factor to account for sea level rise, this increases the estimated cost to £12.9 billion. These results equate to the following potential annual costs of managing third party assets associated with European Sites: assets within sites - in tidal floodplain = £21.8 million, in fluvial floodplain = £26.3 million; assets outside sites – in tidal floodplain = £24.1 million, in fluvial floodplain = £35.4 million. In comparison, overall the Environment Agency currently spends in the region of £800 million a year on flood risk management.

It is acknowledged that whilst the cost calculator provides an indication of the likely future costs of third party asset management and habitat replacement, uncertainties in the quality and extent of input data mean that there is potential for the costs to vary. Nevertheless, the values used in the costing exercise are considered to be best estimates based on the data available.

The cost calculator has been specifically designed to allow modifications to costs, assumptions and levels of uncertainty. Therefore as further information becomes available on climate change or habitat replacement costs for example the costs can be updated to reflect these changes.

The outputs of this study can be used to identify the potential costs associated with taking on the management of some or all of the third party assets effecting international sites in floodplains over the next 100 years. Nevertheless, this needs to be considered alongside the ‘appropriateness’ of taking on the management of third party assets and habitat replacement.

We as the Environment Agency currently spend approximately £800 million on flood risk management per year in England and Wales. The £13 billion costs identified for managing third party assets linked to international sites over the next 100 years would therefore be a significant addition to current expenditure.

The continued maintenance of assets in their current state may not be sustainable, or even possible, over the course of 100 years. Furthermore, whilst this study has identified costs for habitat replacement, this does not imply that there is necessarily a legal responsibility on landowners to do so. In addition, the scope has not allowed for consideration of availability of land for habitat replacement, or the sensitivity of individual sites, which might make replacement difficult or impossible.

Generally, the delivery of sustainable approaches to flood risk management and the issues of habitat replacement (as a result of coastal squeeze for example) are best addressed through a strategic approach for wider areas such as an estuary, a river system or a coastal zone. The strategic approach should include comprehensive benefit cost assessments to determine the appropriateness of continued asset management and replacing habitats at individual international sites.

Considering all of the above, it is recommended that further work in the following areas is progressed:

- Further review of the costs and methods included in the cost calculator in light of future changes in guidance on economic costing. This will ensure that the calculator remains a usable tool for high level estimation of asset management and habitat replacement costs
- Detailed review of the combined effects of uncertainties upon asset management and habitat replacement costs.
- Further consideration of the appropriateness of continued management of third party assets affecting international sites, including:
    - More detailed study of individual international sites to identify the required standard of protection for conservation purposes and the extent to which individual third party assets affect the conservation interests of the site.
    - Further consideration of the appropriateness and sustainability of continued management of third party assets affecting international sites in light of potential future changes in climate and land use.

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Appendix A: Summary of International Areas Lying Within the Flood Zones of England and Wales

Table A1: International Areas within the Flood Zones – England

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
Abberton Reservoir	-	Y	Y	2,558,576	588,473	7,854,829	19,433,104	4,275,283	19,433,104
Alde-Ore & Butley Estuaries	Y	Y	Y	4,872,873	1,120,761	14,959,720	3,653,247	803,714	3,653,247
Arun Valley	-	Y	Y	1,718,406	395,233	5,275,505	2,270,452	499,499	2,270,452
Asby Complex	Y	-	-	2,528,177	581,481	7,761,502	3,951,873	869,412	3,951,873
Ashdown Forest	Y	Y	-	6,317,871	1,453,110	19,395,864	5,584,469	1,228,583	5,584,469
Avon Gorge Woodlands	Y	-	-	16,933,696	3,894,750	51,986,446	295,668	65,047	295,668
Avon Valley	-	Y	Y	218,941,887	50,356,634	672,151,594	15,232,825	3,351,222	15,232,825
Beast Cliff-Whitby (Robin Hood's Bay)	Y	-	-	139,219	32,020	427,403	0	0	0
Benacre to Easton Bavents	Y	Y	-	2,154,312	495,492	6,613,738	0	0	0
Benfleet and Southend Marshes	-	Y	Y	18,541,448	4,264,533	56,922,245	26,421,521	5,812,735	26,421,521
Berwickshire & North Northumberland Coast	Y	Y	Y	63,840,976	14,683,425	195,991,798	105,875,217	23,292,548	105,875,217
Blackstone Point	Y	-	-	12,443,933	2,862,105	38,202,876	0	0	0
Borrowdale Woodland Complex	Y	-	-	24,314,048	5,592,231	74,644,126	3,720,705	818,555	3,720,705
Bowland Fells	-	Y	-	3,141,306	722,500	9,643,810	5,522,496	1,214,949	5,522,496
Braunton Burrows	Y	-	-	28,549,535	6,566,393	87,647,072	72,383,121	15,924,287	72,383,121
Breckland	Y	Y	-	19,427,321	4,468,284	59,641,877	34,189,904	7,521,779	34,189,904
Briddlesford Copses	Y	-	-	4,853,907	1,116,399	14,901,494	269,416	59,272	269,416
Cannock Chase	Y	-	-	11,226,426	2,582,078	34,465,127	2,377,902	523,138	2,377,902
Carrine Common	Y	-	-	510,342	117,379	1,566,750	1,293	284	1,293
Chesil & The Fleet	Y	Y	Y	43,189,847	9,933,665	132,592,829	53,930	11,865	53,930

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
Chew Valley Lake	-	Y	-	13,651,306	3,139,800	41,909,511	7,732,443	1,701,137	7,732,443
Chichester and Langstone Harbours	Y	Y	Y	235,296,656	54,118,231	722,360,735	136,465,173	30,022,338	136,465,173
Chilterns Beechwoods	Y	-	-	30,593,654	7,036,540	93,922,516	1,434,123	315,507	1,434,123
Craven Limestone Complex	Y	-	Y	17,570,809	4,041,286	53,942,385	1,049,975	230,995	1,049,975
Deben Estuary	-	Y	Y	14,297,677	3,288,466	43,893,867	5,639,224	1,240,629	5,639,224
Dorset Heaths	Y	Y	Y	214,802,433	49,404,560	659,443,471	17,888,266	3,935,419	17,888,266
Dover to Kingsdown Cliffs	Y	-	-	697,141	160,342	2,140,221	0	0	0
Downton Gorge	Y	-	-	16,682,934	3,837,075	51,216,608	374,168	82,317	374,168
Drigg Coast	Y	-	-	25,939,771	5,966,147	79,635,096	2,290,632	503,939	2,290,632
Duddon Estuary	Y	Y	Y	81,208,726	18,678,007	249,310,790	79,284,928	17,442,684	79,284,928
Duddon Mosses	Y	-	-	46,904,029	10,787,927	143,995,371	5,241,291	1,153,084	5,241,291
Dungeness to Pett Level	Y	Y	-	26,681,507	6,136,747	81,912,225	49,814,024	10,959,085	49,814,024
Durham Coast	Y	Y	Y	1,899,840	436,963	5,832,509	236,271	51,980	236,271
East Hampshire Hangers	Y	-	-	6,831,497	1,571,244	20,972,697	804,909	177,080	804,909
Ebernoe Common	Y	-	-	1,013,271	233,052	3,110,743	149,160	32,815	149,160
Epping Forest	Y	-	-	14,593,925	3,356,603	44,803,351	2,127,804	468,117	2,127,804
Essex Estuaries	Y	Y	Y	139,156,988	32,006,107	427,211,952	105,165,884	23,136,494	105,165,884
Esthwaite Water	-	-	Y	8,657,210	1,991,158	26,577,636	479,153	105,414	479,153
Exe Estuary	Y	Y	Y	95,778,693	22,029,099	294,040,587	55,456,284	12,200,382	55,456,284
Exmoor & Quantock Oakwoods	Y	-	-	94,898,438	21,826,641	291,338,203	16,935,712	3,725,857	16,935,712
Exmoor Heaths	Y	-	-	130,077,482	29,917,821	399,337,871	67,635,804	14,879,877	67,635,804
Fal & Helford	Y	-	-	49,129,526	11,299,791	150,827,646	11,857,932	2,608,745	11,857,932
Fenland	Y	-	Y	4,781,058	1,099,643	14,677,847	885,918	194,902	885,918
Flamborough Head	Y	Y	-	4,343,634	999,036	13,334,957	0	0	0
Hamford Water	-	Y	Y	10,961,514	2,521,148	33,651,847	22,675,442	4,988,597	22,675,442

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
Harbottle Moors	Y	-	-	2,862,187	658,303	8,786,915	16,268,482	3,579,066	16,268,482
Hartslock Wood	Y	-	-	196,391	45,170	602,921	494,742	108,843	494,742
Hornsea Mere	-	Y	-	815,343	187,529	2,503,103	173,182	38,100	173,182
Humber Estuary	-	Y	Y	71,169,215	16,368,919	218,489,489	100,824,251	22,181,335	100,824,251
Ingleborough Complex	Y	-	-	432,922	99,572	1,329,069	0	0	0
Isle of Portland to Studland Cliffs	Y	-	-	83,471,381	19,198,418	256,257,140	1,319,373	290,262	1,319,373
Kennet & Lambourn Floodplain	Y	-	-	11,106,335	2,554,457	34,096,447	350,715	77,157	350,715
Kennet Valley Alderwoods	Y	-	-	4,267,820	981,599	13,102,208	756,590	166,450	756,590
Lake District High Fells	Y	-	-	138,179,898	31,781,376	424,212,285	131,890,961	29,016,011	131,890,961
Lee Valley	-	Y	Y	194,331,691	44,696,289	596,598,290	11,086,244	2,438,974	11,086,244
Leighton Moss	-	Y	Y	3,492,989	803,387	10,723,477	1,685,043	370,709	1,685,043
Lewes Downs	Y	-	-	14,688,747	3,378,412	45,094,453	514,198	113,124	514,198
Little Wittenham	Y	-	-	98,549	22,666	302,545	1,141,207	251,066	1,141,207
Lower Derwent Valley	Y	Y	Y	18,934,886	4,355,024	58,130,101	5,309,208	1,168,026	5,309,208
Marazion Marsh	-	Y	-	6,586,239	1,514,835	20,219,754	1,215,760	267,467	1,215,760
Medway Estuary & Marshes	-	Y	Y	35,036,656	8,058,431	107,562,535	55,017,229	12,103,790	55,017,229
Mells Valley	Y	-	-	25,714,953	5,914,439	78,944,906	30,204	6,645	30,204
Mendip Limestone Grasslands	Y	-	-	10,405,224	2,393,201	31,944,037	248,446	54,658	248,446
Mendip Woodlands	Y	-	-	3,279,621	754,313	10,068,438	1,733,604	381,393	1,733,604
Mersey Estuary	-	Y	Y	36,033,421	8,287,687	110,622,602	113,680,953	25,009,810	113,680,953
Midland Meres & Mosses - Phase 1	Y	-	Y	29,985,685	6,896,708	92,056,054	3,750,160	825,035	3,750,160
Midland Meres & Mosses Phase 2	Y	-	Y	7,800,923	1,794,212	23,948,833	411,783	90,592	411,783
Minsmere-Walberswick	Y	Y	Y	9,669,212	2,223,919	29,684,481	5,565,043	1,224,309	5,565,043
Mole Gap to Reigate Escarpment	Y	-	-	16,741,014	3,850,433	51,394,912	2,873,005	632,061	2,873,005
Morecambe Bay	Y	Y	Y	275,471,652	63,358,480	845,697,970	465,155,801	102,334,276	465,155,801

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
Mottey Meadows	Y	-	-	1,781,160	409,667	5,468,160	60,068	13,215	60,068
Naddle Forest	Y	-	-	2,168,900	498,847	6,658,522	72,070	15,855	72,070
Nene Washes	Y	Y	Y	63,630,720	14,635,066	195,346,310	19,025,309	4,185,568	19,025,309
Norfolk Valley Fens	Y	-	-	2,046,742	470,751	6,283,496	230,994	50,819	230,994
North Meadow & Clattinger Farm	Y	-	-	6,278,899	1,444,147	19,276,219	1,423,936	313,266	1,423,936
North Northumberland Dunes	Y	Y	Y	54,920,132	12,631,630	168,604,805	17,960,571	3,951,326	17,960,571
North Pennine Dales Meadows	Y	-	-	24,128,443	5,549,542	74,074,321	405,644	89,242	405,644
North Pennine Moors	Y	Y	-	61,400,608	14,122,140	188,499,868	197,633,598	43,479,392	197,633,598
North Somerset & Mendip Bats	Y	-	-	2,671,571	614,461	8,201,724	518,273	114,020	518,273
North York Moors	Y	Y	-	9,287,791	2,136,192	28,513,519	24,645,140	5,421,931	24,645,140
Northumbria Coast	Y	Y	Y	72,921,904	16,772,038	223,870,247	3,581,631	787,959	3,581,631
Ouse Washes	Y	Y	Y	22,805,404	5,245,243	70,012,590	12,733,474	2,801,364	12,733,474
Oxford Meadows	Y	-	-	65,003,664	14,950,843	199,561,248	4,330,399	952,688	4,330,399
Pagham Harbour	-	Y	Y	23,303,757	5,359,864	71,542,533	14,385,070	3,164,715	14,385,070
Pasturefields Salt Marsh	Y	-	-	7,750,434	1,782,600	23,793,831	143,780	31,632	143,780
Peak District Dales	Y	-	-	71,867,766	16,529,586	220,634,041	2,243,519	493,574	2,243,519
Penhale Dunes	Y	-	-	1,498,743	344,711	4,601,141	37,366,587	8,220,649	37,366,587
Pevensey Levels	-	-	Y	18,698,203	4,300,587	57,403,484	3,862,097	849,661	3,862,097
Phoenix United Mine & Crow's Nest	Y	-	-	8,441,297	1,941,498	25,914,781	0	0	0
Plymouth Sound & Estuaries	Y	Y	-	186,375,094	42,866,272	572,171,538	40,145,598	8,832,032	40,145,598
Polruan to Polperro	Y	-	-	7,853,237	1,806,244	24,109,436	0	0	0
Poole Harbour	Y	Y	Y	62,650,161	14,409,537	192,335,993	15,369,718	3,381,338	15,369,718
Portholme	Y	-	-	16,553,267	3,807,251	50,818,528	1,694,609	372,814	1,694,609
Portsmouth Harbour	-	Y	Y	38,651,586	8,889,865	118,660,370	29,671,665	6,527,766	29,671,665
Ribble & Alt Estuaries	-	Y	Y	33,673,993	7,745,018	103,379,157	135,916,006	29,901,521	135,916,006

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
Richmond Park	Y	-	-	57,163,795	13,147,673	175,492,850	9,940,265	2,186,858	9,940,265
River Avon	Y	Y	Y	662,602,115	152,398,486	2,034,188,494	9,716,433	2,137,615	9,716,433
River Axe	Y	-	-	73,069,016	16,805,874	224,321,880	795,988	175,117	795,988
River Camel	Y	-	-	93,746,579	21,561,713	287,801,997	1,443,814	317,639	1,443,814
River Clun	Y	-	-	24,436,853	5,620,476	75,021,139	476,215	104,767	476,215
River Dee and Bala Lake	Y	-	-	60,970,496	14,023,214	187,179,424	183,815	40,439	183,815
River Derwent	Y	Y	-	28,676,838	6,595,673	88,037,893	11,595,011	2,550,902	11,595,011
River Derwent & Bassenthwaite Lake	Y	-	-	392,439,949	90,261,188	1,204,790,645	56,020,604	12,324,533	56,020,604
River Eden	Y	Y	-	741,997,236	170,659,364	2,277,931,514	75,508,973	16,611,974	75,508,973
River Ehen	Y	-	-	40,883,419	9,403,186	125,512,098	739,958	162,791	739,958
River Itchen	Y	-	-	135,910,893	31,259,505	417,246,442	4,945,031	1,087,907	4,945,031
River Kent	Y	-	-	123,401,367	28,382,314	378,842,196	2,731,180	600,860	2,731,180
River Lambourn	Y	-	-	22,703,538	5,221,814	69,699,863	882,265	194,098	882,265
River Mease	Y	-	-	59,485,560	13,681,679	182,620,670	215,687	47,451	215,687
River Tweed	Y	-	-	25,433,327	5,849,665	78,080,315	5,256,152	1,156,353	5,256,152
River Wensum	Y	-	-	9,264,915	2,130,930	28,443,289	1,073,668	236,207	1,073,668
River Wye	Y	-	-	281,280,135	64,694,431	863,530,015	24,610,234	5,414,251	24,610,234
Rochdale Canal	Y	-	-	46,509,959	10,697,290	142,785,573	118,008	25,962	118,008
Rostherne Mere	-	-	Y	19,994,358	4,598,702	61,382,679	1,951,770	429,389	1,951,770
Roudsea Wood & Mosses	Y	-	-	11,016,213	2,533,729	33,819,773	7,002,355	1,540,518	7,002,355
Rutland Water	-	Y	Y	6,489,551	1,492,597	19,922,921	25,067,002	5,514,740	25,067,002
Salisbury Plain	Y	Y	-	16,476,148	3,789,514	50,581,775	8,529,869	1,876,571	8,529,869
Saltfleetby-Theddlethorpe Dunes & Gibraltar Point	Y	Y	Y	1,565,821	360,139	4,807,070	32,706,524	7,195,435	32,706,524
Sandlings	-	Y	-	1,162,285	267,326	3,568,215	1,136,620	250,056	1,136,620
Sefton Coast	Y	Y	Y	7,409,963	1,704,291	22,748,585	29,852,224	6,567,489	29,852,224

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
Severn Estuary	Y	Y	Y	190,432,163	43,799,397	584,626,740	168,262,192	37,017,682	168,262,192
Shortheath Common	Y	-	-	10,952,602	2,519,099	33,624,489	612,221	134,689	612,221
Sidmouth to West Bay	Y	-	-	62,352,187	14,341,003	191,421,213	596,643	131,261	596,643
Solent & Southampton Water	Y	Y	Y	386,827,853	88,970,406	1,187,561,507	95,142,925	20,931,444	95,142,925
Solway Firth	Y	Y	Y	246,984,698	56,806,481	758,243,023	165,448,354	36,398,638	165,448,354
Somerset Levels & Moors	-	Y	Y	41,620,229	9,572,653	127,774,103	34,879,463	7,673,482	34,879,463
South Dartmoor Woods	Y	-	-	22,270,344	5,122,179	68,369,956	4,601,621	1,012,357	4,601,621
South Devon Shore Dock	Y	-	-	36,649,483	8,429,381	112,513,913	590,492	129,908	590,492
South Hams	Y	-	-	37,150,069	8,544,516	114,050,711	228,558	50,283	228,558
South Pennine Moors	Y	Y	-	208,101,628	47,863,374	638,871,997	88,594,844	19,490,866	88,594,844
South Solway Mosses	Y	-	-	78,715,432	18,104,549	241,656,376	8,947,409	1,968,430	8,947,409
South West London Waterbodies	-	Y	Y	222,193,444	51,104,492	682,133,873	12,950,664	2,849,146	12,950,664
South Wight Maritime	Y	Y	Y	24,541,123	5,644,458	75,341,249	3,693,181	812,500	3,693,181
St Albans Head to Durlston Head	Y	-	-	254,797	58,603	782,226	1,193,346	262,536	1,193,346
Stodmarsh	Y	Y	Y	7,512,169	1,727,799	23,062,360	6,467,062	1,422,754	6,467,062
Stour and Orwell Estuaries	-	Y	Y	47,611,232	10,950,583	146,166,481	97,625,058	21,477,513	97,625,058
Subberthwaite, Blawith & Torver Low Commons	Y	-	-	13,427,916	3,088,421	41,223,702	31,282,426	6,882,134	31,282,426
Tarn Moss	Y	-	-	1,452,168	333,999	4,458,157	24,208	5,326	24,208
Teesmouth & Cleveland Coast	-	Y	Y	44,646,102	10,268,603	137,063,533	26,102,207	5,742,486	26,102,207
Thames Basin Heaths	Y	Y	-	72,036,360	16,568,363	221,151,625	28,914,816	6,361,260	28,914,816
Thames Estuary & Marshes	-	Y	Y	14,189,671	3,263,624	43,562,291	88,868,076	19,550,977	88,868,076
Thanet Coast & Sandwich Bay	Y	Y	Y	42,091,955	9,681,150	129,222,302	11,891,067	2,616,035	11,891,067
The Broads	Y	Y	Y	65,752,703	15,123,122	201,860,797	7,841,540	1,725,139	7,841,540
The Dee Estuary	-	Y	Y	9,635,689	2,216,208	29,581,565	125,792,705	27,674,395	125,792,705
The Lizard	Y	-	-	1,588,056	365,253	4,875,332	1,042,460	229,341	1,042,460

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
The New Forest	Y	Y	Y	167,369,483	38,494,981	513,824,313	45,504,309	10,010,948	45,504,309
The Swale	-	Y	Y	22,726,268	5,227,042	69,769,644	79,262,066	17,437,655	79,262,066
The Wash & North Norfolk Coast	Y	Y	Y	24,191,720	5,564,096	74,268,581	83,161,729	18,295,580	83,161,729
Thorne & Hatfield Moors	Y	Y	-	2,331,007	536,132	7,156,192	6,033,851	1,327,447	6,033,851
Thursley, Hankley & Frensham Commons	Y	Y	Y	3,598,235	827,594	11,046,583	4,131,927	909,024	4,131,927
Tintagel-Marsland-Clovelly Coast	Y	-	-	44,410,985	10,214,527	136,341,724	5,483,607	1,206,394	5,483,607
Tweed Estuary	Y	-	-	775,895	178,456	2,381,999	2,283,944	502,468	2,283,944
Tyne & Allen River Gravels	Y	-	-	11,048,936	2,541,255	33,920,233	0	0	0
Tyne & Nent	Y	-	-	358,046	82,350	1,099,200	0	0	0
Ullswater Oakwoods	Y	-	-	18,466,258	4,247,239	56,691,411	1,274,973	280,494	1,274,973
Walmore Common	-	Y	Y	1,222,725	281,227	3,753,767	506,982	111,536	506,982
Walton Moss	Y	-	-	18,817,053	4,327,922	57,768,353	6,377,478	1,403,045	6,377,478
Wast Water	Y	-	-	2,502,114	575,486	7,681,490	9,045,163	1,989,936	9,045,163
Waveney & Little Ouse Valley Fens	Y	-	Y	2,495,467	573,957	7,661,084	921,697	202,773	921,697
Wealden Heaths Phase II	Y	Y	-	12,279,714	2,824,334	37,698,723	3,889,521	855,695	3,889,521
West Dorset Alder Woods	Y	-	-	4,164,967	957,942	12,786,447	281,327	61,892	281,327
Wimbledon Common	Y	-	-	32,838,851	7,552,936	100,815,272	2,313,069	508,875	2,313,069
Windsor Forest & Great Park	Y	-	-	2,175,629	500,395	6,679,181	1,628,305	358,227	1,628,305
Witherslack Mosses	Y	-	-	59,420,989	13,666,827	182,422,436	8,397,555	1,847,462	8,397,555
Wormley-Hoddesdonpark Woods	Y	-	-	14,299,001	3,288,770	43,897,932	2,030,348	446,677	2,030,348
Wye Valley Woodlands	Y	-	-	27,845,457	6,404,455	85,485,554	2,198,818	483,740	2,198,818

Table A2: International Areas within the Flood Zones – Wales

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
Afon Eden - Cors Goch Trawsfynydd	Y	-	-	30,009,263	6,902,130	92,128,437	N/A	N/A	N/A
Afon Gwyrfai a Llyn Cwellyn	Y	-	-	56,859,803	13,077,755	174,559,595	N/A	N/A	N/A
Afon Teifi / River Teifi	Y	-	Y	317,788,349	73,091,320	975,610,231	N/A	N/A	N/A
Afon Tywi / River Tywi	Y	-	-	207,099,002	47,632,770	635,793,936	N/A	N/A	N/A
Afonydd Cleddau / Cleddau Rivers	Y	-	-	169,859,003	39,067,571	521,467,139	N/A	N/A	N/A
Alyn Valley Woods / Coedwigoedd Dyffryn Alun	Y	-	-	13,778,587	3,169,075	42,300,262	N/A	N/A	N/A
Bae Cemlyn / Cemlyn Bay	Y	Y	-	22,887,920	5,264,222	70,265,914	N/A	N/A	N/A
Berwyn	Y	Y	-	77,446,219	17,812,630	237,759,892	N/A	N/A	N/A
Blaen Cynon	Y	-	-	12,711,807	2,923,716	39,025,247	N/A	N/A	N/A
Cadair Idris	Y	-	-	14,311,383	3,291,618	43,935,946	N/A	N/A	N/A
Cardiff Beech Woods	Y	-	-	10,943,272	2,516,953	33,595,845	N/A	N/A	N/A
Cardigan Bay / Bae Ceredigion	Y	-	-	93,129,037	21,419,679	285,906,144	N/A	N/A	N/A
Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd	Y	Y	Y	345,515,585	79,468,585	1,060,732,846	N/A	N/A	N/A
Clogwyni Pen Llyn / Seacliffs of Lleyn	Y	Y	-	94,093,504	21,641,506	288,867,057	N/A	N/A	N/A
Coedwigoedd Dyffryn Elwy / Elwy Valley Woods	Y	-	-	8,488,110	1,952,265	26,058,498	N/A	N/A	N/A
Coedwigoedd Penrhyn Creuddyn / Creuddyn Peninsula Woods	Y	-	-	1,837,947	422,728	5,642,497	N/A	N/A	N/A
Coedydd a Cheunant Rheidol / Rheidol Woods and Gorge	Y	-	-	18,576,263	4,272,540	57,029,127	N/A	N/A	N/A
Coedydd Aber	Y	-	-	4,937,435	1,135,610	15,157,925	N/A	N/A	N/A
Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites	Y	-	-	111,669,141	25,683,902	342,824,263	N/A	N/A	N/A
Coedydd Nedd a Mellte	Y	-	-	16,351,669	3,760,884	50,199,624	N/A	N/A	N/A
Cors Caron	Y	-	Y	29,256,424	6,728,978	89,817,222	N/A	N/A	N/A

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
Cors Fochno	Y	-	Y	10,748,493	2,472,153	32,997,874	N/A	N/A	N/A
Corsydd Eifionydd / Eifionydd Fens	Y	-	-	37,161,964	8,547,252	114,087,229	N/A	N/A	N/A
Corsydd Llyn / Lleyn Fens	Y	-	Y	53,369,744	12,275,041	163,845,114	N/A	N/A	N/A
Corsydd Mon / Anglesey Fens	Y	-	Y	15,248,301	3,507,109	46,812,284	N/A	N/A	N/A
Crymlyn Bog / Cors Crymlyn	Y	-	Y	5,641,070	1,297,446	17,318,085	N/A	N/A	N/A
Cwm Doethie - Mynydd Mallaen	Y	Y	-	6,148,215	1,414,089	18,875,020	N/A	N/A	N/A
Deeside and Buckley Newt sites	Y	-	-	3,245,941	746,566	9,965,039	N/A	N/A	N/A
Dunraven Bay	Y	-	-	5,268,876	1,211,841	16,175,449	N/A	N/A	N/A
Dyfi Estuary / Aber Dyfi	-	Y	Y	24,359,149	5,602,604	74,782,587	N/A	N/A	N/A
Elenydd	Y	Y	-	8,792,153	2,022,195	26,991,910	N/A	N/A	N/A
Eryri / Snowdonia	Y	-	Y	38,956,769	8,960,057	119,597,281	N/A	N/A	N/A
Glannau Mon: Cors heli / Anglesey Coast: Saltmarsh	Y	-	-	97,987,611	22,537,151	300,821,966	N/A	N/A	N/A
Glannau Ynys Gybi / Holy Island Coast	Y	Y	-	45,980,942	10,575,617	141,161,492	N/A	N/A	N/A
Glaswelltiroedd Cefn Cribwr / Cefn Cribwr Grasslands	Y	-	-	1,706,764	392,556	5,239,765	N/A	N/A	N/A
Glynllifon	Y	-	-	21,752,947	5,003,178	66,781,547	N/A	N/A	N/A
Gower Ash Woods / Coedydd Ynn Gwyr	Y	-	-	31,570,690	7,261,259	96,922,018	N/A	N/A	N/A
Gower Commons / Tiroedd Comin Gwyr	Y	-	-	34,237,478	7,874,620	105,109,057	N/A	N/A	N/A
Great Orme's Head / Pen y Gogarth	Y	-	-	1,518,451	349,244	4,661,645	N/A	N/A	N/A
Grogwynion	Y	-	-	10,087,893	2,320,215	30,969,832	N/A	N/A	N/A
Kenfig / Cynffig	Y	-	-	27,325,848	6,284,945	83,890,353	N/A	N/A	N/A
Limestone Coast of South West Wales / Arfordir Calchfaen De Orllewin Cymru	Y	Y	-	65,896,562	15,156,209	202,302,445	N/A	N/A	N/A
Llwyn	Y	-	-	8,012,883	1,842,963	24,599,551	N/A	N/A	N/A
Llyn Dinam	Y	-	-	1,490,780	342,879	4,576,695	N/A	N/A	N/A

International Site Name	SAC	SPA	Ramsar	Asset Management Cost (100yr) (£)	Lowest cost (£)	Highest cost (£)	Habitat replacement cost (£)	Lowest cost (£)	Highest cost (£)
Migneint-Arenig-Dduallt	Y	Y	-	51,049,575	11,741,402	156,722,195	N/A	N/A	N/A
Montgomery Canal	Y	-	-	22,544,410	5,185,214	69,211,339	N/A	N/A	N/A
Morfa Harlech a Morfa Dyffryn	Y	-	-	35,357,973	8,132,334	108,548,977	N/A	N/A	N/A
Mwyngloddiau Fforest Gwydir / Gwydyr Forest Mines	Y	-	-	12,038,984	2,768,966	36,959,681	N/A	N/A	N/A
North Pembrokeshire Woodlands / Coedydd Gogledd Sir Benfro	Y	-	-	21,544,657	4,955,271	66,142,097	N/A	N/A	N/A
North West Pembrokeshire Commons / Comin Gogledd Orllewin Sir Benfro	Y	-	-	3,473,343	798,869	10,663,163	N/A	N/A	N/A
Pembrokeshire Bat Sites and Bosherton Lakes / Safleoedd Ystlum Sir Benfro a Lly*	Y	Y	-	27,341,387	6,288,519	83,938,058	N/A	N/A	N/A
Pembrokeshire Marine / Sir Benfro Forol	Y	Y	-	294,338,156	67,697,776	903,618,139	N/A	N/A	N/A
Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau	Y	Y	Y	319,343,918	73,449,101	980,385,828	N/A	N/A	N/A
Preseli	Y	-	-	6,115,645	1,406,598	18,775,030	N/A	N/A	N/A
Rhinog	Y	-	-	12,077,421	2,777,807	37,077,682	N/A	N/A	N/A
Rhos Llawr-cwrt	Y	-	-	7,541,028	1,734,436	23,150,956	N/A	N/A	N/A
River Dee and Bala Lake / Afon Dyfrdwy a Llyn Tegid (Wales)	Y	-	Y	271,862,598	62,528,398	834,618,176	N/A	N/A	N/A
River Usk / Afon Wysg	Y	-	-	308,371,696	70,925,490	946,701,107	N/A	N/A	N/A
River Wye / Afon Gwy(Wales)	Y	Y	-	213,115,915	49,016,660	654,265,859	N/A	N/A	N/A
St David's / Ty Ddewi	Y	Y	-	80,322,071	18,474,076	246,588,758	N/A	N/A	N/A
Wye Valley Woodlands / Coetiroedd Dyffryn Gwy(Wales)	Y	-	-	33,088,436	7,610,340	101,581,497	N/A	N/A	N/A
Y Fenai a Bae Conwy / Menai Strait and Conwy Bay	Y	Y	-	117,268,971	26,971,863	360,015,741	N/A	N/A	N/A
Y Twyni o Abermenai i Aberffraw / Abermenai to Aberffraw Dunes	Y	-	-	83,905,366	19,298,234	257,589,474	N/A	N/A	N/A
Ynys Feurig, Cemlyn Bay and The Skerries	-	Y	-	11,643,709	2,678,053	35,746,187	N/A	N/A	N/A
Ynys Seiriol / Puffin Island	-	Y	-	7,305,670	1,680,304	22,428,407	N/A	N/A	N/A

Appendix B: Habitat Replacement Costs

Table B1: Habitat Replacement Costs used in Cost Calculator

ENSIS Main_Habitats (MAIN_HABIT)	Source of habitat cost	Reason for selection of source data	Replacement cost/ ha (£)	Land Purchase Cost/ ha (£)	Total cost/ ha (purchase + replacement)
ACID GRASSLAND - LOWLAND	No direct cost comparison with sources of costs	Replacement of drier grasslands is £7752 and replacement of wetter grasslands including alluvial meadows, poorly drained permanent pastues, and inundation grasslands) is £16397. As acid grasslands can be both wet and dry in lowlands the average cost of these two habitats has been taken	12,075	6,672	**£18,747**
ACID GRASSLAND - UPLAND	No direct cost comparison with sources of costs	Replacement of drier grasslands is £7752 and replacement of wetter grasslands including alluvial meadows, poorly drained permanent pastues, and inundation grasslands) is £16397. As acid grasslands can be both wet and dry in uplands the average cost of these two habitats has been taken	12,075	6,672	**£18,747**
ARABLE AND HORTICULTURE	No direct cost comparison with sources of costs	No cost available, so NEOCOMER cost of replacing dry grassland has been used, being 7752.	7,752	6,672	**£14,424**
BOGS - LOWLAND	Bogs, marshes, fens	Lowland assumed to be wetter than upland	15,586	6,672	**£22,258**
BOGS - UPLAND	Bogs, marshes, fens	Upland assumed to be drier than lowland.	15,586	6,672	**£22,258**
BOUNDARY AND LINEAR FEATURES	Hedgerow costs	Costs for hedgerow replace is low of £2.64/m (£26,400/ha) (based on the cost of laying, coppicing, planting and management of hedgerow) and high of £5.28/m (£52,800/ha) (based on the cost of laying, coppicing, planting and management of closely spaced hedgerow plants). The average cost has been taken.	39,600	6,672	**£46,272**
BRACKEN				6,672	**£15,000**
BROADLEAVED, MIXED AND YEW WOODLAND - LOWLAND	Broad-leaved and mixed woodland		9,913	6,672	**£16,585**

ENSIS Main_Habitats (MAIN_HABIT)	Source of habitat cost	Reason for selection of source data	Replacement cost/ ha (£)	Land Purchase Cost/ ha (£)	Total cost/ ha (purchase + replacement)
BROADLEAVED, MIXED AND YEW WOODLAND – UPLAND	Broad-leaved and mixed woodland		9,913	6,672	**£16,585**
BUILT UP AREAS AND GARDENS	No direct cost comparison with sources of costs	No cost available, so NEOCOMER cost of replacing dry grassland has been used, being 7752.	7,752	6,672	**£14,424**
CALCAREOUS GRASSLAND - LOWLAND	No direct cost comparison with sources of costs	calcareous glassland is assumed to be 'dry grassland' as it is located on Limestone (a free draining rock). Replacement of drier grasslands is £7752	7,752	6,672	**£14,424**
CALCAREOUS GRASSLAND - UPLAND	No direct cost comparison with sources of costs	calcareous glassland is assumed to be 'dry grassland' as it is located on Limestone (a free draining rock). Replacement of drier grasslands is £7752	7,752	6,672	**£14,424**
CONIFEROUS WOODLAND	Coniferous Woodland	UKBAP definition: coniferous stands where broadleaved trees make up less than 20% cover with the exception of yew woodlands. Areas of recently felled coniferous woodland are also included in this type.	9,378	6,672	**£16,050**
DWARF SHRUB HEATH - LOWLAND	Heath, scrub and open vegetation	Lowland assumed to be wetter than upland UKBAP definition: vegetation dominated by species from the heath family or dwarf gorse species. It includes the moss and lichen dominated heaths of the East Anglian Breckland but not of mountain summits.	12,074	6,672	**£18,746**
DWARF SHRUB HEATH - UPLAND	Heath, scrub and open vegetation	Upland assumed to be drier than lowland. vegetation dominated by species from the heath family or dwarf gorse species. It includes the moss and lichen dominated heaths of the East Anglian Breckland but not of mountain summits.	12,074	6,672	**£18,746**
EARTH HERITAGE	N/A - It is not anticipated that this habitat can be recreated.			N/A	**£0**

ENSIS Main_Habitats (MAIN_HABIT)	Source of habitat cost	Reason for selection of source data	Replacement cost/ ha (£)	Land Purchase Cost/ ha (£)	Total cost/ ha (purchase + replacement)
FEN, MARSH AND SWAMP - LOWLAND	Bogs, marshes, fens		15,586	6,672	**£22,258**
FEN, MARSH AND SWAMP - UPLAND	Bogs, marshes, fens		15,586	6,672	**£22,258**
IMPROVED GRASSLAND	No direct cost comparison	Replacement of drier grasslands is £7752. As improved grasslands would be managed to reamin dry, this cost has been used.	7,752	6,672	**£14,424**
INLAND ROCK	N/A - It is not anticipated that this habitat can be recreated.	UKBAP definition: natural and artificial exposed rock surfaces where these are almost entirely lacking in vegetation, as well as various forms of excavations and waste tips. It includes inland cliffs, ledges and caves, screes, limestone pavements, quarries and quarry waste.		6,672	**£0**
INSHORE SUBLITTORAL SEDIMENT - COASTAL LAGOONS	N/A - It is not anticipated that this habitat can be recreated.	UKBAP definition: The inshore area is defined as within six nautical miles of the shoreline. The marine biotope classification for Britain and Ireland (developed by JNCC) identifies four major inshore sublittoral sediment biotopes gravels and sands, muddy sands, muds, and mixed sediments.		6,672	**£0**
LITTORAL ROCK	N/A - It is not anticipated that this habitat can be recreated.	UKBAP definition: defined as rock between the high water and low water marks and can be as varied as vertical rock, shoreplatforms, boulder shores, or rocky reefs surrounded by areas of sediment.		6,672	**£0**
LITTORAL SEDIMENT	No direct cost comparison with sources of costs	UKBAP definition: beaches, sand banks, and intertidal mudflats. As no specific cost is available for this habitat, the costs of mudflat replacement have been used.Characteristic habitat is anticipated to be mudflat. Average of ERM mudflat recreation costs is £27,475, so this cost has been used.	27,475	6,672	**£34,147**
MONTANE HABITATS	No direct cost comparison with sources of costs	UKBAP definition: includes montane heath, snow bed communities and dwarf forb communities. It also includes mss and lichen dominated heaths of mountain summits. No direct cost comparison, so the closest cost is for heath, scrub and openland, of £12,074	12,074	6,672	**£18,746**

ENSIS Main_Habitats (MAIN_HABIT)	Source of habitat cost	Reason for selection of source data	Replacement cost/ ha (£)	Land Purchase Cost/ ha (£)	Total cost/ ha (purchase + replacement)
NEUTRAL GRASSLAND - LOWLAND	No direct cost comparison with sources of costs	Replacement of drier grasslands is £7454 and replacement of wetter grasslands including alluvial meadows, poorly drained permanent pastues, and inundation grasslands) is £15766. As Neutral grasslands can be both wet and dry in lowlands the average cost of these two habitats has been taken	11,759	6,672	**£18,431**
NEUTRAL GRASSLAND - UPLAND	No direct cost comparison with sources of costs	Replacement of drier grasslands is £7752 and replacement of wetter grasslands including alluvial meadows, poorly drained permanent pastues, and inundation grasslands) is £16397. As Neutral grasslands can be both wet and dry in uplands the average cost of these two habitats has been taken.	12,075	6,672	**£18,747**
RIVERS AND STREAMS	Inland Water Bodies and Lagoons		25,041	6,672	**£31,713**
STANDING OPEN WATER AND CANALS	Inland Water Bodies and Lagoons		25,041	6,672	**£31,713**
SUPRALITTORAL ROCK	N/A - It is not anticipated that this habitat can be recreated.	UKBAP definition: Supralittoral rock occurs above high water mark and features include vertical rock, boulders,gullies, ledges and pools.			**£0**
SUPRALITTORAL SEDIMENT	No direct cost comparison with sources of costs	UKBAP definition: Supralittoral sediment occurs above high water mark in areas influenced bywave splash and sea-spray. Salt-tolerant species are the characteristic colonisers. Characteristic habitat is anticipated to be saltmarsh. Average of NEOCOMER saltmarsh recreation costs was £109,553 for replacement of 2 hectares per 1 lost. Therefore cost used is half of this = £54,776.50.	54,777	6,672	**£61,449**

Note: orange shading denotes cells in the cost calculator that can be altered by the user

Table B2: Source Data for Habitat Replacement Costs

Habitat Type	Unit Cost Replacement (per Ha)	Date of cost	2007 Cost	2008 Cost	Source of cost data
Land purchase costs	**£6,174**	2006	**£6,415**	**£6,672**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
Inland water bodies and lagoons	(Land Survey, Topographic assesment, hydrological assessment, design/construction of water control structures) **£23,174**	2006	**£24,078**	**£25,041**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
Wet grassland (including alluvial meadows, poorly drained permanent pastures, and inundation grasslands)	(Land Survey, Topographic assesment, hydrological assessment, design/construction of water control structures, grazing, water management plan) **£15,174**	2006	**£15,766**	**£16,397**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
Drier grasslands	(Manual seeding and management for establishment) **£7,174**	2006	**£7,454**	**£7,752**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
Bogs, marshes, fens;	(Removal of nutrient rich layer of silt Removal of scrub / trees, Excavation of ditches, Vegetation management, Construction of water control structures, Water level management plan, Topographical survey, Hydrological assessment, Land purchase) **£14424**	2006	**£14,987**	**£15,586**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
Grazing Marsh	Low (based on payments for restoration/ management of historic water meadows): **£250**	2002	**£302**	**£314**	DOE (1996), ERM (2000) in Ciria 2002, C565 - Costing Environmental Pollution
	Medium (based on costs of restoring historic water meadows): **£890**		**£1,076**	**£1,119**	
	High (based on estimated costs of recreating grazing marsh): **£4000**		**£4,835**	**£5,028**	

Habitat Type	Unit Cost Replacement (per Ha)	Date of cost	2007 Cost	2008 Cost	Source of cost data
Broad-leaved and mixed woodland;	**£9,174**	2006	**£9,532**	**£9,913**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
Broad-leaved woodland'	Low (tree planting density of one tree every two metres): **£5000**	2002	**£6,222**	**£6,471**	Nix (1999) in Ciria 2002, C565 - Costing Environmental Pollution
	High (tree planting density greater than one tree every two metres): **£7500**		**£9,300**	**£9,672**	
Heath, scrub and open vegetation;	(Management to establishment (such as grazing or burning), Scrub clearance, Land purchase) **£11,174**		**£11,610**	**£12,074**	DEFRA, NECOMA, R&D Technical Report FD2017/TR:
Wet woodlands;	(Hydrological and water level management assessment, Establishment costs, Land purchase) **£9674**	2006	**£10,051**	**£10,453**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
Coniferous Woodland	(land purchase, establishment costs) **£8674**		**£9,017**	**£9,378**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
Freshwater Washland Wet grassland	High (land value £1100, site management and habitat creation) **£100,825**	2007	**£100,825**	**£104,858**	Great Ouse, BV project
	Low (land value £9100 site management, habitat creation) **£96,441**	2007	**£96,441**	**£100,299**	Great Ouse, BV project
Salt Marsh long and thin site with high rising ground	SE England: **£74,950**	2006	**£100,202**	**£104,210**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
	E England: **£67,820**		**£70,465**	**£73,284**	
	SW England: **£73,059**		**£75,908**	**£78,944**	
Salt marsh long and thin site with no rising ground	SE England:**£124,126**	2006	**£128,967**	**£134,126**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:

Habitat Type	Unit Cost Replacement (per Ha)	Date of cost	2007 Cost	2008 Cost	Source of cost data
	E England : **£ 120,629**		**£125,334**	**£130,347**	
	SW England:**£124,126**		**£128,967**	**£134,126**	
Saltmarsh Square site with rising ground	S E England: **£90,909**	2006	**£94,454**	**£98,232**	DEFRA, NECOMA, R&D Technical Report FD2017/TR:
	E England: **£87,413**		**£90,822**	**£94,455**	
	SW England:**£90,909**		**£94,454**	**£98,232**	
Saltmarsh Square site with no rising ground	S E England:**£131,119**	2006	**£136,233**	**£141,682**	DEFRA, NEOCOMER, R&D Technical Report FD2017/TR:
	E England:**£127,622**		**£132,599**	**£137,903**	
	SW England:**£131,119**		**£136,233**	**£141,682**	
Saltmarsh	Low (using plant seeds; no re-excavation): **£1200**	2000	**£1,452**	**£1,510**	ERM (2000) in Ciria 2002, C565 - Costing Environmental Pollution
	Medium (included re-excavating natural channels): **£30,000**		**£36,300**	**£37,752**	
	High (re-excavating, plant propagation, etc): **£100,000**		**£121,000**	**£125,840**	
Reedbed habitat' (Freshwater)	Low (no attempt to recreate species rich communities, excludes land purchase): **£2800**	2000	**£3,388**	**£3,524**	ERM (2000) in Ciria 2002, C565 - Costing Environmental Pollution
	High (some attempt to create a species rich community): **£7700**		**£9,317**	**£9,690**	
Mudflats	Low (direct economic costs, includes creation of a counterwall): **£5500**	2000	**£6,655**	**£6,921**	ERM (2000) in Ciria 2002, C565 - Costing Environmental Pollution
	Medium (direct economic costs plus some landscaping): **£15,000**		**£18,150**	**£18,876**	

Habitat Type	Unit Cost Replacement (per Ha)	Date of cost	2007 Cost	2008 Cost	Source of cost data
	High (landscaping, earth movement, design and creation of hole in the sea wall to allow water to enter): **£45,000**		**£54,450**	**£56,628**	
River Bed	Low (channel dredging, hire of equipment only): **£5/metre**	1999	**£6.2/m**	**£6.45**	River Restoration Centre (1999) ABC (1999) in Ciria 2002 C565 Costing Environmental Pollution
	Medium (channel dredging, hire of equipment, disposal of non-hazardous dredgings): **£40/metre**		**£49.6/m**	**£51.58**	
	High (including £20/m for channel construction and £40/m for bank stabilisation): **£60/metre**		**£74.4/m**	**£77.38**	
Intertidal (Saltmarsh/Mudflat)	Average of **£36,950** (completed England sites only)	2006	**£38,391**	**£39,927**	Environmental Futures Ltd, (2006) Economics of Managed Realignment in the UK - Final Report to the Coastal Futures Project.
Hedgerow	Low (based on the cost of laying, coppicing, planting and management of hedgerow): **£2/metre**	1999	**£2/m**	**£2.64**	River Restoration Centre (1999) ABC (1999) in Ciria 2002 C565 Costing Environmental Pollution
	High (based on the cost of laying, coppicing, planting and management of closely spaced hedgerow plants): **£4/metre**		**£4/m**	**£5.28**	

Appendix C: Deterioration curves

Table C1: Deterioration curves for each asset type in NFCDD

Environment Agency primary asset descriptor	Description	Asset class	Time (years) to reach condition grade from new				
			Best estimate (m)				
			1	2	3	4	5
Raised asset (man-made)	Type 1, FP, B&M (m)	4	0	13	40	67	80
	Type 1, CP, B&M (m)	5	0	13	40	67	80
	Type 1, RP, B&M (m)	6	0	13	40	67	80
	flood asset structure	6a	0	13	40	67	80
	non-flood asset structure	6b	0	13	40	67	80
	Type 1, FP, Piles (m)	7	0	15	30	45	60
	Type 1, CP, Piles (m)	8	0	15	30	45	60
	Type 1, RP, Piles (m)	9	0	15	30	45	60
	Type 2, FP, Turf (m)	10	0	13	27	36	40
	Type 2, FP, Rigid (m)	11	0	13	25	42	50
	Type 2, RP, Rigid (m)	13	0	15	30	50	60
	Type 2, FP, Rip-rap (m)	14	0	13	25	42	50
	Type 2, CP, Rip-rap (m)	15	0	14	28	46	55
	Type 2, RP, Rip-rap (m)	16	0	15	30	50	60
	Type 2, RP, Flexible (m)	19	0	15	30	50	60
Raised asset (natural)	Type 3, High Ground (m)	20	NOT APPLICABLE TO HIGH GROUND CASES				
Culverted channel	Type 4, Culverts (m)	21	0	15	30	45	60
	culverted channel	21a	0	15	30	45	60
Raised coastal asset (man-made)	Type 5, CP, Concrete (m)	26	0	8	25	42	50
	raised coastal asset (man-made)	26a	0	8	25	42	50
	Type 5, RP, Concrete (m)	27	0	10	30	50	60
	Type 5, CP, B&M (m)	29	0	9	28	46	55
	Type 5, RP, B&M (m)	30	0	10	30	50	60
	Type 6, FP, Perm (m)	31	0	10	20	33	40
	sea asset (man-made)	31a	0	10	20	33	40
	Type 6, FP, Imperm (m)	34	0	10	20	33	40
Raised coastal asset (natural)	Type 7, Dune (m)	37	0	13	20	27	40
	coastal protection (natural)	37a	0	13	20	27	40
	natural channel	37b	0	15	30	45	60
	raised coastal asset (natural)	37c	0	13	20	27	40
	raised asset (natural)	37d	0	13	20	27	40
	sea asset (natural)	37e	0	13	20	27	40
	Type 7, Shingle (m)	38	0	13	20	27	40
Raised asset (man-made)	Type 1, W, CP, Gabions (m)	40	0	4	13	21	25
	Type 1, W, FP, B&M (m)	41	0	13	40	67	80
	Type 1, W, CP, B&M (m)	42	0	13	40	67	80

Environment Agency primary asset descriptor	Description	Asset class	Time (years) to reach condition grade from new				
			Best estimate (m)				
			1	2	3	4	5
	Type 1, W, CP, Piles (m)	44	0	15	30	45	60
	other	44a	0	15	30	45	60
	maintained channel	44b	0	15	30	45	60
	raised asset (man-made)	44c	0	15	30	45	60
	Type 2, W, FP, Turf (m)	45	0	17	33	45	50
	Type 2, W, FP, Rigid (m)	46	0	15	30	50	60
	Type 2, W, FP, Rip-rap (m)	48	0	15	30	50	60
	Type 2, W, CP, Rip-rap (m)	49	0	15	30	50	60
	Type 2, W, FP, Flexible (m)	50	0	15	30	50	60
	Type 2, W, CP, Flexible (m)	51	0	15	30	50	60
Raised coastal asset (man-made)	Type 5, W, CP, Concrete (m)	55	0	9	28	46	55
	coastal protection (man-made)	55a	0	9	28	46	55
	Type 5, W, CP, B&M (m)	57	0	9	28	46	55
	Type 6, W, FP, Perm (m)	58	0	10	20	33	40
	Type 6, W, CP, Perm (m)	59	0	13	25	42	50
	Type 6, W, FP, Imperm (m)	60	0	10	20	33	40
	Type 6, W, CP, Imperm (m)	61	0	13	25	42	50

Abbreviation	Definition
FP	Front face protection
CP	Crest protection in addition to front face protection
RP	Rear face protection in addition to front face and crest protection
B&M	Brick and masonry
Piles	Steel sheet piles
Turf	Turfed surface protection
Rigid	Rigid protection
Rip-rap	Rock protection
Flexible	Flexible protection
High ground	Not considered in this work
Culverts	Culverts
Concrete	Concrete
Perm	Permeable embankment
Imperm	Impermeable embankment
Dune	Natural or artificial dune
Shingle	Natural or artificial shingle beach
Gabions	Gabions
W	Wide crested
(m)	maintenance
(-)	no maintenance

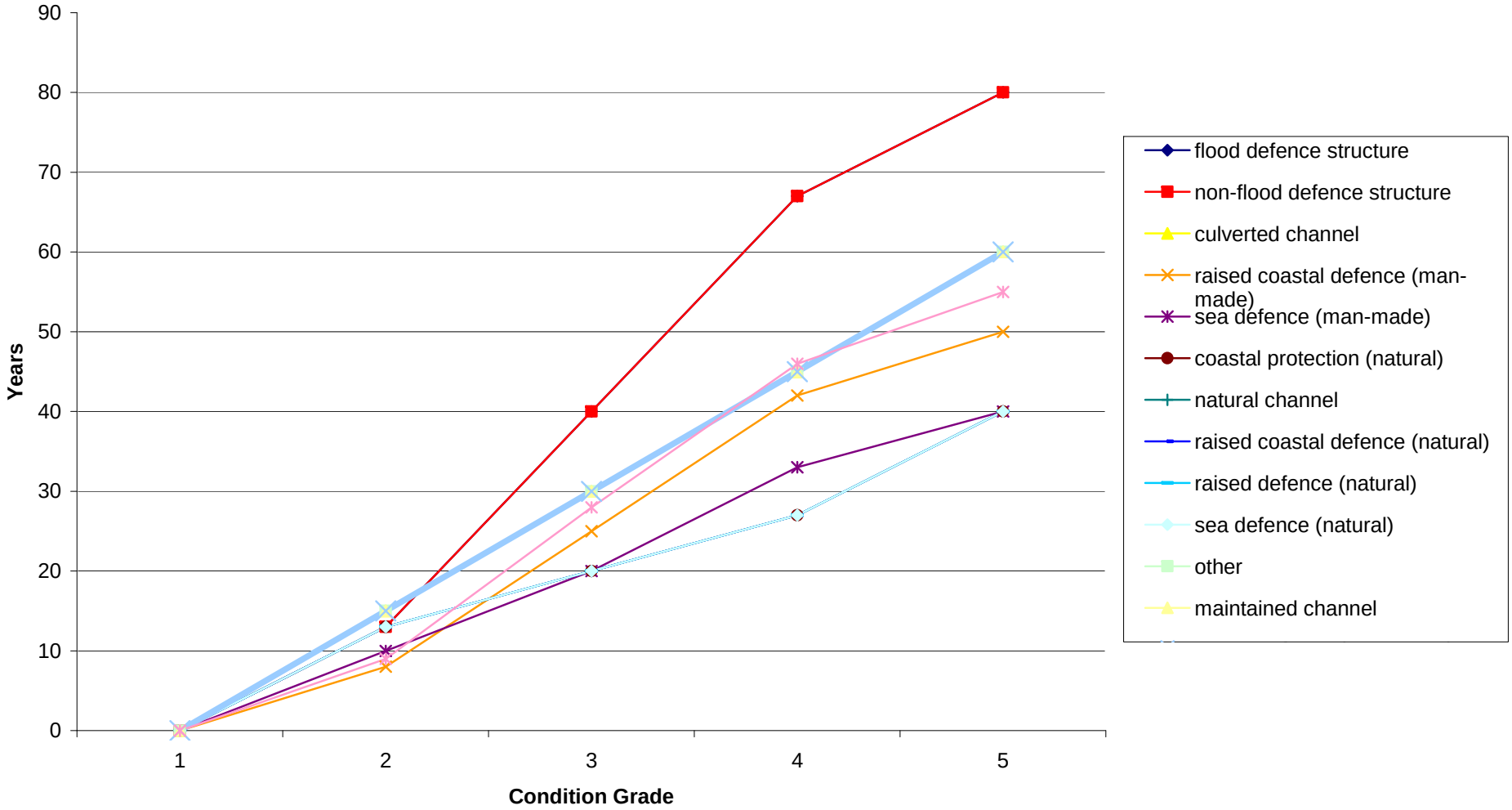

FIGURE C1: Assumed Condition Grade Deterioration profiles of NFCDD assets according to 'Asset Type'

Appendix D: Source for Asset Management Costs

ASSET_TYPE	Total Combined Cost	Combined Cost	Individual Cost	Unit	Cost - Calculations and Assumptions	Asset Class	Description Type	Description Asset	Costs Units (£,000's)	Assumptions - EA FRM Estimating Guide	Comments
Coastal protection (man-made)		1037		£/m	Same as Raised Costal Asset (man-made)						
Coastal protection (natural)		45		£/m	Same as Raised Costal Asset (natural)						
Culverted channel			1520	£/m	Cost estimated using average culverts of 200m lengths x 4.0 Width	21	Type 4 (Culverts)	Culverts	£/m^2	Length (10m, 20m, 50m, 100m, 200m, 500m, 1000m) Width (1.2m, 2.1m, 4.0m, 6.0m)	- cost includes +90% for preliminaries & other non-measured items - min length 4m - min width 0.6m - model error high below capital cost of £100,000 otherwise accuracy +/-50% - data shows minimum cost of £40,000 for any culvert
Flood asset structure			6050	£/m	Cost for fixed weir (moveable weirs are significantly more expensive)						
Flood Storage Area		N/A									
Maintained channel		Assumed as Raised Coastal asset (Natural)									
Natural channel		Cost assumed as 50% of Raised Coastal asset (Natural)									
Non-flood asset structure		Assumed as Raised Coastal asset (Natural)									
Other		Assumed as Raised Coastal asset (Man made)									
Raised coastal asset (man-made)	1037	1522	1522	£/m	Seawall Only - average cost per metres taken over 14 projects	26-34	Type 5 (vertical narrow crested walls)	Concrete	£/m (Min, Max, Median)	Cost stated as 'Seawall' only and does not consider wall type	
			1522	£/m	Seawall Only - average cost per metres taken over 14 projects			Brick & Masonry	£/m (Min, Max, Median)	Cost stated as 'Seawall' only and does not consider wall type	
		552	552	£/m	Earth Embankment only - average cost is £46 per m^3 with average 12m^3 per metre length of embankment (Taken for average of 5-15000m3). Therefore, £46x12 = cost per metre.		Type 6 (protected coastal embankment)	Permeable Embankment		EA Estimating Guide provides costs for fluvial embankments only	
			552	£/m	Earth Embankment only - average cost is £46 per m^3 with average 12m^3 per metre length of embankment (Taken for average of 5-15000m3). Therefore, £46x12 = cost per metre.			Impermeable Embankment		EA Estimating Guide provides costs for fluvial embankments only	
Raised coastal asset (natural)		45	35	£/m of asset	Sand dune protection works - average value taken over 4 projects	37-38	Type 7 (Duned and Shingle Beaches)	Dune	£/m (Min, Max, Median)	EA Estimating Guide provides data based on 4 NCPMS Sand Dune Projects	
			54	£/m of asset	Shingle Recycling Cost only - average value taken over 7 projects			Shingle	£/m (Min, Max, Median)	EA Estimating Guide provides data based on 7 NCPMS Shingle Recycling Projects	
Raised asset (man-made)	1526	2811	1193	£/m	Masonry wall only - Average for all height bands of wall with average 185m length.	4 - 19	Type 1 (Fluvial & Vertical Narrow	Brick & Masonry	Average rate: £/m or £/m2	Height (<1.2m, 1.2m-2.1m, 2,1m-5.3m, >5.3m) Wall Type: Retaining, Retaining + Cut Off, Retaining + Piled, Wall Raising	

ASSET_TYPE	Total Combined Cost	Combined Cost	Individual Cost	Unit	Cost - Calculations and Assumptions	Asset Class	Description Type	Description Asset	Costs Units (£,000's)	Assumptions - EA FRM Estimating Guide	Comments
							Walls)			Foundations, Wave Wall or All wall types	
			4428	£/m	Average cost for urban and rural environment, average depth 8m and average length of piling 230m			Piles (Steel Sheet Piles Only)	£/m, £/m2 (Min, Max, Average)	Urban or Rural Location Average Plan Length >100m, <100m Average 8m Depth for all piling	In addition to physical size the most important issues to consider are: - mobilisation cost - type of piling - section size of piles - access constraints - weather
		1216	1216	£/m	This is the average cost for Revetment as no cost available for gabions. Based on average volume ÷ average length = 16m3 per metre 16m3 per metre * £76 per metre average = £1216 per metre.			Gabions		EA Estimating Guide does not provide costs for Gabions	
		552	552	£/m	Earth Embankment only - average cost is £46 per m^3 with average 12m^3 per metre length of embankment (Taken for average of 5-15000m3). Therefore, £46x12 = cost per metre.		Type 2 (Fluvial Narrow Embankment)	Turf surface protection		EA Estimating Guide provides costs for new and raised embankments only	
			552	£/m	Earth Embankment only - average cost is £46 per m^3 with average 12m^3 per metre length of embankment (Taken for average of 5-15000m3). Therefore, £46x12 = cost per metre.			Rigid Protection		EA Estimating Guide provides costs for new and raised embankments only	
			552	£/m	Earth Embankment only - average cost is £46 per m^3 with average 12m^3 per metre length of embankment (Taken for average of 5-15000m3). Therefore, £46x12 = cost per metre.			Rip-Rap (rock protection)		EA Estimating Guide provides costs for new and raised embankments only	
			552	£/m	Earth Embankment only - average cost is £46 per m^3 with average 12m^3 per metre length of embankment (Taken for average of 5-15000m3). Therefore, £46x12 = cost per metre.			Flexible Protection		EA Estimating Guide provides costs for new and raised embankments only	
Raised asset (natural)	Costs N/A for High Ground					20	Type 3 (High Ground)	High Ground	Deterioration Guidance States Not Applicable to High Ground Cases		
Sea asset (man-made)		552		£/m	Same as Raised Costal Asset (man-made)						
Sea asset (natural)		45		£/m of asset	Same as Raised Costal Asset (natural)						

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