Costing potential actions to offset the impact of development on biodiversity – Final Report

Defra

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GHK

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in association with eftec

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Contents

1 Introduction

1.1 This report

GHK Consulting Ltd (GHK) and Economics for the Environment Consultancy (eftec) were commissioned by Defra to assess the costs of potential options for biodiversity offsets in England.

This final report presents the findings of the study, including the overall cost estimates.

1.2 Background to this report

1.2.1 Biodiversity offsets

Biodiversity offsets are activities designed to counterbalance losses of biodiversity which occur as a result of development. The Business and Biodiversity Offset Programme (BBOP, 2009[1]) defines them as:

"measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and/or rehabilitated or restored, in order to achieve no net loss or a net gain of biodiversity. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risk, protecting areas where there is imminent or projected loss of biodiversity."

Offsets have two principal purposes:

- By requiring developers to take action and incur costs to offset the damage caused by development, they help to internalise the cost of damage to biodiversity and therefore to discourage such damage occurring; and
- They provide direct compensation for any damage that does occur, by requiring equivalent re-creation or restoration measures elsewhere, thereby seeking to ensure that there is no overall net loss of biodiversity (eftec, IEEP *et al*., 2010)[2].

Biodiversity offsets may be facilitated by habitat banking. The latter is "a market where credits from actions with beneficial biodiversity outcomes can be purchased to offset the debit from environmental damage. Credits can be produced in advance of, and without *ex ante* links to, the debits they compensate for, and stored over time" (eftec, IEEP et.al. 2010).

Biodiversity offsets and habitat banking have already been introduced in some other countries. The main examples are in:

- Germany - The planning system has developed banking practices where mechanisms (such as pooling) have developed over time to implement previously overlooked compensation requirements.
- Australia - State-level offset and banking systems (e.g. Bushbroker in Victoria and Biobanking in New South Wales), have been developed and are now being implemented.
- Brazil - Two compensation regimes are: a forest reserve system that allows trading between landowners to deliver their obligations to protect forest cover; and an environmental compensation fund that raises a levy on developers and hypothecates this into the management of protected areas.
- South Africa - Two public-sector led systems are: a biodiversity offset system operated in the Western Cape; and a national wetland banking system.
- USA: There are well-developed systems of conservation banking and wetland banking (eftec, IEEP et.al. 2010).

[1] BBOP (2009) BBOP Biodiversity Offset Design Handbook. BBOP, Washington D.C.

[2] eftec, IEEP et. al (2010) The use of market-based instruments for biodiversity protection – The case of habitat banking – Summary Report. http://ec.europa.eu/environment/enveco/index.htm

The issue of habitat banking has been researched in detail for the European Commission. Europe has also introduced stronger compensation for biodiversity damage through the Environmental Liability Directive, extending the compensation requirements under the Birds and Habitats Directives which apply only in very specific circumstances.

The ideas of offsetting and habitat banking are also being developed in Member States. For example, Germany is adjusting its pooled offset system to allow more 'banking' activity, and a pilot biodiversity 'credit' project is underway in France.

1.2.2 The costs of biodiversity offsets

A policy to require biodiversity offsets can result in a variety of different costs for developers and regulatory authorities. These include:

- The costs of habitat creation, restoration and long term management activities designed to deliver a gain in biodiversity equivalent to that lost through development;
- The costs of acquiring the land on which this conservation activity is to take place, or in entering a management agreement to secure a change in land management;
- Other management and transaction costs incurred by the developer in meeting the requirements of the policy. These include the time, fees and expenses relating to applications, project management, management planning, monitoring and reporting; and
- The costs incurred by the authorities in regulating the offsets system.

The overall scale of the costs of the policy clearly depends on the unit costs of these different activities as well as the extent of biodiversity offsets demanded. The latter is a function of the overall rate of development and the type and level of conservation activity required to offset different types of development.

Little evidence of the costs involved in biodiversity offsets and habitat banking is available from international examples. This is due to factors such as:

- Prices paid for offsets being commercially confidential information; and
- Prices being highly dependent on local circumstances, equivalence methods, and the policy requirements involved.

What is known is that functioning habitat banking markets generally reduce the costs of offsets, but also introduce risks that policy design needs to address.

Because overseas evidence is limited, the costs of the policy in England have been estimated using a specially designed model.

1.2.3 Biodiversity offsets in England

Defra's Business Plan includes a commitment to assess, by Spring 2011, the scope for action to offset the impact of development on biodiversity in England.

Current policy thinking on biodiversity offsets is set out on Defra's website at:

http://www.defra.gov.uk/environment/biodiversity/offsetting/index.htm

Defra's proposal involves a system of analysis to determine how much offsetting is required for a given amount of damage to biodiversity, using:

- A method for determining the equivalence between the biodiversity loss from a development and the gain from the offset. Loss and gain are scored on the same scale, reflecting the distinctiveness and condition of the habitat. The ratio between the scores influences the amount of gain from the offset, relative to the loss.
- Further adjustments are proposed to the ratio between the loss and required gain to reflect:

  i) The uncertainty involved in recreating or restoring habitats, and

  ii) Delays in delivering the offset.

Higher uncertainty and longer delivery periods both result in greater amounts of gain required from the offset, relative to the loss.

The policy requirements relating to equivalence, and the degree to which adjustments are required for reasons of uncertainty and time preference, are key determinants of the level of conservation activity required to offset development, and hence the costs of the policy. They are therefore key elements in the modelling approach.

1.3 Objectives of the study

The overall aim of our study was to develop a tool for assessing the costs of potential new measures to offset the losses of biodiversity that arise due to development. The terms of reference stated that the tool should be flexible to allow the assessment of costs under a variety of offsetting regimes, which could create different demand for offsets in terms of the total area of offsetting required, the habitat type that needs to be created and where geographically this needs to be located.

The specific objectives of the study were as follows:

- Objective 1: To provide an assessment of the demand for biodiversity offsets, based on an analysis of development pressures and the extent of biodiversity loss.
- Objective 2: To provide an assessment of the potential supply of biodiversity offsets, including an analysis of the unit costs of provision of different habitats and the potential land areas available.
- Objective 3: To provide an assessment of the cost of alternative options to reduce biodiversity loss from development.
- Objective 4: To provide comparative information to enable the significance of these costs to be assessed within the context of the overall costs and benefits of development.
- Objective 5: To provide a final report to Defra presenting the findings of the study.

1.4 Outline of methodological approach

The objectives were met through the development of an Excel spreadsheet model, which was used to forecast the rate of development affecting biodiversity in England, the extent of conservation activity required to offset this development, and the costs of providing these offsets.

The work included:

- A quantitative review of relevant economic forecasts, official projections, and existing data on land use trends and rates of habitat loss;
- Specification of a model to forecast the rate of development affecting different types of land;
- Specification of ratios to relate the rate of development to the levels of offset required, based on metrics and multipliers developed by Natural England;
- Estimation of the level of conservation activity required to offset the forecast rate of development, using the ratios defined;
- Identification of relevant unit cost data, based on the UK BAP costings, appropriate land prices and a review of relevant administration and transactions costs;
- Combining the above elements to estimate the costs of biodiversity offsets in England under different options and scenarios.

Further details of each of these steps are provided in the relevant sections of the report.

The model specification was developed and tested through discussions with Defra and Natural England, through Steering Group meetings and a policy workshop.

1.5 Structure of this report

The remainder of this report is structured as follows:

- Section 2 provides an assessment of the area of development requiring offsets in England annually;
- Section 3 estimates the level of conservation activity required annually to offset this development;
- Section 4 examines the costs of activities designed to provide biodiversity offsets;
- Section 5 provides an overall assessment of the costs of offsets under different policy options and scenarios;
- Section 6 provides overall conclusions on completion of the work.

There are two annexes:

- Annex 1 describes the use of metrics and multipliers to determine offset requirements;
- Annex 2 examines the feasibility and potential for creation and restoration of different habitats in England.

2 Assessing the area of development requiring offsets in England

2.1 Projecting future development pressures

Future development pressures have been estimated in terms of the overall land area expected to be developed in England (and each of the former government office regions) in each year between 2011 and 2030. These overall forecasts have been estimated as the sum of a series of separate projections for each of the categories used in the land use change statistics produced by the Department for Communities and Local Government (CLG), which comprise:

- Residential;
- Industrial and Commercial;
- Transport and Utilities;
- Community Services; and,
- Minerals, Landfill and Defence.

The projected areas of these different developments have been estimated in an Excel spreadsheet model. The methodology used for each development category is set out in the subsections below.

One of the CLG land use categories, 'vacant and derelict land', has been excluded from the model to avoid double-counting, since this is likely to be mostly transitional land in the process of changing use and will ultimately be developed into one of the above categories.

2.1.1 Residential Forecasts

The forecasts of residential development are based upon CLG housing projections, which provide forecasts of the total number of households in each region up to 2033. The annual change in these projections has been applied to CLG data on the density of new dwellings built in England (in terms of dwellings per hectare). The density of new dwellings has been increasing over time, so an average between 2005 and 2009 has been used to project demand for residential land by region up to 2030.

The regional projections of demand for residential land are included in sheet 1 of the 'biodiversity offsets model' spreadsheet (i.e. *'1.Projected Land Demand by Use'*).

2.1.2 Industrial and Commercial Forecasts

The industrial and commercial forecasts are based upon regional employment projections produced by Experian in Spring 2010 and available via the website of the South West Observatory. These projections forecast employment across 14 broad sector groups up to 2030 for each region. These projections have been converted into land requirements using a model designed and used by GHK in preparing employment land reviews (ELRs). The key steps in the model are explained briefly below:

1. The projected annual change in employment is calculated to provide the additional demand for new industrial and commercial land in each year.
2. The employment projections are then moderated to exclude employment that does not give rise to demand for industrial and commercial land. (e.g. employment in agriculture, a percentage of construction employment that does not have a fixed place of work, etc.). The moderated employment projections are also distributed between different land use types (i.e. industrial, office, warehousing, etc.).
3. These employment projections are then converted into floorspace using internal employment densities (based upon figures prepared by Arup for English Partnerships and the Regional Development Agencies within the 'Employment Densities: A Full Guide' report. Conversion factors are then applied to convert the internal floorspace estimates into external floorspace.

4 The above steps provide external floorspace projections for the different land use types within each region.
5 The projections also take account of churn - an additional element of demand that arises from companies moving to new premises for a variety of strategic, cost, location and aesthetic reasons. Based on experience from previous ELRs, the annual rate of churn is estimated to be 0.5% of the total existing stock of floorspace within each region, with stock data provided by the CLG 'floorspace and rateable value statistics'.
6 The projections also take account of leakage, which assumes that 10% of the additional employment will not create additional demand for floorspace, since it will be absorbed within existing local centres, above shops, at home, etc.
7 These final floorspace projections are then converted into land requirements using plot ratios based on the ELR guidance, published by the former Office of the Deputy Prime Minister (ODPM).
8 These projections can be negative as well as positive, if projected declines in employment are greater than the demand from churn. This is the case for some regions in the projections for 2011 and 2012. However, for the purposes of this study, any negative demand estimates have been amended to assume zero employment growth, such that the estimates for these years will include only the estimates of churn. Any negative demand estimates have been subtracted from the land projections for the following year, which enables the model to account for the fact that negative demand will result in spare capacity (e.g. vacant properties) that will be re-utilised/re-occupied when employment growth, and demand for employment land, returns positive.

These projections of demand for industrial and commercial land are also included in the first sheet of the spreadsheet (*'1.Projected Land Demand by Use'*).

2.1.3 Projecting the other development pressures

Given the lack of reliable, consistent regional forecasts for the other types of development, these have been projected based on past trends and the projections of residential, industrial and commercial land. The assumptions and data are presented in the sheet *'1.Projected Land Demand by Use'* and described below;

- Demand for 'Transport and Utilities' land is assumed to be 27.2% of the annual projections of residential, industrial and commercial land in each region. The historic CLG land use change statistics show close correlation between these types of development and the transport and utilities infrastructure that will serve them. The figure of 27.2% is an historic average of this ratio taken from the CLG land use statistics for England between 2000 and 2008 and applied to each region (in the absence of data for individual regions).
- Demand for 'Community Services' land is assumed to be 17.5% of the annual projections of residential land in each region. As above, the historic data shows correlation between residential developments and the community services that support these new communities and a similar ratio has been calculated and applied.
- Demand for 'Minerals, Landfill and Defence' land has been relatively stable from 2000 to 2008, so a historic average from 2000 to 2008 has been applied to England data (the average of 610 hectares per annum is assumed to remain unchanged throughout the forecast period). This has then been distributed by region according to relative size of regions (total land area).

2.2 Distributing demand projections between developed and undeveloped land

Sheet 2 of the spreadsheet model (*'2.CLG % of Land Prev Developed'*) provides estimates (averages between 2005 and 2008) of the proportion of land associated with each type of development and within each region that was previously developed land. Sheet 2a (*'2a.CLG Change to Developed Use'*) has been hidden to avoid over-complicating the model since it is only used to provide a similar ratio for 'minerals, landfill and defence' developments, but using national figures in the absence of regional data.

Sheet 3 (*'3. Demand for Prev Developd Land'*) applies the percentage of previously developed land (from the CLG data on sheets 2 and 2a) to the projections of land demand associated with the respective types of development in each region (sheet 1). It is then possible to estimate the future demand for undeveloped land by calculating the difference between the estimates of overall demand and the demand for developed land, which is presented in sheet 3a (*'3a.Demand for Prev Undevpd Land'*).

The demand projections for previously developed and undeveloped land and the overall demand for development land are presented in Table 2.1 below.

Table 2.1 Projected demand for land for future development

	Hectares				
	2011	**2015**	**2020**	**2025**	**2030**
Demand for Developed Land	**5,171**	**6,051**	**5,760**	**5,492**	**5,155**
Industrial & Commercial	582	974	825	791	801
Residential	3,235	3,520	3,442	3,277	3,021
Transport & Utilities	813	975	923	878	825
Community Services	464	505	493	469	432
Minerals, Landfill & Defence	77	77	77	77	77
Demand for Undeveloped Land	**4,450**	**5,218**	**4,960**	**4,751**	**4,481**
Industrial & Commercial	330	702	576	545	549
Residential	2,191	2,373	2,313	2,206	2,030
Transport & Utilities	911	1,084	1,024	977	916
Community Services	485	526	514	491	452
Minerals, Landfill & Defence	533	533	533	533	533
Total Demand for All Land	**9,621**	**11,269**	**10,720**	**10,243**	**9,636**
Industrial & Commercial	912	1,676	1,401	1,336	1,350
Residential	5,426	5,892	5,755	5,483	5,051
Transport & Utilities	1,724	2,059	1,946	1,855	1,741
Community Services	950	1,031	1,007	960	884
Minerals, Landfill & Defence	610	610	610	610	610

The data suggest that these different types of development will require 9,621 hectares of land in 2011, 54% of which (5,171 hectares) is projected to be previously developed land, while 46% (4,450 hectares) is projected to be previously undeveloped land. The overall level of development is expected to increase to a peak around 2013-15 as the economic recovery gathers pace before falling back by 2030, to levels similar to those projected for 2011.

The figures are comparable to recent rates of development in England, which ranged between 5,900 and 16,600 hectares annually over the period 2000 to 2008, according to CLG statistics[3].

2.3 Impacts of development on priority habitats

The next stage of the model determines the extent to which the proposed developments on undeveloped land are likely to impact upon priority habitats.

[3] CLG - Live tables on land use change statistics: http://www.communities.gov.uk/planningandbuilding/planningbuilding/planningstatistics/livetables/landusechange/

2.3.1 Priority habitat groups

Natural England data from the ‘State of the Environment 2008’ report has been used to estimate current stocks of each of the habitat groups presented in Table 2.2 below. Data are not available for all habitat types (particularly water habitats), but the total land cover of the priority habitats for which data is available is estimated to total 2 million hectares as shown in sheet 4 of the model (*‘4. BAP Habitats by Region’*).

Table 2.2 Overview of habitat groups

Habitat group	Main priority habitats	Total area of resource (ha)	% outside SSSIs* (of each habitat)	% of total habitats outside SSSIs	Susceptibility of unprotected land to development	Distribution
Upland habitats	Upland grassland	14,317	30%	13%	Low	Mostly YH and NW
	Upland heathland	243,929	26%		Low (mostly wind farms)	Mostly NW, NE and YH
	Blanket bog	255,308	31%		Low	Mostly NW, NE and YH
Lowland heathland	Lowland heathland	72,331	33%	2%	High (from housing, industry and road construction)	Mostly SE and SW
Lowland grassland	Lowland grassland	95,259	32%	3%	Medium (from housing, industry and road construction)	Widespread, with largest areas in SW, SE and EE
Woodland	Broadleaved, mixed and yew woodland and parkland	770,292	88%	62%	Medium (from housing, quarrying, tourist/recreational facilities)	Widespread, largest areas in SE and SW
Wetlands	Lowland raised bog	10,227	12%	18%	Low	Mostly NW and YH
	Coastal and floodplain grazing marsh	235,046	84%		High (flood defences, infrastructure and housing development)	Widespread, with largest areas in SW, SE, EE, NW
	Fens and reedbeds	28,305	12%		High (flood defences, infrastructure and housing development)	Mostly EE, SE and SW
Coastal	Intertidal mudflats and saltmarsh	231,880	2%	1%	High (housing, industry, defence works, port and energy infrastructure)	Widespread around the coastline, largest areas in NW
	Sand dunes	12,800	15%		High (housing, industry, tourist/recreational facilities)	Mostly SW, NW, EE
	Coastal vegetated shingle, maritime cliffs and slopes, saline lagoons	20,689	31%		Medium (housing, industry, defence works)	Around the coastline

Table 2.2 presents the core habitat groups included in the model (excluding hedgerows which are discussed separately below), which comprise: upland habitats; lowland heathland; lowland grassland; woodland; wetlands; and coastal habitats.

The table gives the area of each habitat, the proportion of area outside SSSIs, and a judgement regarding the susceptibility of each habitat to development (based on the limited statistics available). The habitats most likely to be damaged by development are those which are widespread, where a large proportion of the habitat lies outside protected areas, and which occur in areas most susceptible to development (such as urban fringe and coastal locations).

Woodlands are likely to be particularly affected by development because of their large area, a high proportion of which is outside protected areas. Many also occur in lowland areas susceptible to development pressure. Upland habitats are also large in extent but a higher proportion is protected by SSSIs, and they tend to occur in locations less attractive for development. Coastal habitats are highly susceptible to development pressure but a large majority of priority habitats are in protected areas.

The total area of each habitat group in England, as presented in Table 2.2, has been distributed between the regions in the model. The State of the Environment report does not contain regional data, although the regional distribution of each habitat is presented graphically. The model estimates this regional distribution from 'eyeballing' the charts in the report and applying approximate figures. The figures suggest that the most significant regions in terms of BAP habitats are the South West, South East and the North West, accounting for more than half of all BAP habitats in England.

2.3.2 Protection from, and susceptibility to, development

Sheet 4 (*'4.BAP Habitats by Region*) also uses Natural England data from the State of the Environment 2008 report to estimate the proportion of each habitat area which is included within and outside SSSIs. The model assumes that only the area outside of SSSIs will be subject to significant development pressure, recognising that a significant proportion of priority habitats will be protected by conservation measures, which will either provide alternative compensatory measures or inhibit development altogether. It should be noted that land designated as Natura 2000 is subject to separate compensatory requirements and will not be dealt with by the current proposals for offsets. Natura 2000 sites account for almost 80% of the area of SSSIs in England. The remaining SSSI land could potentially be covered by offsets, but, since it receives a high level of protection under the planning system, the area of such land developed should be very small.

In the absence of regional data, the national estimates (of the percentage of each habitat area outside SSSIs) have been applied to each region. This reduces the area of priority habitats deemed to be sensitive to development pressure to 1.1 million hectares.

Table 2.2 shows that around 60% of this area is woodland (62%), followed by wetlands (18%), upland habitats (13%), lowland grassland (3%), lowland heathland (2%) and coastal habitats (1%).

The next sheet (*'4a.General LandUse Database'*) provides estimates of the land use in each region by different types of land use, based on the latest data (2005) from the CLG Generalised Land Use Database. This has been used to estimate the stock of developed and undeveloped land within each region, as well as the proportion of total land and undeveloped land that is accounted for by the 2 million hectares of priority habitats in England (as well as individual regional estimates based on the stock of priority habitats in each region).

The model estimates that these priority habitats represent 16.7% of all undeveloped land across England, although this figure falls to 9.2% after excluding the area of priority habitats included within SSSIs.

Furthermore, the model has also been refined to consider the susceptibility of the unprotected land of each habitat group to development and take account of protection provided by the planning system and the fact that some habitats are less suitable for development, or are concentrated in areas that are not appropriate or desirable for development. An analysis of Corine Land Accounts data for the UK and EU suggests that development on agricultural land between 1990 and 2000 was around 3.5 times more likely than development on semi-natural habitats. Since these figures will also include designated sites, a factor of 3.5 would double-count the effect of designation in our model. Overall it is estimated that, outside SSSIs, development is twice as likely to take place on non-priority habitats as it is on priority habitats.

Applying this assumption to the model provides a final estimate that 5.2% of the projected development on undeveloped land is expected to take place on priority habitats, after focusing on priority habitat areas outside of SSSIs and taking account of the susceptibility of priority habitats to development. Regional estimates of the likely development on priority habitats, as a proportion of all undeveloped land, range from 2.8% in the East Midlands, to 8.5% in London and the South East.

2.3.3 Projected demand for development on priority habitats

Sheet 5 (*'5.Demand for BAP Habitats'*) presents the projected demand for development on all undeveloped land, split between priority habitats located outside of SSSIs (i.e. on 5.2% of demand for development on undeveloped land) and other (non-priority) Greenfield land (94.8% of demand for development on undeveloped land). These figures take account of the regional distribution of priority habitats and susceptibility to development relative to non-priority areas. The model estimates that development will take place on 237 hectares of undesignated BAP priority habitats across England in 2011, rising to 279 hectares in 2014, before falling to 239 hectares in 2030.

2.4 Accounting for the area of development requiring offsets

The requirements for offsets are assumed to be as follows:

- For priority habitats, all sites developed give rise to a requirement for offsets. Any loss of biodiversity due to development needs to be offset by at least an equal increase in biodiversity through creation and/or restoration of habitats of the same type.
- For non-priority Greenfield sites, all sites developed are also subject to offsets. This will typically involve creation or restoration of more distinctive habitats equivalent in biodiversity terms to the land lost through development.
- For brownfield sites, 25% of sites developed are assumed to have sufficient habitat value to require offsets. The offsets are assumed to involve the creation or restoration of BAP priority habitats.

Sheet 6 (*'6.B&G to be Offset'*) provides estimates of the area of development of brownfield and non-priority Greenfield land that might give rise to requirements for offsets.

The area of development of different types that is estimated to give rise to a requirement for biodiversity offsets is estimated in Table 2.3. The model estimates that development in 2015 will affect more than 11,000 hectares of land across England as a whole. Most of this land (54%) is expected to be brownfield land, followed by non-priority Greenfield land (44%), with only 2.4% of development expected to take place on priority habitats.

Applying the respective assumptions for the area of development requiring offsets suggests that 6,700 hectares of development will require offsets. Most of these offsets (73%) are the result of development on non-priority Greenfield land, followed by developments on brownfield land (22%) and priority habitats (4.1%).

Table 2.3 Development area requiring offsets in England (2015 data)

	Projected Development Area (Hectares)	% Requiring Offsets	Area Requiring Offsets (Hectares)
Priority habitats	276	100%	276
Non-priority Greenfield	4,942	100%	4,942
Brownfield	6,051	25%	1,513
Total	**11,269**		**6,731**

The next section estimates the extent of habitat creation and restoration activity required to offset this level of development.

3 Estimating the Demand for offsets in England

3.1 Estimating the level of conservation activity required to offset development

3.1.1 Introduction to metrics and multipliers

The previous section estimated the area of different types of development in England estimated to give rise to a requirement for offsets. To estimate the costs of offsets, it is now necessary to estimate the extent of habitat creation and restoration activity required to offset this development. This can be achieved by specifying appropriate ratios that estimate the offsets required for the different types of sites affected by development.

Proposed metrics and multipliers have been developed through papers by Natural England which identify the different factors that need to be considered in calculating offset requirements and propose ratios that can be applied in particular circumstances.

The key factors to be taken account in specifying the relevant ratios are:

- Habitat value – taking account of the relative distinctiveness and quality of what is lost and what is provided in return;
- Risk and uncertainty – taking account of the fact that we can know what biodiversity is being lost as a result of development but that creating or restoring habitat is always subject to risks that the offset will fail to deliver habitat of the expected quality;
- Time preference – taking account of the fact that we would prefer to have a given amount of biodiversity now rather than at some point in future. While the loss of habitat due to development is immediate, creation or restoration of habitats may take many years.

These different factors will give rise to different offset requirements for the different types of land affected by development, given the requirement for no net loss of biodiversity through the provision of offsets. For example, where priority habitats are developed, the requirement for offsets will be high relative to the area of habitat loss, but where intensive farmland of low distinctiveness is developed, and this is replaced with more distinctive habitats, equivalence can be achieved with relatively fewer hectares of offsets.

The Natural England papers propose metrics and multipliers to be applied in individual cases. For the purposes of the costings, we need to define some more general scenarios which enable us to define overall ratios that can be used to relate the area developed to the area of offsets required.

We first consider the metrics required to achieve equivalence between the sites impacted and the offsets provided, and then combine these with multipliers for risk and time preference to identify overall ratios that can be applied.

3.1.2 Equivalence ratios

In assessing the need for offsets it is necessary to take account of the net value of habitat lost and gained and to specify an appropriate metric that achieves equivalence between the two, ensuring that there is no net loss of biodiversity. Development results in a loss of habitat and its replacement with built land, and a gain through the offset as a result of habitat creation or restoration, typically on Greenfield land of low biodiversity value – the net change in habitat value in each case needs to be considered.

The Natural England papers measure these changes through a points system based on:

- Habitat distinctiveness – with BAP priority habitats rating high on distinctiveness and intensively used land rating low;
- Habitat condition – with habitats within each distinctiveness class rated as poor to optimum based on their relative quality.

The metrics are given in Table 3.1.

Table 3.1 Matrix showing how condition and distinctiveness scores are combined to give the habitat score for a potential offset

		Biodiversity Distinctiveness		
		Low (2)	Medium (4)	High (6)
Condition	Optimum (4)	8	16	24
	Good (3)	6	12	18
	Moderate (2)	4	8	12
	Poor (1)	2	4	6

Assessing changes in condition is more difficult than changes in distinctiveness, as the resulting condition of the new habitat is difficult to predict. A starting point of optimum condition is assumed when assessing damage[4].

Based on these metrics, generalised equivalence ratios have been calculated for different types of development. In each case we have calculated the number of hectares of the newly created or restored habitat equivalent to one hectare of developed land. The details of the calculations and the assumptions underlying them are given in Annex 1.

Two main options are considered in assessing these equivalence ratios:

- Option 1: The land developed is assumed to be in optimum condition;
- Option 2: The land developed is assumed to be in moderate condition.

Option 1 imposes more stringent requirements on the developer as a higher points gain is required to compensate for land assumed to be in optimum condition. This gives rise to a higher equivalence ratio (i.e. more offsetting activity is required per hectare of development).

Table 3.2 summarises the equivalence ratios derived from these different scenarios.

Table 3.2 Summary of Equivalence Ratios*

Development scenario	Offset scenario	Equivalence Ratio*	
		Option 1	Option 2
Development on low distinctiveness farmland	Creation of priority habitat	0.49	0.24
	Restoration of priority habitat	1.00	0.50
Development on priority habitat	Creation of priority habitat	1.46	0.73
	Restoration of priority habitat	3.00	1.50

[4] This is based on an assumption from a conservation perspective that protecting habitat in location is always preferable to undertaking actions elsewhere to replace it. And whilst the condition of a habitat at a proposed development site might not be high in nearly all cases it would have retained the potential to have its condition improved had it not been destroyed.

Development on brownfield land	Creation of priority habitat	0.97	0.49
	Restoration of priority habitat	2.00	1.00

**Equivalence ratio = Hectares of habitat to be restored or created to achieve biodiversity gain equivalent to loss from 1 hectare of land developed*

3.1.3 Time preference

Multipliers for time preference are given in the Natural England paper, based on application of the standard discount rate of 3.5% specified in the HM Treasury Green Book.

If we assume that an average restoration project takes 10 years and an average creation project takes 20 years, this implies a time based multiplier of 1.4 for restoration and 2.0 for creation.

3.1.4 Combined ratios for equivalence and time preference

Combined multipliers can be calculated by multiplying the equivalence ratios by the multipliers for time preference. These are given in Table 3.3.

Table 3.3 Combined multipliers for equivalence and time preference

	Option 1			**Option 2**		
	Equivalence ratio	Time multiplier	**Overall offset ratio**	Equivalence ratio	Time multiplier	**Overall offset ratio**
Creation						
Priority habitats (Greenfield)	1.46	2.00	**2.91**	0.73	2.00	**1.46**
Other Greenfield development	0.49	2.00	**0.97**	0.24	2.00	**0.49**
Brownfield	0.97	2.00	**1.94**	0.49	2.00	**0.97**
Restoration						
Priority habitats (Greenfield)	3.00	1.40	**4.20**	1.50	1.40	**2.10**
Other Greenfield development	1.00	1.40	**1.40**	0.50	1.40	**0.70**
Brownfield	2.00	1.40	**2.80**	1.00	1.40	**1.40**

The figures indicate that, under Option 1, it is necessary to create 2.9 hectares of priority habitat for each hectare lost to development. This is because the newly created habitat may not be of the same quality as that lost, and because it takes time before it is created.

3.1.5 Dealing with risk

In assessing requirements for offsets, it is also important to take account of the risk that the conservation activities undertaken fail to provide the level of benefits expected. There is always an element of uncertainty in habitat creation or restoration projects which means that there is some risk that the project will fail to provide the biodiversity benefits anticipated.

Risk of failure can be dealt with through:

- Application of an additional risk multiplier, which increases offset requirements further; or
- Alternative risk management measures, e.g. through use of bonds or some other form of assurance scheme designed to minimise risk by offset providers.

We would expect restoration projects to have a relatively low risk of failure and creation projects to have a higher risk of failure. Based on the multipliers in the Natural England papers, risk multipliers could be incorporated as follows:

- Restoration – low/medium risk – average multiplier of 1.25
- Creation – medium/high risk – average multiplier of 2.25

If risk multipliers are incorporated in this way, it further increases the overall offset ratios employed (Table 3.4).

Table 3.4 Combined multipliers for equivalence, time preference and risk

	Overall offset ratio:	
	Option 1	**Option 2**
Creation		
Priority habitats (Greenfield)	6.56	3.28
Other Greenfield development	2.19	1.09
Brownfield	4.37	2.19
Restoration		
Priority habitats (Greenfield)	5.25	2.63
Other Greenfield development	1.75	0.88
Brownfield	3.50	1.75

A further multiplier may be applied where the offset is in a spatially less favourable location than the impacted site. However, for the purposes of the cost assessment, it is assumed that in the majority of cases it will be possible to provide an offset in a spatially appropriate location and that no separate allowance for spatial risk is required.

3.1.6 Applying ratios to estimate demand for offsets

The ratios specified in the sub-sections above can be used to estimate the number of hectares of habitat that has to be created or restored for each hectare of land requiring offsets.

3.2 Estimating land to be offset by restoration and expansion

3.2.1 Breakdown of offsetting activity by habitat creation and restoration

Sheet 4b (*'4b.Restoration&Creation Targets'*) provides data on the relative size of targets for creation and restoration of priority habitats in the UKBAP. The ratio between restoration and creation differs for each habitat group and is based upon the 2010 targets for the restoration and creation of individual BAP habitats (consolidated for the habitat groups). It is important to note that the 2010 targets have been used as a best estimate and the ratio between restoration and creation targets will vary over time and will also be determined by the relative costs of providing offsets through restoration or creation.

However, this approach suggests that, for upland habitats, lowland heathland and wetlands, there is a greater focus on restoration, while creation is relatively more important for lowland grassland and coastal habitats. There is a more even split between the restoration and creation of woodland habitats.

3.2.2 Estimating offsets resulting from development of priority habitats

The requirements to offset development on unprotected priority habitats are disaggregated between the habitat groups for each region in sheet 5a (*'5a.BAP Habitat Rest&Cre Offsets'*).

At the same time, the model also applies the above ratios to estimate the total area to be offset through the restoration and creation of each habitat group (based on the 2010 targets as described above).

When disaggregating between the habitat groups, the model also takes account of the expected level of susceptibility of the unprotected land of each habitat group to development, as presented in Table 2.2, which was informed by an analysis of UK and EU data and information. The model treats priority habitats with a 'medium' susceptibility to development as the norm. It then assumes that development on priority habitats:

- with a low susceptibility to development will be 0.3 times as likely; and those,
- with a high susceptibility to development will be 2 times as likely as for habitats with "medium susceptibility" to development.

These 'susceptibility to development' factors can be amended within the model in the cells F14 to F19 on sheet 5a (*'5a. BAP Habitat Rest&Cre Offsets''*).

The restoration and creation offset areas are then added together in sheet 5b (*'5b.Total BAP Habitat Offsets'*) to provide estimates of the total area of offsets associated with developments on priority BAP habitats.

3.2.3 Estimating offsets resulting from development of brownfield and non-priority Greenfield land

The extent of conservation activity required to offset development of brownfield and non-priority Greenfield sites is estimated in sheet 6a (*'6a.B&G Offsets Habitat Groups'*). This estimates the breakdown of conservation activity between groups of priority habitats, based on the existing regional distribution of priority habitats. However, it is assumed that no offsets involve the creation of coastal habitats, because the high unit costs involved (see Section 4) are likely to make this unattractive for offset providers. The relevant ratios specified in Section 3.1 are applied to estimate the area of restoration and creation of each habitat required.

The restoration and creation offset areas are then added together in sheet 6b (*'6b.Total B&G Offsets'*) to provide estimates of the total area of offsets associated with developments on brownfield and non-priority Greenfield land.

3.2.4 Total Offsets

Sheet 7 of the model (*'7.Total Area of Offsets'*) provides overall estimates of the total area of land over which conservation activity takes place, by adding together the figures for the priority habitats, the brownfield land and the non-priority Greenfield land. Similarly, Sheet 7b (*'7b.Total Restoration & Creation'*) provides a breakdown of this total by restoration and creation activities.

3.3 Overall demand for offsets

The overall area over which conservation activity is estimated to be needed in order to offset development in England in 2015 is given in Table 3.5. The figures include both habitat restoration and habitat creation.

The estimates range from 5,420 hectares to 16,891 hectares, depending on the assumption employed regarding the starting condition of the land developed (Option 1 or 2) and whether or not a multiplier is applied for risk.

Table 3.5 Total area of offsets in hectares (2015 data)

	Option 1	**Option 2**
Without risk multiplier	10,840	5,420
With risk multiplier	16,891	8,445

Table 3.6 provides a breakdown of this area by the different types of land affected. 56% of the conservation activity is required to offset development of non-priority Greenfield habitats and 34% to offset development of brownfield sites.

Table 3.6 Total area of offsets required under option 1 without risk multiplier by developments on different types of land (2015 data in hectares)

	Option 1 without risk multiplier	
	Hectares	**%**
Priority habitats	1,002	9.2%
Non-priority Greenfield sites	6,112	56.4%
Brownfield sites	3,726	34.4%
Total	**10,840**	**100%**

3.4 Hedgerows

It is necessary to treat hedgerows separately in the model because their extent is measured in terms of length (km) rather than area (hectares). Like other priority habitats, the loss of hedgerows requires like-for-like offsets to ensure that there is no net loss. In the case of hedgerows this needs to be achieved through creation of new hedgerows equivalent in biodiversity value to those lost through development.

The offset calculations for hedgerows are included in a separate sheet in the model (*'8.Hedgerows'*).

The requirement to offset hedgerows is estimated in the model by calculating the length of priority BAP hedgerow per hectare of agricultural land and applying this to the estimates of development taking place on non-priority Greenfield land. This provides an estimate of the length of hedgerow lost annually to development. The total length of hedgerow creation required to offset this loss is estimated using an appropriate ratio.

Based on the metrics proposed by Natural England, it is assumed that 3km of hedgerow need to be created to offset each 1km of hedgerow lost to development. This is because newly created hedgerows are assigned a habitat score of 1 (low quality) whereas established hedgerows are assumed to be capable of a habitat score of 3 (high quality). No time or risk multiplier is assumed to be required in this case, as it should be possible to provide a new, low quality hedgerow within a short time and with minimal risk.

Based on these calculations we estimate that 196 km of hedgerows will be lost to development in 2011, rising to 229 km in 2015.

The estimated requirement for the creation of new hedgerows to offset this loss is 587km across England in 2011, increasing to 696km in 2014 before declining to 591km in 2030. These offsets are in addition to area of offsets described above for the other priority habitat groups.

3.5 Offsets for species

In most cases it is assumed that the loss of species is addressed either through existing legal measures or through the habitat based offsets. In certain cases there may be a need to address the loss of species through separate offsets – however this is likely to limited and the costs are unknown. No additional costs are therefore assumed.

4 Assessing the costs of biodiversity offsets

4.1 Overall methodology for costing biodiversity offsets

The model assesses two alternative options in terms of costs:

1. Entering a management agreement to secure the work required. It is assumed that this will involve up front capital payments followed by annual management payments. This is the basis on which the BAP cost estimates are made; and alternatively,
2. Purchase of land followed by costs of restoration/re-creation and management work. This incurs much higher up-front costs, but ongoing costs should be lower as there is no payment for profit foregone – i.e. just the costs of the work required are incurred.

The costs of biodiversity offsets are estimated using the following methods:

- Habitat creation and restoration costs are based on estimates from the UK BAP costings;
- Land purchase costs are based on current prices for agricultural land;
- An additional allowance is made for administrative, transaction and regulatory costs, based on a % of habitat and site costs.

Offsets require habitats to be created and appropriately managed in perpetuity. They therefore involve a combination of one-off capital costs and ongoing management costs. These have been combined by estimating the net present value of the overall profile of costs over a 100 year period.

Further details of the unit costs used are given in the following sections. These unit costs are applied to the estimated area of offsets required in order to estimate the overall costs of the policy.

The cost estimates represent the net present value of the costs arising from the offsets required in each year. Because development continues to take place annually, the costs can be presented as annual costs.

4.2 The unit costs of habitat creation and restoration

4.2.1 Management agreement option

Discounted unit costs per hectare of habitat restored or created under the management agreement option are presented in sheet 9 (*'9.Unit Costs-Mang Agreement Option'*) for each habitat group. The unit costs include all capital, restoration, creation and management costs, based on weighted averages of the costs in GHK's HAPs model for those habitats with restoration and creation targets[5]. Administrative, management, transaction and monitoring costs for implementing the offset requirement are assumed to add 30% to the total cost, while the central regulatory costs for an offset scheme are assumed to add 10% to the total cost. These additional costs are added to the unit costs of restoration and creation to provide total costs under the management agreement option and are described in greater detail below.

The ongoing annual costs have been discounted using a discount rate of 3.5% to provide present value (PV) estimates over a period of 100 years, since the offsets are assumed to be preserved in perpetuity and the annual PV costs are negligible after 100 years. The model assumes capital costs per hectare are paid initially, followed by 10 years of annual restoration or creation costs (as appropriate), followed by a further 90 years of annual management costs. All costs are in real terms, with no adjustment for inflation, and the same unit costs are used for each year of the model up to 2030.

The PV unit costs for the management agreement option are included in Table 4.1 and are also presented in the model. The table shows that the unit costs are estimated to range from

[5] The only exception is capital costs in the creation of certain coastal habitats. Capital costs for the creation of saline lagoons, intertidal mudflats and saltmarsh have been adjusted to exclude management costs and avoid double counting these costs in the model.

around £2,000 to £49,000 per hectare, for different habitats, although only the creation of coastal habitats is estimated to cost more than £12,000 per hectare. Because the cost of creating coastal habitats is so high, the model assumes that this is not implemented as an option for general offsets for developments affecting non-priority habitats.

Table 4.1 PV unit costs of offsetting future developments under the management agreement option (including restoration and creation costs but excluding land purchase costs)

	Restoration PV Unit Costs £ per Hectare (incl admin, regulatory and transaction costs)	**Creation PV Unit Costs £ per Hectare (incl admin, regulatory and transaction costs)**
Upland habitats	2,151	7,382
Lowland heathland	8,530	11,791
Lowland grassland	10,168	11,293
Woodland	7,776	7,436
Wetlands	9,435	11,072
Coastal	4,509	48,758

4.2.2 Land purchase option

Discounted unit costs per hectare of habitat restored or created under the land purchase option are also presented in the model, in sheet 10 (*'10.Unit Costs-Land Purchase Opt'*) for each habitat group. The land purchase costs are considered separately in the following section. However, there is another significant change to unit costs under the land purchase option, since there is no longer a need to compensate landowners for income foregone. To account for this, the ongoing annual costs are assumed to fall to 30% of the levels used in the management agreement option above[6]. This is based on analysis of agri-environment payment rates which on average are made up of 70% income foregone and 30% costs incurred. All other costs and assumptions remain unchanged.

The restoration and creation costs of the land purchase option (excluding land purchase costs) are presented in Table 4.2. The unit costs are considerably lower, and have fallen by more than 50% for most habitats. The costs of creation of coastal habitats are again significantly higher than for other habitats.

Table 4.2 PV unit costs of offsetting future developments under the land purchase option (including restoration and creation costs but excluding land purchase costs)

	Restoration PV Unit Costs £ per Hectare (incl admin, regulatory and transaction costs)	**Creation PV Unit Costs £ per Hectare (incl admin, regulatory and transaction costs)**
Upland habitats	999	4,030
Lowland heathland	2,914	3,892
Lowland grassland	4,552	4,946
Woodland	5,058	3,404
Wetlands	4,268	4,644
Coastal	2,623	28,456

[6] The capital costs for the creation of saline lagoons, intertidal mudflats and saltmarsh have also been adjusted to exclude land purchase costs and payments to compensate for income foregone and avoid double counting these costs in the model.

4.3 Costs of land purchase

It is assumed that most offsetting activity will take place on agricultural land. Agriculture represents the main land use in England, so land is relatively plentiful. The opportunity costs of using it are relatively low. There are few restrictions on the use of farmland for habitat re-creation and restoration, which is common practice in agri-environment schemes. Subject to local conditions, a wide range of habitats – woodlands, grasslands, heathland, coastal habitats and wetlands – can all be created on land that is currently farmed.

Offsets are unlikely to take place on land with development potential that will be prohibitively expensive to use for nature conservation purposes. Offsets will undoubtedly also take place on other types of land – such as former mineral workings and low value forestry land – where this is cost effective. However, the use of agricultural land represents the key reference scenario for offsetting. Assuming the use of agricultural land may tend to exaggerate the costs in some cases but is likely to provide a reasonable approximation for the overall costings.

The costs of land purchase are also presented in sheet 10 of the model. These are included separately because land purchase costs vary by region, while the unit costs of restoration and creation are national estimates applied across all regions. The rural land prices used in the model are estimates published in the Royal Institution of Chartered Surveyors (RICS) latest 'Rural Land Market Survey', which provides data for 2010 H2.

The survey provides regional data for arable and pasture land and the model assumes an arithmetic average (mid-point) between these two figures as its assumed land price within each region. For example, the survey suggests an arable land price of £15,736 and a pasture land price of £13,154 per hectare for England and Wales as a whole, with an average (midpoint) of £14,445 per hectare.

The model also adds the administrative and transaction costs to the land prices to account for the additional costs involved in identifying, purchasing and transferring ownership of the land, as well as related management planning activities, suggesting an overall cost of £20,000 per hectare for acquiring land for the purpose of biodiversity offsets. Regional data are presented in Table 4.3 below

Table 4.3 Rural land prices (£ per hectare)

	Arable Land	Pasture Land	Average (Mid-point)	Total Land Price per Hectare (incl admin/central costs)
North East	14,209	9,946	12,078	16,909
North West	17,298	17,298	17,298	24,217
Yorkshire & the Humber	15,753	11,120	13,437	18,811
East Midlands	14,827	12,603	13,715	19,201
West Midlands	16,062	13,591	14,827	20,757
East of England	16,062	11,120	13,591	19,027
London	14,827	12,356	13,592	19,028
South East	14,827	12,356	13,592	19,028
South West	14,827	12,973	13,900	19,460
England & Wales	**15,736**	**13,154**	**14,445**	**20,223**

Source: RICS Economics, RICS Rural Land Market Survey, H1 2010

Total unit costs for the land purchase option can be calculated by adding these land purchase costs to the capital/annual costs for restoration and creation presented in Table 4.2

for each region. This suggests unit costs under the land purchase option are significantly higher than the management agreement option and range from £18-53,000 per hectare, with the costs for most habitats and regions ranging from £20-25,000 per hectare.

4.4 Administrative, regulatory and transaction costs

4.4.1 Background

As biodiversity offsets are an economic instrument driven by regulation, there will inevitably be costs associated with operating the system. These costs are referred to as administrative, regulatory and transactions costs. Although these terms have specific meanings in UK policy development, their definitions vary between different sources of information about them.

A practical way of analysing these costs is to divide them up into 3 phases:

1. A planning phase, in which a habitat management plan to deliver and maintain the intended biodiversity outcome, and the resources (capital, staff, financial) to deliver this are identified.
2. An implementation phase, in which the works are undertaken and monitoring takes place to check the execution of these and that the habitat reaches its intended condition.
3. Ongoing monitoring, ensuring that the condition is maintained over the relevant time period for the offset.

In each of these phases, responsibilities can be distinguished for the offsetting body (i.e. the developer who must compensate, and other actors it contracts with in this process such as a credit provider), and regulatory authorities (planning authorities and the body with policy oversight for the UK system).

Table 4.4 Administrative and transaction costs at different stages of the offset process

Stage of offset	Offsetting body	Regulatory authority
1. Planning phase	Delivery and management plan for offset, including site selection.	Check of plans if ex-ante credit . Checking and approving applications, agreeing terms and conditions where necessary.
2. Implementation phase	Monitoring and documentation that works have proceeded as per 1.	Check that implementation carried out (habitat quality and distinctiveness achieved) and document this.
3. Ongoing monitoring	Monitoring and documentation of condition of site.	Check that habitat quality and distinctiveness maintained, and document this.

In 2 and 3, as well as the actual monitoring, there is a need to record the results and make these available to relevant bodies that regulate the system.

Estimating the costs of each can draw on different sources:

Agri-environment schemes

Administration costs to Government are added to the BAP costing figures that are the basis for the costs developed in this report. The BAP costings incorporate a 15% increase in the costs of biodiversity actions to cover administration costs. The 15% figure is based on the average administration cost of agri-environmental schemes. These are the estimated public sector costs of delivering the schemes, and include design, administration and monitoring work, but not the administrative and transaction costs incurred by the farmer (i.e. the delivery partner in this case). The relatively low costs reflect the standardised nature of the schemes.

In some ways, the administration costs of agri-environment schemes may be higher than would be expected within an English offsets scheme, as administering EU funds generally brings increased costs. However, agri-environment schemes are relatively simple and formulaic compared to the requirements of offsets, and so adminstration costs and requirements may be higher for offsets than agri-environment payments. Offsets may also have higher regulatory costs than agri-environment schemes, given policing requirements implicit in ensuring offsets are delivered.

Royal Society for the Protection of Birds

The transaction costs for the offsetting body are akin to the work undertaken in proposals to external funders to support habitat creation or restoration work by NGOs, for example, LIFE+ funding bids. The RSPB[7] has provided two examples that represent the high and low end of the range of costs normally present in LIFE+ bids. Each project is worth around €2million over 4 years. The total transactions costs are estimated as:

- Staff time to prepare the proposal (roughly equivalent to preparing a delivery and management plan for biodiversity enhancement);
- Management costs during the project implementation; and
- Monitoring costs during the project implementation.

In the two examples, the total transaction costs are 6% - 45% of the other project costs. The higher figure relates to a very complex project of habitat restoration across a large number of sites in the Outer Hebrides, so is atypical. Discussion with RSPB suggests that a more realistic upper value would be that average transactions costs are 30% of the project costs.

Environment Agency (EA)

Information from EA's East Anglia habitat creation programme has estimated costs of £2k/ha (total) for transaction costs 1, 2 and 3 for freshwater habitat creation. This is slightly higher for more complex habitats (e.g. reedbed) than simpler ones like wet grassland. This compares to approximate HAP costings per ha in the habitats involved of £2,686 (wet grassland) to £6,570 (reedbed) for re-establishment over 10 years (source: HAP costings) for works under 2 and 3 above (with 3. including some ongoing capital works to maintain, e.g. ditch clearing beyond 10 years).

This information suggests that transaction costs are 30% (reedbed) to 74% (wet grassland) of habitat management costs. The high costs may reflect the high negotiation costs to EA of securing areas of land for habitat works. These costs would be expected to be reduced within an offsets system because the market price provides the incentive for landowners to make areas of land available, so proactive negotiation of deals, as needed by the EA, will not be a factor.

Data provided by the EA for the BAP costings estimated administrative costs for coastal managed realignment work at 50% of the cost of land purchase and capital works.

Literature

eftec, IEEP *et al*. (2010) research on habitat banking in the EU suggested that where the habitat banker is a public body transaction costs are lower as no separate regulator is needed. In these cases administrative costs are similar to those for protected areas management.

Recent literature on habitat banking (e.g. Carroll, Fox & Bayon (2008) Conservation & Biodiversity Banking. Earthscan) does not provide any data on the average transaction costs

[7] Nick Folkard, RSPB external funding unit, *pers. com.* 15.2.11

in the US. It states that they are case specific, and can be between tens of thousands and millions of dollars.

Simple Estimate of Long-Term Monitoring Costs

For a site of 20-50 ha for the most common habitats, we can estimate the ecological monitoring time required at 2 single-day visits per year. These might be supported by 2 office days for compiling records and reporting. At a cost for an ecologist of £400-500/day, this would give a cost of £1800 – 2000 per year, or £36-100 per ha per year, for ongoing monitoring. These costs for monitoring alone are low, at around 5% of the HAP costings.

Overall

The above review suggests that overall transaction costs incurred by the offset provider (including site selection, management planning, project management and monitoring) are likely to add around 30% to the costs of the work completed.

Separate provision needs to be made for the costs to the authorities of regulating the system, which are likely to add up to 10% to the overall costs.

4.5 Unit costs for hedgerows

Unit costs for hedgerows are calculated in the same way as for the other priority habitats described above, although costs are per km rather than per hectare and all hedgerow offsets are assumed to involve creation rather than restoration.

Unit costs are discounted over 100 years as above, before adding the same assumptions for the administrative, management, transaction and monitoring costs of implementing the offset requirement and the central regulatory costs for an offset scheme. This provides a present value unit cost estimate of £18,380 per km of hedgerow created through offsets.

Applying these costs to the area of offsets suggests that the total cost of creating hedgerows through offsets is between £10 and £13 million per annum. These costs remain consistent across different assumptions, since hedgerows have their own multipliers in the model.

4.6 Applying unit costs to offset areas

4.6.1 Management agreement option

The appropriate unit costs for restoration and creation under the management agreement option have been applied to the areas of land to be offset for the restoration and creation of each habitat group and the results are presented in sheet 9a (*'9a.Rest&Creat Costs-Mang Agree'*) alongside the hedgerow costs described above.

The restoration and creation costs are then added together to provide overall costs, and totals for each habitat, for England and each region in sheet 9b (*'9b.Total Costs-Mang Agreement'*). The overall costs vary according to the particular assumptions input into the model and are described in greater detail in the following chapter. However, the most significant regions in terms of overall offset costs are estimated to be the East of England, South East, South West and East Midlands regions.

4.6.2 Land purchase option

As above, sheet 10a (*'10a.Land Purch,Rest&Creat Costs'*) applies the relevant unit costs to the land projections to generate costs associated with restoration and creation, including the cost of purchasing land. These are then added together in sheet 10b (*'10b.Total Costs-Land Purchase'*) to provide overall costs, and totals for each habitat, for England and for each region.

These costs also vary according to the assumptions input into the model but are typically around twice as high as under the management agreement option. The regional distribution of costs is also similar to the management agreement option, despite the regional differences in rural land prices.

5 Overall cost estimates

5.1 Overall estimates of the costs of biodiversity offsets in England

Overall estimates of the costs of biodiversity offsets in England are given in Tables 5.1 and 5.2. These range from £51 million per annum (with no land purchase, no risk multiplier, and based on the assumption that the land developed is in moderate condition) to £404 million per annum (with land purchase, incorporating a risk multiplier, and assuming land developed is in optimum condition).

Table 5.1 Total cost of offsets under the management agreement option (2015 data)

	Option 1	Option 2
Without risk multiplier	£89.0m	£50.8m
With risk multiplier	£136.9m	£74.8m

Table 5.2 Total cost of offsets under the land purchase option (2015 data)

	Option 1	Option 2
Without risk multiplier	£263.5m	£138.1m
With risk multiplier	£404.4m	£208.5m

The above costs include the costs of providing offsets for hedgerow loss, which are estimated to amount to £13 million in 2015.

Tables 5.3 and 5.4 break these costs down by the different types of habitat giving rise to offsets. Approximately 50% of the overall costs are estimated to arise from development of non-priority Greenfield habitats.

Table 5.3 Total cost of offsets by developments on different types of land under the management agreement option (2015 data, option 1 without risk multiplier)

	Option 1 without risk multiplier	
	£m	**%**
Priority habitats	£8.9m	10.0%
Non-priority Greenfield sites	£41.5m	46.6%
Brownfield sites	£25.9m	29.1%
Hedgerows	£12.7m	14.3%
Total	**£89.0m**	**100%**

Table 5.4 Total cost of offsets by developments on different types of land under the land purchase option (2015 data, option 1 without risk multiplier)

	Option 1 without risk multiplier	
	£m	**%**
Priority habitats	£24.1m	9.1%
Non-priority Greenfield sites	£140.4m	53.3%
Brownfield sites	£86.4m	32.8%
Hedgerows	£12.7m	4.8%
Total	**£263.5m**	**100%**

Tables 5.5 and 5.6 provide a breakdown of costs by the different habitats being restored or created. The most significant costs are associated with woodland habitats, which represent around 45% of total costs for each option.

Table 5.5 Total cost of offsets by habitat group under the management agreement option (2015 data, option 1 without risk multiplier)

	Option 1 without risk multiplier	
	£m	**%**
Upland habitats	£5.4m	6.1%
Lowland heathland	£4.7m	5.3%
Lowland grassland	£5.3m	6.0%
Woodland	£39.2m	44.0%
Wetlands	£20.9m	23.5%
Coastal habitats	£0.8m	0.9%
Hedgerows	£12.7m	14.3%
Total	**£89.0m**	**100%**

Table 5.6 Total cost of offsets by habitat group under the land purchase option (2015 data, option 1 without risk multiplier)

	Option 1 without risk multiplier	
	£m	**%**
Upland habitats	£52.7m	20.0%
Lowland heathland	£12.0m	4.6%
Lowland grassland	£11.5m	4.4%
Woodland	£122.2m	46.4%
Wetlands	£51.6m	19.6%
Coastal habitats	£0.9m	0.3%
Hedgerows	£12.7m	4.8%
Total	**£263.5m**	**100%**

5.2 Costs of local and regional pilots

The above are estimates of introducing an offset scheme nationally across England. In practice, however, offsets are initially likely to be piloted on a voluntary basis at a regional or sub-regional level. Clearly the overall costs of introducing these pilots will depend on the scale at which they are introduced and the proportion of the country that they cover.

The scale of pilots will be determined by the relevant areas volunteering for them, so cannot be spatially assessed. However, assumptions can be made about rational behaviour by the authorities in the relevant areas in relation to the spatial scale issues that may affect the costs:

- Areas need to have sufficient activity for the market to function efficiently; and
- The prevalence of habitat types in different areas must provide sufficient scope for offsetting to take place.

The key constraint is the availability of land and how authorities form partnerships to participate in the pilots will provide important lessons in this respect. Offsets schemes are expected to be brought forward by groups of neighbouring local planning authorities. To analyse the likely costs within the pilot areas, some assumptions are necessary on the rational behaviour of these authorities in forming groups:

- If an offsets policy is attempted in a small area, costs may escalate significantly as a result of land constraints. We assume that in these circumstances the authorities do not pursue offsets as a policy option (a kind of disproportionate costs exemption).
- It is assumed that authorities group together such that areas a) where development is envisaged/ desired; and b) with habitat creation/enhancement potential are both within the boundaries of the pilot area. Without these conditions an offsets market will not function - If a) not present, there is no demand, if b) not present, offsets will be infeasible or disproportionately costly.

Assuming pilots are undertaken in suitably-sized areas, the costs of piloting offsets can be estimated in proportion to the overall share of the land area of England that they cover (Table 5.7).

Table 5.7 Potential costs of piloting offsets for different proportions of the land area of England (2012 data, option 1 without risk multiplier)

Land Area (% of England total)	Management agreement option (£m)	Land purchase option (£m)
10%	£7.2m	£21.2m
20%	£14.4m	£42.4m
30%	£21.5m	£63.6m
40%	£28.7m	£84.8m
50%	£35.9m	£106.0m
100%	**£71.8m**	**£211.9m**

Note: Costs are assumed to be proportionate to land area

5.3 Sensitivity of costs to assumptions employed

The sensitivity of the costs to key assumptions can be assessed in the model.

One such assumption relates to the proportion of brownfield developments deemed to require offsets. Varying this proportion between 15% and 35% gives rise to the range of costs, which are given in Tables 5.8 and 5.9. The figures demonstrate that the overall costs are sensitive to the assumption about the proportion of brownfield sites requiring offsets.

Table 5.8 Range of offset costs (assuming between 15% and 35% of brownfield land requires offsets) in England under the management agreement option (2015 data)

	Option 1	Option 2
Without risk multiplier	£78.6m - £99.4m	£45.6m - £56.0m
With risk multiplier	£120.1m - £153.8m	£66.4m - £83.2m

Table 5.9 Range of offset costs (assuming between 15% and 35% of brownfield land requires offsets) in England under the land purchase option (2015 data)

	Option 1	Option 2
Without risk multiplier	£229.0m - £298.1m	£120.8m - £155.4m
With risk multiplier	£350.4m - £458.4m	£181.5m - £235.5m

The costs are also affected by the assumptions regarding the types of habitats created or restored through offsets. The unit cost data given in Section 4 indicate that average costs are fairly similar for most habitat groups, except for coastal habitats, which have high creation costs. The costs model assumes that offsetting occurs in proportion to the mix of habitats within each region, but that creation of coastal habitats does not take place because its high cost does not make it an attractive option for offset providers.

The sensitivity of the cost estimates to the choice of whether to include coastal habitats in generic offsetting activity is examined in Tables 5.10 and 5.11. The figures show that including coastal habitat creation in the assumed mix of offset activity significantly increases the overall cost estimates, especially under the management agreement option.

Table 5.10 Range of offset costs (assuming exclusion and inclusion of coastal habitats when offsetting developments on brownfield and non-priority Greenfield land) in England under the management agreement option (2015 data)

	Option 1	Option 2
Without risk multiplier	£89.0m - £129.5m	£50.8m - £71.1m
With risk multiplier	£136.9m - £233.8m	£74.8m - £123.3m

Table 5.11 Range of offset costs (assuming exclusion and inclusion of coastal habitats when offsetting developments on brownfield and non-priority Greenfield land) in England under the land purchase option (2015 data)

	Option 1	Option 2
Without risk multiplier	£263.5m - £282.7m	£138.1m - £147.7m
With risk multiplier	£404.4m - £468.0m	£208.5m - £240.3m

5.4 Putting the costs of offsets in context

The estimates above are that the introduction of biodiversity offsets will cost between £50 million and more than £400 million per year across England by 2015, depending on the assumptions employed and the detailed requirements of the policy.

These costs can be compared with the overall benefits of the policy and with relevant comparators relating to the overall value of the developments involved.

The **benefits** of the policy will be to create or restore between 5,400 and 16,900 hectares of BAP priority habitats annually by 2015, at an overall average cost of between £8,100 and £25,500 per hectare in present value terms, depending on whether or not land is purchased. This will halt the loss of biodiversity due to development and make a substantial contribution to biodiversity conservation in England. The annual expenditures involved represent between 15% and 115% of the overall estimated annual costs of delivering Habitat Action Plans in England which are estimated at £354 million per year from 2015 to 2020[8].

The estimated costs of biodiversity offsets amount to between 0.1% and 0.8% of the overall value of new build construction output in England, which totalled £47.5 billion in 2009 (Table 5.10).

[8] GHK (2010) Costs of the UK Biodiversity Action Plan – Update. Report for Defra.

Table 5.12 Construction output in England, 2009 (current prices, £ billion)

	Construction output in England - 2009 (£bn)
New housing	£12.1bn
Infrastructure	£6.5bn
Other new work (public, private industrial/commercial)	£28.9bn
Total new build	**£47.5bn**
Total repair and maintenance	*£44.4bn*
Total construction output – All work	**£91.9bn**

Source: Office for National Statistics, Construction Statistics Annual 2010

5.5 Other considerations

5.5.1 Feasibility of restoring and creating different habitats

The workability and cost of an offsets policy depends critically on the ability to identify and successfully implement appropriate habitat restoration and creation projects. Where this is not possible for particular areas or habitats, then offsets will not be possible and the development will be unable to proceed. If the opportunities for appropriate restoration or creation projects are very scarce, this will be expected to increase their costs, by limiting the supply of suitable sites and projects.

The costings above are based on the assumption that suitable creation and/or restoration projects can be implemented, and that the choice of such projects is not so limited as to inflate their costs.

The feasibility of implementing biodiversity offsets for different habitats is examined in Annex 2. This review finds that:

- Most BAP priority habitats can be restored and/or re-created, providing appropriate locations are chosen and sufficient time is allowed;
- Some habitats, such as woodlands and some grassland habitats, are widespread and therefore offer numerous opportunities for creation and restoration;
- Other habitats, such as calcareous grasslands, are dependent on local conditions and the scope for creation or restoration is therefore much reduced;
- Some BAP habitats such as limestone pavement and aquifer fed naturally fluctuating water bodies are very rare and opportunities for restoration or creation are either lacking or very limited.

The implications of this are that:

- There are widespread opportunities for habitat restoration and creation across regions. This should mean that generic offsets – e.g. where development of non-priority habitats is offset through restoration or creation of unspecified habitats – should be feasible in all regions, providing a sufficiently large area is chosen within which offsets can take place;
- Where priority habitats are developed, there is a specific requirement to create or restore habitat of the same type. The opportunities to do this for some locally restricted habitats that require particular conditions may be limited. In certain cases, therefore, offsetting on a like-for-like basis will not be possible and this may prevent the development from going ahead. However, the habitats that are most likely to be developed are those that are most widespread and least likely to be protected by designations, such as semi-natural woodlands. Offsets are more likely to be feasible for these more widespread habitats.
- Very rare and localised habitats are unlikely to be suitable for offsets and should be protected from development.

This means that the feasibility of habitat creation and restoration is not expected to significantly increase the overall costs of offsets, but may place some restrictions on the development of particular habitats in some places.

5.5.2 The economics of offset markets

The above analysis assumes a static market with development pressure and unit costs as exogenous variables. In reality introducing offset systems, in particular if developed into habitat banking, will have dynamic effects. Firstly, by increasing the cost of development, less development will occur. Secondly, the cost increase will be greater where the biodiversity loss is greater (as equivalence requires greater biodiversity gain to deliver compensation) relative to areas of lower biodiversity value. This would be expected to shift development away from areas of higher biodiversity (i.e. more distinctive habitats in better condition).

Overall, the design of offset systems involves markets created and driven by regulation. The regulations can be thought of as a trade-off between two factors:

1. A free market that gives the buyers and sellers flexibility and fosters market activity; and
2. A regulated market that mitigates the potential risks for biodiversity, buyers and sellers.

In general, greater regulation (2) reduces flexibility (1) and therefore would be expected to increase the costs of offsets. However, and exception to this is when rules allow 'trading up' through which regulation allows compensation using gains of higher-priority biodiversity than that damaged. Defra's proposals include trading up. This can benefit biodiversity (putting more resources into higher-priority habitats) and increase market flexibility (allowing more options for compensating *for* lower-priority biodiversity, and *with* higher-priority biodiversity).

Following the development of an offsets system, market forces (e.g. the price of land) will continue to influence the costs of offsets and the outcomes over time. Other aspects of the rules of the system (for example how delivery of offsets at different points in time) can also influence the function of the market.

The static nature of the model employed may tend to under-estimate some costs of offsetting and over-estimate others. For example:

- Where offsets influence the pattern of development, encouraging development of lower priority habitats with lower offset requirements, this will tend to decrease the costs compared to those estimated;
- Offset providers are likely to seek low cost solutions, focusing especially on habitats that are relatively quick and inexpensive to restore and create. This can be expected to reduce the costs compared to the estimates;
- However, the model assumes that unit costs are constant, irrespective of the level of offsetting activity, and that costs will not be inflated by the scarcity of offsetting opportunities available. In reality, shortages of suitable sites in particular may drive up the costs of offsets compared to those estimated.

Because of these factors, the cost estimates should be regarded as indicative only. The effect of these economic dynamics could only be considered by modelling supply and demand changes in offset markets, which is beyond the scope of the current study. It is important to note, however, that the assumptions employed regarding the requirements of the policy and the ratios used to offset development can be expected to influence the overall costs more than these economic factors.

6 Conclusions

The overall costs of introducing biodiversity offsets in England have been modelled based on future development projections, the requirements for conservation activity to offset this development, and the costs of that conservation activity.

The analysis demonstrates that **the costs of introducing offsets are highly dependent on the assumptions employed**, particularly with regard to the requirements of the policy. Particular issues are identified with regard to **the treatment of risk**, **the assumed condition of the land that is developed**, and **whether offsets can be achieved through management agreements or require land to be purchased**.

The costs are also dependent on other variables, such as the **proportion of brownfield developments that require offsets**, and the assumed mix of habitat management activity implemented, particularly whether more expensive activities such as **coastal habitat creation** take place.

Overall, the different variables indicate that the cost of the policy could be **between £50 million and more than £400 million annually** depending on the assumptions employed.

While the costs of offsets are not insignificant, the **benefits are also substantial**, halting the loss of biodiversity through development and making a substantial contribution to the UK Biodiversity Action Plan.

Even under the high cost scenarios, **the costs of offsets are expected to amount to less than 1% of the total output on new build construction in England**, while affecting a substantial proportion of new development activity.