SOMERSET

HABITAT EVALUATION PROCEDURE

METHODOLOGY

September 2016

Further Information

If you would like further information please contact the report author: Larry Burrows, Ecologist, Somerset Ecology Services, Planning Control, Somerset County Council, County Hall, Taunton, TA1 4DY. 01823 358118. LBurrows@somerset.gov.uk

Summary of the Habitat Evaluation Procedure

The Habitat Evaluation Procedure is structured around the calculation of Habitat Units (HU), which are the product of a Habitat Suitability Index (quality) for a species and the total area of habitat (quantity) affected.

The Integrated Habitat System coding is used as a base in applying scores to a species' Habitat Suitability Index (HSI). The Integrated Habitat System (IHS)[1] classification comprises over 400 coded habitat categories, the majority drawn from existing classifications.

In constructing a HSI for a species the index scores are applied to each Habitat and Matrix, and Formation and Land Use / Management codes in the Integrated Habitat System (IHS) based on analysis of the ecological requirements, from existing literature and professional judgement, for each species assessed or mapped. A database of Habitat Suitability Indices is kept and reviewed by Somerset County Council.

Each IHS 'Habitat' code will be scored on a scale of 0 to 6 (as defined in Chapter 4) using a potential or precautionary approach as a starting point. The score will be the same across each of the hierarchical levels of the IHS Habitat coding (e.g. poor is scored as 1 whether this is at broadest habitat level or priority habitat level unless there is discernible differences in the type of habitat used, e.g. oak or beech woodland. This means that the full range of scoring is used before the modifiers (the IHS matrix, formation and management codes) are applied.

Matrix Codes[2] are added to or subtracted from the Habitat Code to a maximum score of 6, e.g. grassland score 3 + scrub score 2 would equal 5.

All other Codes are scored as a decimal 0 to 1 according to the effect the formation and /or management of a habitat has on its suitability. These are multipliers. Where there is no effect from Formation or Management codes then a default score of 1 is used.

The HSI metric is Habitat Code (Range 0 to 6) + or – Matrix Code (Range 0 to 6, Default 0) x Formation Code (Range 0 to 1) x Management Code (Range 0 to 1)

The HSI score is multiplied by the location of the proposed site in relation to that of the species record. A Consideration Zone is determined by either the home range or dispersal distance of the species being assessed and divided into three Density Bands. The three Bands are, 'A' closest to the record, 'B' and 'C' furthest from the record valued at 3, 2 and 1 respectively.

[1] http://www.somerc.com/integrated+habitat+system/

[2] IHS considers that patches of scrub and single trees are matrix habitat acting in combination with main habitats types rather than separate habitats in their own right.

Density Banding

Band	Score
A	3
B	2
C	1

The modifiers start from a confirmed record outward for the species affected. The density band widths will vary from species to species depending on its characteristic use of its home range. For example species which use a single focus for a population, such as a bat roost or a pond for great crested newts, are likely to have a decreasing density of use the further removed from the centre (e.g. Rainho & Palmeirim, 2011; Knight, 2006; Rosenberg & McKelvey, 1999), whereas other species populations are spread throughout the area it occupies, such as common dormice which nest throughout the home range would have a large A band and small B and C band widths.

Example of Density Bands within the Consideration Zone for a Species with Single Focus such as a roost

For information the value of the proposed site to a species in Habitat Suitability value is calculated by using the HSI Score and the Density Band (See Table 1). The outcome of the Habitat Suitability Units used in the HEP is on a scale of 0 to 18.

Matrix Combining Habitat Suitability Score and Density Band

		Habitat Suitability Score					
		Poor 1	Marginal 2	Average 3	Good 4	Very Good 5	Excellent 6
Band	A (3)	3	6	9	12	15	18
	B (2)	2	4	6	8	10	12
	C (1)	1	2	3	4	5	6

The replacement habitat required is calculated by multiplying the score by the hectarage of the habitat affected (hectares x [HSI / Density Band]) giving figure in Habitat Units. For example a HSI/Band score of 12 for an area of 1.50 hectares would give a value of 18 Habitat Units.

In order that any offset habitat creation would functionally replace habitat lost to development a 'fraction multiplier' is applied to the resultant Habitat Units needed to replace habitat lost to development in order to provide robust compensation, e.g. to maintain 'favourable conservation status'. This may also be needed due to the limited nature of the surveys; that the IHS mapping does not include an assessment of habitat condition for a species; potential errors of omission; the use of 'foreign' data in establishing a HSI; non validation; and the variability of time required for the offset habitat to become functional.

Delivery risk is set out in the table below.

Multipliers for different categories of delivery risk (Defra, 2012)

Difficulty of recreation/restoration	Multiplier
Very High	10
High	3
Medium	1.5
Low	1

Spatial risk is considered to be taken account by locating the replacement habitat so that it is accessible to a species population affected.

In delivering mitigation there may be a difference in timing between the implementation of the development and the functionality and maturity of the replacement habitat. Temporal risk is set out in the table below

Multipliers for different time periods (Defra, 2012)

Years to target condition	Multiplier
5	1.2
10	1.4
15	1.7
20	2.0

Some habitats are not replaceable. Therefore it is considered that there is a ceiling of 20 years above which priority habitat types should not be developed upon.

Finally, an allowance for the existing habitat on the replacement habitat creation site as this will be lost or included in the value of any enhancement. The formula applied to offset losses of existing habitat at the offset site is:

$$\frac{\text{Area Equivalent of Habitat Units Needed to Offset from Development}}{\text{(Habitat Value of Desired Habitat Type – Habitat Value of Offset Habitat Creation Site)}}$$

The hectarage required is derived by dividing the Habitat Units by 18.

Further information and detail can be found in the main body of the methodology

Contents

1. Introduction

1. This report sets out the Habitat Evaluation Procedure (HEP) methodology employed for calculating the value of a site for species in Somerset to be used in determining the amount of habitat replacement would be required to mitigate for that lost to land use change. It uses an approach based on that devised by Burrows et al, 2011 for species in biodiversity offsetting. A similar methodology was used operationally and successfully for the Appropriate Assessment of Hestercombe House SAC (Somerset County Council, 2009).

2. The HEP can be an important process for ensuring a 'no net loss' of important ecological resource as a result of development. To demonstrate 'no net loss' the value of the habitat needs to be clearly defined, and the methodology transparent and measurable.

3. However, the HEP should not be seen as being applicable in all circumstances. Development should avoid critical areas to biological conservation, for example where irreplaceable habitat occurs such as ancient woodland, which has developed over hundreds of years, or areas which support high densities of a species' population. Forward planning should enable avoidance of such sites in the first place.

4. Many ecological assessments are based on subjective interpretations, which suggest a need to develop and implement quantitative and predictive approaches, as has been the case in North America, to include impacts on connectivity and the maintenance of populations with more certainty. (Gontier, 2004) To this end the HEP would allow for quantitative assessment of what constitutes 'no net loss'.

5. The HEP methodology can be used with the metric for habitats devised by Treweek et al (2010) and adopted by Defra in a simplified form for its two year pilot on biodiversity offsetting, which ran from April 2012 for two years. However, the biodiversity offsetting metrics proposed by Defra (2012) alone are based on habitat replacement and do not address the particular needs of species in cases where the amount, type and "quality" of habitat might not be a valid surrogate for population viability.

6. The methodology also provides a proxy for some of these species as well as those not listed but nonetheless form part of the functioning of ecosystems through use of the habitat based metric. To this end the process includes the metrics being used for pilots in England (Defra, 2012) in Appendix 7. This metric should be used where no species' population are identified on the proposed development site in the HEP process. This would give greater robustness in aiming for a 'no net biodiversity loss' situation. It is considered that the habitat metric alone will not produce a 'no net biodiversity loss', which is the aim of the process.

2. Background

7. The use of Habitat Suitability Indices (HSI) in evaluating habitat for species began in Somerset had its roots in conversations held by Larry Burrows, Bill Butcher, (then manager of Somerset Environmental Records Centre), and Liz Biron (also of SERC) around 2004. The US Fish and Wildlife Service's Habitat Suitability Indices[3] and Habitats Evaluation Procedures[4] served as the starting point but it was quickly realised that HSI could be developed by assigning scores to SERC's Integrated Habitat System (IHS)[5]. Over the next few years several HSI were developed for important species in Somerset through literature searches and professional judgement.

8. Primarily the HSIs were to look at habitat availability compared to species records held by SERC and predict the amount of habitat that might be available to populations of a species in the County. Habitat suitability maps can be produced in GIS. However, it was also realised that the method could also be used in ecological impact assessment.

9. In 2008 the use of HSI in assessing the value of habitat loss to species was first used operationally within a Habitats Regulations Assessment (HRA) carried out to determine the effects of development north of Taunton on the lesser horseshoe bat colony at Hestercombe House SAC from site allocations in the draft Taunton Deane Borough Council Core Strategy[6]. A HSI was developed for lesser horseshoe bats against IHS coding. This study was supported radio tracking, invertebrate surveys, faecal analysis and a literature search. The method was agreed to by Natural England, who stipulated that the term 'offset' be used in order to avoid the term 'compensation' and its meaning within the Habitats Regulations. The HRA was completed in 2009 and the Core Strategy subsequently adopted.

10. Since that date the methodology has evolved and been used in over twenty cases, both for plans and projects, within HRA and in Ecological Impact Assessments, and at the various stages in the planning process from site allocation, pre application through to the planning application stage.

11. In March 2011 a paper was published on an earlier but similar methodology in the Chartered Institute of Ecology and Environmental Management's journal 'In Practice'[7].

---

[3] U. S. Fish and Wildlife Service. 1981. *Standards for Developing Habitat Suitability Indices*. *ESM103*. Washington, D. C.: Department of the Interior

[4] U. S. Fish and Wildlife Service. 1980. *Habitat Evaluation Procedures ESM102*. Washington, D. C.: Department of the Interior.

[5] http://www.somerc.com/integrated+habitat+system/

[6] Somerset County Council. 2009. *Taunton Deane Borough Council Local Development Framework Core Strategy Site Allocations Development Plan Document and Somerset County Council Taunton Transport Strategy Review 2: Habitats Regulations Assessment - Hestercombe House Special Area of Conservation.* Taunton: Somerset County Council

[7] Burrows, L., Butcher, B., & Treweek, J. 2011. Offsets for Species in the UK Planning Context: A Possible Methodology. *In Practice,* 71, 41-43, March 2011

12. In late 2011 Defra announced its intention to trial biodiversity offsetting in England with six pilot projects supported by complimentary projects to run for two years between April 2012 and April 2014. Somerset County Council applied but was awarded a complimentary project status as it was not using the Defra proscribed habitat-led metric but its own species-led approach. It was considered by the County Council that a habitat based metric without spatial constraints would not ensure the Government objective of 'no net biodiversity loss'. The Defra metric was considered inadequate in taking account of the value of habitats for species or the spatial placement of offsets without which the viability of affected populations would be at risk. It is considered critical that offsite offset sites are accessible to populations of any species affected by the development otherwise the amount of habitat lost will result in a loss of resources in supporting that population, which may lead to local decline or even extinction and a reduction in range.

13. During the project period for the complimentary project the only real issue has been one of nomenclature – Natural England's dislike of the term 'biodiversity offsetting' / 'offsets' when using the metric to evaluate sites within Habitats Regulations Assessment despite their previous recommendation. There appears to be confusion when using the 'biodiversity offsetting' in terms of process or the metric used. To avoid this issue the term 'Habitat Evaluation Procedure' (HEP), used by the US Fish and Wildlife Service, has been adopted for the metric itself. This can then be applied both to Habitats Regulations Assessments (HRA), other ecological impact assessments, and Favourable Conservation Status assessment, including those within the biodiversity offsetting process.

14. Habitat Suitability maps cane be produced of a geographic area in GIS and overlain with Consideration Zones based on species records and a buffer equalling the home range or dispersal distance of the species mapped. This is currently being considered for use in predictive mapping for forward planning and alert mapping for planning control purposes by local authorities.

15. HEP is structured around the calculation of Habitat Units (HU), which are the product of a Habitat Suitability Index (quality) and the total area of habitat (quantity) affected or required (U. S. Fish and Wildlife Service, 1980[8]).

[8] U. S. Fish and Wildlife Service. 1981. *Standards for Developing Habitat Suitability Indices*. *ESM103*. Washington, D. C.: Department of the Interior

3. Application

16. The Habitat Evaluation Procedure (HEP) may not be applied in all circumstances due to the sensitivity of a proposed site and/or its conservation value. On the other hand a proposed development may not warrant use of the HEP if there is no significant land take or then if the mitigation provided is obviously adequate to replace that lost.

17. Moreover, there will be cases where HEP will not be feasible or viable resulting in development not being able to proceed and an alternative site chosen (see Box 1 below).

18. The need to carry out the HEP should be judged on a case by case, species by species basis. Disturbance of one or two individuals of a commoner species may not constitute a need for HEP as 'Favourable Conservation Status' of the population may not be affected. However, it is not necessarily below the threshold for a rare species, a species in decline, or a species at the edge of its range as a harmful disturbing impact on a very small number of individuals may impact negatively on the demography of the local population. (Penny Simpson, 2011)

19. Nonetheless it is considered that a precautionary approach where the effects of a development on the local population of any species of European conservation value is uncertain. There should be a presumption against development where mitigation methods would not compensate for any losses due to development (Category A in Box 1).

20. Where mitigation, compensation or biodiversity offsetting are neither possible nor desirable for all impacts on species populations it is essential that safeguards are put in place. There are critical areas where offsetting would not be feasible or viable and development should not be carried forward. These Critical Areas are listed for species in the Species Data Table (see Appendix 2).

21. A Critical Area would be where no development is likely to be permitted due to the sensitivity of a site to the species affected, such as in proximity to a nest site for marsh harriers or the presence of a flora species that is not translocatable.

22. In addition it is considered that some priority habitats, as listed on Section 41 of the Natural Environment and Rural Communities Act 2006, cannot be replaced and development should not be permitted. This is due to the length of time that they have evolved and the irreplaceability of some constituent organisms, at least in the short and medium terms. It is also considered that in the medium and longer terms the management of any replacement habitat may be uncertain.

23. Development will be resisted in Somerset where the required replacement habitat type takes more than 20 years to recreate the s41 habitat type, for example ancient semi natural woodland and raised bog (see Appendix 6).

Box 1: Species Thresholds

Category A
Offset should not be allowed in any case where development would:

- Destroy any habitat parcel supporting a key population of a European Protected Species (i.e. affecting their Favourable Conservation Status);
- Destroy critical feeding, breeding or commuting habitat of a European Protected Species;
- Cause irreversible population decline for any European Protected Species

AND mitigation / offsetting are not possible using proven techniques.

Category B
An offset would be allowable / required where:

- Destruction of any part of a habitat parcel of European protected , UK protected, BAP or LBAP species;
- Destruction of any part of a habitat parcel predicted (e.g. by Habitat Suitability Mapping) to support European protected species (other than in Category A)

PROVIDED THAT an offset is feasible using proven techniques OR is provided in advance

(Defra, 2009)

4. Habitat Evaluation Procedure

Introduction

24. The method used to calculate the amount of habitat required to replace that lost to a species' population due to development is based on the requirements for maintaining that needed to support viable populations. It uses an approach similar to the Habitat Evaluation Procedures (HEP) developed by the U.S. Fish and Wildlife Service (1980) to provide '…*for mitigation and compensation that can allow fair use of the land and maintain healthy habitats for affected species*'.[9] HEP is structured around the calculation of Habitat Units (HU), which are the product of a Habitat Suitability Index (quality) and the total area of habitat (quantity) affected or required (U. S. Fish and Wildlife Service, 1980).

25. A key assumption is that habitat type, amount and distribution influence the distribution of associated animal species. It is also important to recognise that Habitat Suitability Index (HSI) models predict habitat suitability, not actual occurrence or abundance of species populations (Dijak & Rittenhouse, 2009).

26. The Habitat Evaluation Procedure for species uses the Integrated Habitat System (IHS) developed by Somerset Environmental Records Centre, described below, and enables nesting with the habitat-led methodology adopted by Defra (2012) for their pilot projects. It requires a Habitat Suitability Index for the species affected and data set of in the Species Data Table (see Appendix 2)

27. Such methods are considered necessary to allow for quantitative assessment of what constitutes 'biodiversity gain', whereas current ecological impact assessments are often based on subjective interpretations.

Consideration Zone

28. The Consideration Zone (CZ) shows where a species may occur based on a recorded occurrence based on the home range or in some cases the dispersal distance of that species. Although at its centre is a record, a species has the potential to be present, if habitat conditions are suitable to support it, anywhere within the CZ. The likely habitat use of a species within CZ is likely to be determined by the structure of connecting and feeding habitats and the presence of hostile habitat. Patches of isolated habitat within the CZ may also become into use if connectivity is restored.

29. To map the CZ a buffer for each record, corrected to the precise location if known, of a species' home range is produced, after correcting the record's location as necessary (See Figure 1). Alternatively an addition of 200 metres to the Consideration Zone radius is added to allow for recording error (Butcher & Coles, 1999). Home ranges and territorial areas were researched for each species from the literature, scientific journals, consultation with specialists and the Internet. The distances used to produce the CZ buffer is given in the species data sheets on the Species Data Table and metadata accompanying the mapping for each species.

[9] http://www.fort.usgs.gov/Products/Software/HEP/

Figure 1: Example of a Consideration Zone

30. Similarly the CZ for some species can be mapped using the dispersal range if appropriate.

Integrated Habitat System Mapping

31. The Integrated Habitat System coding is used as a basis for describing and calculating habitat values used as a base in applying scores in Habitat Suitability Indices.

32. The Integrated Habitat System (IHS)[10] classification comprises over 400 habitat categories, the majority drawn from existing classifications, together with descriptions, authorities and correspondences arranged in a logical hierarchy that allow application for different purposes. The classification can be customised for a geographical area or special project use without losing data integrity.

33. The IHS represents a coded integration of existing classifications in use in the UK with particular emphasis on Biodiversity Broad Habitat Types, Biodiversity Priority Habitat Types, Annex 1 of the Habitats Directive and Phase 1[11].

34. Standard habitat definitions from these classifications are combined into a hierarchy starting at the level of Broad Habitat Types, through Priority Habitat types, Annex 1

[10] http://www.somerc.com/integrated+habitat+system/

[11] Phase 1 (JNCC, 1993) habitat mapping can be converted to IHS by using the software provided by Somerset Environmental Records Centre.

to vegetation communities which are coded. These are the Habitat Codes.

35. IHS Habitat Codes are hierarchical with the numbers in the code increasing as the habitat becomes more specific. Descriptions of habitats can be found in IHS Definitions (Somerset Environmental Records Centre)[12]. For example:

- WB0 Broadleaved, mixed and yew woodland (Broad Habitat Type)
- WB3 Broadleaved woodland
- WB32 Upland mixed ashwoods (Priority Habitat Type)
- WB321 Tilio-Acerion forests on slopes, screes and ravines (upland) (Annex 1 Habitat)

36. As well as Habitat Codes IHS provides Matrix, Formation and Land Use/Management Codes which are added as a string to the main Habitat Code to provide further description.

37. Ideally habitat information for the whole of the geographic area studied should be mapped in a GIS programme, such as MapInfo or ArcGIS. This includes habitats distinguishing between arable types, improved grassland and neutral grassland, for example, IHS allows this detail and the inclusion of Matrix codes detailing management and such as the presence of scrub and scattered trees in grassland habitats enables scoring of suitability to the species for which the index is being developed.

38. A base map for the geographic area can be established possibly using data derived from Phase 1 survey or LCM2007 and converted to IHS. In the UK IHS mapping has been increasingly carried out for or by local authorities and other organisations, for example in the east of England area and Hampshire. IHS mapping of the geographic area of Somerset has been carried out by SERC for the whole County and, at the time of writing, more detailed coding for the Wildlife Trust's Living Landscape Project Areas. As more detailed habitat survey becomes available coding could be updated to produce an increasingly accurate county wide base map.

39. However, when used in ecological impact assessment for calculating the value of impacts of habitat change on a species population then at minimum it is only necessary that IHS coding is applied the habitat types present on the proposed development site to enable the use of Habitat Suitability Indices in the HEP metrics.

Habitat Suitability Indices

Introduction

40. Habitat Suitability Indices (HSI) has been used in the United States and Canada since the early 1980s as way of assessing the impacts of development on species' populations and distributions. In addition, they have been used to predict what offset habitat needs to be created to maintain species' populations. HSI have also been used in conservation planning and has proven useful in the USA for such as

[12] http://www.somerc.com/integrated+habitat+system/

screening permits in the Southeast and the comprehensive planning of refuges in the Northeast[13]. In Somerset they have been successfully employed in assessing proposed development sites since 2009.

41. The process assumes that the suitableness of habitat for a species can be quantified - the HSI. The overall suitability of an area for a species can be represented as a product of the geographic extents of each habitat and the suitability of those habitats for the species[14].

Description

42. In constructing the HSI the index scores are applied to each Habitat, and Matrix, Formation and Land Use / Management codes in the Integrated Habitat System (IHS) based on analysis of the ecological requirements, from existing literature and professional judgement, for each species assessed or mapped.

43. Each IHS 'Habitat' category is scored on a scale of 0 to 6 (as defined below) using a potential or precautionary approach as a starting point. The score will be the same across each of the hierarchical levels of the IHS Habitat coding (e.g. poor is scored as 1 whether this is at broadest habitat level or priority habitat level unless there is discernible differences in the type of habitat used, e.g. oak or beech woodland[15]. This means that the full range of scoring is used before the modifiers (the IHS Formation and Management codes) are applied.

44. The Habitat Code scoring is considered in combination with the IHS Matrix codes[16]. These are either added or subtracted from the Habitat code. This is to account for species that use grassland with a matrix of scattered scrub or single trees, which would not otherwise use open grassland habitat. Matrix Codes[17] are added to or subtracted from the Habitat Code have a range of 0 to 6 but when considered in combination must not exceed a score of 6 or fall below a score of 0, e.g. grassland score 3 + scrub score 2 would equal 5. Where there is no effect from a Matrix type then a default score of 0 is used.

45. All other Codes are scored between 0 and 1 and are multipliers. Where there is no effect from Formation or Management codes then a default score of 1 is used.

46. Scores will be applied such that a precautionary approach or 'potential' approach is taken, e.g. if a species requires grassland which is most valuable when grazed then grassland scores the top score. This potential score will take into account a combination of the Habitat and Matrix codes. The management modifier would then

---

[13] http://www.fws.gov/r5gomp/gom/habitatstudy/Gulf_of_Maine_Watershed_Habitat_Analysis.htm
[14] http://www.fort.usgs.gov/Products/Software/HEP/
[15] The 1 to 6 scale matches Defra's habitat distinctiveness range used in its Biodiversity Offsetting metric (Defra, 2012).
[16] IHS considers that patches of scrub and single trees are matrix habitat acting in combination with main habitats types rather than separate habitats in their own right. It is possible that further sub codes be added to the grassland habitat codes, e.g. calcareous grassland with scattered scrub, etc. but this would lead to a proliferation of coding and current IHS GIS mapping would need amending to take this into account. Therefore by providing a positive multiplier the needs of those species which require a mosaic of grassland and scrub is taken into account.
[17] IHS considers that patches of scrub and single trees are matrix habitat acting in combination with main habitats types rather than separate habitats in their own right.

maintain the habitat score at this high level by a multiplier of 1. If the management is not grazed a decimal multiplier is applied to reduce the value of the habitat. For example a grassland habitat is valued at 6 but by applying the relevant management code, i.e. either mown or other management type, the value of the habitat will be reduced. Only one management code is allowed. An example is set out in Table 1 below.

47. Habitat Suitability Indices have been assembled for species used in the Habitat Evaluation Procedure and are stored separately from this report. An extract is given in Appendix 3.

Table 1: Example of HSI Calculation

	Habitat Code	Matrix Code	Formation Code	Land Use / Management Code	HSI Score
Code	GN1	SC2	-	GM11	
Description	Lowland Meadow	Scattered Scrub	-	Cattle Grazed	
HSI Score	2	4	1	0.75	4.5

48. The definition of poor, average, good and excellent habitat is adapted from the 'Wildlife Habitat Handbook for the Southern Interior Ecoprovince', British Columbia, Ministry of Environment (Ritcey et al, 1988)[18], in consultation with the Bat Conservation Trust, and expanded as follows:

6. **Excellent** - provides for essential life requisites, including feeding, reproduction or special needs and supports a relatively high population density, implied >70% chance of occurrence, can support positive recruitment. Can be a critical life-cycle association.

5. **Very good** - provides for essential life requisites, including feeding, reproduction or special needs and supports a relatively high population density, implied 50 - 70% chance of occurrence, can support positive recruitment.

4. **Good** - provides for a life requisites, including feeding, reproduction or special needs and supports a relatively high population density, implied 40 - 50% chance of occurrence, can support a stable population.

3. **Average** - provides for moderately required life needs, including feeding, reproduction or special needs and supports a relatively moderate population density, implied 25 - 40% chance of occurrence, can support a stable population.

2. **Marginal** - provides for marginally required life needs, including feeding, reproduction or special needs and supports a relatively modest population density, implied 15 - 25% chance of occurrence, can support a small population.

[18] For example http://www.env.gov.bc.ca/wld/documents/techpub/r20.pdf

1. **Poor** - provides for a non-essential life needs, including feeding, reproduction or special needs and supports a relatively low population density, implied <15% chance of occurrence.

49. In the assessment of scores for a species assessment is also given to other species on which the maintenance of its survival depends.

50. It is recognised that not all habitat patches of the same type have equal value in terms of resource to a species, for example see Dennis, 2010. However, in scoring the overall HSI, i.e. including all Habitat, Matrix, Formation codes, etc., it is considered that a higher value is given as a precaution. It is considered that this can be balanced in part by inclusion of a factor for density at a site in the metric.

51. No allowance is made for seasonal variations, i.e. due to the availability of prey species at different times of year, has been made in developing the HSI. It is considered a habitat valued at 6 at a particular period but not at other times will remain at a value of 6 being necessary to support that species at that time of year when other prey or other resources may not be so readily available.

52. The HSI score arising from the above calculation can be built into the GIS mapping and displayed using thematic mapping.

Validation

53. A HSI model can be reviewed against occurrence data held by the biological records centre. The Gulf of Maine HSI work[19] established the principle of producing several HSI models for one species and retained the model, which had the best association with known occurrences. The mapping is produced and matched with species data at the biological records centre and the model refined to fit the records with a view to errors of omission and commission.

54. Garshelis (2000) concludes that the '...*utility of the models is to guide further study or help make predications and decisions regarding complicated systems; they warrant testing but the testing should be viewed as a never-ending process of refinement, properly called bench-marking or calibration*.'

55. The validation should be seen as a continuous refinement process and models should be reviewed from time to time and up dated[20].

56. In this study HSI have initially scored by the author and then reviewed by species specific conservation organisations before being further validated by species specialists. However, these scores may be adjusted locally to suit local circumstances as long as they are justified as to why they are being modified.

[19] http://www.fws.gov/r5gomp/gom/habitatstudy/Gulf_of_Maine_Watershed_Habitat_Analysis.htm

[20] http://www.fws.gov/r5gomp/gom/habitatstudy/Gulf_of_Maine_Watershed_Habitat_Analysis.htm

Density Band

57. The HSI score is multiplied by the location of the proposed site in relation to that of the species record. The Consideration Zone (CZ) is divided into three Density Bands. This is called ‘feathering’ by Boone & Krohn (1998).The three Bands are, ‘A’ closest to the record, ‘B’ and ‘C’ furthest from the record valued at 3, 2 and 1 respectively. An example is shown in Figure 2 and the values given in Table 2 below.

Table 2: CZ Band

Band	Score
A	3
B	2
C	1

Figure 2: Example of Density Bands within the Consideration Zone for a Species with Single Focus such as a roost

58. The modifiers start from a confirmed record outward for the species population affected. The CZ density band widths will vary from species to species depending on its characteristic use of its home range. For example species which use a single focus for a population, such as a bat roost or a pond for great crested newts, are likely to have a decreasing density of use the further removed from the centre (e.g. Rainho & Palmeirim, 2011; Knight, 2006; Rosenberg & McKelvey, 1999), whereas other species populations are spread throughout the area it occupies, such as common dormice which nest throughout the home range would have a large A band and small width B and C bands.

59. When two Bands occur within one field take the higher value as the score

60. Details of the widths of these bands can be found in the Species Data Table (see Appendix 2). Although normally the CZ Band decreases in value the further away from the record in band widths there may also be higher use areas away from the centre of the CZ and will need identifying on a case by case basis based on the spatial ecology of the species affected.

<u>Zone A</u>

Avoid if possible in the first instance. This is the area where the highest density of a species is likely to be present and if present habitat used by that species will be of the greatest value in maintaining a local population.

In many cases it will also include the central focus of a population, for example a breeding pond for great crested newts or a maternity roost of bats. Habitat in this area is also important as it is likely to support juveniles on first emergence.

Loss of habitat is likely to reduce the fitness of the population through forcing the species to travel further to forage. Loss of resting / breeding places would need carefully planned mitigation if possible and methods would need to be proven to work. Some habitats are not replaceable and development proposals should be rejected, for example grazed pasture, on which juvenile greater horseshoe bats are reliant cannot be mitigated for within a development site.

For those species which rely on habitat structure to commute to foraging areas loss of linear features or new roads and the development itself could cause severance from food sources and threaten the viability of the population.

<u>Zone B</u>

In this zone a species is likely to occur less densely with smaller numbers of individuals affected than in Zone A and impacts on the population are likely to be less. Nonetheless, these can be significant especially to those species which have individual territories within a population’s home range. Surveys may also show high densities of occurrence due to poor habitat quality in Zone A.

<u>Zone C</u>

The species would be expected to occur at low densities and generally population effects from development are unlikely to be significant. Indeed the species may not be present at all depending on the type of habitat affected and the connectivity in the landscape. However, the location of the development and its relationship to a population’s dispersal through the wider landscape may be important, for example the locations of ponds for great crested newts or habitat patches used by butterflies.

61. Following ecological surveys carried out for the proposed development the Density Band score may be modified up, but not down, depending on the recorded activity for a species on that site. This reflects uneven use of a home range and refines the value of the habitat for a species (e.g. see Bontadina & Naef-Daenzer, 2002).

Calculating the Habitat Unit Value

62. For information the value of the proposed site to a species in Habitat Suitability value is calculated by using the HSI Score and the Density Band (See Table 3). The outcome of the Habitat Suitability Units used in the HEP is on a scale of 0 to 18.

Table 3: Matrix Combining Habitat Suitability Score and Density Band

		Habitat Suitability Score					
		Poor **1**	**Marginal** **2**	**Average** **3**	**Good** **4**	**Very Good** **5**	**Excellent** **6**
Band	**A (3)**	3	6	9	12	15	18
	B (2)	2	4	6	8	10	12
	C (1)	1	2	3	4	5	6

63. The habitat offset required is calculated by multiplying the score by the hectarage of the habitat affected (hectares x [HSI * Band]) giving figure in **Habitat Units**. For example a HSI*Band score of 12 for an area of 1.50 hectares would give a value of 18 Habitat Units.

64. The area values used in calculating Habitat Units (HU) are in hectares and derived from interrogating OS Mastermap and the value entered into the calculation worksheet (see Appendix). If more than one habitat is present in a single OS Mastermap polygon than then this need to be divided by editing a mapping layer with the total of the divided segments adding up to the hectares for the whole OS polygon.

65. Hedgerows and some watercourses are not mapped as separate polygons in OS Mastermap. If a width is not known a default width of 3 metres is used and multiplied by the length to give an area in hectares. These values are usually small and do significantly affect the overall area of a site and for simplicity's sake and considering their value to wildlife are not deducted from the area of bordering fields, compartments or OS Mastermap polygons. If preferred calculations can be carried out separately for these features using linear measurements but the end result is the same, especially if a direct replacement value of the hedgerow or watercourse is required.

Fraction Multipliers

Introduction

66. *'The aim of a multiplier is to correct for a disparity or risk. In practice this is very difficult to achieve, not least because of uncertainty in the measurement of the parameters and the complexity of gathering the required data.'* (Defra , 2011a)

67. In order that any habitat creation or enhancement would functionally replace habitat lost to development (and the need to take a precautionary approach in the case of EPS) a 'fraction multiplier' (also known as a 'habitat multiplier' or 'compensation

ratio') is applied to the resultant Habitat Units needed to replace biodiversity lost to development in order to provide robust compensation, e.g. to maintain 'favourable conservation status'. This may also be needed due to the limited nature of the surveys; that the IHS mapping does not include an assessment of habitat quality for a species; potential errors of omission; the use of 'foreign' data in establishing a HSI; non validation; and the variability of time required for the offset habitat to become functional.

68. '*There is wide acknowledgement that ratios should be generally well above 1:1. Thus, compensation ratios of 1:1 or below should only be considered when it is demonstrated that with such an extent, the measures will be 100% effective in reinstating structure and functionality within a short period of time (e.g. without compromising the preservation of the habitats or the populations of key species likely to be affected by the plan or project).*' (European Communities, 2007)

69. The Environment Bank recommend a two for one ratio where habitats are easily re-creatable contiguous to the development or on similar physical terrain as a minimum (Briggs et al, 2008). In many other situations a significantly higher multiplier may be appropriate (Moilanen et al, 2009).

70. *The conclusion of the BBOP* [Business Biodiversity Offsets Programme] paper *(Ekstrom et al, 2008) is that where there are real risks around the methods and certainty of restoration or creation then the Moilanen framework is applicable; but for some other situations, (averted risk ...and where restoration techniques are tried and tested), lower ratios can be used.* (Defra, 2011a)

71. Multipliers are applied only to habitat that is totally lost to use by a species affected. Initial biodiversity offsetting calculations are made on the basis that the total site area would be lost to a species and would therefore produce a maximum offset requirement to develop the site.

72. In delivering the replacement habitat there may also be an issue or risk with delivering a functional offset and the timing of the impact (Defra, 2011a). A loss in biodiversity would result and there could potentially be a risk to maintaining a species population during the intervening period even though it would recover in time. Therefore, it is important and desirable that replacement habitat is in place before development commences on site.

73. Appendices 4 and 5 give a guide to difficulty in creating and restoring habitats and the time frame required to reach maturity or functionality.

Delivery Risk

74. As different habitats have different levels of difficulty in creation or restoration of there will be different risks associated with each. Defra (2011a) consider that restoration is likely to be a lower risk than creation.

75. '*Once there is an estimate of the failure risk, it is possible to work out the necessary multiplier to achieve a suitable level of confidence (Bill Butcher pers com; Moilanen, 2009; Treweek & Butcher, 2010). The work of Moilanen provides a basis for different multipliers of various levels of risk. We have used this work to come up with*

categories of difficulty of restoration/expansion, and associated multipliers....' (Defra, 2011a)

Table 4: Multipliers for different categories of delivery risk (Defra, 2011a)

Difficulty of recreation/restoration	Multiplier
Very High	10
High	3
Medium	1.5
Low	1

76. Appendix 4 shows risk levels which have been assigned habitats to these broad categories using expert opinion by Defra (2011a). These risk levels are meant purely as an indicative guide. Factors such as substrate, nutrient levels, state of existing habitat, etc. will have an impact on the actual risk factor, which may need to be taken into account.

77. Moilanen et al (2009) recommends that where there is uncertainty is high a more robust offset would be achieved through a number of different habitat creation schemes are used across a number of different sites.

Spatial Risk

78. Spatial risk is considered to be taken account of in the screening process. Where there are accessibility issues for a species population then the proposed development should not proceed.

Temporal Risk

79. In delivering replacement habitat there may be a difference in timing between the implementation of the development and the functionality and maturity of the offset. This time lag would be minimised by calculation of existing habitat value in the pre application stage and implementation of the habitat creation and / or restoration in consultation with the local authority and other nature conservation organisations. In some cases the replacement habitat may be planted or managed concurrently with that of the site development.

80. Where a time lag occurs a multiplier will be applied to take account or the risk involved to the 'no net loss' objective. Defra (2011a) have based the time period multiplier recommendation from their Environmental Liability Directive guidance and that used in the Treasury Green Book, which recommends a discount rate of 3.5%. These are set out in Table 5 below. Appendix 5 gives guidance on how long different habitats would be expected to reach maturity. The actual multiplier used needs to be judged on a case by case basis.

Table 5: Multipliers for different time periods using a 3.5% discount rate

Years to target condition	Multiplier
5	1.2
10	1.4
15	1.7
20	2.0

81. It is considered that some priority habitats cannot be recreated due to the length of time that they have evolved and the irreplaceability of some constituent organisms, at least in the short and medium terms. It is also considered that in the medium and longer terms the management of any replacement habitat may be uncertain. Therefore Table 5 has been constrained to a maximum period of 20 years.

82. In some cases the time lag for the development of a habitat to support a population may be too long to be acceptable.

83. Where habitat is created or restored prior to development a baseline population figure should be agreed upon prior to any habitat creation or restoration being initiated and a monitoring strategy implemented.

Summary

84. The total replacement habitat required therefore comprises the following metric for each habitat type within a proposed development site. The whole proposed development site should be included in the calculation. Areas to be retained and maintained as existing habitat or enhanced can then be used in fulfilling the requirement for the site.

The HSI = Habitat Code (Range 0 to 6) + or – Matrix Code (Range 0 to 6, Default 0) x Formation Code (Range 0 to 1) x Management Code (Range 0 to 1)

HSI x Band x hectares x Delivery Risk x Temporal Risk = Habitat Units required.

Habitat Units divided by 18 = hectares required

85. An example of a HEP calculation is given in Appendix 6.

Meeting the Needs of Multiple Species (Umbrella Species)

86. Development often affects multiple species. For each species exposed to residual adverse impacts that cannot be mitigated for at least the equivalent number of HUs would need to be created or restored to achieve “no net loss” for that species. Where affected species use the same habitat type it should be considered whether calculations need only be carried out for one ‘umbrella species’[21] where the offset habitat created would serve multiple species. The umbrella species is likely to be the most sensitive to the land use change. The use of an umbrella species should be recorded.

87. Where an umbrella species is used the offset location must be accessible to all species populations covered by the umbrella. If not then individual species

[21] ‘*… the conservation of some species is thought to provide a protective umbrella to numerous co-occurring species.*’ (Fleishman et al, 2001)

calculations must be made.

Calculation of Off Site Replacement Habitat

88. Where there are residual offsets, i.e. where the replacement habitat cannot be created within the proposed development sites red line boundary an allowance is calculated for the value of the existing habitat on the intended habitat creation site as this will be lost or included in the value of any enhancement. Where replacement habitat is located offsite then the value of that site needs to be taken into account. The formula applied to offset losses of existing habitat at the offset site is:

$$\frac{\text{Area Equivalent of Habitat Units Needed to Offset from Development}}{\text{(Habitat Value of Desired Habitat Type – Habitat Value of Offset Habitat Creation Site)}}$$

89. This figure is then added to the Habitat Units derived from the calculation from the proposed development site and the total divided by 18 to find the about of offsite replacement habitat required. For example the proposed development requires 32HUs to replace that lost to horseshoe bats. The habitat to be created is valued at a suitability score of 6 and the field intended for the creation of replacement habitat at 1. The calculation would be 32 / (6-1) + 32 = 38.4HU (or, divided by 18, 2.13 hectares).

90. It is critical that the replacement site where habitat has been enhanced is accessible to the population of horseshoe bats affected.

5. Type of Habitat Created or Enhanced

91. The type of habitat to be created or then enhanced to replace that lost to a species population should be that which is considered optimal for that species. It is considered the national or regional prescriptions could be established which set what is required giving details of establishment and subsequent long term management measures.

92. Currently there is guidance produced by specialist organisations which give details of habitat creation and enhancement for specific species, for example:

Butterflies
- http://butterfly-conservation.org/4947/Grassland-habitats.html

Herptofauna
- http://www.froglife.org/info-advice/great-crested-newt-conservation-handbook/
- http://www.arc-trust.org/advice/habitat-management/reptiles/RHMH

Birds
- http://www.rspb.org.uk/ourwork/farming/advice/species.aspx
- http://www.barnowltrust.org.uk/infopage.html?Id=71

6. Locating Off Site Replacement Habitat

93. If 'no net biodiversity loss' is to result from the proposed development and replacement habitat is required off site then the location of these off-site offsets is crucial. It is recommended that the selection of the 'area of search' for an offset site would be initially made by an 'Upper Tier' local authority ecologist in consultation with the developer. This is because knowledge of species occurrence and Habitat Suitability mapping is likely to be maintained by this role and would enable a strategic approach to planning habitat connectivity at a sufficient geographic scale.

94. Where a HEP calculation has been made at the site allocation stage of a development then consultation with the 'Lower Tier' Authority on potential locations so that they may be entered into any planning documents in Local Plans or proposed Neighbourhood Plans. Other consultees, such as Natural England and the local Wildlife Trust, may also have an input at this stage.

95. Lawton et al (2010) state that, '*Receptor areas' must not be places of high wildlife value*.' Replacement habitat should therefore be located ideally in existing habitat which is initially of low value to biodiversity in general. Configuration of the created habitat for a particular species may also need to be considered in the design of the replacement habitat's location. Replacement habitat creation should not undermine or compete with agri-environment schemes or should not inadvertently breach double-funding regulations.[22]

96. **It is critical that off-site sites for replacement habitat are accessible to populations of any species affected by the development** otherwise the amount of habitat lost will result in a loss of resources in supporting that population, which may lead to decline or even extinction.

97. Accessibility will vary according to the movement capabilities of the species affected. For species which rely on structural habitat features, such as hedgerows or watercourses, the replacement habitat will need to need to be within or adjacent to the fields accessible to a species population. For species capable of moving freely without the use of or not so reliant on structural habitat features the replacement habitat would be located anywhere within the Consideration Zone with regard for habitat that would not be entered.

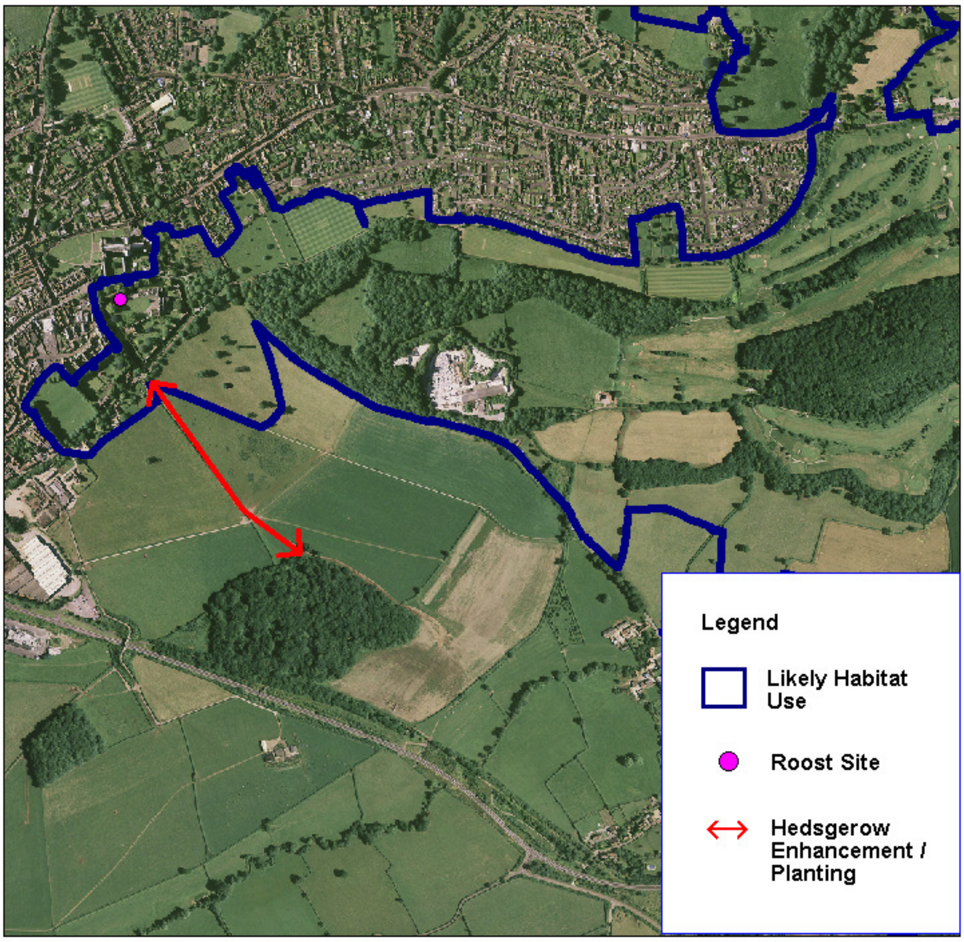
98. As well as through habitat creation, enhancement or restoration the mitigation can be provided by improving connecting features to a principle habitat used by the species that is otherwise currently inaccessible, such as by hedgerow planting and / or management to an existing woodland to provide a flight line for bats. This is one of the principles set out in the Lawton review (2010). For example see Figure 3 below. Calculations would include the value of the hedgerow enhancement and the woodland.

99. Once the location of the mitigating replacement habitat enhancement is set within an area of search the location of the replacement habitat should then consider its

[22] http://www.nfuonline.com/Our-work/Consultations/Biodiversity-offsetting---NFU-responds/

contribution to the Somerset's identified and mapped ecological network[23]. Habitat connectivity or 'natural networks'[24] and their restoration is outlined in the Government White Paper on the Natural Environment (Her Majesty's Government, 2011). It is also stated in the National Planning Policy Framework requiring ecological networks to be identified and mapped in Local Plans.

Figure 3: Example of Provision of Connecting Habitat for Biodiversity Offsetting



100. Another important consideration is the requirement for the habitat to be functional at the time of development otherwise there would be a time lapse where the created habitat for the offset would not fulfil its role in supporting the viability of the population. Appendix 5 gives some examples of the time taken for habitats to become functional.

[23] Somerset Wildlife Trust / Somerset County Council. 2016. *Somerset's Ecological Network Mapping the components of the ecological network in Somerset*, Taunton: Somerset Wildlife Trust

[24] Maintaining and improving habitat connectivity is important in ensuring the long-term survival of biodiversity in a fragmented landscape and especially with a changing climate. Habitat connectivity or 'natural networks' and their restoration is outlined in the Government White Paper on the Natural Environment (Her Majesty's Government, 2011).

101. However, conversely the increased availability of habitat prior to development may lead to an increase in the population for the species affected which would then need to be maintained at that level at least if afforded protection under the Habitats Regulations. Therefore timing should be a careful consideration and the appropriate Fraction Multiplier applied if required.

102. In cases where the value of the site is calculated in habitats alone or where a species affected is not reliant on structural connectivity off site replacement habitat sites can be located anywhere. However, it is considered in any case that locations that contribute to the ecological network will be given priority and lastly site identified for restoration in conservation projects. Nonetheless the maintenance of biodiversity locally is considered important for social, health and economic reasons.

References

Acts of Parliament. 1981. *Wildlife and Countryside Act 1981* (as amended). London: Her Majesty's Stationary Office.

Acts of Parliament. 2000. *Countryside and Rights of Way Act 2000* (as amended). London: Her Majesty's Stationary Office.

Acts of Parliament. 2006. *Natural Environment and Rural Communities Act 2006.* London: Her Majesty's Stationary Office.

Bontadina, F. & Naef-Daenzer, B. 2002. Analysing spatial data of different accuracy: the case of greater horseshoe bats foraging: in Bontadina, F. 2002. *Conservation Ecology in Horseshoe Bats*. PhD thesis. Universität Bern.

Boone, R. B. & Krohn, W. B. 1998. A Technique for Representing Diminishing Habitat Occupation: Feathering Predicted Species Distributions Near Range Limits in Maine: in USGS, 1998. *Gap Analysis Bulletin No, 7*. http://pubs.usgs.gov/gap/07/report.pdf

Briggs, B., Hill, D. & Gillespie, R. 2008. Habitat banking – how it could work in the U.K. http://www.environmentbank.com/docs/Habitat-banking.pdf

Burrows, L., Butcher, B., & Treweek, J. 2011. Offsets for Species in the UK Planning Context: A Possible Methodology. *In Practice, 71, 41-43, March 2011*

Butcher, B. & Coles, V. 1999. *draft Species and Habitat Data on Lowland Heathland*. Bishops Lydeard: Somerset Environmental Records Centre.

Charalambides, L. C. 2004. *Guidance Document for the 'Habitats' Directive 92/43/EEC: "Favourable Conservation Status" from Legal Interpretation to Practical Application*. Bat Conservation Trust, The Herpetological Trust, The Mammal Society, WWF.

Council for European Communities. 1992. *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and wild flora and fauna.* Brussels: European Union.

Defra, 2009. Scoping study for the design and use of biodiversity offsets in an English Context, Final Report to Defra (Contract NE 0801)

Defra, 2012. Biodiversity Offsetting Pilots Technical Paper: the metric for the biodiversity offsetting pilot in England, March 2012. London: Department for Environment, Food and Rural Affairs.
http://www.defra.gov.uk/publications/files/pb13745-bio-technical-paper.pdf

Dennis, R.L.H. 2010. *A Resource-Based Habitat View for Conservation. Butterflies in the British Landscape.* Chichester: Wiley-Blackwell.

Department for Communities and Local Government. 2012. *National Planning Policy Framework*. London: Department for Communities and Local Government

Dijak, W. D. & Rittenhouse, C. D. 2009. Development and Application of Habitat Suitability Models to Large Landscapes: in Millspaugh, J. J. & Thompson, F. R. 2009. *Models for Planning Wildlife Conservation in Large Landscapes*. London: Academic Press.

European Commission, 2007. *Guidance document on the strict protection of animal species of community interest under the Habitats Directive 92/43/EEC*. (http://circa.europa.eu/Public/irc/env/species_protection/library?l=/commission_guidance/final-completepdf/_EN_1.0_&a=d).

European Communities. 2007. *Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC: Clarification of the concepts of: alternative solutions*, *imperative reasons of overriding public interest*, *compensatory measures*, o*verall coherence, opinion of the commission.* Brussels: Office for Official Publications of the European Communities.

Fleishman, E., Murphy, D. D. & Blair, R. B. 2001. Selecting Effective Umbrella Species. http://www.conservationmagazine.org/2008/07/selecting-effective-umbrella-species/

Garshelis, D. L. 2000. Delusions in Habitat Evaluation: Measuring Use, Selection, and Importance: in Boitam, L. & Fuller, T. K. (eds.) 2000. *Research Techniques in Animal Ecology: Controversies and Consequences*. New York: Columbia University Press.

Gontier, M. 2004. Integrating landscape ecology in environmental impact assessment using GIS and ecological modelling: in *Proceedings of the Frontis Workshop From Landscape Research to Landscape Planning: Aspects of Integration, Education and Application Wageningen, The Netherlands 1-6 June 2004*
Her Majesty's Government. 2011. *The Natural Choice: securing the value of nature.* Government White Paper. The Stationary Office Ltd.

Her Majesty's Government. 2010. *Statutory Instrument 2010 No. 490 The Conservation of Habitats and Species Regulations 2010.* London: Her Majesty's Stationary Office

Her Majesty's Government. 2012. *Statutory Instrument 2010 No. 490 The Conservation of Habitats and Species (Amendment) Regulations 2010.* London: Her Majesty's Stationary Office

Knight, T. 2006. *The use of landscape features and habitats by the lesser horseshoe bat* (Rhinolophus hipposideros). PhD thesis. University of Bristol

Lawton, J. H., Brotherton, P. N. M., Brown, V. K., Elphick, C., Fitter, A. H., Forshaw, J., Haddow, R. W., Hilborne, S., Leafe, R. N., Mace, G. M., Southgate, M. P., Sutherland, W. J., Tew, T. E., Varley, J., & Wynne, G. R. 2010. *Making Space for Nature: a review of England's wildlife sites and ecological network*. Report to Defra.

Moilanen, A., Van Teeffelen, A., Ben-Haim, Y. & Ferrier, S. 2009. How much compensation is enough? A framework for incorporating uncertainty and time discounting when calculating offset ratios for impacted habitat. *Restoration Ecology 17, 470-478*.

Morrison, M. L., Marcot, B. G. & Mannan, R. W. 2006. *Wildlife-Habitat Relationships:*

Concepts and Applications (3rd edition). Washington D. C.: Island Press.

Office of the Deputy Prime Minister. 2005. *Government Circular 06/2005: Biodiversity and Geological Conservation – Statutory Obligations and their Impact within the Planning System.* London: ODPM.

Opdam, P., Steingröver, E., Vos, C. & Prins, D. 2002. *Effective protection of the Annex IV species of the EU-Habitats Directive: The landscape approach*. Wageningen: Alterra. http://www.ocs.polito.it/biblioteca/ecorete/590.pdf

Rainho, A. & Palmeirim, J. W. 2011. The Importance of Distance to Resources in the Spatial Modelling of Bat Foraging Habitat. *PLoS ONE, April 2011, 6, 4, e19227*.

Ritcey, R., Low, D., Harestad, A., Wayne Campbell, R. & Harcombe, A. P. 1988. *Wildlife Habitat Handbooks for the Southern Interior Ecoprovince: Volume 5 Species-Habitat Relationship Models for Mammals.* Victoria, British Columbia: Ministry of Forests Research/ Ministry of Environment.

Rosenberg, D. K. & McKelvey, K. S. 1999. Estimation of Habitat Selection for Central-place Foraging Animals. *Journal of Wildlife Management 63 (3): 1028 -1038*.

Simpson, P. 2011.*Supreme Court rules on Habitats Directive*. DLA Piper, UK

Somerset County Council. 2009. *Taunton Deane Borough Council Local Development Framework Core Strategy Site Allocations Development Plan Document and Somerset County Council Taunton Transport Strategy Review 2: Habitats Regulations Assessment - Hestercombe House Special Area of Conservation.* Taunton: Somerset County Council

Somerset Wildlife Trust / Somerset County Council. 2016. *Somerset's Ecological Network: Mapping the components of the ecological network in Somerset*, Taunton: Somerset Wildlife Trust

Treweek, J. 1999. *Ecological Impact Assessment*. Oxford: Blackwell Science Ltd.

U. S. Fish and Wildlife Service. 1980. *Habitat Evaluation Procedures ESM102*. Washington, D. C.: Department of the Interior.

U. S. Fish and Wildlife Service. 1981. *Standards for Developing Habitat Suitability Indices. ESM103*. Washington, D. C.: Department of the Interior

Acknowledgements:

With thanks to:

Bill Butcher, WGB Environment
Carol Williams, Bat Conservation Trust
David Fee, EPS Ecology Ltd
Jo Treweek, Treweek Environmental Consultants
Katherine Boughey, Bat Conservation Trust
Michelle Osbourn, Somerset Wildlife Trust
Mike Barker, company secretary, Chartered Institute of Ecology and Environmental Management; biodiversity chair, European Network of Environmental Professionals
Mike Oxford, Association of Local Government Ecologists
Tony Price, Data Manager, Somerset Environmental Records Centre

Appendix 1: Legislative and Policy Background

The 'Habitats Directive'

The Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') under Article 1 set out the requirements for the protection of species of Community interest, listed under Annex II, IV and/or V[25]. These species are required to be maintained at 'favourable conservation status' (FCS), which is defined as when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Under Article 16 avoidance of impacts should be sought and lists the circumstances for where derogation may be applied. In planning development may only be progressed if in circumstances of overriding public interest.

The goals of the Habitats Directive for species conservation require two basic conditions:

- Quality of habitat (allowing enough for reproduction)
- Habitat area (to prevent extinction by accident)

(Opdam et al, 2002)

Where development occurs which reduces either of the two above conditions maintenance can be achieved through biodiversity offsetting for species affected by a development.

The Conservation of Habitats and Species Regulations 2010

The Conservation of Habitats and Species Regulations 2010 (the 'Habitats Regulations') transposes the provisions of the Habitats Directive into UK legislation.

---

25 Annex IV species are defined as 'animal and plant species in need of strict protection.' Annex II species are those for whose conservation require the designation of Special Areas of Conservation (SAC). Any potential impacts affecting the integrity of a SAC, including those designated for Annex II species, are required to undergo an 'Appropriate Assessment'. Annex V species are 'Animal and plant species of Community interest whose taking in the wild and exploitation may be subject to management measures' which are likewise required to be maintained at 'Favourable Conservation Status'.

The Habitats Regulations make it an offence (subject to exceptions) to deliberately capture, injure, kill or disturb (populations) the animals listed in Schedule 2. Protection from disturbance to individual EPS remains within the Wildlife and Countryside Act 1981 (as amended). With regard to populations under Regulation 41 of the Regulations it is also an offence to deliberately disturb wild animals of EPS in such a way as to be likely to:

a) impair their ability—
(i) to survive, to breed or reproduce, or to rear or nurture their young; or
(ii) in the case of animals of a hibernating or migratory species, to hibernate or migrate; or

(b) affect significantly the local distribution or abundance of the species to which they belong.

Regulation 9(5) requires that all public bodies have regard to the requirements of the Habitats Directive when carrying out their functions. Recent court cases (Regina versus Cheshire East Borough Council and Morge V Hampshire County Council) and a Supreme Court judgement have '… *confirmed that the judgement is one for the relevant decision maker to make* (e.g. the local planning authority) *based on all the facts of the case.*" (Simpson, 2011)

It is County, District or Borough Council's responsibility to ensure that the 'favourable conservation status' of local populations of EPS is maintained, aside from any subsequent licensing requirement. Before granting planning permission to a development the local authority needs to ensure that the development is not detrimental to the populations of the affected EPS 'favourable conservation status' as defined by Article 1 of the Directive and Regulation 41 of the Habitats Regulations, i.e. that there are no adverse effects on the distribution and abundance of the local population from the development. The Council must be satisfied that each of the three tests for EPS is met:

- The development is of overriding public interest;
- There are no satisfactory alternatives; and
- That the development will have no detrimental effect on wild populations of the species concerned.

Through the calculation of biodiversity offsetting for species applied to the development site local authorities would then be able to ensure themselves that the development will have '… *no detrimental effect on wild populations of the species concerned*'.

However, this should not be seen as a requirement of every development where EPS are present but, as the Supreme Court makes clear, should be judged on a case by case, species by species basis. Penny Simpson (2011) writes that "'*deliberate disturbance' offence is likely to apply to an activity which is likely to negatively on the demography (survival and breeding) of the species at the local population level… disturbing one of two individuals is not necessarily below the threshold (i.e. outside the offence) because for a rare species, a species in decline, or a species at the edge of its range, a harmful disturbing impact on a very small number of individuals may impact negatively on the demography of the local population".* Article 1 lists EPS in four conservation status categories. Nonetheless it is considered that a precautionary approach where the effects of a development on the local population of any EPS is uncertain.

Under the 2012 Amendment to the Regulations, Regulation 9 (1 and 3) also applies to forward planning, particularly with regard to allocation of development sites. Indeed the use of biodiversity offsetting calculations at this stage would provide guide to the prospective developer on what was required to ensure that no detrimental effects occur to EPS from the development where impacts occur. Nonetheless forward planners will need to take account of Article 16 of the Directive and avoid impacts in the first place, although it is recognised this is not always possible due to other factors such as transport accessibility. In any case forward planner's decisions should be informed by a sound knowledge of the distribution of an EPS within a geographic area.

The new Birds Directive duties have been into the 2012 amendment to the Habitats Regulations and require the preservation, maintenance and re-establishment of sufficient diversity and area of habitat for wild birds in the United Kingdom, including means to upkeep, management and creation of such habitat, as appropriate, having regard to the requirements of Article 2 of the Directive.

Natural Environment and Rural Communities Act 2006

Under s40 of the Natural Environment and Rural Communities Act (NERC), local authorities are legally required to '*…in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity.'*

Section 41 of the Act lists the species and habitats of principle importance in the conservation of biodiversity in England. The S41 list is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under section 40, to have regard to the conservation of biodiversity in England, when carrying out their normal functions.

Biodiversity offsetting requires 'no net loss' and 'preferably a net gain of biodiversity' In the NERC Act this is defined as, '*restoring and enhancing a population or habitat*' (S.40 (3)) (Defra, 2009)

Government White Paper on the Natural Environment

The Government White Paper on the Natural Environment, *The Natural Choice: securing the value of nature* published in June 2011 includes provision for pilot projects using biodiversity offsetting as a method to halt the decline of biodiversity.

The Government wants to '…*create a resilient and coherent ecological network at a national and a local level across England*' and intends to put in place a clear institutional framework to support nature restoration including '…*strengthening support through the planning system including through biodiversity offsets*.'

The White Paper sets out the need for a '…*more strategic and integrated approach to* *planning for nature within and across local areas, one that guides development to the best locations… and enables development to enhance natural networks…*'. It also states that, '*The planning system will continue to facilitate coherent and resilient ecological networks, with local partners*…' and that the '… *planning system contributes to our objective of no net loss*.'

Biodiversity offsetting is one of the mechanisms the Government sees as using to achieve its objectives.

National Planning Policy Framework

The National Planning Policy Framework (Department for Communities and Local Government, 2012) sets out potential policy for biodiversity in the Government's new planning system. The intention is to move '… *from a net loss of biodiversity to achieving net gains for nature*'.

It states that '*Planning policies and decisions must reflect and where appropriate promote relevant EU obligations and statutory requirements*.' This would include the provisions of the Birds and Habitats Directives.

In defining sustainable development the Framework states that to achieve sustainable development environmental gains should be sought through the planning system. The planning system should play an active role in guiding development to sustainable solutions.

The planning system should contribute to and enhance the natural and local Environment '… *by minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures*.'

The NPPF also states that, '*Local planning authorities should set criteria based policies against which proposals for any development on or affecting protected wildlife sites …will be judged. Distinctions should be made between the hierarchy of international, national and locally designated sites, so that protection is commensurate with their status and gives appropriate weight to their importance and the contribution that they make to wider ecological networks*.'

The Framework specifically states that local planning policies that should:

- plan for biodiversity at a landscape-scale across local planning authority boundaries;
- identify and map components of the local ecological networks, including: international, national and locally designated sites of importance for biodiversity, wildlife corridors and stepping stones that connect them and areas identified by local partnerships for habitat restoration or creation.

- promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species populations, linked to national and local targets; and identify suitable indicators for monitoring biodiversity in the plan.

In addition, Local Plans must set out the strategic approach to delivering creation, protection and enhancement of the natural environment.

Planning permission should be refused for development resulting in the loss or deterioration of irreplaceable habitats, including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss.

Appendix 2: Species Data Table

Species Included

Species for which Habitat Suitability Indices have been or will be developed includes those listed in the:

- Schedule 2 of the Conservation of Habitats and Species Regulations 2010 (as amended)
- Schedules 1 of the Wildlife and Countryside Act 1981 (as amended)
- s41 Priority Species List of the Natural Environment and Rural Communities Act 2006 (as amended) / BAP species 2007[26]

Priorities for the development of HSI are those species most likely to be affected by development.

Species Data Table Components

The Species Data Table lists all species in the above categories by taxonomic group and gives both scientific and common names. For each species the following is set out:

Habitat Use

A referenced description of the habitat used by the species is given.

Critical Areas

Box 2 gives guidance where biodiversity offsetting should not be used (Category A) and where it would be allowable (Category B).

Where replacement habitat as mitigation is neither possible nor desirable for all impacts on species populations it is essential that safeguards are put in place. There are critical areas where offsetting would not be feasible or viable and development should not be carried forward or avoided (See Box 1). These Critical Areas are listed for species in the Species Data Table.

In addition to the Consideration Zone (See below) a Critical Area buffer is also identified for some species in the Species Data Table. A Critical Area would be where no development is likely to be permitted due to the sensitivity of a site to the species affected, such as in proximity to a nest site for marsh harriers or the presence of a flora species that is not translocatable.

Home / Dispersal Range Description

A referenced description of the home range or dispersal distance for that species is given. The use of home range or dispersal distance varies according to the ecology of the species, the distance it moves in day to day activity or migratory movement. Home ranges and territorial areas were researched for each species from the literature, scientific journals, consultation with specialists and the Internet.

Home / Dispersal Range

The home range or dispersal distance is given in metres.

[26] http://jncc.defra.gov.uk/page-5717

Likely Resting Area
Where a species uses a number of resting places in proximity to each other, for example bats are known to roost switch within a few hundred metres of each resting place, a distance in metres is given.

Recording Error
Where Biological Records Centre (BRC) data is used the record should be corrected to ensure it corresponds with the resting place for central point foragers, such as bats. For other species where a population is spread over the available habitat a recording error is used. Butcher & Coles (1999) found that the error for recorders of species presence that the map reference given to the BRC was on average of 200 metres from the actual point of occurrence.

Consideration Zone
The Consideration Zone (CZ) shows where the species may occur based on a recorded occurrence. Although at its centre is a record, a species has the potential to be present, if habitat conditions are suitable to support it, anywhere within the CZ.

Density Bands, A, B and C
The distances from the record that the site falls within

Appendix 3: Example of a Habitat Suitability Index

The following table shows an example of part of a Habitat Suitability Index for a species.

A complete list with full descriptions and parameters of the habitat labels can be obtained from Somerset Environmental Records Centre[27].

Table 6: Example Section of a Habitat Suitability Index

Habitat	IHS Code	HSI
Broadleaved, mixed, and yew woodland	WB0	5
Mixed woodland	WB1	3
Scrub woodland	WB2	2
Broadleaved woodland	WB3	5
Upland oakwood [=Old sessile oak woods with Ilex and Blechnum in the British Isles(AN1)]	WB31	5
Upland mixed ashwoods	WB32	4
Tilio-Acerion forests of slopes, screes and ravines [upland]	WB321	4
Other upland mixed ashwoods	WB32Z	4
Beech and yew woodlands	WB33	4
Lowland beech and yew woodland	WB331	4
Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer (Quercion robori-petraeae or Ilici-Fagenion)	WB3311	4
Asperulo-Fagetum beech forests	WB3312	4
Taxus baccata woods of the British Isles	WB3313	2
Other lowland beech and yew woodland	WB331Z	4
Other beech and yew woodlands	WB33Z	4
Wet woodland	WB34	3
Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	WB341	4
Bog woodland	WB342	3
Other wet woodland	WB34Z	4
Upland birch woodland	WB35	1
Lowland mixed deciduous woodland	WB36	5
Old acidophilous oak woods with Quercus robur on sandy plains	WB361	5
Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli	WB362	5
Tilio-Acerion forests of slopes, screes and ravines [lowland]	WB363	4

[27] SERC, 34 Wellington Road, Taunton TA1 5AW **Telephone**: 01823 664450 **Fax**: 01823 652411

Habitat	IHS Code	HSI
Other lowland mixed deciduous woodland	WB36Z	3
Other broadleaved woodland	WB3Z	3
Coniferous woodland	WC0	1
Native pine woodlands	WC1	2
Caledonian forest	WC11	2
Other native pine woodlands	WC1Z	1
Other coniferous woodland	WCZ	1
Acid grassland	GA0	2
Lowland dry acid grassland	GA1	2
Inland dunes with open Corynephorus and Agrostis grasslands	GA11	0
Other lowland dry acid grassland	GA1Z	2
Upland acid grassland	GAZ	1

In addition to what is shown here columns to the right of the HSI score are filled out with referenced text which was used in informing the scoring of the HSI.

Appendix 4: Risk Factors for Restoring or Recreating Different Habitats

N.B.: These assignments are meant purely as an indicative guide. The starting position with regard to substrate, nutrient levels, state of existing habitat, etc. will have a major impact in the actual risk factor. Final assessments of risk may need to take other factors into account.

Table 7: Risk Factors for Different Habitats

Habitats	Technical difficulty of recreating	Technical difficulty of restoration
Aquifer Fed Naturally Fluctuating Water Bodies	Very high/impossible	Medium
Arable Field Margins	Low	n/a
Blanket Bog	Very high/impossible	High
Calaminarian Grasslands	High	Medium
Coastal and Floodplain Grazing Marsh	Low	Low
Coastal Saltmarsh	Medium	Medium
Coastal Sand Dunes	Very high/impossible	Medium
Coastal Vegetated Shingle	High	High
Eutrophic Standing Waters	Medium	Medium
Hedgerows	Low	Low
Inland Rock Outcrop and Scree Habitats	Very high/impossible	Medium
Limestone Pavements	Very high/impossible	High
Lowland Beech and Yew Woodland	Medium	Low
Lowland Calcareous Grassland	Medium	Low
Lowland Dry Acid Grassland	Medium	Low
Lowland Fens	Medium	Low
Lowland Heathland	Medium	Medium
Lowland Meadows	Medium	Low
Lowland Mixed Deciduous Woodland	Medium	Low
Lowland Raised Bog	Very high/impossible	Medium
Maritime Cliff and Slopes	Very high/impossible	High
Mountain Heaths and Willow Scrub	High	Medium
Oligotrophic and Dystrophic Lakes	Medium	Medium
Open Mosaic Habitats on Previously Developed Land	Low	Low
Ponds	Low	Low
Purple Moor Grass and Rush Pastures	High	Medium
Reedbeds	Low	Low
Saline lagoons	Low	Low
Traditional Orchards	Low	Low
Upland Calcareous Grassland	High	Medium
Upland Flushes, Fens and Swamps	High	Medium
Upland Hay Meadows	Medium	Low
Upland Heathland	Medium	Medium
Upland Mixed Ashwoods	Medium	Low

Habitats	Technical difficulty of recreating	Technical difficulty of restoration
Upland Oakwood	Medium	Low
Wet Woodland	Medium	Low
Wet Heath	High	High
Wood-Pasture & Parkland	Medium	Low

Appendix 5: Feasibility and Timescales of Restoring: examples from Europe

Table 8: Feasibility and Timescales for Habitat Restoration (Defra, 2012)

Ecosystem type	Time-scale	Notes
Temporary pools	1-5 years	Even when rehabilitated, may never support all pre-existing organisms.
Eutrophic ponds	1-5 years	Rehabilitation possible provided adequate water supply. Readily colonised by water beetles and dragonflies but fauna restricted to those with limited specialisations.
Mudflats	1-10 years	Restoration dependent upon position in tidal frame and sediment supply. Ecosystem services: flood regulation, sedimentation.
Eutrophic grasslands	1-20 years	Dependent upon availability of propagules. Ecosystem services: carbon sequestration, erosion regulation and grazing for domestic livestock and other animals.
Reedbeds	10-100 years	Will readily develop under appropriate hydrological conditions. Ecosystem services: stabilisation of sedimentation, hydrological processes.
Saltmarshes	10-100 years	Dependent upon availability of propagules, position in tidal frame and sediment supply. Ecosystem services: coastal protection, flood control.
Oligotrophic grasslands	20-100 years +	Dependent upon availability of propagules and limitation of nutrient input. Ecosystem services: carbon sequestration, erosion regulation.
Chalk grasslands	50-100 years +	Dependent upon availability of propagules and limitation of nutrient input. Ecosystem services: carbon sequestration, erosion regulation.
Yellow dunes	50-100 years +	Dependent upon sediment supply and availability of propagules. More likely to be restored than re-created. Main ecosystem service: coastal protection.
Heathlands	50-100 years +	Dependent upon nutrient loading, soil structure and availability of propagules. No certainty that vertebrate and invertebrate assemblages will arrive without assistance. More likely to be restored than re-created. Main ecosystem services: carbon sequestration, recreation.
Grey dunes and dune slacks	100-500 years	Potentially restorable, but in long time frames and depending on intensity of disturbance Main ecosystem service: coastal protection, water purification.
Ancient woodlands	500 – 2000 years	No certainty of success if ecosystem function is sought – dependent upon soil chemistry and mycology plus availability of propagules. Restoration is possibility for plant assemblages and ecosystem services (water regulation, carbon sequestration, erosion control) but questionable for rarer invertebrates.
Blanket/Raised bogs	1,000 – 5,000 years	Probably impossible to restore quickly but will gradually reform themselves over millennia if given the chance. Main ecosystem service: carbon sequestration.
Limestone pavements	10,000 years	Impossible to restore quickly but will reform over many millennia if a glaciation occurs.

Appendix 6: Example of HEP Calculation

The following table shows the calculation for a particularly large and complex site which straddled two Consideration Zone bands. Most HEP are for far less Fields and Hedgerows.

Table 9: HEP Calculation Example

Field No.	Area (hectares)	Current habitat	IHS Codes	HSI Score	Consideration Zone	Habitat Units Lost	Notes
F1	4.975	Maize (Cereal crops, non-organic)	CR2.CL12	0.5	2	4.975	Field area has been split in two as miscanthus and winter wheat are grown in rotation
F1	4.975	Miscanthus	CR35	0	2	0	
P2	0.053	Pond	AS0. AP1	6	2	0.636	
F4	0.034	Maize (Cereal crops, non-organic)	CR2.CL12	0.5	2	0.034	
F5	0.362	Mixed woodland, Mixed plantation and semi natural, high forest	WB1.WF3.WM1	4.8	2	3.4752	
F6	0.344	Improved grassland, Frequent mowing, Other amenity	GI0.GM23.GL1Z	0.05	2	0.0344	
F7	0.362	Mixed woodland, Mixed plantation and semi natural, high forest	WB1.WF3.WM1	4.8	2	3.4752	
F8	0.2	Built-up Areas and Gardens, gardens	UR0.UA32	0.1	2	0.04	
F9	0.086	Built-up Areas and Gardens, gardens	UR0.UA33	0.1	2	0.0172	
F10	0.154	Mixed woodland, Plantation, Traditional orchards	WB1.WF2.WCL 31	4.8	2	1.4784	
F11	3.484	Arable (wheat & barley)	CR2.CL12	0.5	2	3.484	
F12	0.833	Arable (type not stated)	CR0.CL12	0.5	2	0.833	
F13	5.51	Winter barley (Cereal crops, non-organic)	CR2.CL12	0.5	2	5.51	
F14	0.894	Broadleaved plantation woodland	WB1.WF2	4.8	2	8.5824	
F15	2.56	Arable (wheat)	CR2.CL12	0.5	2	2.56	
F16	2.56	Miscanthus	CR35	0	2	0	
F17	0.49	Improved grassland, Silage	GI0.GM21	0.2	2	0.196	
F18	4.62	Arable (wheat)	CR2.CL12	0.5	2	4.62	

Field No.	Area (hectares)	Current habitat	IHS Codes	HSI Score	Consideration Zone	Habitat Units Lost	Notes
F21	0.05	Cereal Crops, Scrub	CR2.SC0	1	2	0.1	
P22	0.051	Pond	AS41Z.AO0.AP1	5	2	0.51	
F23	3.05	Winter barley (Cereal crops, non-organic)	CR2.CL12	0.5	2	3.05	
F25	1.69	Winter barley (Cereal crops, non-organic)	CR2.CL12	0.5	2	1.69	
P24	0.081	Pond	AS41Z.AO1Z.AP1Z	2.25	2	0.3645	
F27	4.65	Arable (type not stated)	CR0.CL12	0.5	2	4.65	
F28	0.311	Built-up Areas and Gardens, gardens	UR0.UA32	0.1	1	0.0311	
F29	1.178	Grassland, probably improved, Undetermined grassland etc. management, Permanent agricultural grassland	GP0,GM0.GL21	1.5	1	1.767	
F30	0.094	Built-up Areas and Gardens, gardens	UR0.UA32	0.1	1	0.0094	
F31	2.844	Improved grassland; Hay Aftermath Grazing	GI0.GM3	1.5	1	4.266	Bullocks occasionally
F33	1.214	Improved grassland; Hay Aftermath Grazing	GI0.GM3	1.5	1	1.821	Bullocks occasionally
F34	0.642	Improved grassland, Silage	GI0.GM21	0.2	1	0.1284	
F35 (Part)	2.91	Improved grassland; Hay Aftermath Grazing	GI0.GM3	1.5	1	4.365	
F37	0.237	Built-up Areas and Gardens, gardens	UR0.UA32	0.1	1	0.0237	
F38	0.316	Built-up Areas and Gardens, scattered trees	OR0.TS0.UA32	0.1	1	0.0316	
F39	0.049	Built-up Areas and Gardens, gardens	UR0.UA32	0.1	1	0.0049	
F40	0.053	Built-up Areas and Gardens, gardens	UR0.UA32	0.1	1	0.0053	
F41	0.064	Built-up Areas and Gardens, gardens	UR0.UA32	0.1	1	0.0064	
F42	0.047	Built-up Areas and Gardens, gardens	UR0.UA32	0.1	1	0.0047	
F43	0.149	Built-up Areas and Gardens, scattered trees	OR0.TS0.UA32	0.1	1	0.0237	
F62	0.58	Mixed Woodland Plantation	WB1.WF3	4.8	1	2.784	
F63	0.203	Cereal Crops, Bare Ground	CR2.BG1.CL1	1	1	0.203	
H1	0.04	Hedgerow, overgrown without standards	LF11.LM32	6	2	0.48	

Field No.	Area (hectares)	Current habitat	IHS Codes	HSI Score	Consideration Zone	Habitat Units Lost	Notes
H2	0.02	Hedgerow, cut without standards	LF11.LM12	1.2	2	0.048	
H4	0.02	Hedgerow, cut without standards	LF11.LM12	1.2	2	0.048	
H5	0.03	Hedgerow, overgrown with standards	LF11.LM31	6	2	0.36	
H6	0.04	Hedgerow, overgrown with standards	LF11.LM31	6	2	0.48	
H7	0.02	Hedgerow, overgrown with standards	LF11.LM31	6	2	0.24	
H8	0.03	Hedgerow, cut without standards	LF11.LM12	1.2	2	0.072	
H9	0.03	Hedgerow, cut with standards	LF11.LM11	1.8	2	0.108	
H10	0.03	Hedgerow, uncut without standards	LF11.LM22	4.8	2	0.288	
H11	0.07	Line of trees	LF21	4	1	0.28	
H12	0.02	Hedgerow, uncut without standards	LF11.LM22	4.8	2	0.192	
H13	0.05	Hedgerow, uncut without standards	LF11.LM22	4.8	2	0.48	
H14	0.004	Hedgerow, uncut without standards	LF11.LM22	4.8	2	0.0384	
H15	0.01	Hedgerow, overgrown with standards	LF11.LM31	6	2	0.12	
H16	0.02	Hedgerow, uncut without standards	LF11.LM22	4.8	1	0.096	
H17	0.01	Hedgerow, uncut with standards	LF11.LM21	5.4	2	0.108	
H18	0.01	Hedgerow, cut without standards	LF11.LM12	1.2	2	0.024	
H22	0.06	Hedgerow, uncut without standards	LF11.LM22	4.8	1	0.288	
H24	0.003	Hedgerow, cut without standards	LF11.LM12	1.2	1	0.0036	
H25	0.03	Hedgerow, uncut without standards	LF11.LM22	4.8	2	0.288	
H26	0.01	Hedgerow, cut with standards	LF11.LM11	1.8	2	0.036	
H27	0.03	Hedgerow, cut with standards	LF11.LM11	1.8	2	0.108	
H28	0.08	Hedgerow, overgrown without standards	LF11.LM32	6	1	0.48	
H29	0.04	Hedgerow, uncut without standards	LF11.LM22	4.8	2	0.384	
H31	0.02	Hedgerow, cut without standards	LF11.LM12	1.2	2	0.048	
H33	0.1	Hedgerow, uncut with standards	LF11.LM21	5.4	2	1.08	
H34	0.07	Hedgerow, overgrown without standards	LF11.LM32	6	2	0.84	

Field No.	Area (hectares)	Current habitat	IHS Codes	HSI Score	Consideration Zone	Habitat Units Lost	Notes
H37	0.03	Hedgerow, uncut without standards	LF11.LM22	4.8	2	0.288	
H37	0.08	Hedgerow, uncut without standards	LF11.LM22	4.8	1	0.384	
					Habitat Units	67.2065	
		(Habitat required, e.g. Woodland with ponds being optimal habitat for the species) **Delivery Risk**				*1.5	
		(Habitat required, e.g. Woodland with ponds being optimal habitat for the species) **Temporal Risk**				*1.7	
					Habitat Units	171.38	
					Hectare Equivalent	9.52ha	

In this case the replacement habitat was provided off site. The calculation is as follows assuming that the replacement habitat enhancement is located on a field of low value to the species.

$$9.52 / (6-1) + 9.52 = 11.42\text{ha}.$$