

Natural England Joint Publication JP029

The Biodiversity Metric 2.0

auditing and accounting for biodiversity

USER GUIDE

Beta Version

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BETA TEST

Foreword

Biodiversity is the variety of life on earth, it includes all living things and the places in which they live. It is vital for our health, well-being and economy. But biodiversity is declining, both in the UK and internationally. Species are becoming extinct and the habitats needed for wildlife to live and thrive are under increased pressure from development and land management practices. However, we know that development and land management are not incompatible with nature. Both can and do provide spaces for wildlife to thrive in. The challenge is to understand how to design developments and manage land in such a way that supports biodiversity.

Biodiversity metric 2.0 provides developers, planners, land managers and others with a tool to help limit damage to nature in the first place and to help it thrive. The metric uses habitat features as a proxy measure for capturing the value and importance of nature. It uses a simple calculation that takes into account the importance of these features for nature: their size, ecological condition, location and proximity to nearby 'connecting' features. The metric enables assessments to be made of the present and forecast future biodiversity value of a site. This can be applied to an individual field or an entire river catchment.

The biodiversity metric 2.0 enables developers and land managers to better understand and quantify the current value of a place for nature and how proposed changes to that site, either from development or land management practice, will impact on that value. In short, it provides a way of calculating biodiversity gains and losses. The metric enables developers and land managers to see how they might be able to design a site or implement a land management change in a way that increases its value to nature over time.

The biodiversity metric 2.0 is the successor to the biodiversity metric published by Defra in 2012 and commonly referred to as the 'Defra biodiversity metric'. Biodiversity metric 2.0 builds upon that original metric. Co-developed with the help of industry, environmental NGOs, planners and land managers biodiversity metric 2.0 represents a significant advance in our ability to account for and measure biodiversity losses and gains. This new metric can be used in all terrestrial development and land management scenarios. It can measure the value of habitats ranging in scale from individual street trees and green roofs through to very important priority habitats. The biodiversity metric 2.0 includes all terrestrial habitats including linear habitats (hedgerows, lines of trees, rivers and streams) whose biodiversity value is calculated separately to the main metric calculation. Biodiversity metric 2.0 is being published as a beta test version to gather wider feedback.

Chapter 1 of this user guide sets out the importance and value of using a metric to measure and account for impacts upon biodiversity. Chapter 2 goes onto to set out how biodiversity metric 2.0 has been developed and the underpinning calculations that sit at its heart. Chapter 3 describes how the information and data needed to run the metric calculations can be gathered.

In order to simplify the whole process of calculating biodiversity losses and gains a separate [Calculation Tool](#) has been developed. It is designed solely for use with the biodiversity

metric 2.0. Chapter 4 contains detailed guidance on how to use this tool. Shorter, summary user guidance for the tool is also available.

Chapters 5 – 8 provide detailed information about the approach and calculations that inform the biodiversity metric 2.0, including those for the supplementary linear metrics. Chapter 9 provides an introduction to work that is currently underway to extend the biodiversity metric to include inter-tidal habitats. These habitats will be included in an update scheduled for late 2019.

The biodiversity metric 2.0 is designed to provide developers, planners and land managers with a robust yet simple way to account for the value of nature and better understand how development and land management change will impact on its' value over time. It is being initially released as a beta version because we are seeking feedback on its real world application, whether that be the calculation tool or documentation, in order that improvements can be made and bugs fixed. Also, further enhancements such as coastal and intertidal habitat module should be added by the end of 2019. Please provide feedback via the [biodiversity metric 2.0 survey](#)

BETA TEST

1: Introduction

The rationale for using a metric

- 1.1. Biodiversity is the term that is used to describe the variety of all life on earth. It includes all species of animals and plants – and everything else that is alive on our planet. Habitats are the places in which species live. These species and their habitats contribute to the ecosystems services that provide substantial benefits to people and the economy. For example, woodlands and saltmarsh can help prevent flooding whilst parks and greenspaces make our towns and cities healthier and more attractive places in which to live and work. However, biodiversity is under threat, globally and at home. Habitats are being damaged or disappearing and species are declining. This is not just bad news for nature but also for our own health and well-being and that of future generations. Biodiversity and healthy habitats are vital for a well-functioning planet but their value is often not taken into account in decision-making.
- 1.2. In this user guide we introduce and explain how to use the **biodiversity metric 2.0**. This metric provides a way to measure biodiversity and the impact that developments or land management practices may have upon it. Biodiversity metric 2.0 can help developers, ecologists, planners, communities, land managers and many others take biodiversity into account. The metric provides a way to measure biodiversity loss and gain in a consistent and robust way. It can also predict the likely effectiveness of creating new or enhancing existing habitats. Used in combination with appropriate professional advice the metric can help to reduce biodiversity losses and increase gains resulting from development or land management.

Introducing the biodiversity metric 2.0

- 1.3. Biodiversity metric 2.0 is an updated version of the original Defra biodiversity metric¹. This version builds upon the knowledge and experience gained across a variety of different sectors since the original Defra biodiversity metric was first launched as part of Defra's biodiversity offsetting pilots.
- 1.4. Biodiversity metric 2.0 balances robustness with simplicity. The metric uses habitat as a proxy for wider biodiversity with different habitat types scored according to their relative biodiversity value. This value is then adjusted depending on the condition and location of the habitat, to calculate '**biodiversity units**' for that specific project or development. Biodiversity metric 2.0 incorporates similar but separate calculations for habitats that require a different method of measurement such as hedgerows, lines of trees, rivers and streams and street trees.
- 1.5. The metric can be used to measure both on-site and off-site biodiversity changes for a project or development. The metric also accounts within it for some of the risks associated whenever new habitat is created or existing habitat is enhanced. In calculation terms, the change in biodiversity units is determined by subtracting the number of **pre-intervention** biodiversity units (i.e. those originally existing on-site and off-site) from the number of **post-intervention** units (i.e. those projected to be provided). It is important to note that achieving gains in biodiversity from the

¹ DEFRA. 2012. Biodiversity offsetting pilots. Technical paper: the metric for the biodiversity offsetting pilot in England. Defra. March 2012. <https://www.gov.uk/government/collections/biodiversity-offsetting> (Accessed 20-06-2019)

calculation does not necessarily mean a development meets any wider requirements of planning policy or law relating to nature conservation or biodiversity.

- 1.6. All biodiversity unit calculations come with some ‘health warnings’. The outputs of the metric are not absolute values but provide a proxy for the relative biodiversity worth of a site pre- and post-intervention. The quality and reliability of outputs will depend on the quality of the inputs. This user guide provides advice on how to use the biodiversity unit approach and where and when it is appropriate for use. The metric is not a substitute for expert ecological advice. The metric does not override or undermine any existing planning policy or legislation, including the mitigation hierarchy (see section 1.11 below), which should always be considered as the metric is applied.
- 1.7. Biodiversity metric 2.0 does not include species explicitly. Instead, biodiversity metric 2.0 uses broad habitat categories as a proxy for the biodiversity ‘value’ of the species communities that make up different habitats. The metric does not change existing levels of species protection and the processes linked to protection regimes are outside the scope of the metric.
- 1.8. To simplify and streamline the calculation process, the biodiversity metric 2.0 comes with a free tool to calculate biodiversity units. A shortened user guide for the calculation tool is also available.

The mitigation hierarchy and the metric

- 1.9. Planning policy²³ supports the application of the **mitigation hierarchy** (see Figure 1-1). When using the metric application of the mitigation hierarchy might mean looking to retain habitats in situ or avoiding habitat damage. In the metric biodiversity gains are easier to achieve where habitat impacts are avoided due to the way that habitat creation or enhancement risks are accounted for.



FIGURE 1-1: The Mitigation Hierarchy⁴

² Planning policy explained: <https://www.gov.uk/guidance/national-planning-policy-framework>

³ NPPF implementation explained <https://www.gov.uk/guidance/natural-environment>

⁴ Source: adapted from DEFRA, 2018, Net Gain Consultation Proposals. Defra, December 2018. https://consult.defra.gov.uk/land-use/net-gain/supporting_documents/netgainconsultationdocument.pdf (Accessed 20-06-2019)

2: How to use biodiversity metric 2.0

Who is this guidance for?

- 2.1. This guidance is for anyone planning to use the biodiversity metric 2.0 and anyone who wants to understand the outputs of the metric. This includes developers who have commissioned a biodiversity assessment using the metric, communities wanting to understand the impacts of a local development, and planning authority decision-makers interpreting metric outputs included in a planning application or land owners wishing to provide biodiversity units from their sites to others.
- 2.2. This guidance therefore starts by explaining the basic principles and rules underpinning the metric.

Why use this metric?

- 2.3. Using this metric will help you to take better account of biodiversity in designing plans and making land management decisions. It will allow you to demonstrate biodiversity net gains or losses in a robust and consistent manner. Different plan and project proposals for a site can be compared using the same metric, allowing more objective assessments of alternative approaches to be made. The metric can be used option assessment through to detailed design stages.

When can biodiversity metric 2.0 be used?

- 2.4. Biodiversity metric 2.0 is designed to quantify biodiversity to inform and improve planning, design, land management and decision-making. It can be used to both:
 - assess or audit **the biodiversity unit value** of an area of land and
 - to **calculate the losses and gains** in biodiversity unit value from changes or actions which affect biodiversity, such as a building houses or changing the conservation management of a land holding.

BOX 2-1: Biodiversity metric 2.0 can be used both as an auditing tool to quantify the biodiversity value of a place or to measure changes in biodiversity resulting from human activities



Biodiversity metric 2.0:
a versatile tool to audit the
biodiversity value of land

to measure the
biodiversity benefits of
land management



to understand how
temporary works impact
biodiversity and

to calculate how much
compensation is needed
when natural or semi-natural
habitats are permanently lost



How the biodiversity metric 2.0 works

What the metric measures

- 2.5. Biodiversity metric 2.0 uses **habitat**, the places in which species live, as a proxy to describe biodiversity. These habitats are converted into measurable '**biodiversity units**'. These biodiversity units are the 'currency' of the metric.
- 2.6. Biodiversity units are calculated using the **size** of a parcel of habitat and its **quality**. The metric uses **habitat area** as its core measurement, except for linear habitats where habitat length is used (see supplementary modules section 2.8). To assess the quality of a habitat the metric scores habitats of different types, such as woodland or grassland, according to their relative biodiversity value. Habitats that are scarce or declining typically score highly relative to habitats that are more common and widespread. The metric also takes account of the condition of a habitat. The metric accounts for the location of the habitat relative to other similar habitats to measure its connectedness in the landscape. Being 'better' and 'more joined-up' are important facets of habitats that can contribute to halting and reversing biodiversity declines⁵. Last, the metric also accounts for whether or not the habitat is sited in an area identified locally, typically in a relevant policy of plan, as being of significance for nature.
- 2.7. Where new habitat is created or existing habitat is enhanced the difficulty and associated risks of doing so are taken into account by the metric. If habitat is created to compensate for losses elsewhere, then the metric also takes account of its proximity to the impact site. The metric incentivises delivery that is on or close to the impact site.

Supplementary modules of the metric

- 2.8. Biodiversity metric 2.0 includes additional supplementary modules for habitats that are not well described by their area. These are linear habitats, for which habitat length is often a more meaningful measure of their extent than area.
- 2.9. There are two broad categories of linear habitats :
- hedgerows and lines of trees
 - rivers and streams
- 2.10. These supplementary modules of the metric are calculated differently and have their own discrete biodiversity unit types. It is an important rule of the metric that the biodiversity units calculated through the core habitat area-based metric and each of the linear units are unique and cannot be summed or converted. When reporting biodiversity gains or losses with the metric, the different biodiversity unit types must be reported separately and not summed to give an overall biodiversity unit value. For example, a scheme should report a gain of 3 area-based units, a loss of 1 hedgerow unit and a loss of 1 river unit rather than an overall total gain of 1 unit. The separate

⁵ 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. & WYNEE G.R. 2010. Making Space for Nature: a review of England's wildlife sites and ecological network. Report to Defra

[Calculation Tool](#) provides an easy and simple to use way of undertaking both area and/or linear biodiversity unit calculations.

How area habitat biodiversity units are calculated

- 2.11. To measure the biodiversity value of habitats it is first necessary to define the site boundaries and then divide it into appropriate parcels as needed. Parcels are simply distinct portions of each habitat type present. The habitat type and size of these parcels, and the condition of the habitat it contains, should then be recorded. The metric uses standard methodologies for categorising habitats so this can be done alongside routine ecological surveying. The biodiversity unit value of each habitat parcel is then calculated. To determine the unit value of a habitat parcel we assess its 'quality'. The assessment of quality comprises four components.

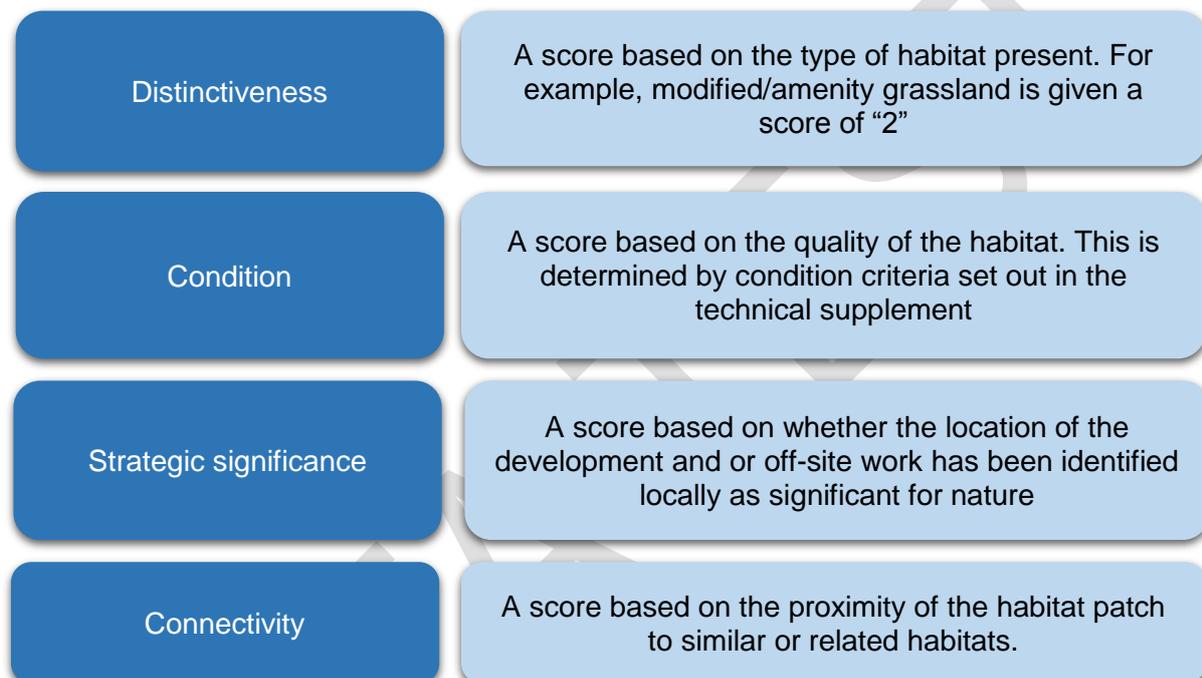
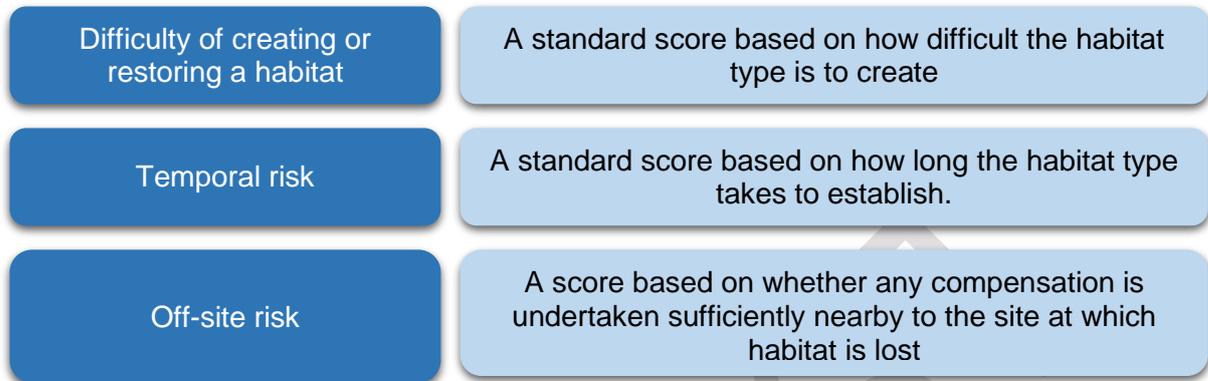


FIGURE 2-1: Quality components in biodiversity metric 2.0

- 2.12. The metric operates by applying a score to each of these elements. It then multiplies the size of each habitat parcel using with each of these 'quality' scores (see BOX 2-2) to produce a number that represents the **biodiversity unit** value of each habitat parcel.
- 2.13. The next update to the metric and calculation tool will come with a tool for calculating connectivity. There will also be a simplified approach for calculating connectivity for smaller sites. In the meantime in the absence of any local data to the contrary, the metric (and the calculation tool) should be populated with 'medium' score for high and very high distinctiveness habitats and low score for all other habitats.
- 2.14. The initial calculation represents the '**baseline**' or '**pre-intervention**' value in biodiversity units.
- 2.15. The calculation is then repeated for the post-intervention (either development or land management change) scenario. This calculation should include any measures to retain existing habitats and create or enhance habitats to generate additional biodiversity units. This gives the user a '**post-intervention**' biodiversity unit score. At

this point, because the metric is measuring predicted changes rather than existing habitats, additional factors to account for the risk associated with creating, restoring or enhancing habitats are also considered. Figure 2-2 sets out the three risks incorporated into the metric.

FIGURE 2-2: Risk components of biodiversity metric 2.0



- 2.16. The predicted value of the habitats in biodiversity units 'post-intervention' is then deducted from the 'baseline' pre-intervention unit score to give a net change unit value. If your project has explicit biodiversity unit requirements the metric can be used to calculate the numbers of units your design is predicted to deliver. The design can be revised to improve the number of biodiversity units obtained.
- 2.17. The metric can be used to measure off-site compensation where this is required. The processes for measuring on-site and off-site changes and compensation are very similar. The biodiversity unit value of the off-site habitats are calculated for the 'pre-intervention' and 'post-intervention' stages. The 'pre-intervention' units are then subtracted from the 'post-intervention' units to work out how many biodiversity units will result from that habitat change.
- 2.18. The example in BOX 2-2 illustrates the general approach used to calculate the biodiversity unit value for habitats described above. A more detailed explanation of this process is given in chapter 5.

BOX 2-2: Calculating the biodiversity unit value of a habitat

How we calculate biodiversity value for habitats is illustrated in the scenario below:

- The pre-intervention calculation that establishes the baseline biodiversity unit value of a habitat. In essence, that multiplies the size of a habitat parcel by its 'quality' scores, and
- The post-intervention calculation that gives you the biodiversity unit value of a habitat after it has been changed. This calculation also takes account of the difficulty and time it takes to create the new habitat.

How these calculations are used in an example scenario is illustrated in BOX 2-3. *N.B. In this example the 'high' connectivity score has been derived from local data.*

PRE-intervention biodiversity calculation (the baseline)

Size of habitat parcel	x	Distinctiveness	x	Condition	x	Strategic location	x	Connectivity	=	Biodiversity units
10 (ha)	x	6 (high)	x	1 (poor)	x	1.15 (high)	x	1.15 (high)	=	79 units

POST-intervention biodiversity calculation (for newly created habitat)

Size of habitat parcel	x	Distinctiveness	x	Condition	x	Strategic location	x	Connectivity	x	=	Biodiversity units
10 (ha)	x	6 (high)	x	3 (good)	x	1.15 (high)	x	1.15 (high)	x		
										=	Biodiversity units
										=	133 units

Note: A dashed blue line connects the 'Connectivity' value (1.15) from the pre-intervention calculation to the 'Connectivity' value (1.15) in the post-intervention calculation.

Calculation of gains or losses

The net effect of an intervention (or a series of interventions) on biodiversity is calculated as follows:

POST units	-	PRE units	=	Net change
133 units	-	79 units	=	+54 units

 Habitat parcel	 Risk factor
 Measure of biodiversity quality	 Value in biodiversity units

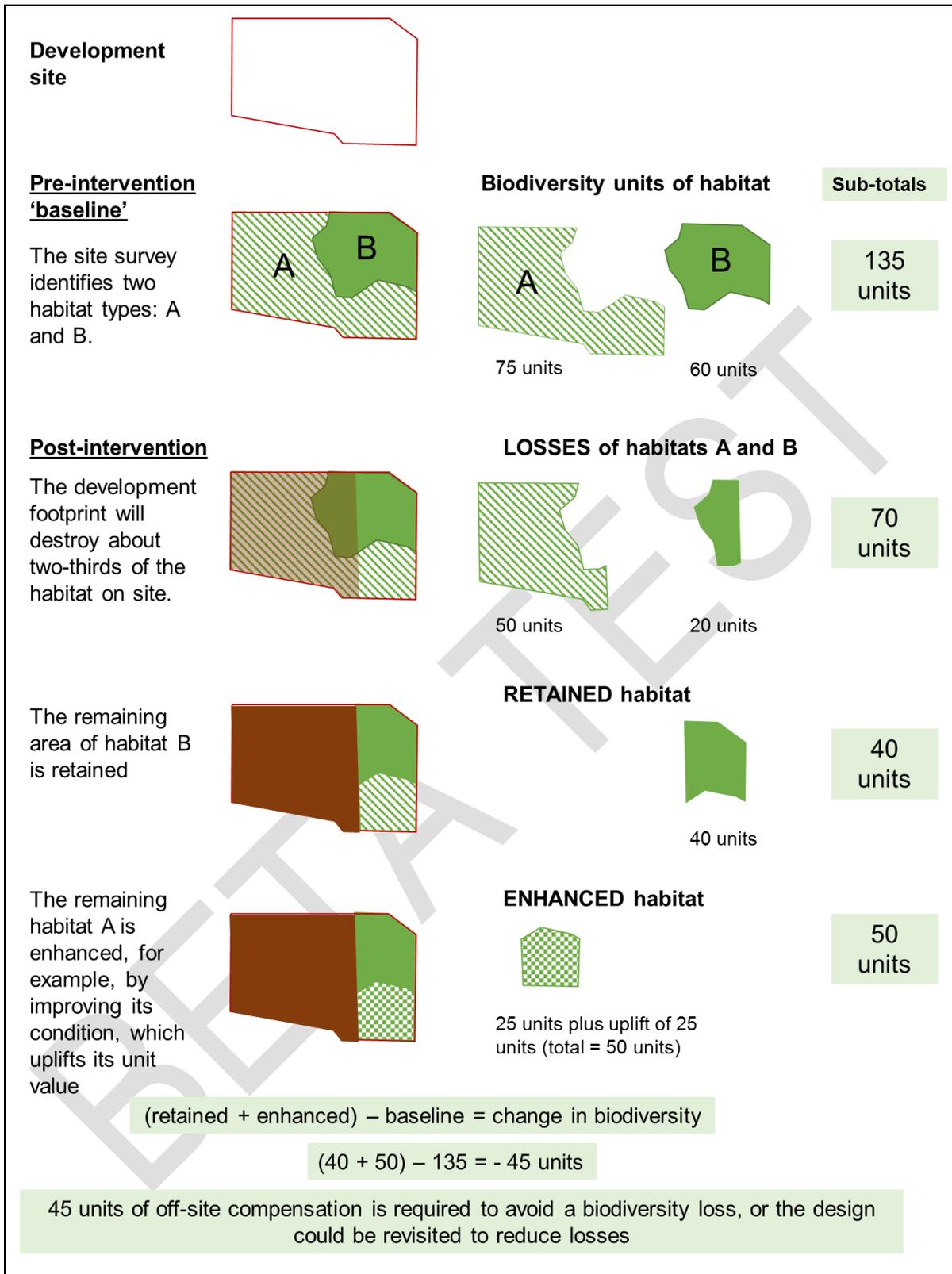
BOX 2-3: Practical application

To calculate the change in biodiversity unit value resulting from a development (or other intervention) you first survey and then divide the site up into distinct parcels of each habitat type. Using this information you can calculate the baseline (or pre-intervention) 'biodiversity unit' value of each habitat parcel using the free calculation tool provided for use with biodiversity metric 2.0. The output of the tool gives you the biodiversity unit value of the habitats on the site before the development.

Next, using your design plans for the development you calculate the biodiversity unit value for the habitats that are expected to be retained after the works finish, plus the values for any enhanced or newly created habitats.

The change in biodiversity is worked out by subtracting the site's baseline biodiversity unit value from the sum of post-intervention values for retained, created and enhanced parcels of the same habitat type. This is then combined with any offsite gains or losses to give a final biodiversity unit value from which net gain or loss for the scheme can be assessed. This is illustrated in the graphic below.

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Key process steps

2.19. The key steps you need to follow to make practical use of the metric are outlined in Figure 2-1.

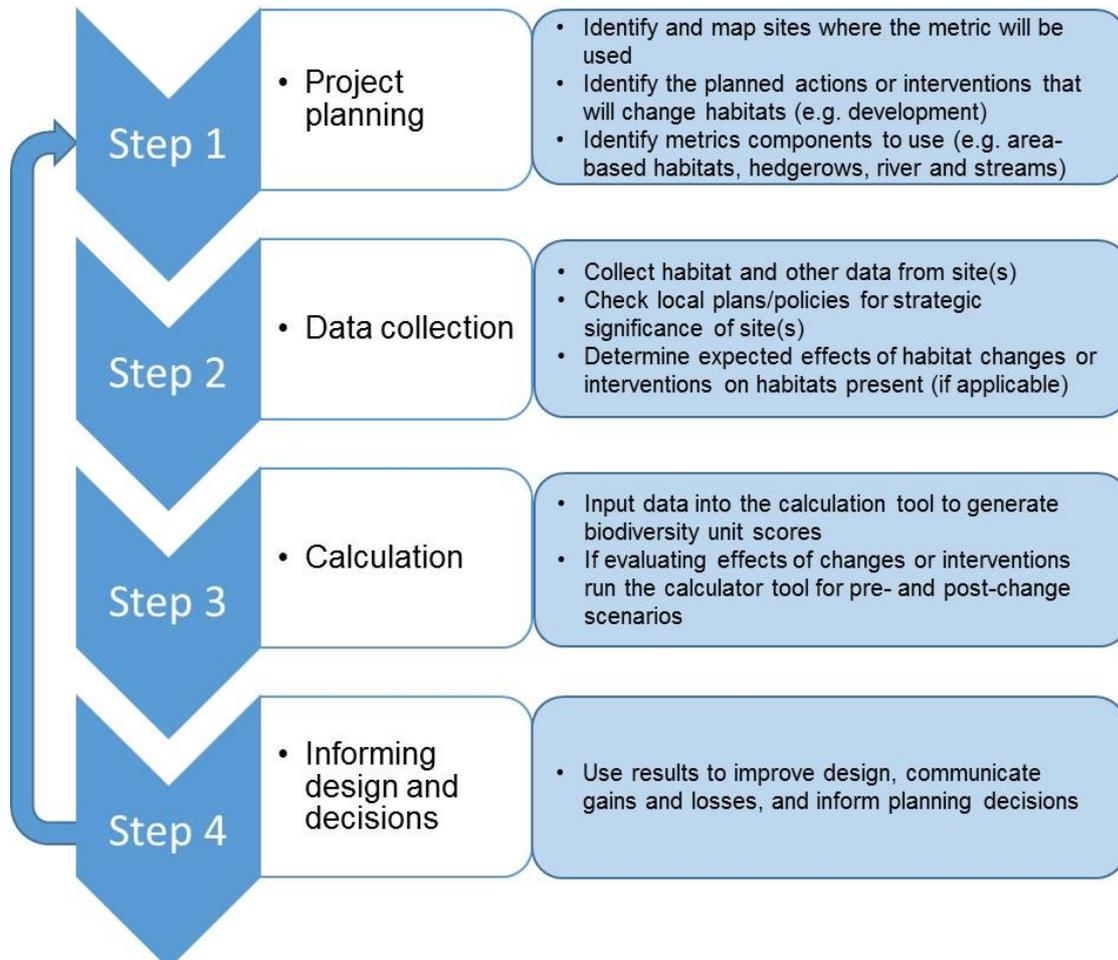


FIGURE 2-1: The 4 key steps to using biodiversity 2.0

Principles and rules for using the metric

- 2.20. The metric is a tool that can be used to help inform plans and decisions. Used properly, it incentivises actions that are expected to benefit biodiversity and discourages actions that harm biodiversity. It is important, however, to be aware of its limitations and to follow some important principles.
- 2.21. The metric uses habitat categories as a proxy for biodiversity. Although this is rational, it is an oversimplification of the real world. Furthermore, while the scoring of habitats is informed by ecological reasoning and the available evidence, the outputs of biodiversity unit calculations are not scientifically precise or absolute values. The generated biodiversity unit scores are proxies for the relative biodiversity worth for the state of a place.
- 2.22. The metric and its outputs should therefore be interpreted, alongside ecological expertise and common sense, as an element of the evidence that informs plans and

decisions. The metric is not a total solution to biodiversity decisions. The metric, for example, helps you work out how much new or restored habitat is needed to compensate for a loss of habitat, but it does not tell you the appropriate composition of plant species to use.

2.23. Users wanting to apply the metric properly should conduct their assessments with regard to a set of **key principles and rules** for its use. These are set out below:

- **Principle 1: The metric does not change the protection afforded to biodiversity.** Existing levels of protection afforded to protected species and to habitats are not changed by use of this or any other metric. Statutory obligations will still need to be satisfied.
- **Principle 2: Biodiversity metric calculations can inform decision-making where application of the mitigation hierarchy and good practice principles⁶ conclude that compensation for habitat losses is justified.**
- **Principle 3: The metric's biodiversity units are only a proxy for biodiversity.** While it is underpinned by ecological evidence the metric is only a proxy for biodiversity and to be of practical use has been kept deliberately simple. The numerical values generated by the metric represent relative, not absolute, values.
- **Principle 4: The metric focuses on widespread species and typical habitats.** Area based habitats are considered a suitable proxy for widespread species found in typical examples of different habitat types.
 - Protected and locally important species needs are not considered through the metric,
 - Impacts on protected (e.g. SSSIs) and irreplaceable habitats are not adequately measured by this metric, and will likely require separate consideration.
- **Principle 5: The metric design aims to encourage enhancement, not transformation, of the natural environment.** Where possible, habitat created to compensate for loss of a natural or semi-natural habitat should be of the same broad type (e.g. new woodland to replace lost woodland) unless there is a good ecological reason to do otherwise (e.g. to restore a heathland habitat that was converted to woodland for timber in the past).
- **Principle 6: The metric is designed to inform decisions.** Decisions and management interventions need to take account of available expert ecological advice and not just the biodiversity unit outputs of the metric.
- **Principle 7: Compensation habitats should seek, where practical, to be local to the impact.** They should aim to replicate the characteristics of the habitats that have been lost, taking account of the structure and species composition that give habitats their local distinctiveness. Where possible

⁶ CIEEM, CIRIA, IEMA. 2016 Biodiversity Net Gain – Good Practice Principles for Development. https://www.cieem.net/data/files/Publications/Biodiversity_Net_Gain_Principles.pdf

compensation habitats should contribute to England’s ecological network by creating more, bigger, better and joined areas for biodiversity

- **Principle 8: The metric does not enforce a mandatory minimum 1:1 habitat size ratio for losses and compensation.** A difference can occur because of a difference in quality between the site impacted and the compensation provided. For example, if a habitat of low distinctiveness is impacted and is compensated for by the creation of habitat of high distinctiveness, the area needed to compensate for losses can potentially be less than the area impacted. Consideration should be given to whether reducing the size of compensation is an appropriate outcome.

Rules

Rule 1

Where the metric is used to measure change biodiversity unit values need to be calculated prior to the intervention and post-intervention for all parcels of land / linear features affected.

Rule 2

Compensation for habitat losses can be provided by creating new habitat, by restoring or enhancing existing habitats, or by accelerating successional processes. Measures to improve existing habitats must provide a significant and demonstrable uplift in distinctiveness and/or condition to record additional biodiversity units.

Rule 3

‘Trading down’ must be avoided. Losses of habitat are to be compensated for on a “like for like” or “like for better” basis. Ideally, new or restored habitats should aim to achieve a higher distinctiveness and / or condition than habitats lost.

Rule 4

Biodiversity unit values generated by biodiversity metric 2.0 are unique to this metric and cannot be compared to unit outputs from the original Defra metric or any other biodiversity metric. Furthermore, the units generated by the each module of biodiversity metric 2.0 (for area, hedgerow and river habitats) are unique and cannot be summed.

Rule 5

It is not the area of habitat created that determines whether ecological equivalence or better has been achieved but the net change in biodiversity units. Risks associated with enhancing or creating habitats mean that it may be necessary to enhance or create a larger area of habitat than lost to fully compensate for impacts on biodiversity.

Rule 6

Deviations from the published methodology of biodiversity metric 2.0 need to be ecologically justified. While the methodology is expected to be suitable in the majority of circumstances it is recognised that there may be exceptions. Any local or project-specific adaptations of the metric must be transparent and fully justified.

3: Data Collection & Fieldwork

Introduction

- 3.1. This section sets out how to collect the data required for the biodiversity metric 2.0 calculation. This includes information that can be collected through ‘desktop surveys’ (i.e. remotely) and information that requires site visits or surveys. The section focusses on the data required for the core (area) calculation of biodiversity metric 2.0. Section 8 details the data needed to undertake the supplementary (linear) calculations.
- 3.2. To complete biodiversity metric 2.0 the following data needs to be obtained for existing and proposed habitats:
- Habitat types present (including sealed surfaces and man-made land cover);
 - Area of each parcel of habitat of a particular type (hectares);
 - Condition of each parcel of habitat (High, Medium, Low).
 - Connectivity (high, medium and low) – *N.B. in the beta version of the biodiversity metric 2.0 these scores should be set at ‘low’ for low and moderate distinctiveness habitats and ‘medium’ for high or very high distinctiveness habitats in the absence of local data.*
 - Strategic significance

Data Collection Approach

- 3.3. The best approach to take for data collection will depend on wider survey and data requirements for the development and the site being affected. However, the steps below set out some useful stages to consider.

Step 1: Pre site-visit background checks

- a. Online data searches (such as using [MAGIC](#)) can help to identify any relevant Habitat Inventory data and SSSI boundary information. This can help to identify whether highly distinctive habitat is likely to be present or whether the site is within a SSSI or other statutory designation and whether there are known to be irreplaceable habitats on site. Designated sites and irreplaceable habitat impacts need to be addressed separately in accordance with existing mechanisms. The biodiversity metric 2.0 is not designed for use determining compensation for impacts on such sites and habitats.
- b. Searching for species records (such as those held within the [NBN Atlas](#)) can give an indication of how biodiversity rich the site and its surroundings might be. This will help determine any constraints or aspects of the site’s biodiversity that may need more detailed consideration outside of the scope of biodiversity net gain. Local Environmental Record Centres (LERCs) can also be good sources of biodiversity information.
- c. It is also advisable to check that recent maps or aerial images of the habitats on the site are consistent with those from recent years. They can highlight if any potential baseline degradation (i.e. the removal of habitat before development to reduce net gain costs) has occurred.

Step 2: Initial walkover on the site

- a. A walkover will give an impression on how the site might be split up and surveyed most effectively. During the walkover consider different land uses across the site and identify any hot spots of biodiversity with higher quality features (i.e. areas with Priority Habitats or Species) that may need more survey time and consideration.
- b. The site should be divided into habitat parcels (contiguous areas of habitats with the same type and condition) as appropriate. Site mapping will usually be the most straightforward way of doing this.

Step 3: Identifying habitat types present on site

- a. This is best completed through the use of [UK Habitat Classification System](#)⁷ (see Box 3-1). This means that habitats are recorded as types that will be widely recognised and that can be put directly into the biodiversity metric 2.0 calculation tool. If a Phase 1 habitat survey is undertaken the results can be translated into UK Habitat Classification System types (see Box 3-1 below). A translation table between Phase 1 and UKHab types is also contained within the calculation tool provided for biodiversity metric 2.0.
- b. Habitat type identification might require a separate survey visit, or might be achievable on the site walkover, depending on the habitats present. For example, a site comprising hardstanding and amenity grassland might not require a detailed habitat survey, but a site with different grassland types and a rich mosaic of habitats would be likely to.

BOX 3-1: The UK Habitat Classification (“UKHab”)

Biodiversity metric 2.0 is based on the UK Habitat Classification system, a free-to-use (open access), unified and comprehensive approach to classifying habitats that is fully compatible with other major existing classifications. It is designed to be suitable for digital or manual use in habitat metrics, impact assessment and sharing data between organisations.

The UK Habitat Classification system was chosen for use in the metric as it translates easily into Priority Habitat types and Habitats Directive Annex 1 types; does have scope to incorporate assessments of condition, origin or management regime; and is much easier to use in electronic mapping systems because of its architecture.

Minor adjustments to the habitat list within the UK Habitat Classification system have been made within the metric. The adjustments include the addition of habitats (all based on a EUNIS code or Annex 1 habitat type) that cut across a number of Priority Habitat types and so work better in the metric as a separate category. Some habitats have been omitted from the list because they are better recorded in the metric as the actual habitat type as represented on the site (e.g. a railway corridor is better split into its individual grassland & scrub types).

If your project uses Phase 1 habitat typologies the biodiversity metric 2.0 calculation tool can convert between Phase 1 and UKHab classifications. A conversion table can be found via the ‘Technical Data’ button in the calculation tool.

⁷ UK Habitat Classification: <http://ecountability.co.uk/ukhabworkinggroup-ukhab/> (Accessed 20/06/2019)

Step 4: Recording size (ha) and mapping the habitat polygon/ parcel.

- a. The size of each habitat parcel should be recorded in hectares (with the exception of the habitats covered by the supplementary modules – see Chapter 8). Whilst there is no firm minimum or maximum size of recorded parcels, it is recommended that a proportionate approach is taken to avoid the recording of habitat types that cover a total area of less than one square meter (0.0001 ha), or recording extremely large areas that are likely to vary in their condition, as one habitat parcel.
- b. Mapping is not always required, but is usually helpful to visualise the inputs and to help decision-makers to make sense of the habitats included in metric calculations. Where practical, it is advisable to use digital mapping as this will typically allow more accurate recording of boundaries and make the process of revising maps easier. If you record reference numbers for each habitat parcel, it can be helpful for reviewers to label any habitat map with these references.

Step 5: Recording condition scores to describe the quality of the habitat present.

- a. Habitat condition is divided into one of 3 categories: High, Medium and Low in the metric. These 3 main categories will be used but the metric and calculation tool does allow for half scores, if for example it is not possible to separate High and Medium condition. Using the appropriate habitat condition sheet (see the Technical Supplement for details) the surveyor will need to assess the quality of each parcel of habitat for wildlife. Some parcels may need to be split, if quality varies across an area, into separate parcels. Each parcel needs to be recorded on the map and calculated separately using the metric. If using the calculation tool each parcel needs to be entered as a separate line in the tool. Identifying habitat condition will require some ecological knowledge in most circumstances. The detailed habitat condition assessment sheets can be found in the technical supplement published alongside this document.

Step 6: Supplementary habitat modules

If the site contains any of the following habitat types then an assessment using the relevant supplementary module of the metric is required:

Linear Habitats (see Chapter 8)

- hedgerow and lines of trees – this module uses length (kilometres), height and condition
- rivers or streams – this module uses length (kilometres), type and nearby habitat type

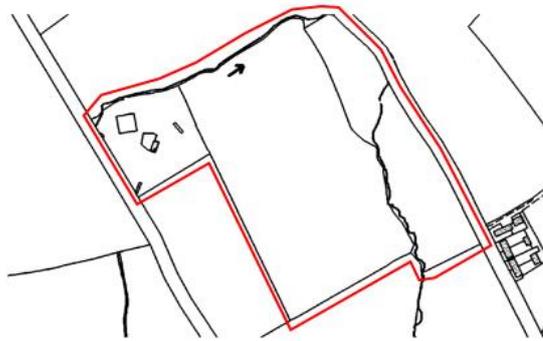
Urban Street Trees (see Chapter 7)

- urban street trees – this module uses stem diameter at breast height (centimetres) and the number of trees involved.

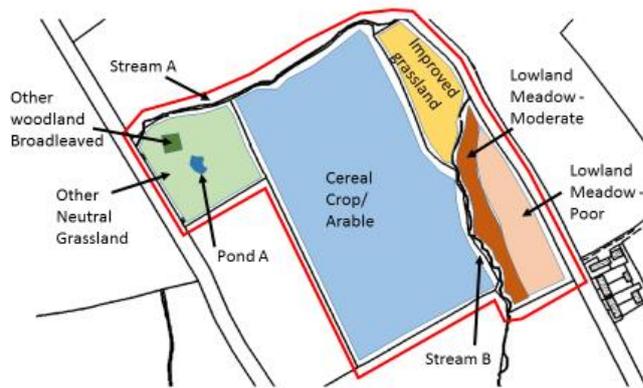
Step 7: Opportunities for onsite Habitat Creation & Enhancement.

It is generally advisable to use any site visits and surveys to also identify opportunities where existing habitats could be enhanced or new habitats created.

Site Plan



Map for Area Habitats



Map for Supplementary Habitats (hedgerow, streams)



FIGURE 3-1: Examples of Data Collection Maps

TABLE 3-1: Simple data collection records for the maps shown in Figure 3-1

Baseline Area Habitat Data	Condition	Size (Ha)	Notes
Improved Grassland	N/A Agricultural	1.3	
Cereal Crops	N/A Agricultural	12.3	
Lowland Meadow	Poor	1.8	
Lowland Meadow	Moderate	1	
Pond A	Good	0.1	
Other Woodland Broadleaved	Good	0.2	
Other Neutral Grassland	Moderate	2	
etc			

Baseline Supplementary Habitat Data	Condition	Length (Km)	Notes
Stream A	Moderate	0.5	
Stream B	Poor	0.23	
Hedge A	Poor	0.18	
Hedge B	Moderate	0.130	
Hedge C	Poor	0.070	
etc			

4: How to use the Calculation Tool

- 4.1. The biodiversity metric 2.0 is accompanied by the ‘**Calculation Tool**’. This will help you calculate the biodiversity units for a site before (baseline) and after a development or management intervention. [Summary guidance](#) explaining how to use the calculation tool is also available. This section provides more detailed information and guidance on the calculation tool.
- 4.2. The tool is pre-populated with much of the key data that underpins the calculation. The majority of the data entry is via dropdown lists. There are separate data entry buttons for baseline and post development/management scenarios. The post development data entry is split into Creation, Enhancement and Accelerated Succession with separate buttons for each. There are also separate sheets for onsite and offsite data entry and calculation.
- 4.3. To use the calculation tool, users will need access to data which covers:
 - habitat types
 - area of habitats
 - habitat condition
 - connectivity of the habitat
 - strategic significance
- 4.4. The tool provides an overview of headline results as well as detailed results, outputs and graphics.

STEP 1: Accessing and preparing the tool

- 4.5. Open the Calculation Tool⁸ on any computer with spreadsheet software installed. The spreadsheet should open with the “Introduction” tab showing as in Figure 4-1.



FIGURE 4-1: Tool Introduction screen

⁸ See <http://nepubprod.appspot.com/publication/5850908674228224>

- 4.6. The tool works best with macros and content enabled⁹ so we recommend enabling content or macros if prompted by your spreadsheet software.
- 4.7. Click on the “Open Tool” button. This will open spreadsheet with the “Start page” visible showing as in Figure 4-2.

Project details	
Planning authority:	Borsetshire
Project name:	Land at Lower Loxley
Applicant:	N White
Application type:	Full planning consent:
Planning application reference:	10/234/845
Assessor:	S. Panks
Reviewer:	M. Heaver
Revision:	Version 1
Assessment date:	18/07/2019
Planning authority reviewer:	L. Moore

Cell style conventions	
	Enter data
	Automatic lookup
	Result

FIGURE 4-2: Calculation Tool start page

- 4.8. Under the header “Project details”, enter the required information into the relevant rows.
- 4.9. When this is complete, click the navigation button on the right labelled “Main menu” (See Figure 4.2). This page provides links to all pages of the calculation tool, including those for data entry and those that will display your assessment’s results. Note that very few projects will need to use all of the pages in the tool, and many will use only a few. To navigate between the worksheets in the tool, click the “Main menu” button to return to the main contents page (from which you can access every part of the tool). If you are using a macro free version use the tabs at the bottom of the screen.

⁹ If your organisation has disabled macros or content in spreadsheets, it is still possible to use the tool but the navigation buttons will not work as intended. You will instead have to use the software’s default mode of shifting between worksheets/tabs.

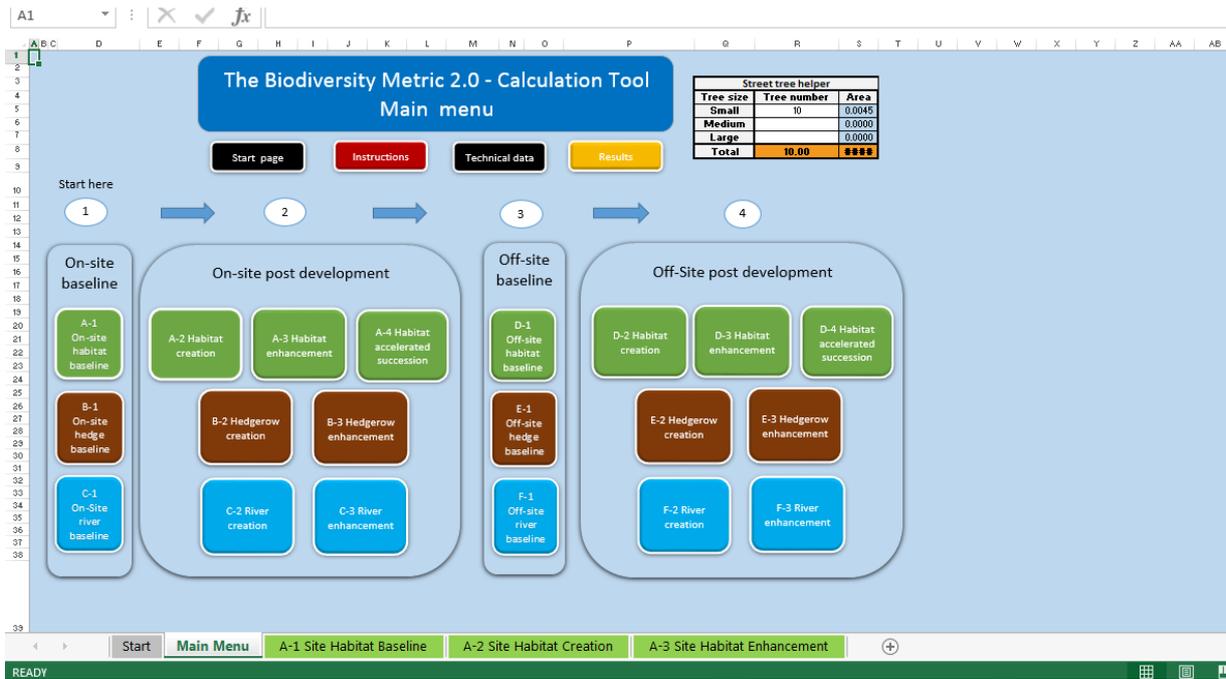


FIGURE 4-3: Calculation Tool Main menu

STEP 2: Baseline (pre-intervention) data entry

Entering baseline data

- 4.10. The information you will need to enter to complete your baseline assessment will depend on the type of habitats you have on your site, and whether you are using any off-site compensation (also referred to as offsets).
- 4.11. All the cells in the tool are colour coded according to the type of information that can be entered into them. The “Cell Style Conventions” box on the “Start” tab, and copied below, provides a key to the colour coding throughout the tool¹⁰.

	Enter data
	Automatic lookup
	Result

FIGURE 4-4: Cell style conventions key from the tool. Any cells requiring data inputs will be shaded white, automated cells blue and results in orange.

- 4.12. Use the main menu and the information in “Step 1” to determine which tabs you will need to complete. In most cases, the first tab to complete will be “A-1 Site Habitat Baseline”.
- 4.13. Use the “Condense/show columns” button, and the equivalent for rows, to switch between views. In full view all the multiplier values are visible. In the condensed view

¹⁰ This colour coding is designed to make it easier to quickly find input columns but is not essential to the use of the tool.

a more limited amount of information is presented which makes the screen easier to view, and which still allows the input of all necessary information. Users can toggle back and forth between views at any time.

Completing the baseline calculation

- 4.14. This section of the tool allows you to describe the habitats as they are before the planned development or other intervention takes place.
- 4.15. Tab “A-1 Site Habitat Baseline” allows you to enter the data for the habitats that are already present on your site.

You will need to enter:

- habitat type,
- habitat area,
- habitat condition,
- ecological connectivity assessment (low, med, high) N.B. For this version use a default value of ‘low’ except for high or very high distinctiveness habitats which should be scored as ‘Medium’
- An appropriate strategic significance description

Row #	Broad Habitat	Habitat and area		Habitat distinctiveness		Habitat condition		Ecological connectivity		Strategic significance			Suggested action to address habitat losses	Ecological Total habitat value	Stratification rate				
		Habitat type	Area (hectares)	Distinctiveness score	Score	Condition	Score	Connectivity	Connectivity multiplier	Strategic significance	Strategic significance	Strategic priority			Area retained	Area habitat loss	Area success	Stratification rate	
1	Grassland	Grassland - Modified grassland	2	Low	2	Poor	1	Medium	Moderately connected habitat	1.1	Area/compensation set in local strategy to local strategy	Low Strategic Significance	1	Same distinctiveness or better habitat required	4.00	0.5			1.0
2	Cropped	Cropped - Traditional orchards	1	High	6	Poor	1	Medium	Moderately connected habitat	1.1	Area/compensation set in local strategy to local strategy	Low Strategic Significance	1	Same habitat required	6.00		1		0.00
		Total site area ha		3.00									Total Site baseline	11.00	0.50	1.00	0.00	1.50	

FIGURE 4-5: Data entry points on ‘A-1 Site habitat baseline tab’

A: Enter habitat type and area

- 4.16. To enter habitat data into the sheet, select the first empty row and select a habitat type from the dropdown list. Then enter the area, measured in hectares, of that habitat into the adjacent “Area” column.

It is good practice to put different habitat parcels on your site into different rows (e.g. recording two separate parcels of woodland on a site in two separate rows). However provided they are of the same habitat type, multiple habitat parcels containing habitat of the same condition and in the same location can be amalgamated into one row, and the total area for this habitat type entered.

B: Enter habitat condition

- 4.17. Enter the condition for each row of habitat using the dropdown list in the “Condition” column. The tool will then automatically apply the corresponding condition score.
- 4.18. If two parts of the same habitat are of markedly different condition, you should split them across two rows and record them as two separate parcels.

- 4.19. If a score for condition is shown as “Not possible”, it means that you are selecting a combination of habitat and condition that is not considered ecologically feasible, such as an arable field that is in good ecological condition. To remedy this, simply change your condition score to the appropriate level and the error message will disappear.

C: Enter ecological connectivity assessment

- 4.20. In the test version of the tool all High and Very High distinctiveness habitats should be assigned a Medium connectivity multiplier, other habitats a Low connectivity multiplier. A connectivity assessment is not appropriate for some habitats such as arable crops. In these cases select N/A and the tool will automatically apply a neutral to reflect this. A forthcoming update to the tool will enable a more sophisticated approach to connectivity to be used.

D: Enter strategic significance assessment

- 4.21. Select the appropriate description for the strategic significance of each habitat from the dropdown list. Select the option that best corresponds to information set out in local plans or policies. The tool will then automatically apply the corresponding strategic significance score. If no such plans or policies are available select the third option in the drop down list.

E: Suggested Action (no input required)

- 4.22. Some particularly biodiverse habitats call for like for like compensation if lost, and you should always try to avoid trading down; this means not replacing biodiverse habitats with large areas of less biodiverse habitats. The “Suggested action” column gives indicative advice that you might want to consider as you design your site and compensation plan. The action suggested does not constitute formal advice.

F: Area retained, enhanced or for succession

- 4.23. Users should use these cells to record how much, in hectares, of each habitat on the site is planned to be:

Area retained: Kept on the site throughout any development or landscaping process and featuring in final site designs

Area enhanced: Kept on the site throughout any development or landscaping process but enhanced (i.e. improved for wildlife) as part of the site design

Area succession: A specific process, “accelerated succession”, in which habitat such as woodland is created on existing habitats such as grasslands. See sections 4.36 and 5.23 for more information.

- 4.24. The tool will use this information at later stages to automatically fill in baselines for habitat enhancement so it is important to record these areas correctly.

G: Assessor and Local Authority Reviewer Comments

- 4.25. At the right end of each row there is a pair of comment boxes where optional text can be added. This provides an opportunity for assessors and those reviewing the assessment or the planning authority to make any comments regarding a particular habitat. Use this section to record any additional justifications for the assessment of habitat type, condition or location if needed. If there are no specific points to raise it can be left blank.

Hedgerow, lines of trees and rivers and streams - baselines

- 4.26. If your site does not contain these habitats, proceed to Step 3. If your site contains hedgerows and lines of trees or rivers, streams or canals, you should complete the relevant worksheets for these habitats. For lines of trees use the ‘hedgerows’ buttons and tabs. Use the main menu or tabs to navigate to worksheets B-1 and C-1.
- 4.27. Enter the relevant data for these habitats, as you would for area-based (non-linear) habitats. However, habitat extent should be recorded as length in kilometres of the habitat feature rather than the area in hectares.

STEP 3: Post-intervention data entry

Navigating the post-intervention data entry tabs

- 4.28. The worksheets you will need to complete for your post-intervention assessment will depend on the type of habitats you include in your designs, and whether you are creating habitats, enhancing habitats or using accelerated succession (see paragraph 5.23). Use the ‘Main menu’ in the tool to determine which tabs you will need to complete. In most cases, the first tab to complete will be “A-2 Site Habitat Creation”.
- 4.29. This section of the tool allows you to describe the habitats as they will be after the planned development or other intervention takes place.

Habitat creation

- 4.30. This tab allows you to enter the data for the habitats you plan to create. You will need to enter the proposed:
- habitat type,
 - area,
 - condition,
 - ecological connectivity assessment (low, med, high) N.B. the test version of the tool uses default values of ‘low’ except for high or very high distinctiveness habitats which are scored as ‘Medium’
 - strategic significance assessment
 - spatial risk (only for off-site habitats)
- 4.31. These are entered in the same way as is done for the baseline assessment. The tool will then automatically apply the appropriate difficulty and temporal multipliers for the selected habitat types and condition, so no input from the user is required for those columns.
- 4.32. If a score for condition is shown as “Not possible”, it means that you are selecting a combination of habitat and condition that is not considered ecologically feasible, such as an arable field that is in good ecological condition. To remedy this, simply change your condition score to the appropriate level and the error message will disappear.
- 4.33. The number of habitat units created is calculated automatically. At the far right of each row there is a comments box which provides an opportunity for assessors and planning authority reviewers to make any observations or comments.

Habitat enhancement

This tab allows you to enter the data for the habitats you plan to enhance. The habitat enhancement calculation factors in elements of the baseline data as the existing habitat is the starting point for enhancement. When you enter the area of habitat being enhanced into the “Area enhanced” column of the baseline sheet, the tool will automatically list the habitats you plan to enhance using the data you first put into the baseline sheets (See Figure 4-6). If they are not appearing correctly, check that you entered an area in the “Area enhanced” column of the baseline sheets (A-1 etc.).

Suggested action to address habitat losses	baseline		Area retained	Area enhanced	su
	Total habitat units				
Same distinctiveness or better habitat required	4.40			0.5	
Same habitat required	6.60			1	
Total Site baseline	11.00		0.00	1.50	

FIGURE 4-6: Input area enhanced on ‘A-1 Site habitat baseline tab’

4.34. Enter the proposed:

- habitat type (if you are not keeping the same habitat type)
- habitat condition
- ecological connectivity assessment (low, med, high) N.B. the test version of the tool uses default values of ‘low’ except for high or very high distinctiveness habitats which are scored as ‘Medium’
- strategic significance assessment
- spatial risk (only for off-site habitats)

in the same way as when you entered the baseline data.

4.35. The calculation tool identifies the change in distinctiveness and condition of the habitat. The enhancement formula references the baseline habitat data. Therefore if a trading down (See Rule 3) error occurs in either the Distinctiveness or Condition Movement cells, it will need to be resolved, otherwise it will prevent the tool delivering a biodiversity unit calculation.

Accelerated succession

4.36. The calculation tool uses elements of the submitted baseline data to calculate gains from habitat created through accelerated succession. For example, where woodland was being created on grassland the calculation tool would need to know what type of grassland was in situ beforehand. When you enter the area of the habitat to be created through accelerated succession into the “Area succession” column on the baseline sheet (See Figure 4-7) the tool will automatically populate the baseline data in accelerated succession sheet. If they are not appearing correctly, check that you entered an area in the “Area succession” column of the baseline sheets (A-1 etc.). Users then only need to enter the remaining data into the white columns.

Suggested action to address habitat losses	Ecological baseline	Retention category			
	Total habitat units	Area retained	Area enhanced	Area succession	Baseline units retained
Same distinctiveness or better habitat required	4.40			0.5	0.00
Same habitat required	6.60		1		0.00
Total Site baseline	11.00	0.00	1.00	0.00	0.00

FIGURE 4-7: Input area accelerated succession on ‘A-1 Site habitat baseline tab’

STEP 4: Off-site data entry

- 4.37. This tab can be used to calculate the contribution any off-site land towards the developments overall biodiversity change (loss or gain) calculation, If you need to use land off-site, you will first need to enter any baseline data for the off-site location. For example, if you were creating a woodland on an arable field away from the main development site, you would need to record the arable field in the off-site baseline tabs.
- 4.38. To do this select the ‘Off-site baseline’ tab from the ‘Main menu’ and enter the baseline data for off-site habitats in exactly the same way as for the on-site habitats by following the guidance at Step 2.
- 4.39. You will need to enter any data for off-site habitat creation or enhancement separately to that for on-site habitats. Use the Main menu to find the appropriate tabs and enter the baseline and post-intervention data for off-site habitats in exactly the same way as you did for the on-site habitats.
- 4.40. For habitat creation, enhancement and accelerated succession undertaken off-site, there is an additional spatial risk multiplier that must be applied.

STEP 5: Viewing and interpreting the results

Headline results tab

- 4.41. The headline results tab takes data from all the other tabs and provides the key results for the biodiversity metric 2.0 assessment. It highlights whether biodiversity losses or gains have been achieved across the main and supplementary metrics relevant for the project. A full dashboard of results is available in the detailed results tab.

Detailed results tab

- 4.42. The detailed results tab takes data from all the other tabs and provides a dashboard summarising the data contained in the other sheets. The results are displayed in tables and visual graphics.

Trading summary tab

- 4.43. The trading summary tab provides details of trading between habitat types and an indication of whether the development has abided by the trading rules (See Rule 3). It is designed to set out the available data in a way that allows assessors and reviewers to determine whether or not trading principles described in rule 3 (see chapter 2) have been adhered to.

Error checking

- 4.44. The tool contains a number of inbuilt error messages which are designed to identify errors in data entry. Typically they can be resolved by checking the input data and common causes of errors include:
- inappropriate condition ratings
 - habitat areas that do not match
 - aiming to create a habitat or condition type that is not considered ecologically feasible

STEP 6 (optional): Understanding and checking supporting data in the tool

- 4.45. All the technical data and multipliers underpinning the calculation can be accessed through the main menu in tabs G-1 to G-9 of the calculation tool. This is not required for normal operation of the tool but regular users of the tool might want to look at the underlying data to better understand the tool's outputs.

Connectivity scoring

- 4.46. In the beta version of the metric, low distinctiveness habitats should be afforded a connectivity score of 'low' and high and very high distinctiveness habitats afforded a connectivity score of 'medium'. A connectivity tool is being developed and will be available in future updates.

5: Detailed description of the biodiversity metric 2.0

- 5.1. This chapter provides explanations of the different components of biodiversity metric 2.0. The aim is to give a sense of the values used for different multipliers, why those multipliers are being used, and the assumptions and limitations around them. This chapter also outlines some the considerations that might be taken into account when designing a project underpinned by the metric.
- 5.2. This chapter focuses on the core components of the metric. Specific area habitat and urban tree components are detailed in chapters 6 and 7 respectively. Chapter 8 provides similar details and explanations for the additional supplementary metric modules covering hedgerows, lines of trees and rivers and streams.

Components of biodiversity quality

Distinctiveness

- 5.3. Habitats are assigned to distinctiveness bands. These are based on an assessment of the distinguishing features of a habitat or linear feature, including the consideration of species richness, rarity (at local, regional, national and international scales), and the degree to which a habitat supports species rarely found in other habitats.
- 5.4. The distinctiveness band of each habitat is preassigned in biodiversity metric 2.0. The bands are based upon the UK habitat classification system. A combination of simple rules and expert judgement have been used to assign each habitat type to the appropriate distinctiveness band. The distinctiveness categories used are tailored to habitat type and are explained later in this chapter for Area Habitats and in chapter 8 for habitats with supplementary modules.

Condition

- 5.5. Parcels of habitat will be in different ecological conditions. In addition, interventions to improve habitats will not always involve taking a habitat in poor condition and improving it to good condition. The metric therefore takes account of variants in habitat condition.
- 5.6. The approach to condition assessment is tailored to habitat type and is explained later in this chapter for Area Habitats and in chapter 8 for habitats with supplementary modules.

Strategic significance and connectivity

- 5.7. 'The spatial location of a habitat is treated as a component of the quality of a habitat parcel in the same way as distinctiveness or condition. Two distinct spatial components are used: strategic significance and connectivity. These are explained in more detail in section 5.29.

Dealing with risk

- 5.8. There are uncertainties and a risk of failure in any endeavour to create or improve the biodiversity unit value of a habitat. One way to deal with these risks is to complete the habitat improvements works in advance of the habitat losses occurring.
- 5.9. Where this is not possible risks can be mitigated by reducing the number of units generated by a unit of compensation habitat. This is done by using a **multiplier** in the metric to correct for disparity or risk. The use of multipliers to account for the risks associated with habitat restoration or creation has several benefits:

- it **provides flexibility** by allowing activities impacting habitats to proceed in advance of compensation being either provided or attaining its target quality in exchange for an increase in the magnitude of compensation provided;
 - it **incentivises** the creation of compensation habitat in advance of loss. If the habitat is established before the impact then there is no need to apply risk multipliers to manage delivery risks or to take account of time differences. More units will therefore be available from a specific parcel of land, and
 - it **creates a disincentive** for damaging habitats that are difficult or take a long time to recreate or restore (the case for many habitats in the Very High and High distinctiveness band), by increasing the area of habitat needed to compensate for the loss.
- 5.10. A typical consequence of applying risk multipliers is to increase the size (e.g. area or length for linear features) of habitat required as compensation such that it exceeds the size of habitat lost or damaged. This is necessary:
- to preserve the incentives and disincentives referred to above;
 - to compensate for temporal losses of biodiversity (e.g. where there is a period of diminished biodiversity between the point in time when a habitat is impacted and it is replaced by habitat of equivalent biodiversity value);
 - to protect against situations where habitats that are created, enhanced or restored fail to adequately compensate for the lost biodiversity. This is necessary because there is no requirement to provide additional compensation if interventions ultimately fail to deliver the predicted biodiversity outcome.
- 5.11. The following three risks are recognised in this metric.
- Difficulty of creation and restoration**
- 5.12. This risk associated with delivery of biodiversity creation or enhancement due to uncertainty in the effectiveness of management techniques used to restore or create habitat.
- 5.13. The level of risk differs between habitat types because of ecological factors (e.g. the different challenges posed by creating different habitat types) and due to the availability of techniques or know-how to create habitats in a realistic time-frame. Uncertainty in achieving the target outcome for each habitat is addressed by a habitat-specific ‘difficulty’ multiplier based on available science and expert opinion.
- 5.14. There is a growing body of experience and expertise associated with habitat creation and enhancement¹¹. Nevertheless, it is important to recognise that it is impossible to exactly replicate habitat losses because of the unique physical and ecological features of every place. This point is of particular relevance to impacts on well-established semi-natural habitats and emphasises why it is so important that the mitigation hierarchy is adhered to so that impacts on such habitats occur only when there is no alternative.
- 5.15. The difficulty and uncertainty of successfully creating, restoring or enhancing a habitat is recognised in this multiplier.

¹¹ As the evidence base on the effectiveness of creation and restoration techniques grows and is reviewed the risk multipliers may be modified. A timetable for future updates/revision to the metric will be published.

TABLE 5-1: Difficulty categories and multipliers

Difficulty categories	
Category	Multiplier
Very High	0.1
High	0.33
Medium	0.67
Low	1

Temporal risk

- 5.16. In delivering compensation there may be a mismatch in the timing of the impact and compensation, i.e. the difference in time between the negative impact on biodiversity and the compensation reaching the required quality. This results in lower levels of biodiversity for that period of time.
- 5.17. This issue can be managed by the creation of compensation habitat ahead of the impact taking place: e.g. by starting the offset work well ahead of the development for projects with a long lead in or through the creation of a bank of habitat units.
- 5.18. However, this is not always possible and even where the management to create compensation habitat starts in advance, the time taken for habitats to mature means that there will almost inevitably be a time lag. Where a time lag does occur, a risk multiplier is applied. This is referred to as the '**Time to target condition**' multiplier.
- 5.19. The time period to use in applying the Time to Target Condition multiplier to a metric calculation is the length of time (in years) between the intervention and the point in time the habitat reaches the pre-agreed target quality (i.e. distinctiveness, condition, area). This time will vary between habitat types, between change scenarios (e.g. creation typically takes longer than enhancement) and due to way the habitat is managed. Time to target condition values – based on based on good practice and typical conditions are provided for all habitats used in biodiversity metric 2.0. These values are set out in detail in the Technical Supplement.
- 5.20. These time to target condition values then need to be discounted. Discounting over time is an economic technique used to compare costs and benefits that occur in different time periods based around the principle that, generally, people prefer to receive goods and services now rather than later. Where time discounting is used in compensation schemes a standard discount rate is typically used. The biodiversity metric 2.0 uses 3.5%, which is the value recommended in the Treasury Green Book¹²(Table 5-2 shows the multipliers for a number of time periods using a discount rate of 3.5 %. It is important to use precise figures (at least to 3 decimal places).
- 5.21. To be practical, the metric:
- **assumes that there is a quality 'jump' from the baseline condition to the target condition** once the relevant number of years has elapsed. Metric

¹² more details on discounting can be found in the Treasury Green Book Guidance, HM Treasury, (2011).

calculations do not take into account incremental increases in quality of the habitat and do not need to be re-done annually, and

- **sets a limit on the discount rate used for temporal risk.** The metric sets a multiplier limit of x0.320 to take account of temporal risk. This equates to approximately 32 years, which is about the maximum time frame that most projects and plans can realistically plan ahead.

Monitoring is, however, recommended to confirm the actual number of biodiversity units delivered matches what was predicted.

TABLE 5-2: Time to target condition: multipliers for different time periods using a 3.5% discount rate.

Time to target condition			
Time (years)	Multiplier	Time (years)	Multiplier
0	1.000	17	0.546
1	0.965	18	0.527
2	0.931	19	0.508
3	0.899	20	0.490
4	0.867	21	0.473
5	0.837	22	0.457
6	0.808	23	0.441
7	0.779	24	0.425
8	0.752	25	0.410
9	0.726	26	0.396
10	0.700	27	0.382
11	0.676	28	0.369
12	0.652	29	0.356
13	0.629	30	0.343
14	0.607	31	0.331
15	0.586	>32	0.320
16	0.566		

Off-site risk multiplier

5.22. There are both ecological and social drivers for compensation habitat to be provided local to where losses occur: e.g. the cultural ecosystem services provided by an area of land to a community. When off site compensation is within the local planning authority area (LPA) or the same National Character Area (NCA)¹³ it is considered

¹³ Further information on NCAs can be found at:
<http://publications.naturalengland.org.uk/category/587130>

that those drivers have been addressed. However there is a risk of compensation being delivered at distance from the impact site. Where this is the case the off-site risk multiplier is applied to those compensation parcels outside of the relevant LPA or NCA. This risk is applied to area habitat, hedgerow and river elements of biodiversity metric 2.0. Note – for rivers and streams different off-site risk multipliers called riparian loss. See Chapter 8 for more details.

TABLE 5-3: Off-site risk categories

Off-site risk categories			
Category	Score	Point applied to calculation	
		Pre-impact	Post-impact
Compensation inside LPA or NCA of impact site	1.0	No	Yes
Compensation <u>outside</u> LPA or NCA of impact site but in neighbouring LPA or NCA	0.75	No	Yes
Compensation <u>outside</u> LPA or NCA of impact site and beyond neighbouring LPA or NCA	0.5	No	Yes

Biodiversity change scenarios

5.23. Different biodiversity change scenarios carry different levels of risk and the multipliers are applied differently to reflect this. Three distinct biodiversity habitat change scenarios (illustrated in Figure 3.1) are recognised in the biodiversity metric 2.0:

- **Habitat creation or recreation.** Where one habitat type is replaced by another or the habitat is destroyed (e.g. by development works) and the same habitat is recreated.
- **Habitat restoration or enhancement** of an existing habitat to improve its distinctiveness and / or condition. An example of restoration would be the transformation of a derelict chalk grassland dominated by scrub and coarse grasses to a continuous area of chalk grassland with isolated woody species and an abundance of fine-leaved grasses.
- **Accelerated habitat succession.** This recognises that certain interventions are comparable with ecological succession processes which result in a more distinctive habitat type (for example, grassland changing into scrub and ultimately woodland). The biodiversity value of the original habitat is not abruptly lost, but gradually changes as the new habitat type emerges. Accelerated succession interventions are subject to 'trading down' principles. Accelerated succession is a purposeful sustained intervention and it is envisaged that there are a limited number of situations where this would apply. For example, the planting of an existing grassland with thorny shrubs to facilitate natural tree regeneration to establish a woodland without removing the grassland.

5.24. Under the above scenarios different portions of the biodiversity value of a habitat may have different risk multipliers applied to it. So, as illustrated in Figure 5-1, in the

case of a straightforward habitat creation, you lose all the original habitat, so the risks apply to the whole value of the habitat being created. Whilst in the case of restoration or enhancement the habitat starts with and retains a certain biodiversity value that interventions increase. The risk multipliers are applied to this uplift (improvement) of the habitat. In accelerated succession the situation is more complex. Recognising that the original habitat retains a biodiversity value while the new habitat emerges the metric applies risk only to the uplift in value resulting from succession.

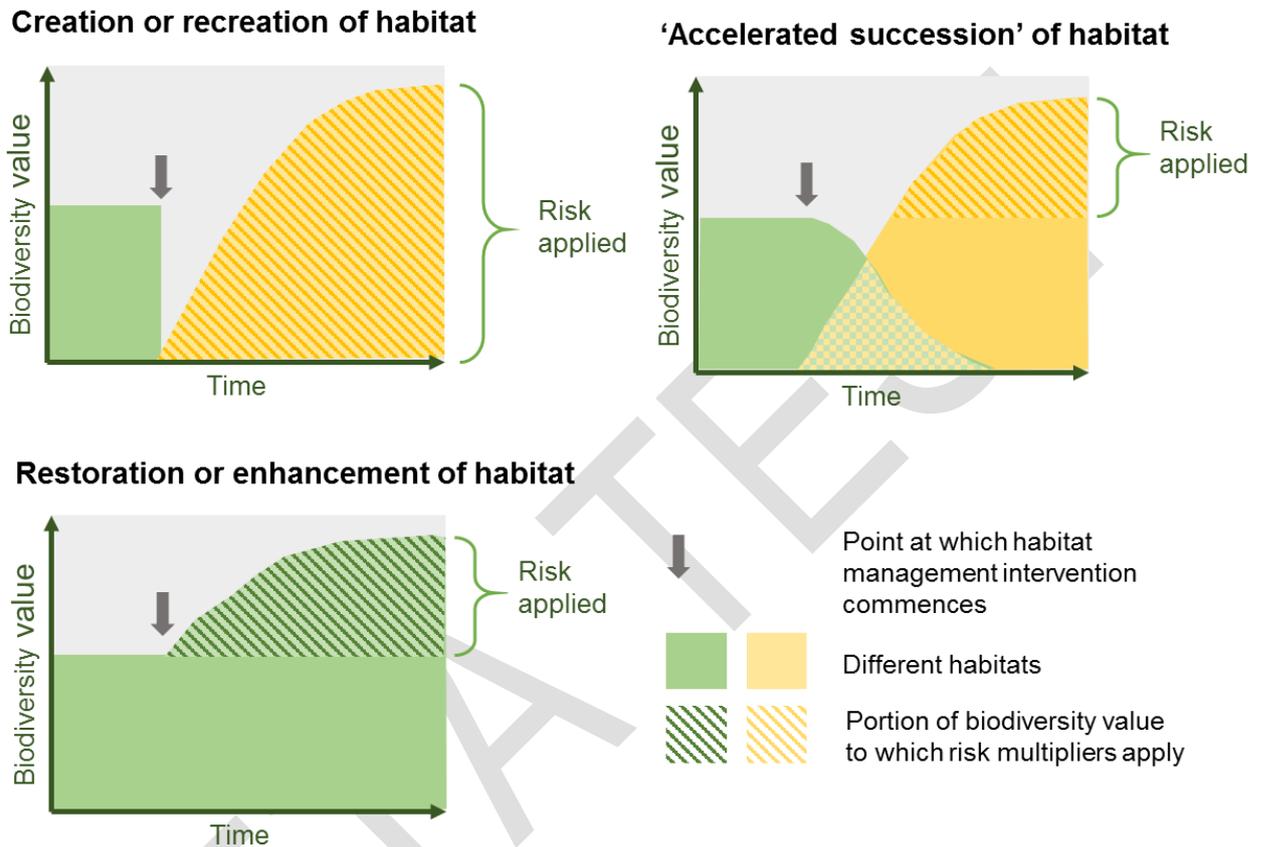


FIGURE 5.1: The biodiversity habitat change scenarios recognised in the metric

- 5.25. This leads to three different equations being used to generate biodiversity unit values pre and post intervention.
- 5.26. It is important to select the appropriate change scenario for each management intervention. This choice is an ecological judgement and is determined by the ecological consequences of the change, not where the habitat is located.
- 5.27. Compensation habitats can be created, restored or enhanced, or subject to accelerated succession on-site as well as off-site. Measures taken to generate biodiversity units by improving existing habitats must provide a significant and demonstrable uplift in distinctiveness or condition.
- 5.28. Good management practice does not, by itself, constitute restoration or enhancement, or accelerated succession.

The spatial component

5.29. In biodiversity metric 2.0 there are two core spatial components. First, the **strategic significance** of a place for biodiversity, its geography. Second, ecological **connectivity**, the relationship of a habitat in a defined place to its immediate surroundings in respect of biological and ecosystem flows. While these concepts are not completely independent of each other they do represent different qualities of a habitat.

Strategic significance

5.30. The idea of strategic significance works at a landscape scale. It gives additional unit value to habitats that are located in preferred locations for biodiversity and other environmental objectives. Ideally these aspirations will have been summarised in a local strategic planning document which articulates where biodiversity is of high priority and the places where it is less so. Strategic significance utilises published local plans and objectives to identify local priorities for targeting biodiversity and nature improvement, such as Nature Recovery Areas, local biodiversity plans, National Character Area¹⁴ objectives and green infrastructure strategies. Table 5-5 shows the multiplier scores for both impact and compensation sites based on its place in a strategic plan.

5.31. In the absence of a locally or nationally relevant strategic documentation indicating areas of significance for biodiversity, the value of 1 should be used in pre and post development calculations. Use of a score of 1 does not penalise a proposal.

TABLE 5-5: Strategic significance categories and scores

Strategic Significance categories			
Category	Score	Point applied to calculation	
		Pre-impact	Post-impact
High strategic significance High potential & within area formally identified in local policy	1.15	Yes	Yes
Medium strategic significance Good potential but not in area defined in local policy	1.1	Yes	Yes
Low Strategic Significance Low potential and not in area defined in local policy	1	Yes	Yes

Connectivity

5.32. The focus of connectivity in biodiversity metric 2.0 is the relationship of a particular habitat patch to other surrounding **similar** or **related** semi-natural habitats. These help facilitate flows of species and ecosystem services increases habitat resilience.

¹⁴ For more details of National Character Areas see: <https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles>

By **similar** habitats we mean, for example, multiple patches of calcareous grassland. By **related** habitats we mean habitats often found in association as part of a dynamic complex, for example lowland heath and scrub. The same approach is applied to impact and compensation sites.

- 5.33. In the beta version of biodiversity metric 2.0 all High and Very High distinctiveness habitats should be assigned a Medium connectivity multiplier, other habitats a Low connectivity multiplier (see Table 5-5).
- 5.34. A connectivity tool will be published in an updated version of biodiversity metric 2.0. which will use an approach based upon the habitat fragmentation or 'structural connectivity' model with the National Biodiversity Climate Change Vulnerability Model (NBCCVM)¹⁵ to assess connectivity and will generate connectivity categories from highly connected to low connectivity. It encompasses the ideas of:
- Larger habitat patches being less susceptible to extreme events;
 - Accommodation of a wider range of soil types, topography and microclimate affords greater niche variation;
 - Potential for species dispersal and local re-colonisation to be facilitated; and
 - Patch size and permeability of surrounding landscape being important for persistence of biodiversity.

TABLE 5-5: Beta version Connectivity multipliers assigned by habitat distinctiveness.

Connectivity Multipliers		
Habitat distinctiveness	Connectivity	Multiplier
Very high distinctiveness	Medium	1.1
High distinctiveness	Medium	1.1
Medium and low distinctiveness	Low	1

Moderating the influence of spatial components

- 5.35. So that strategic significance and connectivity elements do not have a disproportionate effect on the calculation outputs the specific scores are restricted in range in the beta version of biodiversity metric 2.0 to: strategic significance 1 – 1.15, and connectivity 1 – 1.1.

6: Area Habitat biodiversity unit calculations

- 6.1. Areas habitats are perhaps the most familiar ecological currency in the UK, they are the woodlands, grasslands, wetlands and other types that are widely recognised by ecologists and the public alike. The habitats we recognise comprise a community of different species populations living in a place. There is usually a sub-group of those

¹⁵ For more information about the NBCCVM see: TAYLOR, S., KNIGHT, M. & HARFOOT, A. 2014. National biodiversity climate change vulnerability model. Natural England Research Report NERR054. Natural England. ISBN 978-1-78354-084-6.

populations that give a habitat its' defining characteristics, for example trees in a woodland, grasses in a meadow, or reeds in a wetland.

- 6.2. There are a number of habitat classification systems for habitats, for example Phase 1¹⁶ and UKHAB¹⁷ a new unified habitat classification system which features a more detailed nomenclature for urban areas. Whichever habitat classification you use for an intervention you need to consistently use it for the whole project to maintain comparability.

Distinctiveness

- 6.3. Distinctiveness refers to the relative scarcity of the habitat and its importance for nature conservation. The distinctiveness categories used for Area Habitats and examples illustrating the types of habitats assigned to each category are shown in Table 6-1. The actual values assigned to each habitat type used in the metric are given in the Technical Supplement.

TABLE 6-1: Distinctiveness categories used for Area Habitats. Values assigned for each habitat type are given in the Technical Supplement.

Distinctiveness categories		
Category	Scores	Multiplier
Very High	8	Priority habitats as defined in Section 41 of the Natural Environment and Rural Communities (NERC) Act that are highly threatened, internationally scarce and require conservation action e.g. blanket bog
High	6	Priority habitats as defined in Section 41 of the NERC Act requiring conservation action e.g. lowland fens
Medium	4	Semi-natural habitats not classed as a Priority Habitat
Low	2	Habitat of low biodiversity value. Temporary grass and clover ley; intensive orchard; rhododendron scrub
Very Low	0	Little or no biodiversity value e.g. hard standing or sealed surface

Condition

- 6.4. The condition categories used for Area Habitats are given in Table 6-2, while details of how condition should be assessed for each habitat type is explained in the condition assessment sheets in the Technical Supplement.

TABLE 6-2: Condition categories used for Area Habitats. Guidance on how to assess the condition of each habitat type is provided in the Technical Supplement.

¹⁶ JNCC (2010) Handbook for Phase 1 habitat survey - a technique for environmental audit (revised 2010)

¹⁷ UK Habitat Classification: <http://ecountability.co.uk/ukhabworkinggroup-ukhab/> (Accessed 20/06/2019)

Condition categories	
Category	Multiplier
Good	3
Fairly Good	2.5
Moderate	2
Fairly Poor	1.5
Poor	1
N/A – Agriculture	1
N/A - Other	0

Calculating Area Habitat Biodiversity Units (AHBUs)

- 6.5. Box 6-1 shows the formulae used to calculate biodiversity unit values for area habitats. A freely available calculation tool is available to download which simplifies the metric calculations.

BOX 6-1: Calculating Area Habitat biodiversity units (AHBUs)

Equation 1: Pre-impact (t_0) biodiversity value

$$t_0 \text{ Baseline AHBUS} = (A^{t_0} \times Q_D^{t_0} \times Q_C^{t_0}) \times (Q_{SC}^{t_0} \times Q_{SS}^{t_0})$$

Equation 2: Post-impact (t_1) biodiversity value for habitat creation

$$t_1 \text{ Creation AHBUS} = \{[A^{t_1} \times Q_D^{t_1} \times Q_C^{t_1}] \times [R_D \times R_T] \times [Q_{SC}^{t_1} \times Q_{SS}^{t_1}]\} \times R_{OS}$$

Equation 3: Post-impact (t_1) biodiversity value for habitat restoration and enhancement

t_1 Enhancement AHBUS

$$= \left[\left(\left[\{A^{t_1} \times Q_D^{t_1} \times Q_C^{t_1}\} - \{A^{t_0} \times Q_D^{t_0} \times Q_C^{t_0}\} \right] \times \{R_D \times R_T\} \right) + \{A^{t_0} \times Q_D^{t_0} \times Q_C^{t_0}\} \times \{Q_{SC}^{t_1} \times Q_{SS}^{t_1}\} \right] \times R_{OS}$$

Equation 4: Post-impact (t_1) biodiversity value for accelerated succession habitat

t_1 Accelerated Succession AHBUS

$$= \left\{ \left(\left[\{H1A^{t_0} \times H1Q_D^{t_0} \times H1Q_C^{t_0}\} \times \{H1Q_{SC}^{t_1} \times H1Q_{SS}^{t_1}\} \right] \times \left(0.5(1 - H2R_T^{t_1}) \right) \right) + \left(\left[\left(\{H2A^{t_1} \times H2Q_D^{t_1} \times Q_C^{t_1}\} - \{H1A^{t_0} \times H1Q_D^{t_0} \times H1Q_C^{t_0}\} \right) \times \{H2R_D^{t_1} \times H2R_T^{t_1}\} + \{H1A^{t_0} \times H1Q_D^{t_0} \times H1Q_C^{t_0}\} \right] \times \{H2Q_{SC}^{t_1} \times H2Q_{SS}^{t_1}\} \right) \right\} \times R_{OS}$$

A	Area of habitat (hectares)	R _T	Time to target condition (a risk factor)
Q _C	Condition (a quality measure)	R _{OS}	Off-site Risk
Q _D	Distinctiveness (a quality measure)	t ₀	Before intervention

Q _{sc}	Connectivity (a quality measure)	t1	Post intervention
Q _{ss}	Strategic Significance (a quality measure)	H1	Area habitat type before intervention
R _D	Difficulty (a risk factor)	H2	Area habitat type post intervention

Applying multipliers to different interventions

- 6.6. To properly reflect the different risks it is necessary for Area Habitat biodiversity unit calculations to distinguish between creation, enhancement / restoration, and accelerated succession of habitats (see paragraph 5.23). The implication for calculations and application of the multipliers is shown in Table 6-3. A baseline (t_0) and post-intervention (t_1) calculation is needed for each habitat parcel within a scheme.
- 6.7. Even though the full range of multipliers are applied in the post intervention (t_1) scenarios the detail of the calculations are different so risks are only applied to uplifted area habitat biodiversity units, and residual area habitat biodiversity units are accounted for.

TABLE 6-3: Which scores and multipliers to apply in calculations

Multiplier application								
	Area	Distinctiveness	Condition	Connectivity	Strategic Significance	Difficulty to Create	Time to Target Condition	Off-site risk
t₀ Baseline Units	Yes	Yes	Yes	Yes	Yes	No	No	No
t₁ Creation Units	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
t₁ Enhancement Units	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
t₁ Accelerated succession	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

- 6.8. The Technical Supplement includes details of quality attributes and risk multipliers used for each Area Habitat type.

7: Urban Street Trees

- 7.1. The size and type of street tree will make a difference to how important it is to biodiversity, as such any removal of street trees without replacement needs to be factored in biodiversity metric 2.0. Street trees were not included in the original Defra biodiversity metric. They require a slightly different approach to the Area Habitat biodiversity unit calculation. The following sets out how street trees are dealt with in biodiversity metric 2.0.
- 7.2. Street trees have been given a low distinctiveness score in biodiversity metric 2.0 as they vary in the species that are planted, sit in stressed environments and would only be considered a single component of a habitat like woodland.
- 7.3. Street trees are split into small, medium and large trees with a corresponding condition score that is assumed to be of Moderate condition (score 2). These are then converted into an area calculation so that it can be used in the metric.
- 7.4. The area calculation for street trees is worked out using a Root Protection Area (RPA)¹⁸ formula:
- 7.5. Within the biodiversity metric 2.0 calculation tool a ‘street tree helper’ is provided to automate this calculation.

TABLE 7.1 Street tree sizes by girth and their area equivalent

Size	Breast Height Girth (cm)	Stem Diameter (cm)	RPA (radius in metres)	Area equivalent (ha)	Tree equivalent for a ha
Small	30cm	10cm	1.2m	0.0005 ha	2,000 trees
Medium	90cm	30cm	3.6m	0.0041 ha	244 trees
Large	150cm	50cm	6 m	0.0113 ha	89 trees

- 7.6. Once the area equivalent has been calculated street trees are then treated as an Area Habitat within the metric for pre and post impact calculations and should be calculated as per the area habitat calculation approach set out in Chapter 6. The condition of street trees is assumed to Moderate (score 2). The mitigation hierarchy applies and where possible like for like compensation is the preferred approach.

¹⁸ For more information see: Hodge. SJ. 1991. Urban trees: a Survey of street trees in Britain. Forestry Commission Bulletin 99. HMSO, London. Available from: <https://www.forestresearch.gov.uk/research/archive-urban-trees-a-survey-of-street-trees-in-britain/> (Accessed 21/06/2019)

8: Supplementary habitat module calculations for linear habitats

- 8.1. Treating linear habitats like other habitats and accounting for their biodiversity value using the Area Habitat approach alone would undervalue their biodiversity value and would fail to ensure adequate compensation for losses. It is therefore necessary to take separate account of these habitat types so that their contribution to biodiversity is properly acknowledged (Principle 4).
- 8.2. Biodiversity metric 2.0 includes two distinct supplementary modules for linear habitats:
- Hedgerows and lines of trees
 - Rivers and streams
- 8.3. The biodiversity unit values calculated for area and linear habitats cannot be summed together and both need to be retained as separate biodiversity accounts. Similarly, the different metrics used for each type of supplementary habitat cannot be summed together and these also need to be accounted for separately (Rule 4). For example, hedgerow biodiversity units cannot be added to river and stream biodiversity units.

Hedgerows and lines of trees

- 8.4. Hedgerows are a feature almost unique to the British Isles and an example of a linear habitat. They were treated separately in the Defra biodiversity metric and the biodiversity metric 2.0 further refines that approach. A key revision is the inclusion of 'lines of trees'. These can display some of the same functional qualities of hedgerows.

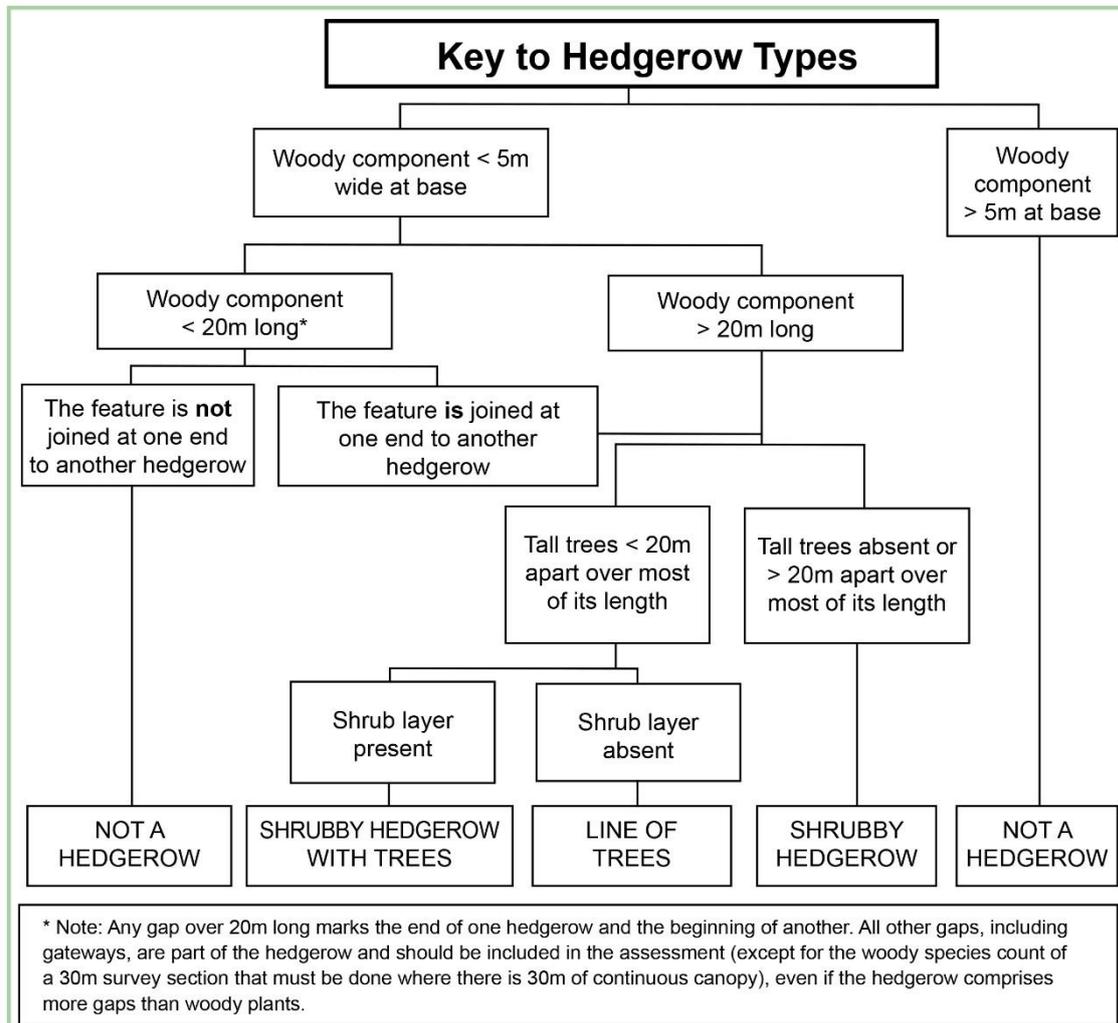
Types of hedgerow and lines of trees recognised

- 8.5. We recommend use of the key and descriptions provided in the Defra 'Hedgerow Survey Handbook'¹⁹ to determine whether or not a feature is a hedgerow (see Box 8-1). This key recognises three different types of hedgerows: 'shrubby hedgerows', 'shrubby hedgerows with trees' and 'lines of trees'. Street trees are considered to be something different to a line of trees, occurring in an urban environment and often surrounded by pavement. For information on how urban street trees are considered in biodiversity metric 2.0 see chapter 7.

¹⁹ DEFRA. 2007. Hedgerow Survey Handbook. A standard procedure for local surveys in the UK. Defra, London. PB1195.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69285/pb11951-hedgerow-survey-handbook-070314.pdf

BOX 8-1: A key for determining if a feature is a hedgerow and the hedgerow type

A simplified key to determine whether or not a feature is classed as a hedgerow, and if so, what type of hedgerow, is given below. This key is taken from Figure 4 of the 'Hedgerow Survey Handbook'.



Calculating Hedgerow and Lines of Trees Biodiversity Units (HBUs)

- 8.6. Box 8-2 shows the formulae used to calculate biodiversity unit values for hedgerows and lines of trees. The details of each element including the value ranges are explained in detail through the remainder of this chapter.
- 8.7. We use 'Hedgerow Biodiversity Unit' (HBU) as the unit of measurement for hedgerows and lines of trees to clearly differentiate values from those representing area habitats and other linear habitats.

BOX 8-2: Calculating Hedgerows and Lines of Trees biodiversity units (HBUs)

Equation 1: Existing (pre-intervention) (T_0) biodiversity value

$$T_0 \text{ Baseline HBU} = (L^{t0} \times Q_D^{t0} \times Q_C^{t0}) \times (Q_{SC}^{t0} \times Q_{SS}^{t0})$$

Equation 2: Post-intervention (T_1) biodiversity value for hedgerow creation

$$T_1 \text{ Creation HBU} = [L^{t1} \times Q_D^{t1} \times Q_C^{t1}] \times [R_D^{t1} \times R_T^{t1}] \times [Q_{SC}^{t1} \times Q_{SS}^{t1}] \times R_{Os}$$

Equation 3: Post-intervention (T_1) biodiversity value for hedgerow restoration and enhancement

T_1 Total HBU after Enhancement

$$= \{ [([L^{t1} \times Q_D^{t1} \times Q_C^{t1}] - [L^{t0} \times Q_D^{t0} \times Q_C^{t0}]) \times \{ R_D \times R_T \}] + [L^{t0} \times Q_D^{t0} \times Q_C^{t0}] \} \times \{ Q_{SC}^{t1} \times Q_{SS}^{t1} \} \times R_{Os}$$

L	Length of hedge (kilometres)	R _T	Time to target condition (a risk factor)
Q _C	Condition (a quality measure)	t ₀	Before intervention
Q _D	Distinctiveness (a quality measure)	t ₁	Post intervention
Q _{SC}	Connectivity (a quality measure)	R _{Os}	Off-site Risk
Q _{SS}	Strategic Significance (a quality measure)		
R _D	Difficulty (a risk factor)		

Assessing the quality of hedgerows and lines of trees

- 8.8. Intervention sites (e.g. development sites) and proposed compensation sites need to be surveyed and mapped. The unit of measurement for linear habitats that must be used is kilometres.
- 8.9. Hedgerows bounding green lanes and double hedgerows should be treated as two hedgerows rather than a single hedge. This distinction recognises that double hedges are known to be particularly important for wildlife^{20,21} Lost double hedgerows are to be compensated with a double hedge, typically a path or track width apart.

Distinctiveness

- 8.10. Hedgerows are assigned a 'distinctiveness' weighting. This is based on their physical structure and the species composition of the woody element of the hedgerow, and

²⁰ WALKER, M.P., DOVER, J.W., HINSLEY, S.A. & SPARKS, TH. 2005. Birds and green lanes: Breeding season bird abundance, territories and species richness. *Biological Conservation*, 126: 540–547.

²¹ WALKER, M.P., DOVER, J.W., SPARKS, T.H. & HINSLEY, S.A. 2006. Hedges and green lanes: vegetation composition and structure. *Biodiversity and Conservation*, 15:2595–2610

their association with physical features (ditches and banks) that may enhance their ecological value by providing additional niches or enhanced capacity to provide habitat connectivity. For the purposes of the metric, ‘shrubby hedgerows’ and ‘shrubby hedgerows with trees’ are regarded as sufficiently similar in their ecological distinctiveness to be given the same weighting.

- 8.11. Following the approach established by the Hedgerow Survey Handbook, a hedgerow is regarded as species rich where the structural species making up a 30m section of hedgerow includes at least five (or at least four in northern and eastern England, upland Wales and Scotland) woody species that are regarded as either native or ancient introductions somewhere in the UK. Climbers and bramble do not count towards the total except for roses²². A list of ancient introduction species (known as archaeophytes) is given in Appendix 11 of ‘Hedgerow Survey Handbook’.
- 8.12. There is no attempt to evaluate the biodiversity unit value of the ground flora associated with hedgerows – despite its potential relevance. This is because the limited survey window and the level of botanical expertise required are incompatible with the aim of a simple and practical metric (Principle 3).
- 8.13. We draw a distinction between lines of trees recognised as being of ecological value and other lines of trees. ‘Ecologically valuable’ lines of trees may be characterised as mainly comprising native species in a mature state with a well-developed, possibly, continuous canopy along the length of the line. This is distinct from say an over-grown or derelict hedge or line of Lombardy poplar. Ecological expert judgement may be required to distinguish ‘ecologically valuable’ lines of trees in a locality.
- 8.14. The distinctiveness weightings assigned to different hedgerow types are set out in Table 8-1, below.

TABLE 8-1: Distinctiveness categories and weightings (scores) for different hedgerow types (with or without emergent trees) and lines of trees

Distinctiveness categories of hedgerows and lines of trees					
Associated features	Woody plant structural composition				
	Species rich hedgerow (inc. hedgerow with trees)	Native species hedgerow	Other hedgerow (ornamental / non-native species)	Line of Trees (Ecologically Valuable)	Line of trees
Associated earth bank or ditch	High 6	Medium 4	Low 2	Medium 4	Low 2
None	Medium 4	Low 2	Very Low 1	Medium 4	Low 2

²² Climbers are an important feature of hedgerows, but are excluded from this criterion as its objective is to ensure a minimum number of species capable of contributing to the woody structure and form of a hedge.

Condition

8.15. To assess condition we assess the dimensions and other physical characteristics of a hedgerow or line of trees against a set of minimum requirements for a hedgerow or line of trees to be considered in a 'favourable' condition. Hedgerows and lines of trees are assessed separately. The condition assessment methodology for hedgerows and lines of trees is based upon the 'Hedgerow Survey Handbook'. The detailed methodology can be found in the condition assessment annex in the technical supplement.

Condition assessment of hedgerows

8.16. A series of eight 'attributes', representing key physical characteristics, are used for this assessment. The attributes, and the minimum criteria for achieving a 'favourable condition' in each, are set out in Table 8-2. The attributes use similar favourable condition criteria to the 'Hedgerow Survey Handbook' and the handbook is the recommended source of reference for assessing hedgerow attributes.

TABLE 8-2: Hedgerow attributes and criteria for meeting 'favourable condition'

Hedgerow favourable condition attributes		
Attributes and functional groupings (A, B, C & D)	Criteria (the minimum requirements for 'favourable condition')	Description
A1. Height	>1.5 m average along length	<p>The average height of woody growth estimated from base of stem to the top of shoots, excluding any bank beneath the hedgerow, any gaps or isolated trees.</p> <p>Newly laid or coppiced hedgerows are indicative of good management and pass this criterion for up to a maximum of four years (if undertaken according to good practice)</p> <p>A newly planted hedgerow does not pass this criterion (unless it is > 1.5 m height)</p>
A2. Width	>1.5 m average along length	<p>The average width of woody growth estimated at the widest point of the canopy, excluding gaps and isolated trees.</p> <p>Outgrowths (e.g. blackthorn suckers) are only included in the width estimate when they >0.5 m in height.</p> <p>Laid, coppiced, cut and newly planted hedgerows are indicative of good management and pass this criterion for up to a maximum of four</p>

		years (if undertaken according to good practice ²³)
B1. Gap – hedge base	Gap between ground and base of canopy <0.5 m for >90% of length (unless 'line of trees')	This is the vertical gappiness of the woody component of the hedgerow, and its distance from the ground to the lowest leafy growth. Certain exceptions to this criterion are acceptable (see page 65 of the Hedgerow Survey Handbook)
B2. Gap - hedge canopy continuity	<ul style="list-style-type: none"> • Gaps make up <10% of total length and • No canopy gaps >5 m 	This is the horizontal gappiness of the woody component of the hedgerow. Gaps are complete breaks in the woody canopy (no matter how small). Access points and gates contribute to the overall gappiness, but are not subject to the >5 m criterion (as this is the typical size of a gate)
C1. Undisturbed ground and perennial vegetation	>1 m width of undisturbed ground with perennial herbaceous vegetation for >90% of length <ul style="list-style-type: none"> ○ measured from outer edge of hedgerow, and is present on one side of the hedge (at least) 	This is the horizontal gappiness of the woody component of the hedgerow. Gaps are complete breaks in the woody canopy (no matter how small). Access points and gates contribute to the overall gappiness, but are not subject to the >5 m criterion (as this is the typical size of a gate)
C2. Undesirable perennial vegetation	Plant species indicative of nutrient enrichment of soils dominate <20% cover of the area of undisturbed ground	The indicator species used are nettles (<i>Urtica</i> spp.), cleavers (<i>Galium aparine</i>) and docks (<i>Rumex</i> spp.). Their presence, either singly or together, should not exceed the 20% cover threshold.
D1. Invasive and neophyte species	>90% of the hedgerow and undisturbed ground is free of invasive non-native and neophyte species	Neophytes are plants that have naturalised in the UK since AD 1500. For information on neophytes see the JNCC website and for information on invasive non-native species see the GB Non-Native Secretariat website .
D2. Current damage	>90% of the hedgerow or undisturbed ground is free of damage caused by human activities	This criterion addresses damaging activities that may have led to or lead to deterioration in other attributes. This could include evidence of pollution, piles of manure or rubble, or inappropriate management

²³ HedgeLink (<http://hedgeline.org.uk/index.php>) provides a resource of management advice for hedgerows.

		practices (e.g. excessive hedge cutting)
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- 8.17. Each attribute is assigned to one of four functional groups (A – D), as indicated in Table 7-2 and the condition of a hedgerow is assessed according to the number of attributes from these functional groups which pass or fail the ‘favourable condition’ criteria according to the approach set out in Table 8-3.
- 8.18. Hedgerow and line of trees condition assessment generates a weighting (score) ranging from 1-3, which is used within the biodiversity metric 2.0. The scores for each are set out in tables 8-3 and 8-4 below.

TABLE 8-3: Hedgerow condition assessment and weighting

Condition categories for hedgerows		
Category	Maximum number of attributes that can fail to meet ‘favourable condition’ criteria in Table 5.2	Weighting (score)
Good	No more than 2 failures in total and no more than 1 in any functional group.	3
Moderate	No more than 4 failures in total and fails both attributes in a maximum of one functional group. e.g. fails attribute 1 & 2, 5 & 7 = Moderate condition.	2
Poor	Fails a total of more than 4 attributes or both attributes in more than one functional group.	1

Condition assessment of a line of trees

- 8.19. Condition assessment for a line of trees is based on continuity of the canopy only, as set out in Table 8-4.

TABLE 8-4: Line of tree condition assessment and weighting

Condition categories for lines of trees		
Category	Continuity of tree canopy	Weighting (score)
Good	Mature trees with continuous canopy Definition: <ul style="list-style-type: none"> a ‘mature tree’ in this context is one that is at least 1/3 expected fully mature height gaps make up <10% of total length and there are no canopy gaps >5 m 	3
Moderate	Continuous canopy	2

	Definition: <ul style="list-style-type: none"> trees < 1/3 expected fully mature height gaps make up <10% of total length and there are no canopy gaps >5 m 	
Poor	Broken canopy Definition: <ul style="list-style-type: none"> gaps make up >10% and / or gaps are >5 m in length. 	1

Strategic significance and connectivity

8.20. In biodiversity metric 2.0 spatial components are treated as a quality of a habitat, and this also applies to hedgerows and lines of trees. The two components of 'strategic significance' and 'connectivity' need to be evaluated when calculating the biodiversity unit value for both existing and newly created or enhanced hedgerows and lines of trees.

Dealing with risk

8.21. Where new hedgerows are being created or existing hedgerows restored / enhanced, multipliers are used to manage delivery risks. Risks do not apply where hedgerows have been created, restored or enhanced if the target quality (judged in terms of distinctiveness and condition) has been successfully achieved before the hedgerow it is intended to compensate. In these cases a risk multiplier value of '1' is used in calculations. See chapter 5 for further detail.

Difficulty of creation and restoration

8.22. The technical difficulty of creating and restoring hedgerows is given a default value of 'Low' (x 1 multiplier)²⁴. Application of this risk multiplier does not, therefore, change the number of biodiversity units generated by a proposed intervention to compensate for losses.

8.23. While a 'Low' rating will be appropriate for most hedgerow replacement schemes, there may be instances where a higher rating will better reflect the difficulty of recreating a particular type of hedgerow²⁵. For example, to replace a particularly species-rich hedgerow, or to replace a local hedge type with features that are more difficult to recreate, such as the hedges associated with tall, steeped-sided banks commonly found in Devon, or where there are management challenges such as a high deer population. Expert ecological advice should be obtained where such an exception may apply.

Temporal risk

8.24. Recommendations for the time it takes hedgerows to achieve a pre-agreed target quality are given in Table 8-5. The multipliers cited are calculated using the 3.5% annual discounting rate (see section 5.16 for more details).

²⁴ This is unchanged from the Defra biodiversity metric.

²⁵ The range of 'difficulty' categories available (and the relevant multipliers) are: Very High (x0.1); High (x0.33), Medium (x0.67) and Low (x1).

TABLE 8-5: Time to target condition (years) and multipliers for different time periods using a 3.5% discount rate.

Hedgerow compensation measure	Time to target condition (Multiplier in brackets)	
	Moderate condition	High condition
Newly planted hedgerow	5 years (x 0.837)	10 years (x 0.700)
Newly planted hedgerow with emergent trees	10 years (x 0.700)	20 years (x 0.490)
Newly planted 'line of trees'	20 years (x 0.490)	30 years (x 0.320)
Restored or enhanced hedgerow	3 years (x 0.899)	5 years (x 0.837)

Applying risks to different interventions

- 8.25. To properly reflect the different risks it is necessary for hedgerow and line of trees biodiversity unit calculations to distinguish between creation and enhancement or restoration (see chapter 5 for explanations). Accelerated succession is not a change scenario recognised for hedgerows in the metric. A baseline (t_0) and post-intervention (t_1) calculation is needed for each hedgerow or line of trees within a scheme.
- 8.26. The biodiversity metric 2.0 calculation tool simplifies the hedgerow and lines of trees calculation.

Rivers and Streams

- 8.27. Rivers and their associated floodplains are natural ecological networks used by multiple species. They are diverse and biologically rich, defined by their climate, geology and land cover. They are linear features with a high degree of landscape connectivity, as hydrological, geomorphological and biological processes create connectivity between channel, floodplain and terrestrial habitats. The channel, riparian zone (the land alongside the top of the river bank) and the floodplain are all inter-connected in a naturally functioning river system. They act as an area of dispersal and migration for aquatic and riparian species. There are a large variety of river types in Britain, from active upland boulder-bed rivers to slower-flowing lowland systems, including internationally rare Chalk Streams.
- 8.28. Most British rivers have been significantly affected by human intervention, in the form of land drainage, flood defence structures, development and direct habitat loss. This has, in some cases, fragmented the river corridor and changed the structure and function of the river channel, riparian zone and floodplain.
- 8.29. In the biodiversity metric 2.0 rivers and streams are defined as those classified as ‘Main River’ or ‘Ordinary Watercourse’²⁶. This classification includes all types of watercourses with a hydraulic function, which includes canals, canalised rivers and rivers with an ephemeral (temporary) nature, such as Chalk Streams. Coastal, tidal and inter-tidal reaches are not measured within the rivers and streams component of the biodiversity metric. These are covered in their own inter-tidal section. See chapter 9.

Calculating River and Streams Biodiversity Units (RBU)

- 8.30. We use ‘River Biodiversity Unit’ (RBU) as the unit of measurement for rivers and streams to clearly differentiate values from those representing area habitats and other linear habitats.
- 8.31. The equations used to calculate River biodiversity unit values are given in Box 8-3.

BOX 8-3: Calculating River Biodiversity Units (RBUs)

Equation 1: Existing (pre-intervention) (T_0) biodiversity value

$$T_0 \text{ Baseline RBU} = (L^{t0} \times Q_D^{t0} \times Q_C^{t0} \times Q_{SS}^{t0}) \times R_{LBU}^{t0}$$

Note: where the riparian zone has been measured as separate lengths of the river

Equation 2: Post-intervention (T_1) biodiversity value for river or stream creation

$$T_1 \text{ Creation RBU} = [L^{t1} \times Q_D^{t1} \times Q_C^{t1} \times Q_{SS}^{t1}] \times [R_D^{t1} \times R_T^{t1}] \times [R_{OS} \times R_{LBU}^{t1}]$$

Equation 3: Post-intervention (T_1) biodiversity value for river or stream enhancement

T_1 Total RBU after Enhancement

$$= \{ \{ [L^{t1} \times Q_D^{t1} \times Q_C^{t1}] - [L^{t0} \times Q_D^{t0} \times Q_C^{t0}] \} \times \{ R_D \times R_T \} \} \\ + \{ [L^{t0} \times Q_D^{t0} \times Q_C^{t0}] \} \times Q_{SS}^{t1} \times [R_{OS} \times R_{LBU}^{t1}]$$

²⁶ Main Rivers are regulated by the Environment Agency, Ordinary Watercourses are regulated by Local Authority or Internal Drainage Boards.

L	Length of river or stream (kilometres)	R _T	Time to target condition (a risk factor)
Q _C	Condition (a quality measure)	t ₀	Before intervention
Q _D	Distinctiveness (a quality measure)	t ₁	Post intervention
R _D	Difficulty of creation or enhancement (a risk factor)	R _{OS}	Off-site Risk
		R _{LBU}	Riparian Loss of Biodiversity Unit modifier

Distinctiveness

- 8.32. Rivers and streams are important ecological features, both at a local and landscape level. The distinctiveness categories for rivers and streams are based on two classifications: Priority Habitats, as defined under section 41 of the Natural Environmental and Rural Communities Act 2006, and ‘River Naturalness’.
- 8.33. Priority River Habitat include a number of river types²⁷:
- Chalk Rivers
 - Watercourses with water crowfoot assemblages (Habitats Directive Annex I habitat H3260)
 - Active shingle rivers
 - Headwater streams
- 8.34. The extent of physical modification, water quality, water availability and chemical status are parameters used to classify those rivers which have a high hydromorphological and ecological status. These rivers are defined as Priority River Habitat²⁸.
- 8.35. ‘River Naturalness Assessment’ has been created to highlight rivers and streams that should be classified as Priority River Habitat. The River Naturalness Assessment derives a number of class scores based on their perceived naturalness, ranging from 1 (natural systems) to 5 (modified).
- 8.36. Biodiversity metric 2.0 has used both Priority River Habitat and the River Naturalness Assessment to categorise distinctiveness due to the known lack of coverage of priority river habitat, particularly for headwater streams. The metric also includes those rivers which are classified as Priority River sub-types as High, to capture their intrinsic value (see Table 8-6).
- 8.37. The distinctiveness assessment should be a desk based exercise, using existing available information. If River Naturalness Assessment²⁹ class scores are not available then a naturalness survey will be need to be completed on site (Figure 8-1).

²⁷ See: <http://jncc.defra.gov.uk/page-5706>

²⁸ See: <http://publications.naturalengland.org.uk/publication/6266338867675136>

²⁹ See: <http://priorityhab.wpengine.com/>

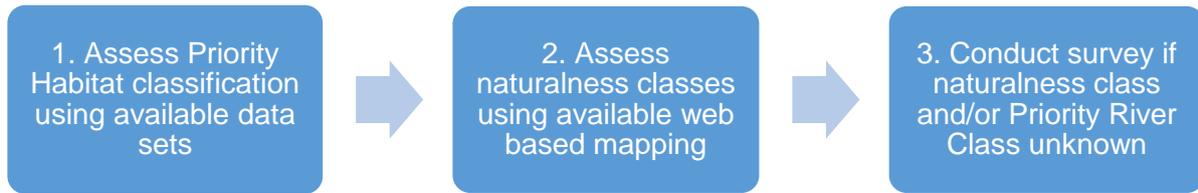


FIGURE 8-1: Recommended stages to follow when assessing Distinctiveness³⁰

TABLE 8-6: Distinctiveness weightings for rivers and streams

Distinctiveness	Description	Weighting	Metric description
Very High	Is on the Priority Habitat Rivers map. OR Meets Class 1 on the River naturalness assessment system.	8	Rivers – Priority Habitat Rivers and Streams of very high hydromorphological & ecological status
High	Meets Class 2 or 3 on the River naturalness assessment system. and/or Is a River Priority habitat Sub-type <ul style="list-style-type: none"> • Headwater Streams • Chalk Rivers • Rivers with an abundance of water-crowfoots • Active Shingle Rivers 	6	Rivers – Rivers & Streams of high distinctiveness and/or naturalness status.
Medium	Meets Class 4 or 5 on the River naturalness assessment system	4	Rivers & Streams (Other)

Condition

- 8.38. The rivers and streams condition assessment is used to describe on-site physical habitat diversity. To understand the condition of the river, we have to understand how the ‘river type’ should operate in a near-natural state, and the habitat features that are typical of that river type. We can then assess how far the current river system has departed from those conditions. This will also allow an understanding of how improvements to river channel, banks and riparian zone could improve condition.
- 8.39. Biological assessments, for example fisheries and macro-invertebrate, and water quality surveys, are useful complements to this assessment. However, their use

³⁰ Links to guidance on each stage:

1: <http://publications.naturalengland.org.uk/publication/6266338867675136>

2: <http://priorityhab.wpengine.com/rivers-data/>

3: <http://priorityhab.wpengine.com/wp-content/uploads/River-naturalness-assessment-guidance-document-February-2019.pdf>

should be scaled to the magnitude of impact and assessed by a competent freshwater ecologist.

The Rivers and Streams Condition Assessment

- 8.40. The rivers and streams condition assessment is based on the extent and diversity of observed physical features in the river channel and riparian zone (including the physical structure of vegetation) as well as the extent and types of any human modifications. The physical state of a river reach is a useful proxy for determining overall riverine ecological quality but it needs to be attuned to the type of river under consideration.
- 8.41. The rivers and streams condition assessment is based on geomorphic principles that are an extension of established citizen science surveys³¹. The assessment, called the River Metric Survey, is implemented in two parts³². A largely desk-based reach-scale assessment indicates the current river type. A subreach scale assessment based entirely on field survey captures physical features / habitats, vegetation structural features, and human interventions to assess the condition of the river at the development site, taking into account the type of river.

Important: the rivers and streams condition assessment requires accreditation and training

Part 1 - Reach scale desk-based assessment

- 8.42. The river is assigned to one of 13 river types that are likely to be encountered in England (Figure 8-2). These are a subgroup of 22 broad types of river that have been identified for Europe^{33,34}, including the United Kingdom³⁵. The river type is determined firstly by identifying a homogenous reach that contains the proposed intervention site. This reach is identified using the latest Ordnance Survey (1:10,000 scale) maps or air photographs (e.g. Google Earth) and searching upstream and downstream from the proposed intervention site. To delimit the start and end point, a homogeneous river reach will show a reasonably consistent planform with no major tributary streams, on-line large lakes or reservoirs, as these could cause a marked change in the flow regime and sediment load.
- 8.43. Once the reach is determined, its gradient and 4 properties of its planform are measured to support an initial assessment of the river type. This is further refined using 4 properties of the river bed sediments observed in field surveys of sub-reaches (see below). The assignment of this indicative river type is automatically carried out within the River Metric Survey information system.

³¹ See: <https://modularriversurvey.org/river-metric>

³² For further information on the method please visit (<https://modularriversurvey.org/river-metric>).

³³ GURNELL ET AL., 2016. A multi-scale hierarchical framework for developing understanding of river behaviour to support river management. *Aquatic Sciences*, 78(1): 1-16.

³⁴ RINALDI, M., GURNELL, A.M., GONZÁLEZ DEL TÁNAGO, M., BUSSETTINI, M. & HENDRIKS, D., 2016. Classification of river morphology and hydrology to support management and restoration. *Aquatic Sciences*, 78(1): 17-33.

³⁵ ENGLAND AND GURNELL, 2016. England, J. and Gurnell, A.M. (2016) Incorporating Catchment to Reach Scale Processes into Hydromorphology Assessment in the UK. *Water and Environment Journal*, 30: 22–30.

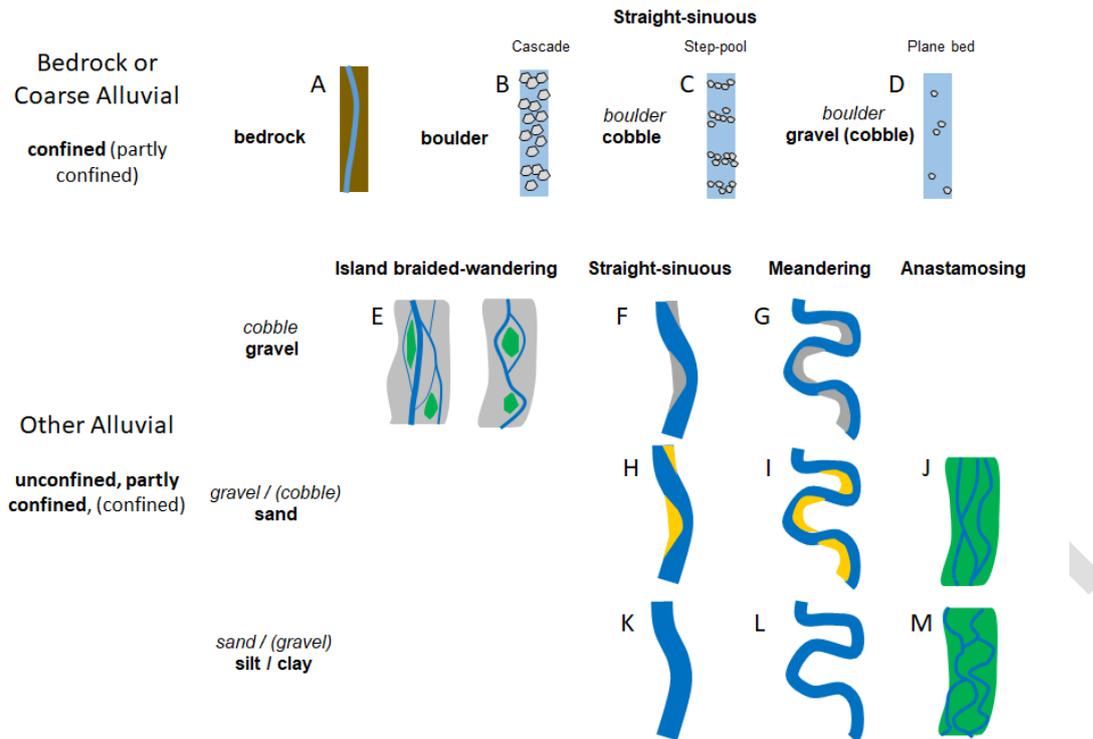


FIGURE 8-2: 13 river types found in Britain based on valley confinement, planform and bed material size (Gurnell et al., 2016, Rinaldi et al., 2016)

Part 2 - Sub-reach scale field assessment

- 8.44. The field element employs the MoRPh survey^{36,37}, which is applied to short lengths of river. For the River Metric Survey, 5 MoRPh field surveys are conducted on contiguous lengths (modules) of river. Each MoRPh module covers a river length that is approximately twice the river width (typically 10, 20, 30 or 40 m in length). Completing 5 contiguous modules provides information for a 50 to 200 m long sub-reach. Depending on the size of the development, the sub-reach survey of 5 modules is repeated to capture at least 20% of the total river length under consideration (i.e. 1 sub-reach survey every 250 to 1000 m). The River Metric Survey captures information on sediments, vegetation, morphological and water-related features; and the extent and severity of physical modification within the channel, channel margins, banks and riparian zone (to 10 m from the bank tops).
- 8.45. Once each set of observations for 5 contiguous modules is entered into the River Metric Survey information system, indicators of the condition of the sub-reach are automatically provided as well as an overall condition score (Table 8-7). The condition score is scaled to a range that is achievable by the particular river type. In addition, guidance is given on which specific geomorphic features are expected, or

³⁶ SHUKER, L.J., GURNELL, A.M., WHARTON, G., GURNELL, D.J., ENGLAND, J., FINN LEEMING, B. & BEACH, E., 2017. MoRPh: a citizen science tool for monitoring and appraising physical habitat changes in rivers. *Water and Environment Journal*, 31(3): 418-424.

³⁷ GURNELL, A.M., ENGLAND, J., SHUKER, L., WHARTON, G. (in review). The contribution of citizen science volunteers to river monitoring and management: International and national perspectives and the example of the MoRPh survey.

highly likely, to be observed in the field surveys if the river is functioning according to river type.

- The extent of the River Metric Survey is only required within the red line boundary of the intervention site (on-site and off-site).
- Surveyors are required to be accredited to use the River Metric Survey and be suitably qualified / experienced to identify the sources of modifications on the site and their potential solutions.
- A low risk condition assessment can be used in situations where the impact on the river reach is considered low, see below in section, Riparian Zone.

TABLE 8-7: Condition weightings for rivers and streams

Classification	Weighting
Good	5
Fairly Good	4
Moderate	3
Fairly Poor	2
Poor	1

Offsetting and River Type

- 8.46. The principles of the mitigation hierarchy should be applied. When seeking to achieve biodiversity net gain for River biodiversity metric units opportunities to create or enhance habitats within the development site should be explored in the first instance before offset habitat sites are considered.
- 8.47. The River Metric Survey information system can support scenario modelling of changes proposed within the surveyed sub-reaches to inform potential mitigation options (**See condition survey example**).
- 8.48. Offsetting locations can only be used on the same river type. This is to ensure condition scores and mitigation/compensation are consistent.

CASE STUDY 8-1: Improving condition

Tokynton Park, River Brent, River Restoration Project

	Habitat description	Condition Score	
Before	<i>Canalised section of river with no/limited in channel habitat diversity, hard revetment and low habitat diversity riparian zone.</i>	<i>Fairly Poor (2)</i>	
After	<i>Re meandered channel re-instating varied flow types and in channel features, such as riffles and pools. Hard revetment removed and banks re-profiled.</i>	<i>Fairly Good (4)*</i> <i>*the presence of invasive species and some sections of hard revetment limit this section achieving Good (5).</i>	

Riparian Zone

- 8.49. The riparian zone is an important feature of the river system. It is a highly functional unit that provides direct inputs and outputs of materials to and from the river channel, such as organic matter and sediments, as well as providing lateral and longitudinal connectivity for species movement.
- 8.50. In biodiversity metric 2.0 the riparian zone is defined as a 10m zone from top of the river bank, which would naturally be periodically flooded, and which directly influences the hydrological, geomorphological and biological functions and processes within the river corridor. As the riparian zone is an intrinsic part of the river system it is not considered as a separate habitat type but as a linear feature within the rivers and streams module of the metric. The state of the riparian zone needs to be taken account of in pre and post development calculations.
- 8.51. The condition of the riparian zone is assessed within the river metric survey using bank top data captured by the field survey. If built development is proposed within the riparian zone, a full condition assessment is required. A low risk condition assessment can only be used where built development is proposed where the riparian zone can be proved not to be a functional part of the river channel (Figure 8-3(a)) i.e.

- it does not contribute to the life cycle of aquatic or riparian species,
- it does not provide a role in sediment and flood management,
- it is not part of the active river system (i.e. there are areas of deposition of organic material)

8.52. Where the development (red line boundary) is within the riparian zone but no built development is proposed (Figure 8-3(b)) a low risk condition assessment can be used. The low risk calculator enters a default condition score of Moderate.

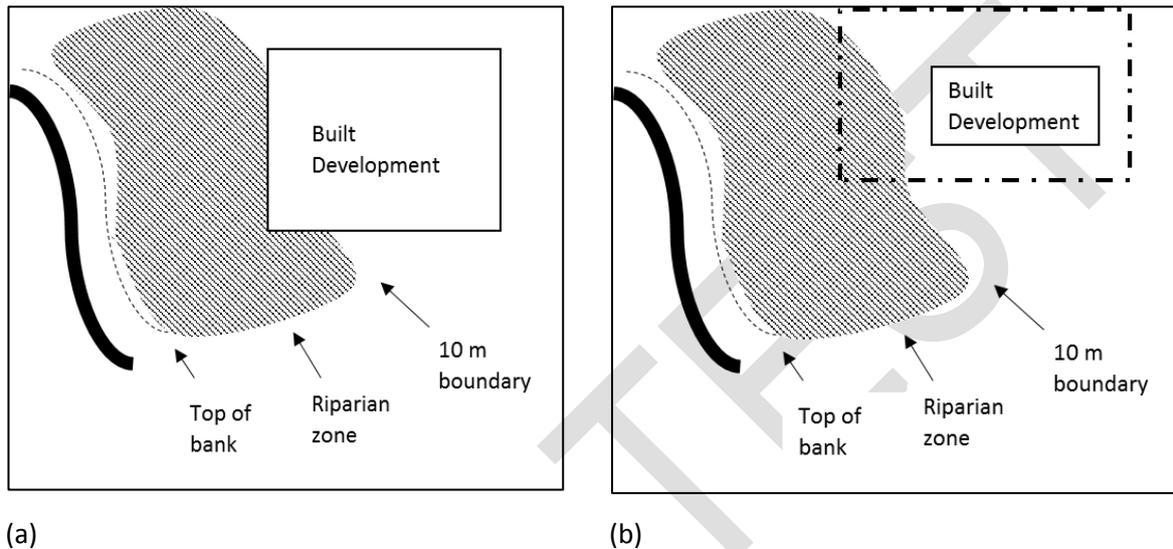


FIGURE 8-3: Assessing condition in the riparian zone

(a) Built development is indicated within the riparian zone. Top of bank is denoted by dotted line, riparian zone is denoted by patterned stripes. Use full River Metric Survey condition assessment if the riparian zone is a functional part of the river system, use low risk assessment if riparian zone is not a functional part of the river system.

(b) Red line boundary (denoted by black line and dot) falling within the riparian zone. Top of bank is denoted by dotted line, riparian zone is denoted by patterned stripes. No built development is indicated within the riparian zone. Use low risk condition assessment

- 8.53. At the post-development assessment stage, if development encroaches into the riparian zone (or increases the footprint of development if development is already existing) this is measured as length of river impacted. This is calculated as Loss of River Biodiversity Units. The loss is measured in the distance (linear metres) that the development is within the riparian zone.
- 8.54. As the loss of River Biodiversity Units in the riparian zone is not calculated as an 'area' based unit, the metric needs to account for differing degrees of encroachment within the riparian zone. For example, a building that encroaches 5 m into the riparian zone requires a greater offset than one that encroaches by 1 m. The rivers and streams component of biodiversity metric 2.0 adds a multiplier for every 2 m that development encroaches into this zone. The closer the development is to the watercourse, the greater the River Biodiversity Units required (see Table 8-8).

TABLE 8-8: Encroachment weightings for rivers and streams

Encroachment	Multiplier
0 m	1
0.1 -2 m	0.95
2.01-4 m	0.9
4.01-6 m	0.85
6.01-8 m	0.8
8+	0.75
Watercourse*	0.1

- 8.55. The riparian zone can be enhanced through improvements in the condition of the riparian zone. For example, by removing hard standing or other structures, appropriate planting that improves riparian habitat complexity, reconnecting channel-riparian interactions, installing green roofs/walls, and/or the inclusion of wetland features such as backwaters and ponds.
- 8.56. Offsetting losses which are created through encroachment into the riparian zone are not restricted to creating riparian betterment. Gains can also be achieved through improvements to the condition of the river. For example, removing toe boarding or installing in-channel deflectors.

* We have also added a multiplier for encroachment into the watercourse. This would include culverting.

Spatial Location

- 8.57. Spatial Location has been included as a quality element of the rivers and streams module as a connectivity and strategic importance spatial multiplier (Table 8-9). Spatial location tools applied to other habitats within the biodiversity metric 2.0 are not applicable for rivers and streams.

TABLE 8-9: Spatial multiplier for rivers and streams

Description of multiplier	Spatial multiplier
Within waterbody	1.0
Outside waterbody	0.75
Outside catchment	0.5

Strategic significance

- 8.58. The purpose of the strategic significance multiplier is outlined in chapter 5. For the Rivers and Streams module we use the delivery of identified actions within River Basin Plans, Catchment Plans and Local Plans to represent delivery in priority areas.

TABLE 8-10: Strategic significance multipliers for rivers and streams

Description of multiplier	Strategic multiplier
Delivery of River restoration actions within: <ul style="list-style-type: none"> • Local Plans • River Basin Management Plan • Catchment Plans • Catchment Planning System 	1.15
Low potential/ action not identified in any plan.	1

Risks

Difficulty of creation and enhancement

8.59. Rivers, by their nature, cannot be created. However, as many rivers and streams have been artificially moved or severely modified, the ability to change the character, processes and features within the channel and floodplain enables habitat to be 'created'. Here we define creation and enhancement for rivers and streams:

'Habitat creation, in this context, is defined as happening if, when you commence work on a site, you could not reasonably classify the habitat as being in 'Good condition'³⁸ based on the plant and animal communities present, but when you have completed the work you are confident that that habitat will, with the agreed management in place and all other things being equal, develop into river system exhibiting near-natural conditions.'

- An example of habitat creation: realigning a river which had previously been severely modified and channelised, to a natural course within its original floodplain
- An example of habitat enhancement: the introduction of large wood deflectors, brush berms, or works to the complexity or connectivity of the riparian zone.

8.60. With rivers and streams the risk associated with creation and enhancement are different from those for other habitats within the rest of the biodiversity metric 2.0. Difficulty of creation is defined as High, and difficulty of enhancement is scored as Moderate. This reflects the technical difficulty of habitat creation, which can often be limited by dispersal pathways of aquatic invertebrates, and achieving channel gradients that correctly allow process-form interactions.

TABLE 8-11: Difficulty of creation and enhancement multipliers for rivers and streams

Description of multiplier	Creation and enhancement multipliers
High difficulty	0.33
Moderate difficulty	0.67

³⁸ 'Good Condition' is defined through the River Metric Survey.

Time to create, enhance or restore

- 8.61. The time to target condition is related to the condition classification, and how far restoration efforts change the classification status. For example, moving from Poor to Good would take 10 years, moving from Moderate to Good would be 5, and so on. The time is based on the complexity of intervention needed to raise condition and the lag time needed for the biological communities to re-establish (Table 8-12).

Table 8-12: Time to target condition.

Classification	Time (years) to target condition
Good	10
Fairly good	8
Moderate	5
Fairly poor	2
Poor	-

Case Study 8-2: Results through Planning

Cornmill Gardens, River Ravensbourne

The river restoration scheme formed part of the 'Urban Renaissance in Lewisham' programme which aimed to create a new public open space within the Town Centre. The objective of the scheme was to remove the river from its concrete banks and create an attractive public open space. The river was restored by removing the concrete walls, regarding banks and improving riparian habitat and marginal planting, and installing gravels in the river channel. The scheme has improved this section of river for people, wildlife and flood risk.



Before



After

9: Coastal and Intertidal biodiversity unit assessment

- 9.1. Biodiversity metric 2.0 is an evolution of the original Defra biodiversity metric. Coastal and inter-tidal habitats will be added as an update to biodiversity metric 2.0 later in 2019. The intertidal and coastal environments are defined as:
- **Coastal:** all habitats above spring high tide limit (or above mean water level in non-tidal waters) occupying coastal features and characterised by their proximity to the sea, including coastal dunes and wooded coastal dunes, beaches and cliffs. Includes free-draining supralittoral habitats adjacent to marine habitats.
 - **Intertidal habitats:** habitats located between the mean high water and mean low water mark and directly connected to marine waters. Marine waters may be fully saline, brackish or almost fresh. It includes those below spring high tide limit (or below mean water level in non-tidal waters) and enclosed coastal saline or brackish waters, without a permanent surface connection to the sea but either with intermittent surface or sub-surface connections (as in lagoons).
- 9.2. We are in the process of developing biodiversity metric 2.0 parameters so that it can be applied on these habitats. A variety of factors are being considered to reflect the differences between terrestrial and intertidal/coastal environments. For example, a suitable classification is needed as UKHABs classification used in the terrestrial biodiversity metric does not cover the habitats in coastal and intertidal environments to the required level. EUNIS³⁹ classification has been chosen as it has the required level of detail and is commonly used.
- 9.3. This supplementary metric will be area-based for simplicity, although it is recognised that area measurements can present challenges when considering ephemeral habitats such as biogenic reefs, or vertical habitats such as sea cliffs and caves.
- 9.4. Distinctiveness levels of habitats will be based on the nature conservation value of the habitat. The condition of habitats, is being defined so that it can be readily evaluated by a surveyor but in accordance with the established assessment of condition within coastal sites.
- 9.5. The way connectivity is defined for habitats that are covered and inter-connected by highly dynamic tidal water bodies will also differ from terrestrial environments. Finally, alternative ways of defining other parameters such as spatial significance or the risk factors are also being considered.
- 9.6. The accompanying calculation tool will be updated later in 2019 to include the intertidal and coastal habitats to enable ease of calculation of biodiversity losses and gains for these habitat types.
- 9.7. The intertidal zone between mean high water and the mean low water mark is covered by marine and land-use planning systems. Therefore we are also looking at the join up and interaction of the different planning systems and delivery mechanisms in this area.

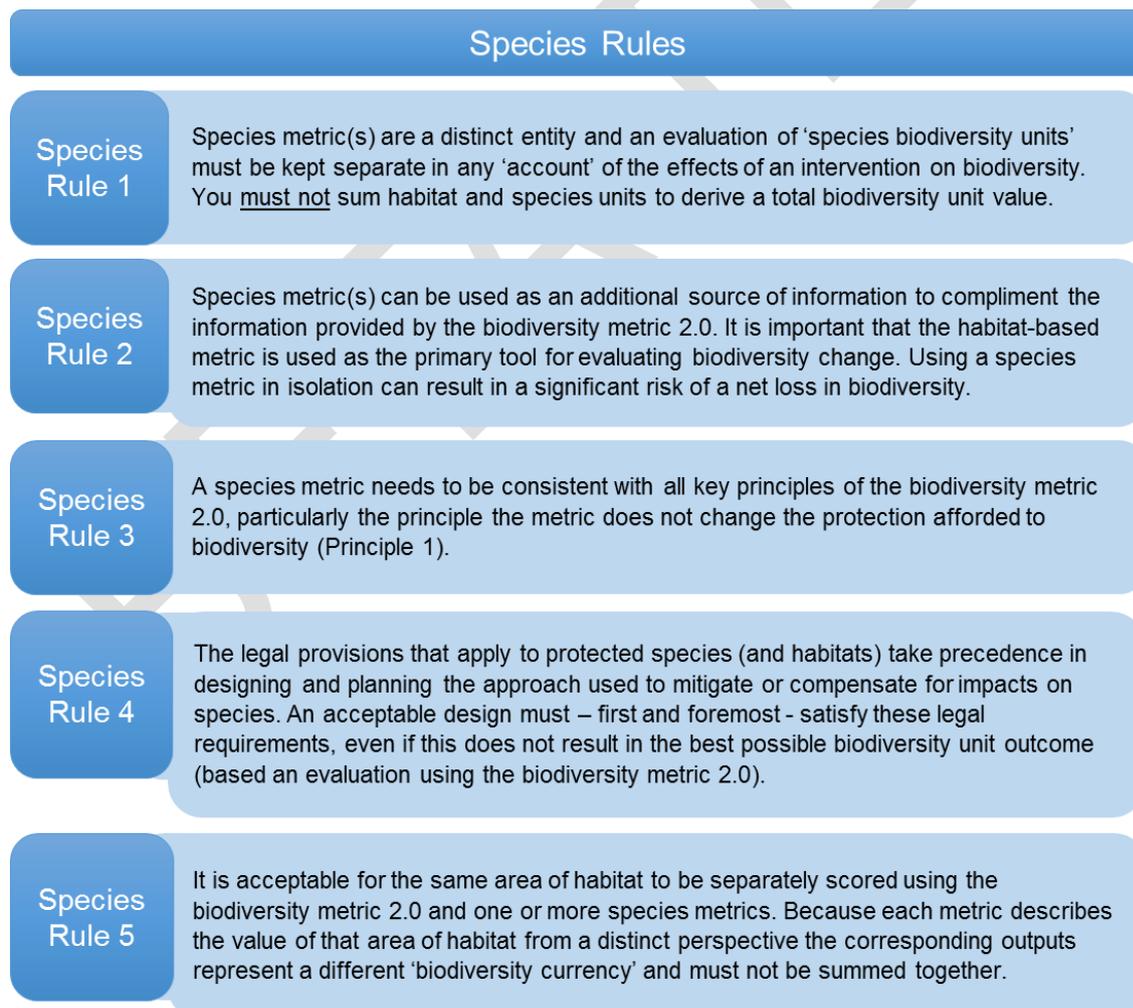
³⁹ The European Nature Information System (EUNIS) habitat classification is a pan-European system, developed by the European Environment Agency (EEA) in collaboration with experts from throughout Europe. Further information can be obtained from the EEA (<https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification>) and from JNCC pages including correlation with other classifications (<http://jncc.defra.gov.uk/page-3365>)

10: Using biodiversity metric 2.0 with other metrics

- 10.1. There may be situations where a project wishes to use metrics to quantify other environmental factors, such as other ecosystems services or use a metric for a specific species. It is perfectly acceptable to use the biodiversity metric 2.0 alongside other metrics so long as you to remember that each metric is a distinct entity and the units of each metric must be kept separate in any metric ‘account’. You cannot sum the units of different metrics to give an overall value.

Species Metrics

- 10.2. As previously stated, biodiversity metric 2.0 uses habitats as a proxy for wider biodiversity. It does not explicitly seek to measure or meet the needs of individual species although many can expect to benefit from the creation of new or enhanced habitats.
- 10.3. Where a species metric is used in a project the rules set out below should be followed to ensure their use is compatible with the biodiversity metric 2.0 habitat metric. Box 10-1 illustrates how a species metric can be used alongside biodiversity metric 2.0.



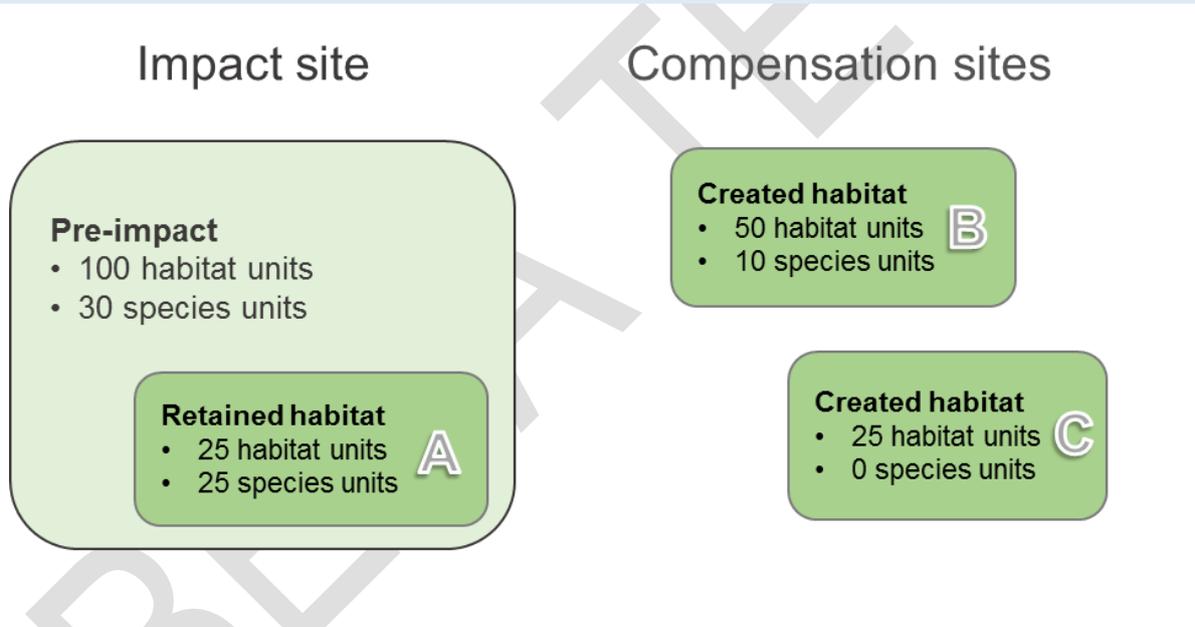
BOX 10-1: Using species and habitat metrics together

Where species metrics are used by a project they should be used alongside biodiversity metric 2.0 to give a broad understanding of the impact of an intervention on biodiversity.

The effects of an intervention on both a species present on a site and on the habitats at that site should be scored separately using their respective metric. Although the outputs of the two metrics are recorded separately this does not increase the level of compensation required. The need to satisfy a target level of units for each (e.g. to achieve non-net-loss) may, however, have a bearing on design and location of compensation.

If, for example, a development destroys an area of grassland that provides an important terrestrial habitat for a protected species population, it may be that compensating for the grassland loss at an off-site location can satisfy the biodiversity metric 2.0 unit requirement to achieve no-net-loss, but be too remote or unsuitable for the protected species population. By the same measure, locating the new grassland habitat at a location that is ecologically more important to protected species could create a greater net benefit for the species for the same number of biodiversity metric units.

The example below illustrates how species and habitat metrics can work in parallel.



Biodiversity unit accounts	Pre-impact site units	Site A units	Site B units	Site C Units	Overall change Compensation – Impact	Outcome
Habitat units	100	50	25	25	$(50+25+25)-100=0$	NNL
Species units	30	10	0	25	$(10+0+25)-30=+5$	Net Gain

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BETA TEST

Glossary

BIODIVERSITY	Biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. Source: Convention on Biological Diversity
COMPENSATION	Measures to recompense make good for loss of biodiversity caused by a project. A more general term than biodiversity offset, which is one type of compensation. Compensation may achieve No Net Loss (in which case it is an offset) or it may involve reparation that falls short of achieving no net loss (and is therefore not an offset). Source: adapted from IUCN (2016)
ECOLOGICAL EQUIVALENCE	In the context of biodiversity offsets, this term is synonymous with the concept of 'like for like' and refers to areas with highly comparable biodiversity components. This similarity can be observed in terms of species diversity, functional diversity and composition, ecological integrity or condition, landscape context (e.g., connectivity, landscape position, adjacent land uses or condition, patch size, etc.), and ecosystem services (including people's use and cultural values). Source: BBOP (2012a).
ECOLOGICAL FUNCTIONALITY	The role and function that a habitat and supporting processes play in supporting an ecosystem. A habitat may be considered to have achieved ecological functionality when it fully supports all of the typical or target species.
ECOSYSTEM	a biological community of interacting organisms and their physical environment
FEP	Farm Environment Plan
HABITAT	The place or environment in which plants and animals live
HBU	Hedgerow Biodiversity Unit. The unit of measurement used for hedgerows and lines of trees.
IRREPLACEABLE HABITATS	Habitats that cannot be recreated within a specified time frame (typically, the timescale of the project)
METRICS	A set of measurements that quantifies results
NET GAIN	Net gain is an approach to development, and/or land management, which aims to leave the natural

	environment in a measurably better state than beforehand.
<p>NO-NET-LOSS NNL</p>	<p>Impacts caused by a project are balanced by biodiversity gains through compensation measures implemented in the locality of the project. The biodiversity changes need to be evaluated against a baseline (e.g. a reference point or trajectory without the project occurring, or prior to the project occurring) of the relevant biodiversity features (in this case the habitats) being impacted by the project. From a conservation perspective, achieving a NNL goal for a given project ultimately (i.e. in the long-term) means no net reduction in the:</p> <ul style="list-style-type: none"> • diversity within and among species and vegetation types; • long-term viability of species and vegetation types; and • functioning of species assemblages and ecosystems, including ecological and evolutionary processes.
OFF-SETS	<p>Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation actions have been taken. The goal of biodiversity offsets is to achieve No Net Loss and preferably a Net Gain of biodiversity on the ground with respect to species composition, habitat structure, ecosystem function and people's use and cultural values associated with biodiversity. Source: BBOP (2012).</p>
SSSI	<p>Sites of Special Scientific Interest. Sites providing statutory protection for the best examples of the UK's flora, fauna, or geological or physiographical features.</p>