Principles of the Environmental Benefits from Nature (EBN tool) approach - Beta Version Update v1.1

Enabling wider benefits for people and nature from habitat change

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Substantive updates marked (New). Universal updates to replace reference to Biodiversity Metric 3.0 with the Statutory Biodiversity Metric tool, and reference to MAGIC/EA/Met Office data with links to the GI Portal have been made throughout. Update contains other minor revisions to other areas.

Further information

This report can be downloaded from the Natural England Access to Evidence Catalogue: **http://publications.naturalengland.org.uk/** . For information on Natural England publications contact the Natural England Enquiry Service on 0300 060 3900 or e-mail **enquiries@naturalengland.org.uk**.

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Foreword

The Covid Pandemic made us all more aware than ever of the benefits that Nature brings and its importance in the built environment. Fully recognising these benefits in decision-making as we build back better can help achieve better, greener, places to live that are both Nature-positive and climate resilient, while addressing local community needs such as health and wellbeing.

Such benefits are often intuitive but can often be hard to quantify. Trees can help store carbon, provide valuable shade, and, when positioned appropriately, help reduce flooding and buffer noise and air pollution. Other diverse habitats can also bring a range of benefits and provide food, pollination, recreation opportunities and pest control, as well as aesthetic value and contribute to our sense of place. However, as these benefits are often hard to measure, consideration of these services can be piecemeal or overlooked.

Our work over recent years on the biodiversity metric has shown what is possible. It has shown how a common means of measurement can be embedded into decision making to help achieve net gains in biodiversity from development, improving the environment, while also providing greater certainty for developers on environmental needs.

The voluntary Environmental Benefits from Nature tool will continue this journey of innovation, building on the biodiversity metric to indicate how changes to habitats can affect the services provided by Nature and the benefits to people. Using metric outputs alongside wider environmental information, it highlights the associated ecosystem service losses and gains from development and how these would vary under different biodiversity net gain options. The ambition is that it helps identify and enable multi-functional approaches and achieve ‘win-win’ opportunities for people and nature.

Restoring nature is one of the most important things we can do for the long-term health and prosperity of people, wildlife and our economy. It is a goal that is being brought closer by government policy, the commitment of industry and the passion of everyone working for the natural environment. Using the EBN tool can support Government’s 25 Year Environment Plan commitment to expand net gain approaches to include wider Natural Capital benefits. It can also help facilitate the kind of holistic decision-making we will need to ensure that thriving nature drives the green recovery of this country. With this release of the Beta version of the tool, you are invited to explore how it can help you deliver wider benefits through planned development work, and to take part in our evaluation. Together we can determine the next steps for both the tool itself and our work in this exciting area.

Tony Juniper CBE, Chair of Natural England (2021)

Environmental Benefits from Nature Tool Update: Foreword

Since its initial release in 2021, the Environmental Benefits from Nature tool has been downloaded over 5000 times and has been used on a wide variety of projects across England - ranging from housing and infrastructure development to urban greening initiatives. The following update is designed to build on the feedback from its growing user community and aims to make the tool even more efficient, more effective, and more integrated.

Key changes include:

- integration with the Statutory Biodiversity Metric and Green Infrastructure Standards - published since the initial version of the tool,
- improved landscape integration - through the inclusion of the Landscape Character Assessment Database, and
- significant improvements to data access - through use of our Green Infrastructure mapping portal and a new EBNT QGIS template, offering server links & automated data processing to technical users.

Changes to associated documentation have been kept to a minimum to provide a familiar experience for existing users. Together it is hoped that these changes will reduce the time required to complete the EBNT and make it easier to integrate nature-based services into a wider range of initiatives, helping more projects deliver growing benefits for people and nature.

David Drake NE Director, Connecting People and Nature Programme (2024)

Executive summary

The Environmental Benefits from Nature Tool (EBN tool)[1] is a voluntary decision-support tool that has been developed to work alongside Biodiversity Net Gain (BNG) and enable wider benefits for people and nature from habitat change. It was developed by Natural England and the University of Oxford in partnership with Defra, the Forestry Commission and the Environment Agency to support the 25 Year Environment Plan commitment to *expand net gain approaches to include wider Natural Capital benefits such as flood protection, recreation and improved water and air quality.* It is designed to be used at a variety of scales and settings to help achieve improved environmental outcomes through better consideration of the services that nature provides. Potential users include environmental consultants, house builders and infrastructure developers, local authorities working on Green Infrastructure, providers of off-site biodiversity units, and other habitat-led projects looking to consider wider benefits. The tool is suitable for use at all stages of project delivery, from initial scoping to optioneering, application and post application assessment.

The EBN tool is expected to be of particular interest to those seeking to align projects with Environmental Net Gain (ENG) commitments and explore ways to achieve more from their planned BNG delivery. The tool provides a common and consistent means of considering the direct impact of land use change across the full range of services that nature delivers. It focusses on ecosystem services[2] (such as recreation, air and water quality regulation), and climate benefits (such as cooling and shading and carbon storage). The tool indicates relative change in ecosystem service provision associated with habitat change and is intended to 'start a conversation' around wider benefits to people and enable better consideration of losses and gains in ecosystem services from development.

The tool has been independently tested and extensively piloted over a six-year period with a range of input from industry, academia and Government to ensure a robust product for publication. It is now at its second Beta release stage and Natural England is continuing to evaluate its effectiveness. This will determine where it works best and how it should be best applied and guide next steps for the project.

[1] The EBN Tool was known as the 'Eco-metric' throughout its development phase from 2017 to 2021.

[2] Ecosystems Services - The components of nature that are directly and indirectly enjoyed, consumed, or used in order to maintain or enhance human well-being.

While suitable for a range of applications, the EBN tool should not be used alone, but instead used alongside – and in addition to – a suite of established approaches, in particular BNG, but also including Environmental Impact Assessments (where required) and detailed impact assessments, such as on landscape, flood risk or air quality.

The EBN tool does not replace or undermine existing legal or policy protections and should be used in accordance with the established mitigation hierarchy of avoid damage, minimise damage, restore or rehabilitate damaged habitats, and only compensate through offsetting as a last resort.

The EBN tool takes a biodiversity-led approach and recognises that healthy, diverse and resilient ecosystems are essential to underpin the long-term delivery of multiple ecosystem services. It is designed to be used in conjunction with the statutory biodiversity metric tool and – when used together with this, and other appropriate tools – can help to highlight wider service gains from proposed environmental work. It can also help enable better consideration and delivery of these benefits to: maximise gains and minimise losses, through better project design; support the business case for investment, by linking multiple objectives and make the impacts of land-use change decisions more transparent to stakeholders.

The wider benefits for people and nature identified through EBN tool are intended to add to, rather than compete with, the primary driver of BNG. Following good practice principles is crucial in ensuring that the approach will be applied correctly – and this will reduce the risk of perverse outcomes. This document presents good practice principles for use. It provides an overview of how the tool works and explains its limitations.

A separate User Guide provides step by step instructions on how to use the tool, and a Data Catalogue describes how to collect all the condition and spatial indicators needed to run the tool. A process now assisted by use of the Green Infrastructure Data Portal and the EBNT QGIS Template.

Contents

1. Introduction

1.1 Why apply the Environmental Benefits from Nature tool? (NEW)

Under the Environment Act 2021 Government has introduced a mandatory Biodiversity Net Gain (BNG) requirement for new development along with Local Nature Recovery Strategies to target the best places for nature recovery and wider environmental benefits.

The National Planning Policy Framework[3] states that planning policies and decisions in England should encourage multiple benefits from both urban and rural land, including through mixed use schemes and taking opportunities to achieve net environmental gains – such as developments that would enable new habitat creation or improve public access to the countryside.

Government's National Policy Statements for Water Resources, Energy Infrastructure and National Networks (road and rail) also require relevant infrastructure projects to seek opportunities to contribute to and enhance the natural environment by providing net gains for biodiversity, and the wider environment where possible[4].

Government's Planning Practice Guidance for England[5] explains wider environmental net gain has the aim to reduce pressure on and achieve overall improvements in natural capital, ecosystem services and the benefits they deliver. For example, habitat improvements can provide a range of benefits such as improvements to soil, water and air quality, flood risk management and opportunities for recreation. This document contains reference to the Environmental Benefits from Nature tool, as a means of enabling wider benefits for people and nature from BNG.

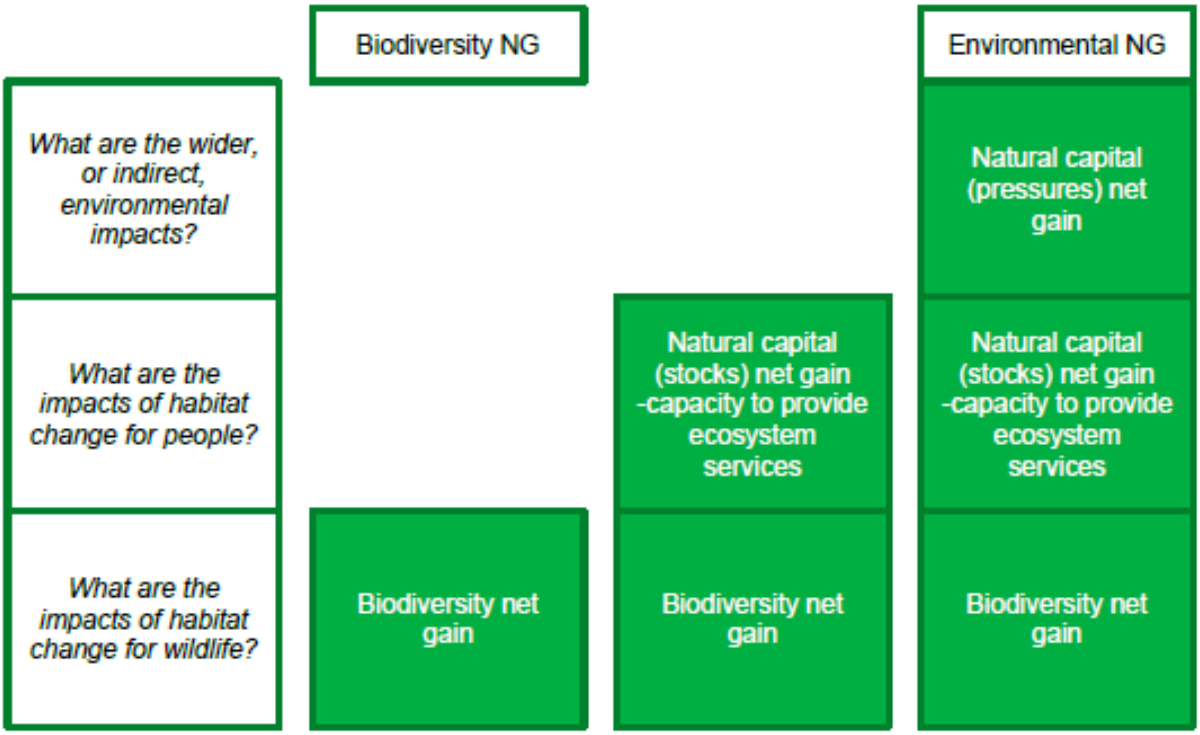
The tool is also embedded within Natural England's Green Infrastructure Framework (further details are provided in section 4.5) as a means of delivering greater multi-functionality within the developed environment.

[3] National Planning Policy Framework - GOV.UK (Dec 2023)

[4] Overarching National Policy Statement for energy (EN-1) - GOV.UK (www.gov.uk). (Nov 2023) This refers to the EBN tool in section 4.6.16, p69

[5] Natural environment - GOV.UK (www.gov.uk) (Feb 2024)

Figure 1: A conceptual diagram illustrating the relationship between biodiversity net gain and potential components often considered as part of environmental net gains.



The EBN tool can help users looking to build on an existing BNG assessment to begin to assess direct impacts on natural capital benefits, by measuring and enabling improvements to ecosystem services flowing from associated natural capital assets (in this case habitats). It can also highlight positive contributions that habitats can make to addressing indirect environmental impacts, for example as strategically placed barriers to reduce future pressures, such as sources of pollution.

Beyond new development, the tool can also help users consider or illustrate similar wider gains through their projects. For example, broadening use to include improvements to existing Green Infrastructure or other environmental assets.

The strength of the EBN tool is that it enables the user to explore the impacts of land use change projects on a wide range of ecosystem services, going beyond the capabilities of current environmental impact assessments. It can be used to raise awareness of how the location and condition of habitats can affect their ability to deliver different ecosystem services. It also provides a way of assessing the broad range of environmental goods and services provided by biodiversity net gain at a scoping level, using a consistent scoring system.

1.2 What does the EBN tool measure?

Environmental net gain is an approach to development that leaves the natural environment in a measurably better state than it was beforehand. The EBN tool supports environmental net gain by focussing on the middle layer of the conceptual framework above (Figure 1) –

assessing the impact of land-use change on ecosystem service provision resulting from biodiversity net gain. Examples of what might be measured in practice are set out in Figure 2.

Figure 2: Expansion of potential elements of ENG (role of EBN tool in red)

			Examples of what might be measured in practice
Environmental net gain	**Natural capital stocks:** natural assets including biodiversity assets such as terrestrial and aquatic habitats or species diversity which underpin the asset's capacity to deliver ecosystem services.	**Biodiversity**: habitats and the wildlife species they support.	Wildlife habitats (as measured by BNG)
			Protected species' habitats / populations
		Ecosystem services: the capacity of habitats, and the wildlife they support, to provide wider ecosystem and cultural services.	Water quality regulation
			Air quality regulation
			Places for recreation
			Carbon storage and sequestration
			Flood water regulation
			Wildlife for enjoyment and appreciation
	Natural capital pressures: on national and international natural capital stocks.	direct and indirect pressures.	Energy efficiency
			Water efficiency
			Transport efficiency
			Construction materials and processes
			Light and noise pollution
			Recreation impacts on protected sites

The tool highlights potential individual service gains and losses associated with proposed works and indicates where provision of these services is likely to be greater than, or less than, the baseline it replaces (along with the relative size of the change). It is therefore useful as a transparent and consistent means of highlighting wider benefits of proposed works to potential decision makers or funders. Where pressures such as noise, air or water pollution have been identified, the tool can also help identify and 'design-in' nature-based provisions that can help address them, often offering multiple benefits.

The tool in its current form is focused on the direct impact of development on ecosystem services, so under the above ENG Framework the EBN tool will not tell you where you

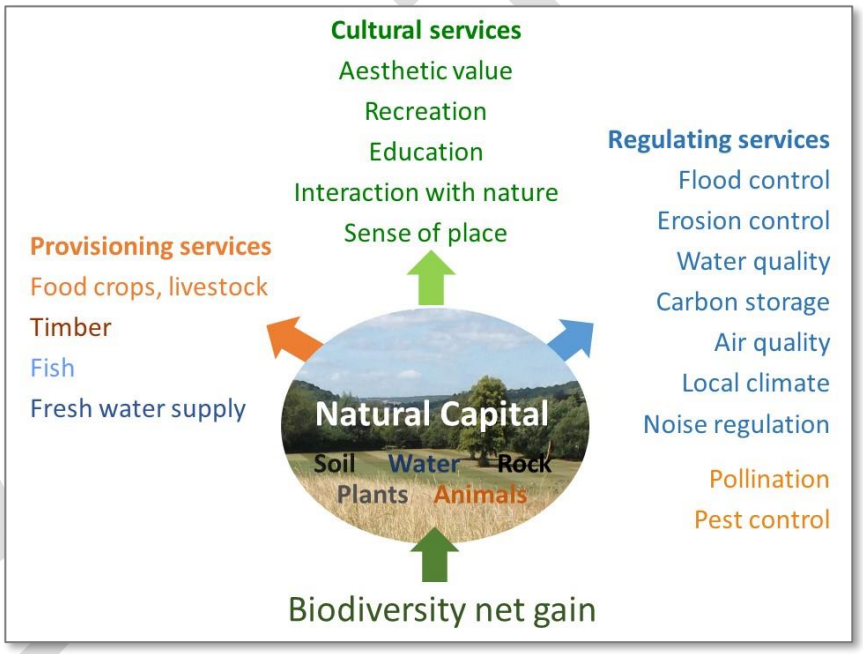
have achieved ENG and ***Environmental Net Gains cannot be claimed following its use***. This is because the tool only considers direct impact on natural capital stocks within the existing potential framework.

1.3 What are the links with Biodiversity Net Gain?

BNG is an approach to development. It makes sure that habitats for wildlife are left in a measurably better state than they were before the development. BNG is a commitment by Government and is mandatory under Schedule 7A of the Town and Country Planning Act 1990 (as inserted by Schedule 14 of the Environment Act 2021).

BNG is the primary driver for use of the EBN tool. The tool has been developed to be biodiversity-led and used in conjunction with the statutory biodiversity metric tool (which is the tool used to measure BNG). The environmental benefits identified in the EBN tool are intended to add to, rather than compete with, BNG considerations and demonstrate wider benefits for both people and nature.

Figure 3: Wider benefits of BNG for natural capital and ecosystem services



As with BNG, any wider benefits should be delivered through the established mitigation hierarchy. Within this hierarchy there is often flexibility in application and design, for example choosing what type of habitats to create or restore and where to position them. The EBN tool allows users to evaluate different design options, for the delivery of wider ecosystem service benefits.

Such benefits can often be optimised by considering multiple objectives, examples include:

- siting new woodland in an optimum location for flood protection or air quality regulation.
- considering how habitats will improve public access for recreation.
- creating flower-rich grassland to benefit pollinators.
- providing green roofs for cooling.
- planting tree species with maximum potential for carbon storage.

1.4 What does it do, and what does it not do?

The design principles of the EBN tool were to create a tool that was:

- simple and easy to use, using freely available data and/or survey data.
- scientifically robust, using best available evidence.
- able to incorporate the impact of ecosystem condition and quality and spatial location on ecosystem service (ES) supply.

The approach mirrors the approach taken over the development of the statutory biodiversity metric tool. Similarly, the EBN tool applies a matrix of scores for different habitats and ecosystem services, which are then modified by factors reflecting habitat condition, spatial location, delivery risk, and time for new habitats to reach maturity.

See section 3 for a full description of how the EBN tool works.

The EBN tool provides an exploratory scoping tool that covers a wide range of ecosystem services. It provides a consistent approach for scoring 18 ecosystem services that flow from natural capital assets, enabling the impacts of land-use change through BNG to be assessed relatively quickly at a broad level. Its strength is that it allows the user to explore the impacts of land use change projects on a very wide range of ecosystem services, going beyond the capabilities of current environmental impact assessments. The EBN tool uses a relative scoring system based on nominal scores from 0 to 10. It does **not** measure ecosystem services in biophysical or monetary units (such as tonnes of carbon stored, tonnes of wheat produced, cubic metres of avoided floodwater runoff or number of recreational visits made to a site). Other ecosystem modelling tools and assessment methods exist for this purpose, but have their own limitations.

See Defra's ENCA webpage for more information on tools for assessing natural capital and environmental valuation.

The EBN tool does **not** replace statutory requirements, such as the requirement for an Environmental Impact Assessment. It should be used alongside other planning information and more detailed assessments if appropriate (see Section 2).

The rapid assessment of a wide range of ecosystem services is a key asset of the tool. Other ecosystem service assessment tools or methods that focus on a smaller range of ecosystem services can provide more specific evaluation, but often focus only on services that are more readily evaluated in monetary terms. If these are used in isolation, there is a

risk that decisions could adversely affect other services omitted from the assessment, especially cultural services (other than recreation, which is often included). The EBN tool therefore provides a broader approach to help ensure that the full range of services is taken into account in decision-making.

1.5 How can the tool be used and what are the benefits?

By measuring gains or losses in ecosystem services, the EBN tool can help to improve the design of projects that deliver BNG to deliver wider environmental benefits. It has been designed primarily to assess the impact of land use change for an individual development project. For example, it could be applied to:

- compare alternative options for site design (habitats, spatial configuration) at the pre-application, masterplanning, feasibility or early or detailed design stages.
- assess the impact of land use change at any stage of a project lifecycle.

The tool is designed to help environmental consultants, house builders and infrastructure developers, local authorities working on Green Infrastructure, providers of off-site biodiversity units, and other habitat-led projects looking to consider wider benefits to:

- improve the design of biodiversity net gain projects so that they deliver multiple benefits for nature and people,
- demonstrate the wider benefits that projects can generate, beyond biodiversity enhancement,
- increase transparency in decision-making on biodiversity net gain, by allowing evaluation of losses and gains of different ecosystem services.

Benefits for developers and their consultants and contractors

When a development project achieves BNG, demonstrating the wider environmental and social benefits generated can smooth the planning process, deliver more appealing places to live and work, and enhance the company's reputation and 'licence to operate' within the community. Understanding and demonstrating the wider natural capital benefits generated through biodiversity net gain, which are not recognised by standard environmental assessments, can strengthen help increase the benefits from investing in improved habitats for biodiversity.

Benefits to development management and policy planners

Understanding and assessing the wider environmental and societal benefits of BNG can help planners, businesses and communities to tailor BNG projects so that they also deliver local and national priorities for investment in natural capital, including emerging priorities of new Local Nature Recovery Strategies (LNRS). Considering ecosystem services alongside the Biodiversity Metric can inform decision-making on the design and location of habitats for biodiversity net gain to generate the best outcomes for nature and people in a transparent way.

Find out more about how the EBN tool can be used alongside an LNRS in section 4.6.

Considering ecosystem services can inform decision-making on the design and location of habitats for BNG to generate the best outcomes for nature and people in a transparent way.

Although the EBN tool has been designed at a project-based level, the tool has been tested at a larger (county or district) scale, e.g. for assessing the relative natural capital impacts of different locations for woodland creation or housing site allocations. When used in this way, there is typically less information available on habitat type before and after change and for the habitat condition and spatial multipliers, meaning that extensive assumptions have to be made. Simplifications are also necessary in order to use the tool at this wider geographic scale, so that only a limited selection of habitat condition and spatial multipliers can be used. However, it may provide a useful tool at this scale to encourage consideration of the potential impact of land use change on ecosystem service delivery.

More information other approaches or tools that can help natural capital and ecosystem service decision making at larger (such as county or district scales) can be found on Defra's ENCA website.

1.6 Use alongside BNG at different stages of development (NEW)

When considering use of the EBN tool, it is useful to identify the links with BNG at each stage of development. This can assist work planning and identify synergies and efficiencies with related processes. It is also useful to consider the stage at which use will be most meaningful for your project.

As set out in British Standard BS 8683:2021[6], developments commonly follow 4 stages that can be matched to implementation of BNG. These steps are:

- preparation.
- design.
- implementation.
- management and maintenance.

[6] Process for designing and implementing Biodiversity Net Gain — Specification

Use of the tool is most strongly associated with the design stage, particularly consideration of BNG options, where delivery of wider gains is encouraged as best practice[7]. Earlier consideration alongside BNG may also be helpful (e.g., as part of early life cycle optioneering) and is desirable, as part of an iterative approach, where service gain is a priority. This can achieve best results and shape design.

A more detailed assessment of how to use the EBN tool at each stage is provided below.

Table 1: Association between the different BNG steps associated with the first two stages of development and associated links with the EBN tool.

Stage and Step	Links with EBN tool
Preparation - Feasibility	As much of the data required to perform an accurate assessment is not yet available, consideration using the EBN tool will be limited, but can still be valuable in limited cases with specific ecosystem service requirements[8]. The EBN tool can make use of initial biodiversity baselines created at this stage, though will require use of assumptions to articulate post-intervention work[9].
Preparation - Optioneering (early lifecycle)	Use of the EBN tool can ensure key early decisions consider ecosystem services, alongside other drivers. This can help avoid significant losses and retain scope to make later gains. Although data will be limited, early results, based on available data, can be built on to form more detailed assessments at later steps as part of an iterative approach. Crucially, use of the EBN tool at this stage can prompt early constructive dialogue within project teams around shared priorities and the role of different habitats as assets and service providers.

[7] Section 6.2.5 BNG options, p16.

[8] Where used alongside other approaches and expert judgement.

[9] Such assumptions cover anticipated coverage of sealed surface, gardens, SUDs, and habitats. The tool's Sub-urban Mosaic functionality provides an easy means of doing this see EBN User guide).

Stage and Step	Links with EBN tool
Design - Impact assessment & Calculations	Use of the EBN tool at this stage provides an opportunity to align multi-objective service delivery with BNG design and assessment. There is potential to combine related activities to form joined-up workflows as part of an iterative process of design, led by formal BNG requirements, such as those set out in the Baseline and Environmental Information checklist (Ref: PB-T01) of the Habitat Management and Monitoring Plan template (HMMP). This includes appropriate considerations that may identify opportunities for design that can be explored further within the tool. This stage requires the establishment of the biodiversity baseline for formal BNG assessment, which can be utilised for all subsequent EBN tool assessments[10]. Figure 4 provides further details on how the statutory biodiversity metric can be used alongside the EBNT. Where feasible, workflows for field data collection can be extended to include collection of data on baseline habitat structure and soil condition required for future ADVANCED assessments (see s7 EBN Data Catalogue).
Design - Consult stakeholders	Use of EBN tool outputs may be desirable/applicable to highlight anticipated wider benefits from planned BNG work. This may be useful to illustrate where design has been tailored to reflect local priorities/opportunities, identified in work to complete the HMMP or prior engagement. Only consider using these results where inputs have been ground-truthed by appropriate experts. This should form part of wider narrative and always be accompanied by the confidence levels generated by the EBN tool results.

[10] when accompanied by assumptions on post-intervention work.

Stage and Step	Links with EBN tool
Design - BNG Options	Use of the EBN tool allows users to compare delivery of different BNG designs against local priorities and explore opportunities identified in the HMMP. The BNG standard encourages such consideration of wider benefits at this stage in situations where there are several design options for achieving the BNG target[11]. The EBN tool allows users to consider the benefits of different BNG options such as selection of different habitats, where appropriate within BNG rules, or explore the merits of differing habitat positioning e.g. as barriers to sources of pollution[12]. Where considered, the BNG Standard recommends that environmental benefits should be reported as best practice. The EBN tool provides a consistent means of doing so.
Design - Finalise BNG outputs	Favoured EBNT options can be used to inform HMMP prescriptions and secure wider benefits. This can help ensure that conditions explored within in the tool are reflected as part of later stages of implementation, management and maintenance. For example, ensuring longer areas of grass are retained to slow the flow of water /habitats are maintained to provide barriers to pollution etc in specific locations.

[11] Use at earlier stages can help shape the BNG options that are considered at this stage and is therefore desirable where increases to specific services are required or maximising multi-objective delivery is a priority.

[12] This requires completion of ADVANCED assessment.

2. Good practice principles

The EBN tool is founded on five good practice principles, described in the following sections. Users should demonstrate that these principles have been applied:

- make biodiversity net gain the primary driver.
- apply the mitigation hierarchy.
- use as a decision-support tool alongside other impact assessments and evidence, and always sense check.
- do not add together scores for individual ecosystem services.
- use early, iteratively and collaboratively (NEW).

Principle 1: Make BNG the primary driver

BNG design should follow official biodiversity net gain guidance and must be demonstrated using statutory biodiversity metric tool only.

Find out more about Biodiversity Net Gain implementation.

If there are different options for delivering BNG then the EBN tool can be used to assess any wider impacts to ecosystem services (secondary goal).

Once BNG is demonstrated, the EBN tool can be used to help explore opportunities to deliver wider natural capital benefits and minimise any negative impacts of final options. The EBN tool should never be only used to maximise EBN tool scores for ecosystem services, without considering BNG. Biodiversity net gain should not be lost to deliver gains in ecosystem services.

The EBN tool is based on the principle that healthy and diverse ecosystems underpin the long-term delivery of the ecosystem services on which we all depend. Therefore, the core principle of the approach is that development should achieve biodiversity net gain. Once this has been demonstrated using the statutory biodiversity metric tool, the EBN tool can be used to help explore opportunities to deliver wider natural capital benefits and minimise any negative impacts. Biodiversity net gain cannot be lost in order to deliver gains in ecosystem services. If there are different options for delivering biodiversity net gain, then the EBN tool can be used to assess which options provide the intended biodiversity net gain (primary goal) and also maximise ecosystem services (secondary goal).

Principle 2: Apply the mitigation hierarchy

Both BNG and use of the EBN tool should firmly embed the mitigation hierarchy within the process, as detailed in the good practice principles and associated guidance (CIEEM, CIRIA and IEMA 2016; Baker et al., 2019). The steps of the mitigation hierarchy are:

- avoid damage,

- minimise damage,
- restore or rehabilitate damaged habitats, and
- only compensate any residual damage through offsetting as a last resort.

Users of the EBN tool should also follow industry good practice principles of BNG (CIEEM, CIRIA and IEMA, 2016), to avoid any perverse outcomes. 'Biodiversity net gain: a practical guide' provides invaluable detailed advice and case study examples on how to implement the good practice principles for BNG throughout the project life cycle (Baker et al. 2019). Further information can also be found in the BNG British Standard BS 8683:2021.

Principle 3: Use as a decision-support tool alongside other impact assessments & evidence, and sense check

The EBN tool should be used as a decision-support tool, alongside other tools such as a full Environmental Impact Assessment (EIA), where required, and other procedures for detailed assessment of important services such as flood protection.

Decisions should not be based on the EBN tool alone - it should be used as part of a suite of approaches. It does not replace the use of other decision-support tools required as part of the planning process, although there can be benefits in aligning these assessments so that data collected can be used to inform the EBN tool.

High quality design principles such as those set out in the National Design Guide, should be followed, as well as the relevant statutory guidance in the NPPF, and industry good practice including on biodiversity net gain (Baker et al 2019). Newly created habitats should be designed and sited to take account of future resilience to climate change and other environmental change (including tree diseases etc.). There should also be long-term monitoring of newly created or restored habitats to demonstrate the achievement of BNG.

As with any other tool or model, you must 'sense check' the EBN tool outputs (ideally as part of a collaborative process with input from different related professions). The tool highlights the impact of habitat types, condition, and location on delivery of different services, to help users reach more informed and transparent decisions on how to maximise ecosystem service provision under BNG. Users should take account of all available supporting knowledge, evidence and expertise, including local stakeholders and community voices, as they develop a narrative around the EBN tool outputs that fits with other sources of information.

Principle 4: Do not add together scores for different ecosystem services

The EBN tool highlights impacts across a wide range of ecosystem services. This is important because if the focus is only on a few services, there can be perverse outcomes for other services. It is likely that the EBN tool will highlight opportunities for certain

habitats to deliver multiple services, but it could also identify trade-offs, e.g. between provisioning services (food, timber) and regulating or cultural services.

The results are presented as arrows that indicate the direction and magnitude of change for each ecosystem service (see Section 4). For transparency, the underlying scores can be viewed on the calculation sheets. However, the scores for different services should not be added together into a single total value because:

- the scores for different services are not comparable because they are not in common units. It is fairly meaningless to add a “unit” of air quality regulation to a “unit” of recreation or carbon storage. A score of 10 for one ecosystem service may have a lower societal value than a score of 5 for another ecosystem service if it contributes less value to human wellbeing.
- the scores do not represent actual biophysical values, only relative rankings between different habitats for delivering each service.
- adding may obscure large gains or losses in individual ecosystem services.
- adding scores together risks double counting, for services that may partially overlap (e.g. aesthetic value and ‘sense of place’).

Principle 5: Use early, iteratively and collaboratively (NEW)

As set out in section 1.6, the early stages of development are where key decisions are made that will shape future design. Using the tool early (where considered feasible) can help embed ecosystem service thinking from the start of a project. This can in turn help start wider conversations about local priorities and the role of habitats in delivering wider project objectives. Working iteratively throughout project design can help build on early consideration to factor in ecosystem service impact at each step to ensure opportunities are not missed.

Working collaboratively can help bring together ecologists, landscape architects, engineers (and others such as historic environment and geodiversity experts) to discuss potential ecosystem services impacts, alongside other considerations throughout the project to achieve greater inter-disciplinary join-up, ensure appropriate sense-checking and prioritization of further work. Wider external collaboration can help ensure design focus on local priorities and objectives.

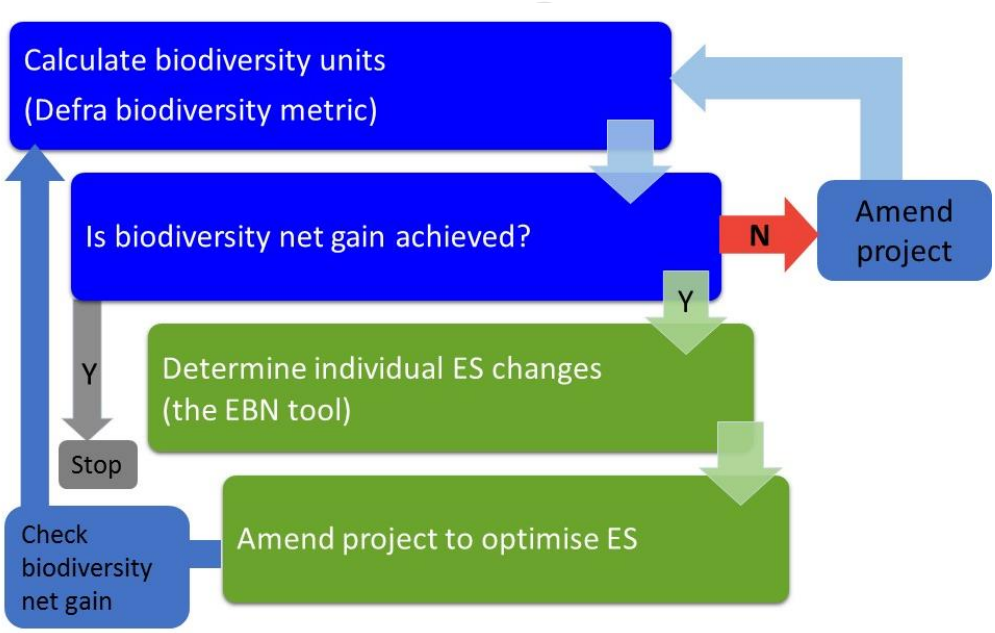
3. Background to how the EBN tool works

This section explains the background to how the EBN tool works. It is useful to have a general understanding of how the tool operates when considering results and improvements. The overall approach is described first, and then the following sections describe the individual components of the tool: habitat classifications, ecosystem service classifications, scores, condition indicators, spatial factors, time lag factors and delivery risk factors. See the separate User Guide for step-by-step instructions on how to use the spreadsheet tool.

3.1 The overall approach

The EBN tool is designed to be used together with a biodiversity net gain assessment (Figure 4). Biodiversity net gain is the primary driver. One way to use the tool is to design a project to deliver biodiversity net gain and calculate the EBN tool scores for this project design. This will show either losses or gains in different ecosystem services, and the project can be amended to reduce losses and increase gains. If the changes are likely to affect the statutory biodiversity metric tool results, the biodiversity and wider net gain assessment should be updated to ensure that biodiversity net gain is achieved.

Figure 4: Applying the EBN tool, showing how biodiversity net gain is the primary driver



Another way is to apply the EBN tool at the same time as the statutory biodiversity metric tool, so that the EBN tool informs the design of a biodiversity net gain project from the start. For example, this could highlight the importance of certain habitats for both their biodiversity value and ecosystem service provision and help to identify areas within the development site to create or enhance habitats that maximise ecosystem service provision for people affected by habitat loss for the development. A collaborative approach as

detailed above is important for this stage of development, to understand which ecosystem services should be prioritised.

The EBN tool mirrors the approach of the Biodiversity Metric. This multiplies habitat area by a habitat score, a condition factor, a spatial location factor, and (for newly created or restored habitats) factors to reflect the time taken for habitats to reach target condition, and the delivery risk (risk that the habitat will not be created or restored successfully).

Within the EBN tool, the habitat distinctiveness score is replaced by a set of ecosystem service scores, reflecting the ability of the habitat type to deliver each of the 18 ecosystem services. The condition and spatial indicators and time-to-reach-target-condition factors are also specific to each ecosystem service because, for example, good condition for flood protection is not necessarily the same as good condition for food production.

The EBN tool

Baseline (before habitat change):

ES1 = Habitat area x Habitat Ecosystem Service Score x Condition x Spatial factors

ES2 = Habitat area x Habitat Ecosystem Service Score x Condition x Spatial factors

ES3 = Habitat area x Habitat Ecosystem Service Score x Condition x Spatial factors

ES4 = Habitat area x Score x Condition x Spatial factors

Post-development or intervention:

ES1 = Habitat area x Habitat Ecosystem Service Score x Condition x Spatial factors x Time to target condition x Delivery risk

ES2 = Habitat area x Habitat Ecosystem Service Score x Condition x Spatial factors x Time to target condition x Delivery risk

ES3 = Habitat area x Habitat Ecosystem Service Score x Condition x Spatial factors x Time to target condition x Delivery risk

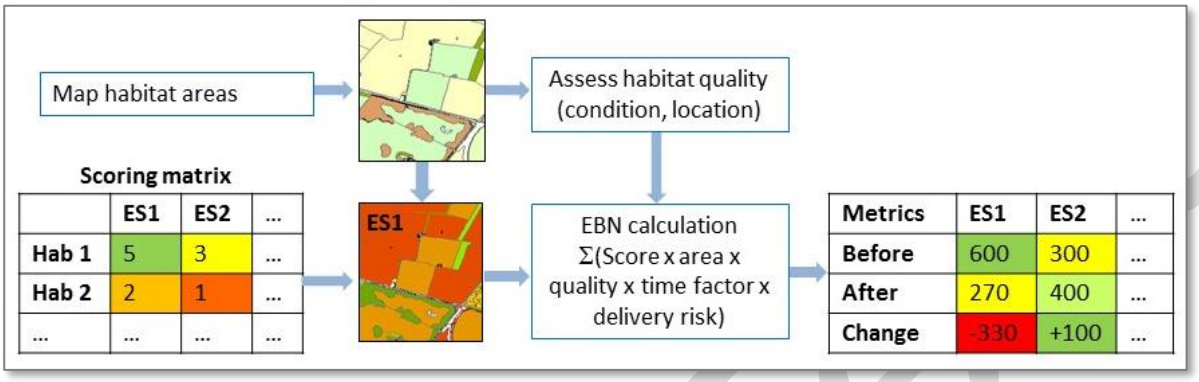
ES4 = Habitat area x Habitat Ecosystem Service Score x Condition x Spatial factors x Time to target condition x Delivery risk

For the Biodiversity Metric, the Scores are calculated for the ‘baseline’ habitats, and then for the post-development habitats. The assessment should cover both on-site change in habitats from the proposed development or management plan, and any associated off-site change in habitats from compensation and net gain activities.

The net gain or loss in each ecosystem service is simply the difference between the total baseline and post-development scores. When losses and gains in habitats are in different locations (whether within or outside the development boundary) they may not benefit the same communities or species as the habitats that are lost. The EBN tool does not show this; it is for the user to identify such issues and design BNG in accordance with good practice for both biodiversity (CIEEM, CIRIA, IEMA, 2016) and people (Bull et al, 2018).

Positive scores indicate that a net gain in a particular service has been achieved and negative scores indicate a net loss. This is indicated by the arrows in the results overview table. If some services show a net loss, this should prompt efforts to amend the BNG design in order to deliver wider gains where possible, whilst recognising that some trade-offs may occur.

Figure 5: How the EBN tool works – formation of total scores



3.2 Habitat / land-use classification

Users can enter habitat types using either UKHab, Phase 1, Biodiversity Metric or UGF Surface Cover Type[13] habitat classifications, and the EBN tool will automatically translate these to a simplified set of 'EBN habitats'. This includes both semi-natural habitats and urban habitats including the built environment, urban green infrastructure (GI) and Sustainable Drainage Systems (SuDS) features. The EBN habitat list aims to distinguish between different habitats that provide noticeably different levels of ecosystem services.

The habitat list is based largely on Level 3 of the UKHab system for rural habitats, and UKHab secondary codes for urban habitats. It is compatible with the habitat classification used by the statutory biodiversity metric tool. Following feedback, we added some 'higher level' habitats such as 'semi-natural grassland' for situations where further detail is lacking, as well as a generic 'suburban mosaic' habitat (see below). This resulted in 72 habitats (see Table 2) which each have a row in the matrix of ecosystem service scores.

Although users should enter separate habitat types for suburban areas (e.g. sealed surfaces and buildings, private gardens and amenity grassland), the 'suburban mosaic' habitat is a broad habitat type for when detailed information is not yet gathered, such as for high level assessments at large scales, or where detailed site design is not yet started.

[13] The tool uses a modified list of Surface Cover Types based on NE's Urban Greening Factor (UGF) Standard – this includes subdivisions of some types to allow for the different service provision.

Details of the composition of the suburban mosaic are entered on the 'Project details' sheet of the tool. A default composition is provided, but users can change these percentages to match their own schemes (see User Guide). The EBN tool scores for the suburban mosaic habitat type are then derived from combining the scores for the component habitats in the appropriate proportions. However, if the split between habitat types is known then the individual habitats should be entered separately.

Table 2: Habitats included in the EBN tool. Colours indicate broad habitats (woodland dark green, semi-natural grassland bright green, farmland orange, mountain and heath purple, freshwater and wetland light blue, coastal and marine mid blue, green infrastructure grey-green, hard surfaces grey). Italicised habitats are sub-habitats under a top-level classification (e.g. five types of 'semi-natural grassland').

Broadleaved, mixed and yew semi-natural woodland	Coastal rock
Broadleaved, mixed and yew plantation	Biogenic reefs
Native pine woodlands	Coastal saltmarsh
Coniferous plantation	Coastal lagoons
Wood pasture and parkland with scattered trees	Seagrass beds
Traditional orchards	Vegetated dunes and shingle
Dense scrub	Beach and bare sand
Hedgerows	Other littoral sediment
Hedgerow with trees	Sealed surface and buildings
Felled woodland	Artificial unvegetated, unsealed surface
Tall herb and fern	Bare ground
Ephemeral / short perennial	Garden
Bracken	*Vegetated garden*
Semi-natural grassland	*Unvegetated garden*
Acid grassland	Open mosaic habitats on previously developed land
Calcareous grassland	Parks and gardens
Neutral grassland	Footpath / cycle path - green
Calaminarian grasslands	Green bridge
Poor semi-improved grassland	Amenity grassland
Improved grassland	Road island / verge
Arable fields, horticulture and temporary grass	Natural sports pitch, recreation ground or playground
Arable field margins	Cemeteries and churchyards
Woody biofuel crops	Allotments, city farm, community garden
Intensive orchards	Intensive green roof
Bog	Green wall
Dwarf shrub heath	Brown roof or extensive green roof
Inland rock	Tree
Freshwater	SuDS retention pond
Standing open water	SuDS detention basin
Canals	Bioswale
Running water	Rain garden
Fen, marsh and swamp	Introduced shrub

Lowland fens	Flower bed
Purple moor grass and rush pastures	Suburban/ mosaic of developed/ natural surface
Upland flushes, fens and swamps	
Aquatic marginal vegetation	
Reedbeds	
Other swamps	

3.3 Ecosystem service classification

It is important to cover a broad range of services because, if key services are omitted, the EBN tool could trigger poorly informed decisions that have unintended adverse impacts on the missing services. Four provisioning services, nine regulating services and five cultural services are assessed, in order to cover all those that could be important to stakeholders in the context of a typical UK development project in either a rural or urban setting. Services that are less relevant for the typical UK development context have been omitted. These include hydropower and provision of medicinal products.

The classification is broadly compatible with CICES (Common International Classification of Ecosystem Services, https://cices.eu), but the terminology has been modified for easier use by non-specialists.

The cultural services can be mapped to the framework used in the UK National Ecosystem Assessment. This considers cultural services to be provided by the interaction of places ('environmental settings') such as parks and woodlands etc., which correspond to the EBN habitats, and activities ('cultural practices') such as playing and exercising. The services give rise to three categories of benefits: experiences, capabilities and identities (Church et al., 2014). A similar framework has been adopted by IPBES (Intergovernmental Panel on Biodiversity and Ecosystem Services), which uses three non-material (cultural) services: learning and inspiration, physical and psychological experiences and supporting identities. Although there is some overlap (for example all five services can provide health benefits, which are classed under 'capabilities'), the five cultural services used in the EBN tool can be broadly mapped to the three categories of benefit as shown in Table 3.

Table 3: Links between cultural services in the EBN tool and those in UK National Ecosystem Assessment and IPBES

EBN tool	UK NEA	IPBES
Recreation and leisure Interaction with nature Aesthetic value	**Experiences** (e.g. tranquillity, inspiration, escape, discovery)	Physical and psychological experiences

Education and knowledge	**Capabilities** (e.g. knowledge, health, dexterity)	Learning and inspiration
Sense of place	**Identities** (e.g. belonging, sense of place, rootedness, spirituality)	Supporting identities

Table 4: Ecosystem services included in the EBN tool

Provisioning	
Food production	Arable crops, horticulture, livestock, orchards, allotments, urban food, wild food (e.g. gathering berries or mushrooms).
Wood production	Timber, wood production for paper, woody biofuel crops, coppice wood or wood waste used for biofuel.
Fish production	Aquaculture, commercial fishing, recreational fishing (recreational fishing is also a cultural service, but the habitat conditions match those for fish production).
Water supply	Impact of soil and vegetation on rainwater runoff and infiltration, and thus on groundwater recharge or surface water flow.
Regulating	
Flood regulation	Reduction of surface runoff, peak flow, flood extent and flood depth through canopy interception, evapotranspiration, soil infiltration and physical slowing of water flow.
Erosion protection	The ability of vegetation to stabilise soil against erosion and mass wastage by protecting the soil from the erosive power of rainfall and overland flow, trapping sediment, and binding soil particles together with roots.
Water quality regulation	Direct uptake of pollutants by terrestrial or aquatic vegetation; interception of overland flow and trapping / filtration of pollutants and sediment by vegetation before it reaches watercourses; breakdown

	of pollutants into harmless forms e.g. by denitrifying bacteria that convert nitrates into nitrogen gas. Also, infiltration into the ground, allowing pollutants to be filtered out by the soil and preventing pollution of watercourses – though pollutants could enter groundwater supplies.
Carbon storage	Carbon stored in vegetation and soil. For a typical development (with complete loss of habitats and often major soil disturbance), this is more relevant than carbon sequestered annually. However, peatland restoration is an exception (see Box 1). The 'time to reach target condition' reflects the time taken for a new habitat to reach a typical carbon sequestration rate for a mature habitat.
Air quality regulation	Air pollution impacts on health, climate and biodiversity. Vegetation can affect pollutant concentrations through dispersion and remove pollutants by deposition. Fine particles ($PM_{2.5}$) are particularly damaging for human health. The right vegetation in the right place can remove particulates, sulphur dioxide, ozone and nitrogen oxides.
Cooling and Shading	Shade, shelter and cooling effect of vegetation and water, especially urban trees close to buildings, green roofs and green walls, which can reduce heating and cooling costs, or trees in urban parks which can provide shade on hot days.
Noise reduction	Attenuation of noise by vegetation.
Pollination	Pollination of crops (and wild plants, supporting other ES) by wild insects (mainly bees and hoverflies). Excludes pollination by managed honeybees.
Pest control	Predation of crop or tree pests by invertebrates (e.g. beetles, spiders, wasps), birds and bats.

Cultural	
Recreation	Provision of green and blue spaces that can be used for any recreational activity, e.g. walking, cycling, running, picnicking, camping, boating, playing or just relaxing.
Aesthetic value	Provision of attractive views, beautiful surroundings, and pleasing, calming, or inspiring sights, sounds and smells of nature.
Education and knowledge	Opportunities for formal education (e.g. school trips), scientific research, local knowledge and informal learning (e.g. from information boards or experiences).
Interaction with nature	Provision of opportunities for formal or informal nature-related activities, e.g. bird watching, botany, random encounters with wildlife, or feeling 'connected with nature'. There is some overlap with biodiversity, but access by people can have negative impacts on some wildlife habitats. Excludes recreational fishing; hunting / shooting (not covered); the intrinsic value of nature (covered by the statutory biodiversity metric tool); existence value (from just knowing that nature exists).
Sense of place	Refers to the way in which people relate to and perceive the distinctive character, history and spirit of an area[14] The tool covers aspects of a place that make it special and distinctive – this could include locally characteristic species, habitats, landscapes, or features; places related to historic and cultural events, or places important to people for spiritual or emotional reasons.

[14] Green Infrastructure Design Guide chapter on sense of place (5.14)

Box 1. Carbon storage and carbon sequestration

Carbon storage is the total amount of organic carbon stored in soil and vegetation. Carbon sequestration is the amount of carbon absorbed from the atmosphere per year, as vegetation grows through photosynthesis and soil organic carbon increases through the incorporation and decomposition of organic matter such as leaf litter and fine roots. Carbon storage and sequestration are two facets of the same process, as carbon storage is simply the sum of all carbon sequestration over time (minus any emissions).

For most types of habitat change we expect the direction and magnitude of changes in carbon storage and carbon sequestration to be very similar. For example, planting a new woodland will result in an increase in both carbon storage and sequestration, while destroying a woodland will result in a large loss of both stored carbon and future sequestered carbon. Therefore, for simplicity, we report only carbon storage in the EBN tool.

However, this is not the case for peat, which has an exceptionally high level of carbon storage, but where sequestration can range from a small annual increase for peat in good condition to a large annual emission of carbon for degraded or cultivated peat, such as on moorland that has been drained or burnt, or on lowland fens that have been drained for agriculture. Restoration of degraded peat, either from moorland or arable land, is therefore expected to result in a switch from carbon emissions to carbon sequestration but without a major short-term impact on carbon storage. This type of restoration will play a vital role in meeting climate mitigation targets. We have therefore added a flag to the results page to notify the user of the potential difference in results between carbon sequestration and carbon storage in projects that involve peat.

3.4 Scores

The core of the EBN tool is a matrix of scores reflecting the ability of different types of habitat or land cover (rows) to deliver different ecosystem services (columns). The score sheet of the EBN tool is accessible from the Technical User Menu.

The scores were derived from an extensive review of a range of over 30 existing tools and data sources as part of Phase 1 of the EBN tool development, supplemented by a literature review of over 700 papers (Smith et al., 2017). The scores were further reviewed by a range of experts in different ecosystem services and habitats in a series of expert workshops and consultations as part of Phase 2. Note that these scores are still under review and may be further refined as new data sources emerge.

Although most scores are simply rankings of the level of services delivered by different habitats, in some cases (carbon storage and air quality regulation) they are set to be

proportional to biophysical evidence (tonnes of carbon stored per hectare, and deposition of air pollutants).

3.5 Habitat condition indicators and spatial factors

The matrix of scores reflects the performance of a ‘typical’ habitat. Multipliers are then applied based on 38 indicators of habitat condition and spatial location. These indicators reflect how a habitat differs to the expected condition. For example, Figure 6 (top) shows two examples of amenity grassland. The top of the picture shows grassland in very poor condition for most services (except certain types of recreation such as football), whereas the bottom shows grassland in better condition that would generate a more diverse range of ecosystem services. Grassland with dense vegetation and many flowering plants will provide better water quality regulation, pollination and aesthetic value than over-grazed or over-mown grassland with compacted soil, limited species diversity and bare patches. Similarly, woodland with larger trees and complex understorey vegetation will provide more carbon storage and better flood protection than woodland with smaller trees and short ground cover (Figure 6, bottom).

Figure 6: Two different examples of amenity grassland (top) Compacted, with short sward and bare patches /Tussocky, good ground cover and abundant and woodland (bottom) with very different condition & associated structures.

Amenity grassland

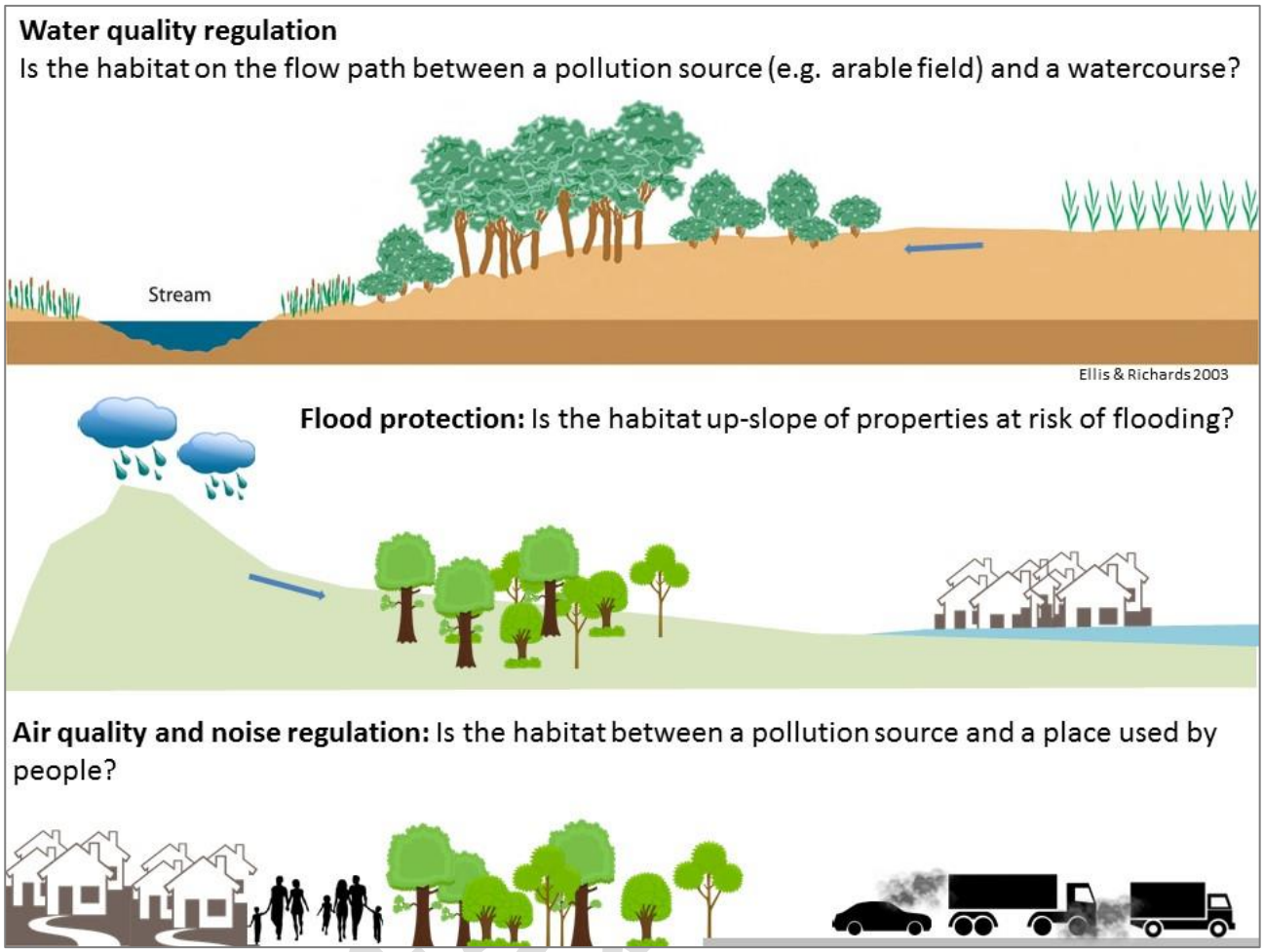
Woodland

Small trees; short grass; low structural diversity

Large trees; complex ground cover; high structural diversity

Spatial factors also influence the provision of many ecosystem services. For example, vegetation can only deliver the service of water quality regulation if it is positioned between a pollution source (e.g. an arable field) and a receptor (e.g. a stream). Similarly, woodland upstream of a flood zone will be more important for flood protection than woodland where there are no properties downstream at risk of flooding, and trees or hedges are better for limiting noise and air pollution if they are between a busy road and a place used by people (Figure 7).

Figure 7: Examples of the importance of spatial factors (habitat position and spatial configuration)



The condition indicators affect the supply of ecosystem services, whereas many of the spatial factors reflect the demand for the services. The demand indicators could be considered as indicators of the priority or weight that could be placed on each service. However, to keep the tool simple for users, the demand indicators only take account of whether or not the habitat is capable of providing a benefit for people, not the number of beneficiaries (except for a basic indicator of population density applied to the services of recreation and education, and some consideration of flood management priority in one of the flood protection demand indicators). Also, some people might benefit whereas others might lose ecosystem services, especially if habitats are cleared at the development site and compensated for in a different location. The EBN tool does not reflect these issues, but they should be taken into account in decision-making (see section 4.4 and Bull et al, 2018).

For certain ecosystem services, linear habitats may have a higher impact than is indicated by their area on the ground. This includes rivers and streams for fish production and cultural services, hedgerows for cultural services, and footpaths for recreation. The statutory biodiversity metric tool accounts for rivers and hedgerows separately to non-linear habitats, as they are high value habitats that must be replaced on a like-for-like basis. In the EBN tool, linear habitats are included alongside other habitats for many

services (such as carbon storage), but we apply a multiplier to indicate their greater value for certain services.

Table 5. summarises the main habitat condition and spatial factors that can be applied for each ecosystem service. It shows which information can be obtained from freely available online sources such as the Natural England Green Infrastructure Data Portal website, and which is to be collected via a site survey. Data requirements for the EBN tool have been harmonised with the survey data needed for the statutory biodiversity metric tool, and that which will be collected for an Environmental Impact Assessment (EIA) for larger developments. However, some indicators, such as tree size, are additional. Data collection for the EBN tool can easily be integrated within the procedure for a Phase 1 habitat survey. Full details of how to determine values for all the indicators are provided in the Data Catalogue.

Table 5: Condition indicators and spatial factors applied for each service (See Data Catalogue for full details) (NEW)

Blue = demand; Green = supply; Brown = position or spatial configuration

Ecosystem Service	Condition indicators and spatial factors	Source
Food provision	Agricultural Land Class	Green Infrastructure Data Portal (Replicates MAGIC data used previously)
Fish production	WFD (Water Framework Directive) overall ecological and chemical status	Green Infrastructure Data Portal (replicates EA Catchment Data Explorer data used previously)
	Barriers to fish passage	Site assessment
	Naturalness of water body	Site assessment
	Linear habitat multiplier	Applies to all running water
Timber production	None (Usually grown on low grade land and can cope with steep slopes, low temperatures, high rainfall and high altitudes).	
Water supply	Surface water availability in the catchment	Green Infrastructure Data Portal (replicates Catchment Abstraction Management Status (EA) data used previously)
	Groundwater availability in the catchment	Green Infrastructure Data Portal (replicates WFD groundwater quantitative status (EA) data used previously)
	Soil drainage	LANDIS

Ecosystem Service	Condition indicators and spatial factors	Source
	Soil compaction	Site assessment
Flood regulation	Ability of habitats to mitigate flood risk: Maximum of three indicators (= Natural Flood Management priority	Green Infrastructure Data Portal (replicates Online maps MAGIC data used previously)
	Canopy cover (%)	Site assessment
	Soil compaction	Site assessment
	Extent of tall or tussocky grasses Extent of shrub layer	Site assessment
	Water body naturalness	Site assessment
Erosion protection	Slope	UK Soil observatory
	Rainfall	Green Infrastructure Data Portal (replicates Met Office data, slight change to original data source)
	Soil erodibility	NSRI (not free)
	Ground cover (%)	Site assessment
	Extent of tall or tussocky grasses Extent of shrub layer	Site assessment
	Peat quality (actively forming or degraded)	Site assessment
	Soil management	Local knowledge
	Position for erosion prevention (Yes, No or Partial): is the habitat positioned below or within an area susceptible to erosion?	Site assessment / maps
Water quality regulation	Is the habitat in a water quality management area?	Green Infrastructure Data Portal (replicates Catchment Data Explorer (Environment Agency) data used previously)
	Ground cover (%)	Site assessment
	Extent of tall or tussocky grasses	Site assessment
	Peat quality (actively forming or degraded)	Site assessment
	Soil management	Local knowledge
	Soil compaction	Site assessment
	Water body naturalness	Site assessment
	Position for water quality regulation: is the habitat located on the flow path between a pollution source (arable field or road) and a water course?	Site assessment or maps
Carbon storage	Tree size	Site assessment
	Canopy cover	Site assessment
	Peat quality (actively forming or degraded)	Site assessment

Ecosystem Service	Condition indicators and spatial factors	Source
Air quality regulation	Canopy cover	Site assessment
	Air pollution barrier: does the habitat provide a barrier between a pollution source and people?	Site assessment
Local climate	Tree size	Site assessment
	Canopy cover	Site assessment
	Shading ability: does the habitat provide shade for a building or area used by people?	Site assessment
Noise reduction	Noise barrier: does the habitat form a noise barrier between a busy road and people?	Site assessment
Pollination	Flower abundance and diversity	Site assessment
	Presence of invertebrate nesting sites (dead wood, tree cavities, dry earth)	Site assessment
Pest control	Presence of invertebrate nesting sites (dead wood, tree cavities, dry earth)	Site assessment
Recreation	Population density in local area	Green Infrastructure Data Portal
	Public access (Y/N)	Local knowledge
	Special recreational value	Green Infrastructure Data Portal (replicates MAGIC data used previously)
	Linear habitat multiplier	Applies to paths, running water, hedges
Aesthetic value	Flower abundance	Site assessment
	Landscape diversity	Site Assessment/ LI Landscape Character database
	Water body naturalness	Site assessment
	Linear habitat multiplier	Applies to running water, hedges
Education	Population density in local area	Local Authority/ Local knowledge Green Infrastructure Data Portal (provides access data only)
	Educational use	Local knowledge
	Nature designation	Green Infrastructure Data Portal (replicates MAGIC data used previously)
	Cultural designation	Green Infrastructure Data Portal (replicates

Ecosystem Service	Condition indicators and spatial factors	Source
		MAGIC data used previously; local authority
	Managed for nature	Local knowledge
	Linear habitat multiplier	Applies to running water, hedges
Interaction with nature	Public access	Local knowledge
	Extent of tall or tussocky grasses Extent of shrub layer	Site assessment
	Tree size	Site assessment
	Flower abundance and diversity	Site assessment
	Presence of invertebrate nesting sites (dead wood, tree cavities, dry earth)	Site assessment
	Nature designation	Green Infrastructure Data Portal (replicates MAGIC data used previously)
	Ancient habitat	Green Infrastructure Data Portal (replicates MAGIC data used previously)
	Managed for nature	Local knowledge
	Resources for local species	Site assessment and local knowledge
	Fish barriers	Site assessment
	Water body naturalness	Site assessment
	Linear habitat multiplier	Applies to running water, hedges
	Nature designation	Green Infrastructure Data Portal (replicates MAGIC data used previously)
	Cultural designation	Green Infrastructure Data Portal (replicates MAGIC data used previously); local authority
	Ancient habitat	Green Infrastructure Data Portal
	Managed for nature	Local knowledge
	Resources for local species	Site assessment and local knowledge
	Local distinctiveness / special value to the local community	Local authority; local knowledge
	Water body naturalness	Site assessment
	Linear habitat multiplier	Applies to running water, hedges

Ecosystem Service	Condition indicators and spatial factors	Source
Sense of Place	Local Distinctiveness	Local Character Area Database
	Resources for local species	Site assessment/Local knowledge
	Nature Designation	Green Infrastructure Data Portal
	Ancient habitat	Green Infrastructure Data Portal
	Cultural and Historic importance	Green Infrastructure Data Portal (replicates MAGIC data used previously) +Historic England, Listed building search

Although it is relatively easy to list the main condition and spatial factors that are important for each service, it is harder to translate these into multiplier values. Where possible, biophysical data is used to inform the multipliers (e.g. for the influence of tree size on carbon storage). However, most of the multipliers are based on expert opinion. The rationale for multiplier selection is presented in the Data Catalogue.

3.6 Time for habitat to reach target condition, and delivery risk

Newly created or restored habitats will typically take some time to reach their full potential to deliver ecosystem services. This time lag will vary depending on the habitat and the ecosystem service in question. This can be reflected in a 'time to reach target condition' multiplier.

The statutory biodiversity metric tool uses a discount rate of 3.5% to calculate the present value of a habitat delivered at the 'time to target condition', compared to the value if the habitat was delivered today. The discount rate reflects society's preference for 'habitats now' rather than 'habitats later'. However, user feedback from pilot testing led us to adopting a simpler approach in the EBN tool. It displays the change from the baseline score at three points in time: 1, 10 and 30 years after the land use change. For newly created habitats, the change in score takes account of the starting habitat. For example, if a woodland is created on improved grassland, the tool calculates the gradual increase in score from the grassland score to the woodland score over the time it takes for the woodland to grow to its target condition.

There is a risk that habitats may not be successfully created or restored, which is expressed as a separate 'delivery risk' factor. The EBN tool uses a similar approach to risk factors to statutory biodiversity metric tool for habitat creation. The delivery risk factors are slightly different, however, because pilot tests showed that using the same factors as the

statutory biodiversity metric tool caused perverse outcomes for some services. For example, semi-natural habitat creation would score less than creation of managed habitats such as amenity grassland. Therefore, we use a simplified set of factors: all semi-natural habitats have a delivery risk of two-thirds (0.667), and all managed habitats have a risk of 1.0 (i.e. zero risk); delivery risk only applies to services that have a time to target condition of over a year[15]. The statutory biodiversity metric tool applies high risk factors because it aims to ensure adequate compensation for any lost areas of semi-natural habitat. As the EBN tool is applied together with the statutory biodiversity metric tool this compensation should already be guaranteed by achieving BNG.

We do not apply a delivery risk factor for habitat restoration / enhancement because enhancement is relatively low risk for ecosystem service delivery, though there could be a higher risk of not achieving target condition for biodiversity.

The time lag and delivery risk factors are only applied to habitats that are newly created, restored or enhanced as part of the land-use change proposal being assessed. They are not applied to existing habitats, even if existing habitats are not yet at full potential (e.g. young woodland). Differences in ecosystem service delivery for young habitats can be captured through condition indicators such as tree size.

Irreplaceable habitats (as provided for in BNG regulations) are technically very difficult to recreate once destroyed (or re-creation would take a significant amount of time). As such, the BNG requirement is disapplied for these habitats. Any losses or deterioration impacts to irreplaceable habitats cannot be calculated by the statutory biodiversity metric tool and they are removed from the baseline. Where there are no losses or deterioration of irreplaceable habitat, their enhancement may contribute towards the calculation of post-development biodiversity units using the statutory biodiversity metric tool. The statutory biodiversity metric tool excludes irreplaceable habitats (e.g. ancient woodlands) because they cannot be offset as part of biodiversity net gain. Irreplaceable habitats should not be destroyed.

Find out more about The Biodiversity Gain Requirements (Irreplaceable Habitat) Regulations 2024.

The EBN tool currently includes ancient habitats, flagged with a specific indicator, in order to make their value more visible to decision-makers. An error check warns if any ancient habitats are not retained or enhanced.

[15] This approach ensures that delivery risk is not applied to semi-natural habitat offering flood management for example, and only applies to services that take longer to deliver and are therefore at greater risk of not delivering.

4. Using the results

This section explains how the results from the tool can be used and key considerations for interpretation and incorporation in project design.

The EBN results show which services are estimated to have gains and which have losses (Figure 8). Where there are losses, the user can experiment with altering the type, condition, or spatial location of habitats to see if losses can be reduced or turned into gains, working within the good practice principles for biodiversity net gain. Following changes of this type, the statutory biodiversity metric tool calculation should be updated to check that the project still produces a biodiversity net gain. The updated tool now includes a similar estimate for Urban Greening Factor, which may be used where this also applies.

Figure 8: Example results from the EBN tool

Potential impacts of on-site and off-site habitat change at three time points (not cumulative): Whole area

Select area of interest:

Whole area	1 year	10 year	30 year	Confidence	Interpretation Expand Collapse
Food production	↓	↓	↓		The results 30 years after development indicate a large decrease in the potential for food production.
Wood production	→	→	↗		
Fish production	→	→	→		
Water supply	↘	↘	↘		The results 30 years after development indicate a decrease in the ecosystem service of water supply. If
Flood regulation	↘	↘	↗		
Erosion protection	→	↗	↗		
Water quality regulation	↗	↗	↗		
Carbon storage	↘	↘	→		
Air quality regulation	↘	→	↗		
Cooling and shading	↘	→	↗		
Noise reduction	↗	↗	↗		
Pollination	↘	↗	↗		
Pest control	↘	→	↗		
Recreation	↑	↑	↑		
Aesthetic value	↘	↗	↗		
Education	↗	↗	↗		
Interaction with nature	↗	↗	↗		
Sense of place	↘	→	↗		

The results reveal opportunities to deliver multiple benefits, but also trade-offs between different services. For example, planting new woodland on arable land could provide benefits for carbon storage, aesthetic value, sense of place, flood protection and air quality regulation, but there will be a loss in food provision. The EBN tool makes these trade-offs explicit, so that local stakeholders can consider their priorities and act accordingly.

The outputs should not be presented in isolation, but as part of a narrative that explains the reasons for the changes in ecosystem service delivery and provides the local context. There should always be a ‘sense check’ to make sure that the EBN tool outputs are logical and consistent with other assessments. Users may wish to examine the interpretation charts and the underlying calculations (links are provided from the main results sheet) to understand the reasons behind the changes in EBN tool scores before and after the development and associated biodiversity net gain activities.

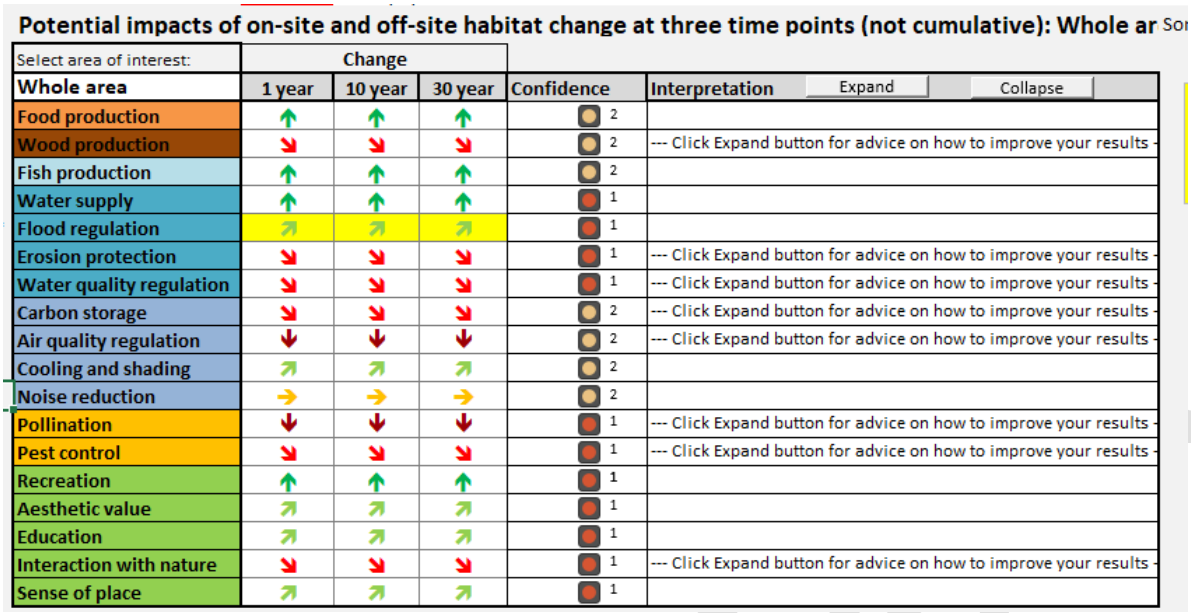
4.1 Consideration of stakeholder needs and priorities

The EBN tool should be applied as part of an inclusive, participatory process with local stakeholders. Both local priorities for ecosystem services and national priorities such as food production or carbon storage should be considered. Information on service priorities should be sought from Local Plans, SPDs, Green Infrastructure and increasingly Local Nature Recovery Strategies, where available. Contextual Data collected through tool completion such as information on water availability, water quality and natural flood management priority may also provide a helpful starting point for engagement. Although it is unlikely that gains in all ecosystem services can be achieved, the EBN tool can be used to make gains and losses visible, so that decision-making is consistent, transparent and thorough. It could be applied as part of a process of Multi-Criteria Decision Analysis (MCDA).

Where service priorities are known, the new version of the tool highlights these services[16] in yellow within the results table for ease of reference. This functionality is intended to help provide clear visibility of priorities within a mixed picture of trade-offs and losses, while maintaining the necessary overview.

[16]Which are entered via the Project Details tab

Figure 9: Example results from the EBN tool showing flood regulation highlighted as a priority (NEW)



Potential impacts of on-site and off-site habitat change at three time points (not cumulative): Whole ar

Select area of interest:	Change					
Whole area	1 year	10 year	30 year	Confidence	Interpretation	Expand / Collapse
Food production	↑	↑	↑	2		
Wood production	↘	↘	↘	2	--- Click Expand button for advice on how to improve your results	
Fish production	↑	↑	↑	2		
Water supply	↑	↑	↑	1		
Flood regulation	↗	↗	↗	1		
Erosion protection	↘	↘	↘	1	--- Click Expand button for advice on how to improve your results	
Water quality regulation	↘	↘	↘	1	--- Click Expand button for advice on how to improve your results	
Carbon storage	↘	↘	↘	2	--- Click Expand button for advice on how to improve your results	
Air quality regulation	↓	↓	↓	2	--- Click Expand button for advice on how to improve your results	
Cooling and shading	↗	↗	↗	2		
Noise reduction	→	→	→	2		
Pollination	↓	↓	↓	1	--- Click Expand button for advice on how to improve your results	
Pest control	↘	↘	↘	1	--- Click Expand button for advice on how to improve your results	
Recreation	↑	↑	↑	1		
Aesthetic value	↗	↗	↗	1		
Education	↗	↗	↗	1		
Interaction with nature	↘	↘	↘	1	--- Click Expand button for advice on how to improve your results	
Sense of place	↗	↗	↗	1		

4.2 Consideration of design

There are many sources of existing guidance on how to improve different aspects of project design to enhance the delivery of natural capital, green infrastructure and biodiversity. The National Design Guide[17] illustrates how well-designed places that are beautiful, enduring and successful can be achieved in practice, and sets out the ten characteristics of good design. The accompanying National Model Design Code[18] provides detailed guidance on the production of design codes, guides and policies to promote successful design, expanding on the ten characteristics of good design. Natural England's National Framework of Green Infrastructure Standards aims to enhance the quantity, quality and functionality of green infrastructure and provides its own design guide to work alongside the EBNT (see 4.5). The EBN tool should be used alongside these and other industry good practice design guidance and can provide a consistent approach to capturing the multi-functional benefits of green infrastructure.

[17] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/962113/National_design_guide.pdf

[18] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/957205/National_Model_Design_Code.pdf

4.3 Using Interpretation and Comparing options (NEW)

As set out in the NE Green infrastructure design guide (see section 4.5), different designs may offer different services, within a given location. The Save and Compare Options functionality within the tool allows users to save and compare results from different design configurations within the same spreadsheet. Where entered, priority services will also be highlighted in each display.

When considering options, the interpretation text provided to the right of the main results can help guide alternatives. This text appears where a potential service loss is anticipated and provides succinct guidance on the sort of interventions that could improve delivery, should the service in question be a priority.

Options should be considered in line with guidance in Section 4 and if presented, should be accompanied by clear confidence ratings and as part of a narrative, providing by an appropriate person with suitable expertise.

4.4 Consideration of landscape impacts (NEW)

When using EBN tool outputs to inform decisions, users should consider how appropriate it is to create or restore different types of habitat in a specific location, taking into account landscape, townscape and historic character, as well as cumulative impacts and the balance between habitat types across the region. For example, if the tool predicts large ecosystem service gains from creating woodland or grassland, there would still be a need to consider the landscape character and how the proposed changes will affect any key characteristics or valued aspects of the landscape. The context of the site and what people value about the place can be taken into account during the decision-making process, allowing for proposals to be adapted to suit the particular place, rather than focusing purely on the type that gives the largest scores. The aim should be to create a mix of habitat types and habitat mosaics appropriate to the context, ideally linking to local nature recovery strategies and networks, green infrastructure strategies and landscape character assessments[19].

[19] The updated tool now included Landscape Institute LCA database to allow easy access to published Landscape Character Assessments for corresponding areas.

4.5 Use alongside Green Infrastructure Standards (NEW)

The EBN tool can support better multi-functional design of new development (or other forms of land use change). The Green Infrastructure Design Guide provides a useful accompanying guide to the EBN tool, setting out how to design green infrastructure for multiple benefits, such as clean air and water, storing carbon or better access to nature.

The EBN tool can work alongside tools & standards within the Green Infrastructure Framework like the Urban Greening Factor (UGF). UGFs can be incorporated into local plan policies to set the quantity and quality of green infrastructure required by local authorities as part of local development. For example, a UGF of 0.4 is commonly used for residential development (reflecting contribution from green roofs, green walls or greenspace). The EBN can be used to demonstrate what services this green infrastructure will deliver and how the services are likely to change over time and help to understand how the development's GI could help to address local needs such as poor air quality or flood risk.

The updated EBN tool also includes automated conversion to UGF surface cover types to provide UGF estimates within the tool and works with spatial information from the Green Infrastructure data portal to allow for integrated delivery (see EBN User Guide).

4.6 Use to support wider delivery projects, such as the pipeline of projects set out in Local Nature Recovery Strategies (LNRS)/ linked to Green Finance (NEW)

The EBN tool may assist the delivery of LNRS pipeline projects by highlighting the environmental benefits of undertaking the interventions set out in the LNRS. In such cases, the tool should be used alongside the statutory biodiversity metric tool, which will often form part a key part of green finance calculations. EBN tool use alongside this tool may provide useful information prior to any engagement with markets associated with ecosystem services. Use for projects focussed on habitat enhancement is not recommended, as calibration of the tool is geared towards land use change (see 4.7).

4.7 Consideration of caveats and limitations

All tools and approaches have their own limitations, and it is good practice to be transparent about these because it helps ensure good application. The following caveats and limitations are intended to provide transparency and help users correctly use the tool.

1.The EBN tool uses habitat extent, condition and location as proxies for ecosystem service delivery

The EBN tool uses changes in habitat extent, condition and location as proxies for changes in the ecosystem services that flow from these habitats. It does not take into account, for example, topography or hydrological factors, so it is not a substitute for a detailed assessment such as a flood risk model. However, it can identify the role of woodland in intercepting rainfall and thus reducing flood risk, and it assigns high flood protection scores to SuDS features such as bioswales, retention ponds, detention basins or raingardens.

2.The EBN tool does not consider impacts beyond ecosystem service provision or impacts on different groups of beneficiaries.

As the EBN tool focuses only on the impacts of habitat change on ecosystem services, it does not provide a detailed assessment of factors such as environmental justice and community impact. It can help users to apply international good practice principles on the 'people' aspects of biodiversity net gain (Bull et al, 2018), although it does not associate losses and gains in ecosystem services with individual groups of people. For example, it might show an overall increase in recreational benefits, but it would not show that residents living near a development site lost a local green space and lived too far from the biodiversity offset site to benefit from it. The user should take this into account, applying the EBN tool appropriately and in-line with good practice including Bull et al, 2018.

3.Confidence ratings for the EBN tool scores and multipliers vary

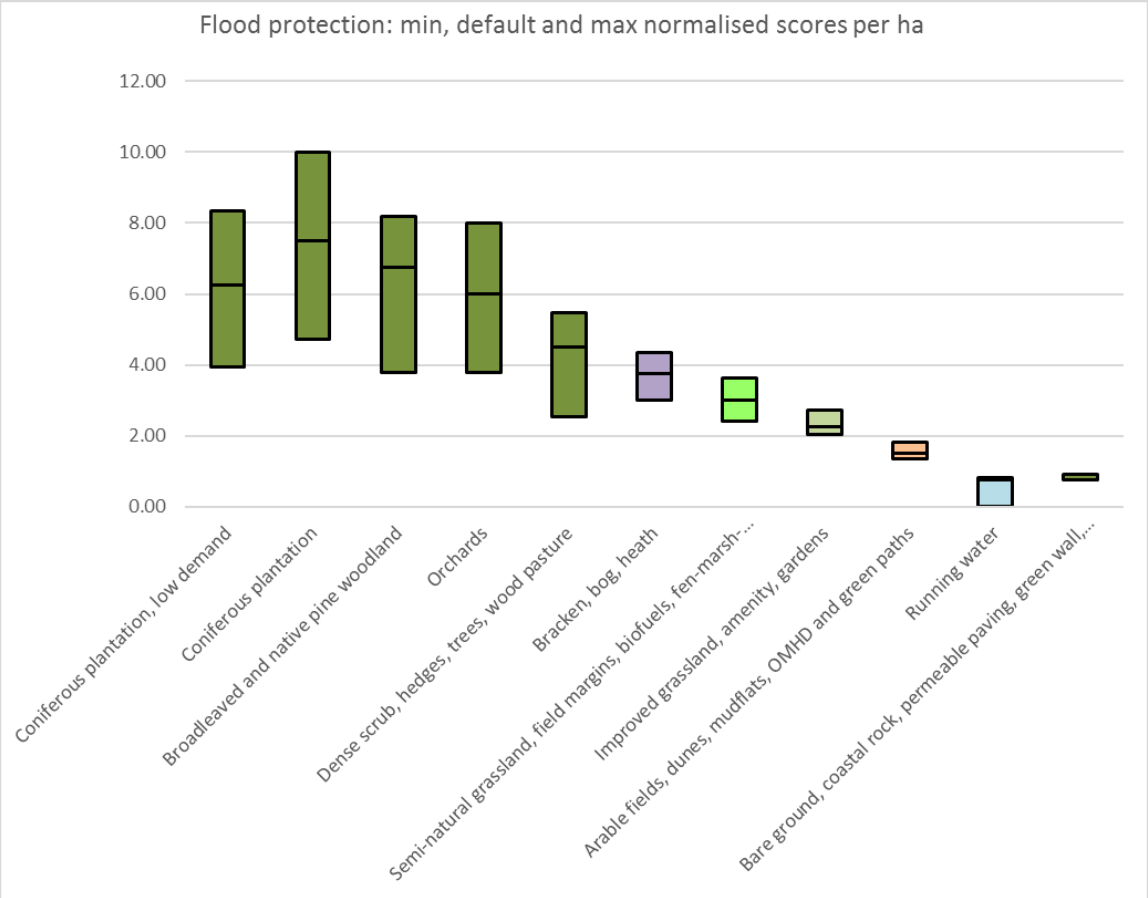
The tool is based on best available evidence. Since this evidence is partial and variable between ecosystem services, and relationships between habitat land use change and ecosystem service provision are complex, the results indicate relative confidence levels for transparency. What this means (as seen in Figure 8) is that where an ecosystem service has an amber rating, there is more evidence available to calibrate the range of scores across habitats and multipliers than where it is red. This emphasises the need to sense-check the results in line with the good practice outlined in this document.

The EBN tool scores have been derived from an extensive review of published evidence and a series of expert consultations (see Section 3). The scoring matrix is robust in comparison with similar score-based approaches, but there is still considerable reliance on expert knowledge and professional judgement. In particular, confidence is lower for the cultural services, because the value of these services is rooted partly in the subjective opinion and personal preference of different users, which can vary widely. Even where evidence is available, often this does not cover all habitat types and the researchers have filled these gaps based on their own judgement, typically by defining scores in relation to comparable habitat types for which evidence was available.

Assigning values to the multipliers for condition and spatial factors is even more challenging. We have restricted the combined impact of the multipliers to realistic upper and lower bounds, such that, for example, the adjusted flood storage score for 'best condition' grassland does not exceed the score for 'worst condition' woodland (Figure).

The scores and multipliers will continue to be refined in response to wider testing and evaluation and user feedback.

Figure 10: Example of sensitivity test comparing the impact of condition and spatial multipliers for the ecosystem service of flood protection



4.The EBN tool results are not cumulative and do not account for the cumulative impact of losses over the time periods shown

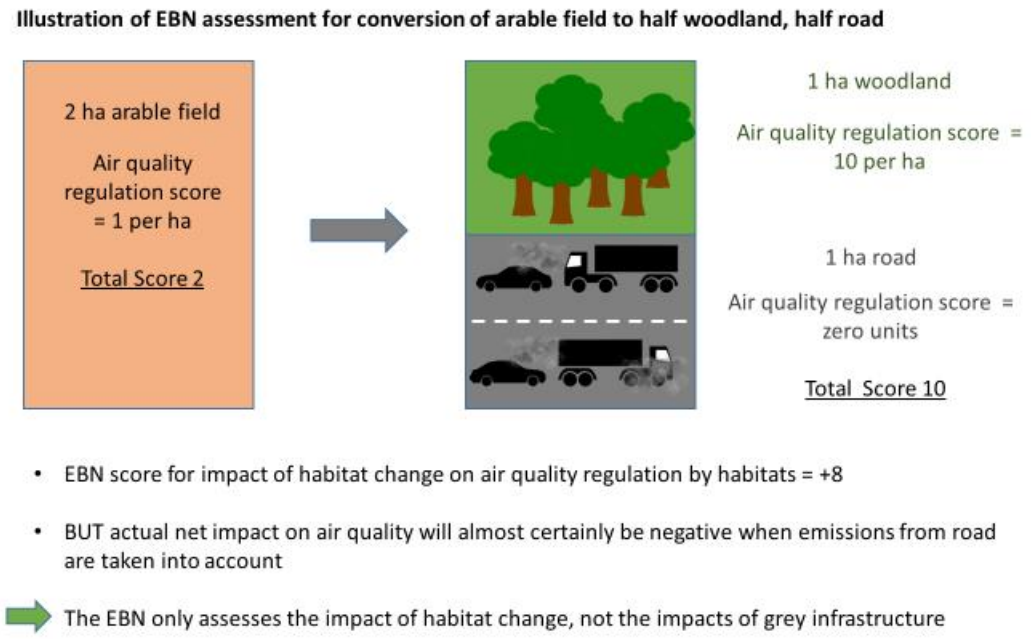
As stated above, and demonstrated in the results table (Figure 8), the potential impacts shown at the three different time periods are not cumulative. This means that where losses have occurred (for example, as shown by downward arrows at year 1 and 10) these are not considered with in the results for year 30. The results simply compare delivery at each of the time periods with service provision from the baseline.

5.The EBN tool assesses losses or gains of ecosystem services related to habitat change, not the wider environmental impacts and pressures caused by 'grey' infrastructure

The EBN tool only captures the impacts of habitat change on ecosystem services. It captures the role that vegetation plays in reducing air pollution and noise, but not non-ecosystem impacts of the development as a whole, such as noise and air pollution from traffic. For example, if half of a field is converted to woodland and the other half to a road, the EBN tool will show a net improvement in the capacity of natural habitats on the site to

regulate air quality, due to the change from arable to woodland on half of the site. This reflects the ecosystem services impact. However, the overall net impact of the whole development on air quality is likely to be negative when emissions from the road are also taken into account. Such non-ecosystem service impacts are subject to statutory and planning requirements, usually informed by an Environmental Impact Assessment. In order to achieve ENG under the potential framework the development would also need to demonstrate a net overall reduction in total emissions, e.g. through stringent vehicle emissions regulations combined with some sort of offsetting investment (Figure 11).

Figure 11: Example showing that the EBN tool assesses only the impacts of habitat change, not other impacts of development (simplified example with no multipliers for condition and spatial factors or time to reach target condition)



6. Confidence Ratings Relate to Services not level of assessment (NEW)

While ADVANCED level data entries will increase the accuracy of assessments, the confidence ratings within the tool do not change as a result of greater data entry. This is because confidence ratings are service-specific and not hard-wired within the system itself.

7. EBN tool assessments are designed to consider land use change, not changes to land management, therefore BNG enhancement may not register gains (NEW)

The sensitivity calibration of the indicative EBN tool means that changes to land management aimed at enhancing biodiversity (such as changes to cutting or grazing) are unlikely to influence the main results display. This is due to the relatively broad change parameters used to create the arrows within the main indicative Results display. These changes may be seen in more detail in the Calculations tab within the tool. Arrow changes

may register where change in condition is significant, for example from highly compacted soil to no compaction, tall tussocky sward to short sward and changes and significant changes to associated flower coverage or bare ground.

8. Delivery risk is habitat not service-specific (NEW).

Where time to target condition is greater than one year for a given habitat to deliver specific service, a fixed delivery risk multiplier allocated to that habitat will apply. This approach ensures that delivery risk is not applied to semi-natural habitats able to offer services that are not linked to diversity, such as water supply from grassland, but represents a simplification for other services.

9, Benefits from habitat enhancement through BNG can only be recorded in an ADVANCED assessment (NEW)

Enhancement is likely to change associated habitat structure. This may be positive or negative for services, depending on the baseline condition and conditions put in place. For example, enhancement of a grassland habitat for biodiversity may increase flower coverage with associated benefits to pollinators, but also reduce grass height and scrub cover, reducing capacity to slow the flow of water etc. It is therefore necessary to record such conditions within the baseline and post-intervention work tabs within an ADVANCED assessment to allow for such associated changes to be recorded and factored into calculation. BASIC assessment will not register increases in service provision from enhancement.

10. Noise reduction requires ADVANCED assessment to establish if this service is being delivered (NEW). For BASIC / STANDARD assessment noise reduction will appear as no change. Users must specify under ADVANCED modifier 29 whether the habitats is providing a barrier or offering vegetation in a position capable of delivering the service. The tool assumes that this service is not being offered unless specified and therefore requires completion of these fields to generate scores.

11. **Impact does not consider beneficiaries or local demand (NEW)**

As stated above (caveat 2), gains shown for some services may not be delivered directly to the local community. This is particularly true if delivery of gains is to be provided off-site (see section 3.5). Equally, highlighted onsite gains to certain services may not always be required locally - for example, a small improvement in access adjacent to a large park may result in a reported increase in recreation services, but this may not be a meaningful benefit if demand is already being/ is likely to be met (see section 4.1). Moreover, an entered improvement to public access in a field separated from a nearby population by a railway line (or similar obstacle) may not deliver the gains in services shown in the tool. Such ‘technical gains’ are limitations of the tool and underline the need for sense checking.

12. **The positive impact of linear barriers may not register in the main results display, particularly for larger sites (NEW).** While providing and positioning barriers to

sources of pollution such as air, noise, or water pollution can be valuable additions to project design, the indicative nature of the tool means that the resolution of such changes may not be sufficient to make the transition between arrow bands (for example, from no change to small increase). This is particularly true for larger sites, as the arrow bands are based on change/ha and the hectarage of linear interventions (such as hedges) is low. In such cases, users are encouraged to look at the calculation sheet which provides a numerical breakdown and should highlight improvements.

13. SuDs contribution to water supply and flood regulation may be undervalued as the EBN tool results are indicative and only records contribution of habitat-related components and do not consider additional contribution from "Grey" engineered/below ground solutions (NEW). It is therefore important to consult within project teams to ensure results are sense checked and impact on related services considers wider contributions, such as demonstrated by CIRIA models, which may demonstrate impact has been addressed through engineered solutions.

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