OTTERPOOL PARK

Environmental Statement Appendix 7.22: Natural Capital Strategy and Ecosystem Service Impact Assessment

MARCH 2022

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Executive summary

Arcadis Consulting (UK) Limited has been commissioned on behalf of Otterpool Park LLP to undertake Natural Capital and Ecosystem Services assessments to inform an Environmental Impact Assessment (EIA) for Otterpool Park, a proposed garden settlement located within Folkestone, Kent.

The site is located within Folkestone, Kent within the administrative boundary of Folkestone and Hythe District Council (F&HDC) and spans a large area located immediately south of Junction 11 of the M20. The site is largely agricultural in nature with the majority of the site comprising arable and pasture fields, a disused horseracing course with an artificial lake ('Folkestone Racecourse Lake'), areas modified from historical use (airfields), existing historic settlements and relatively new industrial areas.

This report details the approaches undertaken to maintain and enhance natural capital asset value and ecosystem services within the proposed project. Two assessment methods were used, a 'qualitative' assessment and the Environmental Benefits for Nature (EBN) tool.

Design measures to maximise the natural capital value of the development, and minimise any loss of ecosystem services provided included (but were not limited to):

- Retention of the areas that provided the most transferrable ecosystem services within the development;
- Buffering of these areas;
- Maximising the value of the GI around the development;
- Minimising potential impacts upon air quality, water quality, flood protection, with SuDS;
- Inclusion of allotments and edible streets within the development; and
- Measures to maximise the cultural value of the site.

Once the illustrative masterplan was finalised for the OPA submission for the development, two assessments of the potential impact of the development upon the natural capital and ecosystem services of the site were conducted. These were a qualitative assessment (conducted using the information) and a formal metric assessment. Two assessment methodologies were conducted as this allows for the benefits of each approach to be maximised to fully understand the potential Ecosystem Service impacts of the development. Although these resulted in slightly different results, the overall results were comparable. In summary, it was concluded that there would be a Positive change (i.e. a net improvement) in the following ecosystem services:

- Human health and wellbeing (including sense of place and interaction with nature);
- Science and education;
- Tourism and recreation;
- Food for pollinators;
- Water quality regulation;
- Pest control
- Wood production (although it is unlikely this will be formally harvested);
- Biodiversity (this is supported by the approximately 20% increase in biodiversity demonstrated in the Biodiversity Net Gain Report, ES appendix 7.21); and
- Aesthetic values.

There would be no (neutral) or 'not significant' changes that subsequently become positive over time in the following ecosystem services:

- Erosion protection;

- Water flow and flood regulation (positive after 10 years); and
- Air quality.

There will be neutral changes in:

- Fish production
- Carbon storage in the long term; and
- Noise reduction

It was assessed that there is likely to be a negative i.e. a net loss in the following ecosystem services:

- Harvested products (food, hay and silage);
- Local carbon (in the first 10 years after construction, becoming neutral once planting is mature);
- Soil formation and quality.

In summary, there is a Positive change in some areas (i.e. net gain), Neutral (i.e. no change) in others and a Negative (i.e. net loss) in some areas. The largest Negative change is in the loss of provisioning due to development on agricultural land. This is balanced by the gain in cultural services such as amenity, recreation, tourism, health and wellbeing. Biodiversity presents the next largest positive change.

While increasing the overall environmental quality of existing agricultural land (off-site) will not compensate for the loss of provisioning services, the re-use of soil combined with the allotments, orchards and edible streets will preserve some of that soil quality that it may be possible to return to some form of agriculture in some small areas in the future. Given the requirement for additional housing and the quality of the green infrastructure proposed within the design of the proposed project overall, the design has been maximised to enhance natural capital value and provision of ecosystem services. These designs will evolve and continue to be enhanced through detailed design throughout the planning process. This assessment and the Biodiversity Net Gain Report provide baselines and targets to be met or exceeded throughout this process. There is potential to increase the building integrated vegetation and GI around the built parcels above those utilised to inform the BNG Report as nature-based solutions technologies continue to improve, this will future proof the development as climate resilience requirements increase along with sustainability drivers.

1 Introduction

1.1 Overview

1.1.1 Arcadis Consulting (UK) Limited has been commissioned on behalf of Otterpool Park LLP to undertake Natural Capital and Ecosystem Services assessments to inform an Environmental Impact Assessment (EIA) for 'Otterpool Park', a proposed garden settlement located within Folkestone, Kent.

1.1.2 Within this report, the 'site' is the OPA application area covered by this application.

1.1.3 Natural Capital and ecosystem services describe the benefits provided by nature and ecosystems that contribute to making human life possible. Ecosystems and their associated services deliver benefits, some of which have economic value for society because people derive utility from their actual or potential use.

1.1.4 While it is recognised that the natural environment has intrinsic value (i.e. is valuable in its own right) and the concept of value has an element of objective ecosystem service delivery, the main focus is on the contribution to human welfare and it is thus an anthropocentric view. However, it is important to note that this value may also include preferences that individuals have that relate to the wellbeing of animals, plants etc. that are not connected to direct or indirect value (i.e. people may prefer to support elements that they would not receive any direct or indirect benefits from) such as altruistic, bequest and stewardship motivations.

1.1.5 This report provides an outline of the approach to natural capital and ecosystem services within the illustrative masterplan design and subsequently an assessment of potential impacts to these assets and benefits within the proposed project. Two approaches to assessing the impacts from the Otterpool Park development were utilised, a qualitative assessment primarily using the information collected from chapters within the Environmental Statement and an assessment utilising the developing Environmental Benefits for Nature (EBN) tool. The methodology and approach to these two methodologies is presented in section 3.

1.1.6 For the qualitative assessment, published data has been utilised, along with project specific data from:

- The ES Agricultural Chapter (Chapter 5);
- The ES Air Quality Chapter (Chapter 6);
- The ES Biodiversity Chapter (Chapter 7);
- The ES Cultural Heritage Chapter (Chapter 9);
- The ES Geology, Hydrology and Land Chapter (Chapter 10);
- The ES Geology, Hydrology and Land Chapter (Chapter 10);
- The ES Landscape and Visual Impact Chapter (Chapter 12);
- The ES Noise Chapter (Chapter 13);
- The ES Socioeconomics Chapter (Chapter 14); and
- The ES Surface Water and Flood Chapter (Chapter 15).

1.1.7 For both of these assessment approaches, the results outline the effect of the proposed project are given for a range of ecosystem services. The impact on each of these services in a 'do minimum' and 'do something' scenario is examined.

1.2 Site location and setting

1.2.1 The site is located within Folkestone, Kent within the administrative boundary of Folkestone and Hythe District Council (F&HDC) and spans a large area located immediately south of Junction 11 of the M20. The site is largely agricultural in nature with the majority of the site comprising arable and pasture fields, a disused horseracing course with an artificial lake ('Folkestone Racecourse Lake'), areas modified from historical use (airfields), existing historic settlements and relatively new industrial areas.

1.2.2 The M20 motorway, Channel Tunnel Rail Link and Westenhanger Station are located to the north of the site, beyond which lie the villages of Stanford and Postling within a largely rural setting including the Kent Downs Area of Outstanding Natural Beauty (AONB). This AONB extends to the east, beyond which lies the town of Hythe, and to the south where it includes Lympne village. In addition, East Stour River flows through the site in a north-east to west direction. The site is centred on BNG TR 111 363.

1.3 Proposed project

1.3.1 The proposed Otterpool Park Development is located on approximately 589 ha of land within the wider study area as shown in Figure 1. The planning application seeks permission for a new garden settlement accommodating up to 8,500 homes (Use Classes C2 and C3) and Use Class E, F, B2, C1, Sui Generis development, including use of retained buildings as identified, with related infrastructure, highway works, green and blue infrastructure, with access, appearance, landscaping, layout and scale matters to be reserved. A summary of the maximum floorspace areas for each land use type is provided in Chapter 4: The Site and the Proposed Project of the Environmental Statement (ES).

1.3.2 The project is being submitted to planning through a 'Three-tier' application, with increasing levels of detail at each stage. This comprises the three stages of the planning process: Tier 1 Outline Planning Application, Tier 2 detailed masterplan and Tier 3 reserved matters application. This document assesses the parameters secured within the application at Tier 1 (outline) and the documents submitted in support. As such, the assessment within this report outlines the potential impact upon Natural Capital, checks on the performance of the project design at Tiers 2 and 3 will be required to ensure that the opportunities identified within this document are secured. It is assumed that there will need to be Assessment of each Tier 2/3 application area in line with the accepted methodology for assessment at the time of the Tier 2/3 application.

2 Natural Capital and Ecosystem Services Approach

2.1 Introduction and Glossary

2.1.1 One of the key approaches to the masterplanning design was to maximise the Natural Capital value of the site and safeguard the Ecosystem Services provided. This was implemented throughout the iterative masterplanning process for Otterpool Park by maximising the value of the development from the outset and minimising impacts through design and construction mitigation, considering the different types of Ecosystem Services provided by the different areas of the site. Table 1 includes the key definitions of the terms used within this assessment.

Table 1: Key word definitions

Term	Definition
Biodiversity	Biodiversity is defined by the UN Convention on Biological Diversity (CBD) as the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of their functions (i.e. ecosystem function).
Biodiversity loss	The reduction in the numbers of different plant and animal species and also their abundance, this can occur at different geographical levels and can lead to extinction,
Buffer	An area designed or incorporated to safeguard an identified ecological feature (baseline or created)
Dependencies	Refers to irreplaceable ecosystem services that are a critical to enabling, enhancing or influencing successful business performance.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
Ecosystem services	The flow of benefits people obtain from ecosystems, which includes timber, fibre, crop pollination, water regulation, climate regulation, recreation, and physical health.
Impacts	Arise when an action significantly affects ecosystem function quantity or quality.
Landscape approach	The landscape approach seeks to unify the complex and widespread environmental, social and political challenges that transcend traditional management boundaries by managing the landscape as a functional unit which can lead to conservation and societal benefits as well as functional efficiencies for business.
Material risk	A financial, operational, reputational or regulatory risk deemed to be significant enough to affect decision making.
Net gain	Following completion of a project the biodiversity associated with the project is greater than the previous baseline values.
Natural Capital	The stock of renewable and non-renewable natural resources on earth (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits or 'services' to people. These flows can be ecosystem services or goods and benefits, which provide value to business and wider society.
Systemic risk	The risk of collapse of entire financial systems or market, as opposed to risk associated with any individual entity, group or component of a system. Biodiversity

Term	Definition
	loss can become a systemic risk when it has far reaching implications for the continuation or profitability of an entire sector. For example, loss of pollinator insects poses systemic risks to a range of sectors beyond agriculture.

2.1.2 The assessment provides a holistic overview as to the functioning of the landscape within which the proposed project would lie and how this may be impacted by its construction and subsequent operation, and what the implications would be regarding the long-term benefits we derive from this land.

2.1.3 The masterplanning approach considered the broad Ecosystem Services provided by the site and examines how these would change as a result of both land take (and more indirect effects) and the proposed mitigation measures (embedded and additional, as secured in the ES Chapter 7). The different categories of ecosystem services considered are presented below in Table 2. The categories presented in Table 2 are taken from their origin in the Millennium Ecosystems Assessment (2005) maintaining the distinction of "supporting services". These services have been subsequently amalgamated by the Common International Classification of Ecosystem Services (CICES) but the distinction is useful in impact assessment (as per the World Resources Institute - Weaving Ecosystem Services into Impact Assessment (2013)).

2.1.4 A summary of natural capital and ecosystem service policy is presented in Appendix B.

Table 2: Ecosystem service categories

Type	Description	Example
Provisioning	Ecosystem services that provide the material or energy outputs from ecosystems.	Food (e.g. game, crops), raw materials (including lumber, skins, fuel wood, organic matter, fodder and fertilizer), genetic resources (including crop improvement genes and health care), water, energy (e.g. hydropower, biomass fuels).
Regulating	Ecosystem services related to regulating ecological processes	Air purification, water quality, carbon sequestration and climate regulation, flood attenuation, waste decomposition and detoxification, pest and disease control.
Cultural	Ecosystem services relating to the non-material bnefits people obtain from contact with ecosystems.	Cultural (e.g. including use of nature as motif in books, film, painting, folklore, national symbols, architecture, advertising, etc.), spiritual and historical (e.g. use of nature for religious or heritage value), recreation, science and education (e.g. including use of natural systems for school excursions, and scientific discovery).
Supporting	Ecosystem services that make it possible for the ecosystems to provide services such as food supply, flood regulation, and water purification.	Habitat provision, biodiversity, water cycling, nutrient recycling, soil formation.

2.2 Retention and Design

2.2.1 In line with the mitigation hierarchy, the design of the parameters has sought to limit impacts to key receptors. Key receptors were identified at the outset for their ecological, natural capital and ecosystem service value.

2.2.2 In order to inform the parameter plans (ES Appendix 4.2) and the illustrative masterplan layout (ES Appendix 4.5), the initial habitat survey, conducted in 2016 and updated throughout 2017 and 2018, categorised and mapped habitats using the Phase 1 habitat category standards (reported in ES Appendix 7.3 and presented in Figure 1). Habitats and areas were then subsequently categorised depending on their likely 'value' to determine their requirement for retention. The following categorisations were utilised:

- 'Grade 1': likely to contain Section 41 or uncommon habitat types that are likely to maintain multiple notable and/or protected species and deliver key ecosystem services and must be retained and buffered;
- 'Grade 2' contain habitats of high value and/or protected species and strongly recommended to retain and buffer, and / or provide or support key ecosystem services;
- 'Grade 3': habitats that provide important connectivity or strategic value throughout the site or have value for notable species and are recommended to be retained, and / or provide or support key ecosystem services;
- 'Grade 4': areas supporting less commonly found habitat across the site, retention desirable; and
- Other habitats: these areas have no intrinsic value for retention, however they may have value for associated notable species.

2.2.3 This valuation was utilised to inform the illustrative masterplan (ES Appendix 4.5) and identify areas where development should not occur (detailed in the ES Appendix 7.3). Valuable retained habitats were 'buffered' within the design to reduce potential impacts, with buffers based upon the requirements of these habitats and the species which they support. For each of the habitat types used to inform this assessment, the key ecosystem services benefits that they provide to humans was identified. This was also used to inform the 'grading'.

2.2.4 Arcadis proposed a natural capital approach to design principles for the illustrative masterplan (ES Appendix 4.5) from the outset (presented in Appendix A (Table 9, 11 and 12) present the ecosystem services identified for each asset retained, enhanced and proposed.

2.2.5 The sections below provide an overview of how these have been incorporated within the illustrative masterplan (ES Appendix 4.5) for the OPA and outline mitigation approaches. Construction impacts will be managed in accordance with best practice at the time of construction, through a Code of Construction Practice. The majority of these design approaches and construction measures are specified more fully within the ES.

2.3 Approach to Provisioning Services

2.3.1 The site provides a range of provisioning services, including the provision of crops, food for animals and grazing space and the potential for water provision and timber products. The baseline status of these services and dedicated mitigation is outlined in full in the ES and other supporting information, predominantly ES Chapter 5 – Agriculture and the separately compiled Design and Access Statement (DAS)(ES Appendix 4.16).

Food production, crops, hay, silage

2.3.2 With regards to provisioning services, it is accepted that there will be a loss of agricultural land to development (arable land and grazing areas). These uses are not easily incorporated, within a residential development, at a scale commensurate with the existing intensive arable farming and grazing. However, maximisation of provisioning services was considered at the masterplanning stage. Within the design there are orchards, allotments and 'edible streets' within the OPA. While there will also an increase in the amount of wood provisioning potential, with an increase in the wood and tree cover on the site, these are envisioned to be delivering regulating, cultural and supporting services rather than provisioning.

Wood and timber products

2.3.3 Within the site there is no known felling for timber. The design limits tree removal (as these are identified as key habitats) and increases the amount of tree cover on the site. Timber that is removed should be retained on site where possible.

Water abstraction

2.3.4 With regards to the provision of water, no water abstraction is known to occur on the site, and there is no proposed change in this regard, although animals may use streams and ditches to drink or bathe.

2.4 Approach to Regulating Services

2.4.1 The site provides a range of regulating services, including climate regulation, water quality regulation, flood prevention and air quality regulation. The baseline status of these services is outlined in full in the ES and other supporting documents, predominantly within ES Chapter 6 – Air Quality, ES Chapter 8 – Climate Change, ES Chapter 10 – Geology, Hydrogeology and Land Quality, ES Chapter 13 – Noise and Vibration, ES Chapter 15 Surface Water Resources and Flood risk.

2.4.2 The regulating services provided by the site were identified at the start of the masterplanning process. Potential impacts upon air quality, water quality and flood attenuation were identified and impact parameters were set into the strategic design principles (ES Appendix 4.3) for Tier 1, for example there would be no additional discharge of water into the East Stour River subsequent to the project.

Water and flood regulation

2.4.3 The design of the proposed project incorporates the following mitigation to prevent impacts on water regulation:

- the proposed project would utilise Sustainable Drainage Systems (SuDS) to manage surface water across the proposed project, in terms of both water quality and quantity. The proposals would ensure that greenfield (existing) discharge rates would not be exceeded during rainfall events up to a 1 in 100 (1%) annual probability including an allowance for climate change. SuDS infrastructure would be included in green infrastructure spaces that would be present throughout the proposed project. Several infiltration areas have also been included in the design where the ground conditions are suitable. Swales, soakaways, permeable paving, rain gardens and green roofs would provide more localised surface water management.

- The development is designed to be nutrient neutral (as detailed in ES Chapter 15).
- Control methods will prevent construction and operational run off containing hydrocarbons, metals, sediments and any other impact pathways that could adversely effect on water quality. Pre-treatment would be utilised to supplement filtration, bioremediation, detention and vegetation uptake processes. Runoff could be from unforeseen events during construction and / or road runoff.
- Development in the floodplain across the Site would be limited to three new road bridges over the East Stour River to connect the north riverside area to the south. To ensure these bridges do not cause constrictions to flow, which could increase flood risk onsite and upstream, the bridges would be designed in accordance with best practice and where required, hydraulic modelling would inform their design.
- The design of watercourses crossings would cause no increase in flood risk either upstream or downstream.

2.4.4 Within the construction phase, construction impacts would be managed in accordance with best practice at the time of construction, through a Code of Construction Practice. Measures to limit water and flood regulation would include project, measures to limit construction impacts are proposed, namely:

- Avoiding the storage of any potentially polluting materials in close proximity to any waterbodies, including stockpiles of soil to reduce potential for sedimentation.
- Soil stripping managed to ensure the minimum area of exposed soil at any one time (further detail in ES Chapter 5).
- Fuels and chemicals would be stored, and refuelling would take place within bunded areas to prevent leakage, and these would be located away from waterbodies. Drainage from these areas would incorporate an isolation facility such that the outlet could be sealed in the event of a spill.
- Provision made for water treatment to remove sediment before discharge to a surface water feature.
- Concrete would be laid only following the suitable preparation of the ground surface and temporary shuttering used to contain potential leaks.
- Designated washing out areas would be set up for concrete lorries with impermeable liners to protect the soil and groundwater below.
- Waste water generated from the construction compound(s) would be disposed of via appropriate means, for example pumped out and removed from site by tanker.

Climate change

2.4.5 With regard to climate change, the following measures would be implemented:

- Passive design including orientation and minimising solar gain.
- Improved building fabric and insulation beyond building regulations.
- Improved performance of glazing.
- Improved air tightness.
- Specification of water recycling, low-flow taps and showers.
- Provision of 100% low energy lighting.
- Battery storage, smart controls, electric vehicles technology etc. will continue to evolve and the Development has the flexibility to increase their use in the future.
- Taking account of the measures to reduce energy demand and generate energy from low and zero energy sources the proposed project has set a commitment to reduce carbon emissions by at least 20% of the Building Regulations (2013) on a site-wide basis and an aspiration towards zero carbon (regulated energy).

2.4.6 Further details are provided in the Climate Change Chapter of the ES (Chapter 8).

Air quality

2.4.7 The following approaches are identified to minimise impacts upon air quality within the design of the development:

- Minimising reliance upon motor vehicle use;
- Promoting alternative transport options;
- Inclusion of integrated cycle paths into surrounding environments;
- Inclusion of pedestrian walkways into surrounding environments;
- Inclusion of electric vehicle charging points;
- Implementation of a Travel Plan; and
- Integration of public transport provisions.

2.4.8 Full details along with the air quality impact assessment is presented in ES Chapter 6.

2.4.9 The retention habitats as outlined in section 2.2 will also minimise impacts to the air quality regulation ecosystem service that the site provides.

2.4.10 Within the construction phase, the following approaches are proposed to safeguard air quality:

- Site Management (logging of incidents/complaints);
- Monitoring (site inspections, soiling checks, compliance with Dust Management plan, etc);
- Preparing and Maintaining the site (locate dust causing activities away from receptors, barriers, cleaning, enclosed specific operations with high potential for dust production, cover stockpiles, etc);

- Operating vehicle/machinery and sustainable travel (comply with NRMM standards, no idling, use mains electricity, travel plan etc);
- Operations (employ dust suppression, use enclosed chutes, minimise drop heights, etc);
- Demolition measures (damp down, avoid explosive blasting, soft strip interiors before demolition, etc);
- Earthworks measures (revegetate promptly, use hessian mulches and cover with topsoil, etc);
- Construction measures (avoid scabbling, keep aggregates damp, ensure fine powder materials are delivered enclosed and stored in silos, ensure bags are sealed after use);
- Dust suppression from vehicle usage (wash access and local roads, avoid dry sweeping of large areas, ensure vehicle-borne materials are covered, install hard surface haul routes, wheel washing, etc).

Noise

2.4.11 The following mitigation measures would require to be considered though the detailed design of any residential areas of the site, especially those to the north within influencing distances of the M20 and HS1 routes, and to the south around the Lympne Business Park:

- Layout considerations to ensure that noise is also controlled by layout design to avoid locating external sensitive areas in positions exposed to significant noise sources (including the proposed business park).
- Provision for acoustic screening where necessary either through optimum placement and design of intervening buildings (layout options) or specific acoustic fencing/bunding where necessary.

2.4.12 The retention habitats including trees and hedgerows will also minimise impacts to the noise attenuation ecosystem service that the site provides.

2.4.13 The full noise impact assessment is presented in ES Chapter 13.

2.5 Approach to Cultural Services

2.5.1 The site provides a range of cultural services, including visual amenity, heritage assets and areas utilised for recreation. The baseline status of these services is outlined in full in the ES and other supporting documents, predominantly ES Chapter 9 – Cultural Heritage, Chapter 11 - Human Health and Chapter 12- Landscape and the Design and Access Statement (DAS)(ES Appendix 4.16), submitted as a standalone document.

2.5.2 Within the Masterplan Design, extensive design measures have been implemented to maintain and enhance these cultural services. These include:

- Visual integration using trees;
- Enhanced recreational facilities across the site;
- Improved setting for cultural heritage assets;
- Enhanced recreational facilities across the site, including parks, play areas and sports facilities;
- Increased access to the SSSI for scientific study and research;

- The retention of trees and hedgerows as specified above to minimise impacts to the ‘tranquility that the site provides;
- Improved settings of natural capital assets to boost tourism.

2.5.3 Further information can be found in the ES Cultural Heritage Chater (Chapter 9) and the Landscape and Visual Impact Chapter (Chapter 12).

Cultural Heritage

2.5.4 Specifically, with regards to cultural heritage, the following approaches are proposed:

- Embedded mitigation such as preservation ‘*in situ*’ i.e. the heritage assets are left undisturbed e.g. by the creation of open space;
- Embedded mitigation such as screening by trees, hedgerows and bunds and creation of buffers of open space to preserve setting;
- Preservation ‘by record’ of archaeological remains;
- Preservation ‘by record’ of a standing building prior to its demolition
- Preservation ‘by record’ involving discrete areas of the Site being subject to archaeological monitoring (‘watching brief’) during construction.
- Preservation ‘by record’ by earthwork survey.
- Archaeologically-led boreholes and test-pits; and
- Maintaining and monitoring open space in order to preserve heritage assets effectively.

2.5.5 Additional measures alongside the mitigation above would also be put in place. These measures would increase public understanding of the historic environment in the vicinity of the site and connect the local community with the heritage resource. These might include:

- Community engagement, for example, involving local groups in researching and recording heritage assets;
- Involving local interest groups in deciding how assets are preserved and interpreted;
- On-site interpretation boards containing information on heritage assets (as derived from the archaeological investigations);
- Open days for the public during excavations;
- Temporary displays of artefacts found from the application site;
- Re-creation of elements of the historic environment;
- Dissemination of data derived on the historic environment on the application site to the local population, general public and academia;
- Improvement to public access and enjoyment of heritage assets;
- Creation of an Ecological and Heritage Trail as outlined in the GI Strategy (ES Appendix 4.11);
- Reducing temporary effects to the settings of heritage receptors from increased construction traffic flow controlled through and around the application site using traffic management i.e. control of vehicle movement through the site, speed limits and defined routes (refer to ES Chapter 16 - Transport);

- Reducing temporary impacts to the settings of heritage receptors caused by construction activity through increased dust (ES Chapter 6 Air Quality, ES Noise and Vibration Chapter 13 – Noise and Vibration). This would be achieved by fencing, hoarding and bunding, damping down of the construction area as well as limiting the hours in which construction can be carried out.

2.5.6 The retention habitats including trees and hedgerows will also minimize impacts to the regulation ecosystem service that the site provides.

Recreation

2.5.7 The site is largely private land with limited or no access to the public. An extensive range of measures are being employed to maximise the recreation value of the site. A list of the post-construction asset typologies that are accessible to members of the public are summarised in Appendix C. The key recreational features and design principles as applied to the site area for recreation are:

- Public access to all the GI areas of the site has been maximised;
- A number of key open spaces are proposed including three park landscapes which will provide destination open spaces, connected both within the Otterpool Park settlement and the wider landscape;
- The cycle network will be designed. A primary and secondary routes grid will create a safe environment where adults and children can move freely and independently on all routes;
- The networked GI will provide pleasant walking and cycling routes via green corridors that link the various assets (parks, play areas, allotments, sports etc.), communities and local centres to homes and to each other;
- Leisure routes will link into the wider landscape via existing footpaths and bridleways, providing opportunities to enjoy the exceptional amenity provided by surrounding assets such as the Kent Downs AONB and the coastline;
- Structural planting strategically located to provide wind breaks, shade and play opportunities.

2.5.8 Full details of the recreational provision proposed within the site are presented in the DAS (ES Appendix 4.16).

Visual amenity, tranquillity

2.5.9 The design of the site was landscape led, with the presence of the Kent Downs AONB around the periphery of the site being key to the layout of the development.

2.5.10 Full details of the measures implemented to maximise the visual amenity value of the suite are presented in ES Chapter 12 – Landscape and Visual Impact.

2.6 Supporting services

2.6.1 The site provides a range of supporting services, including biodiversity, soils and water cycling. The baseline status of these services is outlined in full in the ES and other supporting information, predominantly ES chapters Chapter 5 – Agriculture, Chapter 7 – Biodiversity and in the DAS (ES Appendix 4.16), submitted as a standalone document.

2.6.2 Within the site, extensive design efforts were implemented to maintain and enhance the provision of supporting services within the site.

Biodiversity

Biodiversity overview

2.6.3 The measures designed to maintain and enhance the status of biodiversity on the site are fully outlined in the ES Chapter 7– Biodiversity and also in the Biodiversity Net Gain Report (ES Appendix 7.21). In summary, there is the potential for the proposed project to achieve an approximate 20% increase in biodiversity overall (discussed in more detail below).

2.6.4 The design measures implemented to achieve this include:

- Ensuring the development avoids the most valuable areas;
- Buffering features such as the river corridor and woodlands in appropriate, high quality habitats;
- Creation of new areas of valuable habitat, including wetlands, ponds, areas of tree planting etc;
- Inclusion of over 50% GI within the development;
- Maximisation of the ecological value of the built development areas.

2.6.5 In addition, for species which require large areas of arable land, i.e. wintering and breeding farmland birds, wintering gulls, wintering thrushes, barn owl and brown hare it was foreseen that it would not be possible to fully mitigate for impacts to these species within the site. Habitat mitigation and enhancement will be undertaken on site where possible, however, it will not be possible to fully mitigate for impacts to these groups within the site, due to the space and mosaic habitat requirements of these species. Therefore, an off -site mitigation strategy has been prepared. This is specified within ES Chapter 7– Biodiversity.

2.6.6 During the construction phase of the development, construction impacts would be managed in accordance with best practice at the time of construction, through a Code of Construction Practice, and the following measures are proposed to safeguard the biodiversity of the site and the ecosystem services it provides;

- Site compounds, storage facilities and staff facilities are suitably bunded and located in places that would not have an adverse effect on the environment; the Code of Construction Practice (CoCP) would ensure that retained habitats are protected from degradation.
- In advance of site clearance, protective fencing is installed to protect retained and/or ecologically sensitive habitats (the watercourse, mature trees and hedgerows) and their associated buffer zones to ensure that they are not subject to accidental damage (to be determined on a phase by phase basis).
- Haul routes, storage compounds and staff facilities would be located away from retained habitats to minimise disturbance to the species they support.
- Pre-construction surveys are carried out by an ecologist to confirm the nature and extent of any ecological constraints in advance of site clearance, to ensure that appropriate mitigation measures including licences are in place in advance of site clearance, and to confirm that no new constraints have arisen since the publication of the Environmental Statement.
- An ecological clerk of works is in place to oversee site clearance, in particular any works that have the potential to disturb notable ecological features. They

would also ensure that the mitigation measures proposed adhere to best practice guidelines and take account of any changes in legislation that may have occurred.

- To avoid impacts on breeding birds, works close to retained habitats would commence outside of the bird breeding season (i.e. they would commence in the period between the months of September and February, inclusive). Where this is not possible, specialist ecological supervision would be provided to confirm the absence of nesting birds prior to vegetation removal and ensure the protection of any confirmed nesting sites. Should the presence of nesting birds be established, buffer zones would be fenced to ensure the birds are not disturbed and works would cease in the locality until the young birds have fledged. Note: the area of buffer zones for ground nesting species such as skylark may exceed a 50m radius.
- In advance of construction, bird nesting boxes would be installed in the hedgerows and on retained trees, in suitable locations away from the construction. This would ensure alternative nesting opportunities are provided to mitigate for any disturbance effects.
- Prior to any removal of hedgerows, pre-construction checks for any species of conservation concern, such as reptiles and hedgehogs, would be undertaken. Any features of value to hibernating reptiles would not be disturbed during the reptile hibernation period (October through to March). Should hedgehog(s) be found at this time, they would be moved to a safe location.
- If night-time construction lighting is required, it would be kept away from the watercourses and the hedgerows, during the period April to November when bats are active.
- No-native invasive plants would be controlled on the site;
- An ecological clerk of works would be employed to ensure that the ecological protection measures outlined in are adhered to. They would also undertake regular monitoring to ensure that the protection measures remain in place for the time that they are required.

2.6.7 For individual species there may also be requirements for licensing; noise mitigation and long -term management; bespoke Method Statements, displacement and translocations.

Biodiversity net gain

2.6.8 Alongside this assessment, a biodiversity net gain assessment was conducted, demonstrating how the outline application can achieve biodiversity net gain (in line with planning policies). This section of the report summaries this study, which is presented in full in ES Appendix 7.21. The calculation applied to the baseline and proposed project to assess the potential for biodiversity net gain is that detailed in the Biodiversity Metric 3.0 Metric 3.0 (Natural England 2021).

2.6.9 Post development, the different ‘typologies’ of GI (Green Infrastructure) were assessed for their biodiversity value, based upon the areas and types of habitats within the typology. The valuation of these habitats is also based on their Condition and Distinctiveness, but also takes into account the difficulty and time taken to create these habitats. Where valuations for habitats are open to interpretation, a precautionary lower unit valuation was always utilised, representing a worst-case.

2.6.10 Parameters for the built development parcels were also compiled, which allow for a unit value to be applied to these areas of the site (as the design of these areas will ensure that they have biodiversity value).

2.6.11 The before and after Development calculations allow for a 'unit' valuation of biodiversity change to be calculated.

2.6.12 Overall, even with a precautionary approach taken to the credit valuations taken, there was the potential for the Development to achieve a unit valuation change from 2,021.05 BU to 2455.82 BU, an increase of 434.77 BU, or an approximately 20% increase overall.

2.6.13 The result of this assessment was utilised to further inform the natural capital assessment.

Soils

2.6.14 Impacts to soil quality will be minimised by:

- completion of a Soil Resources Survey and incorporate results into a Soil Management Plan (SMP);
- link the SMP to the Site Waste Management Plan (SWMP);
- ensure soils are stripped and handled in the driest condition possible;
- confine vehicle movements to defined haul routes until all the soil resource has been stripped;
- protect stockpiles from erosion and tracking over; and
- ensure physical condition of the entire replaced soil profile is sufficient for the post-construction use.

2.7 Long-term management and maintenance

2.7.1 At the outline stage a Governance Strategy (ES Appendix 4.13) sets out the key principles for the long term management and maintenance, and the key principles that will be followed and evolved through detailed design are:

- The long-term stewardship of open space, public realm (other than highways) and non-commercial community buildings will be the responsibility of a specific organisation or body;
- The body will be community-led (as distinct from a privately-run management company). It will also allow for future residents and businesses to shape the objectives and governance of the organisation, and to influence the design of new community facilities and spaces, within parameters set within a management plan that considered the natural capital and ecosystem services impacts.
- High quality management and maintenance over the long-term is of fundamental importance when setting out the objectives of the stewardship body.

2.7.2 In addition, measures specific to ecological receptors are specified within a site BAP which has been compiled to support the Otterpool Park ES. This is presented in ES Appendix 7.20.

3 Assessment Methodology

3.1 Introduction

3.1.1 Subsequent to the design of the illustrative masterplan (ES Appendix 4.5), the proposed layout was assessed for its potential impact upon natural capital and ecosystem services.

3.1.2 Two assessment methodologies were used, the 'Qualitative Assessment' which uses results from the ES to determine broad ecosystem services and calculations of land use change, and the Environmental Benefits from Nature Tool (EBN) tool.

3.1.3 The EBN tool uses a more detailed assessment of land use change to calculate a development impact score for 18 different ecosystem services, indicating the direction and magnitude of the impact on each assessed service, over 1, 10 and 30 year timescales post-development (see Appendices E, F and G for further detail).

3.1.4 Monetisation of the of the natural capital and ecosystem service benefits of the project have not been calculated, as this is beyond the remit of this report.

3.2 Qualitative Assessment

Guidance

3.2.1 The assessment has been undertaken using the following guidance:

- Guidance listed within ES Chapters:
  - 5 - Agriculture
  - 6 - Air Quality
  - 7 - Biodiversity
  - 8 - Climate Change
  - 9 - Cultural Heritage
  - 10 - Geology, Hydrogeology and Land Quality
  - 12 - Landscape and Visual Impact
  - 13 - Noise and Vibration
  - 14 - Socioeconomic Effects and Community
  - 15 - Surface Water Resources and Flood Risk
- World Resources Institute - Weaving Ecosystem Services into Impact Assessment (Landsberg *et al*., 2013);
- Natural Capital Protocol (NCC, 2016); and
- Other relevant guidance, where appropriate.

Data sources used

3.2.2 The following chapters of the Environmental Statement for the proposed project have been used in the production of this report.

- Otterpool Park Environmental Statement Chapter 5 Agriculture
- Otterpool Park Environmental Statement: Chapter 6 Air Quality
- Otterpool Park Environmental Statement: Chapter 7 Biodiversity

- Otterpool Park Environmental Statement: Chapter 8 Climate Change
- Otterpool Park Environmental Statement: Chapter 9 Cultural Heritage
- Otterpool Park Environmental Statement: Chapter 10 Geology, Hydrogeology and Land Quality
- Otterpool Park Environmental Statement: Chapter 11 Human Health
- Otterpool Park Environmental Statement: Chapter 12 Landscape and Visual Impact
- Otterpool Park Environmental Statement: Chapter 13 Noise and Vibration
- Otterpool Park Environmental Statement: Chapter 14 Socioeconomic Effects and Community
- Otterpool Park Environmental Statement: Chapter 15 Surface Water Resources and Flood Risk
- Otterpool Park Environmental Statement: Chapter 16 Transport
- Otterpool Park Environmental Statement: Chapter 17 Waste and Resource Management

3.2.3 The qualitative assessment provides an assessment of how the functioning of the landscape within which the project would lie might be compromised by its construction and subsequent operation, and what the implications would be regarding the long-term benefits we derive from this land. An overview of the procedure for assessing the natural capital impact of the project is described below.

Step 1: Establishing the baseline conditions

3.2.4 To understand which ecosystem services are likely to be provided by the affected area, it was first necessary to establish the baseline conditions within the area to be assessed. This focused on describing the habitat features, as it is these habitats (specifically their extent, connectivity, condition and management) that underpin the provisioning, regulating, cultural and supporting services provided. This involved describing the constituent habitats of the site to be assessed, the total area of each and the key species they support, using the ES as the main source of information.

Step 2: Mapping existing ecosystem services provision

3.2.5 The next step in the assessment process was to use this understanding of the habitats present, along with other components of the landscape, to determine which ecosystem services are likely to be provided. As referred to above, these services can be classified in accordance with the Millennium Ecosystem Assessment (2005), which divided them into ‘provisioning’, ‘regulating’, ‘cultural’ and ‘supporting’ services. These are presented in Table 2.

3.2.6 Different types of landscape comprise a variety of habitat features that provide different benefits to people. Determining which of the above services apply to the habitats within the site, and broadly to what extent, is the aim of this step of this largely qualitative ecosystem services assessment process. Quantification of services have been applied where that information is readily available or extrapolated using the EBN tool.

Step 3: Description of Project land take, mitigation and enhancement measures

3.2.7 To determine the extent to which the project would be expected to affect ecosystem services provision, it was first necessary to calculate the habitat change that would result from the land take and land use change for the proposed project.

3.2.8 It was then necessary to describe the mitigation measures embedded into the project design (plus those additional mitigation and enhancement measures also included in the project proposals) as this allows the net impact to be evaluated qualitatively, as outlined in the ES Chapter 2.

Step 4: Qualitative assessment of the change in ecosystem services provision as a result of the Project (utilising some quantitative information)

3.2.9 Having mapped the existing ecosystem services provided by the site, and then described the land take impacts of the proposed project and how they would be mitigated, the next step was to assess the extent to which the mitigated project would lead to changes in ecosystem services provision assessed.

3.2.10 A qualitative assessment was carried out to determine the change in ecosystem services provision as a result of the project. Different chapters of the ES were reviewed to identify information relevant to this assessment.

3.3 EBN Assessment

3.3.1 The Environmental Benefits for Nature (EBN) tool (EBN Tool Beta V1.0) was developed to work alongside the Biodiversity Metric and is:

> *"…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 that achieves biodiversity net gain 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 [of] 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)." (Smith et al., 2021).*

3.3.2 Essentially, the EBN tool uses a variety of ecosystem quality indicator and information sources (documented within the tool) to calculate an impact score for the 18 ecosystem services indicating both the direction and magnitude of the impact of a (proposed) plan or development. The scores are based on a set of habitat scores (e.g. the water quality regulation potential of a certain land-use) as well as a range of spatial factors taking into account the local context (e.g. whether the area is positioned between a pollution source (e.g. an arable field) and a receptor (e.g. a stream) and demand (how many people benefit). The land-use scores and multipliers are set at a level to begin and were informed by expert and stakeholder groups. Impacts are indicated over three timescales: 1, 10 and 30 years post land-use change. A wide range of project partners were engaged in the development and testing of the EBN tool including academics, government agencies, planning authorities, industry partners and NGOs.

3.3.3 The methodology for the use of the EBN Tool, the data that underpins it or details of its development are not repeated here. These can be found in full in Appendix D, Appendix E and Appendix F.

3.3.4 The EBN assessment for the proposed project was based on digitalised land-use information, collected during habitat surveys conducted between 2016 and 2021. Details of these surveys are presented in the Otterpool Park ES Appendix 7.3. The habitats are collated and assessed as outlined in ES Appendix 7.21. The EBN tool has been used to assess and compare two scenarios:

- The actual dominant agricultural land-uses remain unchanged (DM - Do Minimum), and
- The site will be developed as per the outline planning application in line with the parameter plans (DS – Do Something).

3.3.5 The final product is a range of indicators (Image 1) showing the magnitude and direction of potential impacts (positive and negative) on the given areas after the 1, 10 and 30 year time periods, as well as a confidence rating (Image 2) for each result.

Image 1 - Key showing the range of results produced by the EBN tool.

Change in average score per hectare	
Large decrease (more than -2.5 points out of 10)	↓
Decrease (-0.25 to -2.5 points out of 10)	↘
Minor change (-0.25 to 0.25 points out of 10)	→
Increase (0.25 to 2.5 points out of 10)	↗
Large increase (more than 2.5 points out of 10)	↑

Image 2 - Key showing the meaning of the confidence scores produced by the EBN tool.

Confidence

🔴	The relationship between the provision of the ecosystem service and habitats is complex. Evidence for scoring/multipliers is partial, although may be stronger for some habitats than others. Evidence gaps have been filled by consulting experts and with a degree of subjectivity, particularly for cultural services.
🟡	We have some suitable evidence to calibrate our range of scores across habitats and multipliers and/ or scoring applied to a limited range of habitats/ multipliers for which there is a sound and simple rationale.
🟢	We have a strong evidence base upon which to base scores across the range of habitats and multipliers used for this ecosystem service.

3.3.6 The EBN tool requires parcels to be identified within a number of geographical regions. For this assessment, to make the assessment manageable, it was necessary to compile parcels of the same habitat and condition. Where these parcels were within more than one geographical area, the area that the majority of the parcel fell into was utilised in the assessment.

3.3.7 The full completed EBN Calculator is presented as Appendix C.

3.4 Limitations

3.4.1 All of the assessment methodologies for natural capital and ecosystem services have intrinsic limitations. One limitation is the difficulty of combining assessment criteria results into a single assessment of the Natural Capital impact score of a development. Each of the natural capital aspects included within the assessments are intrinsically separate, it is not logical to compare like-for-like. A loss of food growing opportunity cannot be compared in any meaningful way with an improvement in air quality, the impact of each relies upon input from stakeholders. The guidance for the EBN tool (Appendix E) states that:

"…the scores for different services should not be added together into a single total value because:

3.4.2 The scores for different services are not directly 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.

3.4.3 The scores do not represent actual biophysical values, only relative rankings between different habitats for delivering each service.

3.4.4 Adding may obscure large gains or losses in individual ecosystem services.

3.4.5 Adding scores together risks double counting, for services that may partially overlap (e.g. aesthetic value and 'sense of place')."

3.4.6 Considering the anthropogenic nature of an ecosystem service assessment, it is difficult to reconcile a loss of, e.g., food production for an abstract group of stakeholders against a tangible benefit with regards to recreation for the future residents of a development. There is the opportunity to 'weight' the value of each aspect, however this requires extensive liaison with stakeholders to agree, and often produces conflicting opinions on the correct hierarchy of value of natural capital services.

3.4.7 Therefore, within the assessments within this report, each aspect of natural capital is assessed separately, to provide an overview of where gains and or losses are made.

3.4.8 The qualitative assessment is by its very nature reliant upon assessments by individuals. These assessments are supported by data, but the result largely relies on interpretation. As such, there is potential for disagreement with an assessment. It is due to this that a combination of the qualitative assessment and the EBN tool were utilised in relation to the development.

3.4.9 For the EBN assessment, considering the high complexity of the assessment in terms of land-use variety and distribution, but also spatial factors such as Agricultural Land Classification (ALC) and Soil Drainage, some simplifications were necessary to keep the project manageable. Whilst larger land-use areas (polygons) with similar attributes (e.g. similar pre- and post-development land use, ALC Grade, Flood Zone etc.) were assessed based on the best data, for smaller areas some simplifications were necessary such as averaging the ALC grade. However, the effect of these simplifications on the overall results is likely to be small to marginal.

3.4.10 As outlined above, this assessment at Tier 1 outlines the *potential* natural capital impacts of the project (informed by the parameter plans (ES Appendix 4.2) but also the illustrative masterplan (ES Appendix 4.5) which is submitted in support). This will need to be secured through the subsequent planning tiers.

4 Assessment Results

4.1 Qualitative assessment

Baseline status

4.1.1 The majority of the site is farmland, a mixture of arable and permanent pasture with woodland, hedgerows and scattered trees and a riparian corridor of trees along the East Stour River, with its tributaries, ditches and scattered ponds providing the only wetland features.

4.1.2 The baseline habitats within the site have been considered as the following broad eco-habitat types:

- arable farmland;
- permanent grassland;
- woodland scrub, hedgerows and trees; and
- wetland.

4.1.3 Two other broad typologies are not discussed in detail:

- bare ground (due to the very limited area on site)
- developed areas (no ecosystem service provision)

4.1.4 A baseline status of the site's eco-habitat types is presented in Table 3. This report presents a summary of the natural capital assets and ecosystem services provided by key features within these typologies. The input data is the same as that used for the BNG (Biodiversity Net Gain) tool, presented in Appendix 7.21. However, the EBN tool handles rivers and streams as area features (not linear like the BNG metric). This results in a minor difference in the calculated area outputs between the two tools.

Table 3: Ecosystem services typologies before approximate areas

Habitat	Approximate Area (ha)	Approx. % of total site
Cropland	307	52
Grassland	238	40
Heathland and shrub	3	0.5
Lakes / Wetlands	3	0.5
Sparsely vegetated land	4	1
Urban	18**	3
Woodland and forest (including tree lined areas along the River East Stour)	16	3
Rivers and streams	1***	0 (0.2)
TOTAL	590*	100

* The EBN tool calculates the total area to include the areas for rivers and streams as opposed to the BNG metric where these are linear features and calculated separately. Therefore, the total area measurements vary between the BNG tool and the EBN tool.

Habitat	Approximate Area (ha)	Approx. % of total site

** This number does not include the area for urban trees as these are point features in the EBN tool and calculated with no ground layer area, but instead a canopy layer area which is calculated separately (does not contribute to the total area to prevent double counting).

*** The area for rivers and streams calculated in the EBN tool is included for context (as opposed to linear in the BNG tool)

4.1.5 The baseline ecosystem services provided within the site by these typologies are summarised for the entire site and are described in Table 4. Only aspects of ecosystem services that are applicable to the site are presented.

Table 4: Qualitative description of the ecosystem services provided by the site.

Category	Ecosystem services	Potential ecosystem services benefits	Type of benefit	Description of the ecosystem services provided by the site
Provisioning	**Food**	Grasslands in the UK are the result of the human expansion to provide grazing and fodder for animal production— meat, dairy products, wool, etc. Arable land and orchards are similarly the result of a need to provide food for people.	Food for pollinators	All of the areas of grassland within the site and the hedgerows and trees will provide food for pollinators all though the majority of this is low quality. The most valuable areas of the site for pollinators are likely to be the semi-improved grassland areas and the species rich hedgerows.
			Grazing pasture for cattle and sheep	The majority of the grassland is managed as pasture, some of which is left ungrazed to provide a hay / silage crop. Grazing is mostly by sheep, although some fields have cows or horses. The grassland therefore provides valuable provisioning services for livestock (and thus people).
			Crop	The better-quality agricultural land is located at the north and eastern area of the project. Approximately 307ha of the site are currently arable land, providing food resources for people.
			Fish	No commercial (or recreational) fishing on site.
	Water	Provision of water depends on how land is used and managed.	Water provision	Ponds and water-filled ditches are scattered throughout the site. They will provide a water resource for cattle and sheep for farmers and maintain native species. No potable water extraction is currently undertaken. No commercial fishery is known to be present within the site OPA.
Regulating	**Carbon and climate regulation**	The soil and vegetation type will attenuate carbon to varying degrees. UK grasslands sequester carbon at a higher rate than forests and arable land, which is a source of carbon emissions. However, overall attenuation values depend on the management of the land (UK NEA 2011). Grazing can result in the consumption of a large proportion of the annual above-ground net primary production. As grazing by livestock is the most common grassland management on the	Carbon sequestration and climate regulation	Owing to the predominance of improved grassland within these farmland areas, the carbon storage function is likely to be poorer-performing than would be the case if there were extensive areas of unimproved or semi-improved grassland. The woodland, hedgerows and scrub would provide a greater degree of sequestration.

Category	Ecosystem services	Potential ecosystem services benefits	Type of benefit	Description of the ecosystem services provided by the site
		project, there are also carbon emissions resulting from the animals' biology (ruminants or not) and the way they are managed (intensive or extensive farms). Taking all factors into account (Ostle *et al.*, 2009) concluded that grasslands remaining as such were net emitters of 0.2-0.3 Mt C yr^{-1}, whereas (Janssen *et al*., 2005) suggested that UK grasslands (they did not differentiate between improved and unimproved types) sequestered 242±1990 kg C ha-1 yr^{-1}. Overall grazed grasslands are thought to sequester -2.20 tCO2-e ha-1 yr^{-1} (De Deyn *et al.*, 2011). Recent research by Devon Wildlife Trust (Puttock *et al.*, 2014) has demonstrated that unimproved Culm grasslands store up to twice as much carbon compared to intensively managed grassland soils. One of the most important regulating services that woodlands provide. The total carbon stock in UK forests (including their soils) is around 800 megatonnes of carbon (approximately 2,900 Mt of carbon dioxide equivalent). Woodland creation is judged to be a highly cost-effective and achievable form of net emission-reduction, and because forests are less limited in where they can be grown, they have a greater potential to generate income as a land use (through timber, etc.), and have potentially high value for other services (De Deyn *et al.*, 2011). The sequestration ability depends on management, and estimates calculate that unmanaged woodlands sequester at a rate of 6 tCO2-eq ha-1 yr-1 (Read *et al.*, 2009).		
		Green areas provide a source of passive cooling by reducing temperature of surrounding areas (Puttock *et al.*, 2014).	Heat attenuation	While it is likely that the areas of farmland, greenspace and trees are providing passive cooling to some degree, it is not possible to quantify this capacity in this report.

Category	Ecosystem services	Potential ecosystem services benefits	Type of benefit	Description of the ecosystem services provided by the site
	Water flow and flood regulation	Semi-natural grassland stores less water than more woody vegetation, such as trees or bracken. Intensive grazing and the resulting compaction of the soil causes decreased infiltration and increased runoff, which both increases the risk of flooding and reduces the recharging of aquifers (UK NEA 2011). Furthermore, soil compaction in grasslands is caused by high stocking rates, winter grazing and the use of heavy machinery which can decrease water infiltration and increase runoff (UK NEA 2011). Recent research by Devon Wildlife Trust (Puttock *et al.*, 2014) has demonstrated that unimproved Culm grasslands store and release water up to five times more slowly than improved grassland, reducing the risk of downstream flooding and maintaining a sustainable water supply. Woody debris creates dams in watercourses that increases storage and slows the water flow (contributing to flood hazard reduction, a regulating service). In addition, by interception of rainfall, woodlands moderate flooding by delaying and attenuating peak river flows (Forestry Commission, 2015).	Water flow regulation	Field ditches drain the agricultural land and the East Stour River and tributaries provide flood capacity. The areas of permanent grassland and to a greater extent the small areas of woodland will slow the flow of water to these water bodies.
	Water quality regulation	Water pollution is a result of a number of processes including soil erosion, fertiliser inputs and contamination from manure and slurry. The lower intensity management of semi-natural grassland is critical in maintaining water quality and quantity. Semi-natural grassland soils are able to store significant amounts of deposited nitrogen, which would reduce the pollution of groundwater (UK NEA, 2011). In contrast, areas of arable and other crop production will increase soil erosion and fertiliser inputs.	Water quality	It should be noted that, owing to the predominance of improved grassland and arable land within the farmland areas, the water quality regulation function is likely to be poorer-performing than would be the case if there were extensive areas of unimproved or semi-improved grassland. Furthermore, while it is likely that the areas of semi-improved grassland might be providing some water quality attenuation to some degree, the areas of improved grassland, arable and other crop production will be having the opposite effect, owing to the fertiliser and pesticide inputs involved. However, it is not possible to quantify this capacity in this report.

Category	Ecosystem services	Potential ecosystem services benefits	Type of benefit	Description of the ecosystem services provided by the site
		Woodland cover of catchments can minimise the need for water treatment by excluding livestock from watercourses and their immediate catchments, thus reducing the risk of potential water contamination. The presence of trees can also contribute to water quality by maintaining cool temperatures for fish, intercepting pollution from point sources and capturing diffuse pollution (De Deyn et al., 2011).		While the existing woodlands in the area are likely to contribute towards water quality, particularly the riparian areas. There is a relatively small amount of woodland cover in the wider site.
	Improvement in air quality	Plants are involved in the uptake, transport and assimilation (or, in some cases, decomposition) of many gaseous or particulate pollutants and can play a role in influencing urban air quality, and in mediating some of the negative effects of pollutants if configurated effectively.	Air quality	The areas of trees, and farmland will likely provide regulation with regards to the existing road traffic.
	Human health regulation	Open farmland and woodland, if accessible, can increase well-being and quality of life if visually attractive and supportive of physical recreation.	Health and well-being	Pedestrians, cyclists and equestrians currently have access to a relatively limited network of public rights of way across the area, which enables local people to access the area for recreational purposes, thus contributing to increased well-being and better health. However, the degree of access in the site overall is very low.
Cultural	**Science and education**	Grasslands have been the testing ground for key ecological concepts, such as: ecological stability, the productivity-diversity relationship, the regeneration niche, plant strategy theory, population biology (De Deyn *et al.*, 2011). The types of benefit derived from woodlands range from formal learning through Forest Schools to personal development gained through volunteering and apprenticeships. Studies show the long-term educational importance of connecting children and young people with nature (Forestry Commission, 2015).	Science and education	With the exception of the Otterpool Quarry SSSI, overall, the site is realistically, likely to provide negligible opportunities for science and education.
	Tourism and recreation	Landscape features and habitats can form important elements in the appeal of an area for tourism and	Tourism and recreation	The Racecourse is no longer operational and Westenhanger Castle is currently used for private events and is not open to the public. Access to the site

Category	Ecosystem services	Potential ecosystem services benefits	Type of benefit	Description of the ecosystem services provided by the site
		recreation such as petting farms, woodland walks, rambling etc, (De Deyn *et al.*, 2011).		is minimal, there are no known attractions for tourists, there is a motocross site to the west of the site. Adjacent to the site there is a Safari Park, Port Lympne. It is not considered that a significant proportion of the visitors to this site come from within the Otterpool OPA site.
	Sense of place and history	Farmland and open grasslands can also be a source of important archaeological finds. Trees and woods are highly valued by people for their historic and cultural values. Ancient woodland and veteran trees are historic features in their own right and provide a link to past society and culture. Ancient woodland is also increasingly appreciated for its archaeological content because the woodland soil surface has often been less disturbed than surrounding land.	Cultural heritage and visual amenity	The Cultural Heritage features present on the site which give a sense of place and history are fully described and evaluated in Chapter 9 of this ES but include: • Westenhanger Castle and its surrounds and associated features; • Barrows across the site; • A Roman villa identified south of the A20. • In addition, there are trees in the landscape that have been present for over 200 years and the site itself buffers the Kent Downs Area of Outstanding Natural Beauty.
Supporting	**Biodiversity**	The site supports a range of biodiversity features, as outlined within this report. Semi-improved grasslands provide habitats for species of conservation interest, such as UK BAP priority species. Arable land has very limited benefit for biodiversity.	Biodiversity	Areas of the site have notable biodiversity interest, including the hedgerows, ponds, riverine areas, ditches and trees. Generally, though, these large areas of open farmland are relatively poor with regard to biodiversity, as much of the grassland is improved or species-poor semi-improved, and the remaining areas comprise arable fields. Details of the biodiversity on the site are presented above.
	Non-Native Invasive Species	Non-native invasive species can spread to semi-natural areas and de-value them in terms of biodiversity and function. These can spread to urban areas where some species such as Japanese knotweed and Buddleia may cause structural damage. Remediation of such species can be costly and time consuming. Certain species are on Schedule 9 of the WCA (HMSO, 1981) for these it is	This is a disbenefit to biodiversity and built infrastructure removal will be a benefit	Cotoneaster, Montbretia, Virginia Creeper and Variegated Yellow Archangel are all associated with the built development. The ponds on site have a large number of non-native invasive namely Canadian Pondweed, Parrot's Feather, New Zealand Stonecrop and Giant Rhubarb.

Category	Ecosystem services	Potential ecosystem services benefits	Type of benefit	Description of the ecosystem services provided by the site
		an offence to grow or cause these species to grow in the wild.		There is one stand of Japanese Knotweed on the edge of a field adjacent to Barrowhill, Sellindge. The wetland plants and Japanese Knotweed are most likely to cause progressive damage to the semi-natural habitats.
	Soil	Soil formation and functional benefits could be reduced by development. Compaction can decrease water infiltration and increase runoff, increase emissions of nitrous oxide and ammonia, decrease uptake of methane, reduce the abundance of soil fauna, decrease plant growth and yield, and limit food availability for some birds (UN NEA, 2011).	Soil formation and function	The quality of this land varies between Grade 2 to Grade 3 in the ALC (Agricultural Land Classification). Soils on the site include: • Freely draining slightly acid loamy soils; • Loamy soils with naturally high groundwater; • Freely draining slightly acid but base rich soils and slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils. Details of the soils present on the site are presented in Chapter 5 of the ES.

Results of Assessment

4.1.6 This section broadly describes the mitigation and net change in ecosystem services with the mitigation cross-referenced in the table to the relevant ES document.

4.1.7 In summary, out of 20 aspects of ecosystem service applicable to the site and considered, nine of these are likely to increase in qualitative terms, five with no change and six a potential negative impact. The largest likely negatives are due to a loss in farmland and tranquillity but likely substantial increases for biodiversity (approximately 20%), health and tourism due to the project design.

Table 5: Broad eco-habitat typologies within the OPA after the proposed project

Habitat group	Existing area (ha)*	Change in area (ha)	Area After (ha)*
Cropland	306.98	-306.98	0
Grassland	237.74	-58.97	178.77

Habitat group	Existing area (ha)*	Change in area (ha)	Area After (ha)*
Heathland and shrub	3.34	20.91	24.25
Lakes and wetland (not including the River East Stour as under the area calculation methodology (BM3.0) this is a linear feature and does not add to the total area	2.74	18.5	21.24
Sparsely vegetated land	3.87	-3.87	0
Urban	18.46	266.29	284.75
Woodland and forest	16.2	64.13	80.33

*There is a discrepancy of 0.01ha on the ‘area after’ total area due to rounding to two decimal places for input into the EBN tool.

Table 6: Percentage change in broad eco-type typologies after development

Habitat group	Change	Percentage Change
Cropland	Loss	- 100%
Grassland	Reduction	- 25%
Heathland and shrub	Increase	+ > 600%
Lakes and wetlands	Increase	+ > 650%
Sparsely vegetated land	Loss	- 100%
Urban	Increase	+ >1000 %
Woodland and forest	Increase	+ > 350%

Table 7: Results summary of qualitative ecosystem services and natural capital assessment

Category	Ecosystem Service	Type of benefits	Qualitative Assessment of Change	Location of mitigation (if applicable)
Provisioning	**Food**	Food for pollinators	Positive Owing to the extensive creation and/or enhancement of flower-rich habitat as part of the project, in comparison to the relatively species-poor habitats due to be lost, a net gain in habitat for pollinators is expected. A pollinators strategy is provided within the separately provided DAS (Design and Access Statement).	Pollinators Strategy is defined within the GI strategy (ES Appendix 4.13) to be compiled in relation to the development).
		Hay crop, Silage, Grazing pasture (cattle, sheep, horses)	Negative All of the area used for pasture will be lost. There will be an overall net loss of grassland of 25% the majority of the replacement grassland ecological and recreational.	None Management of farmland to increase biodiversity will be undertaken as an offsetting measure primarily for farmland birds, this may result in more sustainable and long-term increased productivity but productivity is not the primary aim of this mitigation. Details of loss of farmland are presented in ES Chapter 5.
		Crop	Negative There will be a loss of arable land. Small scale provisioning would be provided by allotments, orchards and edible streets but this is unlikely to be on a commercial scale at more than a local level. They will be more of a recreational and health and wellbeing benefit.	None Management of farmland to increase biodiversity will be undertaken as an offsetting measure primarily for farmland birds, this may result in more sustainable and long-term increased productivity but productivity is not the primary aim of this mitigation. Small scale cultivation will be available to residents. Details of loss of farmland are presented in ES Chapter 5.
		Fish	No Change - Neutral There is unlikely to be a significant impact on the abundance of fish.	The mitigation for impacts to waterbodies is presented in ES Chapter 15: Surface Water Resources and Flood Risk and within ES Appendix 7.1.
	Water	Water provision	No Change - Neutral	N/A
Regulating	**Carbon**	Carbon sequestration	Negative (Short Term) and Slight Positive (Long Term)	Mitigation presented in Chapter 8 of the ES.

Category	Ecosystem Service	Type of benefits	Qualitative Assessment of Change	Location of mitigation (if applicable)
			There is an increase in woodland over the site of 396% with over double the amount of hedgerows and creation of wetlands which is a new eco-habitat, and a 675% increase in lakes and ponds. There is a reduction in grassland of 25%. Arable land is reduced by 100%. Construction will result in an initial loss of carbon. However, when the habitat matures the permanent species rich grassland establishes and woodlands and the GI within development parcels is included there may be a small increase in greater carbon sequestration potential. Timelines likely to be 30 years+.	
	Climate	Climate regulation	Local climate - Negative There will an increase in radiating heat due to the built environment. The GI integrated into the development parcels will provide some mitigation but there is likely to be an overall increase in radiating heat compared to the baseline. There is the potential to increase building integrated green and blue infrastructure at the detailed design stage to reduce this effect further. There will be large volumes of soil displacement and vegetation removal that will initially release carbon and reduce carbon sequestration in the short term. In the long term this is likely however to be neutral.	Mitigation presented in Chapter 8 of the ES.
	Water flow and flood regulation	Water flow regulation	No Change - Neutral SuDS and, woodland, hedgerows, species rich grasslands and GI within the built parcels with additional water drainage design will meet no net change in flow requirements. The site will be nutrient neutral, with 100% of the water purification delivered as a component of the development.	Mitigation presented within ES Chapter 15.
	Groundwater recharge	Groundwater recharge and quality	No Change - Neutral SuDS and water drainage design will meet no net changed in flow requirements	Mitigation presented within ES Chapter 15.
	Water quality regulation	Water quality	Positive The water quality of the East Stour River will improve due to a reduction in inputs of agricultural chemicals including fertilisers and pesticides, with the development being nutrient neutral.	Mitigation presented within the WFD (and within Chapter 15 of this ES.

Category	Ecosystem Service	Type of benefits	Qualitative Assessment of Change	Location of mitigation (if applicable)
	Air quality regulation	Air quality	No Significant Change - Neutral Whilst there would by some local decreases in air quality directly adjacent to the project, there would be no noticeable change to the functioning of the notable receptors identified within the Air Quality Chapter 6 of the ES.	Mitigation presented in Chapter 6 of this ES.
	Human health regulation	Health and well-being	Positive A beneficial impact upon human health, through the provision of homes within an environment which encourages interaction with green spaces, sports and activity and healthy travel, including cycling and walking. Sports pitches are also being provided across the site. Allotments will provide recreational opportunities that are likely to contribute towards improved health due to activity and locally grown provisions.	Green space design presented within the GI Strategy (ES Appendix 4.11)
Cultural	**Science and education**	Science and Education	Positive There is a large amount of additional environmental data for the site from the wide range of surveys undertaken and this will be combined by further surveys for detailed design and monitoring over the planning and buildout process. The provision of data provides new educational resources that would represent a net benefit with regard to science and education, including the proposed provision of Natural Play areas and increased access to the Otterpool Quarry SSSI. Port Lympne Safari Park is likely to be in greater use for educational purposes by the newly created schools and residential families. It is recommended that the project involve schools in design and monitoring projects in the future.	Proposals for natural play areas and access to SSSI presented within the associated DAS (ES Appendix 4.16). The potential for the Roman Villa to be a valuable educational resource for the future. Potential to involve schools in design and monitoring projects in the future.
	Tourism and recreation	Tourism	Positive The development proposes to enhance the setting of the now privately owned Westenhanger Castle by providing parkland and scenic views and it has the potential to become a tourist destination. Remains of a Roman Villa that are likely to be of high regional importance has been discovered during the cultural heritage surveys and may become a future tourist destination. Finds from the excavation of the Roman Villa may be on temporary display, there is potential for community digs and wider school engagement. The natural and cultural heritage of the site will	Westenhanger Castle is to the north of the site. The Roman Villa (to the south of the site east of the quarry).

Category	Ecosystem Service	Type of benefits	Qualitative Assessment of Change	Location of mitigation (if applicable)
			be combined and showcased via be interpretation boards to present the site and bring life to the past.	
		Recreation	Positive A significant increase in the recreation value of the site is foreseen. Currently, there is minimal access to the site by the public and a largely unappealing landscape dominated by intense agriculture. There will be a large increase in the availability of quality accessible greenspace, including a river park, town park, country park, green routes and play areas. Sports pitches are also being provided across the site.	Proposals for recreational areas presented within the associated DAS (ES Appendix 4.16).
	Sense of place and history	Cultural heritage and aesthetic amenity Historical archaeological sites	Positive The development proposes to enhance the setting of the now privately owned Westenhanger Castle by providing parkland and scenic views and it has the potential to become a tourist destination. Remains of a Roman Villa that are likely to be of high regional importance has been discovered during the cultural heritage surveys and may become a future tourist destination. Finds from the excavation of the Roman Villa may be on temporary display, there is potential for community digs and wider school engagement. The natural and cultural heritage of the site will be combined and showcased via be interpretation boards to present the site and bring life to the past.	Mitigation presented in Chapter 9 of the ES.
		Tranquillity	Negative Although the tranquil setting was not enjoyed by a large number of people this sense of place and tranquillity will certainly be negatively impacted	Proposals for natural play and recreational areas are presented in the associated DAS (ES Appendix 4.16).
Supporting	**Biodiversity**	Increased native biodiversity	Positive Increased diversity of habitats, increased provision of habitats of valuable habitats for notable species is calculated to provide approximately 20% net gain using the Biodiversity Metric 3.0. This project design has been represented by GI typologies, each of which has associated habitat parameters detailed within the Biodiversity Net Gain Report. Any evolution of these parameters, through detailed design, must fulfil the required	Mitigation outlined in this Chapter, Biodiversity Net gain Report (ES Appendix 7.21) and the BAP (ES Appendix 7.20)

Category	Ecosystem Service	Type of benefits	Qualitative Assessment of Change	Location of mitigation (if applicable)
			net gain and ecosystem function as discussed within this Biodiversity ES Chapter and associated appendices.	
	Non-Native Invasive Species	Increase native biodiversity	Positive These will be eradicated from site, a dedicated Non-Native Invasive Species Management Plan	Mitigation outlined in the ES Biodiversity Chapter 7
	Soils	Soil quality	Negative There will be a loss of agricultural land as a result of the development. The quality of this land varies between Grade 2 to Grade 3 in the ALC (Agricultural Land Classification). Soils on the site include: • Freely draining slightly acid loamy soils; • Loamy soils with naturally high groundwater; • Freely draining slightly acid but base rich soils and slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils.	Completion of a Soil Resources Survey and incorporate results into a Soil Management Plan (SMP) which would be aligned to a Site Waste Management Plan. The SMP will ensure that soil is stripped, stored and generally managed to conserve its condition and will be reused onsite. This reuse may benefit the allotments and orchards and provide the potential for some of the site to be returned to small scale agriculture if required in the future. Mitigation presented in ES Chapter 5.

4.2 EBN Assessment

Introduction

4.2.1 The EBN tool assesses the results of land use changes. The tool uses indicators to calculate a score for each of the 18 assessed ecosystem services, indicating the direction and magnitude of the impact of the proposed land-use changes on the value of ecosystem services. The scores are based on expert knowledge encoded into the tool. Details of how the data relating to the proposed project was handled to inform the assessments are presented in Appendix A and Appendix C.

Results

4.2.2 The results in Image 3 indicate the impacts of the proposed project on ecosystem services over timescales of 1, 10 and 30 years post-development. The EBN assessment indicates that after 30 years there will be both net-gains (thirteen ecosystem services) and losses (two ecosystem services). The remaining three ecosystem services are neutral. What the assessed ecosystem services mean within the EBN assessment and how the results should be interpreted is outlined below for each ecosystem service below.

Image 3 - EBN tool Results for Otterpool Park

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 ecosystem service of food
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	→	→	→	●	The results 30 years after development indicate little change in the ecosystem service of carbon storage.
Air quality regulation	→	→	↗	●	
Cooling and shading	→	→	↗	●	
Noise reduction	→	→	→	●	
Pollination	→	↗	↗	●	
Pest control	↘	↗	↗	●	Legend
Recreation	↑	↑	↑	●	
Aesthetic value	→	↗	↗	●	
Education	↗	↗	↑	●	
Interaction with nature	↗	↗	↗	●	
Sense of place	↘	↗	↗	●	

Provisioning

Food production

4.2.3 This is defined as: "*Arable crops, horticulture, livestock, orchards, allotments, urban food, wild food (e.g. gathering berries or mushrooms)*."

4.2.4 The EBN tool shows a large net-loss in food production (mainly agricultural crop and silage/grazing pasture) due to the loss of the dominant agricultural use to date. Some of the negative effect is mitigated by introducing allotments and edible streets which could be used for provisioning, but this is unlikely to be at a commercial scale.

Wood production

4.2.5 This is defined as: "*Timber, wood production for paper, woody biofuel crops, coppice wood or wood waste used for biofuel*."

4.2.6 The EBN tool shows an anticipated increase in wood production from ten years due to the retention of the existing woodland on site and woodland creation. However, this is unlikely to provide a realised natural capital benefit as there are no plans for the timber to be harvested.

Fish production

4.2.7 This is defined as: "*Aquaculture, commercial fishing, recreational fishing (recreational fishing is also a cultural service, but the habitat conditions match those for fish production*)."

4.2.8 The EBN tool shows a neutral change in fish production. This is due to retention of the ponds, enhancement of the river and the creation of new ponds on site. No commercial or recreational fishing is known on the site.

Water supply

4.2.9 This is defined as: "*Impact of soil and vegetation on rainwater runoff and infiltration, and thus on groundwater recharge or surface water flow*."

4.2.10 This is shown as a negative impact in the EBN tool. This is not considered accurate, as the site has a commitment to infiltrate water to maintain greenfield run-off rates.

Regulating

Flood regulation

4.2.11 This is defined as: "*Reduction of surface runoff, peak flow, flood extent and flood depth through canopy interception, evapotranspiration, soil infiltration and physical slowing of water flow*."

4.2.12 The existing land-uses have a limited effect on mitigating flood risk. The proposed introduction of sealed surfaces such as roads, which increase water run-off, are balanced by also introducing land uses that increase water retention such as woodland, grassland and rain gardens. There are large areas of lake and wetland being created along with SuDs to mitigate impacts. There is a neutral impact predicted in the first ten years, from the construction of sealed surfaces, followed by an increase by year thirty due to the establishment of the woodland and other vegetation and creation of the SuDS etc. The EBN tool model does not include the effects of constructed flood walls or other engineered measures, these will further improve the situation on site.

Erosion Protection

4.2.13 This is defined as: "*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*."

4.2.14 There is likely to be an increase in erosion protection from year one. This is due to a reduction in farmland and an increase in the vegetation cover on site from the introduction of new areas of greenspace, tree planting etc.

Water quality regulation

4.2.15 This is defined as: "*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*."

4.2.16 There is likely to be an improvement in water quality regulation form year one as a result if the reduction in farming leading to a reduction in nutrient run-off from agricultural land. The development is committed to being nutrient neutral. There is also an increase in woodland and grassland habitats as well as the installation of rain gardens. These are expected to offset any additional road traffic as a result of the proposed Development leading to the site achieving nutrient neutrality. It should be noted, however, that only the natural capacity of habitats and land-uses to affect water quality is assessed by the EBN tool. Improvements through engineered measures such as the proposed water treatment plant and grey infrastructure like drains and sumps are not reflected in the score, the effect that these will have in improving water quality are evidenced in ES Chapter 15.

Carbon storage

4.2.17 This is defined as: "*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*"

4.2.18 There is likely to be an initial reduction in carbon storage, but this will stabilise providing a neutral carbon storage impact from the one year mark. The increase in vegetation cover and the increase in woodland habitat is anticipated to compensate for carbon released from soils in the longer term, with a neutral impact at year 30.

Air quality regulation

4.2.19 This is defined as: "*Air pollution impacts on health, climate and biodiversity. Vegetation can affect pollutant concentrations through dispersion and remove pollutants by deposition*"

4.2.20 The overall effect on air quality, in terms of ecosystem services, is anticipated to be neutral with an improvement at the thirty year mark. This is due to the increase in woodland areas. These have a positive impact on air quality overall but take time to establish.

Cooling and shading (Local climate regulation)

4.2.21 This is defined as: "*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 provide shade on hot days*."

4.2.22 The introduction of sealed surfaces which will decrease the cooling effect in the early years, however, this will be offset by the increase in heterogenous greenspaces with trees across the site. An initial neutral impact on cooling and shading followed by an improvement at thirty years is anticipated, due to the time taken for the woodland and urban trees to establish.

Noise reduction

4.2.23 This is defined as: "*Attenuation of noise by vegetation*."

4.2.24 The introduction of sealed surfaces will negatively impact noise reduction, but this will be offset by the increase in tree and hedgerow cover. Consequently, a neutral impact on noise reduction is anticipated at the thirty year period.

Pollination

4.2.25 This is defined as: "*Pollination of crops (and wild plants, supporting other ecosystem services) by wild insects (mainly bees and hoverflies). Excludes pollination by managed honeybees*."

4.2.26 Traditional farmland has some limited value for pollinators, but the increase in heterogeneous greenspace and vegetation cover across the site will increase the value of the site for pollinators. Consequently, an initial neutral impact is predicted in the first year followed by improvements in years ten and thirty.

Pest control

4.2.27 This is defined as: "*Predation of crop or tree pests by invertebrates (e.g. beetles, spiders, wasps), birds and bats."*

4.2.28 The removal of farming and introduction of urban areas is expected to cause an initial decrease in pest control in year one. However, this will be offset by the increase in greenspace across the site which will provide habitat for pest predators and result in an improvement in pest control from year ten as these areas become established and colonised by pest predators.

Cultural

Recreation

4.2.29 This is defined as: "*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*."

4.2.30 A large increase is expected in the recreational value of the site from year one. The removal of farmland and establishment of the development will open the site up for public access and increase its recreational value.

Aesthetic value

4.2.31 This is defined as: *"Provision of attractive views, beautiful surroundings, and pleasing, calming, or inspiring sights, sounds and smells of nature*."

4.2.32 A neutral change for aesthetic value is expected in year one with the removal of farmland and the construction of the proposed project. A subsequent increase is expected from year ten with the establishment of area of a large and well-connected network of accessible greenspace across the site, which importantly are publicly accessible.

Education

4.2.33 This is defined as: "*Opportunities for formal education (e.g. school trips), scientific research, local knowledge and informal learning (e.g. from information boards or experiences)*."

4.2.34 An increase in educational value is expected from year one. This is due to the establishment of accessible greenspace across the site in addition to providing public access to the existing areas of greenspace across the site. These include natural play space.

Interaction with nature

4.2.35 This is defined as: "*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 Biodiversity Metric); existence value (from just knowing that nature exists)*."

4.2.36 An increase in the interaction with nature is expected from year one. This is due to establishment of accessible greenspace across the site in addition to providing public access to the existing areas of greenspace across the site. Any negative impacts from recreational access are expected to be offset by the increase in greenspace.

Sense of place

4.2.37 This is defined as: "*The 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.*"

4.2.38 An initial decrease in the sense of place is expected within the first year due to the construction of the proposed project. This is then anticipated to be followed by an increase from year ten as the development and associated areas of greenspace become established and the site becomes publicly accessible. This will also permit public access to the sites of cultural and historical value that are present within the site helping to increase this ecosystem service.

5 Discussion

5.1.1 Although the two assessment methodologies provided the results with regards to a slightly different set of parameters, the parameters are synonymous and the results can be compared and combined to provide a holistic overview. Both methods returned comparable results. The results of the two assessments are summarised in the Table 8.

Table 8: A summary of the compiled results of the two assessments (although the criteria do not align exactly this provides an overview of the results).

Component of Natural Capital – Qualitative Assessment	EBN Type	Qualitative Assessment Result	EBN Result
Provisioning / Food	Food production	Positive change for pollinators. Negative change for hay crop and silage and arable / livestock production Neutral for Fish	Negative Large decrease in years 1, 10 and 30
	Wood production		Positive Neutral in year 1, and increase in years 10 and 30
	Fish production		Neutral Neutral in years 1, 10 and 30
	Pollination		Positive Neutral in year 1 and increase in year 10 and year 30
	Pest control		Positive Decrease in year 1 and increase in years 10 and 30
Regulatory - Water	Water Quality Regulation	Neutral	Positive Increase in year 1, 10 and 30
	Water supply		Negative Decrease in years 1, 10 and 30
Regulatory - Carbon and climate regulation	Cooling and Shading	Negative at the local scale, no-change at the global scale. Carbon storage likely to be neutral or positive in the long term (over 30 years).	Positive Neutral in years 1 and 10, and increase in year 30
	Carbon Storage		Neutral Neutral in years 1, 10 and 30

Component of Natural Capital – Qualitative Assessment	EBN Type	Qualitative Assessment Result	EBN Result
Regulatory - Water flow and flood regulation	Flood regulation	Neutral	Positive Neutral in years 1 and 10, and increase in year 30
Regulatory - Improvement in air quality	Air Quality Regulation	Neutral	Positive Neutral in years 1 and 10, and increase in year 30
Regulatory – Reduction in noise pollution	Noise Reduction	Neutral	Neutral Neutral in years 1, 10 and 30
Cultural - Human health	Recreation	Positive	Positive Large increase in years 1, 10 and 30
	Aesthetic Value		Positive Neutral in year 1, increase in years 10 and 30
Cultural - Science and education	Education	Positive	Positive Increase in years 1 and 10 with large increase in year 30
Cultural - Sense of place and history	Aesthetic values	Positive for cultural heritage, aesthetic amenity and historical archaeology sites, negative for tranquillity	Positive Decrease in year 1, increase in years 10 and 30
Supporting - Biodiversity	Pollination	Positive	Positive Neutral in year 1 and increase in year 10 and year 30
	Pest control		Positive Decrease in year 1 and increase in years 10 and 30
Supporting - Soil	Erosion regulation	Negative	Positive Increase in years 1, 10 and 30

5.1.2 Overall, both assessments concluded that there would be a reduction in provision of food and harvested products. There would be an increase in the provision of food for pollinators and of pest control. The qualitative assessment concluded that there would be a neutral change in water quality, water supply, flood regulation and air quality regulation. In contrast the EBN assessment concluded that there would be a positive change in water quality regulation, flood regulation and air quality regulation with a reduction in water supply. The EBN tool recorded an increase in wood production, However, this will not be realised as the woodland on site will not be harvested.

5.1.3 Both assessments concluded there would initially be a decrease in carbon storage (especially initially), as a result in the increase of built development. The qualitative assessment determined a decrease in cooling and an increase in cooling and shading, as a result of woodland creation.

5.1.4 For long term carbon storage, the qualitative assessment concluded that there would be no significant change, this was mirrored by the EBN tool.

5.1.5 With regard to human health and wellbeing, science and education, tourism and recreation, both assessments concluded there would be a Positive change. This is due to the significant increase in accessible green infrastructure, the quality of those publicly accessible areas, and the increase in the number of people who are able to use them (from the new population). The sense of place and history provided by the site is assessed by both methods to improve after the development largely due to the improved setting and access for people to cultural assets after the development. The EBN tool does not specifically assess tranquillity. However the qualitative assessment concludes that this is likely to decline after the development but that not many people were beneficiaries of the tranquillity as little of the site is currently accessible to the public and there are few private dwellings with access to the immediate landscape of the site.

5.1.6 With regard to biodiversity both methods conclude that there will be a significant improvement in biodiversity value (and a reduction in impacts from invasive species).

5.1.7 With regard to soil quality and formation, there will be a negative impact, determined by the qualitative assessment. The EBN tool does not currently include soils, but did conclude that erosion would be reduced by the proposals.

6 Conclusions

6.1.1 This report provides details the approaches undertaken to maintain and enhance natural capital asset value and ecosystem services within the Otterpool Park development. It presents the results of two methods of assessment of the potential impacts to natural capital and ecosystem services resulting from the illustrative masterplan (ES Appendix 4.5).

6.1.2 Design measures to maximise the natural capital value of the development, and minimise any loss of ecosystem services provided included (but were not limited to):

- Retention of the areas that provided the most transferrable ecosystem services within the development.;
- Buffering of these areas;
- Maximising the value of the GI around the development;
- Minimising potential impacts upon air quality, water quality, flood protection, with SuDS;
- Inclusion of allotments and edible streets within the development; and
- Measures to maximise the cultural value of the site.

6.1.3 Once the illustrative masterplan (ES Appendix 4.5) was finalised for the OPA submission for the development, two assessments of the potential impact of the development upon the natural capital and ecosystem services of the site were conducted (potential impact as the proposals are only at outline stage and the masterplan is illustrative only). Although these resulted in slightly different results, the overall results were comparable. In summary, it was concluded that there would be a Positive change (i.e. a net improvement) in the following ecosystem services:

- Human health and wellbeing (including sense of place and interaction with nature);
- Science and education;
- Tourism and recreation;
- Food for pollinators;
- Water quality regulation;
- Pest control
- Wood production (although it is unlikely this will be formally harvested);
- Biodiversity (this is supported by the approximately 20% increase in biodiversity demonstrated in the Biodiversity Net Gain Report, ES appendix 7.21); and
- Aesthetic values.

6.1.4 There would be Neutral or 'not significant'' becoming positive changes in the following ecosystem services:

- Erosion protection;
- Water flow and flood regulation (after 10 years); and
- Air quality.

6.1.5 There will be neutral changes in:

- Fish production
- Carbon storage; and
- Noise reduction

6.1.6 It was assessed that there is likely to be a Negative i.e. a net loss in the following ecosystem services:

- Harvested products (food, hay and silage);
- Soil formation and quality.

6.1.7 In summary, there is a Positive change in some areas (i.e. net gain), Neutral (i.e. no change) in others and a Negative (i.e. net loss) is some areas. The largest Negative change is in the loss of provisioning due to development on agricultural land. This is balanced by the gain in cultural services such as amenity, recreation, tourism, health and wellbeing. Biodiversity presents the next largest positive change.

6.1.8 While increasing the overall environmental quality of existing agricultural land (off-site) will not compensate for the loss of provisioning services, the re-use of soil combined with the allotments, orchards and edible streets will preserve some of that soil quality that it may be possible return to some form of agriculture in some small areas in the future. Given the requirement for additional housing and the quality of the green infrastructure proposed within the design of the project overall the designed has been maximised to enhance natural capital value and provision of ecosystem services. It is vital that these designs are evolved and enhance through detailed design throughout the planning process and this and the Biodiversity Net Gain Report provide useful targets to be met or bettered throughout this process. There is potential to increase the building integrated vegetation and GI around the built parcels above those parameters presumed and assessed in the BNG Report as nature-based solutions technologies continue to improve, and this should be an aspiration of the proposed project.

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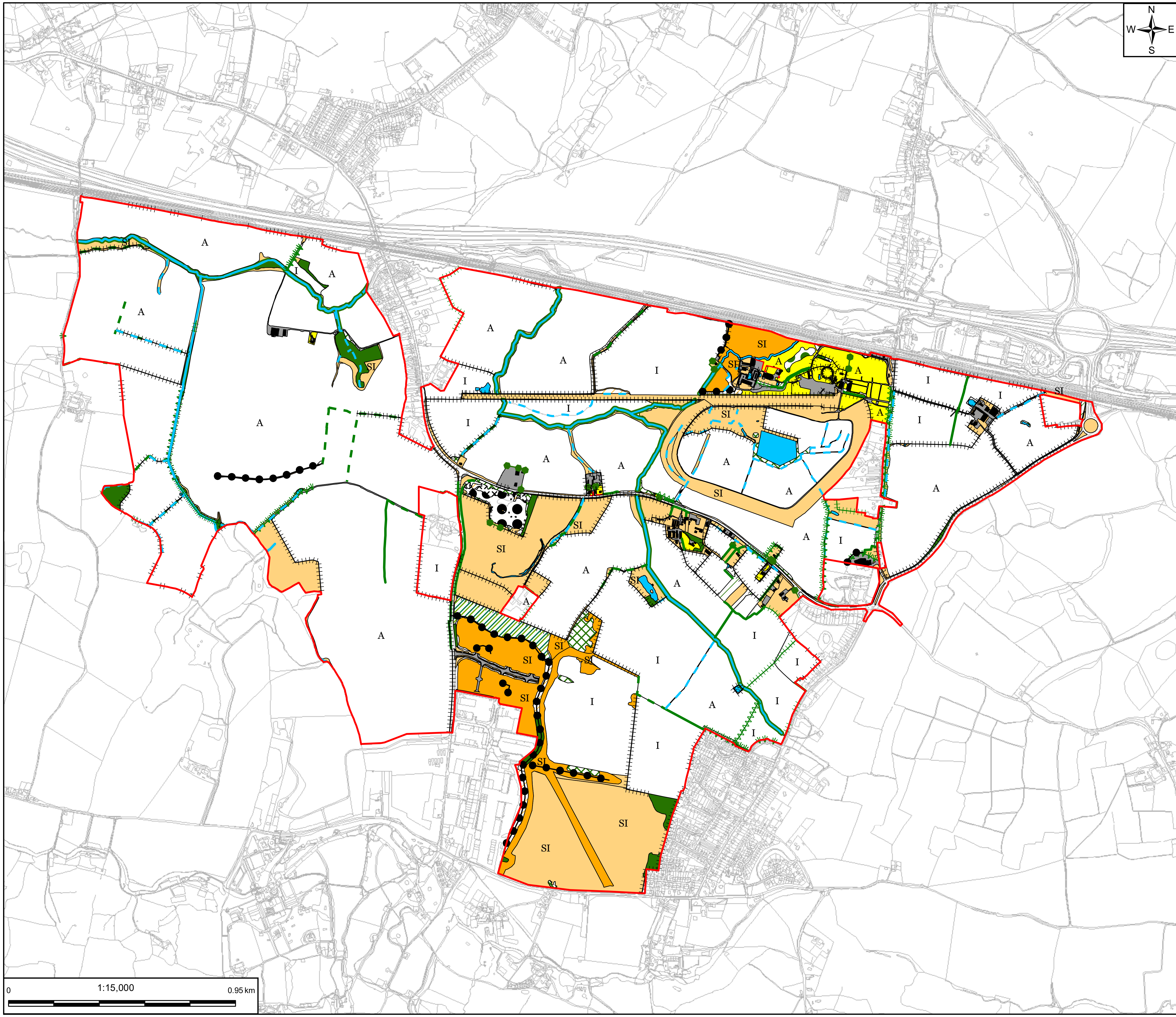
Figure 1: Overview of site habitats pre-development



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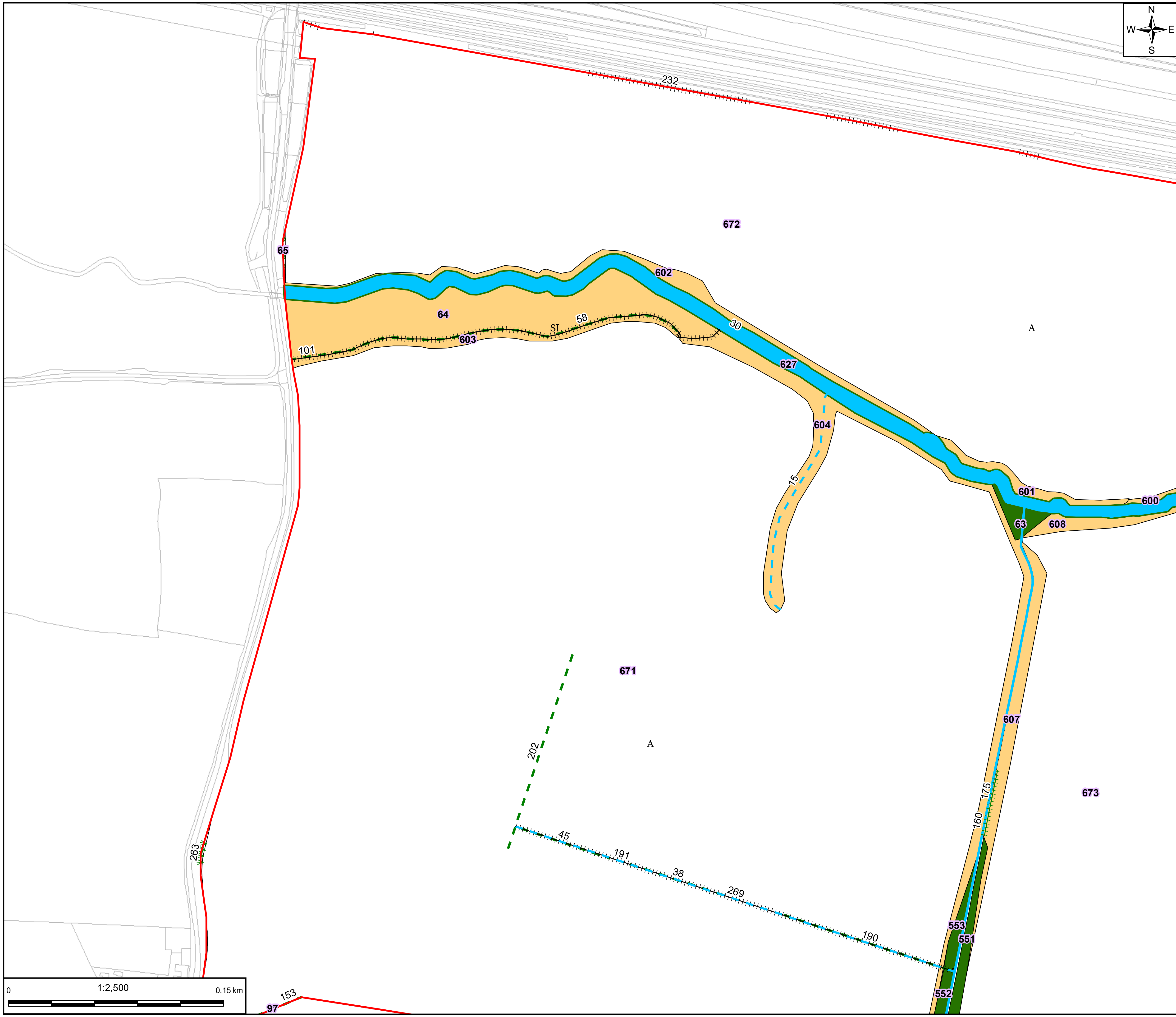

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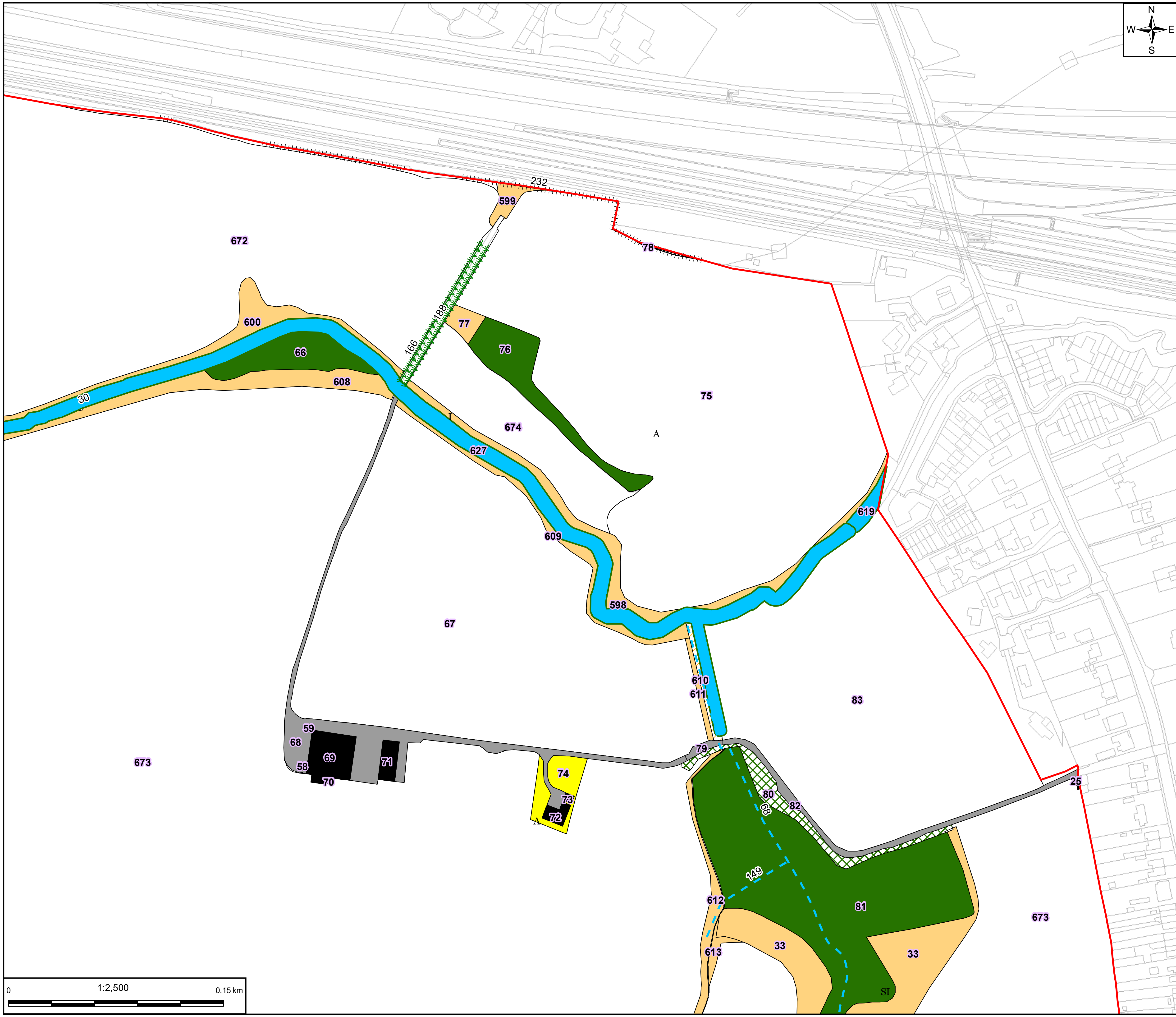

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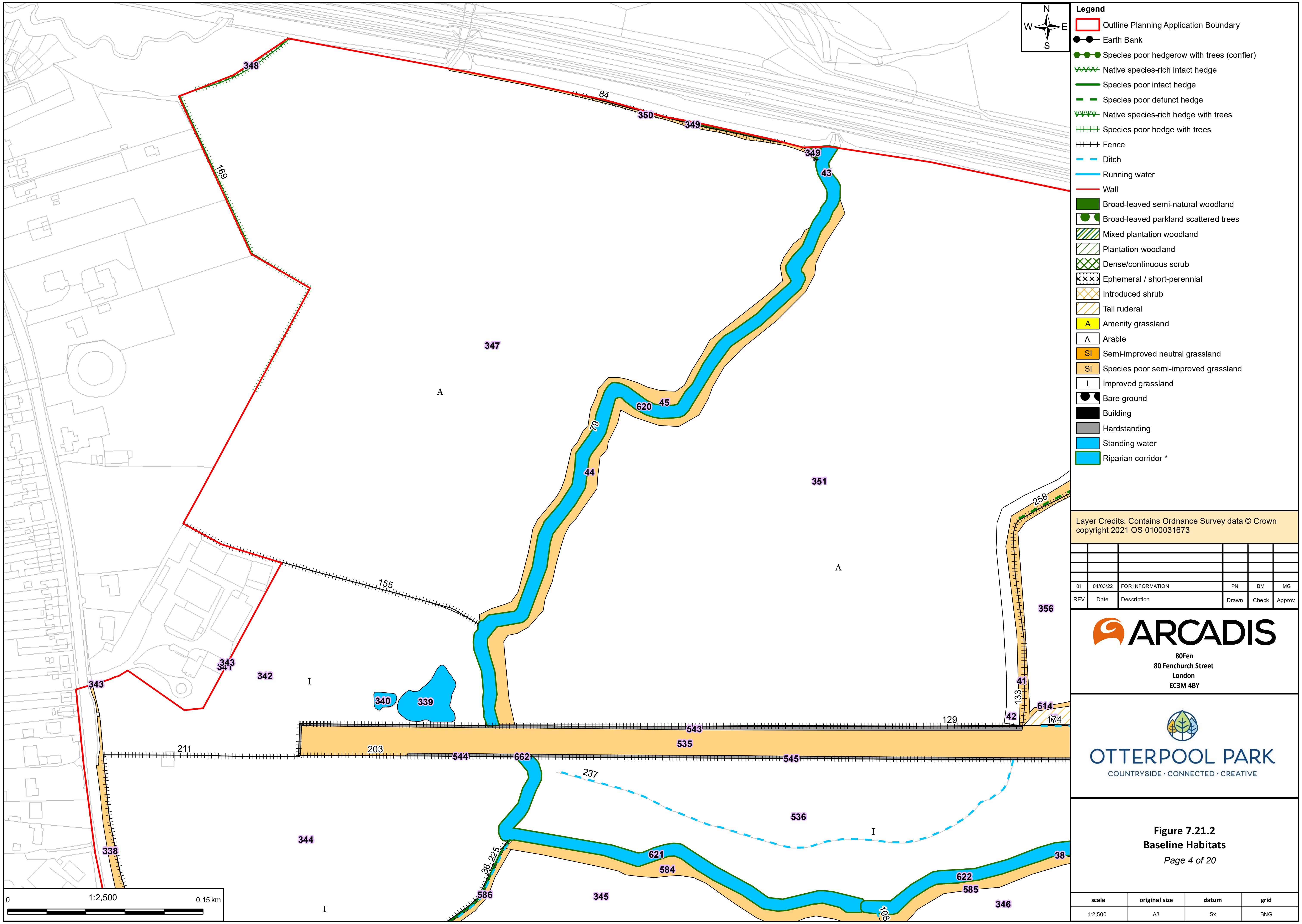

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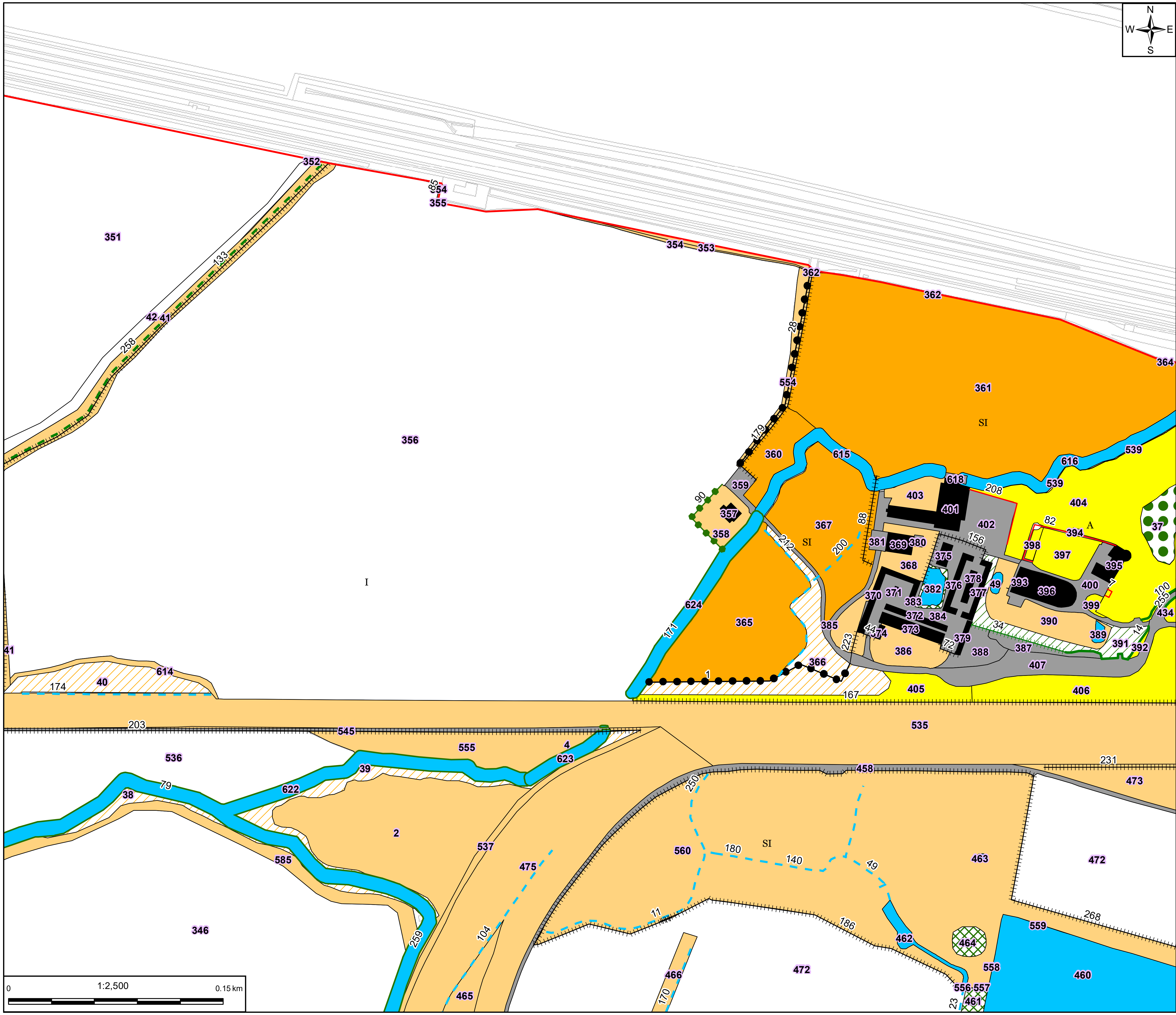

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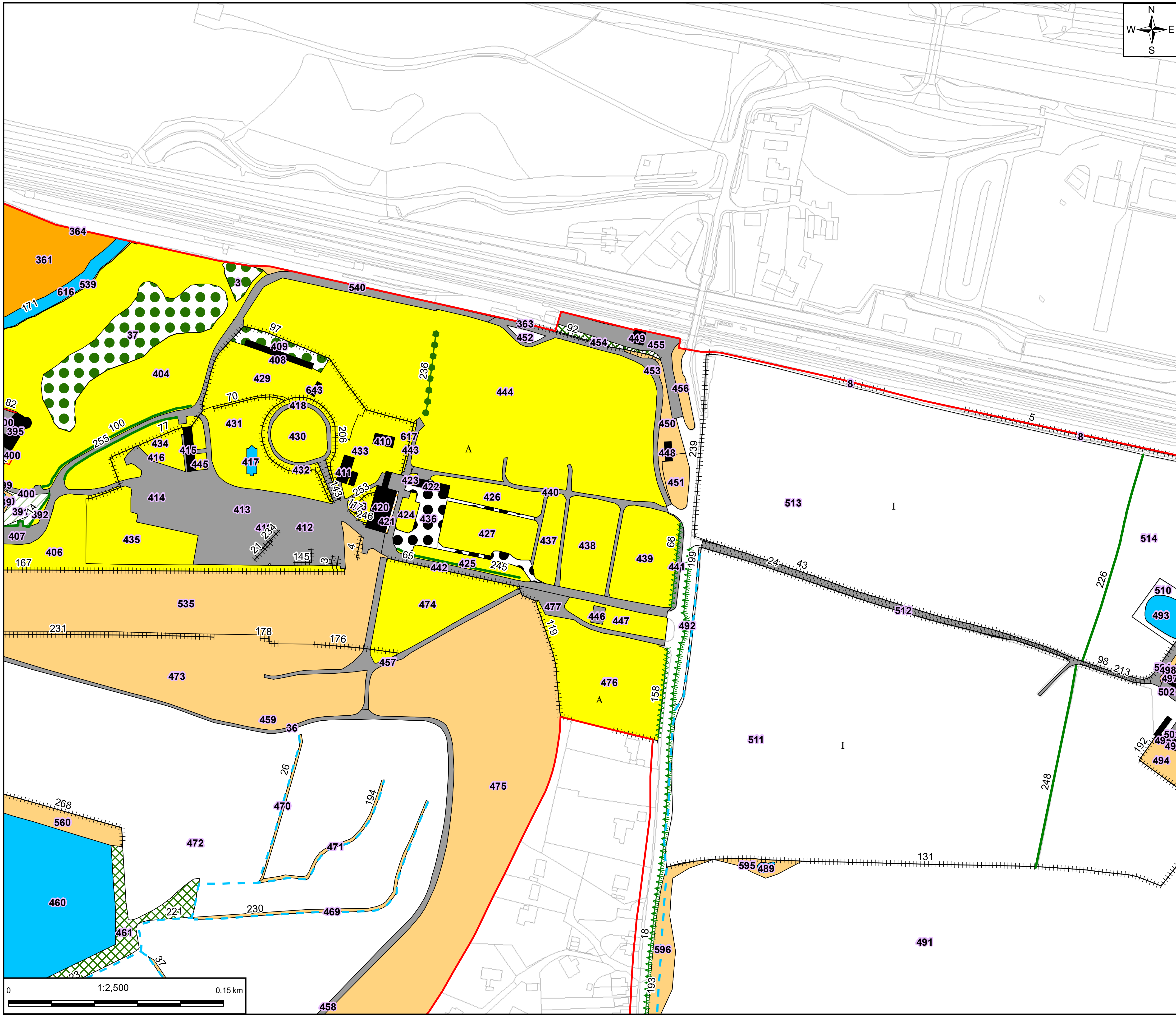

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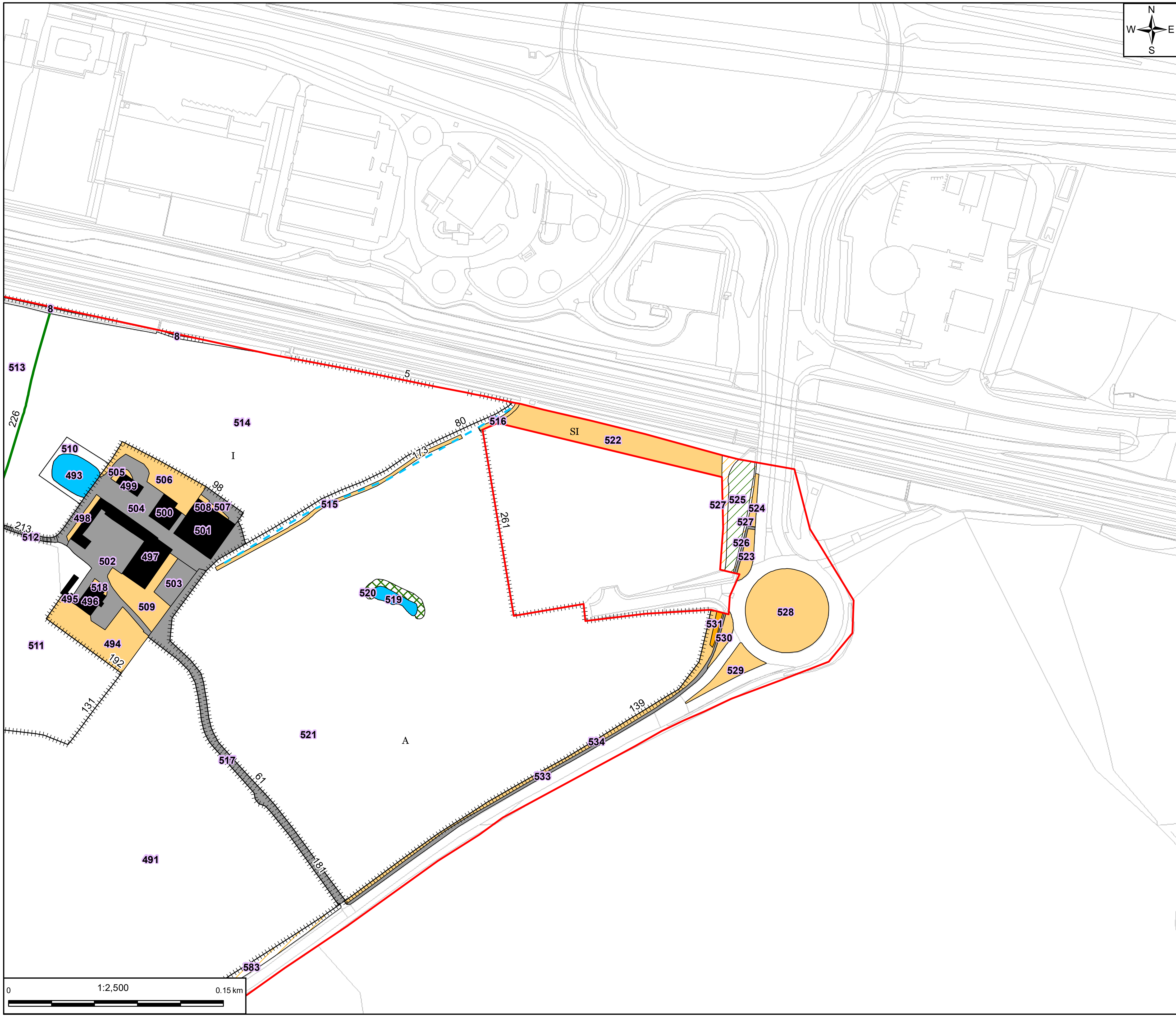

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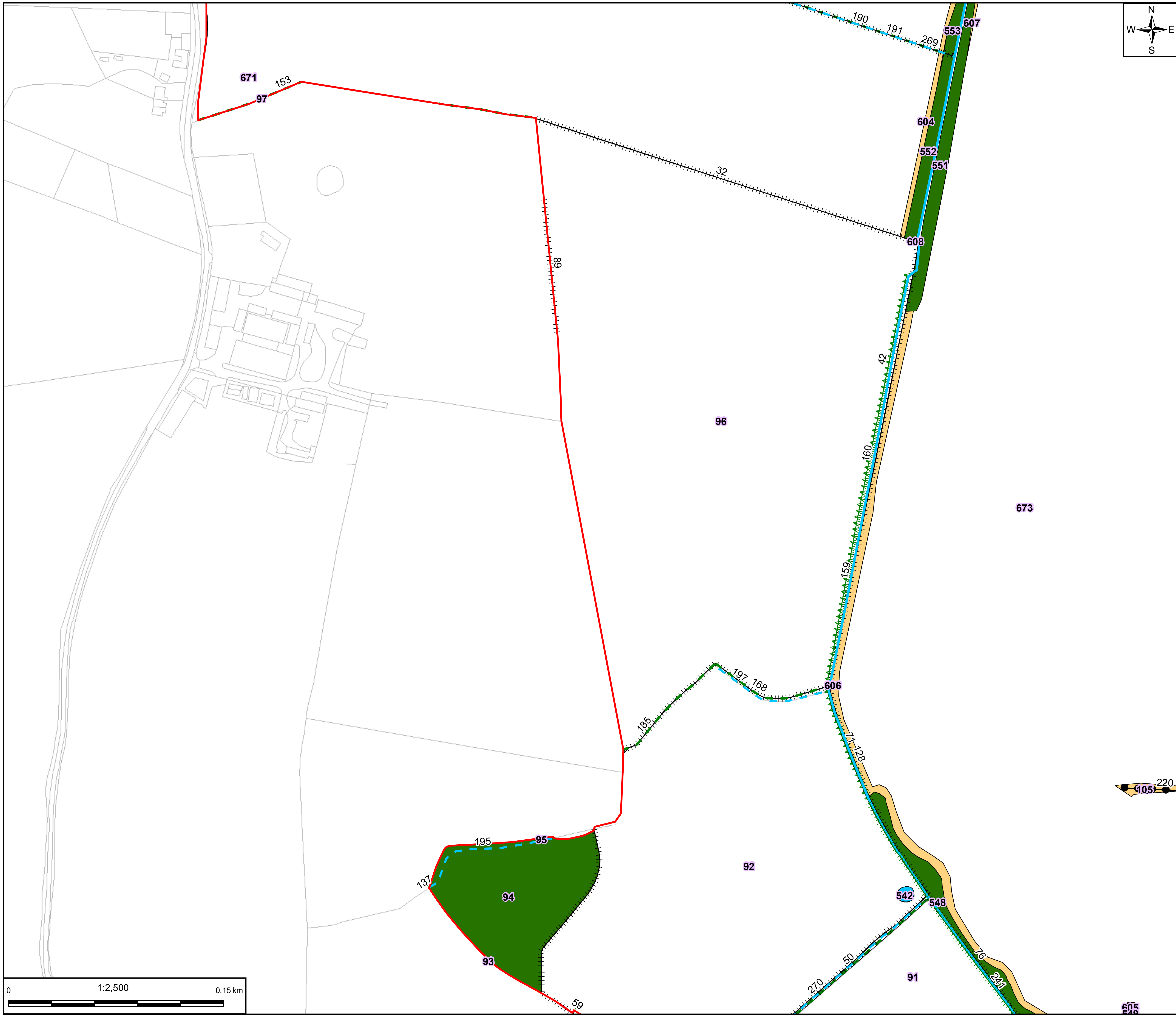

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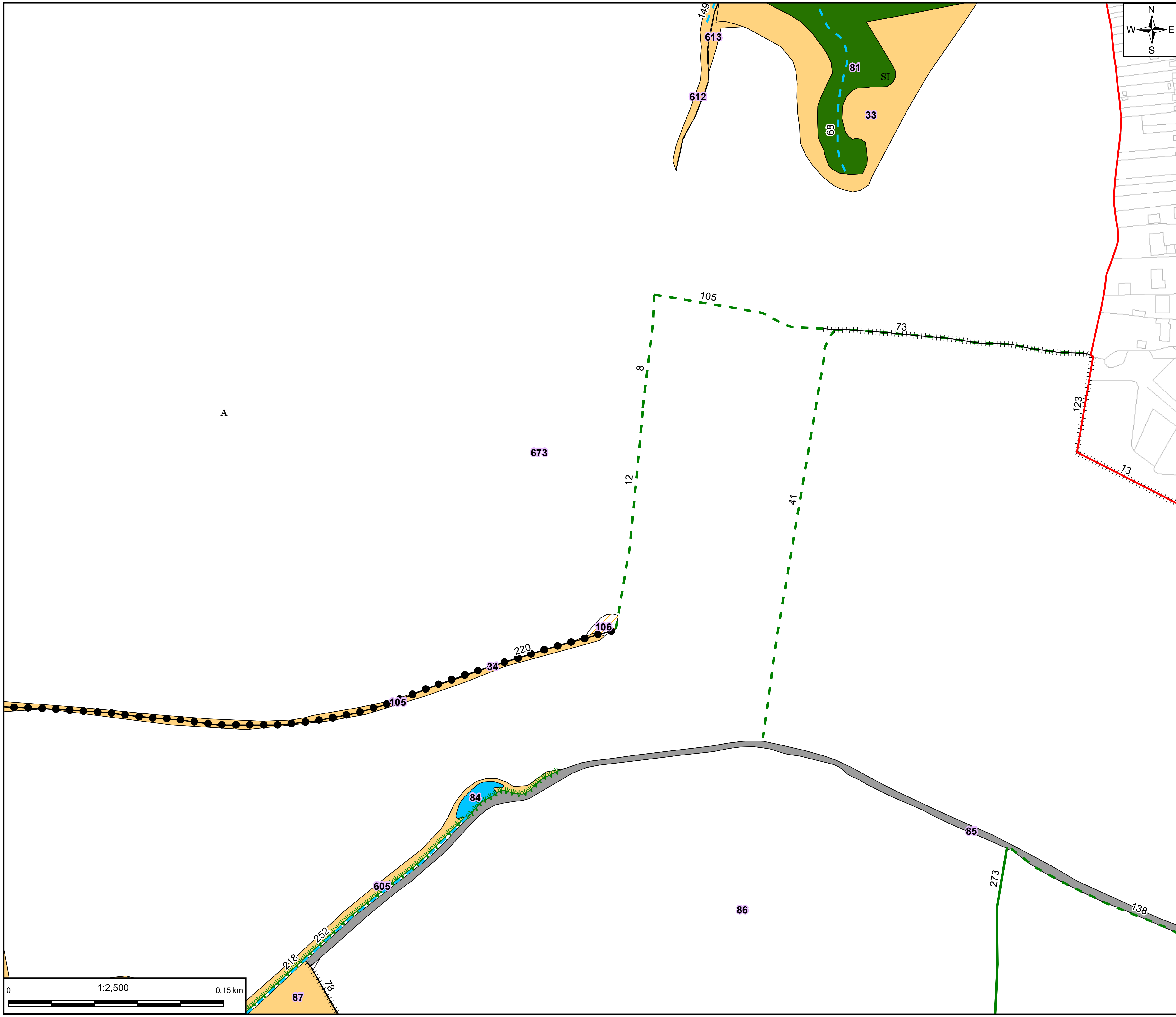

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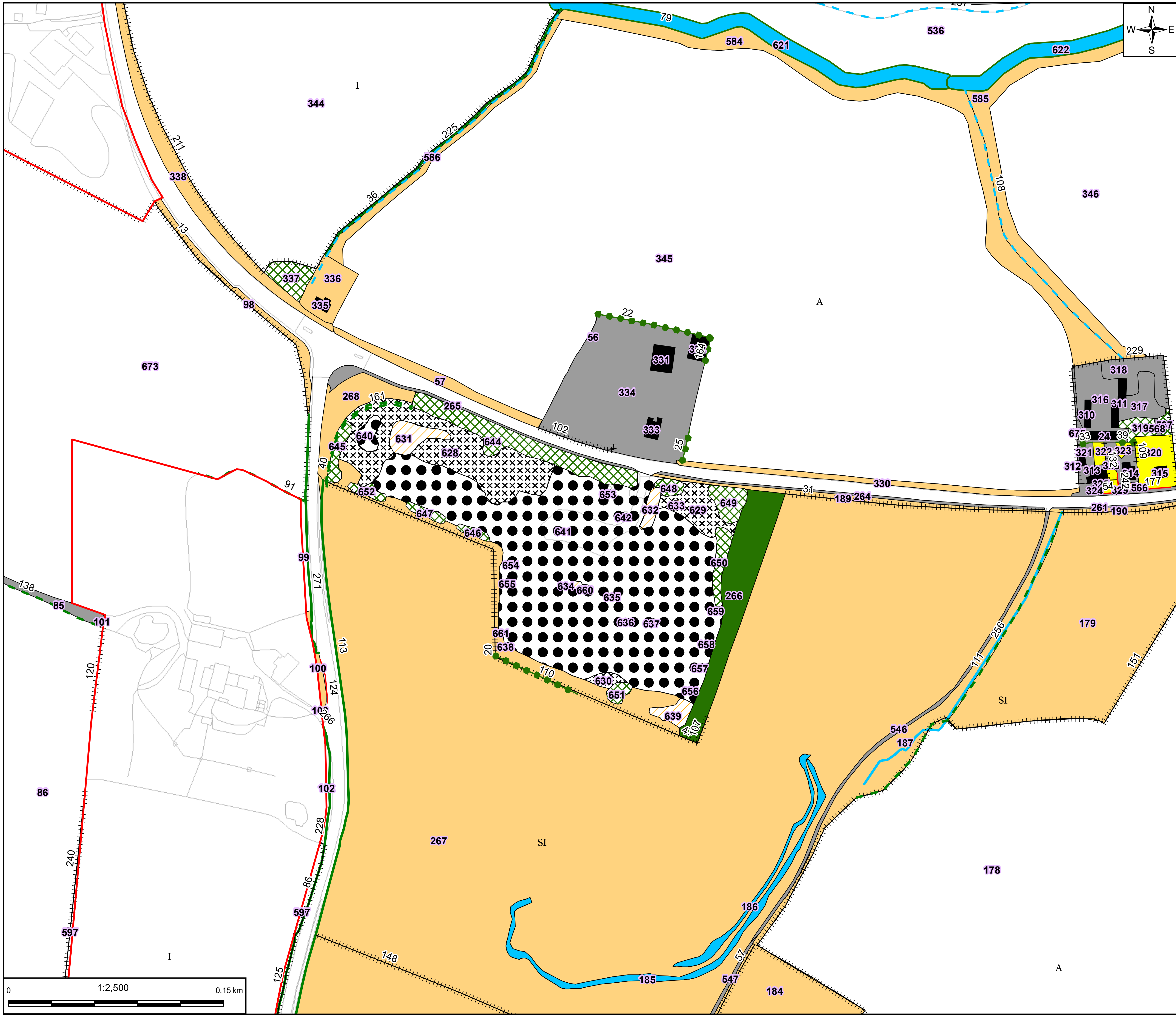

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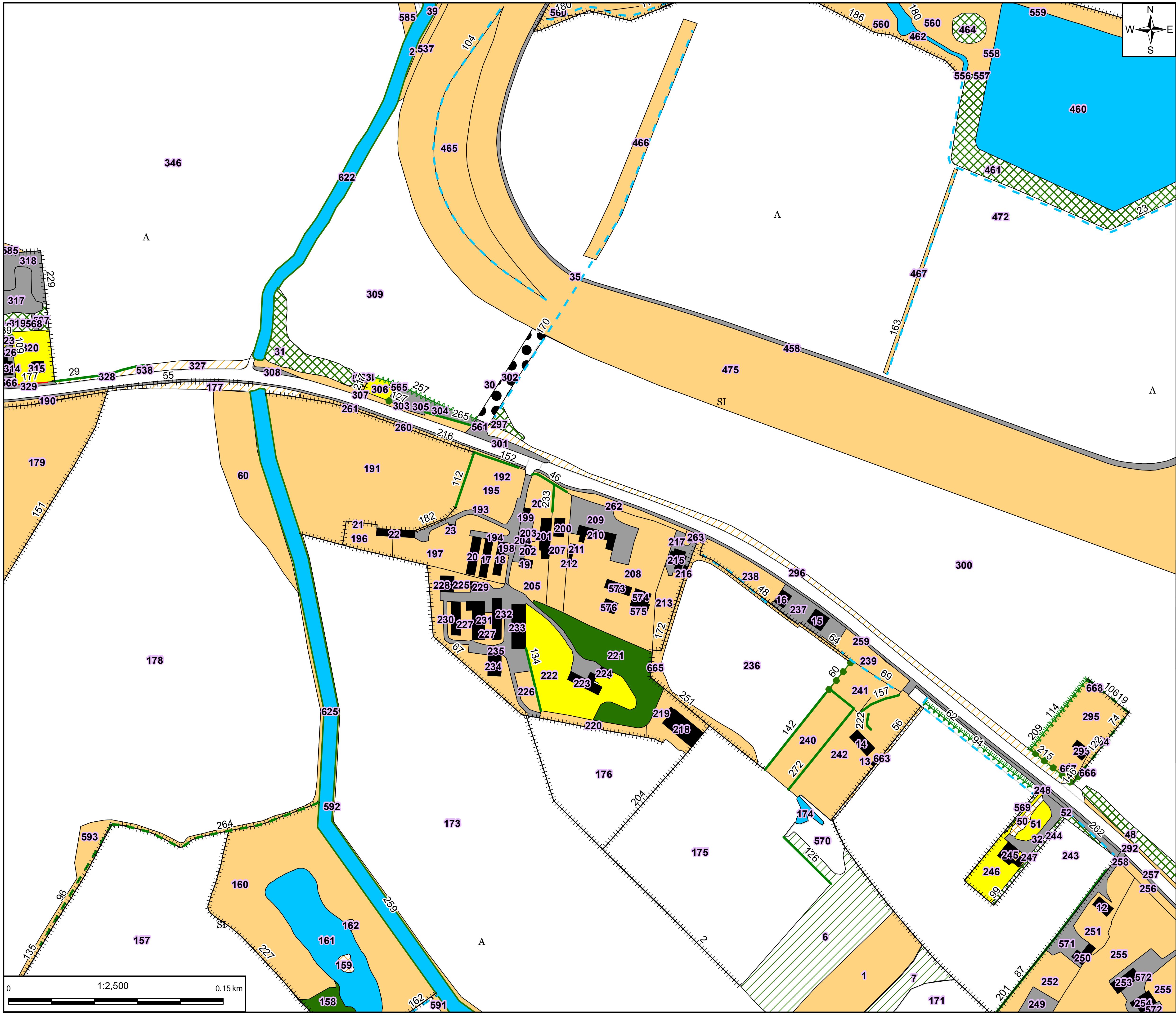

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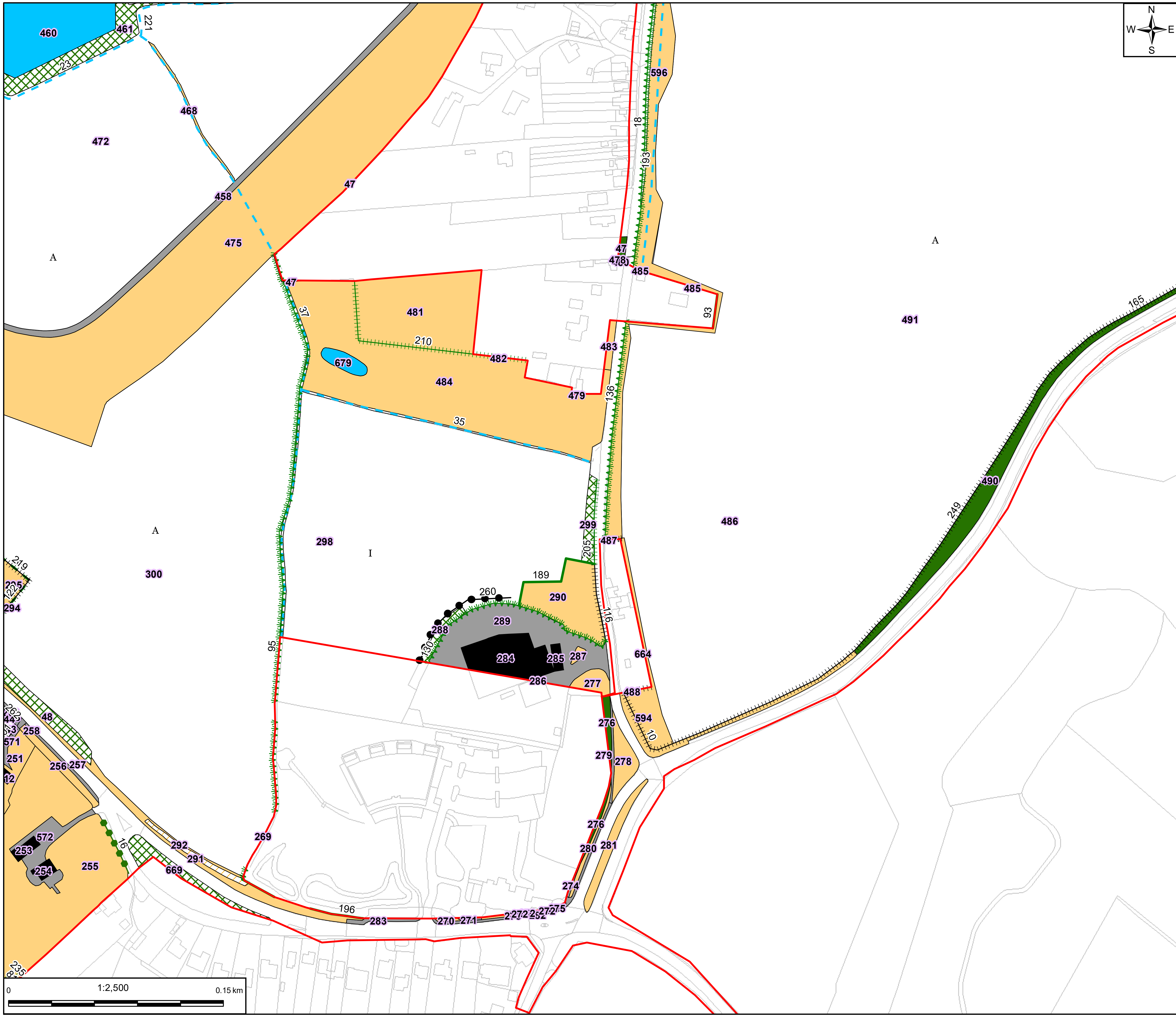

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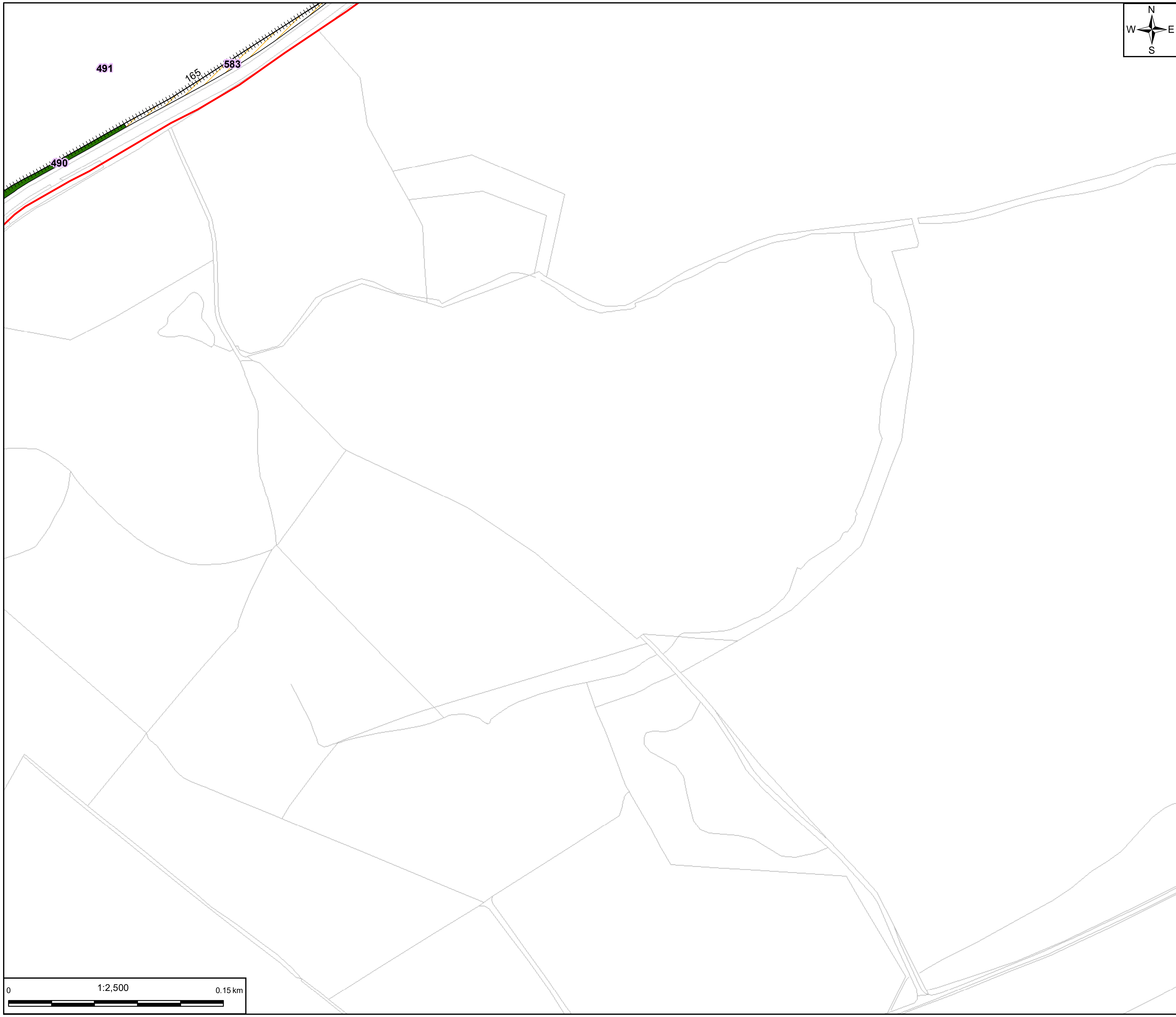

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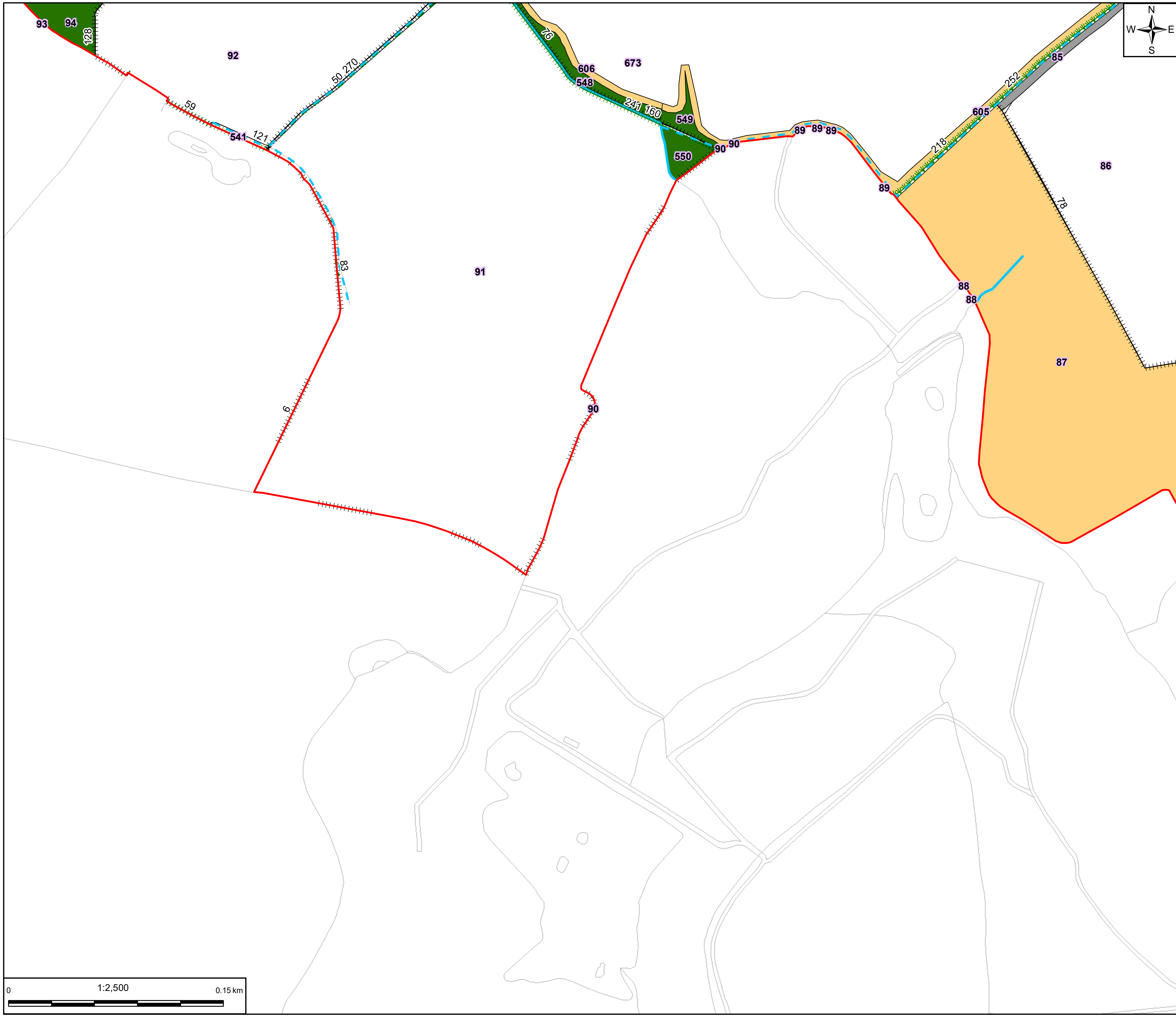

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- Plantation woodland
- Dense/continuous scrub
- Ephemeral / short-perennial
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- Tall ruderal
- A Amenity grassland
- A Arable
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- SI Species poor semi-improved grassland
- I Improved grassland
- Bare ground
- Building
- Hardstanding
- Standing water
- Riparian corridor *

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Figure 7.21.2
Baseline Habitats
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scale	original size	datum	grid
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Legend

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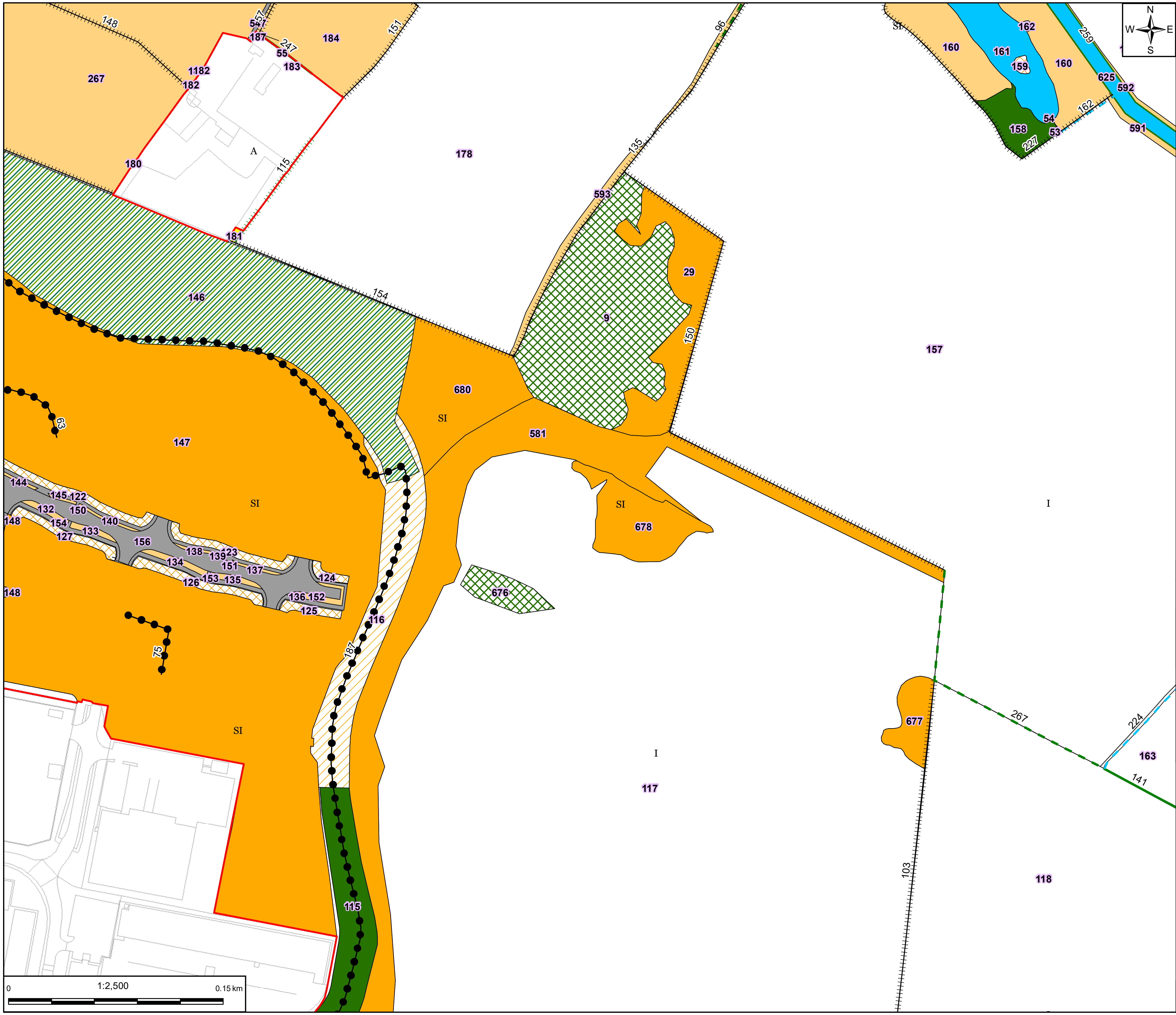

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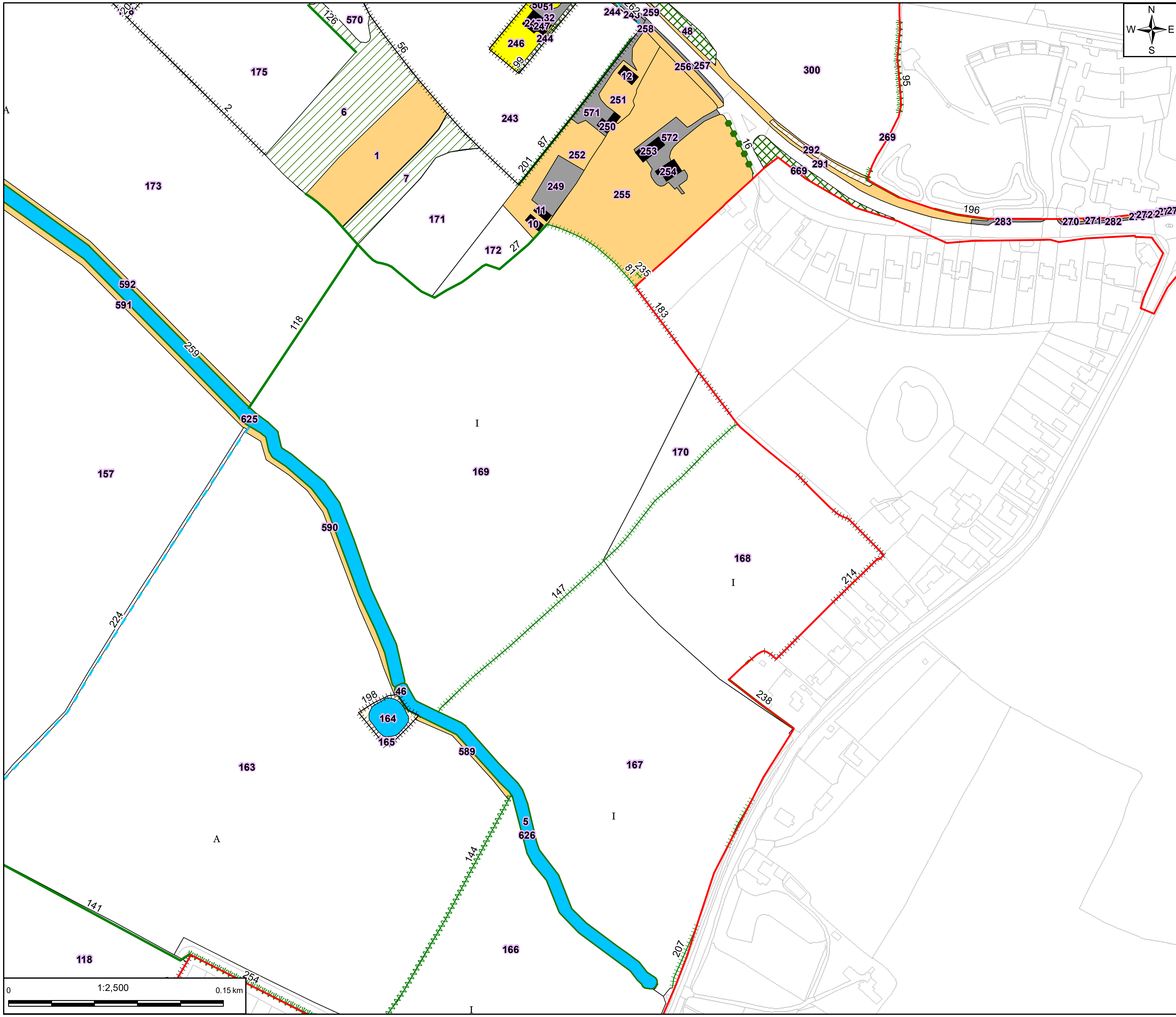

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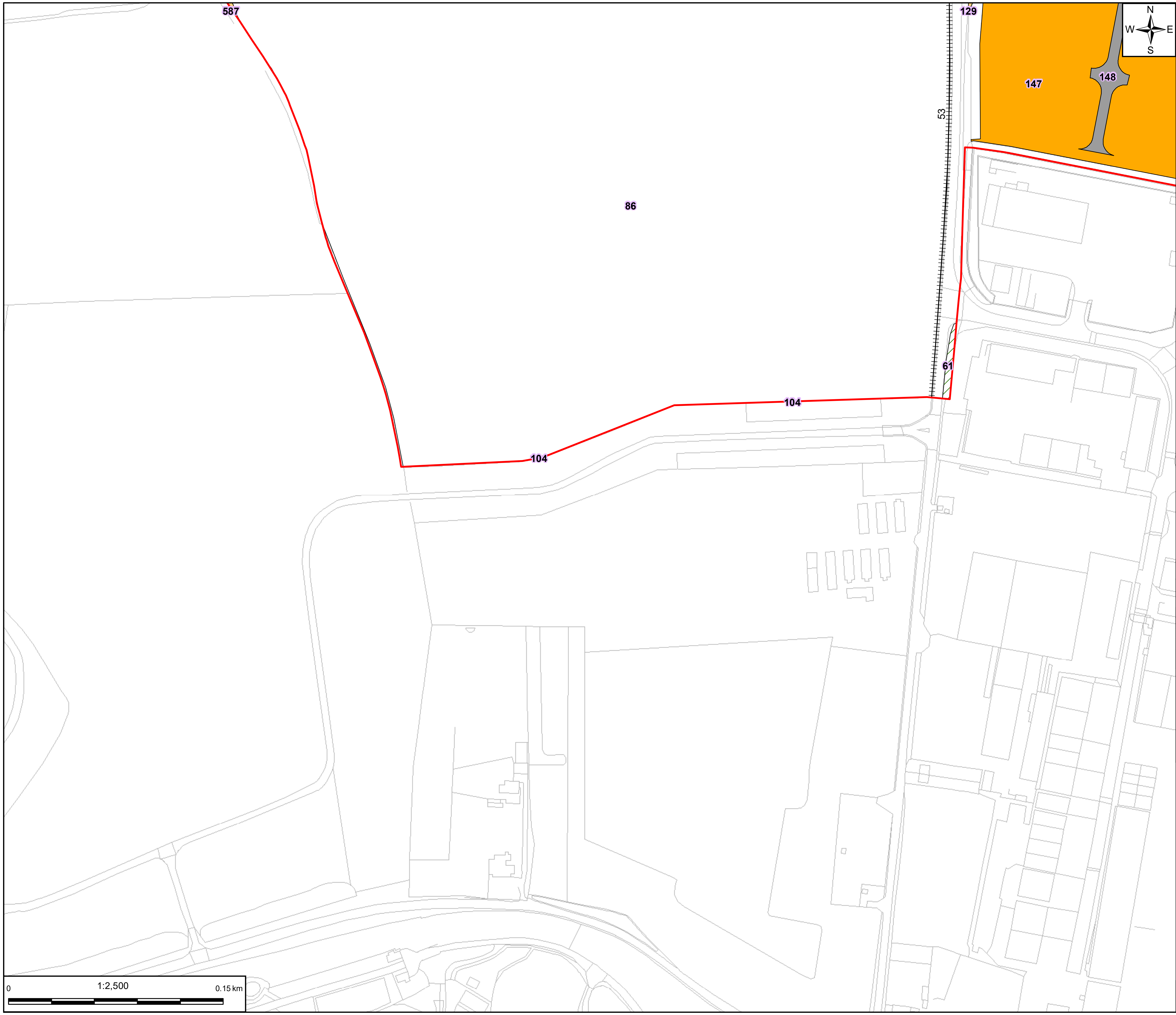

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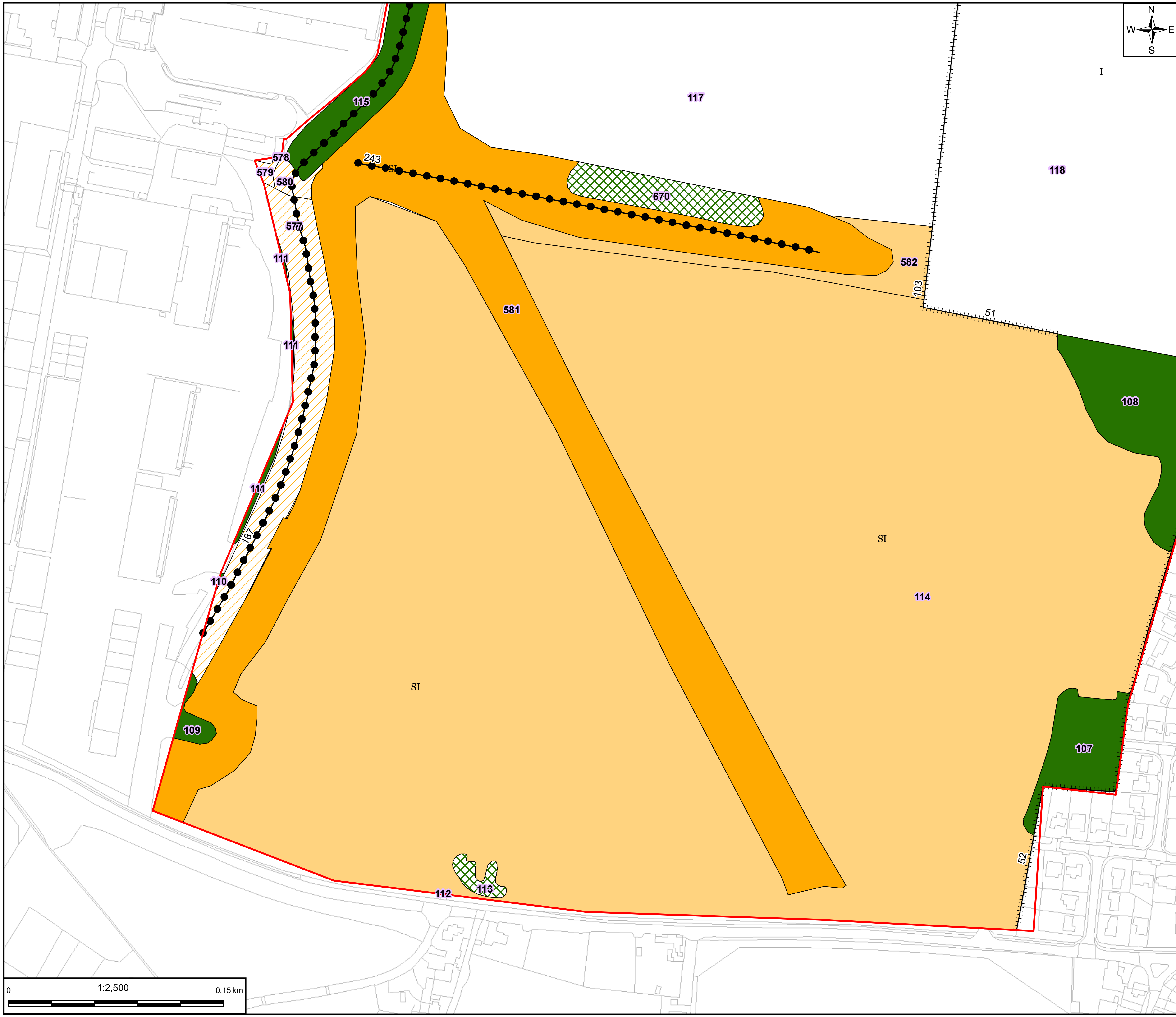

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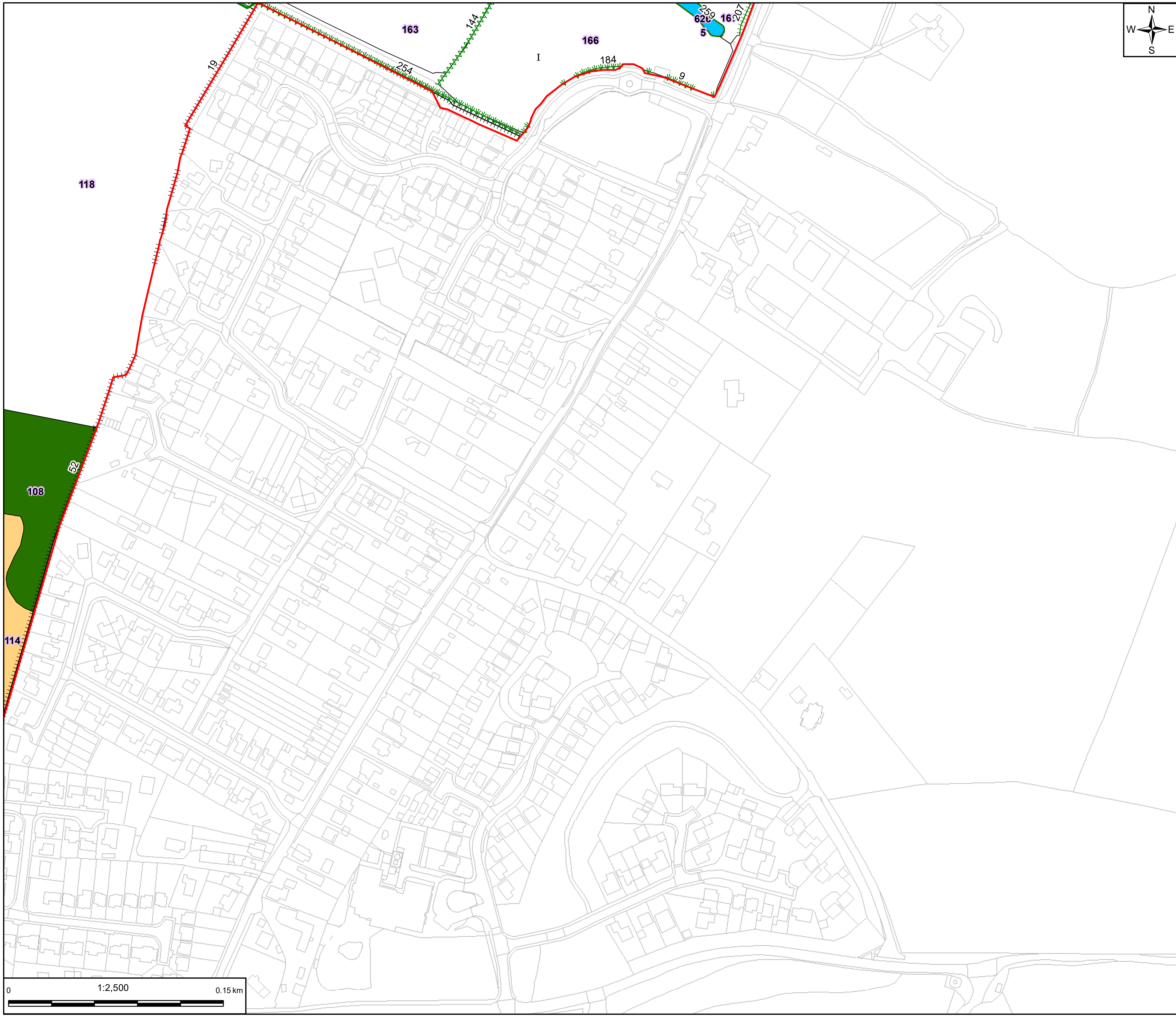

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Baseline Habitats
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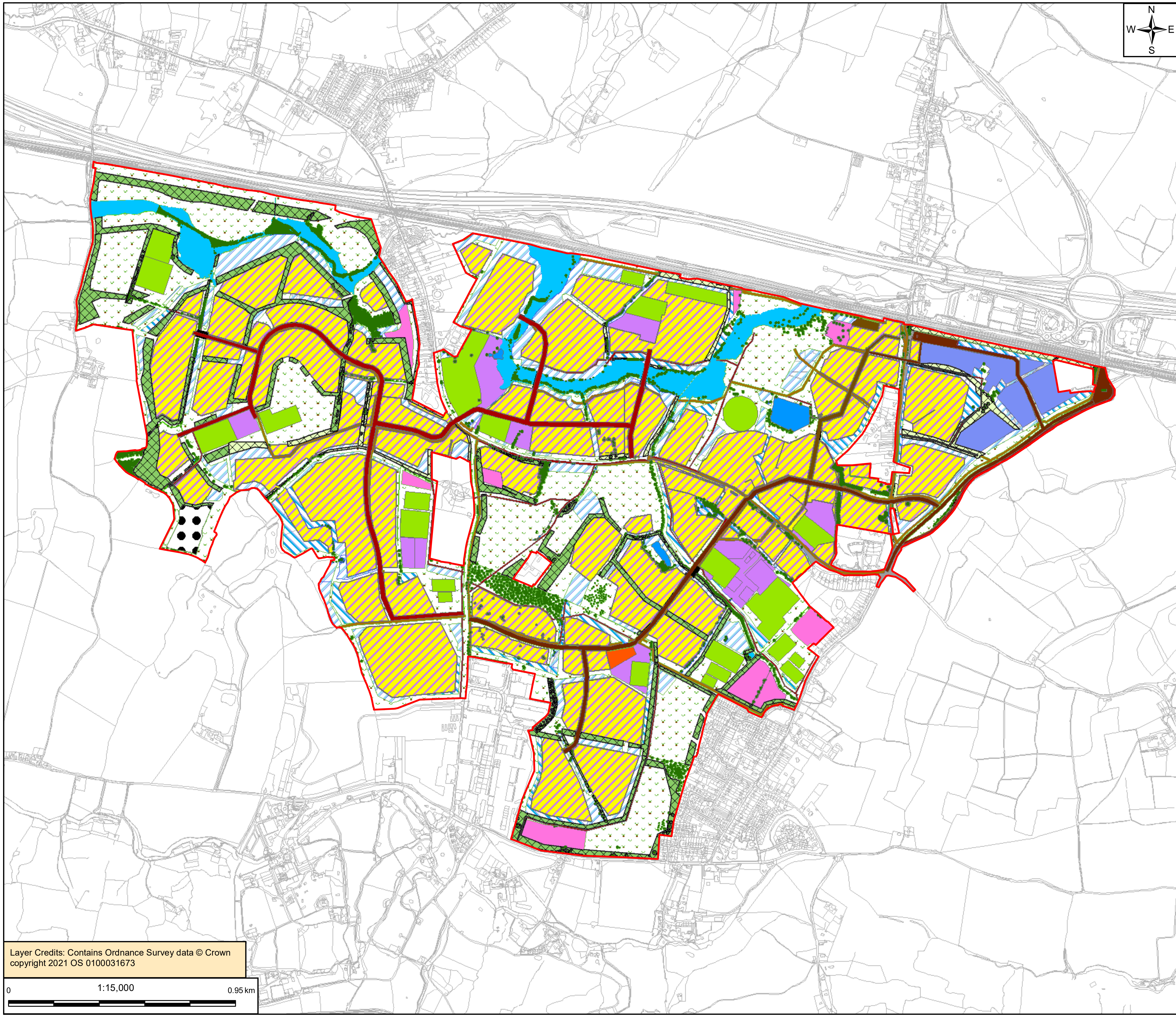
Figure 2: Overview of the Proposed GI within the site



Legend

- Outline Planning Application Boundary
- Proposed Primary Roads
- Proposed Potential Accessibility
- Proposed Movement corridor
- Existing Scattered Trees
- Existing Trees Existing Hedges
- Existing Water Area / Proposed River Park
- Existing Water Pond
- Existing Woods
- Existing Woods Outside
- Proposed Allotments
- Proposed Bridge Crossing
- Proposed Burial Ground
- Proposed Business
- Proposed Cycleways
- Proposed Development Areas.
- Proposed Footpaths
- Proposed General Green infrastructure
- Proposed High School
- Proposed Phasing 1A
- Proposed School Area
- Proposed Sport Field
- Proposed Suds Hatch
- Advance Planting Phase 1
- Advance Planting Phase 2 & 3
- Proposed Suds Water Management
- Proposed Woodland
- Existing Road

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Figure 2
Outline GI Strategy

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APPENDIX A: Retained and Enhanced Natural Capital and Ecosystem Services

This appendix provides detail of the general natural capital assets and ecosystem services benefits supported by the site. This also discusses the retained and new assets proposed and the additional benefits these will bring. Habitat typologies are presented in Figures 1, 3, 4 and 5 before and after the development.

Table 9: Design principles for retention and enhancement of natural capital assets.

Typology/Asset	Retain Y/N	Illustrative Masterplan Integration	Design Principles: Protection Measures/Rules	Design Principles: Enhancement Measures	Proposed Management
Hedgerows (non-dark corridor)	Y (selected)	Utilise to divide plots, inform routing of pedestrian and cycle ways, design to encourage community custodianship provide wildlife corridors	Buffer required, to include supporting habitat, likely to be rough grassland., 5m offset from edge of retained hedge. In the case of hedgerows with significant trees this should be extended to 10m as a minimum. Where it is identified that the hedgerow may be important for the movement of flora, appropriate crossings should be implemented where No access to buffer by motorised vehicle. No lighting within buffer. Lighting on adjacent land directed away from hedgerow, with backspill limited. Pedestrian and cycle routes permitted within buffer.	Planting of supporting habitat, repair and/or connect sections of low quality/failing hedgerow, make new connections where possible. Undertake any planting during the winter, provided the ground is not frozen. The best time is early winter, when the ground is warm and some moisture is available.	To be cut in a three-year rotation in February to avoid the destruction of birds' nests (present from March to August) and to allow any berry crop to be used by wintering birds (September to January)[1]
Hedgerows (dark corridor)	Y (selected)	Link important habitat areas providing wildlife corridors. Utilise to divide plots, inform routing of pedestrian and cycle ways, design to	Buffer 25m from edge of habitat. No lighting within buffer. Lighting on adjacent land directed away	Improve buffer habitats, improve connectivity to other retained areas. Removal of non-native	To be cut in a three-year rotation in February to avoid the destruction of birds' nests (present from March to August) and to allow any berry crop

[1] https://www.rspb.org.uk/Images/Englishhedgerows1_tcm9-133255.pdf

Typology/Asset	Retain Y/N	Illustrative Masterplan Integration	Design Principles: Protection Measures/Rules	Design Principles: Enhancement Measures	Proposed Management
		encourage community custodianship	from hedgerow, with backspill limited. No access to buffer by motorised vehicle. (Unlit) pedestrian and cycle routes permitted within buffer, although require sensitive design (see DAS for detail). Where roads and pathways cross the dark corridor, lighting in these crossing areas should be minimised and measures to ensure that bats can navigate these crossings. Crossings should have sufficient clear span to ensure that fauna can navigate beneath them, or tunnels should be installed. Buffered with a range of habitats, including, wildflower meadows, and grassland. Link into riparian corridor, woodlands and other habitats.	species and gapping up of defunct hedgerows with native species. Include hazel for dormouse. Undertake any planting during the winter, provided the ground is not frozen. The best time is early winter, when the ground is warm and some moisture is available.	to be used by wintering birds (September to January)
Grassland	Y (Selected) Where possible, retain where grassland forms important habitat (e.g. Great Crested Newt habitat).	Utilise to form areas of public open space and/or for visual amenity and educational value.	Certain grassland areas will be identified as specific habitat areas for notable receptors including ground nesting birds, reptiles and great crested newts. These areas will be protected with post and rail fencing or stock fencing to deter recreational use.	Modify management while reducing costs and increasing efficiency and benefits to allow a more diverse plant community to develop. Remove encroaching scrub and tall ruderal dominance. Increase	Management will vary dependent upon the grassland area. Some areas will receive specific management for reptiles, great crested newts or birds. A single rotational (i.e. not all areas are cut every year) cut in October preferred to maximise floral diversity and to ensure a varied habitat structure.

Typology/Asset	Retain Y/N	Illustrative Masterplan Integration	Design Principles: Protection Measures/Rules	Design Principles: Enhancement Measures	Proposed Management
				connectivity between areas. Create varied vegetation sward for reptiles and amphibians. Provide hibernacula.	
Margins	Y (selected) Field margins adjacent to retained features (e.g. hedgerows, woodland and watercourses) to be retained/enhanced. Margins forming valuable habitat in their own right, to be identified and retained.	Utilise to add visual and educational value, and for natural play (where appropriate) and provide numerous ecosystem services.	5m wide margins as a minimum but greater in ecologically dedicated habitat and 10 where hedgerows have significant trees. Fence the most valuable and vulnerable buffer habitats to prevent access by dogs and people (where appropriate and to be influenced by the results of the dedicated species surveys). Certain buffer areas will be fenced with post and rail fencing or stock fencing.	Encourage a native species sward to develop. Encourage/ plant nectar bearing plants and a rough grassland where appropriate for invertebrates, reptiles, and other wildlife. Provide hibernacula and brash piles / egg laying sites.	Management will vary dependent upon the area. Some areas will receive specific management for reptiles, great crested newts or birds. A single rotational (i.e. not all areas are cut every year) cut in October preferred to maximise floral diversity and to ensure a varied habitat structure.
Trees	Y (selected)	Utilise to integrate development into landscape and to add value to public space/street scene and provide numerous ecosystem services.	Buffer sufficiently to exclude construction/post construction activity that would have a detrimental impact on the tree and root zone, including soil compaction and water supply. Buffers should be determined according to BS 5837:2012 as a minimum. In masterplan terms this would be a minimum of 15m for woodland a	Where trees are required to be removed, these should be re-provisioned with appropriate tree specimens. Species should be selected to	Following the production of Tree Impact and Protection Plans, a Tree Management Plan will ensure that establishment of new trees and maintenance of existing trees in undertaken to ensure survival, vigour and safety.

Typology/Asset	Retain Y/N	Illustrative Masterplan Integration	Design Principles: Protection Measures/Rules	Design Principles: Enhancement Measures	Proposed Management
			minimum of 10 m for trees but 15m for significant trees. Allow space for trees to develop to maturity.		
Woodland/Copse	Y	Link with suitable habitat corridors to allow wildlife to move through the natural and built environment. Integrate with public open space, buffers, green corridors and edge zones. Where important corridors for badgers are identified, a double hedge should be installed to create a thoroughfare for this species. Utilise for Visual amenity and provide numerous ecosystem services.	Min 25m buffer No lighting within the buffer. Lighting on adjacent land directed away from feature, with backspill limited. Pedestrian and cycle routes permitted within the buffer and woodlands (but not ancient woodlands). Design to buffer with suitable natural or semi-natural areas. Target habitat for hazel dormice.	Some clearance and tree management may be beneficial to open up sections of woodland and remove hazardous trees. Measures to encourage hazel dormice – gapping up of hedgerows etc.	A Woodland Management Plan will contain bespoke management for each woodland as appropriate.
Ancient Woodland	Y Retained in entirety.	Utilise for biodiversity and visual amenity, and provide numerous ecosystem services, discourage direct access.	Min 50m buffer but up to 100m desirable. Access by the public will be discouraged to limit the risk of vandalism and damage to these areas, and to allow the retention of mature /over mature trees containing deadwood habitat. Additional pedestrian and cycle routes NOT permitted within woodland.	Woodland management measures. Enhanced supporting habitat (within buffers).	A Woodland Management Plan will contain bespoke management for each woodland as appropriate.

Typology/Asset	Retain Y/N	Illustrative Masterplan Integration	Design Principles: Protection Measures/Rules	Design Principles: Enhancement Measures	Proposed Management
			Careful consideration for pedestrian access within the buffer areas.		
Watercourses	Y Retain the River Stour and its tributaries within the site. Retain ditches, where possible.	Utilise the flood zone and buffer to River East Stour, to form a linear park and an adjoining riverside neighbourhood. Utilise ditches within SuDS (where appropriate), and as biodiversity, amenity and provide numerous ecosystem services.	Minimum 30m buffer from centreline (60m total) No lighting within buffer Retention of existing vegetation wherever possible to ensure water quality buffers Careful consideration given to opening up areas (removing scrub) to increase visual amenity value and recreation value Discourage human activity/dog walking in areas of retained/enhanced habitats for e.g. water vole and otter. Locate crossings away from sensitive habitats. De culvert where feasible.	Enhance habitat through design, selected tree planting to maintain buffers and habitat for species e.g. water vole, otter, kingfisher. Ensure all retained areas and new enhancement areas have connectivity through the site via the East Stour River.	Bespoke management for each watercourse as appropriate.
Waterbodies (+associated habitats)	Y Retain where possible, including surrounding and connecting habitats.	Utilise for visual amenity and provide numerous ecosystem services, within public open space, green corridors/transport routes or edge zones.	Min 25m buffer for retained features containing GCN.	Bring any retained water bodies to a 'good' standard according to the HSI scoring system, where appropriate. Complex structures with islands as refuges. Improve linkages between retained and	Bespoke management for each waterbody as appropriate.

Typology/Asset	Retain Y/N	Illustrative Masterplan Integration	Design Principles: Protection Measures/Rules	Design Principles: Enhancement Measures	Proposed Management
				created ponds with suitable habitats (long areas of grassland, ditches, hedgerows and additional hibernacula etc.).	
Spring/Flush	Y	Utilise for biodiversity, visual amenity and provide numerous ecosystem services.	Min 25m buffer for retained spring/flush	Improve the existing species rich grassland via management and incorporate additional SuDS.	Management will vary dependent upon the grassland area. Some areas will receive specific management for reptiles, great crested newts or birds. A single rotational (i.e. not all areas are cut every year) cut in October preferred to maximise floral diversity and to ensure a varied habitat structure.
Cultural Heritage Features	Y (selected)	Utilise for biodiversity, visual amenity and provide numerous ecosystem services.	Feature specific measures	Feature specific measures	Feature specific measures
Natural Heritage Features	Y (selected)	Utilise for biodiversity, visual amenity and provide numerous ecosystem services.	Feature specific measures	Feature specific measures	Feature specific measures

Table 10: Existing, retained habitats and typologies and the natural capital and ecosystem services that they provide.

Typology/Asset	Key Asset/s	Existing benefits	Maintained and enhanced benefits	Existing biodiversity benefits	Maintained and enhanced biodiversity benefits
Hedgerows	Field margins, property boundaries, highway boundaries	Biodiversity, wildlife corridors, historic field pattern, landscape character, wind break, carbon storage, food provision, water management/quality.	Maintained: Biodiversity, wildlife corridors, visual screening, historic field pattern, landscape character, wind break, carbon storage, food provision local distinctiveness, landscape character. Additional: Green Link for walking, visual screening, PM10 attenuation, shelter, shade, visual amenity, Urban Heat Island Effect (UHIE) mitigation.	Of value to nesting birds. Also provide shelter for fauna including invertebrates, dormice, badgers, hedgehogs, reptiles and amphibians. Provide movement routes for species including bats. Edge habitats are valuable for plant diversity (ground flora), and species including reptiles and invertebrates.	Maintained: value to nesting birds. Also provide shelter for fauna including invertebrates, dormice, badgers, hedgehogs, reptiles and amphibians. Provide movement routes for species including bats. Edge habitats are valuable for plant diversity (ground flora), and species including reptiles and invertebrates. Additional: Connectivity and habitat for dormice, birds etc.
Arable	Food production	Biodiversity, historic field pattern, soil quality, landscape character, food provision, water management/quality, tranquillity, visual amenity.	N/A Commercial agriculture will be lost to development	Of value to farmland birds. Edge habitats are valuable for plant diversity (ground flora), and species including reptiles and invertebrates.	N/A Farmland specific biodiversity to be lost to development.
Grasslands	Cultivated agricultural, semi - improved and species -poor semi improved neutral.	Biodiversity, landscape character, water management/quality, carbon storage	Maintained: Biodiversity, landscape character, water management/quality, carbon storage. Additional: Amenity use, health & wellbeing, water management/quality, natural play, sports & fitness, movement, leisure, ecological awareness opportunities.	Of value to nesting birds, farmland birds including skylark, reptiles and amphibians.	Maintain: Habitat for reptiles and birds. Buffer for ancient woodlands and other habitats. Additional: Linking habitat as part of a network of retained habitat areas.

Typology/Asset	Key Asset/s	Existing benefits	Maintained and enhanced benefits	Existing biodiversity benefits	Maintained and enhanced biodiversity benefits
Margin/buffers in general grassland/ tall ruderal / scrub	Field margins, riparian buffers, verges.	Biodiversity, landscape character, wildlife corridors, carbon storage, water management/quality.	Maintained: Biodiversity, landscape character, wildlife corridors Additional: Biodiversity, recreation, ecological awareness opportunities.	These edge habitats are of particular importance for fauna, reptiles, amphibians, small mammals and invertebrates.	Maintain: Habitat for notable species and groups. Additional: These will buffer impacts of the development on retained habitats and link habitat areas where appropriate.
Woodlands/copses	Small woodland blocks.	Biodiversity, visual screening, landscape character, shelter, shade, wind break, carbon storage, heritage value, amenity use (private walking and shooting) water management/quality	Maintained: Biodiversity, visual screening, landscape character, shelter, shade, wind break, carbon store, heritage value. Additional: Aesthetic, amenity and recreation value, access to nature, natural play, reduce airborne pollution (PM10), provide shade, reduce Urban Heat Island Effect (UHIE), mitigate wind chill and turbulence and increase biodiversity. Assimilation of development into landscape, ecological education and awareness opportunities.	Provide habitat for species including bats, woodland birds, badgers, dormice, hedgehogs, reptiles and amphibians. Can support rare or notable plants and plant communities in the understorey. .	Maintain: Habitats for species including bats, woodland birds, badgers, dormice, hedgehogs, reptiles and amphibians. Can support rare or notable plants and plant communities. Additional: Links and nodes in habitat corridors connecting woodlands and educational opportunities.
Ancient woodland	Ancient woodland on site (Harringe Brooks Wood) and off-site woodland blocks	Biodiversity, visual screening, landscape character, shelter, shade, wind break, carbon storage, heritage value, soil value, amenity use (private walking and shooting), water management/quality	Maintained: Biodiversity, visual screening, landscape character, shelter, shade, wind break, carbon storage, heritage value, soil value, amenity use (private walking and shooting), water management/quality Additional: Aesthetic, amenity value, reduce airborne pollution (PM10), provide shade, reduce Urban Heat Island Effect (UHIE), mitigate	Provide habitat for species including bats, woodland birds, barn owls, badgers, dormice, hedgehogs, reptiles and amphibians. Can support rare or notable woodland understorey plants and plant communities. Deadwood is a valuable ecological resource for invertebrates and other species groups.	**NB: Recreation should not be encouraged in these areas, in fact access to other woodland areas should be promoted to protect these features** Maintain: Habitats for species including bats, woodland birds, badgers, dormice, hedgehogs, reptiles and amphibians. Can support rare or notable plants and plant communities.

Typology/Asset	Key Asset/s	Existing benefits	Maintained and enhanced benefits	Existing biodiversity benefits	Maintained and enhanced biodiversity benefits
			wind chill and turbulence and increase biodiversity. Assimilation of development into landscape, additional ecological data.		Additional: identification of ownership, additional survey information and key vulnerabilities and preservation. Links and nodes in habitat corridors connecting woodlands and educational opportunities.
Public rights of way (PRoW)	Footpaths, bridleways	Recreation, limited amenity, health and wellbeing, access to nature.	Maintained: Limited PRoW on the site providing limited health and wellbeing, access to nature and amenity benefits. Additional: Recreation, health and wellbeing, access to nature. Form part of the green grid of the site. Reduce impacts on nearby statutory and non-statutory designated sites by providing facilities for dog walking etc., Provide links to offsite areas, encourage a transport modal shift greatly increasing health and wellbeing, ecological education and awareness opportunities.	Where adjacent habitats are appropriate, form a habitat corridor through the built landscape.	Form a habitat corridor through the proposed project. Will be surrounded by valuable habitats where appropriate. Inclusion of public footpaths will reduce impacts on nearby statutory and non-statutory designated sites by providing facilities for dog walking etc.
Watercourses	East Stour River, tributaries	Biodiversity, micro-climate resilience, climate change resilience, limited amenity use, water management/quality.	Maintained: Biodiversity, micro-climate resilience, climate change resilience, amenity use, water management/quality. Additional: Aesthetic, amenity and recreation value, access to nature, natural play, increase biodiversity, encourage transport modal	Vital habitats for birds, water voles, amphibians, fish and provide a foraging and commuting resource for bats. Support aquatic plant communities. Form habitat corridors through the landscape.	Maintain: Provide habitats for birds, water vole, amphibians, fish and provide a foraging and commuting resource for bats. Additional: Form habitat corridors through the site. There are opportunities to improve connectivity through the site for riparian animals by reducing culverting. These

Typology/Asset	Key Asset/s	Existing benefits	Maintained and enhanced benefits	Existing biodiversity benefits	Maintained and enhanced biodiversity benefits
			shift (pedestrian and cycle movement), greatly increasing health and wellbeing, ecological education and awareness opportunities.		areas are likely to be the basis of the dark network through the site. Improve the habitat for otter.
Waterbodies	Folkestone Racecourse Lake, and numerous ponds	Biodiversity, landscape character, limited amenity use (walking, fishing etc.), water management/quality.	Maintained: Biodiversity, landscape character, amenity use (walking, fishing etc.), water management/quality. Additional: Aesthetic, amenity and recreation value, access to nature, natural play, increase biodiversity, encourage transport modal shift (pedestrian and cycle movement), greatly increasing health and wellbeing, ecological education and awareness opportunities.	Vital habitats for birds, water voles, amphibians, fish and provide a foraging resource for bats. Support aquatic plant communities. Form ‘stepping stone’ habitats for amphibians.	Maintain: Provide habitats for birds, water vole, amphibians, fish, invertebrates, notable plants and provide a foraging and commuting resource for bats. Additional: Where retained, a receptor site can be created around these features for great crested newts. Improve the habitat for otter.
Springs/Flush	Flush to the east of Harringe Brook Woods	Biodiversity, local distinctiveness, landscape character, natural heritage identity	Maintained: Biodiversity, local distinctiveness, landscape character, natural heritage identity. Additional GI functions: Amenity use.	Can support rare plant communities.	Maintain: this area could be valuable for a range of species, including birds and notable plants. Additional: Surrounded by open greenspace, forming a component of the habitat corridors and nodes around the development.
Cultural heritage features	Tumulus/Burial mounds, Roman Villa	Limited visual amenity, sense of place, tranquillity distinctiveness, biodiversity.	Maintained: Amenity, sense of place, distinctiveness, biodiversity. Additional: Increased amenity use, education, recreation,	Can support rare (calcareous) plant communities.	Maintain: These should be retained within development to maintain plant communities if present.

Typology/Asset	Key Asset/s	Existing benefits	Maintained and enhanced benefits	Existing biodiversity benefits	Maintained and enhanced biodiversity benefits
			tourism, additional data gathered.		Additional: educational awareness
Natural heritage features	Quarry (SSSI)	Limited visual amenity, sense of place, tranquillity, distinctiveness.	Maintained: Amenity, sense of place, distinctiveness, Additional: Increased amenity use, education, recreation, tourism, additional data gathered, biodiversity	Low value for biodiversity.	Additional: Enhancement for biodiversity particularly species rich grassland and reptiles.
Trees	Multiple species of tree. Veteran trees.	Biodiversity, limited visual amenity, local distinctiveness, carbon storage, water management and quality, windbreak.	Maintained: limited visual amenity, local distinctiveness, carbon storage, water management and quality, windbreak. Biodiversity, wildlife corridors, visual screening, landscape character, wind break, carbon store, food provision local distinctiveness, landscape character, Additional: Form part of the green link for walking, visual screening, air quality attenuation (PM10), food provision, shelter, shade, visual amenity, Urban Heat Island Effect (UHIE) mitigation, ecological education and awareness opportunities.	Provide habitat for species including bats, birds (including barn owls) and invertebrates and synergistic relationships with soil VAMs (vesicular-arbuscular mycorrhizas).	Maintain: Habitats for species including bats, birds and Invertebrates. Additional: Linking with better quality understorey planting and other semi-natural habitats in some areas, links and nodes in habitat corridors connecting woodlands and educational opportunities.

Table 11: Proposed habitats and typologies and the natural capital and ecosystem services that they provide.

Typology/Asset	Key Asset/s	Proposed benefits within development	Proposed biodiversity benefits
Development areas	Green roofs, gardens, landscaping, bird boxes, bat boxes, hedges within these areas.	Biodiversity, air quality attenuation (PM10), food provision, shelter, shade, visual amenity, Urban Heat Island Effect (UHIE) mitigation, water management and quality, ecological education and awareness opportunities	Will provide nesting habitat for a range of urban tolerant bird species. In time may provide roosting and foraging habitats for bats. Gardens could increase foraging potential for some birds and hedgehogs.
Street trees	N/A	Biodiversity health & wellbeing, local distinctiveness, landscape character, tranquillity, Urban Heat Island Effect (UHIE) mitigation, micro-climate resilience, cleaner air (PM10), shelter, shade, wind break, visual amenity water management and quality, ecological education and awareness opportunities.	Will provide nesting and foraging habitat for a range of urban tolerant bird species. In time may provide roosting and foraging habitats for bats.
Formal sports	Playing fields	Community cohesion, education, health & wellbeing, natural play, amenity, sports & fitness, active & passive recreation, distinctiveness, leisure, vibrancy.	Can provide low value foraging habitats for bats and badger. Form open areas through which some wildlife can traverse (badger etc.).
Formal play	LEAPS, NEAPS	Community cohesion, education, health & wellbeing, natural play, amenity, sports & fitness, active & passive recreation, distinctiveness, leisure, vibrancy.	Form open areas through which some wildlife can traverse (badgers etc.), opportunity for biodiversity education and engagement amongst children and their parents.
Natural play spaces	Rocks, logs etc. within linear parks.	Biodiversity, connectivity with nature, education, amenity, leisure, vibrancy, community cohesion, environmental awareness, health & wellbeing, natural play, vibrancy.	Form open areas through which some wildlife can traverse (badgers etc.). Depending upon design, deadwood can be a valuable habitat for invertebrates. Opportunity for biodiversity education and engagement amongst children and their parents.
Food production	Allotments, community orchards, community gardens, apiaries	Food provisioning, biodiversity, education, visual interest, community cohesion, environmental awareness, health & wellbeing, vibrancy.	Allotment habitats with appropriate margins and buffers between plots can provide resources for animals including reptiles, birds and invertebrates, which in turn become feeding resources for species including bats. Fruit trees provide feeding resources for a range of species. Opportunity for biodiversity education and engagement amongst children and their parents.
Recreation corridors / wildlife margins, buffers	Green corridors, linear	Community cohesion, local distinctiveness, biodiversity, landscape character, natural heritage identity, Urban Heat Island Effect (UHIE) mitigation, amenity, active & passive recreation, distinctiveness, movement, ecological awareness, vibrancy,	Will be part of or interlinked with the green grid to form wildlife corridors. SUDs areas can be valuable habitats for amphibians, plants, reptiles, birds and foraging areas for bats. Opportunity for

Typology/Asset	Key Asset/s	Proposed benefits within development	Proposed biodiversity benefits
to retained habitats	parks, SUDs areas.	transport modal shift. Will form part of the green grid of the site. Reduce impacts on nearby statutory and non-statutory designated sites by providing facilities for dog walking etc.	biodiversity education and engagement amongst children and their parents
Transport corridors	Highways, cycleways, footpaths	Recreation, health and wellbeing, access to nature. Form part of the green grid of the site. Reduce impacts on nearby statutory and non-statutory designated sites by providing facilities for dog walking etc.	Will be part of or interlinked with the green grid to form wildlife corridors where appropriate. See below for integration features.
Green, open space	Parks, public gardens	Community cohesion health & wellbeing, landscape character, carbon store, water management/quality, micro-climate resilience, amenity, sports & fitness, active & passive recreation, movement, leisure, biodiversity.	Permeable area for biodiversity to allow movement, edge habitats can be valuable for invertebrates and reptiles. Bats can forage in these areas. Targeted planting can support notable or valuable plant species. Opportunity for biodiversity education and engagement amongst children and their parents
Hubs	Village greens, public squares	Community cohesion, local distinctiveness, landscape character, carbon store, water management/quality, micro-climate resilience, cultural identity, amenity, distinctiveness, movement, reflective space' leisure, vibrancy.	Permeable area for biodiversity, edge habitats can be valuable for invertebrates and reptiles. Bats can forage in these areas (greens). Opportunity for biodiversity education and engagement amongst children and their parents
SuDS	Swales, attenuation ponds	Biodiversity, water management/quality, Urban Heat Island Effect (UHIE) mitigation, visual amenity, carbon store, water management/quality, micro-climate resilience, distinctiveness.	Can provide valuable habitats for foraging bats, birds, amphibians, invertebrates and reptiles. Can support valuable or notable plant communities. Opportunity for biodiversity education and engagement amongst children and their parents
Architectural features	Green roofs, green walls	Biodiversity, carbon store, water management/quality, Urban Heat Island Effect (UHIE) mitigation, visual amenity, micro-climate resilience, climate change resilience, distinctiveness.	Foraging and habitat for notable invertebrates, bats and birds. Bat and bird boxes added will further enhance this benefit. Green walls can also provide resources for invertebrates, bats and birds.
Buffers, margins & visual screening	Hinterland planting, woodland belts, offsets from retained features	Biodiversity, Urban Heat Island Effect (UHIE) mitigation, visual amenity carbon store, water management/quality, micro-climate resilience, distinctiveness.	Depending upon design, can provide habitat for birds, reptiles, amphibians, invertebrates, etc. Protect existing habitats from disturbance, light, domestic animals and recreational pressure

Typology/Asset	Key Asset/s	Proposed benefits within development	Proposed biodiversity benefits
Streets	Woonerfs, 'edible' streets	Food production, carbon store, water management/quality, micro-climate resilience, community cohesion, health & wellbeing, local distinctiveness, amenity, distinctiveness, movement, vibrancy.	Provide a food resource for birds and bats and notable invertebrates, a permeable area through which animals can move (hedgehogs etc.) if well designed. Opportunity for biodiversity education and engagement amongst children and their parents
Habitat links	Linking hedgerows, rough grassland, scrub habitats.	Biodiversity, carbon store, water management/quality, micro-climate resilience, landscape character, visual amenity.	Habitat for birds, reptiles, invertebrates, etc. Will link important areas for biodiversity within the site and to the wider communities which will increase population stability and provide climate change mitigation for species
Wildlife linking features	Badger and amphibian tunnels, Mammal paths	Biodiversity, environmental awareness, movement.	Throughout the development, areas will need to be allocated for the linking of important biodiversity areas, with suitable habitats incorporated. Will reduce road deaths of wildlife if sensibly deployed and connect meta populations improving the overall fitness of the population
Incidental rough grassland areas with scrub, trees, ponds and other habitats.	Amphibian and reptile areas, areas for invertebrates, birds, plants pollinators etc.	Biodiversity, environmental awareness, movement, landscape character, water management/quality, amenity, cleaner air, ecological awareness.	A significant area of land is allocated for biodiversity mitigation and enhancement reptile and great crested newt mitigation. This will also have value for a range of other species and can be designed to maximise other GI benefits.
Wildlife enhancements within GI and built areas	Bat boxes bird boxes, hibernacula, invertebrate hotels.	Education, ecological awareness, biodiversity, environmental awareness, movement.	These features can be valuable for the target species but can also be useful resources for education and environmental awareness.
Permeable communities	Permeable fences, drop curbs.	Biodiversity, environmental awareness, movement.	Making the development permeable to mammals such as hedgehog will increase the value of the site for this target species and other species and the improved connectivity will support gene transfer, population stability and climate change mitigation for species

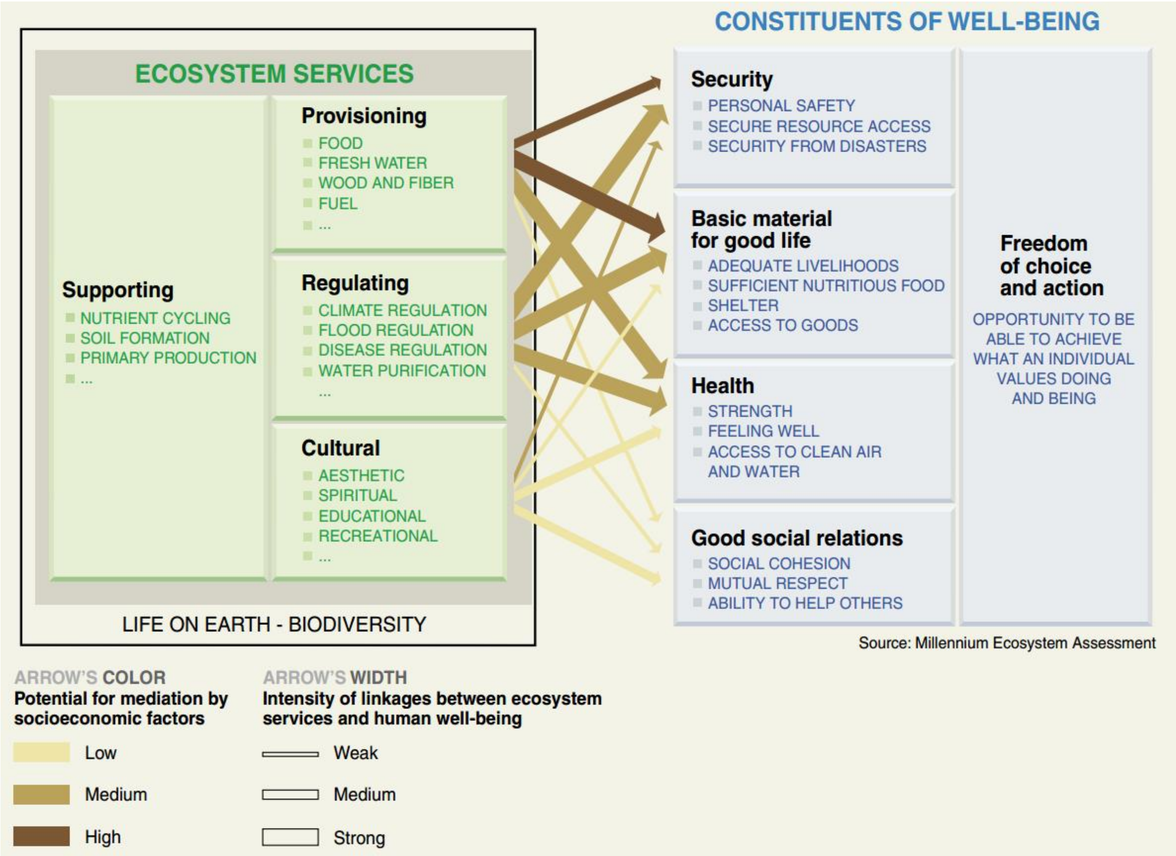
APPENDIX B: Summary of Policy and Guidance in relation to Natural Capital

Millennium Ecosystem Assessment

The Millennium Ecosystems Assessment (2005) was carried out by the United Nations between 2001 and 2005 to assess the consequences of ecosystem change for human wellbeing and to establish the scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems and their contributions to human wellbeing. The Millennium Ecosystems Assessment defines ecosystem services as follows:

'Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling. The human species, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of ecosystem services.'

The Millennium Ecosystem Assessment thus set out the ways in which ecosystems contribute to human wellbeing under four headings: supporting services, provisioning services, regulating services and cultural services. The linkages between these services and wellbeing are illustrated in the diagram below:



One of the aims of the Millennium Ecosystems Assessment was to analyse and, as far as possible, quantify the importance of ecosystems to human wellbeing in order to make better decisions regarding the sustainable use and management of ecosystem services.

UK National Ecosystem Assessment (NEA)

The UK National Ecosystem Assessment (UK NEA, 2011) was completed in 2011 as a response to the UN Millennium Ecosystem Assessment. The UK NEA was intended to:

- Produce an independent and peer-reviewed assessment of the state and value of the UK's natural environment and ecosystem services.

- Identify and understand what has driven the change observed in the natural environment and the services it has provided over the last 60 years, and what may drive change in the future.
- Foster better interdisciplinary cooperation between natural and social scientists to assist in strengthening policy-making, to ensure effective management of the environment and ecosystem services in the future.
- Ensure full stakeholder participation and encourage different stakeholders and communities to interact.
- Use the key messages from the assessment to raise awareness amongst society of the importance of the natural environment to human well-being and economic prosperity.

Chapter 22 of the UK NEA is focussed on the application of economic analysis to ecosystem assessments. It draws on a comprehensive review of academic literature relating to ecosystem services valuation. It sets out the methodologies employed to place monetary values on ecosystem services and identifies existing values (from secondary sources) which can be applied in the UK.

The UK NEA was further updated in 2014 (the ‘UK NEA Follow-On’, UK NEAFO, 2014). The purpose of the UK NEAFO was as follows:

- To further our understanding of the economic and social value of nature;
- To develop tools and products to operationalise the Ecosystem Approach; and
- To support the inclusion of natural capital in the UK’s National Accounts.

Natural Capital Protocol

- NCC (2016) The Protocol provides a standardized framework for business to identify, measure and value their impacts and dependencies on natural capital.

25 Year Plan for the Environment

- The underlying case for the valuation of ecosystem services is that it will contribute towards better decision-making, fully taking into account the costs and benefits of development to the natural environment. In its White Paper “*The Natural Choice: securing the value of nature* (HMG, 2011)”, and repeated in successive manifestos, the UK Government has stated it wishes to be “the first generation to leave the natural environment of England in a better state than it inherited…”. The Natural Capital Committee (NCC, 2016) was set up to advise on how to deliver this objective and the natural capital approach (which is based on the concept of valuing services delivered by the environment) is the key mechanism proposed to achieve this.
- The advice of the NCC has been central to the Government’s 25-Year Plan to Improve the Environment, published in January 2018 (HMG, 2018), whereby it has been acknowledged that protecting and growing natural capital is a vital component for economic success. It is also important to note that the application of this approach is not related to the total value of ecosystems but, rather, to valuing changes in ecosystem services.

Environment Act 2021

The Environment Act 2021 was passed into law in November 2021. On publication, the Government summarised the purpose and main features of the Act as follows:

It will halt the decline in species by 2030, require new developments to improve or create habitats for nature, and tackle deforestation overseas.

It will help us transition to a more circular economy, incentivising people to recycle more, encouraging businesses to create sustainable packaging, making household recycling easier and stopping the export of polluting plastic waste to developing countries.

These changes will be driven by new legally binding environmental targets, and enforced by a new, independent Office for Environmental Protection (OEP) which will…:

- report to Parliament on progress towards national environmental goals and targets, and on environmental law

- advise Ministers on proposed changes to the law and other matters affecting the environment
- investigate complaints about potential breaches of environmental law by government and public bodies
- enforce environmental law through legal action where necessary

The Act commits the government to publishing a policy statement which will set out how ministers should interpret and apply environmental principles. It also commits government to have a plan for environmental improvement.

Agriculture Act 2020

The key elements to the policy framework for agriculture after the UK left the EU are:

- The UK Government's 25 Year Environment Plan (January 2018) set out how a new environmental land management system based on providing public money for public goods (such as habitat enhancement) is proposed to replace current direct payments to farmers in England.
- The introduction of the Direct Payments to Farmers (Legislative Continuity) Act 2020 continued the provision of payments as previously covered by the European Common Agricultural Policy.
- CAP subsidies can make up anywhere from 50-80% of a UK farmer's income and their practices will be sensitive to fluctuations in support or a change of direction or priorities in this support.

A seven-year transition phase (starting in 2021) from farming subsidy to a system of public money for public goods over time whilst limiting some of the largest subsidy payments.

No lower standards for animal welfare or environment in trade deals and a new approach to food labelling with a new "world leading" standard for food and farming quality.

National Planning Policy Framework 2021

The National Planning Policy Framework (2021): The NPPF, sets out how the planning system should protect and enhance nature conservation interests. Section 15 is concerned with conserving and enhancing the natural environment (paragraphs 174 to 188).

174. Planning policies and decisions should contribute to and enhance the natural and local environment by:

(a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);

(b) recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland;

(c) maintaining the character of the undeveloped coast, while improving public access to it where appropriate;

(d) minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;

(e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

(f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

175. Plans should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework 58 ; take a strategic approach to maintaining and enhancing networks of habitats and

green infrastructure; and plan for the enhancement of natural capital at a catchment or landscape scale across local authority boundaries.

176. Great weight should be given to conserving and enhancing landscape and scenic beauty in National Parks, the Broads and Areas of Outstanding Natural Beauty which have the highest status of protection in relation to these issues. The conservation and enhancement of wildlife and cultural heritage are also important considerations in these areas, and should be given great weight in National Parks and the Broads 59 . The scale and extent of development within all these designated areas should be limited, while development within their setting should be sensitively located and designed to avoid or minimise adverse impacts on the designated areas

177. When considering applications for development within National Parks, the Broads and Areas of Outstanding Natural Beauty, permission should be refused for major development 60 other than in exceptional circumstances, and where it can be demonstrated that the development is in the public interest. Consideration of such applications should include an assessment of:

(a) the need for the development, including in terms of any national considerations, and the impact of permitting it, or refusing it, upon the local economy;

(b) the cost of, and scope for, developing outside the designated area, or meeting the need for it in some other way; and

(c) any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated.

178. Within areas defined as Heritage Coast (and that do not already fall within one of the designated areas mentioned in paragraph 176), planning policies and decisions should be consistent with the special character of the area and the importance of its conservation. Major development within a Heritage Coast is unlikely to be appropriate, unless it is compatible with its special character.

Habitats and biodiversity

179. To protect and enhance biodiversity and geodiversity, plans should:

(a) Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity 61 ; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation 62 ; and

(b) promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity.

180. When determining planning applications, local planning authorities should apply the following principles:

(a) if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;

(b) development on land within or outside a Site of Special Scientific Interest, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. The only exception is where the benefits of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of Sites of Special Scientific Interest;

(c) development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) should be refused, unless there are wholly exceptional reasons 63 and a suitable compensation strategy exists; and

(d) development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to improve biodiversity in and around developments should be integrated as part of their design, especially where this can secure measurable net gains for biodiversity or enhance public access to nature where this is appropriate.

181. The following should be given the same protection as habitats sites:

(a) potential Special Protection Areas and possible Special Areas of Conservation;

(b) listed or proposed Ramsar sites 64 ; and

(c) sites identified, or required, as compensatory measures for adverse effects on habitats sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites.

182. The presumption in favour of sustainable development does not apply where the plan or project is likely to have a significant effect on a habitats site (either alone or in combination with other plans or projects), unless an appropriate assessment has concluded that the plan or project will not adversely affect the integrity of the habitats site.

Ground conditions and pollution

183. Planning policies and decisions should ensure that:

(a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

(b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and

(c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.

184. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

(a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life 65;

(b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and

(c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

186. Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan.

187. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

188. The focus of planning policies and decisions should be on whether proposed project is an acceptable use of land, rather than the control of processes or emissions (where these are subject to

separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.

APPENDIX C: EBN Calculator

The Environmental Benefits from Nature Tool

Enabling wider benefits for people and nature from habitat change

Quick Start Instructions

Technical user menu

BETA TEST VERSION 1.00 Short (500 rows)

This tool was formerly known as the Eco-metric. It is a voluntary decision-support tool, designed to be used alongside the Biodiversity Metric 3.0. as part of a project that delivers Biodiversity Net Gain (BNG). The aim is to help improve the design and outcomes of development, and to demonstrate the wider benefits of BNG for people and nature. **Please read the Principles of the EBN Tool approach and the User Guide before using the tool.**

The tool is based on the premise that biodiversity net gain is a primary driver for growing natural capital. Healthy, diverse and resilient ecosystems are essential to underpin the delivery of a wide range of services and long term benefits. It forms part of Natural England's contribution to Defra's work on Environmental Net Gain policy and supports government's 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.

What the tool does

It measures changes in the extent and condition of habitats (natural capital assets)
It indicates relative changes in provision of 18 ecosystem services due to habitat and land-use change.
It aims to make these losses and gains more transparent in order to help 'start a conversation' and flag areas for more detailed consideration.

What the tool does not do

It does not incorporate biophysical modelling of water flow
It does not measure the impacts of human pressures on ecosystems, such as the impacts of air pollution from roads.
It does not replace the need for more detailed assessments such as an Environmental Impact Assessment (EIA) or flood risk assessment.

If you encounter errors when using this tool that cannot be resolved after reading the User Guide, please contact:

EBN@naturalengland.org.uk

The Environmental Benefits from Nature Tool

Enabling wider benefits for people and nature from habitat change

Technical user menu

This tool was formerly known as the Eco-metric

QUICK START

1. Enter project details → 2. Enter baseline habitats → 3. Enter post-development habitats → 4. View results

TIPS FOR DATA ENTRY

1. To paste data from an external source please select 'Paste values' from the Paste menu, to avoid overwriting the format of the cells
2. Do not leave indicators blank unless the cell is greyed out (i.e. not applicable). If not known, please enter 'NK'.

3. You can autofill cells to copy the same value down a column (drag the cross that appears when you hover over the lower right corner of the cell), but do not autofill horizontally or the dropdown links will change.
4. If autofilling an indicator that ends in a number (e.g. population density) excel may extrapolate the numerical trend (e.g. population density of 20-39 will become 20-40, 20-41, etc). This can be avoided by selecting two consecutive identical cells in the column and then autofilling.

INSTRUCTIONS	See the user guide and data catalogue for full instructions
1. Project details	**Enter project details on the 'Project details' sheet.** Enter project name, description, contact details and any comments. Please also enter manually the results of your biodiversity metric calculation. Note: when saving copies of this Excel file please save it as an Excel binary workbook (.xlsb) as this halves the file size and improves performance.
2. Baseline habitats	**Enter on-site and off-site baseline habitat details (habitats before development / change).** Enter area of all pre-existing (baseline) habitats, before the proposed changes, on the 'Baseline habitats' sheet. Both on-site and off-site habitats are entered on this sheet - simply toggle the on-site / off-site cell in column C. A list can be pasted in from another source (e.g. from a table exported from GIS), but **use 'paste values'** in order to preserve the formatting. There is an optional 'ID' column where you can enter a code corresponding to specific habitat parcels, for your own reference. This is filled in as "1,2,3...." by default. It is not used in the calculations.
	Habitat translation will be performed automatically. Choose the system you wish to use from the drop-down box at the top of the data entry sheets (Baseline habitats and Post-dev habitats). The definitions for this system will then appear in the dropdown boxes for each habitat type data entry cell. You can switch systems at any time to see a different list in the dropdown box - this will not affect the habitat types you have already entered. If you want to define your own list based on a subset of existing habitat types (for example, just using a selection of habitats, or with those that you commonly use at the top) you can do this on the 'Habitat selection' sheet (reached from the Menu).
	Linear features can be entered either as an area or as a length and width. The area will be automatically calculated from the length and width if both are entered; otherwise it will be copied from the area input column.
	Only the Basic level indicators are displayed when you first open the sheet. **Fill in all the 'Basic' level condition and spatial indicators** that apply to each habitat. Instructions and links are provided on the 'Data sources' sheet and can be accessed via the Help links at the top of each column. To return to the appropriate column of the data entry sheets, you can use the links in the final two columns of the data sources sheet. More complete guidance is available in the Data Catalogue. There is an optional comment column. **Data can be pasted in using 'paste values'** provided that the data conforms to the list of valid entries for each indicator. **Do not use 'cut', or try to drag the cells around**. You can autofill the whole column with the same value, if appropriate, to save time. If the indicator does not apply to that habitat, it will be greyed out - you can either leave these cells blank or enter 'NA' (not applicable). A default multiplier of 1 will be used in the calculations for these cells, regardless of what you enter (i.e. they will be treated as if you have entered 'NA' (not applicable). **Do not leave values blank**, unless the area of the habitat is zero or the indicator is not applicable to that habitat. If you are unable to estimate a value choose 'NK' (not known', and a default value will be used. When you first open the tool, all indicators will be set to 'NK' by default. **Errors** such as missing or invalid values will be flagged with a red 'ERR' mark at the beginning of the row and top of the column containing the error.
	Optionally, fill in any of the **Standard level or Advanced level indicators** in the same way. These indicators can be revealed by selecting 'Standard' or 'Advanced' using the dropdown in the top left corner. If you are not using these indicators set them all to 'NK' (not known) using autofill for each column.
3. Post-development habitats	**3. Enter post-development / post-intervention habitat details (area and condition of habitats after change).** Repeat step 3 for habitats after the proposed changes, using the 'Post-dev habitats' sheet. For each habitat area, fill in the 'Type of change' cell by selecting Create (for changing to a new habitat type), Enhance (for changing the condition of a habitat) or Retain (for unchanged habitats). For newly created habitats, use the dropdown box to select the starting habitat that the new habitat is planted on (e.g. arable, improved grassland, topsoil removed). Then fill in all the condition and spatial indicators that apply to the habitat. Note: for new woodland, enter tree size as 'Saplings'.
4. Results	4. **Results** The main results are displayed on the 'Results' sheet, with a separate sheet for comparing onsite and offsite scores. To see what habitat types are contributing the most to each ecosystem service, look at the 'Interpretation charts'. A breakdown of the calculation stages can be found on the Breakdown tables sheet. If you wish to see the underlying calculations, a summary is set out on the 'Calculations' sheet, with details on the 'Baseline scores' and 'Post-dev scores' sheets which can be accessed from the menu.

Cell style conventions
User input data
Information
Calculations
Fixed scores and multipliers

Help sheets

Input sheets

Output sheets

Calculation sheets

Scores and multipliers

1. Project details

Instructions | Menu | 2. Baseline habitats | 3. Post-development habitats | 4. Results

Name of project Otterpool Park

	Name	Organisation	e-mail
Lead			
Other			

Description of project

Enter Biodiversity Metric 3.0 outputs

This tool is designed to be used in conjunction with the Biodiversity Metric 3.0. Biodiversity net gain is a pre-requisite. Please enter the output of the metric manually here to check whether net gain is acheived.

	Baseline (before change)			Delivered (post-development)			Change	Comments (optional)
	Onsite	Offsite	Total	Onsite	Offsite	Total		
Biodiversity units			0.0			0.0	0.0	
Hedgerow units			0.0			0.0	0.0	

The tool is designed to work best with separate estimates of the areas of buildings / sealed surfaces, gardens, street trees, amenity grassland and other urban habitats. However, the user can also enter a generic 'suburban mosaic' habitat for convenience, if desired. A standard composition is used, but this can be altered.

Set number of decimal places for display of habitat areas in hectares (lengths are in metres and will use two less than this)

2 | Apply change

Assumptions for default composition of suburban mosaic, if used (users can change this if actual composition is known):

Sealed surfaces and buildings	60.00%
Artificial unvegetated unsealed surfaces	5.00%
Gardens	25.00%
Amenity green space	8.00%
Woodland or trees	2.00%
Total (should be 100%)	**100.00%**

% gardens that are assumed to be vegetated 50%

2. Baseline habitats (before change)

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Level	Select habitat classification system for drop-down:
STANDARD	Biodiversity Metric 3.0

Line & point features (ha)			
12.29	590.40	Total area before change (ha)
12.29	590.40	*On site (ha)*
0.00	0.00	*Off site (ha)*

ID	Onsite / offsite?	Habitat type The input habitat will be translated to the appropriate eco-metric habitat provided that it is listed on the habitat translation sheet. This includes Phase 1, UK Hab and Biodiversity Metric 3.0 habitats.	Length, m	Width, m	Area, ha	Calculated area, ha	Eco-metric habitat
ID	OnOffSite	Input_habitat	Length	Width	Area_in	Area_before_tab	Eco-metric_habitat
1	On site	Cropland - Cereal crops			306.98	306.98	Arable fields, horticulture and tempo
2	On site	Grassland - Modified grassland			228.25	228.25	Improved grassland
3	On site	Grassland - Other neutral grassland			9.49	9.49	Neutral grassland
4	On site	Heathland and shrub - Mixed scrub			3.34	3.34	Dense scrub
5	On site	Lakes - Ponds (Non- Priority Habitat)			0.42	0.42	Standing open water
6	On site	Lakes - Ponds (Priority Habitat)			2.32	2.32	Standing open water
7	On site	Sparsely vegetated land - Ruderal/Ephemeral			3.87	3.87	Ephemeral / short perennial
8	On site	Urban - Introduced shrub			0.47	0.47	Introduced shrub
9	On site	Urban - Vacant/derelict land/ bareground			2.37	2.37	Bare ground
10	On site	Woodland and forest - Lowland mixed deciduous woodland			11.28	11.28	Broadleaved, mixed and yew semi-na
11	On site	Woodland and forest - Other woodland; broadleaved			0.97	0.97	Broadleaved, mixed and yew plantat
12	On site	Woodland and forest - Other woodland; mixed			3.40	3.40	Broadleaved, mixed and yew plantat
13	On site	Woodland and forest - Wood-pasture and parkland			0.55	0.55	Wood pasture and parkland with sca
14	On site	Native Species Rich Hedgerow	396	1		0.04	Hedgerows
15	On site	Native Hedgerow	3379	1		0.34	Hedgerows
16	On site	Native Species Rich Hedgerow with trees	1773	1		0.18	Hedgerow with trees
17	On site	Native Hedgerow with trees	1103	1		0.11	Hedgerow with trees
18	On site	Native Species Rich Hedgerow with trees - Associated wit	768	1		0.08	Hedgerow with trees
19	On site	Native Hedgerow with trees - Associated with bank or dit	591	1		0.06	Hedgerow with trees
20	On site	Native Species Rich Hedgerow - Associated with bank or	617	1		0.06	Hedgerows
21	On site	Native Hedgerow - Associated with bank or ditch	735	1		0.07	Hedgerows
22	On site	Native Hedgerow	3120	1		0.31	Hedgerows
23	On site	Other Rivers and Streams	5340	2		1.07	Running water
24	On site	Urban - Developed land; sealed surface			15.62	15.62	Sealed surface and buildings
25	On site	Urban - Urban Tree			11.04	11.04	Tree

	Agricultural Land Class	Surface water availability	Groundwater availability	Natural Flood Management priority	Water quality: WFD status	Water quality management area	Rainfall	Soil drainage	Soil erodibility	Peat quality	Canopy cover	Tree size
Area where indicator is "not known"	602.686	15.62	15.62	15.62	598.9	553.2	15.62	15.62	15.62	602.7	586.6	602.7
	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	STD	STD	STD	STD
	Online ma	Online map	Online r	Online ma	Online r	Online r	Online r	Online r	Online r	Site surv	Aerial p	Site surv
	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ
	1	2	3	4	7	8	9	11	12	15	17	18
ID	ALC_before	Surface_water_	Groundw	Flood_priorit	WQ_befo	WQMA_b	Rainfall_b	Drainage	Erodibilit	Peat_qual	Canopy_b	Tree_size
1	NK	Water not a	Poor	High	NK	NK	4 to 9 d	Natural	Medium	NK	NK	NK
2	NK	Water not a	Poor	High	NK	NK	4 to 9 d	Natural	Medium	NK	NK	NK
3	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
4	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
5	NK	Water not a	Poor	High	Modera	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
6	NK	Water not a	Poor	High	Modera	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
7	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
8	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
9	NK	Water not a	Poor	High	NK	NK	4 to 9 d	Natural	Medium	NK	NK	NK
10	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	75-100%	NK
11	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	75-100%	NK
12	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	75-100%	NK
13	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
14	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
15	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
16	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	20-50%	NK
17	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	20-50%	NK
18	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	20-50%	NK
19	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	20-50%	NK
20	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
21	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
22	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
23	NK	Water not a	Poor	High	Modera	Medium	4 to 9 d	Natural	Medium	NK	NK	NK
24	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK
25	NK	Water not a	Poor	High	NK	Medium	4 to 9 d	Natural	Medium	NK	NK	NK

	Population density	Nature designation	Ancient habitat	Cultural or historic importance	Special recreation value	Public access	Educational use	Managed for nature	Local distinctiveness	Landscape diversity	Water body naturalness	Comments (optional space for
Area where indicator is "not known"	15.62	15.62	578.6	15.62	15.62	15.62	15.62	15.62	22.23	15.62	601.6	*Total area not known* 15213.5311
	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	STD	BASIC	STD	
	Online (	Online r	Online r	Online r	Online r	Online map and loc	Local au	Local kr	Local au	Site plai	Site survey	
	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	
	30	31	32	33	34	35	36	37	38	39	44	
ID	Proximity	Desig_nat	Ancient_b	Historic_	Special_r	Access_before	Education	Manage_	Special_b	Land_div	Water_na	Comments
1	<20	2	NK	3 or mo	No	No access for recre	No publ	No	No	High	NK	
2	<20	2	NK	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
3	<20	2	NK	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
4	<20	2	NK	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
5	<20	2	NK	3 or mo	No	No access for recre	No publ	No	NK	High	NK	
6	<20	2	NK	3 or mo	No	No access for recre	No publ	No	NK	High	NK	
7	<20	2	NK	3 or mo	No	No access for recre	No publ	No	NK	High	NK	
8	<20	2	NK	3 or mo	No	No access for recre	No publ	No	No	High	NK	
9	<20	2	NK	3 or mo	No	No access for recre	No publ	No	No	High	NK	
10	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
11	<20	2	NK	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
12	<20	2	NK	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
13	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
14	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
15	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
16	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
17	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
18	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
19	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
20	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
21	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
22	<20	2	No	3 or mo	No	No access for recre	No publ	No	Yes	High	NK	
23	<20	2	NK	3 or mo	No	No access for recre	No publ	No	Yes	High	Salmonid	
24	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	
25	<20	2	No	3 or mo	No	No access for recre	No publ	No	No	High	NK	

3. Post-development habitats

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Areas before and after match (within 0.1 ha)

Line & point features (ha)		
12.29	**590.40**	**Total area before change (ha)**
36.34	**590.41**	**Total area after change (ha)**
36.34	*590.41*	*On site (ha)*
0.00	*0.00*	*Off site (ha)*

Level	**Select habitat classification system for drop-down:**
STANDARD	Biodiversity Metric 3.0

ID	Onsite / offsite?	Habitat type The input habitat will be translated to the appropriate eco-metric habitat provided that it is listed on the habitat translation sheet. This includes Phase 1, UK Hab and Biodiversity Metric 3.0 habitats.	Length, m	Width, m	Area, ha	Calculated area, ha	Eco-metric habitat	Type of change	Starting habitat (default bare ground)
ID	Onsite	Input_habitat	Length	Width	Area_in	Area_after_tab	Eco-metric_habitat	Change	Starting_hab
1	On site	Urban - Allotments			9.21	9.21	Allotments, city farm, co	Create	Arable fields, h
2	On site	Urban - Developed land; sealed surface			164.54	164.54	Sealed surface and build	Create	Arable fields, h
3	On site	Urban - Introduced shrub			0.72	0.72	Introduced shrub	Create	Arable fields, h
4	On site	Grassland - Lowland meadows			33.15	33.15	Neutral grassland	Create	Arable fields, h
5	On site	Heathland and shrub - Mixed scrub			24.25	24.25	Dense scrub	Create	Arable fields, h
6	On site	Grassland - Modified grassland			56.24	56.24	Improved grassland	Create	Arable fields, h
7	On site	Grassland - Other neutral grassland			28.49	28.49	Neutral grassland	Create	Arable fields, h
8	On site	Woodland and forest - Other woodland; broadleaved			64.13	64.13	Broadleaved, mixed and	Create	Arable fields, h
9	On site	Lakes - Ponds (Priority Habitat)			11.99	11.99	Standing open water	Create	Arable fields, h
10	On site	Wetland - Reedbeds			6.51	6.51	Reedbeds	Create	Arable fields, h
11	On site	Urban - Urban Tree			22.12	22.12	Tree	Create	Arable fields, h
12	On site	Urban - Vegetated garden			64.19	64.19	Vegetated garden	Create	Arable fields, h
13	On site	Urban - Rain garden			10.70	10.70	Rain garden	Create	Arable fields, h
14	On site	Urban - Intensive green roof			24.28	24.28	Intensive green roof	Create	Arable fields, h
15	On site	Native Species Rich Hedgerow	1800	1		0.18	Hedgerows	Create	Arable fields, h
16	On site	Native Hedgerow	30000	1		3.00	Hedgerows	Create	Arable fields, h
17	On site	Woodland and forest - Lowland mixed deciduous woodland			11.28	11.28	Broadleaved, mixed and	Retain	
18	On site	Woodland and forest - Other woodland; broadleaved			0.97	0.97	Broadleaved, mixed and	Retain	
19	On site	Woodland and forest - Other woodland; mixed			3.40	3.40	Broadleaved, mixed and	Retain	
20	On site	Woodland and forest - Wood-pasture and parkland			0.55	0.55	Wood pasture and parkl	Retain	
21	On site	Lakes - Ponds (Non- Priority Habitat)			0.42	0.42	Standing open water	Retain	
22	On site	Lakes - Ponds (Priority Habitat)			2.32	2.32	Standing open water	Retain	
23	On site	Grassland - Other neutral grassland			50.47	50.47	Neutral grassland	Enhance	Improved gras
24	On site	Other Rivers and Streams	5340	2		1.07	Running water	Enhance	NA
25	On site	Urban - Urban Tree			11.04	11.04	Tree	Retain	
26	On site	Grassland - Modified grassland			10.42	10.42	Improved grassland	Retain	
27	On site	Urban - Developed land; sealed surface			11.11	11.11	Sealed surface and build	Retain	

Total area not known: *17764.126*

No errors

ID	Agricultural Land Class	Surface water availability	Groundwater availability	Natural Flood Management priority	Water quality: WFD status	Water quality management area	Rainfall	Soil drainage	Soil erodibility	Peat quality	Canopy cover	Tree size	Population density	Nature designation	Ancient habitat	Cultural or historic importance	Special recreation value	Public access	Educational use	Managed for nature	Local distinctiveness	Landscape diversity	Water body naturalness	Comments (optional space for	Check that no Ancient habitats have been created
Area where indicator is "not known"	626.7	175.65	175.7	175.65	604.4	242.3	175.7	175.7	175.7	626.7	547	540.5	175.7	175.7	578.6	175.7	175.7	175.7	175.7	175.7	194.2	239.8	625.7		
	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	STD	STD	STD	STD	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	BASIC	STD	BASIC	STD		
	Online r	Online ma	Online r	Online m	Online r	Online r	Online r	Online r	Online r	Site sur	Aerial p	Site sur	Online c	Online r	Online r	Online r	Online r	Online r	Local au	Local kr	Local au	Site plai	Site survey		
	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ		
	1	2	3	4	7	8	9	11	12	15	17	18	30	31	32	33	34	35	36	37	38	39	44		
ID	ALC_after	Surface_wat	Groundw	Flood_polic	WQ_after	WQMA_a	Rainfall_a	Drainage_	Erodibility	Peat_qual	Canopy_a	Tree_size	Proximity	Desig_nat	Ancient_a	Historic_a	Special_r	Access_af	Education	Manage_	Special_af	Land_div	Water_na	Comments	Ancient_chec
1	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	No	No	High	NK		OK
2	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK		OK
3	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	No	No	High	NK		OK
4	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	Yes	Yes	High	NK		OK
5	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	No	Yes	High	NK		OK
6	NK	Water not	Poor	High	NK	NK	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	Yes	Open a	Public a	No	Yes	High	NK		OK
7	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	No	Yes	High	NK		OK
8	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	75-100%	Mature	<20	2	NK	1	No	Open a	Public a	Yes	Yes	High	NK		OK
9	NK	Water not	Poor	High	Modera	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	Yes	NK	High	NK		OK
10	NK	Water not	Poor	High	Modera	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	Yes	NK	High	NK		OK
11	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	Mature	<20	2	No	1	No	Open a	Public a	No	No	High	NK		OK
12	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	No acce	No publ	No	No	NK	NK		OK
13	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	No	No	High	NK		OK
14	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	No acce	No publ	No	No	High	NK		OK
15	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	No	1	No	Open a	Public a	Yes	Yes	High	NK		OK
16	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	No	1	No	Open a	Public a	No	Yes	High	NK		OK
17	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	75-100%	NK	<20	2	No	1	No	Open a	Public a	Yes	Yes	High	NK		OK
18	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	75-100%	NK	<20	2	NK	1	No	Open a	Public a	Yes	Yes	High	NK		OK
19	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	75-100%	NK	<20	2	NK	1	No	Open a	Public a	Yes	Yes	High	NK		OK
20	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	No	1	No	Open a	Public a	Yes	Yes	High	NK		OK
21	NK	Water not	Poor	High	Modera	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	Yes	Yes	High	NK		OK
22	NK	Water not	Poor	High	Modera	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	Yes	Yes	High	NK		OK
23	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	No	Yes	High	NK		OK
24	NK	Water not	Poor	High	Modera	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	Yes	Yes	High	Salmonid		OK
25	NK	Water not	Poor	High	NK	Mediun	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	No	1	No	Open a	Public a	No	No	High	NK		OK
26	NK	Water not	Poor	High	NK	NK	4 to 9 d	Natural	Mediun	NK	NK	NK	<20	2	NK	1	No	Open a	Public a	No	Yes	High	NK		OK
27	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK	NK		OK

4. Results overview

This is an initial scoping assessment to be used alongside or in advance of detailed impact assessments such as an EIA. See 'Links to other tools' for tools that can be used to assess individual ecosystem services in more detail.

The arrows indicate the direction and magnitude of the change in score for each ecosystem service at three points in time compared to the baseline before the intervention. They do not take account of the cumulative impact up to that time. The interpretation text flags where there is a decrease of an ecosystem service in year 30, or a net loss over 30 years (even if the final time slice shows a gain). See the Interpretation charts for a breakdown of the underlying habitat changes that drive these impacts. The results should be considered in the context of demand for different services, which can be local (e.g. recreation), regional (e.g. flood protection), national (e.g. food production) and global (e.g. climate change regulation). There are trade-offs between some services and universal gains may not be possible, especially on greenfield sites, but mitigating actions such as those suggested in the interpretation text can help to reduce any losses.

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
Food production	↓	↓	↓		The results 30 years after development indicate a large decrease in the ecosystem service of food production. Large
Wood production	→	↗	↗		
Fish production	→	→	→		
Water supply	↘	↘	↘		The results 30 years after development indicate a decrease in the ecosystem service of water supply. If water
Flood regulation	→	→	↗		
Erosion protection	↗	↗	↗		
Water quality regulation	↗	↗	↗		
Carbon storage	→	→	→		The results 30 years after development indicate little change in the ecosystem service of carbon storage. However
Air quality regulation	→	→	↗		
Cooling and shading	→	→	↗		
Noise reduction	→	→	→		
Pollination	→	↗	↗		
Pest control	↘	↗	↗		
Recreation	↑	↑	↑		
Aesthetic value	→	↗	↗		
Education	↗	↗	↑		
Interaction with nature	↗	↗	↗		
Sense of place	↘	↗	↗		

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4a. Compare on and off site results
4b. Interpretation charts
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4d. Save scenario
4e. Comparison with 100% suburban mosaic
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Print
See underlying calculations

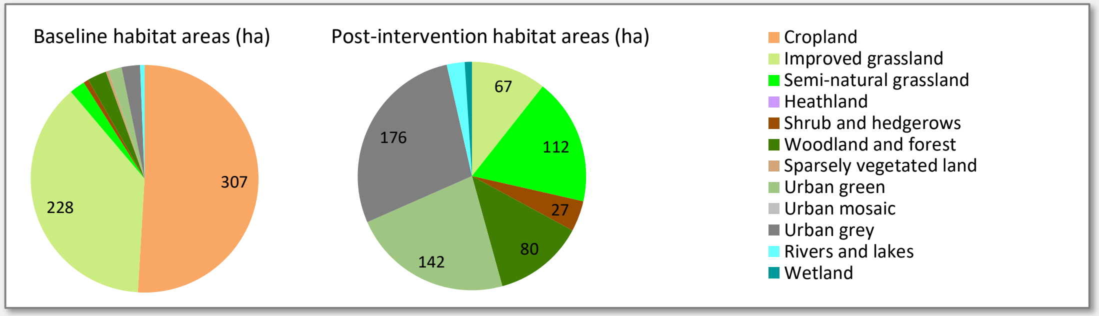
Change in average score per hectare

Large decrease (more than -2.5 points out of 10)
Decrease (-0.25 to -2.5 points out of 10)
Minor change (-0.25 to 0.25 points out of 10)
Increase (0.25 to 2.5 points out of 10)
Large increase (more than 2.5 points out of 10)

Confidence

The relationship between the provision of the ecosystem service and habitats is complex. Evidence for scoring/multipliers is partial, although may be stronger for some habitats than others. Evidence gaps have been filled by consulting experts and with a degree of subjectivity, particularly for cultural services.
We have some suitable evidence to calibrate our range of scores across habitats and multipliers and/ or scoring applied to a limited range of habitats/ multipliers for which there is a sound and simple rationale.
We have a strong evidence base upon which to base scores across the range of habitats and multipliers used for this ecosystem service.

Changes in Natural Capital Assets (total on site and off site)



This shows the percentages of the extent (area) of different habitats, comprising soil, rocks, water, plants and the species these habitats support. Sub-surface natural capital assets (groundwater bodies and mineral deposits) are not included.
The condition of the assets is reflected in the condition indicators, which modify the habitat scores.

Biodiversity net gain check

NO (Either BNG >+10% is not achieved or BNG has not been calculated and entered into Project Data tab)

Data completeness

	Baseline	Post-dev	*Out of*	Overall	*Out of*	
Overall indicators	0	0	*40*	0	*80*	Number of indicators completed (i.e. no rows 'Not known')
BASIC	0	0	*17*	0	*34*	Number of Basic indicators completed
STANDARD	0	0	*6*	0	*12*	Number of Standard indicators completed
ADVANCED	0	0	*17*	0	*34*	Number of Advanced indicators completed
Level achieved	NONE	NONE		NONE		

Errors and missing values

Errors on 'Baseline habitats' and 'Post-dev habitats' sheets are usually caused by **missing or invalid indicator values**. All values must be filled in except for cells that are greyed out because they are not applicable for that habitat. If you do not know a value enter "NK". Other errors can arise if you have auto-filled a numeric cell (e.g. for rainfall range) by dragging the autofill handle from the top cell only. This can cause values in each cell to be incremented by one unit. To avoid this, fill in and select the first two cells before autofilling numeric fields. The values will then remain constant when you autofill.

Only the first error or missing value on each calculation sheet will be displayed below. As each error is corrected, the next error will then be displayed.

Project details	OK	No errors
Baseline habitats	OK	No errors

Post-dev habitats	OK	No errors
Ancient habitats	OK	No errors
Area check	**Areas before and after match (within 0.1 ha)**	

Some linear and point features (e.g. hedges, trees, green walls) are measured separately and entered in addition to the underlying habitat; these are split out below.

	Baseline	Post-dev	Changed
Check ancient habitats retained	0.00	0.00	0.00
Any ancient habitats enhanced?	0.00	0.00	0.00
Onsite footprint area	590.40	590.41	549.94
Onsite line and point features	12.29	36.34	25.30
Total onsite area	602.69	626.75	575.24
Check total onsite area	602.69	626.75	
Offsite footprint area	0.00	0.00	0.00
Offsite line and point features	0.00	0.00	0.00
Total offsite area	0.00	0.00	0.00
Check total offsite area	0.00	0.00	
Total footprint area	590.40	590.41	549.94
Total line and point features	12.29	36.34	25.30
Total area	602.69	626.75	575.24
Check total footprint	590.40	590.41	
Check total line and point	12.29	36.34	
Check total area	602.69	626.75	

Post-dev footprint - baseline footprint	0.01
Difference in onsite footprint	0.01
Difference in offsite footprint	0.00

Line and point features assumed to be entered separately (in addition to the area of the underlying habitat)

	Baseline		
	Onsite	**Offsite**	**Total**
Hedgerows	0.82	0.00	0.82
Hedgerows with trees	0.00	0.00	0.00
Tree	11.04	0.00	11.04
Footpath / cycle path - green	0.00	0.00	0.00
Green wall	0.00	0.00	0.00
Total	11.86	0.00	11.86
	Post-development		
	Onsite	**Offsite**	**Total**
Hedgerows	3.18	0.00	3.18
Hedgerows with trees	0.00	0.00	0.00
Tree	33.16	0.00	33.16
Footpath / cycle path - green	0.00	0.00	0.00
Green wall	0.00	0.00	0.00
Total	36.34	0.00	36.34
	Changed		
	Onsite	**Offsite**	**Total**
Hedgerows	3.18	0.00	3.18
Hedgerows with trees	0.00	0.00	0.00
Tree	22.12	0.00	22.12
Footpath / cycle path - green	0.00	0.00	0.00
Green wall	0.00	0.00	0.00
Total	25.30	0.00	25.30

4a. On site and off site results

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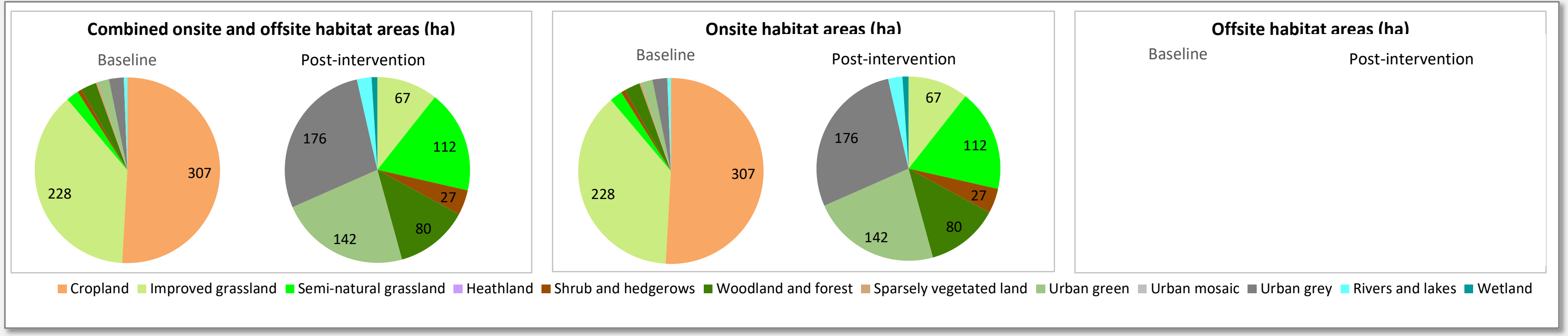
Changes in Natural Capital Assets



Potential impacts on ecosystem service flows: Whole area

Change in total score after each time period compared to baseline before development / intervention

The arrows indicate the direction and magnitude of the change in scores at three points in time after the development or intervention. They do not take account of the cumulative impact up to that time.

Combined on site and off site

Whole area	1 year	10 year	30 year
Food production	↓	↓	↓
Wood production	→	↗	↗
Fish production	→	→	→
Water supply	↘	↘	↘
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	↘	↗	↗

On site

1 year	10 year	30 year
↓	↓	↓
→	↗	↗
→	→	→
↘	↘	↘
→	→	↗
↗	↗	↗
↗	↗	↗
→	→	→
→	→	↗
→	→	↗
→	→	→
→	↗	↗
↘	↗	↗
↑	↑	↑
→	↗	↗
↗	↗	↑
↗	↗	↗
↘	↗	↗

Off site

1 year	10 year	30 year

Key

Size of change:

	Change in average score per hectare
↓	Large decrease (more than -2.5 points out of 10)
↘	Decrease (-0.1 to -2.5 points out of 10)
→	Minor change (-0.1 to 0.1 points out of 10)
↗	Increase (0.1 to 2.5 points out of 10)
↑	Large increase (more than 2.5 points out of 10)

Underlying changes in scores

See calculations

Combined on site and off site

				Changes per ha after:		
	1 year	10 year	30 year	1 year	10 year	30 year
Food production	↓	↓	↓	-2.9	-2.8	-2.8
Wood production	→	↗	↗	0.1	0.3	0.5
Fish production	→	→	→	0.0	0.2	0.2
Water supply	↘	↘	↘	-2.4	-2.4	-2.4
Flood regulation	→	→	↗	-0.2	0.1	0.5
Erosion protection	↗	↗	↗	0.3	1.0	1.0
Water quality regulation	↗	↗	↗	0.7	1.3	1.3
Carbon storage	→	→	→	-0.2	-0.1	0.1
Air quality regulation	→	→	↗	-0.2	0.2	0.4
Cooling and shading	→	→	↗	-0.2	0.1	0.5
Noise reduction	→	→	→	0.0	0.0	0.0
Pollination	→	↗	↗	0.1	1.0	1.4
Pest control	↘	↗	↗	-0.3	0.7	1.0
Recreation	↑	↑	↑	3.9	3.9	3.9
Aesthetic value	→	↗	↗	-0.2	0.9	1.5
Education	↗	↗	↑	1.6	2.3	2.6
Interaction with nature	↗	↗	↗	0.7	1.6	1.9
Sense of place	↘	↗	↗	-0.4	0.6	1.1

On site

			Changes per ha after:		
1 year	10 year	30 year	1 year	10 year	30 year
↓	↓	↓	-2.9	-2.8	-2.8
→	↗	↗	0.1	0.3	0.5
→	→	→	0.0	0.2	0.2
↘	↘	↘	-2.4	-2.4	-2.4
→	→	↗	-0.2	0.1	0.5
↗	↗	↗	0.3	1.0	1.0
↗	↗	↗	0.7	1.3	1.3
→	→	→	-0.2	-0.1	0.1
→	→	↗	-0.2	0.2	0.4
→	→	↗	-0.2	0.1	0.5
→	→	→	0.0	0.0	0.0
→	↗	↗	0.1	1.0	1.4
↘	↗	↗	-0.3	0.7	1.0
↑	↑	↑	3.9	3.9	3.9
→	↗	↗	-0.2	0.9	1.5
↗	↗	↑	1.6	2.3	2.6
↗	↗	↗	0.7	1.6	1.9
↘	↗	↗	-0.4	0.6	1.1

Off site

			Changes per ha after:		
1 year	10 year	30 year	1 year	10 year	30 year

4. Score breakdown by habitat type and calculation stage

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This table summarises the units for each habitat group, shown as Broad habitats (a classification used by Natural England) and Biodiversity Metric 3.0 habitat groups (related to UK Hab Level 2). The tables show the average score over the assessment period (default 30 years) for total onsite and offsite areas. The top two blocks show the scores for Baseline and Post-development for Broad habitats and Biodiversity Metric 3.0 habitats. The next two blocks split out the calculations into three different stages: basic scores, scores after condition and spatial factors have been applied, and (for post-development) scores after time to target condition and delivery risk have been applied. This can be useful if you want to see how the habitat condition and spatial factors, or the time to reach target condition and delivery risk, affect the final scores. Below that is a block showing the calculation stages for every individual habitat type, although you can filter out un-used habitats.

	Total		Onsite		Offsite		Food production		Wood production		Fish production		Water supply		Flood regulation		Erosion protection		Water quality regulation	
	Area (ha) including linear and point features																			
Broad habitats	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev
Woodland	20.79	107.76	20.79	107.76	0	0	8	16	112	283	0	0	65	238	135	474	103	364	121	410
Semi-natural grassland	13.36	112.11	13.36	112.11	0	0	25	227	0	0	0	0	105	967	39	320	50	407	41	329
Enclosed farmland	535.23	66.66	535.23	66.66	0	0	2230	278	0	0	0	0	3747	467	1022	157	496	143	144	42
Mountains, moors and heaths	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freshwater, wetlands and floodplains	3.81	22.31	3.81	22.31	0	0	0	0	0	0	46	138	38	210	10	60	0	26	3	40
Coastal margins	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban green	11.51	142.26	11.51	142.26	0	0	0	60	12	33	0	0	13	656	54	374	38	293	17	205
Urban mosaic	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban grey	17.99	175.65	17.99	175.65	0	0	0	0	0	0	0	0	9	0	2	0	0	0	1	0
Total	602.69	626.75	602.69	626.75	0	0	**2263**	**582**	**124**	**316**	**46**	**138**	**3977**	**2538**	**1261**	**1385**	**686**	**1232**	**327**	**1025**
Biodiversity Metric 3.0 habitat groups (expanded)	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev
Cropland	307.0	-	307.0	-	-	-	1,279.1	-	-	-	-	-	2,148.9	-	483.2	-	-	-	-	-
Improved grassland	228.3	66.7	228.3	66.7	-	-	951.0	277.8	-	-	-	-	1,597.8	466.6	539.0	156.7	496.0	143.3	144.1	42.1
Semi-natural grassland	13.4	112.1	13.4	112.1	-	-	25.3	227.2	-	-	-	-	104.8	966.5	39.0	319.5	49.7	406.5	41.0	329.0
Heathland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shrub and hedgerows	4.6	27.4	4.6	27.4	-	-	1.9	10.5	8.4	50.8	-	-	18.4	107.9	21.3	122.3	20.2	110.5	15.9	88.7
Woodland and forest	16.2	80.3	16.2	80.3	-	-	5.8	5.8	103.7	232.0	-	-	46.4	130.5	113.5	351.8	82.7	253.0	104.9	320.8
Sparsely vegetated land	2.4	-	2.4	-	-	-	-	-	-	-	-	-	9.5	-	1.9	-	-	-	1.5	-
Urban green	11.5	142.3	11.5	142.3	-	-	-	60.3	11.5	33.5	-	-	12.9	655.9	54.0	374.0	37.5	292.7	16.6	204.7
Urban mosaic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Urban grey	15.6	175.7	15.6	175.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rivers and lakes	3.8	15.8	3.8	15.8	-	-	-	-	-	-	45.7	96.6	38.1	145.6	9.6	40.8	-	-	2.7	10.8
Wetland	-	6.5	-	6.5	-	-	-	-	-	-	-	41.4	-	64.8	-	19.6	-	26.2	-	29.4
Marine inlets and transitional water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**602.7**	**626.7**	**602.7**	**626.7**	-	-	**2,263.2**	**581.5**	**123.6**	**316.3**	**45.7**	**138.1**	**3,976.6**	**2,537.8**	**1,261.4**	**1,384.8**	**686.1**	**1,232.4**	**326.8**	**1,025.4**

Score breakdown by habitat type and calculation stage

This table summarises the units for each eco-metric habitat type and habitat group, split by calculation stage. It shows the total units for each habitat type based on just the basic scores from the matrix, and then after applying i) condition factors, ii) spatial (position) factors, iii) linear multiplier (for hedges and watercourses) iv) demand factors and v) time / delivery risk factors. Note that not all of these calculation stages apply to every service.

All score breakdowns are for total onsite and offsite areas

	Total		Onsite		Offsite		Food production					Wood production			Fish production					
	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline		Post-dev			Baseline	Post-dev		Baseline			Post-dev		
Length of hedgerows (m)	8247	31800	8247	8247	0	0														
Area of line and point features	12.2882	36.34	12.288	36.340	-	-	*Basic score*	*Condition*	*Basic score*	*Condition*	*Time*	*Basic score*	*Basic score*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*
Total area excl. line and point features	**590.40**	**590.41**	**590.40**	**590.41**	-	-	**5432**	**2263**	**1528**	**637**	**582**	**124**	**702**	**316**	**38**	**28**	**46**	**223**	**156**	**174**
Broad habitats	Area (ha) including linear and point features						*Basic score*	*Condition*	*Basic score*	*Condition*	*Time*									
Woodland	20.79	107.76	20.79	107.76	0.00	0.00	19	8	41	17	16	112	668	283	0	0	0	0	0	0
Semi-natural grassland	13.36	112.11	13.36	112.11	0.00	0.00	61	25	673	280	227	0	0	0	0	0	0	0	0	0
Enclosed farmland	535.23	66.66	535.23	66.66	0.00	0.00	5352	2230	667	278	278	0	0	0	0	0	0	0	0	0
Mountains, moors and heaths	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freshwater, wetlands and floodplains	3.81	22.31	3.81	22.31	0.00	0.00	0	0	0	0	0	0	0	0	38	28	46	223	156	174
Coastal margins	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban green	11.51	142.26	11.51	142.26	0.00	0.00	0	0	147	61	60	12	34	33	0	0	0	0	0	0
Urban mosaic	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban grey	17.99	175.65	17.99	175.65	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total area	**602.69**	**626.75**	**602.69**	**626.75**	**0.00**	**0.00**														
	Area (ha) including linear and point features						Baseline		Post-dev			Baseline	Post-dev		Baseline			Post-dev		
Biodiversity Metric 3.0 habitat groups (expanded)	Total		Onsite		Offsite		*Basic score*	*Condition*	*Basic score*	*Condition*	*Time*	*Basic score*	*Basic score*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*
Cropland	306.98	0.00	306.98	0.00	0.00	0.00	3070	1279	0	0	0	0	0	0	0	0	0	0	0	0
Improved grassland	228.25	66.66	228.25	66.66	0.00	0.00	2283	951	667	278	278	0	0	0	0	0	0	0	0	0
Semi-natural grassland	13.36	112.11	13.36	112.11	0.00	0.00	61	25	673	280	227	0	0	0	0	0	0	0	0	0
Heathland	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shrub and hedgerows	4.59	27.43	4.59	27.43	0.00	0.00	5	2	27	11	10	8	52	51	0	0	0	0	0	0
Woodland and forest	16.20	80.33	16.20	80.33	0.00	0.00	14	6	14	6	6	104	617	232	0	0	0	0	0	0
Sparsely vegetated land	2.37	0.00	2.37	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban green	11.51	142.26	11.51	142.26	0.00	0.00	0	0	147	61	60	12	34	33	0	0	0	0	0	0
Urban mosaic	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban grey	15.62	175.65	15.62	175.65	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rivers and lakes	3.81	15.80	3.81	15.80	0.00	0.00	0	0	0	0	0	0	0	0	38	28	46	158	111	129
Wetland	0.00	6.51	0.00	6.51	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	65	45	45
Marine inlets and transitional water	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total area	602.69	626.75	602.69	626.75	0.00	0.00														

Breakdown by detailed habitat

Filter out unused habitats				Area (ha)						Food production					Wood production			Fish production					
				Total		Onsite		Offsite		Baseline		Post-dev			Baseline	Post-dev		Baseline			Post-dev		
Used?	**Eco-metric habitats**	**Broad hab**	**UK Hab**	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	*Basic score*	*Condition*	*Basic score*	*Condition*	*Time*	*Basic score*	*Basic score*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*
Y	Broadleaved, mixed and yew semi	Woodland	Woodland and fo	11.3	11.3	11.3	11.3	0.0	0.0	11.3	4.7	11.3	4.7	4.7	67.7	67.7	67.7	0.0	0.0	0.0	0.0	0.0	0.0
Y	Broadleaved, mixed and yew plant	Woodland	Woodland and fo	4.4	68.5	4.4	68.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.0	548.0	163.2	0.0	0.0	0.0	0.0	0.0	0.0
	Native pine woodlands	Woodland	Woodland and fo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coniferous plantation	Woodland	Woodland and fo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Wood pasture and parkland with s	Woodland	Woodland and fo	0.6	0.6	0.6	0.6	0.0	0.0	2.8	1.1	2.8	1.1	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0
	Traditional orchards	Woodland	Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Dense scrub	Woodland	Shrub and hedger	3.3	24.3	3.3	24.3	0.0	0.0	3.3	1.4	24.3	10.1	9.3	6.7	48.5	47.7	0.0	0.0	0.0	0.0	0.0	0.0
Y	Hedgerows	Woodland	Shrub and hedger	0.8	3.2	0.8	3.2	0.0	0.0	0.8	0.3	3.2	1.3	1.2	0.8	3.2	3.1	0.0	0.0	0.0	0.0	0.0	0.0
Y	Hedgerow with trees	Woodland	Shrub and hedger	0.4	0.0	0.4	0.0	0.0	0.0	0.4	0.2	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Felled woodland	Woodland	Woodland and fo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Tall herb and fern	Semi-natur	Semi-natural gras	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ephemeral / short perennial	Semi-natur	Semi-natural gras	3.9	0.0	3.9	0.0	0.0	0.0	3.9	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Bracken	Semi-natur	Semi-natural gras	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Semi-natural grassland	Semi-natur	Semi-natural gras	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Acid grassland	*Semi-natur*	*Semi-natural gras*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Calcareous grassland	*Semi-natur*	*Semi-natural gras*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	*Neutral grassland*	*Semi-natur*	*Semi-natural gras*	9.5	112.1	9.5	112.1	0.0	0.0	56.9	23.7	672.7	280.3	227.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Calaminarian grasslands	*Semi-natur*	*Semi-natural gras*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Poor semi-improved grassland	*Semi-natur*	*Semi-natural gras*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Improved grassland	Enclosed fa	Improved grasslar	228.3	66.7	228.3	66.7	0.0	0.0	2282.5	951.0	666.6	277.8	277.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Arable fields, horticulture and tem	Enclosed fa	Cropland	307.0	0.0	307.0	0.0	0.0	0.0	3069.8	1279.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Arable field margins	Enclosed fa	Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Woody biofuel crops	Enclosed fa	Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Intensive orchards	Enclosed fa	Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Bog	Mountains	Wetland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Dwarf shrub heath	Mountains	Heathland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Inland rock	Mountains	Sparsely vegetate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Freshwater	Freshwater	Rivers and lakes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	*Standing open water*	Freshwater	Rivers and lakes	2.7	14.7	2.7	14.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.4	19.0	19.0	147.3	102.3	102.3
	Canals	Freshwater	Rivers and lakes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	*Running water*	Freshwater	Rivers and lakes	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	8.9	26.7	10.7	8.9	26.7
	Fen, marsh and swamp	Freshwater	Wetland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Lowland fens	Freshwater	Wetland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Purple moor grass and rush pa	Freshwater	Wetland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Upland flushes, fens and swam	Freshwater	Wetland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Aquatic marginal vegetation	Freshwater	Wetland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	*Reedbeds*	Freshwater	Wetland	0.0	6.5	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.1	45.2	45.2
	Other swamps	Freshwater	Wetland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coastal rock	Coastal ma	Sparsely vegetate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Biogenic reefs	Coastal ma	Marine inlets and	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coastal saltmarsh	Coastal ma	Marine inlets and	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Coastal lagoons	Coastal ma	Marine inlets and	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Seagrass beds	Coastal ma	Marine inlets and	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vegetated dunes and shingle	Coastal ma	Sparsely vegetate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Beach and bare sand	Coastal ma	Sparsely vegetate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other littoral sediment	Coastal ma	Marine inlets and	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Sealed surface and buildings	Urban grey	Urban grey	15.6	175.7	15.6	175.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Artificial unvegetated, unsealed su	Urban grey	Urban grey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Bare ground	Urban grey	Sparsely vegetate	2.4	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Garden	Urban gree	Urban green spac	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	*Vegetated garden*	*Urban g*	*Urban green*	0.0	64.2	0.0	64.2	0.0	0.0	0.0	0.0	64.2	26.7	26.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Unvegetated garden	*Urban g*	*Urban grey*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Open mosaic habitats on previousl	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Parks and gardens	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Footpath / cycle path - green	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Green bridge	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Amenity grassland	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Road island / verge	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural sports pitch, recreation gr	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cemeteries and churchyards	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Allotments, city farm, community	Urban gree	Urban green	0.0	9.2	0.0	9.2	0.0	0.0	0.0	0.0	82.9	34.5	34.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Intensive green roof	Urban gree	Urban green	0.0	24.3	0.0	24.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Green wall	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Brown roof or extensive green roo	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Tree	Urban gree	Urban green	11.0	33.2	11.0	33.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	33.2	32.8	0.0	0.0	0.0	0.0	0.0	0.0
	Bioswale	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SuDS retention pond	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SuDS detention basin	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Rain garden	Urban gree	Urban green	0.0	10.7	0.0	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	Introduced shrub	Urban gree	Urban green	0.5	0.7	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0
	Flower bed	Urban gree	Urban green	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Suburban/ mosaic of developed/ n	Urban mos	Urban mosaic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Y	**Total**			**602.7**	**626.7**	**602.7**	**626.7**	**0.0**	**0.0**	**5431.7**	**2263.2**	**1527.8**	**636.6**	**581.5**	**123.6**	**702.3**	**316.3**	**38.1**	**27.9**	**45.7**	**223.1**	**156.4**	**174.2**
Y	**Without line and point features**			**590.4**	**590.4**	**590.4**	**590.4**	**590.4**	**590.4**														
				Error check:						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Carbon storage		Air quality regulation		Cooling and shading		Noise regulation		Pollination		Pest control		Recreation		Aesthetic value		Education		Interaction with nature		Sense of place	
Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev
91	274	115	358	155	476	0	0	114	395	152	510	0	633	170	512	0	360	63	334	158	417
23	203	11	93	22	187	0	0	87	614	104	666	0	705	95	695	0	591	37	517	82	641
649	100	446	56	892	111	0	0	804	100	1181	181	0	536	1147	199	0	88	227	79	1105	190
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	22	0	5	13	67	0	0	3	18	7	46	0	137	47	157	0	122	20	110	45	127
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	194	57	240	76	433	0	0	60	535	83	526	0	295	86	555	0	195	27	243	77	461
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	2	0	0	0	2	0	6	0	0	0	2	0	0	0	1	0	2	0
805	**792**	**629**	**752**	**1160**	**1275**	**0**	**0**	**1071**	**1663**	**1533**	**1929**	**0**	**2306**	**1546**	**2118**	**0**	**1355**	**374**	**1282**	**1469**	**1836**
Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev	Baseline	Post-dev
307.0	-	255.8	-	511.6	-	-	-	461.3	-	558.1	-	-	-	461.3	-	-	-	91.1	-	419.3	-
342.4	99.5	190.2	55.6	380.4	111.1	-	-	343.0	100.2	622.5	180.9	-	536.5	686.0	198.8	-	87.8	135.5	78.5	686.0	190.4
22.9	203.0	11.1	93.4	22.3	186.9	-	-	87.4	614.0	104.2	665.9	-	704.8	94.6	694.9	-	590.6	37.4	517.1	81.9	641.1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.1	76.3	25.7	148.6	22.3	129.5	-	-	31.3	167.8	41.7	224.9	-	151.4	48.2	198.3	-	142.4	19.0	151.2	43.2	154.8
77.4	197.7	89.0	209.3	133.2	346.9	-	-	82.7	227.3	109.9	284.8	-	481.1	121.7	313.9	-	217.3	44.2	183.2	115.1	262.1
1.2	-	-	-	2.0	-	-	-	1.8	-	6.5	-	-	-	1.8	-	-	-	0.7	-	1.6	-
39.6	194.3	56.8	239.5	76.0	433.1	-	-	60.2	535.3	82.9	526.1	-	295.3	85.8	555.3	-	195.3	26.8	242.6	76.7	460.7
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.4	5.3	-	-	12.7	45.8	-	-	2.9	8.4	6.9	28.7	-	110.2	47.1	111.1	-	82.0	19.5	74.2	45.2	87.6
-	16.3	-	5.4	-	21.5	-	-	-	9.8	-	17.3	-	27.0	-	45.6	-	40.0	-	35.7	-	39.7
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
804.9	**792.4**	**628.7**	**751.8**	**1,160.4**	**1,274.8**	**-**	**-**	**1,070.6**	**1,662.7**	**1,532.7**	**1,928.6**	**-**	**2,306.4**	**1,546.3**	**2,117.9**	**-**	**1,355.3**	**374.3**	**1,282.4**	**1,469.0**	**1,836.3**

	Water supply							Flood regulation							Erosion protection											
	Baseline			Post-dev				Baseline			Post-dev				Baseline				Post-dev					Baseline		
Time	*Basic score*	*Condition*	*Demand*	*Basic score*	*Condition*	*Demand*	*Time*	*Basic score*	*Condition*	*Demand*	*Basic score*	*Condition*	*Demand*	*Time*	*Basic score*	*Condition*	*Position*	*Demand*	*Basic score*	*Condition*	*Position*	*Demand*	*Time*	*Basic score*	*Condition*	*Position*
138	**3977**	**3977**	**3977**	**2640**	**2640**	**2640**	**2538**	**1603**	**1603**	**1261**	**2160**	**2160**	**1700**	**1385**	**1570**	**1263**	**1263**	**686**	**2679**	**2679**	**2679**	**1456**	**1232**	**798**	**492**	**492**
0	65	65	65	284	284	284	238	172	171	135	886	886	697	474	189	189	189	103	885	885	885	481	364	174	174	174
0	105	105	105	1009	1009	1009	967	50	50	39	448	448	353	320	91	91	91	50	897	897	897	487	407	59	59	59
0	3747	3747	3747	467	467	467	467	1299	1299	1022	200	200	157	157	1220	913	913	496	267	267	267	145	143	535	228	228
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
138	38	38	38	223	223	223	210	12	12	10	86	86	68	60	0	0	0	0	52	52	52	28	26	4	4	4
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	13	13	13	657	657	657	656	69	69	54	540	540	425	374	69	69	69	38	579	579	579	315	293	24	24	24
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	9	9	9	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2

	Baseline			Post-dev				Baseline			Post-dev				Baseline				Post-dev					Baseline		
Time	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*	*Basic score*	*Condition*	*Demand*	*Basic score*	*Condition*	*Demand*	*Time*	*Basic score*	*Condition*	*Position*	*Demand*	*Basic score*	*Condition*	*Position*	*Demand*	*Time*	*Basic score*	*Condition*	*Position*
0	2149	2149	2149	0	0	0	0	614	614	483	0	0	0	0	307	0	0	0	0	0	0	0	0	307	0	0
0	1598	1598	1598	467	467	467	467	685	685	539	200	200	157	157	913	913	913	496	267	267	267	145	143	228	228	228
0	105	105	105	1009	1009	1009	967	50	50	39	448	448	353	320	91	91	91	50	897	897	897	487	407	59	59	59
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	18	18	18	110	110	110	108	28	27	21	165	165	130	122	37	37	37	20	219	219	219	119	111	23	23	23
0	46	46	46	175	175	175	131	144	144	113	721	721	568	352	152	152	152	83	665	665	665	361	253	151	151	151
0	9	9	9	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2
0	13	13	13	657	657	657	656	69	69	54	540	540	425	374	69	69	69	38	579	579	579	315	293	24	24	24
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	38	38	38	158	158	158	146	12	12	10	60	60	47	41	0	0	0	0	0	0	0	0	0	4	4	4
41	0	0	0	65	65	65	65	0	0	0	26	26	20	20	0	0	0	0	52	52	52	28	26	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Water supply							Flood regulation							Erosion protection											
	Baseline			Post-dev				Baseline			Post-dev				Baseline				Post-dev					Baseline		
Time	*Basic score*	*Condition*	*Demand*	*Basic score*	*Condition*	*Demand*	*Time*	*Basic score*	*Condition*	*Demand*	*Basic score*	*Condition*	*Demand*	*Time*	*Basic score*	*Condition*	*Position*	*Demand*	*Basic score*	*Condition*	*Position*	*Demand*	*Time*	*Basic score*	*Condition*	*Position*
0.0	33.8	33.8	33.8	33.8	33.8	33.8	33.8	101.5	101.5	79.9	101.5	101.5	79.9	79.9	112.8	112.8	112.8	61.3	112.8	112.8	112.8	61.3	61.3	112.8	112.8	112.8
0.0	8.7	8.7	8.7	137.0	137.0	137.0	92.8	39.3	39.3	31.0	616.5	616.5	485.2	269.3	35.0	35.0	35.0	19.0	548.0	548.0	548.0	297.7	189.3	35.0	35.0	35.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.3	3.3	2.6	3.3	3.3	2.6	2.6	4.4	4.4	4.4	2.4	4.4	4.4	4.4	2.4	2.4	3.3	3.3	3.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	13.4	13.4	13.4	97.0	97.0	97.0	95.4	20.0	20.0	15.8	145.5	145.5	114.5	108.2	26.7	26.7	26.7	14.5	194.0	194.0	194.0	105.4	97.7	16.7	16.7	16.7
0.0	3.3	3.3	3.3	12.7	12.7	12.7	12.5	4.9	4.9	3.9	19.1	19.1	15.0	14.2	6.6	6.6	6.6	3.6	25.4	25.4	25.4	13.8	12.8	4.1	4.1	4.1
0.0	1.7	1.7	1.7	0.0	0.0	0.0	0.0	3.0	2.1	1.6	0.0	0.0	0.0	0.0	3.8	3.8	3.8	2.1	0.0	0.0	0.0	0.0	0.0	2.1	2.1	2.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	19.4	19.4	19.4	0.0	0.0	0.0	0.0	11.6	11.6	9.1	0.0	0.0	0.0	0.0	15.5	15.5	15.5	8.4	0.0	0.0	0.0	0.0	0.0	11.6	11.6	11.6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	85.4	85.4	85.4	1009.0	1009.0	1009.0	966.5	38.0	38.0	29.9	448.4	448.4	353.0	319.5	75.9	75.9	75.9	41.2	896.9	896.9	896.9	487.3	406.5	47.5	47.5	47.5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	1597.8	1597.8	1597.8	466.6	466.6	466.6	466.6	684.8	684.8	539.0	200.0	200.0	157.4	156.7	913.0	913.0	913.0	496.0	266.6	266.6	266.6	144.9	143.3	228.3	228.3	228.3
0.0	2148.9	2148.9	2148.9	0.0	0.0	0.0	0.0	614.0	614.0	483.2	0.0	0.0	0.0	0.0	307.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	307.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
69.9	27.4	27.4	27.4	147.3	147.3	147.3	134.9	11.0	11.0	8.6	58.9	58.9	46.4	39.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	2.7	2.7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	1.1	1.2	0.9	1.1	1.2	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.2	1.2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41.4	0.0	0.0	0.0	65.1	65.1	65.1	64.8	0.0	0.0	0.0	26.0	26.0	20.5	19.6	0.0	0.0	0.0	0.0	52.1	52.1	52.1	28.3	26.2	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	9.5	9.5	9.5	0.0	0.0	0.0	0.0	2.4	2.4	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4	2.4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	449.3	449.3	449.3	449.3	0.0	0.0	0.0	192.6	192.6	151.6	130.5	0.0	0.0	0.0	0.0	321.0	321.0	321.0	174.4	162.7	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	64.5	64.5	64.5	64.5	0.0	0.0	0.0	18.4	18.4	14.5	14.5	0.0	0.0	0.0	0.0	9.2	9.2	9.2	5.0	5.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	72.8	72.8	57.3	57.0	0.0	0.0	0.0	0.0	24.3	24.3	24.3	13.2	13.2	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	11.0	11.0	11.0	33.2	33.2	33.2	32.8	66.2	66.2	52.1	199.0	199.0	156.6	127.6	66.2	66.2	66.2	36.0	199.0	199.0	199.0	108.1	98.1	22.1	22.1	22.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	107.0	107.0	107.0	106.5	0.0	0.0	0.0	53.5	53.5	42.1	41.7	0.0	0.0	0.0	0.0	21.4	21.4	21.4	11.6	11.5	0.0	0.0	0.0
0.0	1.9	1.9	1.9	2.9	2.9	2.9	2.8	2.4	2.4	1.8	3.6	3.6	2.8	2.7	2.8	2.8	2.8	1.5	4.3	4.3	4.3	2.3	2.2	1.9	1.9	1.9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
138.1	**3976.6**	**3976.6**	**3976.6**	**2639.9**	**2639.9**	**2639.9**	**2537.8**	**1603.4**	**1602.6**	**1261.4**	**2160.2**	**2160.3**	**1700.4**	**1384.8**	**1569.7**	**1262.7**	**1262.7**	**686.1**	**2679.4**	**2679.4**	**2679.4**	**1455.7**	**1232.4**	**798.4**	**491.6**	**491.6**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Water quality regulation						Carbon storage					Air quality regulation							Cooling and shading							Noise reduction					
	Post-dev					Baseline		Post-dev			Baseline			Post-dev				Baseline			Post-dev				Baseline		Post-dev			Base
Demand	Basic score	Condition	Position	Demand	Time	Basic score	Condition	Basic score	Condition	Time	Basic score	Condition	Position	Basic score	Condition	Position	Time	Basic score	Condition	Position	Basic score	Condition	Position	Time	Basic score	Position	Basic score	Position	Time	Basic score
327	1796	1796	1796	1243	1025	1611	805	2044	1035	792	756	754	629	1253	1253	1044	752	1394	1392	1160	2017	2017	1681	1275	751	0	1309	0	0	1425
121	801	801	801	556	410	182	91	893	447	274	139	138	115	684	684	570	358	188	187	155	966	966	805	476	155	0	805	0	0	152
41	561	561	561	389	329	46	23	448	224	203	13	13	11	112	112	93	93	27	27	22	224	224	187	187	13	0	112	0	0	116
144	67	67	67	42	42	1299	649	200	100	100	535	535	446	67	67	56	56	1070	1070	892	133	133	111	111	535	0	67	0	0	1070
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	61	61	61	43	40	3	1	41	33	22	0	0	0	7	7	5	5	15	15	13	89	89	74	67	0	0	7	0	0	4
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	306	306	306	212	205	79	40	461	230	194	68	68	57	384	384	320	240	91	91	76	605	605	504	433	47	0	319	0	0	80
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	2

	Post-dev					Baseline		Post-dev			Baseline			Post-dev				Baseline			Post-dev				Baseline		Post-dev			Base
Demand	Basic score	Condition	Position	Demand	Time	Basic score	Condition	Basic score	Condition	Time	Basic score	Condition	Position	Basic score	Condition	Position	Time	Basic score	Condition	Position	Basic score	Condition	Position	Time	Basic score	Position	Basic score	Position	Time	Basic score
0	0	0	0	0	0	614	307	0	0	0	307	307	256	0	0	0	0	614	614	512	0	0	0	0	307	0	0	0	0	614
144	67	67	67	42	42	685	342	200	100	100	228	228	190	67	67	56	56	457	457	380	133	133	111	111	228	0	67	0	0	457
41	561	561	561	389	329	46	23	448	224	203	13	13	11	112	112	93	93	27	27	22	224	224	187	187	13	0	112	0	0	116
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	137	137	137	95	89	27	13	161	81	76	33	31	26	192	192	160	149	28	27	22	165	165	137	130	28	0	165	0	0	42
105	664	664	664	461	321	155	77	732	366	198	107	107	89	492	492	410	209	160	160	133	801	801	668	347	127	0	640	0	0	110
1	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	2
17	306	306	306	212	205	79	40	461	230	194	68	68	57	384	384	320	240	91	91	76	605	605	504	433	47	0	319	0	0	80
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	16	16	16	11	11	3	1	15	7	5	0	0	0	0	0	0	0	15	15	13	63	63	53	46	0	0	0	0	0	4
0	46	46	46	32	29	0	0	26	26	16	0	0	0	7	7	5	5	0	0	0	26	26	22	22	0	0	7	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Water quality regulation						Carbon storage					Air quality regulation							Cooling and shading							Noise reduction					
	Post-dev					Baseline		Post-dev			Baseline			Post-dev				Baseline			Post-dev				Baseline		Post-dev			Base
Demand	Basic score	Condition	Position	Demand	Time	Basic score	Condition	Basic score	Condition	Time	Basic score	Condition	Position	Basic score	Condition	Position	Time	Basic score	Condition	Position	Basic score	Condition	Position	Time	Basic score	Position	Basic score	Position	Time	Basic score
78.3	112.8	112.8	112.8	78.3	78.3	112.8	56.4	112.8	56.4	56.4	79.0	79.0	65.8	79.0	79.0	65.8	65.8	112.8	112.8	94.0	112.8	112.8	94.0	94.0	90.2	0.0	90.2	0.0	0.0	79.0
24.3	548.0	548.0	548.0	380.6	240.2	39.3	19.7	616.5	308.3	139.9	26.2	26.2	21.9	411.0	411.0	342.5	142.1	43.7	43.7	36.4	685.0	685.0	570.8	250.2	35.0	0.0	548.0	0.0	0.0	26.2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.3	3.3	3.3	3.3	2.3	2.3	2.8	1.4	2.8	1.4	1.4	1.7	1.7	1.4	1.7	1.7	1.4	1.4	3.3	3.3	2.8	3.3	3.3	2.8	2.8	2.2	0.0	2.2	0.0	0.0	5.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11.6	121.3	121.3	121.3	84.2	78.5	20.0	10.0	145.5	72.8	68.7	23.4	23.4	19.5	169.8	169.8	141.5	131.4	20.0	20.0	16.7	145.5	145.5	121.3	114.5	20.0	0.0	145.5	0.0	0.0	30.1
2.9	15.9	15.9	15.9	11.0	10.3	4.1	2.1	15.9	8.0	7.6	5.8	5.8	4.8	22.3	22.3	18.6	17.2	4.9	4.9	4.1	19.1	19.1	15.9	15.0	4.9	0.0	19.1	0.0	0.0	7.4
1.5	0.0	0.0	0.0	0.0	0.0	3.0	1.0	0.0	0.0	0.0	3.4	1.7	1.4	0.0	0.0	0.0	0.0	3.0	1.8	1.5	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	4.2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.1	0.0	0.0	0.0	0.0	0.0	7.7	3.9	0.0	0.0	0.0	3.9	3.9	3.2	0.0	0.0	0.0	0.0	7.7	7.7	6.5	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	31.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33.0	560.6	560.6	560.6	389.3	329.0	38.0	19.0	448.4	224.2	203.0	9.5	9.5	7.9	112.1	112.1	93.4	93.4	19.0	19.0	15.8	224.2	224.2	186.9	186.9	9.5	0.0	112.1	0.0	0.0	85.4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
144.1	66.7	66.7	66.7	42.1	42.1	684.8	342.4	200.0	100.0	99.5	228.3	228.3	190.2	66.7	66.7	55.6	55.6	456.5	456.5	380.4	133.3	133.3	111.1	111.1	228.3	0.0	66.7	0.0	0.0	456.5
0.0	0.0	0.0	0.0	0.0	0.0	614.0	307.0	0.0	0.0	0.0	307.0	307.0	255.8	0.0	0.0	0.0	0.0	614.0	614.0	511.6	0.0	0.0	0.0	0.0	307.0	0.0	0.0	0.0	0.0	614.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.9	14.7	14.7	14.7	10.2	9.9	2.7	1.4	14.7	7.4	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	11.0	9.1	58.9	58.9	49.1	42.2	0.0	0.0	0.0	0.0	0.0	2.7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.8	1.1	1.2	1.2	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	4.3	3.6	4.3	4.3	3.6	3.6	0.0	0.0	0.0	0.0	0.0	1.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	45.6	45.6	45.6	31.6	29.4	0.0	0.0	26.0	26.0	16.3	0.0	0.0	0.0	6.5	6.5	5.4	5.4	0.0	0.0	0.0	26.0	26.0	21.7	21.5	0.0	0.0	6.5	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.5	0.0	0.0	0.0	0.0	0.0	2.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	128.4	128.4	128.4	89.2	85.1	0.0	0.0	128.4	64.2	64.2	0.0	0.0	0.0	128.4	128.4	107.0	84.7	0.0	0.0	0.0	128.4	128.4	107.0	107.0	0.0	0.0	128.4	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	9.2	9.2	9.2	6.4	6.4	0.0	0.0	27.6	13.8	12.3	0.0	0.0	0.0	18.4	18.4	15.4	15.2	0.0	0.0	0.0	18.4	18.4	15.4	15.4	0.0	0.0	18.4	0.0	0.0	0.0
0.0	24.3	24.3	24.3	16.9	16.8	0.0	0.0	48.6	24.3	24.3	0.0	0.0	0.0	24.3	24.3	20.2	20.2	0.0	0.0	0.0	145.7	145.7	121.4	120.1	0.0	0.0	24.3	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.3	66.3	66.3	66.3	46.1	43.3	77.3	38.6	232.1	116.1	81.5	66.2	66.2	55.2	199.0	199.0	165.8	108.2	88.3	88.3	73.6	265.3	265.3	221.1	151.9	44.2	0.0	132.6	0.0	0.0	77.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	74.9	74.9	74.9	52.0	51.3	0.0	0.0	21.4	10.7	10.7	0.0	0.0	0.0	10.7	10.7	8.9	8.9	0.0	0.0	0.0	42.8	42.8	35.7	35.4	0.0	0.0	10.7	0.0	0.0	0.0
1.3	2.9	2.9	2.9	2.0	1.9	1.9	0.9	2.9	1.4	1.4	1.9	1.9	1.6	2.9	2.9	2.4	2.2	2.8	2.8	2.4	4.3	4.3	3.6	3.4	2.8	0.0	4.3	0.0	0.0	2.8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
326.8	**1795.8**	**1795.9**	**1795.9**	**1242.9**	**1025.4**	**1610.7**	**804.9**	**2043.6**	**1034.8**	**792.4**	**756.1**	**754.4**	**628.7**	**1252.5**	**1252.5**	**1043.8**	**751.8**	**1393.7**	**1392.5**	**1160.4**	**2017.3**	**2017.3**	**1681.1**	**1274.8**	**750.9**	**0.0**	**1309.0**	**0.0**	**0.0**	**1425.0**

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pollination				Pest control					Recreation									Aesthetic value							Education					
eline	Post-dev			Baseline		Post-dev			Baseline				Post-dev					Baseline			Post-dev				Baseline					
Condition	*Basic score*	*Condition*	*Time*	*Basic score*	*Condition*	*Basic score*	*Condition*	*Time*	*Basic score*	*Condition*	*Linear*	*Demand*	*Basic score*	*Condition*	*Linear*	*Demand*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*	*Basic score*	*Condition*	*Linear*	*Demand*	*Basic score*	*Condition*
1071	**2818**	**2117**	**1663**	**1686**	**1533**	**2652**	**2411**	**1929**	**4299**	**0**	**0**	**0**	**4222**	**3547**	**3569**	**2478**	**2306**	**2009**	**2211**	**1546**	**3637**	**4012**	**4110**	**2118**	**1495**	**0**	**0**	**0**	**2924**	**2988**
114	742	557	395	167	152	780	709	510	199	0	0	0	1023	1023	1023	710	633	201	221	170	1029	1167	1237	512	177	0	0	0	707	835
87	1009	758	614	115	104	897	815	666	134	0	0	0	1121	1121	1121	779	705	126	138	95	1121	1233	1233	695	118	0	0	0	1121	1289
804	133	100	100	1299	1181	200	182	181	3817	0	0	0	667	779	779	541	536	1527	1680	1147	267	293	293	199	1070	0	0	0	133	153
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	29	22	18	8	7	51	46	46	38	0	0	0	197	197	218	152	137	38	43	47	223	248	276	157	38	0	0	0	223	257
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	905	680	535	91	83	725	659	526	92	0	0	0	1215	427	427	297	295	114	126	86	997	1070	1070	555	89	0	0	0	740	454
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	7	6	0	0	0	19	0	0	0	0	0	0	0	0	2	3	2	0	0	0	0	2	0	0	0	0	0

eline	Post-dev			Baseline		Post-dev			Baseline				Post-dev					Baseline			Post-dev				Baseline					
Condition	*Basic score*	*Condition*	*Time*	*Basic score*	*Condition*	*Basic score*	*Condition*	*Time*	*Basic score*	*Condition*	*Linear*	*Demand*	*Basic score*	*Condition*	*Linear*	*Demand*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*	*Basic score*	*Condition*	*Linear*	*Demand*	*Basic score*	*Condition*
461	0	0	0	614	558	0	0	0	1535	0	0	0	0	0	0	0	0	614	675	461	0	0	0	0	614	0	0	0	0	0
343	133	100	100	685	623	200	182	181	2283	0	0	0	667	779	779	541	536	913	1004	686	267	293	293	199	457	0	0	0	133	153
87	1009	758	614	115	104	897	815	666	134	0	0	0	1121	1121	1121	779	705	126	138	95	1121	1233	1233	695	118	0	0	0	1121	1289
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	247	185	168	46	42	274	249	225	37	0	0	0	219	219	219	152	151	39	43	48	226	248	318	198	33	0	0	0	177	204
83	495	372	227	121	110	506	460	285	162	0	0	0	803	803	803	558	481	162	178	122	803	919	919	314	145	0	0	0	529	631
2	0	0	0	7	6	0	0	0	19	0	0	0	0	0	0	0	0	2	3	2	0	0	0	0	2	0	0	0	0	0
60	905	680	535	91	83	725	659	526	92	0	0	0	1215	427	427	297	295	114	126	86	997	1070	1070	555	89	0	0	0	740	454
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	16	12	8	8	7	32	29	29	38	0	0	0	158	158	179	125	110	38	43	47	158	176	205	111	38	0	0	0	158	182
0	13	10	10	0	0	20	18	17	0	0	0	0	39	39	39	27	27	0	0	0	65	72	72	46	0	0	0	0	65	75
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Pollination				Pest control					Recreation									Aesthetic value							Education					
eline	Post-dev			Baseline		Post-dev			Baseline				Post-dev					Baseline			Post-dev				Baseline					
Condition	*Basic score*	*Condition*	*Time*	*Basic score*	*Condition*	*Basic score*	*Condition*	*Time*	*Basic score*	*Condition*	*Linear*	*Demand*	*Basic score*	*Condition*	*Linear*	*Demand*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*	*Basic score*	*Condition*	*Linear*	*Demand*	*Basic score*	*Condition*
59.3	79.0	59.3	59.3	90.2	82.0	90.2	82.0	82.0	112.8	0.0	0.0	0.0	112.8	112.8	112.8	78.3	78.3	112.8	124.1	84.7	112.8	124.1	124.1	84.7	112.8	0.0	0.0	0.0	112.8	129.7
19.7	411.0	308.8	164.2	26.2	23.8	411.0	373.6	198.7	43.7	0.0	0.0	0.0	685.0	685.0	685.0	475.7	399.0	43.7	48.1	32.8	685.0	788.8	788.8	225.0	26.2	0.0	0.0	0.0	411.0	494.8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.7	5.0	3.7	3.7	4.4	4.0	4.4	4.0	4.0	5.5	0.0	0.0	0.0	5.5	5.5	5.5	3.8	3.8	5.5	6.1	4.1	5.5	6.1	6.1	4.1	5.5	0.0	0.0	0.0	5.5	6.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22.6	218.3	164.0	149.1	33.4	30.4	242.5	220.5	199.9	26.7	0.0	0.0	0.0	194.0	194.0	194.0	134.7	133.9	26.7	29.4	20.1	194.0	213.4	213.4	136.4	20.0	0.0	0.0	0.0	145.5	167.3
5.6	28.6	21.5	18.7	8.2	7.5	31.8	28.9	25.1	6.6	0.0	0.0	0.0	25.4	25.4	25.4	17.7	17.6	8.2	9.1	18.6	31.8	35.0	104.9	61.9	8.2	0.0	0.0	0.0	31.8	36.6
3.2	0.0	0.0	0.0	4.2	3.9	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	4.7	9.5	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23.3	0.0	0.0	0.0	38.7	35.2	0.0	0.0	0.0	38.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.0	34.1	23.3	0.0	0.0	0.0	0.0	23.2	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64.2	1009.0	758.1	614.0	75.9	69.0	896.9	815.3	665.9	94.9	0.0	0.0	0.0	1121.1	1121.1	1121.1	778.5	704.8	94.9	104.4	71.3	1121.1	1233.2	1233.2	694.9	94.9	0.0	0.0	0.0	1121.1	1289.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
343.0	133.3	100.2	100.2	684.8	622.5	200.0	181.8	180.9	2282.5	0.0	0.0	0.0	666.6	779.1	779.1	541.0	536.5	913.0	1004.3	686.0	266.6	293.3	293.3	198.8	456.5	0.0	0.0	0.0	133.3	153.3
461.3	0.0	0.0	0.0	614.0	558.1	0.0	0.0	0.0	1534.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	614.0	675.4	461.3	0.0	0.0	0.0	0.0	614.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.1	14.7	11.1	7.6	5.5	5.0	29.5	26.8	26.8	27.4	0.0	0.0	0.0	147.3	147.3	147.3	102.3	88.0	27.4	30.1	20.6	147.3	162.0	162.0	82.0	27.4	0.0	0.0	0.0	147.3	169.4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.8	1.1	0.8	0.8	2.1	1.9	2.1	1.9	1.9	10.7	0.0	0.0	0.0	10.7	10.7	32.0	22.3	22.3	10.7	12.9	26.5	10.7	14.2	42.6	29.1	10.7	0.0	0.0	0.0	10.7	12.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	13.0	9.8	9.8	0.0	0.0	19.5	17.8	17.3	0.0	0.0	0.0	0.0	39.1	39.1	39.1	27.1	27.0	0.0	0.0	0.0	65.1	71.6	71.6	45.6	0.0	0.0	0.0	0.0	65.1	74.9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.8	0.0	0.0	0.0	7.1	6.5	0.0	0.0	0.0	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.6	1.8	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	385.1	289.4	209.0	0.0	0.0	256.8	233.4	184.8	0.0	0.0	0.0	0.0	641.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	385.1	385.1	385.1	190.0	0.0	0.0	0.0	0.0	256.8	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	73.7	55.4	51.9	0.0	0.0	36.8	33.5	32.1	0.0	0.0	0.0	0.0	92.1	92.1	92.1	64.0	63.4	0.0	0.0	0.0	46.1	50.7	50.7	32.8	0.0	0.0	0.0	0.0	55.3	63.5
0.0	145.7	109.5	103.4	0.0	0.0	97.1	88.3	84.6	0.0	0.0	0.0	0.0	145.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	121.4	133.5	133.5	86.4	0.0	0.0	0.0	0.0	97.1	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58.1	232.1	174.4	122.5	88.3	80.3	265.3	241.2	165.8	88.3	0.0	0.0	0.0	265.3	265.3	265.3	184.2	183.5	110.4	121.4	82.9	331.6	376.9	376.9	167.3	88.3	0.0	0.0	0.0	265.3	315.2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	64.2	48.2	45.6	0.0	0.0	64.2	58.4	55.1	0.0	0.0	0.0	0.0	64.2	64.2	64.2	44.6	44.5	0.0	0.0	0.0	107.0	117.7	117.7	74.9	0.0	0.0	0.0	0.0	64.2	73.8
2.1	4.3	3.2	3.1	2.8	2.6	4.3	3.9	3.7	3.8	0.0	0.0	0.0	5.8	5.8	5.8	4.0	4.0	3.8	4.1	2.8	5.8	6.3	6.3	4.0	0.9	0.0	0.0	0.0	1.4	1.7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1070.6	**2818.0**	**2117.2**	**1662.7**	**1685.9**	**1532.7**	**2652.4**	**2411.3**	**1928.6**	**4298.8**	**0.0**	**0.0**	**0.0**	**4222.4**	**3547.3**	**3568.7**	**2478.2**	**2306.4**	**2008.6**	**2210.7**	**1546.3**	**3636.9**	**4011.9**	**4110.3**	**2117.9**	**1495.3**	**0.0**	**0.0**	**0.0**	**2924.2**	**2988.1**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

			Interaction with nature							Sense of place						
Post-dev			**Baseline**			**Post-dev**				**Baseline**			**Post-dev**			
Linear	*Demand*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*
3086	**1771**	**1355**	**1208**	**359**	**374**	**2997**	**1709**	**1762**	**1282**	**1976**	**1433**	**1469**	**3348**	**2366**	**2429**	**1836**
908	521	360	188	56	63	824	502	540	334	186	140	158	844	626	672	417
1289	740	591	126	37	37	1121	666	666	517	110	82	82	1121	807	807	641
153	88	88	763	227	227	133	79	79	79	1527	1105	1105	267	192	192	190
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
281	161	122	38	12	20	223	134	149	110	38	28	45	223	149	166	127
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
454	261	195	90	27	27	696	328	328	243	112	77	77	893	592	592	461
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	2	1	1	0	0	0	0	2	2	2	0	0	0	0

Post-dev			**Baseline**			**Post-dev**				**Baseline**			**Post-dev**			
Linear	*Demand*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*
0	0	0	307	91	91	0	0	0	0	614	419	419	0	0	0	0
153	88	88	457	136	136	133	79	79	79	913	686	686	267	192	192	190
1289	740	591	126	37	37	1121	666	666	517	110	82	82	1121	807	807	641
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
277	159	142	39	12	19	226	134	172	151	33	24	43	177	128	173	155
631	362	217	149	44	44	598	368	368	183	153	115	115	666	498	498	262
0	0	0	2	1	1	0	0	0	0	2	2	2	0	0	0	0
454	261	195	90	27	27	696	328	328	243	112	77	77	893	592	592	461
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
206	118	82	38	12	20	158	95	110	74	38	28	45	158	107	124	88
75	43	40	0	0	0	65	39	39	36	0	0	0	65	43	43	40
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Pie chart labels (for habitats >3% of total)					
Total		**Onsite**		**Offsite**	
Before (ha	**After (ha)**	**Before (ha**	**After (ha)**	**Before (ha**	**After (ha)**
307		307			
228	67	228	67		
	112		112		
	27		27		
	80		80		
	142		142		
	176		176		

			Interaction with nature							Sense of place						
Post-dev			**Baseline**			**Post-dev**				**Baseline**			**Post-dev**			
Linear	*Demand*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*	*Basic score*	*Condition*	*Linear*	*Basic score*	*Condition*	*Linear*	*Time*
129.7	74.4	74.4	112.8	33.5	33.5	112.8	67.0	67.0	67.0	112.8	84.7	84.7	112.8	81.2	81.2	81.2
494.8	284.0	139.2	30.6	9.1	9.1	479.5	298.0	298.0	113.0	35.0	26.3	26.3	548.0	413.0	413.0	176.9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.3	3.6	3.6	5.5	1.6	1.6	5.5	3.3	3.3	3.3	5.5	4.1	4.1	5.5	4.0	4.0	4.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
167.3	96.0	88.1	26.7	7.9	7.9	194.0	115.2	115.2	103.2	20.0	15.1	15.1	145.5	104.8	104.8	95.8
109.7	63.0	54.3	8.2	2.4	7.3	31.8	18.9	56.6	48.0	8.2	6.2	18.6	31.8	22.9	68.7	59.0
0.0	0.0	0.0	4.2	1.3	3.8	0.0	0.0	0.0	0.0	4.2	3.2	9.5	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	31.0	9.2	9.2	0.0	0.0	0.0	0.0	15.5	10.6	10.6	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1289.3	739.9	590.6	94.9	28.2	28.2	1121.1	665.6	665.6	517.1	94.9	71.3	71.3	1121.1	807.2	807.2	641.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
153.3	88.0	87.8	456.5	135.5	135.5	133.3	79.2	79.2	78.5	913.0	686.0	686.0	266.6	192.0	192.0	190.4
0.0	0.0	0.0	307.0	91.1	91.1	0.0	0.0	0.0	0.0	614.0	419.3	419.3	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
169.4	97.2	60.9	27.4	8.1	8.1	147.3	87.5	87.5	51.3	27.4	18.7	18.7	147.3	98.2	98.2	62.2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36.8	21.1	21.1	10.7	3.8	11.4	10.7	7.6	22.8	22.8	10.7	8.8	26.5	10.7	8.5	25.4	25.4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74.9	43.0	40.0	0.0	0.0	0.0	65.1	38.6	38.6	35.7	0.0	0.0	0.0	65.1	42.6	42.6	39.7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	2.4	0.7	0.7	0.0	0.0	0.0	0.0	2.4	1.6	1.6	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	256.8	76.2	76.2	58.3	0.0	0.0	0.0	256.8	168.1	168.1	128.5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63.5	36.5	34.3	0.0	0.0	0.0	36.8	21.9	21.9	20.4	0.0	0.0	0.0	92.1	60.3	60.3	56.1
0.0	0.0	0.0	0.0	0.0	0.0	48.6	14.4	14.4	14.3	0.0	0.0	0.0	145.7	95.4	95.4	89.7
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
315.2	180.9	120.1	88.3	26.2	26.2	265.3	162.7	162.7	100.9	110.4	75.4	75.4	331.6	224.3	224.3	145.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73.8	42.4	39.9	0.0	0.0	0.0	85.6	50.8	50.8	47.0	0.0	0.0	0.0	64.2	42.0	42.0	39.5
1.7	1.0	0.9	1.9	0.6	0.6	2.9	1.7	1.7	1.6	1.9	1.3	1.3	2.9	1.9	1.9	1.8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3085.8	**1771.0**	**1355.3**	**1208.1**	**359.3**	**374.3**	**2997.0**	**1708.5**	**1761.5**	**1282.4**	**1975.9**	**1432.6**	**1469.0**	**3347.6**	**2366.2**	**2428.9**	**1836.3**

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

APPENDIX D: EBN Data Catalogue

Environmental Benefits from Nature (EBN) Tool - Beta Release Data Catalogue

First published 7 July 2021

Natural England Joint Publication JP038

www.gov.uk/natural-england

Environmental Benefits from Nature (EBN) Tool - Beta Release Data Catalogue

Smith, A.C., Baker, J., Berry, P.M., Butterworth, T., Chapman, A., Harle, T., Heaver, M., Hölzinger, O., Howard, B., Norton, L.R., Rice, P., Scott, A., Thompson, A., Warburton, C. and Webb, J.

Published 7 July 2021

ISBN: 978-1-78354-760-9

Citation

SMITH, A.C[A]., BAKER, J.[B], BERRY, P.M.[A], BUTTERWORTH, T.[C], CHAPMAN, A.[E], HARLE, T. [E], HEAVER, M.[F], HÖLZINGER, O.[C], HOWARD, B[G]., NORTON, L.R.[H], RICE, P. [E], SCOTT, A., THOMPSON, A [E]., WARBURTON, C [E]. AND WEBB, J [E]. Environmental Benefits from Nature (EBN) Tool Data Catalogue (Beta Version, July 2021)

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Acknowledgements

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Expert reviewers and consultees

We are grateful to the attendees of the Phase 1 and 2 and 4 stakeholder meetings and webinars, the Defra group workshop attendees, the pilot projects in Phases 2 and 4, the many expert reviewers, consultees and information providers listed below, the UK Hab working group, and fpcr (Sam Arthur and team), who thoroughly tested the tool and guidance during Phase 4 and provided many useful suggestions.

Sean Arnott, Environment Agency
Kath Baldock, University of Bristol
John Boardman, University of Oxford
Chris Bolton, Natural England
Tom Breeze, Reading University
Mark Broadmeadow, Forestry Commission
Bill Butcher, eCountability and UK Hab
Pete Carey, Bodsey Ecology Ltd, UKHab
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Stuart Pasley, Natural England
Simon Potts, Reading University
Joanna Russell, Natural England
Sarah Jane Scott, Environment Agency
Dave Stone, Natural England
Jo Treweek, eCountability, UKHab
Chris Uttley, Environment Agency
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Introduction

This document lists details of all the condition and spatial indicators used within the Environmental Benefits from Nature (EBN) tool. It contains descriptions for each indicator, including instructions on how to ascertain the value of the indicator, and the rationale for selecting multiplier values based on each indicator.

The rationale for inclusion of spatial and condition indicators is covered in s.3.5 of the accompanying *Principles of the Environmental Benefits from Nature (EBN tool) approach* document. In line with the principles of the approach, datasets have been selected that are open access to allow public use, and easy to access, largely via the government MAGIC system.

The datasets below have been selected following expert review to best reflect spatial and condition factors that impact each ecosystem service and their application has been tested to ensure proportionate results.

This guide should be used together with:

- **Principles of the EBN tool approach**, which explains the overall approach and summarises good practice principles, caveats and limitations. This is crucial in ensuring that the approach will be applied correctly as part of the biodiversity mitigation hierarchy and will not lead to perverse outcomes.

- **The EBN tool User Guide**, which explains how to use the spreadsheet tool.

MAPPING TIP: Use of the EBN tool will be much easier, especially for large or complex sites, if you can use a Geographic Information System (GIS) such as ArcGIS or QGIS. It is therefore worth trying to obtain site plans and habitat survey maps as GIS files. Converting from CAD (typically used by developers) to GIS files is possible but can be very difficult and time-consuming. See the User Guide for tips on how to import data from GIS into the tool.

Types of data source

Data can be obtained from several sources. These are colour coded in the tables and in the spreadsheet as follows:

Table 1. Breakdown of data sources

	Number of indicators*
Online maps or documents	18
Site survey (expert)	5
Site survey (non-expert)	11
Locally obtained information (e.g. from aerial photos, local authorities, or wildlife trusts)	6

*Note that some indicators can be obtained from more than one type of source.

The following pages contain summary lists of the indicators to be collected through each of these sources (though for some indicators several types of source are possible or needed). After that, there is a catalogue containing detailed information for each indicator in turn.

Basic, standard and advanced levels

Table 2. Levels of EBN assessment

BASIC	**Generally, from freely available online maps and typically do not vary much, if at all, across the site. Recommended for all assessments.**
STANDARD	May require a site survey or collection of local information, or simple GIS analysis. May vary across the site. **Recommended for developments >0.5 ha or where semi-natural habitats are being affected.**
ADVANCED	Typically require a site survey or complex GIS analysis and may vary for every habitat parcel. **Only recommended for developments >500 homes, where priority habitats are affected or where particular indicators are of interest.**

Types of indicator

Table 3. List of EBN indicators and corresponding level of tool assessment

ALC	1	Agricultural Land Class (ALC)	BASIC
Flooding, water supply and water quality	2	Surface water availability	BASIC
	3	Groundwater availability	BASIC
	4	Natural Flood Management priority	BASIC
	5	Woodland for flood risk	ADVANCED
	6	WWNP target zone?	ADVANCED
	7	Water quality: WFD status	BASIC
	8	Water quality management area?	BASIC
Soil and erosion	9	Rainfall	BASIC
	10	Slope	ADVANCED
	11	Soil drainage	BASIC
	12	Soil erodibility	STANDARD
	13	Soil compaction	ADVANCED
	14	Soil management	ADVANCED
	15	Peat quality	STANDARD
Vegetation	17	Canopy cover	STANDARD
	18	Tree size	STANDARD
	19	Ground cover	ADVANCED
	20	Tall or tussocky grasses	ADVANCED
	21	Shrub layer	ADVANCED
	22	Flowers	ADVANCED
	23	Invertebrate nest sites	ADVANCED
	24	Resources for local species	ADVANCED
Position	25	Position for water quality regulation	ADVANCED
	26	Position for erosion prevention	ADVANCED
	27	Air pollution barrier	ADVANCED
	28	Shading ability	ADVANCED
	29	Noise barrier	ADVANCED
Cultural and nature designations	30	Population density	BASIC
	31	Nature designation	BASIC
	32	Ancient habitat	BASIC
	33	Cultural or historic importance	BASIC
	34	Special recreation value	BASIC
	35	Public access	BASIC
	36	Educational use	BASIC
	37	Managed for nature	BASIC
	38	Local distinctiveness	STANDARD
	39	Landscape diversity	BASIC
Water bodies	43	Fish barriers	ADVANCED
	44	Water body naturalness	STANDARD

Note: numbers are not consecutive as indicators 16, 40, 41 and 42 have not yet been implemented and are therefore omitted from this table.

Online maps and data sources

The following table summarises the indicators that can be obtained from online maps and data sources. See the detailed information on each indicator for guidance. Should any of these sources change, resulting in a broken link, please report it to the following address EBN@naturalengland.org.uk.

Table 4. Indicators to be obtained from online maps and data sources

1	Agricultural Land Class (ALC)	MAGIC
2	Surface water availability	Environment Agency Water resource availability and abstraction reliability cycle 2
3	Groundwater availability	Environment Agency Catchment Data Explorer website
4	Natural Flood Management priority	Defra Data Services Platform
5	Woodland for flood risk	MAGIC
6	WWNP target zone	Working with Natural Processes ArcGIS webmap
7	Water quality: WFD status	Environment Agency Catchment Data Explorer website
8	Water quality management area	MAGIC
9	Rainfall	Met Office
10	Slope	UK Soil Observatory
11	Soil drainage	LANDIS soilscapes
12	Soil erodibility	LANDIS soilscapes
30	Population density	CAVAT
31	Nature designations	MAGIC
32	Ancient habitat	MAGIC
33	Cultural or historic importance	MAGIC
34	Special recreational value	MAGIC
35	Public access	MAGIC

Local data, site plans or aerial photos

Table 5. Summary of indicators obtained from local data or aerial photos

No	Indicator	Type	Guidance
14	Soil management	Local knowledge	Are soil erosion management practices used on arable land (e.g. cover crops, crop residue, contour ploughing, no-till)?
17	Canopy cover	Aerial photos	Rough estimate of % canopy cover from site visit or quadrat analysis of a grid of points overlaid on aerial photos/ Google Earth.
33	Cultural or historic importance	Online map and local authority	Online maps of National Parks, AONBs, scheduled ancient monuments, historic parks and gardens, battlefields, etc. Ask Local Authorities for archaeological constraint areas.
35	Public access	Online map and local authority	Public rights of way data and online maps of open access (CROW) land, country parks, etc.
36	Educational use	Local authority	Does the site have special educational value, e.g. use by school groups, use for scientific research, or an information centre?
37	Managed for nature	Local knowledge	Is the site managed to preserve or enhance nature? This would include management by a wildlife trust or similar group, higher level countryside stewardship and organic farming.
38	Local distinctiveness	Local authority and local knowledge	Local landscape character assessment on Local Authority webpage. If time and resources permit, community consultation can feed in here.
39	Landscape diversity	Site plans	Count the number of different habitat groups on the site, from the list of 19 categories (see detailed guidance).

Site survey information

Line and point features: Hedges, rivers, streams, trees, green walls and paths

We assume that larger linear features such as rivers will be recorded as an area that is distinct from surrounding habitats. However, for small linear and point features (hedges, streams and trees) you may not know the area and will have to estimate it (see below).

You do not need to subtract the area of trees and hedges from the surrounding / underlying area. The tool will assign scores to the whole area, including the habitats underlying the trees or hedges, but will subtract the area of trees and hedges to obtain the correct site footprint area when working out scores per hectare (ha). This is done partly to match conventional surveying techniques, but also because the area under the tree or hedge may also deliver services in its own right, so this will enable us to distinguish between a tree on paving or a tree on grass, for example.

- **Hedges**: enter the length and width. If the width is variable, estimate an average. It there are large gaps in the hedge, adjust the length accordingly. Measure the surrounding land cover up to the mid-point of the hedge (i.e. as if the hedge wasn't there).
- **Trees:** enter the area calculated from the canopy diameter, estimated from a site survey or aerial photos. Area = pi r^2 where pi is 3.142 and r is the radius of the canopy. The Defra biodiversity metric contains a useful tree area calculator set up to estimate tree area for typical small, medium, or large trees. Do not subtract the area of the trees from the surrounding area, i.e. enter the entire area of the field, grassland, paved area etc.
- **Green walls:** enter the area of the wall (not just its footprint on the ground). Again, this area will be subtracted automatically when working out the total land footprint area.
- **Rivers:** Enter either as an area, or as a length and width. You need to ensure that the surrounding land area does not include this area, because the EBN tool does not subtract it.
- **Streams** are not currently separated from rivers in the EBN tool; this will be revised in a later version. So, for streams you should treat them as rivers, i.e. enter them as an area or as a length and width, and if necessary, subtract this area from the surrounding land. If the area of the streams is very small compared to the surrounding land area, you probably do not necessarily need to subtract the stream area if this will be complicated. However, in this case you may see small discrepancies in the results.
- **Paths.** If you are mapping at a fine scale, e.g. detailed plans for a housing development, you may have plans that explicitly include the areas of paths. In this case, enter the path area either as sealed surface or 'footpath / cycle path – green' if it is not a sealed surface. You can also estimate the path area by entering length and width separately. In either case, the surrounding habitats should not include the path area because the tool will not subtract it, though the discrepancy will be small. For larger rural areas, where the paths are mainly crossing fields, you do not need to enter paths separately. The impact of paths in enabling recreational access to the surrounding area can be taken into account via the access indicator (see indicator 37).

Figure 1. How to measure line and point features

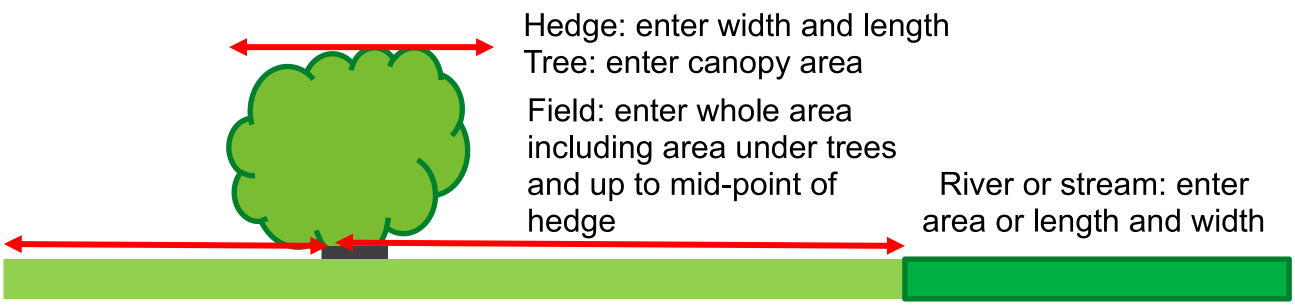


Table 6. Indicators to be collected during a site survey: summary list

13	Soil	Soil compaction	Heavily, locally / slightly, not compacted
15		Peat quality	Actively forming / degraded
18	Vegetation	Tree size	Largest class (saplings, poles, mature, veteran)
19		Ground cover (%)	Under 30%, 30-70%, over 70%
20		Tall or tussocky grasses	Under 5%, 5-33%, over 33%
21		Shrub layer	Under 5%, 5-33%, over 33%
22		Flowering plants	H/M/L (compared to expected)
23		Invertebrate nesting sites	H/M/L (dead wood, veteran trees, etc)
24		Resources for local species	H/M/L (need local info)
25	Position and configuration	Position for water quality regulation	Y/partial/N
26		Position for erosion prevention	Y/partial/N
27		Air pollution barrier	Y/partial/N
28		Shading ability	Y/partial/N
29		Noise barrier	Barrier/ Partial barrier/ Not barrier but tree or shrub near people/ Low vegetation near people/ Not near people
43	Rivers and lakes	Fish barriers	Impassable barriers/ Passable high impact/ Passable low impact/ No barriers
44		Water body naturalness	Salmonid/ Near natural/ Modified/ Heavily modified/ Artificial substrate/ Culvert

Table 7. Indicators to be collected during a site survey: more detailed list

13	Soil compaction	Site survey, looking for signs of soil compaction such as bare, hard ground that does not absorb water when poured from a bottle, or vehicle tracks. Compaction could be inferred from land use to some extent, e.g. grazing density, use of heavy machinery / vehicles. Select from: Good condition / slightly compacted or locally compacted / highly compacted.
15	Peat quality	Is peat actively growing or degraded?
18	Tree size	Identify the largest class of trees present on site: saplings <7cm diameter at breast height (dbh), poles 7-33cm (larger than a can of beans), mature 33-80cm (hides a thin person), very mature/veteran >80cm (larger than a hug). Individual trees outside woodland should be identified separately (at least for veteran trees, >80 cm dbh).

19	Ground cover (%)	Estimate the rough percentage of ground that is covered by vegetation or thick leaf litter as opposed to bare patches (ignoring small bare patches a few cm wide). Select from the options: <30%; 30-70%; 70-100%; bare in winter (e.g. for arable land).
20	Tall or tussocky grasses	Estimate whether cover by tall or tussocky grasses is absent (<5% cover), present (5-33%) or extensive (>33%).
21	Shrub layer	Estimate the extent of any shrubby layer (understorey in woodland habitats; scattered shrub in open habitats such as grassland or heathland). Select from absent (<5% cover), present (5-33%) or extensive (>33%).
22	Flowering plants	The estimate should be based on a site survey in summer, or prior knowledge of the site. Enter 'High' if the abundance or diversity of flowering plants are greater than expected for a typical UK example of this type of habitat, or 'Low' if lower than expected. Otherwise enter 'Medium'. We are aware that these are not very precise instructions and will try to make them more precise in due course.
23	Invertebrate nesting sites	Enter 'high' if at least one of the following applies: • standing or fallen dead wood is visible from at least half of the walkover route (this includes dead trees or stumps over 1m tall and 20cm diameter, fallen logs or large dead branches at least 50cmm long and 20cm diameter and dead wood on live trees, following the Forestry Commission Woodland Condition Survey criteria) • beetle banks or dry earth are visible from at least a quarter of the walkover route • the site includes one or more veteran trees (larger than a hug) with cavities, hollow trunks, crevices or loose or flaking bark • tall or tussocky grasses cover at least 33% of the site • a shrub layer covers at least 33% of the site. Enter 'medium' if some of these features are present but they do not meet the abundance criteria, and enter 'low' if none apply.
24	Resources for local species	Presence and abundance of specific resources for characteristic local species, e.g. larval food plants for specialist butterflies and other invertebrates; nesting sites for bats and birds. Establish which species are important locally, and what their habitat requirements are. Establish whether these requirements are present on the site, through a survey or through asking local experts. New developments might want to consider including these requirements in order to increase the value of their sites
25	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? See entry in Catalogue.

26	Position for erosion prevention	Enter 'Yes' if the habitat is on the downwards side of (or level with) a habitat susceptible to erosion (arable field, improved grassland, horticulture, felled woodland, intensive orchard, biofuel crops, flower bed) AND it runs alongside part of the boundary with this erodible habitat or cuts across it roughly parallel to the contours of the slope, so that it is capable of trapping sediment washed off the field. Enter 'Partial ability' if the habitat is does not meet this criteria but you have another good reason to believe it is playing some role in reducing erosion. Otherwise enter 'No'.
27	Air pollution barrier	Enter 'Yes' if the habitat forms a barrier at least 3m tall and at least 3m wide, with reasonably thick vegetation, between a pollution source (e.g. a busy road) and an area used by people (homes, schools, offices, footpaths, parks etc). Enter 'Partial ability' if the barrier does not meet these criteria but you still think it has some value as a pollution barrier. Otherwise enter 'No'.
28	Shading ability	Enter 'Yes' if the habitat is located on the east, south or west side of a building exposed to sun, and close enough for the shadow to fall on the side of the building at least to half the height of the ground floor windows (assume 30m for trees and woodland; 3m for shrubs and hedges). Enter 'Partial ability' if this does not apply but you have another reason to believe that the habitat provides better shading and cooling ability than a typical habitat of this type, due to its position. Otherwise enter 'N'.
29	Noise barrier	Enter 'Barrier' if the habitat is at least 10m tall and at least 10m wide, with thick vegetation, between a noise source (e.g. road or rail) and an area used by people. Enter 'Partial barrier' if the habitat is at least 3m tall and at least 3m wide, with reasonably thick vegetation, between a noise source (e.g. road or rail) and an area used by people. Otherwise if the habitat is trees or shrubs near people, enter 'Not barrier but tree/shrub near people', or if it is low vegetation near people (e.g. grass) enter 'Low vegetation near people'. Or if not near people enter 'Not near people'.
43	Fish barriers	Presence of fords, culverts, weirs or dams, classified as impassable to fish, passable high-impact or passable medium-impact (see entry in Catalogue, based on the height of any vertical drop, or the length and angle of sloping structures).
44	Water body naturalness	Enter whether the river is salmonid, near natural, modified, heavily modified or has an artificial substrate or flows in a culvert. See entry in Catalogue for more info.

Description of condition indicators and spatial factors

1. Agricultural Land Classification (ALC)

Level	ES	Type	Source type	Link
BASIC	Food provision	**Supply**	Online map	MAGIC (England) or Predictive Agricultural Land Classification Map 2 (Wales)
			Shapefile	provisional-agricultural-land-classification-alc-england (England) or Predictive Agricultural Land Classification Map 2 (Wales)

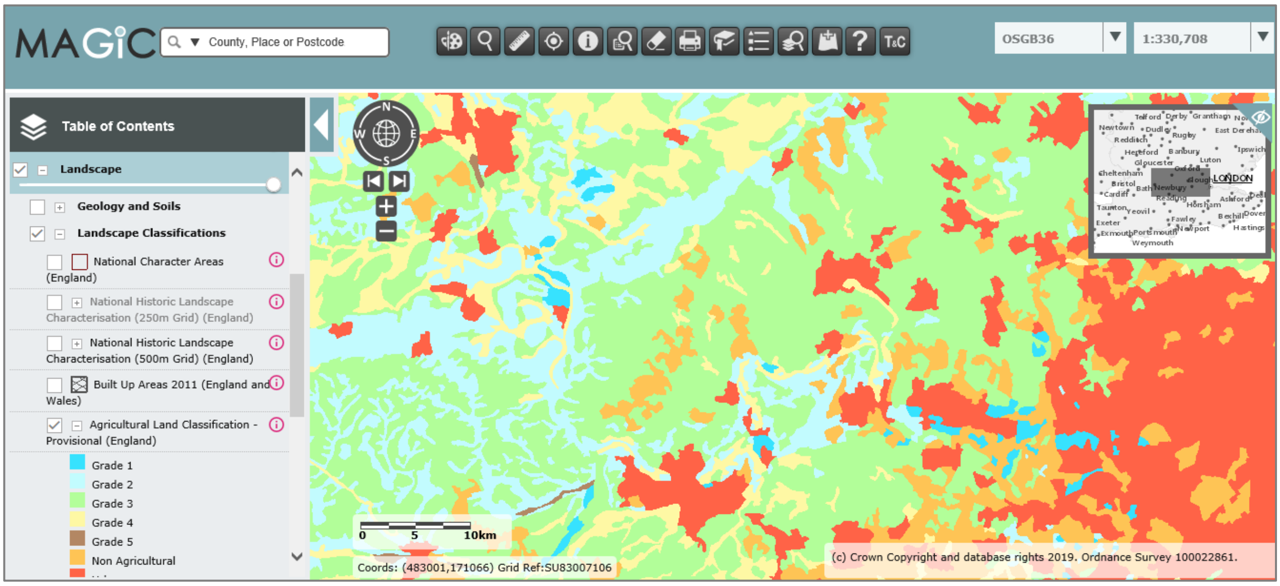
Description. The Agricultural Land Classification classifies land into grades 1 (best) to 5 (worst) for the whole of England and Wales. Grade 1 land is highly productive and also versatile, so that many types of crop can be grown. Grade 5 land is typically bog or moorland suitable only for extensive grazing. The ‘average’ grade is 3b. Grades 1 to 3a are considered ‘best and most versatile’ land which should not be developed.

Applicable habitats: This indicator is used only for habitats where it is thought that the ALC could make a significant difference to the amount of food produced: arable fields, horticulture, orchards and improved grassland. The multiplier is not applied to lower-scoring habitats that could be used for grazing (e.g. semi-natural grassland, wood pasture, purple moor grass and rush pastures, bracken, heath, bog, vegetated dunes, saltmarsh), as these habitats are expected to have a lower ALC and this is accounted for when setting the basic scores. Similarly, it is unlikely that these habitats could produce a higher service if they were classified as having a high ALC, because of the nature of the habitat. Although woodland, scrub and hedgerows could also be used for gathering wild food such as berries or mushrooms or for livestock, it is unlikely that the ALC would make much difference to food production so the multiplier is not applied to these habitats either.

Determining the indicator value. An online map is available from MAGIC. Select 'Landscape', then 'Landscape Classifications' and zoom into your project site. Each dataset can only be viewed at certain magnifications, so zoom in or out until the dataset appears. The Agricultural Land Classification - Provisional (England) covers the whole of England. Limited additional areas have a more detailed classification available under

'Post-1988 Agricultural Land classification (England)' which split the grades further to include 3a and 3b. If your area is covered, use these more detailed grades. Enter the grade for the different habitat areas (Grade 1, Grade 2, Grade 3a, etc) using the drop-down box in each cell. If the whole project area is the same grade, you can enter the grade in the top row and autofill the rest of the column (see User Guide for how to auto-fill). If a number of different grades apply, you may want to download the GIS shapefile from the link above. If some of your habitat polygons fall into more than one ALC grade, you can either subdivide the polygons using the Identity function in GIS (see User Guide) or simplify by selecting the grade that covers most of the polygon. Non-applicable habitats will be greyed out and are not used in the calculation. You have the choice of setting them to ‘NA’ or leaving them auto filled to the same grade as the other habitats. If the area is not farmed and not likely to be farmed in future, select ‘Not farmable’.

Figure 2. Screenshot from MAGIC website displaying different grades of agricultural land



Rationale for the multiplier values. The multipliers are based on a rough estimate of the difference in productivity between alternative grades. Grade 3b is assigned a value of 1, as it represents a typical value for England. We assume that grade 1 land could typically produce 14 tonnes per ha of wheat under ‘good but not outstanding’ management, and Grade 3 could produce the UK average of 6 tonnes per ha of wheat, whereas Grade 5 land (rough grazing) might produce only around 3 tonnes per ha of dry matter. An additional (arbitrary) multiplier is applied to Grades 1, 2 and 3a to reflect their additional benefits in terms of versatility, as well as the link to yield.

Table 8 ALC multipliers (highlighted yellow)

ALC	Potential yield (t/ha) of wheat or dry matter	Multiplier based on yield only	Normalised	Versatility multiplier	Multiplier adjusted for versatility	Normalised
1	14	2.33	*10.00*	1.2	2.80	*10.0*
2	12	2.00	*8.57*	1.1	2.20	*7.9*
3a	10	1.67	*7.14*	1.05	1.75	*6.3*
3	8	1.33	*5.71*	1	1.33	*4.0*
3b	6	1.00	*4.29*	1	1.00	*3.6*
4	4	0.67	*2.86*	1	0.67	*2.4*
5	3	0.50	*2.14*	1	0.50	*1.8*
Not farmable					0	*0*
Not applicable					1	*4.8*
Not known					1	*4.8*

2. Surface water availability

Level	ES	Type	Source type	Link
BASIC	Water supply	**Demand**	Online map or download	Environment Agency Water resource availability and abstraction reliability cycle 2 (online map or shapefile) or https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process (documents)

Description: The Environment Agency Catchment Abstraction Management Status for surface water is used as an indicator of water scarcity in a catchment. This indicator is used to apply a higher multiplier for the service of freshwater supply if water is scarce. In other words, the presence of a permeable surface that allows rainwater to percolate into the ground, where it could either recharge groundwater or gradually pass into surface water via subsurface flow, is more valuable in areas where groundwater or surface water supplies are not sufficient to meet current or expected future demand.

Applicable habitats: All except sealed surfaces (which score zero anyway). Any non-sealed surface will have some value for water supply.

Determining the indicator value. From the webpage, if 'Preview on map' is available then examine the map (this does not work in Internet Explorer but is OK in Chrome); otherwise download the dataset using the link that says '*WaterResourceAvailabilityAndAbstractionReliabilityCycle2_Download*'. This shows the Environment Agency dataset 'Water resource availability and abstraction reliability cycle 2'. If previewing, look at the Q95 map (this shows water availability in a very dry year, when low flows are exceeded 95% of the time) and determine the water availability in the project area. Otherwise display the downloaded dataset in GIS and examine the camscdsq95 attribute for your area.

1. Green = water available
2. Yellow = restricted water available
3. Red = water not available
4. Grey = heavily modified water bodies (these are allocated for water supply) and/or discharge-rich catchments.

Select the appropriate category from the dropdown box. Unless your project area spans more than one catchment, the same value will probably apply to all cells, so the whole column can be auto filled from the top row. The dataset is also available for download as a shapefile or in other formats.

If GIS is not available and the option to preview the map is also not available, you can search for the Catchment Abstraction Management Strategy document for your area on the Environment Agency website https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process and find the map of water availability at Q95.

Rationale for the multiplier values. 'Water available' areas receive a multiplier of 1. This is because even if water is not currently scarce in the area, it could become scarce in future. Areas with restricted or unavailable water supply are allocated higher multipliers to show that permeable surfaces are particularly valuable in these areas. The actual values are arbitrarily chosen and may be revised after testing. In theory, areas with ample water supply ('High hydrological regime') would receive a multiplier of less than one to indicate that it is less important to conserve water in these areas. However, there are very few water bodies in this category and on the online map they are rolled in together with 'Heavily modified water bodies', which are designated for water supply.

This multiplier is paired with the one for Groundwater Availability. The maximum of these two multipliers is used in the calculation. In other words, a multiplier over 1 is applied if either surface water or groundwater is scarce in the area.

Table 9. Surface water availability multipliers

Surface water availability	
High hydrological regime	0.8
Water available	1
Restricted water available	1.1
Water not available	1.2
Heavily modified water body	1
Not applicable	1
Not known	1

3. Groundwater availability

Level	ES	Type	Source type	Link
BASIC	Water supply	**Demand**	Online map or Excel	Environment Agency Catchment Data Explorer website

Description: This indicator is based on Groundwater Quantitative Status, which is reported as part of compliance with the Water Framework Directive. It indicates whether water abstraction from aquifers is sustainable or not, based on whether any of the following four tests are failed:

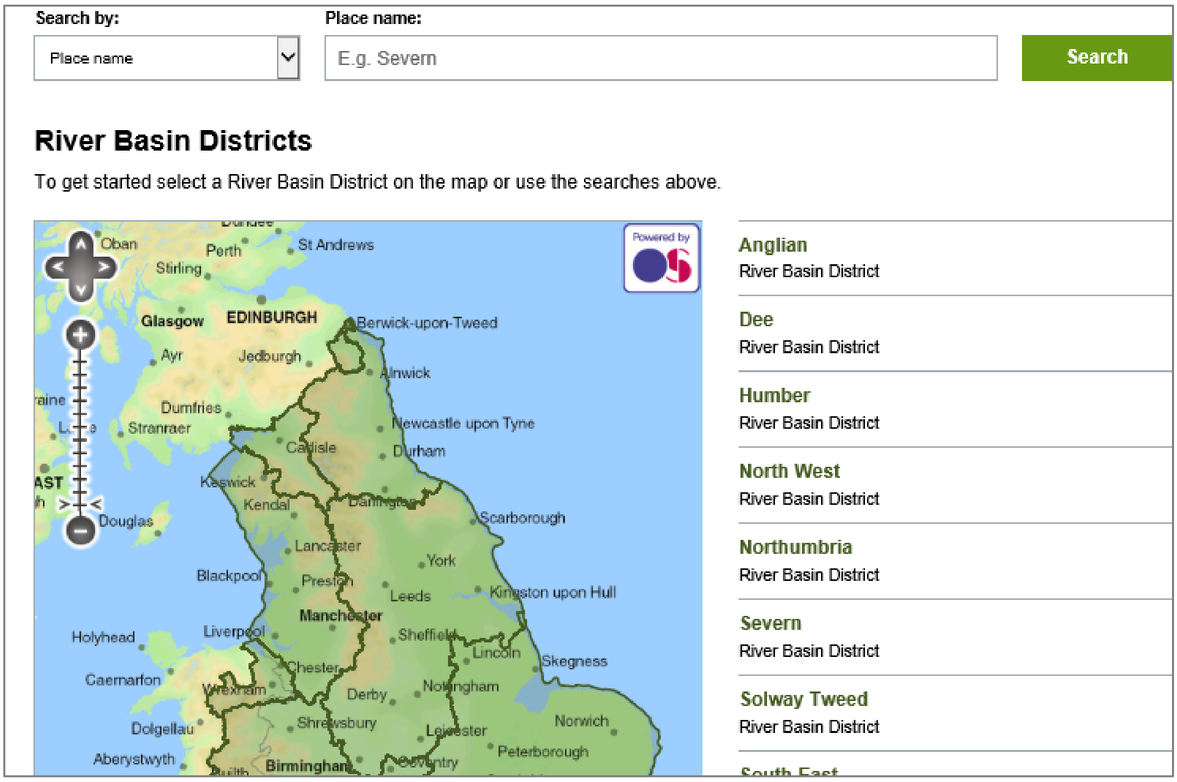
1. Saline intrusion – fail if over-abstraction is causing intrusion of poor-quality water into the groundwater body leading to sustained deterioration in groundwater quality.
2. Groundwater dependent terrestrial ecosystems (GWDTE) – fail if water abstraction is having a negative impact on plant communities in wetlands.
3. Water balance – fail if abstractions exceed the long-term average recharge and affect low flows.
4. Dependent surface water status – fail if groundwater abstractions affect the ecological status of surface water bodies.

Applicable habitats: All except sealed surfaces (which score zero anyway, so a multiplier would have no effect). Any non-sealed surface will have some value for water supply.

Determining the indicator value.

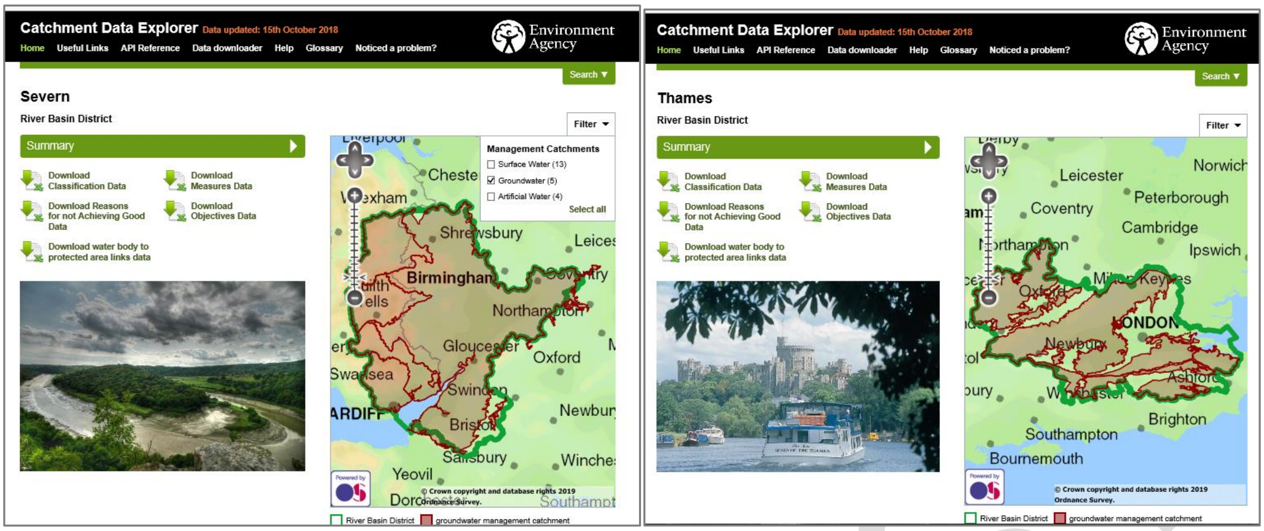
1. Go to the Catchment Data Explorer website and click on the map or enter a place name or post code to find the river basin that your project is located in.

Figure 3. River Basin Districts Map from EA Catchment Data Explorer website



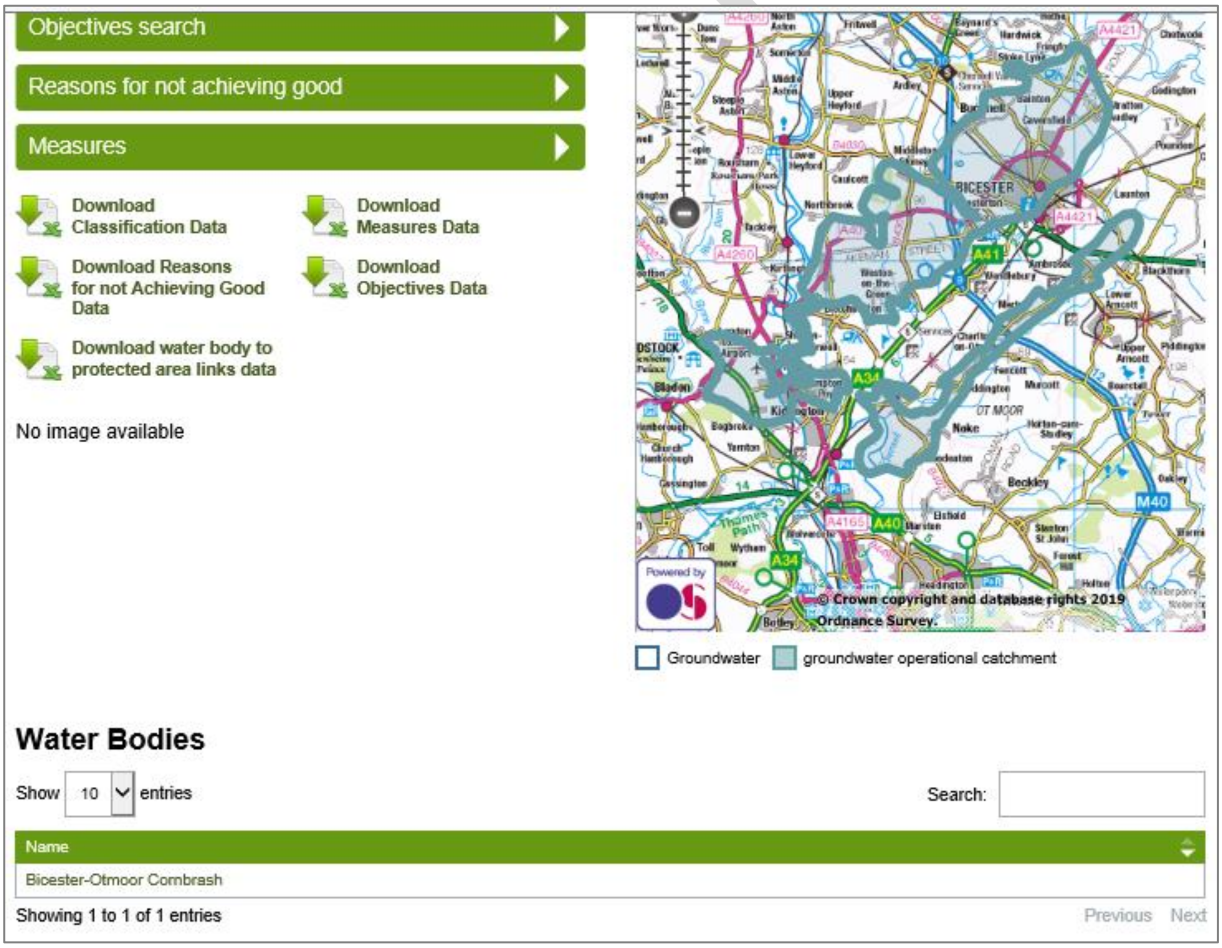
2. Click on the 'Filter' button in the top right corner of the river basin map and select 'Groundwater'. The groundwater management catchments will be displayed on the map. Most river basins have only one, but some (e.g. Severn) have several. Select the management catchment that your project site is in.

Figure 4. Screenshots from individual River Basin Districts



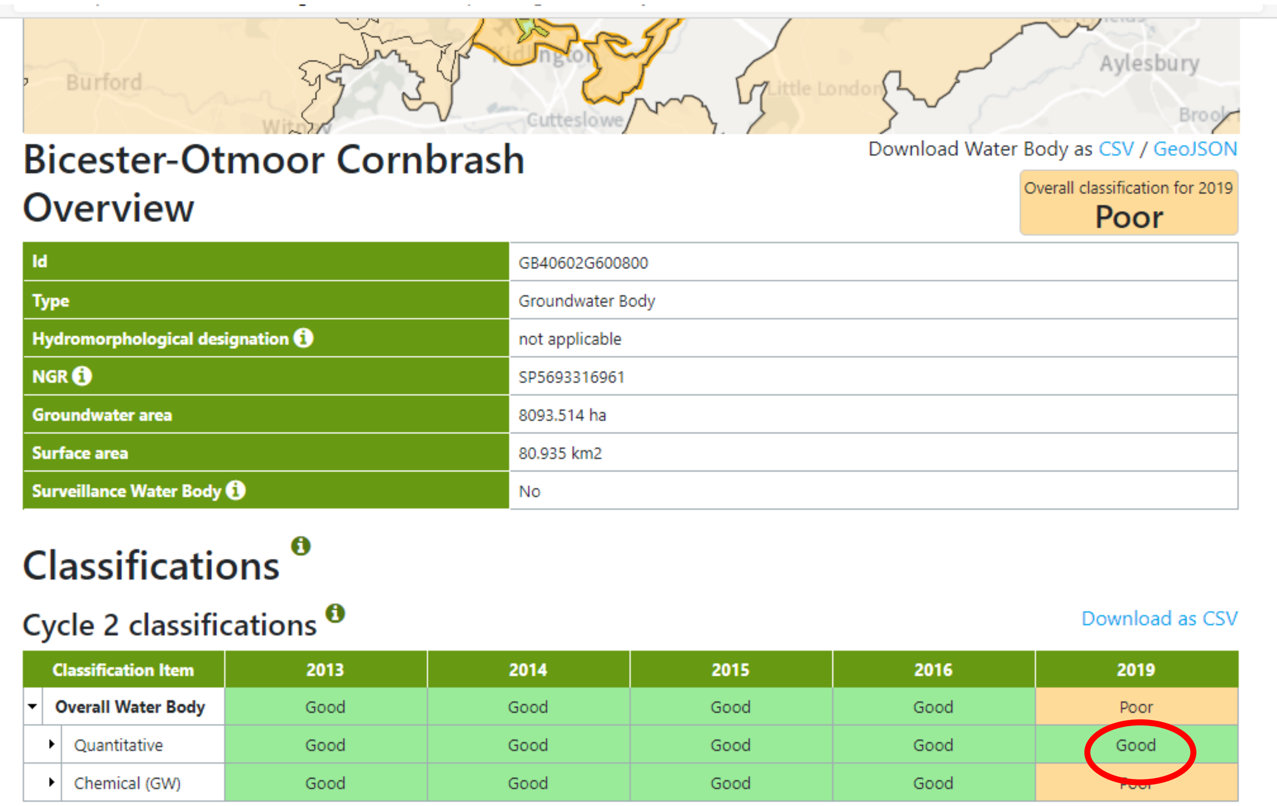
3. It is possible that your project site does not overlie a groundwater aquifer, in which case you can select ‘not applicable’ (NA) in all cells and move on. Otherwise, click again to find the relevant operational catchment (groundwater body), which is the geological formation that forms the aquifer.

Figure 5. Screenshot of Operational Catchment View



4. Click on the name of the groundwater body in the box beneath the map. This will take you to a map of the groundwater body and tables showing its classifications. Enter the overall groundwater quantitative status (high, good, moderate, poor, or bad) in the last year available (currently 2019), in the drop-down box. You can autofill the whole column if the whole of your project site overlies the same groundwater unit.

Figure 6. Screenshot showing groundwater status



Id	GB40602G600800
Type	Groundwater Body
Hydromorphological designation	not applicable
NGR	SP5693316961
Groundwater area	8093.514 ha
Surface area	80.935 km2
Surveillance Water Body	No

Classifications

Cycle 2 classifications

Download as CSV

Classification Item	2013	2014	2015	2016	2019
Overall Water Body	Good	Good	Good	Good	Poor
Quantitative	Good	Good	Good	Good	Good
Chemical (GW)	Good	Good	Good	Good	Poor

Rationale for the multiplier values. If your project is in an area with ‘high’ quantitative status, we have applied a multiplier of less than one to indicate that it is less important to conserve water in these areas. Areas with ‘good’ status receive a multiplier of 1. This is because even if water is not currently scarce in the area, it could become scarce in the future. Areas with ‘moderate’, ‘poor’ or ‘bad’ status are allocated higher multipliers to show that permeable surfaces are particularly valuable in these areas. The actual values are arbitrarily chosen and may be revised after testing.

Table 10 Groundwater multipliers

Groundwater quantitative status (for water supply)	
High	0.8
Good	1
Moderate	1
Poor	1.1
Bad	1.2
Not applicable	1
Not known	1

This multiplier is paired with the one for Surface Water Availability. The maximum of these two multipliers is used in the calculation. In other words, a multiplier over 1 is applied if either surface water or groundwater is scarce in the area.

4.Natural Flood Management priority (1st of 3 flood demand indicators)

Level	ES	Type	Source type	Link
BASIC	Flood regulation	**Demand**	Online maps Shapefile	Defra Data Services Platform Defra Spatial Data Download

This is one of three flood demand indicators (indicators 4-6) that are considered jointly: the highest level of demand will be used to determine the multiplier. Therefore, if the whole of the project area has already been identified as high demand through one of the other two flood demand indicators, you can ignore this indicator.

Description: The Natural Flood Management priority dataset has been developed by the Environment Agency to indicate which catchments offer the greatest opportunities for implementing natural flood management options in order to reduce flood risk. It is geared towards targeting agri-environment (ELMs) funding. Catchments are ranked according to:

1. The number of flood risk receptors (houses and other properties at risk of flooding in the catchment, based on the EA flood risk receptor database).
2. The size of the catchment, assuming that there is greater potential for interventions to make a difference in smaller catchments.
3. The percentage of urban area within the catchment, assuming that if the catchment is more than half urban there will be no opportunity for NFM at a scale great enough to make a difference.
4. Coastal catchments are excluded on the grounds that there is little if any opportunity for habitats to intercept floodwater before it reaches properties at risk.

Because this dataset is aimed at targeting agri-environment funding it does not cover all situations of interest for the EBN tool. It excludes urban catchments where there could still be opportunities for sustainable drainage, and coastal catchments where protection from storm surges could be offered by dunes, reefs and saltmarshes. Also, it is recognised that some areas may have access to more detailed flood risk and opportunity mapping. Therefore, users are allowed to over-ride the ranking suggested by this dataset if they have access to better information. See below for guidance.

Applicable habitats: All except sealed surfaces (which score zero anyway, so the multiplier makes no difference).

Determining the indicator value. Click on the link above and find the sub-catchment(s) containing your site. If using the online map:

1. Click on the Preview dataset link
2. Enter your location into the box top left.
3. Tick the Environmental Data WMS service box under operational layers in the layer list on the right-hand side. Click on the arrow beside it
4. Tick Spatial_Prioritisation_of_catchments_Suitable_for_using_NFM. Click on the arrow beside it.
5. Determine the NFM priority that applies to your project area (High, Medium, or Low). If no priority is shown mark as NK (Not Known) or follow the instructions below (as appropriate).
6. Enter this in the EBN dropdown box.

If your area is within two or more different sub-catchments, enter the relevant option for each habitat parcel. If no data appears on the map zoom in further using the + button on the left of the screen.

For urban or coastal catchments that are not included in this dataset:

- **Urban areas.** Check the Environment Agency's online Flood risk from rivers and the sea and Flood risk from surface water maps, which identify the number of people, services (schools, hospitals etc), non-residential properties, airports and railways at high, medium or low risk of flooding. If there are properties or economic assets at risk of flooding within or downstream of your site (in the same catchment or the next catchment downstream), select High, Medium, or Low depending on the highest risk recorded in the flood maps.

- **Coastal areas**. For any dunes, reefs or saltmarshes, check the Environment Agency's online Flood risk from rivers and the sea map to see whether there are any properties or economic assets immediately inland which are at risk of flooding, and select High, Medium or Low depending on the highest risk recorded in the flood map.

Using local data. If you have access to a local flood risk or natural flood management opportunity assessment or other hydrological study that suggests a different priority to the one provided in the EA NFM priority dataset, you can use that assessment to determine the appropriate value (high, medium or low). Please enter the justification for over-riding the EA NFM priority in the comments boxes on the data entry sheets and/or the Project Details sheet.

Rationale for the multiplier values. High priority indicates that there could be a benefit from natural flood management actions, and therefore equates to high demand. This is one of three flood demand indicators that are considered jointly: the highest level of demand will be used to determine the multiplier. Multipliers over 1 are applied to habitats where there is medium or high demand for flood protection. These multipliers are arbitrary and could be refined following Beta tests. See Appendix 1 for more background information.

Table 11 Natural Flood Management priority multipliers

Overall flood protection demand (max of the three indicators)	
High	1.2
Medium	1.1
Low	1

5. Woodland for flood risk (2nd of 3 flood demand indicators)

Level	ES	Type	Source type	Link
ADVANCED	Flood regulation	**Demand**	Online map (not available for download)	MAGIC

This is one of three flood demand indicators (indicators 4-6) that are considered jointly: the highest level of demand will be used to determine the multiplier. Therefore, if the whole of the project area has already been identified as high demand through one of the other two flood demand indicators, you can ignore this indicator.

This indicator is very similar to indicator 6 (WWNP target zone) and therefore you do not need to enter both of them. Use this one if you prefer to look up the value on the online map in MAGIC (e.g. for small sites where the whole area falls within a single category). For larger or more complex areas where GIS analysis is necessary, you can download the GIS dataset for indicator 6 instead.

Description: This is a map created by the Forestry Commission in 2014 to target Countryside Stewardship (CS) grant aid for woodland creation, and also to target woodland planting for catchment management projects. The maps identify priority areas (at a scale of 1 km2) at risk from flooding from rivers and surface water and areas where runoff from soils is rapid. They identify opportunities to reduce flood risk by planting three types of woodland:

1. **Riparian woodland** – within 50m of smaller river networks.
2. **Floodplain woodland** – in Flood Zone 2 (areas with a 0.1% annual exceedance probability, AEP). **Please note that there is a potential conflict with biodiversity for floodplain woodlands**, as only 3% of the UK's flood plain meadows remain intact. Restoration of floodplain meadows to grassland and wetland mosaics would typically offer much greater biodiversity benefits than planting trees.
3. **Wider catchment woodland** – slowly permeable soils where woodland could break up naturally impermeable soils and reduce surface run-off. This is based on models which estimate which areas of land contribute most to the fast component of flood response of a river, based on standard percentage runoff (SPR) and Hydrology of Soil Types (HOST) data, both derived from National Soil Resources Institute maps.

Road, rail, urban areas, water, peat and **existing woodland** have been removed, because these constrain where new woodland can be planted. Therefore, we have to ensure that existing woodland receives the same score as the adjacent area – otherwise it could be undervalued (see step 4 below).

Applicable habitats: Woodland, grassland, farmland, bog, tree.

<u>Not</u> freshwater, wetland, coastal, bare ground, or urban habitats (except urban trees), because this indicator focuses on the impact of vegetation roots in breaking up poorly draining soil. Not sealed surfaces (which score zero anyway, so the multiplier makes no difference).

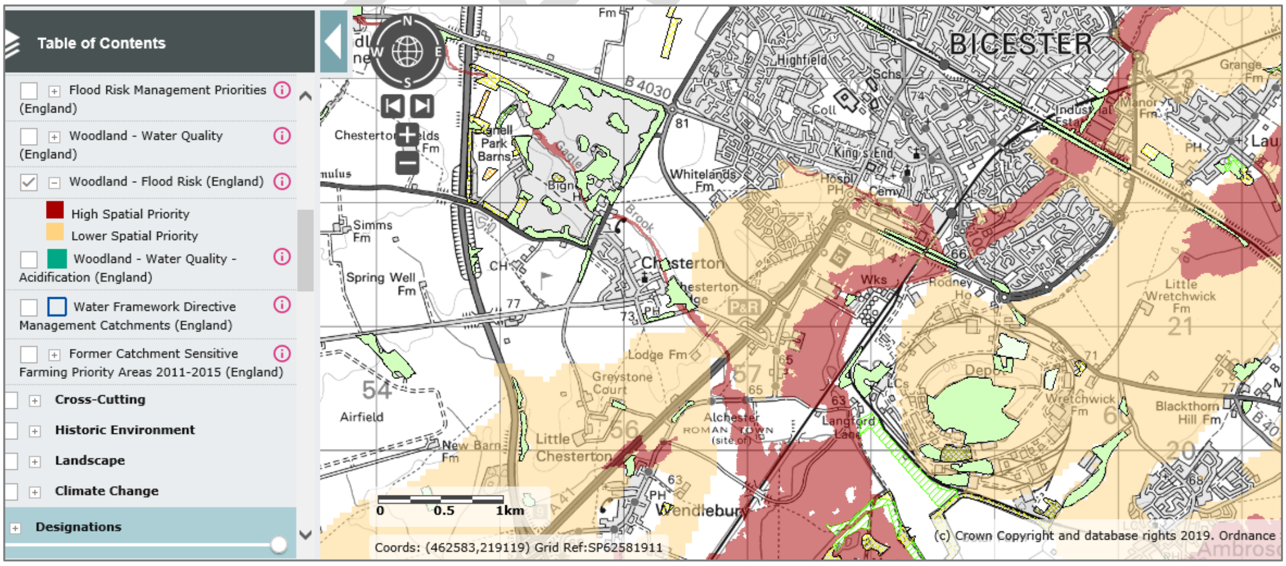
Determining the indicator value.

1. Go to MAGIC and select the Countryside Stewardship Targeting and Scoring / Water / '**Woodland – Flood risk**' layer, then zoom into your project area until the layer is no longer greyed out in the Table of Contents. (The map can also be found on the FC Land Information System website under Targeting and Scoring – CS

Water – Flood Risk, but the layer does not appear here until you are zoomed in to a very high magnification).

2. Add existing woodlands to the map by selecting ‘Habitats / Habitats / Woodland / National Forest Inventory.
3. Enter the appropriate priority in the dropdown box (high spatial priority for areas marked in maroon, lower spatial priority for areas shaded in light brown, or no priority if not shaded).
4. Existing woodlands have been removed from the dataset, so you need to add them back in again. We don’t know exactly what priority they were to start with, but if they adjoin a shaded area, enter the priority of that area. If there is a choice of two priorities, use the highest one. If they are within 50m of a small watercourse, within Flood Zone 2 or on a soil with impeded drainage (see indicator 11), they will also have high priority.
5. For this indicator it is possible that the whole area will not be the same priority, especially if rivers or streams pass through the site. So, you can’t just autofill the whole column – you will have to determine which habitat parcels are in which priority zones (except for non-applicable habitats – see above). If a parcel straddles two zones, enter the higher priority one (unless you feel the need to split the parcel into two parts). The easiest way to allocate the appropriate priorities this would be in GIS, but this layer is not available as a shapefile due to licensing restrictions. Therefore, if this looks like being an impossible task you can mark all cells as ‘Not known’ and move on. As noted above, you could use indicator 6 instead, as that can be downloaded as a GIS dataset.

Figure 7. MAGIC Screenshot showing the Woodland -Flood Risk Priority



Rationale for the multiplier values. The dataset identifies areas where planting woodland would be particularly beneficial for reducing flood risk – because drainage is poor (based on soil type), or because the area is on a flood plain or a stream bank. We are also using this as a proxy for other habitats – for example we are assuming that switching from arable land to tussocky semi-natural grassland would also have an extra benefit in these areas. Habitats in these areas will be given a multiplier greater than 1.

This is one of three flood demand indicators that are considered jointly: the highest level of demand will be used to determine the multiplier. Multipliers over 1 are applied to habitats where there is medium or high demand for flood protection. These multipliers are arbitrary and could be refined following Beta tests. See Appendix 1 for more background information.

Table 12. Woodland for flood risk multipliers

Overall flood protection demand (max of the three indicators)	
High	1.2
Medium	1.1
Low	1

6.WWNP target zone. (3rd of 3 flood demand indicators)

Level	ES	Type	Source type	Link
ADVANCED	Flood regulation	Demand	Online map	Mapping potential for WWNP (ArcGIS online map by Environment Agency) https://www.arcgis.com/home/item.html?id=7315f943998847e2b3797a85665f5438
			Shape-files	WWNP GIS web mapping service

This is one of three flood demand indicators (indicators 4-6) that are considered jointly: the highest level of risk will be used to determine the multiplier. Therefore, if the whole of the project area has already been identified as high demand through one of the other two flood demand indicators, you can ignore this indicator.

The **Working with Natural Processes (WWNP)** maps were generated by JBA consulting, the Environment Agency and Lancaster Environment Centre (available via the EA here and via JBA here). They are a freely available alternative to the Woodlands for Water (WfW) data (indicator 6), because they use BGS geology instead of NSRI soil type data to infer soil drainage and runoff. As for WfW, they show the opportunity for:

1. **Riparian woodland** – a 50m buffer of riparian land on smaller river networks
2. **Floodplain woodland** – in Flood Zone 2 (0.1% annual exceedance probability, AEP). **There is a potential conflict with biodiversity for floodplain woodlands**,

as only 3% of the UK's flood plain meadows remain intact. Restoration of floodplains to grassland and wetland mosaics would typically offer much greater biodiversity benefits than planting trees. For that reason, we do not use this dataset to inform this indicator except for small areas of wet woodland with biodiversity value.

3. **Wider catchment woodland** – slowly permeable soils where woodland could break up naturally impermeable soils and reduce surface run-off. WWNP is based on the underlying geology from BGS, showing surface conditions likely to be associated with the formation of slowly permeable soil. WWNP identifies some areas missed by Woodlands for Water, where planting trees to break up slowly permeable soils could have local benefits.

In addition, WWNP uses national flood mapping datasets including the Environment Risk of Flooding from Rivers and Sea (RoFRS) and Risk of Flooding from Surface Water (RoFSW) maps to target areas of low connectivity between river and floodplain based on RoFRS maps, or areas of high flow accumulations based on RoFSW maps, where it would be effective to temporarily store and hold back water to reduce flood peaks further downstream. This identifies opportunities for:

1. **Enhanced floodplain reconnection**.
2. **Runoff attenuation features** (such as ponds or wetlands) to reduce 1/30 and 1/100 annual flows.

Road, rail, urban areas, water, peat and **existing woodland** have been removed, because these constrain where new woodland can be planted. Therefore, we have to ensure that existing woodland receives the same score as the adjacent area – otherwise it could be undervalued (see step 3 below).

Technical reports and supporting evidence are available https://www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-riskand downloadable maps are here.

Applicable habitats: All except sealed surfaces and bare ground.

Determining the indicator value.

1. Go to the Working with Natural Processes website and scroll down to 'Links'. From the list of options, select 'WebMap ArcGIS – full functionality'. From the next page, click on 'Open in map viewer', or, if you want to be able to download the datasets for use in GIS, 'Open in ArcGIS Desktop' (you will need ArcGIS for this). An alternative map viewer is available at 'An online webmap hosted by JBA consulting', which takes you to the JBA website, where you can click on 'Interactive map' and then 'Areas of potential'. To download the data as shapefiles for the individual opportunity layers (riparian woodland, catchment woodland, floodplain reconnection, runoff opportunities) click on 'Download or stream the layers for use online or offline GIS web mapping service'.

2. From the EA map viewer page or the JBA 'Interactive map', you can see all the different opportunity layers as well as the existing woodland areas. For any parts of the site that are within one of the woodland opportunity areas, select 'Woodland opportunity'. For areas that are within one of the runoff attenuation areas, select 'Runoff opportunity'. For areas that are partly in a woodland opportunity area and partly in a runoff opportunity area, select 'Both opportunity'. For other areas, select 'No opportunity' unless they are existing woodlands – see next step. Alternatively, if working with downloaded shapefiles in GIS for larger and more complex areas, you will need to merge the datasets and overlay them with your site map (see User Guide).

3. Existing woodlands have been removed from the dataset, so you need to add them back in again. We don't know exactly which woodlands would have been in the target zones to start with, but if they adjoin a woodland opportunity area, enter 'Woodland opportunity'. Alternatively, you can create your own version of this map following the WWNP criteria, by including any habitats within 50m of watercourses, or on areas with impeded or slightly impeded soil drainage (Indicator 13).

4. For this indicator it is likely that there will be quite a complex pattern of zones, and the boundaries will not line up with your habitat parcels, especially if rivers or streams pass through the site. So, you can't just autofill the whole column – you will have to determine which habitat parcels are in an opportunity area (except for non-applicable habitats – see above). If a parcel is partly in and partly out of an opportunity zone, consider it to be in the zone – unless you feel it is appropriate to subdivide it into two parcels. The easiest way to handle the determination of categories would be by using GIS. You can get access to full GIS functionality, including importing your own data or exporting layers, by using the 'Open in ArcGIS Desktop' option from the webmap page, or you can download the shapefiles here (see step 1).

Rationale for the multiplier values. The WWNP layers show where it would be most beneficial to create new woodlands or retain existing woodlands or create new runoff attenuation features such as ponds and wetlands. These habitats will therefore be given a higher multiplier if they occur in these zones. This is one of three flood demand indicators that are considered jointly: the highest level of demand will be used to determine the multiplier. Multipliers over 1 are applied to habitats where there is medium or high demand for flood protection. These multipliers are arbitrary and could be refined following Beta tests. See Appendix 1 for more background information.

Table 13. WWNP multipliers

Overall flood protection demand (max of the three indicators)	
High	1.2
Medium	1.1

Low	1

7. Water quality: WFD status

Level	ES	Type	Source type	Link
BASIC	Fish production	**Supply**	Online map and Excel.	[Catchment Data Explorer]

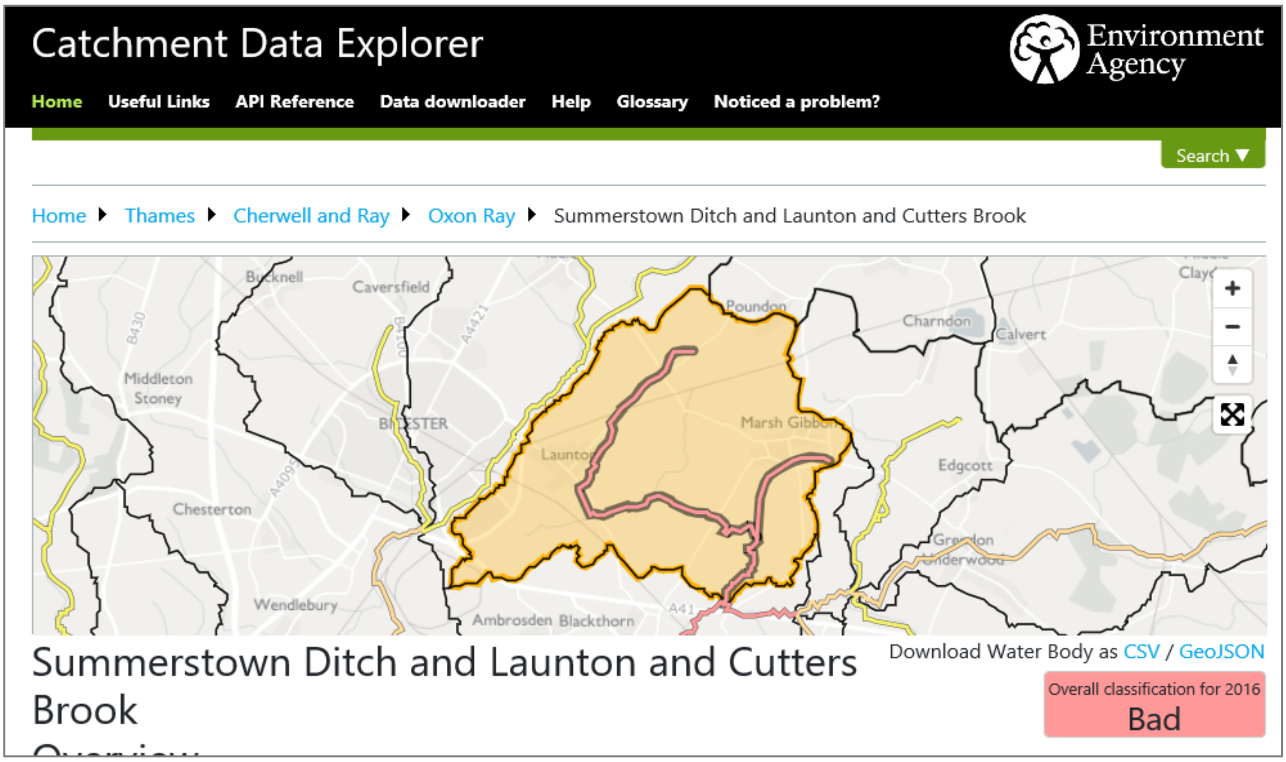
Description: Under the Water Framework Directive (WFD), both ecological and chemical quality are assessed. We use the overall classification level. Ecological quality includes biological (plants and animals), physico-chemical (temperature, nutrients etc) and hydromorphological (water flow, sediment composition and movement, continuity (in rivers) and the structure of physical habitat). See here for details.

Note: this indicator is only used for the service of 'Fish production'. It is not used for the service of 'Water quality regulation', because that service is provided by soils and vegetation in a catchment surrounding a waterbody, not by the waterbody itself. Water quality could be used as a multiplier to indicate high demand for the service of water quality regulation, but this is done using Indicator 10 (Water Quality Management Area) instead, as that is a more accurate indicator of the demand for the service.

Applicable habitats: Freshwater (running water; standing water and canals), aquatic marginal vegetation, reedbeds and coastal saltmarsh.

Determining the indicator value. On the Catchment Data Explorer website, search for your project site and then click on it to reach the river basin, then the surface water management catchment, then the operational catchment and finally the relevant water body. Enter the most recent Overall Status in the dropdown boxes (this reflects a combination of ecological and chemical status). It is likely that the same value will apply to the whole site, so you can auto-fill the whole column from the first cell.

Figure 8. Catchment Data Explorer screenshot showing water quality status



Rationale for the multiplier values. Water quality is used as a multiplier for the service of fish production, as it affects fish populations. It also affects cultural values (aesthetic value, interaction with nature and sense of place) although it is not currently applied to those services (for simplicity). Typical water quality in England is Moderate, so this is assigned a multiplier of 1. Lower quality habitats have a multiplier <1 and higher quality have a multiplier >1 (high quality is very rare). The exact values are provisional and could be refined following Beta testing.

Table 14. WFD Status multipliers

Overall Water Framework Directive status for surface water	
High	1.2
Good	1.1
Moderate	1
Poor	0.75
Bad	0.5
Not applicable	1
Not known	1

8. Water quality management area?

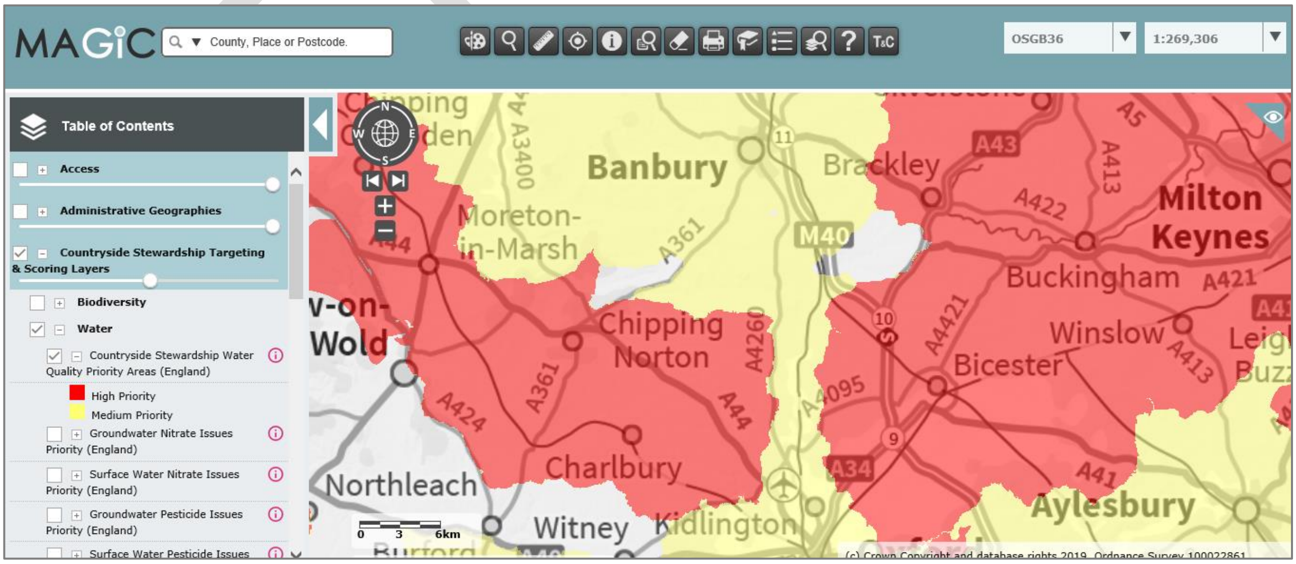
Level	ES	Type	Source type	Link
BASIC	Water quality regulation	**Demand**	Online map	[MAGIC]

Description: This indicator shows whether water quality regulation is particularly important in a certain area, depending on whether pollution is a problem. The Water Quality Priority Areas for Countryside Stewardship have been selected to indicate the demand for water quality regulation because they seem to cover all the sub-layers (areas with nitrate, phosphate, pesticide and sediment issues).

Applicable habitats: All except for potential sources of pollution (cropland, sealed surfaces, flower bed, felled woodland) or those with little ability to regulate pollution (bare ground, footpaths) where it did not seem appropriate to allocate an extra score for being in a water quality management area. This is open to debate and further testing.

Determining the indicator value. Go to MAGIC and select Countryside Stewardship Targeting & Scoring Layers / Water/ Countryside Stewardship Water Quality Priority Areas (England). Zoom in until the layer appears, and determine whether your site is high priority, medium priority or not classified. It is likely that the same value will apply to the whole site, so you can auto-fill the whole column from the first cell.

Figure 9. MAGIC Screenshot showing the Woodland – Water Quality Priority Areas



Rationale for the multiplier values. High and medium priority areas have an arbitrary multiplier >1, subject to testing in the pilots. Areas with no priority have a multiplier of 1, because they could still be playing an important role in protecting water quality, e.g. preventing water quality from deteriorating.

Table 15. Water quality management area multipliers

Water quality management area?	
High priority	1.2
Medium priority	1.1
Not classified	1
Not applicable	1
Not known	1

9. Rainfall

Level	ES	Type	Source type	Link
BASIC	Erosion protection	**Demand**	Online data	Met Office

Description: This aims to capture the fact that the service of erosion protection is more valuable in areas with higher rainfall. The most important aspect is the frequency and magnitude of extreme rainfall events, especially in winter when vegetation is low, leaves have fallen and soils may be bare. We are currently using a proxy indicator of the number of annual average winter days where rainfall is over 10mm. The web map is only available at national scale so you cannot zoom in to locate your project area precisely. We will aim to improve this indicator and make it available in an easier to use format in future (e.g. by importing the map into GIS).

Applicable habitats: All except sealed surfaces (which score zero anyway, so the multiplier makes no difference).

Determining the indicator value. Either use the map below directly, or if you want to look at it online go to the Met Office 'UK Climate' website and click on the 'Averages Maps' tab. Select 'Days of Rain >= 10.0mm' from the 'Climate variable' dropdown box. If there is a choice of 'Averaging periods' use the most recent (currently 1981-2010). Select 'Winter' from the 'Seasons' boxes.

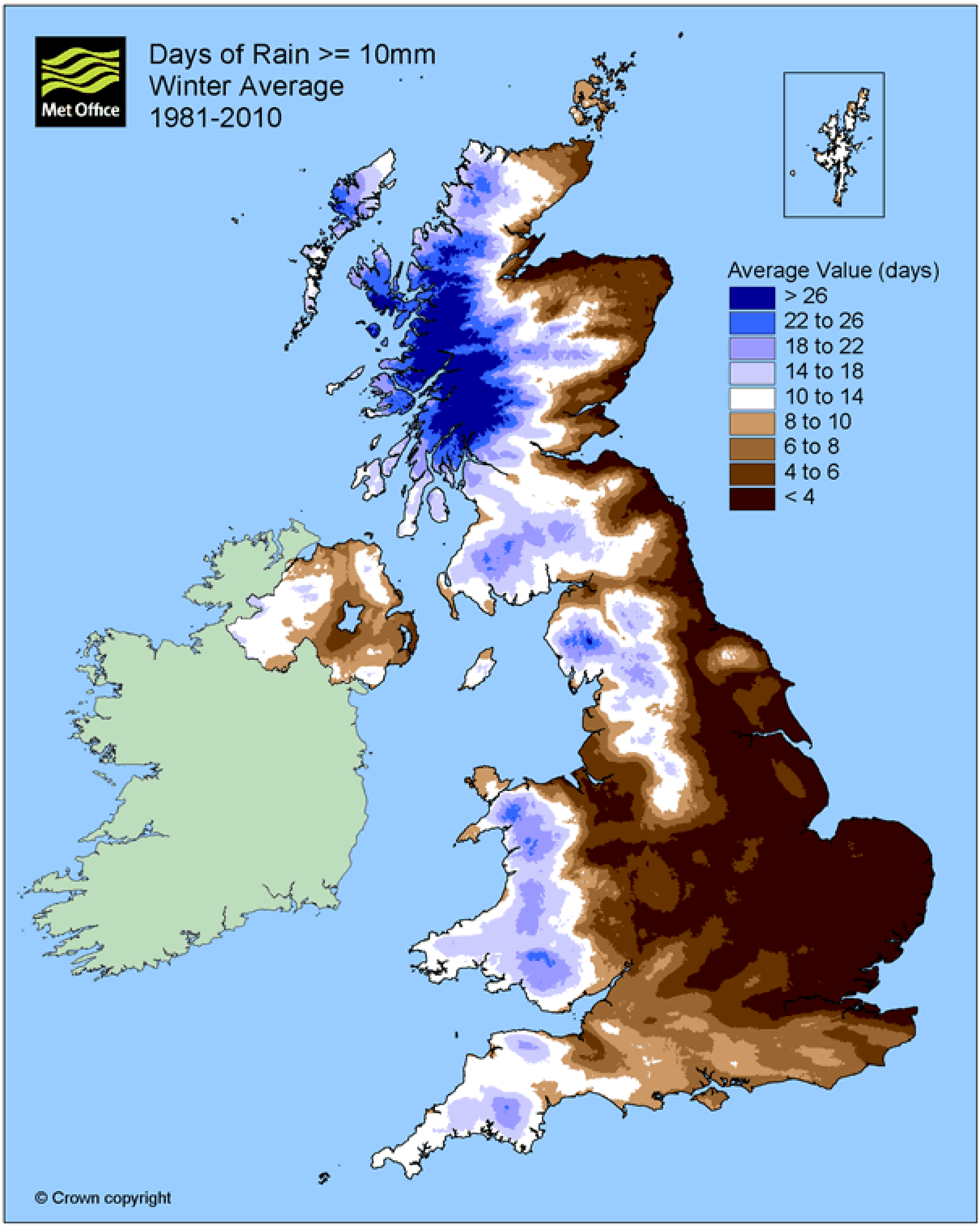
Attempt to identify your project site on the national scale map and determine how many days of rain over 10mm fall there on average in winter. (You will see a dropdown box where you can select a region of the UK for a closer view, but this climate variable is not available by region). Note that the option ‘4-9 days’ is intended to cover the 4-6, 6-8 and 8-10 bands, with ‘10 days or over’ for 10-12 and above.

Rationale for the multiplier values. Multipliers are arbitrary and will be reviewed.

Table 16. Rainfall multipliers

Rainfall	Average days of winter rain over 10mm	Erosion protection
High	10 days or over	1.1
Medium	4-9 days	1
Low	Less than 4 days	0.9
Not applicable		1
Not known		1

Figure 10. Met Office Screenshot showing average rainfall values



10. Slope

Level	ES	Type	Source type	Link
ADVANCED	Erosion protection	**Supply** **Demand**	Online data	[UK Soil Observatory]

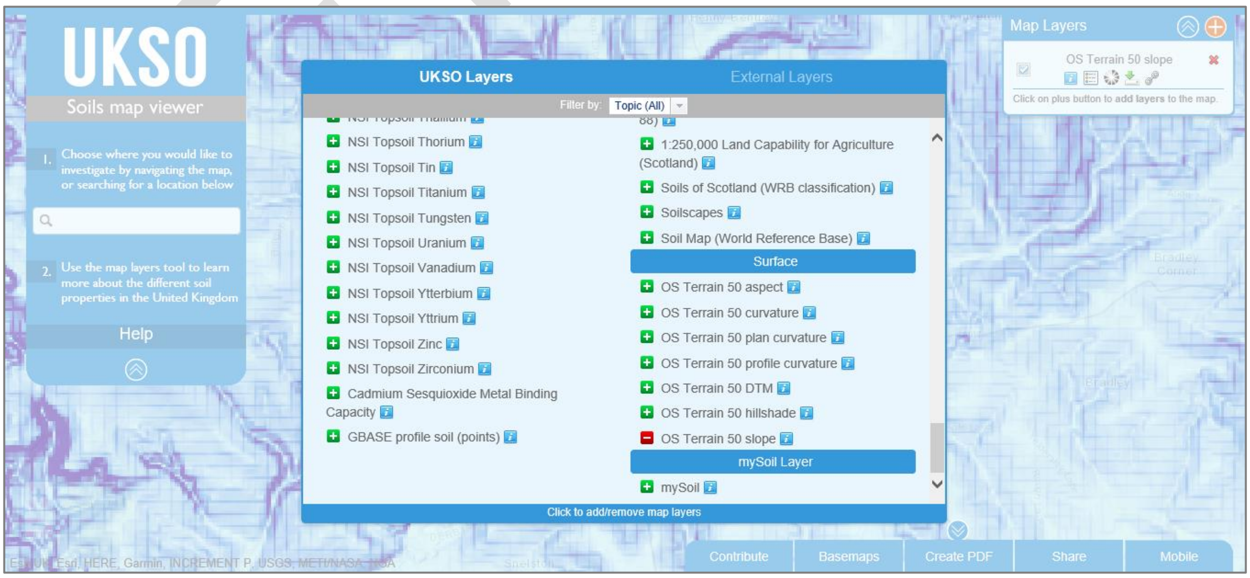
Description: Average or maximum slope in a habitat parcel such as a field, or across a site. Steeper slopes are more at risk of soil erosion, and they also provide less opportunity for groundwater to infiltrate into the ground, so they reduce the service of water supply. However, we only apply this multiplier to the demand for erosion protection.

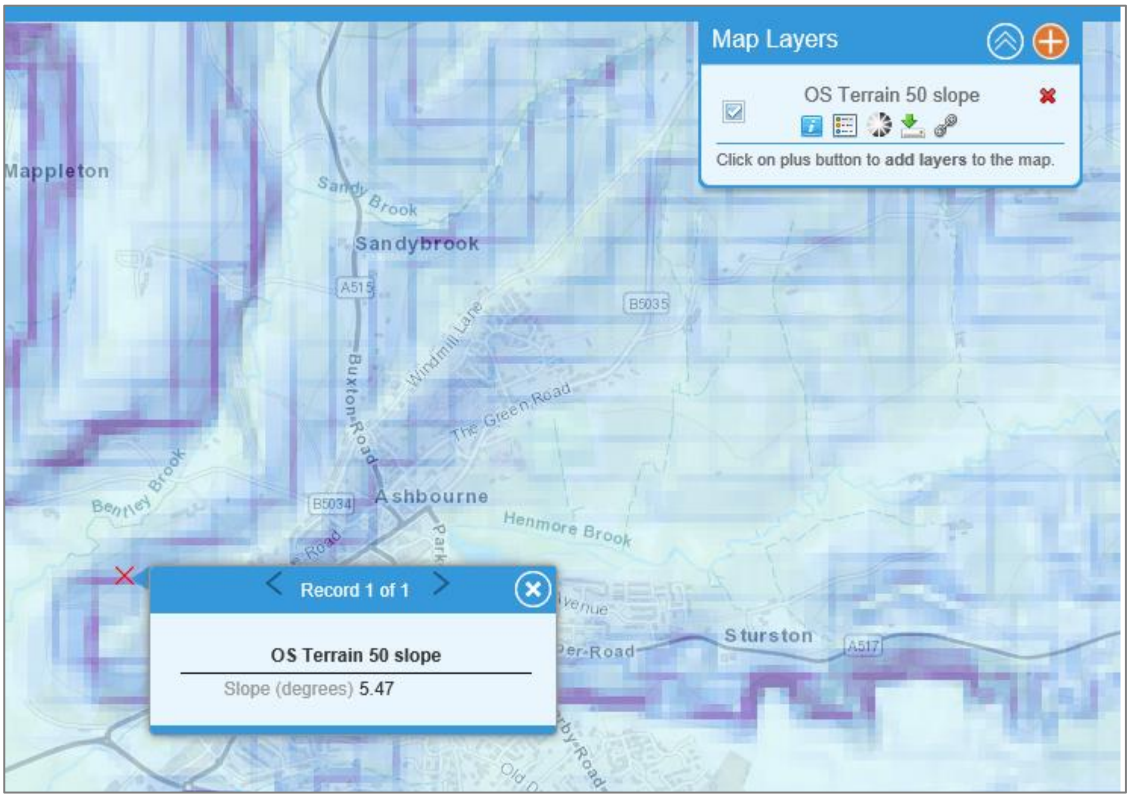
Applicable habitats: All except sealed surfaces (which score zero anyway, so the multiplier makes no difference).

Determining the indicator value. Find your site on the UK Soil Observatory website. Click on the plus button in the top right of the screen to add layers to the map. Scroll down to the bottom of the list of layers to find the 'Surface' group and add 'OS Terrain 50 Slope'. You can display the legend and adjust transparency using the icons in the 'Map Layers' box at top right of the screen.

The web map shows the slope in 50m pixels. You can click anywhere on the map and the slope will be displayed in a pop-up box. The slope will vary across the site but for small sites you can enter just the maximum slope range (0-3 degrees, 3-7 degrees or more than 7 degrees). Click on the darkest shaded pixel to find the maximum slope, then enter the appropriate range. You can autofill the whole column.

Figure 11. UK Soil Observatory Screen shots showing slope values





For larger sites where the slope varies significantly across the site, you may need GIS analysis to determine the value for different habitat parcels. These instructions are for ArcGIS, but similar functions exist in QGIS.

1. Follow the download link from the Soil Observatory page to reach the underlying elevation dataset at 50m resolution, which is the OS Terrain-50 dataset. Download this as the ASCII grid for the whole of GB (160 MB). (The OS 5m Terrain dataset would provide a much more accurate representation of slope, but this is not freely available from OS.)
2. Select and unzip just the tile(s) you require.
3. Use the GIS Slope function to convert the elevation grid to a slope, selecting Degree rather than Percent.
4. Multiply the raster values by 1000 then convert to integers using =Int(Slope_raster*1000) in Raster Calculator (where Slope_raster is the name of your slope dataset).
5. Convert the slope grid from a raster to a vector using Raster to Polygon, ticking ‘Simplify’ to get smooth polygon shapes.
6. Add a text field called ‘Slope’. Select all rows where the slope is less than 3000 and set the range to “< 3 degrees”. Then select all rows where the slope is over 7000 and set to “> 7 degrees”. Finally select all the remaining empty rows and set to “3-7 degrees”.
7. Dissolve the polygons according to the slope range.
8. Use the GIS Intersect function to assign slope ranges to your habitat map.
9. Export to Excel and paste the slope ranges into the EBN tool. (When copying slope data from QGIS it is important not to copy to excel using html format as some start with a <symbol. Go to paste special then choose Unicode.

Rationale for the multiplier values. We apply a higher ‘demand’ multiplier for areas with steeper slopes, because protective ground cover is more valuable in these areas. This multiplier amplifies the impact of differences between habitat scores. In other words, if a higher value habitat such as semi-natural grassland replaces a lower value one such as arable land, the increase in scores will be bigger as a result of this multiplier, even though scores for both habitats have increased.

Multiplier values are arbitrary and will be reviewed. For erosion, the maximum slope and the curvature can be more important than the average slope, so in future we could investigate use of the curvature layers in UKSO. Slope length (>150m) is also important.

Table 17. Slope multipliers

Slope	Erosion protection
<3 degrees	1
3-7 degrees	1.05
>7 degrees	1.1
Not applicable	1
Not known	1

11. Soil drainage

Level	ES	Type	Source type	Link
BASIC	Water supply (Flood regulation – not yet)	**Supply** and **Demand**	Online map	LANDIS Soilscapes or via MAGIC

Description: Soil drainage determines how fast rainfall and overland flow soaks into the ground, which is important both for water supply (groundwater recharge) and flood protection.

Applicable habitats: All except sealed surfaces (which score zero anyway, so the multiplier makes no difference).

Determining the indicator value. The LANDIS Soilscapes national scale dataset is freely available online and is now also available via MAGIC / Landscape / Geology and Soils. A more detailed assessment for a specific site currently costs £102 for a 5x5km area, though this is not necessary. Zoom into your project area and click on the map to display a summary of soil characteristics. Drainage categories are: Freely draining/ Slightly impeded drainage / Impeded drainage / Surface wetness (peat) / Naturally wet (high groundwater) / Impermeable or sealed. Enter the appropriate classification into the dropdown box. If the whole area is a single drainage category, you can autofill the whole column. For larger and more complex sites, it may not be possible to easily enter this indicator unless you purchase the underlying Soilscapes GIS data from a recognised supplier (e.g. from Bluesky mapshop).

Rationale for the multiplier values.

Freely draining soils are more valuable for both water supply and flood protection because they allow water to infiltrate into the ground where it will either recharge groundwater supplies or allow sustained recharge of surface water bodies via horizontal sub-surface flow. For water supply, we therefore apply lower multipliers to soils with slightly impeded or impeded drainage, because rain falling on these soils is likely to run off into nearby water courses and be carried out to sea. Sealing a soil in a freely draining area will therefore have a larger negative impact on water supply than in areas with impeded drainage.

Freely draining soils cover more of England than the other types (37% according to SoilScapes), so as this reflects the ‘typical’ score it is given a multiplier of 1, and soils with impeded drainage are assigned multipliers less than one. These multiplier values are arbitrary and will be reviewed.

Table 18. Soil Drainage multipliers

	Condition for water supply
Freely draining	1
Slightly impeded drainage	0.9
Impeded drainage	0.8
Surface wetness (peat)	1
Naturally wet	1
Impermeable / sealed	0
Not applicable	1
Not known	1

Technical note: There are many complexities with this indicator, because soil drainage also reflects the 'demand' for the service. Planting woodland for flood protection or to improve infiltration to recharge groundwater is more useful on soils with impeded drainage, so new woodland should have a demand multiplier greater than 1 in these areas, though any existing habitat in those areas (including woodland) would have a lower condition multiplier because of the soil type. This depends partly on whether the new habitat has better root penetration than the old habitat (such as when a woodland replaces improved grassland).

For water supply, we do not apply a 'demand' multiplier to reflect the extra value of planting trees on land with poor drainage. This is because trees use water as well as improving infiltration, so the net effect may be small and could go in either direction. Also, the benefits of planting vegetation to improve infiltration are already accounted for via the separate soil compaction indicator.

Because of this complexity, the soil drainage multiplier is currently not applied for flood protection. However, two of the advanced flood demand indicators – the Woodlands for Water and WWNP maps - do take account of soil drainage, and these indicators are currently only applicable to woodland and other habitats that could improve soil infiltration (though the tool does not consider what habitat is being replaced). Also, trees may not make much difference to infiltration on land with a high water table. Further work is needed to consider these complications in more detail.

12. Soil erodibility

Level	ES	Type	Source type	Link
STANDARD	Erosion protection	**Demand**	Online map	LANDIS Soilscapes

Description: This describes how easily erodible soil is. According to Evans (1990), much of the arable land in England (36%) is at moderate to very high risk of erosion, including much of the better drained and more easily worked land, especially sandy soils. In the uplands thin soils or deep peats are most at risk. Habitats with dense ground cover can protect against soil erosion, and this service is more valuable in areas susceptible to erosion.

Applicable habitats: All except sealed surfaces (which score zero anyway,).

Determining the indicator value. The recommended way to determine soil erodibility is to refer to Evans (1990), which divides the 296 soil associations in England and Wales into five classes of susceptibility to erosion (listed in Appendix 2, also available as a spreadsheet or GIS table). However, in order to find out which soil associations are present on your site, you may need to pay to access the NSRI NATMAP either online or as printed copies, or purchase the data from a recognised supplier (e.g. from Bluesky mapshop). Enter ‘High’ for soils classes as high or very high susceptibility; ‘Medium’ for soils classed as moderate susceptibility and ‘Low’ for soils classed as low or very low susceptibility.

Alternatively, the freely available LANDIS Soilscapes webmap includes limited information on erodibility. If erosion is an issue for a particular soil class, it may be mentioned under the section on water protection. For example, soilscape class 10 (Freely draining slightly acid sandy soils) is “Highly erodible under arable and vegetable crops, where sloping”. If erosion problems are not mentioned, enter ‘moderate’; if they are mentioned, enter ‘high’. For larger and more complex sites it may not be possible to easily enter this indicator unless you purchase the underlying Soilscapes GIS data from a recognised supplier (e.g. from Bluesky mapshop).

Another alternative is to use the European Soil Data Centre (ESDAC) maps. However, the ESDAC maps are derived from European scale models and are therefore less suitable for site level assessments in the UK.

Rationale for the multiplier values. A multiplier >1 is applied to soils with high or medium erodibility, and 1 soils with low or unknown erodibility. This is subject to review. Soil management probably has a greater impact on erosion than soil type, except for a small number of soils that are highly erodible.

Table 19. Soil erodibility multipliers

Soil erodibility	Erosion protection
High	1.1
Medium	1.05
Low	1
Not applicable	1
Not known	1

13. Soil compaction

Level	ES	Type	Source type	Link
ADVANCED	Water supply Flood regulation Water quality regulation	**Supply** and **Demand**	Site survey or local knowledge	

Description: This aims to take account of whether soils are more or less compacted than would be expected for this type of habitat.

Applicable habitats: All except sealed surfaces (which score zero anyway, so the multiplier makes no difference).

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

This requires a site survey, looking for signs of soil compaction such as bare, hard ground that does not absorb water when poured from a bottle, or vehicle tracks. Compaction could be inferred from land use to some extent, e.g. grazing density, use of heavy machinery / vehicles. Select from: Good condition / slightly compacted or locally compacted / highly compacted.

Rationale for the multiplier values. Multipliers are arbitrary and will be reviewed. The tool compares the recorded degree of compaction to what is expected for that habitat (expected values are shown on the 'Applicability' sheet in the spreadsheet, accessible from the Technical Menu). For example, the scores already assume that arable and improved grassland will be slightly or locally compacted, so a multiplier of 1.1 is applied if in fact the habitat is not compacted at all, or 0.9 if it is heavily compacted.

Table 20. Soil Compaction multipliers and associated services

Soil compaction	Water supply, Flood protection and Water quality regulation			
Actual value	Expected value			
	Not compacted	Locally or slightly compacted	Heavily compacted	Not applicable
Not compacted	1	1.05	1.1	1

Locally or slightly compacted	0.95	1	1.05	1
Heavily compacted	0.9	0.95	1	1
Not applicable	1	1	1	1
Not known	1	1	1	1

14. Soil management

Level	ES	Type	Source type	Link
ADVANCED	Erosion protection Water quality regulation	**Supply**	Local knowledge	

Description: This aims to record whether any special management approaches are applied to try to conserve soil and prevent erosion. It aims to reflect good soil management on arable land, so that fields which are managed well do not receive a zero score.

Applicable habitats: Arable fields.

Determining the indicator value. Enter 'yes' if soil erosion management practices are used on arable land (e.g. cover crops, crop residue, contour ploughing, no-till).

Rationale for the multiplier values. If no soil management practices are applied, a multiplier of zero will be applied to arable land for erosion and water quality regulation. Otherwise a multiplier of 1 will be applied.

Table 21. Soil Management multipliers

Soil management	Erosion and water quality regulation
Yes	1
No	0
Not applicable	1
Not known	0

15. Peat quality

Level	ES	Type	Source type	Link
STANDARD	Carbon storage Water quality Erosion protection	Supply	Site survey (expert) or local knowledge	

Description: This indicator records whether peat is degraded or actively forming. This is important for carbon storage and also for water quality.

Applicable habitats: Bog. Not yet clear whether this should also be applied to fens and saltmarshes.

Determining the indicator value. Site survey (or pre-existing local knowledge) to determine whether peat is actively growing or degraded. Natural England hold data on moorland peat but it is not freely available.

Rationale for the multiplier values. For carbon storage, actively forming peat has a multiplier of 2. This is applied because the basic habitat scores are scaled. Peat bog receives the same score as broadleaved woodland (10), but peat bogs actually hold around twice as much carbon on average, when carbon in vegetation is added to carbon in the top 30cm of soil (based on a review by Cantarello et al (2011). Soil depth, soil carbon and the amount of soil or peat removed makes a large difference to the change in carbon storage but this has not yet been integrated into the tool.

Degrading peat on the other hand could be a net emitter of carbon. However, if restored, it could eventually become a carbon sink again. Therefore, we apply a multiplier of 0.5, to reflect the potential for restoration, because a multiplier of zero could encourage the destruction of degraded peat rather than restoration.

For water quality and erosion protection we apply a multiplier of 1 for actively forming peat and 0.2 for degraded peat.

17.Canopy cover

Level	ES	Type	Source type	Link
STANDARD	Water supply Flood regulation Erosion protection Carbon storage Air quality regulation	**Supply**	Aerial photos or site survey	

Description: Percentage of woodland area covered by the tree canopy as opposed to clearings or gaps between tree canopies. If the canopy does not provide full cover, services such as flood protection and air quality regulation will be reduced.

Applicable habitats: Woodland, orchards, parks, cemeteries and churchyards, allotments.

Determining the indicator value. Rough estimate of % canopy cover (<25%, 25-50%, 50-75%, >75%) from either a site visit, inspection of aerial photos or quadrat analysis of a grid of points overlaid on aerial photos or Google Earth. For new habitats that are being created, enter the expected canopy cover after the 'time to target condition' (40 years).

Could also use Bluesky tree map in GIS: https://www.blueskymapshop.com/products/national-tree-map(crown diameter, approx. £90/km^2).

Note: If canopy cover is less than 20% the habitat would not be classed as woodland, but in future we could use this to indicate the presence of scattered trees.

Rationale for the multiplier values. Multipliers are derived from the mid-point of the canopy cover range multiplied by the difference in scores between open grassland (i.e. zero canopy cover) and forest (100% cover) for each service (see Multipliers sheet if interested).

Table 22. Canopy cover multipliers

Canopy cover	Flood protection	Carbon storage	Air quality regulation	Shading and cooling
75-100% (high density)	1	1	1	1
50-75%	0.85	0.85	0.75	0.8
20-50% (low density)	0.7	0.7	0.5	0.6
Not applicable	1	1	1	1
Not known	1	1	1	1

Canopy cover is not used for the service of water supply (where it would have a negative impact due to rainfall interception) because deciduous trees lose their leaves in winter, which is when most recharge happens. Potentially it could be applied for coniferous forest, but probably most coniferous forest would have 100% cover (plantations), which is already reflected in the assumptions behind the scores.

Canopy cover is also not used for erosion and water quality: it is implicit in woodland scores to some extent, but there is no need to scale down if canopy <75%, so long as ground cover or leaf litter is present.

18. Tree size

Level	ES	Type	Source type	Link
STANDARD	Carbon storage Shading and cooling Aesthetic value Interaction with nature Sense of place	**Supply**	Site survey (non-expert)	

Description: Tree size is measured as the diameter at breast height (dbh; 4.5 feet above ground) in cm. Note that this indicator is not used for the services of water supply and flood protection, because canopy cover was thought to be a more relevant indicator for those services.

Applicable habitats: Woodland, hedgerows (as they may include trees), orchards, individual trees, parks, cemeteries and churchyards.

Determining the indicator value. Identify the largest size class of trees present on site. For simplicity, we are assuming that the largest trees, even if infrequent, will dominate the level of service delivery.

- saplings <7cm dbh
- poles 7-33cm (larger than a can of beans)
- mature 33-80cm (hides a thin person)
- very mature or veteran >80cm (larger than a hug)).

The National Forest Inventory identifies areas of young or coppiced trees (class as saplings) and felled woodland (separate habitat type). Individual trees outside woodland should be identified separately (at least for veteran trees, >80 cm dbh).

For new habitats that are being created, enter the planted size i.e. 'saplings'. This is the only indicator for which you should enter the actual condition at the time of creation, rather than the target condition after 30 years (or 40 for woodland). This is because the tool has a separate mechanism for changing saplings (either existing or new) to poles after 10 years.

Rationale for the multiplier values. We assume that a 'typical' size of trees, matching the scores assumed for woodland habitats, is mature. This equates to a multiplier of 1. For carbon storage and cooling and shading, habitats with smaller trees get a multiplier of less than one because they will not deliver a full level of service.

For the cultural services, even young woodlands can deliver a good service. However very large trees are assumed to provide a significantly higher level of service so a multiplier above 1 is applied.

For 'Interaction with nature' and 'sense of place', we take the maximum of this multiplier and the 'Ancient habitat' multiplier to avoid double counting.

Table 23. Tree size multipliers

Tree size	Carbon storage	Cooling and shading	Aesthetic value	Education	Interaction with nature	Sense of place
Veteran	1.5	1.25	1.1	1.1	1.1	1.1
Mature	1	1	1.05	1.05	1.05	1.05
Poles	0.9	0.75	1	1	1	1
Saplings	0.8	0.5	0.9	0.9	0.9	0.9
Coppice	0.8	0.5	1	1	1	1
NA	1	1	1	1	1	1
NK	1	1	1	1	1	1

19. Ground cover (%)

Level	ES	Type	Source type	Link
ADVANCED	Erosion protection Water quality regulation	**Supply**	Site survey (non-expert)	

Description: This indicator aims to capture the percentage of the ground that is covered by vegetation or thick leaf litter, as opposed to bare patches.

Applicable habitats: Wood pasture and parkland; orchards; grassland; cropland; bog; fen-marsh-swamp; coastal saltmarsh; vegetated dunes; all urban habitats except gardens and sealed surfaces. Not currently applied to woodland, for which canopy cover is assumed to be more important.

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

Estimate the rough percentage of ground that is covered by low vegetation or thick leaf litter as opposed to bare patches (ignoring small bare patches a few cm wide). Shrub and tree cover only counts as ground cover if the lowest leaves are very close to the ground, i.e. within 15cm of the ground. Select from the options: <30%; 30-70%; 70-100%; bare in winter (e.g. for arable land). If the survey is not carried out in winter, it may be possible to check old Google Earth photos to find an aerial photo taken in a recent winter season.

Rationale for the multiplier values. If ground cover is less than 30%, erosion on arable land is severe because run-off can pass between the bare patches. Otherwise, the vegetation in between the bare patches can intercept runoff. Therefore, we apply a multiplier of zero for ground cover <30%; 0.5 for 30-70% and 1 for 70-100%. The same values are used for the service of water quality regulation because erosion is likely to affect water quality through the influx of eroded sediment (potentially including agrochemicals) into watercourses. These values and bounds will be reviewed.

Table 24. Ground Cover multipliers

Ground cover	Erosion protection	Water quality regulation
70-100%	1	1
30-70%	0.5	0.5
<30%	0	0
Bare in winter	0	0
NA	1	1
NK	1	1

20.Tall or tussocky grasses

Level	ES	Type	Source type	Link
ADVANCED	Flood regulation Erosion protection Water quality regulation Interaction with nature	**Supply**	Site survey (non-expert)	

Description: This is an indicator of structural diversity. It describes the percentage of the habitat area that is covered with tall or tussocky grasses.

Applicable habitats: All except arable fields, water, bare and sealed surfaces (this could be reviewed).

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully. Estimate whether cover is absent (<5% cover), present (5-33%) or extensive (>33%).

Rationale for the multiplier values. Tall and tussocky grasses can provide a dense ground cover that helps slow down and retain water, protect from erosion and trap sediment and pollutants. They also provide habitat for wildlife such as invertebrates, with benefits for the service of 'interaction with nature'. This indicator is also relevant for pollination and pest control, but this is currently covered by the separate data entry for 'invertebrate nesting sites' (this could change).

The basic habitat scores already include consideration of tall and tussocky grasses to some extent – for example, semi-natural grassland is assumed to have a rougher structure than amenity grassland. However, this indicator is useful to assess the condition in more detail because sward height and structure can vary between individual patches of grassland, and also some woodlands might have short grass and others might have tall or tussocky grass. All multipliers are arbitrary and will be reviewed, along with the selection of which habitats this multiplier is applicable to (to avoid overlap with the basic scores).

Table 25. Tall & tussocky grass multipliers for associated services

	Flood protection	Erosion protection	Water quality regulation	Interaction with nature
Absent (<5%)	1	1	1	1
Present (5-33%)	1.05	1.05	1.05	1.05
Extensive (>33%)	1.1	1.1	1.1	1.1
Not applicable	1	1	1	1
Not known	1	1	1	1

21. Shrub layer

Level	ES	Type	Source type	Link
ADVANCED	Flood regulation Erosion protection Interaction with nature	**Supply**	Site survey (non-expert)	

Description: This is an indicator of structural complexity. It assesses the extent of any shrub layer – either as an understorey in woodland habitats or as scattered shrub on grassland and other open land.

Applicable habitats: All except scrub and hedgerows (which already consist of shrubs), arable fields, water, gardens and bare or sealed surfaces (this could be reviewed).

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

Estimate the extent of any shrubby layer (understorey in woodland habitats; scattered shrub in open habitats such as grassland or heathland). Select from absent (<5% cover), present (5-33%) or extensive (>33%).

Rationale for the multiplier values. A shrub layer can help to intercept rainfall, slow down and retain water, protect from erosion and trap sediment. It also provides habitat for wildlife such as birds and invertebrates, with benefits for the service of ‘interaction with nature’. This indicator is also relevant for pollination and pest control, but this is currently covered by the separate data entry for 'invertebrate nesting sites' (this could change).

Table 26. Shrub layer multipliers for associated services

	Flood protection	Erosion protection	Interaction with nature
Absent (<5%)	1	1	1
Present (5-33%)	1.05	1.05	1.05
Extensive (>33%)	1.1	1.1	1.1
Not applicable	1	1	1
Not known	1	1	1

22. Flowers

Level	ES	Type	Source type	Link
ADVANCED	Pollination Pest control Aesthetic value Interaction with nature	**Supply**	Site survey (expert)	

Description: This indicator aims to provide a measure of the abundance and diversity of flowering plants, to support the services of pollination and pest control as well as being attractive and supporting interaction with nature.

Applicable habitats: All except water, sealed and bare surfaces. Arable fields are included as some can have rare arable plants.

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

The estimate should be based on a site survey in summer, or prior knowledge of the site. Enter ‘High’ if the abundance or diversity of flowering plants are greater than expected for a typical UK example of this type of habitat, or ‘Low’ if lower than expected. Otherwise enter ‘Medium’. We are aware that these are not very precise instructions and will try to make them more precise in due course.

Rationale for the multiplier values. All multipliers are arbitrary and will be reviewed.

Table 27. Flowering plants multipliers for associated services

Flowering plants richness and abundance	Pollination	Aesthetic value	Interaction with nature
High	1.1	1.1	1.05
Medium	1	1	1
Low	0.9	0.9	0.95
Not applicable	1	1	1
Not known	1	1	1

23. Invertebrate nest sites

Level	ES	Type	Source type	Link
ADVANCED	Pollination Pest control Interaction with nature	**Supply**	Site survey (non-expert)	

Description: This records the presence and abundance of suitable invertebrate nesting sites, including dead wood, bare dry ground, beetle banks, tree cavities, veteran trees and structurally diverse vegetation (tall or tussocky grass and shrubs).

Applicable habitats: All except arable fields, water, sealed and bare surfaces.

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

This should be determined from a site walkover that passes within view of most parts of the site (by 'site' in this context we mean a habitat parcel, or group of parcels with identical habitat type and condition indicators, that will be entered as a single row in the EBN data entry sheet). We have based our criteria partly on the Woodland Wildlife Toolkit developed by Sylva, the Forestry Commission, Natural England and the Woodland Trust. Enter 'high' if at least one of the following applies:

- standing or fallen dead wood is visible from at least half of the walkover route (this includes dead trees or stumps over 1m tall and 20cm diameter, fallen logs or large dead branches at least 50cmm long and 20cm diameter and dead wood on live trees, following the Forestry Commission Woodland Condition Survey criteria)
- the site includes one or more veteran trees (larger than a hug) with cavities, hollow trunks, crevices or loose or flaking bark
- beetle banks or dry earth are visible from at least a quarter of the walkover route
- tall or tussocky grasses cover at least 33% of the site
- a shrub layer covers at least 33% of the site.

Enter 'medium' if some of these features are present but they do not meet the abundance criteria and enter 'low' if none apply.

Rationale for the multiplier values. All multipliers are arbitrary and will be reviewed.

Table 28. Invertebrate nesting sites multipliers for associated services

Invertebrate nesting sites	Pollination	Pest control	Interaction with nature
High	1.1	1.1	1.05
Medium	1	1	1
Low	0.9	0.9	0.95
Not applicable	1	1	1
Not known	1	1	1

24. Resources for local species

Level	ES	Type	Source type	Link
ADVANCED	Interaction with nature Sense of place	**Supply**	Site survey and local knowledge	

Description: This indicator aims to capture areas that are particularly useful for characteristic local species, such as larval food plants for specialist butterflies (e.g. blackthorn for Brown Hairstreak in parts of central and southern England), nesting sites for bats, or young scrub for Willow Tits.

Applicable habitats: All except sealed surfaces (which score zero anyway, so the multiplier makes no difference).

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

You will first need to establish which species are important locally, e.g. by talking to a county ecologist or local wildlife trust, and what their habitat requirements are. You will then need to establish whether these requirements are present on the site, through a survey or through asking local experts. New developments might want to consider including these requirements in order to increase the value of their sites.

Rationale for the multiplier values. Multipliers are arbitrary and will be reviewed.

Table 29. Local species multipliers

	Interaction with nature	Sense of place
Yes	1.1	1.1
No	1	1
Not applicable	1	1
Not known	1	1

25. Position for water quality regulation

Level	ES	Type	Source type	Link
ADVANCED	Water quality regulation	**Supply** and **Demand**	Site survey (non-expert), GIS, local knowledge, or online map.	Catchment Data Explorer

Description: This indicator aims to determine whether the habitat is in a good position to be able to affect water quality, i.e. is it located on the flow path between a pollution source (arable field or road) and a water course?

Applicable habitats: All except for potential sources of pollution (cropland, sealed surfaces, flower bed, felled woodland); those with little ability to regulate pollution (bare ground, footpaths); or freshwater habitats which are (by definition) on the flow path. This is open to debate and further testing.

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully. Draft criteria are listed below – these are open to revision.

Enter 'Yes' if the habitat is:

- On the downwards side (or level with) and within about 50m of arable land, improved grassland, horticulture, felled woodland, intensive orchard, biofuel crops, flower bed, road, car park or other potential source of pollution
- AND above (or level with) and within about 50m of a water body
- OR you have another good reason to believe it is playing an important role in water quality regulation.

Enter 'Partial ability' if the habitat is:

- On the downwards side (or level with) and within about 50m of arable land, improved grassland, horticulture, felled woodland, intensive orchard, biofuel crops, flower bed, road, car park or other potential source of pollution
- OR above (or level with) and within about 50m of a water body
- OR you have another good reason to believe it is playing some role in water quality regulation.

Otherwise enter 'No'.

This could be done through visual inspection during a site survey, or examination of a map or site plan with contours, or GIS analysis using a Digital Elevation Model (DEM). Catchment Data Explorer (see indicator 9) could be useful – it shows watershed boundaries, which could help to determine whether the habitat is between a pollution source and a water course, and the 'reasons for not achieving good status' could be used to confirm whether agricultural and land management or urban / transport runoff is causing pollution.

In future, it could be useful to record whether the habitat is laid out in a strip parallel to contours, as this would indicate extra value, or indicate flow accumulation in some way.

Figure 12. Catchment Data Explorer screenshot showing ‘reasons for note achieving good status’

Reasons for not achieving good status and reasons for deterioration

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Reason Type	SWMI	Activity	Category	More	Classification Element
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Invertebrates
RNAG	Physical modification	Land drainage - operational management	Agriculture and rural land management	Details	Invertebrates
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Ammonia (Phys-Chem)
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Dissolved oxygen
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Phosphate
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Ammonia (Phys-Chem)
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Invertebrates
RNAG	Natural	Drought	No sector responsible	Details	Invertebrates
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Invertebrates
RNAG	Natural	Drought	No sector responsible	Details	Invertebrates
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Details	Dissolved oxygen
RNAG	Point source	Sewage discharge (continuous)	Water Industry	Details	Phosphate
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land	Details	Dissolved oxygen

Rationale for the multiplier values. If the habitat is in a good or partially in a good position then it scores >1. Otherwise if it does not meet the criteria or if it is ‘Not known’ or ‘Not applicable’ it scores 1, because it will still be delivering some level of service in comparison to polluting habitats. The multiplier values are arbitrary and require testing.

Technical note: it could be more appropriate to have multipliers less than 1 where the indicator is ‘No’. If this was the case, existing, enhanced and retained habitats would be set to 1 if Not known but newly created habitats would be set to the minimum value, to avoid anomalies where low-scoring habitats of unknown condition can score more than high-scoring habitats in poor condition.

Table 30. Position for water quality multipliers

Is habitat in a good position and configuration to provide the service?	Water quality regulation
Yes	1.2
Partial ability	1.1
No	1
Not applicable	1
Not known	1

26. Position for erosion prevention

Level	ES	Type	Source type	Link
ADVANCED	Erosion protection	**Supply** and **Demand**	Local knowledge, site survey (non-expert), GIS, online map.	Environment Agency Catchment Data Explorer website.

Description: This indicator aims to determine whether the habitat is in a good position to be able to reduce soil erosion, i.e. is it located immediately below, within or cutting across a habitat susceptible to erosion (e.g. an arable field)?

Applicable habitats: All except for habitats susceptible to erosion (arable, flower bed, felled woodland) and those with little ability to intercept runoff and thus reduce soil loss through erosion (sealed surfaces, bare ground, footpaths, freshwater). This is open to debate and further testing.

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

- Enter 'Yes' if the habitat is on the downwards side of (or level with) a habitat susceptible to erosion (arable field, improved grassland, horticulture, felled woodland, intensive orchard, biofuel crops, flower bed) AND it runs alongside part of the boundary with this erodible habitat or cuts across it roughly parallel to the contours of the slope, so that it is capable of trapping sediment washed off the field.

- Enter ‘Partial ability’ if the habitat does not meet this criterion but you have another good reason to believe it is playing some role in reducing erosion.
- Otherwise enter ‘No’.

This could be done through visual inspection during a site survey, or examination of a map or site plan with contours, or GIS analysis using a Digital Elevation Model (DEM). Catchment Data Explorer (see indicator 9) could be useful – it shows watershed boundaries, which could help to determine flow paths, and the ‘reasons for not achieving good status’ could be used to confirm whether agricultural and land management is causing sediment loss.

Rationale for the multiplier values. If the habitat is in a good position then it scores 1.25. If it is partially in in a good position then it scores 1.1. Otherwise if it does not meet the criteria or if it is ‘Not known’ or ‘Not applicable’ it scores 1, because it will still be delivering some level of service in comparison to lower scoring habitats (e.g. semi-natural grassland will still be better for erosion protection than arable fields). These multiplier values are arbitrary and require testing.

Table 31. Position for erosion protection multipliers

Is habitat in a good position and configuration to provide the service?	Erosion protection
Yes	1.2
Partial ability	1.1
No	1
Not applicable	1
Not known	1

27. Air pollution barrier

Level	ES	Type	Source type	Link
ADVANCED	Air quality regulation	**Supply** and **Demand**	Site survey (non-expert)	

Description: This multiplier attempts to capture whether the habitat forms an effective barrier between a pollution source (e.g. a busy road) and an area used by people (homes, schools, offices, footpaths, parks etc). Note: a woodland area could be both a barrier and a receptor if it is used by people.

Applicable habitats: Woodland, hedges, orchards, scrub, parks, cemeteries and churchyards, individual trees, green wall, introduced shrub, woody biofuels.

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

- Enter ‘Yes’ if the habitat forms a barrier at least 3m tall and at least 3m wide, with reasonably thick vegetation, between a pollution source (e.g. a busy road) and an area used by people (homes, schools, offices, footpaths, parks etc).
- Enter ‘Partial ability’ if the barrier does not meet these criteria but you still think it has some value as a pollution barrier. Otherwise enter ‘No’.

Rationale for the multiplier values. Pollution such as ozone, nitrogen oxides and fine particles can drift a long way from roads, so vegetation anywhere in the country will perform a pollution removal function, as pollution is absorbed or filtered by the leaves. However, the service will be particularly valuable if the habitat forms a barrier protecting people from a specific pollution source. Therefore, a multiplier of 1.2 is applied for an effective barrier, 1.1 for a partial barrier and 1 otherwise. These values are arbitrary and will be reviewed.

Table 32. Air quality barrier multipliers

Is habitat in a good position and configuration to provide the service?	Air quality regulation
Yes	1.2
Partial ability	1.1
No	1
Not applicable	1
Not known	1

28. Shading ability

Level	ES	Type	Source type	Link
ADVANCED	Cooling and shading	**Supply** and **Demand**	Site survey (non-expert)	

Description: This indicator attempts to capture whether the habitat is located in a particularly good position to provide shade and cooling to a building or an open space used by people (e.g. a street, footpath, or park). It is only intended to capture added value beyond that already captured in the basic scores for the habitat. Note: a woodland area (e.g. in a park) could be both a source of shade and an area used by people.

Applicable habitats: Woodland, scrub, hedgerows, orchards, tree, introduced shrub.

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

Enter 'Yes' if the habitat is located on the east, south or west side of a building that would otherwise be exposed to sun, and close enough for the shadow to fall on the side of the building at least to half the height of the ground floor windows (assume 30m for trees and woodland; 3m for shrubs and hedges).

Enter 'Partial ability' if this does not apply but you have another reason to believe that the habitat provides better shading and cooling ability than a typical habitat of this type, due to its position. Otherwise enter 'No'.

Rationale for the multiplier values. The basic habitat scores already take account of the ability of habitats to provide general shading and cooling, lowering the urban heat island effect. However we apply an additional multiplier for habitats that are located in a particularly good place, e.g. shading an office building or school and thus either improving comfort for the occupants, or saving on the energy costs of cooling the building with air conditioning or mechanical ventilation. Therefore, a multiplier of 1.2 is applied for a habitat in a good position, 1.1 for one classed as 'partial ability' and 1 otherwise. These values are arbitrary and will be reviewed.

Table 33. Shading ability multipliers

Is habitat in a good position and configuration to provide the service?	Shading ability
Yes	1.2
Partial ability	1.1
No	1
Not applicable	1
Not known	1

29. Noise barrier

Level	ES	Type	Source type	Link
ADVANCED	Noise reduction	**Supply** and **Demand**	Site survey (non-expert)	

Description: This indicator attempts to capture whether the habitat provides a noise reduction service by forming a dense or wide barrier between a source of noise (e.g. busy road or railway) and a place used by people (homes, offices, etc). However, even if vegetation does not form a physical barrier, it can still provide a damping effect compared to a hard surface. Note: some habitats could be both a noise barrier or damper and an area used by people (e.g. a park).

Applicable habitats: Habitats that can form a barrier (i.e. with trees, hedges, or shrubs): Woodland, scrub, hedgerows, orchards, parks and gardens, cemeteries and churchyards, tree, introduced shrub. All other habitats with low vegetation (i.e. different types of grassland, heath, or marsh) do not form barriers but can have a noise damping effect.

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully.

- Enter **'Barrier'** if the vegetation is dense, at least 10m tall and at least 10m wide, and sited between a noise source (e.g. road or rail) and an area used by people.
- Enter **'Partial barrier**' if the vegetation is reasonably thick, at least 3m tall and at least 3m wide, and sited between a noise source (e.g. road or rail) and an area used by people.

- Enter '**Not barrier but tree/shrub near people**' if the habitat is trees or shrubs near people but is not dense enough or is not in the right position to form a barrier. This can include scattered trees, e.g. in parks and gardens or cemeteries.
- Enter '**Low vegetation near people**' for low vegetation (anything that is not trees or shrubs, e.g. grass, heath, marsh, or suburban mosaic, as that includes grass) near people, or beach / dunes. This captures the damping effect of vegetation or soft surfaces that do not form a physical barrier.
- If the habitat is not near people enter '**Not near people**'.
- Any other habitats that are near people but are not vegetated (e.g. sealed surface, bare ground, rock, or water) score zero and are not applicable for this service, so enter **'NA'**.

Rationale for the multiplier values. We assume that if a habitat is not near people then it is unlikely to provide any noise reduction service, so we apply a multiplier of zero. Otherwise we apply a multiplier of 1 for a physical barrier and 0.5 for a partial barrier. If trees or shrubs are not in a position to be a physical barrier but still might provide a damping effect, the multiplier is 0.25. This reduces the high score of trees and shrubs (6-10) to a much lower value of 1.5-2.5. For low vegetation such as grass, the basic score is only 1, so if it is near people it is given a multiplier of 1 to reflect its ability to provide a damping effect. These values are arbitrary and will be reviewed.

Table 34. Noise barrier multipliers

Is habitat in a good position and configuration to provide the service?	Noise reduction
Barrier	1
Partial barrier	0.5
Not barrier but tree/shrub near people	0.25
Low vegetation near people	1
Not near people	0
NA	0
Not known	0

30. Population density

Level	ES	Type	Source type	Link
BASIC	Recreation Education	**Demand**	Online data	CAVAT or LSOA statistics

Description: This indicator reflects demand for recreation and education about nature, based on a proxy of the population density in the local area. We are using a freely available dataset compiled for use by the CAVAT (capital asset value) tool for assessing the amenity value of trees, which lists population density in each local authority area. This document is available online and is updated annually. Alternatively, you can use Lower Super Output Area statistics downloadable here, for a more accurate estimate.

Applicable habitats: All except sealed and artificial surfaces.

Determining the indicator value. Consult the CAVAT Community Tree Index Factor document and select the appropriate population density range for your local authority area in the drop-down box (<20 people per ha; 20-39; 40-59; etc.). Or use the LSOA statistics (see above). You can auto-fill the whole column, but make sure you fill in the first two cells then select both cells before auto-filling – otherwise the population density may increment by 1 in each row (see User Guide for tips on auto-filling). For new housing developments, the population may change after development.

Figure 13. CAVAT Screenshot showing population density by local authority

CAVAT
Capital Asset Value for Amenity Trees
National Community Tree Index

LONDON TREE OFFICERS ASSOCIATION

National Community Tree Index

Local Authority	Pop per ha	CTI factor	CTI Band
Adur	14.3	100%	1
Allerdale	0.8	100%	1
Alnwick	0.3	100%	1
Amber valley	4.4	100%	1
Arun	6.4	100%	1
Ashfield	10.2	100%	1
Ashford	1.8	100%	1
Aylesbury Vale	1.8	100%	1
Babergh	1.4	100%	1
Barking & Dagenham	45.4	150%	3

Rationale for the multiplier values. Multipliers are arbitrary and will be reviewed. We have chosen lower multiplier values than are used in the CAVAT tool.

Table 35. Population density multipliers

Population density (people/ha)	CAVAT Community Tree Index Factor	EBN tool indicator
<20	1	1
20-39	1.25	1.05
40-59	1.5	1.1
60-79	1.75	1.15
80-99	2	1.2
>100	2.25	1.2

31. Nature designations

Level	ES	Type	Source type	Link
BASIC	Education Interaction with nature Sense of place	**Supply**	Online map and local authority	MAGIC (England) or Lle (Wales)

Description: This records whether the site has special value for nature, based on the number of designations.

Applicable habitats: All except sealed and artificial surfaces.

Determining the indicator value. Go to MAGIC Designations and find out if the habitat has any of the following designations:

- Land-based designations /Statutory: SSSIs, SPAs, SACs, National and Local Nature Reserves, National Parks, RAMSAR sites.
- Land-based designations /Non-statutory: RSPB reserves.
- Marine-based designations: Marine Protection Zones.
- Habitats and Species: Priority habitats and presence of priority species. If there is more than one priority habitat or species, this counts as multiple designations.
- Ask Local authorities for District Wildlife Sites, Local Wildlife Sites.

Enter the number of designations in the dropdown box: 0, 1, 2, 3 or more. If you select '3 or more' and then autofill, it may increment to '4 or more', 5 or more' etc – so avoid this by selecting the first two rows before auto-filling.

Rationale for the multiplier values. This indicator is grouped with two others: cultural or historic importance, and 'Managed for nature' Rather than applying all these multipliers cumulatively, the maximum is taken. This is done in order to avoid a very large difference in score between a 'typical' habitat such as a woodland and a 'best possible' example of that habitat. Multiplier values are arbitrary and will be reviewed.

Table 36. Nature designations multiplier for associated services

Number of designations	Education /Interaction with nature	Sense of place
0	1	1
1	1.1	1.1
2	1.15	1.15
3 or more	1.2	1.2
Not applicable	1	1
Not known	1	1

32. Ancient Habitat

Level	ES	Type	Source type	Link
BASIC	Interaction with nature Sense of place	**Supply**	Online map	MAGIC

Description: This identifies ancient habitats. It currently applies only to ancient woodlands, veteran trees and hedgerows but could be extended to other habitat types if appropriate, e.g. ancient meadows.

Applicable habitats: Semi-natural woodland, hedgerows, traditional orchards, cemeteries and churchyards and individual trees. Bogs are assumed to be ancient by default and this is accounted for in the basic score.

Determining the indicator value.

Ancient woodland: Check if the site is included in MAGIC Habitats and species / Habitats / Woodland / Ancient woodland (Y/N).

Veteran trees: see Woodland Condition Survey criteria:

Veteran tree circumference at 1.5m height according to tree species (note that in upland areas, veteran trees may not reach large stem circumferences):

>150cm (1 hug): aspen, birch, hawthorn, hazel
>225cm (1.5 hugs): Cherry, field maple, goat willow, grey willow, holly, hornbeam, rowan
>250cm (1.75 hugs): Alder, Scots pine
>300cm (2 hugs): Ash, oak, yew
>450cm (3 hugs): Beech, elm, Horse chestnut, limes, poplars, sweet chestnut, sycamore, other willows, other conifers

An approximate guideline to measure the circumference of tree trunks 1.5m from the ground is in the form of 'hugs'. A hug is where an average adult can reach around the tree trunk and their fingers just meet. One hug is approximately equivalent to a trunk circumference of 150cm. One and a half hugs would be equivalent to a circumference of 225cm, whilst half a hug (i.e. where it is possible to reach around the tree with one arm and touch your chest) is equivalent to a circumference of 75cm. It may be useful to measure the first few trees using a tape to help calibrate the size of a surveyor's hug.

Hedgerows, orchards, wood pasture and parkland, cemeteries: enter 'Yes' if there is evidence that the habitat is ancient, e.g. hedgerows are highly diverse, there are veteran trees, or there are historic records.

If the habitat is ancient enter 'Yes', otherwise enter 'No'.

Rationale for the multiplier values. For 'Interaction with nature' and 'sense of place', we take the maximum of this multiplier and the 'Tree size' multiplier to avoid double counting. Multipliers are arbitrary.

Table 37. Ancient habitat multipliers of associated services

	Interaction with nature	Sense of place
Yes	1.1	1.1
No	1	1
Not applicable	1	1
Not known	1	1

33. Cultural or historic importance

Level	ES	Type	Source type	Link
BASIC	Education Sense of place	**Supply**	Online map and local authority	MAGIC (England) LIe or NRW Evidence and Data (Wales)

Description: This records whether the site has special cultural or historic value, based on the number of designations.

Applicable habitats: All except sealed and artificial surfaces.

Determining the indicator value.

1. Go to MAGIC Designations and find out if the site has any of the following designations (under designations tab):
    - Land-based designations: Statutory: National Parks, AONBs
    - Historic statutory: Scheduled ancient monuments.
    - Non-statutory: Community Forests, Heritage Coasts, Green belt.
    - Historic non-statutory: Registered battlefields; Registered parks and gardens.

- For Wales:
    - AONBs in Wales
    - Landmap Historic Landscape; areas categorised as 'Rural environment' (not Built environment). Ratings of low, moderate, high and outstanding can be equated to the EBN tool options of 0, 1, 2 or >3 designations.
    - Landmap Cultural Landscape – exclude areas where the classification is related to built environment. There is no simple way of doing this from the categorisation though – it will require manual inspection of the descriptions.
    - Scheduled ancient monuments in Wales.

2. Ask Local authorities for archaeological constraint areas (see also https://www.heritagegateway.org.uk/gateway/chr/default.aspx)

3. Add National Trust areas.

4. Enter the number of designations in the dropdown box: 0, 1, 2, 3 or more. If you select '3 or more' and then autofill, it may increment to '4 or more', 5 or more' etc – so avoid this by selecting the first two rows before auto-filling.

Rationale for the multiplier values. This indicator is grouped with two others: nature designations, and 'Managed for nature?'. Rather than applying all these multipliers cumulatively, the maximum is taken. This is done in order to avoid a very large difference in score between a 'typical' habitat such as a woodland and a 'best possible' example of that habitat. Multiplier values are arbitrary and will be reviewed.

Table 38. Cultural and historic designation multipliers for associated services

Number of designations	Education	Sense of place
0	1	1
1	1.1	1.1
2	1.15	1.15
3 or more	1.2	1.2
Not applicable	1	1
Not known	1	1

34. Special recreational value

Level	ES	Type	Source type	Link
BASIC	Recreation	**Supply**	Online map	MAGIC

Description: This records whether the area has special value for recreation. This is intended to capture areas that are remote and therefore do not receive a high multiplier for population density, but are nevertheless very important areas for recreation, such as National Parks, coastlines and AONBs.

Applicable habitats: All except sealed and artificial surfaces.

Determining the indicator value. Check MAGIC to see if the area is in any of the following:

- MAGIC/Designations / land-based designations / statutory / AONB or National Park
- MAGIC/Designations / land-based designations / non-statutory / Heritage Coast

Enter 'Yes' if it is, or if you have another good reason to believe that it is strategically important for recreation (beyond the typical characteristics of the habitat that would already be taken account of in the basic scores and the other multipliers).

Rationale for the multiplier values. Areas with a special recreational value are assigned a multiplier of 1.2. It should be noted that there is a possible perverse effect where increasing the population density through development could increase the recreation score for a previously remote area such as a national park – potentially encouraging the loss of areas that have special recreational value partly because of their wildness and remoteness. This indicator helps to flag the special value of those remote areas, but it does not counteract the perverse impact of increasing the population multiplier.

Table 39. Special value for recreation multipliers

Special value for recreation?	Recreation
Yes	1.2
No	1
Not applicable	1
Not known	1

35. Public access

Level	ES	Type	Source type	Link
BASIC	Recreation Interaction with nature	**Supply**	Local authority, OS maps, site survey and MAGIC	MAGIC

Description: This records whether habitats are openly accessible, accessible via a footpath only (people have to stay on the path) or have restricted or private access.

Applicable habitats: All except sealed and artificial surfaces.

Determining the indicator value. This needs to be determined individually for every applicable habitat parcel. If your data is aggregated into habitat types, you may find that you have to split it into habitat parcels to use this indicator meaningfully. See the User Guide for details of how to do this using GIS.

You may already know the access arrangements on your site or be able to find out simply by visiting the site or from local knowledge. Otherwise you can use the following sources.

- MAGIC / Access. This shows Countryside and Rights of Way (CRoW) Act 2000 Access Layer, which includes Section 15 land, Registered Common Land and other open access areas. It can be downloaded as a GIS layer at data.gov.uk (CRoW Act 200 Access layer)

- ORVal (University of Exeter) Parks and Paths, which can be viewed on the ORVal map or downloaded as a GIS dataset. This includes most of the openly accessible parks and other green spaces in England, including CROW land. However, it also includes some woodland areas which are not open access. Many but not all public rights of way are included in the Paths dataset.
- OS Open Greenspace is a downloadable GIS dataset that shows green spaces suitable for recreation (public parks, playing fields, sports facilities, play areas and allotments), which are thought to be publicly accessible, in rural areas as well as towns and cities.
- OS MasterMap GreenSpace is available under a Public Sector Mapping Agreement license or to academic users for research purposes via Edina Digimap. It is based on OS MasterMap and shows all types of green space, including gardens and roadside verges, but only for towns and cities. It includes public parks and gardens, playing fields, play spaces, bowling greens, golf courses, tennis courts, other sports facilities, natural land, campsites, institutional grounds, religious grounds, cemeteries, school grounds and allotments.
- Public rights of way (PROW) datasets should be available from your local authority although there may be licensing restrictions. A few local authorities have uploaded PROW GIS data to data.gov.uk.
- OS maps (paper copy or via Bing Maps) show public footpaths.
- OpenStreetMap also contains open spaces and paths, but includes those with no public access. There are user-supplied tags which sometimes indicate accessibility, but not always, so it can be hard to tell whether there is public access or not. Data can be downloaded as a GIS file (the Geofabrik download option is particularly useful for larger areas) but this does not include the access tags.

There are two ways of using footpath data. You can set the entire area of a parcel (e.g. a field) to ‘footpath access’ if it is crossed by a path. Alternatively, if you can use GIS, you can get a more nuanced assessment by creating a 50m buffer zone around paths and setting the access just within that zone to ‘footpath access’. The 50m buffer distance is arbitrary but is intended to represent the benefits that people get from walking in a reasonable area of green space, rather than, for example, in an alleyway between walls. See the User Guide (Section 6.1, step 6) for details of how to do this with GIS.

Once you have established accessibility, enter the correct category of access for each parcel: Open access (go anywhere), footpath access (stay on the path), restricted access (e.g. school grounds, members only, guided tours only), private access (private gardens), no access for recreation (e.g. farmland).

Table 40. Access multipliers for associated services

Access	Recreation	Interaction with nature
Open access	1	1
Footpath access	0.75	0.9
Restricted public access	0.5	0.8
Private access	0.25	0.6
No access for recreation	0	0.5
Not applicable	1	1
Not known	1	1

Multipliers are arbitrary and will be reviewed. For Interaction with nature we take account of the value of habitats for sustaining wildlife populations that can then be viewed elsewhere. In other words, a wildlife area may not have public access, but it could sustain populations of birds or butterflies that people then enjoy seeing in local parks or private gardens. Also, public access can sometimes be detrimental to wildlife so restricting access in some places or at certain times can help to preserve the long-term delivery of this service. For this reason, the multipliers for areas with no access are not as low as the recreation multipliers, where access is essential for the service to be delivered.

For education, there is no penalty if access is restricted to groups only so this is covered under a separate indicator 'educational use possible (Y/N)?'

For aesthetic value, 'access to view of habitat' could be relevant but this is too complex to assess at this stage.

36. Educational Use

Level	ES	Type	Source type	Link
BASIC	Education	**Supply**	Local authority	

Description: This indicator captures whether a site is accessible for formal education or research or informal learning.

Applicable habitats: All except sealed and artificial surfaces.

Determining the indicator value. Local enquiries e.g. ask the local authority education department. Does the site have special educational value, e.g. use by school groups (including any parts of school grounds that have a value for learning about nature, e.g. ponds, gardens or wilder areas), use for scientific research, or an information centre? If so, enter 'Special educational value', even if use is restricted to certain groups or to organised visits. If not, enter 'Public access' if it is accessible by the public, or 'No public access' if not.

Rationale for the multiplier values. The multiplier is over 1 if there is special educational value, e.g. use by school groups, even if access is restricted to those groups. It is 1 if there is public access, even if there is no special educational value, because there could still be opportunities for informal learning. It is zero if there is no access.

Table 41. Educational use multipliers

Educational use	
Special educational value	1.1
Public access	1
No public access	0
Not applicable	0
Not known	1

37. Managed for nature

Level	ES	Type	Source type	Link
BASIC	Pollination Pest control Education Interaction with nature Sense of place	**Supply**	Local knowledge and online map	MAGIC

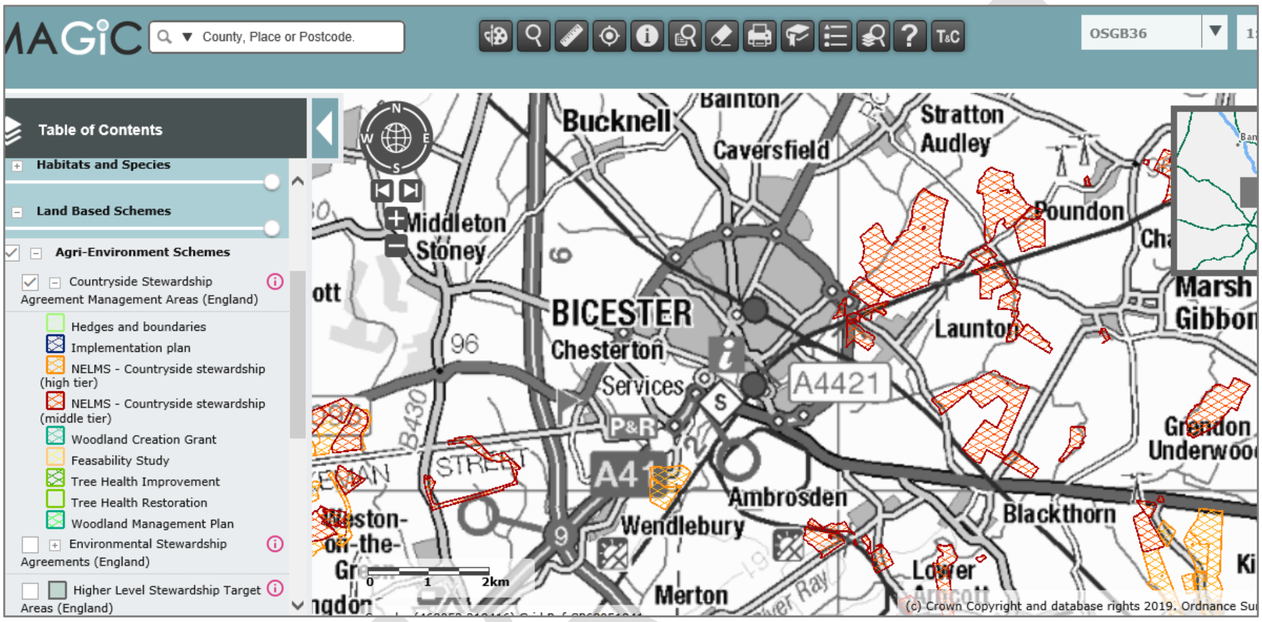
Description: This records whether any special management is taking place to enhance the site for nature.

Applicable habitats: All except sealed and artificial surfaces.

Determining the indicator value. Local enquiries. Is the site managed to conserve or enhance nature? This would include management by a wildlife trust or similar group, higher level countryside stewardship and organic farming. Enter Yes or No.

Countryside stewardship agreement areas are shown in MAGIC under Land Based Schemes / Agri-environment schemes / Countryside Stewardship Agreement Management Areas / NELMS – Countryside Stewardship (high tier) (the lighter orange hatching on the map below).

Figure 14. MAGIC Screen shot showing land under agri-environment schemes



Rationale for the multiplier values. This indicator is grouped with two others: cultural or historic importance, and nature designations. Rather than applying all these multipliers cumulatively, the maximum is taken. This is done in order to avoid a very large difference in score between a ‘typical’ habitat such as a woodland and a ‘best possible’ example of that habitat. Multiplier values are provisional and will be reviewed.

Table 42. Managed for nature multipliers

Managed for nature?	Education	Interaction with nature	Sense of place
Yes	1.1	1.1	1.1
No	1	1	1
Not applicable	1	1	1
Not known	1	1	1

38. Local distinctiveness

Level	ES	Type	Source type	Link
STANDARD	Sense of place	**Supply**	Local authority and local knowledge	[National Character Areas]

Description: This aims to capture areas that have special importance because they help to provide a sense of identity and local distinctiveness, or because they have particular importance to local people for cultural, emotional, or spiritual reasons. It captures aspects that are not reflected in the other multipliers.

Applicable habitats: All except sealed and artificial surfaces.

Determining the indicator value. Start with National Character Areas (NCA): is the habitat characteristic of the area? Search also for local landscape character assessment on Local Authority webpage - this will incorporate more local input so is preferable to the NCA. If time and resources permit, community consultation can feed in here.

Rationale for the multiplier values. Multipliers are arbitrary and will be reviewed.

Table 43. Local distinctiveness multipliers

	Sense of place
Yes	1.1
No	1
Not applicable	1
Not known	1

39. Landscape diversity / habitat mosaic

Level	ES	Type	Source type	Link
BASIC	Aesthetic value	**Supply**	Site plans, local maps, or GIS	

Description: This reflects the mix of different habitats on a site. There is evidence that landscape diversity is important for aesthetic value, i.e. people like views of diverse landscapes.

Applicable habitats: All apart from sealed and artificial habitats.

Determining the indicator value. Count the number of different habitat groups on the site, from the list of 19 categories below. If there are 7 or more types present enter 'High'; if 4 to 6 enter 'Medium'; if three or less enter 'Low'. Autofill the whole column. For large areas (e.g. over 5,000 ha) you could subdivide into appropriate blocks, e.g. sub-catchments or MSOAs, and enter the diversity for each. It might be appropriate to ignore habitats that form a very small proportion of the whole area, e.g. <0.5% (except for hedgerows as these have a prominent impact on the landscape).

1. Broadleaved woodland
2. Native pine woodland
3. Shrubland
4. Native hedgerows
5. Wood pasture and parkland
6. Orchards
7. Semi-natural grassland
8. Fen, marsh and swamp
9. Bog
10. Inland rock
11. Heath
12. Running water
13. Standing water
14. Coastal rock
15. Coastal saltmarsh
16. Farmland (arable, improved grassland or biofuels)
17. Arable field margins
18. Vegetated dunes, beach or other littoral sediment
19. Urban green infrastructure (parks, gardens, allotments, cemeteries, green roofs etc)

Rationale for the multiplier values. A multiplier of 1.1 is applied for 'high'; 1 for 'medium' and 0.9 for 'low. This is a very basic approach, and the multipliers are arbitrary and will be reviewed. It would also be possible to calculate this indicator directly in the tool; this could be done in a future version.

Table 44. Landscape diversity multipliers

	Landscape diversity
High	1.1
Medium	1
Low	0.9
NA	1
NK	1

43. Fish barriers

Level	ES	Type	Source type	Link
ADVANCED	Fish production Interaction with nature	**Supply**	Site survey (non-expert)	

Description: Are there barriers across a water body that could prevent or reduce free movement of fish?

Applicable habitats: Freshwater, aquatic marginal vegetation, reedbeds and coastal saltmarsh.

Determining the indicator value. This requires a site survey or local knowledge to record the presence and size of fords, culverts, weirs or dams. These are classified as impassable to fish, passable high-impact or passable medium-impact based on the height of any vertical drop, or the length and angle of sloping structures. The criteria are loosely based on this guidance document: http://www.wfduk.org/sites/default/files/Media/Environmental%20standards/Annex%206%20Rivers%20Fish%20FCS2%20%26%20Fish%20Barrier.pdf

Classify the barrier as Impassable if it meets any of the following criteria:

- Vertical drop over 1m
- Sloping structure with a slope of over 60°
- Sloping structure over 3m long with a slope of over 40°
- Sloping structure over 10m long with a slope of over 15°

Classify the barrier as Passable – high impact if it meets any of the following criteria:

- Vertical drop between 30cm and 1m
- Sloping structure up to 3 m long with a slope of 40-60%
- Sloping structure between 3 and 10m long with a slope of over 15^{o}

Classify the barrier as Passable – low impact if it meets any of the following criteria:

- Vertical drop between 15 and 30 cm
- Sloping structure up to 3 m long with a slope of 15-40%

Otherwise ignore the barrier. Note: ponds that are not part of a connected water network do not need to be marked as having a barrier.

Rationale for the multiplier values. Multipliers are arbitrary and will be reviewed.

Table 45. Fish barrier multipliers

Barriers to fish passage	Fish production	Interaction with nature
Impassable barriers	0.5	0.8
Passable high-impact	0.75	0.9
Passable low impact	0.9	0.95
No barriers	1	1
Not applicable	1	1
Not known	1	1

44. Water body naturalness

Level	ES	Type	Source type	Link
STANDARD	Fish production Sense of place Interaction with nature Aesthetic value Flood protection Water quality regulation	**Supply**	Online map and data, site survey or local knowledge	Catchment Data Explorer (England)

Description: Naturalness of river. We have divided rivers into broad classes that can largely be determined by a non-expert. In future we hope to make use of the data gathered for the MoRPh (Modular river physical survey) assessment, which is a citizen science method that will be used to assess water body condition. MoRPh records features such as type(s) of substrate present (boulders, cobbles, gravel, sand, silt, peat), presence of natural structures (riffles, meanders, shallows) and amount of vegetation, dead wood, or leaf litter.

Applicable habitats: Freshwater, aquatic marginal vegetation, reedbeds and coastal saltmarsh.

Determining the indicator value. You may need to subdivide water bodies into different lengths if they have very different characteristics.

1. Find the relevant water body in Catchment Data Explorer following the steps for the indicator on water quality, and check whether it is listed as being a Heavily Modified Water Body.

2. Check whether it is a salmonid river using local knowledge or the map here Salmonid rivers for England (unfortunately there are no place names on this map and you cannot zoom in – we will try to find a better source) or here for Wales.

3. Use a site survey to check whether there is a natural riverbed (substrate) of sand, gravel, mud or rocks, or an artificial substrate of concrete or similar, and whether the water body is enclosed within a culvert.

4. If the river is not salmonid, not heavily modified, not in a culvert and has a natural substrate then you can class it as either modified or near natural. For this, ideally, there would be a proper survey (e.g. using MoRPh), but a quick assessment could be made based on whether the river shows a mix of natural substrates (boulders, cobbles, gravel, sand, silt, peat), natural structures (riffles, meanders, shallows) and aquatic vegetation, dead wood or leaf litter.

Rationale for the multiplier values. Multipliers are arbitrary and will be reviewed.

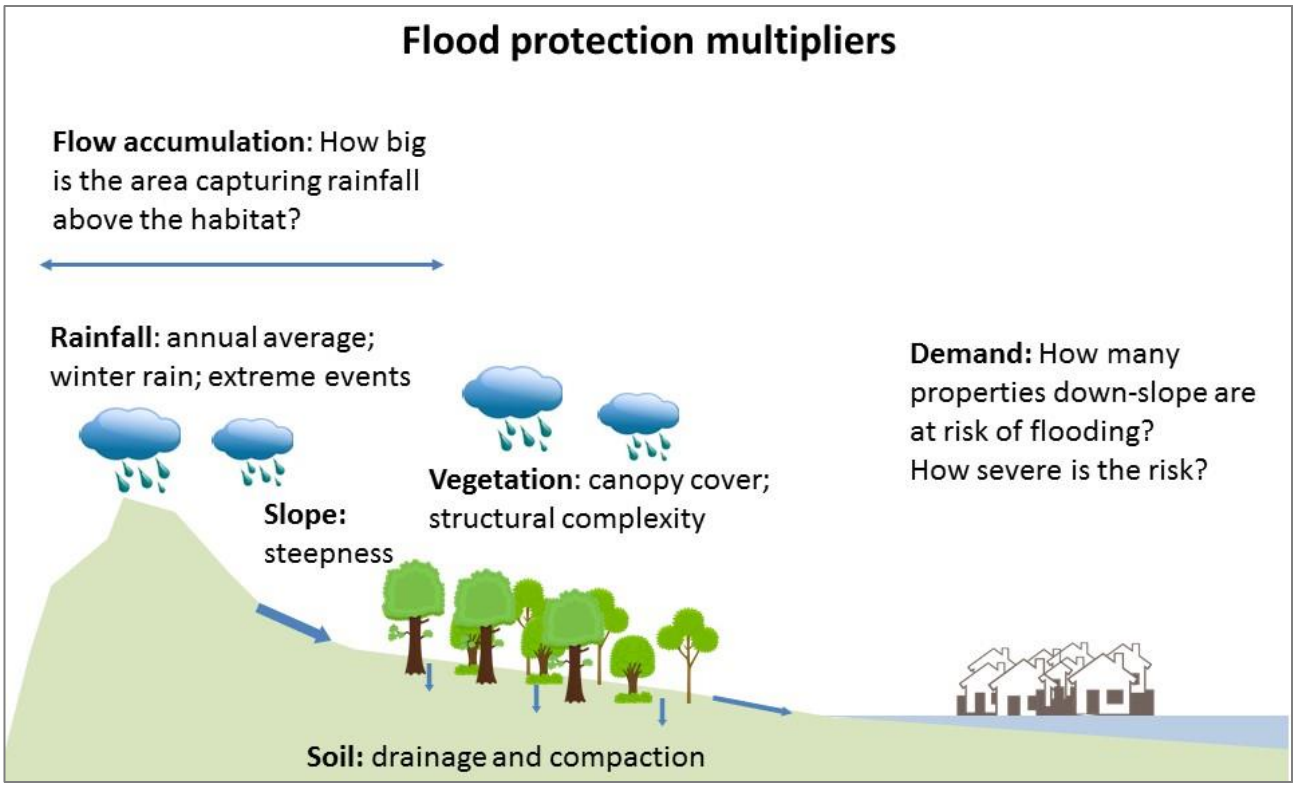
Table 46. Water barrier naturalness multipliers for associated services

Naturalness	Fish production	Flood protection	Water quality regulation	Aesthetic value	Education	Interaction with nature	Sense of place
Salmonid	1.2	1.1	1.1	1.1	1.2	1.2	1.1
Near natural	1.1	1.1	1.1	1.1	1.1	1.1	1.05
Modified	1	1	1	1	1	1	1
Heavily modified	0.9	0.9	0.9	0.8	0.8	0.8	0.8
Artificial substrate	0.8	0	0	0.2	0.2	0.2	0.2
Culvert	0.2	0	0	0	0	0	0
Not applicable	1	1	1	1	1	1	1
Not known	1	1	1	1	1	1	1

Appendix 1: Flood-related indicators

The ability of a habitat to provide a flood protection service depends on:

1. Condition factors:
    - canopy cover
    - vegetation structural complexity
    - soil compaction and drainage
    - river features such as meanders, gravel beds and presence of woody debris.
2. Demand / spatial factors:
    - Whether the habitat is located up-slope of a flood zone.
    - The flow accumulation at this point (i.e. how much water might be flowing through this location that could be slowed down or absorbed by the habitat).
    - The number of people and properties currently at risk that can be protected by a habitat at this location.
    - Soil compaction and drainage, because poorly drained soils pose greater flood risk.
    - Slope, because there will more runoff from steep slopes so more potential for habitats to intercept and reduce the flow.
    - Rainfall, because there will be greater flood risk in areas with high rainfall.



We have devised methods to apply the habitat condition indicators, but the demand indicators are more problematic. Various datasets are available, but they all pose problems with double-counting or gaps.

1. **Flood zones.** Simply identifying whether a habitat is in a flood zone (e.g. using the flood maps at https://flood-warning-information.service.gov.uk/long-term-flood-risk/map) misses out the potential for habitats higher in the catchment to reduce flooding lower down. We would need to check whether the impacts of rainfall, slope and soil drainage are implicit in the flood zone maps, or whether they are based only on topology.
2. **Position**: Identifying whether the habitat is located up-slope of a flood zone could be done by just looking at the flood zone map and considering the slope direction, but where the topology is complex or the habitat is a long way from the flood zone it could require modelling of flow paths using GIS or a hydrological model.
3. **Flow accumulation** requires use of GIS or a hydrological model.
4. **Flood risk management plans** (https://www.gov.uk/government/collections/flood-risk-management-plan-frmp-scoping-reports) include estimates of the number of people and properties at risk of flooding for each river basin but do not show this information on a map, so there is no way of knowing how many properties could be affected by a habitat in a certain location.
5. **Catchment Flood Management Plans** (Environment Agency Catchment Flood Management Plans) contain a very useful summary indicator in the form of a Policy Type number for each sub-catchment. This appears to indicate the areas where habitat-related interventions could have an impact in the local catchment (Policies 4 and 5) or in the wider catchment (Policy 6). The advantage of this indicator is that it combines consideration of the magnitude of the flood risk, including the number of people and properties affected, with the potential of a habitat in a certain location to make a difference. This was used as an indicator in the first version of the tool, but the CFMPs are now becoming outdated and will be replaced with the FRMPs which do not include this information.

P1	Little or no flood risk
P2	Low to moderate flood risk – management can be reduced
P3	Low to moderate flood risk – doing OK
P4	Low, moderate or high flood risk – doing OK but more action needed to keep pace with climate change
P5	Moderate to high flood risk – further action needed
P6	Low to moderate flood risk – can store water or manage run-off to provide overall flood risk reduction

- **MAGIC Countryside Stewardship Targeting and Scoring Layers** include a 'flood risk management priority' layer for agri-environment schemes, originating with Natural England in 2014, but there is no information on how this layer was derived and it seems to cover very isolated sub-catchments (see Appendix 1, indicator 5).

- **Opportunity maps**: Two potentially useful datasets highlighting the best places to plant new woodland to reduce flood risk are:

    - the Countryside Stewardship Targeting and Scoring '**Woodland – Flood risk**' layer from the Forestry Commission (2014), which is on MAGIC and also on the FC Land Information System website (https://www.forestergis.com/Apps/MapBrowser/).

- The **Working with Natural Processes (WWNP)** maps generated by JBA consulting, the Environment Agency and Lancaster Environment Centre (available via the EA here and via JBA here).

Both these maps are based on identifying three types of woodland potential:

- Riparian woodland – a 50m buffer of riparian land on smaller river networks
- Floodplain woodland – in Flood Zone 2 (0.1% annual exceedance probability, AEP). However, note that tree planting on floodplains conflicts with the need to preserve and restore flood plain meadows, of which only 3% remain, and could therefore have an adverse impact on biodiversity.
- Wider catchment woodland – slowly permeable soils where woodland could break up naturally impermeable soils and reduce surface run-off. WWNP is based on the underlying geology from BGS, showing surface conditions likely to be associated with the formation of slowly permeable soil. Woodlands for Water (which is not freely available) uses standard percentage runoff (SPR) and Hydrology of Soil Types (HOST) data, both derived from National Soil Resources Institute maps, to estimate areas of land which contribute the most to the fast component of flood response of a river. WWNP identifies some areas missed by Woodlands for Water, where planting trees to break up slowly permeable soils could have local benefits. Woodlands for Water adds other areas where the conceptual models show a contribution to the rapid response part of the flood hydrograph, but without slowly permeable soils indicators present at the surface.

However, both these datasets have had constraints removed: road, rail, urban, water, **existing woodland** and peat. So, **they cannot be used to assign multipliers to reflect the value of existing woodland**. To get around this, we have to ask users to assign high priority to existing woodlands where the boundary adjoins a high priority area, or where those woodlands occur within riparian or floodplain areas or on soils with impeded drainage.

At the time of writing (June 2021) the Environment Agency is about to release a new dataset, Natural Flood Management Priority, which captures certain elements of the demand for flood risk reduction, and we are now incorporating this into the Beta Test version of the EBN tool (see Indicator 4). After evaluation, we may make further refinements to the flood indicators.

Appendix 2: Soil associations at risk of erosion

Evans (1990) 'Soils at risk of accelerated erosion in England and Wales'. Soil Use and Management 6:125.

See http://www.landis.org.uk/downloads/classification.cfm for descriptions of each class.

SoilAssoc	Erosion Risk	Reason	Erodibility
22	Very small	Water	Low
92a	Very small	Water	Low
92b	Small	Water	Low
92c	Moderate	Water	Medium
311a	High	Water wind frost fire and animals in the uplands	High
311b	Moderate	Water wind frost fire and animals in the uplands	Medium
311c	Moderate	Water wind frost fire and animals in the uplands	Medium
311d	Small	Water wind frost fire and animals in the uplands	Low
311e	High	Water wind frost fire and animals in the uplands	High
313a	Moderate	Water wind frost fire and animals in the uplands	Medium
313b	Small	Water	Low
313c	Moderate	Water wind frost fire and animals in the uplands	Medium
341	Small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
342a	Small	Water	Low
342b	Moderate	Water	Medium
342c	Small	Water	Low
342d	Very small	Water	Low
343a	Moderate	Water	Medium
343b	Moderate	Water	Medium
343c	Small	Water	Low
343d	Moderate	Water	Medium
343e	Small	Water	Low
343f	Small	Wind	Low
343g	Moderate	Water	Medium
343h	Moderate	Water	Medium
343i	Small	Water	Low
346	Very small	Water	Low
361	High	Wind	High
372	Moderate	Wind	Medium
411a	Very small	Water	Low
411b	Small	Water	Low
411c	Very small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
411d	Small	Water	Low
421a	Very small	Water	Low
421b	Very small	Water	Low
431	Small	Water	Low
511a	Small	Water	Low
511b	Moderate	Water	Medium
511c	Small	Water	Low
511d	Small	Water	Low
511e	Moderate	Water	Medium
511f	Small	Water	Low
511g	Moderate	Water	Medium
511h	Very small	Water	Low
511i	Very small	Water	Low
511j	Small	Water	Low
512a	Very small	Water	Low
512b	Very small	Water	Low
512c	Very small	Water	Low
512d	Very small	Water	Low
512e	Very small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
512f	Very small	Water	Low
513	Moderate	Water	Medium
521	Very small	Wind	Low
532a	Very small	Water	Low
532b	Very small	Water	Low
541a	Very small	Water	Low
541a	Very high	Water	High
541b	Very small	Water	Low
541b	High	Water	High
541c	Small	Water	Low
541c	Moderate	Water	Medium
541d	Small	Water	Low
541d	Small	Water	Low
541e	Moderate	Water	Medium
541f	Small	Water	Low
541g	Small	Water	Low
541h	Small	Water	Low
541i	Very small	Water	Low
541j	Small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
541k	Small	Water	Low
541l	Small	Water	Low
541m	High	Water	High
541n	Small	Water	Low
541o	Small	Water	Low
541p	Small	Water	Low
541q	Small	Water	Low
541r	Moderate	Water	Medium
541s	High	Water	High
541t	Moderate	Water	Medium
541u	Small	Water	Low
541v	Very small	Water	Low
541w	Very small	Water	Low
541x	Small	Water	Low
541y	Small	Water	Low
541z	Small	Water	Low
542	Small	Water	Low
543	Small	Water	Low
544	Moderate	Water	Medium

SoilAssoc	Erosion Risk	Reason	Erodibility
551a	Very high	Water	High
551b	Very high	Water	High
551c	High	Water	High
551d	Very high	Water	High
551e	High	Water	High
551f	Moderate	Wind	Medium
551g	Moderate	Water	Medium
552a	High	Wind	High
552b	Moderate	Water	Medium
554a	High	Water	High
554b	Very small	Wind	Low
555	Small	Water	Low
561a	Moderate	Water	Medium
561b	Very small	Water	Low
561c	Very small	Water	Low
561d	Moderate	Water	Medium
571a	Small	Water	Low
571a	Small	Water	Low
571b	Moderate	Water	Medium

SoilAssoc	Erosion Risk	Reason	Erodibility
571c	Moderate	Water	Medium
571d	High	Water	High
571e	High	Water	High
571f	Moderate	Water	Medium
571g	Small	Water	Low
571h	Moderate	Water	Medium
571i	Moderate	Water	Medium
571j	Moderate	Water	Medium
571k	Moderate	Water	Medium
571l	Small	Water	Low
571m	Small	Water	Low
571n	Small	Water	Low
571o	Moderate	Water	Medium
571p	Small	Water	Low
571q	Moderate	Water	Medium
571r	Small	Water	Low
571s	Small	Water	Low
571t	Small	Water	Low
571u	Small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
571v	Small	Water	Low
571w	Small	Water	Low
571x	Moderate	Water	Medium
571y	Moderate	Water	Medium
571z	Small	Water	Low
572a	Small	Water	Low
572b	Small	Water	Low
572c	Moderate	Water	Medium
572d	Small	Water	Low
572e	Moderate	Water	Medium
572f	Small	Water	Low
572g	Small	Water	Low
572h	Small	Water	Low
572i	Small	Water	Low
572j	Small	Water	Low
572k	Moderate	Water	Medium
572l	Small	Water	Low
572m	Moderate	Water	Medium
572n	Small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
572o	Small	Water	Low
572p	Moderate	Water	Medium
572q	Small	Water	Low
572r	Small	Water	Low
572s	Moderate	Water	Medium
572t	Very small	Water	Low
573a	Very small	Water	Low
573b	Moderate	Water	Medium
581a	Very small	Water	Low
581b	Very small	Water	Low
581c	Very small	Water	Low
581d	Very small	Water	Low
581e	Small	Water	Low
581f	Small	Water	Low
581g	Small	Water	Low
582a	Small	Water	Low
582b	Small	Water	Low
582c	Small	Water	Low
582d	Small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
582e	Moderate	Water	Medium
611a	Small	Water wind frost fire and animals in the uplands	Low
611b	Small	Water	Low
611c	Small	Water wind frost fire and animals in the uplands	Low
611d	Small	Water wind frost fire and animals in the uplands	Low
611e	Moderate	Water wind frost fire and animals in the uplands	Medium
612a	Very small	Water	Low
612b	Small	Water wind frost fire and animals in the uplands	Low
631a	Small	Water wind frost fire and animals in the uplands	Low
631b	Small	Water	Low
631c	Small	Water	Low
631d	Moderate	Water	Medium
631e	Small	Water	Low
631f	Small	Water	Low
633	Small	Water wind frost fire and animals in the uplands	Low
634	Small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
641a	Moderate	Water	Medium
641b	Very small	Water	Low
641c	Moderate	Wind	Medium
643a	Very small	Water	Low
643b	Small	Water	Low
643c	Very small	Water	Low
643d	Very small	Water	Low
651a	Moderate	Water wind frost fire and animals in the uplands	Medium
651b	Small	Water wind frost fire and animals in the uplands	Low
651c	Moderate	Water wind frost fire and animals in the uplands	Medium
652	Moderate	Water wind frost fire and animals in the uplands	Medium
654a	Moderate	Water wind frost fire and animals in the uplands	Medium
654b	Small	Water wind frost fire and animals in the uplands	Low
654c	Small	Water wind frost fire and animals in the uplands	Low
711a	Small	Water	Low
711b	Very small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
711c	Very small	Water	Low
711d	Very small	Water	Low
711e	Small	Water	Low
711f	Very small	Water	Low
711g	Very small	Water	Low
711h	Very small	Water	Low
711i	Small	Water	Low
711j	Small	Water	Low
711k	Very small	Water	Low
711m	Very small	Water	Low
711n	Small	Water	Low
711o	Small	Water	Low
711p	Very small	Water	Low
711q	Small	Water	Low
711r	Very small	Water	Low
711s	Very small	Water	Low
711t	Very small	Water	Low
711u	Small	Water	Low
711v	Small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
711w	Small	Water	Low
712a	Very small	Water	Low
712b	Very small	Water	Low
712c	Very small	Water	Low
712d	Very small	Water	Low
712e	Very small	Water	Low
712f	Very small	Water	Low
712g	Very small	Water	Low
712h	Very small	Water	Low
712i	Very small	Water	Low
713a	Small	Water	Low
713b	Very small	Water	Low
713c	Very small	Water	Low
713d	Very small	Water	Low
713e	Very small	Water	Low
713f	Very small	Water	Low
713g	Very small	Water	Low
714a	Very small	Water	Low
714b	Very small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
714c	Very small	Water	Low
714d	Very small	Water	Low
721a	Very small	Water wind frost fire and animals in the uplands	Low
721b	Very small	Water wind frost fire and animals in the uplands	Low
721c	Very small	Water wind frost fire and animals in the uplands	Low
721d	Very small	Water wind frost fire and animals in the uplands	Low
721e	Very small	Water wind frost fire and animals in the uplands	Low
811a	Very small	Water	Low
811b	Very small	Water	Low
811c	Very small	Water	Low
811d	Very small	Water	Low
811e	Very small	Water	Low
812a	Very small	Water	Low
812b	Very small	Water	Low
812c	Very small	Water	Low
813	Very small	Water	Low
813a	Very small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
813b	Very small	Water	Low
813d	Very small	Water	Low
813e	Very small	Water	Low
813f	Very small	Water	Low
813g	Very small	Water	Low
813h	Very small	Water	Low
814a	Very small	Water	Low
814b	Very small	Water	Low
814c	Very small	Water	Low
815	Small	Wind	Low
821a	High	Wind	High
821b	Small	Wind	Low
831a	Very small	Water	Low
831b	Small	Wind	Low
831c	Very small	Water	Low
832	Very small	Water	Low
841a	Small	Water	Low
841b	Very small	Water	Low
841c	Very small	Water	Low

SoilAssoc	Erosion Risk	Reason	Erodibility
841d	Very small	Water	Low
841e	Small	Water	Low
851a	Moderate	Wind	Medium
851b	Small	Wind	Low
851c	Moderate	Wind	Medium
861a	Very small	Wind	Low
861b	Moderate	Wind	Medium
871a	Very small	Water wind frost fire and animals in the uplands	Low
871b	Very small	Water	Low
871c	Very small	Water	Low
872a	Small	Wind	Low
872b	Small	Wind	Low
873	Small	Wind	Low
1011a	Very small	Water	Low
1011b	High	Water wind frost fire and animals in the uplands	High
1013a	Moderate	Water wind frost fire and animals in the uplands	Medium
1013b	Moderate	Water wind frost fire and animals in the uplands	Medium

SoilAssoc	Erosion Risk	Reason	Erodibility
1021	Very small	Wind	Low
1022a	Moderate	Wind	Medium
1022b	Very small	Wind	Low
1024a	High	Wind	High
1024b	Moderate	Wind	Medium
1024c	Very small	Wind	Low
1025	Very small	Wind	Low

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ISBN 978-1-78354-760-9

Catalogue code: JP038

APPENDIX E: EBN Principles

Principles of the Environmental Benefits from Nature (EBN tool) approach - Beta Version

enabling wider benefits for people and nature from habitat change

First published 07 July 2021

Natural England Joint Publication JP038

www.gov.uk/natural-england

Natural England Joint Publication JP038

Principles of the Environmental Benefits from Nature (EBN tool) approach

Published 7th July 2021

ISBN: 978-1-78354-758-6

Project details

This report should be cited as:

SMITH, A.C[A]., BAKER, J.[B], BERRY, P.M.[A], BUTTERWORTH, T.[C], CHAPMAN, A.[E], HARLE, T. [E], HEAVER, M.[F], HÖLZINGER, O.[C], HOWARD, B[G]., NORTON, L.R.[H], RICE, P. [E], SCOTT, A. [I], THOMPSON, A [E]., WARBURTON, C [E]. AND WEBB, J [E]. Principles of the Environmental Benefits from Nature (EBN tool) approach (Beta Version, July 2021).

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Expert reviewers and consultees

We are grateful to the attendees of the Phase 1 and 2 and 4 stakeholder meetings and webinars, the Defra group workshop attendees, the pilot projects in Phases 2 and 4, the many expert reviewers, consultees and information providers listed below, the UKHab working group, and fpcr (Sam Arthur and team), who thoroughly tested the tool and guidance during Phase 4 and provided many useful suggestions.

Sean Arnott, Environment Agency
Kath Baldock, University of Bristol
John Boardman, University of Oxford
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Foreword

The last 15 months have 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 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 Biodiversity Metric 3.0 to indicate how changes to habitats can affect the services provided by Nature and the benefits to people. Using the 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

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 has been developed by Natural England and the University of Oxford in partnership with Defra, the Forestry Commission and the Environment Agency to support Government's 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 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 four-year period with a range of input from industry, academia and Government to ensure a robust product for publication. It is now at its Beta release stage and Natural England will be evaluating its use over the coming year 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.

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)

[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.

and detailed impact assessments, such as on flood risk or air quality. It 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 Biodiversity Metric 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.

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1. Introduction

1.1 Why apply the Environmental Benefits from Nature tool?

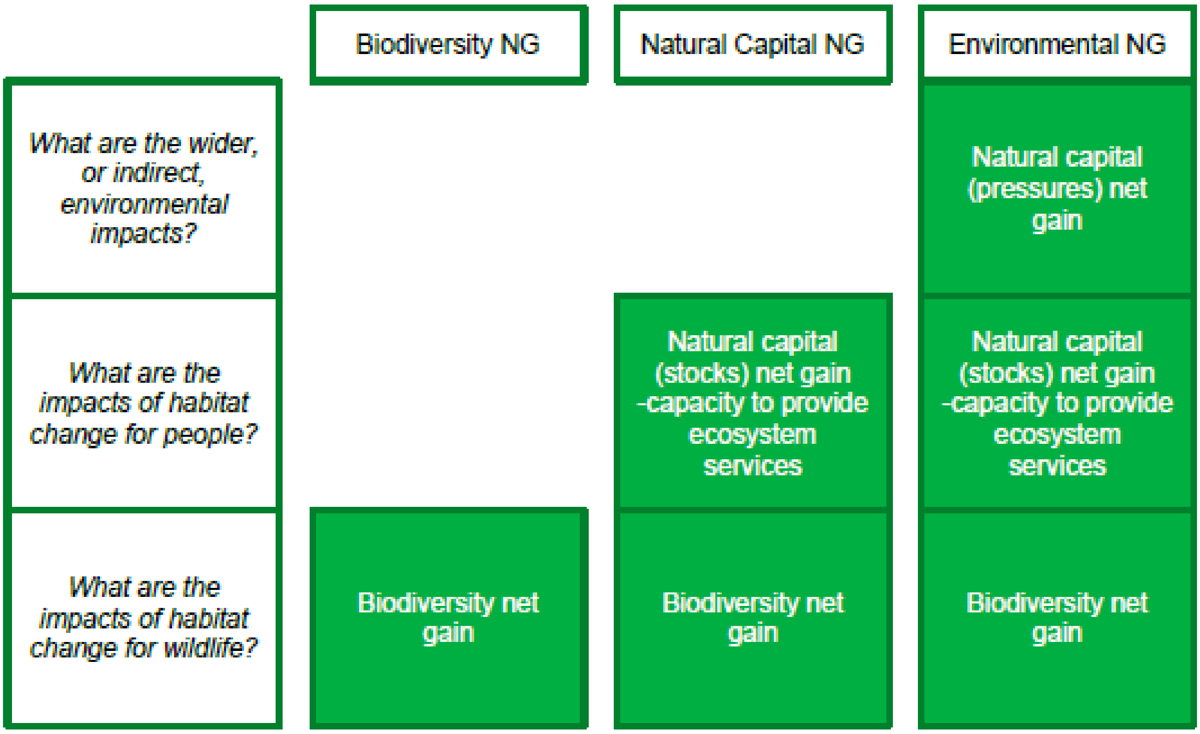
The 25 Year Environment Plan (25 YEP) (HM Government, 2018) sets out the Government's ambition for this generation to leave the environment in a better state than we found it. Achieving this goal is anticipated to require a positive contribution from the development sector. This can be measured at the project level through the concept of 'environmental net gains' referred to through this document as ENG. The 25 YEP states that government will embed an ENG principle for development, including for housing and infrastructure[3]. Government policy in this area is currently under development, but broadly speaking such gains can be described as follows:

Environmental net gains are considered to be: outcomes where a development has resulted in measurable net improvements to the quantity, quality, and/or distribution of locally prioritised natural capital assets and the supply of associated ecosystem services and benefits (above and beyond biodiversity net gain); and reductions in pressures on those assets.

This concept is illustrated in the potential framework for ENG (Figure 1). This shows how ENG incorporates gains in biodiversity and natural capital stocks (soil, water, rocks and all living things), and action to improve resource efficiency that reduces wider pressures on natural capital such as pollution.

[3] "expanding the net gain approaches used for biodiversity to include wider natural capital benefits, such as flood protection, recreation and improved water and air quality".

Figure 1: Relationships between biodiversity net gain and environmental net gains (Defra, 2018)



The EBN tool can help users looking to build on an existing biodiversity net gain 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.

Principles of the EBN tool approach

1.2 What does the EBN tool measure?

The EBN tool supports ENG by focussing on the middle layer of the emerging conceptual framework – assessing the impact of land-use change on ecosystem service provision resulting from biodiversity net gain (see Figure 2). It will highlight potential individual service gains and losses associated with proposed works and indicate 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 policy in this area is still developing and the tool only considers direct impact on natural capital stocks within the existing potential framework (see red box below).

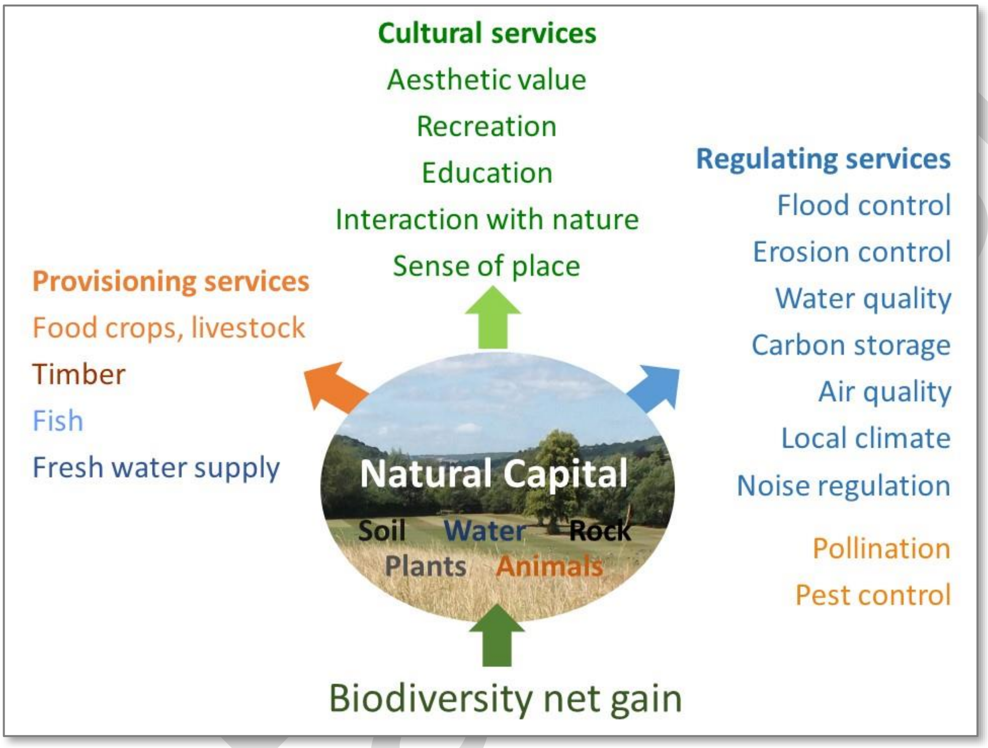
Figure 2: The potential for ENG in development (Defra, 2018). The distinctions made in this table are not clear cut in theoretical or academic terms but are helpful to illustrate the potential scope for ENG in development. Examples of what might be measured in practice are likely to vary for marine development, and for non-development application of net gain. The role of the EBN tool is highlighted 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 the Biodiversity Metric)
			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: direct and indirect pressures on national and international natural capital stocks		Energy efficiency
			Water efficiency
			Transport efficiency
			Construction materials and processes
			Light and noise pollution
			Recreation impacts on protected sites

1.3 What are the links with Biodiversity Net Gain?

The EBN tool is biodiversity-led and recognises that healthy, diverse and resilient ecosystems are essential to underpin the long-term delivery of multiple ecosystem services (Figure 3).

Figure 3: Biodiversity net gain can have wider benefits for natural capital and ecosystem services



The EBN tool is designed to be used in conjunction with the Biodiversity Metric. Gains in biodiversity are expected to act as the primary driver. Other benefits, identified through EBN tool, are intended to add to, rather than compete with, BNG considerations to offer benefits for both people and nature. These should be delivered through the established mitigation hierarchy: avoid damage, minimise damage, restore or rehabilitate damaged habitats, and only compensate through offsetting as a last resort.

Within this hierarchy there are often different ways of achieving biodiversity net gain, for example when choosing what type of habitats to create or restore and where to position them, offering flexibility in its application and design. The EBN tool allows users to explore such opportunities to enable the delivery of wider natural capital benefits.

Such benefits can often be optimised by considering multiple objectives, for example siting new woodland in an optimum location for flood protection or air quality regulation, improving public access for recreation, creating flower-rich grassland to benefit pollinators, providing green roofs for cooling, and planting the right 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:

1. **Simple** and easy to use, using freely available data and/or data gathered as part of Phase 1 or equivalent surveys
2. **As scientifically robust as possible**, using best available evidence
3. Able to incorporate the impact of **ecosystem condition and quality** and **spatial location** on ecosystem service (ES) supply.

The approach mirrors the Biodiversity Metric's methodology, by applying a matrix of scores for different habitats and ecosystem services which are modified by factors reflecting habitat condition, spatial location, delivery risk, and time for new habitats to reach maturity (see Section 3).

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 that achieves biodiversity net gain 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 website for more information on different tools).

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 biodiversity net gain in order to deliver wider environmental benefits from nature for people. 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:

1. Compare alternative options for site design (habitats, spatial configuration) at the pre-application, masterplanning, feasibility or early or detailed design stages.

2. Assess the impact of land use change (e.g. changes to habitat type or condition) 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:

1. Improve the design of biodiversity net gain projects so that they deliver multiple benefits for nature and people
2. Strengthen the business case for investment in biodiversity net gain by demonstrating the wider benefits that it can generate, beyond biodiversity enhancement
3. Increase transparency in decision-making on biodiversity net gain, by allowing evaluation of losses and gains of different ecosystem services.

It can offer the following benefits to key audiences:

Developers and their consultants and contractors: When a development project achieves biodiversity net gain, 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 the business case and help increase the benefits from investing in improved habitats for biodiversity.

Development management and policy planners: Understanding and assessing the wider environmental and societal benefits of biodiversity net gain can help planners, businesses and communities to tailor biodiversity net gain projects so that they also deliver local and national priorities for investment in natural capital. 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.

It has been designed as a project-based tool, though we have also tested the use of the EBN tool 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 can still provide a useful tool at this scale to encourage consideration of the potential impact of land use change on ecosystem service delivery. Defra's ENCA website has more information on other approaches or tools that can help natural capital and ecosystem service decision making at this scale.

Principles of the EBN tool approach

2. Good practice principles

The EBN tool is founded on four 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**
- **Avoid adding together scores for individual ecosystem services**

2.1 Make biodiversity net gain the primary driver

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 an approved Biodiversity Metric, such as Biodiversity Metric 3.0, 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). However, the design of a biodiversity compensation site should be based first and foremost on the biodiversity net gain good practice principles, and never only to maximise EBN tool scores for ecosystem services.

2.2 Apply the mitigation hierarchy

Both the Biodiversity Metric and the EBN tool should be firmly embedded within the mitigation hierarchy, as specified in the UK's biodiversity net gain good practice principles and associated guidance (CIEEM, CIRIA and IEMA 2016; Baker et al., 2019):

1) avoid damage,
2) minimise damage,
3) restore or rehabilitate damaged habitats, and
4) only compensate any residual damage through offsetting as a last resort.

As well as following the mitigation hierarchy, users of the EBN tool should follow all the good practice principles of biodiversity net gain (CIEEM, CIRIA and IEMA, 2016), especially 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 biodiversity net gain throughout the project life cycle (Baker et al. 2019).

2.3 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 ‘the right tree in the right place’ should be followed, as well as the relevant statutory guidance in the NPPF, and industry good practice including on biodiversity net gain (CIEEM, CIRIA and IEMA 2016; 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 biodiversity net gain.

As with any other tool or model, **you must ‘sense check’ the EBN tool outputs**. 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 biodiversity net gain. 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.

2.4 Avoid adding 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 particular 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:

1. The scores for different services are not directly 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.

2. The scores do not represent actual biophysical values, only relative rankings between different habitats for delivering each service.
3. Adding may obscure large gains or losses in individual ecosystem services.
4. Adding scores together risks double counting, for services that may partially overlap (e.g. aesthetic value and ‘sense of place’).

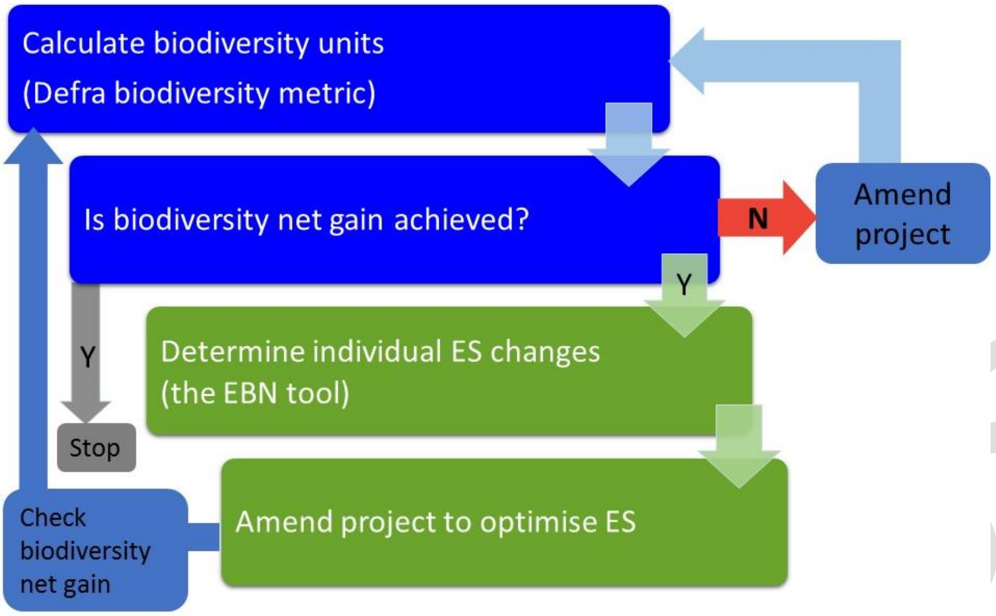
3. Background to how the EBN tool works

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. The full technical report of tool development to date is being finalised and will be published separately.

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 Biodiversity Metric results, the biodiversity and wider net gain assessment should be updated to ensure that biodiversity net gain is achieved in line with good practice guidance.

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 Biodiversity Metric, 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.

The EBN tool mirrors the approach of the Biodiversity Metric. This multiplies habitat area by a habitat distinctiveness 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).

The Biodiversity Metric

Baseline (before habitat change):

Biodiversity units = Habitat area x Distinctiveness x Condition x Spatial factors

Post-development or intervention:

Biodiversity units = Habitat area x Distinctiveness x Condition x Spatial factors x Time to target condition x Delivery risk

For 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.

Principles of the EBN tool approach

The EBN tool

Baseline (before habitat change):

ES1 = Habitat area x Score x Condition x Spatial factors

ES2 = Habitat area x Score x Condition x Spatial factors

ES3 = Habitat area x Score x Condition x Spatial factors

ES4 = Habitat area x Score x Condition x Spatial factors

Post-development or intervention:

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

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

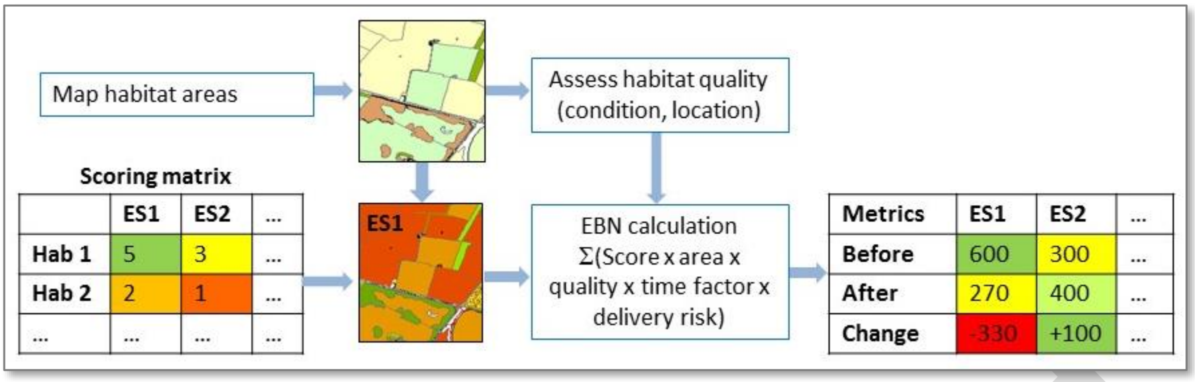
ES3 = Habitat area x Score x Condition x Spatial factors x Time to target condition x Delivery risk

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

For the Biodiversity Metric, the scores for all habitats on the site are added together to give total biodiversity units. For the EBN tool, this is done separately for each ecosystem service, first for the 'baseline' habitats before the proposed change, 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 baseline and post-development scores (Figure 5). 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 biodiversity net gain 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 biodiversity net gain design in order to deliver net gain where possible, whilst recognising that some trade-offs may occur.

Figure 5: How the EBN tool works



3.2 Habitat / land-use classification

Users can enter habitat types using either UKHab, Phase 1 or Biodiversity Metric habitat classifications, and the EBN tool will automatically translate these to a simplified set of 'eco-metric' habitats (named after an earlier name used for this tool). This includes both semi-natural habitats and urban habitats including the built environment, urban green infrastructure (GI) and Sustainable Drainage Systems (SuDS) features. The eco-metric 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 Biodiversity Metric 3.0. 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 1) 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. 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 1: 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
Broadleaved, mixed and yew plantation
Native pine woodlands
Coniferous plantation
Wood pasture and parkland with scattered trees
Traditional orchards
Dense scrub
Hedgerows
Hedgerow with trees
Felled woodland
Tall herb and fern
Ephemeral / short perennial
Bracken
Semi-natural grassland
Acid grassland
Calcareous grassland
Neutral grassland
Calaminarian grasslands
Poor semi-improved grassland
Improved grassland
Arable fields, horticulture and temporary grass
Arable field margins
Woody biofuel crops
Intensive orchards
Bog
Dwarf shrub heath
Inland rock
Freshwater
Standing open water
Canals
Running water
Fen, marsh and swamp
Lowland fens
Purple moor grass and rush pastures
Upland flushes, fens and swamps
Aquatic marginal vegetation
Reedbeds
Other swamps

Coastal rock
Biogenic reefs
Coastal saltmarsh
Coastal lagoons
Seagrass beds
Vegetated dunes and shingle
Beach and bare sand
Other littoral sediment
Sealed surface and buildings
Artificial unvegetated, unsealed surface
Bare ground
Garden
Vegetated garden
Unvegetated garden
Open mosaic habitats on previously developed land
Parks and gardens
Footpath / cycle path - green
Green bridge
Amenity grassland
Road island / verge
Natural sports pitch, recreation ground or playground
Cemeteries and churchyards
Allotments, city farm, community garden
Intensive green roof
Green wall
Brown roof or extensive green roof
Tree
SuDS retention pond
SuDS detention basin
Bioswale
Rain garden
Introduced shrub
Flower bed
Suburban/ mosaic of developed/ natural surface

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 (Table 3), 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 eco-metric 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 2.

Table 2: 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 3: 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.
	Local climate regulation	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 Biodiversity Metric); existence value (from just knowing that nature exists).
	Sense of place	The 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.

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 are 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).

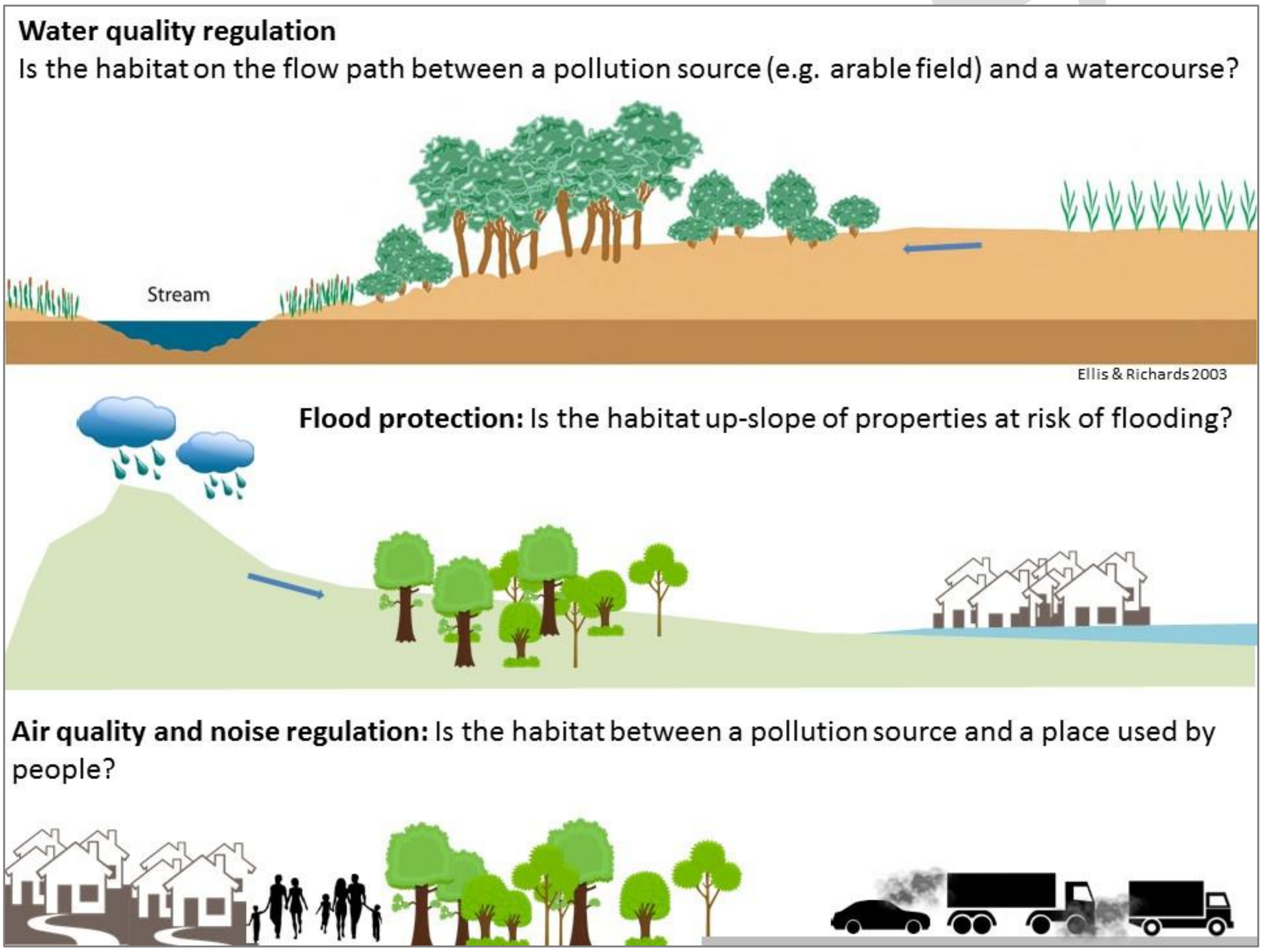
3.5 Habitat condition indicators and spatial factors

The matrix of scores reflects the performance of a ‘typical’ habitat. Multipliers are then applied based on 40 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) and woodland (bottom) with very different condition.

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 Biodiversity Metric 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 4 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 Defra's MAGIC 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 Biodiversity Metric 3.0, 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 4: Condition indicators and spatial factors applied for each service (See Data Catalogue for full details)

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

Ecosystem Service	Condition indicators and spatial factors	Source
Food provision	Agricultural Land Class	MAGIC
Fish production	WFD (Water Framework Directive) overall ecological and chemical status	Catchment Data Explorer (Environment Agency (EA))
	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	Catchment Abstraction Management Status (EA)
	Groundwater availability in the catchment	WFD groundwater quantitative status (EA)
	Soil drainage	LANDIS
	Soil compaction	Site assessment

Ecosystem Service	Condition indicators and spatial factors	Source
Flood regulation	Ability of habitats to mitigate flood risk: Maximum of three indicators (= Natural Flood Management priority (1st of 3 flood demand indicators); Woodland for flood risk (2nd of 3 flood demand indicators; WWNP target zone. (3rd of 3 flood demand indicators)).	Online maps (Environment Agency and MAGIC)
	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	Met Office website
	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?	Catchment Data Explorer (Environment Agency)
	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
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

Ecosystem Service	Condition indicators and spatial factors	Source
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	CAVAT website
	Public access (Y/N)	Local knowledge
	Special recreational value	MAGIC
	Linear habitat multiplier	Applies to paths, running water, hedges
Aesthetic value	Flower abundance and diversity	Site assessment
	Tree size	Site assessment
	Landscape diversity / habitat mosaic: number of different semi-natural habitats on site	Site map
	Water body naturalness	Site assessment
	Linear habitat multiplier	Applies to running water, hedges
Education	Population density in local area	CAVAT website
	Educational use	Local knowledge
	Nature designation	MAGIC
	Cultural designation	MAGIC; 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	MAGIC
	Ancient habitat	MAGIC
	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
Sense of place	Tree size	Site assessment
	Nature designation	MAGIC

Principles of the EBN tool approach

Ecosystem Service	Condition indicators and spatial factors	Source
	Cultural designation	MAGIC; local authority
	Ancient habitat	MAGIC
	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

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 Biodiversity Metric 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 similar delivery risk factors to Biodiversity Metric 3.0 for habitat creation. The delivery risk factors are slightly different, however, because pilot tests showed that using exactly the same factors as the Biodiversity Metric 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). The Biodiversity Metric applies high risk factors because it aims to ensure adequate compensation for any lost areas of semi-natural habitat. The EBN tool is applied together with the Biodiversity Metric and therefore this compensation should already be guaranteed by achievement of BNG. We aim to gather further feedback on this issue during Beta testing.

We do not apply a delivery risk factor for habitat restoration / enhancement because enhancement is considered to be 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.

The Biodiversity Metric excludes irreplaceable habitats (e.g. ancient woodlands) because they cannot be offset as part of biodiversity net gain. Irreplaceable habitats should not be destroyed. 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.

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 Biodiversity Metric calculation should be updated to check that the project still produces a biodiversity net gain in line with good practice guidance.

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
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	↘	→	↗	●	

Expand Collapse

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, 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. 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).

4.2 Consideration of design

There are many sources of existing guidance on how to improve different aspects of project design in order to enhance the delivery of natural capital, green infrastructure and biodiversity. The National Design Guide[4] 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[5] 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 is currently developing a National Framework of Green Infrastructure Standards which aims to enhance the quantity, quality and functionality of green infrastructure. Guidance on designing effective green infrastructure will be integral to this work. 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.

4.3 Consideration of landscape-level impacts

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 maintain a mix of habitat types appropriate to the character of the area, rather than focusing purely on the type that gives the largest scores. The aim should be to create an appropriate 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.

4.4 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

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

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

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.

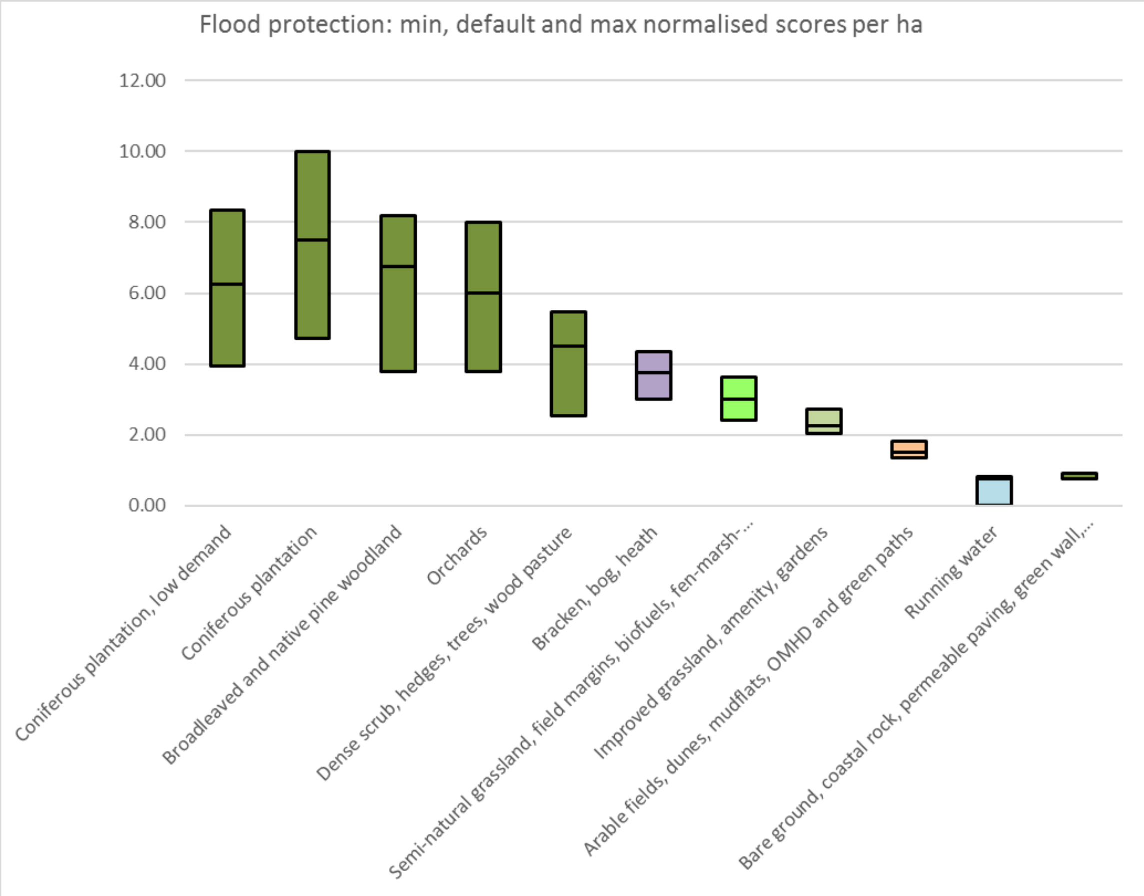
3.Confidence ratings for the EBN tool scores and multipliers vary

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

Figure 9: Example of sensitivity test comparing the impact of condition and spatial multipliers for the ecosystem service of flood protection



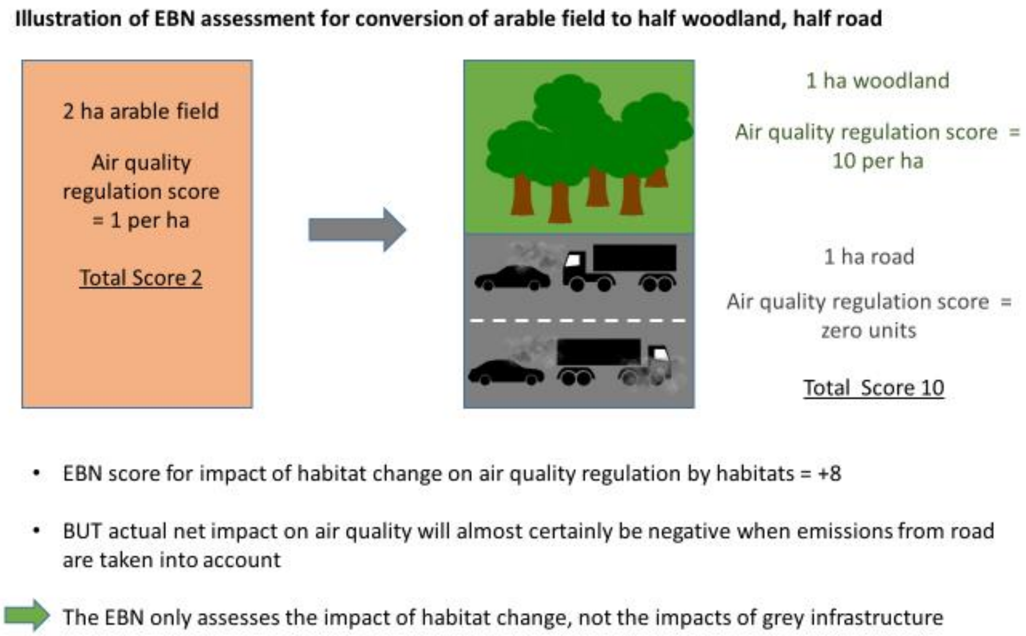
4.The EBN tool results are not cumulative and do not account for the cumulative impact of losses over the time periods shown

As stated above 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 10).

Figure 10: 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)



5. Evaluating Use

The EBN tool has been released as a Beta Test version. A survey is available to allow users to provide feedback to Natural England. Users are encouraged to take part to help Natural England determine next steps for the EBN tool.

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ISBN 978-1-78354-758-6

Catalogue code: JP038

APPENDIX F: EBN User Guide

Environmental Benefits from Nature (EBN) Tool - Beta Release User Guide

First published 07 July 2021

Natural England Joint Publication JP038

www.gov.uk/natural-england

NATURAL ENGLAND

Natural England Joint Publication JP038

Environmental Benefits from Nature (EBN) Tool Beta Release User Guide

Smith, A.C., Baker, J., Berry, P.M., Butterworth, T., Chapman, A., Harle, T., Heaver, M., Hölzinger, O., Howard, B., Norton, L.R., Rice, P., Scott, A., Thompson, A., Warburton, C. and Webb, J.

Published 07 July 2021

ISBN: 978-1-78354-759-3

Citation

SMITH, A.C[A]., BAKER, J.[B], BERRY, P.M.[A], BUTTERWORTH, T.[C], CHAPMAN, A.[E], HARLE, T.[E], HEAVER, M.[F], HÖLZINGER, O.[C], HOWARD, B[G]., NORTON, L.R.[H], RICE, P.[E], SCOTT, A.[I], THOMPSON, A[E]., WARBURTON, C[E]. AND WEBB, J[E]. Environmental Benefits from Nature (EBN) Tool – User Guide (Beta Version, July 2021).

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Acknowledgements

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Expert reviewers and consultees

We are grateful to the attendees of the Phase 1 and 2 and 4 stakeholder meetings and webinars, the Defra group workshop attendees, the pilot projects in Phases 2 and 4, the many expert reviewers, consultees and information providers listed below, the UK Hab working group, and fpcr (Sam Arthur and team), who thoroughly tested the tool and guidance during Phase 4 and provided many useful suggestions.

Sean Arnott, Environment Agency
Kath Baldock, University of Bristol
John Boardman, University of Oxford
Chris Bolton, Natural England
Tom Breeze, Reading University
Mark Broadmeadow, Forestry Commission
Bill Butcher, eCountability, UKHab
Pete Carey, Bodsey Ecology Ltd, UKHab
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Stuart Pasley, Natural England
Simon Potts, Reading University
Joanna Russell, Natural England
Sarah Jane Scott, Environment Agency
Dave Stone, Natural England
Jo Treweek, eCountability and UK Hab
Chris Uttley, Environment Agency
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1. Introduction

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 and enable wider benefits for people and nature from habitat change. It has been developed by Natural England and the University of Oxford in partnership with Defra, the Forestry Commission and the Environment Agency to support Government's 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.*

The EBN tool is designed to be used in conjunction with Biodiversity Metric 3.0. Once biodiversity net gain has been demonstrated using the Biodiversity Metric, the EBN tool can be used to identify opportunities to enhance ecosystem service provision and to avoid then minimise any negative impacts. It can help to inform better project design by indicating potential gains or losses in the supply of ecosystem services and can help to make negotiation over land-use change more transparent for all stakeholders. The EBN tool is a scoping tool and is intended to be used alongside a suite of other approaches, including Environmental Impact Assessments (where required) and detailed impact assessments, such as on flood risk or air quality, where necessary.

The EBN tool is based on scores (on a scale of 0-10) for the ability of different types of land cover to deliver 18 ecosystem services, based on a literature review and expert consultations. The scores are modified by applying multipliers based on 40 indicators of habitat condition and spatial location, and then multiplied by the area of habitats, as well as by multipliers to reflect delivery risk and the time taken for new habitats to reach their target condition. This calculation is performed first for the habitats in the baseline (before change) and then for the habitats after the planned development or other land-use intervention (which should deliver biodiversity net gain – as outlined on section 1.3 of the EBN Principles Document). The results indicate the change in provision of ecosystem services from the baseline to the post-development situation.

This user guide explains how to operate the tool. It should be used together with:

- **The Principles of the Environmental Benefits from Nature (EBN Tool) approach**. This explains the overall approach and summarises good practice principles, caveats and limitations. This is crucial in ensuring that the tool will be applied correctly as part of the biodiversity mitigation hierarchy and will not lead to perverse outcomes. It is strongly recommended that this document should be read before operating the tool.

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

- **The Data Catalogue**, which explains how to determine values for the condition indicators and spatial factors.

A simplified 'quick start' version of the guidance below is also provided on the 'Instructions' tab within the EBN tool for ease of reference.

2. Getting started

2.1 Hardware and software requirements

The tool is designed to be used with Microsoft Excel from version 2012 onwards. It does not work well with earlier versions, including Excel 1997-2003 or Excel Online, as there is loss of functionality. The tool was built and tested in MS Windows. It has only been briefly tested on a Mac and, while it appeared to work, any users wishing to use it on a Mac should be vigilant in case there is any loss of functionality.

Three versions of the spreadsheet are available:

1. Short empty version (500 rows) suitable for relatively simple projects
2. Short version with an example filled in, for information only
3. Long version (5000 rows) for larger or more complex projects.

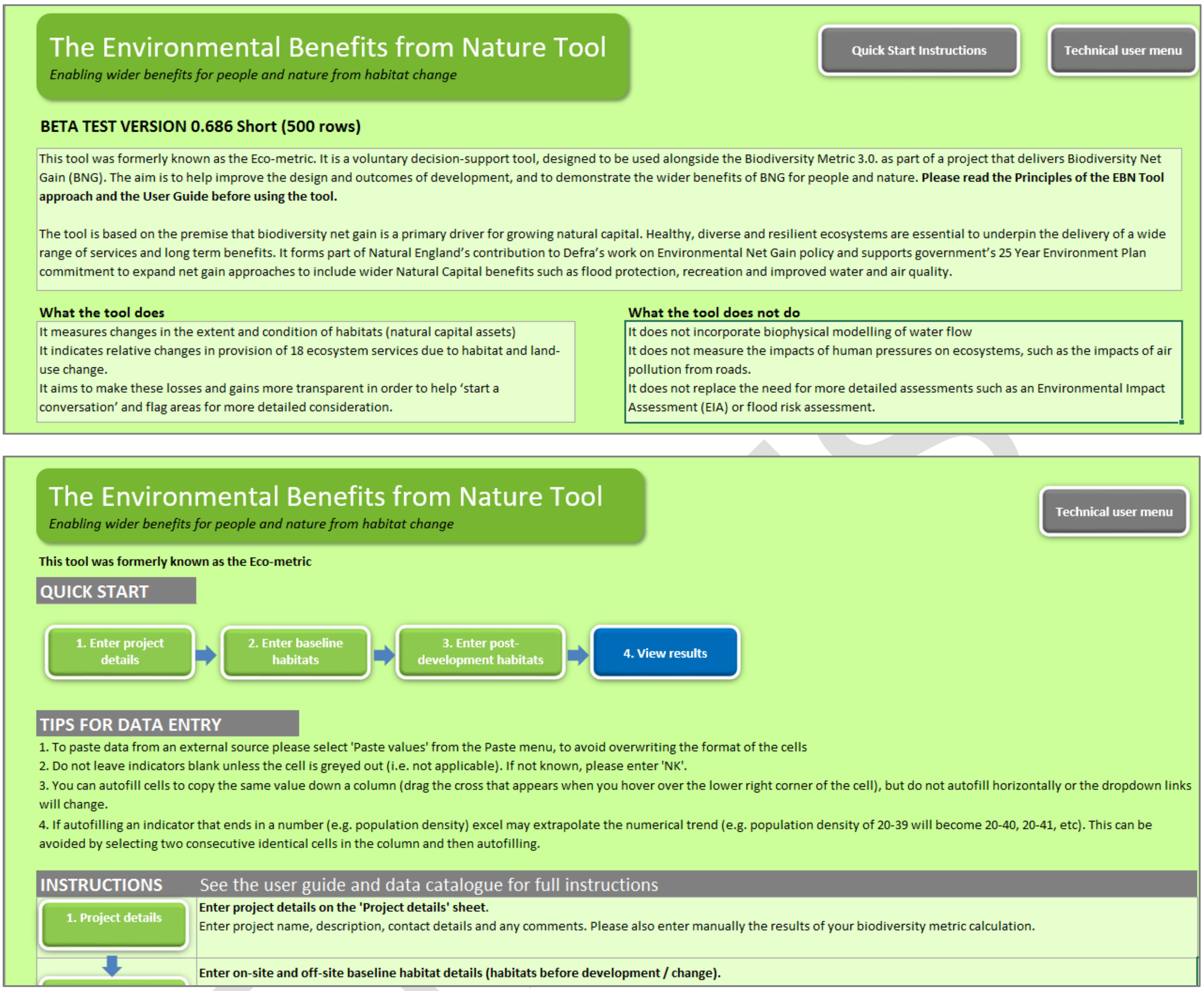
When you open the tool, you may see a prompt saying 'Macros have been disabled. Click to enable content'. Click on OK. The tool uses a few simple macros, e.g. to hide and un-hide sheets that are not being used.

Please note that the tool is saved as an Excel binary workbook (.xlsb extension) simply because this reduces the size of the file by about half and thus improves performance. When saving a copy of the tool please always save as an Excel binary workbook.

2.2 The Welcome and Quick Start Instructions sheets

The Welcome sheet provides a brief overview of the tool, states the version number and whether this is the long or short version. The Quick Start button provides brief instructions and links to the main data entry and results sheets. The Technical user menu provides access to all sheets in the workbook (see Section 2.6), but most users will not need to access these (see Appendix 1 for details of the other sheets).

Figure 1. The Welcome and Quick Start Instructions sheets



The tool contains three data entry sheets (green tabs):

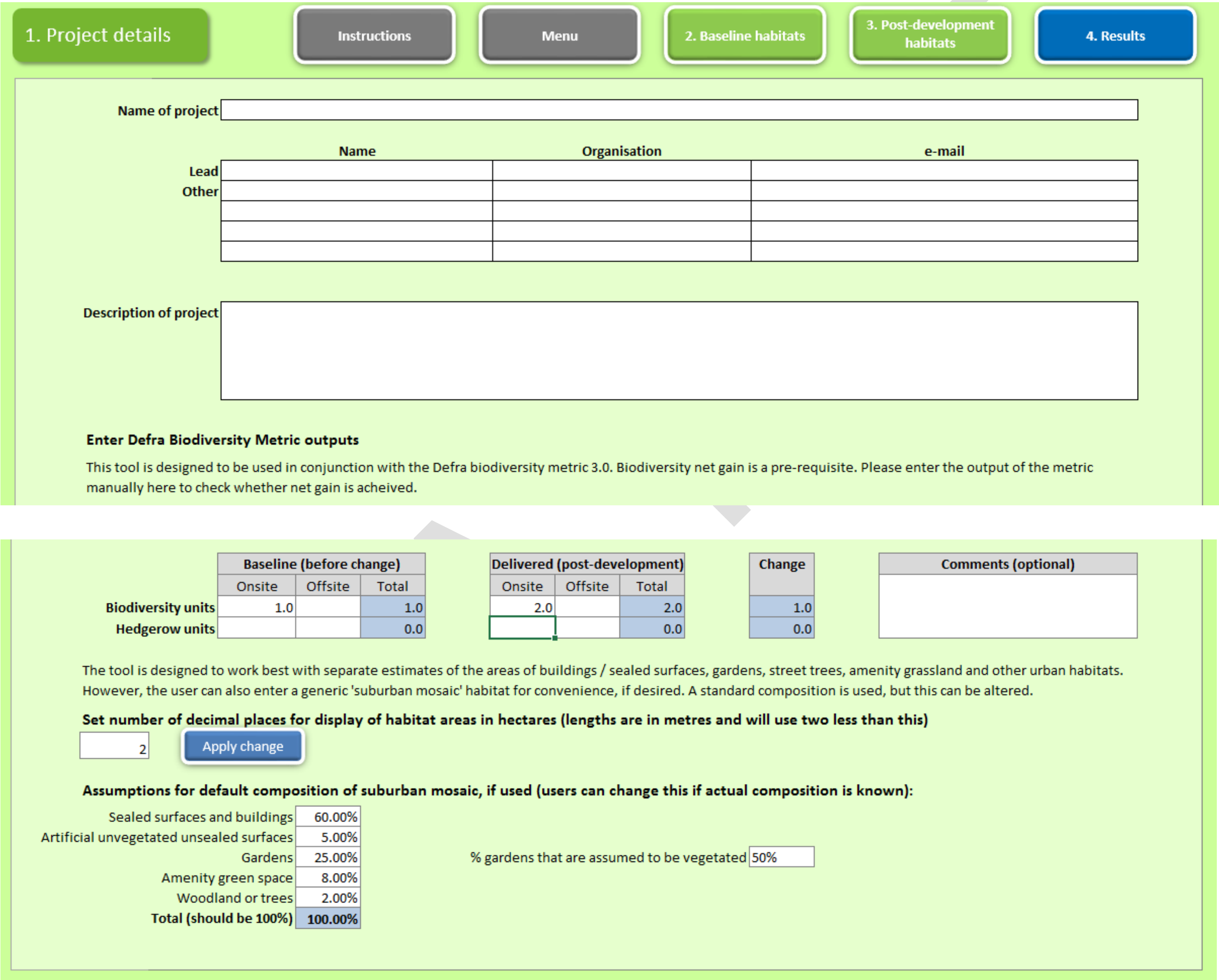
1. Project details
2. Baseline habitats
3. Post-development habitats.

2.3 The Project Details sheet

Start by filling in the white cells in the 'Project details' sheet (Figure 2). You can enter names and contact details of people working on the EBN tool assessment, a title and a brief description of the project. If you are testing alternative design options, make a copy of the EBN tool spreadsheet for each option. The description box can be used to describe each option. There is a larger space for optional notes below these details.

In order to demonstrate that biodiversity net gain has been achieved, please manually enter the results of your biodiversity metric assessment on this sheet. These results are for information only – they are not used in the EBN tool calculations. Alternatively, the EBN tool can be used to inform the design of a biodiversity net gain project, in which case you do not need to enter anything in these cells at this stage.

Figure 2. The Project details sheet


1. Project details | Instructions | Menu | 2. Baseline habitats | 3. Post-development habitats | 4. Results

Name of project

	Name	Organisation	e-mail
Lead			
Other			

Description of project

Enter Defra Biodiversity Metric outputs

This tool is designed to be used in conjunction with the Defra biodiversity metric 3.0. Biodiversity net gain is a pre-requisite. Please enter the output of the metric manually here to check whether net gain is acheived.

	Baseline (before change)			Delivered (post-development)			Change	Comments (optional)
	Onsite	Offsite	Total	Onsite	Offsite	Total		
Biodiversity units	1.0		1.0	2.0		2.0	1.0	
Hedgerow units			0.0			0.0	0.0	

The tool is designed to work best with separate estimates of the areas of buildings / sealed surfaces, gardens, street trees, amenity grassland and other urban habitats. However, the user can also enter a generic 'suburban mosaic' habitat for convenience, if desired. A standard composition is used, but this can be altered.

Set number of decimal places for display of habitat areas in hectares (lengths are in metres and will use two less than this)

2 | Apply change

Assumptions for default composition of suburban mosaic, if used (users can change this if actual composition is known):

Sealed surfaces and buildings	60.00%
Artificial unvegetated unsealed surfaces	5.00%
Gardens	25.00%
Amenity green space	8.00%
Woodland or trees	2.00%
Total (should be 100%)	**100.00%**

% gardens that are assumed to be vegetated 50%

2.4 Setting the number of decimal places for areas, lengths and widths

The Project details sheet allows users to select the number of decimal places that will be used for habitat areas (in hectares) on the data entry sheets, choosing from 2, 3 or 4 decimal places. The options of 3 or 4 decimal places make it easier for users to enter and view data for very small sites.

2.5 Defining ‘suburban mosaic’

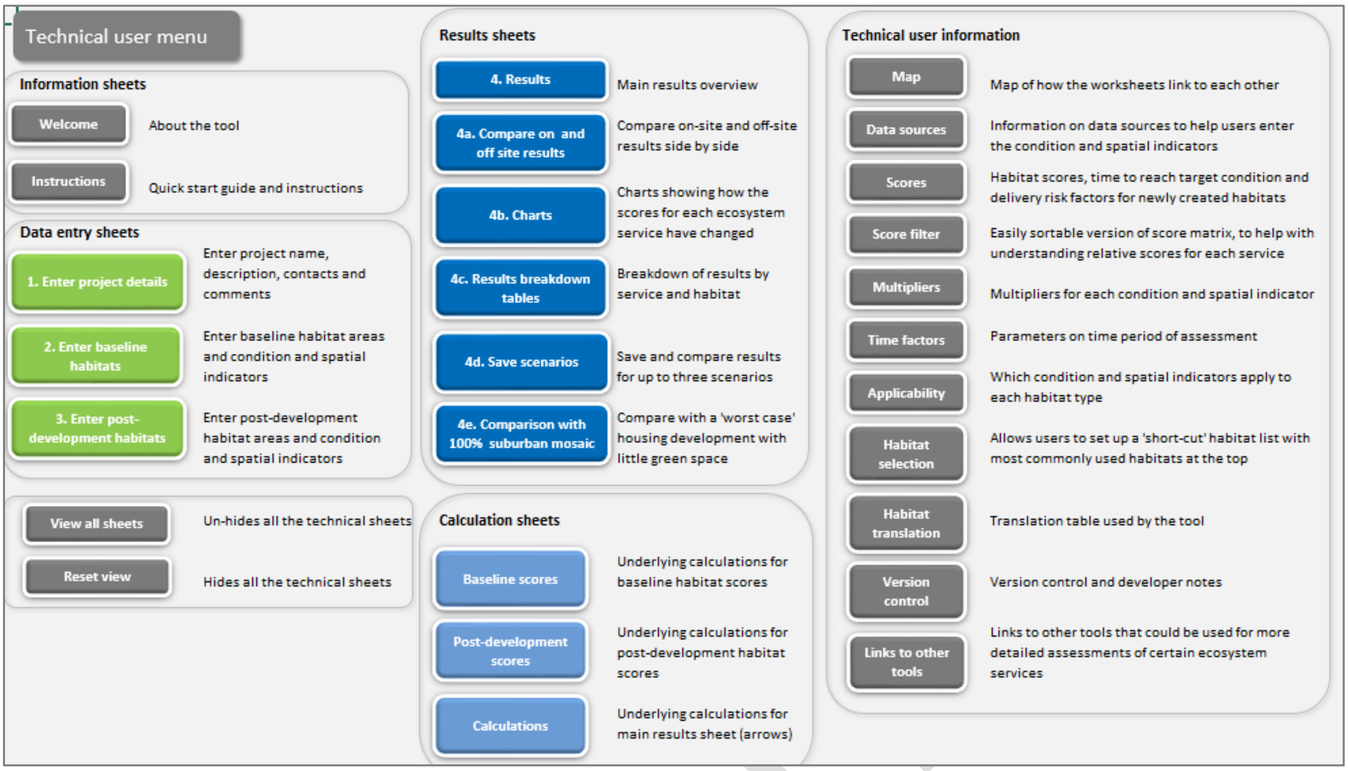
This sheet also provides a facility to define a ‘suburban mosaic’ habitat based on specific proportions of sealed surfaces (buildings, roads, car parks etc.), gardens, amenity grass and woodland, including a parameter to estimate what percentage of gardens are vegetated. It is preferable to specify these habitat types separately when entering data, but the ‘mosaic’ can be used to provide a default estimate if the exact layout of a new development is not yet known. Scores for the suburban mosaic are calculated within the tool by weighting the scores for the individual habitats (sealed surfaces, gardens etc.) according to the proportions defined here. The tool is supplied with a ‘typical’ suburban mosaic, but you can change this on this sheet if your development has a different mix of habitats.

Next you need to fill in the habitat data (see Section 3) and indicators (see Section 4) on the two main data entry sheets: baseline habitats and post-development habitats. While you are in the process of filling in these sheets, you will see errors on the Results sheet, but once they are filled in correctly the results will appear as shown in Section 5.

2.6 Technical menu

The EBN tool is designed to be simple to use yet transparent. When the tool is first opened only the essential data entry sheets and the results sheet are displayed. However, all the sheets used within the tool are available from the technical user menu, accessible from the Menu button at the top of each worksheet. This gives access to the underlying scores and multipliers, the habitat translation tables, and the calculation sheets (see Appendix 1 for full list). You can also reset to the default view in which only the essential sheets are displayed, or unhide all the sheets instantly.

Figure 3. Technical Menu



3. Entering habitat types and areas

3.1 Data structure

The EBN tool is designed to be used together with the Biodiversity Metric 3.0. It can be used to assess housing or infrastructure developments or changes in land use and management which affect habitat type and condition – though it is not designed to capture the fine detail of projects which only involve subtle changes in habitat condition, such as improvements to land management.

Both the EBN tool and the Biodiversity Metric require data on the area of habitats (or length and width for linear habitats such as hedgerows, rivers and streams) for:

- **On-site: the area affected by the development or intervention**, including the site and any surrounding areas where habitats and/or their condition will be directly or indirectly affected:
    - Before development or intervention (baseline).
    - After development or intervention (post-development /biodiversity net gain delivery).
- **Any off-site areas used to create or restore habitats** as part of the development's biodiversity net gain delivery:

- Before habitat creation and/or restoration (baseline)
- After habitat creation and/or restoration (post-development /biodiversity net gain delivery).

Typically, the habitat areas for the baseline (before intervention) could be derived from a habitat survey using JNCC Phase 1 or UKHab, while after development the habitat areas could come from a Masterplan, Ecological Impact Assessment (EcIA), detailed site design or biodiversity net gain management plan.

In this user guide we will refer to 'parcels' of habitat. A parcel is simply a continuous block of habitat as defined on a map, such as a field or garden. Parcels before development do not have to be the same size and shape as parcels after development. There are two main approaches for entering habitat data:

1. For relatively small and simple developments or interventions you can enter a separate row for every parcel of habitat.
2. For large and complex developments with thousands of parcels, you can aggregate parcels of the same habitat into groups that have the same values for all the condition and spatial indicators and enter each group on a single row.

It is best not to start entering habitat data until you know whether you need to sub-divide any of your habitat parcels or groups of parcels to reflect different condition and spatial factors. For example, you might find that an agricultural field is partly in one Agricultural Land Class category and partly in another. If this is the case, you could either simply choose to assign the whole field to the category that covers the greatest area, or you could split the field into two parcels (this is the most accurate option).

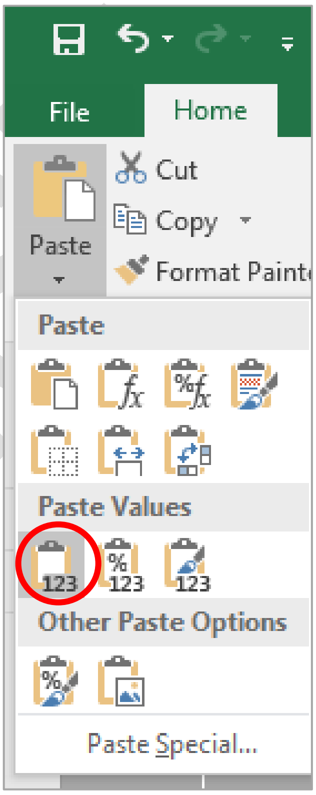
For all but the smallest projects, use of a Geographic Information System (GIS) will streamline calculation of habitat areas and (if necessary) enable parcels to be subdivided according to different condition or spatial indicators (see Section 6).

Sealed surfaces (e.g. roads and buildings) can always be aggregated (i.e. they can be entered on a single row) because they have a score of zero and will therefore not be affected by any condition or spatial factors. Gardens in a new housing development can also probably be aggregated into a single row as their condition is unlikely to vary unless they fall into different zones for indicators such as flood risk.

It is possible to paste habitat types and areas from the Biodiversity Metric into the EBN tool following the instructions in section 3.4. However, you may then need to subdivide the habitat types onto separate rows in the EBN tool data entry sheets, according to their values for the EBN tool condition and spatial indicators. Therefore, it could be easier to generate the EBN tool input data separately in a standalone process.

3.2 Data entry

Box 1: Important tips for data entry



When entering data, please note:

• If pasting from another source, always use ‘Paste Values’. Right click on the cell and choose ‘Paste Special’ or go to the Home tab of the menu, click on Paste in the top left of the menu bar, choose ‘Paste Special’. Then select the plain ‘123’ clipboard icon (<u>not</u> the one with a % sign or a paintbrush). This means that only the values will be pasted, not the formats, preserving the format of the cells.

• Do not try to ‘cut’ or ‘move’ cells as this may corrupt the tool functionality.

• You can autofill cells to copy the same value down a column (drag or double click the cross that appears when you hover over the lower right corner of the cell, see Figure 8, Section 4.2), but do not autofill horizontally across columns because this will change the dropdown selections.

• If auto-filling an indicator that ends in a number (e.g. population density), Excel may extrapolate the numerical trend (e.g. population density of 20-39 will become 20-40, 20-41, etc.). To avoid this, always select two consecutive identical cells in the column and then autofill (see Figure 8, Section 4.2).

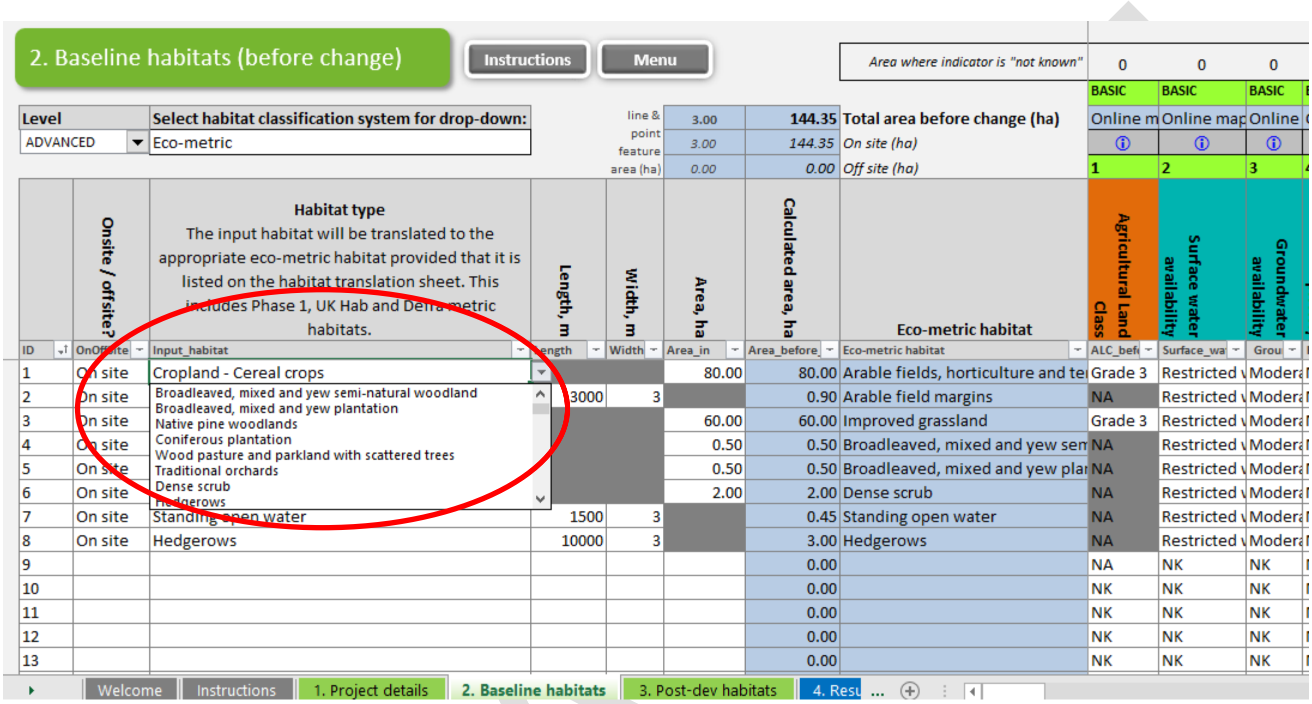
Start by entering habitats on the ‘2. Baseline habitats’ sheet. The white cells are for data entry.

Please note: the data entry sheets and many of the other sheets are set to ‘**Freeze panes’**, so that the left-hand columns and the top rows of labels are always visible as you scroll across and down the sheet. However, this can be turned off if desired by going to the View menu.

There is an **optional 'ID' column** where you can enter a code corresponding to specific habitat parcels, for your own reference. This is filled in as "1,2,3...." by default but can be changed by the user. It is not used in the calculations.

Enter **‘On site’ or ‘Off site’** in the next column. This enables on-site and off-site habitats to be displayed separately on Results sheet 4a. Note that offsetting losses of habitat with gains elsewhere can be on or off-site. If you leave this cell blank but enter a habitat type and area, it will be highlighted in red to remind you to select On site or Off site.

Figure 4. Baseline data entry sheet showing drop-down for habitat selection

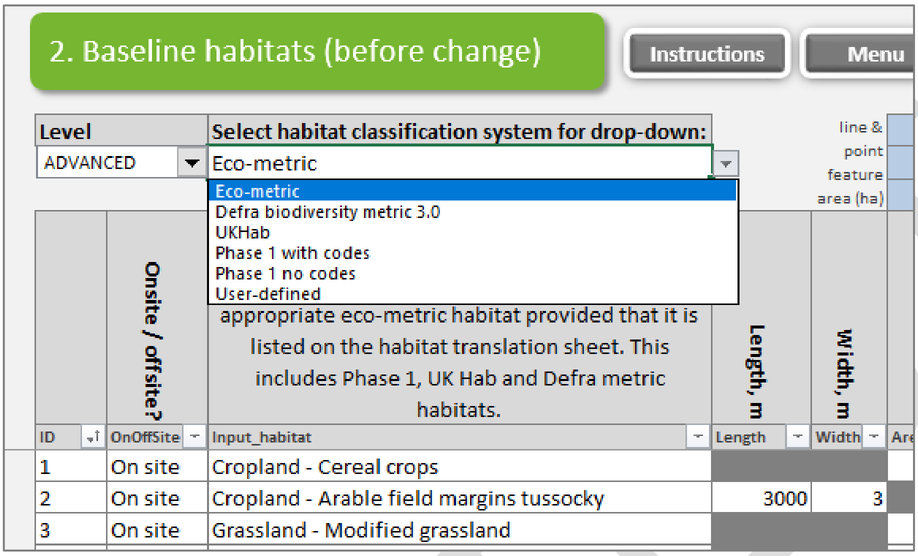


Enter the **type and area** of all baseline habitats, or the length and width for linear features (Section 3.3). For small areas with few habitat rows it is easiest to enter the habitat type by selecting a habitat from the dropdown box. Choose the habitat classification system you wish to use for data entry from the drop-down box at the top of the data entry sheets – you can use Phase 1, UKHab, Biodiversity metric habitats or the 'Eco-metric' habitats (named after the original name of the EBN tool). The definitions for this classification system will then appear in the dropdown boxes for each habitat type data entry cell. You can switch systems at any time to see a different list in the dropdown box - this will not affect the habitat types you have already entered. The habitat type that you enter will be automatically translated to match one of the 'Eco-metric' habitats used in the score matrix, which will be displayed in the blue cells to the right of the habitat areas (Column I).

For larger areas, habitat type and area data can be pasted in from another source such as the Biodiversity Metric (see Section 3.4) or a spreadsheet exported from GIS (see Section 6.1), but you must use '**Paste Values**' in order to preserve the formatting of the cell, including the availability of the dropdown habitat selection list (see Box 1). If pasting from another source, habitat type and habitat area must be pasted in separately as they are not in adjacent columns (they are separated by the habitat length and width columns to be used for linear features). Habitat names must exactly match one of the names used in the EBN tool (see Box 2).

However, it does not matter what habitat system is selected in the habitat classification dropdown box when you are pasting in habitat names.

Figure 5. Dropdown for selecting the habitat classification system



Box 2. Habitat name errors

If you enter an incorrect habitat name, by typing in directly (not recommended) or pasting from another source, you will see ‘Error - invalid habitat name’ and the translated habitat cell (column I) will be highlighted in red.

This is because there must be an exact match with the spelling and punctuation in one of the names used in the EBN tool habitat lists (for any of the classification systems used), including use of uppercase / lowercase, and any spaces. Sometimes a trailing or leading space can cause an error. To eliminate the error, you can simply select the appropriate habitat from the dropdown list in the cell.

If you enter an area but no habitat type, you will also see an error message ‘Error - no habitat selected’, and the translated habitat cell in column I will be highlighted in red.

Box 3: Customising the habitat selection list

You can create your own sub-set of habitats to appear in the habitat selection dropdown list, using only those relevant to you or putting those that you commonly use at the top of the list – just to make the list shorter and easier to use. This is done on the 'Habitat selection' sheet which you can reach from the Menu. However, you can only use habitats already defined in one of the other pre-defined lists on the Habitat selection sheet. Copy and paste habitats from the other lists to the ‘User–defined list’. 25 rows are available. If you do not use all these rows, there will be blank rows at the bottom of the drop-down list. Then choose ‘User-defined’ from the habitat classification system selection drop-down on the data entry sheets. You can always switch back to one of the other classification systems to enter habitats not on your user-defined list.

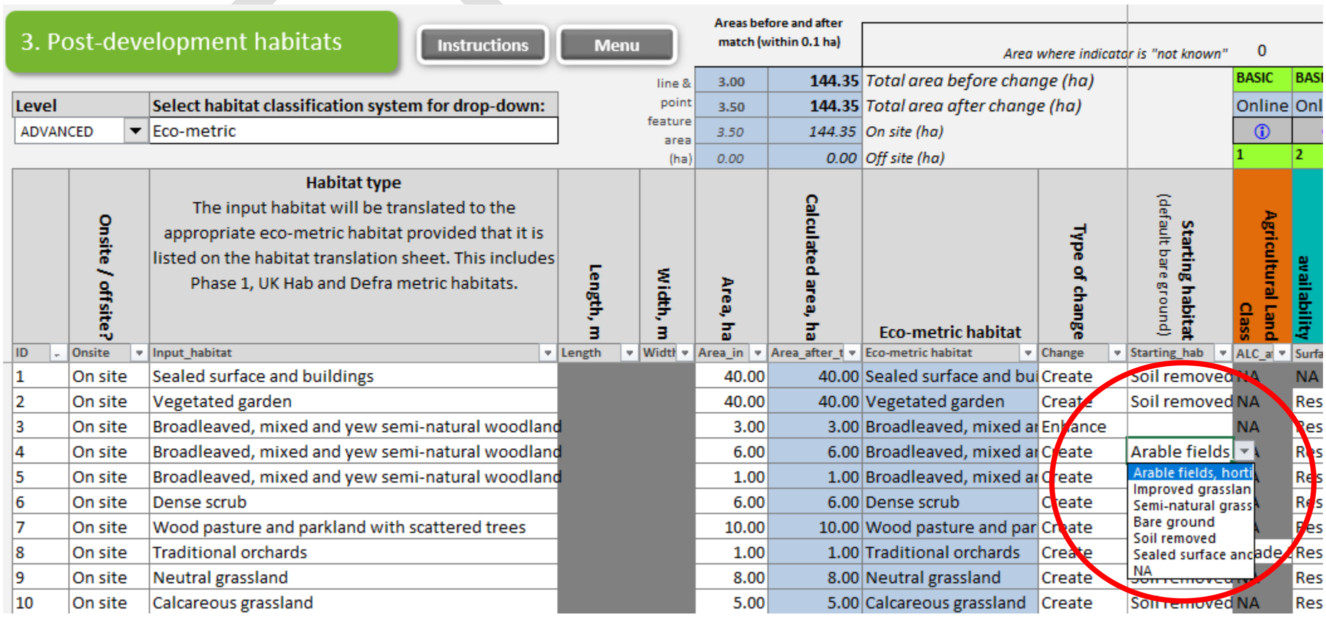
Enter the type and area of all habitats after the development or other land use change on the sheet named ‘3. Post-dev habitats’ in the same way. On this sheet you must also fill in the **'Type of change'** column by selecting or entering:

- ‘Create’: for replacing a habitat with one of a different type
- ‘Enhance’: for changing the condition of a habitat but not the habitat type
- ‘Retain’: for unchanged habitats.

For all habitat rows where the habitat has been created, enter the **‘starting habitat’** from the choice in the drop-down list. You can choose from a list: semi-natural grassland, improved grassland, arable, bare ground, sealed surfaces or ‘topsoil removed’ (for a typical housing development where all the soil is removed before construction). This is to enable the tool to take account of the initial starting condition when calculating the changes over time. For example, if you are planting woodland on improved grassland, the tool will assume that the carbon storage changes linearly from that of the grassland (3) to that of the woodland (10) over the 40 years that it takes for woodland to reach its target condition. This is a simplification, as changes will often not be linear and initial carbon losses due to soil disturbance are not included. However, it is more accurate than ignoring the starting habitat and assuming that all scores start from zero.

For newly created habitats, enter the target habitat on maturity. For example, enter ‘semi-natural broadleaved woodland’ if that is the target, even though the woodland will resemble a broadleaved plantation until it is established.

Figure 6. Post-development habitat data entry, showing dropdown for choosing 'starting habitat'



3.3 Linear and point features

Linear features (e.g. hedges, rivers, or footpaths) can be entered either as an area or as a length and width, whichever is most convenient. In fact, any habitat type could be entered either as a length and width or as an area, or with some parcels as each – this makes no difference to the calculations. The area will be automatically calculated from the length and width if both are entered; otherwise it will be copied from the area input column. If both length and width are entered, any value in the area column will be ignored – the cell will be greyed out to show this. Similarly, if a value is entered in the 'area' cell the length and width cells will be greyed out.

However, although the method of data entry makes no difference, certain habitat types (hedges, trees, green walls and green paths) are treated differently because the tool recognises them as 'line or point' features. The areas of these habitats are listed separately on the Results sheet. **For hedges and trees you should include the area of habitat beneath the feature** (e.g. the full area of the arable field right up to the boundary with the adjacent field, without subtracting the hedge area), **but not for rivers, streams and paths**. For green walls you should enter the area of the wall. **Please refer to the Data Catalogue** for detailed instructions.

For very short and narrow linear features such as a short section of hedge, the area may be less than 0.01 ha and will therefore appear as zero unless you choose to make use of the option of setting the tool to display additional decimal places for areas, lengths and widths (see Section 2).

3.4 Copying data from the Biodiversity Metric

As mentioned in Section 3.1, if the habitat parcels in the EBN tool need to be grouped or subdivided differently to those in the Biodiversity Metric, in order to take account of the EBN tool condition indicators, then it could be easier to generate the input data for each tool separately. However, if the habitat parcels or groups entered in the Biodiversity Metric each have the same EBN tool condition indicators, you can copy the input data across to the EBN tool following the instructions below and those in Section 3.2 above. Do not forget to always use 'Paste values' rather than 'Paste' (see Box 1) and remember that habitat names must match exactly (Box 2). Sometimes trailing or leading spaces have caused errors when copying habitat names from early versions of the Biodiversity Metric. If you find that habitat names in the two tools do not match, please report the issue to the email address provided on the Welcome sheet.

In the Biodiversity Metric the onsite and offsite habitats are entered on different datasheets. In the EBN tool, on-site and off-site habitats are entered together on the baseline and post-development sheets, with 'On site' or 'Off site' being selected in column C. Also, linear features (e.g. hedges and streams) are entered on the same sheet as other habitats in the EBN tool. If you are using the Biodiversity Metric 3.0, copy the habitat types and areas across from the following sheets to the Baseline habitats sheet. For hedges and rivers, you will need to convert the length from km to m and enter a width (e.g. 3m).

Table 1. Sheets to copy from the Biodiversity Metric 3.0 to the EBN tool Baseline habitats sheet

Biodiversity Metric 3.0 sheet	On site or Off site	Linear features
A-1 On-site Habitat Baseline	On site	
D-1 Off-site Habitat Baseline	Off site	
B-1 On-site Hedge Baseline	On site	Add hedge width
E-1 Off-Site Hedge Baseline	Off site	Add hedge width
C-1 On-site River Baseline	On site	Add river width
C-2 Off-site River Baseline	Off site	Add river width

Copy habitat areas and types from the following sheets to the Post-dev habitats sheet, again converting hedge lengths to metres and entering an assumed width. Enter ‘Create’ or ‘Enhance’ in the ‘Type of Change’ column on the Post-dev habitats sheet. Note that ‘Enhance’ can be used where an existing habitat is being upgraded to one of a higher distinctiveness but the same broad habitat type, e.g. upgrading existing woodland to priority habitat woodland.

Table 2. Sheets to copy from the Biodiversity Metric 3.0 to the EBN tool Post-dev habitats sheet

Biodiversity Metric 3.0 sheet	On site or Off site	Linear features	Type of change
A-2 Habitat Creation	On site		Create
A-3 Habitat Enhancement	On site		Enhance
D-2 Off-Site Habitat Creation	Off site		Create
D-3 Off-Site Habitat Enhancement	Off site		Enhance
B-2 On-site Hedge Creation	On site	Add hedge width	Create
B-3 On- site Hedge Enhancement	Off site	Add hedge width	Enhance
E-2 Off-Site Hedge Creation	Off site	Add hedge width	Create
E-3 Off- Site Hedge Enhancement	Off site	Add hedge width	Enhance
C-2 River Creation	On site	Add river width	Create
C-3 River Enhancement	On site	Add river width	Enhance
F-2 Off-site River Creation	Off site	Add river width	Create
F-3 Off-site Enhancement	Off site	Add river width	Enhance

Retained habitats

The Biodiversity Metric notes the area of any habitats that are retained unchanged on the baseline sheet (column S). In the EBN tool, enter retained habitats on both the Baseline habitats and the Post-dev habitats sheet. Enter the initial area on the Baseline habitats sheet and the retained area on the Post-dev habitats sheet and select ‘Retain’ in the ‘Type of Change’ column on the Post-dev habitats sheet.

4. Entering condition indicators and spatial factors

4.1 Basic, standard and advanced levels of assessment

There are 40 condition indicators or spatial factors. We have grouped them into Basic, Standard and Advanced level indicators (see Table 3). We suggest that small projects with limited biodiversity impact, or those at an early stage of development with limited data, can apply the Basic level of assessment (see Table 4). This draws mainly on freely available online datasets. Larger projects and those that affect semi-natural or priority habitats should apply the standard or advanced levels, which require additional data to be gathered via site surveys. Projects that want to focus on specific ecosystem services may wish to apply a mix of indicator levels, e.g. projects affecting rivers might want to apply advanced level indicators for rivers (fish barriers and water body naturalness) but a lower level of assessment for surrounding habitats.

Table 3. Suggested application of Basic, Standard and Advanced level indicators

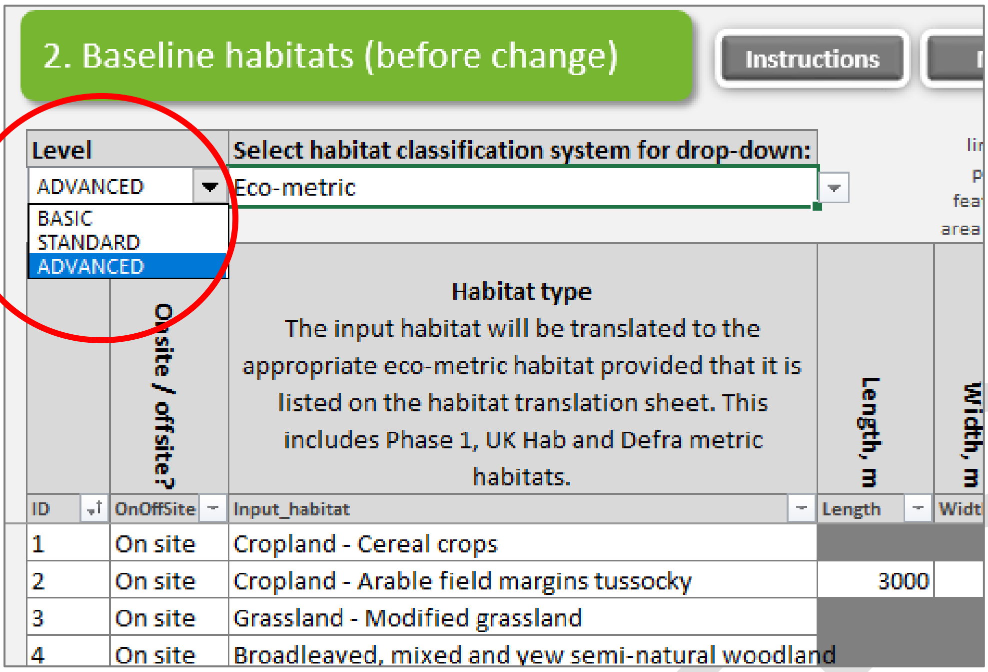
BASIC	**Generally, from freely available online maps and typically do not vary much, if at all, across the site.**
STANDARD	May require a site survey or collection of local information, or simple GIS analysis. May vary across the site.
ADVANCED	Typically require a site survey or complex GIS analysis and may vary for every habitat parcel.

Table 4. Relationship between project area and level of assessment

	Likely level of biodiversity and/or environmental impact		
Size of project	Low (no semi-natural habitats affected)	Medium (semi-natural habitats affected)	High (priority habitats affected)
Small (0.5 ha)	BASIC	BASIC	STANDARD
Medium (<500 homes)	BASIC	STANDARD	ADVANCED
Large	STANDARD	ADVANCED	ADVANCED

When you first go to the data entry sheets, they will only show the Basic indicators. If you want to reveal the Standard and Advanced indicators, use the dropdown list in the top left of the sheet. This will hide or unhide the appropriate indicator columns.

Figure 7. Dropdown list for selecting level of data entry (Basic, Standard or Advanced)



4.2 Entering the indicators

Fill in all the condition and spatial indicators on both the Baseline habitats and Post-dev habitats sheets. This can be done either by selecting the appropriate value from the dropdown boxes in each cell, or by pasting in values from another source **using 'paste values'** (see Box 1), provided that the data conforms to the list of valid entries for each indicator. Please **do not use 'cut' or try to drag the cells around**.

Instructions and links to data sources are provided on the 'Data sources' sheet and can be accessed via the ⓘ help links at the top of each indicator column. To return to the appropriate column of the data entry sheets, you can use the links in the final two columns of the data sources sheet. **More detailed information on each indicator can be found in the Data Catalogue**.

When entering the details of new habitats that will be created, for all indicators <u>except tree size</u> you should enter the target condition that will be achieved after 30 years (or 40 for woodland), not the initial condition when you first create the habitat. **For tree size, however, enter 'saplings' for creating a new woodland**. This is because the tool has a separate calculation that changes saplings (either from existing young woodland or created woodland) into 'poles' (the next size category) after 10 years.

Most of the indicators are specific to each row on the data entry sheets, i.e. they apply to a single habitat parcel or group of parcels with identical habitat types and conditions that are entered on a single row. The exceptions are:

- ‘Rainfall’ which applies to the whole site
- ‘Population density’ which applies to the local area
- ‘Landscape diversity’ which applies to the whole site.

Each dropdown box contains options for ‘not known’ (NK) or ‘not applicable’ (NA):

- **‘Not known’(NK)** means that you do not know the value of the indicator, so a default value will be used (usually this means a multiplier of 1). The percentage of ‘not known’ indicators is reported on the Results sheet as a ‘completeness’ score.
- ‘**Not applicable’ (NA)** means that an indicator does not apply to a specific habitat. For example, peat quality applies only to bogs. If an indicator does not apply to a specific habitat, the data entry cell will be automatically greyed out. A default multiplier of 1 will be used in the calculations for these cells, regardless of what you enter (i.e. they will be treated as if you have entered 'NA').

Do not leave values blank unless the area of the habitat is zero or the indicator is not applicable (greyed out) for that habitat. If you are unable to estimate a value choose 'Not known' (NK), and a default value will be used, as mentioned above. If you are not using some of the Standard level or Advanced level indicators set them all to 'NK' using autofill for the whole column (see below). By default, all indicators are set to “NK” initially.

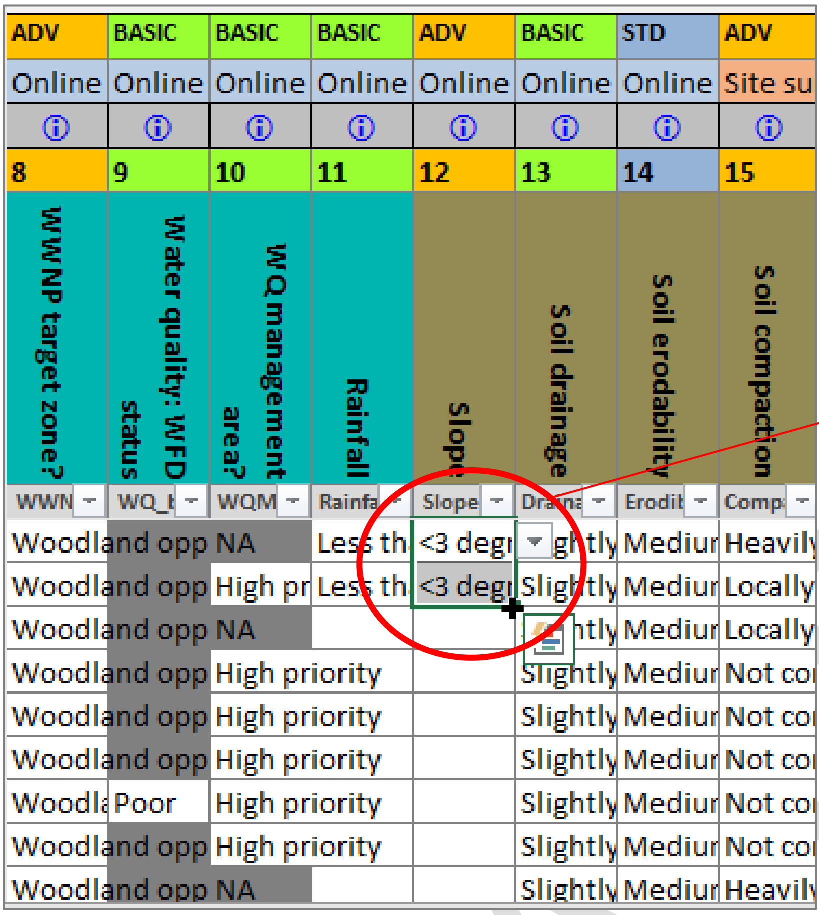
Auto-filling columns to save time

For many indicators the value will be the same for all habitat parcels (except those where the indicator is not applicable). You can autofill the whole column: fill in the top cell correctly, then hover over the bottom right corner of the top cell until you see a plus sign (see Figure), then drag it down to the end of your data.

Auto-filling tips:

- You can double click on the plus sign to fill the whole column. This might fill in all the rows to the bottom of the table (going past the end of your data), especially if all values are pre-filled with ‘NK’ (as in the ‘empty’ version of the tool that we supply). It is fine to leave these surplus values in place, but you can delete them if you want (click on the first cell then use Ctrl-Shift-Down arrow to select to the end of the column, and then press delete).
- If you are auto-filling numeric values or a string containing numeric values (such as ‘3 or more’), you may find that autofill increments the number by 1 on each subsequent row. To avoid this happening, fill in the first two rows and select them both before double clicking the plus sign in the bottom right corner of the cell in the second row.
- If there are some blank cells followed by an existing entry, the autofill will usually stop at the existing entry – and sometimes these existing entry cells look blank. Deleting all the values in the column before auto-filling will fix this. In any case, be sure to check that the autofill has gone right to the bottom of the rows you wish to change.

Figure 8. Auto-filling a column of indicator values



Hover over the bottom right corner and a plus sign will appear. Drag down to autofill further rows, or double click to autofill to bottom of data block.

For data containing a number, select the first two cells so the number does not increment on each row.

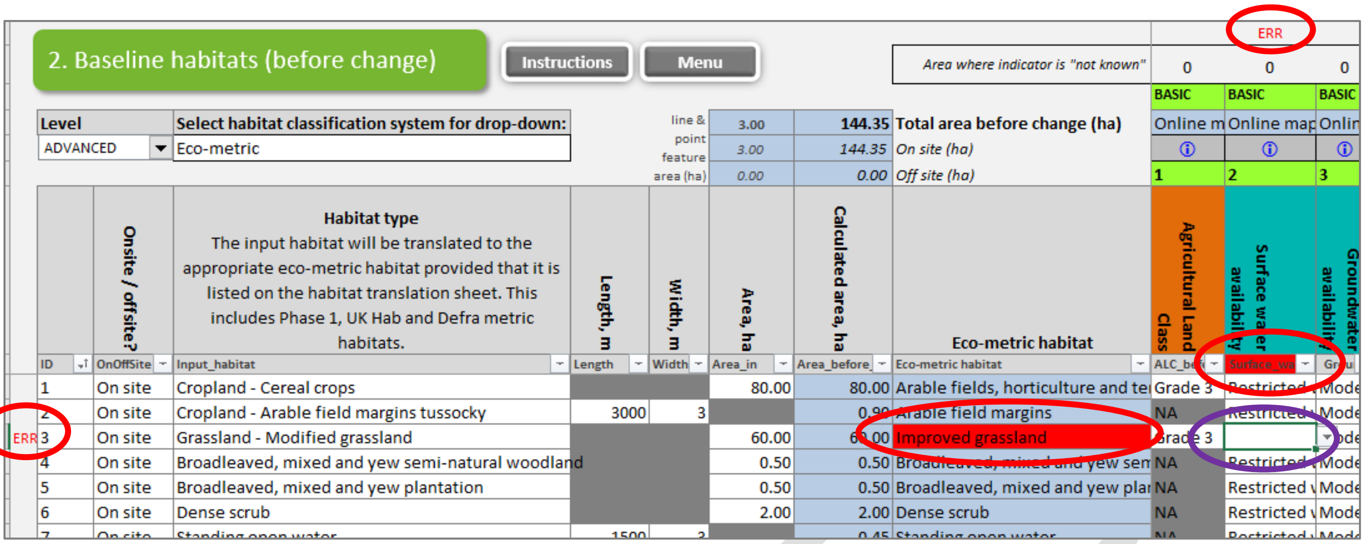
Do not autofill sideways (across columns) or the dropdowns will be wrong.

If the indicator is not applicable for any of the habitat types, it will be greyed out and it will be ignored in the calculation. You can set these cells to ‘NA’ if you wish, for transparency, but you can also just leave them blank or leave them auto filled to the same value as all the other cells.

4.3 Error checking

When all the indicators are filled in correctly, the results will appear on the Results sheet. If there are errors, symbols will be displayed instead of arrows in the Results table (see Figure 9) and the errors will be flagged using a red “ERR” in the first column to identify the row containing the error, and at the top of the column containing the error. The cell containing the habitat type and the indicator name will also turn red (Figure 9). Errors are also noted in the error checking section of the Results sheet, which will help you to identify the cause of the error.

Figure 9. Error checking system using red flags to identify the row and column containing the error (in this case a blank indicator cell shown by the purple ring)



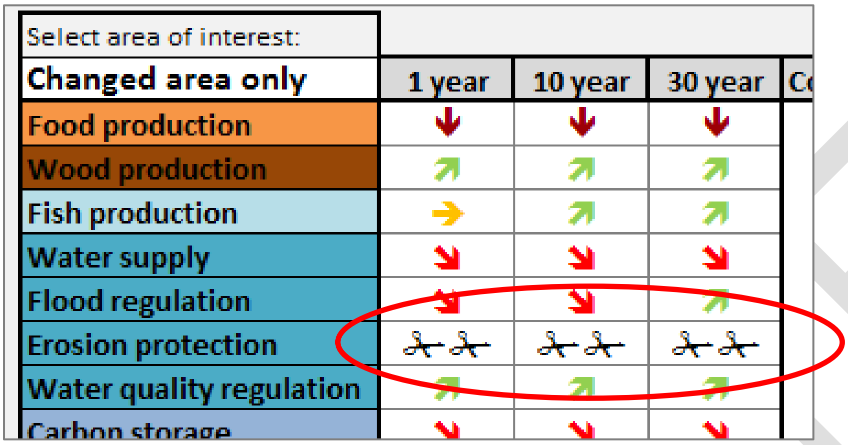
Errors are usually caused by missing or invalid indicator values on the 'Baseline habitats' and 'Post-dev habitats' sheets. The three main causes of errors are:

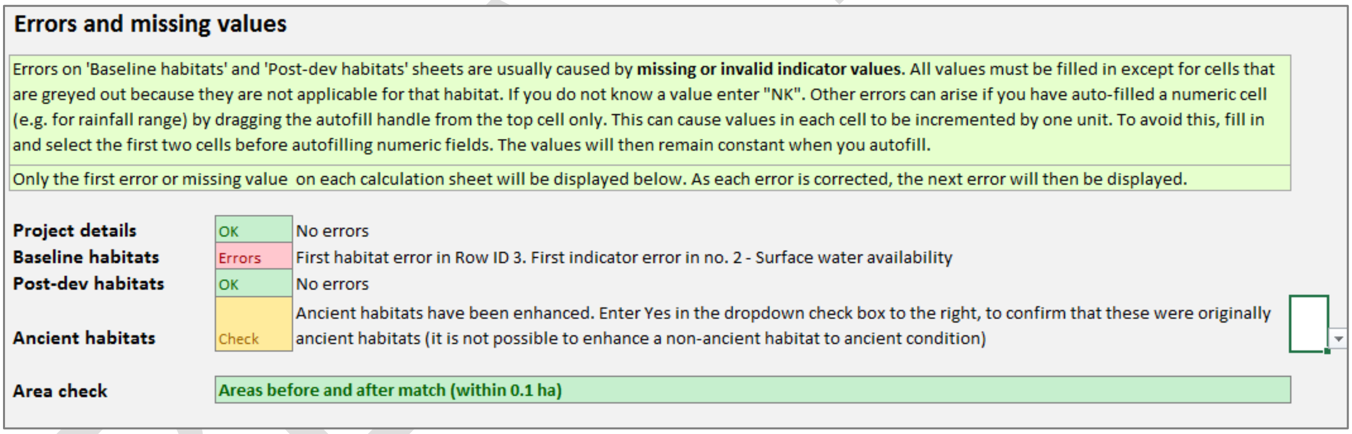
- **Missing values.** All values must be filled in except for cells that are greyed out because they are not applicable for that habitat. If you do not know a value enter "NK". Sometimes it is hard to see where the missing values are because the columns are quite narrow, and the previous column entry may obscure the missing entry. Use the error location section (below) to help track down the missing values.
- **Incrementing values in cells that include numbers.** If you have auto-filled a numeric cell (e.g. for rainfall range) by dragging the autofill handle from the top cell only, this can cause values in each cell to be incremented by one unit. To avoid this, fill in and select the first two cells before auto-filling numeric fields (see Figure , Section 4.2). The values will then remain constant when you autofill.
- **Pasting in indicators from an external source** that do not match the specified options in the dropdown box. This can sometimes happen if you are pasting in data from a previous version of the EBN tool but some of the indicator options have been changed. Go to the 'version control' sheet (via the Technical Menu) and check the Release Notes to see if something has changed. You can also simply try entering data directly via the dropdown to see if that fixes the error.

Sometimes the tool gets confused between text and numeric values, e.g. it looks as if you have entered the correct value for a numerical indicator but you are still getting an error because the tool is expecting either a text version or numerical version of the number and you provided the other format. We have tried to prevent this from happening by including both text and numeric versions in indicator lookup tables that include numbers. However you get this error and you are pasting from an external source you could try pre-formatting by copying your data to a new column using Excel functions such as T() to convert to text or Value() to convert to a number.

In the example in Figure 9, the user has blank or incorrect values in the 'Rainfall' column, starting in Row 6 of the Baseline habitats table. (Note that the error check on the Results page only identifies the first column where an error occurs and the first row where an error occurs. Once you have fixed those errors, the error check may find further errors further down or further across the sheet. So, it is easier to use the red flags on the data entry sheets to find and fix errors).

Figure 10. Error symbols appear on the results sheet instead of arrows if some indicators are missing or incorrect. The error checking flags on the data entry sheets (see above) will help you to find the errors. Errors are also shown on the Results sheet (lower part of this Figure).




Errors and missing values

Errors on 'Baseline habitats' and 'Post-dev habitats' sheets are usually caused by **missing or invalid indicator values.** All values must be filled in except for cells that are greyed out because they are not applicable for that habitat. If you do not know a value enter "NK". Other errors can arise if you have auto-filled a numeric cell (e.g. for rainfall range) by dragging the autofill handle from the top cell only. This can cause values in each cell to be incremented by one unit. To avoid this, fill in and select the first two cells before autofilling numeric fields. The values will then remain constant when you autofill.

Only the first error or missing value on each calculation sheet will be displayed below. As each error is corrected, the next error will then be displayed.

Project details	OK	No errors
Baseline habitats	Errors	First habitat error in Row ID 3. First indicator error in no. 2 - Surface water availability
Post-dev habitats	OK	No errors
Ancient habitats	Check	Ancient habitats have been enhanced. Enter Yes in the dropdown check box to the right, to confirm that these were originally ancient habitats (it is not possible to enhance a non-ancient habitat to ancient condition)
Area check	Areas before and after match (within 0.1 ha)	

Ancient habitat errors

Ancient habitats (e.g. ancient woodland, peatland or meadows) should be noted via the 'Ancient' condition indicator. The tool will check for the following errors connected to Ancient habitats.

- Users are not allowed to 'create' a new ancient habitat.
- Ancient habitats should be retained or enhanced. An error will be recorded on the Results sheet if this is not the case (i.e. there is a smaller area of ancient habitats in the post-development sheet than in the baseline).

- The tool cannot distinguish between genuine enhancement of an ancient habitat and a case where an ancient habitat has been lost and the user has tried to replace it by upgrading a non-ancient habitat to ‘ancient’, by changing the condition indicator and marking the habitat as ‘Enhance’. Therefore, if the tool detects that ancient habitats have been enhanced it will ask users to check a box to confirm that the enhanced habitats were ancient to start with.

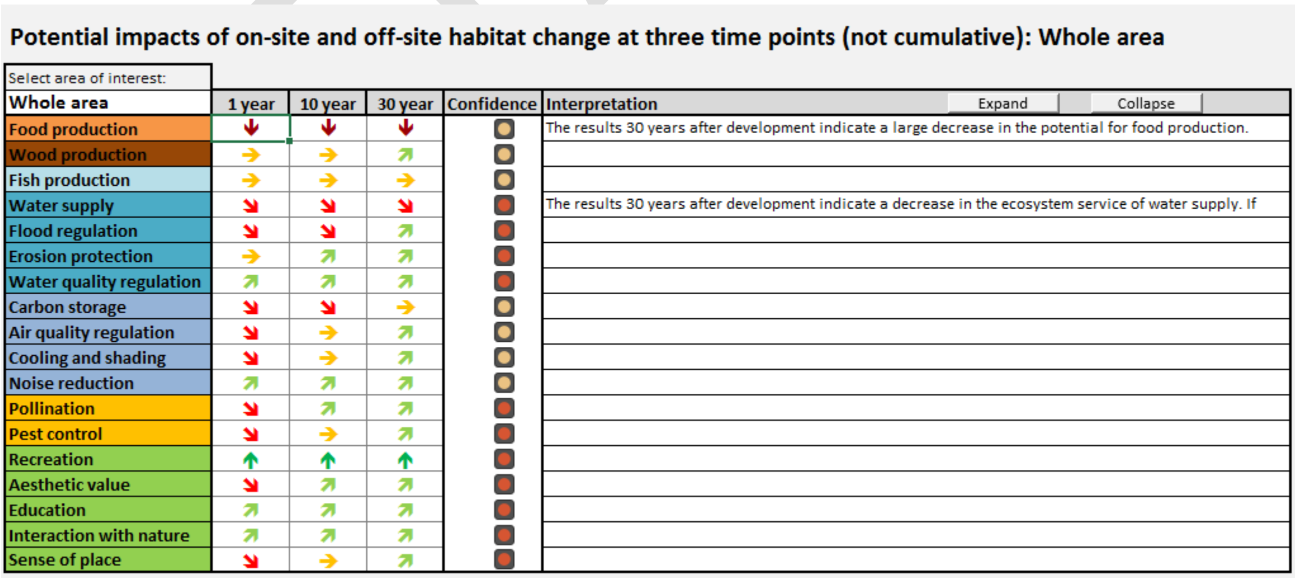
5. Interpreting and using the results

5.1 Results sheets

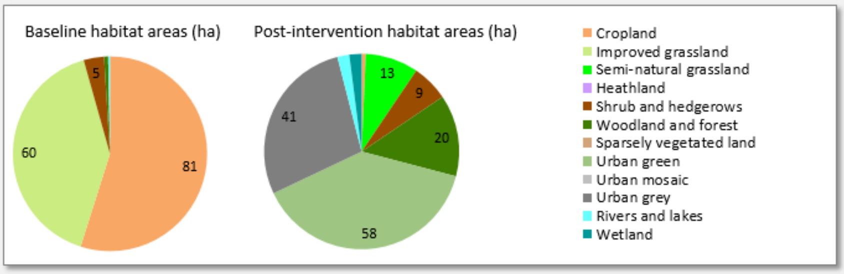
When you have entered all the habitat areas and condition factors, results are calculated automatically and will be displayed on the 'Results' sheet. This shows arrows indicating the direction and magnitude of change in the total score for each of the 18 ecosystem services at three points in time – 1, 10 and 30 years after the development or intervention, compared to the baseline before the development or intervention. The arrows do not take account of the cumulative impact up to that time.

Pie charts beneath this table show the natural capital asset extent, i.e. the habitat areas, for the baseline and post-development. There is also a check of whether biodiversity net gain has been demonstrated, based on the figures entered by the user on the Project Details sheet. This serves as a reminder that the EBN tool is intended to be used in conjunction with the Biodiversity Metric, and that biodiversity net gain is the primary driver.

Figure 11: Results sheet



Changes in Natural Capital Assets (total on site and off site)



This shows the percentages of the extent (area) of different habitats, comprising soil, rocks, water, plants and the species these habitats support. Sub-surface natural capital assets (groundwater bodies and mineral deposits) are not included. The condition of the assets is reflected in the condition indicators, which modify the habitat scores.

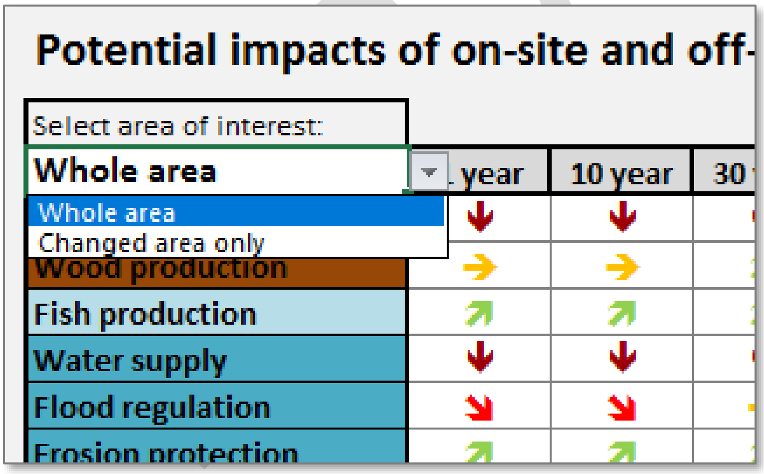
Biodiversity net gain check YES BNG demonstrated (Change >+10%)

Data completeness

	Baseline	Post-dev	*Out of*	Overall	*Out of*	
Overall indicators	40	40	*40*	80	*80*	Number of indicators completed (i.e. no rows 'Not known')
BASIC	17	17	*17*	34	*34*	Number of Basic indicators completed
STANDARD	6	6	*6*	12	*12*	Number of Standard indicators completed
ADVANCED	17	17	*17*	34	*34*	Number of Advanced indicators completed
Level achieved	ADVANCED	ADVANCED		ADVANCED		

There is a dropdown selection box in the top left corner of the results table which allows the user to view the results for the whole site (including and unchanged (retained) habitats) or only for the area where habitats are changed (Figure 12). This can be useful for cases where a relatively small amount of development on a much larger site can cause the changes to be 'diluted' so that the impact is hard to see. There is no right or wrong way of viewing the results, but the user should be aware of which option they are looking at.

Figure 12: Dropdown box on Results sheet for selecting whether to view the results per ha for the whole site or for only the habitats that have changed



Additional results sheets are available from the menu buttons, including:

- **4a. Compare on & off-site results:** arrows and natural capital asset pie charts for on-site and off-site habitats separately.

- **4b. Interpretation charts.** Charts showing the split of ecosystem service scores between habitat groups for each ecosystem service. These charts are useful for understanding the reasons for the changes in scores.
- **4c. Results breakdown tables.** Detailed result tables for each habitat type and service.
- **4d. Save scenario**. This allows users to compare the main results from up to three different runs of the tool side by side.
- **4e. Comparison with 100% suburban mosaic.** For housing developments only, this shows a comparison with what would have happened if the whole site was converted to a 'typical suburban mosaic'. This can be useful to illustrate the benefits of additional on-site green infrastructure.

5.2 How to check and interpret the results

The results show which services are estimated to have net gains and which have net losses. Where there are losses, the user can experiment with altering the type, condition, or spatial location of proposed habitats after the development or intervention to see if the score can be improved. You can make copies of the Excel spreadsheet to test different scenarios if you wish, but the 'Save scenario' option also allows rapid testing and comparison of up to three different options (see Appendix 2). Following proposed changes to the habitat types and conditions, the separate biodiversity metric calculation should be updated to check that the project still produces a biodiversity net gain.

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

Users may wish to consider local priorities to determine which ecosystem services are most important for a given area. It is recommended that the EBN tool is applied as part of a participatory process, if possible, to ensure that priority setting is inclusive, consistent, transparent and thorough. Local stakeholders should be included, but national priorities such as food production or carbon storage should also be considered. Although it is unlikely that net gains in all services can be achieved, the EBN tool can be useful to make net gains and losses visible, to inform decisions. It could be applied as part of a process of [Multi-Criteria Decision Analysis (MCDA)].

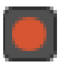
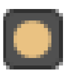
When interpreting the results, it is very important to keep in mind the limitations of the EBN tool, as described in the Principles document. It is just one tool to support decision-making and should always be supported by any other available information. We have provided a button on the Results page to 'Link to other tools', which links to two good sources of information on additional tools that could be used to supplement the EBN assessment: ENCA and the EKN Tool Assessor.

The outputs should not be presented in isolation but should be used to develop a supporting narrative that explains the reasons for the changes in ecosystem service delivery in simple terms, to check that the outputs are logical and consistent with other assessments. Users should therefore perform a ‘sense check’ to ensure that the results make sense intuitively. You may wish to examine the interpretation charts and the underlying calculations to get a feel for the reasons behind the changes in EBN tool scores. To aid this, the Results sheet provides a link to a summary of the underlying calculations via the ‘Calculations’ button. If you want to see more detailed information, calculations for each habitat group or parcel can be seen on the ‘Baseline score’ and ‘Post-dev score’ sheets, accessible from the menu or from the Calculations sheet. On these sheets, the habitat parcels that are particularly valuable for delivering each service, in terms of the score per hectare including condition and spatial factors, are highlighted using a white-yellow-green colour scale (with more valuable habitats in darker shades of green). On the post-development scores sheet these are the scores per hectare that will be delivered *after* newly created post-development habitats have reached target condition.

The ‘Breakdown tables’, also accessed from the Results sheet, offer a breakdown of the scores for each type of habitat (grouped into either the Broad habitat categories used by Natural England or the habitat groups used by the Biodiversity Metric). Further down this sheet you can also see how the basic scores for each habitat type change after the condition and spatial multipliers are applied, and again after the multipliers for time to reach target condition and delivery risk are applied. This information is also presented for every individual habitat type, as well as the broad groups (you can filter out the un-used habitats for ease of viewing). This can help you to understand how the final scores depend on the habitat condition, spatial location and time and delivery factors.

Ratings have also been included to provide confidence using the results (Figure 13). These are displayed adjacent to results in the main dashboard. Ratings provided are set out below. These are each service-specific and will not alter according to the level of assessment used (e.g. Basic/Standard/Advanced).

Figure 13. Confidence ratings within the tool

	The relationship between the provision of the ecosystem service and habitats is complex. Evidence for scoring/multipliers is partial, although may be stronger for some habitats than others. Evidence gaps have been filled by consulting experts and with a degree of subjectivity, particularly for cultural services.
	We have some suitable evidence to calibrate our range of scores across habitats and multipliers and/ or scoring applied to a limited range of habitats/ multipliers for which there is a sound and simple rationale.

	We have a strong evidence base upon which to base scores across the range of habitats and multipliers used for this ecosystem service.

5.3 Printing the output

There are four main ways of printing the output.

1. Select File, Print to print directly from the page. The two main results sheets ('4. Results overview' and '4a. Onsite and Offsite results') have been formatted to print out in landscape format.
2. Export a pdf. From the two main results sheets ('4. Results overview' and '4a. On & Off-site') select File, Export, Create pdf/xps document, enter a filename, click on Options and make sure it is set to print the Active sheet, not the entire workbook, and click 'Publish'. This will create a two-page pdf of the main results overview sheet.
3. For a shortcut, the 'Print' button on the main results sheet will simply print the results using the default mode last selected by the user (which could be to pdf or to a printer).
4. From any sheet, take a snapshot of the screen using Shift-PrtSc (to copy the whole screen and crop later) or the Windows snipping tool (accessed by typing 'snipping tool' into the Windows Start menu, which allows you to select only the desired area). You can then paste this into any application (Word, Powerpoint, etc.).

6. Linking to spatial data

Input data for the EBN tool could be generated with a GIS (Geographic Information System) package such as ArcGIS or QGIS. Similarly, the output scores for each habitat parcel could be shown on maps in GIS.

The instructions below suggest how to import and export scores and data to and from ArcGIS. A few tips are provided for those less familiar with GIS. These instructions relate to ArcGIS, but similar steps should be possible in QGIS (which is free).

6.1 Importing habitat areas and indicators from GIS

Here we provide a suggested sequence of operations for importing data from GIS. Links to the required datasets are all provided in the Data Catalogue and on the Data Sources help sheet in the EBN tool (linked to via the ⓘ hyperlinks at the top of the data entry sheets).

1. Start from the baseline habitat file. This could be derived from OS MasterMap if you have a public sector, academic or other license, and/or Phase 1 habitat data, local site survey data or Natural England Priority Habitat data. Further guidance is available here. In the following steps you will progressively add attributes (columns) to this dataset to hold

information about any of the condition or spatial indicators that vary spatially across your site.

Tip: If you create a geodatabase to hold your habitat file and other output files, rather than working with it as a separate shapefile, you can use longer attribute names (not restricted to 10 characters) and the shape area will be automatically recalculated every time you create a new output dataset. Processing will probably also be faster.

2. Examine the Agricultural Land Class (ALC) in MAGIC.

   a. If the entire area falls within the same ALC grade, you can simply autofill the correct category in the EBN tool after uploading the data. But if you prefer to have everything in your shapefile, add a field for ALC and fill in the value (Grade 1, Grade 2 etc.) using ‘Calculate field’.

Tip: When you create the ALC attribute, set all rows to “NA”. Then select only the applicable habitat types (Arable, Improved grassland, Traditional and Intensive orchards) when you are entering the ALC grade. If any arable, improved grassland or orchard polygons do not have corresponding ALC information set them to “NK” (not known).

   b. Otherwise, if the ALC varies across the area but there is a simple way of matching it to sub-groups of the existing polygons, add an extra field for ALC, select each sub-group of polygons in turn and use ‘Calculate Field’ to set the required value (Grade 1, Grade 2, etc.)

   c. Otherwise if the relationship is spatially complex, download the ALC shapefile from data.gov.uk and intersect it with your habitat dataset using the ‘Identity’ function. Using ‘Identity’ instead of ‘Intersect’ means that you will not lose any parts of your habitat shapefile that are not covered by the dataset you are intersecting with.

Tip: To create a tidier output dataset, before doing the Identity operation you can go to Properties / Fields and turn off the display of any fields you do not need. Only the displayed fields will be exported to the new dataset. You can also set JoinAttributes to ‘NO FID’ in the Identity function to avoid creating extra FID attributes.

3. Repeat for the EA water resource availability shapefile. Download it from the link in the Data Catalogue or the EBN tool Data Sources sheet (see above)) and set the symbology to display the water availability categories for the Q95 attribute for your area (camscdsq95).

   a. If the entire area falls within the same Q95 category, you can simply autofill the correct category in the EBN tool after uploading the data. But if you prefer to have everything in your shapefile, add a field for surface water availability and fill in the value using ‘Calculate field’.

b. Otherwise, if the water availability varies across the area but there is a simple way of matching the Q95 attribute to sub-groups of the existing polygons, add an extra field for surface water availability, select each sub-group of polygons in turn and use ‘Calculate Field’ to set the required value (Water available, Restricted water availability, etc.).

c. Otherwise if the relationship is spatially complex, intersect the habitat-ALC intersect with the water availability shapefile using Identity. Set your habitat map to be the Input dataset and the water resource shapefile to be the Identity dataset. Turn off the display of any attributes that are not needed before you do the Identity function (e.g. all except the camsdcsq95 attribute), so that you keep your output dataset tidy.

Tip: If you are working with a large, complex area with many habitat types you may wish to convert your polygons to a grid shape, by converting the habitat dataset and then each indicator dataset to raster (e.g. a 50m raster) and then back to polygon. See Step 5 below.

4. Work through the other indicators that are derived from online maps, following the steps above to determine whether you need to download the indicator dataset and intersect it with your habitat map. Although the user guide simply gives the link to the website where the maps can be viewed (e.g. MAGIC), many of the datasets are also available for download as shapefiles if you search data.gov.uk, or search the dataset name plus ‘shapefile’.

5. To work out how many nature or cultural designations apply, if you are dealing with a large and complex area you can convert all the designation polygons to rasters and then add them up.

   a. Create a raster layer to use as your ‘snap raster’, to make sure all the rasters will line up neatly to the same grid. This layer needs to cover the whole area, so you could use your habitat basemap. Use Polygon_to_raster to do the conversion, setting the cell size to a suitable value (which will depend on the scale of the area, e.g. it could be 50m or 100m). Set ‘cell assignment type’ to ‘Maximum combined area’ – this will assign the cell value based on the predominant value by area within each pixel.

   b. The input rasters for the designated areas need to have a value of 1 for all pixels in the extent of the designated area, and zero or no data or no pixels outside this area. If necessary, create a new attribute with a value of 1 for all designated areas in the polygon dataset and use that as the value field when rasterising.

   c. Go to Environments / Processing extent. Set the processing extent to Union of Inputs and select the raster that you created in step a to be the Snap raster.

   d. Convert all the designation polygon datasets to rasters using Polygon_to_raster. For each one, choose a value field that will give a value of 1 for all areas in the designation zone and zero or no data outside. Use the same cell size that you did for the snap raster.

   e. Add up all the rasters using Cell Statistics with the overlay statistic set to SUM, ticking the ‘Ignore NoData’ checkbox. This should produce a raster layer with the value representing the number of overlapping designation layers.

   f. Convert this back to polygon using Raster_to_polygon. Select the appropriate attribute to be the Value field and untick the Simplify Polygons checkbox and the Multipart features checkbox.

   g. If you are using a pixelated grid version of the habitat layer, use Identity to merge this grid polygon with your habitat layer. Otherwise try using another method such as a Spatial Join instead, to preserve the shape of your polygons.

6. To determine public accessibility via footpaths, you can create a 50m buffer around a footpath dataset and then set accessibility within this zone to ‘footpath access’. You could ask for a PROW (public rights of way) dataset from the local council, or you could download the Orval paths dataset from the University of Exeter or use Open Street Map paths. Clip the paths dataset to an area slightly larger than your area, use the Buffer function to add the 50m buffer, then use ‘Identity’ to intersect this layer with your habitat layer.

7. Similarly, if you are using the advanced level indicators that depend on habitat position (27 to 31, Air pollution barrier to Noise barrier), you can create a buffer around roads, watercourses or buildings (which can be extracted from OS open roads, OS open rivers or OS MasterMap), and intersect it with your habitat file.

8. When you have finished adding attributes to your habitat base map, make sure that the attributes match the EBN tool data entry categories. Set all non-applicable habitats for each indicator to ‘NA’ – for example, select only freshwater and saltmarsh habitats, invert the selection, and set the WFD overall status indicator to ‘NA’. For the nature and cultural designations, select all rows with 3 or more designations and set to ‘3 or more’. You can do this in a new attribute or over-write the existing field.

9. You have a choice to either:

   a. Enter every row of this dataset separately in the EBN tool or

   b. Dissolve the dataset, setting all the fields you need as Dissolve fields, including the habitat type, ALC and all the other attributes you have merged in, and ticking ‘Allow multipart features’. This means that you will merge any polygons that have exactly identical indicators so that they can be entered into a single row of the EBN tool data entry sheet. This means you will be dealing with fewer rows, but you will lose the distinction between different polygons (e.g. different fields or woodland patches) that have the same habitat type and condition.

10. If you are working with shapefiles rather than a geodatabase, create an attribute to hold the area of each polygon and populate it using 'Calculate geometry', choosing a suitable unit (e.g. hectares). If you are working with geodatabase features, the ShapeArea field is automatically calculated, though it will probably be in square metres (it depends on the units you are using in your map / GIS data frame).

11. If you are working with normal shaped polygons, and have not converted to a pixelated grid, check to see whether all your intersects have created lots of 'slivers' where polygon edges from different datasets are similar but do not quite match. To do this, open the attribute table for your dataset, choose 'Select by attributes' and select all the polygons with small shape areas, e.g. (depending on the scale of your project area) less than $100m^2$. Examine these – they are likely to be slivers along polygon edges, but if some of them are genuine shapes (e.g. small ponds) then de-select them or try a lower cut-off area. To get rid of any unwanted slivers, select the ones you want to get rid of and then use the Eliminate function, which will absorb them into one of the adjacent polygons.

12. Export your baseline habitat dataset to an Excel file (Geoprocessing, Search for tools, Table to Excel).

13. In this Excel file, you may need to add a column to calculate the area of each row in hectares rather than square metres, if it came from a geodatabase.

14. Create a dataset for the post-intervention / post-development habitats. This may require converting from CAD datasets. This can be fiddly and is best done using FME or a similar file converter package.

15. Intersect (Identity) the post-intervention map with the baseline map. This means you will have both the starting habitats and the post-development/intervention habitats in a single dataset, so that you can correctly set the 'starting habitat' for any created habitats. Also, you do not need to go through all the steps above separately for the post-intervention map, as all the information on ALC and the other indicators you merged in will be in this intersected dataset.

16. Some indicators such as ALC and water availability will be the same for post-development as for baseline, but others may have changed. For the changed indicators you can either change them in the GIS dataset, or in the exported spreadsheet, or after you have imported the habitat areas to the EBN tool, whichever is easiest.

17. As for the baseline map, you have a choice to either:

    a. Enter every row of this dataset separately in the EBN tool or

    b. Dissolve the dataset, setting all the fields you need as Dissolve fields, including both the baseline and post-development habitat types, the ALC and all the other attributes you want to keep, and ticking 'Allow multipart features'.

18. Again, if you are working with shapefiles rather than a geodatabase, create an attribute to hold the area of each polygon and populate it using ‘Calculate geometry’, choosing a suitable unit (e.g. hectares). If you are working with geodatabase features, the ShapeArea field is automatically calculated, though it will probably be in square metres.

19. As previously, check for slivers and eliminate if necessary.

20. Export this post-development dataset to an Excel file, as for the baseline habitats (Geoprocessing, Search for tools, Table to Excel).

21. As previously, you may need to add a column in your exported Excel worksheet to calculate the area of each row in hectares rather than square metres, if it came from a geodatabase.

22. You can now start entering data into the EBN tool data entry sheets. You might want to put a data filter on your exported habitat worksheet to get the habitats into a suitable order for entering into the tool (e.g. ordering by habitat type, ALC grade, etc.) – or you could just enter them as they are.

23. If you want to simplify your dataset further, you can create a pivot table in Excel and use this to amalgamate some of the categories if certain indicators are not relevant for some habitats. For example, the ALC grade is only relevant for arable, improved grassland and orchards, so if you want you could combine all the different ALC grades for other habitats such as woodland into a single row to be entered. However, you may find this is not worth the effort – it will make your data entry sheet shorter but will not affect the output of the tool, and it is a bit fiddly.

24. If your habitat names exactly match one of the permitted naming systems included in the EBN tool (Phase 1 with or without codes; UKHab; Biodiversity Metric 3.0 or Eco-metric habitats) you can simply select the entire column of your habitat names and use ‘Paste values’ to paste it into the EBN tool data entry sheet. Otherwise you may wish to either change them in your spreadsheet before copying to the EBN tool, either manually or by setting up a lookup table to translate into suitable input habitats, or you can paste in the incorrect names and then manually correct them in the tool using the drop-downs. If you have sorted by habitat type before entering the data then after you have corrected the first row for each habitat type you can simply autofill the rest by dragging the plus sign that appears when you hover over the bottom right hand corner of the cell.

25. You can then select the column of polygon areas from your spreadsheet and use ‘paste values’ to paste them into the Area column in the EBN tool. Obviously keep the spreadsheet in the same order as it was when you copied and pasted the habitat types – do not sort or filter before copying the areas.

26. If the attribute values in all the other columns are in the right format, they can also be pasted in using ‘paste values’. Otherwise, correct them in your spreadsheet before pasting into the EBN tool. If your spreadsheet has one column for each of the 40 EBN

tool indicators, and they are in the right order, you can copy and paste the whole block of indicators in one go. Otherwise you can do them individually.

27. For the post-development data entry, repeat this process using the ‘before and after’ spreadsheet that you created, and pasting in the ‘after‘ habitat types.

28. For newly created habitats, set the ‘Type of change’ cells to ‘Create’, and paste in the column of starting habitats from your exported spreadsheet.

6.2 Exporting the scores to GIS

A facility for exporting the ENB tool scores for each habitat row to a spreadsheet and then to GIS has not yet been set up.

6.3 Applying the basic scores only (not condition factors) to a GIS habitat map

1. Go to the ‘Scores’ sheet. Type ‘matrix’ into the range box (top left of screen) and hit return. This should select the named range containing the score matrix. Copy this matrix and paste into a new Excel workbook, with no blank rows or columns at the top or to the left (i.e. paste the range into cell A1 of the new workbook).

2. Immediately below the matrix, in the first column, add a list of all the habitat types used in your GIS map. For example, if you are using Phase 1 classifications in your GIS map, you need to list exactly the same classification labels, spelt exactly the same way. One way to derive this list is to export your habitat map to an excel file (Geoprocessing, Search for tools, Table to Excel), and then apply a pivot table to the excel habitat list to see what habitats are listed.

3. Match your habitat types to the equivalent scores in the matrix, using the ‘Habitat translation’ sheet, and copy those rows of scores to your habitat list. Do not copy any rows where the same habitat type is listed in the EBN tool matrix, i.e. the habitat name matches.

4. Change the column headers so they all have a max of 10 characters.

5. Import your extended matrix into GIS using the ExcelToTable tool (Geoprocessing, Search for tools, Excel to Table),.

6. Join the table to the habitat shapefile.

7. You can now use the new joined columns to change the symbology.

7. Copying data to a new version of the tool

It is easy to copy the data from one version of the tool to an upgraded version, or from the Short version to the Long version if you need more rows, or to a clean version of the tool if the input data formats have been corrupted (if the guidance in Box 1 was not followed). The key is to use ‘Paste Values’. The data can then be copied over in four blocks. It should take only a few minutes.

1. Copy the information from the Project Details sheet to the new version,
2. On the Baseline habitats sheet, select the block of data including the On-site – Off-site column, the habitats and the lengths, widths, and areas.

Tip: Copy the whole block of data using short-cut keys (useful if there are many rows). Click in the first cell of the block (C9). Press Ctrl-Shift-Down-arrow, which should select the column as far as the last row of your data. Then press Ctrl-Shift-Right-arrow which should select the whole block of data up to the area column. If your data has gaps where indicators or rows are blank, simply keep pressing the arrow (with Ctrl-Shift still held down) until the whole block is selected. Then press Ctrl-Insert to copy to the clipboard**.**

3. Go to the new version of the spreadsheet, click on cell C9, go to the Paste icon in the Home menu bar and select ‘Paste Values’ (see Box 1).
4. Go back to your original version, and select the whole block of indicator data, from ALC (column J) to the last indicator and, if needed, the Comments column.

Tip: The short cut to the bottom row of the first indicator column (ALC) described in the Tip box above will not work here because all indicator columns are pre-filled with ‘NK’ by default, so Ctrl-Shift-Down arrow will take you right to the bottom of the table. If you don’t have many rows you can select all the rows of data in column J manually. If you have hundreds of rows you can start from the bottom of the block and select upwards instead. Use Ctrl-Shift-Down arrow to get to the bottom of the Habitat list (column D), then use right arrow (without Ctrl or Shift) to go across to the bottom of the first indicator column (ALC), then Ctrl-Shift-Up arrow to select to the top of the column. This will select the header row of the table (row 8) as well, so to come down one row to cell J9 use Shift-down arrow. Then use Ctrl-Shift-right arrow to select to the last indicator column and, if needed, the comments column. If your data has gaps where indicators or rows are blank, simply keep pressing the arrow (with Ctrl-Shift still held down) until the whole block is selected. Then Ctrl-Insert to copy to the clipboard.

5. Go to the new version of the EBN tool, click on the first row of the first indicator (ALC) and use Paste Values (as for step 3).
6. Repeat for the Post-development habitats, but this time you will need to copy the ‘Change’ and ‘Starting habitat’ columns as well as all the indicators. So, click on the first row of the ‘Change’ column first before you select and copy the rest of the block with Ctrl-Shift-Down arrow, Ctrl-Shift-Right arrow, Ctrl-Insert.

7. Check for errors on the data entry and Results sheets. In some upgrades, there may have been changes to the options available in the drop-down boxes for the indicators. If this is the case, you may need to replace some of your data with new values that match the available options. This will be described in the Release Notes on the Version Control sheet and in the email notifying you of the upgrade. If the whole column has the same value, you can simply change the top value and then auto-fill the column. Otherwise it is probably easiest to select the whole column and then use ‘Find/replace’ to update each value in turn.

For some upgrades, it may be necessary to change some of the input data – for example if some of the category names for the indicators have changed. An ‘Upgrade’ spreadsheet has been developed to help users upgrade to the most recent version. Users simply paste their input indicator values onto the ‘Input’ sheet and then copy and paste the upgraded values (with updated category names) from the ‘Upgrade’ sheet.

Appendix 1: Structure of the tool

The EBN tool is an EXCEL workbook consisting of the following worksheets.

Worksheets needed by the user

- **Welcome**: introduction to the tool; what it does and does not do.
- **Instructions:** quick start instructions
- **1. Project details**: space for users to enter basic project details (see section 2).
- **2. Baseline habitats**: data entry sheet for habitat area and condition indicators before development or intervention, both on site and for any compensatory habitat creation or enhancement off site
- **3. Post-dev habitats:** data entry sheet for habitat area and condition indicators after the development or intervention and the associated biodiversity net gain (retained, created, or enhanced habitats) both on site and off site
- **4. Results**: Arrows showing direction and magnitude of change for each ecosystem service at 1, 10 and 30 years after development, and pie charts of natural capital assets (habitat extent)
- **4a. Compare on & off-site results:** arrows and natural capital asset pie charts for on-site and off-site habitats separately.
- **4b. Interpretation charts.** Charts showing the split of ecosystem service scores between habitat groups for each ecosystem service. These charts are useful for understanding the reasons for the changes in scores.
- **4c. Results breakdown tables.** Detailed result tables for each habitat type and service.
- **4d. Save scenarios.** Save the main results table for up to three different scenarios so that you can compare them side by side.
- **4e. Comparison with 100% suburban mosaic.** For housing developments only – shows a comparison with what would have happened if the whole site was converted to a ‘typical suburban mosaic’. This can be useful to illustrate the benefits of on-site green infrastructure.
- **Data sources**: summary table with information on each condition or spatial indicator, including links to the appropriate data sources. Accessed directly or via the info links on the data entry sheets.

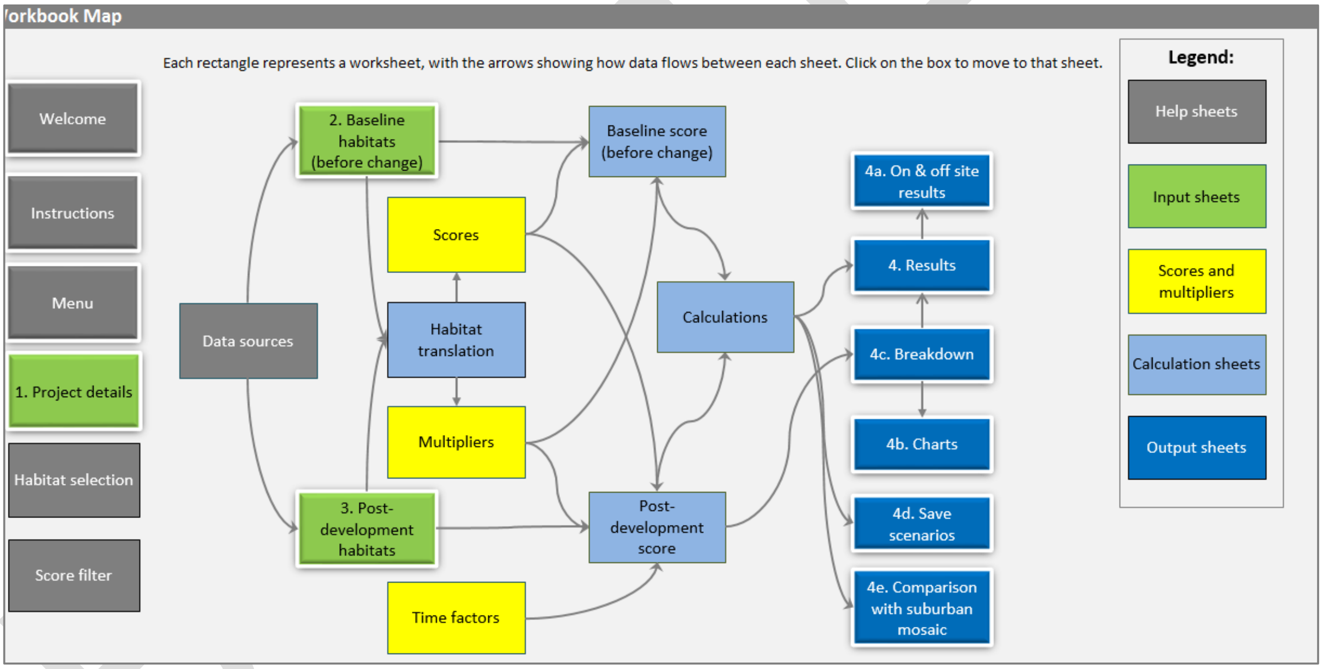
Worksheets used internally by the tool (the user does not need to access these unless interested).

- **Baseline scores:** calculation sheet where the EBN tool units for the habitats before the development or intervention are calculated.
- **Post-dev scores:** calculation sheet where the EBN tool units for the habitats after the development or intervention to deliver biodiversity net gain are calculated.
- **Calculations:** summary calculations which underlie the arrows on the results sheets.
- **Map**: a map showing how the different worksheets are connected (see 3).

- **Scores**: the matrix of habitat scores.
- **Score filter**: a sortable version of the score matrix if users want to see the top habitats for different ecosystem services.
- **Multipliers**: tables of condition and spatial multipliers.
- **Time factors**: table of multipliers to correct for 'time to reach target condition'
- **Applicability**: used to determine which condition and spatial indicators apply to each habitat type.
- **Habitat selection**: source of the dropdown lists of habitat types used for data entry. The user can define their own list on this sheet if desired.
- **Habitat translation**: used to automatically translate different habitat classification systems into the appropriate EBN tool habitat.
- **Version control:** list of updates including release notes where applicable.

The sheets are colour coded as shown in Figure 1. There are only three data entry sheets, identified with green tabs. The user enters input data on these three sheets, and the results are calculated automatically and displayed on the results sheets.

Figure 14: Map of the EBN tool workbook (this is in the workbook)

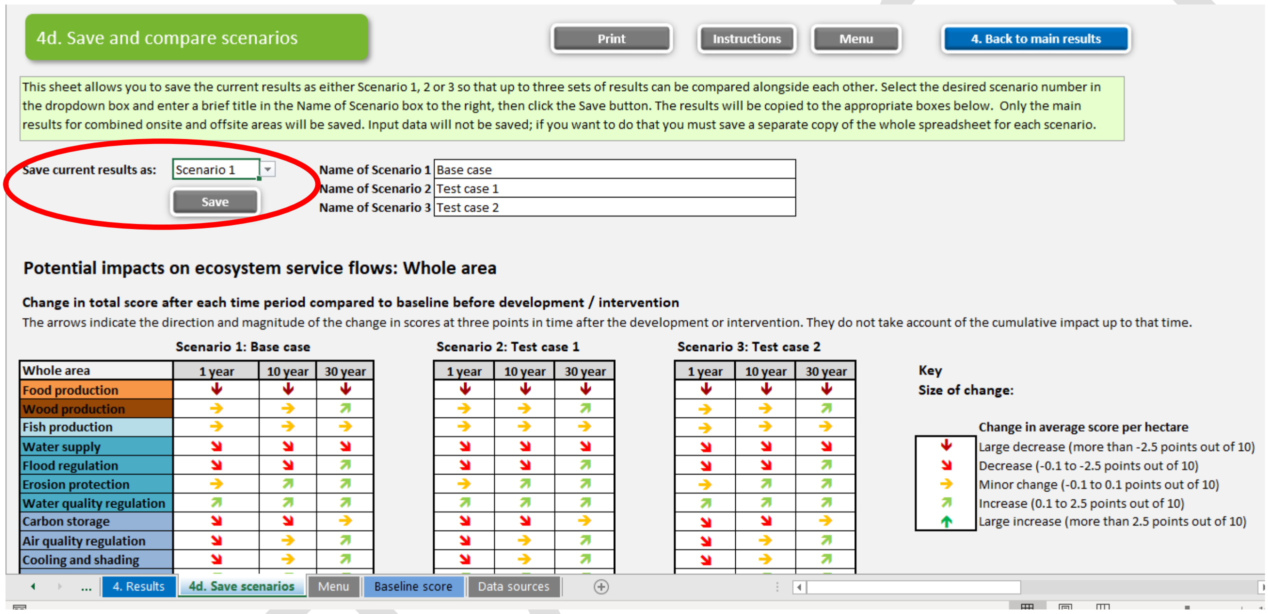


Appendix 2: Saving scenarios

To compare scenarios within the tool first record your ‘base case’ against which you wish to compare results. This should be Scenario 1.

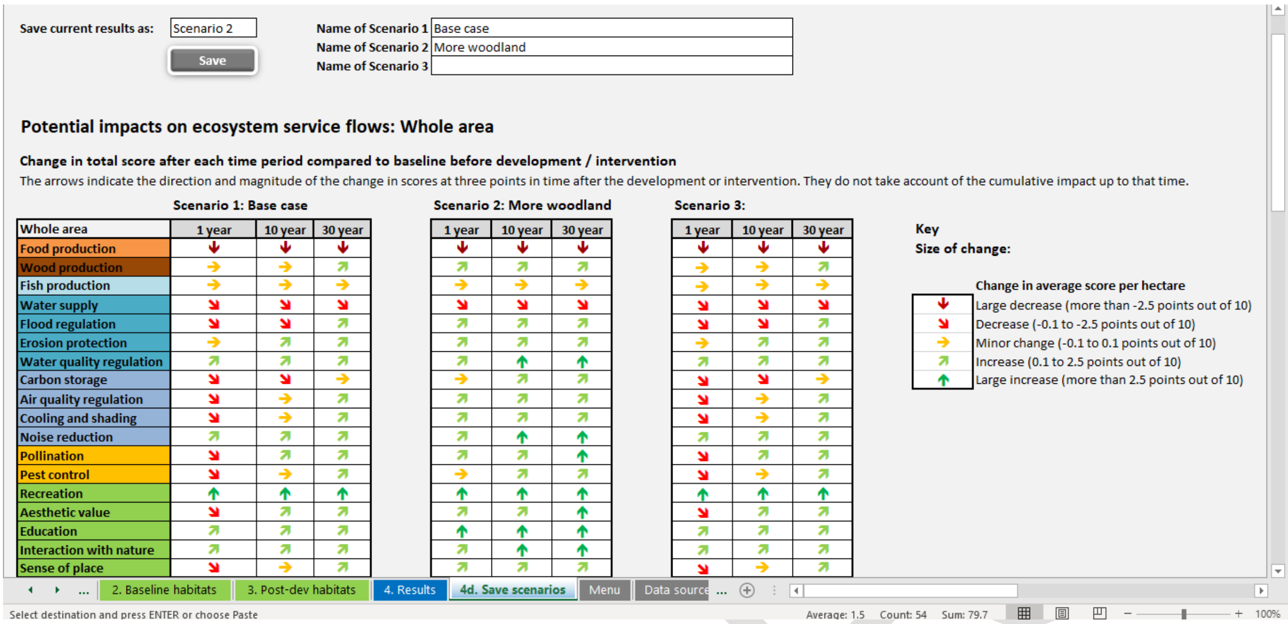
This can be done by running the results, in accordance with instructions above and clicking on the 4d Save Scenario button on the Results tab. This will take you to the screen set out below. Toggle the dropdown box left to Scenario 1 and click on the save button below. The name of the scenario can be changed using the box provided and appears above the left chart

Figure 15. Save Scenario Screenshot



To compare it to a second scenario, make the necessary changes to the baseline habitats or post development plans (for example retaining more of the original habitat, increasing the area of post development habitat, or changing its type for example from grassland to woodland). The results should be re-calculated automatically. The above process then needs to be repeated, this time selecting scenario 2 from the drop down. The charts will then automatically change upon clicking on the save button allowing you to easily compare impact against your original plans (as can be seen in Figure 16).

Figure 16. Example showing impact of significant increase in post-development woodland saved in Scenario 2



A third scenario can be entered in the same way.

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ISBN 978-1-78354-759-3

Catalogue code: JP038

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