# The potential contribution of revenue from Biodiversity Net Gain offsets towards nature recovery ambitions in Oxfordshire

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Chinnor Hill. Photo: Paul Martin.

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# Contents

# Summary

There is a major funding gap for delivering the UK's nature recovery ambitions, including meeting the national and international '30x30' target (30% of land protected and managed for nature by 2030). This work aimed to investigate the potential revenue that could be generated over the next ten years through purchase of Biodiversity Net Gain (BNG) offsets by developers in Oxfordshire, and the extent to which this could contribute to the estimated costs of nature recovery.

We compare potential BNG revenue with the costs of creating sufficient areas of semi-natural habitats in strategic locations (e.g. within Oxfordshire's Nature Recovery Network) to meet the 30x30 target, and maintaining those habitats for 30 years. These costs are estimated at **£800 million**, but this excludes the costs of protecting and monitoring the sites, and any additional costs for organisations that wish to purchase land or compensate landowners for lost opportunity costs. Also, these are not the full costs of nature recovery in its broadest sense, as they do not take account of the cost of restoring species populations to sustainable levels. In particular, this analysis does not consider the cost of recovering any species and habitats lost as a result of the development that gives rise to the BNG revenue, i.e. it is assumed that the compensatory habitats created through BNG will successfully replace those lost and will prevent any loss of associated species. The estimates are simply intended to help organisations involved in nature recovery to understand the potential size of the BNG market, to inform future investment plans.

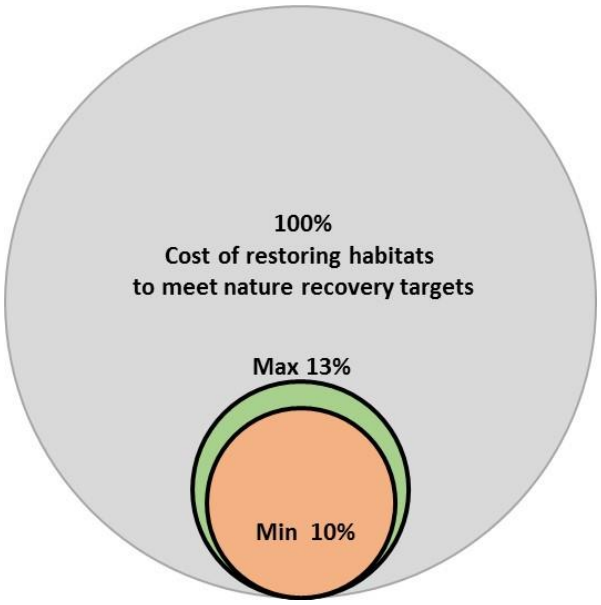
The analysis shows that if only the minimum BNG of 10% is adopted, it is estimated that **the BNG offset market could finance a maximum of between 10% and 13% of the costs of creating additional habitats to meet the 30x30 target**. For the minimum BNG of 10%, we estimate that around 47,000 biodiversity units will be required to offset the impacts of the developments expected in Oxfordshire over the next ten years. The majority of these units are required to compensate for habitat loss due to development, with only 4,309 representing the expected 10% net gain, worth an estimated £108 million, 13% of the estimated cost of habitat creation to meet the 30x30 target.

The estimates depend on assumptions about the proportion of biodiversity units that are delivered off-site, outside the development boundary, and could therefore be used to fund the restoration of strategically important sites that could contribute to the 30x30 target. On-site habitat creation can also have biodiversity benefits but there is currently no legal mechanism to enforce long term monitoring and protection, as required in order to count towards the 30x30 target. At least 9% of biodiversity units need to be delivered off-site in order to deliver the £108 million of revenue that could contribute towards nature recovery. However, currently, only 7% of biodiversity units are delivered off-site, which would generate around £83 million in offset funding over the next 10 years, just 10% of the estimated habitat creation costs.

These estimates would increase if a larger target for BNG was adopted. For example, some councils elsewhere in England have adopted targets of 20% or above. If this was done in Oxfordshire, then BNG could contribute up to 26% of expected nature recovery costs (provided that at least 17% of biodiversity units are delivered off-site).

We conclude that when additional costs of protecting and monitoring new habitats or any necessary land purchase or opportunity costs are taken into account, the true proportion of nature recovery that the BNG market can fund (for a 10% BNG target) is likely to be lower than the maximum estimate of 13%**.** Whilst Oxfordshire is the focus of this case study, it provides a useful illustration of the factors influencing the BNG offset market and its ability to finance nature recovery, which could be more widely applicable to other councils in England.

**The proportion of the total cost of creating habitats to meet the 30x30 target which could be funded by the maximum and minimum estimates for the size of the BNG market for a 10% BNG target**




**Acronyms**

**BNG =** Biodiversity Net Gain

**BU =** Biodiversity Unit

**NRN =** Nature Recovery Network

**NDP =** Neighbourhood Development Plan

**LP** = Local Plan

**LPA** = Local Planning Authority

# 1 Background and rationale

The 2021 Environment Act (UK Goverment 2021) introduces new strategies to support better spatial planning for nature; amongst these are the creation of Local Nature Recovery Strategies. These are biodiversity strategies specific to local regions, comprising a list of nature recovery priorities for the area together with a local habitat map which identifies priority areas for recovering and enhancing biodiversity. For Oxfordshire, a draft Nature Recovery Network (NRN) map has been developed which details 'Core' areas which are already protected or which comprise Priority Habitat, and a 'Recovery Zone' which links those areas into a coherent network that could be a target area for nature recovery (Wild Oxfordshire 2023).

However, there is a major funding gap for delivering the UK's nature recovery ambitions, including meeting the national and international '30x30' target (30% of land protected and managed for nature by 2030). It has been estimated that an extra £19 billion is needed over the next ten years to plug the funding gap for protection and restoration of biodiversity in the UK, on top of the £7 billion currently committed from public, private and NGO sources (GFI, eftec and Rayment Consulting, 2021).

As a consequence of the Environment Act, there is potential to support Nature Recovery ambitions through private funding in the form of BNG offset payments. From late 2023, developments will need to demonstrate a minimum 10% net gain in biodiversity, measured using the latest version of the DEFRA Biodiversity Metric (Panks, et al. 2022), in order to gain planning permission. In accordance with the mitigation hierarchy (CBSI 2015), developments should first avoid, then minimise, then remediate, detrimental effects on biodiversity, before using offsetting to compensate for any unavoidable losses. The Metric incentivises developers to meet their biodiversity liability on-site, within the development boundary, in order to reduce loss of existing habitats and the species that depend on them, and retain green space for local people. When developments are unable to do so, compensation can occur off-site, outside the development boundary, in order to achieve 10% BNG. This requires the purchase of off-site biodiversity units, representing areas of habitat which are created/enhanced by landowners or managers.

BNG is a compensation mechanism, designed to prevent a net loss of biodiversity through development. Whilst BNG itself does not form a part of the conservation objectives of Nature Recovery, the market for these compensatory off-site biodiversity units could be used in financing part of these Nature Recovery objectives. This would occur by directing BNG offset payments towards restoration of semi-natural habitats in the recovery zone of the NRN.

The overall objective of this work is therefore to provide an indication of the financial potential for private funding of Nature Recovery ambitions in Oxfordshire through the BNG offset market. The work is split into three stages.

1. **Estimate the costs of delivering habitats to meet the 30x30 target in Oxfordshire**

   This involves an assessment of:

   - The area of land currently managed for nature recovery,
   - The area of land needed to meet the 30x30 target, contributing towards Oxfordshire's nature recovery ambitions,
   - The cost of nature recovery per ha, and therefore the total estimated cost of nature recovery.

2. **Estimate the size of the BNG offset market in Oxfordshire over the next ten years:**

   This involves an assessment of:

   - The scale of development projected for Oxfordshire within the next ten years,
   - The number of off-site biodiversity units this development is likely to generate,

- The likely cost of these units, and therefore the total estimated size of the BNG market.

**3. Evaluate the potential for the BNG market to contribute to financing Nature Recovery**

This uses the results from stages one and two, comparing the costs of delivering the nature recovery ambitions and the size of the BNG market. This will provide an indication of the ability of BNG offsets to contribute towards the funding of nature recovery in Oxfordshire. We report the proportion of this revenue that can be considered to be genuinely contributing to nature recovery, not simply offsetting losses elsewhere.

# 2 Methods

## 2.1 Estimating the costs of meeting the 30x30 target as part of Nature Recovery ambitions

The overall approach was to estimate the cost of creating and maintaining different habitat types (Section 2.1.1), estimate the area of each habitat type that could be created (Section 2.1.2), and then simply multiply these to estimate the total costs for nature recovery (Section 3.1) (Figure 2).

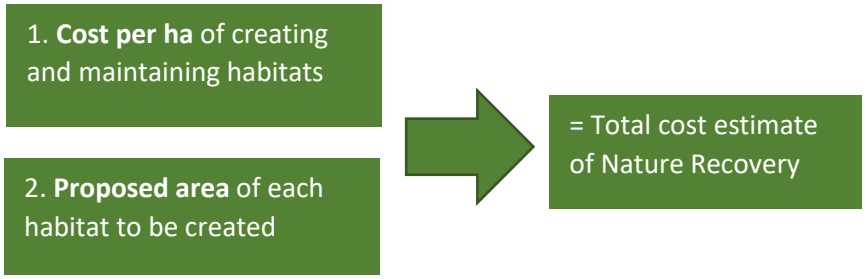



**Figure 1. Simplified method used to estimate the cost of Nature Recovery**

### *2.1.1 Costs of restoration*

A literature review was conducted (Appendix 1) to obtain estimates for the mean costs per ha of creating or restoring each semi-natural habitat type, using multiple estimates from a variety of sources. Habitats are classified into broader categories, and specific habitat types. Where possible, a mean cost estimate for each detailed habitat type was obtained. Where there were insufficient data to do so, the mean cost estimate for the broad habitat type was applied. These costs include the capital costs of creating the habitat as well as the operational costs of maintaining it for 30 years.

We assume that many nature recovery activities will be carried out by farmers and landowners on land they own and manage. However, organisations may sometimes wish to purchase land for nature recovery, e.g. to extend or create a new nature reserve. Also, additional costs may occur when intermediary organisations use funds generated through offset payments to support projects which deliver BNG. For example, some landowners may require compensation for lost income (e.g. on agricultural land converted to another habitat type). These costs are not factored in to the calculations, but they would be substantial: the average costs of purchasing land for habitat creation in Oxfordshire is currently estimated by the Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust at around £25,000 per hectare. We also do not include transaction costs involved with preparing and enabling projects (e.g. farm advice, data and payment management, community engagement) or costs related to monitoring and protecting the sites in perpetuity, due to lack of information. These costs are therefore an underestimate of the full cost of meeting the 30x30 target.

### *2.1.2 Proposed area of each habitat to be created*

*Defining Oxfordshire's Nature Recovery ambitions*

Currently, 32,265ha of Oxfordshire is classified as semi-natural habitat, comprising 12% of Oxfordshire. The global target set for the proportion of Earth's land and sea to be protected and restored by 2030 is 30% (CBD 2021). This is Target 3 of the Global Biodiversity Framework, a more ambitious goal than the predecessor Aichi target 11 (17% of land and 10% of sea) (CBD 2011). The UK has signed up to this target (GOV.UK 2020). For Oxfordshire to align with this global and national conservation goal, and increase the proportion of semi-natural habitats to 30%, an additional 45,913ha would be required. Ideally, this would all be protected and managed to ensure that the habitats are in good condition. However, as a first step, this analysis focuses on the costs of creating the additional habitat area required to fulfil the target and maintaining them for 30 years.

*Determining the area available for restoration*

To determine the area of land in Oxfordshire where nature recovery ambitions can be met, the total areas of each habitat type in Oxfordshire were taken from the Natural Capital map of Oxfordshire (Smith 2021).

We focused on areas within the NRN Recovery Zone and excluded the following areas:

1. Areas in the NRN Core zone, which include the majority of protected sites and priority habitats.
2. Areas which are already being restored, according to the HERO database of nature recovery activities in Oxfordshire (HERO 2023)
3. Ancient woodland (as this is not included in the NRN Core zone).
4. Areas of high grade farmland (Agricultural Land Classifications 1 or 2).

The remaining habitat areas are those with the greatest potential for future nature recovery. Of these areas, two habitat types form the majority of the available land and are considered the main target for restoration in this analysis: arable land (24,465ha), and Improved grassland (22,289ha). By coincidence, these areas total 46,753ha, which, if restored to semi-natural habitats, could deliver the 30% target.

Hence, for the purposes of this analysis, we make the simplistic assumption that 'Nature Recovery' is considered to be equivalent to the creation of semi-natural habitats on arable and improved grassland in the Recovery Zone of the NRN (Figure 1). This is an illustrative scenario, representing one theoretical option for nature recovery, and does not imply that all nature recovery will take place in these types of areas. In practice, there will be important trade-offs and synergies between nature recovery, climate action, farming, other industries, and development that will need to be explored in depth by all stakeholders as the Local Nature Recovery Strategy is developed.

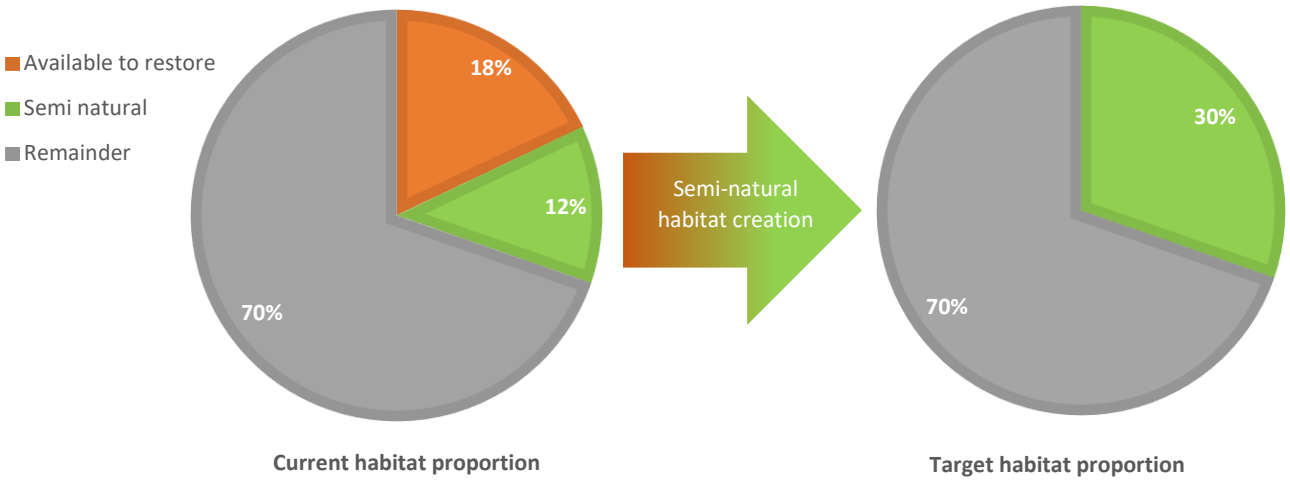



**Figure 2. Assumptions regarding conversion of low to medium grade arable and improved grassland that is suitable for restoration to reach the target of 30% of Oxfordshire being 'semi-natural' habitats**

*Proportion of habitat types to be created*

Based on the methodology of the PAZCO report (Pathways to a Zero Carbon Oxfordshire) (Hampton, et al. 2021), we use a scenario where new semi-natural habitats are created in proportion to the existing areas of these habitats within Oxfordshire, with the exception of two under-represented habitats – acid grassland and heathland – where we create larger areas. Here we assume, for illustrative purposes, that 1000 ha each of acid grassland and heathland could be created, although this would be subject to biophysical and practical constraints that have not yet been assessed. Relative to the existing areas of semi-natural habitat types, **an increase of +140% of each habitat type**, in addition to **1000 ha each of acid grassland and heathland**, would result in the creation of an additional 46,802 ha of semi-natural habitat: approximately the area of arable and unimproved grassland targeted for restoration (Table 1).

*Hedgerows*

For hedgerows we use a different approach. The starting point was two datasets indicating the current extent of hedgerows and lines of trees (jointly termed 'linear woody features', or lwf) in Oxfordshire:

1. An Ordnance Survey line dataset (the Ecological Focus Areas Landscape Features Reference Layer). This is only available for research purposes, as it has not been validated for wider use. It shows 16,971 of linear woody features in Oxfordshire: 9,564 km of hedgerows and 7,407 km of lines of trees or linear woodland strips. However, these include over 4,500 km that are actually the edges of existing larger blocks of woodland (rather than linear features), and over 800 km of garden boundaries, which are not considered suitable targets for new hedgerow creation because long term maintenance cannot be guaranteed. Thus the actual length of linear woody features relevant for nature recovery is 9,907 km.
2. A new experimental dataset generated by Google based on machine learning classification of aerial photos, based on a training dataset generated by volunteers. This is a polygon dataset rather than a line dataset, so the estimated length of hedgerows and linear woodland features has to be extracted by overlaying it with a map of expected boundaries that could have hedges, consisting mainly of the boundaries of agricultural fields and orchards. This indicates that there are around 13,000 km of linear woody features along field boundaries; picking up more features than the OS dataset.

We also overlaid both datasets with the map of field boundaries to show that the length of field boundaries with no linear woody features was around 15,000 km according to the OS dataset and around 12,000 km according to the Google dataset.

We considered three methods of setting a target for creation of new hedgerows (see Table 1).

1. Using the OS dataset, we identified 9,100 km of 'high priority' boundaries, defined as being those within 1 ha grid cells that have less than 100 m of existing linear woody features along field boundaries and more than 100 m of field boundaries with no hedges. This creates hedges on 62% of the field boundaries that currently have no hedges.
2. We considered applying the Climate Change Committee's Balanced Net Zero pathway target of a 40% uplift in hedgerow length (CCC, 2020). This was in turn based on an estimate of existing hedgerow length derived from the 2007 Countryside Survey (Carey et al., 2008), which sampled 591 1km$^2$ grid cells across the UK, excluding urban areas, concluding that there were 547,000 km of hedgerows in England in 2007, an average of 4.2 km per km$^2$. A 40% uplift would create an extra 3,963 km of hedges based on the OS dataset (26% of the field boundaries that have no hedges) or 5,219 km based on the Google dataset (43% of the field boundaries that have no hedges).
3. Finally we considered attempting to meet the target of 10 km hedgerow per 1km$^2$, defined in a recent academic paper (Staley et al., 2023). This is a very rough estimate of an upper bound for hedgerow creation based on the level at which hedgerows might begin to have adverse impacts on species that prefer open habitats (such as certain ground-nesting birds). This would involve very high levels of hedgerow creation: 16,000 km using the OS dataset or 13,000 km using the Google dataset. In both cases, this exceeds the length of existing field boundaries with no hedgerows, meaning that new boundaries would need to be created (e.g. by sub-dividing fields).

**Table 1. Alternative methods for setting a hedgerow creation target**

| Potential targets for hedgerow creation | Dataset | Existing lwf[a] on field boundaries (km) | Empty field boundaries (km) | New hedgerows (km) | Starting km/km$^2$ | Final km/km$^2$ | % of empty boundaries restored | % increase in existing lwf |
|---|---|---|---|---|---|---|---|---|
| High priority boundaries[b] | OS | 9,907 | 15,365 | 9,600 | 3.80 | 7.49 | 62% | 97% |
| Increase to 10 km/km$^2$ | OS | 9,907 | 15,365 | 16,152 | 3.80 | 10.00 | 105%[c] | 163% |
| | Google | 13,048 | 12,224 | 13,011 | 5.01 | 10.00 | 106%[c] | 100% |
| Increase by 40% (CCC) | OS | 9,907 | 15,365 | 3,963 | 3.80 | 5.32 | 26% | 40% |
| | Google[d] | 13,048 | 12,224 | 5,219 | 5.01 | 7.01 | 43% | 40% |

Notes:

a. Lwf = linear woody features (hedgerows or lines of trees)
b. High priority boundaries are those with no lwf that occur in 1ha grid cells with >100m empty boundaries and <100m boundaries with lwf.
c. For these options, new boundaries need to be created (e.g. by subdividing large fields)
d. This option was selected for the analysis

A local hedgerow expert (Nigel Adams) was consulted, and we were advised that the higher targets (over 9,000 km) were unrealistic, given constraints on local skills and nursery stock for saplings. Of the lower targets, for the 40% increase, we decided that the target based on the Google dataset was more realistic as it included many features omitted in the OS dataset (checked by visual examination of both datasets compared to aerial photos in ArcGIS, for a few randomly selected locations). Therefore this target, for creation of 5,219 km of new hedgerows, was chosen for the analysis of costs.

Nigel Adams also advised that many hedgerows are in poor condition, and therefore a nature recovery target should also aim to restore existing hedgerows. This is confirmed by the 2007 Countryside Survey which estimated that in England as a whole, only 50% of 'managed' hedgerows were in good structural condition. Hedgerow restoration could involve active intervention (e.g. re-laying a hedge), or could simply involve a change in management style, e.g. stopping over-trimming, which could require a programme of outreach and awareness for land managers. We assumed that of the 50% of hedgerows in poor structural condition, about a third might require active intervention, equating to 950 km of hedgerows (using the Google dataset for hedgerows on field boundaries, and excluding lines of trees), which we rounded up to 1000 km.

**Table 2. Scenario used to determine the area of different semi-natural habitats to be created.**

| Habitat type | Current area in Oxfordshire (ha) | Additional area created (ha) | Final area (ha) |
|---|---|---|---|
| **Acid grassland** | 58 | 1000 | 1058 |
| **Calcareous grassland** | 1221 | 1710 | 2931 |
| **Neutral grassland** | 5645 | 7903 | 13548 |
| **Other semi-improved grassland** | 2763 | 3869 | 6632 |
| **Fen, marsh and swamp** | 3350 | 4690 | 8040 |
| **Scrub** | 1624 | 2273 | 3897 |
| **Heathland** | 6 | 1000 | 1006 |
| **Semi-natural woodland** | 14932 | 20905 | 35837 |
| **Parkland and scattered trees** | 2466 | 3452 | 5918 |
| **Total area excluding hedgerows** | **32065** | **46802** | **78866** |
| ***Hedgerows and lines of trees, and hedgerows created (km)*** | *13,048 km* | *5,219 km* | *18,267 km* |
| ***Hedgerows restored (km)*** | *5,701 km* | *1000 km* | *5,701 km* |

## 2.2 Estimating the size of the BNG offsets market in Oxfordshire

### *2.2.1 Overview*

The size of the financial market for BNG offsets in Oxfordshire is dependent upon a number of factors. Firstly, the cost per biodiversity unit (BU), influencing how much developers will pay to offset their biodiversity impacts off-site. Secondly, the number of off-site units that developments are likely to generate. This is dependent on the number and type of developments, the proportion of units delivered off-site, and the percentage requirement for BNG imposed by the council.

The overview of methods is represented in figure 3. The cost per BU was first determined (Section 2.2.2). Pre-existing BNG data was then used to determine the average total baseline BUs (on and off-site) for each development type (Section 2.2.3). The total number of projected developments for Oxfordshire was then estimated using local planning data (Section 2.2.4). This was multiplied by the average units per development to estimate the total number of units generated, and the additional BUs which would be required for 10% BNG to be achieved (Section 2.2.5). Three estimates (minimum, medium and maximum) were applied for the proportion of these total BUs which are delivered off-site (Section 2.2.6). We then used two different methods to account for the proportion of the total off-site BUs that could be considered to contribute towards net gain (above and beyond the units needed to compensate for lost habitats due to development). For each of these methods, the cost per unit was multiplied by total estimated off-site units delivered in Oxfordshire that contribute to a net gain, to estimate the revenue from the BNG offset market that could contribute to funding nature recovery activities (Section 2.2.6). Finally we tested different

assumptions concerning the proportion of units delivered off-site in major and minor dwellings (Section 2.2.7).

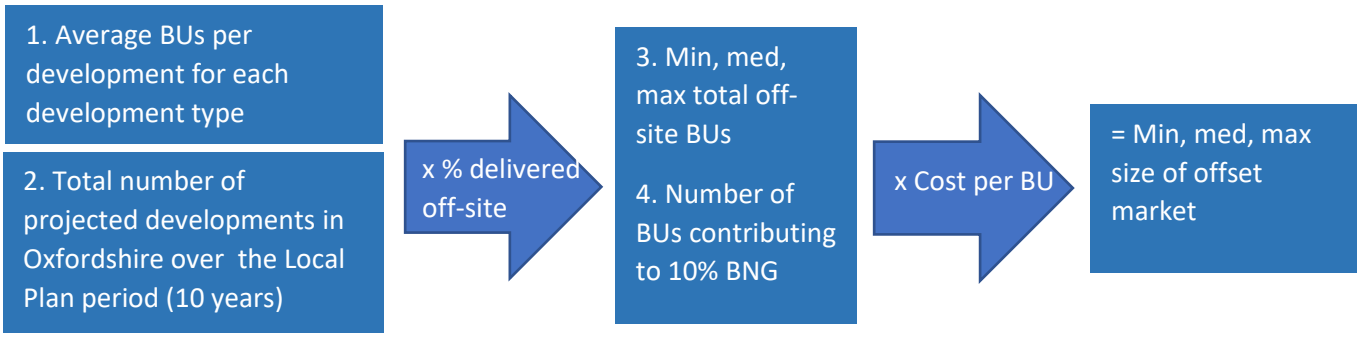



**Figure 3. Simplified overview of method for calculating the size of BNG market**

### *2.2.2 Cost of Biodiversity Units*

The cost per biodiversity unit has been estimated using data from the Wildlife Trusts (BBOWT), Trust for Oxfordshire's Environment, who are delivering offsite BNG solutions in Oxfordshire, and national estimates from Defra. The Trust for Oxfordshire's Environment is using a working estimate of **£19,200** for a standard unit, with work undergoing on reviewing costs, which could lead to another £3,000-4000 increase per unit. Defra's market analysis study gives an estimated value of **£20,000** per unit, increasing to **£25,000** in LPAs where units are more scarce (DEFRA 2021). BBOWT data indicate a **£25,000** value per unit.

The value for a biodiversity unit within Oxfordshire is therefore taken at £25,000/unit**,** aligned with DEFRA's high-end estimates.

### *2.2.3 Average number of biodiversity units delivered per development*

To estimate the average number of units generated per development, we used a database of BNG calculations for six councils which are early adopters of mandatory BNG, prior to the national adoption expected in November 2023: South Oxfordshire District Council, West Oxfordshire District Council, Vale of White Horse District Council, Leeds City Council, Tunbridge Wells Borough Council, and Cornwall County Council (zu Ermgassen, et al. 2021).

Ideally, we would have used estimates of the typical biodiversity units that could be delivered per hectare of land developed, or per dwelling (for residential developments). However information on development area and number of dwellings was not available for all future developments (especially for windfalls) at the time of the analysis. We therefore used estimates of the number of biodiversity units per development, but we made use of different categories of development that were listed in the early adopter database (Table 3), as different types of development tend to differ in the typical unit requirement to achieve BNG. For example, large developments resulting in greater loss of habitat will require more BUs to achieve +10% on the biodiversity baseline.

**Table 3. The categories of developments considered.**

| Category | Definition |
|---|---|
| Commercial | Infrastructure for commercial use: shopping; business use; offices. |
| Education | Education infrastructure |
| Transport | Transport infrastructure: road; rail; cycle and pedestrian; airport. |
| Industry | Industrial use: warehouses; water and waste works; industrial units. |
| Energy | Energy infrastructure, including solar farms. |
| Health and social care | Health provision; care homes and supported living. |
| Recreational | Infrastructure for recreational use: sports and leisure centres; holiday parks; amenity land; community space. |
| Settlement and mixed use | Large mixed-use developments. Often comprising major dwelling development of 500+ dwellings, and associated infrastructure. |
| Dwellings | Housing developments of fewer than 500 dwellings:<br>Major dwelling developments: 10+ dwellings or site area >0.5ha.<br>Minor dwelling developments: 1-9 dwellings and site area <0.5ha. |

Baseline biodiversity units (both on-site and off-site) for all developments in each category were extracted from the database and the average number of baseline biodiversity units per development was calculated. For the category of minor dwellings, there were only two developments, which was an inadequate sample to generate a representative average. For this category we therefore used a different approach. We estimated the average number of biodiversity units per dwelling for major dwelling developments and multiplied this by an assumed average of five dwellings per minor development (as the range is 1-10 dwellings). We could also have used BUs per hectare and multiplied by an assumed average size of 0.3 ha per minor dwelling development – this gave a very similar result.

### *2.2.4 Projected number of developments*

In order to estimate the total number of BUs likely to be generated through development within Oxfordshire over the next ten years, it is necessary to determine the number of developments projected for Oxfordshire during this time period. Developments can be allocated in Local Plans and Neighbourhood Development Plans, in addition to those which are granted planning permission outside of allocated sites.

*Allocated developments*

To capture **allocated developments,** the Local Plans were reviewed for all Oxfordshire Councils, and the planned developments extracted, and classified into categories based on type of development (Table 3). In addition, Neighbourhood Development Plans for any town or village which had made one were reviewed (only those which showed additional information to the LPs are included in the figure). The Local Transport and Connectivity Plan, and the Infrastructure Development Plan, were also used.

These plans do not all span the same time periods; hence, a necessary constraint is to treat the plan period of ten years as an approximation only.

**Table 4. The sources used to extract allocated developments for Oxfordshire**

| Source | Date range | Council(s) |
|---|---|---|
| **Local Plans** | | |
| West Oxfordshire Local Plan 2031 | 2011-2031, adopted 2018 | West Oxfordshire |
| South Oxfordshire Local Plan 2035 | 2011-2035, adopted 2020 | South Oxfordshire |
| Cherwell Local Plan 2031 | 2011-2031, adopted 2016 | Cherwell |
| Vale of White Horse Local Plan 2031 | -2031, adopted 2016 (part 1) and 2019 (part 2) | Vale of White Horse |
| Oxford City Council Local Plan 2036 | 2016-2036, adopted 2020 | Oxford City |

| Source | Date range | Council(s) |
|---|---|---|
| Cherwell Local Plan Partial Review- Oxford's Unmet Housing Need, 2020 | 2011-2031 (made 2020) | Cherwell |
| **Infrastructure Delivery Plans and Transport Plan** | | |
| Cherwell Infrastructure Delivery Plan, 2021 update | 2011-2031 (update for 2020-2021) | Cherwell |
| West Oxfordshire Infrastructure Delivery Plan | 2011-2031, adopted 2016 | West Oxfordshire |
| South Oxfordshire Infrastructure Delivery Plan, 2020 update | 2011-2035 (update for 2020) | South Oxfordshire |
| Oxford City Council Infrastructure Delivery Plan, 2022 | -2036 (update for 2022) | Oxford City |
| Vale of White Horse Infrastructure Delivery Plan | -2031 (update for 2018) | Vale of White Horse |
| Oxfordshire Local Transport and Connectivity Plan | 2022-2050 (adopted 2022) | County Council (all districts + city) |
| **Neighbourhood Development Plans** | | |
| Barton Area Action Plan | | Oxford City |
| Berinsfield NDP | 2015-2027 | South Oxfordshire |
| Brightwell cum Sotwell NDP | 2016-2032 | South Oxfordshire |
| Chalgrove NDP | 2018-2033 | South Oxfordshire |
| Chinnor NDP | 2021-2034 | South Oxfordshire |
| Cholesy NDP | 2022-2035 | South Oxfordshire |
| Culham NDP | 2020-2041 | South Oxfordshire |
| Goring NDP | 2018-2033 | South Oxfordshire |
| Henley and Harpsden NDP | 2012-2027 | South Oxfordshire |
| Long Wittenham NDP | 2018-2035 | South Oxfordshire |
| Sonning Common NDP | 2011-2035 | South Oxfordshire |
| Wallingford NDP | 2019-2035 | South Oxfordshire |
| Watlington NDP | 2017-2035 | South Oxfordshire |
| Wheatley NDP | 2019-2035 | South Oxfordshire |
| Woodcote NDP | 2013-2035 | South Oxfordshire |

*Windfall dwellings*

Local plans allocate strategic developments. However, windfall developments can still occur outside of these allocations.

To capture windfall dwellings in addition to allocations, planning officers for the councils were contacted, and data was obtained on the numbers of major and minor developments permitted each year, in each council. Major dwelling developments are classed as those where the number of dwellings is 10 or more, and/or development is carried out on a site of 0.5ha or more. Minor dwelling developments comprise 1- 9 dwellings, on sites less than 0.5ha (UK Goverment 2010). Where data was unavailable from planning officers, the relevant planning portal was searched year-by-year, and relevant developments manually extracted. Developments were not included in these total if they were any of the following: change of use; re-development of existing buildings; applications to vary planning conditions.

For each council, the mean numbers of minor and major dwelling developments per year were calculated, using these data. These means were then multiplied by ten, to generate an estimate for the dwelling development projected over the next ten years.

The sources used to make these estimates, and the date ranges, are shown in Table 4.

**Table 5. Sources used to estimate the number of dwellings projected for Oxfordshire.**

| Council | Data source |
|---|---|
| **South Oxfordshire** | Datasheet on major and minor developments permitted from 2013-2022. Obtained from Planning Officer, filtered to remove 'change of use' and 'variation in conditions'. |
| **West Oxfordshire** | Datasheet on minor developments permitted from 2011-2020, obtained from Planning Officer. Major developments extracted from planning portal. |
| **Vale of White Horse** | Datasheet on major and minor developments permitted from 2012-2022. Obtained from Planning Officer, filtered to remove 'change of use' and 'variation in conditions'. |
| **Cherwell** | Datasheet on major and minor developments permitted from 2012-2022, obtained from Planning Officer. |
| **Oxford City** | Minor and major developments extracted from planning portal, years 2013-2021. |

### *2.2.5 Total projected biodiversity units generated in Oxfordshire for a 10% BNG target*

To calculate the estimated total biodiversity units generated by development in Oxfordshire, the total projected numbers of each type of development were multiplied by the estimated average biodiversity units per development for each category from the database.

The pre and post development BUs were then compared for each development within a category. Some developments in the database achieve a 10% uplift post development; however, some do not. Therefore, instead of considering the actual reported BU uplift, the baseline BU for each development was multiplied by 1.1 to determine the hypothetical post-development BUs require for each development to achieve 10% BNG. In other words, the analysis estimated the outcome if all Oxfordshire councils set a 10% BNG requirement. The results would therefore increase if some or all councils go beyond the legal minimum, e.g. to 20%.

The BU baseline was then subtracted from this post-development total, giving the **average additional number of BUs (on and off-site) per development required for 10% BNG.** This represents the 10% uplift in biodiversity units that could be considered to contribute to net gain, above and beyond the units needed to compensate for losses due to development. This average additional BU requirement was calculated for each category separately.

The method is summarised in Figure 4.

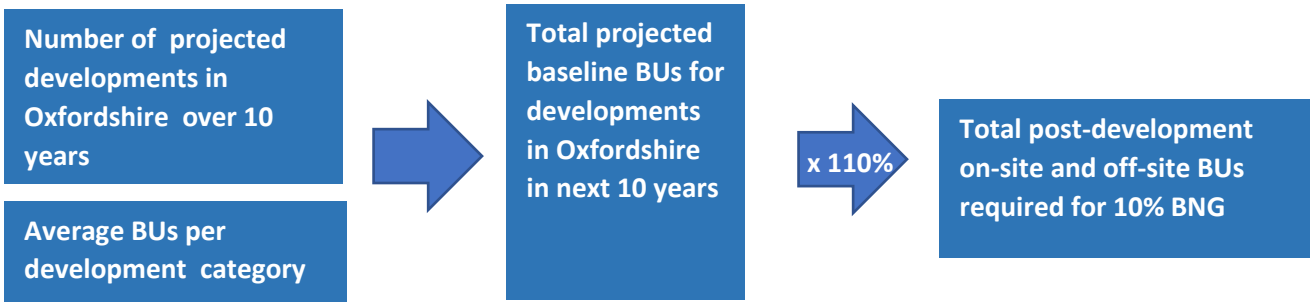



**Figure 4. The calculation of the additional biodiversity units required, on average, for developments of each category to achieve a 10% net gain in biodiversity**

### *2.2.6 Total off-site units generated in Oxfordshire*

When biodiversity liability cannot be met on-site, developments will require a proportion of their BNG to come from off-site units. We applied three estimates (minimum, medium, maximum) of the proportion of

BUs generated off-site, to estimate the total off-site units expected to be generated by the developments projected for Oxfordshire within the plan period, for each development category. (Figure 5).


**Figure 5. Simplified method for calculation of minimum, medium and maximum units generated off-site, for each development category.**

As BNG will not become mandatory until late 2023 (UK Goverment 2021), a range of estimates currently exist for the proportion of units expected to be generated off-site. A market analysis study for DEFRA (DEFRA 2021) estimated the proportion of units generated off-site as 50%. This is taken as the high-end estimate for this study. However the database of existing BNG calculations for early adopters shows on average a much lower proportion, ~7%, of BUs are generated off-site: this is the low-end estimate. We take a mid-point estimate from current data from the Vale of White Horse District, an early-adopter council in Oxfordshire, where 16% of BUs are delivered off-site (Table 5).

**Table 6. Sources of the three estimates for the proportion of biodiversity units delivered off-site**

| Estimate | Percentage off-site | Source |
|---|---|---|
| **Minimum** | 7% | BNG database of early-adopter councils |
| **Medium** | 16% | Data from Vale of White Horse |
| **Maximum** | 50% | DEFRA market study estimate |

### *2.2.7 Projected size of the BNG market contributing towards nature recovery*

The BNG offset market is a compensatory mechanism which creates habitats alongside facilitating loss of existing habitats through development. So most of the BNG offset revenue should be considered to be offsetting losses elsewhere rather than contributing to nature recovery. We use two different approaches to estimate the number of biodiversity units generated off-site that could be considered to contribute to nature recovery (net gain), i.e. units delivered above and beyond the units needed for compensation for lost habitats. For each of these methods, the size of the BNG offset market was then estimated by multiplying the estimated number of off-site units contributing to net gain by the cost per unit, taken as £25,000.

*Method 1: assume that an equal proportion of on-site and off-site units contribute to net gain.*

This method assumes that 10% of the on-site units and 10% of the off-site units contribute to net gain. The number of off-site units contributing to net gain is therefore 10% of each of the three estimates for the BUs generated off-site under the 7%, 16% and 50% off-site scenarios (Figure 6). This gives the minimum, medium, and maximum projected off-site units counting towards net gain, for each development category.


**Figure 6. Method 1 for calculating the number of off-site biodiversity units contributing to net gain (for 10% BNG), beyond the units needed for compensation**

*Method 2: Assume that up to 10% of total BUs can contribute to net gain*

Method 2 assumes that 10% of the total on-site and off-site BUs contribute to net gain, but this does not have to be distributed evenly between on-site and off-site BUs. In other words, if there are 100 baseline BUs plus an extra 10 BUs to deliver net gain of 10%, if 10 BUs are delivered off-site then they could all be considered to contribute to net gain (with none of the on-site BUs contributing). So any number of the offsite BUs can contribute to net gain until the total limit of 10% of all units is reached.

*Deciding which method to use*

After discussion amongst the co-authors, it was decided that there was no right or wrong method and we would present results for both methods. However it was felt that method 2 was more appropriate for presenting the final results, because this is more consistent with highlighting the role that off-site habitats are likely to play in delivering high quality and well-managed biodiversity units that contribute to nature recovery. See Figure 8 in the Results section for a graphical illustration of the two methods.

### *2.2.8 Major vs minor dwelling developments*

The three broad estimates for the size of the BNG market consider that 7%, 16% or 50% of the total BUs are delivered off-site, for all types of development. However, there is evidence from a study on early-adopter councils that smaller developments, including minor dwellings developments, may have a lower ability to meet their biodiversity liability on-site, compared to major developments (Rampling, et al. 2023). These smaller developments may therefore require a higher proportion of BUs to be delivered off-site, on average.

Consequently, a more detailed range of estimates for the number of BUs generated, and subsequent size of the BNG offset market, were calculated. These estimates consider minor dwelling and major dwelling developments separately, with a higher proportion of BUs generated off-site being assigned to the minor dwellings category. The scenarios considered are:

| *Scenario* | Minor dwellings | Major dwellings |
|---|---|---|
| **A** | 50% off-site | 16% off-site |
| **B** | 50% off-site | 7% off-site |
| **C** | 16% off-site | 7% off-site |

For each scenario, projected dwelling developments were separated into minor and major, and the respective percentage multipliers applied, to estimate the off-site BUs generated.

# 3 Results

## 3.1 Cost of meeting the 30x30 target as a contribution towards Nature Recovery

The estimated costs for the creation of semi-natural habitats are detailed in Table 7, based on the cost of creation and maintenance per ha for each habitat type multiplied by the proposed areas of each habitat to be created. The costs of increasing the area of each semi-natural habitat type in Oxfordshire by 140% (or by 1000 ha each for the under-represented habitats of acid grassland and heathland,) increasing the length of linear woodland features by 40% through adding 5,219 km of hedgerows and restoring another 1,000 km of hedgerows to good condition is projected at around **£800 million.**

**Table 7. The estimated costs of increasing the proportion of semi-natural habitat in Oxfordshire to 30%**

| Habitat | Area to be created (ha) | Cost per ha (£) | Total cost (£) |
|---|---|---|---|
| **Acid grassland** | 1,000.00 | 8,512 | 8,512,000 |
| **Aquatic marginal vegetation** | 0.11 | 13,944 | 1,491 |
| **Calcareous grassland** | 1,192.68 | 11,270 | 13,441,472 |
| **Calcareous grassland: semi-improved** | 252.07 | 11,270 | 2,840,869 |
| **Calcareous grassland: unimproved** | 264.85 | 11,270 | 2,984,848 |
| **Dense scrub** | 1,719.48 | 4,018 | 6,908,854 |
| **Ephemeral vegetation** | 53.27 | 13,112 | 698,459 |
| **Fen, marsh and swamp** | 57.14 | 13,944 | 796,824 |
| **Heathland** | 1,000.00 | 13,097 | 13,097,000 |
| **Lowland fens** | 270.05 | 14,923 | 4,029,952 |
| **Marsh with scattered scrub** | 6.97 | 15,965 | 111,349 |
| **Marsh with scattered trees: broadleaved** | 32.10 | 15,965 | 512,512 |
| **Marsh with scattered trees: mixed** | 0.24 | 15,965 | 3,870 |
| **Marshy grassland** | 4,237.22 | 15,965 | 67,647,256 |
| **Neutral grassland** | 3,719.06 | 18,170 | 67,575,245 |
| **Neutral grassland: semi-improved** | 4,033.84 | 18,170 | 73,294,825 |
| **Neutral grassland: unimproved** | 150.20 | 18,170 | 2,729,063 |
| **Parkland and scattered trees** | 117.10 | 9,144 | 1,070,732 |
| **Parkland and scattered trees: broadleaved** | 3,081.21 | 9,144 | 28,174,553 |
| **Reedbed** | 76.54 | 10,879 | 832,664 |
| **Scattered scrub** | 438.41 | 4,018 | 1,761,520 |
| **Scrub on semi-natural grassland** | 109.31 | 13,112 | 1,433,225 |
| **Scrub with scattered trees: broadleaved** | 115.23 | 4,018 | 462,987 |
| **Semi-natural grassland** | 3,223.47 | 13,112 | 42,266,164 |
| **Semi-natural grassland with scattered scrub** | 450.46 | 13,112 | 5,906,443 |
| **Semi-natural grassland with scattered trees: broadleaved** | 253.85 | 9,144 | 2,321,195 |
| **Swamp** | 9.40 | 13,944 | 131,063 |
| **Tall herb and fern** | 32.21 | 13,112 | 422,349 |
| **Traditional orchards** | 372.09 | 10,688 | 3,976,850 |
| **Wet woodland** | 191.78 | 11,291 | 2,165,442 |
| **Woodland** | 74.87 | 11,291 | 845,331 |
| **Woodland: broadleaved** | 11,075.13 | 11,291 | 125,049,348 |
| **Woodland: broadleaved, semi-natural** | 9,191.23 | 11,291 | 103,778,189 |
| ***Hedgerow creation (linear habitat), km*** | *5,219 km* | *40,000/km* | *208,765,543* |
| ***Hedgerow restoration (linear habitat), km*** | *1,000 km* | *7,660/km* | *7,660,000* |
| **Total** | **46,828.86 ha** | | **802,209,487** |

The proportion of the total cost required for the creation of each broad habitat type is shown in figure 7. The majority of the total costs are due to the creation of hedgerows, semi-natural grassland and broadleaved woodland, as a result of the higher area of these habitats created.

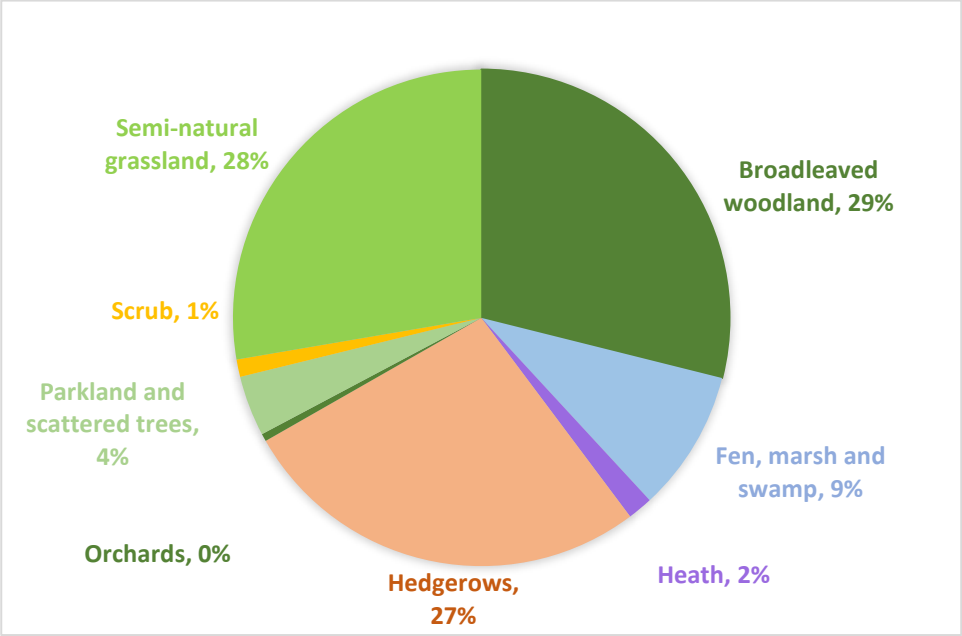



**Figure 7. The costs of creating habitats to meet the 30x30 target split by broad habitat type**

## 3.2 Size of the BNG offset market

### *3.2.1 Average number of BUs delivered per development*

The total number of biodiversity units generated per development, on average, for +10% BNG to be achieved, is shown below for each development category. The number of off-site biodiversity units are also shown for the three scenarios, where 7%, 16% or 50% of Bus are generated off-site.

Settlement and mixed use developments require, on average, the most BUs to achieve a 10% BNG, a reflection of the larger areas of these developments.

Two development categories, 'transport' and 'health and social', comprise relatively small sample sizes in the database from which BNG data is extracted, at four and three developments within these categories, respectively.

**Table 8. The average total baseline BUs (on and off-site) per development**

| Development type | Average total on-site and off-site baseline BU per development |
|---|---|
| **Commercial** | 12.91 |
| **Education** | 14.91 |
| **Transport** | 69.58 |
| **Industry** | 76.86 |
| **Energy** | 75.71 |
| **Health and social** | 1.53 |
| **Recreational** | 36.59 |
| **Settlement and mixed use** | 194.38 |
| **Major dwellings** | 17.66 |
| **Minor dwellings** | 0.96 |

### *3.2.2 Projected number of developments*

The total number of projected developments, within each category, are shown for each council over the plan period.

**Table 9. The total projected developments for each Oxfordshire council within each local plan period**

| | Number of developments within the plan period | | | | | |
|---|---|---|---|---|---|---|
| **Development type** | South Oxfordshire (present-2035) | West Oxfordshire (present-2031) | Vale of White Horse (present-2031) | Cherwell (present-2031) | Oxford City (present-2036) | **Total** |
| **Commercial** | 22 | 6 | 12 | 6 | 4 | **50** |
| **Education** | 0 | 11 | 8 | 9 | 6 | **34** |
| **Transport** | 14 | 43 | 29 | 45 | 22 | **153** |
| **Industry** | 1 | 10 | 1 | 9 | 1 | **22** |
| **Energy** | 5 | 0 | 0 | 2 | 1 | **8** |
| **Health and social** | 1 | 1 | 0 | 7 | 6 | **15** |
| **Recreational** | 4 | 6 | 0 | 24 | 4 | **38** |
| **Settlement and mixed use** | 21 | 3 | 6 | 23 | 18 | **71** |
| **Major dwellings** | 74 | 104 | 89 | 243 | 18 | **529** |
| **Minor dwellings** | 1400 | 811 | 810 | 1280 | 336 | **4637** |

### *3.2.3 Total biodiversity units generated in Oxfordshire*

We multiplied the estimated total number of developments projected of each type over the next ten years by the estimates for the average baseline BUs generated per development for each category, to give estimates for **total onsite and off-site BUs** generated in Oxfordshire over the next 10 years. This was simply multiplied by 1.1 to give the total BUs required for a 10% net gain (Table 10).

**Table 10. Projected biodiversity units in Oxfordshire over the next 10 years for a 10% net gain**

| Development type | Projected number of developments over 10 years | Average total on-site and off-site baseline BU per development | Estimated total onsite and off-site baseline units | BUs required for 10% BNG | BUs contributing to net gain |
|---|---|---|---|---|---|
| Commercial | 50 | 12.91 | 646 | 710 | 65 |
| Education | 34 | 14.91 | 507 | 558 | 51 |
| Transport | 153 | 69.58 | 10,645 | 11,710 | 1,065 |
| Industry | 22 | 76.86 | 1,691 | 1,860 | 169 |
| Energy | 8 | 75.71 | 606 | 666 | 61 |
| Health and social | 15 | 1.53 | 23 | 25 | 2 |
| Recreational | 38 | 36.59 | 1,390 | 1,529 | 139 |
| Settlement and mixed use | 71 | 194.38 | 13,801 | 15,181 | 1,380 |
| Major dwellings | 529 | 17.66 | 9,340 | 10,274 | 934 |
| Minor dwellings | 4637 | 0.96 | 4,441 | 4,885 | 444 |
| **Total** | | | **43,090** | **47,399** | **4,309** |

### *3.2.4 Off-site BUs generated in Oxfordshire*

We multiplied the total projected BUs by the three estimates for the percentage delivered off-site to give minimum, medium and maximum estimates of the number of off-site units delivered (Table 11).

**Table 11. The minimum, medium and maximum estimates for the number of off-site BUs generated from developments in Oxfordshire assuming that either 7%, 16% or 50% of total BUs are generated off-site.**

| Development type | Total biodiversity units for 10% BNG | Total off-site biodiversity units | | |
|---|---|---|---|---|
| | | Minimum (7% off-site) | Medium (16% off-site) | Maximum (50% off-site) |
| Commercial | 710 | 50 | 114 | 355 |
| Education | 558 | 39 | 89 | 279 |
| Transport | 11,710 | 820 | 1,874 | 5,855 |
| Industry | 1,860 | 130 | 298 | 930 |
| Energy | 666 | 47 | 107 | 333 |
| Health and social | 25 | 2 | 4 | 13 |
| Recreational | 1,529 | 107 | 245 | 765 |
| Settlement and mixed use | 15,181 | 1,063 | 2,429 | 7,591 |
| Major dwellings | 10,274 | 719 | 1,644 | 5,137 |
| Minor dwellings | 4,885 | 342 | 782 | 2,443 |
| **Total** | **47,399** | **3,318** | **7,584** | **23,699** |

### *3.2.5 Projected size of the BNG market*

The final stage of the analysis was to estimate the revenue from the BNG market that could be used to fund nature recovery in Oxfordshire. For this we applied two different methods for calculating the number of biodiversity units that can be considered to contribute to net gain, rather than just compensating for the habitats lost due to development (see Section 2.2.7). Method 1 assumes that for 10% BNG, 10% of the off-site units contribute to BNG. Method 2 assumes that up to 10% of the total onsite and off-site units contribute to BNG, and that this is the upper limit for the number of off-site BUs that can contribute to net gain (Figure 8, Table 12, Table 13).

**Figure 8. The two methods of estimating the proportion of biodiversity units that could contribute to nature recovery (above and beyond the units required to compensate for habitat loss)**

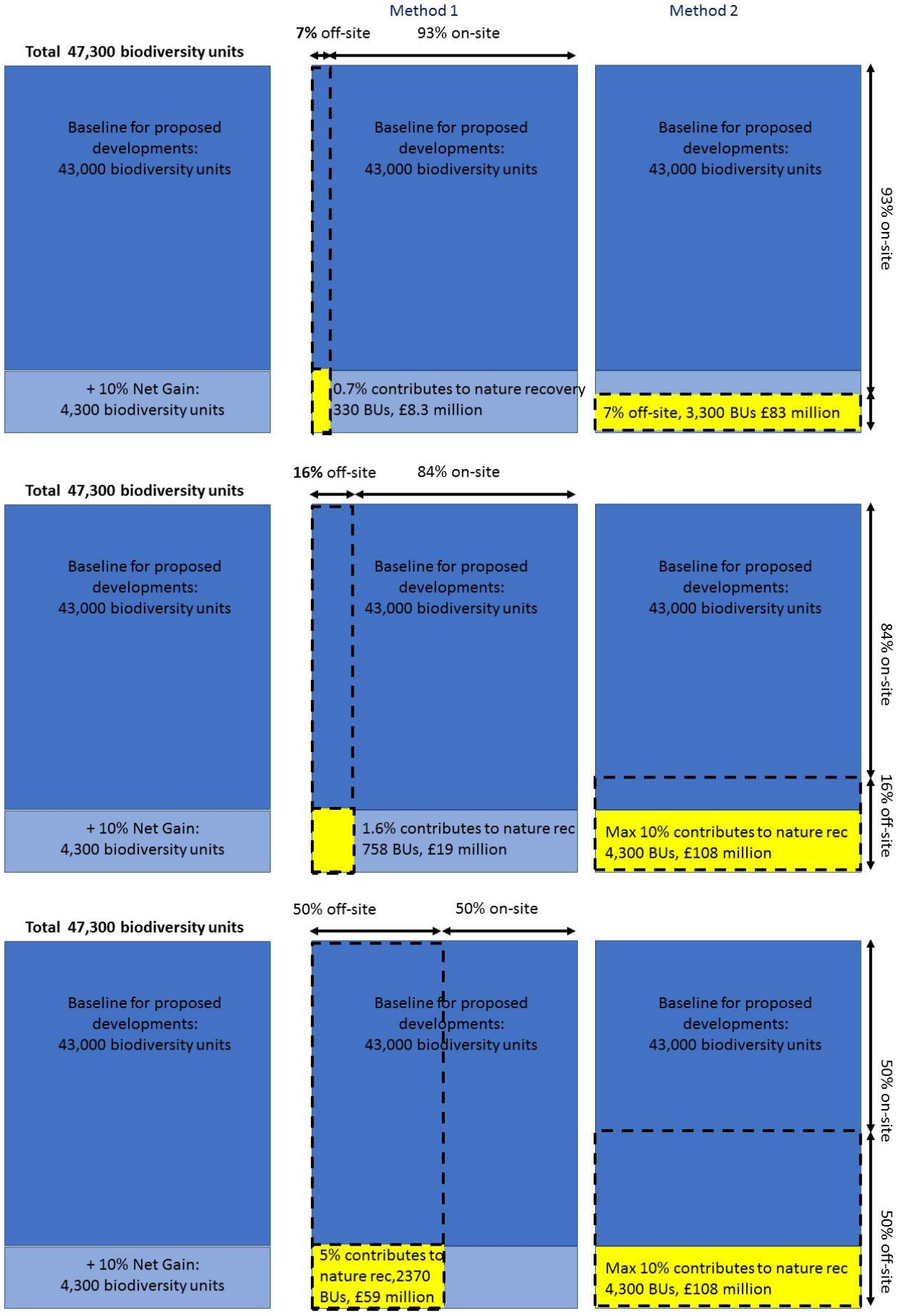


**Table 12. The estimated off-site BUs contributing to net gain over 10 years using two different methods**

| Development type | Offsite BU counting towards net gain for Oxfordshire | | | | | |
|---|---|---|---|---|---|---|
| | Method 1: equal proportion of onsite and offsite count towards net gain | | | Method 2: all offsite can count towards net gain up to the limit | | |
| | 7% offsite | 16% offsite | 50% offsite | 7% offsite | 16% offsite | 50% offsite |
| Commercial | 5 | 11 | 36 | 50 | 65 | 65 |
| Education | 4 | 9 | 28 | 39 | 51 | 51 |
| Transport | 82 | 187 | 585 | 820 | 1,065 | 1,065 |
| Industry | 13 | 30 | 93 | 130 | 169 | 169 |
| Energy | 5 | 11 | 33 | 47 | 61 | 61 |
| Health and social | 0 | 0 | 1 | 2 | 2 | 2 |
| Recreational | 11 | 24 | 76 | 107 | 139 | 139 |
| Settlement and mixed use | 106 | 243 | 759 | 1,063 | 1,380 | 1,380 |
| Major dwellings | 72 | 164 | 514 | 719 | 934 | 934 |
| Minor dwellings | 34 | 78 | 244 | 342 | 444 | 444 |
| **Total** | **332** | **758** | **2,370** | **3,318** | **4,309** | **4,309** |
| **Revenue** | **£8,294,777** | **£18,959,490** | **£59,248,405** | **£82,947,767** | **£107,724,373** | **£107,724,373** |
| **Proportion of habitat creation costs** | **1%** | **2%** | **7%** | **10%** | **13%** | **13%** |

**Table 13. The estimated revenue from off-site BUs contributing to net gain over 10 years using two different methods**

| Development type | Revenue from off-site BUs counting towards net gain for Oxfordshire | | | | | |
|---|---|---|---|---|---|---|
| | Method 1: equal proportion of onsite and offsite count towards net gain | | | Method 2: all offsite can count towards net gain up to the limit | | |
| | 7% offsite | 16% offsite | 50% offsite | 7% offsite | 16% offsite | 50% offsite |
| Commercial | 124,276 | 284,058 | 887,682 | 1,242,755 | 1,613,968 | 1,613,968 |
| Education | 97,607 | 223,101 | 697,191 | 976,068 | 1,267,620 | 1,267,620 |
| Transport | 2,049,248 | 4,683,996 | 14,637,486 | 20,492,480 | 26,613,611 | 26,613,611 |
| Industry | 325,482 | 743,958 | 2,324,870 | 3,254,818 | 4,227,036 | 4,227,036 |
| Energy | 116,587 | 266,484 | 832,762 | 1,165,866 | 1,514,112 | 1,514,112 |
| Health and social | 4,418 | 10,098 | 31,556 | 44,179 | 57,375 | 57,375 |
| Recreational | 267,637 | 611,741 | 1,911,692 | 2,676,368 | 3,475,803 | 3,475,803 |
| Settlement and mixed use | 2,656,702 | 6,072,461 | 18,976,439 | 26,567,015 | 34,502,617 | 34,502,617 |
| Major dwellings | 1,797,946 | 4,109,591 | 12,842,473 | 17,979,463 | 23,349,951 | 23,349,951 |
| Minor dwellings | 854,875 | 1,954,001 | 6,106,254 | 8,548,755 | 11,102,279 | 11,102,279 |
| **Total** | **£8,294,777** | **£18,959,490** | **£59,248,405** | **£82,947,767** | **£107,724,373** | **£107,724,373** |
| **% of habitat creation costs** | **1%** | **2%** | **7%** | **10%** | **13%** | **13%** |

Using method 1, assuming that 10% of the off-site BUs contribute to net gain, the minimum estimate for the size of the BNG offset market in Oxfordshire for the next ten years is around **£8 million.** This reflects the

estimated cost of delivering the additional 10% of off-site BUs in Oxfordshire if 7% of all additional BUs are delivered off-site,. On average, this would therefore lead to the BNG market generating **£800,000 annually** over the next ten years (i.e. approximately to the end of the current local plan periods for the different councils), which could be directed towards the cost of creating habitats to meet the 30x30 nature recovery target. The medium estimate, assuming that 16% of additional BUs are off-site, is around **£19 million,** generating an average **£1.9 million annually**. The maximum estimate, with 50% of total Bus being delivered off-site, is around **£59 million,** generating an average **£5.9 million annually**.

Using method 2, assuming that any number of off-site BUs could contribute to net gain so long as the total limit of 10% of all BUs is not exceeded, the minimum revenue from the offsets contributing towards net gain (for 7% of BUs delivered off-site) is estimated as **£83 million, £8.3 million per year** for 10 years. For both the medium and maximum estimates (16% and 50% delivered off-site) the maximum limit of **£108 million (£10.8 million per year)** applies.

#### *3.2.6 Scenarios where minor dwelling developments deliver more BUs off-site*

For the scenarios where minor dwelling developments deliver a higher proportion of BUs off-site than other developments (A, B, C), the estimated revenue generated for major and minor dwellings is shown in Figure 9. The broad scenarios, applying the 7%, 16% or 50% multipliers equally to major and minor dwellings, are included as a comparison. The total off-site BUs and revenue generated for i) all dwelling developments (major and minor) and ii) all developments of any type are shown in Table 14 (using method 1 to calculate the BUs that contribute to net gain) and Table 15 (using method 2 to calculate the BUs that contribute to net gain).

Using method 1 to work out the number of BUs contributing to net gain, scenario A (increasing the off-site proportion from 16% to 50% for minor dwelling developments) gives around an extra £4 million of revenue over 10 years compared to the medium scenario where all developments have 16% off-site. This is a 40% increase (from £19 million to £23 million) in the revenue from all development types.

For the two scenarios that are based on the minimum scenario, increasing the off-site percentage from 7% to 16% for minor dwelling developments (scenario C) increases the off-setting revenue from all dwelling developments by around £1 million over 10 years, a 13% increase from £8 million to £9 million. For scenario B, where the off-site percentage increases from 7% to 50% for minor dwellings, revenue increases by around £5 million over 10 years, a 63% increase.

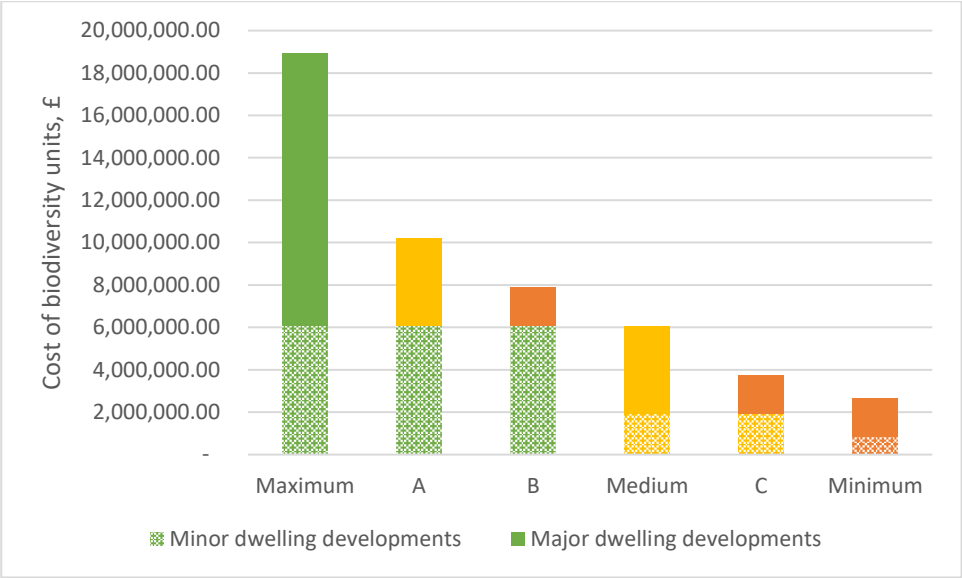



**Figure 9. The additional off-site BUs generated from dwelling developments projected for the next ten years when different proportions of BUs are delivered off-site for major and minor developments, using method 1 to account for the number of off-site BUs contributing to net gain.**

**Table 14. Off-site BUs and costs when minor dwelling developments deliver a higher proportion of BUs off-site, using Method 1 to account for the number of BUs contributing to net gain**

| Scenario | Minor dwelling developments: % off-site | Other developments: % off-site | Off-site BUs for major and minor dwellings | BU cost for major and minor dwellings | BU cost for all developments (£) |
|---|---|---|---|---|---|
| Maximum | 50 | 50 | 758 | £18,948,727 | £59,248,405 |
| A | 50 | 16 | 409 | £10,215,845 | £23,111,742 |
| B | 50 | 7 | 316 | £7,904,200 | £13,546,155 |
| Medium | 16 | 16 | 243 | £6,063,593 | £18,959,490 |
| C | 16 | 7 | 150 | £3,751,947 | £9,393,902 |
| Minimum | 7 | 7 | 106 | £2,652,822 | £8,294,777 |

For method 2, scenario C (minor dwellings have 165 instead of 7% off-site units) projects around £2.5 million more revenue for nature recovery than the minimum scenario, just 3% more. However scenarios A and B do not offer any further increases because the maximum limit of 10% of BUs contributing to net gain has been reached (Table 15).

**Table 15. Off-site BUs and costs when minor dwelling developments deliver a higher proportion of BUs off-site, using Method 2 to account for the number of BUs contributing to net gain**

| Scenario | Minor dwelling developments: % off-site | Other developments: % off-site | Off-site BUs for major and minor dwellings | BU cost for major and minor dwellings | BU cost for all developments (£) |
|---|---|---|---|---|---|
| Maximum | 50 | 50 | 1,378 | £34,452,231 | £107,724,373 |
| A | 50 | 16 | 1,378 | £34,452,231 | £107,724,373 |
| B | 50 | 7 | 1,163 | £29,081,742 | £85,501,291 |
| Medium | 16 | 16 | 1,378 | £34,452,231 | £107,724,373 |
| C | 16 | 7 | 1,163 | £29,081,742 | £85,501,291 |
| Minimum | 7 | 7 | 1,061 | £26,528,218 | £82,947,767 |

# 4 Discussion

## 4.1 The potential for funding Nature Recovery in Oxfordshire through BNG offsets

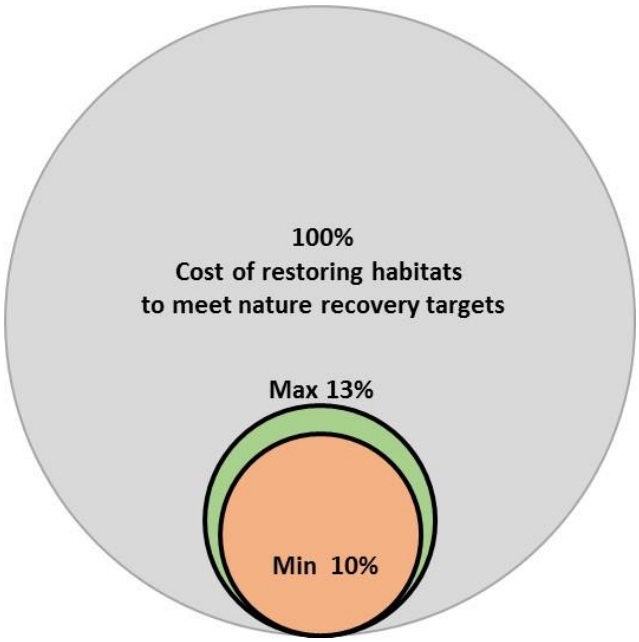
The cost of restoring 30% of the county to semi-natural habitats, our defined Nature Recovery objective, was estimated to be around **£800 million,** substantially higher than the projected size of the BNG offsets market, an estimated **£83 to £108 million over the next 10 years** (for a 10% BNG target, using method 2). Consequently, under these projections, we estimate that the BNG offset market could fund **between 10% and 13% of the cost of creating habitats to meet the 30x30 target.**

However, it is important to understand that the BNG offset market is a compensatory mechanism which creates habitats alongside facilitating loss of existing habitats through development. So while BNG revenue can directly contribute to delivering new habitats to meet the 30x30 target, the extent of its contribution to nature recovery as a whole depends on a number of factors.

1. Firstly, these calculations take account of the fact that most of the BNG offset revenue should be considered to be offsetting losses elsewhere rather than contributing to nature recovery. We have used two different methods to account for the number of BUs contributing to net gain, and the choice of method makes a large difference to the outcome, with maximum estimates of £59 million for method 1 and £108 million for method 2, although we believe method 2 to be more appropriate. .
2. The biodiversity units delivered would only contribute to nature recovery if all the units – those used for the gain and those used to offset existing losses – are maintained in good condition and protected from development. This depends on the governance, monitoring and enforcement regime, which can be less certain if habitats are delivered onsite in urban developments.
3. This also assumes that the habitats lost are of a low value for biodiversity, i.e. modified grassland, agricultural land or developed land. If semi-natural habitats are lost, this will increase the area of habitats that has to be delivered to meet the 30% target, and thus increase the cost of nature recovery. However, even loss of low value habitats can adversely impact some species in the area.
4. It also depends on there being no time lag between current losses of biodiversity and gains of new habitat. If compensatory establishment of semi-natural habitat occurs after development has occurred, rather than before, the result will be a current loss in habitat cover, until compensation is delivered, with potentially irreversible adverse impacts on dependent species
5. Even for loss of low biodiversity farmland, food production could be displaced into other areas either in the UK or overseas which could entail further biodiversity loss (unless this is offset through measures such as dietary change, e.g. Smith et al., 2022).

Should these assumptions be met, losses of modified habitat with lower biodiversity value (according to the Biodiversity Metric) could, in theory, be compensated for by future creation of more connected semi-natural habitats through BNG offsetting. However, in practice, it is unlikely that all these caveats will be met. This emphasises the importance of the mitigation hierarchy: biodiversity loss should always be avoided if possible, then reduced as far as possible, with compensation through offsetting being a last (imperfect) resort.

**Figure 9. The proportion of the cost of creating habitats to meet the 30x30 target which can be funded by the maximum and minimum estimates for the size of the BNG market for a 10% BNG target**




The true proportion of the nature recovery costs which the BNG offset market will fund is likely to be smaller than these estimates. This is firstly because the costs of nature recovery are an underestimate, as they do not include any additional costs for purchasing land or opportunity costs of entering into land agreements with landowners (e.g. compensation for loss of income).

Additionally, the size of the BNG offset market may be smaller than this maximum estimate. The value used for cost per biodiversity unit, £25,000, is the upper estimate of DEFRA's market study: therefore, if the cost per unit is closer to the lower estimate (£20,000), the BNG market will be 20% smaller.

Overall, these hypothetical scenarios reveal the significance of the percentage of BU delivered off-site on the size of the BNG market: an important factor for when BNG becomes mandatory in 2023. However, the true proportion of BUs which will be delivered off-site is yet unknown. Consequently, multiple estimates exist, including DEFRA's estimate of 50% from the market analysis study. However, data from councils which are early-adopters of BNG, indicate lower percentages of BUs being delivered off-site: 7% on average from the database of six early-adopter councils, and 16% on average from the Vale of White Horse planning data. Therefore, if the average proportion of BUs delivered off-site is closer to one of these estimates, the BNG offset market will be substantially smaller. If all developments align with the minimum estimate of 7% of BUs being delivered off-site, the total cost of the BNG market is estimated at around **£83 million** over ten years (using method 2 to determine the number of BUs contributing to net gain), just **10% of the cost of meeting the 30% target,** and an **average annual contribution of just £8 million.**

The proportion of biodiversity units which are generated off-site may also depend on the types of development occurring. Smaller developments may be less able to meet their biodiversity liability on-site than larger developments, as they comprise smaller total areas for habitat creation/enhancement. We may therefore expect smaller developments, such as minor dwellings, to deliver a higher proportion of BUs off-site. Accounting for these potential differences in the proportion of BUs delivered off-site generates variation of **£2 million** in the estimated size of the BNG market, increasing the size of the market by 3% (for method 2).

However, all the estimates of the size of the market will increase in proportion if councils adopt a higher than 10% target for BNG. For example, if a 20% target is adopted the market could increase to a maximum of **£216 million** using method 2, covering **26%** of the estimated 30x30 habitat creation costs, for a scenario where at least 17% of BUs are delivered off-site.

Here, Oxfordshire is the focus as a case study; however, these conclusions could also be applicable more widely to other councils when BNG becomes mandatory.

## 4.2 Limitations and further steps

### *4.2.1 Suitability of land for habitat creation*

This work considers the costs of converting arable and improved grassland to a variety of semi-natural habitat types, in proportion to their current areas within Oxfordshire. However, for the purpose of this work, the areas which would actually be suitable for conversion to different semi-natural habitat types were not considered. In order to do so, a detailed analysis of factors such as soil types, geology and hydrology of the arable and improved grassland habitat would be required. This would provide a more accurate picture of the areas of each semi-natural habitat type which could feasibly be created on the existing arable and improved grassland habitat, and the subsequent cost of this nature recovery.

### *4.2.2 Investigation of BNG percentage requirements*

This work also made the assumption that all Oxfordshire councils will aim for 10% BNG, in line with the minimum requirement (UK Goverment 2021). However, should some councils set a higher requirement, the estimated size of the BNG market would also increase. Therefore, research into the effects of different BNG targets on the size of the BNG market, and its ability to fund nature recovery, would be an important next step.

### *4.2.3 Number of Biodiversity Units per development*

The number of units was estimated per development, based on past history and taking account of the broad category of development. However, the number of units will vary strongly with the size of the development (area of land and number of dwellings). It would be more accurate to repeat the analysis using data on the area of allocated sites and the number of dwellings allocated in each site.

### *4.2.4 Detailed cost of Nature Recovery*

We were unable to determine an estimate of any additional costs incurred through protection, monitoring, purchase of land or entering into agreements with landowners, such as compensation for lost income. A valuable next stage would be an in-depth study of these additional costs, to provide a more precise estimate for the total costs of nature recovery.

### *4.2.5 The habitat types affected by development*

This analysis estimates the total off-site biodiversity units projected to be generated by development in Oxfordshire; however, this does not consider which habitats are likely to be affected by this development. To provide a more comprehensive understanding of the scope of the offset market to fund nature recovery, it would be valuable to analyse the total area of each habitat type which is likely to be affected by the projected developments, using a GIS map of allocated sites. This could then be used to provide an estimate of the areas of each habitat which are required to be created/enhanced outside of the development boundary, to form the off-site biodiversity units. The habitats that the off-site units are likely to deliver could therefore be compared to the habitats that nature recovery aims to create, providing a more detailed picture of how off-site biodiversity units can contribute to funding nature recovery.

# 5 Conclusions

Private funding has the potential to contribute towards achieving Oxfordshire's nature recovery ambitions. One mechanism for this is the sale of biodiversity units which are used to meet BNG liability outside of a development boundary. Revenue from offsetting loss of habitat through development could potentially be used to create new habitats in strategic locations that could contribute to meeting Oxfordshire's nature recovery targets, including the 30x30 target to protect 30% of land for nature by 2030. The overall objective of this work was to provide estimates of both the cost of fulfilling nature recovery ambitions (defined as creating habitats to meet the 30x30 target) and the expected revenue from BNG offsets during the current Local Plan period (approximately over the next 10 years). Comparison of these costs allowed estimates of the financial potential of the BNG market in Oxfordshire to support the funding of Nature Recovery ambitions.

If councils require only the minimum 10% BNG, the estimated revenue from sale of BNG offsets varies between £83 million and £108 million over 10 years, depending on the percentage of BUs delivered off-site by different types of developments and taking account of the number of units contributing to net gain (rather than simply compensating for lost habitats due to development). This equates to between 10% and 13% of the costs of creating sufficient areas of semi-natural habitat to meet the 30x30 target for Oxfordshire.

The true contribution from BNG offset market could be significantly smaller than these estimates, for several reasons: the costs exclude protection, monitoring and any land purchase or opportunity costs; the price of BNG units could be lower than the assumed value of £25,000; the upper estimate relies on 50% of units being delivered off-site, far higher than the current average of 7%; some offsets could involve a time delay in the compensatory restoration of habitats; and there is a lack of resources for monitoring and enforcing the delivery of both onsite and offsite units. Setting the BNG target to be higher than the legal minimum of 10% could help to mitigate these factors. However, the study also underlines the need for additional funding sources, beyond BNG, to enable the conservation and restoration of semi-natural habitats in Oxfordshire.

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## Appendix 1: costs of habitat creation

This table shows estimated costs of creating, maintaining and restoring semi-natural habitats over 30 years. The values used to calculate the costs of Nature Recovery for this analysis are the mean value from the different estimates of the costs per ha of creating a new semi-natural habitat and maintaining this for 30 years. Restoration costs, i.e. for enhancing the ecological condition of an existing semi-natural habitats, are included here for comparison, but were not used in estimating the cost of Nature Recovery. Broad habitat type is shown in column one, with the specific habitat cost estimates detailed under these.

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| Semi-natural grassland | Semi-natural grassland overall mean for 'creation': **£13,112**<br>Median: **£9,310** | | Overall mean for 'restoration': **£7,679**<br>Median: **£7,530** | |
| Semi-natural grassland | '**Lowland grassland'**<br>Creation:<br>= **£11,293/ha over 30 years**<br>**Or**<br>**£19,391/ha** WITH land purchase<br>(Rayment, A, et al. 2011) | **£11,293** | **Lowland grassland'**<br>Restoration in perpetuity:<br>= **£10,168/ha**<br>**Or**<br>**£18,997/ha** WITH land purchase<br>(Rayment, A, et al. 2011)<br><br>**Semi-natural grassland:**<br>Restoration costs:<br>**=£6,509/ha** over 15 years (upper bound)<br>**= £2,430/ha** over 4 years (lower bound)<br>(Maskell, et al. 2014)<br><br>**'Restoration towards species-rich grassland'**<br>Countryside stewardship scheme payments at £235/ha/year<br>= **£7,050** over 30 years (payments actually made for 10 years only, just indicative of costing)<br>(GOV.UK 2022) | **£10,168**<br><br>**£6,509**<br>**£2,430**<br>**£7,050** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | **<u>Acid grassland:</u>**<br>Creation: £1,714/ha<br>Creation and 30 year management<br>= **£7,714/ha**<br>( Warwickshire Country Council 2018)<br><br>Creation**:** £5,670/ha<br>Management costs per ha: £180/ha<br>Accounting for time for establishment, total over 30 years = **£9,310/ha**<br>(Dorset County Council 2022) | **£7714**<br>**£9310**<br><br>**Mean: £8,512** | **<u>Acid grassland:</u>**<br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of managing/restoring this habitat:<br>£280.9/ha/yr<br>**= £8427/ha** over 30 years<br>(M. Rayment 2017)<br><br>Restoration costs: £830/ha capital costs<br>And £200/ha/yr management costs:<br>= **£6830/ha** over 30 years<br>(Rayment and & Lindberg 2006) | **£8427**<br>**£6830**<br><br>**Mean: £7,629** |
| | **<u>Calcareous grassland:</u>**<br><br>***<u>Lowland</u>***<br>Creation: £6536/ha average (BBOWT 2023)<br>Creation plus 30 year management<br>= **£19,422/ha**<br><br>Re-establishment costs:£2,100/ha capital costs and £280/ha/yr annual costs<br>= **£10,500/ha** over 30 years<br>(Rayment and & Lindberg 2006)<br><br>Creation/restoration: £2,408/ha<br>Maintenance costs: £200/ha/yr<br>( Warwickshire Country Council 2018)<br>Creation plus 30 year management | **£19,422**<br>**£8,408**<br>**£9,310**<br>**£10,500**<br>**£8,711**<br><br>**Mean: £11,270**<br>**Median: £9,310** | **<u>Calcareous grassland:</u>**<br><br>***<u>Lowland</u>***<br>Restoration costs: £2,063/ha capital costs and £200/ha/yr maintenance<br>=**£8,063/ha** over 30 years.<br>(Rayment and & Lindberg 2006)<br><br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of managing/restoring this habitat: £251/ha/year<br>**= £7,530/ha** over 30 years (M. Rayment 2017) | **£8,063**<br>**£7,530**<br>**£12,211**<br>**£6,311**<br><br>**Mean: £8529**<br>**Median: £7797** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | = **£8,408/ha**<br><br>Creation: £5,670/ha<br>Management costs per ha: £182/ha<br>Accounting for time for establishment, total over 30 years = **£9,310/ha**<br>(Dorset County Council 2022)<br><br>***Upland:***<br>Re-establishment: £311/ha capital costs and £280/ha/yr management costs<br>= **£8,711/ha** over 30 years<br>(Rayment and & Lindberg 2006) | | **Semi-improved restoration to chalk grassland:**<br>Restoration cost per ha (not including monitoring or maintenance) estimate calculation at £6,751/ha (TOE 2023)<br>Estimated management costs £182/ha/yr = £5460 over 30 years<br>**= £12,211/ha**<br><br>***Upland:***<br>Restoration: £311/ha capital costs and £200/ha/year management costs<br>= **£6,311/ha** over 30 years<br>(Rayment and & Lindberg 2006) | |
| | **Neutral grassland**<br>***Meadows:***<br>Creation: £1498/ha<br>Maintain per year: £200/ha/yr ( Warwickshire Country Council 2018)<br>**= £7,498/ha** over 30 years<br><br>Creation: £6250/ha<br>Management costs per ha: £267ha (Dorset County Council 2022)<br>Accounting for time for establishment, total over 30 years = **£11,860/ha**<br><br>Creation: £14,631/ha average creation cost from arable land *(Range: £13,445- £16,290/ha)*<br>Management costs per ha per year, on average: £977/ha/year = £29,299 over 30 years<br>**= £43,660/ha**<br>(BBOWT 2023) | **£7,498**<br>**£11,860**<br>**£14,361**<br>**(+£29,299)**<br>**£8,961**<br><br>**Mean: £18,170**<br>**Median: £10,410** | **Neutral grassland:**<br>***Meadows:***<br>Restoration costs: £453/ha capital costs and £200/ha/yr management cost=<br>**£6,453/ha** over 30 years<br>(Rayment and & Lindberg 2006) | **£6,453**<br><br>**Mean: £6,453** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | Re-establishment costs: **£**561/ha capital costs, and £280/ha/yr management costs<br>= **£8,961/ha** over 30 years<br>(Rayment and & Lindberg 2006) | | | |
| Woodland | Woodland overall mean for 'creation': **£10,356**<br>Median: **£9,730** | | Woodland overall mean for 'restoration': **£6,293**<br>Median: **£7,776** | |
| Woodland | **<u>Woodland:</u>**<br>Creation from improved grassland:<br>£6642 /ha<br>Average management costs per year: £499/ha/yr, £14,966 over 30 years<br>= **£21,608/ha over 30 years**<br>(BBOWT 2023)<br><br>Creation costs:<br>**= £7,436/ha**<br>(includes admin, regulatory and creation costs, not including land purchase costs)<br>Creation WITH land purchase: **£17,849/ha**<br>(Rayment, A, et al. 2011)<br><br>From 'The Finance Gap for Uk Nature, 2021', estimate cost of creation per ha from dividing total area created by total cost:<br>= **£9,787/ha** (M. Rayment, The Finance Gap for UK Nature 2021) | **£21,608**<br>**£7,436**<br>**£9,787** | **<u>Woodland:</u>**<br>Restoration costs in perpetuity (for 100 years, but costs will decline over time)<br>**=£7,776/ha**<br>Or WITH land purchase:<br>**£19,503/ha**<br>(Rayment, A, et al. 2011)<br><br>*Native woodland:*<br>Restoration capital cost: £3000/ha<br>Management costs: £75/ha/yr<br>= **£5,250/ha**<br>(Rayment and & Lindberg 2006) | **£7,776**<br>**£5,250** |
| | **<u>Mixed woodland:</u>**<br>***Lowland mixed deciduous:***<br>Creation: £8,800/ha<br>Management costs per ha: £100/ha<br>Accounting for time for establishment, total over 30 years | **£10,800**<br>**£6,880**<br>**£9,174**<br><br>**Mean= £8,951** | **<u>Mixed woodland:</u>**<br>***Lowland mixed deciduous:***<br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total | **£12,081**<br>**£9,174**<br><br>**Mean= £10,628** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | = **£10,800/ha**<br>(Dorset County Council 2022)<br><br>***Mixed woodland:***<br>Creation: **£4,880/ha**<br>Management costs per ha: **£100/ha**<br>➢ Accounting for time for establishment, total over 30 years = **£6,880/ha**<br>(Dorset County Council 2022)<br><br>Creation or restoration:<br>**=£9,174/ha**<br>Broadleaved or Mixed<br>(DEFRA 2006) | **Median= £9174** | estimated cost per year of managing/restoring this habitat:<br>£402.7/ha/yr<br>= £**12,081/ha** over 30 years<br>(M. Rayment 2017)<br><br>Creation or restoration:<br>**=£9,174/ha**<br>Broadleaved or Mixed<br>(DEFRA 2006) | |
| | **<u>Broadleaved</u>**<br>Creation and establishment costs:<br>Min UK estimate: £4,000/ha<br>Mid: £6000/ha<br>High: £8,000/ha<br>Maintenance for *newly planted woodland:* £90-225/ha/yr average: £150/ha/yr<br>= average £4500/ha over 30 years<br>Creation and 30 years management:<br>**= £6,700- £12,500/ha , average =£10,500/ha**<br>(Vivid Economics 2020)<br><br>Creation or restoration:<br>**=£9,174/ha**<br>Broadleaved or Mixed<br>(DEFRA 2006)<br><br>Planting and establishment costs: | **£10,500**<br>**£9,174**<br>**£14,198**<br><br>**Mean= £11,291**<br>**Median: £10,500** | **<u>Broadleaved:</u>**<br>Creation or restoration:<br>**= £9,174/ha**<br>Broadleaved or Mixed<br>(DEFRA 2006)<br><br>**'Native broadleaved'**<br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of managing/restoring this habitat: £402.7/ha/year<br>**= £12,081/ha** over 30 years<br>(M. Rayment 2017) | **£9,174**<br>**£12,081**<br><br>**Mean= £10,628** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | £6,182/ha<br>Maintenance costs:<br>£2586/ha<br>Management costs:<br>£5,430/ha<br>**= £14,198/ha over 30 years (**assuming management + maintenance)<br>(Dicks, Dellaccio and Stenning 2020) | | | |
| | **<u>Wet woodland:</u>**<br>Creation:<br>**= £3,500/ha (**2006 costs)<br>(Keating, Pettit and Rose 2015)<br><br>Creation/restoration:<br>**= £9,674/ha**<br>(DEFRA 2006) | **£3,500**<br>**£9,674**<br><br>**Mean= £6337** | **<u>Wet woodland:</u>**<br>Creation/restoration:<br>**= £9,674/ha**<br>(DEFRA 2006) | **£9,674**<br><br>**Mean= £9,674** |
| | **<u>Traditional orchards:</u>**<br>Creation: £10,190/ha<br>Maintenance: £212/ha/year<br>Accounting for time to establish: combined cost over 30 years<br>= **£14,430/ha**<br>(Dorset County Council 2022)<br><br>Creation/restoration: £1123/ha<br>Maintenance: £250/ha/yr<br>Over 30 years<br>= **£8,623/ha**<br>( Warwickshire Country Council 2018) | **£14,430**<br>**£8,623**<br>**£9,010**<br><br>**Mean= £10,688**<br>**Median= £9,010** | **<u>Traditional orchards:</u>**<br>Creation/restoration: £1123/ha<br>Maintenance: £250/ha/yr<br>Over 30 years<br>= **£8,623/ha**<br>( Warwickshire Country Council 2018)<br><br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of managing/restoring this habitat:<br>£299.7/ha/yr<br>**= £8,991/ha over 30 years** | **£8,623**<br>**£8,991**<br><br>**Mean= £8807** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | **Traditional orchards Countryside Stewardship payments:**<br>£373/ha for creation (10 years)<br>£264/ha for management<br>For 10 years creation payments and 20 years management<br>= **£9,010/ha**<br>(GOV.UK, BE5: Creation of traditional orchards. Countryside Stewardship grant finder 2022) | | (M. Rayment 2017) | |
| Wood pasture and parkland | **Wood pasture and parkland overall mean for 'creation': £9,144/ha**<br>**Median: £7,120/ha** | | **Wood pasture and parkland overall mean for 'restoration': £5,359/ha** | |
| | **<u>Wood pasture and parkland:</u>**<br>Creation: £12,490/ha<br>Management costs per ha: £46/ha<br>Accounting for time for establishment, total over 30 years = **£13,410/ha**<br>(Dorset County Council 2022)<br><br>Creation: £1503/ha<br>Maintenance : £180/ha/yr<br>= £**6,902/ha** over 30 years<br>( Warwickshire Country Council 2018)<br><br>**Restoration Wood Pasture and Parkland payments Countryside Stewardship:**<br>£316/ha (per year, over 10 years) £3160 (10 years); £9480/ha (30 years) Management payments: £198/ha/yr<br>For 10 years creation payments, and 20 years management payments<br>= **£7,120/ha**<br>(GOV.UK 2021) | **£13,410**<br>**£6,902**<br>**£7,120**<br><br>**Mean= £9,144**<br>**Median =£7,120** | **<u>Wood pasture and parkland:</u>**<br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of managing/restoring this habitat: £120.6/ha/yr<br>**=£3,618/ha over 30 years**<br>(M. Rayment 2017)<br><br>Restoration costs:<br>Capital cost £1700/ha<br>Maintenance per year: £180/ha/yr<br>**= £7,100/ha over 30 years**<br>(Rayment and & Lindberg 2006) | **£3,618**<br>**£7,100**<br><br>**Mean= £5,359** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| Heathland | **Heathland overall mean for 'creation': £13,097/ha**<br>**Median: £13,650/ha** | | **Heathland overall mean for 'restoration': £8,015/ha**<br>**Median: £8,530/ha** | |
| | **<u>Heathland:</u>**<br>Creation: £8,170/ha<br>includes heath, wet heath/acid grass mosaic<br>(Dorset County Council 2022)<br>Accounting for time to establishment :<br>= **£13,650/ha**<br><br>Creation: £**11,791/ha**<br>(includes admin, regulatory and capital costs, not including land purchase)<br>(Rayment, A, et al. 2011)<br><br>Re-establishment costs':<br>Capital cost: £350/ha<br>Management costs: £450/ha/yr<br>**=** £**13,850/ha** over 30 years<br>(Rayment and & Lindberg 2006) | **£13,650**<br>**£11,791**<br>**£13,850**<br><br>**Mean= £13,097**<br>**Median= £13,650** | **<u>Heathland:</u>**<br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of managing/restoring this habitat:<br>56800 ha in England / £17,369,000 annual cost:<br>£305.8/ha/yr<br>(lowland heathland)<br>**= £9,174/ha over 30 years**<br>(M. Rayment 2017)<br><br>Restoration costs in perpetuity:<br>**= £8,530/ha**<br>Or<br>**£17,359** WITH land purchase<br>(Rayment, A, et al. 2011)<br><br>***Lowland heathland***<br>Restoration costs:<br>Capital cost: £350/ha<br>Management costs: £200/ha/year<br>**= £6350/ha for 30 years**<br>(Rayment and & Lindberg 2006) | **£9,174**<br>**£8,530**<br>**£6,350**<br><br>**Mean= £8015, Median = £8530** |
| Scrub | **Scrub overall mean for 'creation': £4,018/ha** | | **Scrub overall mean for 'restoration': £4,470/ha** | |
| | **<u>Mixed scrub:</u>**<br>Creation: £1,715/ha<br>Management costs per ha: £74/ha<br>Accounting for time for establishment, total over 30 years = **£3,565ha** | **£3,565**<br>**£4,470**<br><br>**Mean= £4018** | **<u>Mixed scrub</u>**<br>Payments made for creation of successional areas and scrub: £149/ha/yr<br>**= £4,470/ha** | **£4,470**<br><br>**Mean= £4470** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | (Dorset County Council 2022)<br><br>**Successional areas and scrub: Countryside stewardship**<br>Payments made for creation of successional areas and scrub: £149/ha/yr<br>**= £4,470/ha**<br>(GOV.UK, WD8: Creation of successional areas and scrub. Countryside stewardship grant finder 2023) | | (GOV.UK, WD8: Creation of successional areas and scrub. Countryside stewardship grant finder 2023) | |
| Fen, marsh and swamp | Fen, marsh and swamp overall mean for 'creation'= **£13,944/ha**<br>Median= **£12,761/ha** | | Fen, marsh and swamp overall mean for 'restoration'= **£7,400/ha**<br>Median= **£9000/ha** | |
| Fen, marsh and swamp | **<u>Floodplain grazing marsh:</u>**<br>Creation costs average: £6458/ha<br>Management costs average: £755/ha/year =£22,650 over 30 years<br>= **£29,108/ha**<br>(BBOWT 2023)<br><br>Creation /'establishment and management' £11,840/ha<br>Management costs per ha: £194/ha<br>Accounting for time for establishment, total over 30 years = **£13,780/ha**<br>(Dorset County Council 2022)<br><br>Restoration/creation:<br>£1504 upfront + £335/ha/yr<br>= £**11,554/ha** over 30 years<br>( Warwickshire Country Council 2018)<br><br>Capital cost: £1280/ha, Re-establishment costs: £315/ha/year, Management costs: £200/ha/yr<br>**= £16,730/ha** over 30 years<br>(Rayment and & Lindberg 2006) | **£6,458 + £22,650**<br><br>**£13,780**<br>**£11,554**<br>**£9,000**<br>**£16,370**<br><br>**Mean= £15,965**<br>**Median= £13,780** | **<u>Floodplain grazing marsh:</u>**<br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of managing/restoring this habitat:<br>£318.4/ha/yr (coastal and floodplain grazing marsh)<br>**= £9,552/ha** over 30years<br>(M. Rayment 2017)<br><br>Restoration/creation:<br>£1504 upfront + £335/ha/yr<br>= £**11,554/ha** over 30 years<br>( Warwickshire Country Council 2018)<br><br>Restoration costs:<br>Capital cost: £1280/ha<br>Restoration cost: £200/ha/year<br>Management costs: £200/ha/year<br>= for capital cost + management + re-establishment/restoration<br>**= £13,280/ha** over 30 years | **£9,552**<br>**£11,554**<br>**£13,280**<br><br>**Mean = £11,462**<br>**Median = £11,554** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | **'Wet grassland'**<br>**£15,174/ha**<br>Or **£9,000/ha** WITHOUT land purchase<br>(DEFRA 2006) | | (Rayment and & Lindberg 2006) | |
| | **<u>Wetland</u>**<br>Creation:<br>= **£11,072/ha**<br>(not including land purchase)<br>**£19,089/ha** WITH land purchase<br>(Rayment, A, et al. 2011) | **£11,072** | **<u>Wetland:</u>**<br>Restoration cost:<br>= £**9,000/ha**<br>(Warner 2020) (Keating, Pettit and Rose 2015)<br><br>Restoration in perpetuity:<br>**= £9,435/ha**<br>Or<br>**£18,713/ha** WITH land purchase<br>(Rayment, A, et al. 2011) | **£9,000**<br>**£9,435** |
| | **<u>Reedbed</u>**<br>Creation/restoration cost £1486/ha<br>£90/ha/yr management<br>**=£3,286/ha** over 30 years<br>( Warwickshire Country Council 2018)<br><br>Creation: £6,230/ha<br>Management costs per ha: £518/ha<br>Accounting for time for establishment, total over 30 years = **£16,590/ha**<br>(Dorset County Council 2022)<br><br>Re-establishment costs: £1361/ha capital costs and £380/ha/yr annual cost<br>**= £12,761/ha over 30 years**<br>(Rayment and & Lindberg 2006) | **£3,286**<br>**£16,590**<br>**£12,761**<br><br>**Mean= £10,879**<br>**Median= £12,761** | **<u>Reedbed:</u>**<br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of managing/restoring this habitat:<br>£196/ha/yr<br>**= £5,880/ha over 30 years**<br>(M. Rayment 2017)<br><br>Management costs= £60/ha/yr<br>Restoration costs: £817/ha capital costs, and £60/ha/yr annual costs<br>= £**2617/ha over 30 years**<br>(Rayment and & Lindberg 2006) | **£5,880**<br>**£2,617**<br><br>**Mean = £4024** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | **<u>Lowland fens:</u>**<br>Creation: £10,500/ha<br>Management costs per ha: £343/ha<br>Accounting for time for establishment, total over 30 years = **£17,360/ha**<br>(Dorset County Council 2022)<br><br>Re-establishment costs: £815/ha capital costs, and £380/ha/yr annual cost.<br>= **£12,215/ha over 30 years**<br>(Rayment and & Lindberg 2006) | **£17,630**<br>**£12,215**<br><br>**Mean= £14,923** | **<u>Lowland fens:</u>**<br>Restoration and maintenance costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of managing/restoring this habitat:<br>£96.8/ha/yr<br>**= £2, 904/ha over 30 years**<br>(M. Rayment 2017)<br><br>Restoration costs: £575/ha capital costs, £60/ha/yr annual costs.<br>= **£2,375/ha over 30 years**<br>(Rayment and & Lindberg 2006) | **£2,904**<br>**£2,375**<br><br>**Mean= £2639** |
| Hedgerows | **Hedges 'creation': £40/m** | | **Hedges mean for 'restoration': £7.66/m** | |
| | All estimates for hedgerows based on phone call and email communication with Nigel Adams (local Oxfordshire hedge expert), April 2023<br><br>Planting £8-10/m<br>Fence £14/m. Assume a fence is required along one side of the hedge because most hedges will be created alongside existing fences or walls. Assume only half of hedges are in pasture fields and will therefore require a fence (those in arable fields will not, and the areas of arable and pasture are approximately equal in Oxfordshire). So the average cost of fencing along all hedges is £7/m.<br><br>Hedge-laying £18/m. Will occur once in the 30 year period. There are two options: leave the hedge to grow | | Restoration costs: **£8/m**<br>(Rayment and & Lindberg 2006)<br><br>Restoration costs, taken from the 2017 'Assessing the costs of Environmental Land Management in the UK' by Wildlife trusts. Cost is the total area of this habitat in the UK, divided by their total estimated cost per year of restoring this habitat: **£7313.9/km = £7.31/m**<br>(M. Rayment 2017) | **£8/m**<br>**£7.31/m**<br><br>**Mean = £7.66/m** |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | untrimmed, then lay after 20-25 years, or trim lightly on a regular basis (e.g. every 1-3 years) then lay after 30 years. Assume option 1.<br><br>£5/m – estimated extra costs (mulch, irrigation in early years, rabbit guards if rabbits are a problem).<br><br>Total costs for creation: £10 planting + £7 fence + £18 laying + £5 other = £40/m.<br><br>**Other estimates for comparison:**<br>**Overall mean per m:**<br>£27.4 for planting + £18.86 for 2x laying over 30 years<br>**= £46.26/m**<br>**= £46,260/km**<br><br>**<u>Creation: planting</u>**<br>Creation: **£45/m** (Dorset County Council 2022)<br><br>Planting: **£3.40-30.00/m**<br>Mean: **£16.70/m** (Nix 2018)<br><br>Planting **£8-10/m** (Nigel Adams pers comm), plus fencing and other costs (see above)<br><br>*Current CS payments:* ***£22.97/m for creation***<br>(GOV.UK 2022)<br><br>Creation: **£25/m** (The National Association for Areas of Outstanding Natural Beauty 2020)<br><br>**<u>Laying:</u>**<br>Laying hedgerows indicative cost **£12-15/m** (Nix 2018) | | | |

| Broad habitat type | Creation costs | Creation estimate | Restoration costs | Restoration estimate |
|---|---|---|---|---|
| | Laying cost at **£9.40/m** (DEFRA 2019)<br><br>Laying cost ( Warwickshire Country Council 2018) : **£9/m**<br><br>Laying cost (BBOWT 2023)**£7.80/m**<br><br>Laying costs : **£7/m** (Keating, Pettit and Rose 2015)<br><br>Laying cost: **£18/m** (Nigel Adams pers comm) once in 30 years (see above).<br><br>*Laying every 15 years= twice over 30 years* (Buglife 2023) | | | |