Brownfield Habitats and Biodiversity Net Gain

Introduction and Context

West Midlands Combined Authority | Greener Together

University of East London | SRI Sustainability Research Institute | Grass Roof Company — Working with plants for people

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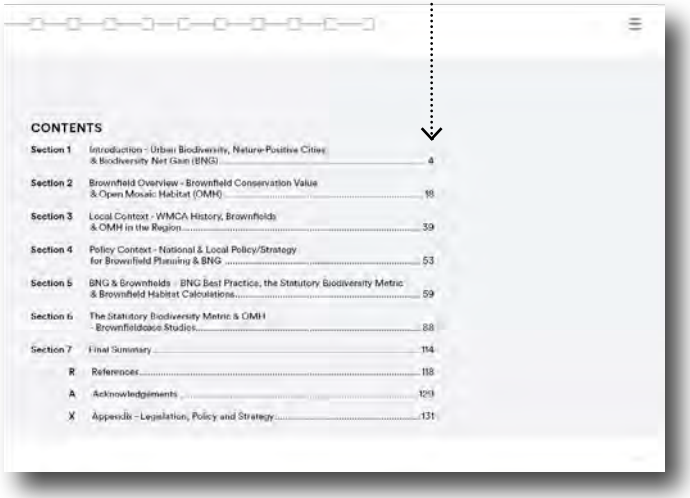

Main contents page

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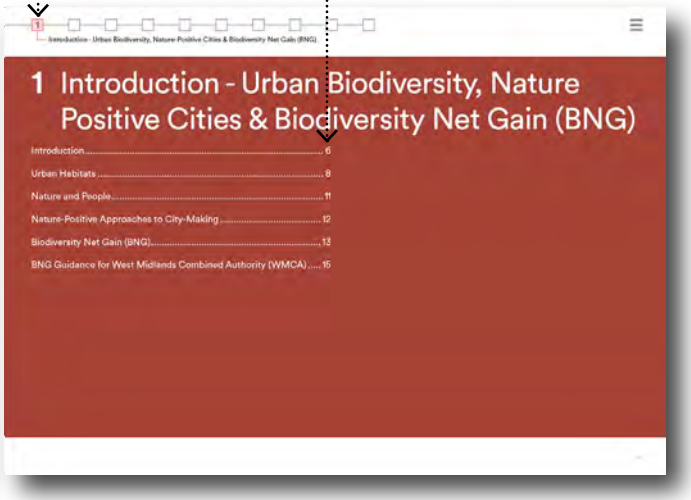
Click here to go to any titled page within this Section.



Section contents page

Click here to navigate to the source.

Click here to go to the Main contents page.

Titled page

CONTENTS

1 Introduction - Urban Biodiversity, Nature Positive Cities & Biodiversity Net Gain (BNG)

SECTION SUMMARY

- Background on biodiversity losses globally and in the UK, setting the scene for why biodiversity net gain was needed and introduced
- The role and importance of urban areas and urban habitats for biodiversity, the ecosystems services they provide
- The conflicting pressures on urban green and blue spaces from competing urban demands and development
- The emerging concept of nature-based solutions as an approach to renaturing cities that offers a framework for decision-makers to balance the competing demands of delivering sustainable, 'nature-positive' development that benefits both people and biodiversity
- Emerging best practice approaches for designing urban greenspaces for biodiversity, such as 'ecomimicry' and Biodiversity Sensitive Urban Design (BSUD)
- A brief introduction to Biodiversity Net Gain (BNG) and the need for tailored guidance for the West Midlands Combined Authority to support them in delivering nature-positive regeneration of urban brownfields in the region
- A summary of what is covered in the next sections of the report

INTRODUCTION

Nature is in crisis at a local and global scale [1, 2].

Recognition of this crisis has resulted in an international consensus on reversing these declines. The Kunming-Montreal Global Biodiversity Framework [3] was adopted during the fifteenth meeting of the Conference of the Parties (COP 15). This Framework establishes an ambitious pathway to living in harmony with nature by 2050, with the milestone of becoming nature positive by 2030 (Figure 1). Each signatory to this Framework has a responsibility to set targets for achieving this ambition.

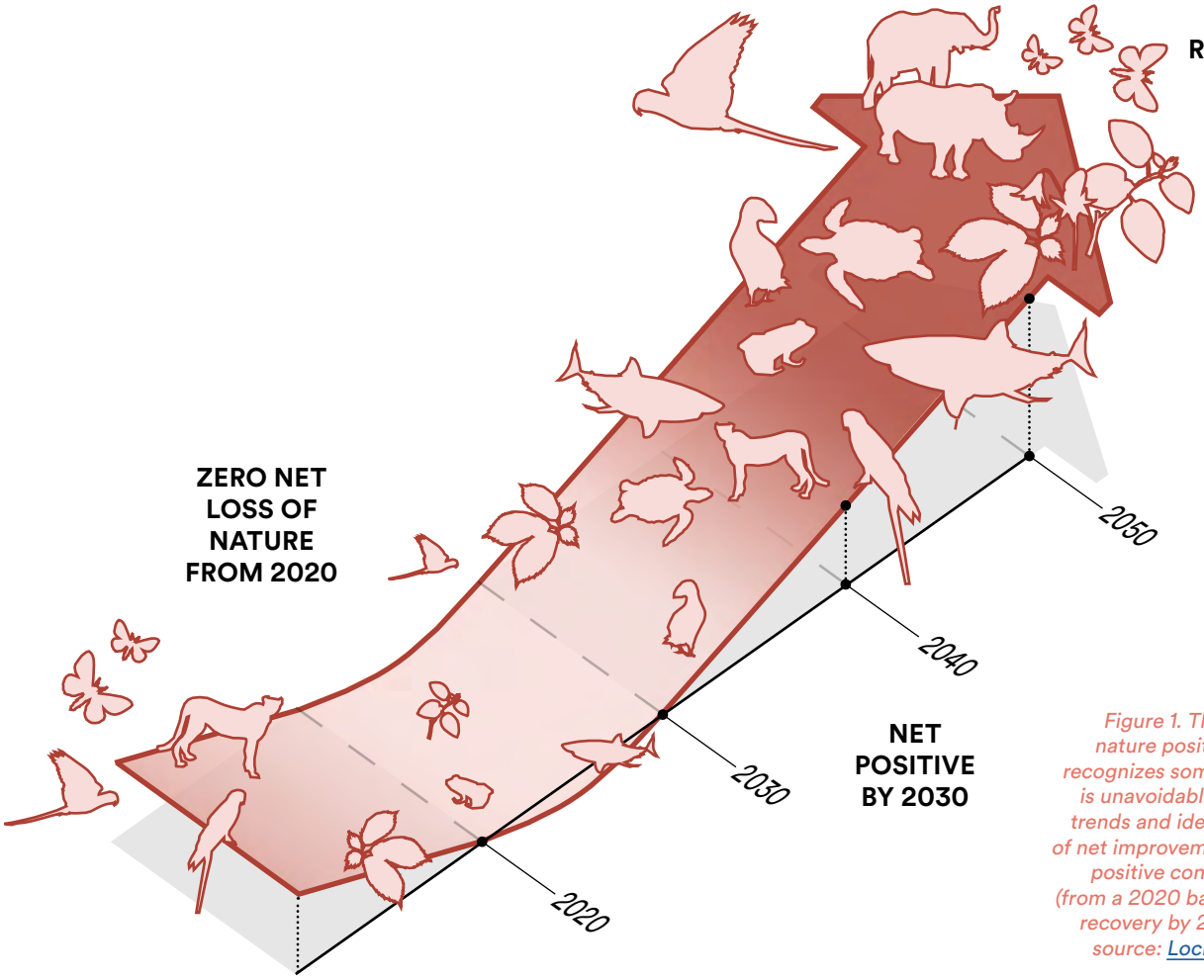


Figure 1. The trajectory of nature positive by 2030. It recognizes some ongoing loss is unavoidable given current trends and identifies the goal of net improvement to a nature positive condition by 2030 (from a 2020 baseline) and full recovery by 2050 (Based on source: Locke et al., 2021).

The UK's State of Nature report [2] confirms that the UK's biodiversity is following a similar fate. The UK's natural environment has been massively depleted by centuries of habitat loss, management changes, development, and persecution, from before the report's 1970 baseline.

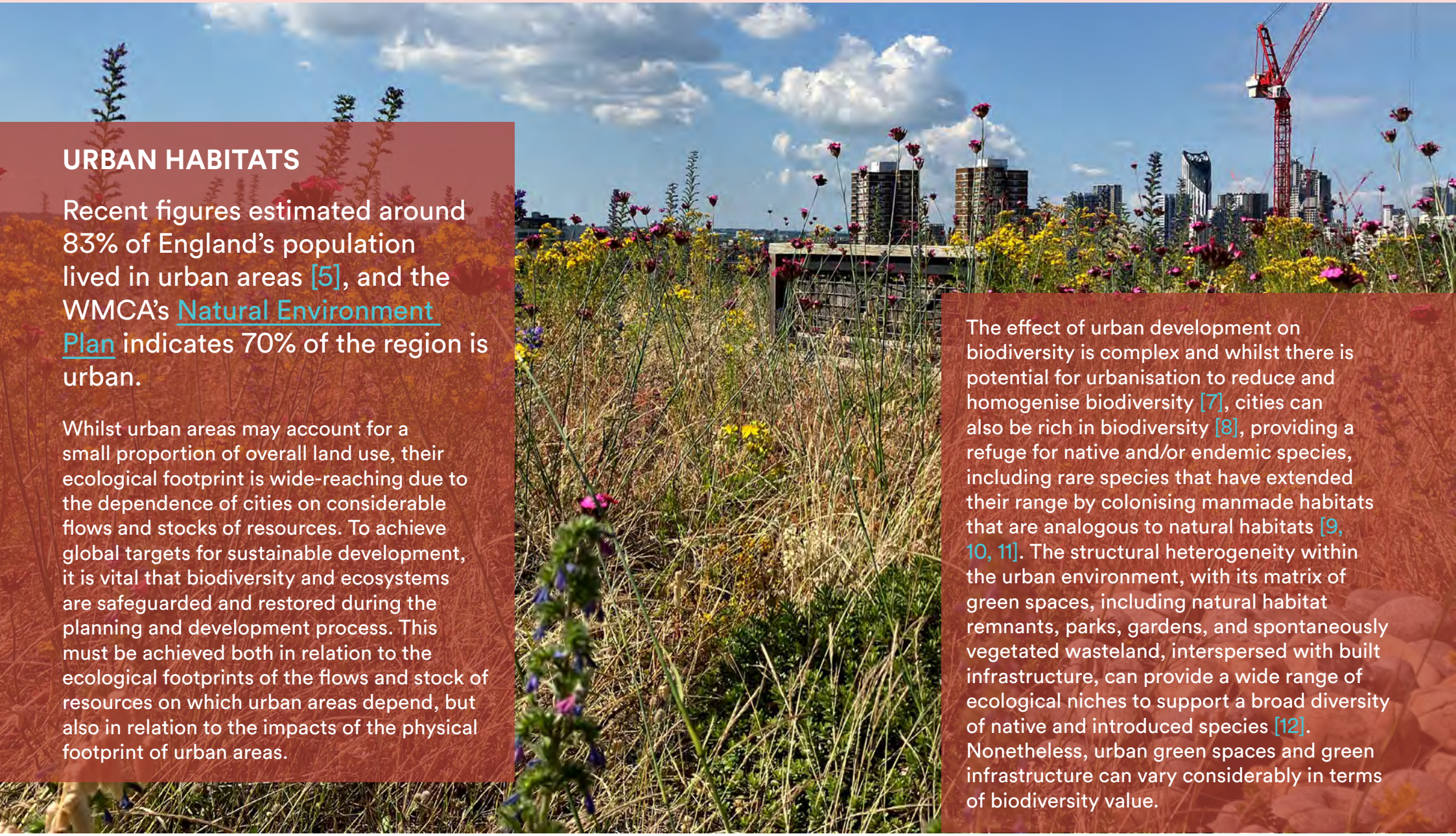
The latest report identifies that, on average, this pattern of decline has continued, with the abundance and distribution of the UK's species showing an ongoing declining trend, and no let-up in the net loss of nature in the UK in the last decade.

The UK Government's Environmental Improvement Plan [4] has set out an ambition to leave the natural environment in a better state for future generations.

This plan targets net gains for the natural environment and sets out plans for a biodiversity net-gain approach to development. Biodiversity Net Gain (BNG) is a new approach to development and land management that aims to leave the natural environment in a measurably better state by facilitating development to move towards nature positive outcomes and contribute to the recovery of nature. BNG bacame mandatory for almost all developments in England in February 2024, making it incumbent on developers to deliver at least 10% biodiversity net gain to secure planning permission. This also means local planning authorities (LPAs) will have additional responsibility for assessing planning applications in relation to their BNG plans as part of planning consent. The West Midlands Combined Authority's (WMCA) Natural Environment Plan 2021 - 2026 set out a framework for action and ambition to support the principles of nature recovery and BNG.

To ensure that the opportunities presented by biodiversity net gain are fully realised, there is a need to support local authority planners, developers, landscape architects, and ecologists to understand how to recognise, protect, create, and manage biodiversity. Central to this is understanding how biodiversity net gain can be most effectively applied in different development contexts.

This report is intended to be a guide to one of those contexts: the application of biodiversity net gain in urban contexts with a particular focus on evaluating and mitigating development on brownfield (post-industrial) sites. Commissioned by the WMCA, the report has a specific focus on the West Midlands region. However, much of the knowledge and practice presented in the report has transferability to support practitioners addressing biodiversity net gain on urban sites nationally.

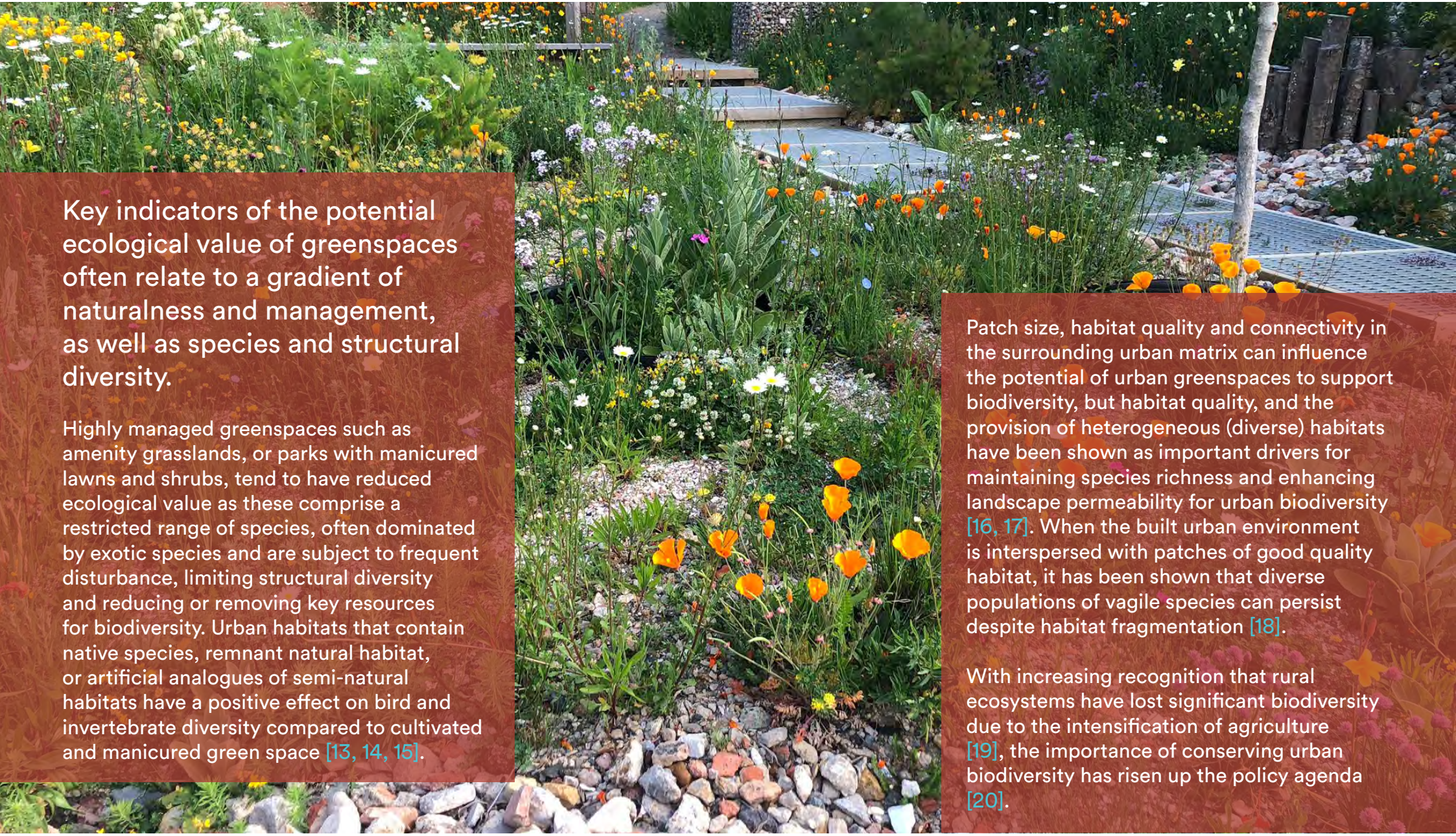


URBAN HABITATS

Recent figures estimated around 83% of England's population lived in urban areas [5], and the WMCA's Natural Environment Plan indicates 70% of the region is urban.

Whilst urban areas may account for a small proportion of overall land use, their ecological footprint is wide-reaching due to the dependence of cities on considerable flows and stocks of resources. To achieve global targets for sustainable development, it is vital that biodiversity and ecosystems are safeguarded and restored during the planning and development process. This must be achieved both in relation to the ecological footprints of the flows and stock of resources on which urban areas depend, but also in relation to the impacts of the physical footprint of urban areas.

The effect of urban development on biodiversity is complex and whilst there is potential for urbanisation to reduce and homogenise biodiversity [7], cities can also be rich in biodiversity [8], providing a refuge for native and/or endemic species, including rare species that have extended their range by colonising manmade habitats that are analogous to natural habitats [9, 10, 11]. The structural heterogeneity within the urban environment, with its matrix of green spaces, including natural habitat remnants, parks, gardens, and spontaneously vegetated wasteland, interspersed with built infrastructure, can provide a wide range of ecological niches to support a broad diversity of native and introduced species [12]. Nonetheless, urban green spaces and green infrastructure can vary considerably in terms of biodiversity value.



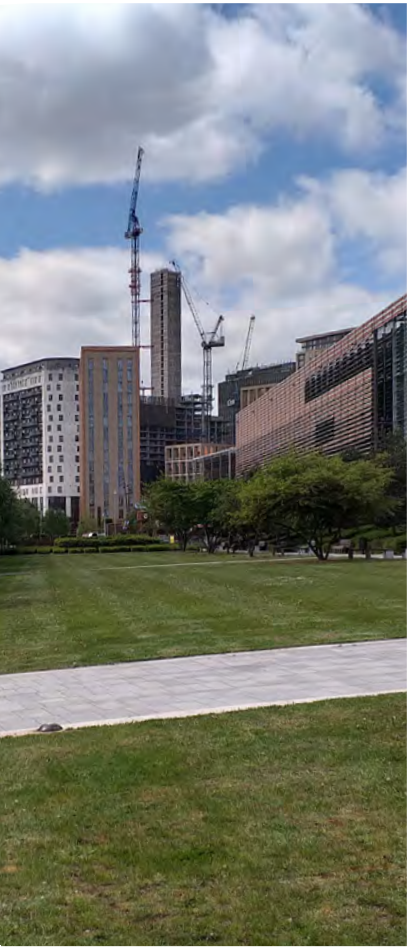
Key indicators of the potential ecological value of greenspaces often relate to a gradient of naturalness and management, as well as species and structural diversity.

Highly managed greenspaces such as amenity grasslands, or parks with manicured lawns and shrubs, tend to have reduced ecological value as these comprise a restricted range of species, often dominated by exotic species and are subject to frequent disturbance, limiting structural diversity and reducing or removing key resources for biodiversity. Urban habitats that contain native species, remnant natural habitat, or artificial analogues of semi-natural habitats have a positive effect on bird and invertebrate diversity compared to cultivated and manicured green space [13, 14, 15].

Patch size, habitat quality and connectivity in the surrounding urban matrix can influence the potential of urban greenspaces to support biodiversity, but habitat quality, and the provision of heterogeneous (diverse) habitats have been shown as important drivers for maintaining species richness and enhancing landscape permeability for urban biodiversity [16, 17]. When the built urban environment is interspersed with patches of good quality habitat, it has been shown that diverse populations of vagile species can persist despite habitat fragmentation [18].

With increasing recognition that rural ecosystems have lost significant biodiversity due to the intensification of agriculture [19], the importance of conserving urban biodiversity has risen up the policy agenda [20].

INNOVATION IN URBAN LANDSCAPING - TAKING INSPIRATION FROM NATURE



Generic urban landscaping

Traditional approaches to urban landscaping have often been driven by a uniform and manicured aesthetic and a long tradition of intensive management practices.

This approach has many drawbacks:

- A 'cut and paste' reliance on the same hardy species of limited biodiversity value
- High greenhouse gas (GHG) emissions from frequent management & use of topsoil/peat, fertiliser, pesticide/herbicides, etc
- Less resilient to climate change
- Mowing removes structural diversity, seed-heads, flowers
- More management = higher £££s
- Simple, similar habitats homogenise urban landscapes diminishing their nature potential and offering limited resources for biodiversity

Biodiverse urban landscaping

Innovation in urban landscaping offers an alternative, nature-positive solution by taking inspiration from biodiverse urban habitats of known nature conservation value.

This approach has many advantages:

- Planting reflects diverse locally important habitats of high biodiversity value
- Lower GHG emissions from recycled waste materials with no need for topsoil/peat, fertiliser, etc
- More resilient to climate change
- Lower management promotes structure, seed-heads, flowers
- Less management = lower £££s
- Complex habitat attuned to local nature, provides vital resources for biodiversity (forage, larval foodplants, breeding habitat)

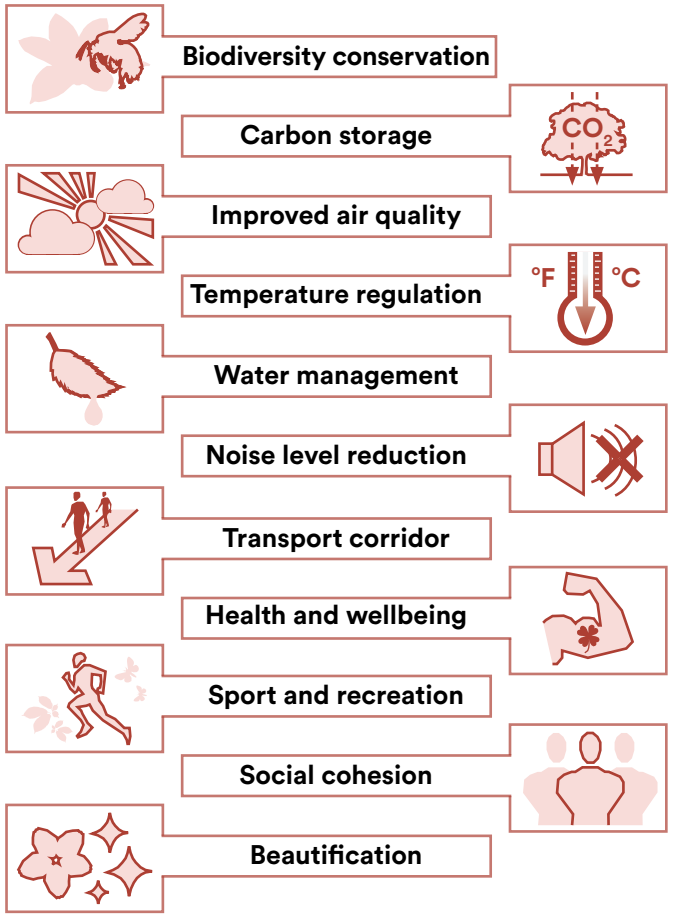
NATURE AND PEOPLE

The anthropogenic pressure on urban green and blue spaces from development is immense, with numerous competing demands on limited space [21].

As urban areas expand and/or densify, a general pattern of associated loss of biodiversity has also meant a loss of natural capital. Natural capital is the value of the multifunctional benefits that nature can provide for human health and wellbeing, including building resilience in the face of climate change [22, 23, 24]. These benefits that nature provides (ecosystem services) are increasingly being recognised as vital for supporting healthy, sustainable, and thriving urban communities [25]. Despite an increasing awareness of the importance of biodiversity to deliver these ecosystem services for urban communities, biodiversity is often sacrificed at the expense of other anthropogenic uses of urban spaces, contributing to the UK being one of the most nature depleted countries globally [2].

Nature-based solutions are emerging as a concept that strategically delivers the ecosystem service benefits of biodiversity restoration to communities [26, 27]. By adopting a solutions-based approach to re-naturing, it is possible to simultaneously tackle climate change, create healthier more resilient places for people to live, and provide economic opportunities in terms of green jobs and skills. As well as providing important ecosystem services such as cooling and flood alleviation, urban greening offers city-dwellers vital opportunities to reconnect with nature, which can foster a sense of appreciation and encourage safeguarding of biodiversity, for both its intrinsic and functional value [28].

IMPORTANCE OF NATURE IN URBAN AREAS TO IMPROVE HEALTH/WELLBEING AND FOR CLIMATE RESILIENCE



NATURE-POSITIVE APPROACHES TO CITY-MAKING

Maintaining and restoring nature and green infrastructure in cities is critical for human and health and wellbeing and to make urban areas resilient and adaptive to climate change [29].

Nature-based solutions approaches offer a cost-effective framework for renaturing cities. Emerging nature-based solutions implementation frameworks [30, 31] also support decision-makers in balancing the competing demands of delivering sustainable development that benefit both people and nature. However, due to the inevitable trade-offs created by the competing demands on urban open spaces, biodiversity restoration can often become marginalised leading to 'greenwashing' approaches rather than nature positive outcomes [32, 33].

Crucial to the success of renaturing/nature-based solutions is to ensure ecologically-informed approaches to habitat creation and/or enhancement, rather than relying on assumptions of the intrinsic benefits of urban greening [34, 35], which can result in trade-offs that limit multifunctionality opportunities and risk greenwashing [36]. The nature-based solutions approach seeks to address this by ensuring that all actions are 'nature-positive' and that the complexity in managing the competing demands of greenspaces in urban areas do not come at a cost to biodiversity. Creative design of urban greenspaces can help to protect and enhance biodiversity, for instance through an 'ecomimicry' approach that embeds the key ecological features and functions of locally important habitats into urban greenspace design [37], or Biodiversity Sensitive Urban Design (BSUD) that that aims to create urban areas that deliver on-site benefit to native species and ecosystems through the provision of essential habitat and food resources [38].

BIODIVERSITY NET GAIN (BNG)

Biodiversity Net Gain (BNG) has been introduced as a mechanism primarily to support the recovery of nature whilst developing land, and to ensure that development creates measurable improvements for biodiversity through creating or enhancing habitats as part of the development process.

Biodiversity underpins the health and functioning of the planet but has often been overlooked and under-valued in decision-making, contributing to biodiversity declines. Valuing, restoring, and enhancing biodiversity are therefore crucial to achieving sustainable development. Biodiversity net gain became mandatory in England in February 2024, under a statutory framework introduced by Schedule 7A of the Town and Country Planning Act 1990 (inserted by the Environment Act, 2021). Under the statutory framework for biodiversity net gain, subject to some exceptions, planning permission will require that the biodiversity gain objective is met ("the biodiversity gain condition"), with the objective for development to deliver at least a 10% increase in biodiversity value relative to the pre-development biodiversity value of the onsite habitat. This increase can be achieved through biodiversity gains on site, or through offsite biodiversity gains (biodiversity offsetting) or through a combination of both.

Well designed and delivered BNG can deliver benefits for nature, people, places and the economy, and offers a strategy for development to support nature conservation, nature-based solutions, climate change adaptation and levelling-up access to greenspace for communities (83). Properly planned BNG can contribute to local and strategic biodiversity priorities, helping to recover biodiversity and build healthier and more resilient ecosystems. For local planning authorities (LPA), BNG can support delivery of high-quality sustainable development within the authority area. Embedding BNG in local planning policies and strategies can demonstrate LPA action on national legal, policy, and strategic biodiversity requirements, empowering LPAs to target BNG towards meaningful positive gains for local biodiversity, and enabling linkages to wider strategic priorities such as health and wellbeing, climate change and the economy.

By creating Local Plan BNG policies and strategies that set out the Council's vision for BNG, LPAs can provide clear, measurable objectives for developers to follow, guiding them to deliver BNG in accordance with local biodiversity needs and to contribute to local biodiversity priorities. Further detail on BNG principles and best practice are provided later in this report.

BNG GUIDANCE FOR THE WEST MIDLANDS COMBINED AUTHORITY (WMCA)

The purpose of this report is to provide locally-contextualised BNG guidance for key stakeholders in the WMCA involved in developing urban, and specifically brownfield sites, to ensure their biodiversity can be appropriately assessed in accordance with the requirements for mandatory BNG in England.

Brownfield urban sites across the West Midlands region represent a significant opportunity for nature recovery and delivering ecosystem services for local communities. They can also represent ideal places for essential urban regeneration, particularly on brownfield sites with little to no existing biodiversity value. Consequently, the WMCA have commissioned this study to develop best practice guidance on how biodiversity net gain can play a key role in ensuring development and biodiversity restoration are delivered in harmony when regenerating brownfield sites, and how using a nature-based solution approach can facilitate the process of nature-positive city-making and support WMCA's brownfield regeneration programme.

This document provides an introduction to the topic of brownfields and biodiversity and gives an overview of BNG in the brownfield redevelopment context. It comprises a synthesis of the findings of a stakeholder consultation and literature review, including data from previous research and consultancy work by the University of East London's (UEL) Sustainability Research Institute (SRI) on urban development, brownfields and nature-based solutions. The next section of the report provides background on brownfield sites and their potential nature conservation value, including details on sites that qualify as Open Mosaic Habitat on Previously Developed Land (herein termed OMH), a national Priority Habitat, and a short summary of the multifunctional benefits/ co-benefits vegetated brownfields can provide. It then sets out the context in the WMCA region, including a summary review of its growth plans as a devolved authority, its industrial history and post-industrial brownfield site legacy, and a synthesis of collated data on the status of OMH in the region.

This is followed by a section on BNG principles and best practice, along with a review of key policies, legislation and strategies related to planning, nature conservation and BNG. After this there are sections on the Statutory Biodiversity Metric, an exploration of how this tool can be used to evaluate urban brownfield habitats and OMH, and a summary analysis of potential opportunities and barriers related to OMH/brownfields, BNG and the Statutory Biodiversity Metric. The report closes with two emerging good practice case studies related to OMH habitat creation as part of brownfield redevelopment.

KEY LEARNING OUTCOMES

- Global biodiversity is in decline and the UK has become one of the most nature-depleted countries in the world
- Biodiversity conservation is critical for delivering a nature positive future that sustainably provides the ecosystem services (benefits) that are essential for people
- Biodiversity Net Gain (BNG) is a new approach to development and land management that aims to leave the natural environment in a measurably better state than before and contribute to the recovery of nature
- Urban areas can be important reservoirs for biodiversity and good quality urban habitats can play a vital role in reversing biodiversity declines
- Nature-based solutions approaches provide a cost-effective approach for restoring nature to cities whilst delivering environmental, social and economic co-benefits, creating resilient and liveable cities and a nature-positive economy
- To avoid 'greenwashing' and to manage the competing demands on urban greenspaces, nature-based solutions should be creatively designed using emerging best practice approaches such as 'ecomimicry' or Biodiversity Sensitive Urban Design, that take inspiration from locally important ecosystems, and consider biodiversity requirements as part of urban planning and development.
- Biodiversity net gain can play a key role in ensuring development and biodiversity restoration are delivered in harmony using a nature-based solutions approach that can facilitate the process of nature-positive city-making
- This study was commissioned by the WMCA to develop best practice guidance to support developers and other key stakeholders in delivering biodiversity net gain when regenerating urban brownfield sites in the region
- The next sections provide a synthesis of the findings of the first phase of this study

2 Brownfield Overview - Urban Brownfield Conservation Value & Open Mosaic Habitat

SECTION SUMMARY

- An overview of the ecology of vegetated urban brownfields
- Details from best practice guidance on identification of Open Mosaic Habitat on Previously Developed Land (OMH), a UK Priority Habitat that can develop on brownfield sites
- The value of small sites with OMH that do not qualify as Priority Habitat
- Studies examining the multifunctional benefits/co-benefits of brownfields

BROWNFIELD CONSERVATION VALUE

Brownfield sites that have been spontaneously revegetated have been recognised as a uniquely urban form of 'wilderness', with the capacity to support diverse communities of nature conservation value [39].

The term brownfield describes previously-developed land that has been abandoned or become unused, variously termed post-industrial land, derelict/vacant land and wasteland. Brownfield sites encompass an array of former uses such as railway lines, quarries, waste tips, mines and power stations and typically occur in developed urban areas and former industrial landscapes. They can range in terms of nature conservation value from sites of recent origin covered with impervious artificial surfaces that support little biodiversity, to long-standing, disused sites that have been colonised by vegetation and have developed analogous communities to semi-natural habitats such as meadows, heathland, and chalk grassland [9, 40]. Figure 2 includes some examples of brownfield habitat features (left) that mimic natural/semi-natural habitat (right).

Most brownfields contain manmade structures, areas of hardstanding, modified nutrient-poor substrates, and/or contaminated soils. Depending on previous site history, this could include by-products of industrial processes such as pulverised fuel ash (PFA) from coal-fired processes, mine spoil, blast furnace slag [41], brick rubble sites from housing and factory demolition following industrial decline [39], or sub-soil exposures from mineral and peat extraction activities. Mounds of materials and quarrying activities can create complex topography, such as vertical slopes or hollows that can support seasonal wetlands or permanent water bodies. Ground and below-ground resource heterogeneity, along with varied topography and moisture conditions, plus sequences of disturbance and neglect create a dynamic environment [42, 43], and these combined conditions can result in simultaneous distinct successional stages occurring within one site [39].

In the WMCA region, disused sites from the extractive industries (e.g. coal mining, quarrying for clay and Etruria marl for glass and brick making, plus sand and gravel for building) and abandoned factory sites, resulted in brownfields characterised by materials such as coal, blast furnace and dolerite spoil, solid furnace slag and factory demolition waste, although many of these types of sites have become rare in the landscape. The conditions created by these waste materials on the sites has led to the development of locally distinctive habitats with nature conservation value.

BROWNFIELD HABITATS AND NATURAL HABITATS THEY MIMIC

Examples of brownfield habitat features

Natural/semi-natural habitats

- Brownfields mimic natural habitat features found in grassland, heathland, coastal habitats and scrub
- These natural habitats are declining and fragmented nationally and globally and many of the species that rely on them are becoming endangered
- Brownfields with habitat mosaics can provide alternative novel ecosystems for species associated with natural habitats, and offer the juxtaposition of features over appropriate scales critical for many species

Varied ground conditions and sporadic disturbance events (such as trampling, fire or burrowing from wild animals such as rabbits/ foxes) can create conditions that produce a variety of habitats in close proximity, creating small-scale landscape detail (microhabitats), which form into a mosaic. These mosaics can be structurally diverse and offer a multitude of niches of value to a wide range of biodiversity [44]. Sites with successional mosaics containing patches of scrub/young woodland alongside diverse early successional habitats and wetlands can be particularly valuable for species requiring multiple resources to complete their lifecycles [45]. This can include rare species that have disappeared from surrounding heavily managed urban and rural greenspace [46].

This juxtaposition of the varied habitats can often occur on a single high quality brownfield site and at appropriate spatial scales critical for many species (e.g. exposures of friable, bare substrates for breeding in proximity to flower-rich grassland for foraging), whereas these resources can be rare and/or highly fragmented in the managed countryside. Figure 3 illustrates some of the key features and functions of habitat mosaics that can develop on brownfield sites that can make them important refuges for biodiversity. Additionally, Buglife's 'Introduction to brownfields' [47] provides a good overview of the biodiversity value of brownfield habitats and examples of the species that rely on them.

EXAMPLES OF KEY FEATURES AND FUNCTIONS OF OPEN MOSAIC HABITAT THAT CAN DEVELOP ON BROWNFIELD SITES

- Last remnants of unmanaged urban 'wildspace'
- Mosaic of habitats on varied, nutrient-poor substrates
- Analogue for (semi)natural habitats
- Structural diversity - mounds, tussocks, bare areas, tall and short vegetation
- **Bare & sparsely vegetated ground** for nesting and basking

- **Flower rich habitats** for nectar and pollen
- **Scrub / woodland patches** for shelter, shade, larval foodplants
- **Wetland habitat** for species with an aquatic stage
- Ecosystem service such as microclimate and air pollution regulation

Figure 3. Examples of the key features and functions of open mosaic habitat that can develop on brownfield sites.

FLORISTIC DIVERSITY

The varied pH, moisture, and nutrient content characteristic of the modified substrates found on brownfield sites promotes diversity in plant species composition [48].

The nutrient-poor, thin, drought-stressed and often contaminated substrates exert selective pressure that suppresses common, competitive plant species that dominate more managed urban green spaces, allowing a rich floral community to develop [49, 50, 51, 52]. Attributes of the modified substrates on brownfields influence plant community development, with acidic substrates such as PFA characterised initially by salt-loving (halophyte) plants, followed by establishment of orchids, and eventually closed canopy woodland (30+ years).

Other legacy wastes have sustained orchid-rich calcareous grasslands over decades (50+ years) without active management such as grazing [53]. Heavy metal contamination of substrates can limit plant diversity and retard successional processes due to abiotic stress, but these factors can also lead to the development of distinctive communities of conservation importance such as Calaminarian grassland. Different substrates undergo different successional and ecological trajectories, adding to the diversity of habitat types that develop on brownfields.

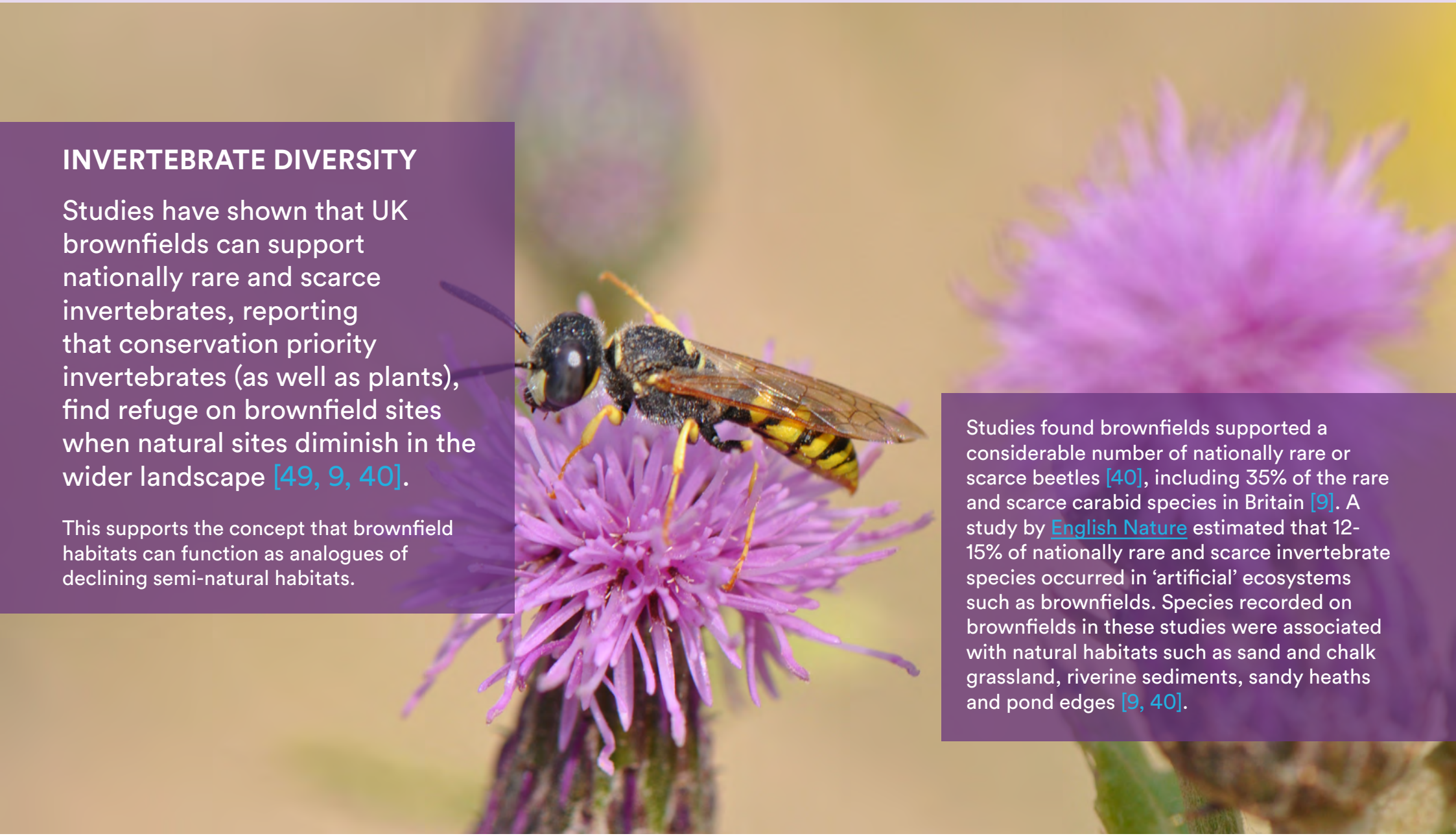
In the WMCA region, brownfields such as disused coal workings and blast furnaces developed locally distinctive grasslands, heathlands and early successional annual communities. Subsidence for mining and pits from quarrying have enabled wetland communities such as reed-swamp to establish. Post-industrial, as well as derelict railway and housing land, left vacant for several years, has been recorded to develop a rich flora of over 150 species [54].

Urban brownfield sites have been shown to support greater plant species richness than other urban habitats such as lawn and remnant urban forest, and a broader variety of life forms, functional types, and nectar producing plants [52]. A study in Greater Manchester found a quarter of sites of biological importance had a history of industrial use, and many rare and scarce plants recorded in the region were confined to brownfield sites [49]. A proportion of the floristic diversity of urban brownfield sites can be attributed to the presence of exotic (alien/neophyte) plants [43, 50, 51, 52]. Whilst some exotic species can become invasive and reduce biodiversity value, some function as pioneers during early colonisation of brownfield sites [42], and can extend the flower season, contributing to the value of habitat for invertebrates.

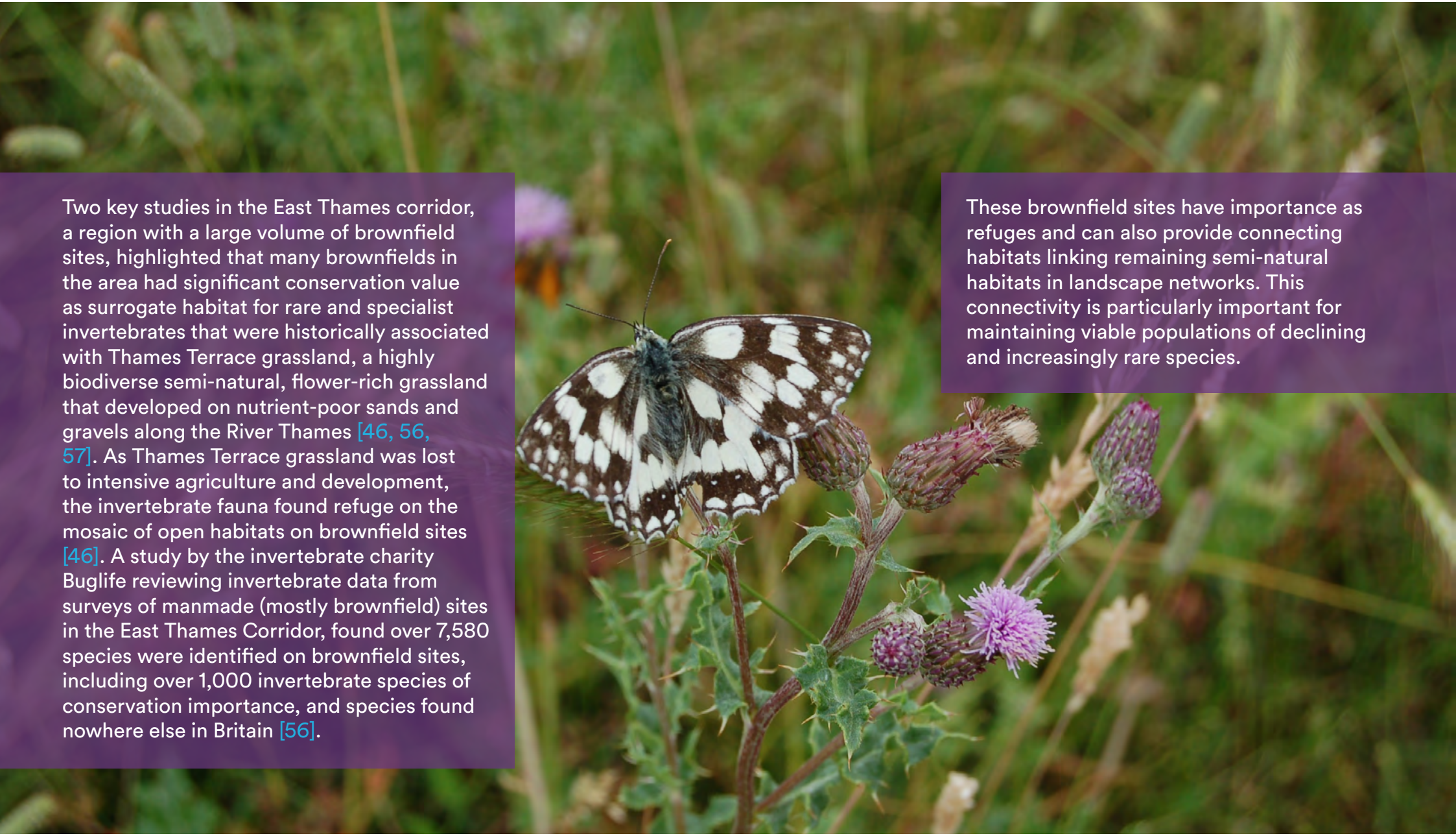
INVERTEBRATE DIVERSITY

Studies have shown that UK brownfields can support nationally rare and scarce invertebrates, reporting that conservation priority invertebrates (as well as plants), find refuge on brownfield sites when natural sites diminish in the wider landscape [49, 9, 40].

This supports the concept that brownfield habitats can function as analogues of declining semi-natural habitats.



Studies found brownfields supported a considerable number of nationally rare or scarce beetles [40], including 35% of the rare and scarce carabid species in Britain [9]. A study by English Nature estimated that 12-15% of nationally rare and scarce invertebrate species occurred in 'artificial' ecosystems such as brownfields. Species recorded on brownfields in these studies were associated with natural habitats such as sand and chalk grassland, riverine sediments, sandy heaths and pond edges [9, 40].



Two key studies in the East Thames corridor, a region with a large volume of brownfield sites, highlighted that many brownfields in the area had significant conservation value as surrogate habitat for rare and specialist invertebrates that were historically associated with Thames Terrace grassland, a highly biodiverse semi-natural, flower-rich grassland that developed on nutrient-poor sands and gravels along the River Thames [46, 56, 57]. As Thames Terrace grassland was lost to intensive agriculture and development, the invertebrate fauna found refuge on the mosaic of open habitats on brownfield sites [46]. A study by the invertebrate charity Buglife reviewing invertebrate data from surveys of manmade (mostly brownfield) sites in the East Thames Corridor, found over 7,580 species were identified on brownfield sites, including over 1,000 invertebrate species of conservation importance, and species found nowhere else in Britain [56].

These brownfield sites have importance as refuges and can also provide connecting habitats linking remaining semi-natural habitats in landscape networks. This connectivity is particularly important for maintaining viable populations of declining and increasingly rare species.

In the WMCA region, sites with a brownfield history have become important for invertebrates, for instance Pelsall Common, which has an industrial history but has since become a valuable nature reserve and a Site of Importance for Nature Conservation (SINC). Historic ironworks at the site, when decommissioned, left behind a legacy of foundry waste known as 'cinder and tap', and over time this developed into heathland and acid grassland. This site historically supported a population of the nationally scarce tormentil mining bee Andrena tarsata, also listed as a Species of Principal Importance in England, that requires bare or sparsely vegetated ground for nesting and a pollen stock from the flower tormentil Potentilla erecta to feed their larvae. This species remains present at other local sites where coal waste has become colonised.

The heathland habitats that regenerated on the post-industrial wastes at Pelsall Common have the potential to be re-colonised to create a more resilient metapopulation of this species, as well as other rare pollinating insects. The Purple Horizons partnership project has been restoring key plants and bare ground to the area to provide crucial nesting and feeding spaces for the tormentil mining bee [58].

Far more published studies outside the UK have shown the importance of brownfields for invertebrates and demonstrated the function of post-industrial sites as analogues for declining semi-natural habitats [59, 60, 61, 62, 63, 64].

OTHER BROWNFIELD BIODIVERSITY

Whilst most studies have focused on the plant and invertebrate conservation value of vegetated brownfield sites, they can also be important for birds, reptiles and amphibians, and small mammals. This includes Protected Species such as great crested newts, bats, water voles and the black redstart, a very rare bird in the UK associated almost exclusively with urban brownfield sites [65].

UK PRIORITY HABITAT DESIGNATION - OPEN MOSAIC HABITAT ON PREVIOUSLY DEVELOPED LAND

In recognition of the nature conservation value of some of the best examples of biodiverse brownfield sites, Open Mosaic Habitat on Previously Developed Land (OMH) was designated a UK Biodiversity Action Plan (BAP) Priority Habitat [66].

OMH was also listed as a Habitat of Principal Importance in England and Wales under Sections 41 and 42 of the NERC Act, 2006. OMH became the new term to describe brownfield sites that had developed a diverse patchwork of microhabitats, and sites were designated on the basis of habitat structure, and the presence of biodiverse communities, principally invertebrates.

The UK BAP Priority Habitat designation criteria for OMH [66] are shown in Table 1 and each criteria must be met to qualify.

CRITERION	
1	The area of open mosaic habitat is at least 0.25 hectare in size.
2	Known history of disturbance at the site or evidence that soil has been removed or severely modified by previous use(s) of the site. Extraneous materials/substrates such as industrial spoil may have been added.
3	The site contains some vegetation. This will comprise early successional communities consisting mainly of stress-tolerant species (e.g. indicative of low nutrient status or drought). Early successional communities are composed of (a) annuals, or (b) mosses/liverworts, or (c) lichens, or (d) ruderals, or (e) inundation species, or (f) open grassland, or (g) flower-rich grassland, or (h) heathland.
4	The site contains unvegetated, loose bare substrate and pools may be present.
5	The site shows spatial variation, forming a mosaic of one or more of the early successional communities (a)–(h) above (criterion 3) plus bare substrate, within 0.25ha.

Table 1. Criteria for designation of Priority Habitat Open Mosaic Habitat on Previously Developed Land (JNCC, 2010).

Explanatory notes for the BAP habitat description for OMH state "a mosaic is defined as an area where a range of contiguous plant community types occur in transition with one another, usually with ecotone habitat gradients and repeated occurrences of each community, and often at a small scale", and cites the habitat's importance for invertebrates as a principle reason for its designation [66].

Whilst the main qualifying criteria focus on early successional habitats, in describing the invertebrate value of OMH, the definition also states "At any particular site, features such as scrub may be essential to maintain the invertebrate value of the main habitat. Therefore, scattered scrub (up to 10-15% cover) may be present and adds to the conservation value of the site. Other communities or habitats might also be present (e.g. reed swamp, open water), but early successional communities should comprise the majority of the area". The explanatory notes also states "Continuous blocks of a closed plant community greater than 0.25 ha would be classified as a habitat other than OMH, although those containing very fine-grained mosaics might qualify" [66].

Further guidance was produced to refine the original OMH identification methodology [67], resulting in a new OMH survey handbook that addressed concerns that the communities described in Criterion 3 for designation (Table 1 above) were confusing or misleading, particularly because whilst OMH sites have varying amounts of early successional communities, more established communities such as scrub and grass tussocks can be highly valuable to invertebrate communities when they occur as part of the overall mosaic [68]. Additionally, in recognition of the ecological importance of vegetation function and structure, the survey method also sought to capture a measure of pollen and nectar resources and three structural elements - grass tussocks, dead stems and seed heads, and prostrate bramble – that provide important resources for invertebrates (e.g. over-wintering sites) [68].

In the new OMH survey handbook [65], the following habitats and communities were defined as indicators of OMH (Table 2) and include specific reference to the later successional scrub and woodland components that can be of value on such sites. Nonetheless, the handbook defers to the UK BAP OMH definition criteria for determining whether OMH is present, therefore whilst the scrub/ woodland components of OMH add value, their presence is not considered in the designation criteria for OMH. Similarly, in Buglife's 'Identifying Open Mosaic Habitat' [69] guidance, many of the images illustrating examples of good quality OMH show varying degrees of scrub and/or woody habitat as part of the mosaic.

OMH HABITATS AND CHARACTERISTIC COMMUNITIES/FEATURES

EARLY SUCCESSIONAL VEGETATION

- Bare ground – larger (>50cmx50cm) areas
- Sparse vegetation
- Stress tolerant annuals
- Moss or liverwort communities
- Lichen communities
- Other pioneer vegetation

GRASSLAND

- Acid
- Neutral
- Rank neutral
- Calcareous

WOODLAND AND SCRUB

- Scrub (continuous scrub >0.25ha treat as woodland)
- Scattered trees
- Woodland (areas >0.25ha exclude from OMH)

HERB DOMINATED

- Tall herb (if with >20% grass, should be grassland)
- Creeping herb (as above)

HEATHLAND

- Dwarf scrub
- Lichen/bryophyte heath

WETLAND

- Marshy grassland
- Inundation vegetation or seasonally wet areas
- Saline/brackish seasonally wet areas

WATER FEATURES

- Pools (<25 m2)
- Ponds (25 m² to 2 ha) hold water at least 4 months/year
- Temporary pools (hold water <4 months/year)

Table 2. Habitats and vegetation types that characterise OMH, taken from the OMH Survey Handbook (Lush et al., 2013).

The BAP designation, and subsequent OMH guidance detailed above, have helped with identifying good quality OMH in the field. Nonetheless, due to their highly varied character and differing interpretations of what elements of a site qualify as OMH, and due to their habitat characteristics and the spatial extent of microhabitats within the mosaic, inconsistencies remain in evaluation of OMH [69]. A study in the East Thames Corridor region in 2013 highlighted that even with improved understanding that brownfield sites can support high quality habitat such as OMH, habitat loss continued at unsustainable rates with potentially serious consequences for regionally important invertebrate communities and nationally rare species [70].

This represents a major challenge for BNG assessments of vegetated brownfield sites, as the accurate categorisation of OMH and its extent, particularly given the qualifying spatial threshold of >0.25 ha, could have significant effects on BNG baseline calculations and compensation requirements, which in turn could impact the conservation status of this Priority Habitat and the species that depend on it.

SMALL OMH SITES

With many larger brownfield sites already lost to development [70], the remaining urban brownfield sites may support smaller areas of OMH, that do not meet the size threshold to qualify as Priority Habitat.

Nonetheless, even relatively small areas of OMH can have local importance for biodiversity, as they can act as habitat stepping-stones, and/or provide important habitat niches not widely available in typical, managed urban greenspaces. Whilst larger sites may be able to support populations of species, smaller sites may require a network of habitat areas nearby to provide sufficient habitat overall to support some species [65].

Consultation with WMCA stakeholders indicated that these smaller habitat pockets were considered a valuable component of greenspace for biodiversity, but that they were often undervalued as they did not meet OMH designation, leading to losses, with no requirement to provide replacement habitat that could deliver similar functions and ecological value.

The incremental loss of these smaller habitat patches in the urban landscape could have a cumulative negative impact on OMH communities. This could have implications for BNG, particularly where the system of measuring losses and gains relies on the spatial scales of habitats for determining biodiversity value.

UEL'S BEETLE BUMP - EXAMPLE OF SMALL-SCALE OMH VALUE

The Beetle Bump was created to showcase how urban landscaping can be designed to support rare invertebrates without compromising on aesthetics.

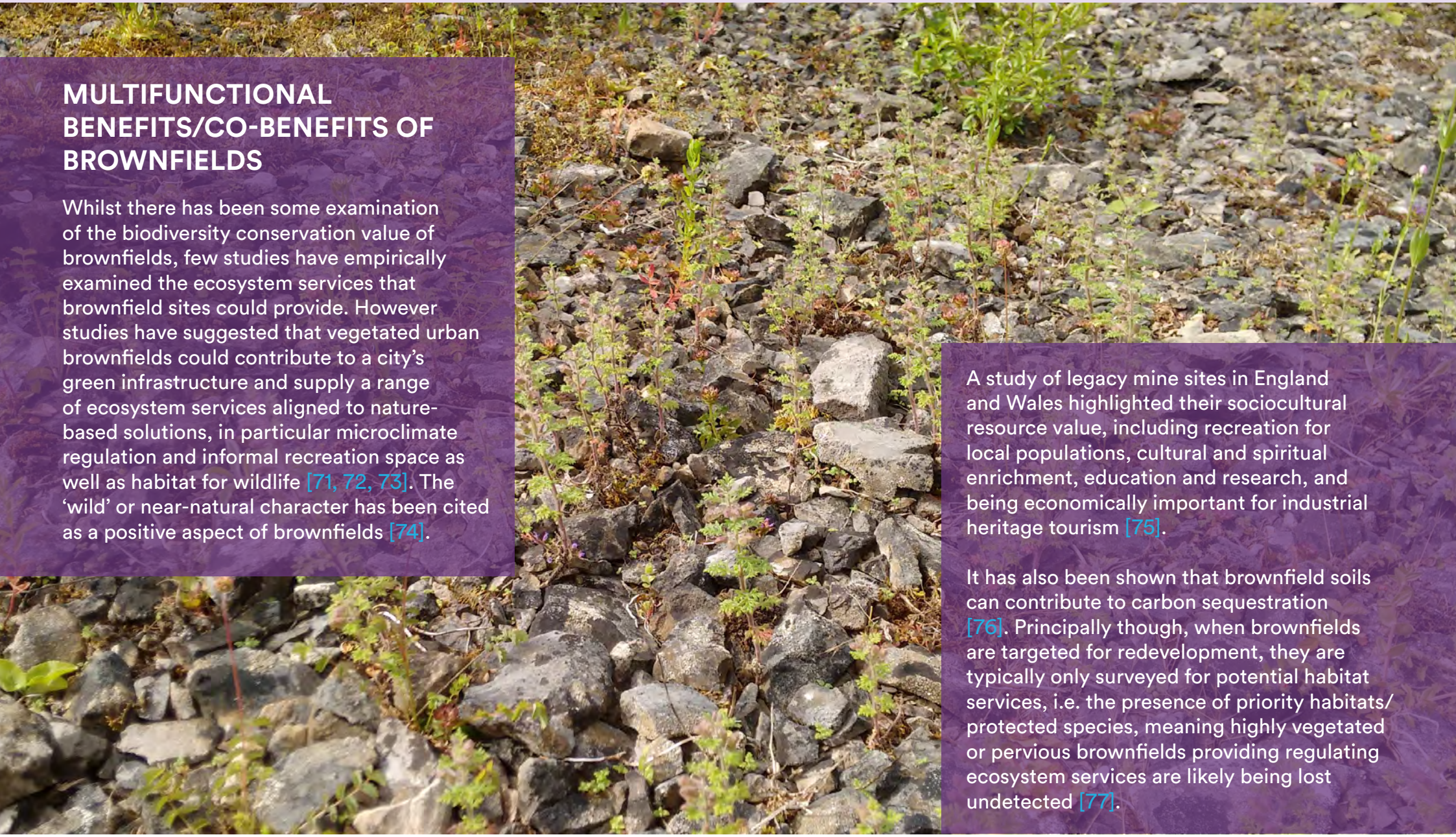
A brownfield nature reserve was created on a 0.1 hectare triangle of unused land on UEL's Docklands Campus, which used an ecomimicry design [37] approach to create suitable habitat for the rare brownfield specialist species the streaked bombardier beetle (*Brachinus sclopeta*). It included a variety of microhabitats of known value to brownfield biodiversity in the region, and these were artfully arranged to create an attractive design. A diverse seed mix, rich in typical brownfield wildflower species was sown at a low density to help speed up colonisation and overall aesthetics.

UEL researchers have monitored the site and as well as sustaining a population of streaked bombardier beetles, the Beetle Bump has attracted a variety of species characteristic of local high-quality brownfields in the region such as the brown-banded carder bee (*Bombus humilis*), a Priority Species and target for brownfield conservation efforts in the region.

A comparative invertebrate survey of the more traditional amenity urban greenspaces on the campus highlighted that a far greater diversity of species occurred on the Beetle Bump, demonstrating that even small pockets of good quality brownfield habitat can support important biodiversity and provide connecting stepping-stone habitat amongst lower quality urban habitats. The project also showcases the opportunities and value of restoring pockets of brownfield habitat into urban landscaping.

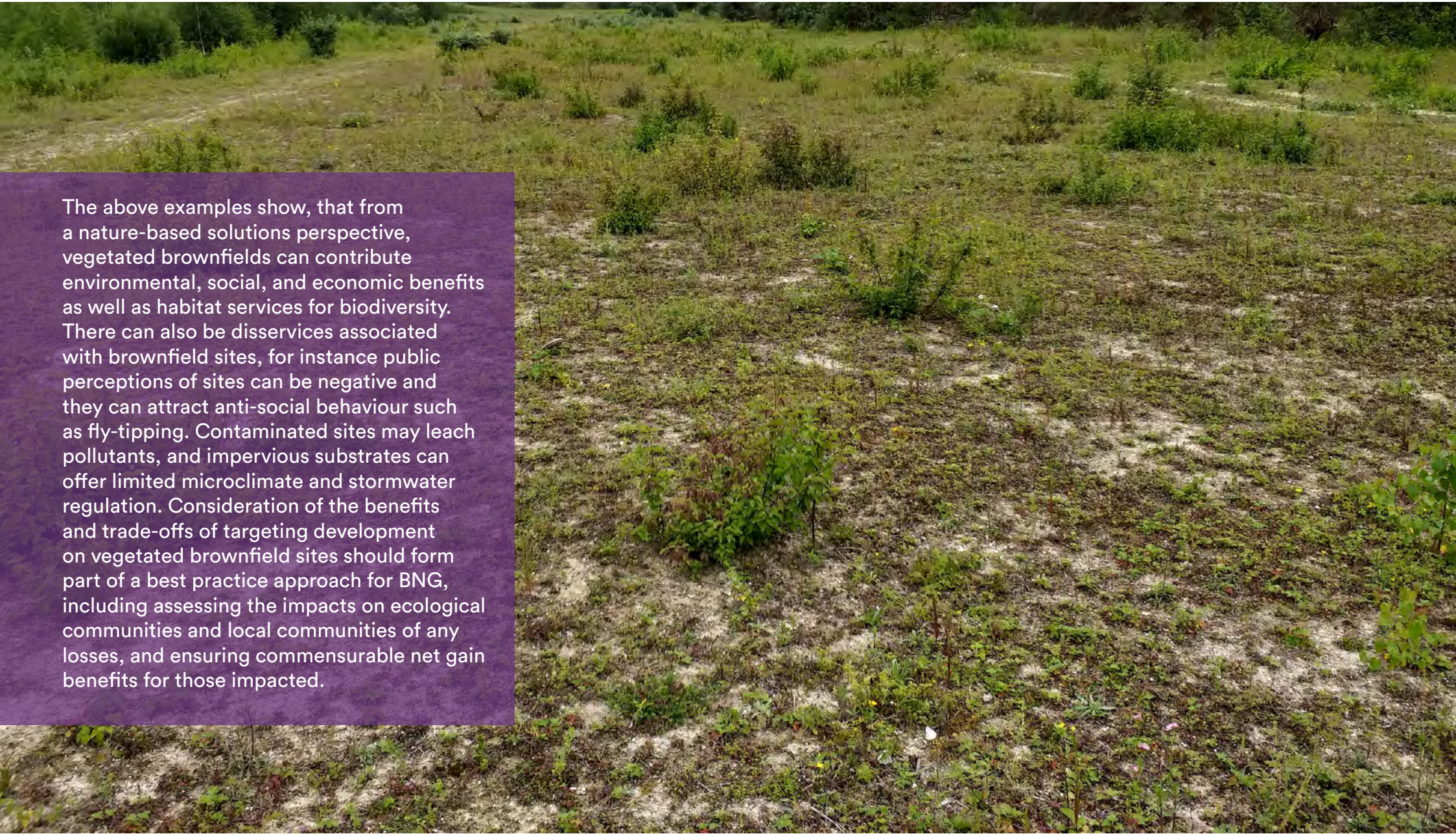
MULTIFUNCTIONAL BENEFITS/CO-BENEFITS OF BROWNFIELDS

Whilst there has been some examination of the biodiversity conservation value of brownfields, few studies have empirically examined the ecosystem services that brownfield sites could provide. However studies have suggested that vegetated urban brownfields could contribute to a city's green infrastructure and supply a range of ecosystem services aligned to nature-based solutions, in particular microclimate regulation and informal recreation space as well as habitat for wildlife [71, 72, 73]. The 'wild' or near-natural character has been cited as a positive aspect of brownfields [74].



A study of legacy mine sites in England and Wales highlighted their sociocultural resource value, including recreation for local populations, cultural and spiritual enrichment, education and research, and being economically important for industrial heritage tourism [75].

It has also been shown that brownfield soils can contribute to carbon sequestration [76]. Principally though, when brownfields are targeted for redevelopment, they are typically only surveyed for potential habitat services, i.e. the presence of priority habitats/ protected species, meaning highly vegetated or pervious brownfields providing regulating ecosystem services are likely being lost undetected [77].



The above examples show, that from a nature-based solutions perspective, vegetated brownfields can contribute environmental, social, and economic benefits as well as habitat services for biodiversity. There can also be disservices associated with brownfield sites, for instance public perceptions of sites can be negative and they can attract anti-social behaviour such as fly-tipping. Contaminated sites may leach pollutants, and impervious substrates can offer limited microclimate and stormwater regulation. Consideration of the benefits and trade-offs of targeting development on vegetated brownfield sites should form part of a best practice approach for BNG, including assessing the impacts on ecological communities and local communities of any losses, and ensuring commensurable net gain benefits for those impacted.

CANVEY WICK - BROWNFIELD NATURE RESERVE & PUBLIC GREENSPACE

Canvey Wick is a large post-industrial site in Essex. The site was developed to construct an oil refinery but the project was abandoned and the site left derelict. The site was highly modified, with altered hydrology and low nutrient conditions. It developed a complex mosaic of habitats, with bare ground, sandy banks, herb-rich grasslands, sallow carr and wetlands. After 40 years, scrub encroachment and a lack of disturbance meant open habitats were becoming threatened and these were key to the site's invertebrate interest - an outstanding assemblage of over 1,400 species including many rarities. Such was its invertebrate value, it became the first brownfield site to be designated a Site of Special Scientific Interest (SSSI). Part of the site has been managed in partnership by Buglife and the RSPB on behalf of the Land Trust as a nature reserve with public access, offering opportunities for public events and workshops for the community and specialist groups.

The site showcases how valuable brownfield sites can be for biodiversity and the potential for securing net gains for biodiversity through fine-scale habitat enhancements such as managing encroaching scrub. It also provides a template for delivering co-benefits through nature-sensitive public access and facilities that enable education and community engagement with brownfield landscapes. This provides opportunities for positive human-brownfield nature interactions that can encourage community acceptance and stewardship of these unique habitats.

This type of approach could be adopted by WMCA for OMH brownfield sites that have potential to become habitat banks. If suitably managed, they could also increase the provision of accessible greenspace for communities. The sites could be important 'core' site reservoirs of brownfield biodiversity, providing resource populations for any newly created OMH sites in the region.

- Former oil refinery site
- Supports 1,400 species of invertebrate including British rarities
- Plus reptiles, water voles, rare orchids and declining bird species
- Dubbed a brownfield 'rainforest' containing 'more biodiversity per square foot than any other site in the UK'

KEY LEARNING OUTCOMES

- Brownfield sites can vary considerably, from sites of recent origin covered with impervious artificial surfaces to long-standing disused sites that have been colonised by vegetation and have high ecological value. Sites can also provide multiple ecosystem services such as microclimate regulation, carbon sequestration and informal recreation space, representing key socio-cultural assets in urban landscapes
- Factors such as low-nutrient, varied substrates, complex topography, and sporadic disturbance can result in the development of highly diverse, flower-rich habitat mosaics that mimic natural habitats (e.g. heath, chalk grassland) that have declined in the wider landscape
- Vegetated brownfields can become important refuges for biodiversity, particularly rare and scarce invertebrates, and the value of the best examples of these biodiverse brownfield habitats has been recognised through designation as the Priority Habitat Open Mosaic Habitat on Previously Developed Land (OMH)
- The main qualifying criteria for OMH sites include an open mosaic of early successional habitats >0.25 ha on developed land, but some of the best sites also include patches of later successional scrub and woodland, and smaller sites below <0.25 ha threshold can have local biodiversity value and provide functional habitat assemblages
- Sites with a brownfield history in the WMCA region have become important for invertebrates, including Pelsall Common, now a valuable nature reserve and a Site of Importance for Nature Conservation (SINC)
- Vegetated urban brownfields can contribute to a city's green infrastructure and supply a range of ecosystem services aligned to nature-based solutions, for example microclimate regulation, informal recreation space and industrial heritage tourism, as well as habitat services for wildlife
- The pressure to redevelop brownfield land and difficulties with appropriate classification of OMH due to the high variability amongst sites has seen widespread losses and inadequate replacement habitat, imperilling OMH communities and with no account taken of the ecosystem services the sites can provide
- BNG best practice will need to consider the benefits and trade-offs of targeting vegetated brownfields for development, to ensure commensurable net gain benefits for the ecological and human communities that may be impacted

3 Local Context - WMCA History, Brownfields & OMH in the Region

SECTION SUMMARY

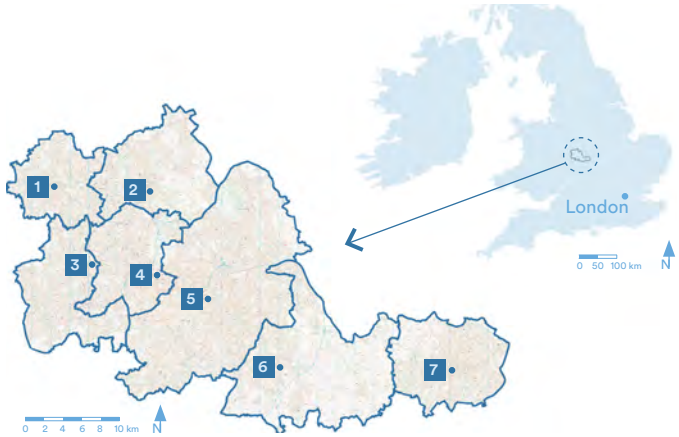
- Background on the WMCA, its industrial history and the legacy of post-industrial brownfields in the region
- A synthesis of data and literature related to brownfields and OMH in the WMCA region
- A summary of findings from local stakeholder engagement regarding OMH and brownfield resources/character in the WMCA region

WMCA – CONTEXT AND INDUSTRIAL HISTORY

The WMCA is made up of 17 local councils with varied degrees of power and involvement in WMCA's decisions.

There are seven Constituent Councils of the WMCA that have full voting rights on WMCA decisions: Birmingham City Council, Coventry City Council, Dudley Metropolitan Borough Council, Sandwell Metropolitan Borough Council, Solihull Borough Council, Walsall Council and City of Wolverhampton Council (Figure 4).

Central government gives combined authorities the money and power to make decisions for their regions (devolution). Since its establishment, the WMCA has set out plans to grow the region. A priority has been identifying land for new homes and employment, with an objective to continue to lead the way in the UK in redeveloping brownfield land across the region for housing, having already brought hundreds of acres of brownfield land back into use, after decades of being unused. As part of the devolution deal provided by central government, and in recognition of WMCA's success in brownfield regeneration and housing delivery, the WMCA has been awarded a large pot of funding for delivery of high-quality brownfield regeneration projects, to support commercial, employment land and mixed-use development, as well as delivering 4,000 homes.



1 Wolverhampton
2 Walsall
3 Dudley
4 Sandwell
5 Birmingham
6 Solihull
7 Coventry

Figure 4. Map of the seven Constituent Councils of WMCA

WMCA INDUSTRIAL HISTORY

The West Midland region has a long history of industry and manufacturing, largely due to its important underlying geology.

The region is situated on and dominated by exposed coalfield, as well as other rich mineral deposits such as limestones, sandstones, and clays; the geology determined its industrial development and heritage. Mining has taken place in the region since the Middle Ages, contributing to the industrial and economic development of the area and earning it the 'Black Country' name, both for the colour of the coal seams and the air pollution from the foundries and factories that rapidly developed in the area during the industrial revolution.

Black Country UNESCO Global Geopark

The area became one of the most important industrial regions in the country and by the end of the second world war, was at the forefront of the government's plans for the recovery of the economy, by manufacturing products for export. The region's industries diversified to mass production as well as producing bricks, steel, and iron for post-war building and regeneration. Post-war regeneration saw the landscape change from small, scattered communities to the expansion of towns, with increasing urbanisation alongside industry. After its era of prosperity and development, many of the industries and businesses in the area closed down, and the region experienced a tremendous level of deindustrialisation during the late 1970s and into the 80s. The legacy of the industrial period and subsequent deindustrialisation has resulted in concentrations of derelict, post-industrial land in the area.

WEST MIDLANDS BROWNFIELD SITES

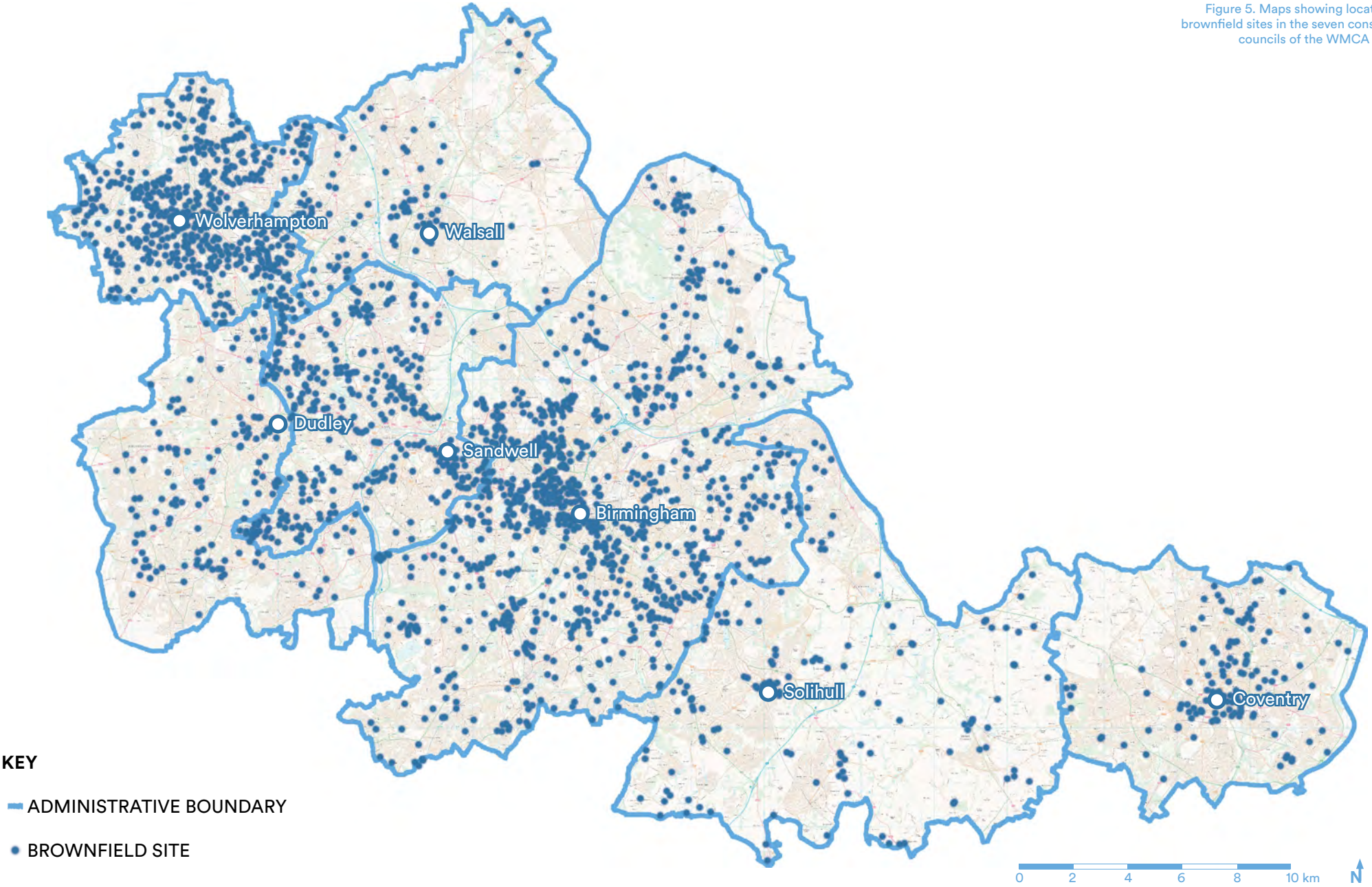
Whilst in recent times the amount of vacant and derelict brownfield land in the West Midlands has fallen, the remaining resource represents a significant regeneration opportunity.

The following maps show the current brownfield site resource within the WMCA seven constituent councils, taken from the national brownfield land dataset [78], held on the UK Government website (Figure 5).

The maps show there is an uneven distribution of brownfield sites within the WMCA region, with the highest concentrations in Wolverhampton and Birmingham, and much lower and scattered distribution in Councils such as Dudley and Solihull. Whilst these datasets should be based on relatively recent and accurate brownfield inventories that Local Authorities in England are required to submit annually, there may be discrepancies as new sites are created and existing sites are lost to development. This data should therefore be considered indicative. Nonetheless, it suggests a considerable brownfield resource exists in the WMCA region.

The brownfield dataset should only include sites that Local Authorities consider appropriate for residential development, in accordance with regulation 4 of the Town and Country Planning (Brownfield Land Register) Regulations 2017. The legislation states that brownfield sites should not be included if development would cause any adverse impact on the natural environment, however the criteria for determining an 'adverse impact' have not been clearly defined. Therefore, it is possible this register includes brownfield sites that contain vegetation that could potentially be of value to biodiversity or providing ecosystem services in addition to habitat value. These functions could be lost as these sites are prioritised for regeneration.

Figure 5. Maps showing locations of brownfield sites in the seven constituent councils of the WMCA region.



To reduce pressure on greenfield sites and limit urban sprawl, many national, regional and local policies in the UK have targeted urban brownfields for housing and regeneration as an opportunity for sustainable development. Two potential trade-offs to this approach that have been identified are [77]:

- This can lead to high-density development and its associated risks such as reduced opportunities for greenspaces in cities where people live and work;
- Some brownfield sites may be vegetated and therefore provide greenspace and ecosystem services, such as important habitat for wildlife or informal (uncurated) recreational space for local communities.

A study of Greater Manchester found over half (51.25%) of brownfield land was vegetated and pervious, comprising 27% trees and shrubs, 24% grass and herbaceous vegetation, 6% bare earth, 1% water [77]. This highlights the potential for brownfields to contribute to urban green infrastructure and biodiversity conservation and potentially provide many important ecosystem services. It also indicates that there could be potential for brownfield sites in the West Midlands region to support habitats of value for biodiversity. This generates a challenge of reconciling obligations, for biodiversity conservation, commitments to house building and infrastructure development on brownfield sites, and the requirement for delivery of mandatory BNG.

OMH IN THE WMCA REGION - NATIONAL OMH INVENTORY

A starting point for determining the status of OMH in the WMCA region was analysing the national OMH inventory [77]. This resource was developed to separate OMH from the national register of brownfield sites, in an effort to reduce the likelihood of further losses of brownfield sites that contain OMH to development. Much of the work generating this dataset relied on interpreting aerial photography to determine whether OMH was likely to be present, and sites were annotated to note the degree of uncertainty that OMH would be present [68]. For sites that could potentially contain OMH, the feature was replaced with an accurately mapped boundary, the data digitised in GIS and a polygon added to the OMH inventory.

This GIS layer provides supporting information that includes qualifiers related to the reliability of the priority habitat interpretation and for some sites, some detail on the site history and potential characteristics. It should be noted that for many sites, the qualifying data stated that the probability that the site contained OMH priority habitat was low, meaning many of the polygons shown on the map should be interpreted with a high degree of caution, until the data can be verified, which would ideally require a ground-truthing survey exercise. Additionally, much of the data provided for the inventory is now outdated, having been originally created over 14 years ago in 2010, with revision in 2017. Given these timeframes, sites included in the inventory may a) have been lost to development or any OMH present may have transitioned through succession to other habitats, or b) it may not include more recent brownfield sites whose habitats may have developed into OMH (or were in development) when the inventory was created.

Nonetheless, this resource was interrogated to understand the potential extent of brownfield sites with OMH in the WMCA region and to begin to categorise and characterise brownfield sites with OMH in the area. This data was then used to determine if there are types of habitats 'typical' to these sites to understand the local brownfield ecological context and what may be required for BNG to be achieved.

The inventory indicated that a number of potential OMH brownfield sites occur in the WMCA region (Figure 6). These were particularly concentrated around Birmingham and Wolverhampton. A summary of the total number of OMH sites in each constituent council are provided below, along with a breakdown of size categories to give an indication of the extent of the resource in each area (Table 3). OMH sites covered a range of size classes, including a fairly low number of larger sites >10 ha in extent, with the majority below 5 ha. Walsall had the highest number of large OMH sites, the largest being 34.2 ha in extent.

Examining the supporting data for a selection of the OMH polygons revealed most had very limited data to verify the industrial history or potential habitat character of the sites. For a small number of sites where some data was provided, the most common historic uses were disused mineral workings and historic landfill. For disused mineral workings, additional habitat data indicated substrates or geology, and for the few sites where data was provided, this included coal, limestone, clay, shale, sand and gravel.

CONSTITUENT COUNCIL	TOTAL SITES	TOTAL SITES <1.0 HA	TOTAL SITES 1.0 - 5.0 HA	TOTAL SITES 0.5 - 10 HA	TOTAL SITES >10 HA
BIRMINGHAM	61	36	19	2	4
COVENTRY	15	5	7	2	1
DUDLEY	23	6	12	2	3
SANDWELL	49	29	12	6	2
SOLIHULL	2	0	2	0	0
WALSALL	86	35	32	7	12
WOLVERHAMPTON	34	15	14	4	1
TOTALS	270	126	98	23	23

Table 3. Summary of the number of OMH sites and their size range in each constituent council in the WMCA.

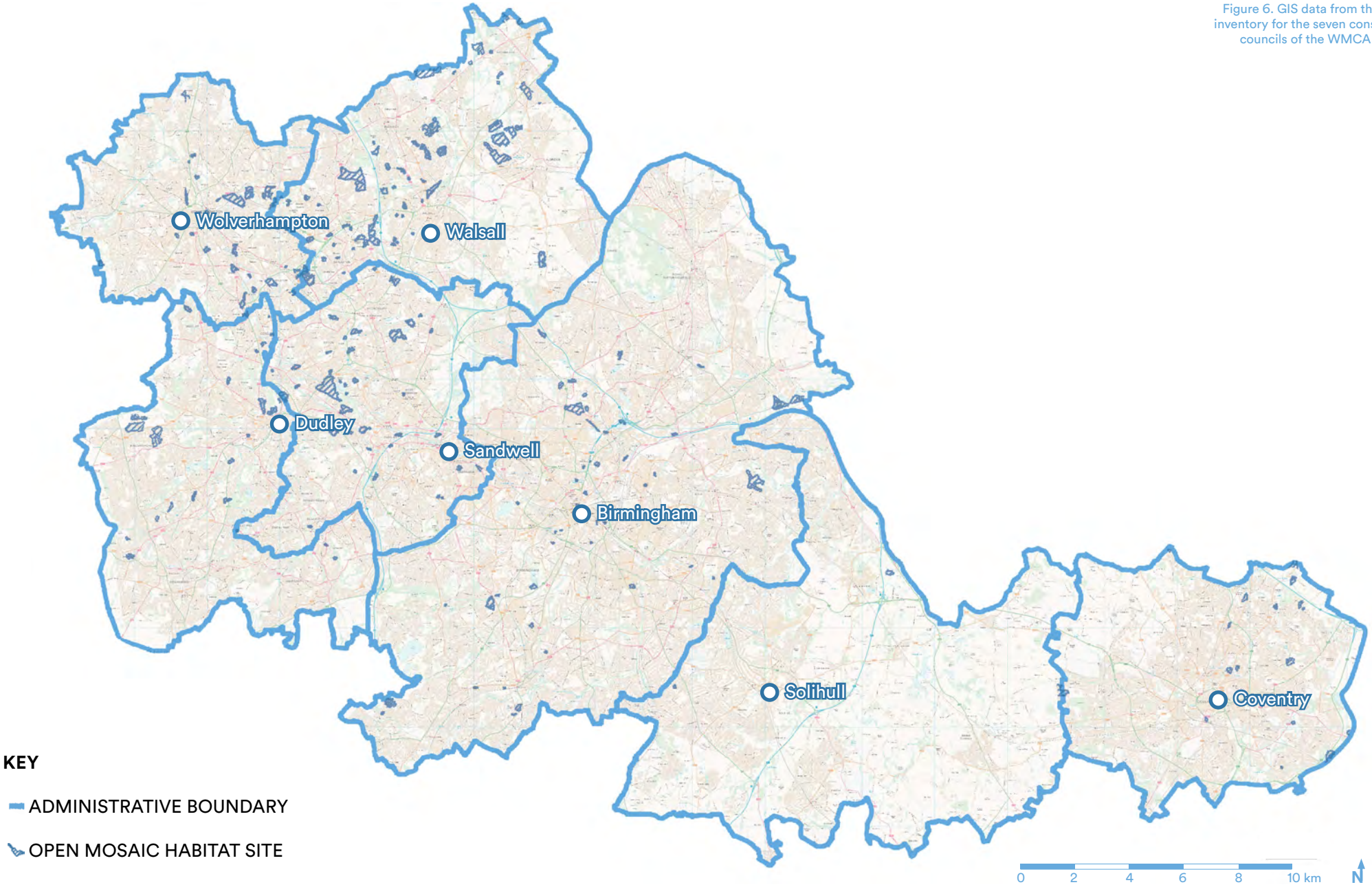


Figure 6. GIS data from the OMH inventory for the seven constituent councils of the WMCA region.

LOCAL BIODIVERSITY ACTION PLAN FOR OMH

Local Biodiversity Action Plans (LBAP) identify local priorities for protecting and enhancing biodiversity and set out a strategy to achieve agreed actions and targets.

There are two key LBAPs in the WMCA region, the Warwickshire, Coventry and Solihull (WCS) LBAP, and Birmingham and Black Country (BBC) LBAP. The WCS LBAP includes a habitat action plan for OMH (updated in 2021) that indicates some large and ecologically diverse post-industrial sites still exist in the region, but many only have fragments of 'quality' habitat – presumably OMH.

The best sites have been designated as SSSIs, or Local Nature Reserves (LNR)/ Local Wildlife Sites (LWS), although several of the latter have been lost to development. Nonetheless, several disused railways have been designated as LWSs in more recent times due to the presence of OMH, and these seem to be a significant resource within the region (approximately 350 km of disused railway line in the subregion). Characteristic habitats include species-rich grassland and scrub mosaics.

In addition to losses of OMH sites to development, lack of appropriate management was also cited in the LBAP as a factor affecting losses of OMH in the region, with substantial encroachment of scrub and/or succession to secondary woodland reducing the value of OMH sites. Nonetheless, the LBAP states that OMH in the Midlands are some of the best sites for invertebrates, with nearly 15% of all nationally scarce species recorded within this priority habitat and many nationally rare species present. The LBAP also highlights the value of small, temporary sites, that can be created, for instance, during phased developments, but do not qualify as OMH. These can contribute by providing stepping-stones for connectivity and boosting biodiversity in urbanised areas. New transport schemes are cited as a future opportunity for increasing the OMH resource in the region.

The BBC LBAP includes OMH as a priority habitat and states that considerable knowledge has been gained on the ecology of OMH in area, citing rich wasteland habitats occurring in the east side of Birmingham city centre. It also suggests that a basic inventory of OMH sites produced by one local authority was often difficult to define, with the transitory nature of OMH proving difficult to survey comprehensively, meaning its total extent was unknown. The LBAP does not provide much detail on OMH in the area, but states the habitat is concentrated within former industrial areas, and that the open nature of the OMH vegetation and its long flowering period makes these sites important for invertebrates and bird species. In particular for black redstart, which is designated a Local Priority Species in the BAP, and is strongly associated with brownfields and OMH. Targets in the LBAP covering 2010 to 2026 seek to maintain the extent of OMH, and proposes restoration of the habitat by 2026. This could have strategic significance for BNG in the region.

In the future, regional level plans for nature recovery will be provided by the West Midlands Local Nature Recovery Strategy (LNRS), which is currently under development and will identify the most valuable existing areas for nature in the region and identify opportunities to create and improve habitat for nature and wider environmental goals [80]. Given its high ecological value, any OMH resource in the region that could be protected or improved should be identified within the LNRS process to secure its strategic significance as part of BNG.

LOCAL STAKEHOLDER CONSULTATION

To further establish the local context for brownfields and OMH in the WMCA region, a selection of key stakeholders were consulted to request local knowledge and information on the types/extent of habitats that occur on post-industrial sites in the area, and to understand if there are characteristic OMH sites typical to the region.

The following sections summarise information gathered for the consultation exercise.

The following information was provided by a researcher (Aaron Bhambra, pers. comm., 2023) based at the University of Birmingham, studying pollinator assemblages on heathlands in the West Midlands region (Table 4).

RUDERAL SITES (WITH HIGH DENSITIES OF YELLOW COMPOSITES)	**Inner city post-industrial sites** – may not qualify as OMH but have biodiversity value (e.g. old, abandoned factories)
SPECIES-RICH GRASSLAND/ SCRUB/POOLS	**Disused railway lines** – variable quality (e.g. Ashlawn & Goldicote Cuttings)
HEATHLAND & ACID GRASSLAND MOSAICS	**Sand & gravel extraction/mining sites** – mostly in Walsall (e.g. Brownhills Common, Saltwells NNR)
CALCAREOUS GRASSLANDS	**Limestone quarries/pits** – mostly in Walsall & Dudley (e.g. Park Lime Pits, Saltwells NNR)
WETLANDS	**Flooded quarry sites** – Walsall, Dudley & Sandwell (e.g. RSPB Sandwell Valley, Fens Pool)
EARLY SUCCESSIONAL WOODLAND	**Natural succession over old brownfields** (e.g. Moorcroft Wood)

Table 4. Summary of results from local stakeholder consultation on local brownfield/OMH characterisitcs in the WMCA region (a. Bhambra, pers.comm, 2023).

Post-industrial sand and gravel extraction and coal mining activities have resulted in heathland mosaics sites being characteristic on brownfields in the area. These sites are a target of the Natural England funded Nature Recovery Project 'Purple Horizons', restoring fragmented nationally and internationally-important heathlands to create a mosaic of heathland-wetland-woodland-grassland, vital for the recovery and long-term resilience of the area's reptiles, birds and pollinators. Similarly, disused (and active) limestone pits and quarries have exposed calcium-rich sediments that support the development of calcareous grassland mosaics.

Consultees in Coventry advised that much of the OMH resource in the area has been lost due to natural successional processes, with many of the old mine workings that supported the habitat now covered with secondary woodland. This finding did not correlate with the information recorded in the OMH inventory datatset for Coventry summarised above, confirming that there are disparities between that dataset and the current situation on the ground. One site, Hawkesbury Junction, an old pit site that was designated as OMH (and included in the OMH national inventory) was highlighted as a target area for management to recreate OMH.

Consultees identified that the Coventry area contains many green roofs with OMH type habitats, representing a potential supporting/stepping-stone habitat resource for OMH communities. Of significance in this area (and as highlighted in the WCS LBAP), consultees identified naturally 'rewilded' areas of numerous brownfield sites in the Coventry region as an important biodiversity resource. These sites have OMH qualities, but most would be too small to qualify as Priority Habitat and these types of brownfields are a priority for development in the region. Also of importance, consultees suggested that pilot projects trialling existing Metrics (Biodiversity Metric and small site metric discussed further below) for measuring BNG have not performed well in terms of capturing the biodiversity value of these pockets of habitat. Instead Natural England's Green Infrastructure Framework [81] was found to be more effective for capturing biodiversity value in the urban context.

The results of this local context review indicated that brownfield urban sites across the WMCA region are under great pressure from development but also represent a significant opportunity for conserving and restoring biodiversity and delivering ecosystem services for local communities. This situation highlights the importance of understanding how biodiversity net gain can be most effectively applied in different development contexts and the need for appropriate tailored guidance and carefully drafted local planning policies and strategies to support local authority planners, developers, landscape architects, and ecologists to navigate towards delivery of effective biodiversity net gain in the brownfield development context.

KEY LEARNING OUTCOMES

- WMCA comprises 7 constituent councils that have devolved powers and funding to grow the region, including prioritising land for new homes and employment
- The WMCA region's history as a leading industrial region in the UK was largely due to the underlying geology e.g. coal, limestone, sandstone, meaning the region was once characterised by mining, quarries, factories and foundries
- Deindustrialisation in more recent times has left a legacy of derelict, post-industrial (brownfield) land in the area that is earmarked for new development, funded by the devolution deal
- The national brownfield inventory data indicated a considerable brownfield site resource still exists in the region but distribution varies across the seven councils
- OMH sites exist in the WMCA region, but the accuracy and reliability of data from sources such as the OMH inventory was found to be low
- Examples of characteristic OMH 'types' in the region include heathland mosaics on disused coal and sand extraction sites, calcareous grassland mosaics on limestone quarries, wetland mosaics on flooded quarries and species-rich grassland mosaics on disused railway lines
- Local stakeholder consultation suggested that some OMH sites have been lost to development or natural successional processes, but fragments of OMH do occur, especially small sites under the OMH size threshold
- The local context review indicated that locally tailored guidance as well as targeted planning policies/strategies could be key for delivering effective BNG on urban brownfields in the WMCA region and more widely

4 Policy Context – National & Local Policy/ Strategy for Brownfield Planning & BNG

SECTION SUMMARY

- Summary of key policies and strategies at the national and local level related to planning and nature conservation that link to brownfields, OMH and biodiversity net gain

- Any potential conflicts or opportunities between planning and nature conservation/BNG strategies

POLICY CONTEXT FOR BNG AND BROWNFIELDS

Urban habitats, particularly those on brownfield sites, have conflicting priorities in local and national planning policy and nature conservation legislation. A review of key policies, legislation and strategies related to planning and nature conservation, including BNG, is provided in Appendix 1.

National policy example

Examples identified in the review include the National Planning Policy Framework [82], that includes sections on:

- "...planning policies and decisions should contribute and enhance the natural and local environment by... minimising impacts on and **providing net gains for biodiversity**, including by establishing coherent ecological networks that are more resilient to current and future pressures" (para 180d);
- "To protect and enhance biodiversity and geodiversity, plans should... identify and pursue opportunities for securing **measurable net gains for biodiversity**" (para 185b).

Whilst also requiring:

- "Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land" (para 123);
- "Planning policies and decisions should... give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land" (para 124c).

With previous sections in this report highlighting that there has been widespread loss of brownfield sites that had significant biodiversity value, there is potential for this situation to continue if the ecological value of brownfield habitats are not appropriately evaluated. There is also pressure to deliver development nationally, particularly to increase residential development to meet housing targets. This can lead to trade-offs to biodiversity.

In January 2023, the government's Department for Levelling Up, Housing and Communities (DLUHC) announced £60 million would be made available for councils through the Brownfield Land Release Fund 2, to prioritise brownfield land for new housing, with an expected 5,800 new homes to be delivered by March 2027. WMCA have previously been successfully awarded brownfield land release funding for housing.

WMCA BROWNFIELD & BNG STRATEGY

As such, for the WMCA, key objectives where contrasting priorities for brownfield sites and nature positive targets occur include:

- Using derelict land to build homes
- Protecting our greenspaces

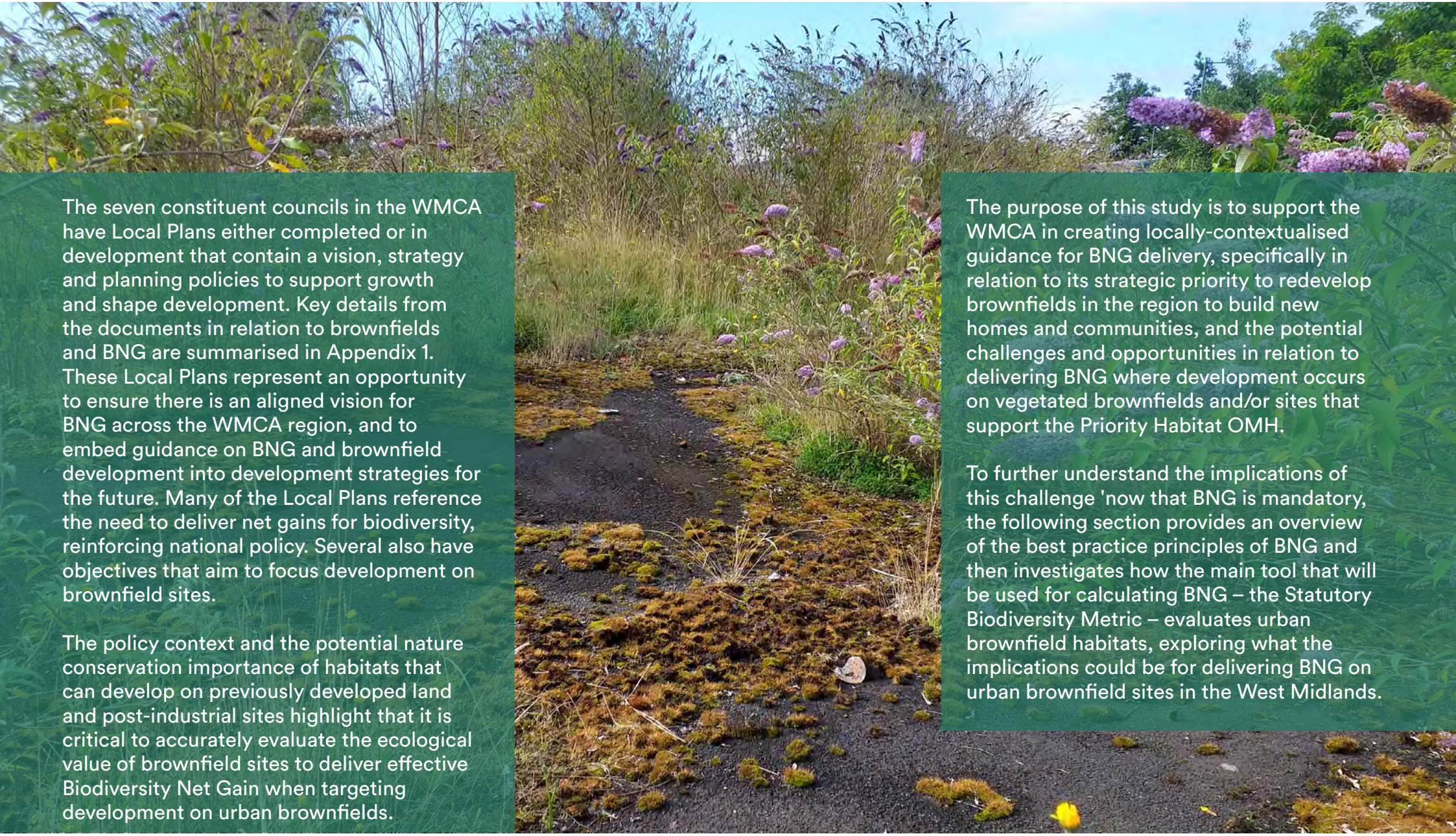
A priority for the WMCA is to identify land for new homes and employment, with an objective to continue to **lead the way in the UK in redeveloping brownfield land across the region**, having already brought hundreds of acres of brownfield land back into use, after decades of being unused.

The WMCA Trailblazer Deeper Devolution Deal agreed between the government and WMCA is a landmark housing deal worth up to £500 million, offering greater flexibility to drive brownfield regeneration and unique powers and funding to deliver affordable housing at pace, including:

- Pioneering new approaches to brownfield development and zero carbon homes. This deal will support WMCA's continuing development of brownfield land and the building of new homes, and the government will devolve £100 million brownfield funding to WMCA to drive placemaking, housing and urban regeneration across the region. This will be deployed within this spending review period, supporting WMCA to deliver 4,000 homes.

At the same time, the WMCA Environment Plan 2021-2026 sets out actions to:

- Explore ways to ensure **biodiversity net gain** across new transport infrastructure and other developments funded by the WMCA
- Develop regional natural capital data capture and mapping to better understand the state of the region's nature and prepare the foundations for a Local Nature Recovery Strategy.



The seven constituent councils in the WMCA have Local Plans either completed or in development that contain a vision, strategy and planning policies to support growth and shape development. Key details from the documents in relation to brownfields and BNG are summarised in Appendix 1. These Local Plans represent an opportunity to ensure there is an aligned vision for BNG across the WMCA region, and to embed guidance on BNG and brownfield development into development strategies for the future. Many of the Local Plans reference the need to deliver net gains for biodiversity, reinforcing national policy. Several also have objectives that aim to focus development on brownfield sites.

The policy context and the potential nature conservation importance of habitats that can develop on previously developed land and post-industrial sites highlight that it is critical to accurately evaluate the ecological value of brownfield sites to deliver effective Biodiversity Net Gain when targeting development on urban brownfields.

The purpose of this study is to support the WMCA in creating locally-contextualised guidance for BNG delivery, specifically in relation to its strategic priority to redevelop brownfields in the region to build new homes and communities, and the potential challenges and opportunities in relation to delivering BNG where development occurs on vegetated brownfields and/or sites that support the Priority Habitat OMH.

To further understand the implications of this challenge 'now that BNG is mandatory, the following section provides an overview of the best practice principles of BNG and then investigates how the main tool that will be used for calculating BNG – the Statutory Biodiversity Metric – evaluates urban brownfield habitats, exploring what the implications could be for delivering BNG on urban brownfield sites in the West Midlands.

KEY LEARNING OUTCOMES

- The national and local policy context can lead to conflicting priorities for development and nature conservation
- National and local policy/strategy prioritises development on brownfield sites, but their ecological value can be inappropriately evaluated
- This can lead to habitat loss without due consideration for biodiversity or requirements for appropriate habitat compensation
- This will have greater strategic significance now that Biodiversity Net Gain has become mandatory
- This locally-contextualised BNG guidance being developed for the WMCA aims to support developers as they navigate BNG requirements and planning targets when redeveloping brownfield sites

5 BNG & Brownfields – BNG Best Practice, the Statutory Biodiversity Metric & Brownfield Habitat Calculations

SECTION SUMMARY

- An overview of Biodiversity Net Gain best practice guidance and a summary of steps and principles of good practice for BNG design and delivery
- A summary of the Statutory Biodiversity Metric, a tool for calculating BNG
- A brief overview of the Small Site Metric and BNG exemptions
- The use of the UKHab habitat classification for BNG habitat classification, including details on OMH in UKHab
- A brief examination of how the Biodiversity Metric evaluates OMH and exploration of the implications of categorisation of urban brownfield habitats
- A summary analysis of potential opportunities and barriers related to OMH, BNG and the Statutory Biodiversity Metric

BIODIVERSITY NET GAIN (BNG)

The UK Government's Environmental Improvement Plan set out its commitment to improving the environment, including mainstreaming biodiversity net gain approaches within the planning system.

Section 1 of this report introduced BNG as an approach to development and land management that aims to ensure measurable improvements for biodiversity through the development process. BNG is needed to tackle ongoing biodiversity declines, which have not been adequately addressed by existing approaches to assisting nature recovery. As discussed in Section 1, biodiversity underpins so many of the ecosystem services that support the health and functioning of the planet and people. We need mechanisms such as BNG to ensure that biodiversity is appropriately valued in decision-making, to protect the natural environment from further degradation and to achieve truly sustainable development. Properly planned BNG can facilitate this process, delivering benefits for nature, people, places and the economy, and offering a strategy for development to support nature conservation, nature-based solutions, climate change adaptation and levelling-up access to greenspace for communities [83].

The Environment Act, 2021, (S.98) introduced a mandatory requirement for BNG to be provided as a part of most development, and this became a condition of planning permission in England in February 2024. The Biodiversity Net Gain Regulations form part of the Environment Act (see Appendix for more detail). They set out that development has to deliver a minimum of 10% biodiversity net gain (inserted as Section 90A and Schedule 7A of the Town and Country Planning Act, 1990, and under the Planning Act, 2008 for Nationally Significant Infrastructure Projects (NSIPs) – with a delayed start for mandatory BNG for NSIPS to November 2025). Exemptions from BNG are detailed detailed in the following BNG Metric section. There will be a requirement that biodiversity gain sites must be secured for a minimum of 30 years (to be reviewed no sooner than 2026) through landscape management plans and conservation covenants.

BNG is in addition to other existing species and habitat protections (for example the Conservation of Habitats & Species Regulations, 2017; the Wildlife & Countryside Act, 1981 (as amended); the Natural Environment & Rural Communities Act, 2006) and is meant to reinforce and complement the mitigation hierarchy. Therefore, any activities required to mitigate or compensate for protected species impacts should be calculated separately and in addition to the mandatory 10% BNG requirement. BNG is also in addition to the mitigation hierarchy requirements to avoid, mitigate, or compensate for biodiversity losses from development, and evidence on actions undertaken to apply the mitigation hierarchy will be a requirement for demonstrating that good practice principles were followed during the BNG process.

The planning enforcement regime will be the principal mechanism for enforcing BNG delivery, and government guidance to support local planning authorities, developers and land managers has been provided by Defra online [84, 85]. In addition to BNG, the Environment Act 2021 requires the creation of Local Nature Recovery Strategies (LNRS), that will:

- agree priorities for nature recovery,
- map the most valuable existing areas for nature
- map specific proposals for creating or improving habitat for nature and wider environnmental goals.

LNRS can help target BNG delivery to where it will bring greatest benefit, as well as strengthening the duty of local authorities to conserve/enhance biodiversity, and to support delivery of nature-based solutions to manage wider environmental problems like flooding. Offsite BNG units generated in locations proposed within LNRSs will be incentivised through the BNG Metric to encourage developers to focus on these places where the benefit will be greatest.

BNG can be delivered on-site, off-site, or as a combination of both. The approach utilises a spatial hierarchy to incentivise onsite or local delivery as the first and best option (and that this approach should be embedded in local planning policy). Where onsite gains cannot be achieved, local offsite net gain should be pursued, either through bespoke sites secured by the developer or ideally through localised habitat compensation schemes/strategic sites in the local authority's area or within the same National Character Area (NCA). As an option of last resort, where onsite and local offsite gains cannot be achieved, there is an option to purchase 'statutory biodiversity credits' from a government led scheme that will fund landscape-scale projects across the country. Mandatory BNG is a mechanism for delivering nature positive outcomes by disincentivising schemes that could harm biodiversity. Habitat banks for trading biodiversity units to developers who cannot meet the net gain requirements locally have been promoted as an opportunity for private sector investment in nature regeneration, including funding LNRSs for LPAs [86].

BEST PRACTICE PRINCIPLES & GUIDANCE

Table 5 summarises key steps and principles from the guidance and Table 6 details a selection of the key best practice guidance and resources on BNG.

BNG in an LPA can best be achieved where there are clear, measurable objectives for developers to follow, for instance through local plan policies that guide developers to deliver BNG in accordance with local biodiversity needs and priorities. The purpose of this study is to support the WMCA in developing locally-contextualised BNG guidance for key stakeholders involved in redeveloping brownfield sites, so their biodiversity value can be appropriately assessed, and to outline potential challenges and opportunities for BNG delivery using the standard metric approach.

KEY STEPS & PRINCIPLES FROM BNG GOOD PRACTICE GUIDANCE	
1	Apply the mitigation hierarchy
2	Clarify measures that avoid, mitigate or compensate
3	Define and calculate/qualify the baseline scenario
4	Define and calculate/qualify the predicted outcomes (e.g. net gain plus link to local and strategic priorities)
5	Show that designs deliver at least ecological equivalence in functionality as well as net gain in biodiversity units
6	Optimise locations to keep gain local and aligned to strategic biodiversity priorities and landscape context (e.g. Local Plan, BAP targets)
7	Ensure commensurable net gain benefits for those communities/stakeholders impacted by any losses
8	Demonstrate additionality – the positive impacts in addition to business as usual
9	Avoid/minimise risks – time lags in biodiversity loss/gain and risks to achieving BNG
10	Measure and calculate BNG using a consistent method (e.g. the Statutory Biodiversity Metric) and supporting evidence (i.e. qualitative assessment)
11	Provide a long-term BNG habitat management & monitoring plan (HMMP) (e.g. timescales, monitoring/management activities, safeguarding mechanisms, finance, etc.)
12	Create accessible outputs to support all stages of BNG delivery (e.g. BNG HMMP)

Table 5. Key steps & principles from BNG good practice guidance

KEY BEST PRACTICE GUIDANCE/RESOURCES

BIODIVERSITY NET GAIN COLLECTION
- Government guidance on BNG (Defra)

STATUTORY BIODIVERSITY TOOLS AND GUIDES
- Tools and guides for measuring the biodiversity value of habitat for BNG (Defra)

BNG GOOD PRACTICE PRINCIPLES FOR DEVELOPMENT
- 10 main principles for BNG [CIEEM, CIRIA and IEMA (2016)]

BS 8683:2021 PROCESS FOR DESIGNING AND IMPLEMENTING BNG - SPECIFICATION
- Builds on the above guidance by defining the process for achieving BNG [British Standards Institute (BSI) 2021]

BSI LITTLE BOOK OF BNG
- Sets out BNG headlines and how BS 8683 supports delivery [Baker, Butterworth & Treweek (2023)]

BNG GOOD PRACTICE PRINCIPLES. A PRACTICAL GUIDE
- Builds on the principles, providing guidance on 'what good looks like' and checklists to support the achievement of BNG as well as case study examples of good practice [Baker, Hoskin & Butterworth (2019)]

DELIVERING BNG IN GREATER MANCHESTER
- Online guidance resources on BNG and case studies on lessons learned from retrospectively applying metric calculations to development schemes in the region [Greater Manchester Combined Authority (GMCA)]

BNG POLICY BRIEFING
- Outlines how landscape professionals can best implement BNG [The Landscape Institute (2022)]

ENSURING NO NET LOSS FOR PEOPLE AS WELL AS BIODIVERSITY: GOOD PRACTICE PRINCIPLES
- Guidance for assessment of the social impacts of BNG measures [Bull et al, (2018 for International Union for Conservation of Nature (IUCN))]

Table 6. Key best practice guidance and resources on BNG

THE STATUTORY BIODIVERSITY METRIC

The Statutory Biodiversity Metric has been developed by Natural England and Defra as an accounting tool for calculating biodiversity net gain. The tool has been designed to support ecologists, developers, local authorities, and other key stakeholders measure and forecast biodiversity losses and gains.

The metric uses habitats as a proxy measure for biodiversity and scores habitats based on their relative biodiversity value. The tool calculates biodiversity losses and gains for developments by calculating a score for baseline (pre-development) and post-development 'biodiversity units', based on pre-determined criteria in the metric summarised on the right.

KEY INFORMATION FOR BNG METRIC BASELINE BIODIVERSITY UNIT CALCULATION

DISTINCTIVENESS

Based on the type of habitat and its distinguishing features such as suitability to support protected and important species.

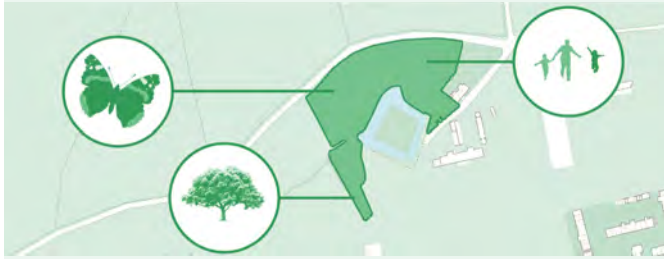
AREA (OF HABITAT)

Hectares (or squared metres in the small sites metric) or length (kilometres, or metres in the small sites metric).

CONDITION

A measure of the state of a habitat (e.g. good, moderate, poor).

STRATEGIC SIGNIFICANCE



A measure of the local significance of a habitat/its importance in local plan, LNRS, strategy or policy.

The post-development calculation uses the above measures, and includes two additional risk factors.

RISK FACTOR MULTIPLIERS FOR POST-DEVELOPMENT CALCULATION

TEMPORAL RISK

A measure of the time taken for a created or enhanced habitat to reach target condition (e.g. good, moderate, poor).

DELIVERY RISK

A measure of the technical difficulty in creating or enhancing habitat.

A further additional risk factor must be calculated for any habitat interventions that occur off-site.

RISK FACTOR MULTIPLIER FOR OFF-SITE POST-DEVELOPMENT HABITAT

SPATIAL RISK

Distance of habitat creation or enhancement from the development or location of land use change – this incentivises delivery close to the development impact.

The risk multipliers reduce the biodiversity unit value of post-development units so that a hectare of newly created habitat would not deliver the equivalent number of biodiversity units as a retained hectare of the same habitat in the same condition, adding contingency for time-lags and technical uncertainties. The metric tool calculates the change in biodiversity units from the baseline to post-development to indicate whether a net gain has been achieved.

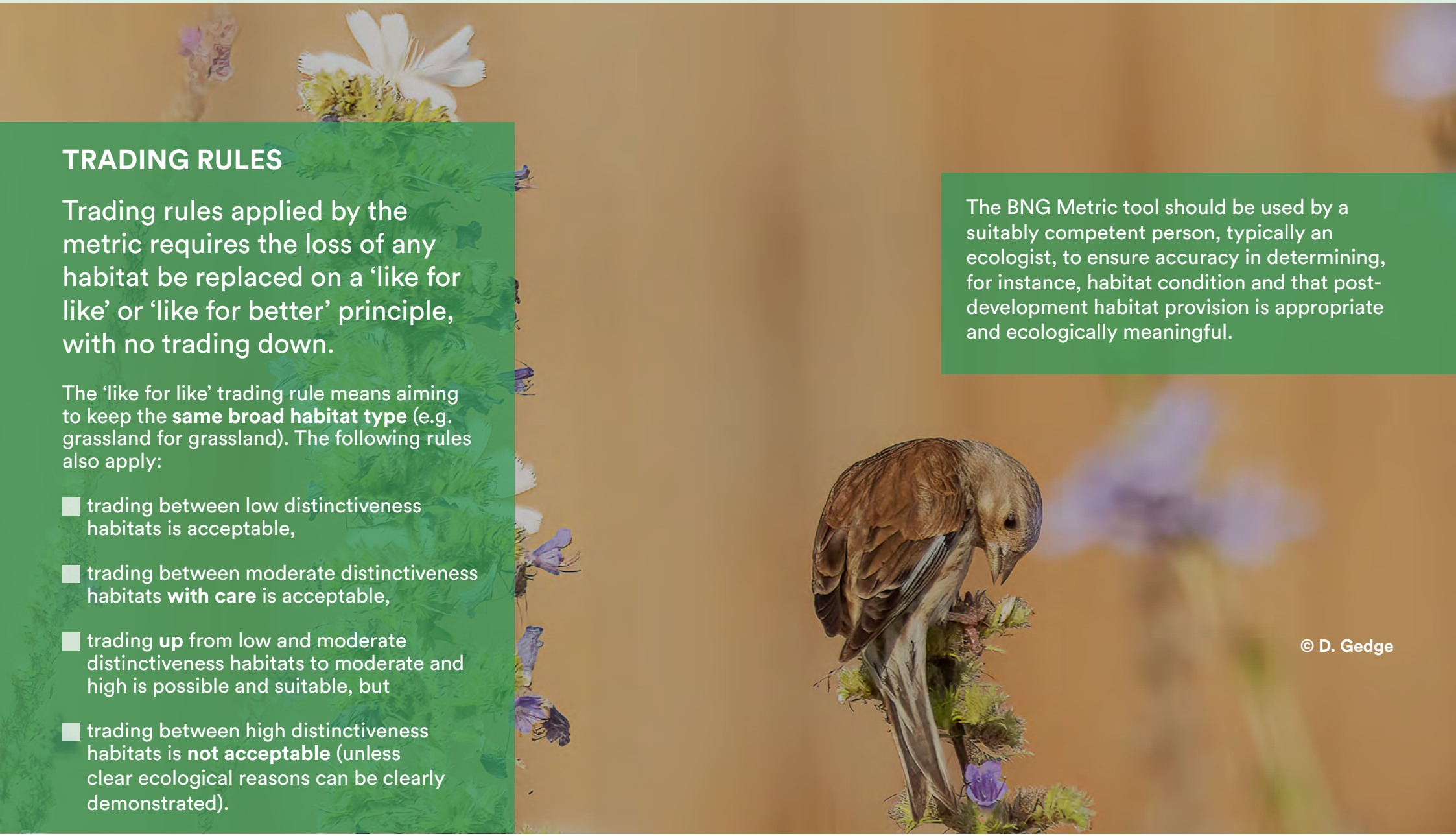
TRADING RULES

Trading rules applied by the metric requires the loss of any habitat be replaced on a 'like for like' or 'like for better' principle, with no trading down.

The 'like for like' trading rule means aiming to keep the **same broad habitat type** (e.g. grassland for grassland). The following rules also apply:

- trading between low distinctiveness habitats is acceptable,
- trading between moderate distinctiveness habitats **with care** is acceptable,
- trading **up** from low and moderate distinctiveness habitats to moderate and high is possible and suitable, but
- trading between high distinctiveness habitats is **not acceptable** (unless clear ecological reasons can be clearly demonstrated).

The BNG Metric tool should be used by a suitably competent person, typically an ecologist, to ensure accuracy in determining, for instance, habitat condition and that post-development habitat provision is appropriate and ecologically meaningful.



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THE SMALL SITE METRIC

The Small Site Metric is a simplified version of the BNG Metric, available for 'small site' developments, incorporating only low or medium distinctiveness habitats (including hedgerows and field margins).

It therefore cannot be used for high distinctiveness habitats such as OMH, and instead the Statutory Metric should be used. Both criteria shown below must be met for a development to qualify using the small sites metric. Ideally an ecologist would be involved for small sites but competency for use of the small site metric has been defined as a person 'who is confident in identifying habitats present on the site before the development and identifying the management requirements for habitats which will be created or enhanced within the landscape design' (this differs from the definition for the Statutory metric).

SMALL SITE METRIC QUALIFYING CRITERIA

1. The development is either: residential and comprises fewer than 10 residential units on a site area < 1 hectare (ha)/ or the number of residential units is not known on a site area < 0.5 ha; or it is a non-residential development < 0.5 ha.
2. There is no high or very high distinctiveness habitat within the development area. These are Habitats of Principal Importance as defined by the Joint Nature Conservation Committee.

BNG EXEMPTIONS

Some development will be exempt from the BNG requirement, although opportunities for biodiversity enhancements could be secured for these via planning policy. Currently, the Environment Act 2021 exempts:

- developments that are granted planning permission by a development order (including permitted development rights);
- urgent crown developments.

The government makes exemptions for:

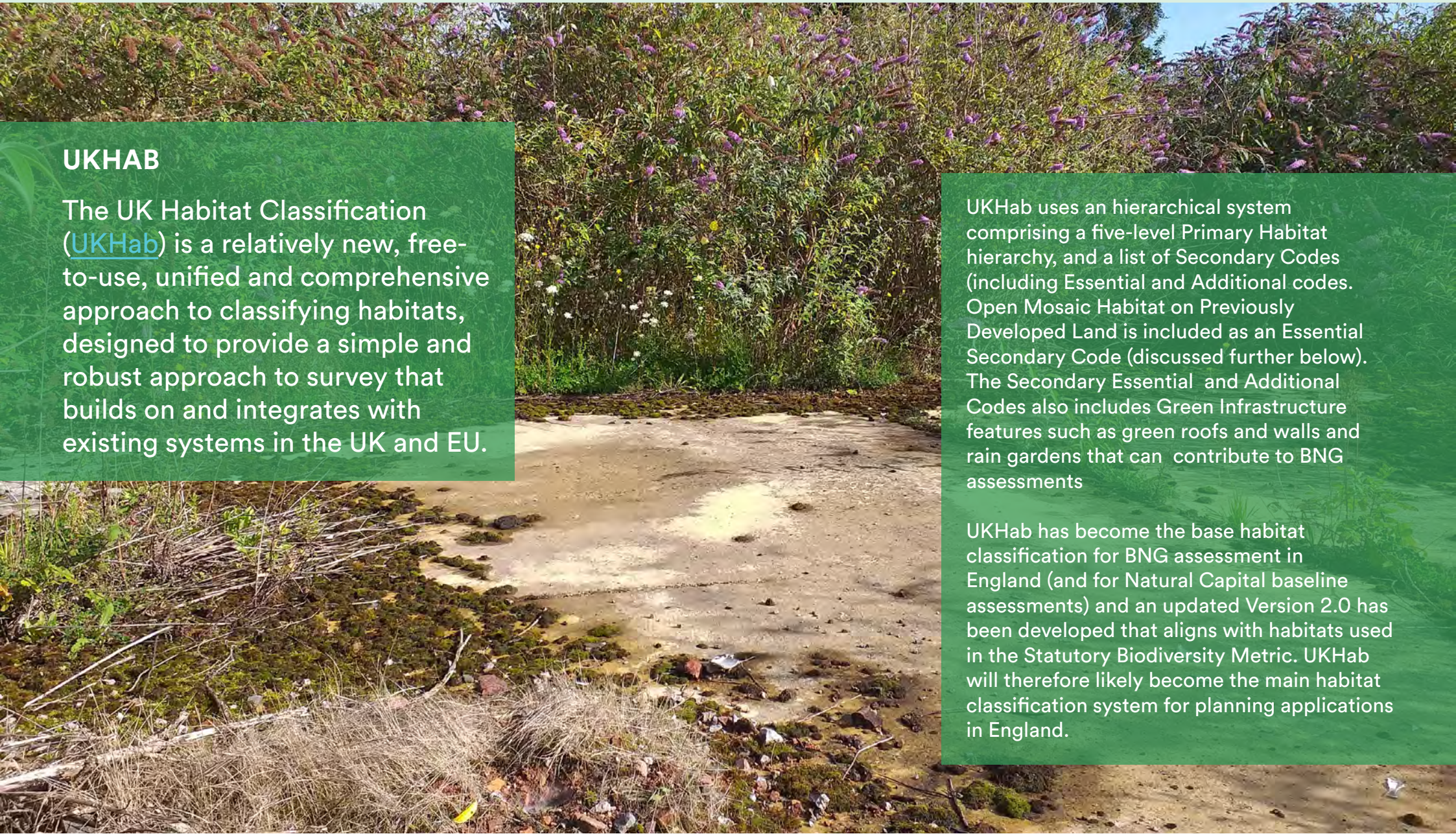
- existing planning applications for development that were made before mandatory BNG on 12th February 2024;
- a development that does not impact a priority habitat and impacts less than 25 metres squared (25 m2) of on-site habitat, or 5 m for linear habitats such as hedgerows;
- householder applications (e.g. for small projects like home extensions, conservatories or loft conversions);
- small scale self-build and custom housebuilding (e.g. < 9 dwellings on a site no larger than 0.5 ha, consisting exclusively of self-build or custom housebuilding as defined in section 1(A1) of the Self-build and Custom Housebuilding Act 2015);
- biodiversity gain sites (where habitats are being enhanced for wildlife);
- any development forming part of, or ancillary to, the high-speed railway transport network, comprising connections between all or any of the places or parts of the transport network specified in section 1(2) of the High Speed Rail (Preparation) Act 2013.

The Metric scores existing sealed-surfaces (such as tarmac/hard-standing) as zero, effectively exempting them from the % net gain. The Metric also allows for temporary impacts that can be restored within 2 years to be excluded from calculations.

Irreplaceable habitats (e.g. habitat such as ancient woodland that once lost cannot be replaced elsewhere within a reasonable timeframe) are excluded from the mandatory 10% BNG requirement and instead secondary legislation will be used to apply requirements for planning applications that include irreplaceable habitats to ensure appropriate compensation. Nonetheless, development on irreplaceable habitat will still require a biodiversity gain plan (see below), and a separate tab within the metric tool must be completed to document irreplaceable habitat onsite. Statutory biodiversity credits cannot be used to compensate for irreplaceable habitat loss and the biodiversity gain plan will need to include a robust summary of the avoidance options explored and why these were not feasible. The definition and list of irreplaceable habitats for BNG are set out in the Biodiversity Gain Requirements (Irreplaceable Habitat) Regulations 2024.

Whilst the metric uses a quantitative numerical 'score' for habitats, BNG should involve a qualitative assessment of biodiversity affected by a project so that net gains are proportionate, commensurable, and contribute to strategic priorities [88]. The baseline condition is that which exists in the absence of any proposed development activities, and this should capture qualitative aspects such as connectivity and the spatial context within an ecological network, and the ecological functionality (e.g. breeding sites, wintering/migration hotspot etc.) as well as a loss/gain calculation. Good practice BNG projects will align with local, regional, and national biodiversity priorities and demonstrate consultation with local communities and key stakeholders to ensure any social, cultural, and economic impacts are addressed.

The Metric relies on the recording of habitat areas for the baseline and post-development scenarios. Habitat classification schemes are a prerequisite for a unified approach to data collection and an important tool for nature conservation. In the UK, several classifications have emerged and the main systems used include: Phase 1 Habitat Classification [66]; The National Vegetation Classification (NVC) [96]; UK Biodiversity Action Plan Broad [97] and Priority Habitats [98] now Habitats of Principal Importance and the UK Habitat Classification System [99]. BAP Priority Habitats became Habitats of Principal Importance in England included in Section 41 of the NERC Act, 2006, used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under section 40, to have regard to the conservation of biodiversity in England, when carrying out their normal functions. BNG assessments should use a standard spatial habitat classification scheme to record habitats (and use the same system for baseline and post-development scenarios). For the Statutory Biodiversity Metric, the majority of habitats follow definitions set out by UK Habitat Classification (UKHab).



UKHAB

The UK Habitat Classification (UKHab) is a relatively new, free-to-use, unified and comprehensive approach to classifying habitats, designed to provide a simple and robust approach to survey that builds on and integrates with existing systems in the UK and EU.

UKHab uses an hierarchical system comprising a five-level Primary Habitat hierarchy, and a list of Secondary Codes (including Essential and Additional codes. Open Mosaic Habitat on Previously Developed Land is included as an Essential Secondary Code (discussed further below). The Secondary Essential and Additional Codes also includes Green Infrastructure features such as green roofs and walls and rain gardens that can contribute to BNG assessments

UKHab has become the base habitat classification for BNG assessment in England (and for Natural Capital baseline assessments) and an updated Version 2.0 has been developed that aligns with habitats used in the Statutory Biodiversity Metric. UKHab will therefore likely become the main habitat classification system for planning applications in England.

In the latest UKHab V2.0, OMH has been moved to an Essential Secondary Code – 80 – which is added to confirm the identity of habitat mosaics or complexes of multiple Primary Habitats. OMH sits within the Secondary Code Grouping of Built Environment, which comprises 'habitat complexes, mosaics, land uses and green infrastructure principally associated with the built environment'. This coding system means that mapping OMH will require a surveyor to assign Primary Codes to habitats that form the mosaic, with each given the Secondary Code of 80, so that they are recognised as forming OMH overall. Applying this secondary code is essential, to ensure habitats are entered into the Statutory Metric Calculation Tool as OMH and not as the individual habitat types that make up the mosaic, which as individual habitats may have lower conservation value.

Within the UKHab Essential Secondary Code List in the handbook, OMH is defined as follows:

EACH OF THE FOLLOWING 5 CRITERIA MUST BE MET:

1 OMH ≥0.25 ha in size.

2 Known history of disturbance or evidence that soil has been removed or severely modified by previous use(s). Extraneous materials/substrates such as industrial spoil may have been added.

3 Site contains some vegetation.
This will comprise early successional communities consisting mainly of stress-tolerant species (e.g. indicative of low nutrient status and drought). Early successional communities are composed of (a) annuals or (b) mosses/liverworts, or (c) lichens, or (d) ruderals, or (e) inundation species, or (f) open grassland, or (g) flower-rich grassland, or (h) heathland.

4 Contains unvegetated, loose bare substrate and pools may be present.

5 The site shows spatial variation, forming a mosaic of early successional communities (a) to (h) above (Criterion 3) plus bare substrate, within 0.25 ha.

This definition mostly aligns with the OMH Priority Habitat qualifying criteria, but lacks any of the explanatory notes regarding the additional value that features such as scrub/woodland patches confer for ecological functionality for invertebrates.

OMH AND THE STATUTORY BIODIVERSITY METRIC

The following is a brief examination of how the Metric evaluates OMH.

DISTINCTIVENESS CATEGORY FOR OMH

The Statutory Biodiversity Metric assigns a distinctiveness category to habitats based on various criteria related to its nature conservation value. This is an important determinant of the outcomes of applying the Metric as it governs various aspects regarding the potential compensation route.

For OMH the Metric assigns a '**High**' level of distinctiveness, due to its Priority Habitat status, and the trading rules automatically applied by the Metric for **High** distinctiveness habitats require losses to be replaced with area units of the **same habitat type**.

The Metric user guide states that when compensating for the loss of high distinctiveness habitats:

- a 'like for like' habitat must be provided and input into the metric,
- target habitat must replicate the type being lost,
- a realistic target condition should be set (e.g. good, moderate, poor).

CONDITION ASSESSMENT FOR OMH

Condition is a measure of the state of a habitat, and the Statutory Biodiversity Metric technical guidance provides key indicators to make the assessment. It can be used to measure the quality of parcels of the same type of habitat within a site, if parcels of the same habitat vary in quality. The condition categories range from good to poor, and the Statutory Biodiversity Metric Condition Assessment spreadsheet provides guidance on their application for habitats.

In the spreadsheet, OMH sits within the URBAN habitat types, and requires the assessment of four criteria, shown in Table 7 on the right. For OMH, all four criteria must be assessed, and based on the number of criteria that are met, a condition assessment score of good, moderate or poor is determined (see over page).

CORE CRITERIA FOR CONDITION ASSESSMENT OF OMH IN THE STATUTORY BIODIVERSITY METRIC	ADDITIONAL CRITERIA FOR CONDITION ASSESSMENT OF OMH IN THE STATUTORY BIODIVERSITY METRIC
A – Vegetation structure is varied, providing opportunities for vertebrates and invertebrates to live, eat and breed. A single structural habitat component or vegetation type does not account for more than 80% of the total habitat area.	D – The parcel shows spatial variation and forms a mosaic of bare substrate PLUS: - **at least four** early successional communities (a) to (i); Communities: (a) annuals or (b) mosses/ liverworts, or (c) lichens, or (d) ruderals, or (e) inundation species, or (f) open grassland, or (g) flower-rich grassland, or (h) heathland, (i) pools.
B – The habitat parcel contains different plant species that are beneficial for wildlife, for example flowering species providing nectar sources for a range of invertebrates at different times of year.	
C – Invasive non-native plants species (listed on Schedule 9 of the Wildlife & Countryside Act, 1981) and others which are of detriment to native wildlife (using professional judgement) [2] cover less than 5% of the total vegetated area [3]. *Note: to achieve Good condition, this criterion must be satisfied by a complete absence of invasive non-native species (rather than <5% cover)*	

[2] *Key sources for non-native species https://www.nonnativespecies.org/home/index.cfm and https://publications.naturalengland.org.uk/publication/40015*

[3] *Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone with a size relative to its risk of spread to adjacent habitat, using professional judgement*

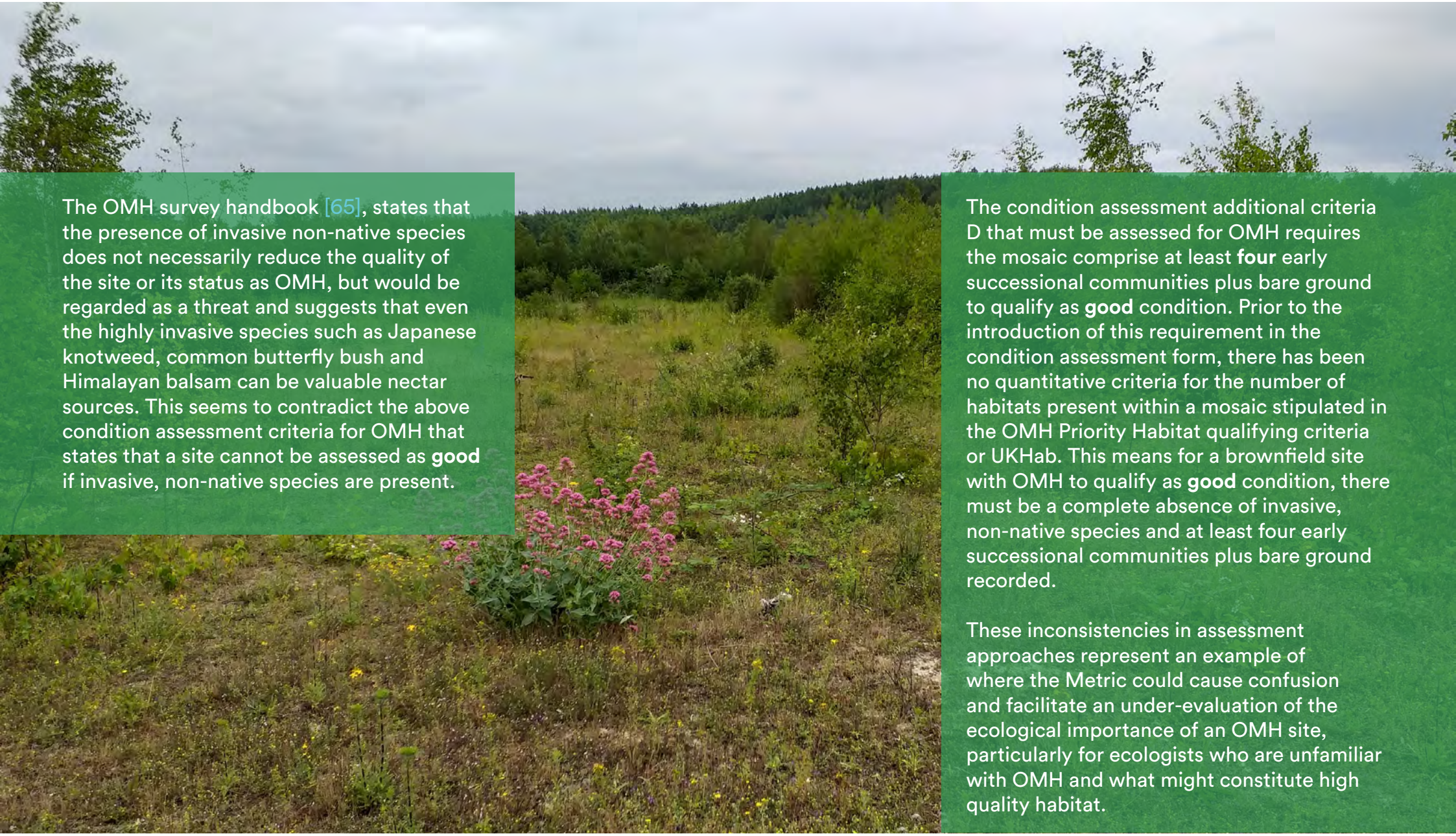
Table 7. Criteria for condition assessment of OMH in the Statutory Biodiversity Metric.

The Metric requires certain criteria to be met as an assessment of the condition of OMH parcels (Table 8).

The core condition assessment requirement for OMH to have a complete absence of invasive non-native species to achieve good condition will likely result in many urban brownfield sites being assigned moderate condition, even when the site is considered to be a good quality example of OMH. Whilst the other condition assessment criteria refer to the habitat 'parcel', Criteria C refers to the 'total vegetated area', indicating that presence of invasive species anywhere on vegetated areas of a site would disqualify this category. It is not clear from the guidance whether invasive, non-native species growing through or on hardstanding would count as 'vegetated areas' or could be excluded.

CONDITION SCORE AND CRITERIA	
GOOD (3)	Pass all 3 core criteria; AND meets requirements for Good condition within Criteria C; AND passes all additional criteria in D
MODERATE (2)	Passes 2 or 3 of 4 criteria; OR Passes 4 criteria of 4 criteria but does not meet requirements for Good condition within criteria C
POOR (1)	Passes 0 or 1 of 4 criteria

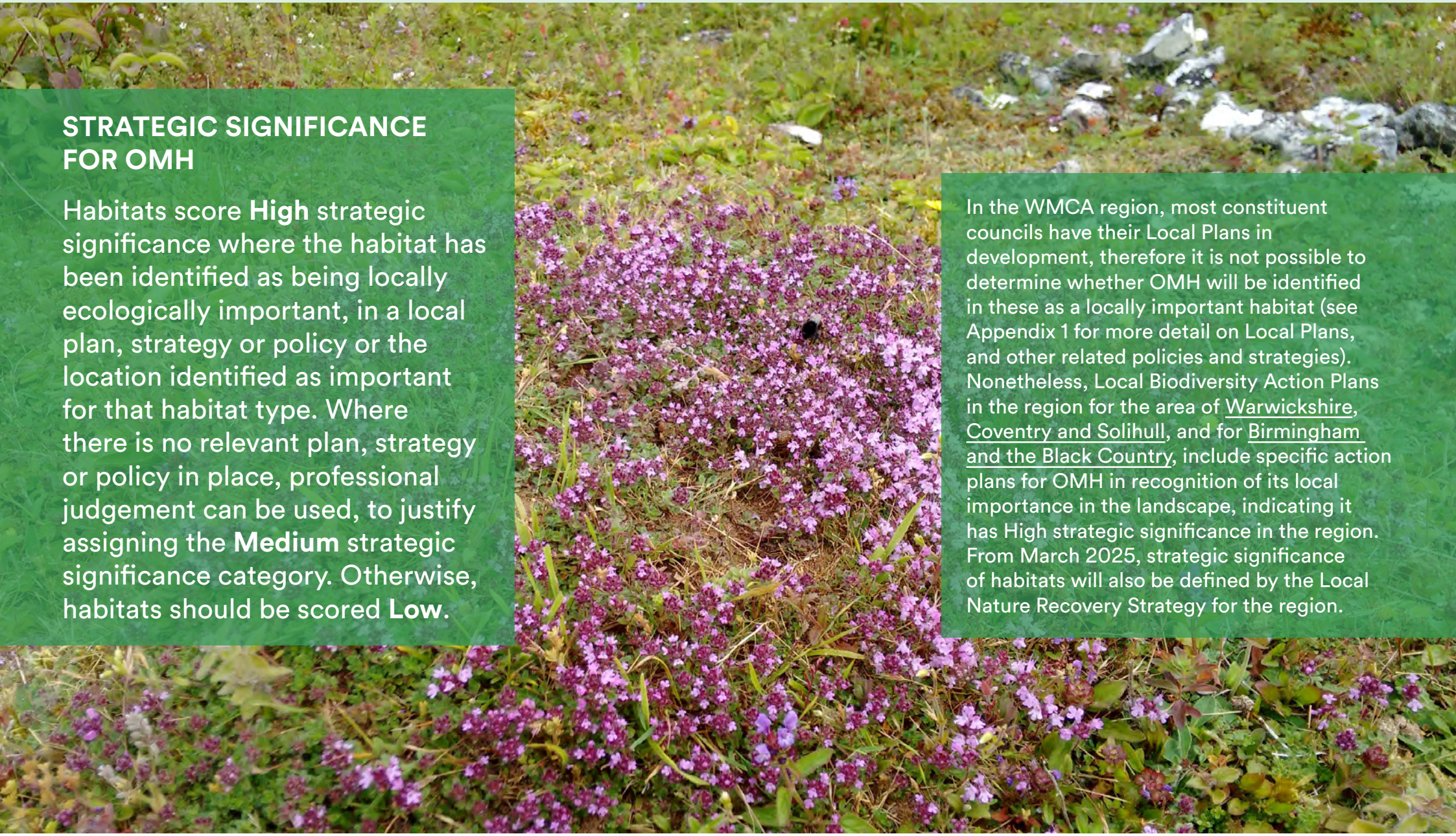
Table 8. Criteria for categorising the condition of OMH in the Statutory Biodiversity Metric.



The OMH survey handbook [65], states that the presence of invasive non-native species does not necessarily reduce the quality of the site or its status as OMH, but would be regarded as a threat and suggests that even the highly invasive species such as Japanese knotweed, common butterfly bush and Himalayan balsam can be valuable nectar sources. This seems to contradict the above condition assessment criteria for OMH that states that a site cannot be assessed as **good** if invasive, non-native species are present.

The condition assessment additional criteria D that must be assessed for OMH requires the mosaic comprise at least **four** early successional communities plus bare ground to qualify as **good** condition. Prior to the introduction of this requirement in the condition assessment form, there has been no quantitative criteria for the number of habitats present within a mosaic stipulated in the OMH Priority Habitat qualifying criteria or UKHab. This means for a brownfield site with OMH to qualify as **good** condition, there must be a complete absence of invasive, non-native species and at least four early successional communities plus bare ground recorded.

These inconsistencies in assessment approaches represent an example of where the Metric could cause confusion and facilitate an under-evaluation of the ecological importance of an OMH site, particularly for ecologists who are unfamiliar with OMH and what might constitute high quality habitat.



STRATEGIC SIGNIFICANCE FOR OMH

Habitats score **High** strategic significance where the habitat has been identified as being locally ecologically important, in a local plan, strategy or policy or the location identified as important for that habitat type. Where there is no relevant plan, strategy or policy in place, professional judgement can be used, to justify assigning the **Medium** strategic significance category. Otherwise, habitats should be scored **Low**.

In the WMCA region, most constituent councils have their Local Plans in development, therefore it is not possible to determine whether OMH will be identified in these as a locally important habitat (see Appendix 1 for more detail on Local Plans, and other related policies and strategies). Nonetheless, Local Biodiversity Action Plans in the region for the area of Warwickshire, Coventry and Solihull, and for Birmingham and the Black Country, include specific action plans for OMH in recognition of its local importance in the landscape, indicating it has High strategic significance in the region. From March 2025, strategic significance of habitats will also be defined by the Local Nature Recovery Strategy for the region.

BNG AND OMH - POTENTIAL CHALLENGES WITH BASELINE CATEGORISATION AND CONDITION ASSESSMENT

OMH comprises a composite of habitats, and these may occur intermixed with areas of artificial surfaces and manmade structures, and these novel parameters can make categorisation of what is and what isn't OMH a challenge.

The current guidance sets out the types of habitats that should be present and sets a threshold for the minimum overall size of the mosaic (0.25 ha). It does not specify how intimately mixed or scattered within a site this mix of habitats can be for them to constitute OMH, rather than being mapped and assigned as individual habitats. The original OMH BAP explanatory notes states 'a mosaic is defined as an area where a range of contiguous plant community types occur in transition with one another, usually with ecotone habitat gradients and repeated occurrences of each community, and often at a small scale'.

An element of judgement and expertise can therefore be needed to accurately recognise that a patchwork of habitats and artificial surfaces/substrates constitute OMH. The BAP explanatory notes also state that 'continuous blocks of a closed plant community greater than 0.25ha would be classified as a habitat other than OMH, although those containing very fine-grained mosaics might qualify' indicating larger patches of a single habitat type would be categorised and mapped separately to OMH.

There can be instances where ruderals have recently colonised post-industrial sites, and these do not have the complexity to qualify as OMH. Equally, there can be areas of varied habitats in patches amongst artificial surface/features that constitute a mosaic, and should be categorised as OMH – but ecologists unfamiliar with this novel habitat have mapped and assigned a mosaic as individual habitats. With the new coding system in UKHab assigning OMH as a Secondary Code that should be applied to a mosaic of Primary Habitats, there is further potential for confusion and misidentification of OMH as part of BNG.

The following pages briefly outline some potential consequences of inconsistencies in categorisation of baseline habitats and assessment of their condition for BNG in relation to OMH. Some potential enablers for OMH creation/enhancement are also summarised.

POTENTIAL CHALLENGES WITH CATEGORISATION - HABITATS THAT CAN FORM PART OF OMH

The list of early successional communities that are detailed in the qualifying criteria for OMH Priority Habitat includes habitats such as ruderals, open/flower-rich grassland and heathland. These communities are also recognised separately within the Statutory Bioiversity Metric Calculation tool as singular habitats distinct from OMH. OMH can also include features such as bare ground and inundation and wetland communities (e.g. reedbed, ponds etc) that similarly occur as distinct habitats within the Metric. As singular habitats, they have been assigned their own distinctiveness category, as outlined in Table 9. Unlike OMH, most of these habitats have not been categorised as High distinctiveness.

HABITAT TYPE	DISTINCTIVENESS CATEGORY
Grassland – lowland calcareous or other lowland acid	HIGH
Grassland – other neutral	LOW
Sparsely vegetated land – tall forbs	LOW
Sparsely vegetated land – ruderal/ephemeral	LOW
Heathland and shrub – lowland heathland	HIGH
Urban - artificial unvegetated, unsealed surface	V. LOW
Urban – vacant or derelict land	LOW
Urban – bare ground	LOW
Wetlands – reedbed	HIGH
Lakes – ponds (non-priority habitat)	MEDIUM
Watercourse - ditches	MEDIUM

Table 9. Habitats that can form part of OMH Priority Habitat that have different distinctiveness categories in the Statutory Biodiversity Metric if assessed as distinct habitats.

As described in the Priority Habitat definition and the OMH survey handbook, OMH sites can often contain patches of scrub and woodland as part of the mosaic and these can be valuable components of the mosaic for some of the important invertebrates that rely on these sites. Whilst the UKBAP definition acknowledges scrub can be an essential component of the mosaic for invertebrates, this is not included in the UKHab definition of OMH, therefore may be mapped separately, rather than included as OMH. Table 10 shows the distinctiveness categories for likely habitats that could occur on OMH sites and would contribute to the ecological/functional value of the habitat mosaic for many species.

HABITAT TYPE	DISTINCTIVENESS CATEGORY
Heathland and shrub – e.g. bramble, gorse, hawthorn or mixed scrub	MEDIUM
Woodland and forest – other woodland; mixed/broadleaved	MEDIUM

Table 10. Habitats that can form part of OMH Priority Habitat but would likely be mapped separately and their relative distinctiveness category.

These examples highlight that if a mosaic of habitats is mapped and categorised as a series of separate habitats, rather than as OMH, there can be important implications for baseline biodiversity unit scores and habitat trading rules. This has consequences for what will then need to be delivered to achieve a net gain for biodiversity as part of development. Principally, any deviation from assigning qualifying habitat mosaics as OMH at the baseline, will likely lead to poorer outcomes for biodiversity, as lower distinctiveness habitats that differ in quality and functionality to OMH could be provided as part of the development proposal, and a net gain could still be achieved.

These examples highlight some of the potential challenges related to the categorisation of habitats that constitute OMH, how these might be mapped for the baseline and how these could be assessed using the Statutory Biodiversity Metric. To some extent, the Metric is reliant on the subjective judgement of an ecologist to assign habitats to a certain category, bringing scope for error in terms of distinctiveness and condition scores [86] and potential misrepresentation of the true ecological value of OMH, or other habitats. For OMH, this could potentially be particularly problematic, as sites vary so widely in character, contain novel features untypical of many semi-natural/natural habitats, and can been undervalued by practitioners with insufficient training in surveying OMH.

These issues will be explored further in the next section, looking at case study examples where potentially inappropriate baseline categorisation of habitats could facilitate an under-evaluation of the ecological importance of an OMH site, and a reduction in the requirement for habitat compensation in order to achieve a net gain for biodiversity.

BNG AND OMH – FURTHER POTENTIAL CHALLENGES FOR OMH REDEVELOPMENT

Ideally, all developments should seek to retain important on-site habitats within the new development footprint. This can be a particular challenge when High distinctiveness habitats such as OMH occur within the development baseline.

The 'like for like' requirement for OMH could represent a barrier to redevelopment of urban brownfield sites as the weighted multipliers (see also delivery risk multipliers below) mean that a greater area of habitat than the perceived mandatory 10% would be needed to compensate for the loss (depending, to some extent, on the habitat condition at the baseline), and this additional area could exceed space available within the site. For many urban sites, this is likely to lead to the requirement for off-site compensation. This potential challenge could also be viewed as an opportunity for WMCA to improve the condition of some of its brownfield land to generate an OMH habitat bank and deliver on strategic biodiversity recovery targets.

BNG AND OMH - POTENTIAL OPPORTUNITIES

For Low and Medium distinctiveness habitats, the Metric trading rules allow for higher value habitats to be created as compensation, and the various multipliers related to the habitat condition and temporal and technical risks mean that it can be possible to achieve a net gain with higher distinctiveness/ condition habitats without requiring additional land.

This could offer an opportunity for creation of OMH on sites with low category habitats and could drive the diversification of urban habitats and encourage wider interest in OMH landscaping in urban developments. However, it has been shown that the trading-up approach can also lead to a trade-off in terms of loss of overall greenspace area. In some cases this may not result in overall positive impacts for biodiversity, although the true impacts have yet to be measured [86]. The high biodiversity unit value of OMH could also encourage retention and expansion/enhancement of small patches of this habitat (below the 0.25 ha threshold for priority habitat status) that may occur on sites.

DELIVERY RISK SCORE FOR OMH COMPENSATION

OMH is assigned a Medium Technical Difficulty for Creation and Enhancement in the Metric, reflecting a predetermined evaluation that some habitats are more difficult to successfully recreate. The Time to Target Condition are multipliers that account for risks associated with habitat creation. Values for time to target condition are set within the metric and vary according to the habitat type, condition and whether the habitat is being created or enhanced. For OMH this has been set as 4 years for moderate condition and 10 years for good. This timescale is shorter than for some other habitats, with potentially positive implications for OMH as an opportunity habitat for creating a habitat bank.

OTHER POTENTIAL OPPORTUNITIES/CONSTRAINTS FOR OMH THROUGH BNG

The following sections in the Metric guidance could offer opportunities or constraints to justifying how OMH redevelopment/recreation is assessed for BNG. For example, the Metric guidance sets out 9 principles that should inform its use.

BIODIVERSITY METRIC PRINCIPLES

Key guiding principles to consider with regard to OMH redevelopment/recreation that the guidance from this study may help to inform can be found on the right.

STATUTORY BIODIVERSITY METRIC PRINCIPLES

PRINCIPLE NUMBER/DETAIL	OPPORTUNITY FOR OMH LOCAL STRATEGY
PRINCIPLE 3: This metric is not a complex or comprehensive ecological model and is not a substitute for expert ecological advice.	This principle may allow LPAs in conjunction with ecologists to explore the potential to deliver OMH <0.25 ha on site if it fits into a broader mosaic of neighbouring habitats and the management/ monitoring agreement encompasses all of these areas.
PRINCIPLE 5: This metric is designed to inform decisions in conjunction with locally relevant evidence, expert input, or guidance.	As above, LPA decisions (in conjunction with expert advice) could explore deviation from the strict requirements of the Metric if it enables meaningful BNG for OMH and other biodiversity e.g. 0.25 ha OMH is created, but across a landscape mosaic.
RULE 4: This allows for deviation from the Metric methodology and is only permitted through prior agreement with the planning authority/consenting body.	The Metric guidance states that Rule 4 should only be used in rare or exceptional ecological circumstances when the Metric does not fully reflect the ecological benefit provided by a specific intervention. It may be used *where a site has optimal conditions for restoration of a wildlife-rich habitat and the project team has the expertise and resource to deliver the habitat with negligible risk of failure*. Where LPAs lack knowledge or experience of OMH creation, this could be a potential (last resort) mechanism for agreeing the use of features that do not match the Metric trading rules e.g. ecologically important features such as Aculeate nesting habitat that may not match OMH criteria/habitat area but provide a critical ecological function.

This section has set out the BNG approach and how this might operate in relation to brownfield habitats and OMH when using the Statutory Biodiversity Metric. The principles of BNG represent a positive step towards ensuring the consideration of biodiversity in the development process, but for some habitats such as OMH, there remains some uncertainty on how effective this might be. The following section will use case study examples to further explore some of the potential challenges of baseline mapping and categorisation of brownfield habitats and OMH. It will highlight the implications of inappropriate baseline surveys on the BNG baseline score and the subsequent requirements for habitat compensation in order to achieve a net gain for biodiversity. The section will also include two case study examples of innovative approaches to creating OMH features and functions within landscaping as part of brownfield redevelopment.

KEY LEARNING OUTCOMES

- BNG can support the recovery of nature whilst developing land and ensure development creates measurable improvements for biodiversity
- Well designed and delivered BNG can deliver benefits for nature, people, places and the economy
- In 2024, BNG became mandatory for most development in England under the Environment Act (2021), requiring a minimum 10% net gain and that biodiversity gain sites must be secured for a minimum of 30 years
- BNG can be delivered on-site, off-site, or as a combination of both with on-site and local delivery incentivised as the best option. If no on or off-site delivery can be secured, it is possible to purchase statutory biodiversity credits
- BNG is in addition to other existing species and habitat protections and complementary to the mitigation hierarchy
- Local Nature Recovery Strategies (LNRS) will help target BNG delivery to where it will bring greatest benefit
- The Statutory Biodiversity Metric is the tool that must be used for calculating biodiversity value (units) for the purposes of BNG
- The metric uses habitats as a proxy measure for biodiversity and scores habitats based on their relative biodiversity value, using 'biodiversity units' as a measure of value that are based on pre-determined criteria within the Metric
- Biodiversity losses and gains for development are scored by the Metric for the baseline (pre-development) and post-development habitats, including any off-setting (if required)
- There is also an expectation that qualitative assessment of biodiversity value and the impact of the development is included in any BNG evaluation
- Trading rules applied by the metric require habitat losses be replaced on a ‘like for like’ or ‘like for better’ principle, with no trading down. Risk multipliers ensure that risks associated with habitat creation increase the area required compared to retaining existing habitat.

- High distinctive habitat losses must be replaced with the same habitat type and irreplaceable habitats are excluded from BNG requirements
- The majority of habitat characterisation in the Metric follow UKHab classification and this is likely to be the main classification system for planning applications
- Condition assessment is also included as a mechanism for categorising the state of habitats. This includes an invasive, non-native species criteria, which could lead to undervaluing OMH due to the conflict with the condition assessment criteria and the OMH survey handbook [65] appraisal of invasive non-natives on OMH sites
- Habitats are also characterised based on their geographical/strategic significance. This is strongly linked to local plans and designations (including upcoming LNRS) and represents an opportunity to raise the value of OMH in the WMCA region
- BNG provides a challenge in relation to whether habitats are treated as a mosaic or on their individual distinctiveness. The new system in UKHab of applying OMH as a Secondary Code could create more complication for accurate OMH mapping
- BNG guidance allows some flexibility to define local priorities and this may represent an opportunity to raise the importance of OMH

6 The Statutory Biodiversity Metric & OMH – Brownfield Case Studies

SECTION SUMMARY

- Testing scenarios in the Statutory Biodiversity Metric to understand the implications for baseline unit values using different approaches to designating and mapping microhabitats within a case study OMH site
- Comparing the results of the different baselines scenarios and outlining the potential implications for Local Authorities and developers in terms of baseline unit values and potential compensation requirements to achieve net gain
- Outline best practice for defining and mapping OMH for BNG baseline assessment
- Two emerging good practice case studies to highlight potential approaches for OMH habitat creation as part of brownfield development

ECOLOGICAL SIGNIFICANCE OF OMH

OMH is not a widely recognised and understood habitat, and the fact that it occurs on derelict sites means it if often considered of lower ecological value than natural/semi-natural habitats and even managed greenspaces such as parks.

As outlined in Section 2, far from being a waste ground of valueless 'weeds', habitats that occur on brownfield sites can be extremely important for biodiversity and can provide a wide range of ecological functions, often equivalent to or exceeding those provided by more natural habitats. Whilst the conditions on brownfield sites may be ecologically challenging, this is what drives their floristic diversity, enabling plant species to flourish that would struggle to compete in other habitats, creating a rich mix of species that can offer a variety of resources for a broad range of species.

When this floristically-rich foundation occurs with other important features such as bare, friable ground, dead wood/stems, undulating ground and temporary pools, it then provides essential functions for fauna such as insects. For instance, it can provide insects with nesting, basking, hunting, foraging, egg-laying and over-wintering sites. This can provide vital resources for species to complete their often complex lifecycles, allowing them to successfully reproduce and persist. OMH can also make a significant contribution to urban ecology as a stepping-stone habitat, providing breeding and feeding sites and also aiding movement across the landscape. Some species have become increasingly reliant on brownfield habitats to provide appropriate resources at the landscape scale alongside natural/semi-natural habitats, where they function as part of ecological networks for rare and scarce plants, invertebrates, birds, reptiles and amphibians. Whilst the ecological value of habitats on brownfield sites may not always be obvious, they should not be underestimated.

ECOLOGICAL SIGNIFICANCE OF OMH IN WMCA

For the WMCA context, the stakeholder engagement exercise indicated that brownfield/OMH sites in the West Midlands were of variable quality, and that most of the larger peri-urban mineral/mining sites have either been lost to natural succession to woodland/scrub, have only fragments of good quality habitat still present, or have been redeveloped. Feedback suggested that the majority of inner urban sites likely to be targeted for redevelopment comprised disused railway lines with species-rich grassland/scrub mosaics, disused factories that may support ruderal communities that have biodiversity value but may not qualify as OMH or small, temporary sites, created, for instance, during phased developments, but do not qualify as OMH. Whilst heathland and acid and/or calcareous grassland do occur on disused mineral workings/mining sites in the WMCA area and could be associated with brownfield sites in the region, very few of the sites where these habitats occur would be subject to development, and most are designated for their conservation value in some form. Therefore, brownfield sites in WMCA most likely to be impacted by development tend to be derelict commercial sites that have been cleared or abandoned. Vegetation on these sites would likely comprise a mosaic of ruderal/ephemeral, tall forbs, grassland, scrub and bare ground. Despite the fact these sites may not represent the 'best' examples of OMH, they can still offer important resources for OMH communities, and generally represent a more valuable habitat for biodiversity than typical, highly-managed urban greenspaces.

For BNG to be truly successful it is therefore critical that brownfield sites with ecologically valuable habitats are recognised and appropriately categorised in BNG baseline assessments. Losing their function in the landscape without suitable compensation will be detrimental to the aspirations of BNG and could facilitate further losses of already declining biodiversity.

BNG ASSESSMENT FOR OMH CASE STUDIES

OMH comprises a composite of habitats, and these may occur intermixed with areas of artificial surfaces and manmade structures, and these novel parameters can make categorisation of what is and what isn't OMH a challenge.

There can be instances where ruderals have recently colonised post-industrial sites and these do not have the complexity to qualify as OMH. Equally, there can be areas of varied habitats in patches amongst artificial surface/features that constitute a mosaic, and should be categorised as OMH, but are mapped and assigned as individual habitats, rather than a mosaic. Whilst the definitions for OMH indicate the types of habitats that should occur in a patchwork to qualify, and that the overall mosaic of these habitats must exceed 0.25 ha, there is little indication of how scattered these parcels can be within a site for it still to function as OMH.

For instance, a site may contain a variety of OMH type habitat patches, and overall their areas exceed the 0.25 ha threshold, but they are separated by (for example) areas of hardstanding. Areas of artificial surfaces such as hardstanding do not necessarily represent a barrier to many of the characteristic OMH invertebrate species found on sites, as many are mobile and adapted to moving within and between sites to find suitable habitat. Nonetheless, if parcels are small and isolated within a matrix of hard surfaces their value for OMH species is likely to be reduced. Ultimately, without specific parameters in the guidance, the decision for qualification as OMH resides with the ecologist. Having a knowledgeable and experienced ecologist can therefore be crucial for accurate assessment.

The following case studies illustrate the potential repercussions for BNG when sites with OMH have been evaluated by an ecologist as a series of separate habitat parcels, but these could arguably qualify as OMH. In the first case study, there was evidence that the original categorisation of habitats was inappropriate, and that part of the site baseline should have been mapped as OMH. In the second case study, the parcels of OMH-type habitats occur within a large area of hardstanding and so are less of an intimate mosaic. In the absence of a follow up site visit by an experienced OMH ecologist, it is more challenging to define whether these parcels function as OMH, but they certainly comprise the characteristic habitat types. Furthermore, a 0.84 ha section of baseline habitat classified as sparse ruderal/ephemeral vegetation, appears from the condition assessment to match several criteria that mean it would qualify as OMH. As such, for the purposes of this exercise, the case study is analysed as both individual parcels of habitat and as OMH for those habitats that would qualify for inclusion.

CASE STUDY 1. URBAN POST-INDUSTRIAL SITE IN THE SOUTH-EAST

The following case study is based on a real-life urban development project, but the identity of the site and arrangement of the habitats have been changed to anonymise the project. Whilst this site was not located in the WMCA region, it represents a typical example of a brownfield site with OMH that could occur in urban areas anywhere in the UK.

The application site was approximately 2.33 hectares in extent and was previously developed land that had been used historically for industrial purposes. When the industry became redundant, the site was decommissioned and over time became derelict.

For almost ten years, the site was mostly undisturbed, allowing vegetation to colonise the made ground within the site. The site had some small areas of topographical variation, comprising some south-facing sandy/gravel mounds, but otherwise was predominantly level. The surrounding context was urban, predominantly residential, but with several nearby greenspaces, including a Site of Importance for Nature Conservation with acid grassland and heathland that supports an important invertebrate population. The application site was connected to this greenspace via residential gardens and interstitial greenspaces, offering opportunities for colonisation by this invertebrate assemblage. The proposed development for the site was a fairly high-density, residential led scheme with a central, communal greenspace and provision of green roofs on buildings.

SCENARIO 1. INITIAL HABITAT ASSESSMENT FOR PLANNING APPLICATION

A planning application to redevelop the site for the new housing project was submitted and the preliminary ecological assessment designated the baseline habitats on site as shown in Figure 8.

Table 11 provides a summary of the BNG baseline values that were generated by Statutory Biodiversity Metric based on the original habitat survey for the project.

In this scenario, the types of habitats identified were mostly low distinctiveness, and were assigned poor condition and low strategic significance. The total baseline biodiversity units therefore totalled 3.46 units.

Figure 8. Map of baseline habitat designations for the preliminary ecological assessment for the new development - Scenario 1.

In accordance with the Metric's trading rules, the suggested actions to address habitat loss were as follows:

- for Low distinctiveness habitats (e.g. ruderal/ephemeral and modified grassland), the 'same distinctiveness or better habitat' would be required;
- for Medium distinctiveness habitat (e.g. mixed scrub), the 'same broad habitat type or a higher distinctiveness habitat' would be required.

For the original planning application, the BNG compensation comprised on-site habitat creation only, including areas of green roof (not biodiverse), rain garden, amenity grassland, trees, ornamental shrubs and hedge, and a ground-based green wall (all **Low** distinctiveness habitats, most aiming to achieve Moderate condition). This delivered **4.61 units**, plus hedgerow units, **resulting in an on-site net gain of 33.2%**.

BROAD HABITAT	HABITAT TYPE	AREA	DISTINCTIVENES	CONDITION	STRATEGIC MULTIPLIER	UNITS LOST
URBAN	DEVELOPED LAND/SEALED SURFACE	0.69	V. LOW	N/A	1	0.00
SPARSELY VEGETATED LAND	RUDERAL/ EPHEMERAL	0.72	LOW	POOR	1	1.44
GRASSLAND	MODIFIED GRASSLAND	0.83	LOW	POOR	1	1.66
HEATHLAND & SHRUB	MIXED SCRUB	0.09	MEDIUM	POOR	1	0.36
ECOLOGICAL BASELINE			**TOTAL UNITS LOST**			**3.46**

Table 11. Initial BNG baseline values for the case study site, in accordance with the original ecological assessment.

SCENARIO 2. REVISED HABITAT ASSESSMENT FOR PLANNING APPLICATION

The original planning application was challenged by a local independent ecologist, concerned that the ecological assessment was out of date, and that habitats within the site had been incorrectly designated and consequently undervalued as part of the BNG baseline assessment. A subsequent update habitat survey was completed, and the habitats were re-evaluated as shown on the map in Figure 9.

The update resulted in some key changes to the mapping and designation of baseline habitats within the site as follows:

- recognition that part of the habitat on site qualified as Open Mosaic Habitat – a High distinctiveness habitat;

Figure 9. Map of baseline habitat designations for the updated ecological assessment for the new development - Scenario 2.

- the grassland area had extended, and been upgraded from modified grassland (Low distinctiveness) to 'species-poor grassland', which aligns with the UKHab classification 'other neutral grassland' – a Medium distinctiveness habitat;
- certain areas that had previously been designated as 'developed land/sealed surface' (V. Low Distinctiveness and zero units), were categorised as 'bare ground' which has Low distinctiveness and generates a unit value;
- whilst its ecological value was upgraded, **the grassland and all the bare ground were mapped and designated separately from OMH.**

The revised BNG baseline calculations resulting from the updated habitat assessment are shown in Table 12.

BROAD HABITAT	HABITAT TYPE	AREA	DISTINCTIVENES	CONDITION	STRATEGIC MULTIPLIER	UNITS LOST
URBAN	DEVELOPED LAND/SEALED SURFACE	0.30	V. LOW	N/A	1	0.00
URBAN	BARE GROUND	0.35	LOW	POOR	1	0.70
GRASSLAND	OTHER NEUTRAL GRASSLAND	1.27	MEDIUM	POOR	1	5.08
HEATHLAND & SHRUB	MIXED SCRUB	0.15	MEDIUM	POOR	1	0.60
HEATHLAND & SHRUB	BRAMBLE SCRUB	0.01	MEDIUM	N/A	1	0.04
URBAN	OPEN MOSAIC HABITAT	0.25	HIGH	POOR	1	1.50
ECOLOGICAL BASELINE			**TOTAL UNITS LOST**			**7.92**

Table 12. BNG baseline values for the case study site, in accordance with the revised ecological assessment.

In the revised BNG calculation, the total baseline biodiversity units totalled 7.92, **an increase of 4.46 units** compared to the original scenario. This case study demonstrates the significant impact that inaccurate identification and mapping of habitats can have on the BNG baseline unit calculation for sites with OMH. Furthermore, the revised habitat classification has implications for the suggested actions to address habitat loss as follows:

- the identification of High distinctiveness habitat OMH on site creates a requirement for like for like compensation, (e.g. the same habitat must be provided either on site, off-site or a combination of both, and/or enhancement to improve the condition of habitat);
- there is a greater proportion of Medium distinctiveness habitats (i.e. other neutral grassland, mixed and bramble scrub), requiring compensation with the 'same broad habitat type or a higher distinctiveness habitat'.

It is clear therefore that the on-site package of habitat creation outlined in the original planning application would no longer be sufficient in terms of units to provide a net gain (4.6 units versus the revised 7.92 baseline), and more significantly, in terms of the trading rules, there would now be a requirement for like for like compensation for the loss of any OMH. Additionally, the same broad habitat or higher distinctiveness habitat would need to be provided for the loss of on-site scrub habitat.

SCENARIO 3. HABITAT ASSESSMENT BASED ON BEST PRACTICE GUIDELINES

An analysis of the revised habitat assessment report undertaken for this study indicated that mapping the grassland with its areas of scattered scrub and bare ground as distinct from OMH was a misinterpretation of the guidance for identifying OMH. Following OMH identification guidance for BAP designation and the OMH survey handbook guidance [65], the area of grassland should be included as the overall mapped unit classified as OMH. Open grassland (and species-rich grassland) is included in both the UK BAP and the UKHab description of the early successional communities that comprise OMH. Yet ecologists unfamiliar with OMH frequently assign sections of grassland (and other habitats) as a separate habitat polygon, only assigning the sparse, early successional vegetated areas as OMH (as in this case study example).

Similarly, the patches of scrub are relatively small and scattered, and offer some additional structural diversity that likely adds to the conservation value of the mosaic (according to the BAP criteria, only continuous blocks of closed habitats >0.25ha should be classified as a habitat other than OMH). Some sections of the bare ground were friable and/or sandy and offered nesting opportunities for invertebrates, making them also a valuable feature that should be included within the OMH area.

Following this assessment, a revised map of the site (Figure 10) shows the extent of OMH on site, in accordance with the key qualifying BAP criteria and the guidance in the OMH survey handbook.

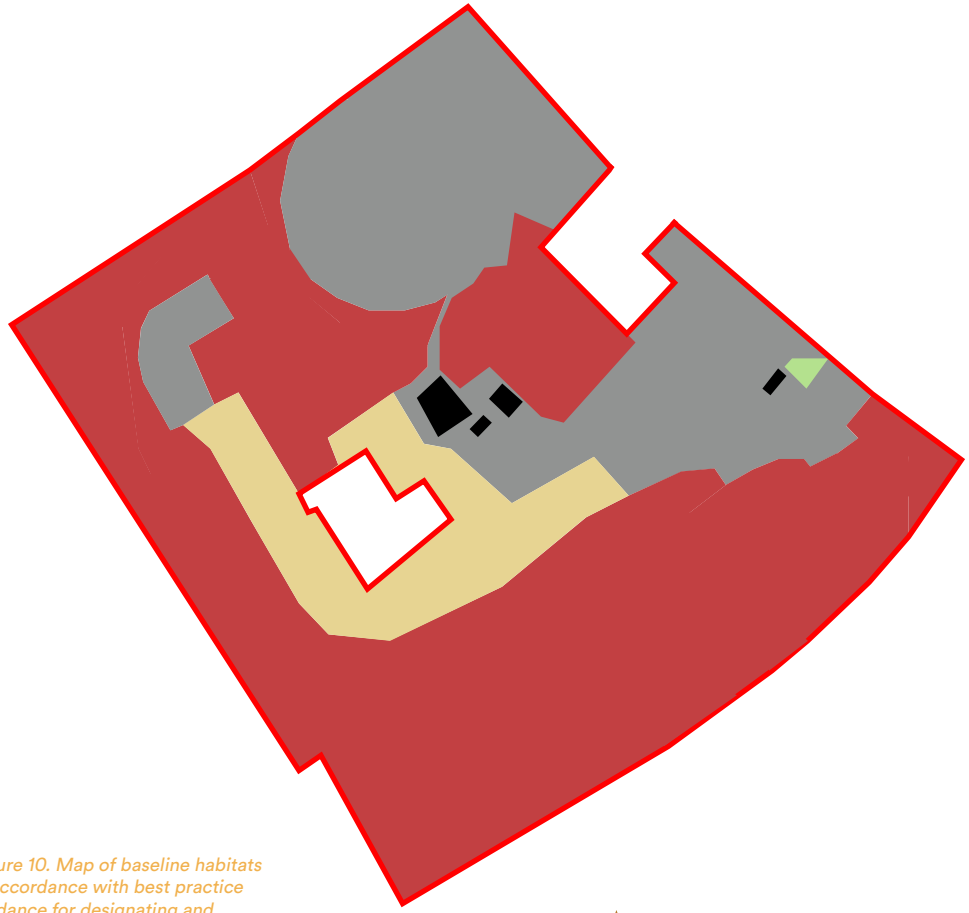


Figure 10. Map of baseline habitats in accordance with best practice guidance for designating and mapping OMH - Scenario 3.

Table 13 details the resulting BNG baseline unit calculations based on the reallocation of habitats in accordance with best practice for designating and mapping OMH.

In this OMH best practice mapping scenario, the total baseline biodiversity units equal **10.86**, resulting in an **increase of 7.4 units** compared to the initial habitat assessment. The original habitat creation plan that was proposed for the development would fall far short of the trading rules under this scenario, in terms of units and the requirement to provide like for like compensation for OMH. It is clear therefore from this case study, that ecological understanding of OMH is critical for accurate mapping of baseline habitats and can have a significant impact on the baseline unit calculation, which will in turn have important consequences for compensation requirements, given the like for like trading rules for OMH.

BROAD HABITAT	HABITAT TYPE	AREA	DISTINCTIVENES	CONDITION	STRATEGIC MULTIPLIER	UNITS LOST
URBAN	DEVELOPED LAND/SEALED SURFACE	0.30	V. LOW	N/A	1	0.00
URBAN	BARE GROUND	0.33	LOW	POOR[4]	1	0.66
URBAN	OPEN MOSAIC HABITAT	1.70	HIGH	POOR	1	10.20
ECOLOGICAL BASELINE			**TOTAL UNITS LOST**			**10.86**

Table 13. BNG baseline values for the case study site, in accordance with results from best practice habitat designation/mapping for OMH.

[4] The condition criteria within the Metric always scores bare ground as poor (due to lack of vegetation), whereas on a site like this, sandy areas of bare ground situated in proximity to the area of habitat mapped as OMH that are being used by nesting Aculeates could be considered 'good', but the system does not allow for this. As these areas offer resources for OMH invertebrates such as ground-nesting bees, this should also be mapped as OMH rather than separately as bare ground.

In the case study, the proposed development was fairly high-density, and whilst there would be opportunities for inclusion of OMH-type habitats and features, the majority of compensation for loss of the existing OMH would likely need to be off-site without revising the layout of the development to provide greater opportunities to incorporate OMH features into the site. In the case of offsetting, the area of off-site OMH habitat creation needed would depend on a variety of factors, such as:

- the off-site habitat baseline (e.g. existing habitat distinctiveness/condition)
- the strategic significance of the baseline habitat;
- the proximity of the compensation site to the local authority boundary (the spatial risk multiplier).

Alternatively, if available, it may be possible to purchase units from an OMH habitat bank. Any off-site compensation delivered away from the development site clearly results in a local loss of OMH. Ideally, where this is unavoidable, at least some of the valuable features of OMH could be creatively embedded into the designs of the new development, to compensate as much as possible for this local loss. The accompanying OMH Design Guide to this report (available here) provides users with the fundamentals and directions on best practice for achieving this.

CASE STUDY 2. URBAN BROWNFIELD SITE IN THE WEST MIDLANDS

The following case study uses data from the LPA planning portal to examine the BNG assessment of an urban development project in the West Midlands.

The application site was approximately 25.31 ha, and formed part of an industrial complex for car production, which ceased activity in 2016 when it became a derelict brownfield site. The site has undergone a series of demolition works since 2020 to remove most buildings, resulting in a large area of hardstanding, with a patchwork of habitats (concentrated at the boundaries) that comprised a mix of remnant soft landscaping and vegetation that had naturally colonised the site.

The immediate surroundings include residential housing, a wooded railway line, parkland and farmland, providing connecting habitat for species to colonise the site from the wider landscape. The proposed development for the site was a mixed-use commercial and residential scheme with an integrated public open space. The landscaping would retain the existing woodland and include new features such as an orchard, neutral grassland and wildlife ponds.

SCENARIO 1. BNG BASELINE HABITAT ASSESSMENT FOR PLANNING APPLICATION

A planning application to redevelop the site for the new commercial and housing project was submitted in 2021 and the BNG assessment report for the development submission designated baseline habitats for the site as shown in Figure 11.

Figure 11. Map of baseline habitat designations for the BNG assessment for the proposed redevelopment of the site.

KEY

- APPLICATION AREA
- GRASSLAND - MODIFIED GRASSLAND
- HEATHLAND AND SHRUB - MIXED SCRUB
- LAKES - PONDS (NON-PRIORITY HABITAT)
- SPARSELY VEGETATED LAND - RUDERAL/ EPHEMERAL
- URBAN - DEVELOPED LAND; SEALED SURFACE
- WOODLAND AND FOREST - LOWLAND MIXED DECIDUOUS WOODLAND
- LINE OF TREES
- URBAN - BUILT LINEAR FEATURE
- HEATHLAND AND SHRUB - MIXED SCRUB
- URBAN - INRODUCED SHRUB
- URBAN - STREET TREE

The original BNG assessment was made using version 2.0 of the Metric. For consistency with current practice, these have been transferred to the current Statutory Biodiversity Metric, and Table 14 provides a summary of the BNG baseline values generated.

BROAD HABITAT	HABITAT TYPE	AREA	DISTINCTIVENES	CONDITION	STRATEGIC MULTIPLIER	UNITS LOST
URBAN	DEVELOPED LAND/SEALED SURFACE	21.95	V. LOW	N/A	1	0.00
SPARSELY VEGETATED LAND	RUDERAL/ EPHEMERAL	0.84	LOW	GOOD	1	5.04
GRASSLAND	MODIFIED GRASSLAND	0.19	LOW	MODERATE	1	0.76
HEATHLAND & SHRUB	MIXED SCRUB	0.26	MEDIUM	POOR	1	1.04
LAKES	PONDS (NON-PRIORITY HABITAT)	0.02	MEDIUM	POOR	1.15	0.09
WOODLAND	LOWLAND MIXED DECIDUOUS WOODLAND	2.13	HIGH	MODERATE	1.15	29.39
INDIVIDUAL TREES	URBAN TREES	0.08	MEDIUM	MODERATE	1	0.64
ECOLOGICAL BASELINE			**TOTAL UNITS LOST**			**36.96**

Table 14. BNG baseline values for the case study site (taken from the BNG assessment report)

In this scenario, the habitats were mapped separately and those that could potentially be considered to form part of a habitat mosaic akin to OMH (e.g ruderal/ephemeral, grassland, mixed scrub) in the north-west corner of the site were mostly categorised as low distinctiveness habitat with low strategic significance. The total baseline biodiversity units therefore totalled 3.46 units.

In accordance with the Metric's trading rules, the suggested actions to address habitat loss were as follows:

- for Low distinctiveness habitats (e.g. ruderal/ephemeral and modified grassland), the 'same distinctiveness or better habitat' would be required;
- for Medium distinctiveness habitat (e.g. mixed scrub), the 'same broad habitat type or a higher distinctiveness habitat' would be required;
- for High distinctiveness habitat (e.g. lowland mixed deciduous woodland), 'like for like' habitat would be required.

The BNG compensation comprised on-site habitat creation only, including a variety of habitats such as vegetated gardens, allotments, neutral grassland, orchard and wildlife ponds, as well as retention and enhancement of existing woodland on site. According to the BNG assessment report this would deliver **66.15 units**, (plus hedgerow units), **resulting in an on-site net gain of 66.85%**.

SCENARIO 2. REVISED HABITAT ASSESSMENT RECLASSIFYING SUITABLE HABITAT AS OMH

Analysis of the BNG assessment report and supporting documents on the planning portal indicated that certain elements of the patchwork of habitats on site could be assessed to comprise OMH, principally the patches of ruderal/ephemeral with modified grassland and scattered scrub, circled on Figure 12. The area calculations exclude areas of hardstanding between habitat patches. Whilst some of the parcels are separated by patches of hardstanding, for mobile invertebrate species such as pollinators, the extent of this would not preclude movement between patches, and many OMH invertebrate species can navigate a less hospitable matrix to access suitable habitat (and some species use areas of hardstanding to bask and warm up for flight).

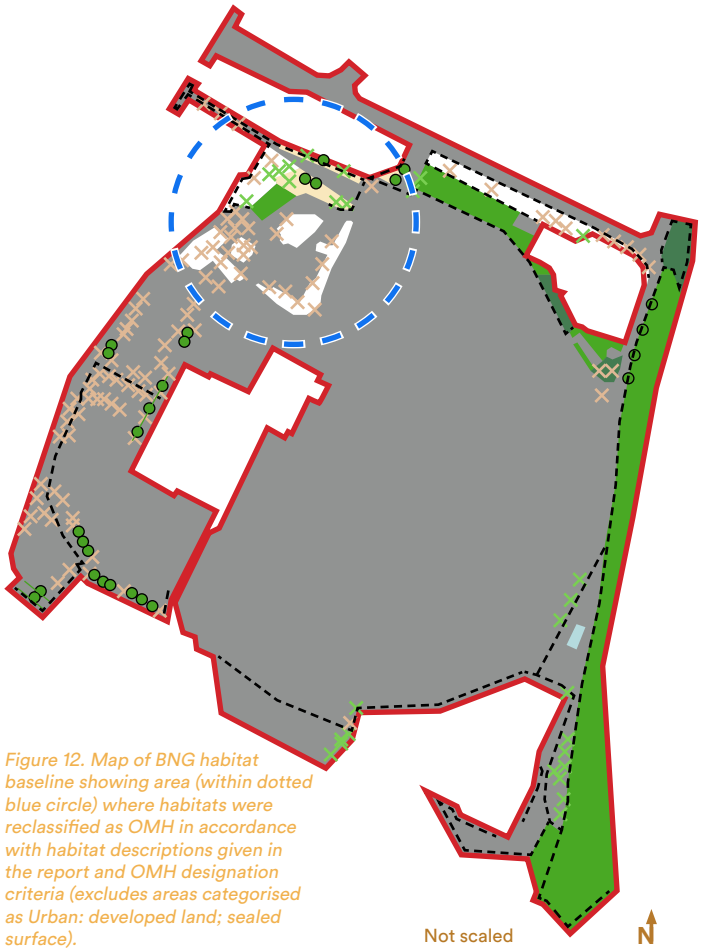


Figure 12. Map of BNG habitat baseline showing area (within dotted blue circle) where habitats were reclassified as OMH in accordance with habitat descriptions given in the report and OMH designation criteria (excludes areas categorised as Urban: developed land; sealed surface).

KEY

- APPLICATION AREA
- GRASSLAND - MODIFIED GRASSLAND
- HEATHLAND AND SHRUB - MIXED SCRUB
- LAKES - PONDS (NON-PRIORITY HABITAT)
- SPARSELY VEGETATED LAND - RUDERAL/ EPHEMERAL
- URBAN - DEVELOPED LAND; SEALED SURFACE
- WOODLAND AND FOREST - LOWLAND MIXED DECIDUOUS WOODLAND
- LINE OF TREES
- URBAN - BUILT LINEAR FEATURE
- HEATHLAND AND SHRUB - MIXED SCRUB
- URBAN - INRODUCED SHRUB
- URBAN - STREET TREE
- INDICATES HABITATS RECLASSIFIED AS OMH (NB: URBAN - DEVELOPED LAND; SEALED SURFACE EXCLUDED FROM AREA CALCULATION)

Table 15 details the resulting BNG baseline unit calculations based on the reallocation of habitats in accordance with best practice for designating and mapping OMH. For this calculation, OMH condition was assessed as 'moderate'. Whilst the original condition assessment for ruderal/ephemeral habitats was 'good', the latest Metric condition assessment sheets for OMH require a mosaic of at least four early successional communities plus bare ground to qualify as good condition.

In this scenario, where suitable habitat was mapped as OMH, the total baseline biodiversity units equal **42.92**, resulting in an **increase of 5.96 units** compared to the initial habitat assessment. The original habitat creation plan would no longer be viable as it would need to meet the requirement to provide like for like compensation for OMH either on site of off-site.

BROAD HABITAT	HABITAT TYPE	AREA	DISTINCTIVENES	CONDITION	STRATEGIC MULTIPLIER	UNITS LOST
URBAN	OPEN MOSAIC HABITAT	0.93	HIGH	MODERATE	1	11.16
URBAN	DEVELOPED LAND/SEALED SURFACE	21.95	V.LOW	N/A	1	0.00
SPARSELY VEGETATED LAND	RUDERAL/ EMPHEMERAL	0.10	LOW	GOOD	1	0.60
HEATHLAND & SHRUB	MIXED SCRUB	0.26	MEDIUM	POOR	1	1.04
LAKES	PONDS (NON-PRIORITY HABITAT)	0.02	MEDIUM	POOR	1.15	0.09
WOODLAND	LOWLAND MIXED DECIDUOUS WOODLAND	2.13	HIGH	MODERATE	1.15	29.39
INDIVIDUAL TREES	URBAN TREES	0.08	MEDIUM	MODERATE	1	0.64
ECOLOGICAL BASELINE			**TOTAL UNITS LOST**			**42.92**

Table 15. BNG baseline values for the case study site with habitats reclassified as OMH (see Figure 12 blue circle), in accordance with criteria for OMH habitat designation

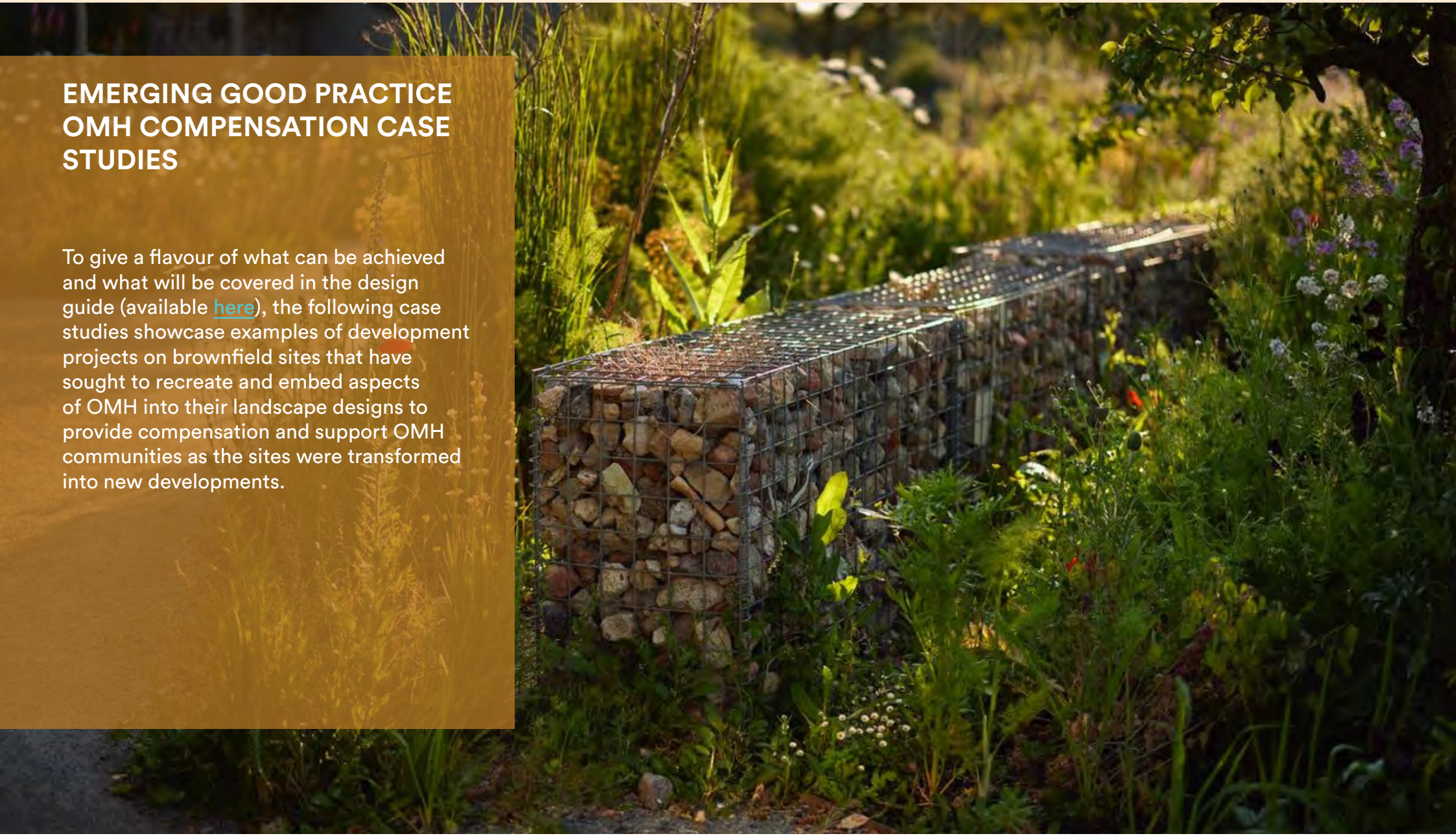
As has been shown with these two case studies, inaccurate mapping of OMH during the baseline habitats can have a significant impact on the baseline unit calculation as well as the requirements for compensation, and could lead to poor outcomes for the biodiversity associated with OMH.

For BNG to truly deliver net gains for OMH biodiversity it is critical that baseline habitats are accurately mapped so that appropriate compensation can be delivered. Best practice should be to deliver as much as possible on-site, and this can be achieved through innovative, best practice landscaping that includes the key ecological features of OMH combined with visually attractive urban landscape design.

The accompanying 'Compensatory Habitat Guide' to this report (available here) sets out the principles and practical approaches to creating OMH-style features that function for biodiversity and meet the visual requirements for inclusion in most urban developments. The following pages show two examples of emerging approaches to incorporating OMH features into urban landscaping on brownfield development sites.

EMERGING GOOD PRACTICE OMH COMPENSATION CASE STUDIES

To give a flavour of what can be achieved and what will be covered in the design guide (available here), the following case studies showcase examples of development projects on brownfield sites that have sought to recreate and embed aspects of OMH into their landscape designs to provide compensation and support OMH communities as the sites were transformed into new developments.



BARKING RIVERSIDE: RESEARCH SITE FOR INNOVATIVE APPROACHES TO NATURE-POSITIVE BROWNFIELD REDEVELOPMENT

Barking Riverside was a former brownfield site in East London, being transformed into a new community of approximately 11,000 homes.

The site had hosted a coal-fired power station, decommissioned in the 1980s. Parts of the derelict site contained waste fuel ash deposits, that were gradually colonised and developed OMH that supported a regionally important invertebrate fauna.

Planning consent for the development required a green infrastructure masterplan to conserve the site's important biodiversity, including public greenspaces and green roofs. A Knowledge Transfer Partnership with the developer, the local authority and the local university UEL, enabled UEL researchers to undertake state-of-the-art research, investigating best practice for designing nature-based solutions for the site that were suitable for an urban residential development and delivered ecological functionality for important brownfield communities.

Using a novel ecomimicry design approach that took inspiration from the important features and functions of biodiverse brownfield sites in the region, innovative landscaping and green roofs were developed and trialled at the site, to test their performance as a beneficial mitigation measure for conserving brownfield biodiversity. Experimental 'brownfield' landscaping and novel ephemeral wetland green roofs were designed to provide locally-attuned habitat niches for important brownfield species. Monitoring demonstrated that these designs were delivering much better outcomes for target groups, with more than double the number of conservation priority invertebrates recorded on the ecomimicry landscaping compared to traditional formal landscaping in the development site.

These promising results offered a blueprint for OMH compensation approaches for the Barking Riverside development and could be implemented in future residential developments as part of BNG.

Blending valuable brownfield habitat niches with the aesthetics of traditional urban landscaping techniques to provide ecological functionality and visual amenity and offers a template for OMH compensation approaches as part of BNG.

SILVERTOWN: A NEW EAST LONDON DEVELOPMENT INTEGRATING OMH PLANT COMMUNITIES INTO A DENSE URBAN DEVELOPMENT

Silvertown centres on the historic Pontoon Dock, whose story divides into two eras of industry: ship repair from the mid to late 1800s and flour milling up to 1992 with the Millenium Mills remaining as a key feature on the existing site.

The site, parts of which have been classified as OMH, is being regenerated into a residential-led mixed use masterplan. The design team are rising to the challenge of successfully delivering OMH into the public realm, courtyards and roof-spaces of this complex urban development.

Inspired by the OMH landscapes and proxies of John Little and James Hitchmough, the team of landscape architects, ecologists and soil scientists are experimenting with trial plots of varied substrates such as crushed brick/concrete, recycled sand, and a novel recycled waste product from Tate and Lyle's sugar production plant nearby - calcium carbonate (chalk). These are seeded using 4 different wildflower seed mixes with additions of typical OMH species. The trials are an opportunity to discover which species emerge and thrive, durations, perception, resilience, and critically whether the habitats constitute OMH. The trials also aim to inform maintenance and management strategies for the public realm landscape as it is established over the coming years.

Images kindly provided by Churchman Thornhill Finch

7 Final Summary

BNG represents a new mechanism to deliver a nature positive future, reversing decades of biodiversity decline. For it to be an effective tool, it needs to be delivered in a strategic way:

- in harmony with the local landscape context,
- delivering conservation of the most ecologically valuable sites,
- extending, buffering, and reconnecting these important protected sites, and
- making the landscape more liveable and permeable for biodiversity.

BNG in parallel with Local Nature Recovery Strategies, has the potential to deliver these goals, but there remain some challenges to its successful implementation. Post-industrial sites on previously developed land represent one such unique challenge. Whilst redevelopment of post-industrial sites to meet housing and regeneration targets can be a successful strategy, a proportion of brownfield sites that become recolonised by nature have value as a key part of blue/green infrastructure across the urban fabric. Biodiverse brownfields can provide key ecosystem services to urban communities as well as supporting rich pockets of urban biodiversity. Indeed, post-industrial sites of the highest environmental quality can be some of the most biodiverse areas in England's heavily managed landscapes, leading to the Priority Habitat designation as Open Mosaic Habitat on Previously Developed Land (OMH).

Brownfield sites that support biodiversity can pose a paradox, with competing requirements to meet national and local planning policies that prioritise their brownfield redevelopment for housing, versus targets for delivery on nature conservation. Areas such as the West Midlands Combined Authority region face such a challenge. With the areas rich industrial history, and subsequent deindustrialisation, there is a legacy of post-industrial brownfields such as disused factories, mines and foundries, some of great ecological value, and others ideal sites for redevelopment.

If Biodiversity Net Gain (BNG) is to leave the natural environment in a measurably better state than before, and contribute to the recovery of nature, then biodiverse brownfield sites and OMH must be appropriately characterised and valued within the planning process. OMH however, represents a complex challenge for BNG, with its mosaic of habitat types, its minimum size threshold, and its complex condition assessment criteria meaning that a single site could be dealt with very differently through different BNG interpretations. This document is intended to support ecologists, local authority planners, and other urban development practitioners to understand the complex nuances of OMH evaluation and decision-making as part of the BNG process, to enable best practice outcomes and nature positive development.

Whether it be identification of OMH in the planning process, mitigation of OMH through BNG, creation of OMH as a high distinctiveness habitat unit as part of BNG trading, or merely a desire to create more biodiversity-friendly green spaces in and around cities, OMH has the potential to provide many lessons for landscape designers in terms of what nature needs to thrive. That includes habitat characteristics such as varied substrates and nutrient levels, complex topography, and sporadic disturbance.
To support users in understanding why OMH is so important for biodiversity, and how to recreate this value as part of urban redevelopment, this report is accompanied by a Design Guide (available here), to support users in planning the design and management of OMH landscapes.

The accompanying design guide (available here) showcases best practice for creating high quality urban green infrastructure that incorporates the important features and functions of OMH and biodiverse brownfield sites, demonstrating how this can provide a nature-rich and sustainable alternative to traditional urban landscaping approaches, enabling delivery of high quality OMH landscaping as part of BNG.

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A Acknowledgements

CONTACT INFORMATION

West Midlands Combined Authority
16 Summer Lane
Birmingham
B19 3SD

Get in touch e: environment@wmca.org.uk

Mondays, Tuesdays, Thursdays
and Fridays, 8am to 6pm
Wednesdays, 10am to 6pm
Saturdays, 9am to 1pm
Sundays and Bank Holidays, Closed

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UEL TEAM

Caroline Nash (Senior Research Fellow)

Stuart Connop (Professor and Director of Sustainability Research Institute)

Robert Vida (Graphic Design)

Joseph Sanchez (Research Assistant)

OTHER CONTRIBUTORS

Mike Webb and officers of the WMCA

Chris Hogarth and Nick White of Natural England

Sam Ralph of Defra

Simon Newell and Elspeth Page of Coventry Council

Andy Jukes of Conops Entomology

Aaron Bhambra of University of Birmingham

Dusty Gedge

John Little of Grass Roof Company

X Appendix - Legislation, policy and strategy

INTERNATIONAL

LEADER'S PLEDGE FOR NATURE	Pledges to be Nature Positive by 2030
GLOBAL BIODIVERSITY FRAMEWORK	30 × 30 commitment)- to protect 30% of our land and seas for nature by 2030
UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS	Specifically: **SDG 15: Life on Land** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss **SDG 11 – Sustainable Cities & Communities** Make cities and human settlements inclusive, safe, resilient and sustainable. Also links to other SDGs, including climate action, reduced inequalities, decent work and economic growth, amongst others

UNITED KINGDOM

UK GOVERNMENT'S 25 YEAR ENVIRONMENT PLAN (25YEP)	Sets out an ambition to leave the natural environment in a better state for future generations, refers to net gains for the natural environment and sets out plans for BNG. Also, to establish a Nature Recovery Network to protect and restore wildlife and complement and connect existing high quality wildlife sites
ENVIRONMENTAL IMPROVEMENT PLAN	Update of above – apex goal: improving nature, including BNG. **Challenge**: Government ambition for a major increase in housebuilding – 300k extra homes – and infrastructure investment.
NATURE POSITIVE 2030 (STRATEGY)	"*…this means that just stopping any further habitat loss is not enough to halt biodiversity decline: we now need to make more space for nature.*"

NP2020 EVIDENCE REPORT	4.1 Plan for a Healthy Planet & Healthy People: prioritising the integration green and blue infrastructure into developments on land using natural solutions in place of built 'grey' infrastructure. The use of greenspace standards to ensure people can easily access nature, even in urban settings. Securing environmental gains alongside built development through the planning system, and ensuring gains are maintained in long-term. Aim for administrative body responsible for housing not just having an objective to build new houses, but also having a stake in the quality of the lives of the people who will live in them: an important opportunity to achieve win-wins for nature and people is by delivering many of the outcomes currently sought primarily through built 'grey' (concrete) infrastructure through 'green and blue' infrastructure.
INVASIVE NON-NATIVE SPECIES STRATEGY	About 10 to 15% of NNS established in GB cause significant adverse environmental, economic, and social impacts. Environmental impacts include *disrupting habitats and ecosystems, preying on or out-competing native species*. The strategy aims to prevent and reverse these patterns, aligning with other environmental strategies.

BIODIVERSITY 2020 (UNTIL POST-2020 STRATEGY RELEASED)	Halt overall biodiversity loss by 2020, set ambitious goals: ■ better wildlife habitats – quality goals for priority habitat and Sites of Special Scientific Interest (SSSIs) ■ more, bigger and less fragmented areas for wildlife – an increase in priority habitats by at least 200,000ha ■ the restoration of 15% of degraded ecosystems – as a contribution to climate change mitigation and adaptation ■ establishing a Marine Protected Area network ■ managing and harvesting fish sustainably ■ marine plans in place by 2022 ■ an overall improvement in status of our wildlife and prevention of further human-induced extinctions of known threatened species ■ significantly more people engaged in biodiversity issues, aware of its value and taking positive action

ENGLAND

NATIONAL PLANNING POLICY FRAMEWORK - THE DEPARTMENT FOR LEVELLING UP, HOUSING AND COMMUNITIES (DLUHC)	**3 (PPS3)** - Government's commitment to the 60 per cent target for new homes built on brownfield land, stressing that local authorities should continue to prioritise brownfield land in their plans and "take stronger action" to bring more brownfield land back into use. The following paragraphs directly relate to the conservation of habitats in planning applications: Part 11. Making effective use of land: b) recognise that some undeveloped land can perform many functions, such as for wildlife, recreation, flood risk mitigation, cooling/shading, carbon storage or food production. Part 15. Conserving and enhancing the natural environment: 174. planning policies and decisions should contribute and enhance the natural and local environment by... minimising impacts on and **providing net gains for biodiversity**, including by establishing coherent ecological networks that are more resilient to current and future pressures;... (para 179) To protect and enhance biodiversity and geodiversity, plans should... identify and pursue opportunities for securing **measurable net gains for biodiversity**. 175. Plans should: distinguish between the hierarchy of international, national, and locally designated sites; **allocate land with the least environmental or amenity value**, where consistent with other policies in this Framework; **take a strategic approach to maintaining and enhancing networks of habitats and green infrastructure**; and plan for the enhancement of natural capital at a catchment or landscape scale across local authority boundaries.

THE ENVIRONMENT ACT, 2021	Introduces a new framework for setting long-term, legally binding targets for environmental improvement, including mandating BNG: Part 6 – Nature and Biodiversity, Schedule 14: '*makes provision for biodiversity gain to be a condition of planning permission in England*' (and Schedule 15 for Nationally Significant Infrastructure Projects). Sets out the requirement for a biodiversity gain site register, biodiversity credits and for preparation and publication of Local Nature Recovery Strategies by responsible authorities (e.g. Local or Combined Authorities).
THE BIODIVERSITY GAIN (TOWN AND COUNTRY PLANNING) (CONSEQUENTIAL AMENDMENTS) REGULATIONS 2024	The Regulations introduce amendments to the Town and Country Planning Act 1990, specifically addressing biodiversity gain in England, mandating every planning permission for land development in England submit a biodiversity gain plan before development can commence lawfully. This plan must demonstrate a net gain of at least 10% in biodiversity between pre- and post-development states.
THE BIODIVERSITY GAIN SITE REGISTER REGULATIONS 2024	Sets out the details and eligibility criteria for the creation of a publicly available "biodiversity gain site register", that will be established and maintained by Natural England.

THE BIODIVERSITY GAIN SITE REGISTER (FINANCIAL PENALTIES AND FEES) REGULATIONS 2024	Allows for fees to be incurred when registering land in the biodiversity gain register and financial penalties to be charged where incorrect information is provided.
THE BIODIVERSITY GAIN REQUIREMENTS (EXEMPTIONS) REGULATIONS 2024	Sets out the categories of development that are exempt from creating biodiversity net gain.
THE BIODIVERSITY GAIN REQUIREMENTS (IRREPLACEABLE HABITAT) REGULATIONS 2024	Lists the habitats that are considered irreplaceable and for which the standard 10% requirement will not be applied.
THE BIODIVERSITY GAIN (TOWN AND COUNTRY PLANNING) (MODIFICATIONS AND AMENDMENTS) (ENGLAND) REGULATIONS 2024	Details how the BNG process will work within the existing planning application procedure, and includes details of how appeals should be made.

THE ENVIRONMENT (LOCAL NATURE RECOVERY STRATEGIES) (PROCEDURE) REGULATIONS 2023	Details requirements for the preparation LNRS, in particular, the procedure to be followed in their preparation and publication, and review and republication. Requires responsible authorities to publish certain information relating to LNRS and to take all reasonable steps to ascertain the location and area of all local nature reserves and other relevant sites (as defined) wholly or partly within the strategy area.
THE NATURAL ENVIRONMENT AND RURAL COMMUNITIES (NERC) ACT, 2006	Section 40 includes a duty for public authorities to conserve biodiversity... "*the public body must in exercising its functions have regard as far as is consistent with the proper exercise of those functions...to the purpose of conserving biodiversity...conserving biodiversity includes in relation to a living organism or type of habitat, restoring or enhancing a population or habitat...*"
LEVELLING UP WHITE PAPER (DLUHC)	Aims to improve productivity in North and Midlands, including: ■ 101 towns across England receiving £2.4bn from the Towns Fund to unleash their economic potential, and the £830m Future High Streets Fund regenerating 72 towns and high streets and helping them recover from the pandemic. ■ £4.8bn infrastructure investment in towns across the UK via the Levelling Up Fund.

LOCAL AND STRATEGIC PRIORITIES

WMCA NATURAL ENVIRONMENT PLAN 2021-2026

Actions include:

- Explore ways to ensure **biodiversity net gain** across new transport infrastructure and other developments funded by the WMCA.
- Develop regional natural capital data capture and mapping to better understand the state of the region's nature and prepare the foundations for a Local Nature Recovery Strategy
- Set up a Wildlife Corridors Commission to develop a 'doorstep to landscape' vision for the region, maximising the connectivity, for both people and wildlife, through green and blue corridors

Local Nature Recovery Strategies, with their focus on comprehensive habitat mapping and biodiversity net gain, will be central to this. Our focus is on genuine net gain, not just covering losses from new development.

WMCA emerging LNRS can be found at:
https://www.wmca.org.uk/what-we-do/environmentenergy/local-nature-recovery-strategy-for-the-westmidlands/

WEST MIDLANDS INDUSTRIAL STRATEGY (2019)	Led by the Mayoral Combined Authority, working with Local Enterprise Partnerships and local authorities, in partnership with government it is a long-term plan aimed to increase productivity. "*...committed to celebrating and improving the high quality natural environment, public spaces and biodiversity that make the region a great place to succeed and is integrating the environment into all its decision-making.*" The West Midlands will: "*remain committed to developing a long-term plan for Natural Capital and to the principle of an annual net gain for natural capital, developing the tools that enable us to work towards reversing the current trend in biodiversity loss*" **Challenge:** The West Midlands will: ■ *increase the rate of housing delivery in line with the Housing Package agreed with government;* ■ *invest in land remediation, bringing sites forward and developing the skills required through the National Brownfield Institute in Wolverhampton.*

	National Brownfield Institute: A crucial asset for tackling land availability shortages for housing and employment land is the National Brownfield Institute at the University of Wolverhampton. A team of specialist researchers, consultants, and industry experts who will advise on all aspects of brownfield development, from dealing with contaminated land to repurposing buildings and sites. The Housing Package includes the growing brownfield construction cluster in Wolverhampton The Black Country Land and Property Investment Fund will support the re-use of brownfield land and buildings and the delivery of supporting infrastructure.
BIRMINGHAM AND BLACK COUNTRY NATURE IMPROVEMENT AREA ECOLOGICAL STRATEGY 2017-2022 WILDLIFE TRUST FOR BIRMINGHAM AND BLACK COUNTRY	Identifies **Core Ecological Areas** that are richest in wildlife… "*includes areas where wildlife has reclaimed sites that were once at the heart of the industrial Black Country*". Protect and sympathetically manage as part of planning development/sustainable land use. **Ecological linking areas** include "*remaining 'natural' open spaces… often in very close proximity to dense human populations.*" Enhance by restoring/enhancing habitats. **Ecological opportunity areas** include "*most intensively used parts of the landscape… formal parks, public open spaces, gardens, road verges…*". Create new sites here to form networks for wildlife movement in the most developed areas.

WILDLIFE TRUST FOR BIRMINGHAM AND BLACK COUNTRY LOCAL NATURE RECOVERY OPPORTUNITIES MAP	A draft map through analysis of local and national data sets including designated sites, priority habitats, species distribution, land use and ecological connectivity. Comprises a number of components that depict the areas of current high ecological value, ecological connectivity between these areas, and prioritises opportunities for investment in nature's recovery on a landscape scale.
BIRMINGHAM NATURE RECOVERY STRATEGY 2022-2030	Includes ambitions to: *protect from harm* and improve the wildest places (SSSIs, LWS – core sources of wildlife in the city), including increasing their size; *make connections between them* creating and conserving stepping-stones and corridors; and provide a bigger overall area for wildlife through land management or development to strengthen, not weaken, the network of habitats. BNG and Nature Recovery Network are instrumental to this to provide a long-term income stream and delivery mechanism for the improvement and enhancement of biodiversity in the city's parks and open spaces. Also highlights the inequality in access to the wealth of wildlife and important habitats across Birmingham and the Black Country, resulting in disconnection from the natural world. **Key goal:** *Nature is playing a central and valued role in helping to address local and global problems, including all new development provides a positive impact on biodiversity and ensuring maintenance and planting schemes have a positive impact on the future climate.*

BIRMINGHAM LOCAL PLAN [IN DEVELOPMENT]

Birmingham have undertaken a consultation on their Local Plan Preferred Options Document prior to preparing the publication version of the BLP. The 'vision' statement within this document states Birmingham will be "*A city of nature with more wildlife, trees and a rich multifunctional, connected green infrastructure network that can be enjoyed by everyone*".

Objective 3 - Resilient City aims: "*To ensure development is designed to create resilient, adaptive and liveable environments that supports nature and human health and well-being*".

Amongst the aim of Objective 9 – City of Nature is:
- To **deliver net gains in biodiversity** and improve fair access to nature.

Section 4 'planning for growth' includes a complementary approach of '**Maximising the use of brownfield land**' for development.

Section 5 'proposed development strategy' states it "…*will focus development predominantly within the existing urban area through the regeneration of brownfield land…*"

Section 8 'homes and neighbourhoods' prioritises previously developed land for new housing.

Section 9 'climate and environment' includes **Policy CE11 Biodiversity Net Gain** that aligns with statutory BNG requirements, and states "*New developments must deliver a specified proportion of their BNG requirement on site, unless there is robust evidence that it is not be feasible to do so*" It also includes an alternative policy option to be considered that states: "*One option may be to adopt a more flexible approach to BNG requirements across the City through progressing a typology based BNG policy based on particular site characteristics. For example, this may seek a higher % of BNG on brownfield sites*".

Policy CE10 on Biodiversity and Geodiversity states "…*All development proposals, **including those that are exempt from mandatory Biodiversity Net Gain requirements, must provide biodiversity and geodiversity enhancement measures** that are appropriate to the location, nature and scale of the development. **All BNG exempt developments must incorporate ecological design features** including biodiversity roofs and walls, water features, native trees, shrubs and wildflowers, and species-specific interventions such as integrated bat roost features, bird nest boxes for swifts and other target species, hedgehog highways in walls and fences and insect homes. Development proposals must clearly identify how the ongoing management of biodiversity and geodiversity enhancement measures will be secured, including combating invasive non-native species.*"

WOLVERHAMPTON LOCAL PLAN [IN DEVELOPMENT]	In January 2023, the Council announced that they will wait to consider the full implications of the final version of the National Planning Policy Framework before progressing the new Wolverhampton Local Plan. The announcement also stated a potential **challenge**: "*We have always promoted a brownfield first approach to our Local Plan…our focus is on developing brownfield sites. The Wolverhampton Local Plan will provide a vibrant mixed use city centre while enabling new housing and employment opportunities on brownfield sites across the city, supporting local centres and strengthening the local economy.*"
DUDLEY LOCAL PLAN - DUDLEY COUNCIL [IN DEVELOPMENT]	Dudley Borough Development Strategy includes a focus on biodiversity including: *Developments will be positively encouraged where they demonstrate improvements, expansion or increased links to nature conservation sites, evidenced from up-todate ecological surveys.* Also states a potential **challenge**: *The Black Country Core Strategy promotes the development of 'Brownfield first' ensuring that previously developed land, particularly where vacant, derelict or underused, is prioritised for development over greenfield sites.*

COVENTRY LOCAL PLAN (2011-2031) – COVENTRY CITY COUNCIL	Adopts a green infrastructure approach: *New development proposals should make provision for green infrastructure to ensure that such development is integrated into the landscape and contributes to* ***improvements*** *in connectivity and public access,* ***biodiversity****, landscape conservation, design, archaeology and recreation.* *Development proposals will be expected to ensure that they:* *a. lead to a* ***net gain of biodiversity****, where appropriate, by means of an approved ecological assessment of existing site features and development impacts;* *b. protect or enhance biodiversity assets and secure their long term management and maintenance;* *c. avoid negative impacts on existing biodiversity;* *d. preserve species which are legally protected, in decline, are rare within Coventry or which are covered by national, regional or local Biodiversity Action Plans* *Policy EM2: Building Standards* *1. New development should be designed and constructed to meet the relevant Building Regulations, as a minimum, with a view to:* *f. Incorporating measures to enhance biodiversity value.* Identifies a priority for development on brownfield, but also that it is a diminishing resource.

SANDWELL LOCAL PLAN - SANDWELL COUNCIL	Sandwell Local Development Plan – in development. The Council's Sandwell Vision 2030 sets out ambitions which will have relevance for the new SLP. Ambition 1: "*…to protect and enhance the natural environment, nature conservation and open spaces; deliver opportunities for biodiversity net gain, landscaping and tree planting.*" Objective 9: "*Protect and improve Sandwell's environment, including its natural landscapes, green infrastructure and biodiversity, as well as its rich historic built environment.*" Objective 10: "*Encourage the effective and prudent use of previously developed land and natural resources, including the efficient use of land and buildings and the use of sustainable and climate aware construction techniques within new developments, as well as providing for waste management and disposal.*"
SOLIHULL LOCAL PLAN - SOLIHULL.GOV.UK [NEW PLAN IN DEVELOPMENT]	The old Local Plan included a focus on halting and reversing biodiversity declines, including a blue/green infrastructure focus. *Developers will be required to undertake a full ecological survey and to deliver a net gain or enhancement to biodiversity, unless it is demonstrated that it is not appropriate or feasible.*

WALSALL LOCAL PLAN [NEW PLAN IN DEVELOPMENT AFTER BLACK COUNTRY PLAN ENDED]	The former Unitary Development Plan stated: "*The protection, management and enhancement of the natural environment is recognised as being fundamental to the social, economic and ecological wellbeing of the Borough and will be promoted and encouraged accordingly. Development proposals should not destroy, damage or adversely affect nature conservation interests and, where possible, should enhance provision for wildlife. The Council will seek to achieve the targets for the conservation of species and habitats set by the Birmingham and Black Country Biodiversity Action Plan and will seek to keep up to date information about local species, habitats, geology, and landform. The Council will seek to identify, protect, and enhance new wildlife sites that are of appropriate quality for designation.*"
WARWICKSHIRE, COVENTRY & SOLIHULL LOCAL BIODIVERSITY ACTION PLAN	52 plans including: Open Mosaic Habitat HAP with a target to complete the identification of all 90 ha of existing open mosaic habitats and their ownership by 2026, and to restore 80 ha of degraded priority sites by 2026. Built Environment HAP includes targets conserve the biodiversity elements within the existing built environment and create new opportunities for biodiversity in and around the existing and new built environment. Progress reports indicate better progress towards targets for OMH, but limited progress towards the built environment targets.

BIRMINGHAM AND THE BLACK COUNTRY BIODIVERSITY ACTION PLAN (2010)	Includes OMH targets for restoration/creation and detailed description of OMH: "*Considerable knowledge has been gained on the ecology of urban wasteland, now a national priority habitat called Open Mosaic Habitat on Previously Developed Land. The rich wasteland habitats of the east side of Birmingham city centre have recently been surveyed to provide baseline data for the regeneration of this area. One local authority has produced a basic inventory of sites, although this often difficult to define and transitory habitat has proved difficult to survey comprehensively and its total extent is unknown*". Appendix 5 states the extent of OMH in 2015 was 147 hectares, to be maintained as no net loss of extent to 2026, with 16 hectares restored by 2026.

West Midlands Combined Authority

Greener Together

University of East London

SRI Sustainability Research Institute

Grass Roof Company
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