Brownfield Habitats and Biodiversity Net Gain

Compensatory Habitat Guide

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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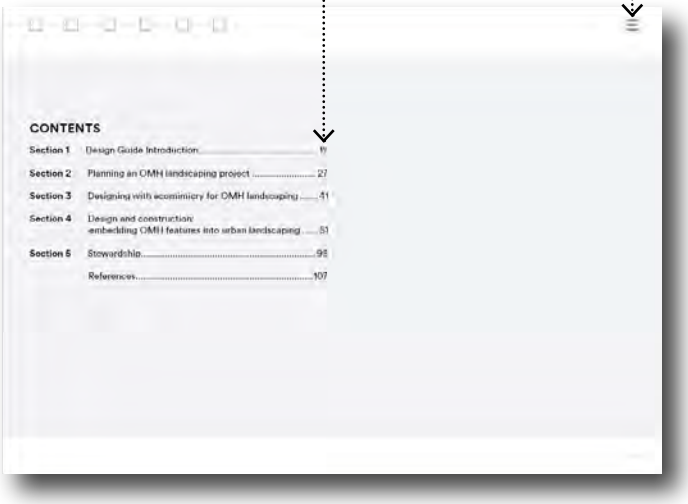

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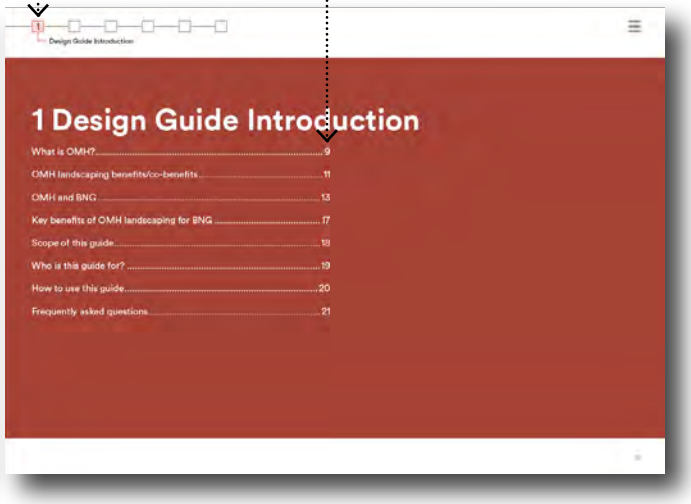

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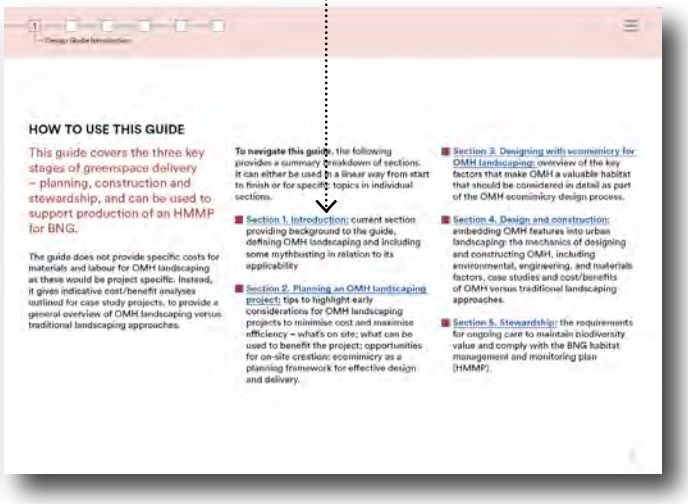

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FOREWORD

Mike Webb
Senior Natural Capital Programme Manager, West Midlands Combined Authority

England is one of the most nature depleted countries in the world and our biodiversity continues to decline due to a range of factors. To address this the government has set a clear ambition to halt the decline of biodiversity and to take additional steps towards nature recovery. The West Midlands Combined Authority (WMCA) is playing a key role in this through its work on the Local Nature Recovery Strategy and other initiatives driving nature recovery projects, for example the Local Investment in Natural Capital (LINC) programme.

Around 70% of the region is dominated by built up and suburban areas and our industrial past has, in places, changed the nature of our landscape in the most unusual way. In some cases where varied ground conditions occur, due to historic land uses, alongside dereliction and abandonment a 'novel' composite of habitat types can establish to form Open Mosaic Habitat on previously developed land (OMH). This habitat can be of high ecological value for a range of species and, as such, it is recognised as a national 'Priority habitat' type. Further to this, urban brownfield sites have been shown in some cases 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.

To meet our national needs, thousands of new homes will be built as part of the government's plans to get the country building again, create jobs and grow the economy. These plans are driven by a 'brownfield-first' policy focusing development on these areas which have had previous uses. Though most previously developed sites have limited ecological value, we do understand and appreciate that in some cases sites may contain the OMH priority habitat type. Where this occurs the responsible action to take is to ensure that appropriate habitat compensation for any impacts is built into the development. Such measures are also now a requirement of new development following the introduction of the mandatory requirement of Biodiversity Net Gain.

With an understanding of the challenges of developing brownfield sites, the WMCA has developed this design guide to support stakeholders involved in urban development, and specifically brownfield sites, to ensure positive outcomes for biodiversity and delivery of high-quality habitat as part of Biodiversity Net Gain (BNG).

This is an important piece of work, not only for the West Midlands, but for other urban areas across England, as it will help to address the need to deliver housing on brownfield sites in a more sensitive and sustainable way, creating better multi-functional green infrastructure for people and nature to benefit from.

Nick White

Principal Advisor - Net Gain, Natural England

With biodiversity net gain (BNG) now a legal requirement for many developments, and with a Government emphasis on brownfield first development, this guide is a useful and very timely publication that can help practitioners design for and deliver brownfield BNG whilst incorporating the ecologically highly valuable features of Open Mosaic Habitat (OMH) into their designs.

Chris Hogarth

Senior Specialist- Urban Ecology, Natural England

Open Mosaic Habitats on Previously Developed Land (OMH) by definition has to occur on brownfield sites and so will always be at risk of loss due to redevelopment. A desk review of the draft OMH inventory carried out in 2024 comparing inventory GIS polygons to recent aerial photographs suggested that around 25% of polygons in the original dataset needed to be removed, mostly because of development or vegetation succession. This trend will continue. The guide comes at the right time to help practitioners develop innovative and creative ways to retain good quality OMH in the design of developments, create new areas of OMH type habitats where losses cannot be avoided and manage the OMH resource well so that it contributes to nature's recovery.

I Introduction

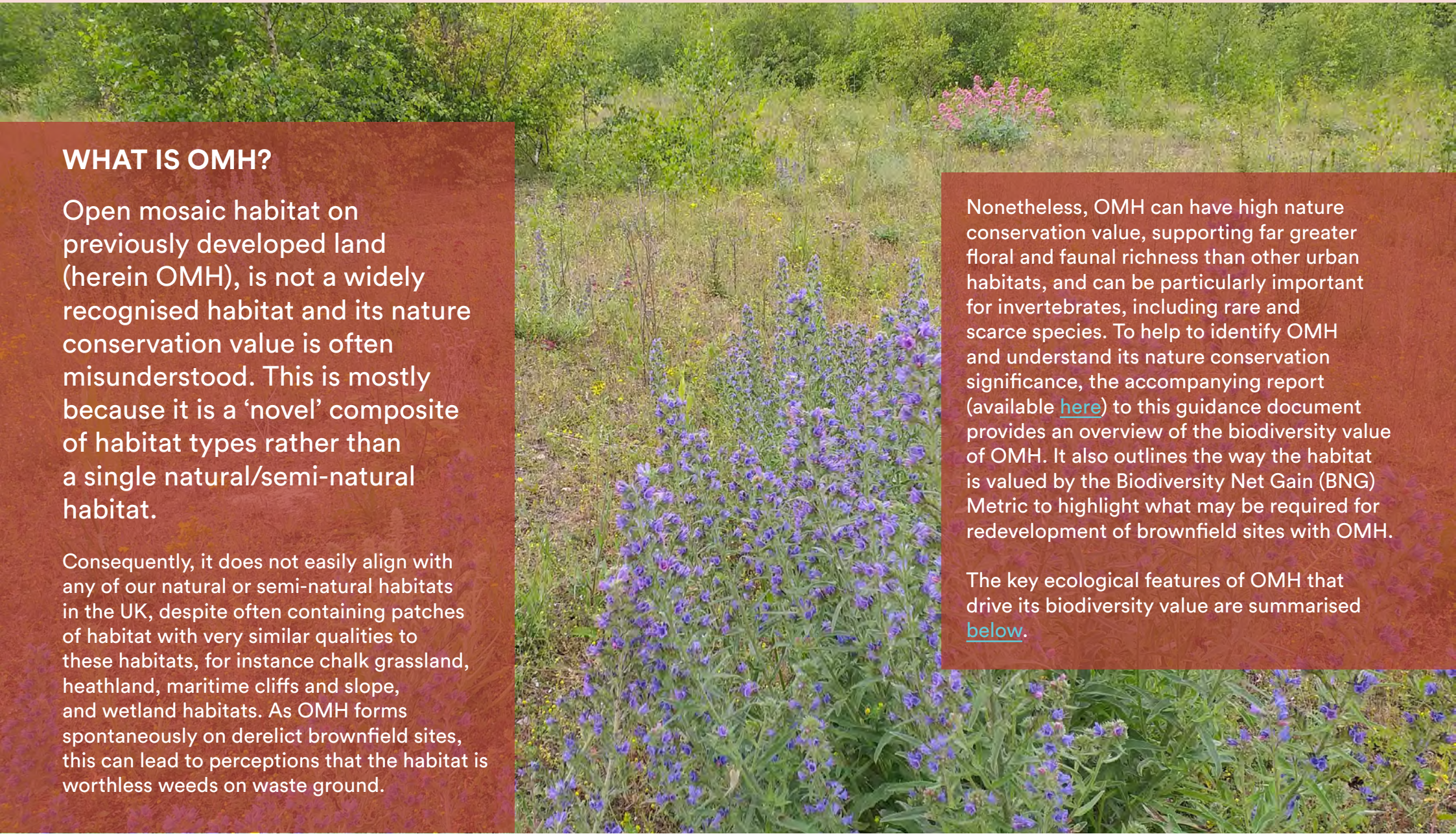
INTRODUCTION

This guidance document forms the accompanying part of an overall study supporting the West Midlands Combined Authority (WMCA) in developing locally-contextualised guidance for stakeholders involved in urban development, and specifically brownfield sites, to ensure positive outcomes for biodiversity and delivery of high quality habitat as part of Biodiversity Net Gain (BNG).

The opening report – Brownfield Habitats and Biodiversity Net Gain: Introduction and Context (available here) – provides a detailed overview of brownfield biodiversity, Open Mosaic Habitat on Previously Developed Land (herein referred to as OMH), the local (WMCA) and national planning and nature conservation policy context, and sets out brownfield habitats and OMH within BNG requirements, the Statutory Metric and BNG best practice.

This complementary design guide showcases best practice for designing and creating high quality urban green infrastructure that incorporates the important features and functions of OMH and biodiverse brownfield sites. The guide illustrates how this approach can provide a nature-rich and sustainable alternative to traditional landscaping approaches, enabling delivery of good quality OMH and brownfield habitats as part of BNG.

1 Design Guide Introduction



WHAT IS OMH?

Open mosaic habitat on previously developed land (herein OMH), is not a widely recognised habitat and its nature conservation value is often misunderstood. This is mostly because it is a 'novel' composite of habitat types rather than a single natural/semi-natural habitat.

Consequently, it does not easily align with any of our natural or semi-natural habitats in the UK, despite often containing patches of habitat with very similar qualities to these habitats, for instance chalk grassland, heathland, maritime cliffs and slope, and wetland habitats. As OMH forms spontaneously on derelict brownfield sites, this can lead to perceptions that the habitat is worthless weeds on waste ground.

Nonetheless, OMH can have high nature conservation value, supporting far greater floral and faunal richness than other urban habitats, and can be particularly important for invertebrates, including rare and scarce species. To help to identify OMH and understand its nature conservation significance, the accompanying report (available here) to this guidance document provides an overview of the biodiversity value of OMH. It also outlines the way the habitat is valued by the Biodiversity Net Gain (BNG) Metric to highlight what may be required for redevelopment of brownfield sites with OMH.

The key ecological features of OMH that drive its biodiversity value are summarised below.

KEY ECOLOGICAL FEATURES OF OMH

OMH typically occurs on sites that have varied, generally nutrient-poor soils, as well as varied topography and aspects.

This creates underlying and above-ground structural diversity, generating a range of growing conditions and microclimates. This drives a patchwork of mixed habitats to develop, including sparse early successional communities, flower-rich habitats, bare ground and often seasonal wetlands. Informal, sporadic small-scale disturbance events by animals or humans (e.g. rabbit grazing/digging, fires, off-road vehicles) are an important feature of OMH sites, as these can restart successional processes, reinstating bare ground (a valuable resource for ground-nesting invertebrates and other wildlife) and help to maintain habitat diversity by kickstarting fresh habitat development.

KEY ENVIRONMENTAL FEATURES:

- VARIED NUTRIENT-POOR SOILS
- VARIED ASPECTS
- VARIED TOPOGRAPHY
- VARIED HYDROLOGY

CREATES:

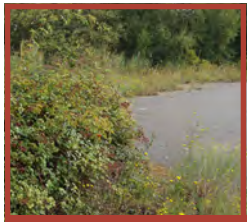
- STRUCTURAL DIVERSITY
- VARIED MICROCLIMATES
- DRIVES DEVELOPMENT OF HABITAT MOSAICS

HABITAT MOSAICS MAY INCLUDE

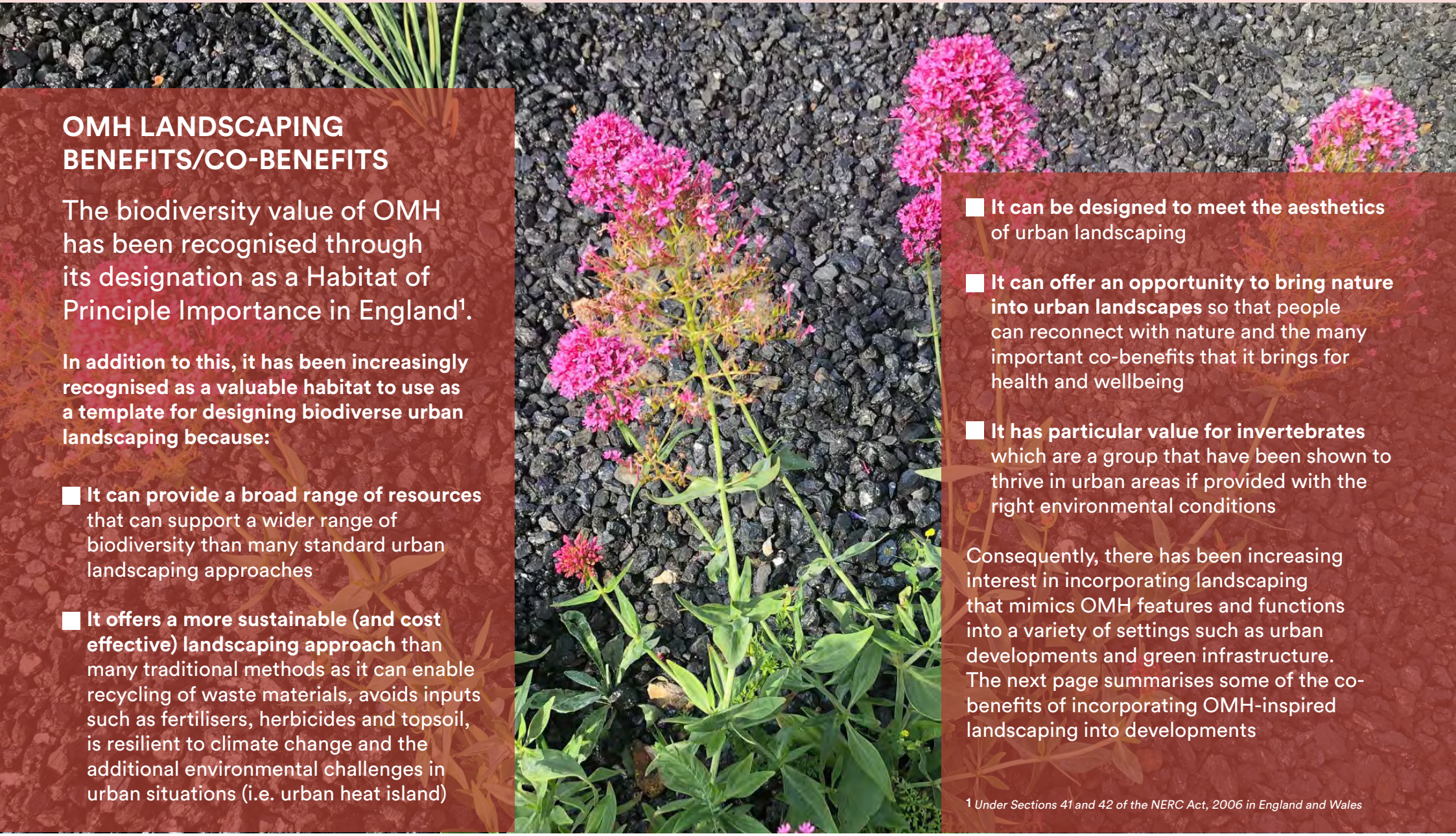

BARE GROUND


PIONEER PLANTS


FLOWER-RICH HABITATS


SCRUB


SEASONAL WETLANDS



OMH LANDSCAPING BENEFITS/CO-BENEFITS

The biodiversity value of OMH has been recognised through its designation as a Habitat of Principle Importance in England[1].

In addition to this, it has been increasingly recognised as a valuable habitat to use as a template for designing biodiverse urban landscaping because:

- **It can provide a broad range of resources** that can support a wider range of biodiversity than many standard urban landscaping approaches
- **It offers a more sustainable (and cost effective) landscaping approach** than many traditional methods as it can enable recycling of waste materials, avoids inputs such as fertilisers, herbicides and topsoil, is resilient to climate change and the additional environmental challenges in urban situations (i.e. urban heat island)
- **It can be designed to meet the aesthetics** of urban landscaping
- **It can offer an opportunity to bring nature into urban landscapes** so that people can reconnect with nature and the many important co-benefits that it brings for health and wellbeing
- **It has particular value for invertebrates** which are a group that have been shown to thrive in urban areas if provided with the right environmental conditions

Consequently, there has been increasing interest in incorporating landscaping that mimics OMH features and functions into a variety of settings such as urban developments and green infrastructure. The next page summarises some of the co-benefits of incorporating OMH-inspired landscaping into developments

1 *Under Sections 41 and 42 of the NERC Act, 2006 in England and Wales*

CO-BENEFITS OF OMH LANDSCAPING

The following summarises some the key co-benefits of OMH landscaping in relation to people, nature and placemaking.

- The distinctive character and biodiversity value of OMH landscaping represents an 'upgrade' from typical amenity landscaping
- It can provide an alternative but complementary habitat to nearby areas of semi-natural vegetation such as grassland and woodland, providing a nectar/pollen and nesting resource for invertebrates.
- Offers a **climate change adapted** approach, as plant communities are typically stress-tolerant species that are resilient to heat, drought and can withstand inundation, plus has lower irrigation requirements and lower carbon footprint
- Can contribute to **climate change adaptation** by creating spaces that can help manage and store water (in addition to SuDS), as well as contribute to cooling the urban heat island and reducing air pollution
- Provides environmental co-benefits, e.g. wetland features can be designed as SuDS for water attenuation, uses repurposed and recycled construction materials and avoids topsoil/peat lowering the carbon footprint, plus no diffuse pollution from inputs of herbicides/fertilisers, and lower irrigation requirement
- It provides an opportunity for people to connect with nature, benefitting health and wellbeing
- It offers an opportunity for locally distinctive placemaking - a chance for developers to showcase innovation in landscaping and placemaking
- OMH landscaping can be promoted as an asset for nature and people, offering a nature positive approach to development

OMH AND BNG

Now that BNG is mandatory in England, sites with OMH will require suitable habitat compensation for loss of any baseline habitat.

As OMH is recognised by the Metric as a high distinctiveness habitat, the trading rules require like-for-like replacement where the habitat is impacted by development. As much as feasible, this will need to be delivered on site, which can be a challenge for developers (and habitat bank providers) unfamiliar with how this novel habitat might be recreated. For instance, understanding how OMH features can be incorporated into landscaping in a way that it delivers ecological functionality, but also aligns with the various other requirements of green infrastructure space in developments, e.g. visual amenity, recreational space, sustainable drainage, ease of maintenance, etc.

This guidance aims to showcase best practice for delivering OMH features within developments (whether as part of OMH compensation, or a target of nature positive design for urban landscaping). It also provides a framework to make design, delivery and stewardship as efficient and effective as possible. Many of the practices set out in this document could also be used to enhance an area of low quality OMH habitat on a site, so that it can deliver uplift in net gain biodiversity units.

OMH is the only habitat that has a spatial threshold included in the criteria for its designation (minimum 0.25 hectares (ha)). This is explored further in the accompanying report – Brownfield Habitats and Biodiversity Net Gain: Introduction and Context (available here), highlighting the fact that OMH-type habitats that fall below this threshold can still have ecological value beyond other typical urban habitats. Therefore, some flexibility for the spatial extent of OMH compensation habitats/landscaping where these clearly demonstrate good practice in terms of design and ecological functionality (e.g. align with this guidance) would be beneficial. For instance, by enabling inclusion of high quality OMH landscaping at smaller scales to be assigned as OMH in the Metric, this could incentivise the inclusion of good quality OMH landscaping within developments (and avoid default offsetting), given that high distinctiveness habitats generate greater biodiversity units in the Metric.

In many urban situations, smaller areas of OMH landscaping accessible to biodiversity could contribute more for urban nature recovery than traditional urban landscaping approaches and could align with BNG principles. Therefore, allowing deviation from the strict threshold in conjunction with clear evidence of good practice design and construction, could offer an opportunity for creation of OMH landscaping on sites with low category habitats. This could drive the diversification of urban habitats and encourage wider interest in OMH landscaping in urban developments. Nonetheless, any deviation from the 0.25ha threshold would need prior agreement with the planning authority/consenting body. Whilst acceptance would be at the discretion of the consenting authority, it is hoped that being able to demonstrate compliance with this guide will help LPAs determine that ecological quality and functionality can be achieved beyond the restriction of the spatial threshold. The Statutory Biodiversity Metric guidance sets out a series of principles to inform use of the Metric.

Principle 4 and 6 state the Metric is designed to '*inform decisions in conjunction with locally relevant evidence, expert input, or guidance*' and is not '*a substitute for expert ecological advice*',

suggesting that an LPA could specify that 'expert input' and advice could allow for some deviation from the strict requirements of the Metric, where it was evident the landscaping could deliver gains and provide a valid compensation habitat of high distinctiveness. An example could be where an area of OMH-inspired habitat smaller than the 0.25ha threshold was provided on site, but this formed part of a wider landscape mosaic of features within a site that would be complementary and beneficial to OMH communities, e.g. biodiverse green roofs, pockets of native grassland, scrub, woodland, ponds and wetlands, etc.

Sites with OMH or good quality brownfield habitats should ideally aim to recreate a mosaic of habitats within the new development, even if the 0.25ha threshold can not be achieved. A proportional approach could be used when designing greenspaces, so that it reflects the composition and balance of habitats that comprised the baseline mosaic. This approach could enable at least partial provision and continuity on site of key ecological features and functions on which OMH communities depend, potentially leading to better outcomes for local biodiversity.

Most habitats in the Statutory Biodiversity Metric require a condition assessment which involves a process of assigning habitat condition (good, fairly good, moderate, fairly poor or poor) [3].

The condition assessment sheet for OMH sets out a series of useful criteria to understand the types of features that make up a mosaic. This can help define what a project needs to aim for in the design to achieve good quality OMH landscaping (Table 1).

CORE ASSESSMENT CRITERIA - MUST BE ASSESSED FOR ALL URBAN HABITAT TYPES		Criterion passed (Yes/No)
Core criteria must be assessed for all urban habitat types:		
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.	
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 plant species (listed on Schedule 9 of 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)	
Additional criterion - must be assessed for OMH only:		
D	The parcel shows spatial variation and forms a mosaic of bare substrate PLUS: - At least four early successional communities (a) to (i) below. 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, (h) heathland, (i) pools.	
	Essential criteria relevant for habitat type achieved (Yes or No) →	
	Number of criteria passed →	

2 *Sources of information about detrimental non-native species can be found on the GB Non-native Species Secretariat (GBNNSS) website: nonnativespecies.org, and Natural England Access to Evidence page should also be checked for up-to-date information (http://publications.naturalengland.org.uk/publication/40015).*

3 *Use professional judgement. Sources of information about non-native species that are not detrimental to native wildlife can be found on GBNNSS website: https://www.nonnativespecies.org/what-can-i-do/be-plant-wise/suggested-plants/*

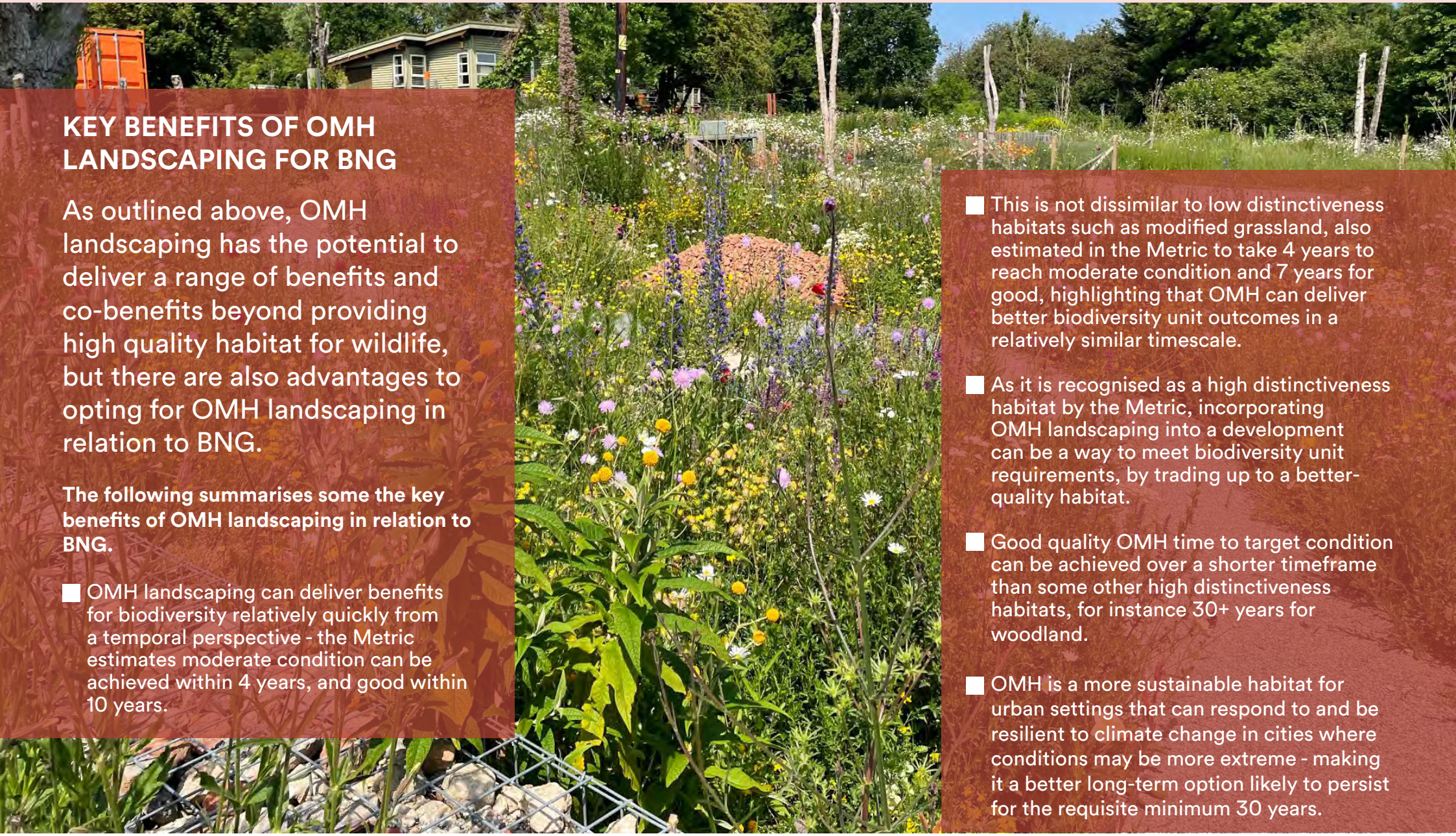
Once the core and additional criteria for OMH have been assessed, the total number passed equate to the condition score achieved.

To achieve 'good' there needs to be varied vegetation structure and types – a mosaic of at least four of the listed vegetation communities and bare ground – plus an absence of invasive species. There needs to be a range of flower types that provide nectar resources throughout the year, offering resources for invertebrates and other species.

This guide offers insights and examples that can enable schemes aiming for the creation of good quality OMH landscaping to fulfil these BNG condition assessment criteria.

Condition assessment results	Condition assessment score	Score achieved
Results for **Open mosaic habitat on previously developed land** (requiring assessment of 4 criteria only - core criteria plus additional criterion specified for habitat type):		
Passes all 3 core criteria; AND Meets the requirements for Good condition within criterion C; AND Passes additional criterion relevant to specific habitat type (D)	Good (3)	
Passes 2 or 3 of core criteria; OR Passes 4 of 4 criteria but does not meet the requirements for Good condition within criterion C	Moderate (2)	
Passes 0 or 1 of 4 criteria	Poor (1)	

Table 1. Criteria for condition assessment of OMH in the Statutory Biodiversity Metric



KEY BENEFITS OF OMH LANDSCAPING FOR BNG

As outlined above, OMH landscaping has the potential to deliver a range of benefits and co-benefits beyond providing high quality habitat for wildlife, but there are also advantages to opting for OMH landscaping in relation to BNG.

The following summarises some the key benefits of OMH landscaping in relation to BNG.

- OMH landscaping can deliver benefits for biodiversity relatively quickly from a temporal perspective - the Metric estimates moderate condition can be achieved within 4 years, and good within 10 years.
- This is not dissimilar to low distinctiveness habitats such as modified grassland, also estimated in the Metric to take 4 years to reach moderate condition and 7 years for good, highlighting that OMH can deliver better biodiversity unit outcomes in a relatively similar timescale.
- As it is recognised as a high distinctiveness habitat by the Metric, incorporating OMH landscaping into a development can be a way to meet biodiversity unit requirements, by trading up to a better-quality habitat.
- Good quality OMH time to target condition can be achieved over a shorter timeframe than some other high distinctiveness habitats, for instance 30+ years for woodland.
- OMH is a more sustainable habitat for urban settings that can respond to and be resilient to climate change in cities where conditions may be more extreme - making it a better long-term option likely to persist for the requisite minimum 30 years.

SCOPE OF THIS GUIDE

The guide can be used for any project intending to provide good quality habitat in an urban development/setting that mimics the features and functions of OMH, but also when OMH compensation is required as part of BNG.

It sets out what needs to be considered from the outset of a project, and provides a good practice guide to support the successful design, delivery, and stewardship of high quality OMH landscaping. For those embarking on projects that seek to recreate the features of good quality OMH within landscaping, or those that wish to enhance existing OMH-type habitats within a site, the lack of existing formalised guidance on OMH creation/maintenance, as well as a widespread low level of knowledge and experience with this habitat in the ecology and landscape architecture sectors can make approaching such projects daunting.

This guidance is intended to begin to address these issues by:

- Providing a framework that highlights the key factors that need to be considered for successful OMH landscaping, including at the design, delivery and stewardship phases
- Myth-busting some of the misconceptions about the suitability of OMH for landscaping in new development projects, including examples of the costs/benefits of OMH landscaping as an alternative to traditional urban landscaping approaches
- Case studies highlighting best practice for delivering good quality OMH landscaping and/or opportunities for including OMH-inspired features into urban landscaping projects to bring more biodiversity to any site

The objective of the guide is to demystify the practicalities and processes of creating urban landscaping that mimics the important characteristics of OMH. The guide showcases examples of successful OMH landscaping projects and research, including experiences on construction and management, to illustrate the practical steps and costs and benefits. The guide draws on the knowledge and expertise of the authors, as well as the project steering group and a wider network of specialists involved in similar OMH work.

WHO IS THIS GUIDE FOR?

From the perspective of BNG, OMH habitat creation/ enhancement would typically occur on developments where this habitat has been identified on site during the BNG baseline survey. It is therefore anticipated that developers with a site where OMH has been identified during the baseline surveys would be a key audience for this document.

Nonetheless, this guidance is not only limited to sites where OMH compensation is required. It can be used on sites with low scoring baseline habitats, which can be traded up to OMH to deliver BNG credits for other development. It can also be used for developments that recognise the benefits of providing high quality habitat, such as OMH landscaping, on any suitable site, given that it can provide a rich habitat for wildlife and a fantastic opportunity for people to reconnect with nature close to where they live or work. This also includes existing developments where land managers are interested in delivering nature positive outcomes on the land they occupy/manage.

As such, this guidance aims to support all stakeholders involved in development, biodiversity net gain, and green infrastructure provision. It is intended to be accessible to non-specialists whilst also providing enough technical detail to deliver successful OMH landscaping projects. It is therefore envisioned that this document will be used as resource for a range of key personnel such as developers (and landowners/land managers), local authorities and urban designers, nature conservation organisations, ecologists/ ecological consultants, landscape architects, construction/demolition contractors and green infrastructure/landscaping practitioners. It could also be used by community groups with a role in greenspace management.

HOW TO USE THIS GUIDE

This guide covers the three key stages of greenspace delivery – planning, construction and stewardship, and can be used to support production of an HMMP for BNG.

The guide does not provide specific costs for materials and labour for OMH landscaping as these would be project specific. Instead, it gives indicative cost/benefit analyses outlined for case study projects, to provide a general overview of OMH landscaping versus traditional landscaping approaches.

To navigate this guide, the following provides a summary breakdown of sections. It can either be used in a linear way from start to finish or for specific topics in individual sections.

- **Section 1. Introduction:** current section providing background to the guide, defining OMH landscaping and including some mythbusting in relation to its applicability
- **Section 2. Planning an OMH Landscaping Project:** tips to highlight early considerations for OMH landscaping projects to minimise cost and maximise efficiency – what's on site; what can be used to benefit the project; opportunities for on-site creation; ecomimicry as a planning framework for effective design and delivery
- **Section 3. Designing with Ecomimicry for OMH Landscaping:** overview of the key factors that make OMH a valuable habitat that should be considered in detail as part of the OMH ecomimicry design process
- **Section 4. Design and Construction - the Basics:** understanding what 'good' OMH looks like, key features checklist and four basic steps for OMH projects
- **Section 5. Design and Construction - Embedding OMH Features into Urban Landscaping:** the mechanics of designing and constructing OMH including environmental, engineering and materials factors; costs/benefits of OMH versus traditional landscaping approaches
- **Section 6. Design and Construction - Case Studies:** best practice examples of projects that have included OMH features and habitats
- **Section 7. Stewardship:** the requirements for ongoing care to maintain biodiversity value and comply with the BNG habitat management and monitoring plan (HMMP)

FREQUENTLY ASKED QUESTIONS

OMH-inspired landscaping is not an entirely new approach but it remains an emerging concept. Consequently, there can be misconceptions around this type of landscaping that can represent a barrier to its wider inclusion as an on-site habitat in developments. The following are some myths that this guidance will seek to bust:

? OMH landscaping is too complex to create and maintain.

! Whilst OMH landscaping does need a different approach to design and management compared to more standard amenity landscaping, this can be relatively simple once the design basics are understood. Whilst it can require different landscape management approaches to standard landscaping, it typically requires much lower intensity management. Consequently, there may need to be some training initially for landscape managers, but it can be cheaper in the long-term to manage.

? OMH is a transitional habitat that is likely to change.

! This is true of most habitats. Grassland and scrub will also succeed to another habitat type if not managed. In fact, the low-nutrient substrates used for OMH landscaping can actually delay succession processes longer than might occur with nutrient-rich, topsoil landscapes. Management of OMH landscaping should focus on maintaining a largely open character in most of its composite habitats.

? OMH landscaping is easy, just dump some rubble on a site and let nature take its course.

! Whilst this approach might have some value, much greater outcomes can be achieved through more strategically planned OMH creation. If the OMH is being created as part of BNG mitigation, there will need to be much better design consideration than this approach to convince LPAs that it provides ecological functionality to support key OMH communities.

? OMH will encourage invasive species such as Japanese knotweed and ragwort.

! There is no evidence to suggest that OMH landscaping would be any more likely to support invasive species than other types of landscaping. The same control programmes for eradication of invasive plants would apply and OMH landscaping would be subject to careful plant selection and management to avoid introduction of invasive species.

? OMH landscaping is too unsightly for urban developments.

! Appropriately designed OMH landscaping can meet the visual aesthetics for urban developments and is increasingly being mainstreamed into garden design and urban landscaping with very positive responses[4].

[4] https://www.gardensillustrated.com/chelsea/brownfield-garden-site-what
https://www.tommassey.co.uk/royal-entomological-society-garden/
https://wilsongardendesign.co.uk/brownfield-metamorphosis-2017/
https://www.houzz.co.uk/magazine/meet-the-designers-championing-sustainable-brownfield-gardens-stsetivw-vs~169440793

2 Planning an OMH Landscaping Project

PLANNING: GENERAL

The Biodiversity Net Gain Good Practice Principles for Development [1] emphasises that planning and budgeting for BNG in the early stages of a project is *essential*. This is because it can secure efficiencies, realise opportunities, minimise risks and lead to the best outcomes for a project.

Green infrastructure and landscaping can often be implemented towards the end of a development project timeline, but this can lead to missed opportunities for cost savings and efficiencies, particularly when creating OMH landscaping. As OMH is not always well recognised or understood by key stakeholders in the development process, for instance landscape architects, environmental engineers, landscaping contractors, and the public, it is critical to raise awareness of this habitat, and the objectives for the site, as early as possible. This way opportunities can be optimised and any potential barriers considered. The Table below highlights some simple but effective ways to save time and money through early and strategic planning for OMH landscaping.

Simple ways to **save time and money** when planning OMH landscaping

- **Make decisions on habitats and topography requirements for the landscaping early** in development planning, to understand the requirements for landscaping works at the start of the development process and identify what onsite resources can be exploited
- **Work with the site characteristics** such as soil type/geology, topography and drainage to reduce costs and help with habitat creation and establishment
- **Investigate any suitable locally-available low nutrient/waste materials** that can be used for OMH landscaping features, e.g. waste sand/chalk from nearby road widening schemes or taking materials out of the waste stream for reuse
- **Factor in the feasibility for topography work** using machinery available on site early in the development process for demolition activities to avoid costs of re-hiring machinery/contractors later
- **Try to incorporate any existing on-site OMH type habitats into the landscaping**, e.g. rough grassland or ruderal patches, that can be enhanced to encourage desirable plants to become dominant
- **Consider the materials** you have available on-site. Materials such as crushed concrete/brick from demolition, and other spare materials and/or waste materials planned for off-site disposal can be excellent substrates for OMH landscaping
- **Get demolition contractors, landscape architects and landscaping teams** up-skilled with what OMH is and what needs to be delivered as early as possible, so that everyone has an aligned vision and can recognise opportunities and barriers early on
- **Early buy-in of the development team** (e.g. developer, ecologist, landscape architect, on-site contractors) can smooth the process for OMH landscaping projects, ensuring understanding of, and commitment to, executing the landscaping to the design vision, and exploring the opportunities to maximise on-site resources for time and cost savings

Some **key points to consider** at the planning stage for a successful landscaping project:

- **Allow time to plan** effectively and utilise resources to maximum efficiency
- **Allocating suitable resources** i.e. materials, machinery, contractor expertise, finance for planning, construction, and ongoing maintenance
- **Ensuring suitably experienced ecologist, landscape designer, contractors are part of the project** from the outset, to realise the design/delivery/management
- **An appropriate management and monitoring programme** can ensure landscaping achieves its intended functions and value
- **Developer vision and commitment** is key to successful delivery
- **Turn a constraint into an opportunity**, for instance work creatively with challenging site characteristics such as topography and drainage to create habitats (e.g. ephemeral wetlands)

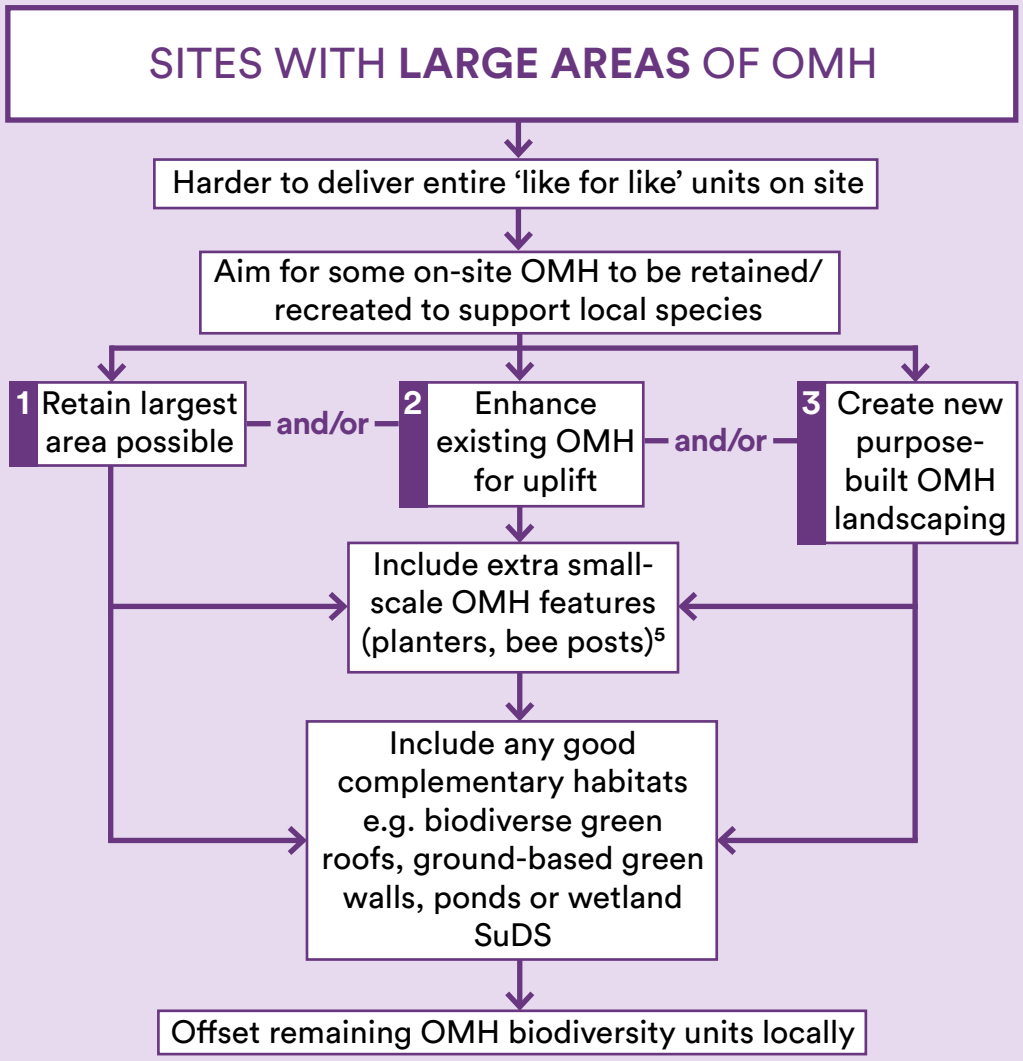
Potential **pitfalls to avoid** (for any habitat creation project):

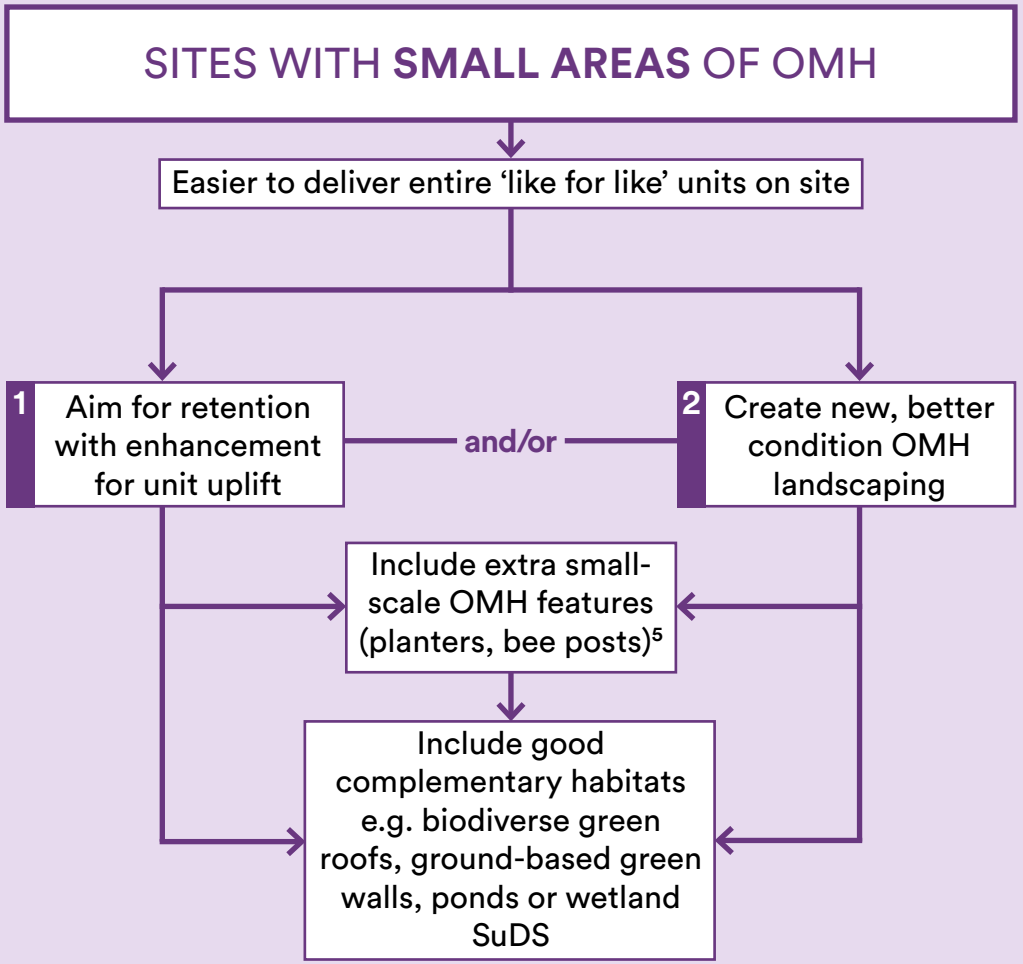
- **Many habitat creation projects fail due to poor planning**
- **Too little consideration can be given to soils**, leading to the use of top-soils with fertility too high to deliver target habitat, particularly where OMH landscaping is the target
- **Inadequate planning for stewardship** (i.e. habitat management plans and financial resources) to ensure habitat value is maintained in the long-term
- **Inadequate monitoring** to ensure the habitat achieves its target condition and/or that management can adapt/respond to changes in condition of a habitat or site, and in response to climate change

PLANNING FOR BIG AND SMALL OMH PROJECTS

The amount of effort and the resources needed for OMH landscaping will likely relate to the extent and quality of baseline habitats identified in the BNG assessment.

The greater extent and higher quality the baseline OMH habitat is, the greater resources and effort will be needed to maximise on-site delivery and achieve best practice standards. The subsequent diagrams below indicate the levels of input and resources likely to be needed for sites with large or small areas of OMH identified in the baseline BNG survey.





5 *Whilst these features can provide additional ecological functionality for a site, they do not contribute towards biodiversity units in the Statutory BNG Metric*

PLANNING THE DESIGN WITH ECOMIMICRY

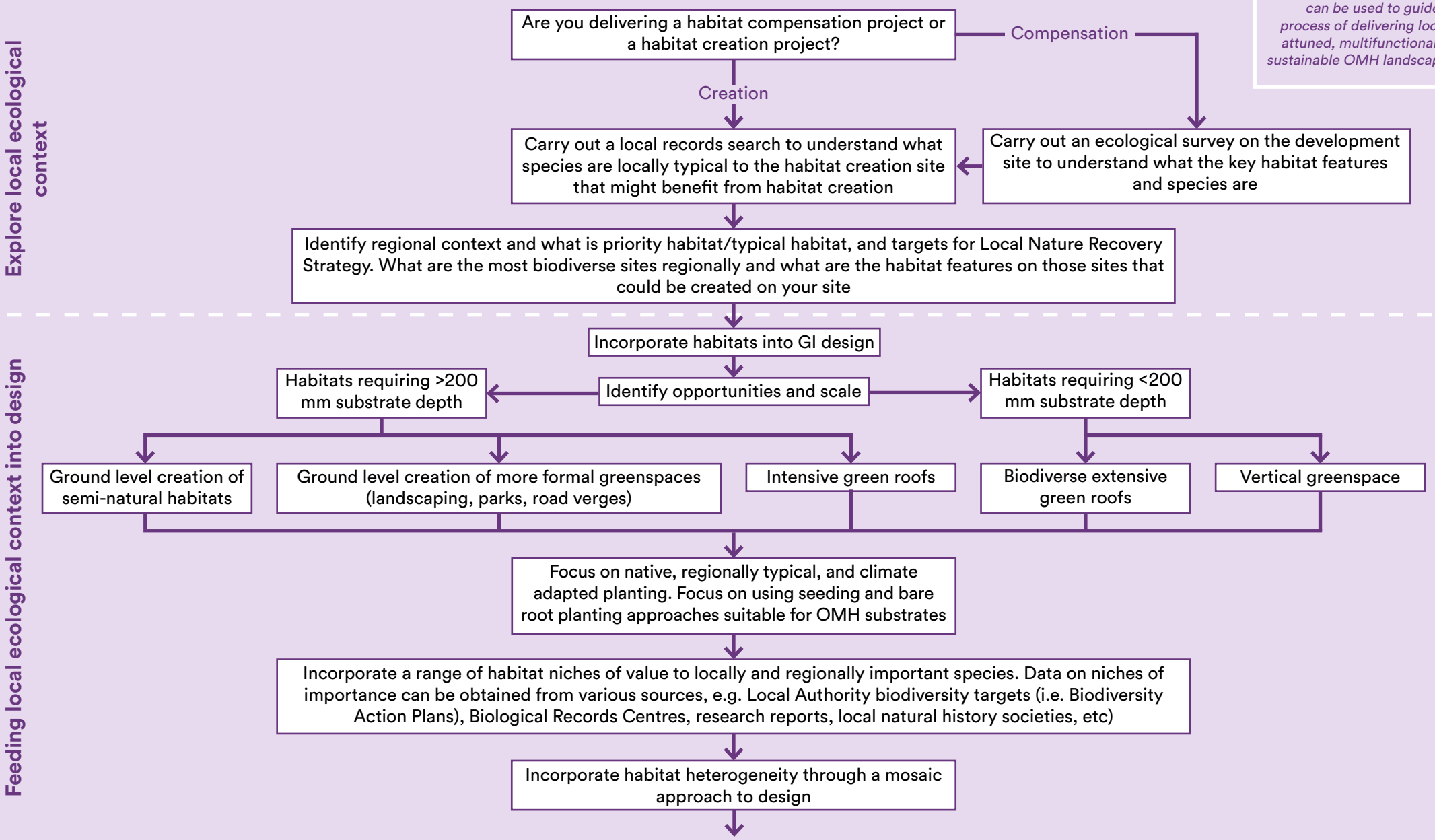
Taking inspiration from natural and semi-natural habitats (biomimicry) has been used to solve human design and engineering strategies, but this can be taken a stage further through *ecomimicry* when designing habitats for developments.

Ecomimicry is a process that starts by reading the local landscape to identify important and locally distinctive habitats, and then takes design inspiration from substrates, plant diversity and habitat structure typical of local habitat of regional, national or international conservation value [7]. Ecomimicry helps landscape designers to recognise the important features and functions of habitats, so that these can be creatively embedded into greenspace and green/blue infrastructure design.

By following an ecomimicry approach at the planning and design phase, there is greater likelihood that landscaping will be designed not only to deliver multifunctional benefits, such as air quality improvement or recreational space, but will be characteristic of the local landscape and attuned to locally important biodiversity. By adopting these design principles, it is possible to achieve biodiverse landscaping that provides broad ecosystem services and meets development compensation targets in terms BNG. In relation to the WMCA, a description of the local habitat characteristics of OMH sites in the region can be found in the accompanying report on brownfield sites and BNG (available here).

Figure 1 (next page) presents an 'ecomimicry framework' that provides a decision tree. It starts with initially reading the local landscape to identify important habitats and features. It then feeds those findings into the design, determining the appropriate form of landscaping to deliver these habitats, including locally-appropriate plants and substrates, and incorporation of habitat heterogeneity. The framework also illustrates how the ecomimicry approach to designing habitats can deliver sustainability and potential ecosystem service benefits. These align with nature-based solutions targets by achieving environmental, social and economic co-benefits.

Figure 1. The ecomimicry framework decision tree can be used to guide the process of delivering locally-attuned, multifunctional and sustainable OMH landscaping.



Consider environmental sustainability of construction

Is reuse of waste material possible on site for use as substrates and/or to create structural habitat features?

No → Identify opportunities for using locally sourced sustainable secondary waste materials for ecomimicry of regional habitat context

Yes

Explore to what extent habitat creation can be delivered on site reusing existing materials. Explore any contamination issues.

Are additional substrates still needed?

Yes → Identify opportunities for using locally sourced sustainable secondary waste materials for ecomimicry of regional habitat context

No

Explore other aspects of the environmental impact of the habitat creation (e.g. Life Cycle Assessment of materials, local procurement, low carbon landscaping approaches).

Consider the socio-ecological sustainability of design

Identify key societal challenges on, or surrounding, the site that could be addressed through a multifunctional nature-based solution design.

- SuDS
- Access to greenspace/ nature
- Health & wellbeing, active travel, natural play
- Air pollution
- Noise pollution
- Water attenuation/ quality
- Urban heat island/urban comfort zones
- Food security
- Natural play/ exercise
- Encouraging active travel

Ensure additional nature-based solution benefits are being realised through the design

- Economic
- Environmental
- Social

Ensure the legacy of the benefits through a long-term stewardship plan

AN OMH ECOMIMICRY CASE STUDY: BARKING RIVERSIDE BROWNFIELD LANDSCAPING

The following case study shows how ecomimicry can be used for OMH landscaping in urban developments. The approach helped to define the key characteristics of OMH on the pre-development brownfield site of a major new development at Barking Riverside, London, UK.

This knowledge was used to inform the design of their innovative office landscaping, to ensure that it was meeting the ecological requirements of the key species of conservation value at the site – in this case an invertebrate assemblage that included many rare and scarce species of regional and national nature conservation value.

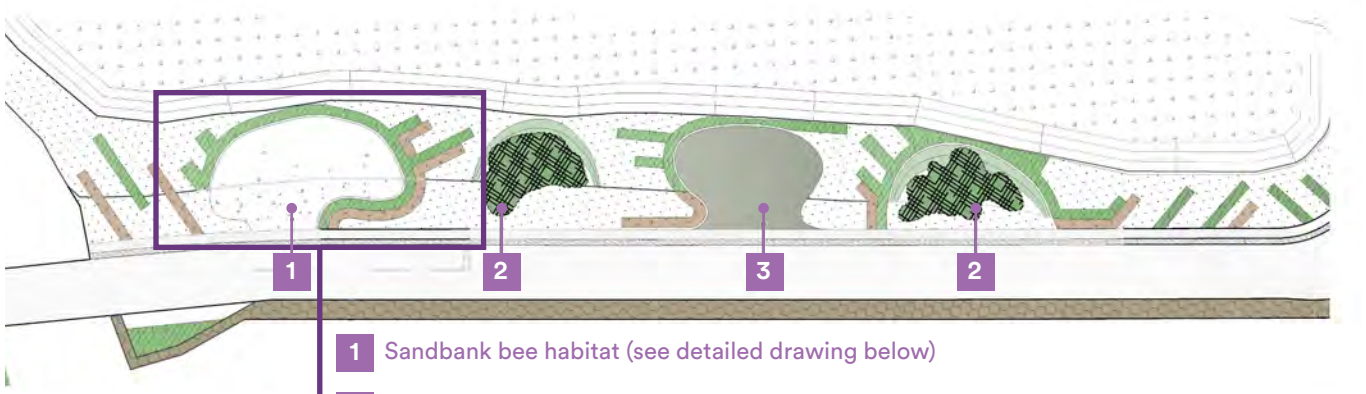
Recent history of the Barking Riverside Site

Originally marshland, the site was drained and a coal-fired power station was built in the 1920s. Deindustrialisation of urban areas brought closure to the power station in the 1980s and the site remained mostly unmanaged until purchased in 1994. Largely covered in pulverised fuel ash (PFA) from the time of the power station operation, the site developed a rich mosaic of habitats from saline lagoons to flower-rich areas and drought-stressed scrub. The combination of low-nutrient friable substrates and lack of formal management meant the site developed a rich diversity of wildlife including wildflowers, insects, birds, reptiles and mammals.

BARKING RIVERSIDE OMH ECOMIMICRY LANDSCAPING APPROACH

Ecomimicry can be used to combine urban landscaping design principles with OMH habitat features. At Barking Riverside, this approach to landscaping meant the design took inspiration from important features of the pre-development brownfield site, for instance: **low-nutrient substrates, south-facing banks, flower-rich grasslands, scrub and dead wood habitats.**

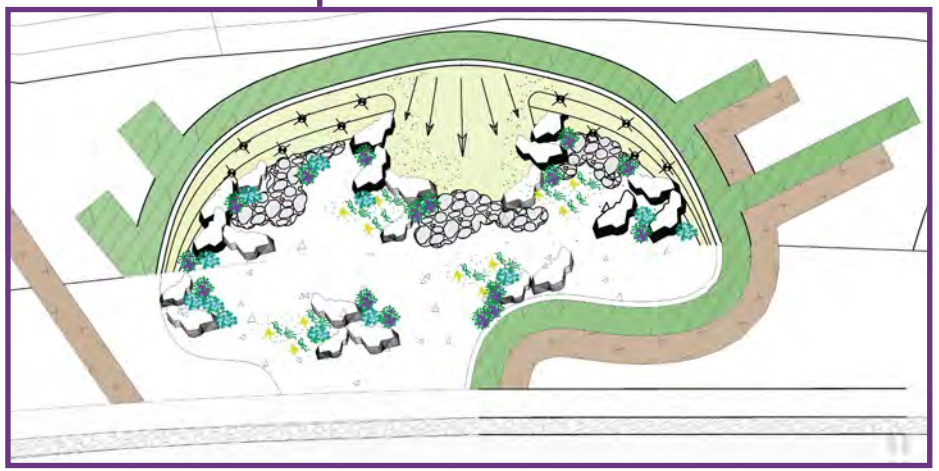
These elements were then creatively embedded into the landscape design and blended with more traditional greenspace elements such as ornamental flower beds and mown grassland. This blended approach provided the visual aesthetic of typical urban landscaping alongside the novel brownfield features. This technique makes it possible to enhance the biodiversity value, ecosystem service provision and aesthetics of urban landscaping and offers a blueprint for OMH landscaping for BNG.



1 Sandbank bee habitat (see detailed drawing below)

2 Planting pocket of nectar-rich shrubs

3 Woodland pocket



Legend

- Nectar-rich shrub planting
- Indigenous shrub planting
- Herbaceous planting
- Woodland pocket planting
- Indigenous hedge
- Clover and meadow grass
- Wildflower and meadow grass
- 1 metre strip of mown grass
- Exposed sandbank bee habitat
- Friable bare substrate

OMH LANDSCAPING ECOMIMICRY AT BARKING RIVERSIDE

Pockets in the Barking Riverside OMH landscaping included ecomimicry of important microhabitats and features found on the pre-development site and biodiverse brownfield sites in the region.

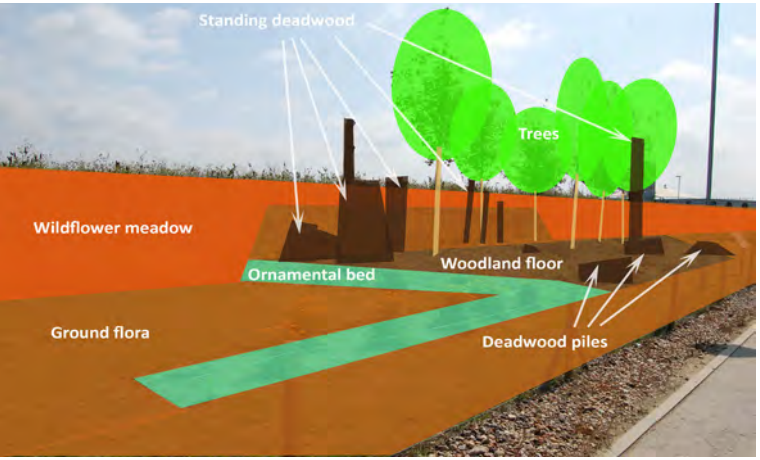
Together, the pockets of microhabitats within the landscaping mimicked the habitat mosaics characteristic of OMH. A selection of OMH habitats/features embedded into the landscaping (illustrated next page) included:

- **Wildflower meadows** to provide **forage resources** for a wide range of species, including rare and scarce pollinators found in the region
- **South-facing sand bank**, providing valuable **nesting habitat** for solitary bees and wasps to ensure breeding and forage resources were available at **appropriate spatial scales** for key insects
- **Woodland pocket** with scrub, **dead wood piles** and **standing deadwood** for specialist and rare species that rely on dead wood habitats (saproxylics)
- **Rubble** and sculpted **concrete** and **metal** features to **provide niches** for ground beetles and basking areas for warmth-loving insects and reptiles
- Ornamental planting of **pollen and nectar-rich plants** to support foraging pollinators
- **Structural diversity** and **topography**, through features such as banks/mounds, standing deadwood, concrete sculptures and variation in vegetation height and types

BEE WOLF (PHILANTHUS TRIANGULUM) ON A THISTLE FLOWER AT BARKING RIVERSIDE

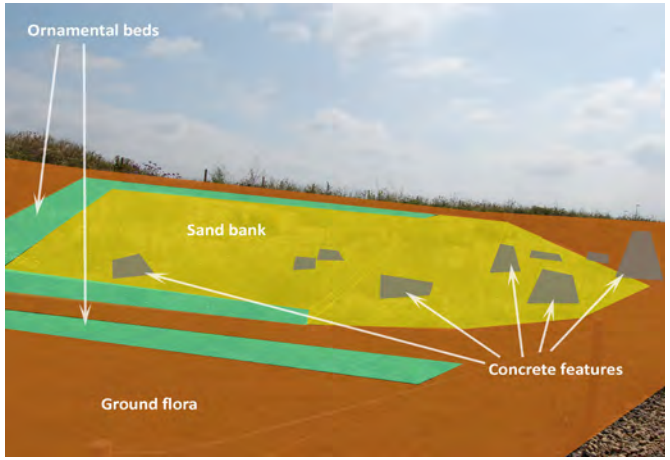
WOODLAND POCKET

WITH STANDING/FALLEN DEAD WOOD FOR SAPROXYLIC (DEAD WOOD SPECIALIST) SPECIES



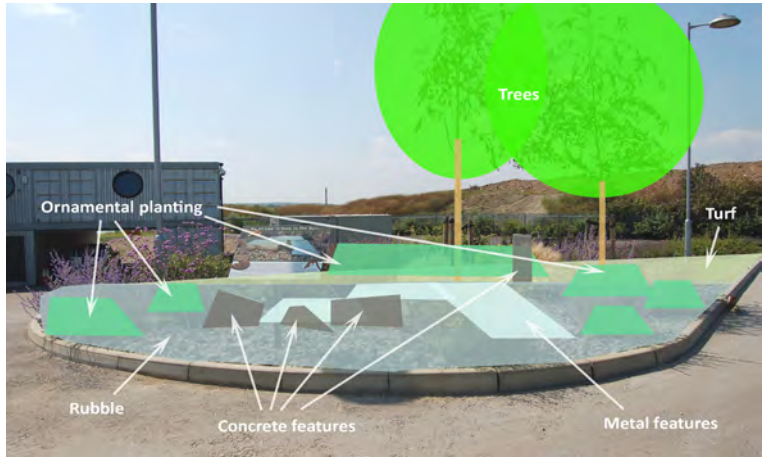
SOUTH-FACING SANDBANK

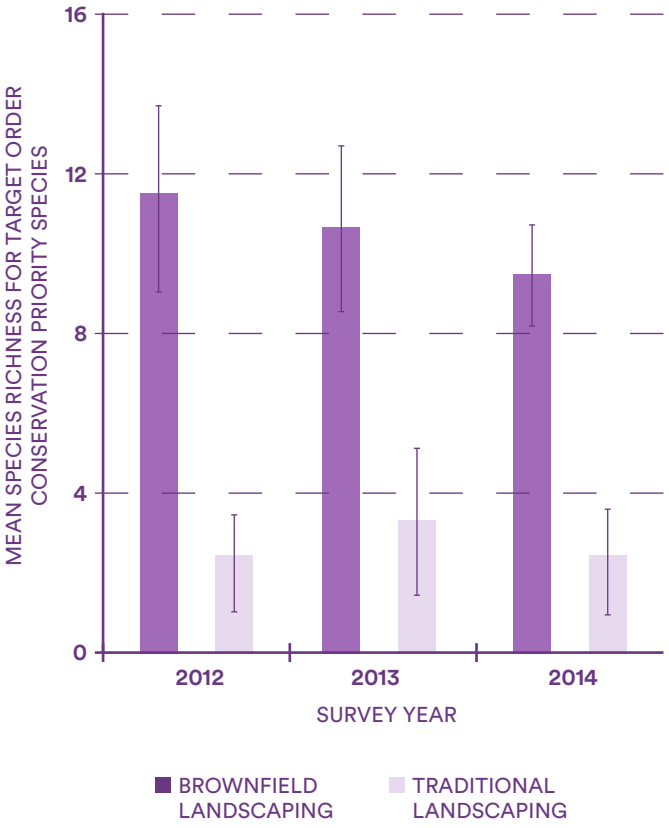
FOR NESTING BEES AND WASPS



POLLINATOR PLANTING

WITH RUBBLE AND METAL FEATURES





This graph shows that the OMH landscaping consistently supported a significantly greater number of invertebrate species than the traditional landscaping.

This approach was developed prior to the advent of BNG, but PhD research [8] investigating how the OMH landscaping performed compared to some more typical urban landscaping within the development site demonstrated that:

- This was successful in delivering high quality landscaping that supported the types of habitat niches and invertebrate assemblages associated with OMH
- It very clearly out-performed the traditional landscaping at the site, in terms of floristic and invertebrate diversity recorded in the OMH landscaping, including a much greater proportion of rare/scarce invertebrate species associated with OMH
- The study findings illustrated that the ecomimicry approach can be effective when designing OMH landscaping and could be a valuable technique for designing habitats for BNG

HAIRY-FOOTED FLOWER BEE (ANTHOPHORA PLUMIPES) ON WALLFLOWER ON THE BARKING RIVERSIDE BROWNFIELD LANDSCAPING

3 Designing with Ecomimicry for OMH Landscaping

UNDERSTANDING KEY ENVIRONMENTAL FEATURES FOR ECOMIMICRY OF OMH

Developing a landscaping project using ecomimicry starts with reading the local landscape to identify the character and key environmental features that need to be creatively emulated and embedded into the landscaping design and construction.

This section outlines the main factors that make OMH such an important habitat for biodiversity. These elements should be considered in detail as part of the OMH ecomimicry design process, referencing the important microhabitats and features of the baseline OMH and/or regionally important and distinctive biodiverse brownfield sites local to the project.

The following summaries are designed as a guide for defining the key environmental features of OMH. At the outset of an OMH landscaping project, these essential factors should be examined using an ecomimicry lens. This will help to develop a landscaping design that takes inspiration from the local character of OMH, and embeds the important features and functions of OMH into the landscaping design and construction.

SCATTERED SCRUB 1

TALL RUDERALS 2

GRASSLAND WITH WILDFLOWERS 3

EXPOSED, SUNNY SAND BANK 4

THE ESSENTIAL OMH FACTORS

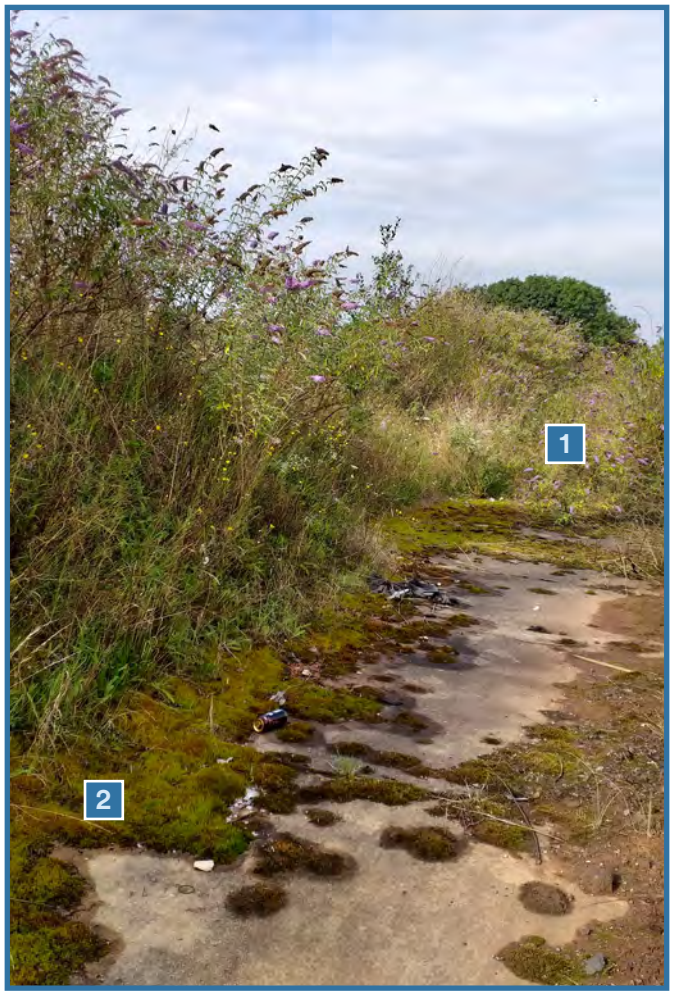
- Aspect
- Topography
- Structure
- Hydrology
- Substrates (nutrients)
- Vegetation

The following pages show examples of features found on brownfield sites that are valuable for creating a wildlife-rich habitat mosaic and should be emulated when designing biodiverse urban green infrastructure. Later in the document we provide examples demonstrating how these features can be creatively reproduced using ecomimicry, to provide attractive and ecologically functioning urban landscaping.

ASPECT

Aspect relates to the direction that land is facing: north, south, east and west. This typically dictates how much sun hits an area of a site.

A site's topography (see next section) can also create aspects, for instance providing sunny/shady microclimates. Some OMH fauna require particular microclimate conditions for nesting habitats, e.g. sunny sites that provide warmth for larval development, cooler north facing banks for hibernation. Requirements can vary for different species, and different behaviours of the same species, therefore features in a range of aspects can be beneficial and support a wider range of biodiversity. Generally, a site's location and surroundings (i.e. surrounding tall structures/trees that cast shade) will dictate at least some of the aspect, however site design can be used creatively to provide greater aspect variation. For example, north-south and east-west linear features such as mounds can create a variety of aspects.



Sunny and south-facing aspects are a key element of OMH as this is where flower-rich habitats thrive. The drier, harsher conditions help to suppress competitive species, enabling a broader range of species to develop and, also, helping to maintain the open character of the vegetation and bare ground. Shadier aspects can enable different communities to develop such as mosses and ferns, but also the increased moisture in shaded areas can enable temporary wetlands to develop and can provide damp refuges for species during drought spells. Reading the local landscape using ecomimicry can help to understand what aspects are driving biodiversity and need to be embedded into OMH landscaping design.

1 SUNNY & DRY, FLOWER-RICH

2 SHADY & DAMP

TOPOGRAPHY

Many OMH sites have undulating topography.

This can be an important driver for the development of the patchwork of varied habitats/microhabitats that make OMH so valuable for biodiversity. Topography provides habitat features that are used by key OMH species for breeding, for instance many nesting bees and wasps use sloping banks, with some requiring different slopes from vertical to shallow, whilst other species prefer level ground. Diversity in topography typical to many OMH sites therefore provides a broad range of conditions that supports a wide range of flora and fauna.

Topography can also provide moisture refugia, with deeper areas holding moisture for longer, helping plants and fauna to be more resilient to drought/climate change impacts. Hollows, scrapes and ditches can collect water, developing ephemeral or permanent wetlands. Topography combined with aspect can generate important microclimates, for instance south-facing slopes are used by some thermophilic (warmth loving) species to help with larval development during nesting, or simply as places to bask when species need to warm up to be active. Different species tend to favour different conditions for different aspects of their lifecycles, for example north-facing slopes can be used by certain species for hibernation. Avoidance of flat and uniform landscapes is therefore critical for OMH landscaping, as this greatly limits biodiversity value. Ecomimicry can help identify important topographical features that should be emulated within OMH landscaping to provide a diversity of niches for a broad range of OMH species.

1 MOUNDS

2 SOUTH-FACING BANK

3 HOLLOWS

4 LEVEL GROUND

STRUCTURE

Structural diversity is the relative degree of complexity of a habitat and its vegetation.

Structurally diverse landscapes provide a much wider range of conditions and niches than uniform landscapes, enabling more species to find suitable resources, leading to richer natural communities. Most OMH sites are structurally complex, which is why they are able to support such a wide range of species, and this should be emulated in OMH landscaping. For example, many pollinators require open-flower rich habitats as nectar and pollen sources, but require grass tussocks, stems, or cavities in the ground for nesting. If one of these factors is missing in a landscape, the pollinators cannot persist. Similarly, while many pollinators like open flower-rich habitats, other groups like spiders and beetles depend on more structural complexity to persist. Structures such as standing dead wood and log piles are vital for species dependent on dead/decaying wood (saproxylic species) at some stage of their lifecycle.

Built structures on OMH sites can add further complexity and their function for biodiversity should also be considered and emulated (e.g. as gabions). Lack of management at OMH sites means features such as dead wood, grass thatch, dead stems and seed heads are retained for species, unlike most intensively managed greenspaces where these important resources are typically removed. Lack of management plus varied substrates, topography and aspect create structurally diverse OMH vegetation, which further adds to their complexity. It is important to identify key OMH structural features as part of the ecomimicry design process, so that their functions can be creatively incorporated into OMH landscaping.

1 BUILT STRUCTURE
2 SPOIL MOUND
3 STANDING DEADWOOD
4 LOG PILES
5 VARIED VEGETATION STRUCTURE

HYDROLOGY

Site hydrology relates to the movement of water on, across or through a site. On OMH sites, this is often related to parameters such as substrate types (particularly permeability), vegetation cover, topography (i.e. hollows accumulate water), underlying water tables, and surrounding impervious cover (if the aspect promotes run-off into areas of the site).

OMH sites often contain areas that are highly free-draining alongside more impermeable areas that experience seasonal inundation. Free-draining areas tend to develop flower-rich meadows or dry grasslands and they stay open for longer, slowing succession and maintaining areas of bare ground. Poor-draining areas on OMH sites often develop temporary wetlands or even permanent wetlands such as ponds. When OMH sites encompass a range of hydrological regimes, this often increases their biodiversity value, as wetlands can be vital for species with an aquatic stage (i.e. dragonfly larval stages), that then go on to rely on terrestrial habitats (e.g. adult stage dragonflies often hunt away from wetlands). Wetland features can therefore be valuable drivers for biodiversity.

They can also promote resilience, with hydrologically diverse sites offering a range of moisture microclimates, which in turn can support a broad range of flora/fauna that are adapted to a wide range of conditions from drought to inundation.

It is important to consider the hydrology of a site intended for OMH landscaping and to understand the hydrological regimes that need to be emulated in the ecomimicry design. This includes changes to the permeability of baseline substrates. Designing for hydrology can also be linked to overall stormwater management across the site (covered in a later section).

EPHEMERAL WETLAND

SUBSTRATES (NUTRIENTS)

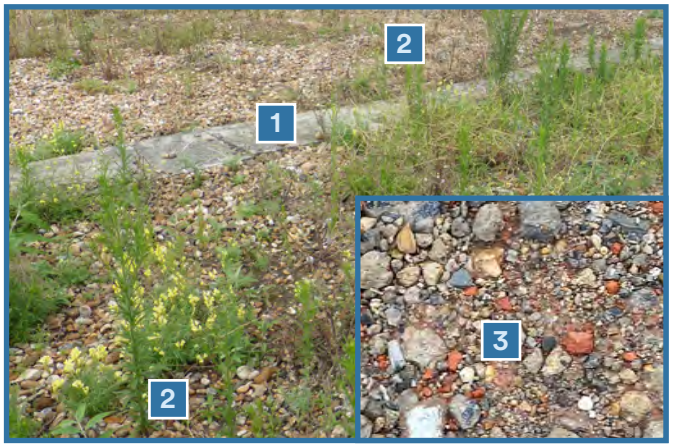
Substrates are a crucial resource and underpin many of the ecological processes that result in the above-ground habitats on OMH sites.

Natural substrates, or soils, are derived from underlying geology such as chalk or sandstones. For OMH sites, substrates are often artificial, created as a consequence of industrial activities, or are derived from made ground and demolition rubble, which degrade through weathering processes and become colonised by flora and fauna. Despite their artificial or sometimes contaminated nature, OMH substrates, particularly low-nutrient, friable substrates, have a vitally important role in determining the biodiversity value of these sites. Brownfields with varied, nutrient-poor substrates, plus varied topographies, aspects and hydrology, will often develop a patchwork of habitat types that are characteristic of high quality OMH.

The nutrient status of OMH substrates will be closely related to habitat and vegetation development. Typically, low fertility substrates are characteristic and are an important determinant of high quality OMH sites. Nutrient-poor substrates suppress aggressive plant species, enabling a richer and diverse flora to develop. They slow natural succession processes, keeping habitats open and flower-rich for longer. Plants growing on these more challenging substrates are often drought-tolerant, making them resilient to climate change.

Substrate types can also be linked to associated faunal diversity. This can be indirectly related to floral diversity, or directly, for example different solitary bee and wasp species nest in different substrates, some preferring loose friable substrates, others more compact clay substrates. Consideration of the types of substrates and their nutrient status is an important element of ecomimicry for OMH landscaping so that locally distinctive and important habitat features can be recreated.

On some sites, substrates will have been created by processes that no longer take place, making them essentially a finite and irreplaceable resource. Examples include pulverised fuel ash (PFA), alkaline slags and Le Blanc waste. These should be prioritised for re-use either on-site or off-site.



1 CONCRETE

2 PEBBLES & GRAVEL

3 DEMOLITION RUBBLE - CRUSHED BRICK & CONCRETE

VEGETATION

Vegetation is one of the key defining characteristics of OMH and good quality sites typically support high plant diversity and high flower abundance.

The range of plant species and the diversity of habitat types within a single OMH site means they can support rich assemblages of invertebrates, including those species that require two or more habitats nearby to complete their lifecycles. Nutrient-poor OMH sites often have diverse communities of nectar-rich wildflowers that provide an abundance of forage. OMH sites typically support a mix of flower types and include species that flower early and late in the season to provide an extended floral resource throughout the season. The lack of management on OMH sites means resources such as vegetation seed heads, stems and leaves are left in-situ for overwintering invertebrates, a scarce resource in highly managed urban greenspaces. These aspects should, as much as possible, be emulated in OMH landscaping designs.

Ecomimicry can help identify key species from the OMH baseline site and/or good quality OMH sites in the region. Resources such as the 'Open Mosaic Habitat Survey Handbook' [5] have useful guidance on the types of habitats and species that characterise OMH sites. Looking at locally typical OMH sites as well as taking inspiration from these plant lists can help with delivering good quality OMH landscaping. OMH is characterised by having a range of different habitats, often small areas that are intermixed, but it may include homogenous blocks, although these should not exceed certain extent thresholds (see [3], [4], [5] and the companion report to the guide for guidance). The locally distinctive mix of habitats should be determined and recreated as closely as possibly in OMH landscaping so that it provides locally-appropriate resources for OMH communities.

FLOWER -RICH RUDERAL AND PIONEER SPECIES

SPARSELY VEGETATED BARE GROUND

TUSSOCKY GRASSLAND WITH SCATTERED SCRUB

SEASONALLY WET INUNDATION COMMUNITIES

The following are key habitats and example vegetation types taken from the OMH survey handbook that characterise good quality OMH.

Not all of these may be present at a site for it to qualify as OMH, and some of the habitat types may not be locally distinctive to OMH sites in a region. Nonetheless, this provides a reference point for the mix of habitats that should be considered when developing an OMH landscaping plan.

GRASSLAND

acid, calcareous, neutral, rank (tussocky)

WETLAND

marshy grassland, seasonally wet areas (some brackish), reedbed/fen, swamp and bog

HERB DOMINATED

tall herb, creeping herb

WATER FEATURES

pools (<25 m^2), ponds (25 m^2 to 2 ha), temporary pools

EARLY SUCCESSIONAL VEGETATION

mosses, stress tolerant annuals, lichens and bare ground

HEATHLAND

heather, lichen/ bryophyte heath

WOODLAND AND SCRUB

scrub, scattered trees, woodland pockets

4 Design and Construction: The Basics

WHAT DOES 'GOOD' OMH LANDSCAPING LOOK LIKE?

Good quality OMH landscaping should be able to evidence an ecomimicry approach (e.g. includes locally characteristic features). Unless there are specific site requirements related to a baseline OMH site, the landscaping should incorporate:

- Varied low-nutrient substrates [e.g. a minimum of 2 different (locally characteristic) low-nutrient substrates, and these should comprise a large proportion of the total substrate extent (e.g. at least 70-80% low-nutrient substrates)
- Varied topography (e.g. mounds, hollows, steep banks)
- Structural features (e.g. rubble mounds, log piles, standing deadwood) and resources for OMH communities to breed and/or overwinter (e.g. plant stems, prostrate bramble, seed heads, grass thatch, bare friable substrates)
- Structural variation in vegetation (i.e. low-growing/tall, open/tussocks) without a single habitat accounting for ~80% of the total habitat area
- A mosaic of different early successional habitat types (e.g. annuals, early successional mosses/liverworts, flower-rich grassland, ruderals) PLUS bare ground[6]
- A predominantly native mix of plants (avoidance of non-natives detrimental to native biodiversity)
- A range of plant species that provide resources for typical OMH communities to feed (e.g. pollen/nectar sources, larval foodplants, a resource that is available across the main season)

[6] the BNG condition assessment requires at least 4 communities to achieve 'good' condition and an absence of invasive species

Where possible there should be an aim to have varied hydrology beyond that driven by topography/substrates, for instance an ephemeral or permanent wetland habitat. Patches of scrub can provide structural diversity and can be essential to maintain invertebrate value of the overall mosaic, but should generally not exceed 10-15% of cover [4]. Similarly scattered trees and small stands of woodland can add value [5], but should be of limited extent as with scrub. Additionally, aggressive species and those that spread rapidly should be avoided as these can quickly become dominant and generate management problems.

Currently OMH designation relies on a 0.25ha threshold limit for qualification. It can be possible to deliver ecological functionality and biodiversity value with OMH-inspired landscaping without the challenge of meeting this minimum habitat size requirement (see Beetle Bump case study for an example), but for BNG projects, approval would need to be obtained from a planning/consenting authority that they would accept OMH landscaping <0.25ha being assigned as OMH in the Metric.

OMH LANDSCAPING – A COMPOSITE OF HABITATS AND FEATURES

The previous pages give a checklist of the key features found on good quality OMH sites that should ideally be recreated in OMH landscaping.

A simpler way to understand this is to consider OMH landscaping as composite of habitats and features. These can be structured and blended to either replicate aspects of a baseline site or to mimic the key features and functions so that the ecological functionality is delivered but the design is more appropriate for the site layout or required aesthetics. Landscaping that does not recreate a structurally complex mosaic is unlikely to qualify as OMH.

The following images offer some examples of urban sites that contained a composite of habitats that meet the criteria for OMH. An image showing an example of OMH landscaping with similar habitats and features is shown adjacent, to illustrate how OMH features can be recreated within urban landscaping projects. This is followed by the four key steps to follow for OMH landscaping projects.

OMH SITE FEATURES → OMH LANDSCAPING

FROM OMH SITE FEATURES TO OMH LANDSCAPING – EXAMPLE HABITATS

OMH SITE FEATURES

OMH LANDSCAPING

1 RUBBLE MOUND

2 SCATTERED SCRUB

3 TALL RUDERAL

4 SPARSE ANNUALS

5 BARE GROUND

OMH SITE FEATURES

OMH LANDSCAPING

1 SCATTERED SCRUB

2 TALL RUDERALS

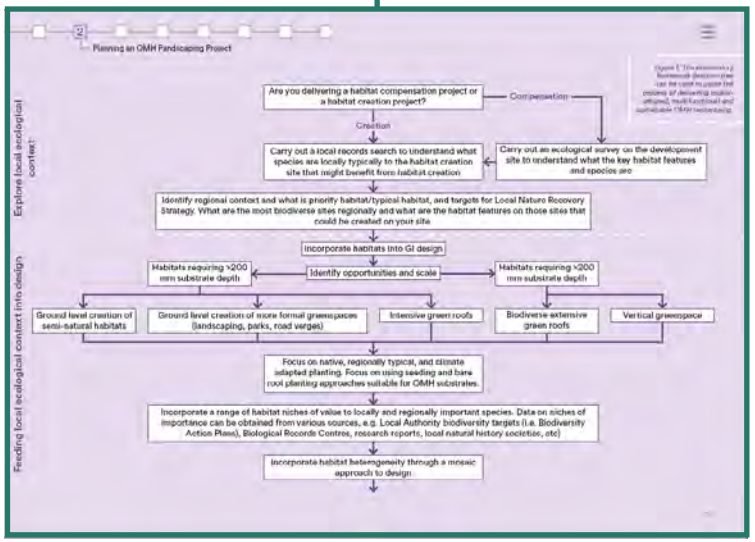
3 FLOWER-RICH GRASSLAND

4 SPARSE ANNUALS

5 BARE GROUND

FOUR BASIC STEPS FOR OMH LANDSCAPING PROJECTS

STEP 1.



Consult the ecomimicry process

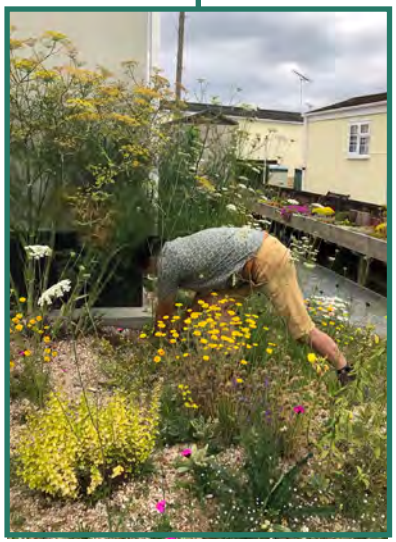
STEP 2.

Design for aspect, topography, substrates and structure

STEP 3.

Introduce OMH vegetation

STEP 4.



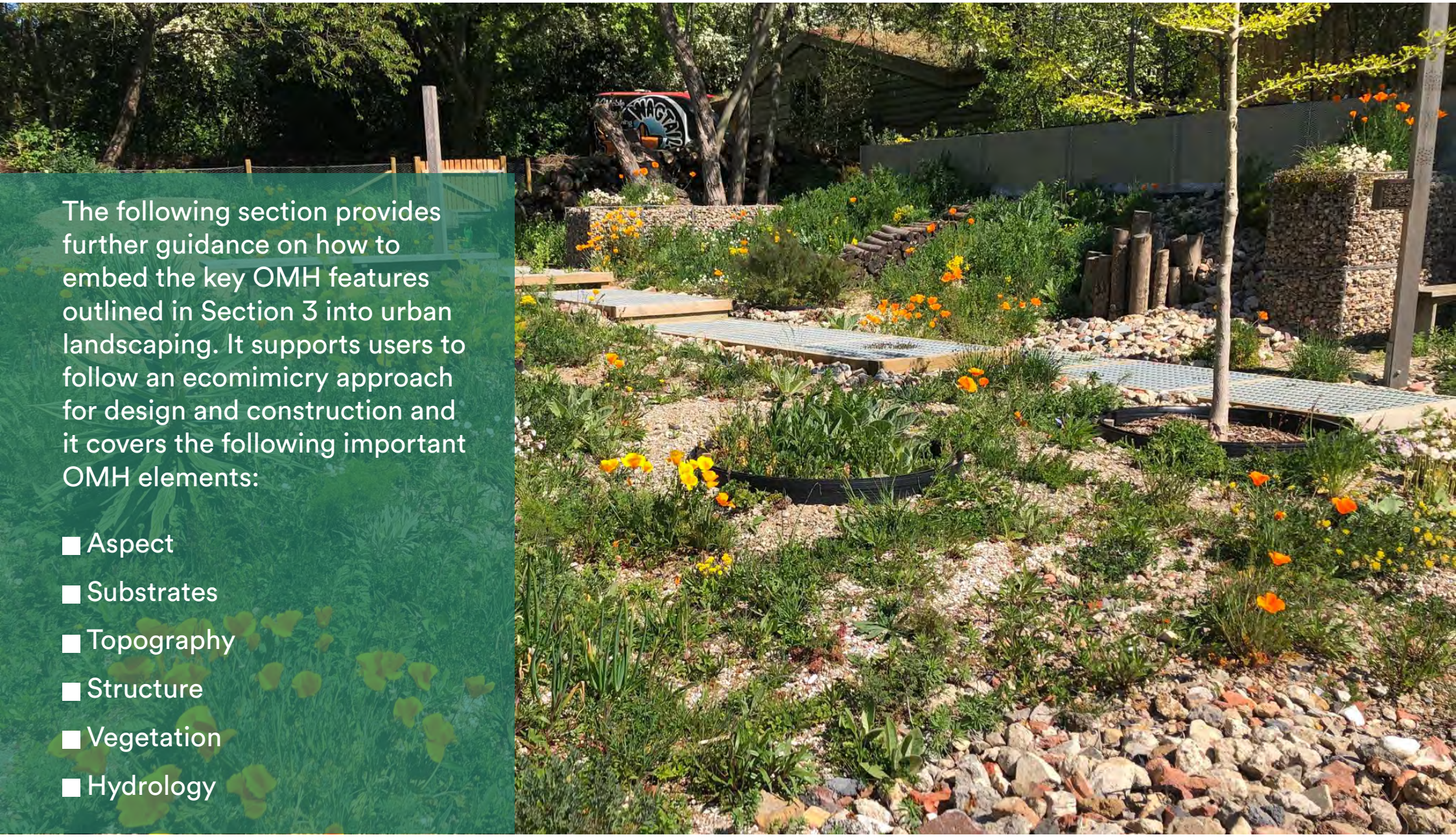
Practice mosaic management

The above description and consideration of the factors set out in the previous section will bring benefits to the design and constructions phases. Ecomimicry of the key environmental factors of OMH can provide a reliable mechanism for ensuring that the landscaping provides ecological functionality.

Early planning can provide some useful shortcuts and cost savings for construction, for example:

- **Making use of materials, structures and staff/machinery already on site** (but needs to be planned-in early as stated above)
- **Allows for simple elements of landscaping to be delivered by construction staff**, e.g. making paths, profiling for topography, hand-sowing seed, creating dead wood structures
- **OMH landscaping avoids the need to import resources such as topsoil, landscape fabric and mulches** (low nutrient plants need no mulching) for the construction phase

It should be noted that there might be trade-offs to some of the methods recommended for OMH landscaping. For example, the impact of installing a barrier material to suppress vegetation/nutrient transfer from underlying soils into low-nutrient substrates. The barrier material does not biodegrade and it may suppress important soil organisms such as mycorrhizae from colonising substrates, although this needs further research to better understand in-situ processes.



The following section provides further guidance on how to embed the key OMH features outlined in Section 3 into urban landscaping. It supports users to follow an ecomimicry approach for design and construction and it covers the following important OMH elements:

- Aspect
- Substrates
- Topography
- Structure
- Vegetation
- Hydrology

5 Design and Construction: Embedding OMH Features Into Urban Landscaping

ASPECT – EMBEDDING ASPECT INTO OMH LANDSCAPING

Sunnier areas
(e.g. south-facing aspects)

- Sunlight is a driver for biodiversity
- Sunny areas may stay open for longer (drier/harsher conditions restrict growth)
- Focus for flower-rich habitats
- Sun-exposed standing deadwood and log piles good for some species
- South-facing banks good for nesting bees

Shadier areas
(e.g. north-facing aspects)

- Focus for shrubs and trees
- Shady ditches for temporary wetlands, mosses/ferns, amphibians etc.
- Shady standing deadwood and log piles good for some species
- Partially shaded banks used by some species for nesting

UTILISING ASPECT FOR OMH LANDSCAPING

South-facing aspects tend to be the sunniest and are an important factor in OMH landscaping as many of the rare and declining insects found on brownfield sites nest in friable substrates on sunlit, south-facing slopes.

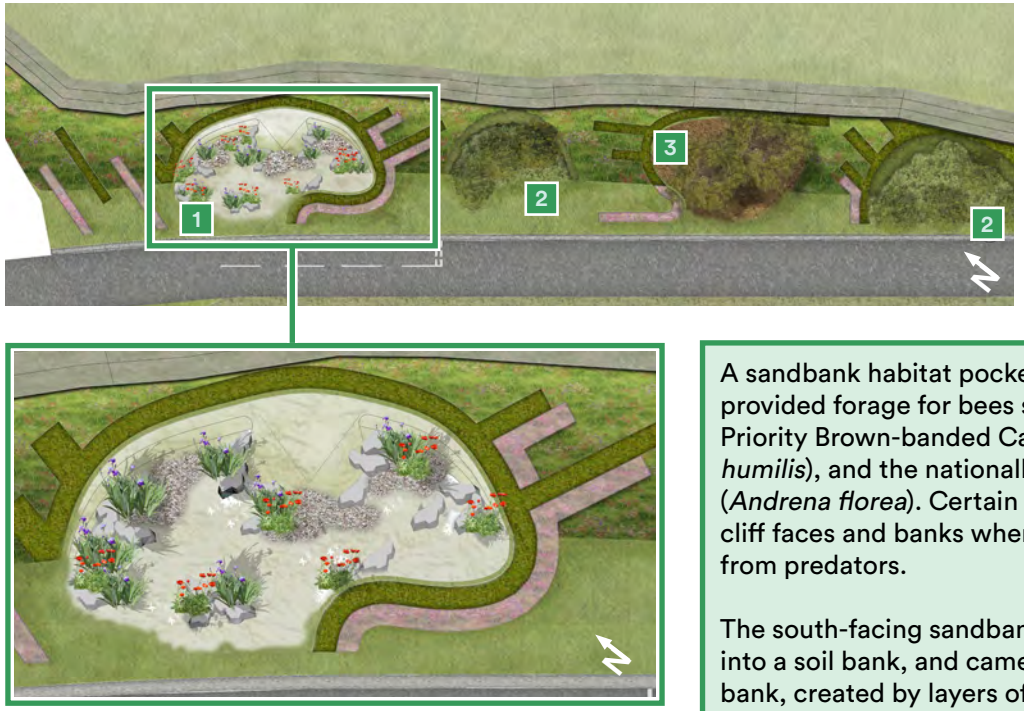
The south-facing sandbank shown here was created at Barking Riverside to provide nesting habitat for solitary bees and wasps. A scallop was cut into a previously constructed soil bank, and this was back-filled with Thanet sand.

The ecologically important OMH sandbank feature was bordered by a meadow and blended with artistic concrete sculptures, ornamental pollinator planting and areas of mown grassland, to provide a more managed and designed aesthetic.

This feature was an extremely successful element of the OMH landscaping at Barking Riverside. It supported much higher numbers of species than typical amenity landscaping at the site and many of the target species for conservation at the site were recorded using the sandbank for breeding, for instance the Hairy-legged Mining Bee (*Dasypoda hirtipes*) [7].

Cost/benefit:

- Forward planning to work with the site's aspects can be cost saving in terms of creating the right habitats in the right places where they will thrive
- Use of aspect with suitable planting can reduce the need for management and/or irrigation
- Aspect can also be used to blend features for biodiversity with features for play



1 SAND BANK BEE HABITAT

2 PLANTING POCKET set 3m into the bank creating sheltered mass of nectar rich flowering shrubs

3 ORNAMENTAL WOODLAND set 3m into the bank providing shelter and further shade

A sandbank habitat pocket was created that provided forage for bees such as the UK BAP Priority Brown-banded Carder Bee (*Bombus humilis*), and the nationally rare Bryony Mining Bee (*Andrena florea*). Certain bees burrow into sandy cliff faces and banks where it is warm, dry and safe from predators.

The south-facing sandbank was created part way into a soil bank, and came out with an additional bank, created by layers of different sized stone aggragate.

The bottom area of the sandbank pocket was designed to be a haven of nectar-rich shrubs and herbaceous plants, including an area laid out like a dry garden with large boulders and plants. All grass areas within the pocket were planted with clover and wildflower species.

SUBSTRATES AND NUTRIENTS – THE FUNDAMENTALS

Substrates underpin vegetation and a variety of fauna, including mycorrhizae (beneficial fungi), springtails and earthworms (detritivores that help soil health), and the larvae of many insects such as ground-nesting bees, flies and beetles.

When trying to recreate/restore any habitat, having the right substrate will be fundamental to successful habitat creation and also for providing the ecological needs of associated fauna such as mining bees. Understanding the physical (e.g. particle size), chemical (e.g. acid/alkaline) and hydrological (free-draining or impeding) properties in combination with elements such as topography and aspect will be critical to achieving the desired habitats.

For OMH landscaping, construction waste and sands offer user-friendly materials that are already graded and sorted for the building industry. Nonetheless, it is essential to ensure that all recycled substrates are free from invasive plant species, particularly species such as Japanese knotweed *Reynoutria japonica* that are listed under Schedule 9 of the Countryside and Wildlife Act 1981 (as amended), as there are penalties for causing the spread of these species. Details on substrates provided on the next page are taken from an article published in the Chartered Institute of Ecology and Environmental Management (CIEEM) 'In Practice' magazine [9] on the importance of substrates in delivering BNG.

SUBSTRATE TYPES AND DESCRIPTIONS

RECYCLED SHARP SAND

Screened from soils/waste taken off sites that would otherwise go to landfill. Very good substrate for most plants, cheaper than standard sharp sand. it often out-performs this substrate (in John Little's experience) because of its wider particle size enabling moisture retention and some nutrients. A default option for planting, though rarely used by ground-nesting invertebrates. Encourages deep rooting and reduced watering.

FINE SAND

Locally characteristic fine sands, such as Thanet sand, emedded with some silt/clay are favoured by a range of ground-nesting bees as the texture ensures nest cavities do not collapse. This sand can be used to form south-facing slopes. By keeping the vegetation down, solitary bees quickly colonise. Using drought-tolerant plants planted towards the apex of the slope ensures the strong capillary action of this fine sand avoids keeping the plants too wet through winter.

CRUSHED BRICK AND CONCRETE

Wonderful choice, comes in various grades: 10, 20, 50 and 50-100 mm; all clean or with fines. Using 50-100 mm in 'spoil heaps' or in gabions provides niches and voids for a wide range of invertebrates. The material remains unvegetated for longer, creating a long-term bare ground environment for basking (see on page 91). Using material with fines ensures the clay content from the brick dust retains moisture, in addition to being higher in phosphorus. This invites more competitive forbs and grasses that reduce plant diversity.

CRUSHED GLASS

Sold as a recycled alternative to mined sharp sand; inert, safe and low fertility planting medium. One of the most hostile and stressed substrates available, providing superb opportunities to grow species that don't tolerate competition. Calcicolous plants thrive; though this is a poor medium for ground-nesting invertebrates.

CRUSHED CONCRETE TYPE 1/3

Useful substrate; readily available as an alternative to mined granite/limestone type 1. The particle size mix works well, and, if not compacted, drains well. Seeds readily germinate; high pH suits a lot of species associated with open mosaic landscapes.

CRUSHED CERAMIC DUST FROM SANITARY WARE WASTE

Smaller particle size (8 mm to dust) works well at ground level and on green roofs; free-draining, low-fertility substrate. It act likes horticultural grit. One of the most useful materials in brownfield landscapes.

The substrates listed above offer a range of textures and aesthetics as well as differing drainage and nutrient levels. A substantial advantage is that they typically contain a very minimal seed bank, meaning direct sewing is possible as soon as the substrate is installed, with no preparation (i.e. herbicide) required. This represents a cost-saving as no fertilisers or top-soil are required and direct sewing avoids pots or composts, reducing transportation costs and the associated carbon footprint. In certain locations or contexts, particular substrate materials and landforms may need to be considered from a safety perspective, and this can be managed with careful design e.g. such features are embedded into areas not publicly accessible.

Anecdotal evidence suggests that the base beneath substrates can greatly influence the way the substrate performs, possibly through movement of nutrients, therefore a barrier may be needed to inhibit this process. Adding layers of crushed material or shingle beneath installed substrates to a depth and on top of geotextiles can help limit nutrient exchange. This method needs further research to better understand in-situ processes of substrate nutrient exchange and its impact on vegetation.

SUBSTRATES AND NUTRIENTS – DESIGN AND CONSTRUCTION PRINCIPLES

- Substrate diversity drives floral (and faunal) diversity, so using a range of varied substrates will benefit biodiversity by providing a wider range of growing conditions and niches
- Substrates such as crushed concrete encourage alkaline-tolerant plants, controlling competition from species that dominate in more neutral conditions
- Using free-draining substrates encourages drought-tolerant plants, which can improve the resilience of habitats to climate change
- Plants can cope with growing in more 'challenging' substrates and be healthy and attractive - they may be smaller, but they flower for longer and the maintenance burden of growing in topsoil is reduced

1 GLACIAL OUTWASH SAND

2 FINE SAND (E.G. THANET SAND)

3 CRUSHED BRICK & CONCRETE

- Low-nutrient soils allow for more herbaceous planting compared to topsoil, and with reduced maintenance costs - e.g. sand slows down unwanted plant colonisation and removing unwanted plants is much easier (by hand)
- Aesthetics and perceptions can be good with the right low nutrient substrates, and this reduces maintenance intensity
- Whilst topsoil can give an instant aesthetic, it needs much high levels of maintenance instantly and the need to mulch topsoil can prevent opportunities for nesting bees
- Reusing site topsoil can reintroduce unwanted plants whereas low-nutrient substrates tend to be weed-free and control competitive species
- Sites with increasingly rare substrates such as pulverised fuel ash (PFA), alkaline slags and Le Blanc waste should prioritise their re-use either on-site or off-site

SUBSTRATES AND NUTRIENTS – DESIGN AND CONSTRUCTION PRINCIPLES

- Variation in nutrient levels is good but low-nutrient aggregates should predominate rather than topsoil
- Low fertility substrates are critical for the success of wildflower-rich habitats and slower colonisation maintains open flower-rich habitats and areas of bare ground for longer
- Using low-nutrient substrates offers the opportunity to direct sow vegetation and there is no requirement to use herbicides to prepare ground (unlike topsoil)
- Low-nutrient aggregates can come from site waste or demolition materials (which are cheaper and have a reduced project carbon footprint)
- Contamination levels may need to be assessed for reused site materials (in line with industry standard methods for managing contaminated materials on construction sites)

- Examples of suitable recycled waste materials for low-nutrient substrates include sand, gravel, and crushed concrete, brick or ceramics
- Low fertility habitats require lower intensity maintenance
- It is necessary to consider ground conditions where low-nutrient material will be used - underlying substrates can change how imported material behaves by raising nutrient levels
- Building on crushed materials to a depth rather than topsoil/subsoil can reduce fertility transfer to low-nutrient substrates
- Building on an impermeable layer can give more predictable performance but will need topography to ensure drainage and avoid anaerobic conditions
- Layers of shingle and geotextile such as ‘Terram’ can limit nutrient exchange between substrates and sub-layers

THE IMPORTANCE OF LOW-NUTRIENT SUBSTRATES FOR OMH LANDSCAPING

Traditionally, many landscaping schemes have relied on the age-old application of topsoil to establish a standard planting scheme recognisable across the UK. Using low nutrient growing mediums offers a novel technique for landscaping that through the example of OMH, is shown to be a crucial driver for biodiverse habitat. Topsoil allows competitive species to thrive and dominate, whereas low fertility substrates suppress these species, allowing floristically and faunistically rich communities to develop. The added-value of using nutrient-poor substrates beyond the obvious biodiversity benefits are detailed opposite.

Cost/benefit:

- Reusing materials from the site reduces costs of landscaping and its carbon footprint
- Using low-nutrient aggregates reduces the need for intensive maintenance
- Low-nutrient recycled aggregates typically are lower cost and have a lower environmental impact than using topsoil
- Low-nutrient aggregates can enhance plant resilience
- Also reduces the need for mulching and/or herbicides to suppress weeds

Biodiversity benefits:

- Delivers flower-rich habitats (pollen/nectar resources)
- Provides nesting habitat for bees

TOPOGRAPHY – DESIGN AND CONSTRUCTION ESSENTIALS

- Include existing site topography into the landscaping designs as much as possible
- Topography can be created by using materials on site, i.e. from demolition, or can be created by importing new, recycled and locally distinctive materials
- Including diversity in topography provides a broader range of conditions for plants and a greater variety of planting depths
- Topography can provide moisture refugia, with deeper areas holding moisture for longer helping plants and fauna to be more resilient to drought/climate change impacts
- Providing vertical and shallow slopes as variation in topographical profiling generates varied microclimates for plants and nesting invertebrates (e.g. drier at top of mounds, damper at the base, hollows hold water)
- Consider above AND below ground-level topography, this creates moisture variation, e.g. ephemeral wetlands - important features of OMH (can be incorporated as part of SuDS or used as part of general site drainage work)

OVERVIEW OF TYPICAL COST/BENEFITS ASSOCIATED WITH SUBSTRATES AND TOPOGRAPHY FOR OMH LANDSCAPING PROJECTS

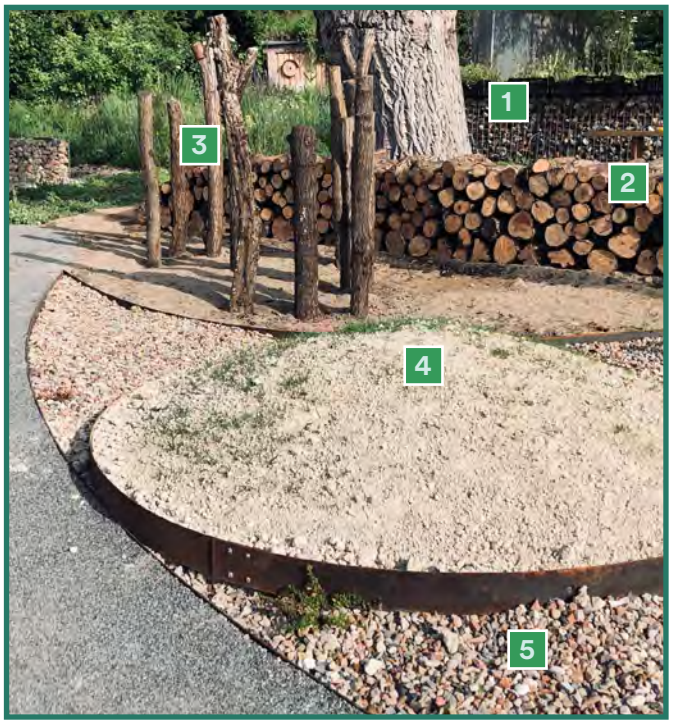
- On site materials from demolition and ongoing maintenance can be used to create topography, avoiding costs associated with off-site disposal and import of new materials
- Topography can enhance habitat resilience, helping to reduce maintenance costs, e.g. irrigation, and reduce the need for re-planting failed habitats
- Topography may require a tailored approach to traditional habitat management practices such as brush-cutting/mowing
- Utilising site waste materials and/or recycled, low-nutrient aggregates such as ceramic waste, or waste calcium carbonate from sugar refining is cheaper and more sustainable than topsoil
- Innovative and emerging substrates such as crushed ceramics (in certain contexts), Leica recycled-PFA aggregate, brick waste with no organics or crushed concrete can deliver cost savings and sustainability benefits e.g. concrete dust might promote inorganic carbon storage in urban soils[7]
- Exploring local sources for substrates can reduce costs and the carbon footprint of materials as well as promote locally characteristic habitats
- Screened waste materials require no herbicide application as there is typically no seed bank

There is a case study on page 91 that showcases how varied substrates and topography were used in an OMH landscaping project called the “Beetle Bump”.

[7] https://www.ncl.ac.uk/press/articles/archive/2016/12/carboncapture/

STRUCTURE (WITH FUNCTION) – KEY FEATURES AND OPPORTUNITIES FOR DESIGN AND CONSTRUCTION

- Dead material can be used to create standing dead wood, log piles and dead hedges
- Substrates can be mounded and cairns of rubble introduced (site won demolition materials can be used)
- Site and path boundaries can be used as locations for structures (e.g. standing dead wood, gabions)
- Gabions create structure and can be filled with site won material, crushed to varied sizes for more diversity
- Linear habitat features such as gabion runs or reed-bed trenches can give protection plus additional habitat niches that cross through/connect habitats in a designed way
- Below-ground structure can be achieved through shallow scrapes filled with logs or to create an ephemeral pond with dead wood
- Structure can be created within wetland features - adding floating or standing dead wood to mimic fallen trees
- Habitat planters can add important vertical and horizontal structure providing nesting opportunities and sites for plants
- Art can be added to sites and provide structure or structures can be designed as art - these can be wooden, metal or concrete features mimicking the function of structure found on OMH sites



1 GABIONS
2 LOG PILES
3 STANDING DEAD WOOD
4 SUBSTRATE MOUND
5 VARIED SUBSTRATES

STRUCTURE (WITH FUNCTION) – KEY FEATURES AND OPPORTUNITIES FOR DESIGN AND CONSTRUCTION

- Vegetational structure can be achieved through diverse planting e.g. low growing and tall herbs, open and tussocky grassland, shrubs; and also through maintenance - cutting mosaics that leave some areas longer/shorter
- Materials from maintenance works can be used for structure e.g. log piles, standing dead wood, dead hedges, and cuttings from meadow maintenance can be mounded into tall piles, left overwinter, removed in spring (less mass to move and creates an area of bare ground beneath to resow/leave bare)
- Existing infrastructure such as fences and small buildings provide structure to support habitats e.g. climbers, nesting features
- Non-natural structural features can increase shelter and provide protection e.g. compost bins
- Structure can be used for place-making to make an area distinct in character. This can include using aggregates to create artistic shapes, patterns or words and designing bee nesting posts with branding

STRUCTURE (WITH FUNCTION) – OMH ECOMIMICRY EXAMPLES AND TYPICAL COSTS/BENEFITS

Structure can be embedded into OMH landscaping using a blend of natural and manmade elements that mimic features found on OMH sites.

Examples shown here include:

- Standing dead wood (natural and machined with added bee nesting features)
- Log piles
- Substrate/rubble mounds
- Gabions
- Dead hedges
- Vertical bee nest posts

Cost/benefit:

- On site materials from demolition and ongoing maintenance can be used to create structure, avoiding costs associated with off-site disposal
- Structure can enhance habitat resilience, helping to reduce maintenance costs e.g. irrigation, replanting failed habitats
- Structure can be used to provide pockets of shade and condensation, providing refuges for plants and animals during drought periods

STRUCTURES THAT CAN PROVIDE PLANTING, NESTING AND REFUGIA FUNCTIONS

Features such as the planters and gabions shown opposite can be added to sites to provide structural diversity.

Planters and gabions can be planted up to provide attractive pollen and nectar resources like traditional planters. But the *additionality* is that the sand planters have been specifically designed to provide vertical and horizontal nesting habitat for bees and wasps, and the rubble planters/gabions provide a variety of refuges and niches that are used by a multitude of species such as spiders, reptiles, amphibians and nesting bumblebees.

Cost/benefit of planters/gabions:

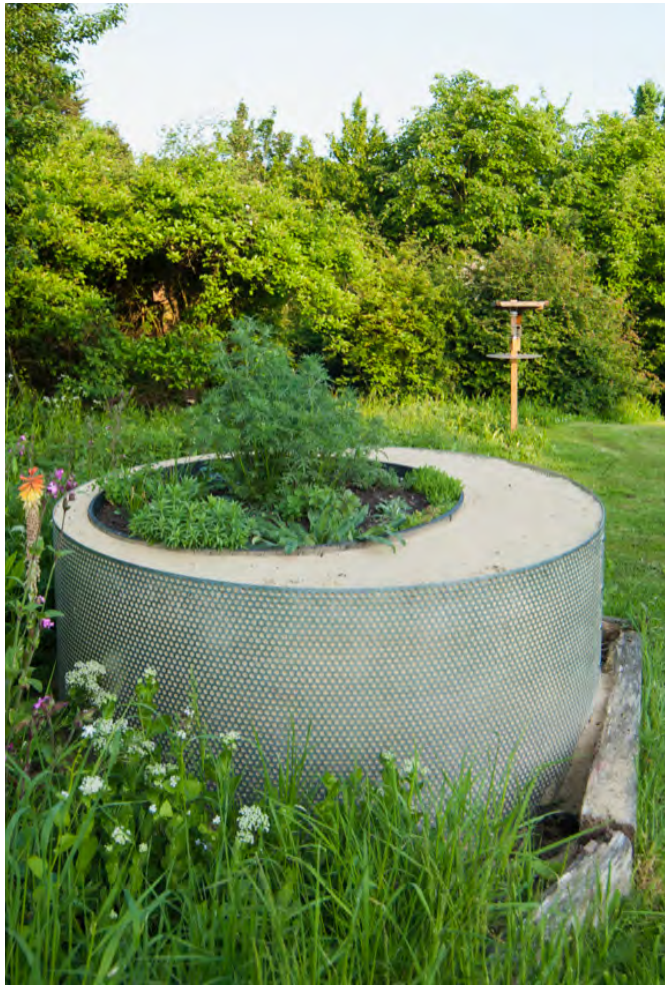
- On site materials from demolition can be used, avoiding costs associated with off-site disposal, whilst adding structure and important nesting/resting functions for biodiversity
- Planters can be installed at an early phase to enable colonisation by fauna and then moved to a permanent location later

STRUCTURES THAT CAN PROVIDE PLANTING, NESTING AND REFUGIA FUNCTIONS

These planters offer a 'designed' approach to introducing important OMH substrates such as rubble and sand into a development in a structured way, that does not involve a mound of material that may not be acceptable or practical for some urban landscaping aesthetics.

Provision of nesting features are *critical* to the functionality of OMH landscaping, and there needs to be suitable habitat beyond purely flower forage incorporated into landscaping schemes.

The example of the sand planter shown opposite was created with a central plastic core, that mimics a standard planter, surrounded by an external skin of perforated steel, with the space between packed with sand. The steel holds the sand in place and has a designed aesthetic.



Vertical sand bank/cliffs are used by a variety of bees and wasps that have become almost entirely restricted to OMH sites since their natural habitats have been lost or degraded in the wider landscape. The planter acts as a habitat analogue, and the bees nest in the sand via the 10 mm diameter holes in the perforated steel, or in the exposed horizontal sand at the top.

This design was developed to provide a suitable depth of substrate for ground-nesting bees. Their nesting burrows can be a complex network of shafts up to 40 cm deep, or further, therefore when providing nesting habitat for bees, the functional depth needs to be considered for the feature to be a viable habitat. Similar consideration is needed for the width and depth of holes in wooden bee nesting habitats.

GABIONS – MULTIFUNCTIONAL STRUCTURES FOR OMH LANDSCAPING

Gabions offer a great way to repackage OMH type features so that they look good and deliver structure and function in landscaping. When created with care, i.e. fill materials are sorted and installed according to size/shape to look 'neat, they can be an attractive designed feature, suitable for most landscaping projects. From a cost and sustainability standpoint, they make use of site materials that might otherwise be disposed of and can be embedded in the planting design as an engineering solution or a standalone structure.

Experimentation with gabion design has begun to extend the additional ecological functions and complexity they can provide. For OMH landscaping projects this includes important habitat features such as log piles for dead wood specialist (saproxylic) species, bumblebee nest boxes and solitary bee tubes, hoverfly lagoons and vole nest boxes. Gabions can offer a multifunctional solution for embedding key ecological functions into OMH landscaping.

Gabions offer many advantages as part of OMH landscaping:

- Speedy to construct
- Provide a habitat/shelter feature for a wide range of wildlife, especially for spiders
- Permeable to water (unlike solid walls)
- Strong and sturdy so not prone to vandalism
- Can protect slopes from erosion
- Create basking areas (filled with rubble) and promote heat exchange/ thermoregulation for invertebrates and reptiles
- Local material can be used for filling, e.g. wood, hardcore, building waste

- Eco friendly - gabion walls are extremely long lasting, durable, sustainable and no maintenance required compared to traditional brick walls
- Large reduction in transport costs and associated fuel consumption compared to a traditional brick wall
- Gabions are unfixed so can be reused and moved to different locations rather than destroyed
- Cost efficient - can be filled with inorganic and organic materials e.g. rubble and logs, which may be present on site, recycling waste, instead of going to land-fill

BOUNDARIES AS SPACES FOR OMH FEATURES AND STRUCTURE

The perimeter of a site can be a useful and underused space within developments for making space for nature.

At a minimum, default security fence-lines can be used as a support for climbing plants, but they can also be places to attach dead wood and habitat panels that provide additional niches for species such as invertebrates and birds.

The images opposite show innovative examples of creating structure at a boundary, for instance by using dead wood in an attractive and artistic design to provide ecological functionality and striking aesthetics

Boundaries can also be used to install habitat features for nesting bees and birds.

PATHS AS OMH HABITAT FEATURES

Pathways that are created as 'desire lines' through OMH sites are often important features; they create openings in vegetation, providing structural diversity and resetting succession, but often most importantly they create a microhabitat that is used by species of invertebrates and reptiles for warming up, and by many bee and wasp species for nesting.

Paths in OMH landscaping can therefore be designed as a multifunctional feature providing habitat as well as a footway and permeable paths can also help with stormwater drainage. Using sand as a paving material can offer nesting habitat at the edges for ground-nesting mining bees.

Where tarmac paths are needed the base can be extended and have ~ 150mm deep, sand or low fertility substrate either side which could be sown to provide a low maintenance additional habitat and incorporate bare exposed areas for nesting and resting invertebrates. This simple type of feature could be created by the construction team rather than a landscaper.

Creatively designed permeable paths can not only act as a soakaway but can have free-draining substrates and trample-tolerant plants (e.g. creeping thyme) or bare sand installed beneath protective galvanised steel grating to offer extra habitat for pollinators for foraging or nesting.

VEGETATION – FUNDAMENTALS FOR OMH LANDSCAPING

- OMH is characterised by high plant diversity and high flower abundance, this should be emulated in landscaping
- When preparing a plant palette, reference key species on the OMH baseline site and/or good quality OMH sites in the region
- Alternatively commercial chalk downland or green roof seed mixes can be a suitable substitute
- It is possible to harvest seeds from sites, but this is less reliable and may introduce unwanted species
- Low-nutrient substrates allow direct sewing rather than using pot plants (unlike topsoil)
- Preparation costs for sewing are lower when using recycled materials or sand, as no herbicide/fertiliser required (unlike topsoil)
- Planting should include a mix of flower types as different pollinators depend on particular flower shapes (e.g. umbellifers, pea-shaped and daisy-type flowers)
- Use a mixture of plant species including some that flower earlier/later to extend the flowering period for early/late foraging pollinators

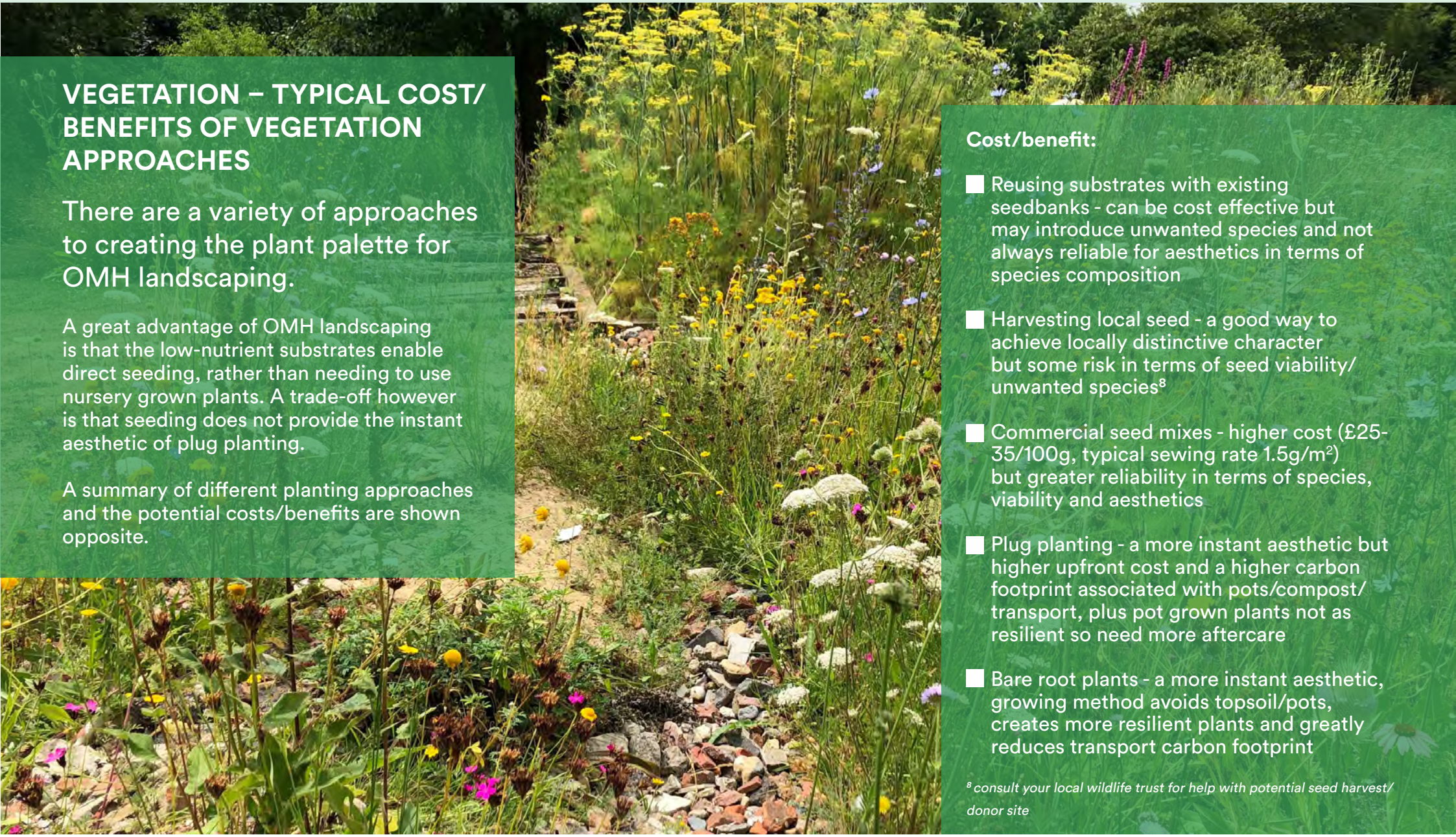
- Where pre-grown plants are needed, bare root plants are more sustainable and resilient than pot grown plants - not transporting with soil means 100s more plants in a shipment are feasible, with significant transportation/carbon savings
- Interplanting herbaceous species with sub-shrubs can create vegetation structure, but these do not establish so well with direct sewing, especially Mediterranean species. For these, use pot grown plants, including tussock ornamental grasses
- Trees can be included in OMH landscaping but this needs serious consideration so that they do not shade out key herbaceous species or important features. Aggressive species should be avoided and leaf litter removal would be needed to avoid nutrient enrichment of substrates

- Landscaping design can combine more ornamental areas with 'wilder', OMH features to blend more traditional urban greenspace aesthetics with ecological functionality e.g. ornamental, more managed areas near paths and wilder habitats further back
- Substrates can follow this pattern, low nutrient by paths graduating outward to topsoil to create density/height diversity
- Vegetation management should follow a mosaic approach, to encourage vegetation structural diversity and to leave some unmanaged overwintering habitat

Having a range of plant groups can be as important as the actual range of species.

The following includes example groups and some characteristic species that are indicators of good quality OMH [5].

- Daisy family (composites): ox-eye daisy, mayweeds, thistles, knapweeds, hawkbits, cornflowers, mugwort, ragwort, fleabanes
- Pea family (legumes): bird's foot trefoils, clovers, vetches, gorse
- Figworts: red bartsia, toadflaxes, and mulleins
- Umbellifers: yarrow, fennel, cow parsley and wild carrot
- Borage family: especially vipers bugloss, forget me nots, borage
- Mint family: dead nettles, selfheal, horehounds, wild marjoram, thyme, meadow clary
- Yellow crucifers: garlic mustard, rocket, mustards (although many will likely self-seed at many sites)
- Crane's bills (*Geranium* genus): dove's foot cranesbill, herb Robert, hedgerow cranesbill;
- Mallows: common, musk and dwarf
- Pink family: campions, catchflys, Dianthus, soapwort and corncockle
- Scabious: field, devil's-bit and small scabious
- Valerians: red valerian and cornsalads
- Additional groups such as St-John's worts, stonecrops, teasel, wild mignonette and weld, nettles, bracken
- Shrubby species: white bryony, blackthorn, hawthorn, cherry plum, sallow



VEGETATION – TYPICAL COST/ BENEFITS OF VEGETATION APPROACHES

There are a variety of approaches to creating the plant palette for OMH landscaping.

A great advantage of OMH landscaping is that the low-nutrient substrates enable direct seeding, rather than needing to use nursery grown plants. A trade-off however is that seeding does not provide the instant aesthetic of plug planting.

A summary of different planting approaches and the potential costs/benefits are shown opposite.

Cost/benefit:

- Reusing substrates with existing seedbanks - can be cost effective but may introduce unwanted species and not always reliable for aesthetics in terms of species composition
- Harvesting local seed - a good way to achieve locally distinctive character but some risk in terms of seed viability/ unwanted species[8]
- Commercial seed mixes - higher cost (£25-35/100g, typical sewing rate 1.5g/m^2) but greater reliability in terms of species, viability and aesthetics
- Plug planting - a more instant aesthetic but higher upfront cost and a higher carbon footprint associated with pots/compost/ transport, plus pot grown plants not as resilient so need more aftercare
- Bare root plants - a more instant aesthetic, growing method avoids topsoil/pots, creates more resilient plants and greatly reduces transport carbon footprint

[8] consult your local wildlife trust for help with potential seed harvest/ donor site

HYDROLOGY – DESIGN AND CONSTRUCTION OPPORTUNITIES

- Consider existing site drainage and topography at the design stage - naturally poor-draining areas can be used for temporary wetlands, free-draining areas for meadows
- Including different topographies can create wetlands with different depths from permanent water bodies to ephemeral wetlands, adding habitat diversity and complexity for a wider range of species
- Structural elements can benefit from being in different hydrology regimes to enhance diversity e.g. log piles can be placed in dry and wetter areas providing different niches for a broader range of species
- Structural elements can influence hydrology, for example structures that shade the ground can keep it wetter for longer making it suitable for less drought-tolerant species
- Wetland features can be incorporated into structures, for instance gabions can include reservoirs of water and organic matter (wood/leaves) that mimic the natural lagoons used by hoverflies for nesting
- Appropriately designed wetland features can also function as Sustainable Drainage Systems (SuDS) helping with stormwater management as well as providing a habitat for biodiversity

SuDS AS WETLANDS FOR OMH LANDSCAPING

Many OMH sites have varied hydrology that results in seasonally wet areas that either hold water during rainy seasons or support inundation communities such as reeds and rushes due to prolonged waterlogging of substrates. These wetland features can be extremely valuable for many species within OMH invertebrate communities.

Sustainable Drainage Systems (SuDS) are widely used in developments to manage stormwater and provide greenspace. SuDS and OMH landscaping do not have to be separate within a development. Appropriately designed SuDS can be incorporated into OMH landscaping schemes, to provide the dual benefits of nature restoration and stormwater management, a win-win for development projects.

OMH design principles can be applied to SuDS features such as rain gardens, green roofs, swales and detention/ retention basins. SuDS features lend themselves to being designed into the mosaic as either ephemeral wetlands or permanent water bodies. Similarly, SuDS creative designs can bring the topographical variation key for OMH landscaping.

Many of the low-nutrient, free-draining substrates typical of OMH are suited to SuDS features and if these are planted with species characteristic of OMH wetland habitats, they can provide an additional and ecologically valuable features in OMH landscaping.

Combining OMH landscaping and SuDS can be cost effective as SuDS can act as a mechanism to co-fund OMH landscaping.

ADDING OMH FEATURES TO INFRASTRUCTURE

Aspects of OMH can be the inspiration for the design of habitats on biodiverse green roofs.

Features such as low-nutrient, free-draining substrates, early successional, flower-rich vegetation and structural elements such as log and rubble mounds are typically incorporated into biodiverse green roof design. These can provide resources akin to those found on OMH sites, but with constraints – for instance the restricted substrate depths and spatial extent of these measures can limit their ecological value in terms of providing the range of resources offered by ground level OMH. Additionally, conditions at roof level can often be harsher than ground level, and when combined with shallow green roof substrates, can lead to more frequent drought stress events that can be challenging for certain OMH communities.

Nonetheless, habitat akin to components of OMH have been successfully installed on the roofs of various infrastructure, and studies have shown that well designed biodiverse green roofs can provide a valuable refuge and habitat stepping-stone for a variety of species (e.g. [6]). Examples of guidance for designing good quality roof top habitats to support OMH communities include Buglife's guide [2] plus guidance on following ecomimicry principles for green roof design [7].

The background images on the following pages provide examples of this innovative approach to restoring nature into some of the more sterile spaces within developments. The roof top habitats created for bicycle shelters and bin stores are fixed to a heavy-duty, galvanised steel frame with stainless steel trays to waterproof. They are built to last, have great aesthetics, provide space for nature as well as an opportunity for people to connect with nature.

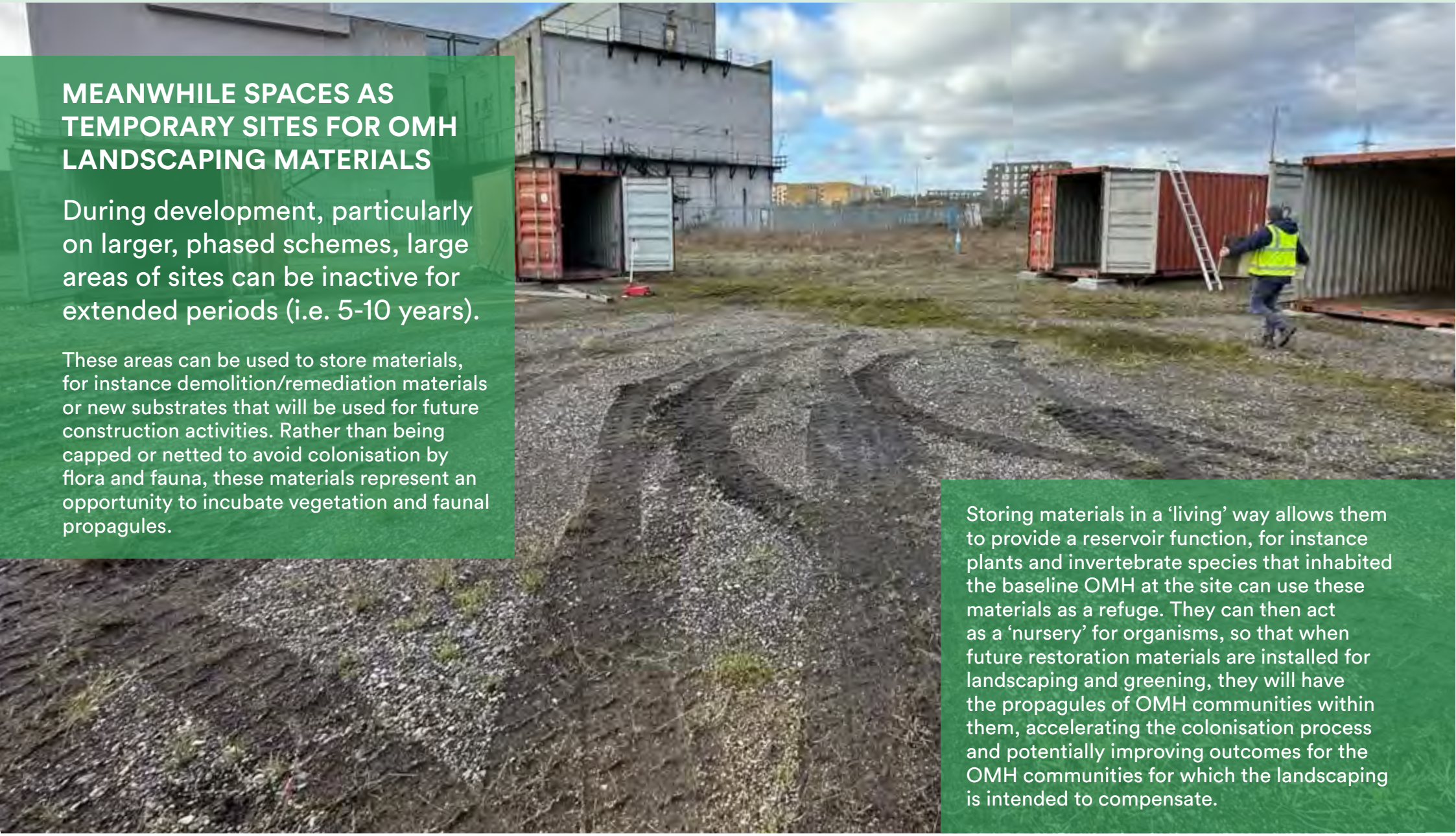
Within the BNG Metric tool, biodiverse roofs have been assigned a separate category, with medium distinctiveness. Therefore, it is expected that the trading rules will preclude roof habitats akin to OMH being assigned as OMH in the Metric where this is being provided at roof level only and within the constraints of typical extensive biodiverse green roof design. In cases where the quality and extent of habitat at roof level is assessed by an ecologist to be of equivalent ecological value to OMH, and it complements and contributes to ground level habitats to create an overall OMH, then agreement to use the OMH category for roof level habitats would need to be negotiated with the consenting planning authority. It may be possible to argue that these small-scale roof habitats provide a complementary element of the overall OMH mosaic if OMH landscaping is being provided at roof level, for instance early successional, flower-rich habitat.

Whilst OMH style habitats at roof level can be a valuable resource for OMH communities, the shallow substrate depths and higher levels of exposure to wind and sun for most extensive biodiverse green roofs creates a particularly harsh environment for plants and associated fauna. Consequently, during prolonged periods of drought in the summer, green roof vegetation can be subject to widescale die-off in the absence of irrigation (and generally biodiverse green roofs are not irrigated as lack of irrigation helps create the stress conditions that prevents grasses from becoming dominant). This means critical plant resources may not be available at a key time for OMH faunal communities. At these times, good quality landscaping in the surrounding environment would be needed as a refuge for roof top communities.

Incorporating OMH-type habitats onto the roofs of buildings and other structures such as shelters, bike sheds and bin stores can be a great way to restore nature into highly urban, high-density environments, where space at ground-level can be at a premium.

A case study on page 97 showcases how OMH features can be incorporated into green roof design and deliver for target OMH species.

OMH has been a longstanding habitat template for the design of biodiverse green roofs, which typically use varied substrates, topography and structural features, combined with native wildflower mixtures akin to OMH early-successional flower-rich habitats. For the purposes of the BNG metric, biodiverse roofs have their own category, but for the purposes of biodiversity these features can provide valuable support for OMH communities within the built environment.



MEANWHILE SPACES AS TEMPORARY SITES FOR OMH LANDSCAPING MATERIALS

During development, particularly on larger, phased schemes, large areas of sites can be inactive for extended periods (i.e. 5-10 years).

These areas can be used to store materials, for instance demolition/remediation materials or new substrates that will be used for future construction activities. Rather than being capped or netted to avoid colonisation by flora and fauna, these materials represent an opportunity to incubate vegetation and faunal propagules.

Storing materials in a 'living' way allows them to provide a reservoir function, for instance plants and invertebrate species that inhabited the baseline OMH at the site can use these materials as a refuge. They can then act as a 'nursery' for organisms, so that when future restoration materials are installed for landscaping and greening, they will have the propagules of OMH communities within them, accelerating the colonisation process and potentially improving outcomes for the OMH communities for which the landscaping is intended to compensate.

OMH TRANSLOCATION

Habitat translocation is a process of moving soils with their vegetation and other organisms that inhabit them to a receptor site, with a view retaining habitats that would otherwise be lost to development.

This can be a fairly complex and labour-intensive procedure and remains controversial as there has been high risk of failure or ongoing issues. Nonetheless, examples of successful habitat translocations exist, and this includes for OMH.

A case study on OMH translocation at the Tilbury port development site can be found on page 99.

6 Case Studies

This section includes case studies where OMH features and habitats have been incorporated into developments.

These represent best practice examples of habitat compensation or enhancement measures that could help with delivery of BNG and secure high quality green infrastructure for biodiversity and for people. They demonstrate how many of the principles and practices outlined in this guidance can be successfully implemented in real world situations.

USING VARIED SUBSTRATES AND TOPOGRAPHY FOR OMH LANDSCAPING – UEL'S BEETLE BUMP

Mounds of materials can be used to provide topography for OMH landscaping. Site won materials that originate from demolition can be ideal, i.e. crushed brick or concrete, but it may also be possible to import local materials and divert them from waste streams e.g. sand from road widening schemes.

UEL's Beetle Bump is an OMH nature reserve that was designed specifically for the streaked bombardier beetle, which has an affinity for mounds of earth and brick rubble and is associated with OMH sites. When creating the Beetle Bump for this species, brick and earth mounds were created using waste brick from a local site. Varied substrates were used to provide a wide range of conditions to enable the site to support a diversity of OMH plants and provide a broad range of niches for a variety of OMH fauna.

The Beetle Bump substrates were arranged artistically by hand to create topography, provide aesthetic appeal and mimic locally-important OMH features.

The following recycled aggregates were used:

- 20 tonnes of broken brick
- 20 tonnes of screened recycled soil
- 10 tonnes of chalk
- 10 tonnes of crushed concrete

Once the substrates had been installed, a diverse seed mix that included native species typical of OMH sites in the region was sown at a low density to help speed up colonisation and overall aesthetics.

Monitoring since establishment has shown that streaked bombardier beetles along with a variety of other important OMH invertebrates have been sustained by the nature reserve. Compared to more traditional areas of landscaping within the campus, the Beetle Bump supported a far greater richness of flora and fauna.

At only 0.1 hectares in extent, the Beetle Bump also showcases how small pockets of OMH landscaping can support important biodiversity and provide connecting stepping-stone habitat amongst lower quality urban habitats.

ESSEX WILDLIFE TRUST LANGDON NATURE RESERVE - TRANSFORMING A CAR PARK WITH OMH

The original brief for this project was to provide wildlife-friendly landscaping for a car park attached to a new visitor centre for the nature reserve.

The budget for landscaping the 150-space car park was £40k, and as planning permission was granted prior to mandatory BNG, it had been possible to gain planning consent with very limited consideration for green infrastructure. This meant the landscaping design opportunities could be defined, and a decision was made to provide a contrasting and complementary habitat to those typical of the wider nature reserve. Due to its potential for supporting rich biodiversity in South Essex, an OMH landscaping design was chosen to drive greater biodiversity rather than replicating existing habitat and simply increasing the existing biomass on site.

The main nature reserve was on heavy clay and although in places was rich in biodiversity, it offered little opportunity for OMH. The car park provided an ideal space for OMH landscaping and was also a key part of the site, as it was where most visitors would experience their first impression of the nature reserve. Through creative design and good interpretation, there was an opportunity to create a place where visitors could connect with and learn about biodiversity and take away ideas that they could embed into their own greenspaces.

LANGDON NATURE RESERVE OMH LANDSCAPING CAR PARK TRANSFORMATION

The car park design limited landscaping to a 1200 mm outer edge and a 900 mm centre spine. Gabions were used to form the main structure bounding the car park, providing a retaining wall for new substrates that would be added, as well as a structure to create nesting and hibernation opportunities for a wide mix of invertebrates and mammals.

Typically, gabions are filled with mined gabion stone that is transported many miles. This project used crushed demolition waste (75-150 mm) made from local houses, sourced from within 2 miles of the site.

It was agreed that 8 of the 150 parking spaces could be repurposed for landscaping, and these were framed with box steel and filled with a mix of construction waste and local sand.

These low-nutrient, friable substrates would encourage floristic diversity typical to OMH and provide opportunities for ground nesting invertebrates. The new bays would highlight the need to reduce car use and to make space for nature within everyday infrastructure.

The bays were planted and seeded with species resilient to climate change. A designed bee post provided space for aerial nesting solitary bees.

The rear of the perimeter gabions was back-filled with local sands from the A13 road widening no more than 2 miles from the site. This provided a weed-free, low fertility substrate ideal for the native seed mix. The sand had the additional advantage of providing breeding space for many of the local bees and wasps, which was further enhanced by adding topography to ensure provision of warm, south-facing slopes.

A sterile car park was transformed into an ecologically-rich example of OMH landscaping, delivering BNG using locally-sourced waste materials from within 2 miles and without compromising the aesthetic. The landscaping was paired with good interpretation so that visitors could understand and appreciate these valuable habitats, and the themes of biodiversity and sustainability.

BRINGING OMH LANDSCAPING INTO RECREATION USE – LONDON'S OLYMPIC PARK OMH MOUNTAIN BIKE TRACK

Many OMH sites are accessed by the public informally and used for recreational activities such as dog walking and off-road biking.

Some of these activities can be beneficial for the biodiversity value of OMH sites, for instance disturbance created by tracks from walking and off-road biking can help to maintain areas of bare ground and open habitat, helping to reset succession and providing basking or nesting opportunities for species such as nesting bees and wasps.

Similarly, some of the habitats that occur on OMH sites are analogous to those found on the scree slopes of mountains and cliffs, that are subject to disturbance from natural weathering. As such, the resilient character of some of the vegetation communities within OMH means they can withstand a certain degree of disturbance and can be compatible for embedding within recreational sites.

This concept was put into practice in London's Olympic Park, when they created a mountain bike track that was landscaped with vegetation characteristic of OMH. The bike track was designed with banks of substrates typical of OMH sites and was sown with a wildflower mix characteristic of OMH. A range of different substrates were used as part of the design, providing a mosaic of habitats. These were also designed to provide a range of challenges for the mountain bikers and included use of different slopes and aspects.

The cycling activity helps to provide some of the management required to maintain the ecological and functional value of the site. This includes adding to the overall mosaic by creating different levels of intensity of management related to the proximity to, and frequency of use of, the main cycle routes.

LONDON'S OLYMPIC PARK OMH BIOSOLAR ROOF

The 0.25 ha biosolar roof on the Here East building in London's Olympic Park was designed to contribute to Biodiversity Action Plan (BAP) targets to compensate for loss of OMH at the site.

The roof design included bands of varied substrates with differing nutrient and drainage statuses installed at varied depths. This was combined with features such as log piles and rubble mounds to create structural diversity and microclimates, which encouraged a vegetation mosaic to develop.

1 WOOD AND RUBBLE PILES to create structural diversity, shelter and microclimates

2 BANDS OF TWO DIFFERENT SUBSTRATES AT DIFFERENT DEPTHS to recreate a mosaic

The solar panels also created microclimates, adding to the mosaic effect [6]. Results from monitoring the roof for the Park's BAP demonstrated that the roof supported a diverse range of wildflowers (65% indicators of good quality OMH) and invertebrates (40% designated rare, scarce or notable), plus target bird species such as the rare black redstart. The findings confirmed the roof was contributing to BNG targets for the Park, offering suitable resources for target OMH species and outperforming some ground-level habitats in the Park for rare and scarce invertebrate species. The roof also provided multifunctional co-benefits, including SuDS, cooling and a renewable energy source.

1 LOG PILE AND SOLAR PANEL REFUGIA EFFECT promotes stronger plant growth

2 BARE GROUND AND SPARSELY VEGETATED AREAS ON BRICK SUBSTRATE

3 FLOWER-RICH NECTAR AND POLLEN RESOURCE ON CERAMIC SUBSTRATE

© Rebecca Read

TILBURY 2 PORT DEVELOPMENT OMH TRANSLOCATION

Tilbury 2 was part of a major port expansion project that involved redevelopment of brownfield land. This included a site containing waste ash from the former Tilbury power station. The ash deposits had been naturally colonised by plants and invertebrates, developing important OMH communities of high conservation value.

As part of the port development, a pioneering OMH translocation project was undertaken in collaboration with environmental consultants Bioscan, who helped design the translocation scheme. Pulverised fly ash (PFA) from the power station donor site was moved in shipments, involving around 14,500 tonnes of material. This was then installed at the receptor site (a former landfill site) to construct 'PFA dunes', crescent shaped mounds approximately 5 metres wide and 1 metre high. These were built with a thick, underlying 'blinding layer' to provide the important, low-fertility surface to suppress vigorous plants, and a thin surface layer containing seeds, plant and invertebrate propagules from the original brownfield site.

The OMH translocation resulted in 3.5 hectares of compensation habitat, located within a larger brownfield nature reserve managed by Essex Wildlife Trust.

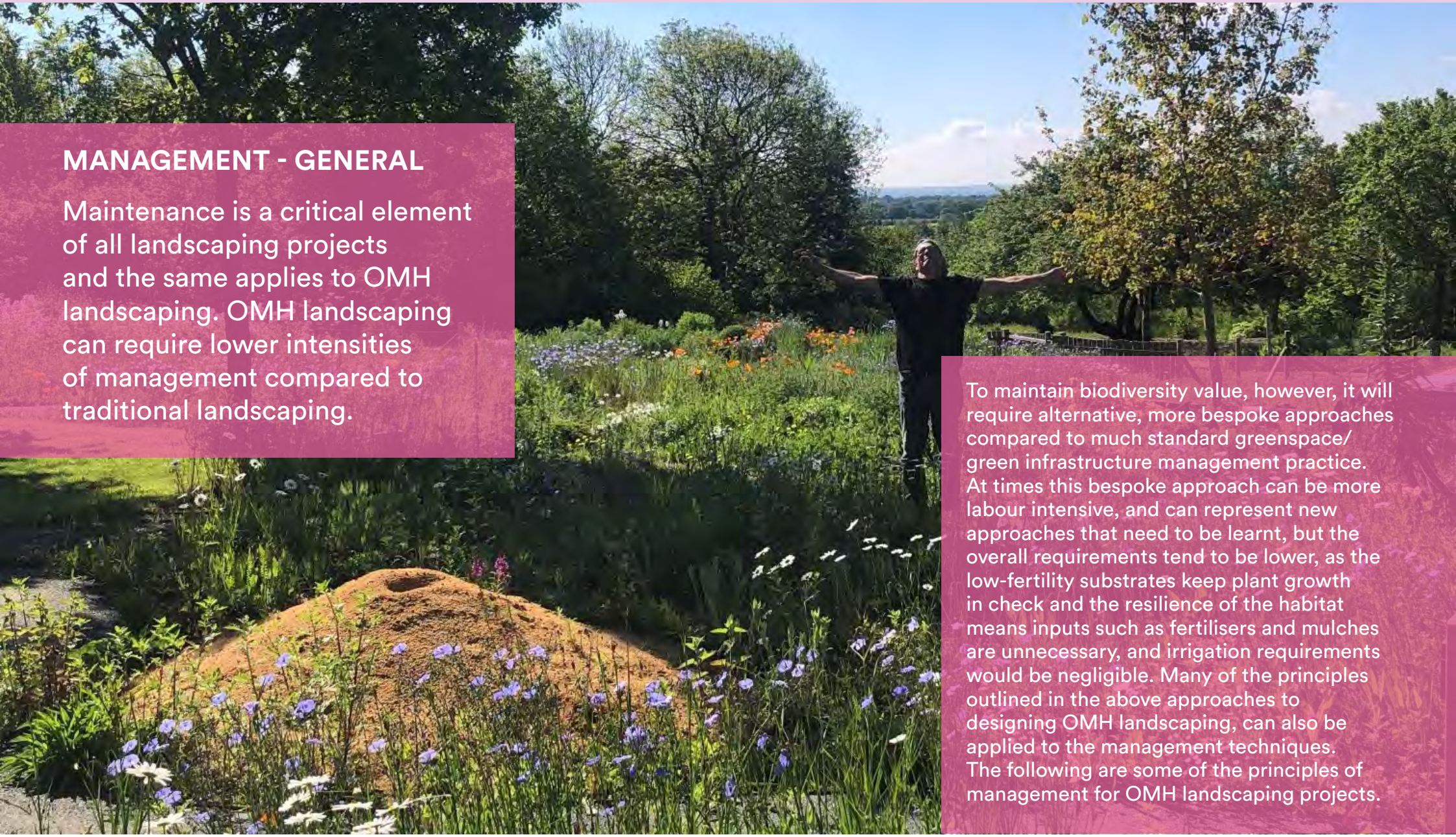
This project showcases an innovative approach to recreating OMH as part of development, whilst trying to retain some of the species from the original site. There has been ongoing monitoring of the translocation receptor site, to assess whether the area was successfully providing compensatory habitat for invertebrates. Surveys in 2020 found that the site supported a high-quality assemblage of invertebrate species, including many rare and scarce species, making it of high conservation importance for invertebrates and indicating the translocation had so far been successful.

Given that OMH is a dynamic habitat that results out of man-made disturbance, under some circumstance/stages of colonisation, it is possible that the process of translocation may not be as catastrophic for OMH as for other habitats. Nonetheless, long-term monitoring will be critical to understanding the success of this approach and whether this is something that could be attempted more widely.

Further innovative examples of using OMH features and principles to inspire greenspace design include:

- Beth Chatto Meanwhile Garden
- Atelierhouse C21
- Knepp Rewilded Garden

7 Stewardship



MANAGEMENT - GENERAL

Maintenance is a critical element of all landscaping projects and the same applies to OMH landscaping. OMH landscaping can require lower intensities of management compared to traditional landscaping.

To maintain biodiversity value, however, it will require alternative, more bespoke approaches compared to much standard greenspace/ green infrastructure management practice. At times this bespoke approach can be more labour intensive, and can represent new approaches that need to be learnt, but the overall requirements tend to be lower, as the low-fertility substrates keep plant growth in check and the resilience of the habitat means inputs such as fertilisers and mulches are unnecessary, and irrigation requirements would be negligible. Many of the principles outlined in the above approaches to designing OMH landscaping, can also be applied to the management techniques. The following are some of the principles of management for OMH landscaping projects.

MANAGEMENT PRINCIPLES FOR OMH LANDSCAPING

- The mosaic goes beyond the design, it is also part of the management - rotational, mosaic cutting where sections of the landscaping are cut and sections are left uncut, rotated on an annual or biennial basis
- Cutting the sward to different heights in different sections to increase vegetation structural diversity for invertebrates
- Cutting small sections of meadows in early summer to promote late flowering for key OMH species such as brown-banded carder bee (*B. humilis*) that fly into autumn
- Leaving some sections of sward on a longer cutting rotation to enable a thatch of vegetation to develop to provide suitable nesting resources for carder bees
- Creating exposures of substrates to provide bare ground for ground-nesting and thermophilic invertebrates as well as helping to increase plant and flower diversity

- OMH value depends on a degree of disturbance to reset/open-up habitats e.g scrapes - maintenance teams will need to introduce that disturbance
- OMH management needs a tailored approach i.e. topography has implications for traditional mowing/brush-cutting
- Shrubs/hedges need to be managed on a coppicing cycle rather than hedge-trimming cycle e.g. variation of intensity of hedge management can create more diversity (mimic animal browsing)
- Materials from tree/shrub management within a development can be used for habitat creation/enhancement e.g. dead hedges, standing dead wood, log piles
- Materials from meadow management can enhance meadow diversity e.g. small stacks of cut material can be left on site over winter, giving patches of nutrient enrichment whilst allowing bare soil to be created, which can be plug planted or seeded when material is cleared to increase sward diversity

Cost/benefit:

- Can be more labour intensive to do a mosaic approach (cost) but needs less frequent management (benefit)
- Little to no requirement for inputs such as topsoil, fertiliser and irrigation (benefit)
- Material created by management can be used creatively within landscaping, reducing costs associated with removal (benefit)
- More resilient to climate change (benefit)

MAINTAINING OPEN ASPECTS IN OMH LANDSCAPING

Over time vegetation cover needs to be managed on features with varied topographies and aspects such as the south-facing sandbank shown opposite. Vegetation cover on a feature such as this is desirable to some extent as it can help stabilise the friable substrate. But maintaining exposed bare ground is crucial to allow sunlight to permeate and heat the ground. This helps a range of biodiversity with thermoregulation and larval development.

Selective hand-pulling of vegetation to create exposures can be the best practical technique for managing more complex OMH landscaping features. For the sand bank, creation of some excavated hollows (mimicking digging activity by mammals) during maintenance can be beneficial for providing additional structural diversity for sand nesting invertebrates.

For more structurally complex OMH habitat features and those with friable substrates, typical management practices such as brush-cutting and mowing may not be suitable.

There can be cost/benefits to this:

- lower CO_2 emissions with hand weeding
- a tailored management plan is needed

BLENDED MANAGEMENT FOR OMH LANDSCAPING

To achieve acceptance of some of the unfamiliar aspect of OMH landscaping such as standing dead wood and ‘wilder’ looking meadow areas, it can be beneficial to blend these with more managed areas that have a more familiar urban landscaping aesthetic.

The OMH landscaping at the Barking Riverside offices employed this blended management approach, opting for more managed pockets of landscaping adjacent to pathways, graduating to OMH features such as less managed wildflower areas and dead wood features.

The more managed areas comprised mown grassland and included flower beds planted with ornamental species that offered pollen and nectar resources, therefore bringing benefits for pollinators.

This blended approach provides reassurance that the landscaping is being cared for and dispels any concerns that the ‘wilder’ aspects indicate that management has been abandoned.

LONG-TERM STEWARDSHIP APPROACHES

- Community participation can be engaged by (suitably resourced) landscape maintenance teams and enable citizen science to monitor performance and perceptions
- For BNG - maintenance schedules need to be properly costed and realistic for 30 years. Regular visits (particularly during the establishment phase) are needed to allow for adaptive management in response to habitat development and climate change
- Traditional maintenance contracts need to be adapted so that they are focused on harnessing biodiversity and about engaging the local community in the landscaping so that they care about it and care for it
- OMH landscaping lends itself to a more interactive maintenance practice, such as tailored hand weeding rather than gardening with machines, allowing maintenance staff an opportunity to connect with local communities and involve them in caring for the landscaping

HABITAT MANAGEMENT AND MONITORING PLAN (HMMP)

A Habitat Management and Monitoring Plan will be required for all habitats created as part of BNG and will need to demonstrate a properly costed and realistic maintenance schedule for 30 years.

OMH landscaping is aligned to many of the requirements of the site baseline and environmental information/impacts checklist in Section 1 of the HMMP template. For instance, information in this guide can help demonstrate compliance with the following:

CLIMATE	Are local climate conditions and, or, climate change likely to impact the target habitat retention, creation or enhancement?	**OMH landscaping is a resilient habitat, tolerant of drought and inundation, making it climate change resilient**
GEOLOGY AND TOPOGRAPHY	Any geological or topographical constraints or opportunities?	**The ecomimicry design approach will identify local context and opportunities to include in OMH landscaping**
SOILS AND SUBSTRATES	Do soils and substrates present any constraints or opportunities?	**The ecomimicry approach will identify local substrates and opportunities to include in OMH landscaping**
HYDROLOGY AND DRAINAGE	Will the site hydrology present any constraints or opportunities?	**With OMH landscaping there are greater possibilities to adapt to local hydrology**
LANDSCAPE CHARACTER AND DESIGNATIONS	Does the landscape character of the site present any constraints or opportunities?	**The ecomimicry design approach will identify local context and opportunities to include in OMH landscaping**

For the remaining sections of the HMMP template, this guide and the accompanying report, along with important resources such as the OMH survey handbook [5] can help demonstrate how OMH principles informed the design stage, the strategic significance of OMH and provide a supporting framework for condition assessment.

For the section in the HHMP on risk factors/ triggers for action, the following are examples of key triggers for action in OMH landscaping:

- Loss of bare ground
- Dominance of grasses over wildflowers
- Uniformity in habitats that results in deterioration of the habitat mosaic

These would require remedial measures such as:

- Management targeting vegetation clearance to reinstate bare ground e.g. scrapes
- Removal of dominant undesirable vegetation such as grasses before they set seed
- Reseeding exposed ground with yellow rattle and wildflower seed to encourage wildflower establishment
- Management of vegetation and substrates to reinstate the habitat mosaic

For the Monitoring Strategy and Adaptive Management section of the HMMP, this guide along with the OMH survey handbook could be used to assess whether landscaping is still meeting key criteria. This should be undertaken annually for first five years, then every two years thereafter. The intensity would need to be adapted as required where habitats are for instance becoming too closed/rank under the current regime and would need to be adjusted to improve outcomes and meet condition requirements.

R References

REFERENCES

[1] Baker, J., Hoskin, R. & Butterworth, T. (2019) Biodiversity Net Gain. Good Practice Principles for Development. Available at: https://cieem.net/wp-content/uploads/2019/02/C776a-Biodiversity-net-gain.-Good-practice-principles-for-development.-A-practical-guide-web.pdf

[2] Buglife (2019) Creating green roofs for invertebrates. Best Practice Guide. Available at: https://cdn.buglife.org.uk/2019/07/Creating-Green-Roofs-for-Invertebrates_Best-practice-guidance.pdf

[3] DEFRA (2024) The Biodiversity Metric User Guide. Available at: https://assets.publishing.service.gov.uk/media/65c60e0514b83c000ca715f3/The_Statutory_Biodiversity_Metric_-_User_Guide_.pdf

[4] JNCC (2010) UK Biodiversity Action Plan Priority Habitat Descriptions - Open Mosaic Habitats on Previously Developed Land. Available at: https://data.jncc.gov.uk/data/a81bf2a7-b637-4497-a8be-03bd50d4290d/UKBAP-BAPHabitats-40-OMH-2010.pdf

[5] Lush, M. J., Kirby, P. & Shepherd, P. (2013) Open Mosaic Habitat Survey Handbook. Powys: Exegesis. Available at: https://cdn.buglife.org.uk/2019/07/Open-Mosaic-Habitat-Survey-Handbook.pdf

[6] Nash, C, Clough, J., Gedge, D, Lindsay, R., Newport, D., Ciupala, A. and Connop, S.(2016) Initial insights on the biodiversity potential of biosolar roofs: a London Olympic Park green roof case study. Israel Journal of Ecology and Evolution, 62, 74-87. Available at: https://repository.uel.ac.uk/item/8555z

[7] Nash, C., Ciupala, A., Gedge, D., Lindsay, R. and Connop, S. (2019) An ecomimicry design approach for extensive green roofs. Journal of Living Architecture, 6, 62-81.Available at: https://livingarchitecturemonitor.com/s/JLIV-An-ecomimicry-design-approach-for-extensive-green-roofs-final-updated.pdf

[8] Nash, C. (2017) Brownfield-inspired green infrastructure: a new approach to urban biodiversity conservation. PhD Thesis. Available at: https://repository.uel.ac.uk/item/84vy8

[9] Wilson, R and Little, J. (2023) What lies beneath? The importance of substrates in delivering Biodiversity Net Gain. In Practice, Issue 119, 54-59. Chartered Institute of Ecology and Environmental Management (CIEEM)

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