

# Working with nature Integrating nature-based solutions across urban environments and landscapes



Developed by Lloyds Banking Group with input from the RSPB

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# **Executive summary**

#### Nature-based solutions offer win-win interventions

To mitigate climate change, we need to rapidly decarbonise our economy and invest in high-quality nature-based solutions (NbS)<sup>1</sup>. These are actions that protect, sustainably manage, and restore natural and modified ecosystems in ways that address societal challenges effectively to provide both human wellbeing and biodiversity benefits.

This paper focuses on NbS for water management, exploring how integrating nature into land management and urban infrastructure can safeguard biodiversity and support wider adaptation to the effects of climate change.

# Working with nature: NbS in action in agricultural and urban environments

We have experienced record rainfall in the UK over the last two years. Investing in NbS will be essential if we are to meet our national aspirations for housing growth and economic development, given the pressure on our sewer systems and flood defence infrastructure, as well as halting nature loss and tackling climate change.

NbS offer a cost-effective approach, often providing lower cost alternatives to traditional 'grey infrastructure'. For example, nature-based Sustainable Drainage Systems (NbSuDS) have been shown to save an average of £9,000 per new home in capital costs in Wales, potentially reducing aggregate construction costs by nearly £1 billion annually<sup>2</sup>. Through showcasing examples of NbS in action in the UK, this paper aims to demonstrate that investing in NbS is not only an environmental imperative, but a crucial step towards building resilient and thriving urban and rural communities.

# The financial services industry can play a key role in scaling up nature-based solutions

Global finance flows to NbS currently sit at US\$200 billion, which is just a third of the estimated investment required to reach climate, biodiversity, and land degradation targets by 2030<sup>3</sup>.

Private financial institutions have a vital role to play in closing the finance gap for NbS. Globally, it is estimated that only 17% of finance for NbS<sup>4</sup> comes from the private sector, despite their proven costeffectiveness.

Alongside government and businesses, financial institutions can play an essential role in scaling NbS through fostering investor confidence and developing innovative financing mechanisms, but they need a structured policy framework that unlocks certainty and incentives to invest.

This paper showcases NbS already underway across agricultural and urban environments in the UK, highlighting the raft of positive outcomes these can bring for nature, climate, and people and the steps we need to take to unlock their delivery at scale.



At Lloyds Banking Group we recognise the importance of nature-based solutions in the agricultural and urban environments and have started on a journey to educate ourselves and bring our clients on the journey with us.

As part of a ten-year partnership, Lloyds Banking Group has supported Soil Association Exchange in developing and deploying both a standardised approach for measuring a farm's environmental impact, and tailored advice on how this can be reduced and improved. To date, it has spanned 238,494 hectares of farmland across 685 farms and looked at six areas: soil health, carbon, biodiversity, animal welfare, water, and people and society. Our consultancy did not just audit the wealth of natural resources in our farms - it also put forward over 4,000 bespoke recommendations to the 685 farmers involved and this has been converted into over 750 definitive actions. Many of these include nature-based solutions, such as active hedgerow management and improving the environmental health of a farm through more diverse planting schemes.

In early 2024 we also announced our role as a founding business partner of **Projects for Nature** – an innovative project aiming to upgrade the protection and restoration of England's natural environment. Lloyds Banking Group has donated £250,000 split between three nature recovery projects enabling a tangible difference to be made in combating nature loss in communities across England, exploring innovative approaches to protect and restore our natural ecosystems and ultimately helping Britain prosper.

One of the projects, **Resilient Glenderamackin** in Cumbria, aims to deliver nature-based solutions to reduce flood risk, restore nature and mitigate climate change. Led by the West Cumbria Rivers Trust, the project is being co-designed with farmers and land managers to implement natural flood management interventions, which include re-wiggling rivers, planting trees and restoring wetlands. This project demonstrates the types of opportunities that investing in nature can bring businesses and communities in the long term.



# Why are nature-based solutions important?

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Nature-based solutions (NbS) are defined by the International Union for the Conservation of Nature (IUCN) as "actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human wellbeing and biodiversity benefits."

We must find ways to achieve urban development and manage landscapes in a way that safeguards nature, supports adaptation to the effects of climate change and manages water sustainably. NbS can play a key role in the UK's climate adaptation strategy, including through catchment management measures such as natural flood management, river restoration and peatland restoration<sup>5</sup>. Wildlife benefits can be derived from improved habitats in urban areas when NbS are applied, such as the planting of trees and hedgerows, creation and management of parks and green spaces, and design and retrofitting of buildings. These provide nesting, roosting and feeding areas for different species and habitats for nature to thrive in. NbS support water management in multiple ways; in the management of the flow and quantity of water, filtering of pollutants and replenishment of groundwater and evapotranspiration which helps cool the atmosphere, particularly in heated cities. They can also ease the pressure on our conventional water infrastructure by reducing wastewater volumes entering the sewer systems.

NbS can be delivered through sustainable farming practices that reduce runoff and water pollution; planting of trees, hedgerows and woodlands to absorb and filter water; and restoration of peatlands, wetlands and other natural habitats that store and filter water and restoration of rivers and floodplains, such as the re-meandering and re-creation of floodplain wetlands, to slow down flows into urban areas.

![](_page_4_Picture_5.jpeg)

# Nature-based solutions in agricultural environments

Ensuring the UK agricultural sector transitions to a more sustainable future is critical to increasing the country's food security, delivering on the UK's legally binding net zero goals, and meeting targets around the protection and restoration of nature. Farming, land management and nature are inextricably linked, putting landowners and farmers in the perfect position to drive environmental improvements. Last year's winter was one of the wettest on record, threatening crops, and livelihoods, demonstrating how critical it is that we ensure that UK farm businesses can transition to a more sustainable future.

NbS in agricultural environments can include tree and hedgerow planting, creating field margins and on-farm wildlife habitats, and adopting natural flood management techniques. These agricultural practices help to improve the long-term resilience of farming by improving soil heath, absorbing, and filtering water (and fertiliser and pesticide) runoff, and providing a space for nature.

New government funding schemes under development for roll-out in the four UK nations include measures that reward farmers for action to invest in their natural capital, protect and support wildlife and engage in implementing NbS. Practices that improve the management of soil and water, benefit pollinators and encourage greater biodiversity should enhance the sustainable productivity of the sector. Private or third sector initiatives also exist to support these improvements, such as the Woodland Trust's MORE Hedges scheme, which offers funding and advice to farmers and land managers to help cover the costs of hedgerows and tree planting. Planting hedgerows can have further benefits by acting as a physical barrier to water runoff helping to slow the amount of water that reaches our rivers which contributes to flood risk reduction. Farmers and land managers have a key role to play in addressing water management by participating in land management schemes and catchment management programmes.

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**Overview:** High Oaks Farm is a family dairy farm in the Eden Valley of Cumbria, milking 350 dairy cows across 127ha of land within the catchment of the River Petteril. As part of United Utilities' Catchment Nutrient Balancing (CNB) trial, which aimed to tackle phosphate pollution from agriculture and wastewater treatment works entering the Petteril, the farm used a blend of private and public funding to significantly reduce dirty water, phosphate, and sediment runoff into the river. This work also led to significant upgrades in farm infrastructure and improvements in farm management practices.

Benefits: Over a 5-year period, 'grey' solutions such as concreting dirty yards and fencing off watercourses were completed alongside NbS such as earth bunding and sediment pond creation. This combination of interventions helped contribute to the 63% reduction in phosphorus seen in the catchment as part of the wider CNB trial<sup>6</sup>. The improvement in water quality has also led to an increase in biodiversity and ecosystem functioning along the River Petteril. White watercrowfoot, brown trout and grey heron populations have all increased following the reduction in nutrient loading. These investments in NbS contribute to improving water quality and alleviate flooding downstream in Carlisle, which suffered major flood events in 1968, 2005 and 2015. The interventions were delivered by Eden Rivers Trust, who utilised local knowledge and constructive relationships with farmers and landowners to encourage positive action up and down the Petteril.

![](_page_5_Picture_3.jpeg)

![](_page_5_Picture_4.jpeg)

![](_page_5_Picture_5.jpeg)

The creation of two sediment ponds has also led to a partnership with Loughborough University as part of an ongoing research programme, and existing partnerships with Eden Rivers Trust and United Utilities are maintained through farm walks and training days for staff. Motivated by these improvements in sustainability, the farm is planning for wider actions to incorporate rainwater harvesting, solar panels and tree planting into an upcoming cattle housing project.

The upgrades in farm infrastructure delivered through this project have allowed previously unsuitable pasture to be used as rotational grazing land for the milking herd. This provides an additional benefit to the farm business through economic sustainability, as it can better utilise its existing resources and reduce reliance on imported feedstuffs. Rotational grazing improves water infiltration, limits surface runoff and boosts soil biodiversity.

![](_page_6_Picture_0.jpeg)

# Nature-based solutions in urban environments

NbS can help to address the problems of flooding and poor water quality in our cities, while beginning to restore urban wildlife populations. If our urban areas were greener, with more trees, parks, and natural features, it would both benefit water management and have positive impacts on the wellbeing of the population<sup>7</sup>.

Unlike the development of built infrastructure such as flood defences and wastewater treatment plants, NbS can provide a host of other benefits for people and the environment. For example, NbS can improve air quality, help to manage noise and temperature, improve the attractiveness of the living and working environment, and enhance our physical and mental health. In the UK, the government is considering legislation for new developments to include plans to improve green spaces and create new accessible areas for local people<sup>8</sup>. Natural England has developed a Green Infrastructure Framework to help increase the amount of green cover to 40% in urban residential areas<sup>9</sup>. In addition, Biodiversity Net Gain (BNG) became mandatory in England in February 2024 to ensure that all new developments deliver a 10% measurable positive impact on biodiversity<sup>10</sup>. Natural England further recommends 'nutrient neutrality' for new developments and projects on sites protected by Habitat Regulations to prevent additional nutrient pollution. Nutrient neutrality is achieved when the development can demonstrate it will cause no overall increase in nutrient pollution.

As an example of NbS in urban environments, naturebased Sustainable Drainage Systems (NbSuDS) are designed to use natural features and processes to manage surface water urban drainage and water quality. These approaches mimic natural processes and reduce flooding by managing rainfall close to its source and, wherever possible, at or near the surface. By building in rain gardens, permeable paving, channels, green roofs, swales, soakaways, or ponds, NbSuDS slow, store, and treat water that could cause damage. Benefits of NbSuDS also include contributing towards replenishing groundwater supplies and cooling urban areas through natural processes. The use of vegetation delivers benefits for amenity and biodiversity alongside water quantity and quality.

![](_page_6_Picture_5.jpeg)

Case Study 2: Waterbeach Barracks – NbS for water, wildlife, and people in a new housing development

![](_page_7_Picture_1.jpeg)

**Benefits:** The surface water strategy used swales to convey water to attenuated areas and discharge into the water table during conveyance. Nature-based attenuation ponds were created, within habitat areas designed to enhance biodiversity and thereby achieve a significant net gain compared to the predevelopment position. Discharges to the existing ditch network were controlled through regulators and impurities removed through settlement.

The development has established five habitat areas, helping to achieve a 25% Biodiversity Net Gain improvement score on a site which previously had a low value for biodiversity. The two existing grassland areas have been protected and woodland management reinstated. An ecologist has been on site since 2016, undertaking surveys ahead of the planning application. Species present on site include Barn Owl, Brown Hare,

![](_page_7_Picture_4.jpeg)

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![](_page_7_Picture_6.jpeg)

![](_page_7_Picture_7.jpeg)

Brown Long-eared Bat, Common Lizard, Great-crested Newt, Hedgehog, Kingfisher, a nationally scarce pond skater, Swift and Water Shrew.

The final flood risk assessment for the development was based on a 1 in 100 year plus 25% event to accommodate future impacts of climate change. Monitoring of water quality and flows in ditches and the water table are ongoing as the development continues, to update design solutions and inform future phases. This indicates that flood risk has been reduced and the quality of water entering drainage ditches has improved.

Surface water drainage solutions were achieved within the anticipated capital expenditure budget and were cost-effective compared with alternatives. Implementation of the NbS was a key factor in achieving planning consent necessary to progress the project. The nature-based solutions on the project contributed to Urban&Civic's three key sustainability 'universal challenges' of carbon reduction, restoration and protection of biodiversity and health and wellbeing. A carbon budget and targets have been set for the site, which in turn requires the development to use resources efficiently and cost-effectively.

# What are the costs vs benefits of nature-based solutions?

Compared to "grey infrastructure" solutions to alleviate flooding and improve water quality, one of the greatest advantages of NbS is that they can deliver multiple wider indirect benefits for people and wildlife, which often greatly exceed their costs and are sometimes hard to place a financial value on.

One RSPB study that attempted to quantify the economic costs and benefits of nature-based solutions for climate mitigation found positive benefits-cost ratios across all the NbS types that were investigated<sup>11</sup>. For example, for every £1 invested in peatland restoration, the average expected returns are estimated to be at least £4.62 in economic and social benefits. For woodland creation, every £1 invested returns £2.79, and for saltmarsh restoration £1 returns at least £1.31. Further benefits of NbS were identified in the study that could not be accurately quantified, so it is likely that these figures are underestimates.

Some of the wider benefits that nature-based solutions deliver include:

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**Improved air quality:** The UK government considers poor air quality to be a significant risk to public health in the UK. The planting of trees and vegetation helps to trap particulates and remove pollutants from the air, improving local air quality. The UK Tree Equity Score<sup>12</sup> by the Woodland Trust shows that neighbourhoods with high tree cover have roughly 30% less nitrogen dioxide pollution and 10% less particulate matter pollution than neighbourhoods with low tree cover.

**Storing and sequestering carbon:** The planting of trees and vegetation also help to store and sequester carbon. At a landscape level restoring peatlands, soil and wetlands all sequester carbon and bring multiple benefits. The amount of carbon removed by woodland in UK urban areas was estimated to be worth £89.0 million during 2017<sup>13</sup>. Peatlands provide the service equivalent to £888 million per year due to filtering of water into rivers and sequestering three million tonnes of carbon dioxide per year.

Reduced energy consumption: Trees,

vegetation and wetlands also contribute to cooling (through shading, evaporation, and transpiration) and insulation. They can help to improve micro-climate and reduce urban heat island effects. This can also lead to a reduction in energy consumption by reducing the need for heating and air conditioning, saving money for households and businesses. By reducing wastewater volumes, NbS can reduce energy needed by pumping stations and wastewater treatment works. Green roofs deliver energy cost savings of 6.7% and green walls 8% for the spaces adjacent to/below them<sup>14</sup>.  $\mathbb{N}$ 

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#### Enhanced physical and mental wellbeing:

Access to nature has been shown to enhance physical and mental wellbeing, through improvements in the living environment, air quality, recreation, and physical activity. Studies have found that the provision of visually stimulating spaces including elements of the natural environment was linked to an 18% reduction in staff turnover for workplaces, a 10% reduction in sick leave, and a 15% increase in worker productivity with green office environments<sup>15</sup>. Being connected to nature has been shown to increase feelings of worthwhileness and life satisfaction, and a decrease in depression risk<sup>16</sup>.

**Enhanced land and property values:** NbS can lead to urban areas being more attractive to people and businesses. Properties within 200m of "green or blue infrastructure" have price premia of 0.5% to 3.6%<sup>17</sup>. Studies find price premia of 2.5% for green walls, 2.9–6.9% for green roofs, 4.7% for street trees and 9.5% for direct or close proximity to a park<sup>14</sup>. A green roof can extend the lifespan of the roof by an average of 23 years compared to a conventional roof<sup>14</sup>.

![](_page_8_Picture_13.jpeg)

### Case Study 3: Unpave the Way – Front Gardens for Water and Wildlife

**Overview:** 'Unpave the Way' is a show garden at the 2024 RHS Tatton Park Flower Show. It was designed by Leon Davis and sponsored by the North West Regional Flood and Coastal Committee (North West RFCC) and United Utilities. It showcases a holistic and sustainable approach to front garden design, seeking to inspire garden design choices which mitigate the flooding impacts caused by a growing national trend of paved front gardens, by utilising SuDS and rainwater harvesting to maximise opportunities for rainwater capture, storage, and drainage. The garden displays two approaches: one involving a retrofit of an existing front garden, and the other a new garden design. Features include permeable paving for driveways, rain gardens, downspout SuDS planters, green roofs, and rainwater butts.

Many householders have replaced green space (such as flower beds and natural lawns) with impermeable hard surfacing, typically to create off street parking. This prevents rainwater infiltration. In 2015, 1 in 4 front gardens in the UK were completely paved over<sup>18</sup>. Paved front gardens increase the volume and speed of rainwater runoff, raising pressure on highway drainage, sewers, and watercourses, leading to more incidences of flooding. This can increase flood risk for householders, neighbours, and communities, as well as increasing incidences of water pollution through stormwater overflows.

Artificial grass has commonly been used in sports arenas but is becoming more popular for residential lawns. A survey by Aviva found that a fifth (21%) of UK homeowners have already replaced or plan to switch their natural lawn with artificial grass<sup>19</sup>. These lawns are manufactured from synthetic fibres made to look like natural grass. They are easier to maintain and stand up to heavy use. However, it does not provide any food for living creatures, restricts access to the soil, and can make it more difficult for water to be absorbed causing flooding. It also reaches significantly greater temperatures than those reached by natural grass under the same conditions<sup>20</sup>.

There are multiple barriers to unpaving front gardens, which include the demand for low maintenance gardens, increased demand for car parking (including growth in vehicle size and numbers and the rise in electric cars), and a lack of awareness of the problems caused by impermeable paving and the alternative solutions available. Unpave the Way aims to raise awareness of these issues and point to solutions that enable greener front gardens and driveways compatible with sustainable water management.

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![](_page_9_Picture_6.jpeg)

**Benefits:** Enhancing greenspace means that plants can capture and filter pollutants within surface water runoff, further decreasing pollutant loads in runoff. Improving garden habitats can contribute to increases in wildlife (including birds, hedgehogs, and pollinators).

The garden designs demonstrate ways in which gardens can make space for water, planting, and nature whilst maximising opportunities to manage water. They can enhance the living environment, provide visual amenity, support wildlife, urban cooling, household wellbeing and improve climate and air quality.

It is thought that adding a driveway can add 5-10% to value of a home, especially in areas where on road parking is limited. Unpave the Way demonstrates that front gardens can still provide parking spaces while contributing to sustainable water management, reducing flood risk, and improving water quality.

# Examples of how water management NbS specifically provide benefits to nature:

- NbSuDS provide habitat for wetland species (such as amphibians and wetland birds) and other green spaces that benefit wildlife, particularly if planted with native species;
- Green roofs and walls provide habitat for pollinators and other invertebrates, as well as birds such as black redstart, a rare species mostly breeding in urban areas in the UK;

#### Costs vs benefits of NbS

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NbS reduce the costs of flooding and water pollution and can facilitate development by easing pressure on flood defence, drainage, and waste water treatment infrastructure (Table 1).

![](_page_10_Figure_6.jpeg)

The financing of NbS often has lower capital and maintenance costs than conventional built infrastructure.

![](_page_10_Picture_8.jpeg)

• Parks, gardens, and street trees enhance urban

wildlife habitats, if sympathetically planned

Re-meandering of rivers and restoration of

while helping to alleviate flooding.

floodplain wetlands enhance their value for wildlife

and managed;

Globally, NbS achieve up to 50% cost savings compared to grey infrastructure in providing the same services, offering potential cost savings of USD 250 billion annually<sup>21</sup>.

#### Table 1: Benefits and costs of NbS for water management

Type of benefit	Examples and values
Cost-effectiveness compared to built infrastructure	<ul> <li>Capital costs of landscaped SuDS solutions are lower than comparable conventional solutions at every level. For example:</li> <li>SuDS could on average save Wales over £9,000 per new home in capital costs alone. This could reduce construction costs by almost £1bn annually in aggregate<sup>2</sup>.</li> <li>Rail freight Terminal, Telford, £321,171 saving in capital costs.</li> <li>Stebonheath Primary School, Llanelli – 57% saving in whole life costs<sup>2</sup>.</li> <li>By attenuating waves, a 200m wide strip of saltmarsh avoids the need to build a sea wall at a cost of £2,116 per metre, equating to a value of £105,000 per hectare of saltmarsh<sup>5</sup>.</li> </ul>
Reduced costs of flooding and water pollution	Targeted strategic SuDS approach in London could reduce flood damage by <b>£190m</b> <b>per borough, for £35m invested.</b> The benefit cost ratio is estimated at 5.4 for flood management alone <sup>22</sup> . The average cost to businesses of the 2013/14 floods was <b>£82,000</b> , while it is estimated that 40% of businesses fail to reopen after a flood <sup>23</sup> .
Facilitating development	A strategic SuDS approach in Beckton & Crossness STW catchments could create wastewater network capacity for 116,000-180,000 additional dwellings, with comparable or lower capital expenditure than typical strategies <sup>22</sup> .

### Case Study 4: Yorkshire Water - Constructed Wetlands to Manage Wastewater and Flooding

**Overview:** Yorkshire Water's (YW) wastewater treatment works at Clifton, near Doncaster in South Yorkshire, required upgrading to meet new phosphorus water quality standards. Instead of a traditional chemical treatment facility, YW trialled one of the first integrated constructed wetlands in England for municipal wastewater treatment. The Clifton ICW uses natural (physical, chemical, and biological) processes in wetlands to provide secondary and tertiary treatment. This nature-based solution provides a natural, sustainable, cost-effective, and low-carbon way to remove phosphorus and treat water to a high standard before returning it to the environment. The wetland features interconnected pools containing 24,000 wetland plants, designed to cut inputs of energy and chemicals, reduce carbon emissions and benefit biodiversity.

The project has won multiple awards for its contribution to sustainability and net zero. Its success has led YW to begin construction of another eight wetlands, with a further eighteen planned for delivery before 2030. It has also attracted interest from other water companies and from OFWAT, through its successful demonstration of NbS as a means of addressing water sector challenges.

**Benefits:** Clifton is one of the first biodiversity net gain wastewater treatment works in the UK. It is expected to attract a range of wildlife including bees and other pollinators, breeding birds, amphibians, and reptiles. The soil cleared from the site was reused in a habitat creation area, which planted 4,000 trees and plants

and constructed a natural scrape, which provides a catchment area for runoff from fields.

Clifton Wetlands meets the water treatment requirements for around 180 people – approximately half of the population of Clifton Village. The ICW also slows the flow of water entering the River Don catchment, thereby helping to reduce flood risk, and lessening the risks associated with climate change to local communities.

This NbS was completed at 35% lower cost than building a conventional solution. The operational costs are also 40% lower, with no chemicals used and savings in energy. The operational carbon saving is 79% and there is an embodied carbon saving of 50%. As well as benefits for nature, the facility has provided opportunities for training, education, and local community engagement. The economic and social value of these benefits is estimated at over half a million pounds (net present value over 40 years).

As part of Yorkshire Water's largest environmental improvement plan, nature-based solutions for wastewater treatment are now planned for a further 25 sites across the region. Together, these naturebased solutions will support Yorkshire Water build resilience to climate change and help deliver its vision of a thriving Yorkshire that's right for customers and right for the environment.

#### committing to progress towards nature positive as well as net zero goals.

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# To scale up and maximise the opportunities to deliver NbS requires a range of challenges and barriers to be overcome:

Now is the time for the UK to step up the financing of NbS for climate, nature, and people. A unique combination of financial, policy and societal drivers have come together to provide an impetus for action. **Financial drivers** include an increasing focus on climate and nature related financial risks via the Taskforce for Nature based Financial Disclosures (TNFD), as well as growth in the green finance sector. Economically, it can be more cost-effective to implement NbS due to cost-effectiveness and longevity. **Policy drivers** include legislation and policy relating to climate adaptation, water quality, flood management, planning, farming and land management, biodiversity, and net zero, combined with targets for housebuilding and priorities for economic development. **Societal drivers** comprise increasing pressure on businesses to play their role in addressing the climate and nature crises, as part of wider Environmental, Social and Governance (ESG) policies. A growing proportion of businesses are

1. Incentives to invest. Finance is among the most significant barriers to nature protection and restoration that exists today. The Green Finance Institute has estimated that the finance gap to meet the UK's nature related outcomes in the UK is £56 billion<sup>24</sup> over the next decade, and stresses that increasing private finance is crucial to address this. While NbS deliver a range of environmental, social, and economic benefits, many of these (such as benefits for air quality, biodiversity, and the living environment) are public goods. Property owners and developers may underinvest in NbS because they receive only a proportion of the wider benefits. Because of the multiple benefits they provide, the direct financial returns of NbS are often less than the benefits to society overall. Incentives for farmers and land managers, who might otherwise struggle to afford to finance NbS, can help to reward them for providing these wider benefits to society.

What is needed to scale up

nature-based solutions?

2. Public financial constraints. Many NbS in towns and cities require investment in public spaces – such as parks, gardens and green spaces, streets, and public premises such as schools and hospitals. In rural landscapes there is a need for funding large-scale NbS for activities such as peatland restoration and woodland creation. While investing in NbS can deliver against a range of policy agendas, it is often constrained by limited budgets for local authorities and public bodies. Private finance has a vital role to play in closing the finance gap for NbS. Globally, it is estimated that only 17% of finance for NbS comes from the private sector, despite their proven cost-effectiveness. Stepping up private finance for NbS will benefit from action to raise awareness and improve evidence of their role and benefits, as well as efforts by government to provide the right incentives and a facilitating policy environment.

3. Regulatory gap. Stronger regulation is needed to ensure that NbS are adopted in new and existing developments. For example, for urban flooding regulation, Schedule 3 of the Flood Act has not been mandated in England, meaning complete SuDS management trains are not mandated for new developments. There is also a lack of a nationwide retrofit programme for SuDS. Financial institutions can also work with government and business to foster investor confidence to secure funding for NbS and to develop innovative financing mechanisms. Creating the right level of risk-sharing with blended finance mechanisms such as debt for nature swaps and green bonds.

- 4. Skills, knowledge, and awareness. Delivering NbS often requires an innovative approach and the application of different skills and techniques. The wider adoption of NbS challenges traditional ways of working and may be constrained by a lack of awareness about the opportunities, a reluctance among property owners and developers to adopt novel solutions, and/or gaps in the skills required to deliver NbS.
- 5. Uncertainty, data, and evidence gaps. While knowledge of the effect of NbS in alleviating flooding and improving water quality is improving, data gaps and uncertainties can be a constraint to their implementation. Projects demonstrating location specific effectiveness and impact of NbS will allow for data sharing and support scaling.

A multi-stakeholder approach is required to scale up the delivery of NbS across the agricultural and urban environments. This includes the following recommended actions:

1. Local and national governments to mandate NbS at a regional and national level. Local and national governments can strategically implement NbS throughout the UK to provide catchment-wide water management benefits and reduce the overall risk of urban flooding. By targeting the delivery of environmental land management schemes, flooding could be alleviated, water quality improved and habitat for wildlife enhanced. Governments can continue to support trials for financing and investment mechanisms that reward NbS for delivering public and private benefits.

#### > Actions:

- Mandate Schedule 3 of Flood and Water Management Act in England.
- Integrate NbS for water and wildlife into house-building targets and infrastructure development plans and require these from new developments.
- Incentivise water saving initiatives such as water butts and grey water recycling for all new developments and retrofitting.
- 2. Unblock flows of green finance to UK farmers, and work with private actors to overcome the financial barriers to greater uptake of sustainable practices. Action to create the right level of risk-sharing can help unlock significant new investment in UK farming and deliver the environmental and economic benefits of sustainable farming. There is scope to deploy lessons from blended finance mechanisms that have worked in other sectors of the economy, to help increase investment at minimal upfront cost to the public purse – supporting similar outcomes as, and maximising the value of spending in, areas such as the Sustainable Farming Incentive.

#### > Actions:

- Continue to develop, trial, and deploy financing and investment mechanisms that reward NbS on farmland, blending finance to deliver public and private benefits.
- Target the delivery of environmental land management schemes to deliver NbS that secure multiple benefits including wildlife habitats, flood alleviation, improved water quality and carbon storage.
- Continue to develop the evidence and awareness base on the benefits of sustainable agriculture for food production, biodiversity, soil health, water, and wildlife.

3. Support businesses and landowners to implement NbS for new and retrofit developments, and in readiness for legislation such as BNG. Businesses and landowners can retrofit green roofs and walls, and SuDS on existing premises, as well as replacing sealed surfaces with vegetation, trees, or hedgerows. Planting trees, shrubs and flowering plants on previously sealed surfaces can provide high wildlife value to pollinators and contribute to water management on site. Businesses and landowners can also survey and monitor the wildlife on the premises to showcase their benefits to biodiversity. For publicly owned land, such as schools and hospitals, NbS can encourage engagement with nature to help educate members of the public, while improving the wellbeing of the users.

#### > Actions:

- Integrate NbS into the design of new developments to ensure that new sites benefit wildlife, future proof the development against climate change, and provide green spaces to the new residents.
- Construct NbSuDs on their premises and in the wider environment to help alleviate flooding, treat wastewater, and improve local water quality.
- Replace sealed surfaces (such as pavements or roads) with permeable paving or porous surfaces.
- 4. Raise awareness of NbS that individuals can implement on their own properties and the benefits and cost savings these can bring. Such as the introduction of green roofs, walls, rain gardens and other features designed to reduce runoff from severe storm events. Replacing sealed surfaces such as paved driveways or artificial lawns with vegetation, flower beds and/or permeable paving or porous surfaces will help to aid water absorption and reduce runoff. In gardens the planting of trees, shrubs, wildflower enhanced lawns and flowering plants can deliver high wildlife value for pollinators. It is also possible to explore the introduction of water saving measures in the home and garden (such as water saving taps, water butts, grey water recycling) which can reduce inhabitants' water bills while supporting water management more broadly.

#### > Actions:

- Planting trees, shrubs, wildflowers, or enhanced lawns to encourage more flowering plants which help support wildlife.
- Introduce water saving taps, water butts and grey water recycling.
- Replace sealed surfaces (such as parking) with permeable paving or porous surfaces.

# **Appendix: Case studies**

We would like to thank Joe Lyall (High Oaks Farm), Richard Hepworth and Richard Quartermaine (Urban&Civic plc), Leon Davis (Leon Davis Design), Phillip Blaen (Yorkshire Water), Sam Jarrett and Henry Powell (LandSec U&I), Barratt Homes and Sophie Bretonnet (Cambridge Conservation Initiative) for providing information for the case studies. And thank you to the West Cumbria Rivers Trust for the inclusion of the Resilient Glenderamackin project.

In addition to the four case studies in the main body, a further four case studies are provided in the Appendix.

### Case Study 5: Mayfield Park, Manchester – Green and blue infrastructure in a new developmen

![](_page_15_Picture_1.jpeg)

Overview: Mayfield Park is a new public park at the centre of an ambitious 24-acre city centre development in Manchester, transforming a site that has been largely derelict for 60 years. The project is an example of the power of the public and private sector working together. Established in 2016, the Mayfield Partnership comprises Manchester City Council, Transport for Greater Manchester, LCR (the UK Government's property vehicle) and LandsecU+I, the site's Development Managers. Running through the park is the River Medlock, which before the development was covered over and redirected, with only a small section visible. The creation of the park, and the uncovering and restoration of the river, was at the heart of the regeneration of the area. Since opening in September 2022, the park has won awards and commendations for river ecology, nature conservation, landscape design, accessibility, placemaking, and community engagement.

40 tree species have been planted, from native varieties such as Hawthorn, Birch, and Willow, to less commonly planted species, such as Foxglove Tree and Strawberry Tree. A variety of habitats that have been created with different micro-climates: south-facing steep, dry banks; north-facing steep banks and north-facing shallow banks; riverbanks; a wildflower space; and a rain garden. **Benefits:** As well as uncovering and restoring the river, the project has created a floodable landscape and established 230m2 of rain gardens. The park's drainage system has been designed to alleviate flooding downstream and to reduce pressure on the sewage system, by increasing infiltration and slowing water flows, restricting the amount of water entering sewers and the river. Mayfield Park has been designed to manage the equivalent of 12 Olympic swimming pools' worth of runoff water and to handle a 1-in-100-year climate emergency.

A major achievement of the project is its success in re-establishing fish to the previously lifeless river. A recent fish survey recorded fifteen brown trout, as well as bullhead, stone loach, minnow, and three-spined stickleback. Prior to the establishment of Mayfield Park, no fish were observed within this stretch of the River Medlock. Kingfisher, Sand Martin, and bats have also been spotted in the park.

The creation of the park, restoration of the river and creation of the drainage system are the first steps in a whole new city district that will come forward over the next decade. Mayfield Park will one day be home to 4,000 people and provide workspace for 13,000 people. It is estimated that the park will provide mental wellbeing benefits worth c£300,000 to city residents every year, helping to increase productivity.

### Case Study 6: Lamb Drove, Cambridgeshire – Demonstrating Sustainable Drainage Techniques

Photo: Robert Bray Associates

**Overview:** Lamb Drove is a residential development of 35 affordable homes, developed and owned by Cambridge Housing Society, on a 2.5 acre site in Cambourne, Cambridgeshire. Its SuDS scheme, completed in 2006, successfully showcased practical and innovative techniques for sustainable water management and flood resilience within new residential developments, and demonstrated that SuDS are a practical, cost effective and attractive alternative to more traditional forms of drainage. The range of SuDS components included: water butts; permeable paving; a green roof; swales; filter strips; detention and wetland basins; and a retention pond.

**Benefits:** Monitoring found that the SuDS significantly reduced peak surface water flows compared to a control site, as well as delivering reductions in concentrations of a variety of indicators of water pollution. Three surveys found a higher number of species present at Lamb Drove than the control site, as well as positive trends in the numbers of species present. Biodiversity has been enhanced by seeding and planting with native wildflowers, while the management of grassed areas has encouraged colonisation by local, native plants, invertebrates and amphibians.

Overall, both capital and maintenance costs at Lamb Drove were much lower than those for the conventional piped drainage system control site:

- Capital cost savings were estimated at £314 per home (averaging £5,645 compared to £5,960 in 2006).
- Annual SuDS maintenance costs, at £1,340 in 2011, were found to be 20-25% cheaper than conventional drainage, especially since maintenance is integrated into landscape and wildlife management regimes.
- Attenuation storage within the site has effectively reduced surface water flows, avoiding the need for balancing lakes which would otherwise take land and incur capital and maintenance costs.

Lamb Drove SuDS do not connect to the public sewer and therefore avoid any connection and annual charges for storm water disposal, saving each household an additional £30 per year (2011 prices). Each house was given two water butts to collect rainfall from the roof, which can be used for watering gardens and other applications. It is estimated that around 24,000 litres of water can be saved from the average roof each year<sup>25</sup>. The sculptured swales and detention basins enhanced the landscape, providing increased amenity and social value to residents and the local community. Case Study 7: The David Attenborough Building – A green retrofit for a concrete structure

Photo: John Day, RSPB

Overview: The David Attenborough building at the University of Cambridge was reopened in 2015, following a redevelopment programme led by the Cambridge Conservation Initiative. It demonstrates the potential to deliver urban nature-based solutions by refurbishing a building which previously was of very low environmental quality.

The new green building design incorporates a green roof, a four-storey tall internal living green wall in the building atrium, a range of energy efficiency measures, water and energy monitoring systems and swift nest boxes which are now in use. In addition to the biosolar green roof, SuDS rain garden planters have been included into a roof terrace, designed to reduce runoff into the existing antiquated drainage system. The roof aids in thermal regulation of the building while the terrace garden provides an outside space for workers to relax. More than 60% of the roof area is vegetated, with planting chosen to replicate the local chalkland to encourage wildlife. On the roof are bee hotels, and bat and bird boxes. Recovered rainwater is used to irrigate the external landscaped areas and green walls.

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Benefits: The green roof is designed to reduce surface water runoff and therefore to alleviate surface water flooding and water quality issues in Cambridge. It has

been visited by black redstarts and a range of bees, other pollinating insects, and invertebrates. Nestboxes have been successful in attracting breeding Swift, which are shown to the public via webcams<sup>26</sup>.

It was one of the first green roofs in the city and has inspired Cambridge City Council to adopt a policy stipulating that developments are only permitted where all flat roofs are created as either green roofs or brown (biodiverse) roofs.

The roof has low maintenance costs, and contributes to insulating and cooling the building, as well as generating up to 16.5 KW of solar electricity.

![](_page_17_Picture_9.jpeg)

Case Study 8: Kingsbrook – Wildlife and Water Benefits from a new Housing Development

# PADDINGTON LANE

Photo: BlueGreen Urban

**Overview:** In 2014, Barratt Homes, Aylesbury Vale District Council (now Buckinghamshire Council) and the RSPB began working on a major project to develop a large, exemplar wildlife-friendly housing development on the edge of Aylesbury, Buckinghamshire. The development is called Kingsbrook and aims to demonstrate how housebuilding can provide homes for wildlife while benefiting residents. The work at Kingsbrook now forms part of a wider partnership programme between the RSPB and Barratt. Kingsbrook has 2,450 homes, including 490 affordable homes, built across three distinct villages, with open green spaces spread over the 756-acre site.

Benefits: Kingsbrook has a SuDS designed to reduce flood risk and ease pressure on the sewer system. Rainwater is directed along swales on the surface and held in storage ponds. Newer phases of the development now include open kerb features that allow road run-off into under-drained flower-rich swale verges running between the footpaths and road. The SuDS uses nature to clean the water, reduces pressure on the storm water drainage system, provides a home for wildlife and adds to the quality of the living environment. The SuDS ponds have been planted with native local wildflowers and have attracted wildlife including Little Egret, Kingfisher, and several species of dragonflies. The development also retained many of the old hedgerows and fields, created hedgehog highways, provided hundreds of

integral Swift and bat boxes, and planted thousands of new trees and other plants designed to benefit pollinators. The development includes 395+ acres of new public green space, with sports pitches, community orchards and a 247-acre nature reserve with visitors centre. RSPB monitoring has recorded 65 bird species, of which 42 showed evidence of breeding. There have been substantial increases in a range of bird species, including House Sparrow (up 3941%), and Starling (up 96%).

The nature friendly aspects of the Kingsbrook project helped to secure its planning approval and have enhanced the attractiveness of homes to buyers. Surveys found that they were welcomed by a majority of residents, with 43% mentioning nature as a motivation to buy their property. Many of the measures are low-cost or no-cost and can be incorporated into any new or existing development. The SuDS scheme is believed to have saved costs by reducing the need for larger and more complicated underground drainage systems. The wildflower verges have required less maintenance once established, while native hedging is cheaper than planting with non-native species.

Barratt is now working to roll out the low-cost features nationwide and encouraging other developers to do the same. The project demonstrates that greening our local spaces can have benefits for us all, by improving health and wellbeing through connections with nature, reducing flood risk, absorbing pollution and helping cool local heat island effects.

## Glossary

**Grey infrastructure** – Refers to human-engineered infrastructure for water resources, such as water and wastewater treatment plants, pipelines, and dams. Grey infrastructure typically refers to components of a centralised approach to water management<sup>27</sup>.

Blue infrastructure – These are water features which typically assist with water management and deliver environmental, social, and economic benefits.

**Green infrastructure** – Green spaces and natural features that provide environmental, economic, and social benefits.

**Greenfield runoff** – The rate of natural rainwater runoff from an undeveloped permeable site, such as a field. The measured rate forms the baseline measurement to manage and limit the amount of surface water runoff from a new development to prevent localised flooding in the immediate vicinity of the site and further downstream in the catchment.

Heat island effect - Urban areas emit more heat than surrounding rural areas. The difference can be at least 3°C or more and is due to buildings, roads and paved areas absorbing and emitting more heat than soft landscapes of parks, woods, and water bodies.

**Evapotranspiration / Transpiration**<sup>28</sup> – A plant does not use most of the water that it absorbs. About 97-99% of the water is lost through transpiration. Transpiration is defined as the physiological loss of water in the form of water vapor, mainly from the stomata in leaves, but also through evaporation from the surfaces of leaves, flowers, and stems.

**BNG -** BNG is an approach to development. It makes sure that habitats for wildlife are left in a measurably better state than they were before the development. Developers must deliver a BNG of 10%. This means a development will result in more or better-quality natural habitat than there was before development<sup>10</sup>.

![](_page_19_Picture_8.jpeg)

![](_page_20_Picture_0.jpeg)

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