Living Cities

Scottish Wildlife Trust

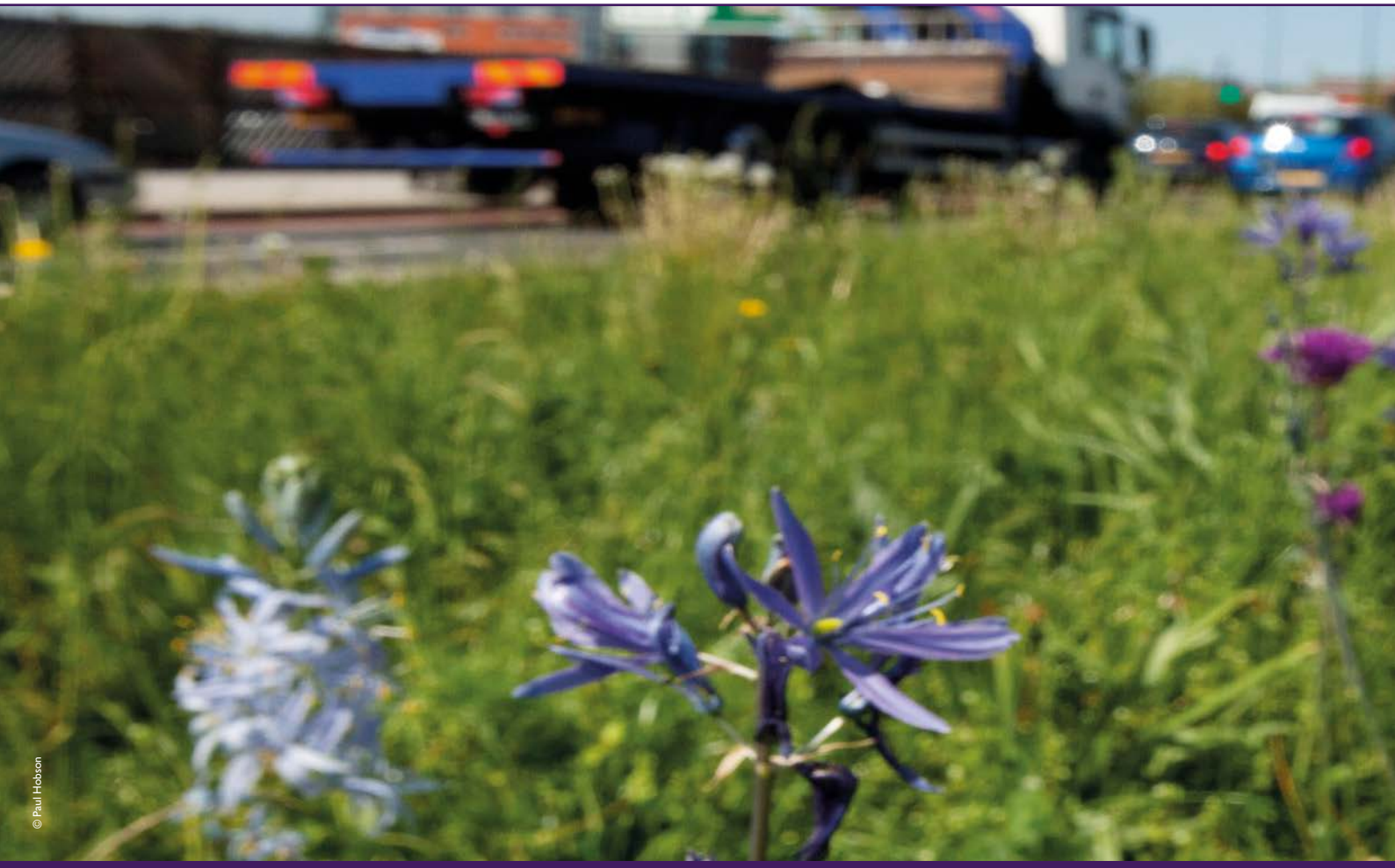
towards ecological urbanism

Policy Futures Series No. 4/2018

TAYLOR ARCHITECTURE & URBANISM

IUCN Urban Alliance

CEM



© Paul Hobson

For over 50 years, the Scottish Wildlife Trust has worked with its members, partners and supporters in pursuit of its vision of healthy, resilient ecosystems across Scotland's land and seas.

The Trust successfully champions the cause of wildlife through policy and campaigning work, demonstrates best practice through practical conservation and innovative partnerships, and inspires people to take positive action through its education and engagement activities. It also manages a network of 120 wildlife reserves across Scotland and is a member of the UK-wide Wildlife Trusts movement.

This report should be cited as: Hughes, J., Taylor, E. and Juniper, T. (2018) *Living Cities: towards ecological urbanism*. Scottish Wildlife Trust. Edinburgh.

CONTENTS

Connected habitat networks are vital for urban wildlife. Wildflower verges act as super-highways for pollinators, enabling them to move more easily through the city.

Acknowledgements

We wish to thank Pete Haskell (Scottish Wildlife Trust) for his help in pulling this report together, and Deryck Irving (Trustee of the Scottish Wildlife Trust) for his comments on an early draft. Thanks also to Alan J. Tait for designing this document and to Paul Hollingworth for producing the illustrations.

Any opinions, conclusions or errors in this report are the sole responsibility of the authors.

Scottish Wildlife Trust

Harbourside House
110 Commercial Street
Edinburgh EH6 6NF

T 0131 312 7765
W scottishwildlifetrust.org.uk

KEY MESSAGES

Street trees improve air quality, and reduce noise pollution and wind tunnel effects, as well as regulating the urban climate.

One

Ecological urbanism is an approach to urban planning which puts nature at the centre of the design process in order to create better places and provide solutions to the multiple social, economic and environmental challenges facing the 21st Century city.

Two

There is an urgent need to use ecological urbanism to build **resilience** within cities in response to a combination of rapid urbanisation and unpredictable climate change impacts.

Three

Investment in quality green infrastructure in cities and their hinterlands is a **cost effective** way of delivering a wide range of social, psychological, economic and environmental outcomes.

Four

Suburban sprawl is an unsustainable response to the need for new housing and infrastructure, exacerbating car dependency, increasing carbon emissions and fragmenting important natural assets in urban hinterlands.

Five

Compact, mixed use, walkable neighbourhoods that include habitat features designed-in at all scales of the urban ecosystem can reduce sprawl on the city periphery whilst enhancing nature within the heart of a city if well designed.

Six

Three fundamental ecological factors are critical to successful ecological urbanism: habitat **connectivity**, **naturalness** and structural **diversity**.

Seven

Green infrastructure that delivers high connectivity, naturalness and structural diversity at building, neighbourhood and city scales can help compensate for lack of traditional greenspace in high-density urban environments.

Eight

Good outcomes are more likely to be achieved if the **people** who benefit from healthy urban ecosystems are enabled to shape the planning and design decisions that affect them.

INTRODUCTION

Achieving truly sustainable cities is one of the great global challenges of the 21st Century.

The United Nations[1] expects that the proportion of people living in cities will increase from about 54% in 2017 to an estimated 66% by 2050. During that time the world population is also expected to increase, from about 7.5 billion to some 9.5 billion people.

The scale of urban growth needed to accommodate such an increase is the equivalent of more than 250 times the size of London (8.7 million people). Much of this growth will occur in less economically developed parts of the world, although most places are likely to experience expansion, particularly in larger cities.

The way in which this expansion takes place will determine not only the physical character of towns and cities, but also our ability to live healthy, peaceful and prosperous lives.

It is in cities where most energy, food and materials are consumed. If we are to reverse global biodiversity declines, tackle climate change and sustainably manage natural resources, it is likely many of the solutions will need to be found in urban areas. These areas are also where many of the impacts arising from environmental change will be felt most acutely. For example, climate change-induced flooding already disproportionately affects towns and cities. How can we anticipate such changes and make design decisions that help build resilience in urban environments so they cope better with shocks and recover more quickly?

If design solutions are to be successful, we need a fundamental rethink about how we perceive cities. This means seeing them as ecosystems in their own right, rather than separate and distinct from the geology, soil, water and vegetation they are founded upon.

In reality, all urban areas are more or less modified from the natural and semi-natural ecosystems that preceded them. Semi-natural features are often still in evidence even in the most intensely urbanised areas. Ecological urbanism seeks to understand this underlying armature of the city and enhance it to create great places where people and nature co-exist to mutual benefit.

A compelling body of science has emerged in recent decades which reveals the multiple benefits that can be gained from conserving, restoring and enhancing 'green infrastructure' in cities. Green infrastructure within parks, gardens, streams, rivers, street trees and micro greenspaces can be combined and blended with the grey infrastructure of streets and buildings in ways that add value and provide tangible benefits to neighbourhoods. These benefits include improved physical health and wellbeing, reduced flood risk, cleaner air and water, and enhanced inward investment. Ecological urbanism provides an approach that can secure these and other benefits whilst at the same time reducing climate emissions and reversing wildlife declines.

The need for ecological urbanism is driven not only by the importance of building resilience in the face of climate change, but also the need to address the causes of multiple sustainability challenges, including the decarbonisation of transport, power, materials and food systems, reversing the degradation of global and local ecosystems, and promoting the wiser use of both renewable and non-renewable assets such as minerals, water, food and fibre.

In the words of The Prince of Wales, Patron of the Scottish Wildlife Trust, this agenda is about the "importance of working with the grain of nature to maintain the balance between keeping the Earth's natural capital intact and sustaining humanity on its renewable income". [2]

The thoughtful integration of built and natural environments in urban areas to advance social and economic goals has become a 21st Century imperative. In response, this paper proposes some fundamental principles of ecological urbanism for use by planners, designers, architects and other professionals. The paper makes use of examples and context from Scotland, but the underlying principles and key messages are, we believe, universal and can inform decision making anywhere in the world.

Box 1. The Scottish Wildlife Trust's vision for Living Cities in Scotland

"It is 2050; Scotland's towns and cities are widely regarded as amongst the best places to live in the world. They are exemplars of sustainable living where both people and nature thrive, even within the heart of the larger cities. People mostly access their local neighbourhoods on foot or by bike, and all vehicles are powered by clean energy, helping make urban areas more culturally vibrant, breathable and liveable. The high quality of both the built environment and our greenspaces, both within and around urban areas, has significantly improved the health, wellbeing and happiness of people living and working in Scotland and cut greenhouse gas emissions dramatically. This quality has attracted considerable inward investment and talented people, particularly in the flourishing green economy. Local people have taken ownership of safeguarding the health of their urban ecosystems by becoming actively involved in planning decisions and the day-to-day stewardship of the urban environment."

Box 2. Some key terms used in this publication

Connectivity

For the purposes of this paper, ecological connectivity is taken to mean the relative connectedness of the patches of greenspace within the built urban fabric. As a general principle, the higher the physical connectedness of patches of green, the higher the functional connectivity, i.e. the easier it becomes for plants and animals to move through the urban ecosystem and the greater their chances of survival.[2] The concept of connectivity also applies to the human species. Settlements with good networks of paths and green walking and cycling routes have high connectivity for people; whereas those fragmented by inaccessible grey infrastructure, such as wide busy roads, have low connectivity in terms of walkability.

Ecological urbanism

Ecological urbanism is an approach to urban planning which puts nature at the centre of the design process in order to create better places and provide solutions to the multiple social, economic and environmental challenges facing the 21st century city. It is an approach that integrates green infrastructure into the built environment in a way that minimises loss of natural capital assets and optimises the healthy functioning of the urban ecosystem so they provide a range of benefits to people.

Ecosystem health

Ecosystem health is a measure of the ability of an ecosystem to be productive, the extent to which its biological diversity is intact and its resilience under pressure and change. Measuring ecosystem health requires assessment of a range of ecological factors, including biodiversity, water quality, air quality, degree of habitat fragmentation and modification, soil quality and extent of soil sealing.[4]

Green infrastructure

In the field of sculpture, an armature is a framework around which the sculpture is built; it provides the underlying structure and stability for the art to be created. Green infrastructure forms the underlying foundations of the settlement on which the stability and form of the built environment is shaped. Green infrastructure comprises the geology, soils, hydrology, watercourses and the diversity of living species, which together form habitats on these topographical features.As is the case with built infrastructure, green infrastructure provides essential services, including drinking water, flood risk reduction and improved human health and well-being for example. As urbanisation progresses, the green infrastructure becomes modified from its natural state into a network of greenspaces at a range of spatial scales. These can be strategically planned or evolve more organically. At the smallest scale these include features such as small gardens, verges, green roofs and individual street trees. At larger scales they include parks and gardens, allotments, rivers and burns, and even tracts of urban forest.

Blending expert opinion with local community insights can lead to better outcomes and foster commitment to long-term stewardship.

Box 2. Some key terms used in this publication (continued)

Habitat structure

A patch of habitat within a settlement can have a simple structure (e.g. mown, fertilised grass) or a complex structure (e.g. an urban garden with trees, shrubs and open space). In general, the more complex the structural diversity of a habitat patch, the greater its ecological value because it can support a more diverse range of species.[5] Habitat structure does not necessarily always correlate with naturalness (see below), for example ornamental gardens may be highly complex in terms of their habitat structure but have relatively low levels of naturalness.

Natural capital

Natural capital is defined here as the stock of natural ecosystems on Earth including air, land, soil, biodiversity and geological resources. This stock underpins our economy and society by producing value for people, both directly and indirectly. Goods and services provided to humans by sustainably managed natural capital include a range of social and environmental benefits, including clean air and water, climate change mitigation and adaptation, food, energy, places to live, materials for products, recreation and protection from hazards.

Naturalness

Green infrastructure will have relative degrees of naturalness ranging from 'near-natural' habitats to highly modified greenspaces that contain very few species which would have existed prior to the settlement being developed. As a general principle, a higher degree of naturalness equates to higher levels of biodiversity. An urban park with plentiful mature native trees and patches of scrub and unmown grass will support many more species than a park with non-native trees and extensive areas of mown, fertilised grass.[6] Research also suggests that naturalness, particularly in combination with the complexity associated with structural diversity, is an attribute of greenspaces highly valued by people linked to increased mental and physical health and wellbeing.[7]

Urban ecosystem

Urban ecosystems are dynamic ecosystems that have similar interactions and behaviours to natural ecosystems, at least in so far as they have an input of matter and energy, recycling within the system, and an output of matter and energy. Unlike natural ecosystems, however, urban ecosystems are a hybrid of natural and man-made elements whose interactions are affected not only by the 'natural' environment, but also culture, personal behaviour, politics, economics and social organisation.

THE VALUE OF URBAN NATURE

There is now a strong, growing and compelling body of scientific evidence that demonstrates how urban nature not only enhances the overall attractiveness and liveability of cities, but also significantly improves people's quality of life.

We now know that well-designed natural features in cities can lead to longer, healthier, more fulfilled and more active lives.[8]

A comprehensive critical literature review commissioned by The Wildlife Trusts and published in 2015 summarises the scientific evidence base for the health and wellbeing benefits of greenspace.[9]

This work reinforces the findings of earlier reviews from 2007 and 2008 by Greenspace Scotland on the health and wellbeing benefits of greenspace.[10] Some of the key findings of these and related studies include:

Health benefits

- Accessible and safe parks and school grounds that are close to where children and young people live correlate with increased physical activity.
- Positive relationships exist between the quality and access to greenspace, and the walking times of older people.
- There is fairly strong evidence in support of the links between greenspace and stress reduction.
- Greenspace is positively associated with feelings of happiness and can reduce.
- Viewing real or simulated natural (or non-urban) landscapes contributes to positive moods and actual restoration from stress.
- Greenspaces reduce the heat island effect, which can in turn reduce heat stress among vulnerable groups such as older people during the summer.
- There is evidence that some behavioural or emotional problems in children such as Attention Deficit Disorder can be improved by exposure to greenspace.

Social and community benefits

- Individuals who have some nearby vegetation or live closer to greenspace seem more effective in managing major life issues, coping with poverty and performing better in cognitive tasks. This applies to both adults and children, especially those living in difficult economic or social circumstances.
- Amount of vegetation (e.g. tree density) is not necessarily correlated with crime or lack of safety, as has been previously stated in some studies.
- Greenspaces promote social cohesion amongst and between different groups in different places, such as parks and gardens. This is linked with findings from other studies that reveal how the people that benefit most from greenspaces near to where they live are those on lower incomes and with worse indicators of deprivation.
- Green areas are assets to schools to use for outdoor learning.
- Parks and public gardens provide opportunities for direct involvement by local people in the management of their local communal areas.
- Green routes to work promote health and reduce traffic congestion.

Economic benefits

- Most, but not all, studies suggested proximity to greenspace has a statistically significant effect on increasing house prices.
- Parks with a natural character have the highest statistically significant effect; this effect also has the longest reach.
- Some studies found a positive impact on inward investment, but did not place numbers on this impact. More research would be useful in this important area.

Environmental quality benefits

- Greening in urban areas improves air quality.
- Green areas improve the local climate and reduce the heat island effect.
- Green areas can reduce noise pollution and the visual intrusion from traffic.
- The risk of flooding is lower where there is plenty of urban vegetation to intercept and absorb storm water.
- Urban green areas can provide a diverse habitat for a range of, mainly common, bird and animal species.

Perceptions of greenspace

- Naturalness is the most highly appreciated physical attribute of greenspace; however, understandings of naturalness vary across, as well as within, different societies.
- A majority of people feel greenspace design should aim to enhance the ecological functions of greenspace habitats.
- Planning should be as participatory as possible. There is increasing evidence that places developed with the active participation of local people meet their needs better and help people develop place attachment, as borne out by the evidence in the earlier section 'Social and community aspects'.

There are few areas of public policy where relatively modest investment might result in such broad ranging and measurable public benefits.

Green walls and roofs can help turn buildings into wildlife habitats whilst improving ecological connectivity.

A SIMPLE FRAMEWORK FOR CREATING A LIVING CITY

Having established the wide-ranging social, economic and environmental benefits arising from natural and other green areas within urban settings, the question arises of how it might be possible to maintain and increase those benefits through planning, design and other interventions?

Urban ecosystems are comprised of different components running from the micro (individual street trees or small gardens, for example) through to the macro (such as large river corridors or major semi-natural parks). These different components can, if well designed, link together to form a connected system. Once these different elements and different scales are understood, it becomes easier to take practical actions that enhance the health of the whole urban ecosystem.

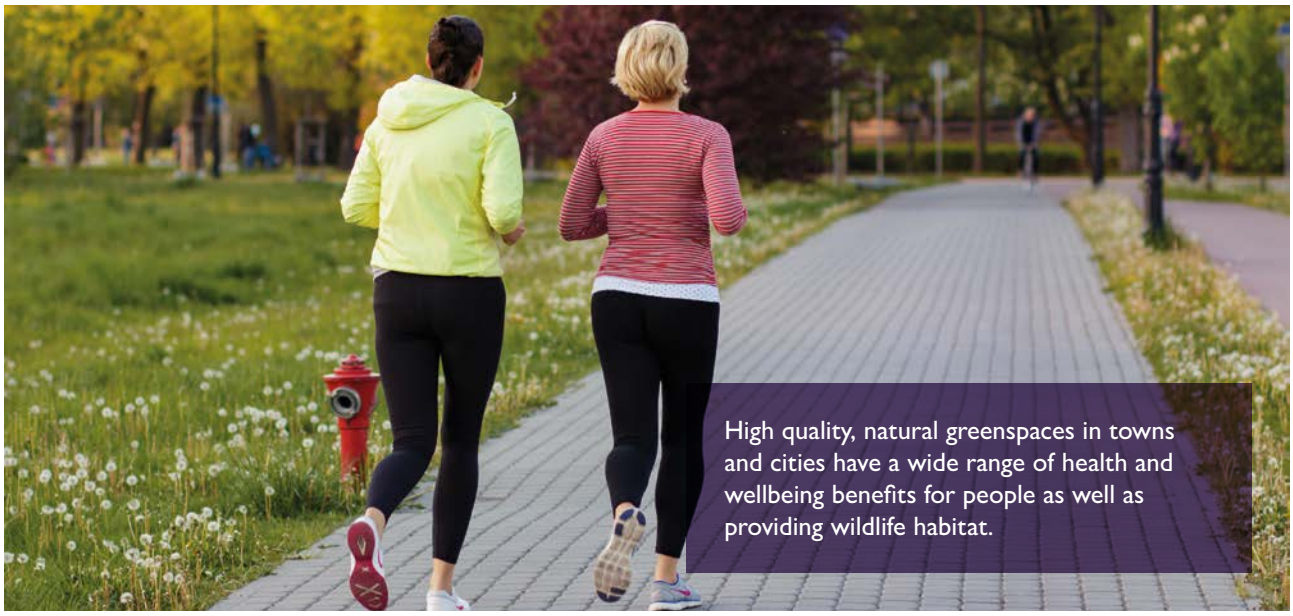
Aside from the sheer amount of greenspace, there are three key ecological principles that determine the degree to which urban ecosystems can support health, wellbeing and related benefits:

1. Level of **connectivity** – the extent to which large and small greenspaces are joined up
2. Degree of **naturalness** – how close the flora and fauna is to what existed before the settlement was built
3. **Structural diversity** – the complexity and variety of the flora and fauna present

Interestingly, these three ecological principles can also be applied to the grey infrastructure. In so doing, the *underlying ecology* of the green infrastructure in the first principle becomes the *overlying urbanism* in the second principle and thus

- connectivity becomes integrated sustainable and **active transport networks**;
- naturalness becomes the **local adapted** design styles and building materials; and
- structural diversity becomes vibrant, relatively dense **mixed use** neighbourhoods.

There is a sound scientific basis for highlighting connectivity, naturalness and structural diversity as the most important factors determining urban ecosystem health. In general, the smaller and more isolated an area of greenspace, the fewer species it can support and the less likely those species are able to move to other green patches in the city. In effect, individual greenspaces act like islands in a sea of built development. This phenomenon, known as the *Theory of Island Biogeography*, was first described in1967 by ecologists Robert MacArthur and Edward Wilson.[11] Simply put, the theory holds that larger and less isolated islands support more species in a more stable equilibrium than smaller, more isolated islands. Hence by linking up isolated patches of greenspace, they begin to behave like one larger, more stable patch, with more species that are less likely to become locally extinct.



High quality, natural greenspaces in towns and cities have a wide range of health and wellbeing benefits for people as well as providing wildlife habitat.

A typical example of unsustainable suburban sprawl in the UK. Compact, walkable neighbourhoods rich in nature are a more sustainable alternative, requiring less land-take and lowering carbon footprints.

The **connectivity** of greenspace is a critical factor determining the health of the urban ecosystem. Large areas of unbroken grey infrastructure are not only impenetrable to nature but can mean large sectors of the urban population have little, or no, daily contact with nature. This has both physical and psychological impacts on health and wellbeing.

When it comes to **naturalness**, the proportion of native plant species is a good indicator. Native plants usually support more species of birds, mammals and invertebrates than exotic, introduced species.[12] This is for the simple ecological reason that communities of species that have evolved together for millennia are better suited to each other - they have co-evolved. To give just one example, native common hawthorn (*Crataegus monogyna*) supports up to 300 insect species in the UK, including rare moths, and provides food for fieldfares and redwings in the early winter. By contrast, most commonly used non-native ornamentals support just a handful of widespread insects.[13]

Similarly, the more **structural diversity** within vegetation, the more 'ecological niches' available to support a greater diversity of species (see Box 2).

By designing large and small greenspaces that are **connected** to each other, are rich in native species and have diverse habitat structure, it is possible to significantly increase the health of the urban ecosystem and its capacity to provide services to both people and wildlife. Permeability for nature also improves permeability for people, not just along classic green corridors but throughout the grey–green interfaces of the city.

Urban environments can be seen as complex ecosystems in which the grey and green infrastructure are so inextricably bound together they need to be managed together, as a system. For example, improving the quality and connectedness of the green infrastructure encourages walking and cycling that in turn decreases car use and increases the vibrancy of places. Because more people are using the urban landscape, this in turn might increase the community sense of security and reduce crime. This may subsequently attract new talent to the settlement and encourage businesses to invest in the area, leading to greater investment in green infrastructure and further improvements in air quality and the health of the local population and so on.

Clearly this is not a linear relationship but more a highly complex network of connections similar to the web of life in nature. What is important is that the *whole* system functions – and functions effectively. Ecological urbanism seeks to do exactly this.

TOWARDS ECOLOGICAL URBANISM

In this paper, we are not proposing a rigid definition of ecological urbanism. The global, national and regional responses to climate change, although driven by science-based emissions reductions targets, must necessarily be adaptive as we simply do not know what the scale and severity of the impacts are going to be.[14]

Ecological urbanism should therefore not be seen as rules-based but more a broad philosophy that seeks to combine some fundamental ecological principles with fundamental urbanism principles (see Box 3).

Such a philosophy will undoubtedly be challenging to those with deeper green leanings or to those who advocate technological solutions to urbanisation. Some environmentalists may feel uncomfortable with advocating medium- and high-density settlements, yet there are many persuasive arguments for these. They tend to encourage modal shifts from cars to active travel and promote community cohesion.

The per capita carbon emission levels in such neighbourhoods are also lower as they tend to be less car dependent, and their buildings more heat efficient. From a biodiversity perspective, building at higher densities can reduce pressure for suburban sprawl into surrounding rural areas that are more likely to contain important wildlife habitats as well as prime agricultural land.

Combining compact, walkable urban forms with nature is a question of design. The fusion of attractive grey–green urban forms can be successfully delivered and the benefits maximised if the principles of connectivity, naturalness and structural diversity underpin planning and design from the outset. And while island biogeography theory suggests that larger greenspaces are more likely to support a greater abundance of nature, there are other ecological factors at play. For example, it is sometimes the case that a small, well-connected network of greenspaces with lots of native species will support a greater diversity of wildlife than, for example, a large mown grass field.

Design and species selection is crucial and so is fostering the attractiveness and vibrancy of what, when exterior space is well defined, has been called 'outdoor rooms'.[15] The most successful greenspaces are those that flourish with both people and nature, or perhaps flourish with people because of nature.

This line of thinking would suggest, therefore, that a recurrent sustainability theme in relation to the creation of new urban communities will be the provision of medium- to high-density developments designed to a high standard to incorporate well-planned and managed green infrastructure, both between the buildings (e.g. pocket parks, street trees, squares) and within the buildings (e.g. vertical greening, green roofs and building integrated habitat).

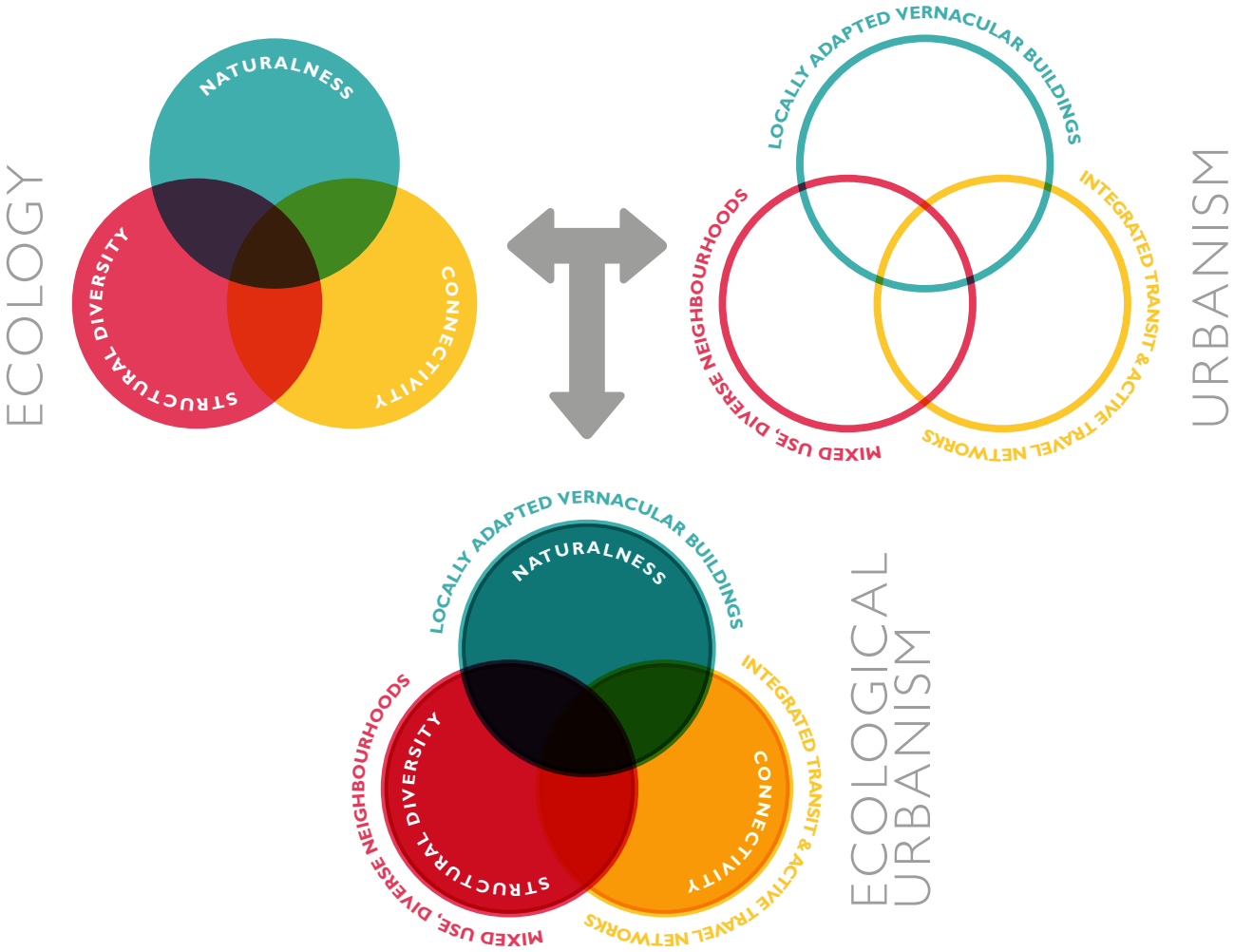
We also strongly advocate that new developments work with the existing grain of nature (landscape 'traces'), for example by retaining mature trees, watercourses, old walls and other natural elements (biological and geological) as features during the master planning phase. This makes good ecological and economic sense. For example, the presence of mature urban trees is positively correlated with desirable neighbourhoods and high house prices, and ignoring the natural hydrology of a site can mean expensive flooding clean-ups in the future.

As the idea of ecological urbanism takes on a clearer form through the accumulation of evidence and best practice, it is important to signal that the idea is emerging in parallel with other 'types' of urbanism. New urbanism, for example, is defined by the following nine principles:

1. Walkability
2. Connectivity
3. Mixed use and diversity
4. Mixed housing
5. Quality architecture and urban design
6. Traditional neighbourhood structure
7. Increased density
8. Green transportation
9. Sustainability

Similarly, the Princes Foundation for Building Community defined a set of 'sustainable urbanism' principles[16] as follows:

A simple model for Ecological Urbanism



- **Mixed use:** while the schemes will be predominantly residential, they will also contain a mix of other uses such as retail, business and community.
- **Mixed tenure:** a variety of income groups and occupations.
- **Mixed housing type:** to support movement within the neighbourhood and thus encourage community stability.
- **Good public transport connections:** to encourage walking and cycling and reduce car dependency.
- **Walkable neighbourhoods:** community and commercial facilities accessible by foot, and a street layout which is well interconnected and avoids cul-de-sacs and so encourages a range of routes for pedestrians (and vehicles).
- **Relatively high new densities:** high enough to support the viability of mixed use areas and convenient public transport.
- **Well-integrated open space:** this should have a clearly defined use and a long-term management regime, as well as being easily accessible.
- **Opportunities for a range of work and lifestyle choices:** accommodating economic as well as residential activity.

Similar principles exist for 'green urbanism' and transit-oriented development.

So where does this leave *ecological* urbanism? As stated, we suggest ecological urbanism is in fact an overarching credo, but one with profound practical implications for planning and design. What it is not is a detailed 'how to do' guide. It is a concept that considers how the grey and the green work together to deliver a *living* and *liveable* environment.

In essence, it is a philosophy that recognises our dependency on the health of urban ecosystems and their hinterlands and encourages the use of nature-based solutions to improve this health over time.

Even the most exceptionally designed places are nothing without a community of people to bring them alive. People are both the customers and the caretakers of their neighbourhoods, but the debate continues as to what extent they should also be the architects and designers of their neighbourhoods, or whether the balance of power to shape the physical form of communities should remain with the trained 'professionals'. But what is certain is that people within communities make or break a place, sometimes almost regardless of the quality of the built and natural environment.

Whilst this paper does not cover issues of community empowerment, community-led design or long-term stewardship, it is important to highlight that, as ecological urbanism is adopted in the coming years, it will be essential that a range of methodologies are used to ensure people in communities are at the heart of shaping the future of the places in which they live and work.

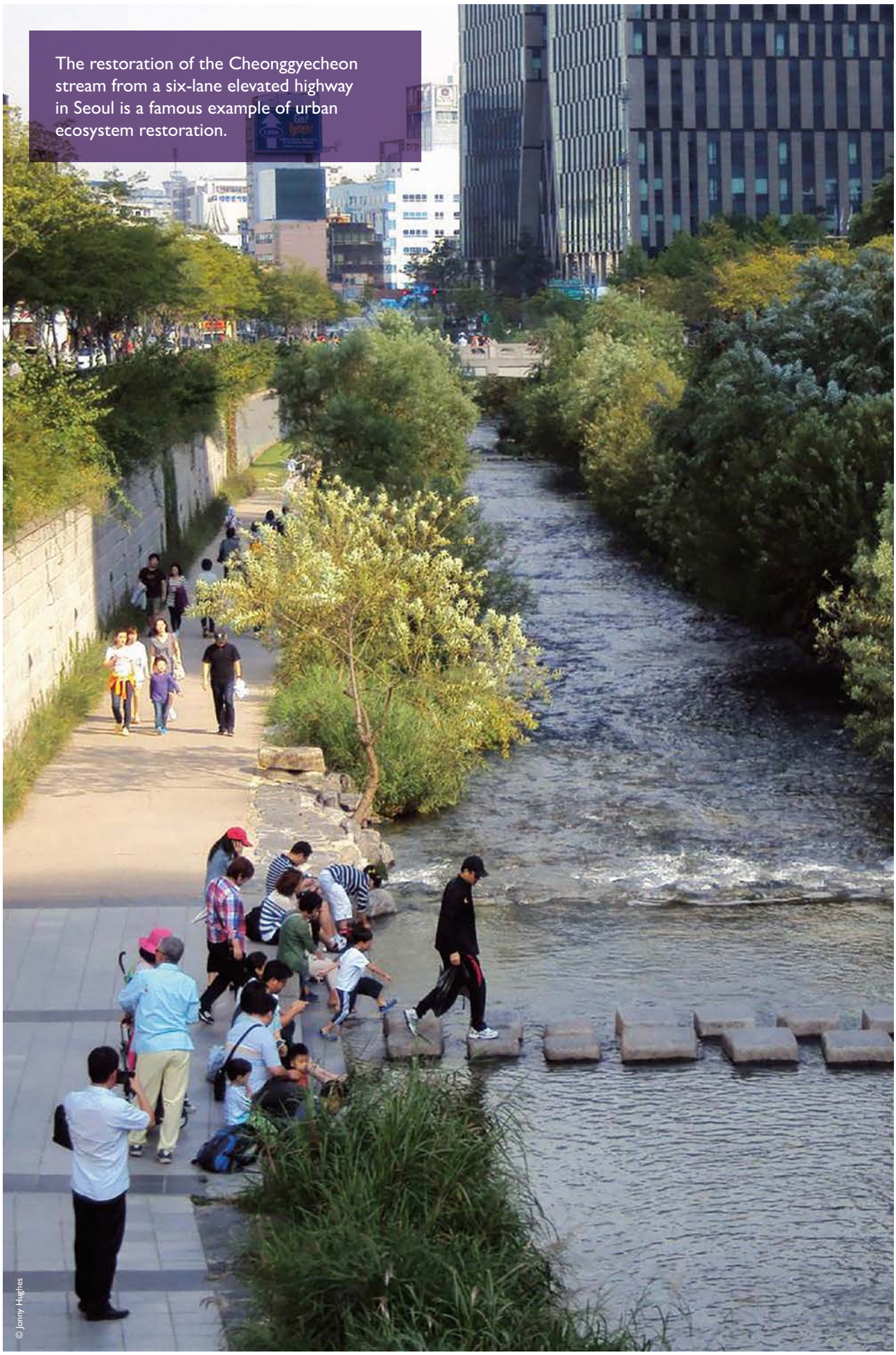
PRACTICAL RECOMMENDATIONS FOR EMBEDDING NATURE IN THE URBAN ENVIRONMENT

The following checklist is designed for developers, planners, architects, landscape architects and urban designers in Scotland, and we hope local authorities and public bodies will find it useful in discharging their statutory biodiversity duty enshrined in the Nature Conservation (Scotland) Act 2003.

The recommendations are in no way comprehensive and any one of several excellent books on the greening of urban areas will provide much more detail on practical management. However, the authors felt it was important to give a sense of what ecological urbanism means in practice at different scales within the urban ecosystem.

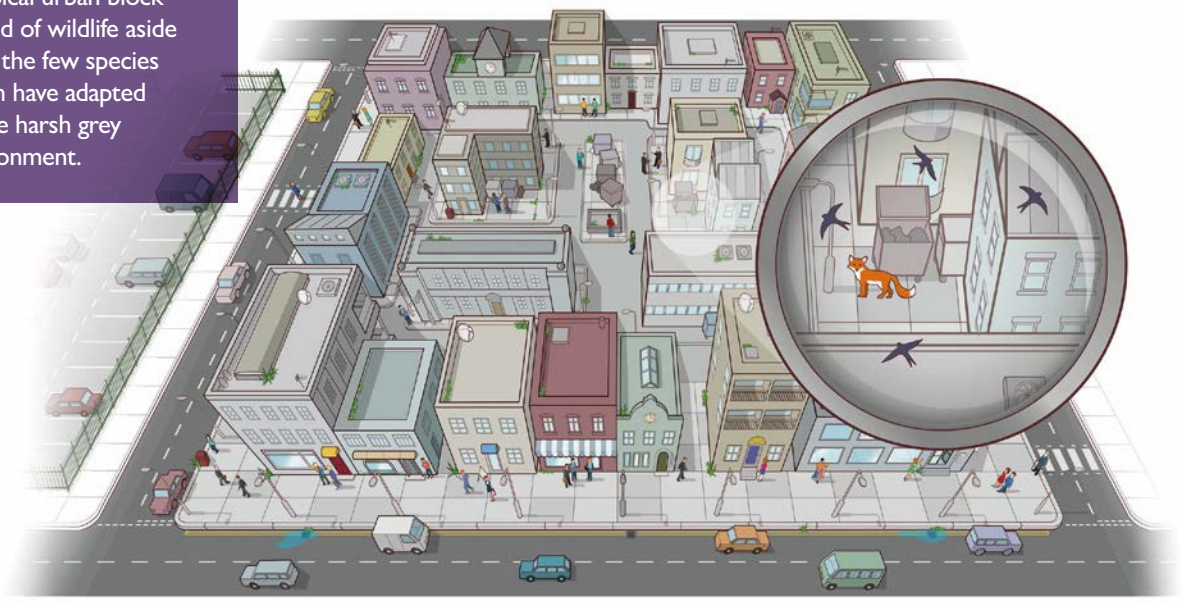
Our recommendations are divided into scales, beginning with the micro level and working through to the green network scale at the city region level. This is because we consider the idea of green and integrated grey–green infrastructure simultaneously working at several different overlapping scales to be crucial for successful ecological urbanism.

For each scale we set out five simple measures that would make a tangible positive difference to nature across the urban environment. Note that wildlife gardening in private gardens is hugely important for enhancing biodiversity in towns and cities, but is outside the scope of this particular publication, which is more focused on the public realm.



The restoration of the Cheonggyecheon stream from a six-lane elevated highway in Seoul is a famous example of urban ecosystem restoration.

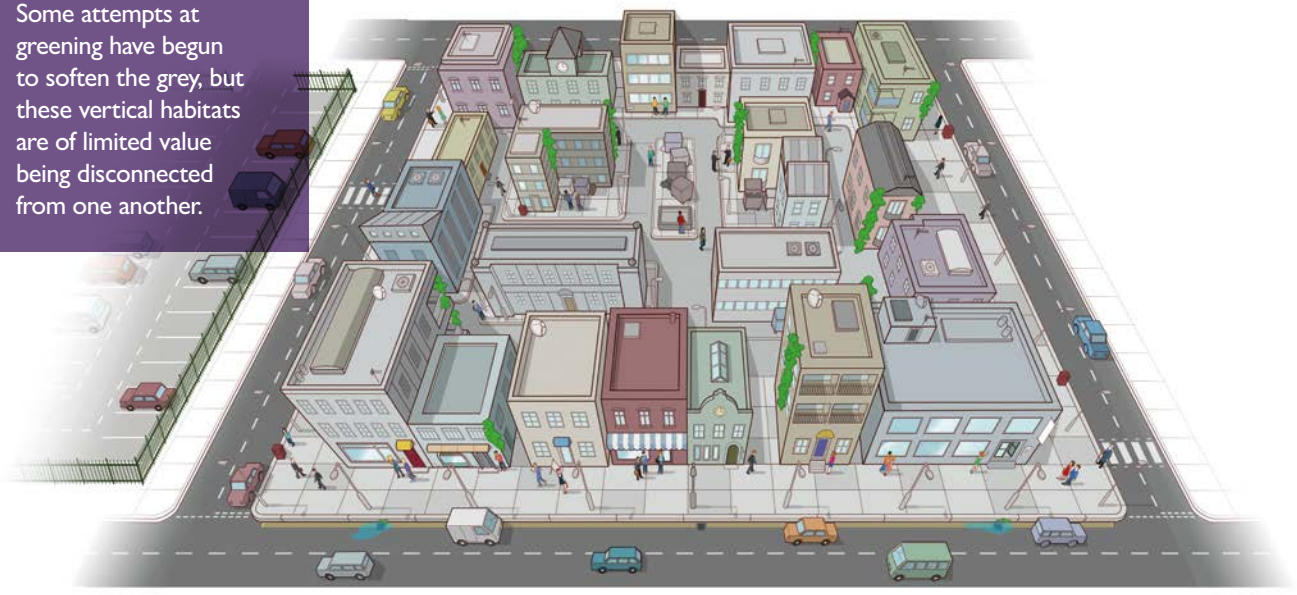
A typical urban block devoid of wildlife aside from the few species which have adapted to the harsh grey environment.



Micro-scale measures

1. **Build traditional**. Use local, traditional building techniques and materials to encourage wildlife to colonise new buildings, including using lime mortar to encourage lower plants and solitary bees.
2. **Leave gaps**. Design in small gaps of at least 2.5 cm in different parts of the roof, such as under barge and soffit boards, in the eaves, between roof tiles and felt, in the roof apex and in cavity walls for bats to colonise (see www.bats.org.uk/pages/new_build.html).
3. **Homes within homes**. Install swift boxes in new developments; a medium-sized house will take one to four and a small block of flats between four and 10 (see www.swift-conservation.org/swift_bricks.htm).
4. **Retain character.** Avoid unnecessary 'cleaning' of existing buildings of non-invasive plants and lichens.
5. **Attract inspiring wildlife**. Iconic wildlife attracts people. One example might be to build a peregrine platform onto a suitable large building to inspire local people and schoolchildren.

Some attempts at greening have begun to soften the grey, but these vertical habitats are of limited value being disconnected from one another.



Vertical greening has been joined by green roofs retrofitted to existing buildings, helping to create networks for pollinators, attracting more species of birds and providing a healthier, more attractive environment for people.

Spaces on and around buildings

1. **Make building surfaces into living surfaces**. Well-designed green roofs (particularly on flat-roofed office stock) and vertical greening through non-invasive creepers have multiple benefits and can add value to new properties (see www.livingroofs.org).

2. **Go native in pocket parks**. By planting native trees and shrubs in pocket parks, the small greenspaces in cities and towns could coalesce into connected networks of native woodland.

3. **Build place identity through natural features**. Retain and use surviving natural features in new developments to help create places with a clearer identity and aesthetic character, including old trees, walls, hedgerows and topographical features.

4. **Street trees before cars**. In wider streets, extend pavements and plant street trees to help regulate wind tunnel and heat island effects and reclaim public spaces for people

5. **Mini-wetlands all add up.** Design in small-scale sustainable urban drainage systems, such as filter strips and swales with natural vegetation where appropriate.

The addition of street trees has connected the habitats on the buildings to the wider neighbourhood. The air is more breathable, the temperature in the summer is lower and it's easier for pollinators and birds to move through the neighbourhood.

Ecological urbanism on a city block scale. The car park has been converted to a park and community growing space. The green block is connected to other green neighbourhoods throughout the city.

Large greenspaces

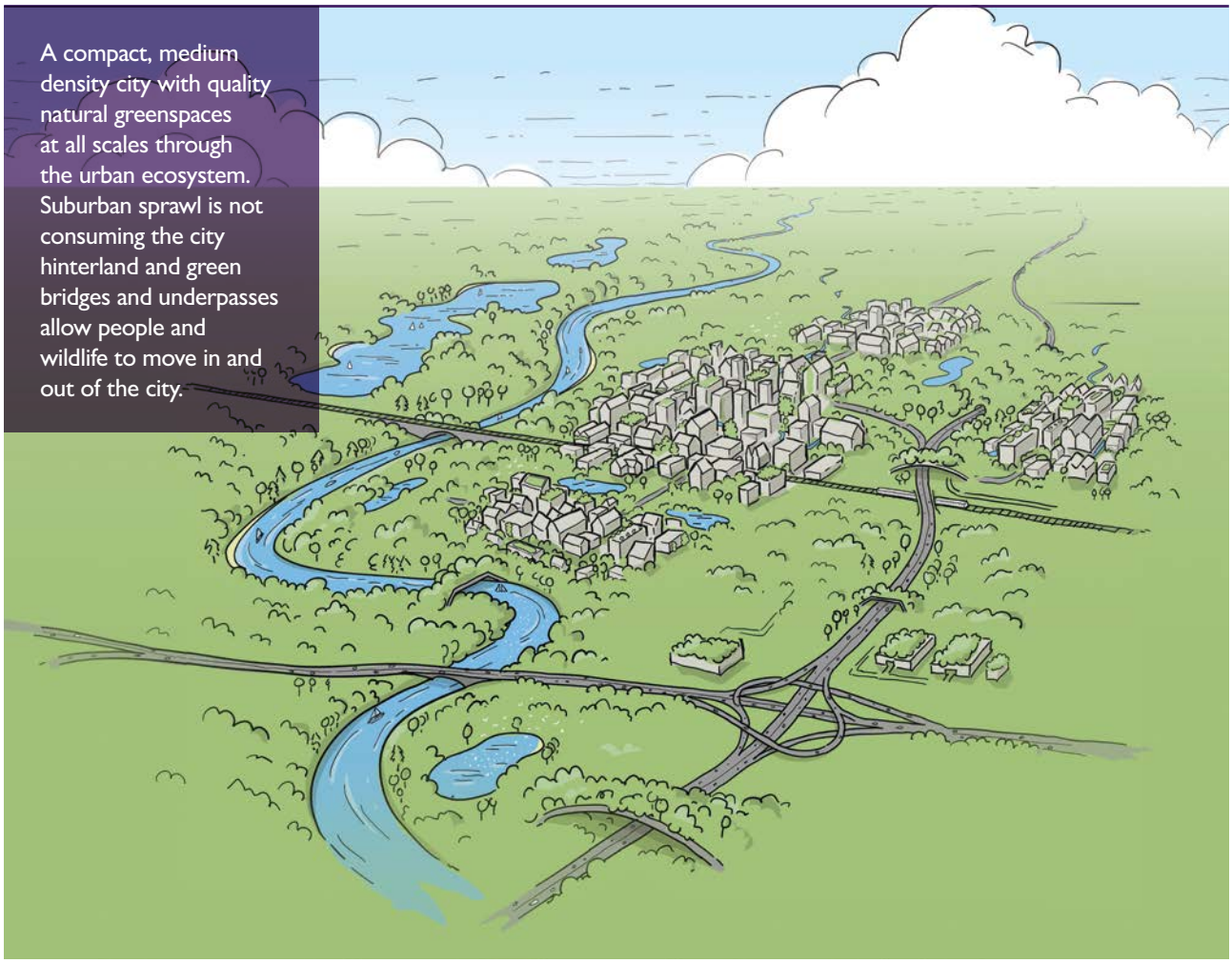
1. **Make greenspaces work for people**. Design and manage greenspaces so they are multifunctional, vibrant places with high levels of biodiversity as standard. For example, many urban parks are unnecessarily sterile patches of closely cropped grass monocultures. In most cities there is considerable scope for semi-natural areas to be created in such places.

2. **Protect and manage natural hotspots**. Non-statutory Local Nature Conservation Sites (LNCSs) and statutorily-designated sites (e.g. Sites of Special Scientific Interest, Special Areas of Conservation, Special Protection Areas and Local Nature Reserves) are vital nodes in the wider green network extending beyond city boundaries. These natural hotspots should be protected and managed to the highest standards and, where possible, better connected or made bigger through decisions that affect the land and water bodies around them (see www.snh.org.uk/publications/on-line/heritagemanagement/LNCS/default.asp).

3. **Undermanage fields and verges and save money**. Resist the temptation to mow every open patch of grass. Long grass is rich in invertebrates, providing food for birds.

4. **Create splashes of colour.** Wildflower meadows now come in kit form and are a fantastic project with which to engage community groups and schools.

5. **Grow local**. Embrace the trend in growing local produce in areas of bland greenspace.



A compact, medium density city with quality natural greenspaces at all scales through the urban ecosystem. Suburban sprawl is not consuming the city hinterland and green bridges and underpasses allow people and wildlife to move in and out of the city.

Green networks

1. **Bridge the green islands**. Have a long-term plan to connect the green infrastructure through micro-scale measures, pocket parks, street trees and other natural features.
2. **Provide for urban hikers**. Long-distance paths shouldn't just be a rural phenomenon.
3. Assess the **urban nature connectivity** index and improve it.
4. **Mix blue and green**. So-called blue networks include rivers, canals, wetlands and other water features. Combine these 'blueways' with 'greenways' to create corridors for wildlife and people.
5. **Overstep the line**. Administrative lines on maps hinder the development of truly functional green networks. Go beyond them and deliver at the right scale (see www.centralscotlandgreennetwork.org).

IMAGINING THE LIVING CITY

To conclude, we have tried to imagine the future and what a city shaped by an ecological urbanism philosophy might look like. It is by no means an exhaustive list and is intended, like the rest of this paper, to provoke debate and thought rather than laying down any hard and fast prescriptions.

Box 3. What might an ecological urbanism city look like?

Characteristic	Future vision
Compact	High-density, traditional urban forms created using timeless pattern languages have created vibrant, attractive and multifunctional places where people live, work and play.
Walkable	Travel distances between work and home are short so more people walk and cycle. Urban streetscapes are more accessible and attractive on foot. This is encouraging people to spend more time in their own neighbourhoods and adding to the life of the neighbourhood.
Carbon neutral	Buildings are contributing to energy demand through generation of decentralised energy and regulating their own temperature. Green roofs and street trees are helping insulate buildings in winter and keep them cool in summer.
Energy efficient	High-density neighbourhoods are becoming more energy efficient due to the closer proximity and smarter, greener design of buildings.
Water smart	Permeable surfaces and more ground drainage through wetlands and greenspace is helping to ameliorate flash flooding and is creating attractive water environments, enhancing the urban aesthetic.
Multifunctional at neighbourhood level	People work, live and play more within their neighbourhoods. This is increasing the 'cultural capital' of place and attracting inward investment and talented in-migrants.
Networked	Public transport networks are properly joined up with effortless interchanges at key locations. These interchanges link into active travel networks that follow strategically planned green networks. Such networks also help nature adapt to climate change and enable species to move through the urban fabric.
Liveable	Heat island effects, wind tunnels, air pollution and noise are minimised through the strategic deployment of quality green infrastructure. This is measurably improving the health and wellbeing of citizens year on year.
Recreational	People are spending more days out in the city. They hear birdsong and can enjoy time by clean water bodies where they can see wild fish. Larger greenspaces are increasingly providing activity-based recreation, but also areas for quiet recreation.

Box 3. What might an ecological urbanism city look like? (continued)

Proactive	City authorities recognise that investment in quality places and green infrastructure are reaping rewards and are actively improving city form and function.
Partly self-sufficient	Food is being grown in increasingly surprising places – from road verges to roofs. Organic allotments and private gardens are becoming more productive.
Planned and flexible	The city is planned with a light touch. Spaces morph from living spaces to working spaces to recreational spaces and back again without facing unnecessary bureaucracy.
Complex and multi-layered	Ecological, social, economic and cultural networks overlay each other in a way that leads to a complex and fascinating urban living environment.
Clean and healthy	Air quality, active lifestyles and quality local food are improving life expectancy and life quality. Air pollution levels are falling year on year as the 'tipping point' for the modal shift to public transport and active travel is surpassed. Electric vehicles increasingly dominate, supported by a new charging infrastructure that is encouraging the rapid phase out of diesel and petrol vehicles.
Part of sustainable hinterlands	Sustainable hinterlands are locally producing much of the city's food for both neighbourhood shops and supermarkets. It is possible to walk from the city centre to the hinterland along green networks linked with long-distance paths. Market gardens thrive, supplying the urban population with plentiful local produce.
Desirable	Inward investment is increasing and new talent is moving in, attracted to the clean, green and sociable credentials of the post-climate change city.
Wildlife rich	Greenspaces at all scales contain mostly native plants, which are attracting a rich array of birds, mammals and invertebrates. The improved conditions for wildlife are helping to reverse historic trends among a number of key species, including songbirds and wild plants.
Inclusive and democratic	Decisions about new developments and how to manage the urban environment involve a range of local stakeholders and communities of interest, including children.
Educational	School classes spend at least a fifth of their week engaged in experiential outside learning. Greenspaces have become tools for teaching children about the natural world and allowing them to explore nature at first hand. By helping children feel confident outside and used to exploring their environment, an investment is being made in improved public health in the future, thereby reducing pressures on public health services.

REFERENCES

[1] United Nations (2014) 'World's population increasingly urban with more than half living in urban areas' [ONLINE], viewed 10 September 2018, <www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html.>.

[2] HRH The Prince of Wales (8 July 2009) 'The Richard Dimbleby Lecture, titled "Facing the Future" as delivered by HRH The Prince of Wales, St James's Palace State Apartments, London' [ONLINE], viewed 10 September 2018, <https://www.princeofwales.gov.uk/speech/richard-dimbleby-lecture-titled-facing-future-delivered-hrh-prince-wales-st-jamess-palace>.

[3] Shanahana, D.F., Miller, C., Possingham, H.P. and Fuller, R.A. (2011) The influence of patch area and connectivity on avian communities in urban revegetation. Biological Conservation, 144(2), 722–729.

[4] 'Ecosystem Health Indicators' (n.d.) [ONLINE], viewed 10 September 2018, <www.environment.gov.scot/our-environment/state-of-the-environment/ecosystem-health-indicators/>.

[5] Savard, J.-P.L., Clergeau, P. and Mennechez, G. (2000) Biodiversity concepts and urban ecosystems. Landscape and Urban Planning, 48, 131–142.

[6] Pryke, J.S. and Samways, M.J. (2009) Recovery of invertebrate diversity in a rehabilitated city landscape mosaic in the heart of a biodiversity hotspot. Landscape and Urban Planning, 93(1), 54–62.

[7] Fuller, R.A., Irvine, K.N., Devine-Wright, P., Warren, P.H. and Gaston, K.J. (2007) Psychological benefits of greenspace increase with biodiversity. Biology Letters, 3(4), 390–394.

[8] Gascon, M., Triguero-Mas, M., Martinez, D., Dadvand, P., Rojas-Rueda, D., Plasencia, A. and Nieuwenhuijsen, M.J. (2016) Residential green spaces and mortality: a systematic review. Environment International, 86, 60–67.

[9] Bragg, R., Wood, C., Barton, J. and Pretty, J. (2015) Wellbeing Benefits from Natural Environments Rich in Wildlife. A Literature Review for The Wildlife Trusts. Essex: The University of Essex.

[10] Bell, S., Hamilton, V., Montarzino, A., Rothnie, H., Travlou, P. and Alves, S. (2008) Greenspace and Quality of Life: A Critical Literature Review. Greenspace Scotland. For similar reports from Greenspace Scotland, see: Greenspace Scotland (n.d.) 'Research and Surveys' [ONLINE], viewed 10 September 2018, <https://www.greenspacescotland.org.uk/FAQs/research-and-surveys>.

[11] MacArthur, R.M. and Wilson, E.O. (1967) The Equilibrium Theory of Island Biogeography. Princeton, NJ: Princeton University Press.

[12] Knops, J.M.H., Tilman, D., Haddad, N.M., Naeem, S., Mitchell, C.E., Haarstad, J., Ritchie, M.E., Howe, K.M., Reich, P.B., Siemann, E. and Groth, J. (1999) Effects of plant species richness on invasion dynamics, disease outbreaks, insect abundances and diversity. Ecology Letters, 2(5), 286–293.

[13] Burghardt, K.T., Tallamy, D.W. and Shriver, W.G. (2009) Impact of native plants on bird and butterfly biodiversity in suburban landscapes. Conservation Biology, 23, 219–224.

[14] Pachauri, R.K. and Reisinger, A. (Eds.) (2007) Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva: IPCC.

[15] Trancik, R. (1986) Finding Lost Space: Theories of Urban Design. New York, NY: Van Nostrand Reinhold, pp. 1–20.

[16] The Prince's Foundation for the Built Environment (2007) Valuing Sustainable Urbanism. A Report Measuring & Valuing New Approaches to Residentially Led Mixed Use Growth. London, England: The Prince's Foundation.

Scottish Wildlife Trust
Harbourside House, 110 Commercial Street, Edinburgh EH6 6NF
T 0131 312 7765 **E** enquiries@scottishwildlifetrust.org.uk

scottishwildlifetrust.org.uk

Supported with funding from:

Supported by players of
PEOPLE'S POSTCODE LOTTERY

Scottish Natural Heritage
Dualchas Nàdair na h-Alba
nature.scot