Technical Solutions Guidebook

Connecting Nature

Bringing Cities to Life,
Bringing Life into Cities

Acknowledgments

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1 | Introduction

What are Nature-Based Solutions?

The European Commission defines nature-based solutions as solutions to societal change that are:

"inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions."

Nature-Based Solutions benefit biodiversity and support the delivery of a range of ecosystem services.

What is the Connecting Nature Framework?

Designing and implementing Nature-Based Solutions on a scale that delivers economic, environmental and social co-benefits, while also building resilience and benefiting biodiversity is complex with many different issues to consider.

In response to this uncertainty, Connecting Nature has developed a process tool to help cities and other organisations navigate the path towards implementation of Nature-Based Solutions on a large scale: the **Connecting Nature Framework**. The Framework identifies **three distinct phases of development** for a nature-based solution: planning, delivery and stewardship.

Throughout each phase there are **seven separate elements** that cities and other entities need to consider when shaping their individual nature-based solution: **technical solutions**, **governance**, **impact assessment**, **finance**, **entrepreneurship**, **co-production** and **reflexive monitoring**.

Cities may choose to start with any element of the Framework process and consider the others in the order that suits their context. What emerges from the Framework process is a comprehensive 360° overview of each stage of development of the nature-based solution.

Guidebooks

To assist you in developing your nature-based solution, Connecting Nature has produced a series of guidebooks. The overall Connecting Nature Framework Guidebook is a good starting point. There is also a guidebook for each element of the framework process describing the implementation steps and providing case studies to show how it works in practice. A step-by-step how-to manual on the Connecting Nature Framework process is also available.

All the Connecting Nature guidebooks and the manual may be downloaded from **www.connectingnature.eu.**

Many questions arise and need answers.

- What is the best solution for the area?
- Who will manage it?
- How will it be financed?
- How to measure the economic, environmental and social impact?
- Who needs to be involved in the planning, delivery and stewardship?
- Will it support innovation and generate jobs?
- How can we manage change?
- Even identifying where to start can often be a challenge!

Connecting Nature Framework

- TECHNICAL SOLUTIONS
- GOVERNANCE
- FINANCING AND BUSINESS MODELS
- NATURE-BASED ENTERPRISES
- CO-PRODUCTION
- REFLEXIVE MONITORING
- IMPACT ASSESSMENT

Glossary

Co-Production:
Co-production means that diverse policy, practice and science actors collectively identify problems and priorities, produce and combine knowledge and put that knowledge into action for the planning, delivery and stewardship of a nature-based solution.

Ecosystem Services:
Ecosystem services are the direct and indirect contributions of ecosystems to human well-being. They support directly or indirectly our survival and quality of life.

Benefits:
Designed for/intended positive outcomes from the installation of the nature-based solution.

Co-benefits:
Non-designed for/unintended positive outcomes from the installation of the nature-based solution.

Stewardship:
Stewardship of a nature-based solution is the term used to describe the ongoing participatory operation management and maintenance of the nature-based solution.

Stewardship includes the monitoring and evaluation of the nature-based solution. This enables you to make adaptations that ensure long-term sustainability and resilience.

Ecomimicry:
Reading the local landscape to understand the important habitats and species, then using this information to design nature-based solutions that would take account of the local species and habitats in a sustainable design.

Upscaling
"The action of increasing the size or improving the quality of something". In nature-based solution terms we consider this increasing the size and quality of a nature-based solution pilot.

Out-scaling:
"Addition of new resources instead of increasing the capacity of current resources". In nature-based solution terms we consider this increasing the rollout of a nature-based solution pilot.

Social Return on Investment:
Social Return on Investment measures change in ways that are relevant to the people or organisations that experience or contribute to it. It tells the story of how change is being created by measuring social, environmental and economic outcomes and uses monetary values to represent them. This enables a ratio of benefits to costs to be calculated.

Pocket park:
A pocket park is a small park accessible to the general public. Pocket parks are frequently created on a single vacant building lot or on small, irregular pieces of land. They also may be created as a component of the public space requirement of large building projects.

Remote sensing:
Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation, especially the Earth.

Grey infrastructure:
Grey infrastructure are engineering projects that use hard impermeable surfaces (e.g. concrete and steel) to create infrastructure such as play areas or concrete pipes/drainage systems.

Biodiversity:
Biodiversity collectively describes millions of unique living organisms that inhabit Earth and the interactions among them. They represent a vital element of our lives but are under continuous threat. The conservation status of more than 60% of species and habitats protected under the EU Habitats Directive is unfavourable. This has fundamental consequences for our society, economy and human health. (www.eea.europa.eu/themes/biodiversity)

2 | What are Technical Solutions?

'Technical solutions' are the technical components that go into the planning, delivery and the long-term stewardship of nature-based solutions. Technical solutions would include, for example, the type of nature-based solution selected, the plants selected, anything that takes into account the local circumstances and, when it comes to the stewardship or ongoing management of the nature-based solution, feeding the results of evaluation and on-going measurement into the project is also considered a technical aspect.

Technical Solutions are one of the building blocks of the Connecting Nature Framework.

Working efficiently:
How do our findings affect the other building blocks?

Whilst the Connecting Nature building blocks follow a linear order in the Framework document, the project will probably have a better outcome if, between each step and especially after steps 1 and 2, of the Technical Solutions building block, attention is paid to the other building blocks of the Framework.

This would mean that the knowledge assembled during steps 1 and 2 could be used to help shape, for example, Finance (eg. exploiting multiple funding streams associated with co-benefits) or Governance strategies (eg. bridging different departments for collaborative objectives), before final decisions on planning, delivery and stewardship are made.

Paying attention to the technical solutions helps nature-based solutions work effectively and deliver benefits that outweigh the costs.

Some examples of technical aspects:
• Making sure the design goals for the nature-based solution are in tune with the natural character of the area where the solution will be created and with the specific needs of the locality/city/region.

• Practical construction aspects of the nature-based solution. For example: What type of nature-based solution? Where? How big? What plants? What additional infrastructure is needed to support the nature-based solution? How will it be maintained?

• Planning the construction/delivery phase so as to make sure the benefits and co-benefits of the scheme are maximised and to consider the broader environmental impacts of the construction process.

• Long-term planning to ensure that the benefits and co-benefits are experienced for many years and that the nature-based solution can be adapted to future changes or challenges.

Figure 1. *Derbyshire Street Pocket Park in Tower Hamlets, London, UK.* **Credit**: *Stuart Connop*

This Pocket Park is a good example of how the technical design of a nature-based solution helped deliver multiple benefits. The Pocket Park that was created showcases how Sustainable Drainage Solutions (SuDS) design can be implemented in densely populated urban areas, helped by a detailed understanding of the background to the underused space.

Whilst SuDS was the key driver behind the project, those involved recognised the potential for many other benefits to be gained.

This nature-based solution therefore supports locally important biodiversity, reduces anti-social behaviour (fly-tipping), provides a secure storage point along a cycling network, creates an outdoor dining space for a local café, an events space for a neighbouring arts centre, and provides urban foraging opportunities by way of herb planters.

The specific benefits of nature-based solutions

Nature-based solutions share many characteristics: they are adapted to the locality, they use resources efficiently and they relate to a whole system rather than one part.

The potential to improve biodiversity in urban areas

Compared to grey infrastructure alternatives such as hard surface play areas or concrete pipes/drainage systems, nature-based solutions have the potential to help urban areas conserve and increase biodiversity. 'Green' or 'natural' solutions that do not improve biodiversity or the natural environment are not considered to be nature-based solutions as defined by the European Commission.

Why is it important to consider the technical aspects of nature-based solutions?

- Giving detailed consideration to the technical aspects of the nature-based solution gives it a better chance of delivering a range of benefits which accommodate the special characteristics of a locality.

- Well designed nature-based solutions minimise the need to trade one benefit off against another eg. design a solution to increase visits to a new park in such a way that it minimises the negative impact on biodiversity.

- Good planning and design of the technical aspects makes it easier and more cost-effective to maintain and care for the nature-based solution in the long-term.

- Unless the technical aspects of each project are carefully considered, the risk is that generic nature-based solutions will be rolled-out across cities or communities. Generic solutions tend to be focused on a single benefit or provide a very narrow range of benefits which reduces community buy-in. Customised solutions better meet the needs of users, stakeholders or neighbouring communities, improve biodiversity and deliver multifunctional co-benefits opening up a range of funding options.

A co-benefits approach

A co-benefits approach is where a **nature-based solution** designed for one purpose generates additional spin-off benefits.

For example, nature-based solutions such as city trees or other green infrastructures will not only have the planned effects of reducing temperatures and mitigating flooding, but they will also have the co-benefit of improving the health and well-being of urban citizens.

Minimising trade-offs

A trade-off is where one benefit is decreased when another benefit is increased. In installing a walkway along a stream, for example, the unspoilt nature of the area may be sacrificed in favour of the benefits a walkway would bring. The more trade-offs there are, the lower the return on investment in terms of benefits.

Nature-based solutions that are built around technical information in every phase from planning through to stewardship are much more likely to maximise the return on investment because trade-offs will have been minimised.

In the example of the walkway by the stream, a good nature-based solution will maximise both biodiversity and amenity use, rather than one at the other's expense.

The Technical Solutions building block of the Connecting Nature Framework helps navigate through **nature-based solutions** development with a series of guiding steps to maximise the benefits realised.

Figure 2. A representation of the potential impact of appropriate and inappropriate technical input in the planning, delivery and stewardship phases when implementing nature-based solutions. Appropriate consideration of the technical aspects of nature-based solutions throughout the implementation process can ensure that benefits are fully realised and sustained over the operational lifetime of the nature-based solution.
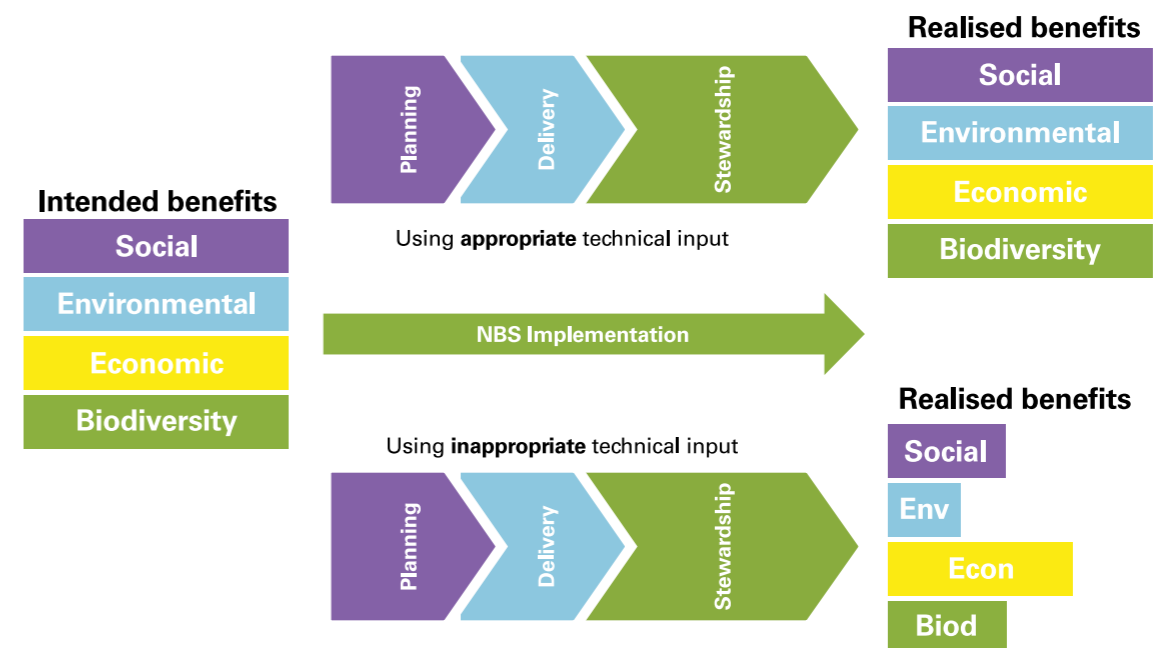
3 | How we do it?

The Connecting Nature Framework is designed so that there can be several starting points for a nature-based solution.

For example, some projects start with a community co-production process where the community comes together with a common need such as the need for a community garden.

Alternatively the **nature based solutions** may arise out of an enterprise/opportunity-based approach such as new housing development requiring green roofs, or a governance/policy-delivery approach such as reducing CO_2 levels to meet EU targets (see relevant Building Block Guidebooks for further details). Regardless of the approach taken, the project team needs to identify a number of factors:

Where exactly will the solution be?

In what specific location or locations would a nature-based solution be desirable?

What is the scale?

Is it one solution in one location, or multiple solutions in a number of locations?

What do we want to build?

Design the solution that will deliver the intended benefits.

How will it be maintained?

Develop a plan for how the desired benefits will be sustained.

The Technical Solution building block of the Framework provides a series of guiding steps to support you in answering these questions.

Five steps to help achieve your nature-based solutions.

Step 1: Define the nature-based solution

In the first step, the location and scale of the nature-based solution need to be determined. At this point, a basic outline or conceptual design for the type of nature-based solution planned could be produced.

This design will of course be shaped by the initial drivers for the proposed nature-based solution. For example, the location and scale could be underused public open space with an opportunity for redevelopment, or a site with a surface-water flooding problem or a redevelopment opportunity tasked with delivering biodiversity net-gain.

The conceptual design could be a green roof, a sustainable drainage system, a grow-your-own project, or a series of pocket parks.

Figure 3. The Stiemer Vallei, Genk, Belgium. At a Connecting Nature project meeting the team explores the site of the proposed nature-based solution to better understand the challenges.

Credit: Adrian Hill Osmos

The Stiemer Vallei, Genk, Belgium – In Genk, the Connecting Nature City team has identified a valley route that runs through the centre of the city as an ideal location for a large-scale nature-based solution. The valley route runs alongside a waterway that connects a number of important wetland areas across the city.

This waterway is predominantly used as an overflow from the city's combined sewer system. The valley route is used by some residents as an active travel route but, due to poor surfacing and water-quality issues, it is not a popular feature in the city.

Due to its location, it has the potential to provide accessible and high-quality green space to a substantial number of Genk's residents.

For the Genk Connecting Nature team, with the site and scale identified and defined, the first step in the process was to design a nature-based solution in a way that took into account the landscape, hydrology and local community needs all along the route.

Given the importance of securing community buy-in to make sure the **nature-based solution** would be used, co-production of the **nature-based solution** design was chosen as the starting point.

Information on local community needs from the co-production process along with information on landscape and hydrology informed the technical planning of the **nature-based solution**, the design of the governance processes and the development of funding bids for the **nature-based solution**.

Step 2: Develop an understanding of the landscape context and ecosystem services needs

Once the location and scale have been determined, the next technical step is to explore the context of the natural landscape in the location.

This step can include everything from a water catchment scale (ie the area from which rainfall flows into a river, lake, or reservoir) – which can extend beyond a city – down to identifying locally typical habitats or habitats of local conservation importance. It should include consideration of geology, landform, habitats and species.

All this knowledge will provide the context for ensuring that the nature-based solution is a good fit with the local landscape and makes a positive impact on local biodiversity and ecosystem services.

> **Ecosystem services are the services such as food and water, climate control and recreational facilities that the natural environment provides for humans.**

The human side: understanding what the people of the area need from the natural landscape

In addition to developing an understanding of the natural landscape, it is also vital to understand what the people of the area need in terms of the benefits that nature can provide. Therefore, an important part of step 2 is understanding the social, economic and environmental needs of the people living in or using the area and inputting this information into the design of the nature-based solution. Incorporating these community needs

leads to a more bespoke and holistic nature-based solution.

This understanding of social, economic and environmental needs should consider place not only from the perspective of immediate community needs but also taking into account the needs of the city as a whole and the wider environment. The indicator list provided in the Indicator element of the Framework provides a guide to the range of different benefits that nature-based solutions can deliver.

Monitoring and managing outcomes

Technical assessment can take into account a wide range of information sources from large-scale mapping and remote sensing down to local community engagement and co-production activities (eg. data on how biodiversity has increased or air quality has improved or rainwater flooding has reduced).

An effective method for delivering, managing and sharing information could be through the development of a centralised spatial dataset portal that combines all available datasets (eg. flood maps, air pollution, access to green space, crime, unemployment, etc) in a single searchable portal.

Ecomimicry, Barking Riverside, London, UK – Ecomimicry has been defined as reading the local landscape to understand the important habitats and species, then using this information to design sustainable nature-based solutions that would take account of the local species and habitats.

This research was carried out on a site called Barking Riverside, a post-industrial site being developed to create a new community for about 26,000 people. Ecomimicry designs developed during the project included experimenting with the creation of ephemeral wetlands on green roofs and a series of novel landscaping habitat features that mimicked important habitats being lost to the housing development.

The design provided a range of benefits including education opportunities, attractive greenspaces for residents and stormwater management features. The habitats have been monitored and results indicate that the innovative designs of the nature-based solutions in place have delivered substantially better biodiversity outcomes than more traditional systems, particularly for locally rare and important species.

The designs and design principles were then fed into a local design guidance document for all developers working on the construction site.
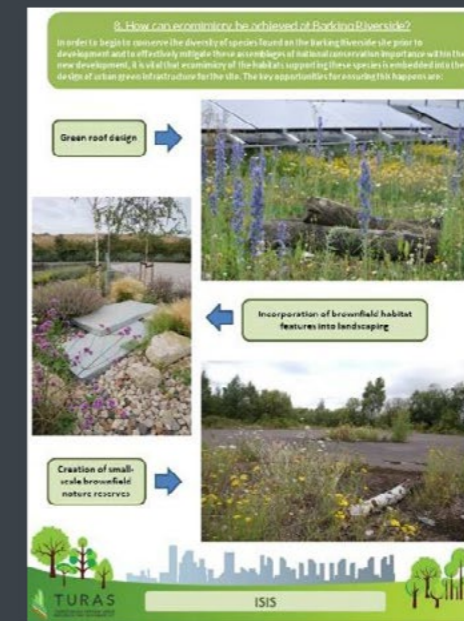
Figure 4. Images from the Barking Riverside design guidance document. Adopting an ecomimicry approach to nature-based solutions by taking inspiration from locally typical habitats.

For more information on the ecomimicry approach adopted see: Nash, C., Ciupala, M.A., Gedge, D., Lindsay, R. and Connop, S. (2019) An ecomimicry design approach for extensive green roofs. Journal of Living Architecture, 6(1), 62-81.

Credit: Stuart Connop
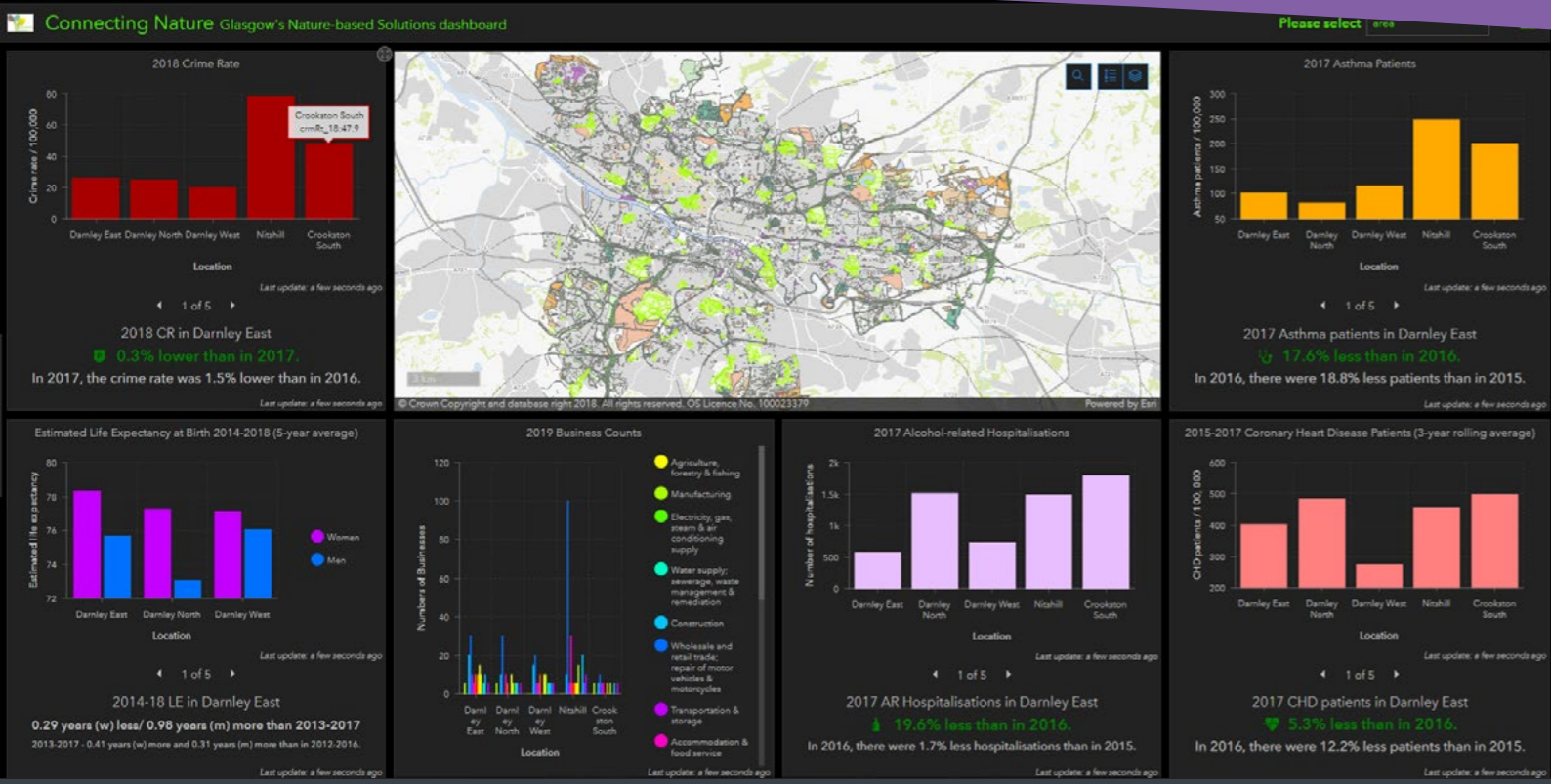
Figure 5. Prototype example of the Glasgow
Nature-based Solution dashboard.

Glasgow's Nature-based Solutions Dashboard, Glasgow, UK – The Glasgow City Council Connecting Nature team is developing a nature-based solution 'dashboard' to centralise spatial datasets that are relevant to nature-based solution development in the city (biodiversity, environmental, social, health-related and economic data).

Centralising this data will support decision making by making the data more accessible. The database will also be used to showcase how the rollout of nature-based solutions positively impacts these factors.

The overarching objectives for the development of the platform are to aid decision-making when it comes to implementing a nature-based solution and to engage colleagues and stakeholders in a broader rollout of nature-based solutions across the city.

The dashboard contains a map and graphs based on different evaluation indicators collected as part of the Connecting Nature Indicators building block.

The map contains layers of geospatial data that are filtered based on the user's selection of a location on the map. The dashboard is one of the many interfaces available through ArcGIS Online that allow the production of live, interactive maps and visualisation.

Part of the innovation lies in the diversity of datasets being brought together and made accessible, which in turn helps to build the evidence-base for the benefits of nature-based solutions.

By presenting in a visual way the multifunctional benefits and co-benefits that can be delivered by a joined-up interdepartmental nature-based solution approach, the dashboard can help to reverse siloed working practices within a local authority. It can also help

local communities and nature-based solution practitioners better understand the local needs of any given area in relation to the potential for their nature-based solution.

An additional benefit of this approach is it demonstrates the tools that are available through the ArcGIS Online platform, which is an opportunity to get more city council colleagues involved in the creation, sharing and updating of useful spatial datasets.
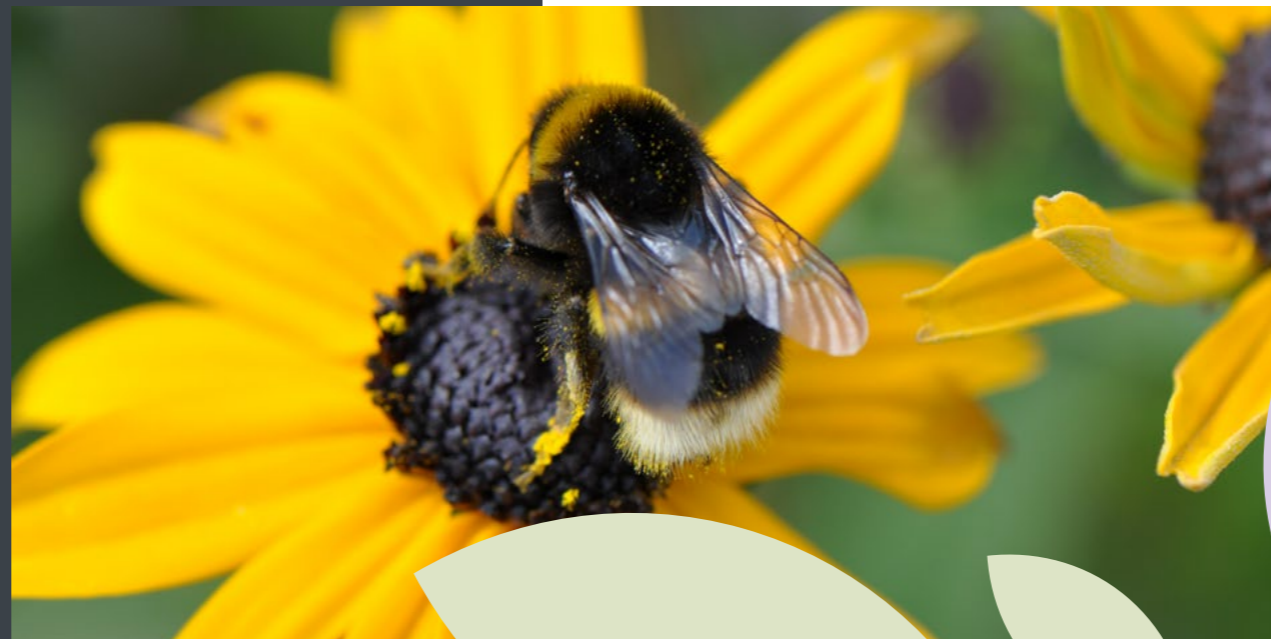
Step 3: Embedding multiple functions into the planning, delivery and stewardship of the nature-based solution

This step involves feeding the insights gathered in steps 1 and 2, namely information on the location, the scale of the project, the landscape, and the needs of the stakeholders in terms of ecosystem services, into the planning, delivery and stewardship of the nature-based solution.

This step is where multifunctional benefits, based on the locality's unique needs, can be locked into the design and when decisions regarding trade-offs need to be made.
It is at this stage that the type of nature-based solution will be finalised.

Now is when the technical design will be completed in relation to scale, needs and available capacity to deliver the design. This step also represents the transition from technical planning to technical delivery of the nature-based solution.

Step 4: Monitoring and evaluation

Nature-based solutions are not one-off projects undertaken at a moment in time. Once the solution has been implemented, it must be managed and maintained. Of central importance to effective management and maintenance is the constructive use of information from the evaluation process.

From a Technical Solutions standpoint, ongoing evaluation is critical in helping the project team understand the technical management required to ensure the project continues to deliver the benefits that were planned for, and to adapt the technical aspects of the nature-based solutions to changing needs over time.

There is also a need to consider how to feed the results of such monitoring back into the overall nature-based solution planning process, and how learning from monitoring can be used to create better long-term management plans.

This approach ensures the nature-based solution can evolve over time to meet changing demands and environmental conditions. Another advantage, of course, is that lessons may be learned and shared with other people interested in developing their own nature-based solution.
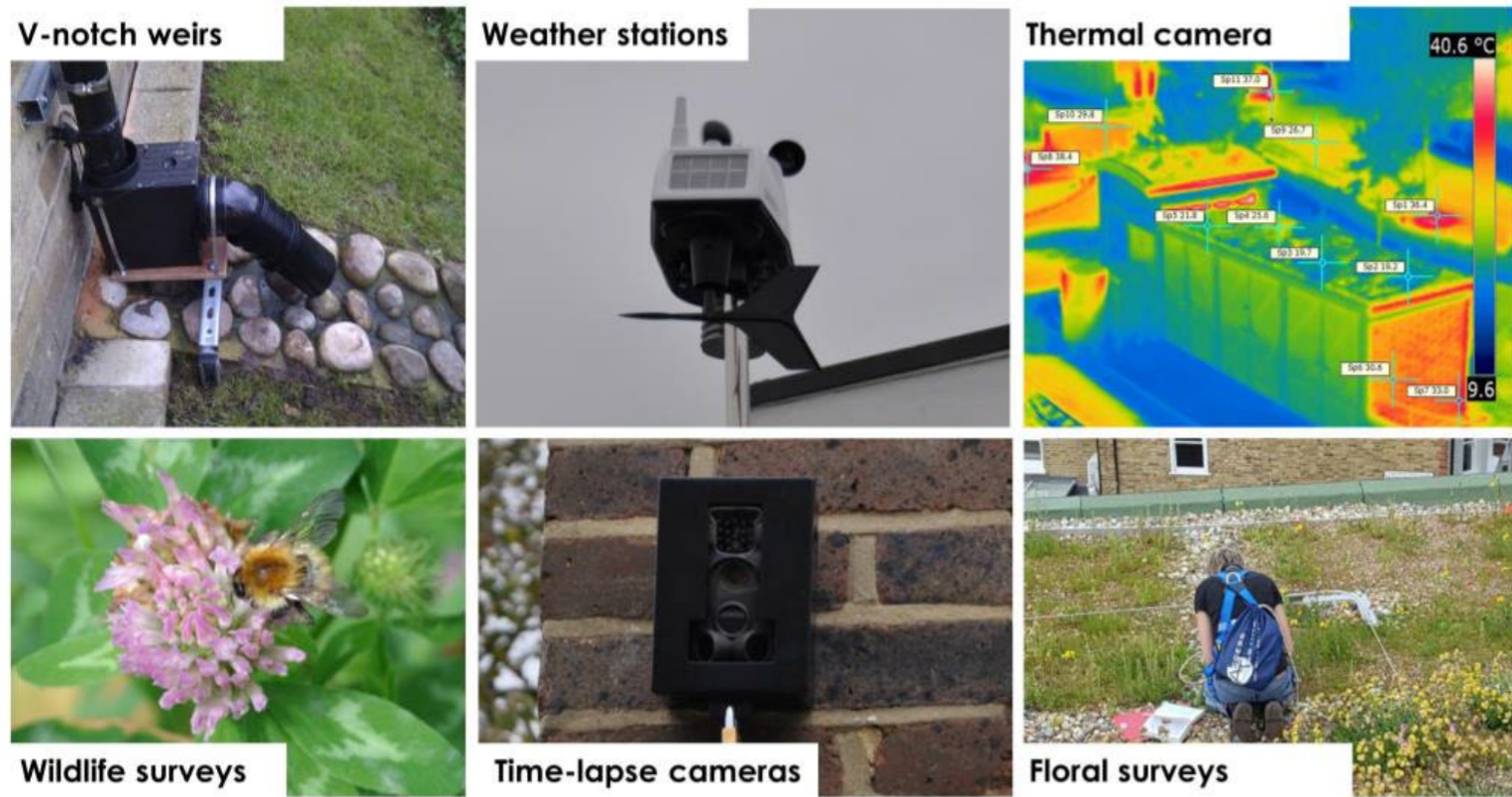
Figure 6. Examples of monitoring methods adopted on the climate-proofing housing estates project, London, UK.

Credit: Stuart Connop

Climate-proofing housing estates, London, UK

The charity Groundwork London and the London Borough of Hammersmith and Fulham partnered on an EU LIFE+ project that investigated the potential for developing cost-effective methods of implementing nature-based solutions to climate-proof houses across three social housing estates in the borough.

Low-cost monitoring was implemented to evaluate the performance of the nature-based solutions and to demonstrate how such approaches could be scaled on low-budgets.

This included evaluating changes in factors such as green space distribution, stormwater management, biodiversity, thermal comfort and Social Return on Investment.

Data from this monitoring was used to inform site management and maintenance plans.

It was also used to build an evidence base to make the case for moving forward with nature-based solutions of similar and bigger scales across other sites. Indeed, similar nature-based solutions have since been implemented in the White City Estate in the borough, the largest social housing estate in London.

Step 5: Build an evidence base to promote nature-based solutions to a wider catchment

Step 5 is about promoting the concept of nature-based solutions to a wider audience. It involves using the learning from steps 1 to 4 to reproduce nature-based solutions in other areas (out-scale) and to consider how nature-based solutions can be increased in size, scale or ambition (upscale).

Upscaling and out-scaling nature-based solutions ensures that benefits are delivered beyond individual communities to communities right across a city.

This can only be achieved by building evidence of the value of nature-based solutions and sharing it among a wide audience. Sharing learning from failures is also important so that mistakes can be learnt from.

It should be noted, however, that when moving from a localised example of a nature-based solution to upscaling or out-scaling, it is important to tailor the technical solution design to the new area and to the needs and scale of that area, rather than merely replicating a generic solution.

By sharing successes in relation to delivering bespoke benefits tailored to local needs, it is hoped that others involved in city-making or community development processes will adopt similar approaches, promoting widespread adoption of the Connecting Nature Framework building blocks across city or local government departments and external stakeholders.

Figure 7. Eco-garden at one of the kindergartens in the city of Poznań. A social event being held in the newly opened garden.

Credit: Miasto Poznan

Kindergarten Eco-gardens, Poznań, Poland

In the City of Poznań, the Connecting Nature team successfully implemented an eco-garden in one of the city's kindergartens. The idea behind the eco-garden was to convert a poorly designed outdoor space with areas of hard impermeable surfaces into a nature-based solution.

The eco-garden was designed to provide opportunities for education about the natural environment, healthy play-spaces through the design of natural play features, and grow-your-own opportunities.

In addition to these designed-for benefits, the garden also provided co-benefits in relation to soil unsealing (removing the artificial surface), increased biodiversity provision, a more attractive kindergarten, relief from heat stress and a space for social events.

Learning from this initial scheme was captured by the Poznań Connecting Nature team and shared with other kindergartens and colleagues in the city council to enable out-scaling of this process across Poznań. The outcome was lots of demand from kindergartens and examples of cross-departmental funding collaboration. Rather than a generic solution, each eco-garden created across Poznań is being developed in response to the local context and need.

A nature-based solution catalogue of options has been developed to support the process. One solution involves an innovative social garden where half the kindergarten eco-garden is open to the local community during the operating hours of the kindergarten.

Such has been the success of this scheme that lessons learned are also now being fed into the redesign of other urban open spaces.

A vast number of resources exist to support the delivery of the Technical Solutions building block.

These come from a diversity of sources, some related to exploring local context and others related to translating the intended benefits and co-benefits of any nature-based solution into an operational model or plan.

Resources include established sources of tried and tested information on the different types of nature-based solutions and methods for reading the landscape.

There are resources on emerging methods for determining local ecosystem service needs and emerging resources related to novel types of nature-based solutions and approaches to delivering benefits.

Examples of useful general resources for building nature-based solution benefits and co-benefits into an operational plan and dealing with trade-offs include:

- Direct information/support from industry involved in the planning, delivery or stewardship of nature-based solutions (nature-based enterprises). These enterprises can be identified through a variety of mechanisms including emerging nature-based enterprise marketplaces (eg. Connecting Nature and Oppla); https://www.naturebasedenterprise.eu/

- Research and information associations, such as green roof associations (eg. the European Federation of Green Roof Associations), stormwater drainage associations (eg. Susdrain), etc;

- Case studies on past experiences with nature-based solutions (this includes websites such as Oppla, Naturvation, Connecting Nature, etc);

- Catalogues of nature-based solution typologies (eg. ThinkNature Nature-based Solutions Handbook);

- Statutory guidance (eg. local/national government and EU guidance);

- Biodiversity conservation resources. These can come in a variety of formats including peer-review journals (eg. Conservation Evidence), local wildlife trusts (eg. London Wildlife Trust) and national/global conservation organisations (eg. IUCN, RSPB, Buglife).

It is challenging to provide a list of resources that supports the incorporation of the local context into the Technical Solution building block because every case is different.

The local landscape, local ecosystems, local species and the local needs (ecosystem service needs) of the particular locality in which you are implementing the nature-based solution are unique.

As such, it is not possible to generate a concise resource list that is relevant to all localities. Instead, it is important that all practitioners implementing nature-based solutions develop their own locally contextualised resource lists.

Several of the Connecting Nature building blocks provide support in this process (eg. Co-production processes to explore local community needs).

Below is a list of some examples that might support cities in how to go about this process for the Technical building block steps:

• UrbanByNature webinar #1: City Needs (Parts 1, 2 and 3)

• UrbanByNature webinar #5: Implementation (Parts 1, 2, 3 and 4).

• Exploring Ecosystem Service Needs of a Locality (Pedersen Zari (2015) Ecosystem services analysis: Mimicking ecosystem services for regenerative urban design. International Journal of Sustainable Built Environment 4(1), 145-157.);

• Taking a locally-contextualised multifunctional approach to nature-based solution implementation (Connop et al. (2016) Renaturing cities using a regionally-focused biodiversity-led multifunctional benefits approach to urban green infrastructure. Environmental Science and Policy 62, 99-111.)

• Using ecomimicry to shape the ecology design of nature-based solutions (Nash et al (2019) An ecomimicry design approach for extensive green roofs. Journal of Living Architecture, 6(1), 62-81.)

• Categorising natural landforms on a city scale to inform nature-based solution design: Natural England (2011) London's Natural Signatures. Report produced by Natural England. http://publications.naturalengland.org.uk/publication/6540238365130752

• Green Infrastructure Focus Map to support decision-making in relation to local needs. https://apps.london.gov.uk/green-infrastructure/

• Experiences of cities that have begun the Connecting Nature Framework journey: Genk, Glasgow, Poznan. https://connectingnature.eu/cities

• For further information, contact: Stuart Connop (s.p.connop@uel.ac.uk) or Caroline Nash (c.nash@uel.ac.uk)