Blue Green Infrastructure and Nature-based Solutions Framework

Our Green Region

Contents

1. Introduction

Smithfield Grey to Green Project, UK

1. Introduction

This Framework for Blue Green Infrastructure (BGI) and Nature-based Solutions (NbS) has been created by Arup on behalf of the Southern Regional Assembly as part of the Regional Action Plan for the Interreg Europe Blue Green Cities Project.

Blue Green City (BGC) – Interreg Europe Project

The Southern Regional Assembly is the Irish partner in an Interreg Europe Project called Blue Green City (BGC). The project started in August 2019 and includes partners from across Europe. Blue Green City seeks to increase awareness and knowledge of the concept of ecosystem services and of the value of green and blue infrastructure. This will be accomplished through a process of interregional learning and strong collaboration in finding common solutions to common challenges posed by climate change, in particular by sharing experience and exchanging good practices.

From our uplands and agricultural areas, through cities to coastal areas, it is essential that we make nature and BGI central to planning, problem-solving and place-making. The shift from traditional infrastructure thinking is represented in policy and best practice at a European, National and Regional level. This framework has been designed to inform the implementation of high-level intentions on using natural systems throughout project lifecycles.

Working with nature is an integral part of the Irish culture and language and there is a richness in the way Irish people describe the natural landscape. Irish words and phrases, which have transferred from our ancestors, tie together beauty, importance, and insight to the natural world. The Irish language, which has been spoken for thousands of years, is rooted in the landscape and to a way of living in tune with nature that is uncanny and precious. The use of aire meaning ‘care’ within iascaire (carer of fish or fisherman) implies that we should fish in a sustainable manner. The Irish word beachaire (carer of bees or beekeeper) infers working with bees rather than just keeping them. The Irish word saoil means both life and world. Life and our world, being the environment, are one.

Faced with global challenges effecting our environment and people such as biodiversity loss, climate change and health and wellbeing, it is now time to reconsider the place of nature and landscape in our lives and the way we plan for them. Linking back to our ancestral wisdom inspires an integrated and collaborative relationship with nature, which sets the scene for this framework for BGI and NbS for the Southern Region.

The Southern Regional Assembly (SRA) links local and national policy goals through Regional spatial and economic planning and the roll out of the statutory Regional Spatial and Economic Strategy (RSES) for the Southern Region. The RSES recognises that our natural vegetated areas (the green) and our waterways and water management infrastructure (the blue) provide a broad range of economic, social, and environmental benefits in and around our settlements. Considering the expected population growth in the Region to 2040, the Southern Region needs to respond by delivering a new way forward. It is within this context that BGI and NbS become extremely important in achieving national and Regional policy. High-quality green and blue spaces are important not just for nature but health and wellbeing, particularly in the context of an increasingly urban society and increasing settlement densities.

Fitzpark, Arup, London, UK

Guggan Barra, Cork, Ireland

The implementation of Blue Green Infrastructure and Nature-based Solutions is embedded within a good understanding of place, problems to solve, principles, and policy.

1.1 Our Climate is Changing

The Southern Region is already experiencing the impacts of climate change and climate-related hazards. The average temperature in Ireland has increased by 0.8°C compared to 1900.[1] If climate change is left unabated and the Region experiences greater effects of climate change in the future, current scenarios are expected to worsen. By 2060 the projected average annual temperature is expected to be 1.3-1.6°C warmer than 1900.[1] The years 2010-2019 were the warmest in Irish record.[1]

Global warming is changing weather patterns, causing sea level rise, glacial melt and threatening the lives and futures of entire nations. In the Southern Region many of coastal towns are expected to be impacted by sea level rise by 2050.[2] BGI and NbS present opportunities to mitigate and adapt to changes in sea level. Climate change is one of the greatest threats to human rights, posing a serious risk to the provision of food, shelter, health, and an adequate standard of living.

Rising temperatures have triggered other changes to our planet's climate and led to an increase in the number of extreme weather events. Severe natural events can have catastrophic consequences for settlements and the environment in the Region. BGI and NbS can help communities build resilience. The number of very intense storms is projected to increase over the North Atlantic Region and the number of storms stretching south and over the Southern Region will also increase.[1] Those counties on the Atlantic seaboard, Clare, Limerick, Kerry, and Cork, will likely be particularly adversely affected and must be prepared for an increased number of extreme wind and precipitation events and flooding.

Global, national, Regional, and local policy supports mitigation against and adaptation to climate change. There must be collective action towards an ecologically wise and socially just world. A summary of relevant policy is provided in Appendix B.

1.2 BGI and NbS Solutions for the Southern Region

The Southern Region must adapt to the challenges it faces such as climate change, Regional disparity, environmental issues, and global uncertainty. The RSES states that, "an unchecked 'business as usual' scenario will diminish our quality of life, our environment, erode our competitiveness and compound Regional disparity."[3] This framework aims to turn this scenario around to create a Region that is "more prosperous, sustainable, climate resilient and attractive [..] for the benefit of all its people".[3]

Benefits flow from healthy ecosystems. Using nature to transform and modify natural ecosystems in the Region can meaningfully and adaptively address the local drivers of societal challenges, providing benefits to people's wellbeing and the environment. Using nature to solve problems is embraced by NbS thinking. Connecting places and spaces to sustainably manage water and promote high quality habitats is addressed through creating BGI.

Together, BGI and NbS are designed to address major societal challenges, such as food security, climate change, water security, human health, placemaking and compact growth.

The 'Nature-based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. Water Sensitive Urban Design. Best Practice Interim Guidance Document' prepared by the Department of Housing, Local Government and Heritage provides a plan and design-led approach whereby all urban interventions or projects must incorporate water sensitive urban design and manage rainwater in a nature-based and sustainable manner. The Guidelines and this Framework complement each other, and it is anticipated that there will be a more detailed Guidance Document produced as part of an overall national strategy for the implementation of nature-based management of urban rainwater.

Evolution of the Framework

This Framework has been developed in close collaboration with the Southern Regional Assembly. Stakeholder inputs and engagement shaped its evolution and stakeholders were informed of the project from the outset. Initially, discussions were held with three stakeholders representing Regional agencies and Local Authorities. Following this, a workshop was set up with each of the Southern Region's Local Authorities as well as relevant government agencies and public bodies. Feedback has been taken on board and incorporated into this Framework. A detailed description of the stakeholder workshop and the outcomes it generated is provided in Appendix C 'Stakeholder Engagement Workshop'.

This framework aims to provide a resource for Local Authorities, decision makers and developers working in the Region to guide the implementation of BGI and NbS. Of critical importance are our Region's Local Authorities, at County and City level, who ensure the implementation of BGI and NbS in the Region through decision making, development control, and planning.

This framework is of tremendous value to the Region enabling the implementation of a network of nature-based interventions to solve local challenges in our settlements and the landscapes that they link to. The framework is the first of its kind at a Regional level in Ireland and its uptake is strongly encouraged.

Connswater Community Greenway, Belfast, United Kingdom

2. Framework Overview

Cambridgeshire guided busway, UK

2.1 Framework Overview

This section provides an overview of the framework.

How is the Framework Organised?

Three by Three approach.

The framework presents a series of actions and guidance notes that relate to three key implementation strands, which are:

1. Nature-based Solutions
2. Blue Green Infrastructure
3. Governance & Management

Nature-based Solutions and Blue Green Infrastructure are two separate but interlinked concepts and so are dealt with as two separate strands of the framework. Section 2.4 BGI and NbS Solutions and Systems for the Southern Region, contains a full explanation of both ideas and the commonalities and contrasts between the approaches.

Appendix D contains the full list of tools, as outlined throughout the report, which can provide further guidance and assistance to deliver the lifecycle phases.

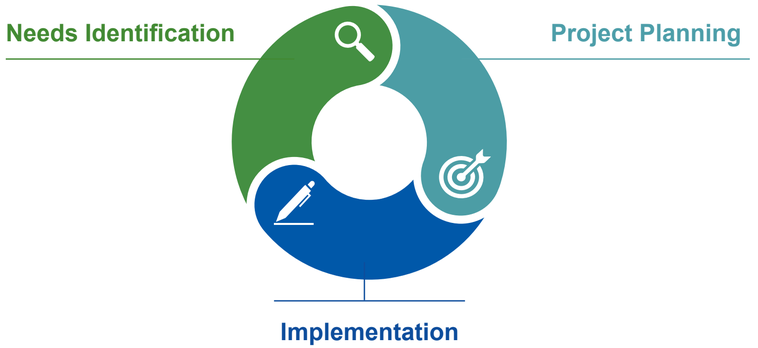
[1]The Framework's lifecycle phases are based on those identified by Resilient Shift's Infrastructure Pathways[33] which provides a is a global approach to creating resilient infrastructure through the project lifecycle.

NbS and BGI can deliver a network of nature-based interventions.

Governance & Management is an independent strand of the framework but is relevant to both BGI and NbS planning. This is because implementing BGI and NbS requires a collaborative approach. Organisations in charge of infrastructure planning, financing, design, delivery, and maintenance all have an important role to play.

Governance and Management Strategies aid inclusive and efficient project organisation.

Actions are organised around three main stages of typical project lifecycles for implementation[1];



Bridgewater Basin, Manchester, UK

This high-level lifecycle can be applied to all projects and processes in the Region.

1. Needs Identification

Climate risks and development needs are identified, and associated strategies and actions are prioritised.

This phase covers:

- Policies, Principles, & Governance
- Needs Identification

2. Project Planning

Conceptual approaches to delivering a prioritised project are studied and a delivery plan developed.

This phase covers:

- Feasibility & Strategy
- Funding & Finance

3. Design and Implementation

Design and construction services are procured and the NbS is built. Maintenance and monitoring of the NbS occur until it reaches the end of its life.

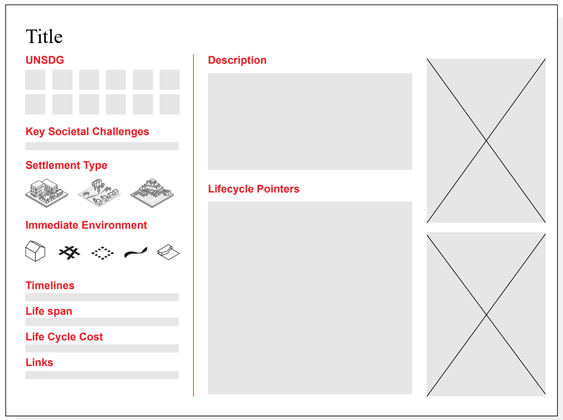
This phase covers:

- Design & Implementation
- Management and Monitoring
- End of Life

2.2 Framework Features

Decision Making Tools

Throughout the framework, a series of tools have been developed to guide users through decisions that are required at various stages in a project lifecycle across the three strands. The tools are sometimes linked but can also be used independently. Key decision-making tools are signposted with a light-bulb symbol. Nature-based Solutions Catalogue.



Checklist

The Checklist provides a quick reference go to for decision makers and developers to understand where along the project lifecycle, key actions are required to be undertaken. This is provided in Section 2.3.

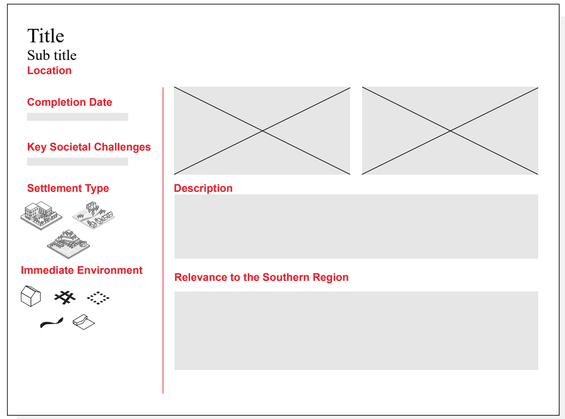
Nature-based Solutions Catalogue

The Catalogue consists of 37 NbS information cards, one for each NbS identified in the NbS matrix. The cards provide links back to overarching drivers and context, SDGs, and guidance to inform the first steps in planning, designing, and implementing each solution. Please see the Catalogue of Nature-based Solutions in Section 6.

Case Studies

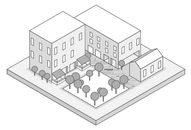
The Framework refers to a series of 21 case studies which are collated in Section 7 and are organised according to the Framework. These have been presented in a way that demonstrates how they have added value to place, planning, processes, and purses and are relevant to the Southern Region.

Some case studies present an example of global good practice, others show lessons learned, and guidance on how to successfully finance, implement, and maintain NbS.



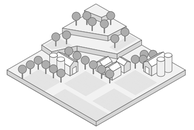
Symbol Legend

Symbols and icons are used throughout the Framework to represent places, spaces and actions as follows:



Urban

Brownfield/Urban Fringe



Rural Settlements

Buildings

Streets

Open Spaces & Fields

Rivers

Coastal

Interactive links

The online version of the framework is interactive, so solutions highlighted within the NbS Intervention Selection or tool links to information on the delivery of that solution.

Extra reading

There is a wealth of information available online for readers who want to know more. When relevant, links to further tools, guidance and project examples are indicated with this symbol.

Extra Information

This is extra information provided that is not a central part to the framework.

Key Decision-making tools

		Lifecycle Phase		
		Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management			

Framework Navigation

This diagram acts a navigation tool so readers know where they are in the framework as they move through it.

2.3 Checklist

Organised according to the three strands of BGI, NbS, and Governance and Management and by the overarching project lifecycle stages, this checklist collates all the instructions from the framework providing a quick-access guide. Section 3.0 (please provide link) provides the background to key contexts and concepts. Section 4.0 onwards contains the full framework.

		Life Cycle Stage		
		1. Needs Identification	**2. Project Planning**	**3. Implementation**
	Towards a healthy ecosystem of networked nature-based interventions			
	Indicative content	**Needs & Priorities**	**Feasibility & Strategy**	**Design & Implementation**
Strand	**BGI strand** *Towards planning and delivering BGI*	• BGI 1.1 Establish BGI Baseline & Priorities	• BGI & NbS 2.1 Plan BGI & NbS interventions • BGI & NbS 2.2 Use the BGI & NbS Interventions Tool	• BGI & NbS 3.1 Approaches to design • BGI & NbS 3.2 Key Management & Maintenance considerations • BGI & NbS 3.3 Design for Uncertainty
	NbS strand *Towards selecting and implementing NbS*	• NbS 1.1 Define the place • NbS 1.2 Define problems and goals		
	Towards an organised, efficient, and inclusive project approach			
	Indicative content	**Policies, Principles & Governance**	**Funding & Finance**	**Management, Monitoring, & End of Life**
	Governance & Management strand *Towards inclusive and efficient project organisation*	• GM 1.1 Identification of team • GM 1.2 Identification of stakeholders • GM 1.3 Identification of a Governance Strategy	• GM 2.1 Technical and Economic Assessments • GM 2.2 Economic Valuation of BGI and NbS interventions	• GM 3.1 Monitoring and evaluation • GM 3.2 End of Life

Table 1 Framework organisation

2.4 BGI and NbS

BGI 1. Needs Identification

BGI 1.1 Establish BGI Baseline & Priorities

There are three key actions in establishing a BGI baseline and project priorities:

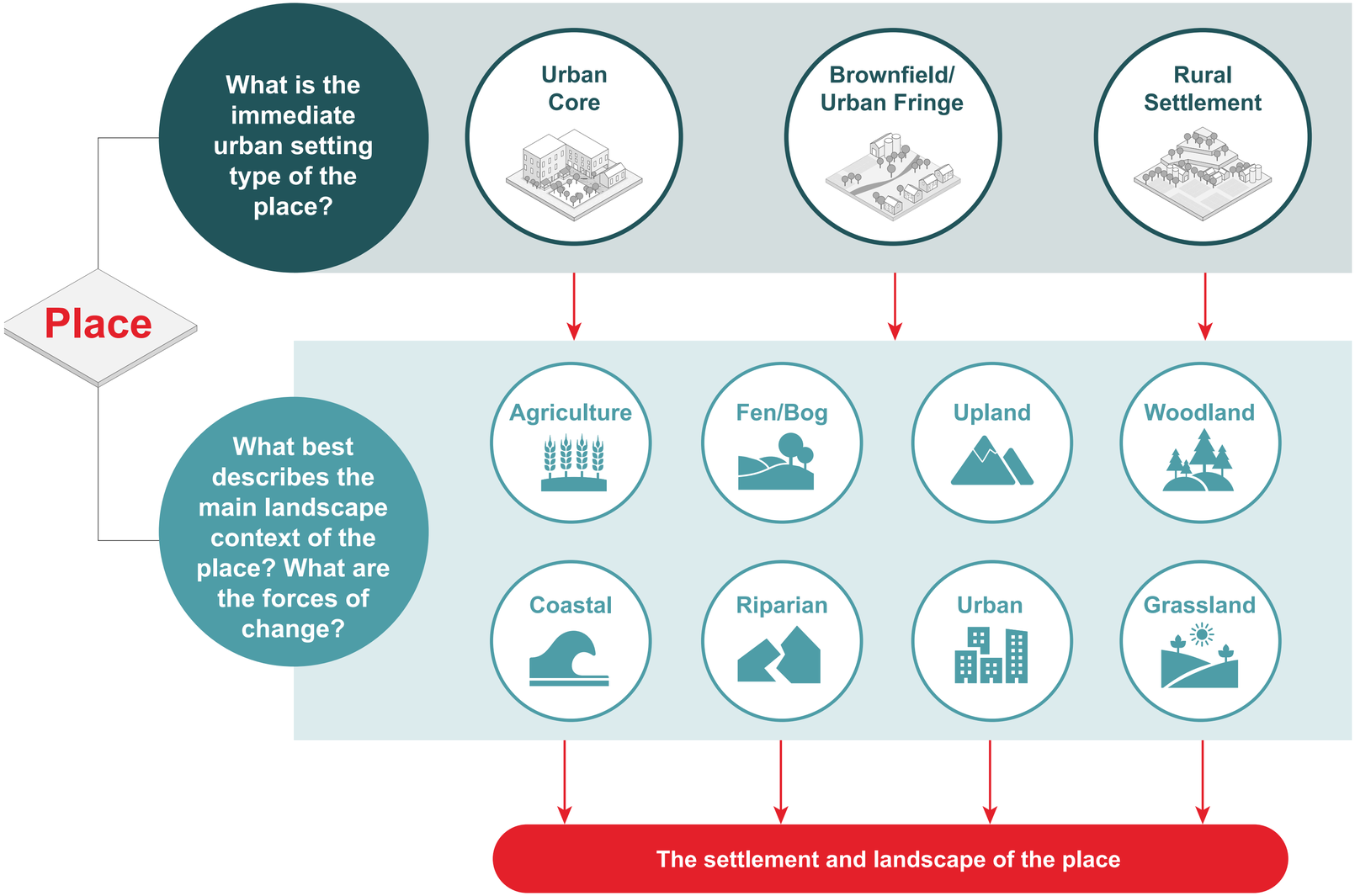
- ☐ Collect baseline data
- ☐ Understand local drivers
- ☐ Undertake stakeholder consultation

NbS 1. Needs Identification

NbS 1.1 Define the place

There are two stages to define the place:

- ☐ Identify the immediate existing or proposed settlement type (More information in NbS 1.1)
- ☐ Identify the main landscape context(s) of the site/settlement (More information in NbS 1.1)



NbS 1.2 Define the Problems and Goals

There are two stages to define the problems and goals

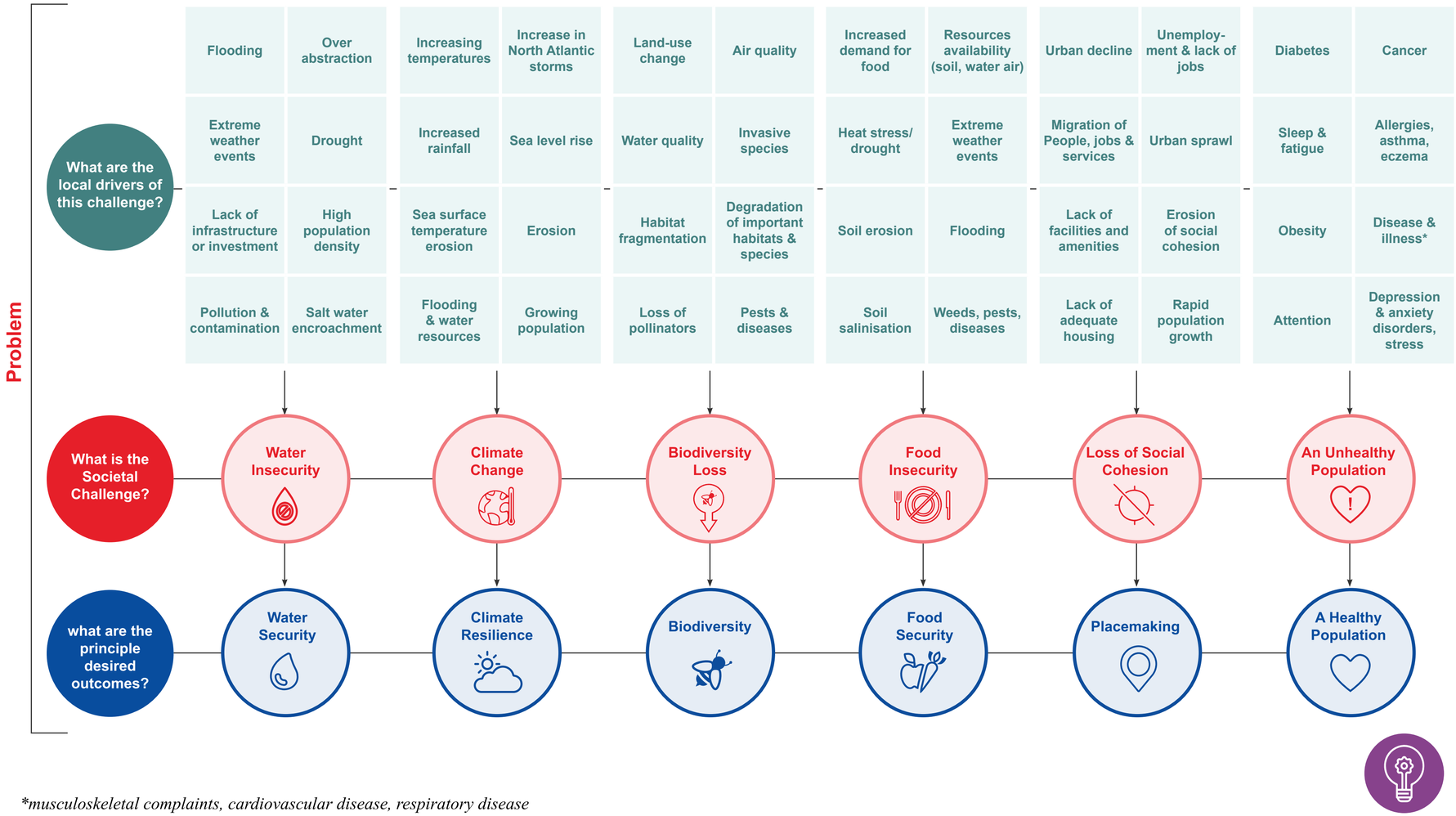
- [ ] Use local drivers to identify main societal challenges and broad desired outcomes (More information in NbS 1.2)
- [ ] Review and set indicators and performance standards (More information in NbS 1.2)
  - Define appropriate Key Performance Indicators (KPIs).
  - Choose a baseline year

BGI & NbS 2. Project Planning

BGI & NbS 2.1 Plan BGI and NbS Interventions

BGI & NbS 2.2 Use the BGI and NbS Interventions Tool

Drivers & Outcomes tool



**musculoskeletal complaints, cardiovascular disease, respiratory disease*

BGI & NbS 2.3 Select and Prioritise Interventions

Identify potential solutions

- Use potential solutions tool to identify which NbS could be applied in your place.
- Consider the following questions:
  - How does the proposed NbS intervention fit in the broader institutional and social context of the local area?
  - Is the NbS intervention supported as being legitimate by stakeholders?
  - Are there constraints or trade-offs associated with the intervention?
  - How does the potential intervention fit within the policy environment? (See section on policy)
  - Are there special permissions or permits required for this intervention?
  - What is the local technical capacity to implement the interventions?
  - What are the capacity building and training opportunities available for the Region?
  - What are the opportunities to secure funding and financing? What is the realistic timeframe?
  - Are there any potential negative environmental, social, or economic impacts of implementing this intervention in the location?

Deciding on the best intervention

- Gather the information needed and compare the interventions against one another.
- Identify the most viable solutions to advance.

BGI & NbS 3. Implementation

BGI & NbS 3.1 Approaches to Design

Conceptual Design Phase

- Ensure that the conceptual design meets the project principles and place specific requirements.
- Ensure design is economically and financially sustainable.
- Ensure design is policy compliant.
- Ensure design meets the social and community needs.
- Ensure the design promotes biodiversity and is environmentally sound.

Preliminary Design Phase

- Estimate a detailed cost breakdown for the preliminary design.

Detailed Design Phase and Specifications

- Develop a detailed project budget.
- Detail programme of work by task and construction phase.
- Estimate the material, labour, equipment, and techniques to be used in each phase.

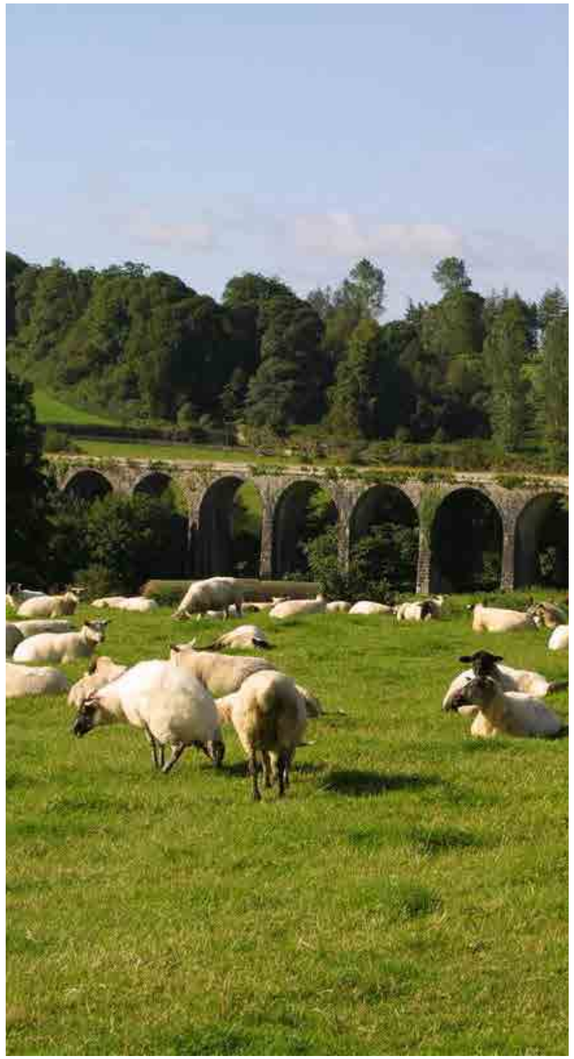
BGI & NbS 3.2 Key Management & Maintenance Considerations

- Consider the following questions and develop an O&M plan:
  - Describe the maintenance activities and what they involve.
  - Who is responsible for maintenance activities?
  - What is the maintenance schedule? Considering site and project requirements and the various BGI or NbS components?
  - What are the inspection requirements?
  - How frequently will the BGI/NbS be inspected?

BGI & NbS 3.3 Design for Uncertainty

- Use climate projections to develop a predictive and anticipatory approach. Where appropriate conduct and incorporate climate change risk assessments.
- Apply proactive monitoring and remote sensing techniques to allow for both rapid collection of information over large areas and focuses and detailed monitoring of NbS and BGI that may be vulnerable to climate impacts.
- Prioritise and schedule BGI and NbS maintenance according to a risk-based assessment which incorporates climate risk.
- Understand and plan for extreme weather events.

London Olympic Park, UK



Borris Viaduct, Carlow
© SRA

2.5 Governance & Management

GM 1. Needs Identification

GM 1.1 Identification of Team

- Establish a core project team.
- Assign and clarify the roles and responsibilities.
- Set out a framework for decision-making.
- Ensure that project information and decision-making is transparent and accessible.

GM 1.2 Identification of Stakeholders

- Identify the goal(s) for engagement.[53]
- Identify and understand priority stakeholders.[55]
- Design and undertake stakeholder engagement.
- Evaluate and upgrade the engagement process to deliver better outcomes next time.

GM 1.3 Identification of Governance Strategy

- Identify supporters who can speak to the benefits of nature in the Region.
- Identify who is benefiting from BGI and NbS and make their multiple values visible and understood.
- Make and leverage opportunities to bring BGI and NbS to the Region.
- Work with change-makers and bridge-building organisations to link with those who can benefit from BGI and NbS.
- Align Local Authority, civil society group and businesses goals with those of European and national government.

GM 1.4 Finding Opportunities in Policy

- Use the societal challenge to policy tool.
- Show the legal compliance of the BGI or NbS.
- Ensure appropriate assessments and authorisations.
- Consider the interactions between BGI, NbS, policy and regulation including trade-offs and co-benefits.

GM 2. Project Planning

GM 2.1 Identification of Funding

- Discount cash flows to present value.
- Identify the sources of revenue during the project lifetime:
  - Co-benefits such as eco-tourism, carbon sequestration, enhanced water security.
- Establish the timeline of capital requirements
  - Evaluate capital investment, transactions, and operations and maintenance costs and when the capital for each will be needed.
- Analyse the ability of the project cash flows to cover the future financial requirements under various funding mechanisms.

GM 2.2 Analysing Technical and Economic Information

As appropriate take the following actions, depending on the scale, context, location and regulatory requirement:

- Conduct a baseline risk assessment to establish a business-as-usual scenario.
- Conduct a risk assessment of current and future risks such as natural hazards, climate change, policy, environmental, social, and governance risks.
- Develop a contingency plan for disaster.
- Define the life span of the BGI or NbS.
- Undertake scenario modelling.
- Conduct a benefits analysis to establish the range of benefits that the BGI or NbS will offer in the short-, medium- and long-term.
- Conduct an environmental impact assessment.
- Conduct a cost benefit analysis.

GM 3. Monitoring & Evaluation

GM 3.1 Monitoring and Evaluation

- Consider the following questions and develop a monitoring plan:
  - Where will the funding for monitoring come from?
  - How will information be collected and synthesised?
  - Is baseline data required to support the monitoring process?
  - Is additional expertise needed to undertake the monitoring and evaluation?
  - What methods will be used?
  - Who will undertake the monitoring?
  - Who will receive and review the monitoring reports?
- Select a set of indicators to monitor implementation, effectiveness, and performance.

GM 3.2 End of Life

- Select a BGI NbS end-of-life strategy that supports desired societal outcomes;[33,64]
  - Consider societal challenges when making end of life decisions.
  - Undertake an end-of-life process that supports resilience to societal challenges.
  - Plan for climate-related failure.
  - Proactively engage with stakeholders throughout the process to ensure that the impacts are completely understood by the relevant communities.
- Employ circular economy considerations in relation to BGI & NbS Interventions;
  - Reuse and recycle material, components, and organic aspects.
  - Reuse and repurpose a space or solution post-decommissioning.

Sheffield Grey to Green Project, UK

3. Context & Concepts

Killarney, Ireland
© SRA

3. Context and Concepts

3.1 Introduction to Blue Green Infrastructure

An introduction to the key concepts and principles underpinning Nature-based solutions and Blue Green infrastructure thinking finishing with a summary of overarching aims.

Blue Green Infrastructure (BGI) is a defined by the European Commission as a:

> "Strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem service".[4]

BGI is a network that provides eco-system services for example biodiversity enhancement, water purification, air quality, space for recreation and climate mitigation and adaptation. BGI networks refer to a combination of water-based and landscape-based elements. [5]

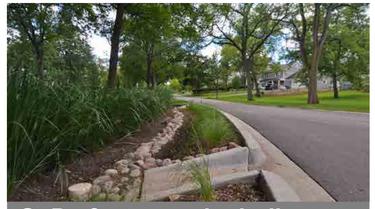
BGI water-based elements include:

Existing and/or restored rivers, streams, and their valleys

Canals and mill streams

Ponds, lakes and reservoirs

Wetlands

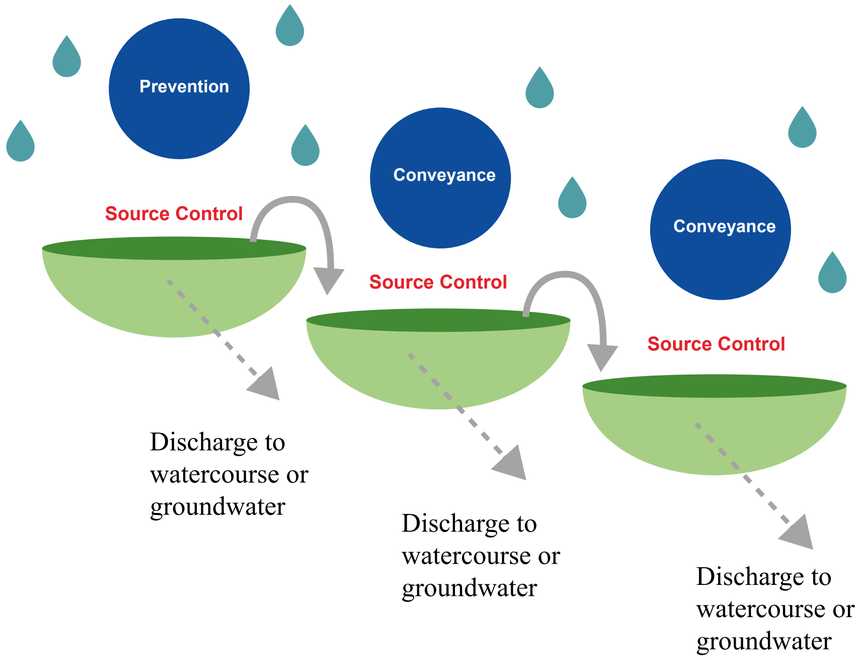


SuDs features - including swales, ditches and bioretention features

Oceans, seas and the inter-tidal zone

London Olympic Park, UK
© Arup

Priorities for water based BGI elements are to control water at its source, at site and how it impacts its wider catchment within the Region and the way water moves between these three conceptual spaces.



The four pillars of Sustainable Urban Drainage Systems (SuDs) design seek to have positive impacts on:[6]

Water Quantity
By controlling run off and slowing the flow

Water Quality
Through managing the quantity of run-off to prevent pollution and filtering water as it moves through the system

Biodiversity
Through creating and sustaining better places for nature

Amenity
Through creating and sustaining better places for people.

Working with and mimicking the natural water cycle is a fundamental principle of effective SuDs systems, which seek to mimic natural water cycle processes of infiltration, evaporation, transpiration, reuse, and attenuation of rainfall. These processes are best replicated above ground using landscape-based elements as opposed to concrete and plastic systems underground.

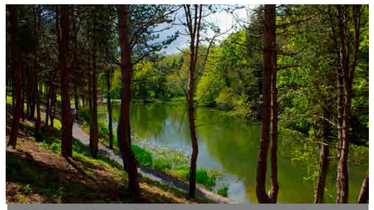
Mountshannon, Cork, Ireland

BGI landscape-based elements include:[7]

Parks, open spaces, gardens and sports pitches

Agricultural areas, orchards, horticultural-land and hedgerows

Cemeteries, school and church grounds



Woodlands, forestry and scrub

Grasslands, dunes, heathland and bog

Derelict land and dis-used works.

Allotments, community gardens and urban farms

Greenways and recreational pathways

It should be noted that of the list above, cemeteries, school and church grounds, derelict land and dis-used works may not always add to the accessible network of BGI creating amenity for people and indeed, may not always add much biodiversity value, or be of benefit to natural water cycles.

All blue and green infrastructure planning should seek to:

- Restore natural water systems, catchment areas and networks.
- Use multi-functional landscapes to slow water flow and mimic natural water cycles while creating and providing habitats for nature and places for people to enjoy.
- Connect, improve, and preserve individual landscape elements to create a coherent and high-quality network of networks.

The physical connection between individual elements or parcels of habitats and landscape is fundamental in the creation a network of functional wildlife corridors.

Blue and green networks can be applied to all scales of intervention from site to neighbourhood, to city to Regions and sub-Regions. Successful BGI planning requires integration between these scales to form networks of networks.

3.2 Introduction to Nature-based Solutions

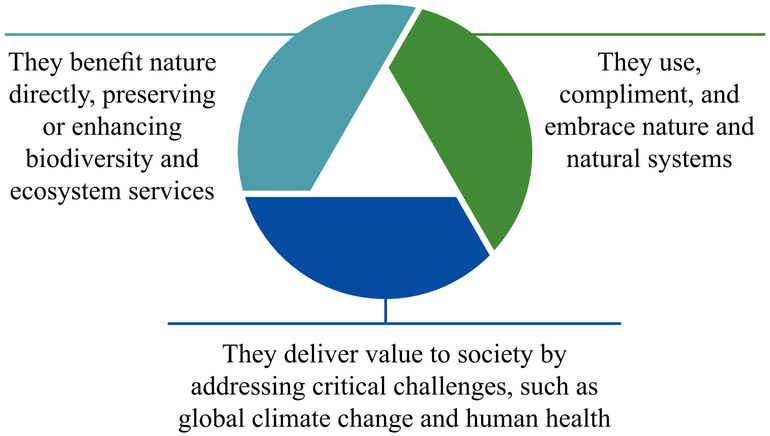
The European Commission define Nature-based Solutions (NbS) as:

"Solutions 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."[8]

The International Union for Conservation of Nature (IUCN) is the global authority on the status of the natural world and the measures needed to safeguard it define NbS as:

"Actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" [9]

All NbS must involve three common elements:



Here are some examples of Nature-based Interventions selected from this framework.


Kelp forests


Sand dune stabilisation


Green roofs & green walls


Habitats for pollinators


Street trees


Filtration strips


Buffer strips


Hedgerows


Reedbeds


Ponds

It is clear from reviewing the examples above that NbS can applied in different shapes and sizes and across different extents of space and sites. It is helpful to consider NbS in context of a wider eco-system and the receiving environment. Different solutions may be used to solve a single or a collection of issues in a place. This framework provides a methodology for thinking through these considerations.

BGI and NbS: Commonalities & Contrasts

Blue Green Infrastructure and Nature-based Solutions are different concepts, as described above, however they are interrelated and share many of the same goals. The relationship between the two concepts is described below.

Addressing problems using nature by considering whole ecosystems makes NbS an overarching concept that has many parts. Several NbS may be required to upgrade an ecosystem. For example, to help deal with the urban heat island effect, street trees, green walls, green roofs, and frequent parks of varying sizes may be required.

It is the connectivity between the NbS interventions, that creates BGI. NbS can be used to solve issues in blue green networks.

It is useful to think of NbS interventions as a system of methods that will expand and enhance the existing framework of BGI, which together can provide a network of healthy ecosystems.

Together Blue Green Infrastructure and Nature-based Solutions aim to deliver a healthy system of networked nature-based interventions.

Working with Nature & Systems Thinking

BGI and NbS are complex, interconnected solutions. Individual NbS within a BGI network will often be dependent on other NbS they are connected to in a BGI network. Therefore, a decline in the quality or connectedness of one solution can disrupt others and may result in substantial and or unforeseen cascading impacts. As the climate crisis increases the pressure on our natural systems and networks, BGI connections and interdependencies and their consequences become increasingly important.

By applying a systems thinking approach at the design phase interdependencies can be fully considered and unintended impacts prevented. Systems thinking also allows designers to consider how to maximise the desired societal outcomes and co-benefits provided by NbS and BGI.

A particularly strong and inspiring example of using nature as a system to drive project implementation is found in Animal-Aided Design.

This methodology takes a priority species, or collection of priority species and uses the requirements of these to influence design and implementation. The need to provide habitats for priority species are linked to biodiversity drivers. Key actions to implement the approach are needed throughout the project lifecycle.

Case Study

BGI and NbS Design Considerations

Animal aided design City Park

Waterford Greenway, Ireland

3.3 Overarching aims

Meeting the basic needs for all within planetary boundaries is humanity's biggest challenge for the twenty-first century and achieving this goal requires a radical, transformation change in our economic mindset.

In September 2015, UN Member States adopted the 2030 Agenda for Sustainable Development ("Transforming our World"). The 2030 Agenda is a plan of action for people, planet and prosperity and applies to both developed and developing countries. The focus of the 2030 Agenda is the 17 Sustainable Development Goals (SDGs) and their respective 169 sub-targets. This framework links all interventions and solutions back to the SDGs.

4. BGI & NbS

Towards a healthy ecosystem of networked nature-based interventions

Tierra del Fuego, Argentina

4. BGI & NbS | Towards a healthy ecosystem of networked nature-based interventions

This section presents actions within each of the project lifecycle stages for the Blue Green Infrastructure and Nature-based Solution strands of this framework.

BGI and NbS in the Needs Identification Stage

Processes to inform the needs identification stage for BGI and NbS are presented separately owing to the different nature of the concepts (as described in 2.3 Checklist).

Project Planning and Implementation

At the Project Planning and Implementation stage of BGI and NbS lifecycles, actions and tools become interlinked. The two strands converge here and are dealt with in a united way.

4.1 BGI 1. Needs Identification

The starting point when identifying the needs and priorities for BGI projects is to understand the existing place, its qualities, its landscape, and ecology and pressing drivers for change.

Strategies and interventions for change and the way they are prioritised must be linked to the societal challenges that most need addressing to support local communities and neighbourhoods.

BGI 1.1 Establish BGI Baseline & Priorities

Establishing BGI needs and priorities stems from developing a good understanding of local drivers and baseline or existing assets. Local drivers can be established by reviewing relevant policy and contextual information as well as through stakeholder consultation.

Adopting an evidenced-based approach to understanding local drivers and mapping the outcomes of the research undertaken provides the most useful starting point for spatial planning.

Collect baseline data

Existing BGI assets are understood by gathering data and undertaking thematic mapping. The scale of the site or area will determine the most efficient method or series of methods to use for this. Traditional mapping by hand is still suitable for smaller sites, villages and neighbourhoods and can be undertaken with community groups and stakeholders if appropriate. However, large scale places and Regions are mapped using Geographical Information Systems (GIS).

Sound of Barra, Scotland

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI	●		
	NbS			
	Governance & Management			

Baseline data across the physical, cultural, and natural environment should be collected in relation to topography, geology, hydrology, natural systems, ecological assets, landscape character, cultural assets, access and movement networks, and planning. Understanding the existing network of blue and green infrastructure, its impacts and potential along with its relationship with other layers of place will inform future strategies.

Analysing the existing ecological quality of landscapes and open spaces informs decisions on BGI actions and strategies. Habitat surveys and mapping at the outset of the project, can form the basis of monitoring Biodiversity Net Gain achieved by the project. Environmental Net Gain is an emerging methodology that facilitates the calculation of wider natural capital benefits such as flood protection, recreation and improved water and air quality. Both Biodiversity and Environmental Net Gain are concepts that are not, at present, enshrined in Irish policy. The Chartered Institute of Ecology and Environmental Management (CIEEM) will be producing Irish guidance on net gain but in the interim, the references below will be useful for decision makers in the Region.

For more on BGI strategy development, see Section 4.3, BGI & NbS 2.1 Plan BGI & NbS interventions.

For more on Monitoring impacts see Section 5.3, GM 3.1 Monitoring and Evaluation.

Mapping designated sites provides insights into the attributed value of local assets. Further evidence and strategies could also be gained from referring to the following Council sources if available:

Landscape focused references

- Open Space Strategy or Objectives
- Tree Strategy
- Biodiversity Strategy
- Landscape Character Assessment
- Landscape Capacity Study
- Climate Action Regional Office resources

Water focused references

- SuDs Strategy or Objectives
- Local Authorities Water Programme resources
- CFRAMs
- Water Framework Directive
- River Basin Management Plans (RBMPs) Directive

Read more on how to calculate Biodiversity Net Gain

Read more on Environmental Net Gain: The Environmental Benefits from Nature Tool - Beta Test Version

Case Study
Blue Green Infrastructure
Shanghai Drainage Model

Case Study
BGI and NbS Design Considerations
Animal aided design City Park

Lifecycle Phase

Strands	Needs Identification	Project Planning	Implementation
BGI	●		
NbS			
Governance & Management			

Newly planted wetland creation in Silverthorne, Colorado, USA
© Birchecology.com

Understand local drivers

Understanding local drivers needs to be based on a well-evidenced, mapped and analytic review of existing, and where appropriate, future provision of:

- Place, boundaries, neighbourhoods
- Population, health, and demographics
- Infrastructure & housing provision
- Landscape and public open space distribution, quality, function, ecosystems, and accessibility
- Climate conditions (air & water quality)
- Water Environment - water bodies, waterways and catchment distribution, flooding zones and rainwater management plans
- Ecological habitats and designated areas, quality, and value.

The cross-referencing of layers of data allows the identification of needs and priorities for each area, which feed into the identification of appropriate nature-based solutions to address these.

Existing frameworks can help analyse accessibility to particular assets such as the:

SRA's Ten Minute Town publication

In addition, local accessibility standards can inform an assessment of provision (or under-provision) of public open space, access to nature and recreational facilities which links to the place-making priorities of the Region.

Undertake stakeholder consultation

Stakeholder consultation is key to understanding issues, checking findings, identifying projects and initiatives, setting priorities, and developing a vision to steer the evolution of BGI.

Green Infrastructure: A 'How To' Guide for Disseminating and Integrating the Concept into Spatial Planning Practice[37]

The above guide includes a methodology for running stakeholder workshops. As part of the stakeholder consultation for the Cork City Green and Blue Infrastructure Study[38], Miro, an online whiteboard software was used to interactively capture instant feedback.

		Lifecycle Phase		
		Needs Identification	Project Planning	Implementation
Strands	BGI	●		
	NbS			
	Governance & Management			

Clashganny Lock, Co. Carlow, Ireland
© SRA

4.2 NbS 1 Needs Identification

The BGI and NbS Interventions Tool presented in BGI & NbS 2.2 requires the user to have already made decisions about:

1. The receiving environment of the NbS or 'Place and Setting'.
2. The problem to be solved by the nature-based solution (NbS) and desired outcome to be achieved – or goals.

NBS 1.1 - Define place and setting

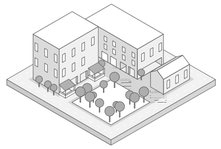
There are two stages involved in defining place and setting. It is important to;

- **A** Define the immediate existing or proposed site/settlement type
- **B** Define the landscape context surrounding the site/settlement.

		Lifecycle Phase		
		Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS	●		
	Governance & Management			

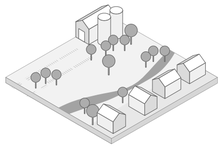
Stage A. Identify the immediate existing or proposed settlement type

The RSES is committed to supporting people and places throughout the Region. This Framework adopts a settlement focus to include all urban and rural communities. Settlements in the Southern Region can be characterised as:



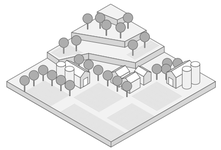
Urban Core

A contiguous area inhabited at urban density levels.[39,40] This area may traverse city, town or county boundaries and include networks of neighbourhoods.[39] Other attributes of urban core areas will be strong connectivity, retail, education, business, and cultural roles.[3,39] These areas will also have an important housing, employment, and service function.[3]



Brownfields and Urban Fringe

Transitional places with proximity to urban core areas.[40] Often these are areas that are located on the outskirts of cities or large towns.[39,40] These areas will have a lower population density and concentration of infrastructure than urban core areas.[3,39] They may be characterised by a mix of land-uses such as: agricultural and urban; industrial and urban; and post-industrial and industrial.[40]



Rural Settlement

Areas of low population density including villages of less than 1500 inhabitants.[3,40] These areas will include rural villages and the wider Region.[3] Livelihood activities are [or were traditionally] predominantly centred on agricultural production.[40]

Case Study

Define what's there

Biotape Area Factor

Stage B. Identify the main landscape context (s) of the site/settlement

This stage requires decisions to be made about which ecosystems and habitats are relevant to each place.

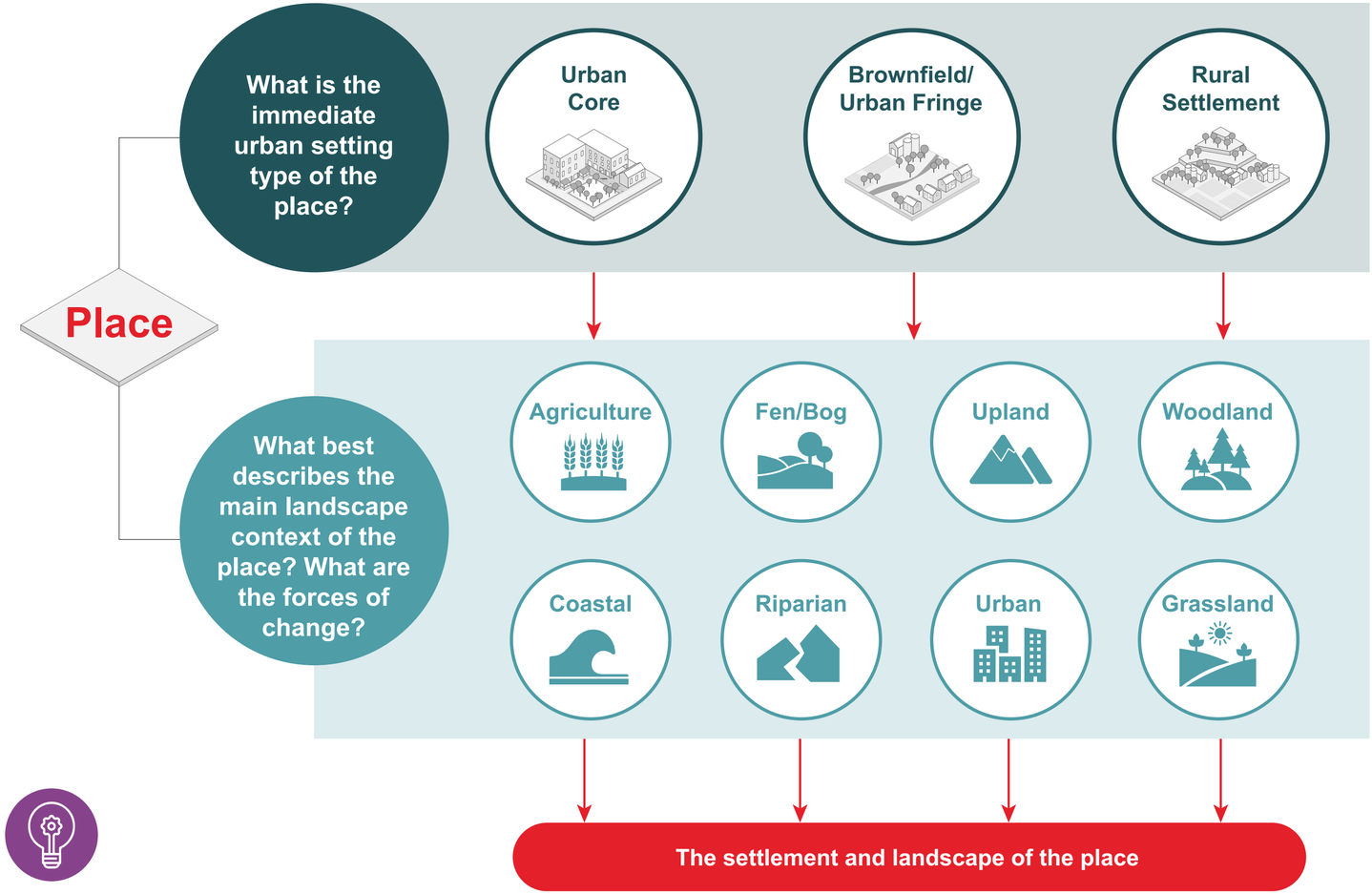
The landscape typologies of the Southern Region have been categorised into eight types and are described in detail in Appendix A on Summit to City to Sea. Each landscape is itself diverse in ecosystems and habitats. The overarching landscape types are;[41,42]

- **Agricultural** (e.g., arable land, horticulture, pastureland, and fallow land)
- **Coastal** (e.g., sea cliffs and islets, inter-tidal water bodies, salt marches, shingle and gravel, sand dune systems, inter-tidal rocky and gravel shores, and sandy and muddy shores)
- **Fen or Bog** (e.g., marsh, heath, raised bog, blanket bog, degraded and cutover bog, fens, and flushes)
- **Grassland** (e.g., improved grassland, semi-improved grassland, semi-natural grassland)
- **Riparian and or Freshwater** (e.g., freshwater courses and freshwater lakes)
- **Upland** (e.g., highlands, moors, mountains, hills, rock faces)
- **Urban** (e.g., towns, cities and metropolitan areas with buildings, open sealed surfaces, artificial green surfaces roads, ways, and other infrastructure)[39]
- **Woodland and Scrub** (e.g., broadleaved forest, coniferous forest, mixed forest, clear-felled and transition coniferous forest, scrub)

If the place has multiple landscape contexts, prioritise by considering the most dominant force of change.

Characterising the Regional landscape

A national or Regional landscape characterisation has yet to be carried out. It is recommended that when available that this informs the Regional landscape definitions.



NBS 1.2 - Define problems and goals

Understanding and defining local problems and drivers allows the selection of the most appropriate nature-based solution to help solve it.

Societal Challenges for the Southern Region and their Drivers

The International Union for the Conservation of Nature (IUCN) has identified global societal challenges that NbS can address.[43] Using the IUCN global societal challenges and the challenges identified in the RSES for the Southern Region six societal challenges affecting the Region were defined:[3,43]

- **Water Insecurity**
- **Food Insecurity**
- **Climate Change**
- **Loss of Social Cohesion**
- **Biodiversity Loss**
- **An Unhealthy Population**

Societal challenges are stimulated by local drivers.[44] They are interconnected and systemic by nature, so one challenge may also be a driver of another (e.g., biodiversity loss leading to reduced pollinator services and therefore increasing the challenge of food security).[43] Here are some examples of local drivers:

- **Flooding**
- **Habitat fragmentation**
- **Extreme weather events**
- **Urban Sprawl**
- **Erosion**

Lifecycle Phase

Strands	Needs Identification	Project Planning	Implementation
BGI			
NbS	●		
Governance & Management			

There are two stages involved in defining problems and goals:

A Use local drivers to identify main societal challenges and broad desired outcomes

B Review and set indicators and performance standards

Stage A. Use local drivers to identify main societal challenges and broad desired outcomes

The Local Authority or project owner may already have a broad understanding of the challenge(s). The tool on the next page:

- provides the opportunity to assess the problem(s) in more detail and link those problems to the correct societal challenge.
- allows potential project wins and broader outcomes to be explored and expanded, and
- provides a framework for working through challenges to stakeholders.
- Local drivers of societal challenges were identified by reviewing national and Regional documents.[3,42,45–49.]

Key resources for choosing indicators and KPIs:

- Think Nature-based Solutions Handbook (EU Horizon 2020)
- Nature-based Solution evaluation indicators: Environmental Indicators Review (EU Connecting Nature Project)
- Evaluating the impact of nature-based solutions – A handbook for practitioners (European Commission)

Stage B. Review and set indicators and performance standards

BGI and NbS Interventions Tool presented in BGI & NbS 2.2 includes typical Key Performance Indicators (KPIs) to measure each societal challenge and illustrates which Nature-based intervention is most, or in some part, effective at meeting that goal.

Co-create KPIs

Co-create the KPIs with stakeholders. Engage with government and academics to access data for baseline. landscape definitions.

Case Study

Defining a landscape

Ballincollig Regional Park

Case Study

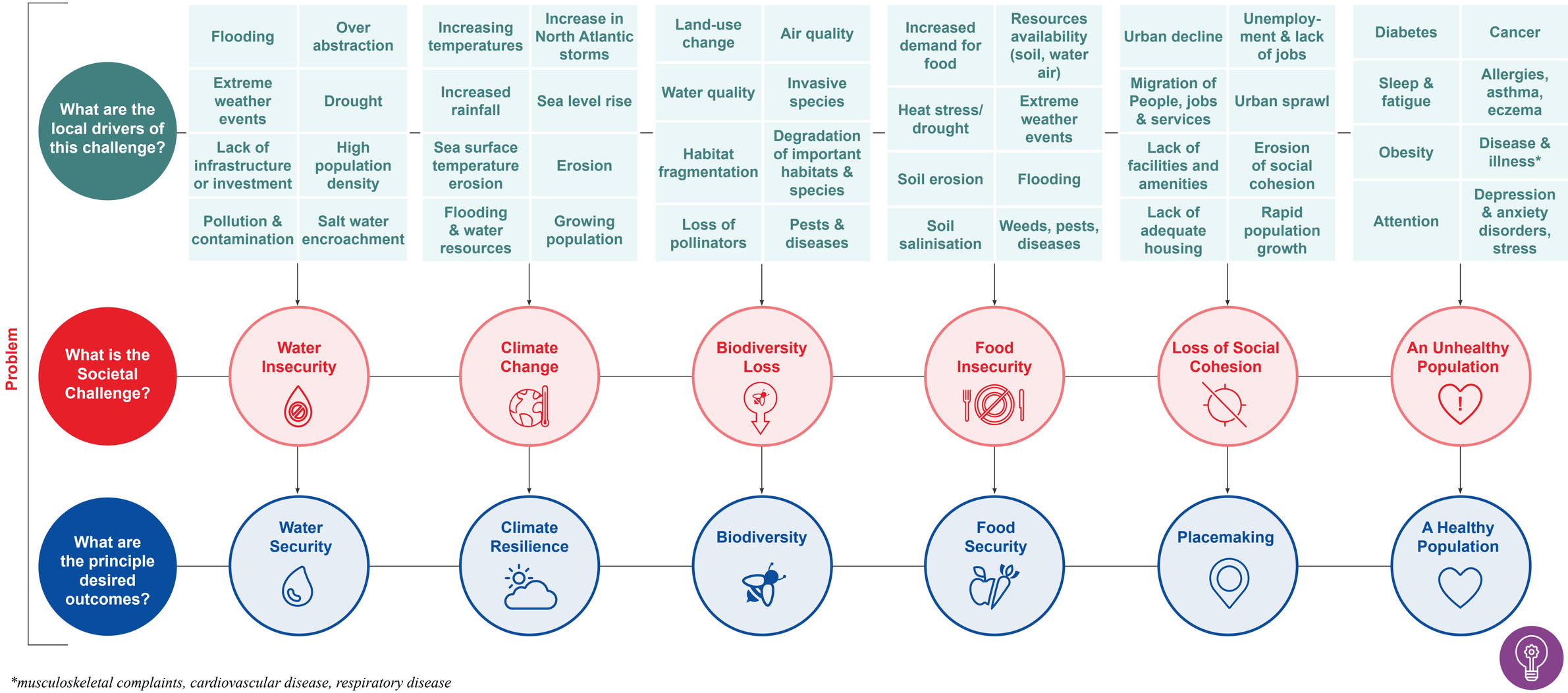
Greenway

Passage Railway Greenway Improvement Scheme

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS	●		
	Governance & Management			

London Olympic Park, UK
© Arup

Drivers & Outcomes tool



*musculoskeletal complaints, cardiovascular disease, respiratory disease

Further considerations for a finer grain review of local drivers :

- What are the systemic effects of the problem? (e.g., broader environment, and socio-economic challenges).
- What are the direct and indirect impacts for the Region? (e.g., direct impacts: flooding roads, indirect impacts: inability to drive to school, work, supermarket when roads are flooded).
- How do local drivers rank in order of priority?
- Define how the local drivers are likely to be exacerbated by societal challenges in the future.
- Define and assess the uncertainties that are relevant for project planning.

Here is some additional guidance for setting further KPIs.

How to determine the success criteria for the project

- Define appropriate Key Performance Indicators (KPIs). These should be a combination of qualitative and quantitative indicators and should include co-benefits of the solutions.[50] (e.g., reduce the number of flood events to no more than 2 per year).
- Choose a baseline year[50] (e.g., In 2018 8 flood events were experienced).

4.3 BGI & NbS 2. Project Planning

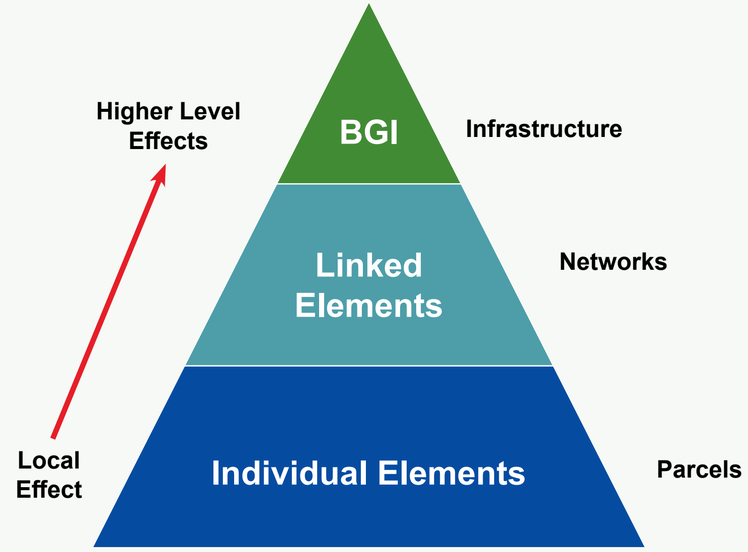
It is at this stage in the project lifecycle where Blue Green Infrastructure (BGI) and Nature-based Solution (NbS) planning decisions can converge. The tools presented here enable the:

BGI & NbS 2.1 Plan BGI & NbS Interventions

All BGI networks should aim to create a healthy ecosystem of networked nature-based interventions.

This requires all parts of the BGI network to have a role in delivering NbS. NbS, as noted in section 2.2, must have a biodiversity function to be considered as such.

BGI components cannot function in isolation as parcels or islands. They must be connected and linked to function as a network. BGI is a network of networks that together deliver high quality, multifunctional ecosystem benefits that positively impacts water issues. The diagram to the right[2] illustrates the importance of establishing BGI links at all scales of interventions to create networks that deliver the maximum impact. This can be achieved by looking strategically at BGI at a contextual scale and slotting in finer grain links and interventions at a local level.



[2]*Reworked from Figure 5 in The Green Infrastructure Planning Guide*[7]

Lifecycle Phase

Strands	Needs Identification	Project Planning	Implementation
BGI		●	
NbS		●	
Governance & Management			

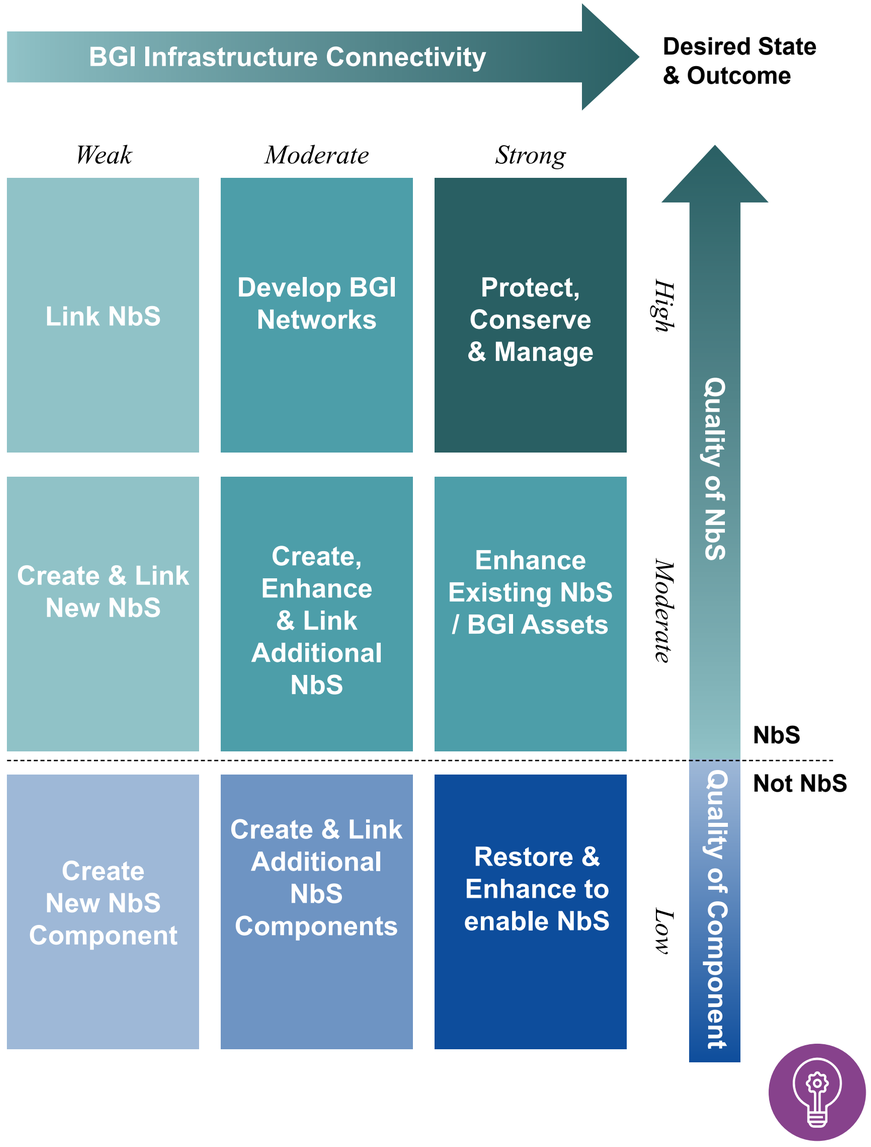
BGI / NbS Planning Matrix

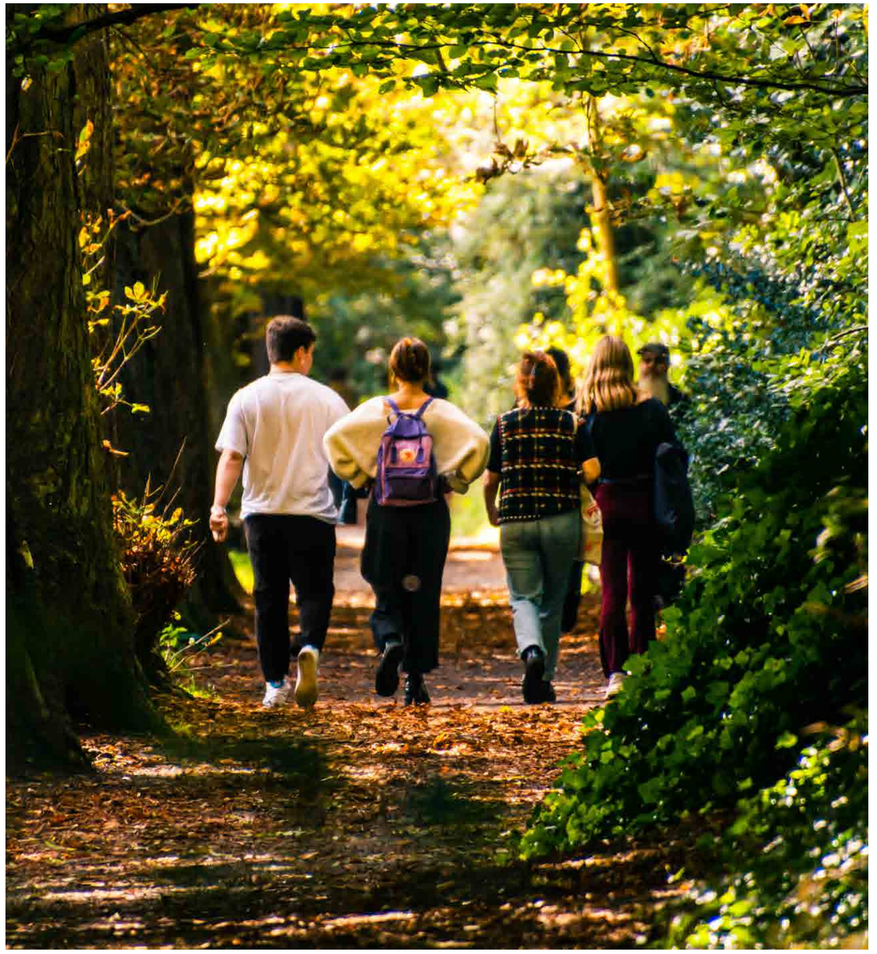
The Needs Identification stage of BGI covered the need to collect baseline information and data across sites and areas, at different scales. Once the baseline is established, each component of the existing BGI network should be assessed in relation to its quality and connectivity.

The following matrix has been derived from that produced in the Green Infrastructure Planning Guide[7]. It has been adapted to demonstrate that only BGI components of a particular quality can be classed as NbS components.

Key notes to help use the tool are listed here.

- The desired state and outcome of all BGI is to achieve a network of high quality NbS interventions.
- Each component or site within the BGI network should be assessed for quality and connectivity.
- High quality, well-connected components should be conserved, protected and managed. Components that are key components of critical infrastructure should be protected.
- Where No or Low-quality components exist, NbS should be created, enhanced or restored.
- Where weak links are noted, it is important to reconnect BGI components.





Lifecycle Phase

		Needs Identification	Project Planning	Implementation
Strands	BGI		●	
	NbS		●	
	Governance & Management			

Quality definitions can be developed through stakeholder consultation and reference to plans and policies.

Once gaps in BGI provision have been established, use the NbS Interventions Tool in the following section (BGI & NbS 2.2) to help fill the gaps. Further work with stakeholders looking to establish the most suitable landscape typology could also be informative and necessary.

Actions resulting from the BGI planning stage need to be developed into an action plan with clear objectives to detail what and where the proposed intervention will be and how will it be delivered.

Cork City Green Blue Infrastructure Study

Cork City Council undertook a Green Blue Infrastructure study to develop an evidence base to inform land use planning and policy in the city, including the Cork City Development Plan. The Study is a vision and framework document for Green Blue Infrastructure in the city.

Additional resources for BGI planning are:

- Protecting and developing Ireland's GB Spaces (EPA)
- Manual for Creating Evidence based green infrastructure
- Cities Alive: Rethinking green infrastructure (Arup)

		Lifecycle Phase		
		Needs Identification	Project Planning	Implementation
Strands	BGI		●	
	NbS		●	
	Governance & Management			

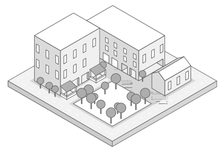
BGI & NbS 2.2 Use the BGI & NbS Interventions Tool

This BGI & NbS Interventions Tool is designed to allow the selection of interventions that either:

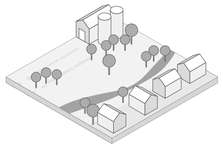
- Can be applied in a particular place (identified in NbS 1.1).
- Address problems and achieve specific goals (identified in NbS 1.2).

By combining the typology of place and the societal challenge(s) it faces an appropriate solution(s) can be selected.

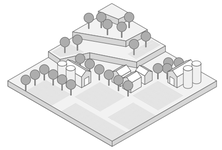
Three tables are presented for each of the three types of urban settlement (described in NbS 1.1).



Urban Core



Brownfield & Urban Fringe



Rural Settlement

The interventions within each matrix have been organised in terms of its immediate receiving environment which could be one of the following;

Buildings

Open spaces and fields

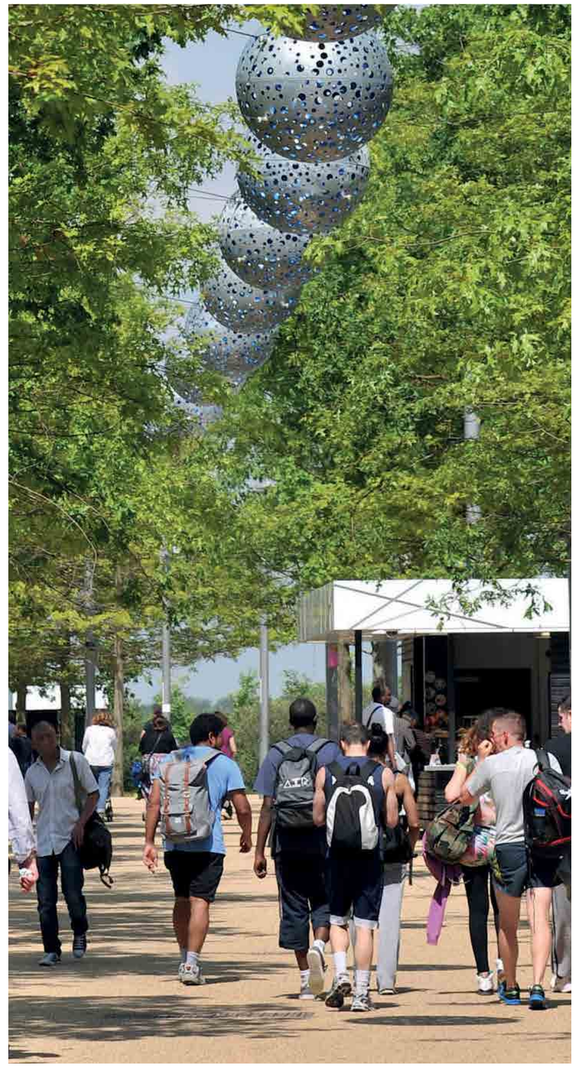
Coastal

Streets

Riparian

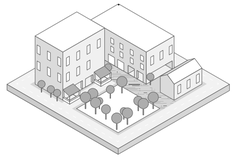
Solutions will be best fitted to one or more of the landscape types identified in section NbS 1.1 . Each solution has been labelled in terms of the landscapes in which it can be applied most effectively.

The six societal challenges and indicators of change for each have been included which are determined by decisions made in NbS 1.2. The matrix of benefits shows the potential for improvement for each solution by indicator.



London Olympic park, Arup, UK
© Arup

BGI & NbS Interventions Tool for the Urban Core



Urban Core

Place

- Settlement Type
- Main Immediate Environment

Intervention

- BGI/ NbS Intervention
- Main Landscape Context for Application

Challenges and Indicators

Indicators of Measurable Change

Climate Resilience
- 1.1 Greenhouse Gas Reduction
- 1.2 Resilience to extreme weather events
- 1.3 Erosion mitigation

Biodiversity
- 2.1 Species Relative Abundance & Distribution
- 2.2 Pollinator Preservation and Conservation
- 2.3 Habitat quality & connectivity

Water Security
- 3.1 Sustainable Water Management
- 3.2 Flood Risk Reduction
- 3.3 Water Quality

Food Security
- 4.1 Sustainable agricultural practices
- 4.2 Biodiversity preservation & conservation
- 4.3 Soil quality and Sustainable Land Management

A Healthy Population
- 5.1 Recreation and aesthetic appreciation
- 5.2 Air Quality
- 5.3 Water Security
- 5.4 Pest and disease control
- 5.5 Human happiness, wellbeing & reduced stress
- 5.6 Food Security

Placemaking
- 6.1 Economic prosperity
- 6.2 Recreation & aesthetic appreciation
- 6.3 Social Justice, Cohesion & Equity

Main Immediate Environment	BGI/ NbS Intervention	Upland	Woodland	Urban	Agricultural	Fen/Bog	Riparian	Coastal
Buildings	Green Roof/Green Wall			●	●			
	Rainwater Harvesting	▲		●	●			
	Green Screens			●	●			
	Infiltration/Rain gardens	▲		●	●			
Steets	Vegetated Swales			●	●			
	Rain Gardens			●	●			
	Urban Trees (with bioretention			●	●			
	Temporary flood water storage			●	●			
	Channels and rills			●	●			
	Filter strips			●	●			
	Permeable pavements/surfaces			●	●			
Open Spaces & Fields	Pond/Basin			●	●	●		
	Pocket, Local & Neighbourhood			●	●			
	Urban Forest			●	●			
	Permeable pavements			●	●			
Rivers	Natural Bank Stabilisation			●	●		●	
	River restoration (urban rivers)			●	●		●	
	Filtration Strips			●	●			
	Wetland creation/ restoration			●	●	●	●	
Coastal	Cliff/Seafront stabilisation			●	●			●
	Dune reinforcement and strengthening			●	●			●
	Beach Nourishment			●	●			●
	Living Seawalls			●	●			●

BGI & NbS Interventions Tool for Brownfield/ Urban Fringe Sites

Place

Settlement Type

Main Immediate Environment

Brownfield / Urban Fringe

Intervention

BGI/ NbS Intervention

Main Landscape Context for Application

Upland, Woodland, Urban, Agricultural, Fen/Bog, Riparian, Coastal

- **Buildings**
  - Green Roof/Green Wall
  - Rainwater Harvesting
  - Rainwater Garden
- **Steets**
  - Vegetated Swales
  - Buffer Strip and Hedgerow
  - Sediment capture ponds
  - Biortention areas (strips/ponds)
  - Pond/Basin
  - Bioretention ponds
- **Open Spaces & Fields**
  - Local, Neighbourhood & Regional Park
  - Wildlife Corridors
  - Greenway
- **Rivers**
  - River Renaturalisation
  - River restoration
  - Buffer Strip and Hedgerow
  - Wetland creation/ restoration
- **Coastal**
  - Native Oyster Restoration
  - Dune reinforcement and strengthening
  - Beach Nourishment
  - Living Seawalls
  - Managed Coastal Realignment
  - Cliff/Seafront stabilisation

Challenges and Indicators

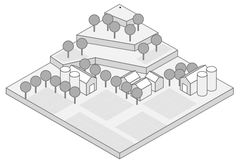
Indicators of Measurable Change

- **Climate Resilience**
  - 1.1 Greenhouse Gas Reduction
  - 1.2 Resilience to extreme weather events
  - 1.3 Erosion mitigation
- **Biodiversity**
  - 2.1 Species Relative Abundance & Distribution
  - 2.2 Pollinator Preservation and Conservation
  - 2.3 Habitat quality & connectivity
- **Water Security**
  - 3.1 Sustainable Water Management
  - 3.2 Flood Risk Reduction
  - 3.3 Water Quality
- **Food Security**
  - 4.1 Sustainable agricultural practices
  - 4.2 Biodiversity preservation & conservation
  - 4.3 Soil quality and Sustainable Land Management
- **A Healthy Population**
  - 5.1 Recreation and aesthetic appreciation
  - 5.2 Air Quality
  - 5.3 Water Security
  - 5.4 Pest and disease control
  - 5.5 Human happiness, wellbeing & reduced stress
  - 5.6 Food Security
- **Placemaking**
  - 6.1 Economic prosperity
  - 6.2 Recreation & aesthetic appreciation
  - 6.3 Social Justice, Cohesion & Equity

BGI & NbS Interventions Tool for Rural Settlements

Place

Settlement Type



Rural Settlements

Main Immediate Environment

- Buldings
- Steets
- Open Spaces & Fields
- Rivers
- Coastal

Intervention

BGI/ NbS Intervention

Main Landscape Context for Application

Upland, Woodland, Urban, Agricultural, Fen/Bog, Riparian, Coastal

- Green Roof/Green Wall
- Rainwater Harvesting
- Rainwater Garden
- Wildlife Corridors
- Vegetated Swales/Ditches
- Sediment capture ponds
- Biortention areas (strips/ponds)
- Woodland creation
- Agroforestry
- Pond/Basin
- Native Woodland Plantation/Restoration
- Buffer Strip and Hedgerow
- Forest cover in headwater areas
- Buffer Strip and Hedgerow
- River Meandering
- Wetland creation/restoration
- Water sensitive forest management
- Cliff/seafront stabilisation
- Dune reinforcement and strengthening
- Wetland creation/ Wetland extension
- Kelp Forest
- Living Seawalls
- Seagrass Meadow Restoration
- Beach Nourishment

Challenges and Indicators

Indicators of Measurable Change

Climate Resilience
- 1.1 Greenhouse Gas Reduction
- 1.2 Resilience to extreme weather events
- 1.3 Erosion mitigation

Biodiversity
- 2.1 Species Relative Abundance & Distribution
- 2.2 Pollinator Preservation and Conservation
- 2.3 Habitat quality & connectivity

Water Security
- 3.1 Sustainable Water Management
- 3.2 Flood Risk Reduction
- 3.3 Water Quality

Food Security
- 4.1 Sustainable agricultural practices
- 4.2 Biodiversity preservation & conservation
- 4.3 Soil quality and Sustainable Land Management

A Healthy Population
- 5.1 Recreation and aesthetic appreciation
- 5.2 Air Quality
- 5.3 Water Security
- 5.4 Pest and disease control
- 5.5 Human happiness, wellbeing & reduced stress
- 5.6 Food Security

Placemaking
- 6.1 Economic prosperity
- 6.2 Recreation & aesthetic appreciation
- 6.3 Social Justice, Cohesion & Equity

Other Constraints and Opportunities to Consider

- How long will it take for the intervention to provide its full range of benefits (see the timespan information on in the Catalogue of Nature-based Solutions)
- How does the NbS intervention fit into the social and governance context of the local area?
- Is the NbS intervention supported by stakeholders?
- Are there constraints or trade-offs with the intervention?
- How does the intervention fit within the policy environment? (See section on policy)
- Are there special permissions or permits required for this intervention?
- What is the local technical capacity to implement the intervention?
- What are the capacity building and training opportunities available?
- What are the opportunities for funding and financing? What is the realistic timeframe?
- Are there any potential negative environmental, social, or economic impacts of this intervention in the location?

Other available tools for assessing NbS:

- Urban Nature Navigator by the EU Naturvation Project helps assess how different NbS can meet urban sustainability challenges.
- ReNature's Interactive Research & Support Tool provides recommendations for choosing the right nature-based solution, based on existing NbS projects/what others have done.

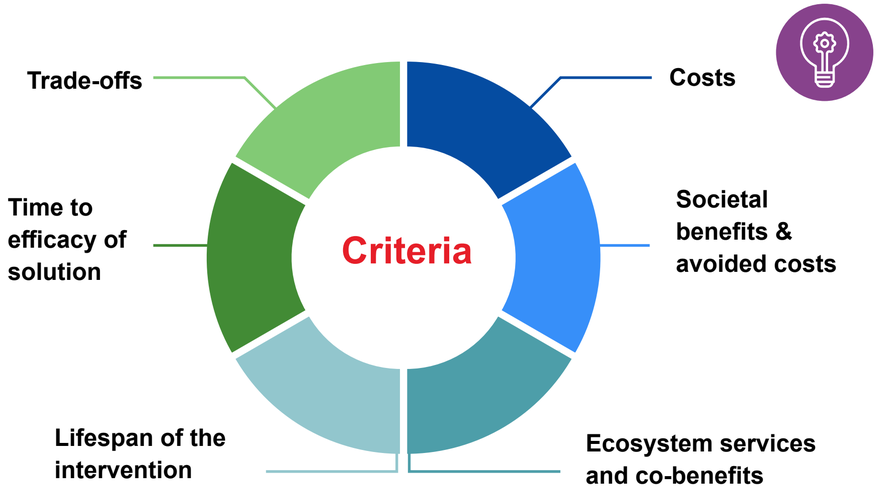
BGI & NbS 2.3. Intervention Selection and Prioritisation

Chapter 6 Catalogue of Nature-based Solutions includes 37 NbS cards to introduce the full range of interventions cited in the BGI / NbS framework. The cards provide links back to overarching drivers and context, SDGs, and guidance to inform the first steps in planning, designing, and implementing each solution.

Other available tools for delivering NbS:

- More information on Water Sensitive Urban Design is available on the LAWPRO's website (Local Authority Waters Programme).

When comparing or prioritising, consider the societal challenges, local drivers, and KPIs defined. The following criteria could be used for comparison:



When comparing nature-based interventions for selection the following steps will be taken:

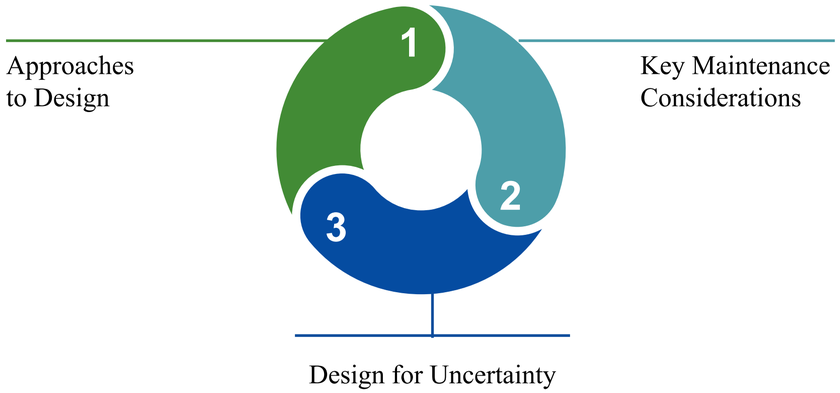
- Gather the information needed and compare the interventions against one another.
- Identify the most viable solutions to advance.

The set of viable solutions can then be advanced for further consideration in subsequent stages.

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI		●	
	NbS		●	
	Governance & Management			

4.4 BGI & NbS 3. Implementation

In this stage of the project lifecycle, design services are procured to develop the technical details for construction and operation. Construction services are procured, and the Blue Green Infrastructure or nature-based intervention is built for operation. The solution operates with periodic inspection, monitoring, maintenance and or renewal.



BGI & NbS 3.1 Approaches to Design

As BGI and NbS are diverse solutions with greatly different scopes and technical requirements there is no singular approach to design or implementation. However, generally the implementation of BGI and NbS design will be an iterative and multidisciplinary and multi-party process from conceptual, preliminary, and detailed design stages, considering stakeholder feedback, regulatory requirements, financial needs and KPIs. The table on the next page has been adapted from the Inter-American Development Bank's report titled, "Increasing Infrastructure Resilience with Nature-based Solutions"[50].

Case Study

Approaches to Design

The Hare's Corner Initiative

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			●
	NbS			●
	Governance & Management			

Design Phase	Tasks
Conceptual Design *explore design possibilities*	• Ensure that the conceptual design meets the project principles and place specific requirements (link to relevant section of framework) • Ensure design is economically and financially sustainable • Ensure design is policy compliant • Ensure design meets the social and community needs • Ensure the design promotes biodiversity and is environmentally sound
Preliminary Design *define and assess the main design components*	• Estimate a detailed cost breakdown for the preliminary design
Detailed Design and Specifications *performance indicators and detailed work plan for implementation*	• Develop a detailed project budget • Detail programme of work by task and construction phase • Estimate the material, labour, equipment, and techniques to be used in each phase

The following links provide additional technical guidance and reading:

- IUCN Global Standard for Nature-based Solutions (International Union for Conservation of Nature)
- US EPA's guidance on the design and implementation of green
- Technical Solutions Guidebook (EU Connecting Nature Project)
- Policy and Planning Tools for Urban Green Justice (BCNUEJ and ICLEI)

Case Study
Approaches to Design
Connswater Community Greenway

Case Study
BGI & NbS Implementation
LAWPRO and their work with Landowners

Case Study
Water Sensitive Urban Design
Greener Grangetown

BGI & NbS 3.2 Management and Maintenance

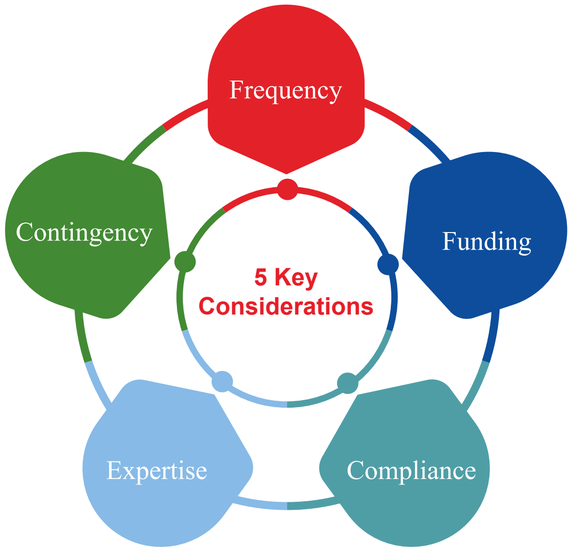
The management and maintenance of NbS is a crucial part of their success and is an integral decision in establishing a design response in many cases.

Management activities should seek to achieve long-term goals linked to the local drivers and societal challenges identified in NbS 1.2. Examples could be:

- Achieve continuous woodland cover.
- Achieve a varied age structure with a woodland.
- Maximise the flowering season.
- Increase the number of native species in a park.

Regular maintenance plans should strive to meet long-term management goals.

Developing an Operations & Maintenance (O&M) plan is best practice for optimising the lifespan and service delivery of BGI and NbS interventions. Operations and Maintenance should be considered at the planning stage, structured as a component of the financial budgeting and planning, and considered at the design stage. This will ensure that appropriate funding, people, and expertise are available to maintain the BGI and NbS.



Questions to Help Establish Your O&M Plan

- Describe the maintenance activities and what they involve.
- Who is responsible for maintenance activities?
- What are the maintenance schedules considering site- and project- requirements and the various components of the intervention?
- What are the inspection requirements?
- How frequently will the BGI / NbS intervention be inspected?

Case Study
BGI & NbS Management & Maintenance
Grey to Green

Case Study
BGI & NbS Implementation
Vibrant Verges in Fingal

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			●
	NbS			●
	Governance & Management			

Typical Maintenance Activities

- Fertilisation
- Slope re-stabilisation
- Irrigation
- Debris and sediment removal
- Pruning and trimming
- Mulching
- Invasive species removal and or weeding
- Pest and disease monitoring and control
- Transplantation

BGI & NbS 3.3 Design for Uncertainty

BGI and NbS exist in ecological, social, and economic systems that are dynamic, and all encompasses uncertainties. It is therefore important to design with uncertainty in mind.

Accounting for the Climate Crisis

The climate crisis presents a host of challenges. These challenges should be considered and addressed when planning, designing, and maintaining BGI and NbS. The table below was developed from Hallegatte et al. (2020).[51]

Climate related challenge	Response
Climate change leading to rapid environmental changes	Proactive and adaptive management practices. Use climate projections to develop a predictive and anticipatory approach. Where appropriate conduct and incorporate climate change risk assessments.
Climate change leading to the deterioration of the quality of the BGI or NbS intervention	The likelihood and type of deterioration will vary across NbS, both in terms of level of exposure to climate change impacts and the sensitivity of the solution to them. Proactive monitoring and remote sensing techniques can allow for both rapid collection of information over large areas and focuses, detailed monitoring of NbS and BGI interventions that may be vulnerable to climate impacts.
Climate change increasing the likelihood of a NbS failing to provide its primary solution	BGI and NbS intervention maintenance can be prioritised and scheduled according to a risk-based assessment which incorporates climate risk.
Climate change increases BGI and NbS exposure to a wider range and severity of direct climate threats.	Understand and plan for extreme weather events.

Plan for Climate-related Failure – The Safe-to-Fail Principles

The Rijkawaterstaat "room for the river" project [46] put safe-to-fail principles into practice. After two close calls with major flooding events in 1993 and 1994 that almost overwhelmed the existing system of flood defences, the Rijkswaterstaat reflects a paradigm shift in water management approaches. This civil engineering program in the Netherlands aimed to reduce flood risk by restoring natural, dynamic flow patterns to four major rivers. This was represented a notable shift away from hard grey solutions such as higher and stronger dikes to a broader nature-based approach, including the principles of safe-to-fail.[45]

An effective safe-to-fail strategy requires system-wide stakeholder engagement.

"Continuous engagement with local stakeholders [throughout the Rijkswaterstaat project] played a central role in fostering the acceptability of the solutions which required difficult trade-offs. Detailed planning and monitoring coupled with budget certainty facilitated the move from undertaking vulnerability assessment to implementing measures to reduce this vulnerability. Lastly, measures designed to work with nature, sometimes labelled 'green infrastructure', can preserve flexibility towards potential futures, and generate important co-benefits that support both public acceptability and sound financial outcomes"[45]

Room for the River IJsseldelta, The Netherlands
© Rijkswaterstaat.nl (NL Ministry of Infrastructure and Water

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			●
	NbS			●
	Governance & Management			

5. Governance & Management

Towards inclusive and efficient project organisation

High-Speed 2 Project, UK

5. Governance & Management | Towards inclusive and efficient project organisation

This section presents actions within each of the project lifecycle stages for the Governance and Management strand of this framework.

At the outset of the project lifecycle, decisions relating to governance and management create a basis for ongoing action around the areas of principles, policy, and project organisation. It is fundamental to establish the enabling environment for BGI and NbS projects from the outset[33].

Action areas include:

- Team and stakeholder identification
- Identifying a governance strategy
- Finding opportunities in policies.

Actions in the later stages of the infrastructure lifecycle build upon the foundation set in this phase, making it amongst the most critical phases for enhancing the societal value that BGI and NbS can deliver.[33]

5.1 GM 1. Needs Identification

GM 1.1 - Identification of team

Developing BGI or NbS needs an engaged and resourced team to bring the project to fruition.[53] The project team should be identified in the preliminary stages of the project, although it will likely evolve as the project becomes more defined. The principles for organising an effective project team are discussed below:[33,53,54]

Establish a core project team with the necessary skill set and qualifications to ensure the integration of the BGI or NbS intervention. This team should be multi-departmental and usually should include an ecologist and landscape architect within the team from the outset. Ensure that individuals in the team have knowledge of local ecology, landscape, and the local drivers of societal challenges. Identify and address capacity gaps early on. Where capacity gaps may exist consider drawing on national, Regional, and local networks, including neighbouring Local Authorities.

Assign and clarify the roles and responsibilities within the team and of all the stakeholders. Assign a team leader role. If the project is a Public-Private Partnership (PPP), the roles of the public and private sector should be clearly outlined. A Memorandum of Understanding (MoU) can be used to document the roles and responsibilities defined.

Set out a framework for decision-making that meets rules and regulations, is equitable and cognisant of the project timeline.

Ensure that project information and decision-making is transparent and accessible.

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management	●		

Case Study

Conserving character in a changing climate

Coirib go Cósta - Galway City Flood Relief Scheme

GM 1.2 - Identification of stakeholders

Building a BGI network must be an inclusive and collaborative process with input from a diverse range of stakeholders, engaging groups with an interest in or an influence on NbS and BGI.[53]

Identify the goal(s) for engagement.[53]

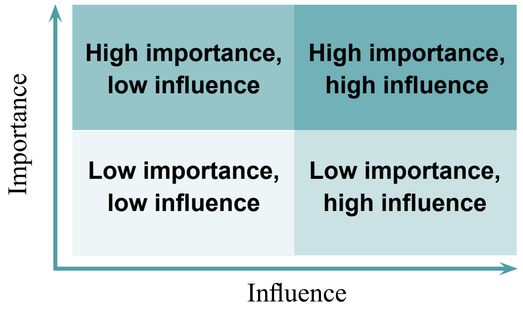
This is the vision setting stage. In an NbS project, the objectives for engagement should be aligned with broader BGI goals and informed by relevant policies. The objectives should also be informed by the team's capacity to undertake stakeholder engagement. The engagement objectives should be committed to transparency, accessibility, equity, and inclusivity[3], especially for priority groups. The objectives can be translated into measurable targets to help with monitoring and evaluation.

The Inclusive Community Engagement Playbook by C40 Cities is a useful tools to help you meaningfully engage with community stakeholders

Identify and understand priority stakeholders.[55]

Carry out detailed stakeholder mapping to identify priority stakeholders, what their influence or interest in NbS or BGI might be, and how to effectively engage theme. This will inform the engagement strategy. [56]

- Using a tool like the one below, translate your analyses into a stakeholder map:



- Priority stakeholders in NbS and BGI should include:[56]
  - Those most impacted by societal challenges.
  - Those critical to the implementation of the solution in key sectors – Local Authority departments, engineers, builders, maintenance operators.
  - Those with influence that are likely to be supportive of the solution, raise ambition and bring others on board, as well as those likely to oppose the solution.

[3]Inclusivity means addressing the needs of the entire population, particularly marginalised communities, regardless of their socioeconomic status, gender, ability, sexuality, job status or living conditions.[70]

Design and undertake stakeholder engagement.

Using the Local Authorities' existing engagement strategy and practices, and the knowledge gained from stakeholder mapping, develop an engagement plan. The plan should encourage engagement at an appropriate level for each group/stakeholder. From the lowest to highest levels of engagement, this means informing, consulting, involving, collaborating, or co-designing with stakeholders.

Evaluate and upgrade the engagement process to deliver better outcomes next time.

Using the targets and feedback processes established earlier, assess the degree to which the engagement achieved the objectives. Evaluating engagement efforts will help to maximise the success of engagement in other NbS BGI projects or in later phases of the project. Documenting the learnings will help to deliver better outcomes later.

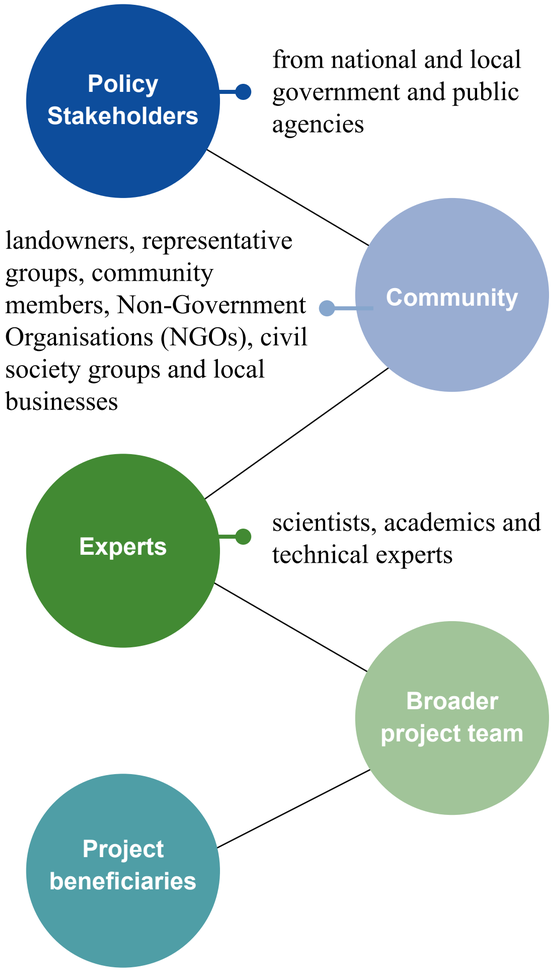
Getting everyone on the same page

Before engaging with stakeholders, make sure the project team is clear on the key messages. Consider developing a list of key facts, answers to frequently asked questions, and 'points' to take to key stakeholders. This will help to ensure that the message is consistent.

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management	●		

Who to engage with?

The project's spatial and temporal characteristics will define stakeholder engagement. Project developers should engage with:



Case Study
Community Engagement
Inishowen Rivers Trust

GM 1.3 – Identification of governance strategy

There is no 'one-size-fits-all' governance model for the implementation of NbS and BGI interventions.[57] Difficulties are often encountered when governing ecological systems using jurisdictional boundaries.[22] Ecological and man-made boundaries do not typically coincide with one another often resulting in a mismatch between ecosystem management and socio-political boundaries.[58]

Researchers have found that collaborative governance approaches are key to the success of NbS.[57]

Aligning top-down policies with grassroots initiatives

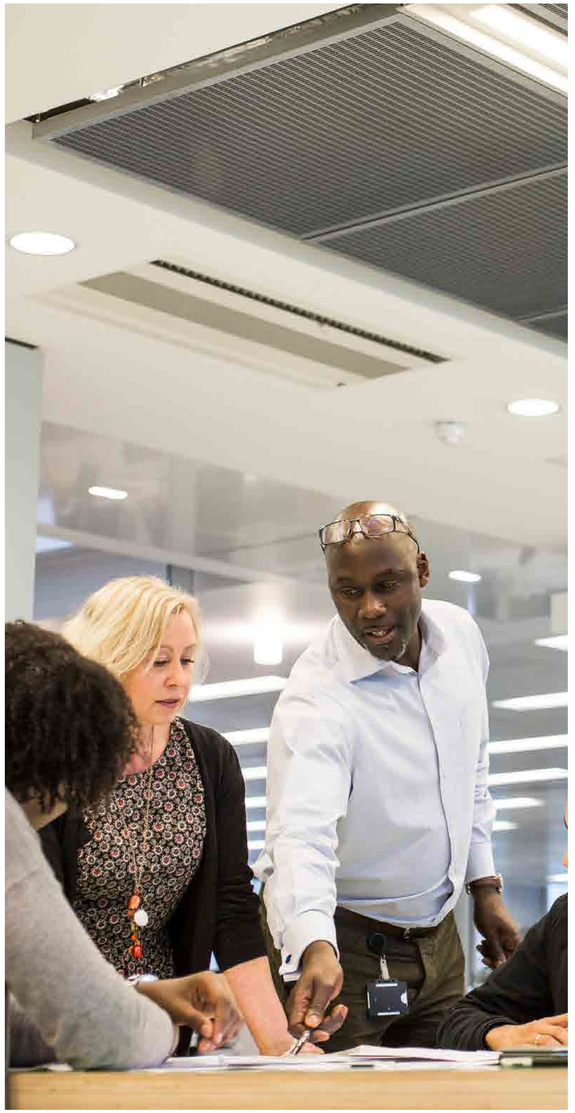
A disconnect can occur between top-down policies that promote NbS and BGI interventions at a national and Regional level and bottom-up initiatives that emphasis the recreational, well-being and economic benefits.[34]

The following governance actions can help fill the opportunity gap:[34]

- Identify supporters who can speak to the benefits of nature in the Region (See Section GM 1.2 Identification of Stakeholders).
- Identify who is benefiting from BGI and NbS and make their multiple values visible and understood (See Section GM 1.2 Identification of Stakeholders).
- Make and leverage opportunities to bring BGI and NbS to the Region (See Section GM 1.4 Finding Opportunities in Policy).
- Work with change-makers and bridge-building organisations to link with those who can benefit from BGI and NbS (See Section Gm 1.1 Identification of Team and Section GM 1.2 Identification of Stakeholders).
- Align Local Authority, civil society group and businesses goals with those of European and national government as this will ground them in current policy thinking and help them to fulfil their potential (See Section GM 1.4 Finding Opportunities in Policy).

Case Study
Good Governance
Bees on the rooftops of Krakow

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management	●		

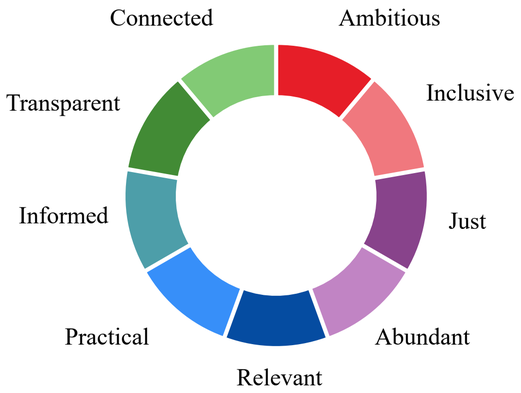


Case Study
Carbon Neutral City
Green Journey of Växjö

The values and principles of good governance

The values and principles which underly BGI and NbS initiatives are the aspects upon which effective governance depends. Projects can struggle to apply multiple principles and values in a coordinated reinforcing manner.[34] Developing and strengthening these values can be challenging as they may conflict.[34] Identifying these conflicts and actively targeting them is vital for BGI and NbS interventions to thrive.

A healthy system of networked nature-based interventions must be:[26,34]



GM 1.4 - Finding opportunities in policy

To be granted planning, BGI and NbS interventions must demonstrate compliance with policy and legislation. The metrics for compliance described in planning and policy may not easily translate to BGI and NbS interventions.

As securing planning can be a time and effort intensive stage, the process should be begun during project inception and should be reflected in the project investment or transaction costs.[50]

The project team should:

1. Show the legal compliance of the BGI or NbS intervention (i.e., does the design of the constructed wetland treat water to current and future regulatory requirements?).
2. Ensure appropriate assessments and authorisations (i.e., land, EIA, and natural resources).

Increased cooperation between Local Authority departments may be required compared to a traditional infrastructure project as BGI and NbS interventions may fall beyond typical planning processes. Additional engagement with regulating and permitting bodies gives Local Authorities an opportunity to encourage early-stage project buy-in.

Synergies and Trade-offs between policy and BGI and NbS

Policy is an important mechanism for embedding NbS and BGI because it articulates how public resources will be deployed to incentivise and restrict investment, design, construction, and operation of solutions.[54] Policy is also a setting for resolving conflicting interests, coordinating actions across sectors and jurisdictions, and solutions that are equitable within and between generations.[54]

Planning tools take multiple forms and serve several, sometimes competing, objectives, such as: enabling the provision of housing, commercial areas, and green spaces; promoting health outcomes; economic development; or sustainable transport.[59,60]

When considering the policy and legislation relevant to NbS and BGI interventions, it is important to consider the different potential interactions between policies and policy objectives to understand how to integrate effective NbS and BGI interventions.[54]

The EPA have published a guide on integrating 'green' into spatial planning:
Integrating Ecosystem Approaches, Green Infrastructure and Spatial Planning (EPA)

Case Study
Finding Opportunities in Policy
London's Green Belt

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management	●		

Cambridgeshire, UK
© Arup

To help identify potential synergies and trade-offs for NbS and BGI in policy, we have adapted the C40 Cities key concepts to “boost resilience” to define four key types of NbS-BGI-policy interactions:[54]

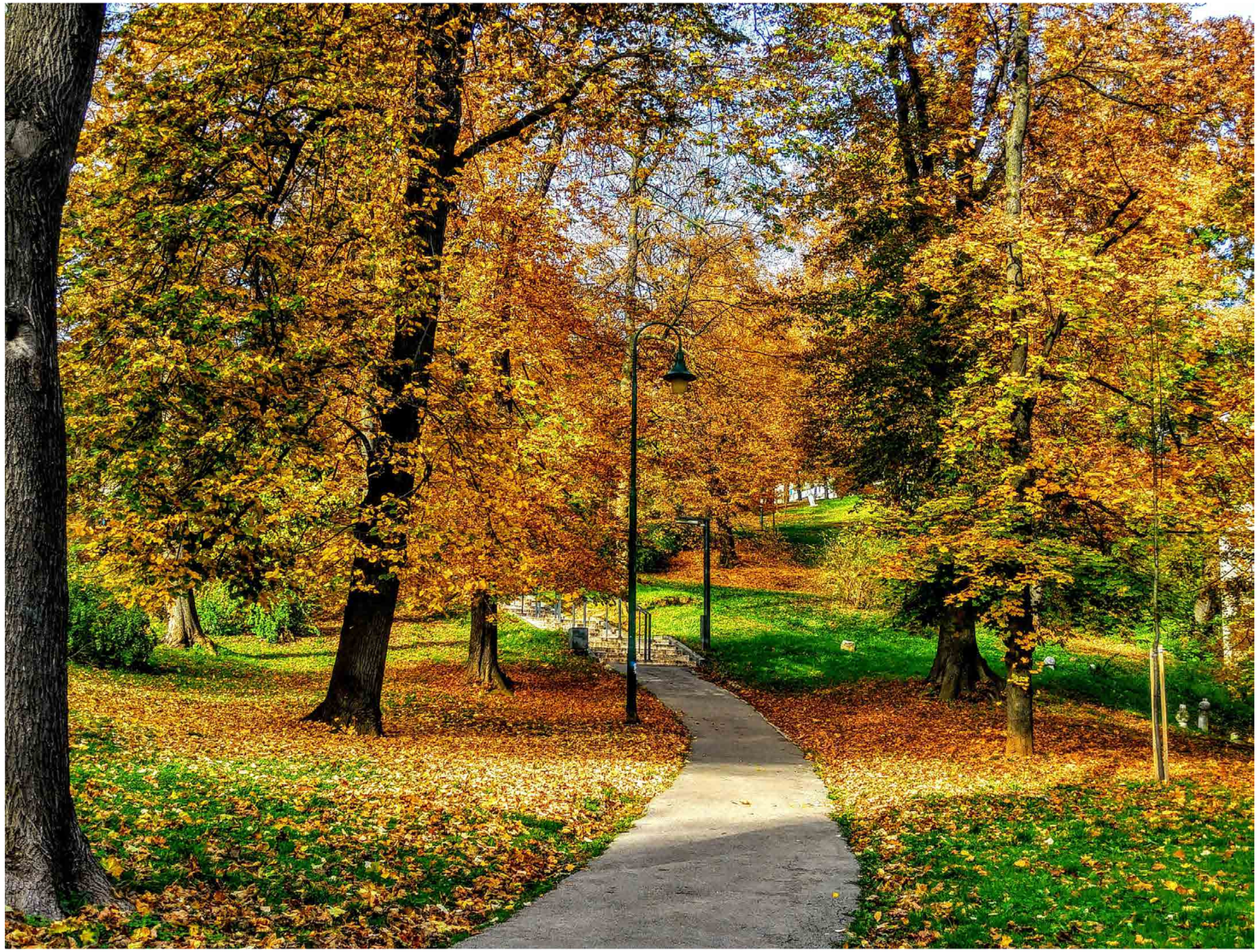
Mal-Investment – When a NbS interventions fails to account for relevant policy and planning objectives and therefore ends up being undermined by another aspect of policy or planning that defeats the goals of the NbS.

Trade-Offs – Some NbS interventions will not promote or will adversely affect a Local Authorities’ planning objectives, equally some Local Authority objectives may have adverse effects on NbS or BGI priorities. In some cases, these trade-offs are acceptable to meet the prioritised policy objective: in all cases identifying the trade-offs is best practice for decision-making.

Piggybacking – When a project that primarily has a NbS or BGI goal is implemented, a range of other policy objectives, that the Local Authority wants to promote can ‘piggyback’ on the primary NbS intervention and bring additional co-benefits.

Win-Win Measures – Going beyond piggybacking, win-win measures fulfil NbS objectives and other local policy priorities, maximising the positive effect.

		Lifecycle Phase		
		Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management	●		



Matrix of Societal Challenges and Policy Objectives

This matrix shows which international, national and Regional policy objectives can be leveraged to address societal challenges by implementing BGI and NbS.

	Water Security	Climate Resilience	Biodiversity	Food Security	Placemaking	A Healthy Population
Sustainable Development Goals						
Project Ireland 2040 - National Strategic Outcomes	Sustainable management of water and other environmental resources	Transition to a low carbon and climate resilient society	Sustainable management of water and other environmental resources	Sustainable management of water and other environmental resources	Enhanced amenities and other heritage, access to quality childcare, education and health services, compact growth	Enhanced amenities and heritage, access to quality childcare, education and health services, sustainable management of water and other environmental resources
Regional Spatial and Economic Strategy (RSES) for Southern Region - Statements of strategy	Sustainable, planned and infrastructure-led development	Low carbon, climate resilient and sustainable society	Sustainable, planned and infrastructure-led development	Sustainable, planned and infrastructure-led development	Diversity, language, culture and heritage enhancement, a healthy and learning Region, inclusive international Region, compact growth	Diversity, language, culture and heritage enhancement, a healthy and learning Region, inclusive international Region, compact growth
RSES - Regional Policy Objectives	1,11,26,111,112-122,212-218	1,5,88,89,90,217	1,89,123,124	1,5,26,89,110,113-120,122,123-126,130	6,10,11,12-25,31,55,61,89,175,200-202	31,61,111,130,131,174,182,190,191,198,200

5.2 GM 2. Project Planning

In this Project Planning stage, the framework addresses.

Technical and Economic Assessments

Funding and Finance

GM 2.1 Identification of Funding

Capital sources of funding necessary to pay for the development, capital, and operational costs of a proposed project are always critical.

In most cases, for NbS and BGI development, financing can be considered as the initial capital required to deliver a project while funding is the regular expenses that must be paid over the operational life of the solution, including fees relating to maintenance and monitoring. The terms are linked and often interchanged, but they are distinct.

To obtain financing, it is important to show that the BGI or NbS project is sustainable over its lifecycle. Some of the information on this will have been gathered during the Technical and Economic Assessment phase.

Key resources for additional information:

Chapter 4 Funding of Measures of the Natural Water Retention Measures (NWRM) by the NWRM Working Group Report provides a list of funding available in Ireland.

Investing in Nature: Financing Conservation and Nature-based Solutions a Practical Guide for Europe

The Nature-based Solution Business Model Canvas and Guidebook (EU Connecting Nature Project)

Investment Finance for Green Infrastructure (Interreg Europe)

Useful Resources:

InVEST tool – for exploring how changes in ecosystems lead to changes in benefits (Stanford University)

Value and benefits assessment methods database for Urban Nature-based Solutions (EU Naturvation Project)

To understand the capital requirements and revenue generated by a project follow these steps:

- Discount cash flows to present value.
- Identify the sources of revenue during the project lifetime:
  - Co-benefits such as eco-tourism, carbon sequestration, enhanced water security.
- Establish the timeline of capital requirements.
  - Evaluate capital investment, transactions, and operations and maintenance costs and when the capital for each will be needed.
- Analyse the ability of the project cash flows to cover the future financial requirements under various funding mechanisms.

GM 2.2 Analysing Technical and Economic Information

The following technical and economic assessments should be considered, according to the planning and regulation requirements, scale, context, and the project scope.

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management		●	

Case Study
Sustainable Rehabilitation and Responsible Innovation
VERDIR

Case Study
Technical and Economic Assessment
All London Green Grid

Economic Valuation of BGI and NbS interventions

BGI and NbS provide goods and services for the well-being of the community. However, most of these goods and services are provided beyond the market. Therefore, it can be challenging to place a value on what people are willing to pay or accept to use or conserve BGI or NbS. As there is no price indicator of total value this has resulted in economists under valuing or attributing a zero value to environmental goods and services during decision making. This can lead to the over exploitation of BGI and NbS.[62]

Non-monetary Valuation Methods

Non-monetary valuation methods such as surveys, participatory interviews, and citizens assemblies could be used as an alternative or complement to monetary valuation.

Useful Resources:

Economic Valuation of Ecological Functions and Services of Natural Ecosystems: Guide on the Use of Simple Methods (IUCN)

5.3 GM 3. Monitoring & Evaluation

Monitoring BGI and NbS interventions occurs while the solution is in operation. It is possible to incorporate resilience into the use of BGI or NbS interventions, by rethinking normative approaches to maintenance, day-to-day operations, and monitoring of societal impacts. This includes undertaking robust assessments of societal risk to operations and building the capacity of Local Authorities in the Region to adapt and make changes because of these assessments.

In their oversight role and in collaboration with one another, Local Authorities, at a Regional level, can encourage and set the expectations for BGI and NbS around resilience to societal challenges.

GM 3.1 Monitoring and Evaluation

Monitoring and evaluation of BGI and NbS interventions provides evidence and information on the benefits and performance of solutions. It also facilitates capacity building. Monitoring a project allows for adaptive management whereby a project can be modified if required to improve performance or respond to a change in conditions. Any technical or specific expertise required for monitoring and evaluation should be identified at the stakeholder engagement and team identification stage.

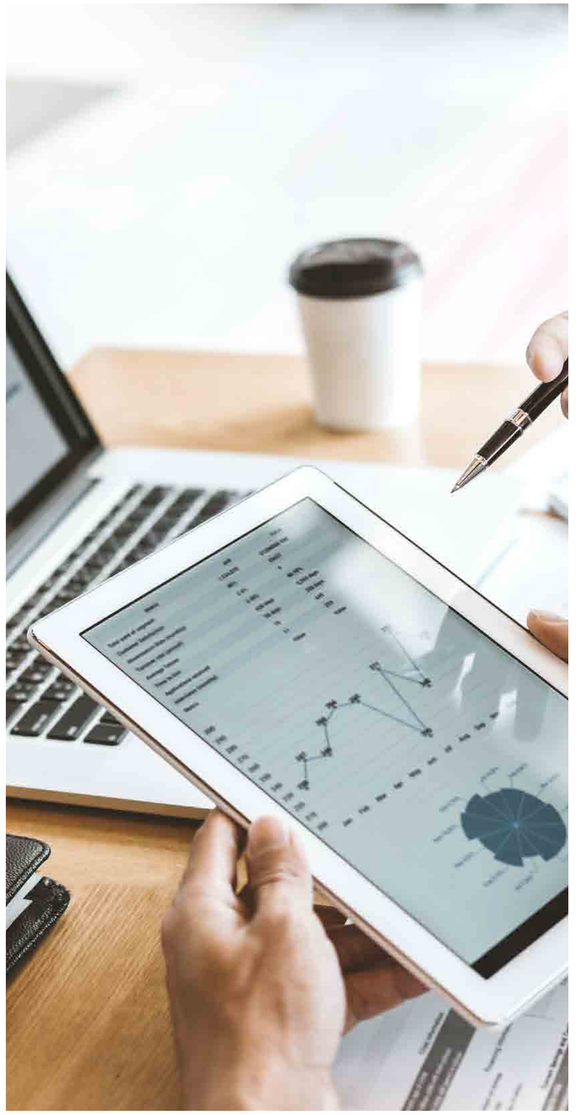
		Lifecycle Phase		
		Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management			●

The following resource is recommended as optional reading:

The Importance of Operation and Maintenance for the Long-Term Success of Green Infrastructure (Environmental Protection Agency, US)

Case Study
Biodiversity Net Gain
Keyn Glas

Case Study
Monitoring and Evaluation
Fitz Park London

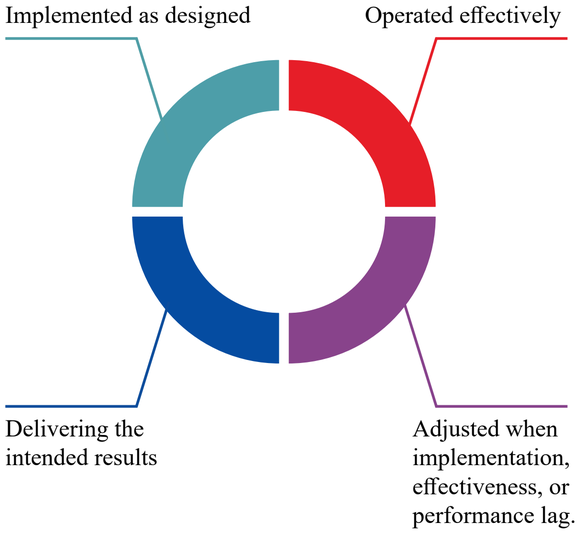


Resources for Optional Reading

Reflexive Monitoring Guidebook (EU Connecting Nature Project)

Impact Assessment Guidebook (EU Connecting Nature Project)

Projects should be:



Stakeholder Engagement

Innovative and stakeholder-based monitoring can ensure the sustained monitoring of a project over its lifetime such as community-based monitoring or monitoring by academic institutions.

Questions to Consider When Developing a Monitoring Plan[50]

1. Where will the funding for monitoring come from?
2. How will information be collected and synthesised?
3. Is baseline data required to support the monitoring process?
4. Is additional expertise needed to undertake the monitoring and evaluation?
5. What methods will be used?
6. Who will undertake the monitoring?
7. Who will receive and review the monitoring reports?

Evaluation Performance Indicators

A set of indicators should be selected to monitor implementation, effectiveness, and performance. These indicators should be relevant and align with the KPI's previously identified (link to KPI section).

GM 3.2 End of Life

In the last phase of the infrastructure lifecycle, the end-of-life phase, Local Authorities can maximise the usefulness of the materials, components, and organic aspects that form part of a redundant NbS as well as the land/space that it occupies. While actions in this phase may not directly address societal challenges, as the NbS is being decommissioned, they can lead to other co-benefits. Planning and funding policies such as the NPF, NDP and RSES should inform and guide the decommissioning phase.

Upstream decisions and actions can significantly influence the ease with which resilience-enhancing approaches can be carried out at the end of a solution's lifespan. These actions can include introducing modularity into the design and construction phases. BGI and NbS teams should apply multi-decadal foresight which will facilitate resilience-enhancing decommissioning practices. BGI and NbS interventions should be designed with circularity in mind. Adaptive management and monitoring practices can support resilience at the end-of-life stage, but novel approaches and concepts are also needed to ensure resilience during the final lifecycle phase. NbS can themselves be seen as enablers to transition from linear to circular settlements[32,63]

The following resources have been identified as helpful optional reading to understand addressing societal challenges at the end of a NbS's life.

Completing the Picture: How the Circular Tackles Climate Change (Cowes: Ellen MacArthur Foundation)

The European Commission's Circular Economy Action Plan

Villages Enhancement Scheme, Carmarthenshire, Wales
© Arup

		Lifecycle Phase: Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management			●

1. Select an end-of-life strategy that supports desired societal outcomes[33,64]

- Consider societal challenges when making end of life decisions.
- Undertake an end-of-life process that supports resilience to societal challenges.
- Plan for climate-related failure.
- Proactively engage with stakeholders throughout the process to ensure that the impacts are completely understood by the relevant communities.

2. Employ circular economy considerations at End-of-Life

- Reuse and recycle material, components, and organic aspects.
- Reuse and repurpose a space or solution post-decommissioning.

Case Study

End-of-Life

Granby Park, A Temporary Park

		Lifecycle Phase		
		Needs Identification	Project Planning	Implementation
Strands	BGI			
	NbS			
	Governance & Management			●

Reduce, Reuse, Recycle, Replant.

By reusing and recycling materials, components and natural aspects, circular economy approaches at the decommissioning stage ensure that less virgin material is required in future projects.[32,65] This therefore ensures that fewer emissions are produced as a result. Replant By replanting trees and shrubs in new locations, their carbon sequestration potential can continue to be achieved.

End-of-Life Equity Considerations

It is important to consider the holistic benefits BGI and NbS interventions may be providing, particularly those services to underserved or marginalised communities.[26,66–69] An equitable end of life approach should ensure no community is disproportionately negatively affected by the absence or change of use of BGI or NbS.

Equitable decision-making would ensure that no community is forced to relocate or is further marginalised by a change in function. If the decision to repurpose is being made to protect vulnerable populations, the alternative solution should be equal to, or better than the original situation.

An optional resource:

StoryMaps collections documenting community struggles for equitable access to green space and housing (BCNUEJ)

Connswater Community Greenway, Belfast, United Kingdom

6. Catalogue of Nature-based Solutions

London Olympic Park, UK

6. Catalogue of Nature-based Solutions

The following set of NbS cards introduce the full range of interventions cited in the Framework. For each NbS intervention the following information is provided:

UNSDGs
Highlights the UNSDGs that can be progressed with the application of this solution

Societal Challenges
Highlights the UNSDGs that can be progressed with the application of this solution

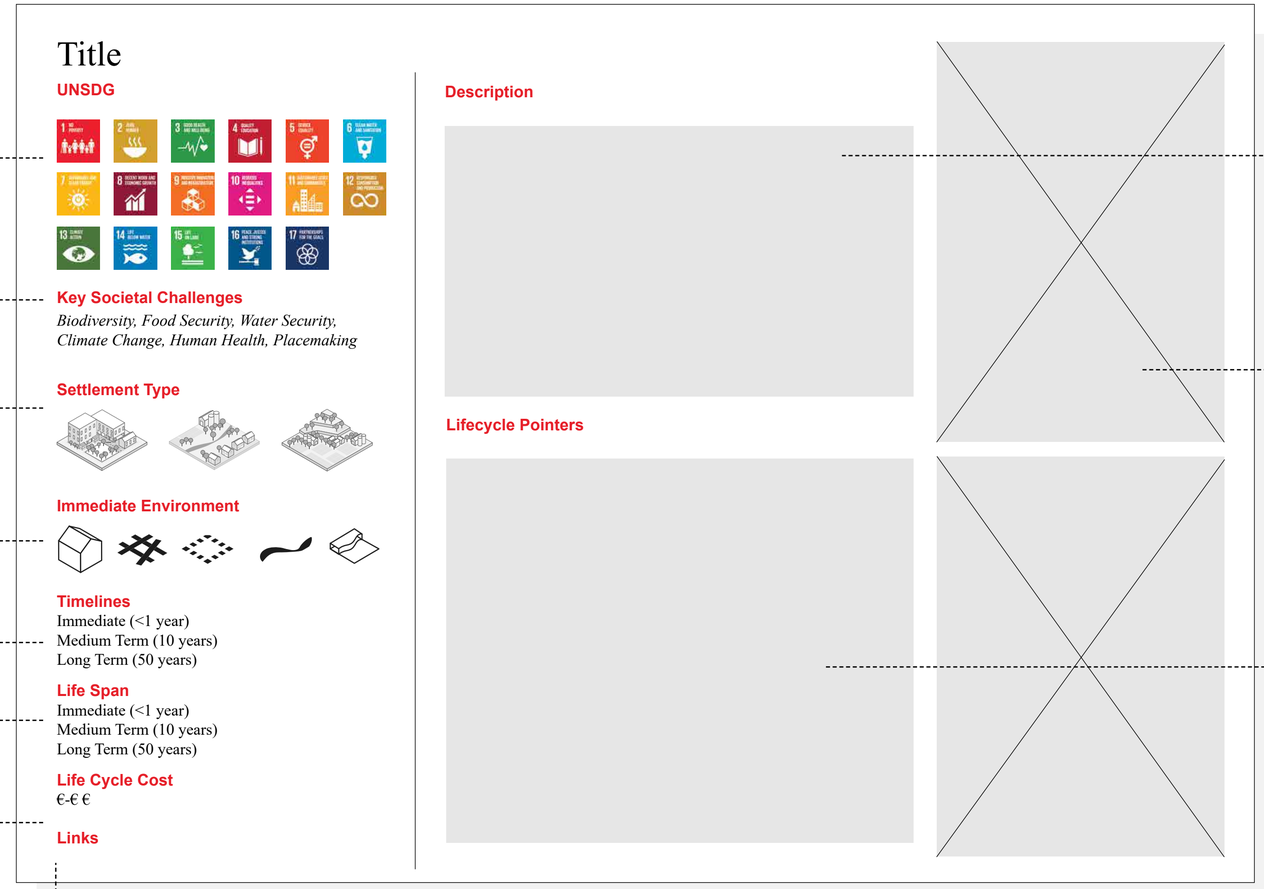
Settlement Type
Information about the scale of settlement the NbS can be applied to

Immediate Environment
Information about the type of environment the NbS can be applied to, with respect to the position of the urban settlement.

Effective Efficacy
Estimated typical time from implementation to when the potential benefits of the solution are realised

Life Span
Estimated typical lifespan of the solution

Life Cycle Cost
This section provides a cost rating for the how lifespan cost of the solution in the Southern Region



Description
Generic background information about the solution

Visualisation of the NbS
This section includes visualisations, photos, and landscaping sketches of the solutions to illustrate the solution in the “wild”.

Technical information by Lifecycle Phase
This section provides a technical profile of the NbS based on the lifecycle phases of needs identification, planning, and design and implementation .

Links
This section provides links to global good practice examples of the solution, further guidance on its implementation and or other example projects.

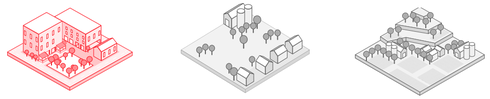
Agroforestry

UNSDGS

Key Societal Challenges

Placemaking, Climate Resilience, Biodiversity, Water Security, Food Security, A Healthy Population

Settlement Types



Immediate Environments

Timelines

Medium Term (10years)

Life span

Long term (50 years)

Life cycle cost

€

Links

Getting started in forestry - 5 steps

Sustainable forest Management

Description

Agroforestry is the practice of combining forestry and agriculture in a mutually beneficial way. The system gives landowners the flexibility to graze and even cut silage and hay while growing trees for timber or produce in the same field. This system enables farmers to maximise the potential of their land. Three common components of agroforestry schemes are trees or woody perennials, crops and animals.

Lifecycle Pointers

- Consider the following factors when choosing the agricultural model: land topography, soil fertility and drainage, water resources, climate conditions, the needs and priorities of landowners, land ownership, management rights, and the intended use of products.
- Plan for the extent of ground preparation required for the scheme, the appropriate sourcing of plant material and animals, and the ongoing management and care needed.
- If the scheme is intended to be commercial, ensure the market has been research and is well understood.
- Once the land is converted to agroforestry, it will be classified as forest land and forest legislation will apply.
- Grant rates and payment structure are similar to the Afforestation Scheme 2014-2020, with grant and premium category (GPC) 11 applying. Premiums will be paid for 5 years and will cover the cost of maintenance. Agroforestry is also eligible for Woodland Improvement Scheme grants for thinning, tending and pruning.
- Develop a management plan for the scheme. The plan should consider the dynamic nature of the whole system including competition between trees and plants, market influences, and resource availability. Common maintenance practices for agroforestry systems include: seedling protection, weed and pest control, fertilisation, irrigation, thinning, pruning, coppicing, harvesting and post-harvesting operations.
- Monitor the monitor the performance of agri-forestry schemes using good baseline data and a set of relevant and measurable criteria.

Loughgall, Northern Ireland

Skibbereen, West Cork, Ireland

Back to Interventions Tool for:

Urban Core

Beach Nourishment

UNSDGS

Key Societal Challenges

Placemaking, Biodiversity, Water Security, Climate Change

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Short term <10 years

Life cycle cost

€ € €

Link

Beach Nourishment - an overview | ScienceDirect Topics / Beach and shoreface nourishment — Climate-ADAPT (europa.eu)

Description

Beach nourishment, or beach filling, is the adding of large quantities of sand to the beach in order to improve the recreational beach, to halt shoreline erosion, and to afford storm protection for beachfront buildings. Beach nourishment builds a wider, higher, high-tide dry beach; to fill in any trough-like lows that drain across the beach; and to encourage additional sand to aggregate on the lower beach. Removal of sand in the lower beach deprives downdrift beaches of their natural nourishment, steepens the beach topographic profile, and can destroy beach organisms. However, nourishment provides a source of sand for dunes building and space that allows well-vegetated dunes to be rapidly established.

Lifecycle Pointers

- Cost the project in the long-term including the need for future nourishment projects. Beach nourishment is not a long-term solution as the processes of erosion will continue and nourishment will need to be repeated.
- Match the sand to the original physical and chemical composition of the natural sand. Consider how the grain size of the introduced sand may influence the rate of erosion and lead to changes in beach shape.
- Consider the environmental impacts of sourcing sand either from inland excavation or from offshore dredging.
- Place sand up coast and in the nearshore zone and allow waves to move it onto and along the beach.
- Plough the sand immediately after adding it to the beach to prevent it from becoming too compacted for beach species.
- Undertake the nourishment at a time of year when birds and other organisms are less prevalent.
- Gradually add sand to the beach in several small nourishment projects and do so in consultation with an ecologist as sudden large inputs of sand can kill beach organisms and the use of heavy machinery also has the potential to disturb or kill beach animals.
- Allow enough time between nourishment projects for the slowest reproducing beach organisms to recolonise and reproduce.

Nags Head, North Carolina, USA

Nags Head, North Carolina, USA

Back to Interventions Tool for:

Brownfield/ Urban Fringe

Rural Settlements

Bioretention Areas (strips/ponds)

UNSDGS

Key Societal Challenges

Placemaking, Climate Resilience, Biodiversity, Water Security, Food Security, A Healthy Population

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Medium – Long term (up to 20 years)

Life cycle cost

€

Links

https://www.ors.ie/wp-content/uploads/CIRIA-report-C753-The-SuDS-Manual-v6.pdf

Description

Bioretention systems (including rain gardens) are shallow landscaped depressions that can reduce run-off rates and volumes and treat pollution through the use of engineered soils and vegetation. They are particularly effective in slowing flow rates and filtering particulates and can also provide: 1. Attractive landscape features that are self-irrigating and fertilising 2. Habitat and biodiversity 3. Cooling of the local microclimate due to evapotranspiration. Bioretention areas are often a cost-effective retrofit option due to their flexibility in size, detailing and ability to be integrated within existing landscaped areas. The installation of bioretention areas reduces the frequency of traditional maintenance operations. Bioretention systems can be designed to manage a wide range of rainfall events. As a general principle, the systems should drain relatively small areas close to the source of runoff. They will not work effectively if designed to drain large catchments that discharge into the system at a single location without flow control.

Lifecycle Pointers

- At the planning stage, ensure collaboration between landscape architects and engineers to optimise falls and drainage networks.
- Apply bioretention areas to small catchments with maximum recommended area that should drain to a bioretention system of 0.8 ha.
- Prevent rapid clogging of the bioretention surface by designing the Bioretention system to be 2-4% of the overall site area to be drained.
- Design the surface of the Bioretention system to be level to allow distribution of flows across it. Within steeper catchments, to be effective, they may require some form of small retaining structure or earth embankment to achieve a level surface.
- Bioretention systems can be used to provide treatment of water before its use in harvesting systems (note that disinfection of the discharge from the feature will still be required where treatment of pathogens is critical).

Greener Grangetown, Cardiff, Wales

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rural Settlements

Buffer Strip and Hedgerow

UNSDGS

Key Societal Challenges

Climate resilience, biodiversity, water security, food security

Settlement Types

Immediate Environments

Timelines

Short - Medium term (2 to 5 years)

Life span

Long term (>50 years)

Life cycle cost

€- € €

Link

https://www.farmingfornature.ie/resources/best-practice-guides/hedgerow-management/

Description

Buffer strips protect and enhance important features such as streams, ponds, ditches and woods. They can also be used to reduce soil run-off and may therefore be part of a soil management plan. When located correctly they can provide additional nesting cover for game and animals like hares. Buffer strips can also slow down water flows, as well as providing bank stabilisation and habitats. A buffer strip can consist of grassland, wetland, scrub or trees.

Hedgerows are strips of densely planted trees, shrubs and other plants that form a border. They may vary in height, width, depth, and species mix. Hedgerows are important habitats for flora and fauna.

Lifecycle Pointers

- Carry out a simple assessment of the field boundaries: Where are they? What material are they (hedgerows, stone walls, embankments, wire/post)? What condition are they in?
- Assess the species present in the hedgerows including trees, shrubs, flowers, mammals, birds etc. Identify areas where the condition of the hedgerow might be improved (i.e., gaps in the hedge)
- Observe the laws around the cutting of hedgerows (Section 40 of Wildlife (Amendment) Act 2000) and the Heritage Act 2018. It is an offence to destroy vegetation on uncultivated land between the 1st of March and the 31st of August each year. Encourage conversation between farmers and contractors before hedges are cut to ensure that hedges remain fit for birds and bees.
- To benefit wildlife, select a location that links habitats or that is next to a watercourse, hedgerows (especially those with mature trees), adjacent to remnants of trees on former boundary lines, near groups of trees in fields or along a woodland edge.
- A strip of at least 10m is recommended for buffer strips. Generally, the wider the buffer strip the more beneficial it is for wildlife.
- In the case of buffer strips along rivers in agricultural lands, consider the use of ‘off-stream’ watering troughs or pumps to allow stock access to water.
- Line wire fencing is often best next to a river as it resists trapping too much debris during flood events.
- Design hedgerows to have a dense base and sufficient height for nesting birds, the presence of flowering thorn bushes will encourage bees. See Teagasc advice on achieving a dense base.

River Dee, Northeastern Scotland

St.Annes Park, Raheny

Back to Interventions Tool for:

Brownfield/ Urban Fringe

Rural Settlements

Channels and Rills

UNSDGS

Key Societal Challenges

Climate resilience, Water Security

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Medium-Long Term (10 years)

Life cycle cost

€ €

Link

https://www.ors.ie/wp-content/uploads/CIRIA-report-C753-The-SuDS-Manual-v6.pdf

Description

Channels and rills are open surface water channels with hard edges. They can be designed at varying widthsto suit the urban landscape and can also be planted, which helps purify water. In dense urban developments where space can be at a premium, channels and rills are an effective way of contributing tp Sustainable Urban Drainage Systems and can also act as pre-treatment to remove silt before water is conveyed into further features. There are many schemes that use channels in imaginative ways to enhance hard urban landscapes. Channels and rills work in synergy with rain gardens, green areas, swales and tree pits.

Lifecycle Pointers

- Use channels and rills to collect runoff in a small area. Narrow channels should have shallow gradients and slow flow rates to allow suspended solids to settle out.
- Design channels and rills to slow runoff and encourage sediment deposition. They should have a shallow depth with a suggested maximum depth of 150mm-300mm.
- Incorporate this intervention as part of broader landscaping schemes. As their design is highly adaptable, they can be integrated into many architectural and landscape choices.
- Ensure the land on which the channel or rill is being constructed is stable and not on a steep slope.
- Consider channels and rills as part of a wider SuDs scheme, to provide a routing function and link between other features. When costing for this intervention, it should therefore be considered within the context of the broader SuDs scheme.
- Maintenance is crucial to allow correct functioning and water flow. It is important to conduct regular maintenance to clean up and remove debris to avoid clogging and creation of ponds.

Sct Olai Square, Roskilde, Denmark

Sovereign Square, Leeds, UK

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Cliff/Seafront Stabilisation

UNSDGS

Key Societal Challenges

Biodiversity, Water security, Climate change

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Short -medium term (1-20 years)

Life cycle cost

€ - € €

Link

Cliff stabilisation — Climate-ADAPT (europa.eu) / Canford Cliffs Stabilisation Works, 2020-2021 - Poole & Christchurch Bays Flood & Coastal Erosion Risk Management (twobays.net)

Description

Coastal cliff or seafront stabilisation are measures to reduce cliff or seafront erosion and its impacts such as landslides, collapse and falling rocks. Stabilisation methods aim to increase stability of the slope and reduce marine erosion. There are two solutions that are widely used and often combined. These are:

1. Re-vegetation, which is the managing of existing vegetation to regain damaged areas or establishing vegetation cover on the slope to limit the risk of instabilities. These approaches can be applied by creating forested berms or water draining ditches. On very loose slopes, fast growing and deep rooted species are favoured. On more stable slopes, a ground-cover vegatation can be sufficient to act as a protective skin.
2. Littoral strip reloading: compensate littoral imbalance from marine erosion by placing sand or pebbles at the foot of the cliff. Littoral strip reloading is similar to beach nourishment.

Lifecycle Pointers

- In littoral strip reloading, use a good quality sand or pebble with similar characteristics to the original. Ensure that the source area has sufficient quantities of material and that the source site is close enough to reload. Multiple reloads will be required as erosion will be ongoing.
- In revegetation, carefully choose the appropriate plant species according to the soil and rock types. Local, native species are typically more suited to the soil and landscape. Typically revegetation can only be applied in small areas.
- Consider applying revegetation and littoral strip loading in combination. Revegetation alone will in most cases be only a short-term solution, as structural erosion will significantly diminish its benefits, unless littoral strip loading is simultaneously applied. Moreover, if not well managed, the growth of the roots can have the reverse effect of causing instability by causing rock fractionation.
- In cases where ground slipping is becoming too dangerous for human activities, nail a geotextile before hydro seeding the area.

Slea Head, Co. Kerry, Ireland

Ardmore, Co.Waterford, Ireland

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rural Settlements

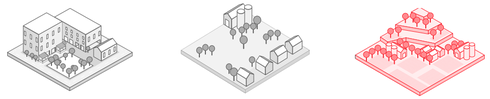
Dune Reinforcement and Strengthening

UNSDGS

Key Societal Challenges

Water security, Climate change

Settlement Types



Immediate Environments

Timelines

Vegetation – medium term

Internal structure - immediate

Life span

Medium term – 25 to 50 years

Life cycle cost

€ €

Link

USACE_Rockaway_April_2015_Poster9.pdf (army.mil)

Description

Sand dune reinforcement and strengthening is a coastal management technique for preventing erosion. Sand dunes may be reinforced and strengthened through the planning of vegetation. Sand dunes trap sand and beach material that is washed or blown up. They are important for preventing erosion and create an effective flood barrier.

Vegetation has recently been seen as an important factor influencing erosion processes on dunes. When vegetation is at forward positions on the dune, it decreases run-up, increases reflected energy and transfers it to low frequency bands, and reduces the eroded volume on the exposed dune face. Another means of dune reinforcement is the installation of internal structures within dune systems. Both means can be used together for maximum protection.

Lifecycle Pointers

- Identify different planting regimes for different locations on the dune: the angled side facing the ocean (foredune), and a flat expanse at the top of the dune, and an angled side facing away from the ocean (backdune).
- Select salt tolerant plants, that can survive in high winds and under sand burial for the foredune. Select grasses that grow together in sense vegetation ‘dune mat’ for the backdune. Once a dune mat is established, consider larger shrubs that can be introduced to the backdune.
- Vegetalisation of the dune should always be considered even in addition to structural works. The creation/adding of new wildlife habitats should be considered as priority for coastlines.
- Consider the length of the shoreline to be reinforced. If dunes are moving fast, consider a buried seawall as a good, protective solution. Establishing vegetating on dunes is also commonly used to prevent sand flying off the dune and spilling over roads and buildings.
- Decide based on the site, technique and landownership if the dunes can be reinforced in segments, or should be contiguous for the entire project.

Dune Reinforcement and Strengthening, Co. Kerry, Ireland - Before

Dune Reinforcement and Strengthening, Co. Kerry, Ireland - After

Back to Interventions Tool for:

Rural Settlements

Filtration Strips

UNSDGS

Key Societal Challenges

Biodiversity, Climate resilience

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Short-long term (0-50) years

Life cycle cost

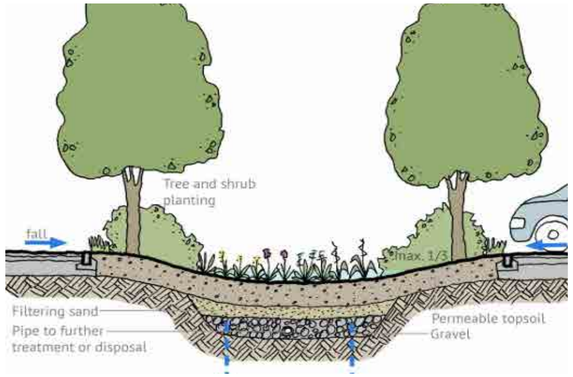
€ € €

Description

Filtration strips are strips of ground where water running off a site can pass through before entering a water course. They often lie between a hard-surfaced area and a receiving stream, surface water collection, treatment or disposal system. They are effective at removing contaminants or polluting solids from runoff providing a buffer before water enters another system or body of water. Through a process of filtration, sedimentation and infiltration, the vegetation traps organic and mineral particles that are then incorporated into the soil, while the vegetation can take up any nutrients. Vegetation can be semi-natural or planted although species that support biodiversity priorities are most beneficial. Filtration strips can serve as a buffer between incompatible land uses and are often integrated into surrounding land uses such as public open space or road verges. To qualify as a nature-based intervention that can contribute to NbS, filtration strips must have a positive impact on biodiversity. Simple changes to the management regime of existing mown verges can achieve this beneficial impact.

Lifecycle Pointers

- Filtration strips can be applied and used effectively in several sites such as areas adjacent to water courses, at stormwater management structures, along the bases of slops and as a vegetative filter strip to provide runoff treatment of conventional pollutants.
- Filtration strips may occur naturally or be constructed but is important that they are designed so that runoff flows uniformly across the filtration strip as sheet flow, as effectiveness is reduced if the flow becomes concentrated. Soil compaction must be avoided to ensure filtration and minimise rapid surface runoff. A shallow stone trench can be used to distribute the runoff.
- Design recommendations need to be considered such as drainage area, entrance conditions, the length, slope, width of strip and vegetation.
- Filter strips should be maintained as natural areas once the vegetation is established and protected from damage by fire, grazing, traffic, and dense weed growth.



Filtration strip cross-section

Filtration strip in agricultural land

Back to Interventions Tool for:

Rural Settlements

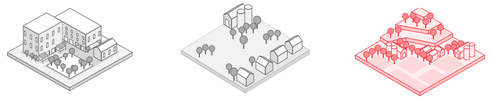
Forest Cover in Headwater Areas

UNSDGS

Key Societal Challenges

Water Security, Climate Change, Human Health, Biodiversity

Settlement Types



Immediate Environments

Timelines

Medium to long term (5 to 25 years)

Life span

Long term (>50 years)

Life cycle cost

€ €

Link

f2_-_maintenance_of_forest_cover_in_headwater_areas_0.pdf (nwrm.eu)

Description

Headwaters are the source for rivers and streams. They are key to maintaining downstream ecosystems and the hydraulic cyclic. They are an important location for precipitation contributing to surface and groundwater. Headwaters are often less used than downstream locations. Forests in headwater areas bring benefits in terms of water quantity and quality. This is an intervention used in the headwater catchments for many global cities, including New York and Singapore, as these cities rely on headwater forests for drinking water provision. Forest soils have a higher infiltration capacity than other land covers and slowly release rainfall. In upland areas and areas with a high gradient, forestation of headwater catchments can stabilise slopes and reduce the risk of landslides.

Lifecycle Pointers

- Select a site of several to tens of square kilometres. Forest cover in headwaters is dependent on large scale land conversion or preservation. The most suitable headwater catchments are located upstream of urban or peri-urban areas where flood risk reduction or water quality improvements are required.
- Use county forest cover maps and the national forest ownership map when considering site selection. The maps can be found here.
- Consider this intervention as part of broader flood risk management strategies.
- Estimate the costs of the project such as land acquisition, tree planting, seedling establishment, thinning and sustainable forest management.
- Prioritise native species which are known to be robust to the effects of climate change.


Before


After - Agach, Istanbul

Back to Interventions Tool for:

Rural Settlements

Green Roof/Green Wall

UNSDGS

Key Societal Challenges

Climate Resilience, Biodiversity, Placemaking

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Medium-Long term (10-50 years)

Life cycle cost

€ €

Link

https://www.dlrcoco.ie/sites/default/files/atoms/files/appendix16.pdf

Description

Green roofs, walls and façades are multi-layered systems that cover various surfaces of a building with vegetation and/or a drainage layer. There are two main types of green roofs - intensive and extensive which describe proposed function of the space and types of planting purposed. Extensive green roofs include low maintenance self-sustaining vegetation that is drought and frost resistant. These are lightweight and have a shallow soil layer. They do not normally include access for people. Intensive systems require frequent management and provide similar benefits as a small urban park. They have a deeper layer of soil which supports a range of plants, trees, and shrubs. Trees and shrubs can be planted in raised planters on rooftops to ensure soil depth.

Similarly, there are different types of green walls that are used for different purposes and in various environments. Green walls can be found inside or outside buildings and can integrate smart or active technology to aid maintenance and play an active role in terms of improving the urban environment and purifying air. To stay healthy and to serve their purpose, both green walls and smart and active green walls need upkeep. Like all living plants, greenery in planted walls requires periodical replacements to compensate for plant loss. For both green roofs and walls a range of materials and plants can be used, depending on the most suitable solution for each space. To qualify as a nature-based intervention that can contribute to NbS, the green roof or wall must have a positive impact on biodiversity.

Lifecycle Pointers

- Consult landscape architects and other qualified professionals as appropriate to ensure the best result and that the design solutions are technically viable, sustainable and well-integrated.
- Decide what type of green roof and wall is best for the development in question. Is it mainly to reduce storm water run-off? Is the main purpose to design for amenity and/ or biodiversity? Review ideas early on with site managers to ensure the maintenance budgets accommodate the delivery of each solution (note that extensive green roofs are low budget interventions).
- Undertake feasibility studies to check if the existing structures holding the green surfaces provide enough strength and resistance to new loads.
- Consider relevant policies i.e. National Climate Change Adaptation Framework, Building Resilience to Climate Change (Dec 2012). Planting proposals can tie in with recommendations in the All-Ireland Pollinator plan (2021-2025)
- Consider requirements for proposed land uses in the area. For example - under DLRCC land use plan "A Green Roof proposal is a requirement for all roof areas greater than 300m² for the following development types unless exempted or partially exempted by DLRCC's Municipal Services Section following consideration of the suite of complimentary or alternative 'soft' SUDS (Sustainable Drainage Systems)* measures being proposed: - Apartment Developments - Employment Developments - Retail and Ancillary Shopping - Leisure Developments - Education Facilities ".
- Avoid interference with existing uses (e.g., safety exits).

Marriot Hotel, Belfast, Northern Ireland

NEC, Birmingham, UK

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rural Settlements

Green Screens

UNSDGS

Key Societal Challenges

Climate Resilience, Biodiversity

Settlement Types

Immediate Environments

Timelines

Immediate (>1year)

Life span

Medium-Long term (10-50 years)

Life cycle cost

€

Link

https://greenscreen.com/shared/2021/07/greenscreen_Catalog_spring2021.pdf?x70762

Description

Green screens consist of welded wire trellises that vary in width and size, creating a rigid and lightweight modular panel suitable for outdoor use. The panel is used as a structure to support vegetation. Climbing and hedging plants are normally used. Green screens are useful for covering blank façades or less attractive parts of buildings, or for external areas where privacy and security in a way that delivers a connected, vegetated solution. Particular attention should be paid to plant selection, soil volume and the size of the plant upon installation. In high-visibility projects, panels can be pre-grown off site which creates an instant effect. The use of vegetation for shade creation can help to minimize building cooling requirements, increase evapotranspiration, mitigate the Urban Heat Island effect and create comfortable outdoor spaces. To qualify as a nature-based intervention that can contribute to NbS, the green screen must have a positive impact on biodiversity.

Lifecycle Pointers

- Planting specifications should be developed by qualified landscape professionals.
- Shade, climate, height, irrigation and style are important factors to consider when specifying green screens. In addition to the hardiness zone, a plant's growth habit is key to success. At a minimum, plant material may need to be pruned, fertilised, mulched and irrigated annually.
- Consider the use of different species in relation to seasonal change and low maintenance requirements. Planting proposals can comply with recommendations in the All Ireland Pollinator plan (2021-2025)
- The most common climbing plant species used for green screens are:Hedera Helix of different varieties, Hedera hibernica, Pyracantha and Euonymus fortunei.
- Panels can be stacked side to side or top to bottom to cover larger areas.
- Multi-floor heights can be vegetated from a narrow planting bed that eliminates walkway encroachment or by integrating above grade planters to reach higher elevations. The panels are easily adaptable for new projects or to retro-fit onto existing buildings. The unique panel construction spans between floors and attaches directly to the building face or to a secondary steel frame.

Amersfoort, Netherlands

Library of Birmingham, Birmingham, UK

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Greenway

UNSDGS

Key Societal Challenges

Biodiversity, A Healthy Population, Placemaking

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Long term

Life cycle cost

€ € €

Links

https://www.interregeurope.eu/policylearning/good-practices/item/6080/waterford-greenway/

Description

A park is an area of natural, semi-natural or designed public open space used for recreation and the protection of wildlife or natural habitats. Parks are fundamental in the evolution of healthy, liveable cities and settlements contributing positively to the needs of people and playing a critical environmental role. Today's parks need to be multi-generational and multi-functional, requiring designs and plans that create spaces that accommodate all ages. The design and management of parks is informed by current practices of urban planning, design attitudes, modes of recreation, philosophies of landscape preservation, and beneficial social interaction. The size and scale of a park must comply with the development plan of each local authority (see the link to Dublin City Council's parks strategy as an example). Parks must contribute positively to biodiversity and wider ecosystems to qualify as a nature-based solution or intervention. Changes in seed sowing, management regimes and water management can all boost the biodiversity and habitat value of existing parks and green spaces.

Lifecycle Pointers

Factors for the design of successful parks as stated in the 'Sustainable Residential Development in Urban Areas, Guidelines for Planning Authorities', published in 2009 include:

- Design: The layout and facilities – particularly in larger parks – should be designed to meet a range of user needs, including both active and passive recreation.
- Accessibility: Local parks should be located to be within not more than 10 minutes' walk of the majority of homes in the area; district parks should be on public transport routes as well as pedestrian/ cycle paths. Playgrounds should be carefully sited within residential areas so that they are both easily accessible and overlooked by dwellings, while not causing a nuisance to nearby residents.
- Variety: A range of open space types should be considered having regard to existing facilities in the area and the functions the new spaces are intended to provide.
- Shared use: The potential for maximising the use of open space facilities (such as all-weather pitches) should be explored, for example, by sharing them with nearby schools.
- Biodiversity: Public open spaces, especially larger ones, should provide for a range of natural habitats and can facilitate the preservation of flora and fauna. Sustainable Urban Drainage Systems are often used to reduce the impact of urban runoff on the aquatic environment.
- Provision for allotments and community gardens: Allotments are small plots of land which are let (usually by a local authority) to individuals for the cultivation of vegetables and plants. They are of particular value in higher density areas.

It is advised that landscape architects and a suitably qualified design team be appointed to ensure the delivery of a well-placed park that meets all these requirements and more.

Waterford Greenway, Co. Waterford, Ireland

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rural Settlements

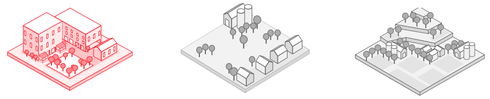
Habitat Creation on Buildings

UNSDGS

Key Societal Challenges

Biodiversity, Climate resilience

Settlement Types



Immediate Environments

Timelines

Immediate (<1 year)

Life span

Short - Medium Term (1-10 years)

Life cycle cost

€

Link

https://www.heritagecouncil.ie/content/files/Wildlife-in-Buildings-linking-our-built-and-natural-heritage.pdf

https://www.jll.ie/en/trends-and-insights/cities/why-the-rooftops-are-alive-with-the-buzz-of-bees / Bee highway project

Description

Buildings are an integral component of urban areas, meaning habitat creation in buildings is a solution that helps restore, preserve and enhance biodiversity within urban settlements. The expansion of the modern built environment can have a negative effect on biodiversity, but it can creates opportunities for wildlife. As humans have created structures for shelter, wildlife also uses these same structures for shelter and protection. The implementation of different technical solutions for the creation of habitats for wildlife (insects, bees, small birds, etc.) supports biodiversity and should have a net positive effect. Buildings can create biodiversity-sensitive spaces and become part of larger systems like ecological corridors, etc. Understanding why wildlife interacts with buildings is essential for ensuring that sites are suitable

Habitat creation is in synergy with green roofs and walls, as well as a varied typology of structures from old abandoned buildings to modern buildings. New buildings can incorporate species-specific friendly building components such as bat blocks and beehives or can be designed to be a new habitat in its own right.

Lifecycle Pointers

- The creation of a new habitat needs to be approached in a way that is feasible, effective and suitable, where the scale of the development or intervention will require different planning and design processes.
- Initially understanding the area and existing features is important before enhancements are made as any changes can impact animals presently associated.
- Define spaces that are accessible and could host green surfaces, hives, animal shelters, etc. Make sure these spaces are easy to access and are not in conflict with technical aspects of the building (fire exits, vents, etc.).
- Identify flowers and other plants that could provide nutrients and attract insects and small birds. Determine water supplies and needs and maintenance requirements of the species or habitat.
- Consider the seasons and define the target species.
- Manage the presence of species that could create discomfort for building inhabitants. Ensure that people, pets and traffic will not disturb the species.

Alvéole's Urban Beekeepers

Mellor Primary School, Stockport © Beccy Lane

Back to Interventions Tool for:

Urban Core

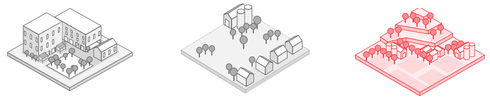
Kelp Forest

UNSDGS

Key Societal Challenges

Placemaking, Biodiversity, Climate Change, Water Security, Food Security

Settlement Types



Immediate Environments

Timelines

Immediate (plants grow very rapidly>1 year)

Life span

Long term (>50 years)

Life cycle cost

€ €

Link

Restoring Kelp Forest Habitat - Project Watershed / Kelp beds and forests | The Wildlife Trusts

Description

Kelp is the name given to several species of large brown seaweed that grow in cold-water either in tidal areas or in clear waters up to 45m deep. Kelp forests are underwater habitats. They are amongst the most productive ecosystems on the planet. Kelp forests provide a wide range of ecosystem services: increasing fish stocks; de-acidifying marine water; provision of employment for coastal communities; storing carbon; creating marine habitat; filtering excess nutrients; enhancing biodiversity; supporting the coastal food-web; and oxygenating marine water.

Planning a kelp forest is still a very new concept and few experiments have shown encouraging results as well as difficulties.

Lifecycle Pointers

- Assess the existing population of kelp along the studied coast and use this to inform the location of seed planting.
- Assess predator prey dynamics in the studied location. If urchins (kelp predators) don't have sufficient predators (rock lobster or seals) they may threaten kelp development. A predator exclusion cage may required to start the development of the plant. These cages can be removed when the Kelp Forest is strong enough to resist over predation.
- Establish a mooring system to withstand the expected drag from tidal and wind driven currents. Use information on strom wind direction, maximum fetch, and wave height and period. Install a lattice and flotation system to support culture system.
- Install grow lines just before seeding. Plant out saprophytes seeded on twine.
- Monitor early survivorship and growth rates.
- Plan for harvesting, processing and marketing.
- Consider developing synergetic relationships. Farming kelp alongside shellfish may offer growers a way to buffer vulnerable oysters and mussels from corrosive effects of ocean acidification or the effects of storms. If harvested, kelp may be used as a compost and the carbon and nutrients integrated into the soil. Kelp also presents a versatile and nutritious food source.

Sound of Barra, Scotland

Ancient Kelp forest, Bantry Bay, Co. Cork, Ireland

Back to Interventions Tool for:

Rural Settlements

Living Seawalls

UNSDGS

Key Societal Challenges

Biodiversity, Climate Change

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Medium-Long term (10-50 years)

Life cycle cost

€ - € € €

Links

https://www.livingseawalls.com.au/

Description

Living seawalls are enhancing biodiversity by adding complex habitats to seawalls that support marine life which helps to conserve or restore native species diversity. Living seawalls can be made using artificial rock pools, pits and crevices on breakwaters; precast habitat enhancement units; varied stone sizes in gabion baskets; 3D printed modular tiles that mimic natural features; and by encouraging the establishment of native habitats.

Lifecycle Pointers

- Actively work with ecologists to identify a biodiversity goal. Consider the potential levels of intervention that are possible or necessary to achieve the biodiversity goal.
- Consider which factors are uncontrollable (i.e., tidal range, wave action, sediment supply and dynamics), and controllable (hardness of rock in artificial structure, water-retaining features, habitat creation of target species).
- Ensure the whole ecology of the target species is well-considered.
- Consult engineers at the planning phase to allow for more imaginative, larger scale and cheaper interventions that ensure any potential negative effects on performance of the artificial structure is negligible. If structures are built in a rocky setting, mimic as close as possible the natural conditions. If structures are built in a sedimentary setting, design to mitigate as much as possible changes to these habitats.
- Match natural patterns in topography to create a mosaic of habitats operating at a variety of scales.
- Use a mixture of local rock types and seek to achieve heterogeneity in rock quality and characteristics. If rock pools are common in the area incorporate water retaining features.
- Avoid areas that are in proximity to places susceptible to species introductions (e.g., ports). This will minimise the colonisation of invasive species, reduce the amount of maintenance work needed or other severe disturbances, and promote the establishment of diverse native habitats.
- Minimise scouring and maintenance. Actively manage desired target species if natural colonisation potential is low.

Sydney, Australia

Sydney, Australia

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rural Settlements

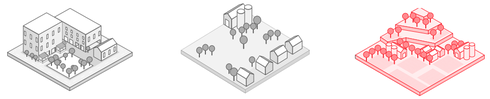
Managed Coastal Realignment

UNSDGS

Key Societal Challenges

Water security, Climate change

Settlement Types



Immediate Environments

Timelines

Immediate (for Coastal work) – Medium term (for intertidal habitats)

Life span

Long term >50years

Life cycle cost

€ € €

Link

The Medmerry project for intertidal habitat restoration with managed coastal realignment : Nature-based Solutions case studies (naturebasedsolutionsinitiative.org)

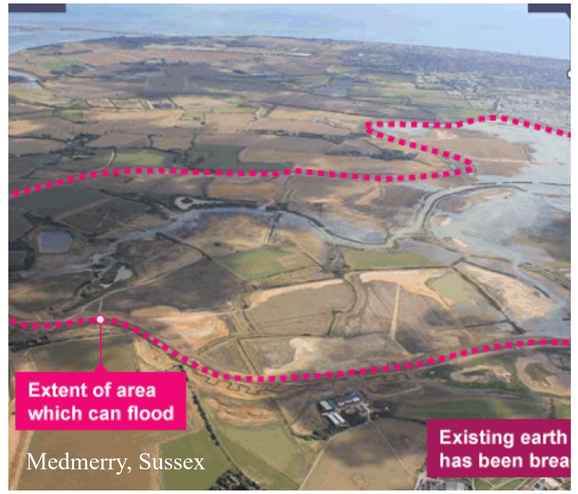
Description

This coastal management technique requires making new intertidal zones between the sea and the land where the sea is allowed to flood the land. Managed realignment usually results in the creation of a salt marsh or mudflat by removing coastal protection and allowing for an area previously protected from flooding to become flooded. Managed realignment can be a response to sea level rise and coastal erosion. Rather than relying on hard structures for defence, managed realignment depends on natural defences to absorb or dissipate the force of waves.

Realignment is considered a soft measure and can significantly reduce the cost of protection against coastal flooding and erosion. Intertidal habitats reduce the energy and inertia of incoming waves and thus the damage that they do.

Lifecycle Pointers

- Consider the following conditions when undertaking managed realignment: presence of coastal defences; availability of low-lying land; desire or need to improve flood or coastal defence systems; desire or need to create intertidal habitats; presence of sustainability-orientated stakeholders; and societal awareness about the benefits of managed realignment.
- Undertake economic assessments to understand the impact of the measure including potential gain in ecosystem diversity, value of ecotourism activities, benefits to water quality, the loss of land, cost of relocating coastal infrastructure and compensation to landowners.
- Undertake stakeholder engagement to understand public acceptance and any landowner conflicts resulting from relinquishing land to the coast. Ensure there is a participatory process in decision making and planning.
- Evaluate the feasibility and effects of this approach in the specific location. The approach is not suitable for all environments as wetlands and saltmarshes typically occur in locations with low wave energy and high volumes of available sediment.
- This approach isn't appropriate for all environments as wetlands and saltmarshes tend to occur where wave energy is low and where a high volume of sediment is available. Intertidal habitats won't settle in areas where conditions are different. Relocation of coastal infrastructure can also be subject to high costs.
- Created saltmarshes can become new tourist sites, therefore, consider the regulation of activities and access during flooding events.



Back to Interventions Tool for:

Rural Settlements

Natural Riverbank Stabilisation

UNSDGS

Key Societal Challenges

Water Security, Biodiversity

Settlement Types

Immediate Environments

Timelines

Short term (<1 year)

Life span

Medium term (5 to 20 years)

Life cycle cost

€ - € €

Link

MPSection4 (menlopark.org

Description

Riverbank represents both natural and artificial terrain following the river flow. Many artificial banks were built with concrete or other types of retention walls, therefore limiting rivers' natural movements, leading to degradation of the river, increased water flow, increased erosion and decreased biodiversity. Riverbank stabilisation consists of using ecological components to stabilise the bank and reverse the damage done by concrete and other hard interventions. Article 10 of the Habitats Directive promotes the natural rivers which are "essential for the migration, dispersal and genetic exchange of wild species"

Lifecycle Pointers

- Engage an ecologist or landscape architect to ensure that the aquatic habitats that are created align with the restored natural features of the river and the slowing down of the flow. The re-introduction of riparian vegetation on the banks will be a source of new riparian habitats.
- Undertake appropriate analysis to ensure the right Nature-based Solutions are used for this measure. Several solutions can be employed with very different effectiveness. It is important to undertake analysis of the local needs to choose the best river bank stabilisation approach.
- When choosing the appropriate stabilisation approach, consider the effort and cost associated with monitoring of the intervention to keep it efficient and prevent deterioration as well as to maintain the vegetation and the stabilisation system.
- Establish the appropriate dimensions and space for the intervention this will depend on the dimensions of the river and for large rivers may stretch tens of meters on both sides of the river all the banks.
- This measure may be considered alongside re-naturalisation of rivers and the creation of wetlands.

Natural Riverbank Stabilisation, Riverbank reinforcement, Wales

Aqua rock bags, Cumbria

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rural Settlements

Native Oyster Restoration

UNSDGS

Key Societal Challenges

Placemaking, Biodiversity, Climate Resilience, Food Security, Water Quality

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Medium – Long term (up to 20 years)

Life cycle cost

€ € €

Links

https://nativeoysternetwork.org/portfolio/deep/

Description

Native Oyster Restoration is the process of establishing or re-establishing communities of or habitats for native oysters. Native Oysters provide a range of ecosystem services and hold both economic and environmental importance. The significant decline of native oyster populations across Europe has highlighted the need for active intervention to recover this species from the brink of extinction. A single European native oyster (Ostrea edulis) can filter 200 litres of seawater per day, significantly improving water quality and clarity. Oysters can also absorb excess nutrients and promote microbial activity in sediments to identify the water body. Native oysters create complex three-dimensional habitats that support higher biodiversity and biomass of species than the surrounding seabed. Oyster reefs can increase fish production by providing a protective nursery for young fish. Protecting restoration areas can lead to larvae spillover that may seed and support sustainable fisheries.

Lifecycle Pointers

- Work with an ecologist and specialist organisations such as the European Native Oyster Restoration Alliance (NORA).
- Undertake a feasibility study, baseline surveys to identify a suitable site.
- Ensure the selected site is within the biological range and environmental tolerances of the native oyster to maximise the restoration potential.
- Consider the logistics and license requirements of the project and plan for these in terms of cost, time and resources. The following competent authorities and advisory agencies should be considered in engagements: Aquaculture and Foreshore Management Division; Department of Housing Planning, and Local Government; National Parks and Wildlife Service; Marine Institute; Bord Iascaigh Mhara; and the EPA.
- If working in a Marine Protected Area, engage with statutory agencies early in the process.
- Set clear, measurable goals and targets for the project. Use KPIs that will allow measurement of success and progress.
- Engage key local stakeholders to ensure local ecological knowledge is incorporated into the project design and to maximise stakeholder engagement and support.
- To select an appropriate restoration approach, determine if an area is limited by the size of oyster population/ insufficient larvae or by the suitability of substrate for larvae to settle on, or both.
- Native oysters can be obtained through hatcheries, spatting ponds, fisheries, or by natural recruitment.
- Consider the biosecurity risk. Aim to avoid the translocation of material and species from one water body to another. Assess sites and oysters for biosecurity.
- Oysters should be deployed in early summer (May/June) before spawning in July.
- Assess project progress by undertaking regular monitoring. Metrics should include: project footprint, oyster habitat area, oyster density, oyster size frequency, temperature and salinity.
- Mitigation programmes to remove introduced oyster populations from areas may be required to reduce competition as part of maintenance.

Letterfrack, Connemara, Co. Galway, Ireland

Back to Interventions Tool for:

Brownfield/
Urban Fringe

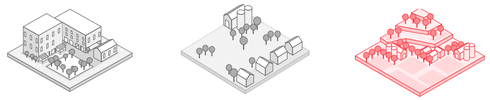
Native Woodland Creation

UNSDGS

Key Societal Challenges

Placemaking, Climate Resilience, Biodiversity, Water Security, Food Security

Settlement Types



Immediate Environments

Timelines

Medium Term(10years)

Life span

Long Term (50years)

Life cycle cost

€ €

Links

https://www.teagasc.ie/crops/forestry/grants/establishment-grants/native-woodland-establishment/

The Classification of Native Woodlands in Ireland and its Application to Native Woodland Management

Description

Native woodlands are an important part of Ireland's natural heritage, history and culture and are among the richest habitats for biodiversity in this country. Woodland is defined by an area of trees over 10m2. Woodlands are typically characterised by well-developed layers including the canopy, shrub, dwarf shrub and ground layer. Native species are important as they tend to be better integrated into our woodland communities ad a more stable component of woodland ecosystems that have shown themselves to be resilient and well adapted. There are four principle native woodland types in Ireland: oak woodlands, ash woodlands, alder woodlands and birch woodlands. There are a further 22-subtypes which represent variations in the soil or hydrological regime and current/historic management. Native woodland creation is important in relation to carbon capture and water protection. The strategic planting of native woodlands can improve water quality and help reduce the risk and severity of flooding.

Lifecycle Pointers

- The Native Woodland Establishment Scheme (NWS Est.) supports the establishment of new native woodlands on 'green field' sites. Its focus is on native species, minimal site disturbance and long-term 'close-to-nature' management. High biodiversity habitats that correspond to Annex I listed habitats (EU Habitats Directive (92/43/EEC) are not eligible under NWS Establishment.
- The Government's Creation of Woodland on Public Lands Scheme offers grants to establish new native woodlands on bare lands.
- Selection of native tree species should be informed by soil type, altitude, and other soil related factors. When choosing a species composition, aim to move towards mixed species stands. A useful tool for identifying the most appropriate native woodland type to plant is the Native Woodland Scheme Framework (PDF).
- Consider the effects of grazing on the structure and species composition of woodland. Overgrazing may prevent regeneration of trees and shrubs and lead to the absence of a shrub layer and a monoculture of certain herbs and grasses. Preventing grazing in a woodland can result in prolific regeneration and dominance of a single species.
- Maintenance activities should consider thinning and cutting under-storey; felling and coppicing; restocking and regenerating; opening up rides; deer and grazing management; conserving deadwood and veteran trees.
- The carbon stored within soils, understorey and canopy trees of native woodland is significant. Consider ways to conserve and enhance carbon stores when developing a harvesting plan.
- Harvesting methods, machines and routes should be chosen to minimise disturbance of sensitive areas.

Clogrennane Wood, Co. Carlow, Ireland

Sika deer in Wicklow forest, Co. Wicklow, Ireland

Back to Interventions Tool for:

Rural Settlements

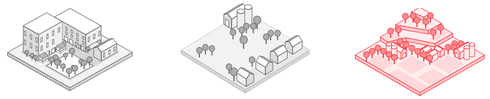
Native Woodland Restoration / Conservation

UNSDGS

Key Societal Challenges

Placemaking, Climate resilience, Biodiversity, Food security, Water Security, A healthy population

Settlement Types



Immediate Environments

Timelines

Medium Term(10years)

Life span

Long Term (50years)

Life cycle cost

€ €

Link

https://www.coillte.ie/our-business/our-projects/priority-woodland-habitats/

Description

Native woodland (>10m2) are diverse ecosystems that have often developed over hundreds of years. Restoration and conservation of native woodlands involves securing features from the former ancient semi-natural woodland, removing introduced species of trees and plants, encouraging the re-establishment of native species; and initiating or enhancing ecological processes which may be absent or damaged (such as appropriate grazing regimes).

Old native woodlands are still to be found as small, scattered stands in Ireland and in larger areas within old estates. Native woodlands have also developed in recent decades on abandoned rough pasture in uplands and on cutaway bog, especially in the midlands. The importance of our native woodlands has been recognised under the EU Habitats Directive, as demonstrated by the inclusion under Annex I of five woodland habitat types of relevance to Ireland, and the designation of numerous woodlands as Special Areas of Conservation (SACs), forming part of the European-wide Natura 2000 network.

Lifecycle Pointers

- Engage a native woodlands ecologist. Native Woodlands ecologists identified by the government can be found on a list here.
- At the needs identification stage, assess the health of the existing woodland and the pressures that impact it. Consider the possible species to be restored and maintained for each different location/scope. Consider which species need to be removed. Consider the feasibility of adopting new management practices. Bring in experts to advise as appropriate.
- For a description of Ireland's native woodlands and their associated flora and fauna see 'Ireland's Woodland Heritage' a booklet by the National Parks and Wildlife Service
- If there are a range of potential sites existing and resources are limited, undertake a process of prioritisation to identify those sites which would deliver the greatest benefits to biodiversity. Prioritisation should consider the following ecological criteria:
- See the native woodland conservation scheme for available grants. The scheme priorities sites of high ecological significance and sites where native woodland restoration will deliver benefits in protecting riparian and aquatic habitats.
- Consider the threats posed by Ash Dieback, Sudden Oak Death and invasive species, Plan a coordinated approach to these with stakeholders.
- Engage a registered forester. See list here.

Kilanerin-Curragh Wood, Co.Wexford, Ireland

Kelly's Wood, New Ross, Co.Wexford, Ireland

Back to Interventions Tool for:

Rural Settlements

Parks (Local-Regional)

UNSDGS

Key Societal Challenges

Climate resilience, Biodiversity, A Healthy Population

Settlement Types

Immediate Environments

Timelines

Medium Term (10 years)

Life span

Medium-Long Term (10-50 years)

Life cycle cost

€ € - € € €

Link

https://www.dublincity.ie/sites/default/files/2020-11/dublin-city-parks-strategy-2019-2022-part-1.pdf

Description

A park is an area of natural, semi-natural or designed public open space used for recreation and the protection of wildlife or natural habitats. Parks are fundamental in the evolution of healthy, liveable cities and settlements contributing positively to the needs of people and playing a critical environmental role. Today's parks need to be multi-generational and multi-functional, requiring designs and plans that create spaces that accommodate all ages. The design and management of parks is informed by current practices of urban planning, design attitudes, modes of recreation, philosophies of landscape preservation, and beneficial social interaction. The size and scale of a park must comply with the development plan of each local authority (see the link to Dublin City Council's parks strategy as an example). Parks must contribute positively to biodiversity and wider ecosystems to qualify as a nature-based solution or intervention. Changes in seed sowing, management regimes and water management can all boost the biodiversity and habitat value of existing parks and green spaces.

Lifecycle Pointers

Factors for the design of successful parks as stated in the 'Sustainable Residential Development in Urban Areas, Guidelines for Planning Authorities', published in 2009 include:

- Design: The layout and facilities – particularly in larger parks – should be designed to meet a range of user needs, including both active and passive recreation.
- Accessibility: Local parks should be located to be within not more than 10 minutes' walk of the majority of homes in the area; district parks should be on public transport routes as well as pedestrian/ cycle paths. Playgrounds should be carefully sited within residential areas so that they are both easily accessible and overlooked by dwellings, while not causing a nuisance to nearby residents.
- Variety: A range of open space types should be considered having regard to existing facilities in the area and the functions the new spaces are intended to provide.
- Shared use: The potential for maximising the use of open space facilities (such as all-weather pitches) should be explored, for example, by sharing them with nearby schools.
- Biodiversity: Public open spaces, especially larger ones, should provide for a range of natural habitats and can facilitate the preservation of flora and fauna. Sustainable Urban Drainage Systems are often used to reduce the impact of urban runoff on the aquatic environment.
- Provision for allotments and community gardens: Allotments are small plots of land which are let (usually by a local authority) to individuals for the cultivation of vegetables and plants. They are of particular value in higher density areas.

It is advised that landscape architects and a suitably qualified design team be appointed to ensure the delivery of a well-placed park that meets all these requirements and more.

Phoenix Park, Dublin, Ireland

Mardyke Gardens, Co. Cork, Ireland

Back to Interventions Tool for:

Urban Core | Brownfield/ Urban Fringe | Rural Settlements

Permeable Pavements/Surfaces

UNSDGS

Key Societal Challenges

Climate resilience, Placemaking, Water Security

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Long Term (50 years)

Life cycle cost

€ €

Link

https://www.ors.ie/wp-content/uploads/CIRIA-report-C753-The-SuDS-Manual-v6.pdf

Description

Permeable surfaces consist of a variety of types of pavement, pavers and other devices that provide stormwater infiltration while serving as structural surface. Those are welcome in parking spaces, large, asphalted areas, streets, open spaces and walkways. Permeable surfaces are often reducing heat at ground level. Options include permeable interlocking concrete pavers, concrete grid pavers, previous pavements and plastic reinforcing grids.

Permeable paving can be an effective feature in sustainable water management. However, in isolation the contribution of permeable paving is very limited because it does not itself contribute to any new habitats or attract biodiversity benefits.

Lifecycle Pointers

- This solution typically takes runoff from only the permeable area itself. This can correspond to any size. If appropriate use the permeable paving to collect drainage from the surrounding area, limited to the maximum sub-base volume it can hold.
- Assess the effects of water storage on the structural capacity of the underlying soils. Slopes and collection systems should be employed to manage ponding water.
- Consider the potential for pollution to groundwater if there is infiltration. Ensure that all components of the permeable paving are composed of inert materials to avoid contributing to pollution.
- Design the permeable pavement/surface to withstand storm events and be able to discharge storm water in a controlled manner to the sub-grade or drainage system. Design the pavement to withstand the loadings of vehicles above.
- If infiltration under the permeable paving could lead to slope or foundation instability, apply a lined sub-base to control drainage towards an outflow from the pavement. If planning to use an unlined permeable paving on embankments, cuttings and close to foundations, a qualified engineering geologist will be required to undertake a geotechnical survey
- Use internal dams on steeper slopes to control drainage flow and maximise sub-base storage. However the slope should not be greater than 2.5% to avoid surface runoff.
- Maintenance activities include: monitoring weed growth and sediment build up; monitoring slabs and sub-base for damage; cleaning of the system once a year to prevent clogging; brushing and vacuuming or the use of pressurised water hoses; stabilising and mowing adjacent areas; cleaning silt build up in sub-layer; repairing broken slabs.

University of Salford, UK

Escofet, Spain

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Ponds

UNSDGS

Key Societal Challenges

Biodiversity, Water Security, Place making

Settlement Types

Immediate Environments

Timelines

Medium term (<10 years)

Life span

Long term (>50 years)

Life cycle cost

€ - € €

Link

Why Ponds are Important to the Environment (How you can help) - Pond Informer

Description

Ponds are bodies of water that store surface run-off. A pond, as distinct from a detention basin, contains water in both dry and wet weather, and is designed to hold more water when it rains. Ponds can be created in almost any available open area that is relatively flat and has an appropriately- seized drainage catchment. The size of a pond will depend on factors like topography, the effective contributing areas, and the dynamics between incoming and discharged water. Ponds require large accessible areas that are relatively flat and have an appropriately sized drainage catchment. Ponds create a relatively stable aquatic environment for aquatic species. Article 10 of the Habitats Directive promotes the ponds which are "essential for the migration, dispersal and genetic exchange of wild species", and highlights that "stepping stones (such as ponds)" are of the utmost importance for those species.

Lifecycle Pointers

- Adapt the size of the pond to the drainage area. The typical depth is 3-5m and typical size is 500-5000m3. The depth and size will depend on the drainage area. For drainage areas of less than 3 hectares, the outlet throttle diameter would be very small (<150mm) to reduce outflow rates. This increases the risk of blockage. Install multiple ponds to treat large drainage areas.
- Consider the underlying geology and water table when designing a pond and the potential for increased infiltration and or groundwater recharge.
- If a pond is intended to intercept pollution pathways, consider the settlement of particulate pollutants and pollutant uptake by vegetation at the design phase and plan for adequate maintenance regimes.
- Make the pond as level as possible to maximise the storage and infiltration potential and to minimise erosion. Do not install a pond on a slope great than 30º.
- Analyse the soil conditions to determine how the proposed pond should be constructed. There are no specific conditions on soil permeability or depth.
- As appropriate engage an ecologist or landscape architect to determine the plant selection and provision of habitats for wildlife.
- Undertake quarterly inspections of inlets and outlets as well as sediment and waste dredging. Seasonal mowing around the pond margins may be required.

Father Collins Park, Co. Dublin, Ireland

Mardyke Gardens, Co. Cork, Ireland

Back to Interventions Tool for:

Brownfield/ Urban Fringe

Rural Settlements

Rain Gardens

UNSDGS

Key Societal Challenges

Climate resilience, Biodiversity, Water Security, Placemaking

Settlement Types

Immediate Environments

Timelines

Immediate (<1year)

Life span

Medium Term (10 years)

Life cycle cost

€

Link

https://www.urbandesignlondon.com/documents/85/UDL_Rain_Gardens_for_web_0vwx1Ls.pdf

Description

Rain gardens are made by a shallow depression, with absorbent, yet free draining soil and planted with vegetation that can withstand occasional temporary flooding. Rain gardens are designed to mimic the natural water retention of undeveloped land and to reduce the volume of rainwater running off into drains from impervious areas and treat low level pollution. Rain Gardens work in synergies with channels, rills and green areas. These are often proposed after de-paving interventions and or pavement refurbishment.

Rain gardens use a range of components and are typically incorporated into the garden/verge landscape design as appropriate. Components can include: grass filter strips to reduce incoming runoff flow velocities and to filter particulates; ponding areas for temporary storage of surface water; organic/mulch areas for filtration and to create an environment conducive to micro-organisms; planting soil, for filtration and as a planting medium; woody and herbaceous plants; and sand beds for drainage and aerobic conditions.

Lifecycle Pointers

- Apply rain gardens in the following CORINE land uses: Urban Fabric; Industrial/Commercial/Transport Units; Artificial non-Agricultural Vegetated Areas.
- Consider weather data to understand precipitation levels and trends.
- Define drainage capacity and overflows management (existing drain/alternative drain).
- Consider slope and existing context to shape solutions (distance from existing buildings, piping, width, length, raised edges, etc.) Maintain at least 3m from buildings basement. Minimum width for rain garden is 1.5m, ideal width is between 3 to 5m. Length extension is mainly limited by slope (gradient more than about 12% may require retaining structures) and presence of walkways, private driveways, etc.
- Avoid interference with existing electrical ICT conducts/systems. Define plumbing to guide water flow to existing underground sewers.
- When choosing plants, consider height, colour and flowering period. Adopt native species to attract bees and other wildlife.
- Create a densely vegetated, stable and thriving bed with dense and thick root systems which will thrive without frequent maintenance. A typical planting density is 6-10 plants per square metre but may vary depending on the size and nature of the plants chosen.
- Occasional weeding may be required during the first two years of the life of the rain garden. As the plants in the beds mature, they will fill in any gaps and suppress weed growth.

Grey to Green Project, Sheffield, UK

Greener Grangetown, Cardiff, Wales

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rainwater Harvesting

UNSDGS

Key Societal Challenges

Climate resilience, Water security

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Medium-Long term (10-50 years)

Life cycle cost

€ €

Link

https://www.ors.ie/wp-content/uploads/CIRIA-report-C753-The-SuDS-Manual-v6.pdf

Description

Rainwater is the collection and storage of rain for reuse on-site, rather than allowing it to run off. There are two ways of harvesting rainwater: surface runoff harvesting and rooftop rainwater harvesting. The stored water is used for various purposes, such as gardening, irrigation, etc. This practice is important to improve resiliency, reducing the demand of water especially in drought periods, and for contributing to the maintenance of green spaces. Rainwater harvesting works in synergy with rain gardens, swales, channels, rills and parks. The main challenge is related to the water storage which can have a major impact for some solutions (e.g., tanks).

Lifecycle Pointers

- Consider weather data to understand precipitation levels and trends. Define different solutions that could provide more complexity and resiliency to the system, combining different elements (ponds, rills, permeable soils, etc.).
- Define the proper filtration system to release cleaner water into the environment and reduce pollutants. Evaluate the use of artificial systems (tanks/plumbs) especially for high demand or large areas. Investigate soil composition and existing infrastructure.
- In the design phase, consider solutions that could be efficient and avoid high maintenance costs (avoiding, where possible to dig the ground).
- Depending on the application (i.e., domestic use, agriculture, industry) define the water cycle to avoid introducing pollutants to the soil. For domestic uses, it is possible to provide drinking water, domestic water, water for livestock, water for small irrigation. In rural areas, develop rainwater harvesting solutions can reduce runoff and floods.
- Rainwater harvesting systems can range in complexity, from systems that can be installed with minimal skills, to automated systems that require advanced setup and installation. There are common components that are installed in such systems, such as pre-filters, drains/gutters, storage containers, and depending on whether the system is pressurized, also pumps, and treatment devices such as UV lights, chlorination devices and post-filtration equipment

Faroe Islands, North Atlantic

Rainwater Harvesting, Antony, France

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rural Settlements

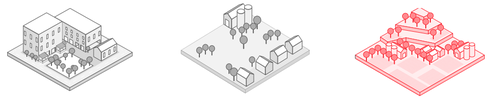
River Re-Meandering

UNSDGS

Key Societal Challenges

Climate resilience, Biodiversity, Water security

Settlement Types



Immediate Environments

Timelines

Medium Term(10years)

Life span

Long Term (50years)

Life cycle cost

€ € €

Link

http://nwrm.eu/sites/default/files/nwrm_ressources/n4_-_re-meandering.pdf

Description

Re-meandering is usually implemented by reconnecting cut-off meanders, floodplain restoration and creation of wetlands. The new form of the river channel creates new flow conditions and very often also has a positive impact on sedimentation and biodiversity. The newly created or reconnected meanders also provide habitats for a wide range of aquatic and land species of plants and animals. River re-meandering consists of creating a new meandering course or reconnecting cut-off meanders, therefore slowing down the river flow. The new form of the river channel creates new flow conditions and very often also has a positive impact on sedimentation and biodiversity.

A stable stream meandering through a restored landscape will produce lush green vegetation, bright flowers, and seeds and fruits that will attract a variety of butterflies, birds, and other wildlife species. Restored river functional areas can be managed as natural or manicured areas, depending on the site and its intended use. Re-meandering slows down flows by increasing channel length.

Lifecycle Pointers

- Engage LAWPRO from the outset of this initiative.
- Select an alluvial system site with conditions in which meanders naturally occur. Implementation sites are likely to be in lowlands (less than 200m), at around 0,5 - 1% slopes.
- The scale at which re-meandering is applied depends on the length of the river.
- The functional area for applying this intervention is the minimal space in which meanders can reach the maximum amplitude they would under natural conditions. Therefore, the width of the area is equal to the maximum amplitude of a meander.
- Re-meandering provides habitat for species such as aquatic plants, otter, salmon, insects and birds, fish, macroinvertebrates, macrophytes and phytoplankton, and kingfishers. The existence of hydraulic annexes, quiet water areas or wet lowlands that can be created by the dynamics of meandering, improves the preservation and resilience of ecological communities and habitats.
- The modification of the erosion process also affects the quality and habitat diversity of benthic fauna and fish, as well as riparian species. The first positive impacts of re-meandering habitat, fauna and flora are visible after about two years, including riparian forest.

Beam Parklands, UK

Back to Interventions Tool for:

Rural Settlements

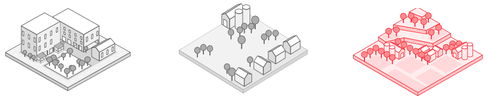
River Renaturalisation

UNSDGS

Key Societal Challenges

Water Security, Biodiversity

Settlement Types



Immediate Environments

Timelines

Medium-Long term (5 to 20 years)

Life span

Long term (>50 years)

Life cycle cost

€ € €

Link

n8_-_riverbed_material_restoration_0.pdf (nwrm.eu)

Description

River renaturalisation consists of removing some concrete or ‘grey’ structures in the riverbed and on riverbanks and replacing them with vegetated ‘green’ structures. Rivers have previously been artificially reconstructed with concrete and large stones which have changed the flows and decreased biodiversity and habitat provision. These changes may have been made to reduce flooding. River renaturalisation can have a large impact on the erosion processes and stabilisation approaches are the main measures to be implemented. The maximum positive impact is achieved when the stabilisation approach restores the vegetation and the naturalness of the banks. Typically, plants are used for bank stablisation.

Lifecycle Pointers

- Assess the current hydrometric character of the river through the project reaches.
- Undertake a topographical survey to characterise the current morphology/ prediction for changes in the hydromorphology in short and long term without and with the proposed physical works.
- Assess the social/economic situation to understand the potential gain or loss due to the restoration options.
- Prioritize individual restoration sites on terms of likely benefits to the restoration of natural processes.
- Consider robust, simple and cost-effective method to monitor the effects of change.
- Estimate the cost of each restoration options.
- In-stream restorations can be boulder weir removal/reduction, bank re-profiling, reinstating side channels/back waters and removal/ reduction of boulder bank protection.
- Remeandering is often used to increase the biological properties of the river (enhancing deposit-erosion process that enables a better transportation of solid sediments).

Thornton Creek, Seattle, USA

River Aire, Geneva, Switzerland

Back to Interventions Tool for:

Rural Settlements

River Restoration/Revitalisation (urban rivers)

UNSDGS

Key Societal Challenges

Water Security, Biodiversity, Place making

Settlement Types

Immediate Environments

Timelines

Medium to long term (2 to 10 years)

Life span

Long term (>50 years)

Life cycle cost

€ € €

Link

European Centre for River Restoration

Description

In urban areas, rivers have often been channelised with concrete banks and culverts, to accommodate development and flood protection. Actions taken to revitalize urban watercourses support the improvement of the condition or ecological potential of waters described in the Water Framework Directive (WFD). In addition to the protection and creation of natural resources as well as high-quality urban space, revitalisation greatly contributes to flood protection by increasing the retention capacity and slowing down the outflow. Restoring and/or re-opening an urban river channel can be very costly and may not be possible along the whole course of the river.

Lifecycle Pointers

- Consider the constraints on the potential for river restoration at your site.
- 'Look' upstream and downstream and at the surrounding area and use this to influence the design. Consider all elements of masterplanning, including water access and transport routes, wider wildlife corridors and sustainable drainage systems in parallel with the river and riverbank design options.
- If the urban river is to restrained to undertake a large-scale restoration, consider in-channel enhancements that introduce additional habitat complexity to improve biodiversity. These may include: narrowing the channel; introducing gravels; adding woody materials; removing or lowering weirs; creating a fish pass; and planting riparian areas or enhancing bank protection.
- If larger scale restoration is possible, floodplain reconnection or re-meandering may be considered. Techniques such as removing or replacing artificial protection, re-meandering, wetland creation, improving surface water outfalls, Sustainable Drainage Systems, daylighting and increased accessibility may be initiated.
- Consider how any existing land or urban drainage strategy will interact with the river works.
- Consider all relevant features of the flood risk management system.
- Encourage native species and natural colonisation to create locally appropriate communities. Ensure that the timing of the planting and pre-establishment of species of the correct genetic strain is appropriate.

Aarhus River Project, Denmark

City River, Seoul, Korea

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Seagrass Meadow Restoration

UNSDGS

Key Societal Challenges

Biodiversity, Water security

Settlement Types

Immediate Environments

Timelines

Medium term (<10years)

Life span

Medium term (25 to 50 years)

Life cycle cost

€ €

Link

Restoring Kelp Forest Habitat - Project Watershed / Kelp beds and forests | The Wildlife Trusts

Description

Seagrass meadows are engineered ecosystems of seagrass species on wave sheltered areas of soft seabed. They provide an important three-dimensional habitat for many species including nursery areas for fish. They are highly productive ecosystems with high biodiversity potential. Seagrass meadows reduce coastal erosion and store large amounts of carbon. Seagrass meadows are found at intertidal zones down to a maximum of 12m. Eutrophication and decreased water quality has led to the loss of many seagrass meadows this may be caused by pollution sources such as sewage, agricultural and urban runoff.

Lifecycle Pointers

- Consider getting permission for a no-anchor zone around newly planted or restored seagrass meadows to help protect it from physical disturbance from boats.
- Locate healthy seagrass meadows from which seagrass seeds for planting can be gathered. Seeds may be gathered on collection dives.
- Seeds will need to be cared for and cultivated. Consider working with the National Aquarium of Ireland, Galway Atlantaquaria.
- Pack seeds into seed bags to plant across the seabed at the restoration site. Engage volunteers to help pack the seeds. Use ethically sources, sustainable hessian bags which will break down naturally on the seabed. Measure between 30 and 50 seeds into each bag.
- Plant the seeds soon after the bags have been packed. Place the bags on the seabed to germinate. Consider sending the bags down long tubes (circa 4m) from the boat to assist them on their journey to the seabed. Bags should be spaced at 1 bag per 50 centimetres to give a sufficient density of plants.
- Establish an advanced mooring system around the seagrass habitat to protect it. Develop a clear set of guidelines for specific vessel and depth combinations.

Kilmore Quay, Co. Waterford, Ireland

Studland Bay, Dorset, UK

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rural Settlements

Sediment Capture Pond

UNSDGS

Key Societal Challenges

Biodiversity, Water Security

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Short to medium term (5 to 10 years)

Life cycle cost

€ € €

Link

How-to-build-a-SRP.pdf (d3kkkvz3vcvzu4.cloudfront.net)

Description

Sediment capture ponds are engineered ponds placed in drainage networks to help slow down the water runoff and the carrying of large quantities of sediments from upstream to downstream. Sediment capture ponds are most useful for managing the effects of ditch construction and maintenance and road work. While used primarily in forests, sediment capture ponds may be a useful temporary measure for preserving water quality in and around construction sites or mines. They may also be useful for capturing sediment in agricultural runoff. It is vital that the Sediment Retention Pond is maintained until the disturbed area is fully protected against erosion by permanent stabilisation. Nitrogen and Sediment capture can also be undertaken by hydroponically growing plants using Floating Treatment Wetland (FTW) : more here.

Lifecycle Pointers

- Can be applied on artificial surfaces, agricultural areas, forests and semi-natural areas and in some wetlands. A relatively small amount of the space (10s metres) is needed for installation of a Sediment Capture Pond in an existing ditch network).
- Apply in upstream drainage areas or catchment areas of 0-10km3. While sediment capture ponds are only effective when they have a small upstream drainage area, their beneficial effects for the aquatic environment are visible in much larger catchments.
- Generally, locate the sediment capture pond on the main ditch before it flows into the watercourse. To establish the exact location consider the ecological conditions, the gradient of the ditch and the river. If the distance between the pond and river is too small, there is a risk of turbulent water movement from the river increasing transport of suspended solids.
- If seeking to store or slow runoff, implement a network of sediment capture ponds across the landscape. Each pond is limited in its ability to store additional runoff by its size and preceding wetness.
- Consider how the sediment capture pond will preserve downstream aquatic habitat by preventing sediment pollution or eutrophication.
- As appropriate, combine this measure with riparian buffer strips, continuous cover forestry and other sustainable forestry management practices.
- Dredge the ponds to clear sediment. The frequency of dredging will depend on the sediment load in the ditches.

Krivany, Slovakia

Norway

Back to Interventions Tool for:

Brownfield/ Urban Fringe

Rural Settlements

Temporary Flood Water Storage

UNSDGS

Key Societal Challenges

Water security, Climate change

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Long term >50 years

Life cycle cost

€ €- € € €

Link

Floodwater Detention and Retention Basins – Naturally Resilient Communities (nrcsolutions.org)

Description

A detention basin is an area that has been designed and designated for the temporary or permanent retention of floodwater during rain or flood events. Detention basins are generally designed in two forms- dry or wet basins. Dry basins retain water only during storm events, later releasing the water at a controlled rate until the basin is empty. Wet basins retain a permanent pool of water, similar to a pond, irrespective of storm events and hence are wet year-round. The depth of the permanent pool of water is generally designed to take into consideration water quality volumes and wet retention basins also act as water treatment devices. Detention basins may only be used for water quantity control. They must be combined with other water quality practices to receive credit for water quality improvements.

Lifecycle Pointers

- To identify where current and potential future flood issues exist - identify middle of the watershed.
- Use subsurface investigation such as testing pits or borings to identify groundwater tables and bedrock.
- Set retention duration goals, assess rain intensity and measure the drainage area to determine the appropriate size of the detention basin.
- Consider taking advantage of naturally low-lying areas next to the main watercourse, or relatively close to regular occurring flooded areas.
- Design riparian inflow and outflow areas to help prevent erosion run-off and changes to the basin profile over time. This will increase the durability of the basin.
- On principal spillways, all basins must have trash racks to control clogging by debris. Self-cleaning racks are preferable.
- Plan for maintenance activities such as periodic removal of sediments and particles, basic mowing, vegetation management and inspection of pipes.

Davis Park, Florida, US

Greater Manchester - Salford

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Urban Forestry

UNSDGS

Key Societal Challenges

Placemaking, Biodiversity, Climate Resilience, Water Security, Food security, A healthy population

Settlement Types

Immediate Environments

Timelines

Medium Term(10years)

Life span

Long Term (50years)

Life cycle cost

€ € €

Link

https://www.tdag.org.uk/trees-in-the-townscape.html

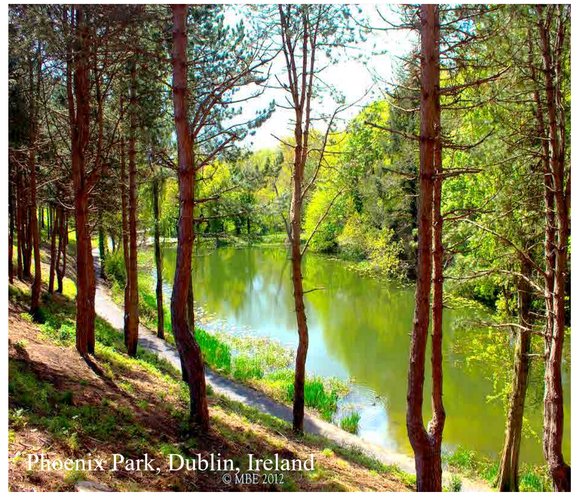
Description

Urban forests are made up of trees and shrubs in an urban area including trees in gardens, along streets and roads, in protected areas, and in watersheds. This includes individual trees, street trees, trees in green spaces and the associated vegetation and soil beneath trees. When well-planned and well-managed urban forests can contribute benefits to physical and mental health, improve air quality, enhance community cohesion, mitigate the heat island effect, amongst other benefits.

The UK Forestry Commission's i-Tree London estimates that London's 8.4 million trees provide more that £133 million worth of benefits each year.

Lifecycle Pointers

- Adopt a right-tree-right-place approach to species selection. Urban forests need to deliver ecological, aesthetic and functional benefits.
- Consider the context where the trees will be hosted, to provide the appropriate technical solution (underground soil, presence of underground facilities, roots growth, tree crown shape and maximum extension, trunk type and dimension, water need, tree-pit minimum dimensions, etc.).
- Apply the 3-30-300 rule as a design principle to provide tangible outcomes on health and wellbeing, as well as climate change adaptation. This rule states: 3 trees from every home, 30% tree canopy cover in every neighbourhood, 300m from the nearest public park or green space.
- Plant no more than 10% of any one species, 20% of any one genus, or 30% of any family.
- The underground and overground conditions within which trees are planted are crucial to their success. Refer to TDAGs publications on trees in hard landscape for further guidance on tree pits and trenches, planting mediums, root barriers, services, retrofitting tree pits and management of the urban forest.



Phoenix Park, Dublin, Ireland
© MBE 2012

Triangle Park, Cambridge, UK

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Urban Trees with bioretention areas

UNSDGS

Key Societal Challenges

Climate resilience, Biodiversity, Placemaking

Settlement Types

Immediate Environments

Timelines

Medium Term (10 years)

Life span

Long Term (50 years)

Life cycle cost

€ €

Link

https://www.tdag.org.uk/trees-in-the-townscape.html

Description

Urban forests provide a wide range of essential benefits. Those could be located in different spaces such as streets, squares, gardens, and green areas. They have a huge impact on local wildlife, mental and physical health, and pollution levels, while also being aesthetically pleasing. Urban forests are in synergy with green areas, sidewalks, and other green spaces that can host them.

Urban trees are often planted in bioretention areas. Bioretention areas are shallow landscaped depressions which usually under drained and depend on engineered soils, enhanced vegetation and filtration to remove pollution and reduce runoff downstream.

Lifecycle Pointers

- Consider the possible species to be adopted for each different location/scope.
- Take into account the context where the trees will be hosted, to provide the appropriate technical solution: underground soil; presence of underground facilities; growth of roots; tree crown shape and maximum extension; trunk type and dimension; water need; and tree-pit minimum dimensions, etc.
- Generally, about 30m^3 of potential rooting volume is needed to allow most tree species a viable chance to successfully establish. If this space is not available, consider the species selection and management of roots.
- In exposed locations, assess the vulnerability to high winds and disturbances from pets, pedestrians and vehicles. If required, choose an appropriate form of support to help the tree establish.
- The 3-30-300 rule is a design principle that can be used to provide tangible outcomes on health and wellbeing, as well as climate change adaptation. This rule stipulates: 3 trees from every home, 30% tree canopy cover in every neighbourhood, 300m from the nearest public park or green space.
- Tag each new tree and map it to monitor its health and better plan for future transformations.
- Test soil infiltration capacity periodically to determine possible clogging. Include seasonal trimming of vegetation as part of maintenance practices.

Northwood Hills, UK

DCU St.Patrick's Campus, Dublin, Ireland

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

Rural Settlements

Vegetated Swales and Ditches

UNSDGS

Key Societal Challenges

Climate Resilience, Biodiversity, Water Security

Settlement Types

Immediate Environments

Timelines

Immediate (<1 year)

Life span

Medium-Long Term (10-50 years)

Life cycle cost

€

Link

https://www.ors.ie/wp-content/uploads/CIRIA-report-C753-The-SuDS-Manual-v6.pdf

Description

A vegetated swale is a broad, shallow, trapezoidal or some cases parabolic channel, densely planted with a variety of trees, shrubs, and/or grasses. It is designed to attenuate and in some cases infiltrate runoff volume from adjacent impervious surfaces, allowing some pollutants to settle out in the process. Vegetated swales are often used as an alternative to, or an enhancement of, traditional stormwater piping. They are commonly integrated into carparks and road meridians and parallel to roadways to infiltrate and treat a portion of the stormwater volume. Rain gardens work in synergy with channels, rills and green areas. These are often integrated into new and upgraded public realm areas and streets.

Lifecycle Pointers

- Use vegetated swales and ditches as the first stage of a SuDs ‘train’ to accept diffuse runoff from nearby impermeable or low permeability areas. They are more effective when receiving diffuse runoff than point inflow. The contributing catchment area will therefore be relatively small such as a car park or road surface.
- Design the swale to have capacity to cope with a once in 10-30 year rain event. Consider swale efficiency has a key feature of its design this will require understanding of the catchment and local landscaping characteristics.
- Where infiltration can occur, consider the potential for pollution to groundwater. This is particularly relevant in if the location has an industrial land use.
- If the swale is intended to retain sediment and particulate pollutants, landscape the swale with denser vegetation.
- Plant the swale with native vegetation to be most effective at enhancing biodiversity.
- Divide large areas and treat these using multiple swales. Do not install vegetated swales in areas with high water tables where the groundwater reaches the bottom of the swale.
- Poorly drained sites may require underdrain system. Slopes greater than 5% may require multiple ditch blocks or weirs perpendicular to the flow to facilitate storage volume and extend time for infiltration. A high flow bypass should be included to safely convey high flows.
- Conduct regular monitoring and maintenance of the vegetation, infiltration capacity, and structures to identify signs of erosion, accumulation of debris and signs of excessive sedimentation.
- Test soil infiltration capacity periodically to determine possible clogging. Include seasonal trimming of vegetation as part of maintenance practices.

Norritonville, Pennsylvania, US

Grey to Green Project, Sheffield, UK

Back to Interventions Tool for:

Urban Core

Brownfield/ Urban Fringe

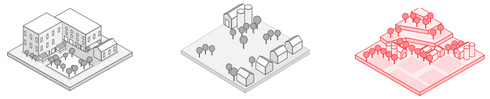
Water Sensitive Forest Management

UNSDGS

Key Societal Challenges

Water Security, Biodiversity

Settlement Types



Immediate Environments

Timelines

Medium to long term (5 to 25 years)

Life span

Long term (>50 years)

Life cycle cost

€ €

Link

Water sensitive forest management — Climate-ADAPT (europa.eu)

Description

This measure can be considered a composite of multiple interventions including measures to increase water yield, regulate water flow, and reduce drought stress for a forest. The effects of forest management on the soil water storage are multiple and diverse. Measures may include: reduced density of standing stocking; shorter length of the cutting cycles; planting hardwood species; regeneration from seedlings rather than sprouts; and afforestation.

Water Sensitive Forest Management is important to maximise the wide range of potential forest benefits without detriment to water resources and ecosystem function. As an example, forest managers may wish to consider the species and quantity of trees that are planted as this will affect the demand for water and may create a stress around the new planted zone.

Lifecycle Pointers

- Key stakeholders to implement this intervention will be river managers, farmers, forest services, National Parks and Wildlife Service, Coillte and Local Authorities.
- Select water-related indicators that give information about the general status of forest water resources for the site. These may include measurement of water bodies; the height of the water table; and volume of precipitation. These indicators may fluctuate seasonally and from year to year so choose a reliable period to observe long-term trends (8-10 years).
- In the operation and maintenance of the forest, aim to maintain permanent vegetation cover, limit the compaction of soils, maintain a high amount of organic matter in the soil and increase the unevenness of the soil surface.
- Establish good tree cover with healthy undergrowth to minimise water sediments.
- Plan for forest extraction that will minimise sediment production from roads, log landings, skid trails and soil compaction.
- Consider risks of and effects to water quality, landslip and biodiversity from tree removal. Slip-prone areas should be kept forested to reduce the occurrence and severity of shallow landslips. Tree harvesting in slip-prone areas should be light and non-mechanised.

Phoenix Park, Dublin, Ireland

Water Sensitive Forest Management, Florence, Alabama

Back to Interventions Tool for:

Rural Settlements

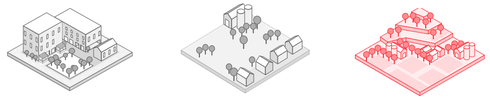
Wetland Creation/Extensions

UNSDGS

Key Societal Challenges

Placemaking, Biodiversity, Water Security

Settlement Types



Immediate Environments

Timelines

Medium to long term (5-25 years)

Life span

Long term (>50 years)

Life cycle cost

€ €

Link

Wetland Restoration and Creation (usgs.gov)

Description

Wetland creation or extension is when areas where water covers the soil or is present either at or near the surface of the soil, are created/extended. Water saturation (hydrology) is the main decider of how the soil develops and the types of species and communities that live on and in the soil. The creation/extension of wetlands support both aquatic and terrestrial species. The prolonged presence of water means that conditions favour the growth of specially adapted plants and promote the development of wetland (hydric) soils. Wetlands can be characterised as either coastal or tidal wetlands or as inland or non-tidal wetlands.

Restoration and creation can help maintain the biodiversity benefits of wetlands and their surrounding ecosystems, and at the same time provide water-quality improvement, flood attenuation, aesthetics, and recreational opportunities. Restoring a former wetland can be complex if the soil has been used for other activities.

Lifecycle Pointers

- Determine the hydrology of the site. Establish the source of water and the elevations throughout the year.
- Determine the soils present at the site. Consider if they are sufficient to allow proper permeability and rich enough for plant development. Determine if the roots of the vegetation will get established in the soil.
- Answer the following questions: ‘Which is more important, the existing or the replacement function?’ or ‘Will the proposed wetland increase wildlife diversity?’ or ‘Is the increases diversity worth the loss of habitat of any endangered species?’
- Design the size, shape and plant community for the project. Consider the soil, hydrology and project goals. Project wetlands that are designed to be self-sustaining or self-managing will have the best chance of survival. The installation of control structures, such as tide gates or pumps, that will require maintenance and are subject to vandalism could be disadvantageous to the life of the project wetland.
- To increase the likelihood of successful colonization, select herbaceous species that rapidly stabilize the substrate and that have potential value for fish and wildlife. Select species that are adaptable to a broad range of water depths. Avoid choosing only those species that are foraged by wildlife expected to use the site-muskrats and geese have been known to denude sites. Avoid committing significant areas of the site to species that have questionable potential for successful establishment
- After construction and planting, undertake annual evaluations during and at the end of the growing season for five years. Monitoring criteria may include: water permanence; wetland size; water quality; percentage vegetative cover; vegetative composition; species diversity; and presence of undesired plants or animals.
- Take fixed point photographs as part of the annual monitoring.

Dunmore East, Co.Waterford, Ireland

Cabragh Wetlands, Co. Tipperary, Ireland

Back to Interventions Tool for:

Rural Settlements

Wildlife Corridors

UNSDGS

Key Societal Challenges

Biodiversity

Settlement Types

Immediate Environments

Timelines

Short – medium term (1 to 5 years)

Life span

Long term (>50 years)

Life cycle cost

€ - € € €

Link

C:\Inetpub\wwwroot\Programs\sprawl\wild-corridors.prn.pdf (biologicaldiversity.org)

Description

Wildlife corridors are contiguous natural areas that can increase the genetic diversity of native flora and fauna and encourage the survival or rare, threatened, and endangered species that are isolated. In fragmented habitats, restoring connectivity between different patches of the habitat may help to limit negative impacts on biodiversity. Typically, the smaller and more isolated the patches of habitat, the greater the need for wildlife corridors to enable wildlife to disperse and migrate between areas. The ecological value of a corridor is dependent on its design and on the characteristics on each species. In cases where some development may be acceptable, corridors can be incorporated into the design of a development project by conserving an existing landscape linkage or restoring habitat to function as a connection between larger protected areas

Lifecycle Pointers

- Identify the habitat areas the corridor is designed to connect.
- Select several target species for the design of the corridor (i.e., select "umbrella species"). Evaluate the relevant needs of each target species. For each potential corridor, evaluate how the area will accommodate movement by each target species.
- Design the corridor to be as wide as possible.
- If a road or rail crossing is required, bridged undercrossings are preferable. Natural materials should be used on the bottom of the culvert and replaced as necessary. On the road above the culvert, install speed bumps, wildlife crossing signs, and prohibit street lighting.
- Aim to maintain as much natural open space as possible next to any culvert to encourage species to use the culvert.
- Plant native species to provide food and cover as well as nesting places.
- Design the corridor to ensure that the land uses adjacent to the corridor reduce human impacts to the corridor. Consider implementing similar habitats to those found in the corridor in the surrounding areas. Housing and development projects should not encroach on the corridor.
- No wild animal feeding should be allowed aside from bird feeders. No pets should be allowed on the corridor.
- Do not install wood fences in the corridor or adjacent to it.

Natuurbrug Zanderij Crailoo, Netherlands

Wildlife Corridor

Back to Interventions Tool for:

Brownfield/ Urban Fringe

Rural Settlements

7. Catalogue of Case Studies

34. Taipei, Taiwan

BGI and NbS Design Considerations

Animal Aided Designed City Park

Inglostadt, Germany

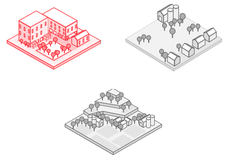
Completion Date

Launched in 2019

Key Societal Challenges

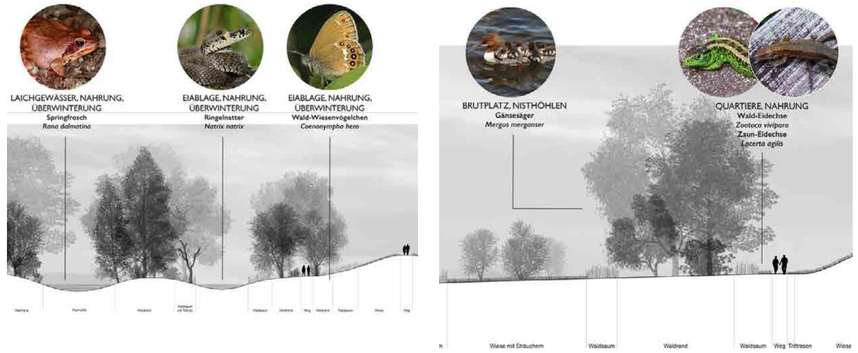
Biodiversity, Place making

Settlement Types



Immediate Environments

BGI 1.1 Establish BGI Baseline and Priorities



Description

The city of Ingolstadt aims to make the river more accessible to urban inhabitants, but at the same time allow for the passage of animals. An Animal-Aided Design studio was commissioned by the city of Ingolstadt for the inclusion of target species in the planning of a part of the city park along the Danube. The idea behind AAD is that animals should be included in the planning process, therefore they become an integral part of the design. In AAD, the desired species is chosen at the beginning of a project. The needs of the target species establish both the boundary conditions for the design and also inspire the design itself.

Relevance to the Southern Region

Like in the cities in the southern Region, wildlife life cycle movement are often stopped by cities. Continuity along the wildlife corridors even through cities are key to plan sustainable cities and Regions.

Define what's there

Biotape Area Factor

Berlin, Germany

Completion Date

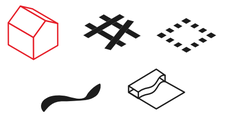
1994

Key Societal Challenges

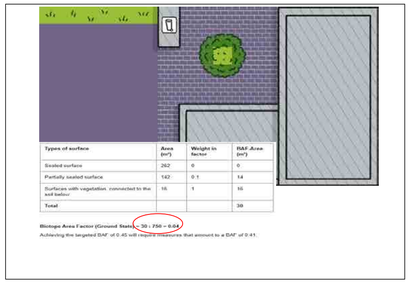
Biodiversity, Placemaking, Climate Resilience, Water Security

Settlement Types

Immediate Environments



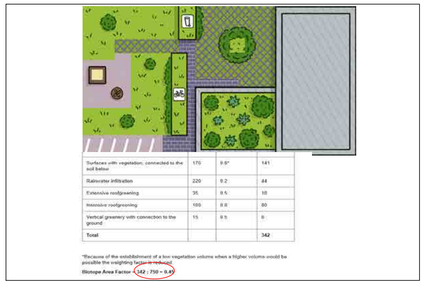
NbS 1.1 - Define place and setting



Types of surface	Area (m²)	Weight in factor	BAF Area (m²)
Sealed surface	262	0	0
Partially sealed surface	142	0.1	14
Surfaces with vegetation, connected to the soil below	16	1	16
Total			30

Biotope Area Factor (Ground Slab): 30 : 750 = 0.04

Achieving the targeted BAF of 0.45 will require measures that amount to a BAF of 0.41.



Surfaces with vegetation, connected to the soil below	170	0.8*	141
Rainwater infiltration	220	0.2	44
Extensive roofgreening	35	0.5	18
Intensive roofgreening	100	0.8	80
Vertical greenery with connection to the ground	15	0.5	8
Total			342

*Because of the establishment of a low vegetation volume when a higher volume would be possible the weighting factor is reduced.

Biotope Area Factor 342 : 750 = 0.45

Description

As a response to the shortage of green space in the city, Berlin developed the 'Biotope Area factor (BAF)' which is a regulation that measures the proportion of green space to the entire development to create more green space within densely built up urban locations. The key aim of the BAF is to ensure that a given proportion of a particular site is left undeveloped (i.e., covered by vegetation). Different permeable/vegetation solutions have specific weight in the factor (cf. adjacent tables) to ensure environmental objectives are met by the proposed developments.

Relevance to the Southern Region

Urban areas in the Southern Region take many forms: residential, commercial, infrastructure. The Region's cities have many under-used spaces such as walls and roofs that can be better utilised. Adopting a Biotape Area Factor formulates an ecological minimum standard for structural changes and new construction and incorporates all possible greening sites including courtyards, roofs and walls. As the Southern Region is set to undergo unprecedented population growth in the near future, the Local Authorities should consider how planning regulation may go hand in hand with promoting ecological value. Using a Biotape Area Factor presents a standardised, easy to use, indicator which offers a flexible approach to densification and greening policies.

Blue Green Infrastructure

Shanghai Drainage Model, Arup

Shanghai, China

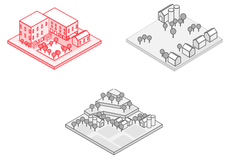
Completion Date

2017

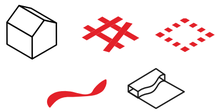
Key Societal Challenges

Water
Security, Placemaking, Climate Change, Biodiversity

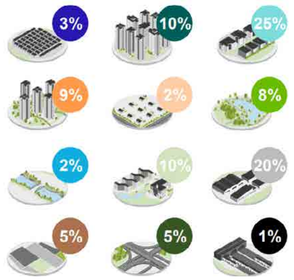
Settlement Types



Immediate Environments



BGI 1.1 Establish BGI Baseline & Priorities



Description

Cost concerns and a mission to improve the city's resilience to climate change have prompted the Chinese megacity to rewrite its urban-drainage strategy, putting nature-based solutions first. Ten years in the making, the 2017 Shanghai drainage masterplan was designed to contribute to the ambitious city-development masterplan, reducing urban flooding and first-flush water pollution of watercourses and canals. Shanghai will implement its urban-drainage masterplan across its 285 districts in three stages. A full city characterisation analysis was undertaken, to define the various land-use typologies of the city, from historic urban fabric to the latest highway and railway infrastructure.

Relevance to the Southern Region

By applying remote sensing imagery and machine learning technologies, a total of 12 'types' were identified, which have been incorporated into the final masterplan. An urban flooding model was built to identify both the opportunities and challenges of using this blue infrastructure. This was the first ever model of its kind to integrate the river and drainage network in Shanghai. This combined approach also draws out additional urban elements above ground into stormwater management functions, including roads, green space, rivers and other open spaces. The success of this masterplan - and the idea of a water-oriented urban planning approach - will be a showcase for next generation urban ecological developments.

Defining a landscape

Ballincollig Regional Park

Cork City, Ireland

Completion Date

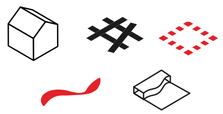
-

Key Societal Challenges

Placemaking, Human Health, Biodiversity

Settlement Types

Immediate Environments



NbS 1.2 Define problems and goals

Description

Located on the banks of the River Lee, Ballincollig Regional Park is characterised by a network of sluices, weirs and canals drawing on the River Lee. As a result, the park provides a valuable matrix of wet woodland, wet grassland, parkland, wildflower and scrub habitat. The park won the Urban Land Institute Excellence in Place Making Award in 2019 in recognition of work completed to enhance the site mostly due to the vision established in the Ballincollig Regional Park Development Plan published in 2012, outlining a €1.4 million investment in park amenities. Improvement in the Regional park is ongoing, with plans to reinstate the weir and canal system.

Relevance to the Southern Region

Ballincollig Regional Park provides a good example of how heritage and ecological functions can successfully complement one another to promote health and well-being within a park setting. The success of the Ballincollig Regional Park Development Plan illustrates the value of developing an ambitious plan for key open space assets and demonstrates how targeted investment can result in increased value and visitor numbers. Interactive apps which either provide education benefit, or engage visitors in a citizen science projects, have the potential to help to engage a new demographic with outdoor spaces.

Greenway

Passage Railway Greenway Improvement Scheme

Cork, Ireland

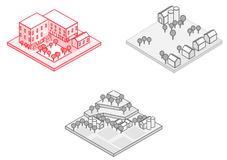
Completion Date

Works started in Feb 2022

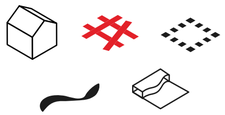
Key Societal Challenges

Placemaking, Human health

Settlement Types



Immediate Environments



NbS 1.2 Define problems and goals

Description

The Passage Railway Greenway Improvement Scheme was identified as a key project in the promotion of sustainable transport by the Council. Providing significantly improved facilities for cyclists and pedestrians along the existing Passage Railway Greenway from Parc Ui Chaoimh to Mahon, the scheme aims to facilitate new access points to promote connectivity. The GBI centred approach has aimed to attract a modal shift within the locality, with additional benefits associated with air quality and enhanced fauna and flora. A target of 8% has been set by the Council for the cycle mode share in this southeastern electoral area of the city.

Relevance to the Southern Region

This project is a good example of how a Local Authority in the Southern Region put a GBI approach into practice. This project took an existing Greenway and upgraded aspects to better solve the local problems and achieve the goals of the Passage Railway Greenway.

Approaches to Design

The Hare's Corner Initiative

Clare, Ireland

Completion Date

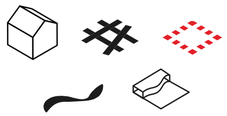
2022

Key Societal Challenges

Climate Resilience, Biodiversity, Water Security, Placemaking

Settlement Types

Immediate Environments



BGI & NbS 3.1 Approaches to Design

Description

This is an initiative to help landowners make more space for nature by creating a pocket-sized woodland, orchard, or pond on their land. Participating landowners incur no cost and minimal paperwork is needed. All trees, materials and contractors are locally sourced. Farmers are required to dedicate an area of up to 0.1ha for the creation of a native woodland habitat. The Burrenbeo Trust provide up to 400 native trees including 100 endangered Buren Pine trees. Those creating a pond are asked to dedicate 5x5m. For the mini-orchard 6-12 fruit trees are supplied by Irish Seedsavers. Funding, guidance and training are provided to farmers as required.

Relevance to the Southern Region

As an active project within the Region, this initiative is improving Clare's green infrastructure in a way that is sensitive to and supportive of the needs of local farmers and landowners. This approach could be trialled in other counties across the Region. The Hare's Corner project is improving farm's climate resilience as well as contributing to farming family's sense of enjoyment and wellbeing. The initiative creates a natural legacy in the Region to be enjoyed by future generations. When participating in the initiative, farmers are asked to sign a pledge this may help them to market their food products and other farm services.

Approaches to Design

Connswater Community Greenway, Arup

Belfast, Northern Ireland

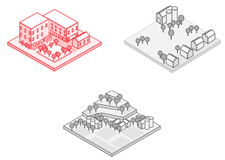
Completion Date

2006

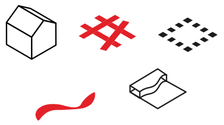
Key Societal Challenges

Biodiversity, Water Security, Place making

Settlement Types



Immediate Environments



BGI & NbS 3.1
Approaches to Design

Description

An analysis study was conducted and found that there was an opportunity for a large-scale regeneration intervention to improve local health and wellbeing, the physical environment and the economy in Easter Belfast. During the early stages of the project development of a green way, East Belfast experienced its most severe recorded flooding. Flood prevention and greenway works were combined to reduce disruption to locals and businesses and deliver better value for money. The resulting project, is a 9km linear park that runs through East Belfast, linking green spaces and rehabilitating the polluted rivers, and preventing floods, returning the banks to community use.

Relevance to the Southern Region

East Belfast was identified by Northern Ireland's Rivers Agency as requiring greater protection against fluvial and tidal events. Flooding has also been identified as a challenge for many of towns and cities across the Southern Region. Connswater is a great example for the Southern Region when designing urban flood alleviation schemes as it presents the vital link between flood alleviation and urban regeneration.

BGI & NbS Implementation

LAWPRO and their work with Landowners

Ireland, Nationwide

Completion Date

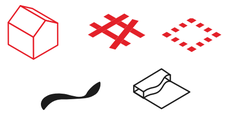
Ongoing

Key Societal Challenges

Biodiversity, Climate Resilience, Water Security

Settlement Types

Immediate Environments



BGI & NbS 3.1
Approaches to Design


Gap of Dunloe, Kerry


Guggan Barra, Cork

Description

The Local Authority Waters Programme (LAWPRO) is a new way of working to achieve better water quality. It is a service working with Local Authorities and state agencies to improve water quality by developing and implement Water Framework Directive (WFD) River Basin Management Plans (RBMP) in Ireland. LAWPRO aims to:

- Support and coordinate public bodies and other stakeholders to implement RNMPs
- To engage and activate local communities.

Relevance to the Southern Region

LAWPRO enables local authorities and other stakeholders to navigate the institutional complexity of river basin management in Ireland, which in all cases involves several Regional or state organisations including local authorities (city/county councils), the Environmental Protection Agency (EPA) and Inland Fisheries Ireland as well as local stakeholders such as landowners (farmers) and user groups (e.g. anglers).

LAWPRO has two teams: The Communities Team supports communities and stakeholders to deliver of local water quality projects and initiatives, as well as emerging river trusts and catchment partnerships. The team also provides a necessary link between active communities and funding streams (e.g. LEADER).

The catchments team is made up of scientists implementing measures identified in priority Areas For Action aimed at improving water quality. These measures include river assessments and stream walks to understand issues affecting water quality as well as working with local groups including farmers to develop workable solutions.

Water Sensitive Urban Design

Greener Grangetown, Arup

Cardiff, Wales

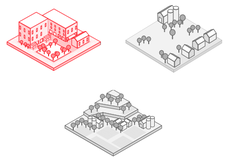
Completion Date

2016

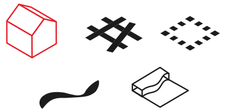
Key Societal Challenges

Water Security, Healthy Community, Placemaking, Climate Change

Settlement Types



Immediate Environments



BGI & NbS 3.1 Approaches to Design

Description

Greener Grangetown is a sustainable drainage scheme located in an existing urban area of Cardiff, South Wales. The design maximises the use of green infrastructure to future proof the drainage network; providing climate change resilience whilst also delivering enhanced public spaces, promoting sustainable travel, and improving ecology. An integrated approach to drainage design stems from a unique collaborative funding structure and has continued through community and stakeholder engagement. Public consultation involved the residents in the design of their streets, and in parallel with continued engagement and education is encouraging a behavioural change.

Relevance to the Southern Region

Greener Grangetown present an effective retrofit example for the Southern Region. This project would be particularly relevant to areas of flood risk or facing intensive drainage requirements. Over 40,000 cubic metres of water is removed from the sewer network annually due to the Greener Grangetown project. This is achieved with 127 new trees and 1,700 square metres of new green space, forming green-blue corridors whilst improving transport links, protecting community assets and creating safe, attractive urban spaces.

BGI & NbS Implementation

Vibrant Verges in Fingal

Fingal County Council

Completion Date

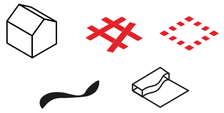
Ongoing

Key Societal Challenges

Biodiversity, Placemaking

Settlement Types

Immediate Environments



BGI & NbS 3.2 Management & Maintenance

Description

Fingal County Council have been steadily increasing the extent of wildflower meadows and long grasses in parks, along road margins and medians. There has been an approximate increase of 10 hectares per year over the last 4 years (FCC CCAP update 2020). The approach Fingal takes in the most visible areas of the county is to plant a mix of bulbs to create colour, which masks the emergence of native long grasses between the carefully choreographed, long-lasting floral display. This approach has helped gain public support for the change in management regime while benefitting biodiversity. Verges and medians are typically mown along the edges on a monthly basis throughout the growing season.

The sward is cut annually in November.

BGI & NbS Management & Maintenance

Grey to Green

Sheffield, UK

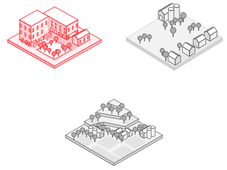
Completion Date

Phase 1 in 2016
Phase 2 in 2019

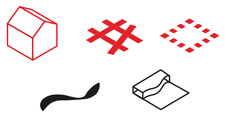
Key Societal Challenges

Biodiversity, Placemaking, Climate Resilience, Water Security

Settlement Types



Immediate Environments



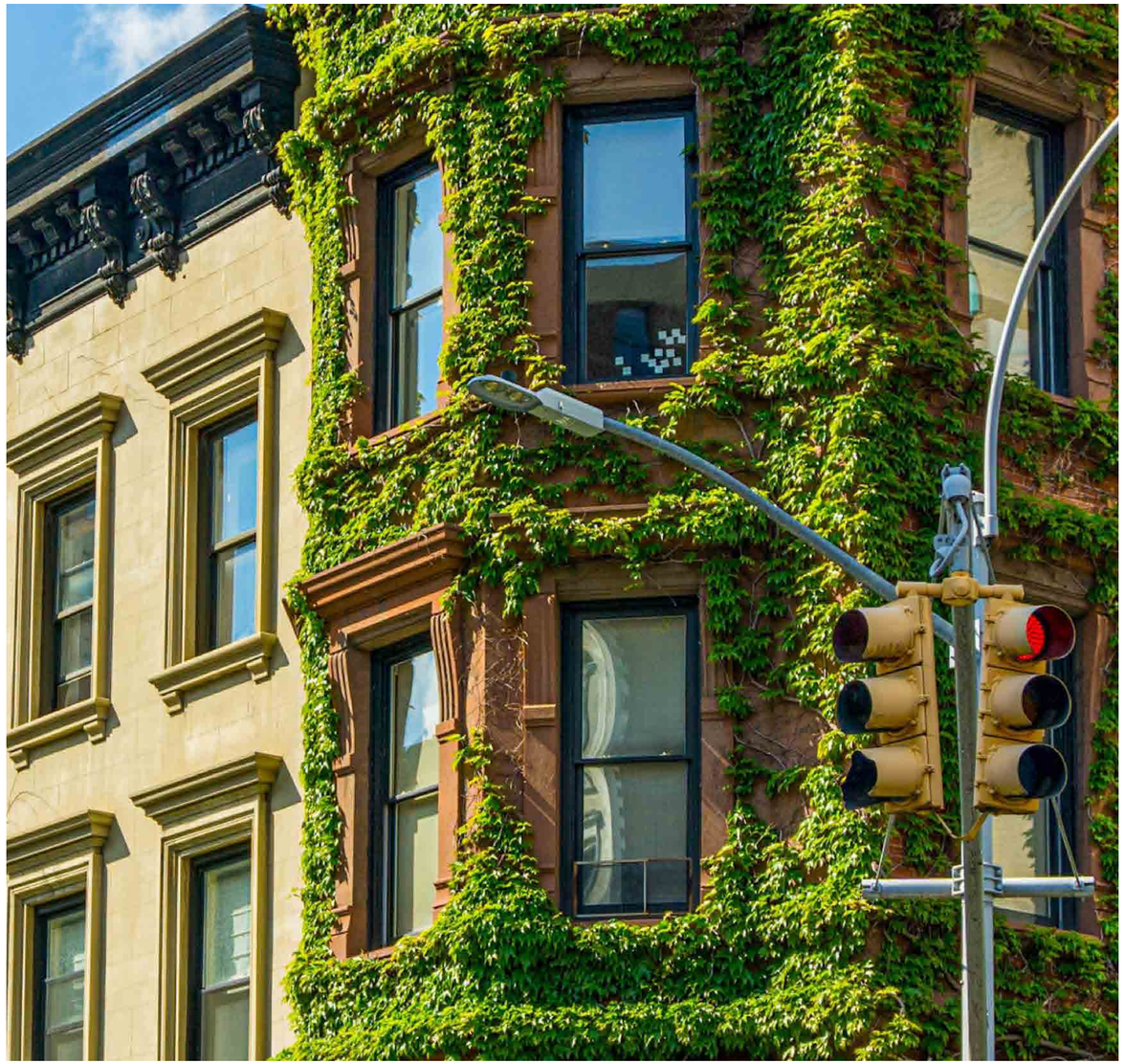
BGI & NbS 3.2 Management & Maintenance

Description

Grey to Green has become a truly multifunctional project which continues to push the boundaries for the future visions for a healthy green streets approach. Using research based urban greening principles and sustainable water management principles throughout (SuDS) the project aimed to increase urban biodiversity through a green living corridor, helping protect people from air pollution through multi-layered planting, achieve urban cooling through increased green surfaces, treat contaminated water and microplastics within a healthy new soil and promote health and wellbeing for people using and living within the areas. The combined length of the project area is 1.3km though a part Sheffield's city centre which had lacked ambition and required significant regeneration. The project and the funding have outputs to encourage a setting for development and job creation as well as the BGI and biodiversity gain. The project is Britain's longest retrofit SuDS and green streets approach to date.

Relevance to the Southern Region

Grey to Green, Sheffield is an exemplary case as it resonates so well with many of the challenges and aspirations for the Southern Region, the importance to attract people to the area and offer a placemaking to the heart of the Region's cities. We believe this can be achieved through the use of a strong landscape design framework which embraces innovative, sustainable. play and research based horticultural principles.



Conserving character in a changing climate

Coirib go Cósta - Galway City Flood Relief Scheme, Arup

Co. Galway

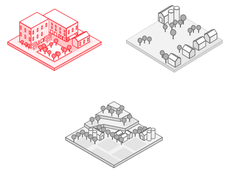
Completion Date

Ongoing

Key Societal Challenges

Biodiversity, Placemaking, Climate Resilience, Water Security

Settlement Types



Immediate Environments

GM 1.1 Identification of team

Description

Coirib go Cósta aims to identify, assess, design and deliver a technically viable, socially, environmentally and aesthetically acceptable, and cost-effective flood relief scheme for Galway city. It is primarily focused on addressing the sustainable and effective management of flood risk while keep the city's character at its heart. The project is currently at Stage 1 Options Assessment which includes baseline data collection, hydrological and hydraulic analysis, and option appraisal and selection. The multi-disciplinary team includes flood risk management specialists, flood modellers and design engineers, as well as landscape, architecture, archaeology, ecology specialists.

Relevance to the Southern Region

From the project outset, Coirib go Cósta has focused on the elements of Galway city that make it such an attractive place to live, work and visit to ensure any flood defence measures successfully integrate into the city's fabric. Key to this has been stakeholder engagement via the (virtual) Public Engagement Day, virtual consultation room and collating submissions to understand the public's priorities. The project website hosts an interactive webmapper where key project constraints can be reviewed alongside predicted flood extents data. Collaborative workshops are scheduled to be held throughout the project lifecycle for the Client, design team, specialists and key stakeholders to identify the challenges and opportunities for added value for people, places and the planet.

Community Engagement

Inishowen Rivers Trust

Donegal, Ireland

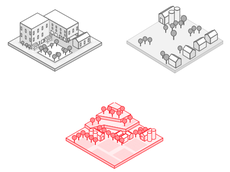
Completion Date

2021

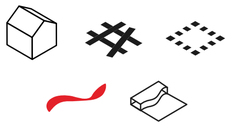
Key Societal Challenges

Water Security, Placemaking

Settlement Types



Immediate Environments



GM 1.2 Identification of stakeholders

Description

The Inishowen community recognised the importance of their rivers and the need to keep them healthy. Inishowen developed a strong and active Rivers Trust group. They focus on developing understanding, capacity building and learning within the community. They host courses such as Bank Erosion Control, Hydromorphology and on surveying techniques. The Rivers Trust group have participated in local projects such as the Glennagannon River Restoration Project and the Culdaff Riverbank Protection Project.

Relevance to the Southern Region

Inishowen Rivers Trust shows how a local community initiative can benefit both the community and the environment. Similar groups are in place across the southern Region. Learning, understanding and capacity building is a fundamental objective of the Inishowen group. A similar approach in the southern Region will advance placemaking and provide practical, hands-on experience with NbS and BGI. The Inishowen group offers multiple forms of engagement for its members and volunteers from bank side and riparian surveys, erosion mitigation and river restoration projects. This facilitates the engagement and active participation of a wide range of stakeholders and encourages community buy-in. There are six Rivers Trust groups in existence in the southern Regions (Slaney, Nore Rivers, Malgue, Blackwater, Bandon, and Waterville).

Good Governance

Bees on the rooftops of Krakow

Krakowa, Poland

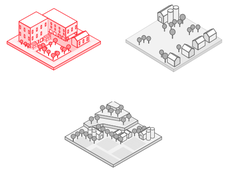
Completion Date

Ongoing

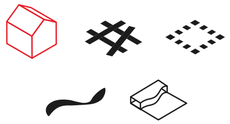
Key Societal Challenges

Biodiversity, Food Security

Settlement Types



Immediate Environments



GM 1.3 Identification of governance strategy

Description

The project called “The Apiary of Kraków” includes several interrelated initiatives to establish beehives on the rooftops of various institutions in Krakow. The aim is to provide habitat for bees, and protect biodiversity, support urban pollination, increase social awareness on the topic. Urban honey is of better quality than honey produced in rural areas where pesticides are more common. The local administration-led initiative aims to promote Cracow as a pro-ecological city which soon will be selling its honey.

Relevance to the Southern Region

This example shows how a bottom-up initiative in the southern could be supported with top-down interventions. In 2017, Jagiellonian University purchased bees from the “Szeligów” apiary near Krakow and set up beehives on the roofs of its multiple buildings. Citizens got involved in the educational workshops there. The municipality followed that initiative and decided to scale it in two steps: 1) new regulations on beehives were introduced; 2) the city itself invested in new rooftop apiaries in Krakow. The project was funded from the local authority’s budget with funding that had specifically been earmarked.

Carbon Neutral City

Green Journey of Växjö

Växjö, Sweden

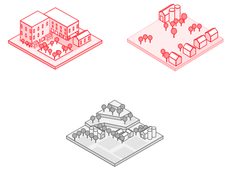
Completion Date

1996-2050

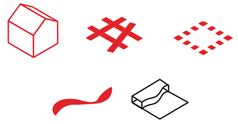
Key Societal Challenges

Human health, Place Making, Biodiversity

Settlement Types



Immediate Environments



GM 1.3 Identification of governance strategy

Description

Växjö became the first city in the world to set the goal of becoming fossil fuel free by 2030 and carbon neutral by 2050. As part of the Sustainable Växjö 2030 Vision, the approach to GBI aims to create environments that foster good health, support opportunities for active travel and enhance the water and built environment to support a rich variety of species. The city has a long tradition of broad institutional collaboration on environment-related initiatives, including taking the lead in the monitoring of carbon dioxide emissions and the introduction of policies to reduce these emissions within the city’s geographical boundaries.

Relevance to the Southern Region

Like the cities in the Southern Region, Växjö benefits from a unique geography; comprising a network of existing green spaces and landscape assets which provide natural resource and are successful in the promotion of active travel initiatives. The water environment plays an important role in strategic decision making in Växjö as in the cities in the Southern Region. The recreational potential of waterside environments, including opportunities to enhance accessibility to natural resources, is well recognised within the cities. This example underlines the importance of urban planning in the development of Växjö, aiding the establishment of ambitious sustainability priorities and the ‘green city’ agenda. Växjö prepared their strategy for and guidance documents on NbS followed. This is similar to the approach we see taken with Cork and Limerick’s Green Blue Infrastructure Studies.

Finding Opportunities in Policy

London's Green Belt

London, United Kingdom

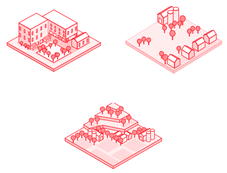
Completion Date

1919

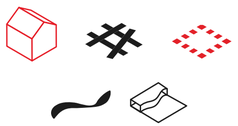
Key Societal Challenges

Place Making, Biodiversity, Climate Change

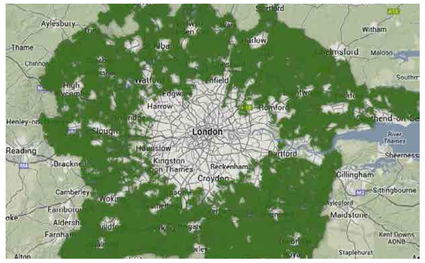
Settlement Types



Immediate Environments



GM 1.4 Finding opportunities in policy



Description

The Metropolitan Green Belt encircles London with strict planning regulations to keep it open and undeveloped. It extends across up to 35 miles deep in places. The Green Belt is three times the size of London and covers most of Hertfordshire and Surrey and extends beyond Southend. According to the London Green Belt Council, "Green Belt protection has ensured Londoners enjoy open land and countryside in and near the city. Many areas of Green Belt are country parks or playing fields, they support sport and recreation, tourism and health – including reducing stress by providing peaceful, breathing spaces and 9,899km of public rights of way" and there are many eco-system benefit.

Relevance to the Southern Region

The fundamental aim of Green Belt policy is to prevent urban sprawl by keeping land permanently open; the essential characteristics of Green Belts are their openness and permanence. It is there neither to protect nor to enhance the landscape, although it may do that incidentally. The Southern Region could benefit from land protection around towns and cities as the expected rapid population growth in the Region is likely to put pressure on urban and peri-urban green space.

Sustainable Rehabilitation and Responsible Innovation

VERDIR

Liège, Belgium

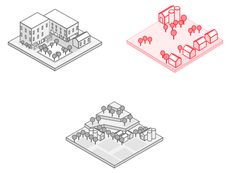
Completion Date

Ongoing

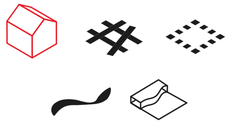
Key Societal Challenges

Placemaking, Food Security

Settlement Types



Immediate Environments



GM 2.1 Identification of funding

Description

VERDIR is a project of the University of Liège, about the development of local economic activities based on urban and peri-urban agriculture. It aims to convert existing brownfield sites according to the needs of the community. This involves the large-scale production of vegetables and plants which can be used for food but also for the pharmaceutical industry and the production of biomass, which is increasingly needed . The project has been funded from EU funds, public Regional budget and corporate investment in the form of direct funding or subsidies and asset-backed funding. Land was provisioned by private sector actors.

Relevance to the Southern Region

VERDIR takes advantage of brownfield sites, a key settlement type in the Southern Region. VERDIR also has a strong emphasis on Placemaking – one of the southern Regions core challenges. It creates a platform for networking the actors who will contribute to the transformation of the Liège basin. This is an example of how co-governance with government and non-government actors can succeed. This is relevant for Local Authorities in the southern Region wishing to work with researchers or universities in the Region to scale a project. The mixed financing model shows how cross-sectoral and cross-institutional funding could be leverage in the southern Region.

Technical and Economic Assessment

All London Green Grid

London, United Kingdom

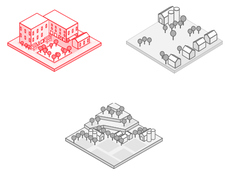
Completion Date

2012

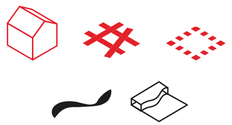
Key Societal Challenges

Placemaking, Food Security

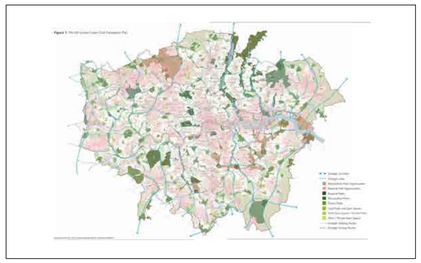
Settlement Types

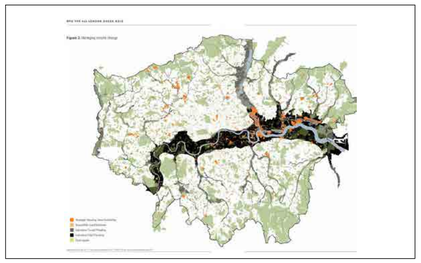


Immediate Environments



GM 2.2 Analysing technical and economic information





Description

The All London Green Grid (ALGG) is a policy framework to promote the design and delivery of 'green infrastructure' across London, for the benefit of people and wildlife. London's green infrastructure is its network of green spaces (including features such as street trees and green roofs) and blue spaces (including rivers, canals and ponds) that is planned, designed and managed to provide a range of benefits, including: recreation and amenity, healthy living, reducing flooding, improving air quality, cooling the urban environment, encouraging walking and cycling, enhancing biodiversity and ecological resilience.

Relevance to the Southern Region

While the context of London may be very different to that of the Southern Region, this example shows how natural hazard and risk mapping can be used to prevent development in vulnerable areas, reducing the risks for communities from future disasters. The reduced vulnerability to landslides can directly impact the health and of vulnerable communities, saving lives and avoiding injury. Tree planting provided a natural solution to an area which is prone to landslides by reducing rainfall run-off and stabilising slopes. The 7,500 new native trees planted on the hills and the edge of the city have the additional benefit of providing a new area of habitat and carbon sequestration.

Monitoring and Evaluation

Fitz Park London, Arup

London, United Kingdom

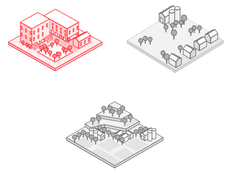
Completion Date

2017

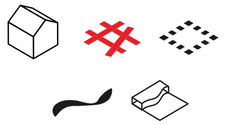
Key Societal Challenges

Placemaking, Biodiversity

Settlement Types



Immediate Environments



GM 3.1 Monitoring and evaluation

Description

Arup have undertaken an extensive pre and post installation monitoring exercise of one of their temporary public realm project, FitzPark, which is a key project in promoting healthy streets. This project has involved the transformation of a loading bay on a central London street into a temporary seating area, or parklet. The aim of the monitoring was to provide rigorous method of measuring success against the project's key objectives. In a four-step process (observe, measure, ask, respond) the monitoring captured the impact of the installation on movement, dwell time, ecology, local businesses and wellbeing. The results of the wellbeing evaluation questionnaire showed an increase of 41% in self-reported well-being.

Relevance to the Southern Region

The monitoring results demonstrated that green spaces can be successfully integrated into our cities in exciting and innovative ways, highlighting huge potential in the design value of rolling our similar temporary or permanent interventions in cities in the Southern Region. Monitoring and evaluation also helped quantify the value of the project which will encourage the rollout of similar interventions at other locations in the future.

Biodiversity Net Gain

Keyn Glas, Arup

Cornwall, UK

Completion Date

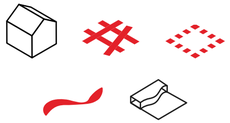
2019 - 2025

Key Societal Challenges

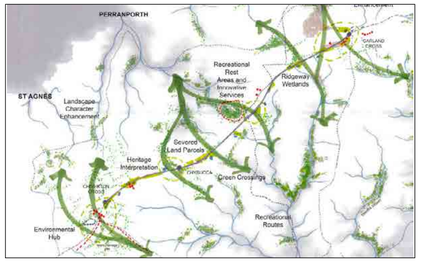
Placemaking, Climate Change, Biodiversity

Settlement Types

Immediate Environments



GM 3.1 Monitoring and evaluation



Description

It delivers an unprecedented and innovative programme of 15 landscape-scale projects covering 50km2 of central Cornwall. These projects are geographically focused on the landscape within approximately 3km of the A30 Chiverton to Carland Cross Road Scheme. Enhancements proposed as part of this project are additional to and separate from the A30 project and seek to reconnect the cultural and natural layers of this landscape while promoting environmental growth in Central Cornwall. The projects are modular with landowners able to choose to be a part of the design of Cornwall's future landscape. Engagement with landowners and communities is fundamental to the project.

Relevance to the Southern Region

This is an excellent example of what a landscape-scale approach to biodiversity could look like in the Southern Region. This project was able to deliver significant and impressive biodiversity net gain. To understand this impact, it was important to measure baseline condition at the outset of the project. Collectively the projects will deliver benefits to the landscape, wildlife and communities, much greater than the sum of their parts. Three of these projects, known as Green Ribs exemplify the landscape scale approach taken each Green Rib delivered over 90% Net Gain in biodiversity.

End-of-Life

Granby Park, A Temporary Park

Dublin, Ireland

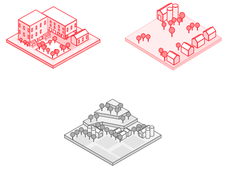
Completion Date

2017

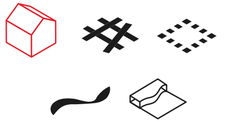
Key Societal Challenges

Placemaking, Biodiversity

Settlement Types



Immediate Environments



GM 3.2 End of life

Description

Granby Park was a temporary park that was built on a vacant site in Dublin's north inner city in August 2013. It was open for one month. It was made from up-cycled, recycled, donated & found materials and was a collaboration between some of the city's most talented artists, event coordinators, architects, performers and creatives. Built & coordinated voluntarily, almost 400 volunteers and 1,100 supporters helped create Granby Park. The park consisted of an education hub space, 30 artist installations, a cafe, a children's play area, a 300-person amphitheatre, graffiti wall & boules pitch, surrounded by planting and furniture. It was visited by 40,000 people.

Relevance to the Southern Region

Granby Park transformed a place that was unused and transitional and showed the potential of the site. It was co-designed with the local community and children and used material which referenced the area's significance as home to Dublin's markets. However, the liberties is under resourced in terms of permanent, sustainable amenities. In the southern Region, Local Authorities should consider the demand and need in the long-term and aim to appropriately address those needs equitably. Granby was a testament to the creativity and thought of everyone involved but the "what happens next" question is an important consideration.

8. Conclusion & Next Steps

8. Conclusion and Next Steps

This Framework for Blue Green Infrastructure (BGI) and Nature-based Solutions (NbS) has been created by Arup on behalf of the Southern Regional Assembly as part of the Regional Action Plan for the Interreg Europe Blue-Green Cities Project. It is the first of its kind at a Regional level in Ireland and aims to provide a resource for Local Authorities, decision makers and developers working in the Region to use BGI and NbS to solve local challenges in our settlements and the landscapes that they link to.

The Southern Region's RSES aims to create a Region that is "more prosperous, sustainable, climate resilient and attractive [..] for the benefit of all its people"[3]. The role that our natural and vegetated areas (the green) and our waterways and water management infrastructure (the blue) provide in delivering a broad range of economic, social, and environmental benefits in and around our settlements is strongly recognised. As critical infrastructure, BGI and NbS will play a fundamental role in how the Region responds to projected climate change and population growth.

The framework presents a series of actions and guidance notes that relate to three key implementation strands, which are:

1. Nature-based Solutions
2. Blue Green Infrastructure
3. Governance & Management.

The structure of the framework allows users to refer to relevant sections or use it in its entirety.

Actions are organised around three main stages of typical project lifecycles for implementation.

1. Needs Identification
2. Project Planning
3. Implementation

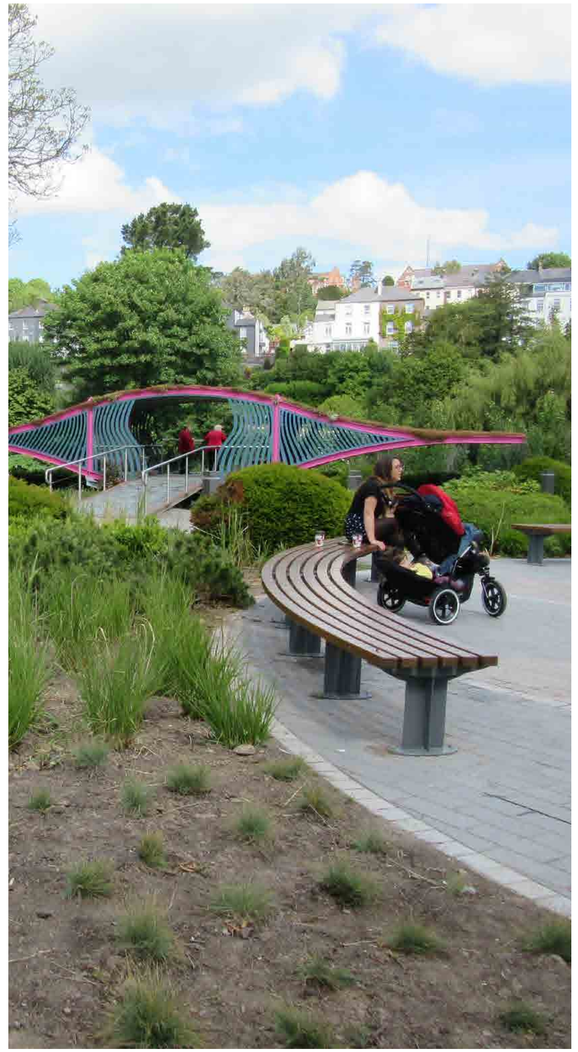
Together, BGI and NbS aim to deliver a healthy system of networked nature-based interventions. Governance and Management Strategies aim for inclusive and efficient project organisation.

This framework provides a roadmap for implementation. Initially, key concepts and contexts and introduced, which provide a foundation for reference. The framework itself is then presented as a series of actions and consideration with tools that have been developed to aid decision making along the way.

We are conscious that almost as soon as this Framework is published, the Southern Region will have evolved. Our landscapes change naturally from season to season and under our influence as their stewards, and their dependents. New BGI and NbS will be planned, designed, implemented and monitored, and new City and County Development plans will be launched. Decision-makers will develop plans and projects and will develop new partnerships for delivery and ongoing management.

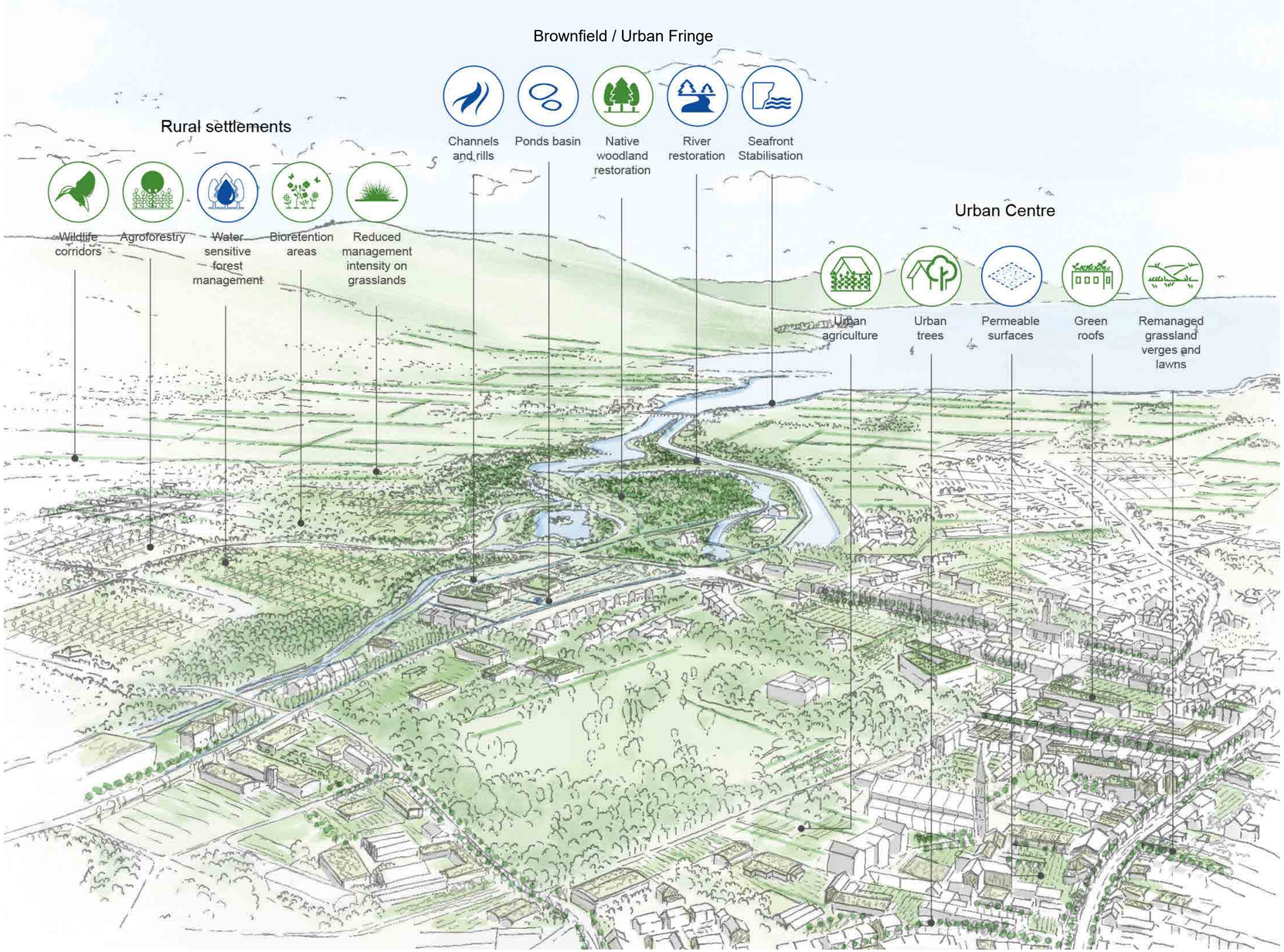
We want to finish with a prediction of where we think the Region is going in the future.

The Southern Region is set to experience unprecedented growth of population. This will lead to changes in the Region as it accommodates the accommodation, employment and amenity needs of their new inhabitants. BGI and NbS planning, design and implementation must be integral to facilitating this change to maximise the opportunities to make Our Green Southern Region a climate resilient, biodiverse and attractive place to live, work and play.



Mardyke Gardens, Co. Cork, Ireland

Aspirational application of NbS and BGI in the Southern Region

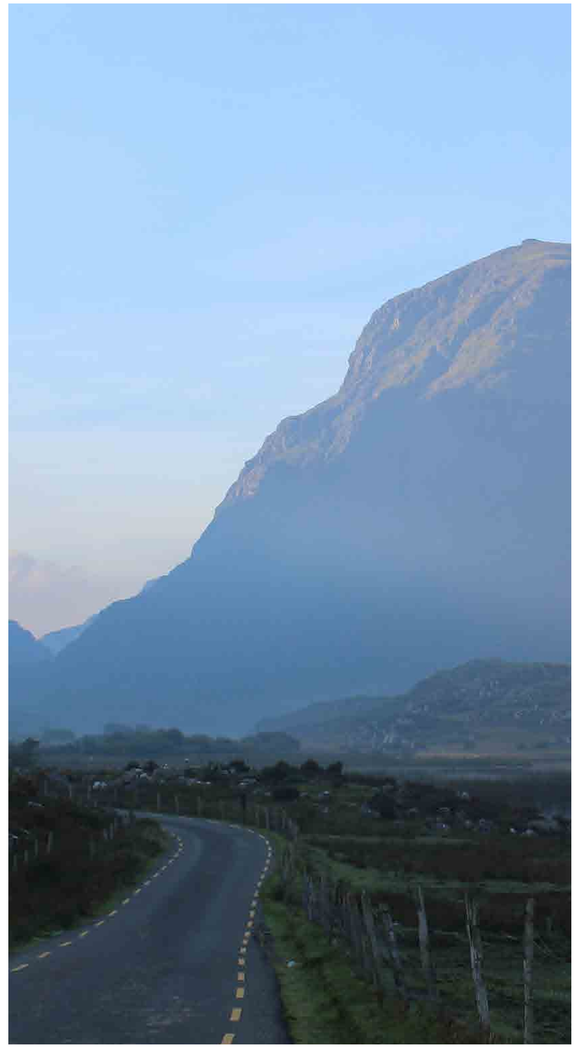


9. Bibliography

Connswater Community Greenway, Belfast, Northern Ireland

9. Bibliography

1. EPA. What impact will climate change have on Ireland? https://www.epa.ie/environment-and-you/climate-change/what-impact-will-climate-change-have-for-Ireland/ (2022).
2. Climate Central. Coastal Risk Screening Tool - Land Projected to be Below Annual Flood Level in 2050.
3. Southern Regional Assembly. Regional Spatial & Economic Strategy for the Southern Region.
4. European Commission. Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the Regions Green Infrastructure (GI) — Enhancing Europe's Natural Capital . (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0249, 2013).
5. European Commission. Creating blue-green networks. Green Best Practice Community (2022).
6. Woods Ballard, B. et al. The SuDs Manual. (2015).
7. Davies, C., MacFarlane, R., McGloin, C. & Roe, M. Green Infrastructure Planning Guide. (2006).
8. European Commission. Nature-based Solutions - The EU and Nature-based Solutions. https://ec.europa.eu/info/research-and-innovation/research-area/environment/nature-based-solutions_en (2022).
9. IUNC. The IUCN Global Programme 2013–16. (2012).
10. Carliera, J., Doyle, M., Finn, J. A., Ó hUallacháin, D. & Morana, J. A landscape classification map of Ireland and its potential use in national land use monitoring. Journal of Environmental Management 289, (2021).
11. Southern Regional Assembly. Submission in response to Ireland 2040 –National Planning Framework Issues and Choices initial consultation paper. (2017).
12. Irish Peatland Conservation Council. Action for Bogs and Wildlife in Ireland. . http://www.ipcc.ie/ (2017).
13. Coillte. Ireland's Native Woodlands Today. https://www.coillte.ie/irelands-native-woodlands-today/ (2022).
14. Cross, J. R. Ireland['s Woodland Heritage. (2012).
15. MosArt. The Cork Landscape Character and Sensitivity Assessment. (2003).
16. Limerick City and County Council. Limerick Development Plan 2022 -2028, Background Paper Environment, Heritage, Landscape & Green Infrastructure. (2022).
17. Waterford City and County Council. Appendix 8: Landscape and Seascape Character Assessment, Scenic Routes and Protected Views. in Draft Waterford City and County Development Plan 2022-2028 (2021).
18. Waterford County Council. Waterford County Development Plan 2011-2017. (2011).
19. O'Neill, F. H., Martin, J. R., Devaney, F. M. & Perrin, P. M. The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78. (2013).
20. United States Department of Agriculture. Riparian Areas Environmental Uniqueness, Functions, and Values. RCA Publication Archive (1996).
21. Fossit, J. A. A Guide to Habitats in Ireland. (2000).
22. Daly, H. E. & Farley, J. Ecological economics: principles and applications. (Island press, 2011).
23. Daly, H. A new economics for our full world. in Handbook on Growth and Sustainability 85–106 (2014).



Gap of Dunloe, Ireland

24. IUCN. Nature-based solutions to address global societal challenges. Nature-based solutions to address global societal challenges (2016) doi:10.2305/iucn.ch.2016.13.en.
25. Pascual, U. et al. Valuing nature's contributions to people: the IPBES approach. Current Opinion in Environmental Sustainability 26–27, 7–16 (2017).
26. Frantzeskaki, N. et al. Nature-based solutions for urban climate change adaptation: linking science, policy, and practice communities for evidence-based decision-making. BioScience 69, 455–466 (2019).
27. Haase, D. et al. Greening cities – To be socially inclusive? About the alleged paradox of society and ecology in cities. Habitat International 64, 41–48 (2017).
28. Frantzeskaki, N. Seven lessons for planning nature-based solutions in cities. Environmental Science and Policy 93, 101–111 (2019).
29. Nevens, F., Frantzeskaki, N., Gorissen, L. & Loorbach, D. Urban Transition Labs: Co-creating transformative action for sustainable cities. Journal of Cleaner Production 50, 111–122 (2013).
30. van der Jagt, A. P. N., Raven, R., Dorst, H. & Runhaar, H. Nature-based innovation systems. Environmental Innovation and Societal Transitions 0–1 (2019) doi:10.1016/j.eist.2019.09.005.
31. Wolfram, M. & Frantzeskaki, N. Cities and systemic change for sustainability: Prevailing epistemologies and an emerging research agenda. Sustainability (Switzerland) 8, (2016).
32. Pearlmutter, D. et al. Enhancing the circular economy with nature-based solutions in the built urban environment: green building materials, systems and sites. Blue-Green Systems 2, 46–72 (2020).

International Coalition for Sustainable Infrastructure, The Resilience Shift & Arup. Infrastructure Pathways. https://infrastructure-pathways.org/ (2022).

33. Bulkeley, H. Taking Action for Urban Nature: Effective Governance Solutions. (2019).
34. Lafortezza, R., Chen, J., van den Bosch, C. K. & Randrup, T. B. Nature-based solutions for resilient landscapes and cities. Environmental Research 165, 431–441 (2018).
35. Pauleit, S., Zölch, T., Hansen, R., Randrup, T. B. & Konijnendijk van den Bosch, C. Nature-Based Solutions and Climate Change – Four Shades of Green. in Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice (eds. Kabisch, N., Korn, H., Stadler, J. & Bonn, A.) 29–49 (Springer International Publishing, 2017). doi:10.1007/978-3-319-56091-5_3 LB - Pauleit2017.
36. Scott, M., Lennon, M., Collier, M. & Foley, K. Green Infrastructure: A "How To" Guide for Disseminating and Integrating the Concept into Spatial Planning Practice. (2016).
37. Cork City Council. Cork City Green and Blue Infrastructure Study. (2021).
38. UN Habitat. What is a City? (2020).
39. World Vision & Cities for Children. Defining Urban Contexts. https://www.wvi.org/sites/default/files/Defining%20urban%20contexts%2012.11.17.pdf (2012).
40. Brennan, M., Tubridy, M. & Associates. National Landcover and Habitat Mapping Programme for Ireland - Use Case Analysis and Economic Value Study. (2017).
41. EPA. Ireland's Environment – An Integrated Assessment 2020. (Environmental Protection Agency (EPA), 2020).
42. Cohen-Shacham Walters G., J. C. et al. Nature-based Solutions to address global societal challenges. Nature-based solutions to address global societal challenges https://portals.iucn.org/library/sites/library/files/documents/2016-036.pdf (2016) doi:https://doi.org/10.2305/IUCN.CH.2016.13.en.
43. Albert, C. et al. Addressing societal challenges through nature-based solutions: How can landscape planning and governance research contribute? Landscape and Urban Planning 182, 12–21 (2019).
44. Brennan, M., Tubridy, M. & Associates. National Landcover and Habitat Mapping Programme for Ireland: Use Case Analysis and Economic Value Study. (2017).
45. Haughey, E. Climate Change and Land Use in Ireland. (2021).
46. Natural Water Retention Measures (NWRM) Working Group. Natural Water Retention Measures (NWRM) Overview and Recommendations for Use in Ireland. (2020).
47. Government of Ireland. Climate Action and Low Carbon Development (Amendment) Bill 2021. (Government of Ireland, 2021).
48. Government of Ireland. Climate Action Plan 2021 Securing Our Future. (2021).
49. Inter-American Development Bank (IAB). Increasing infrastructure resilience with Nature-based Solutions (NbS) | NbS Technical Guidance Document for Project Developers. https://libapps.s3.amazonaws.com/customers/1020/images/ (2020).
50. Hallegatte, S., Rentschler, J. & Rosenberg, J. Adaptation Principles : A Guide for Designing Strategies for Climate Change Adaptation and Resilience. (2020).
51. Kim, Y., Chester, M. v, Eisenberg, D. A. & Redman, C. L. The infrastructure trolley problem: Positioning safe-to-fail infrastructure for climate change adaptation. Earth's Future 7, 704–717 (2019).
52. C40 Cities Climate Leadership Group & C40 Knowledge Hub. Climate Action Planning Guide. https://www.c40knowledgehub.org/s/guide-navigation?language=en_

Appendices

.Beach Nourishment, Nags Head, USA
© Firstcoastal.com

Appendix A - City to Summit to Sea

The landscapes and townscapes of the Southern Region of Ireland are a rich mosaic of Ireland's highest mountain ranges, indented coast lines with a variety of features including islands, and a variety of urban, rural, and agricultural environments. Each county in the Southern Region contains several landscape classifications including extensive bedrock plains and mountainous lands, semi-intensified elevated lands, intensified lowlands, marshlands/estuarine lands, semi- intensified lowlands, sand coastlands and associated water bodies.[10] Landscape character areas and protected sites, such as NHAs, SACs and SPAs, frequently overlap administrative boundaries within the Southern Region.[3]

Uplands

Mountain areas are a vital source of freshwater and enhance the biodiversity of the Region while providing recreational and inspirational places for the people of Ireland. The mountains are also places of production, providing foods, energy and employment as well as many ecosystem services. [11] Ireland's highest summits are in Kerry (Carrauntoohil) and Tipperary (Galtymore) which are home to a variety of habitats such as blanket bog, heath and upland grasslands. In Ireland the blanket bog habitat is very well developed and 8% of the worlds blanket bog can be found here. Upland blanket bogs occur on relatively flat terrain on mountains above 200m altitude. Due to their ability to accumulate and store carbon they play an extremely important role in controlling the greenhouse gases that cause climate change.[12] Heath and upland grassland habitats also are vital and directly impact climate change through their rich carbon sequestration ability and biodiversity attributes.

Case Study
BGI and NBS Design Considerations
Animal Aided Designed City Park

Woodland and or scrub landscape

Native woodland is among the richest habitats for biodiversity in this country. Since the last Ice Age, thousands of species have evolved over millennia to live in this environment.[13] The EU Habitats directive has designated c.9,500 ha of native woodland in Ireland as special area of conservation (SACs) or Natura 2000 sites. These include oak woodlands, alluvial woodlands, yew woods and bog woods. Currently the area of native woodland in Ireland is fragmented and of poor quality. Ireland is obligated, under the EU Habitats Directive, to improve the quality of Nature 2000 sites and expand the area while ensuring proper management of these areas.

There is a concentration of native woodlands in upland areas due to poor soils and low agricultural value, although they are widely scattered across the country. In the southern Region there is a concentration in the mountain valleys of Waterford, Kerry and west Cork. Parts of Clare and Galway, where shallow limestone soil is present, are covered in extensive areas of hazel scrub woodland that is expanding as agricultural practices change. Killarney woods provides c.1,200 ha of Ireland's most diverse native woodlands.

The establishment of 29 nature reserves in Ireland highlights the importance of our native woodlands in terms of their ecological value in the context of the climate crisis.[14] There is a need for better management of these woodlands for both people and nature to benefit.

Settlements

The Southern Region has a strong network of urban centres including three cities and thirteen towns with populations of over 10,000. The Region has 15 towns with populations between 5,000 and 10, 000, and 45 settlements with populations between 1,500 and 5,000 that act as key service centres for their hinterlands. The Region has diverse and vibrant rural settlements, which includes villages of less than 1500 residents. [3]

Wexford, Ireland

Deer spotted in Phoenix Park, Dublin
© Fireglo

Cork City is identified as a City Harbour and Estuary landscape character type. While County Cork is made up of an indented Estuarine coast and rolling patchwork farmlands to the southwest. Lowland valleys lie to the west and fertile middle-ground to the north. Broad, fertile lowland valleys lie to the east of the City Harbour and Estuary. The southeast edge is identified as the Broad Bay Coast.[15]

Limerick City has a unique and distinctive landscape that defines its character. The River Shannon provides a backdrop to the much of the city and is essential part of the character and attraction of the city. The current Limerick City Development Plan clearly recognises the significance of watercourses in the city saying, “rivers and waterways are very important assets of Limerick and play a significant role in the layout and structure of the city and are an integral element of the city’s landscape character”[16]

The 2020 Waterford Landscape & Seascape Character Assessment[17] identified seven landscape character types including coastal landscape, farmed lowland landscapes, river corridor landscapes, estuaries, foothill landscape, uphill landscapes, and urbanising landscapes. Waterford has a diverse range of landscapes and is characterised by the Comeragh and Knockmealdown mountains, several south-flowing river systems and a rugged coastline with coves and beaches.[18]

There are six key towns in the Southern Region that have a significant population scale including Kilkenny City, Carlow, Ennis, Tralee, Clonmel and Wexford. These towns all have different landscape typologies and environments that allow them to be self-sustaining Regional drivers[3] in the Southern Region. Although, all settlement types from cities to rural villages play an important role in climate adaptation.

Agricultural or lowland landscape

Outside of the cities and key towns, the Region’s character becomes rural and there are many intensively managed agricultural areas. This rural landscape also consists of a mosaic of semi-natural and managed landscapes. While acknowledging that some of the more remote rural areas are challenged in terms of economic opportunity and population retention, the majority are modern, dynamic and creative, and are an integral part of the Region’s identity and economy.[11] In relation to the land use, most of these countryside settlements, rural communities are focused on agriculture, forestry, tourism, and rural enterprise.

A unique farming landscape exists within this typology in Co. Clare. The Burren is a vast area of karst limestone and is a designated UNESCO site. Here there are several programmes in place that encourage farming conservation and promote a healthy environment such as the Burren Programme, which is an agri-environmental measure focused specifically on the conservation of the unique farming landscape in counties Clare and Galway.[3]

Grassland landscape

The EU Habitats Directive has contributed to the conservation of semi-natural grasslands in Ireland. Fossitt’s (2000) habitat guide identifies five grassland habitats in Ireland as follows: GS1 - Dry calcareous and neutral grassland, GS2 - Dry meadows and grassy verges. GS3 - Dry-humid acid grassland. GS4 - Wet grassland. GM1 - Freshwater marsh. Over the last 50 years, the number of vegetation studies of grassland habitats has been disproportionately small considering the large area that grasslands occupy due to most of the Irish grassland vegetation being low-diversity agricultural grassland.[19]

Grassland habitats in Ireland cover approximately 60 % of the overall land area. The majority of this falls under improved agricultural grassland, while semi-natural grassland habitats only contribute to a smaller portion of the total. Remaining semi -natural grassland areas are threatened by abandonment of management, which will result in reversion to scrub and ultimately woodland, or else by the intensification of management, which can result in a decrease in species diversity. Semi natural grasslands act as a significant refuge for invertebrate, birds and mammals and provide suitable habitats for rare and protected plant species, but they are also extremely vulnerable in Ireland.[19]

Riparian and Freshwater

The Southern Region is home to many of Ireland’s major river courses including The Shannon, The Barrow, The Nore, The Suir, The River Lee and The Slaney. Not only do riparian and freshwater areas help to control pollution by using nutrients and reducing sediment, but they are also important for recreation and scenic values. They also supply food, cover and water for a large

variety of animals and serve as migration routes and steppingstones between habitats for a diversity of wildlife. Due to the variation of riparian areas across the southern Region, they function in different ways depending on the exact location. Despite these differences, all riparian areas possess some similar ecological characteristics such as energy flow, nutrient cycling, water cycling, hydrological function and plant and animal population.[20]

Coastlands

Coastlands are rich in biodiversity and play a vital role in climate resilience. Many coastal habitat types are Annex I habitats and are protected under the Habitats Directive. These include: 1. Estuaries, 2. Large shallow inlets and bays, 3. Mudflats and Sandflats not covered by sea water at low tide, 4. Reefs, 5. Sandbanks which are slightly always covered by seawater, and 6. Submerged or partly submerged Sea Caves.*

The Region has several marine and coastal habitats, from the Atlantic Ocean to the Celtic Sea and the Irish Sea.[3] The coastlands of the Southern Region provide a major tourist destination including the popular Wild Atlantic Way route, while providing a home to four out of five nationally significant ports. Other extensive coastal and marine assets include the islands, harbours, and fishing ports, and the culture and heritage associated with these coastal zones.[11]

Peatlands -Fen and Bog

Peatlands in the Southern Region can be subdivided into two main types, bogs and fens. Bogs are ombrotrophic (rain-fed) peatlands whereas fens are minerotrophic peatlands, which means they are fed by groundwater or moving surface waters. Fens have a higher nutrient status than bogs. [21]

Fossitt's habitat guide identifies five categories within bog habitat's as follows: PB1: Raised bog categories PB2: Upland blanket bog and codes PB3: Lowland blanket bog PB4: Cutover bog PB5: Eroding blanket bog. Unfortunately, a large proportion of Ireland's original raised bog has failed to remain intact or in good condition. They have been damaged mainly by peat extraction, drainage and burning. Both upland and lowland blanket bogs are threatened by overgrazing and afforestation which results in loss of habitat resource.[21]

Under the EU Habitats Directive, the National Parks and Wildlife Service (NPWS) are obliged to complete a report every 7 years on the condition of designated habitats. Assessments carried out in 2006 and 2013 found that no peatland type of priority importance in Ireland is in good conservation status. Blanket bogs were given a bad assessment in these reports, which highlights the need for improved and continued conservation measures.[12]

Ballybunion, Ireland

Appendix B - Policy Context

Policy support for BGI, NbS and the goals driving this framework are present from an international to local level.

UN Sustainable Development Goals

Examples

- Flood Directive (Directive 2007/60/EC)
  Water Framework Directive (Directive 2000/60/EC)
- National Marine Planning Framework
- Climate Action Plan 2021
  Climate Action & Low Carbon Development (Amendment) Act 2021
- National Landscape Strategy for Ireland 2015-2025
  Strategy for the Future Development of National & Regional Greenways
- European Green Deal
  EU Biodiversity Strategy
  EU Strategy on Green Infrastructure
  EU Climate Adaption Strategy

EU National Legislation and Policy

1. EU Directives
2. Planning Legislation
3. Government Policy
4. National Strategies
5. Capital Programmes
6. EU Strategies

National
NPF & NDP 2021-30

Regional
RSES

Local
County Development Plans
Local Area Plans

Establishes Policy Context for BGI and NbS

Local Authority

1. Local Economic & Community Plans
2. Housing Strategy
3. Retail Strategy
4. Capital Programmes
5. Blue/Green Infrastructure Plans
6. Tree Strategies
7. Flooding Strategy
8. Climate Change Plans
9. Water Programme

International and European Context

The international policy landscape sets the high-level strategic goals for enhancing placemaking, improving biodiversity and tackling climate change. The UN Sustainable Development Goals[15] represent a call for action by all UN countries to promote prosperity while protecting the planet.

Ireland

- International Convention on Biological Diversity[21]
- UN Paris Climate Change Agreement[14]

The UN Paris Climate Change Agreement commits to keeping the global average temperature increase to below 2°C based on pre-industrial levels.

At the European level, there are several EU directives that focus on protecting and conserving the environment:

Europe

- the EU Water Framework Directive (WFD)[22]
- Habitats Directive[23]
- Birds Directive[24]

The importance of BGI and NbS in the EU's strategy and vision are noted in the following:

- EU Strategy on Green Infrastructure[25]
- EU Biodiversity Strategy for 2030[26]
- EU Climate Adaptation Strategy[27]

Irish Context

Project Ireland 2040, the National Planning Framework and National Development Plan 2021-2030, set out the Government's long-term overarching strategy for a better Ireland for all of us.

The NPF provides the objectives and strategy for national development to 2040 and the NDP sets the investment strategy for achieving Project Ireland 2040.

The NPF intends to promote focused growth in the Southern Region as part of tackling the 'Regional dominance' of the Eastern and Midland Region and attain 'Regional parity'. It is planned that the population of the Southern Region will increase to around 2 million people, a growth of 340,000-380,000 people. The NPF sets a combined target growth of over 8,000 2people per annum to 2040 for the three cities in the southern Region. This level of growth has never been achieved in Ireland's history.

The NPF outlines 10 shared goals for communities across the country. BGI and NbS can contribute to delivering 4 of these objectives:

- Compact Growth
- Enhanced Amenities and Heritage
- Transition to a Low Carbon and Climate Resilient Society
- Sustainable Management of Water, Waste, and other Environmental Resources

The NDP 2021-2030 consists of a €165bn programme of public investment in the period. The NDP supports the Government's climate ambitions. Current and planned BGI and NbS investments across the Southern Region will be delivered under the following Strategic Investment Priorities, as set out in the NDP 2021-2030:

- Natural Heritage and Biodiversity – implementation of the National Biodiversity Action Plan 2017-2021, including Peatlands Restoration and Conservation
- Flood Risk Management
- Supporting more all-island approaches to biodiversity production, building on the success of the All-Ireland Pollinator Plan
- Support for the work of Waterways Ireland in maintaining, developing, and promoting over 1,000 km of inland navigable waterways across the island.

At the national level, BGI and NbS are highlighted as important in several policies and strategies. The National Marine Planning Framework (NMPF) commits to developing integrated network of greenways and blueways to promote more sustainable and active travel modes. In the National Landscape Strategy for Ireland 2015-2023, greenways and blueways are noted as providing a range of environmental services.

BGI and NbS are supported by the Climate Action Plan 2021[32] as actions for meeting Ireland's ambition to achieve a 51% reduction in overall greenhouse gas emissions by 2030 and net-zero emissions by 2050. These actions include:

> Action 231 Continue the improvement and expansion of Active Travel and Greenway Network [33]

> Action 386 80,000 hectares in 2030 of reduced management intensity of grasslands on drained organic soils[33]

> Action 402 Coordinate the actions in the Programme for Government regarding peatlands to maximise the benefits for biodiversity[33]

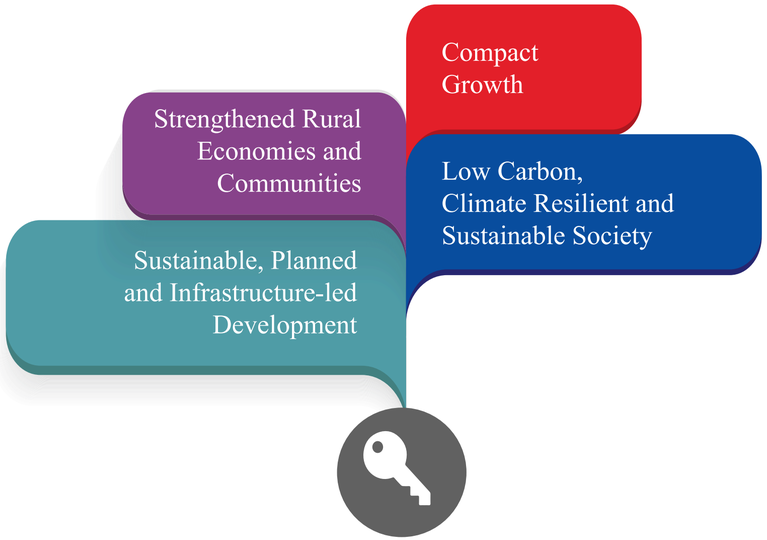
In 2021, the Irish government enacted the Climate Action and Low Carbon Development (Amendment) Act 2021 which accelerates the transition to a climate resilient and "climate neutral economy". It enshrines into law Ireland's "national climate objective" to pursue and achieve by 2050 a resilient, biodiversity-rich, environmentally sustainable, carbon neutral economy.

Regional Context

The Southern Regional Assembly has prepared a Regional Spatial and Economic Strategy (RSES) to implement the NPF in the Southern Region. The RSES sets a 12-year statutory strategic planning and economic development framework for future economic, spatial, and social development of Southern Region to become one of Europe's most "Creative and Innovative", "Liveable" and "Greenest" Regions.

Local Authorities are required to ensure that Development Plans and Local Area Plans align with the Regional Policy Objectives (RPOs) of the RSES to make sure national and Regional policy objectives are promoted and reached.

The RSES progresses the National Strategic Outcomes of the NPF through eleven Strategy Statements that include the following:



This Framework progresses [55] Regional Policy Objectives (RPOs) under these broad themes: health and wellbeing; climate change mitigation and adaptation; enhancing ecosystems health and biodiversity; water infrastructure management; flood mitigation; and placemaking. In addition to the RPOs a further 20 Metropolitan Area Strategic Plan (MASP) Policy Objectives will be progressed by this Framework. For example, each MASP contains a specific objective in support of the preparation of Metropolitan Open Space, Recreation and Greenbelt Strategies connecting green infrastructure corridors across the Region's cities, suburbs and metropolitan settlements.

City and County Context

The 10 City and County Development Plans are key to achieving the RSES, and subsequently the National Planning Framework. They provide the detailed and coordinated plans to guide and shape the development of communities in the Southern Region.

At a local level, Local Authorities in the Southern Region support the development of BGI and NbS through county and local plans. While across the Region, Local Authorities recognise the important contribution BGI and NbS can have to climate change, biodiversity and placemaking, each authority has a slightly different interpretation and focus.


Home

Appendix C - Stakeholder Engagement Workshop

The stakeholder workshop was conducted online on 2nd February 2022.

The workshop was conducted using Miro (an online whiteboarding software) and Menti (an online survey tool) which allowed facilitators to zoom into the detail of the framework on screen and gather immediate feedback on questions that related to general responses, place and physical context, drivers and local problems, technical detail, governance, and funding.

The stakeholder workshop was followed up through an interactive online Miro board which enabled stakeholders to provide further feedback on the framework and the key questions from the workshop.

Workshop Tools

The workshop was held on the 2nd of February 2022 over MS Teams. To gather feedback two online interactive tools were used, Miro and Mentimeter.

Miro is an online interactive whiteboard which allows workshop participants to collaborate during a live workshop session. The tool allows participants to create notes and designs to communicate their thoughts and feedback.

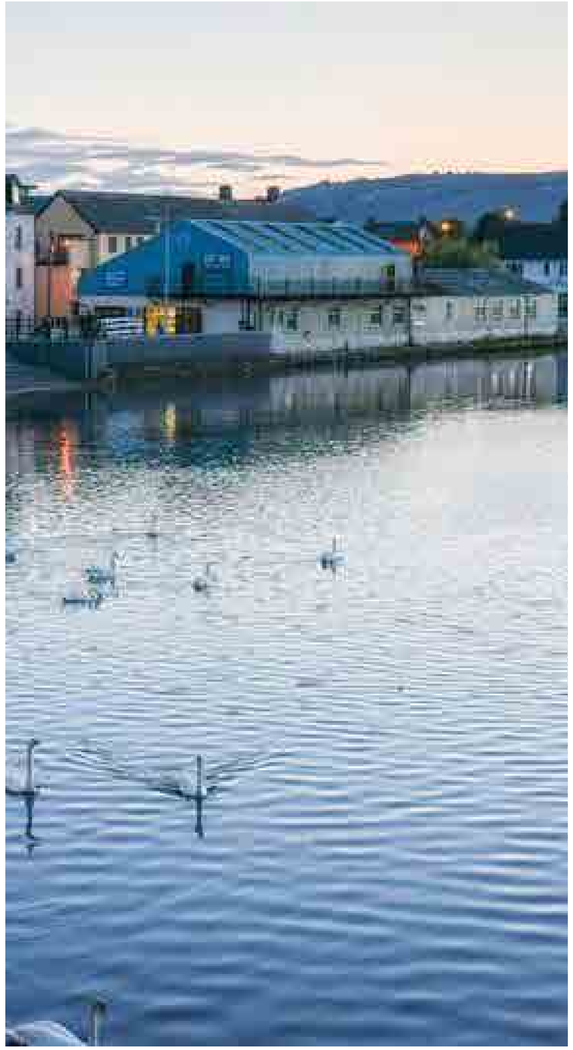
Mentimeter is an online interactive presentation software where the participants can use their own devices to connect to the presentation and answer live questions. The responses are visualised on screen in real time which helps to create an interactive experience and have discussions throughout the workshop based on the live results.

Workshop Structure

The first section of the workshop consisted of introductions and setting the scene for the framework. The second section of the workshop was an interactive review of the framework. Throughout the second section live questions were posed to the group on Mentimeter.

Below is a summary of the questions asked:

- What environments do you frequently apply NbS in?
- In which sort of settlements have you applied NbS?
- What are the main drivers influencing your approach to BGI / NbS planning?
- To what extent do you agree that we have got the right breakdown of settlements and typologies?
- To what extent do you agree that we have organised the principles and indicators in a way that is useful for your organisation?
- What is the status of your Local Authorities' GBI/BGI strategy?
- If a strategy is in place, is it named as a BGI or GBI strategy or something else?
- What type of additional or different information is important, in your opinion, that we include in relation to each tool?
- Whose role is it within your organisation to implement NbS / BGI?
- What are the barriers to implementing NbS?
- Can you cite any good examples of NbS that have been applied in your area (which may not have been already published already)?
- How have BGI/NbS interventions been delivered or funded in your area?



Barrow Graigcullen, Carlow, Ireland

- What are the current or predicted drivers for funding going forward that could potentially embrace NbS?
- How useful will a framework like this be for your organisation?
- How do you see this framework being used?

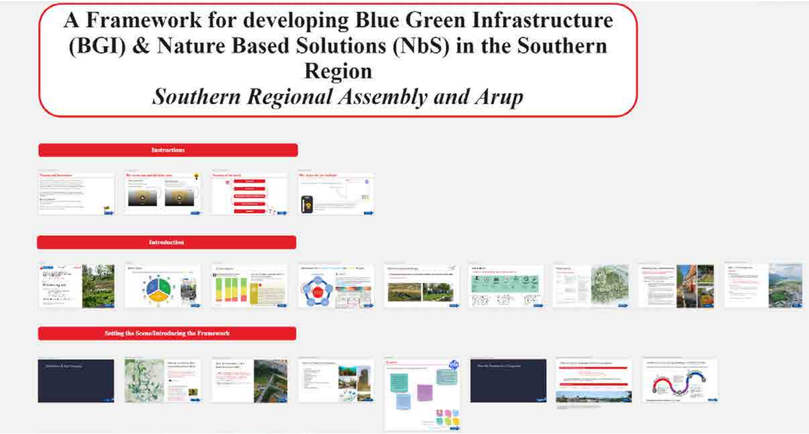
Post-workshop Feedback

After the workshop a follow up Miro board was sent to the participants which comprised of the full presentation and outline of the framework. Throughout this board, the Menti questions were integrated to allow the participants the opportunity to provide further detailed feedback. The post event board also gave those who couldn't attend the workshop the opportunity to explore the framework and share their feedback.

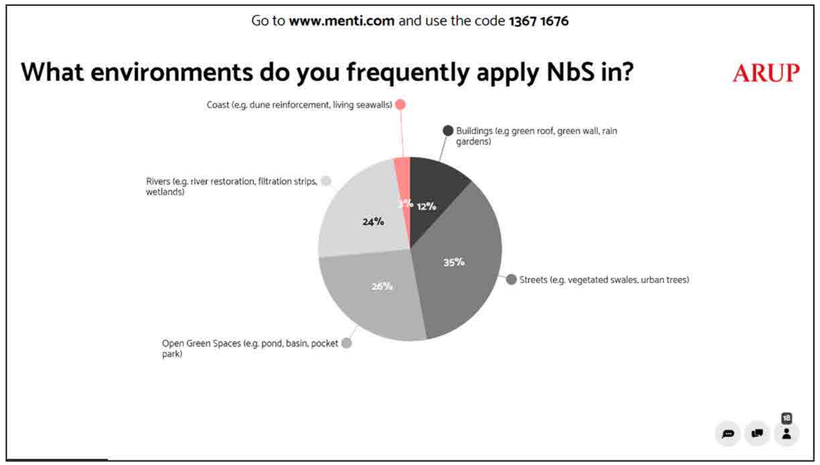
Workshop Outcomes

The following points summarise the main outcomes of stakeholder consultation. All feedback was taken on board and influenced the outcome of this framework.

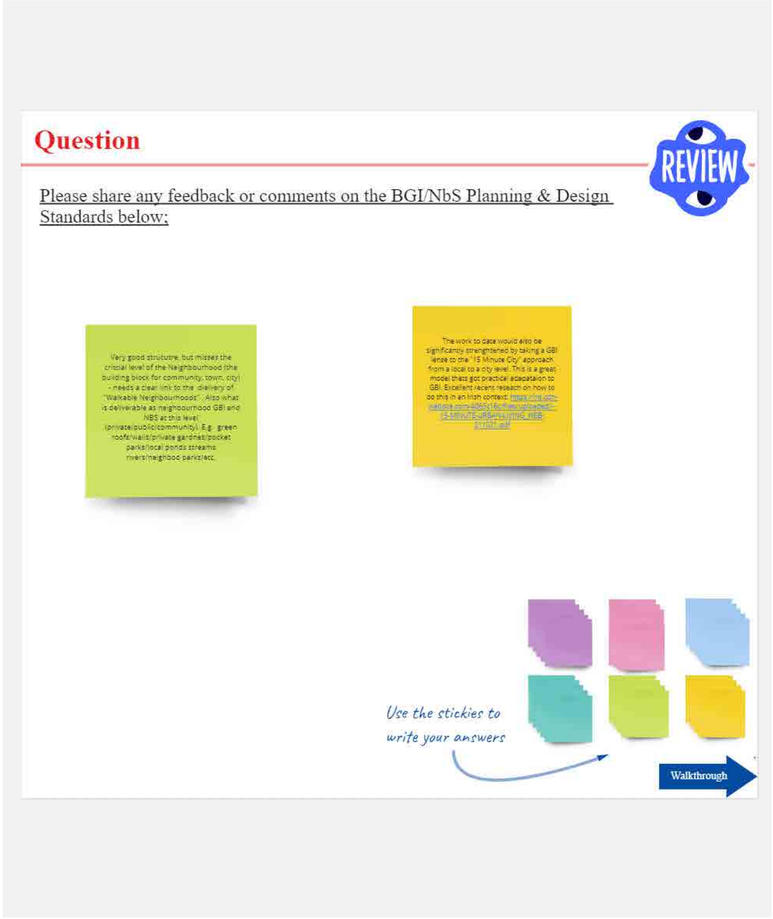
Summary of Stakeholder Feedback



Picture 1 Screenshot of Miro Board from the Workshop



Picture 2 Example of Menti Live Results



Picture 3 Example of feedback sections on the post event Miro board

Summary of Stakeholder Feedback

General Feedback

- The stakeholder feedback confirmed we are on the correct trajectory.
- There was general support for our understanding of the challenges and the tools we have developed.
- The feedback on the organisation of principles and indicators was positive.
- Positive feedback was received on how useful the framework will be to their organisations.
- Detailed feedback relating to the way that greenways relate to different settlement types and linking in with 10-minute towns and 15-minute cities frameworks were taken on board.
- Suggestions were made about the need for practical application throughout the project lifecycle and the need for further work to support development management (for example the provision if a template for developers) were noted.

> *"The framework should also consider inclusion of practical examples showing how a NBS proposal can sit within an existing and emerging GBI network."*
>
> – Quote from stakeholder workshop

- It was suggested that a project review group would ensure the successful application of the framework throughout the project lifecycle. It was noted that earlier project reviews enable maximum opportunities for change.

Feedback about Place and Project Context

- The most common application of NbS is in are predominantly urban environments, particularly streets.

> *"Urban centres should also consider allowing for greenways/green corridors and for brownfield/edge could have greenway/ green corridors included in open space"*
>
> – Quote from stakeholder workshop

- Coastal areas were the environments where NbS are least frequently applied. This is notable given there are six coastal counties and Waterford, Cork and Limerick are all coastal cities.

> *"Thinking about and planning projects at Neighbourhood level is very important for GBI in terms of open space, biodiversity, health and wellbeing and local access to city GBI networks - greenways, city parks, rivers, lakes, forests, etc."*
>
> – Quote from stakeholder workshop

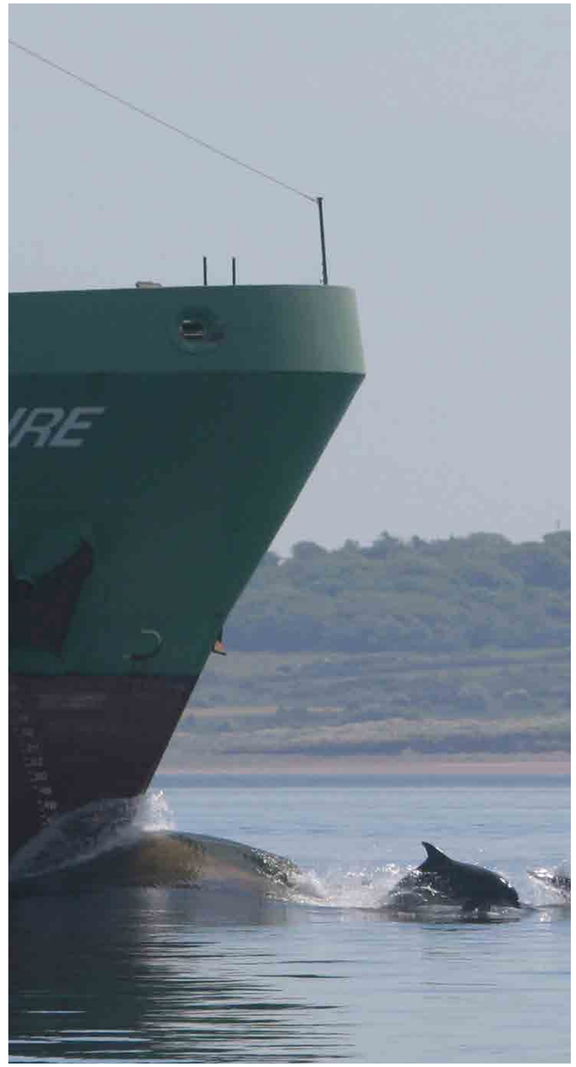
- There was some disagreement and uncertainty about the breakdown of settlements and typologies we had chosen–This appears to link to the need to represent the application of ideas at a neighbourhood scale and the need to articulate well how settlements are influenced by their geography and landscape setting

Feedback about Drivers

- The three main drivers that stakeholders identified as influencing their approach to BGI/ NbS planning were biodiversity, climate change and placemaking. These are congruent with the project objectives.
- Interestingly placemaking was identified as the 3rd most important strategic driver to stakeholders. This suggests that Local Authorities may not yet associate BGI and NbS with placemaking potential.
- The OPW raised a concern that flooding wasn't identified among the main drivers. We are satisfied that flooding is well considered within the water security driver.

Feedback about Technical Aspects

- Comments on technical aspects such as the integration of BGI planning approached will inform the how the framework progresses
- Stakeholders provided useful suggestions as to the information required in each tool, we will further review this and consider how best to adopt suggestions.



Shannon Esturary, Ireland

- Suggestions on case-studies and funding sources were received.
- It was noted that the incremental and cumulative impacts of GBI also critical (in terms of Climate adaptation, etc.) -both positive (green roofs, rain gardens, tree pits) and negative impacts (e.g., hard surfacing, tree removal, surface water run off management, culverting, attenuation soak pits, etc.)
- An important comment was made about the importance of not amalgamating BGI and NbS.
- Stakeholders fed back that information on how each NbS intervention reinforces a wider network, on a detailed checklist of what a development should consider and best practice examples that refer to practicality of delivery would be if use.

> *"A detailed checklist of what a development should consider would be useful"*
>
> – Quote from stakeholder workshop

Feedback about Aspects relating to Governance

- NbS and BGI are delivered by planning and operations departments within local authorities but there is strong desire that implementation would have to be cross-departmental. Barriers to implementation are the culture of the organisation, the lack of multi-disciplinary design and delivery, the lack of training, the lack of strategies, perceived costs, and the lack of project focus.

> *"Ensuring effective implementation would need to be cross departmental"*
>
> – Quote from stakeholder workshop

- NbS interventions have been delivered though research projects, locally, nationally, and European-wide projects and private developments.
- Current or predicted drivers for NbS are climate adaptation plans, agricultural schemes, EIP projects, the climate action plan, the capital flood relief scheme, public realm plans, URDF / RRDFs, the Town Centre First Policy, the water framework directive, the National Biodiversity Plan, community biodiversity plans, emerging LAPS, Active Travel Plans, Village Design Plans, Masterplans, SDZs and SHDs.

Fermoy Island, Ireland
© SRA

Appendix D - Directory of Tools

9.1.1 Needs Identification

- Regional Economic and Spatial Strategy for the Southern Region (Southern Regional Assembly)
- 10 Minute Towns (Southern Regional Assembly)
- Close to Home – Exploring 15-Minute Urban Living in Ireland (Hassell/Irish Institutional Property)
- Green Infrastructure: A 'How To' Guide for Disseminating and Integrating the Concept into Spatial Planning Practice (EPA)
- Think Nature-based Solutions Handbook (EU Horizon 2020)
- Nature-based Solution evaluation indicators: Environmental Indicators Review (EU Connecting Nature Project)
- Evaluating the impact of nature-based solutions – A handbook for practitioners (European Commission)
- Inclusive Community Engagement Playbook by C40 Cities
- Governance Guidebook (EU Connecting Nature project)
- Innovative Governance for Urban Green Infrastructure – A Guide for Practitioners (Green Surge)
- Governing natural resources for effectiveness, equity, and sustainability: what matters? Ecosystem Services for poverty alleviation
- Integrating Ecosystem Approaches, Green Infrastructure and Spatial Planning (EPA)

9.1.2 Planning

- Urban Nature Navigator by the EU Naturvation Project helps assess how different NbS can meet urban sustainability challenges
- ReNature's Interactive Research & Support Tool provides recommendations for choosing the right nature-based solution, based on existing NbS projects/what others have done.
- InVEST tool – for exploring how changes in ecosystems lead to changes in benefits (Stanford University)
- Value and benefits assessment methods database for Urban Nature-based Solutions (EU Naturvation Project)
- Economic Valuation of Ecological Functions and Services of Natural Ecosystems: Guide on the Use of Simple Methods (IUCN)
- Cities Alive: Rethinking green infrastructure (Arup)
- Investing in Nature: Financing Conservation and Nature-based Solutions a Practical Guide for Europe
- The Nature-based Solution Business Model Canvas and Guidebook (EU Connecting Nature Project)
- Investment Finance for Green Infrastructure (Interreg Europe)

9.1.3 Design and Implementation

- IUCN Global Standard for Nature-based Solutions (International Union for Conservation of Nature)
- US EPA's guidance on the design and implementation of green
- EcoShape Five basic steps for 'Building with Nature'
- Green Infrastructure Flexible Model (GIF Mod) – open-source conceptual modelling tool for water management solutions design
- Technical Solutions Guidebook (EU Connecting Nature Project)
- Policy and Planning Tools for Urban Green Justice (BCNUEJ and ICLEI)
- A Roadmap for the Blue Green Infrastructure (BGI) Manual – Bridging the knowledge gap in the field of BGIs (JCNN)
- The Adaptation Principles: A Guide for Designing Strategies for Climate Change Adaptation and Resilience (World Bank)
- Managing Infrastructure Assets for Sustainable Development (United Nations)
- The Importance of Operation and Maintenance for the Long-Term Success of Green Infrastructure (Environmental Protection Agency, US)
- Reflexive Monitoring Guidebook (EU Connecting Nature Project)
- Impact Assessment Guidebook (EU Connecting Nature Project)
- Completing the Picture: How the Circular Tackles Climate Change (Cowes: Ellen MacArthur Foundation)
- The European Commission's Circular Economy Action Plan
- StoryMaps collections documenting community struggles for equitable access to green space and housing (BCNUEJ)

Abbreviations

BCNUEJ	Barcelona Lab for Urban Environmental Justice
BGI	Blue Green Infrastructure
EPA	Environmental Protection Agency
EU	European Union
GIS	Geographic Information Systems
IUCN	International Union for the Conservation of Nature
KPI	Key Performance Indicator
MASP	Metropolitan Area Strategic Plan
MCA	Multi-Criteria Assessment
MoU	Memorandum of Understanding
NbS	Nature-based Solution
NDP	National Development Plan
NHAs	National Heritage Areas
NMPF	National Marine Planning Framework
NPF	National Planning Framework
O&M	Operations and Maintenance
PPP	Public Private Partnership
RPO	Regional Policy Objective
RSES	Regional Spatial and Economic Strategy
SAC	Special Area of Conservation
SDGs	Sustainable Development Goals
SPA	Special Protection Area
UN	United Nations

Glossary

Biodiversity	is the variety and variability of living species on earth.
Blue Green Infrastructure	is a ‘strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem service’.[4]
Brownfield and Urban Fringe	transitional places with proximity to urban core areas.[40]
Circular Economy	is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products for as long as possible.
Climate Change	is a change in global or Regional climate patterns, particularly those changes accelerated by human activities.
Climate Change Mitigation	is efforts to reduce or prevent the emission of greenhouse gases to the atmosphere.
Climate Change Adaptation	is actions to adjust to current or expected climate change and it’s impacts.
Climate Crisis / Climate Emergency	is a situation characterised by highly dangerous, irreversible changes to the global climate
Climate-related Failure	is the collapse of part of or all aspects of a social, economic, or environmental system due to climate change and its impacts
Food Security	is the state of having reliable access to enough nutritious food at an affordable price
Geographic Information System	is a computer-based tool for capturing, storing, checking, and displaying data related to position on Earth’s surface.
Key Performance Indicator (KPI)	is a quantifiable measure used to evaluate success
Life-Cycle Stage	is a phase within a series of changes of the life of BGI or NbS including needs identification, project planning and implementation.
Memorandum of Understanding (MoU)	is an agreement between two or more parties.
Nature-based Solution	are solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience.[8]
Operations and Maintenance (O&M)	Plan is a formal plan that describes how the solution is to be operate on a daily basis.
Pre-industrial Temperature	The IPCC Special Report on Global Warming of 1.5°C uses the reference period 1850–1900 to represent pre-industrial temperature.
Resilience	is the ability to withstand and respond to changes.
Rural Settlement	areas of low population density.[3,40]
Societal Challenge	are economic, social and environmental problems of a global scale.
Sustainable Development Goals (SDGs)	are a collection of 17 interlinked global goals designed to be a “blueprint to achieve a better and more sustainable future for all”. The SDGs were set up in 2015 by the United Nations General Assembly.
Systems Thinking	is a holistic way to investigate factors and interactions that could contribute to a possible outcome.
Systems Thinking	is a holistic way to investigate factors and interactions that could contribute to a possible outcome.
Urban Core	a contiguous area inhabited at urban density levels.[39,40]
Water Security	is the capacity of a population to safeguard sustainable access to enough quality water for sustaining life, livelihoods and socio-economic activities.

Images

Pg. No	Image Title	Source
3	Grey to Green Project, Arup, Sheffield, UK	Copyright Arup
4	Fitzpark, Arup, London, UK	Copyright Arup
5	Guggan Barra, Cork, Ireland	Copyright SRA
6	Connswater Community Greenway, Arup, Belfast, United Kingdom.	Copyright Arup
7	Guided Busway, Arup, Cambridgeshire, UK	Copyright Arup
9	Bridgewater Basin, Manchester, UK	Biomatrix.com
14	London Olympic park, Arup, UK	Copyright Arup
15	Carlow, Ireland	Copyright SRA
16	Grey to Green Project, Arup, Sheffield, UK	Copyright Arup
17	Killarney House and Gardens, Killarney, Ireland	Copyright SRA
18	London Olympic park, Arup, UK	Copyright Arup
19	Mountshannon, Cork, Ireland	Copyright SRA
22	Waterford Greenway, Ireland	Independent.ie
24	Tierra del Fuego, Argentina	Mongabay.com , Enric Sala/National Geographic
25	Sound of Barra, Scotland	Nature.scot
26	Newly planted wetland creation in Silverthorne, Colorado, USA	Birchecology.com
27	Carlow, Ireland	Copyright SRA
30	London Olympic park, Arup, UK	Copyright Arup
34	London Olympic park, Arup, UK	Copyright Arup
41	Room for the River IJsseldelta, The Netherlands	Rijkswaterstaat.nl (NL Ministry of Infrastructure and Water Management)
42	High-Speed 2 Project, Arup, UK	Copyright Arup
46	Guided Busway, Arup, Cambridgeshire, UK	Copyright Arup

Pg. No	Image Title	Source
51	Villages Enhancement Scheme, Arup, Carmarthenshire, Wales	Copyright Arup
52	Connswater Community Greenway, Arup, Belfast, United Kingdom.	Copyright Arup
53	London Olympic Park, Arup, UK	Copyright Arup
55	Loughgall, Northern Ireland	blogspot.com
55	Skibbereen, West Cork, Ireland	blogspot.com
56	Nags head, North Carolina, USA	dredgingtoday.com
57	Greener Grangetown, Arup, Cardiff, Wales	Copyright Arup
58	River Dee, Northeastern Scotland	Researchgate.net
58	St.Annes Park, Raheny, Ireland	eghn.org
59	Sct Olai Square, Roskilde, Denmark	i.pinimg.com
59	Sovereign Square, Leeds, UK	landezine.com
60	Slea Head, Kerry, Ireland	viatour.com
60	Ardmore, Waterford, Ireland	cumnor.ie
61	Sand dune restoration work Castlegregory, Kerry, Ireland	catshments.ie
62	Queen Elizabeth Park, Arup, UK	Copyright Arup
63	Afforestation in Agach, Istanbul, Turkey	intechopen.com
64	Marriot Hotel, Belfast, UK	thermohouse.ie
64	NEC, Birmingham, UK	images.squarespace-cdn.com
65	Amersfoort, Netherlands	mobilane.com
65	Library of Birmingham, UK	landscapejuice.com
66	Waterford Greenway, Ireland	Waterford Intellectual Disability Association (Wida.ie)
66	Waterford Greenway, Ireland	independent.ie

Note - Images are © Unsplash unless otherwise stated.

Images

Pg. No	Image Title	Source
67	Galtee Farm, Tipperary, Ireland	independent.ie
67	Valley of Glenasmole, Dublin Mountains, Ireland	images.squarespace-cdn.com
68	Sound of Barra, Scotland	nature.scot
68	Ancient Kelp forest, Bantry Bay, Ireland	greennews.ie
69	Living Seawalls, Sydney, Australia	images.squarespace-cdn.com
70	Medmerry, Sussex, UK	bbc.co.uk
70	Medmerry, Sussex, UK	environmentagency.blog.gov.uk
71	Bank stabilisation with stones, Minnessota, USA	siave.net
71	Aqua rock bags, Cumbria, UK	salix-6aa7.kxcdn.com
71	Letterfrack, Connemara, Galway, Ireland	nativeoysternetwork.org
72	Letterfrack, Connemara, Galway, Ireland	afar-production.imgix.net
73	Clogrennane Wood, Carlow, Ireland	pbs.twimg.com
73	Sika deer in Wicklow forest, Ireland	coillte.ie
74	Kilanerin-Curragh Wood, Co.Wexford, Ireland	RTE
74	Kelly's Wood, New Ross, Co.Wexford, Ireland	Reddit.com
75	Mardyke Gardens, Cork, Ireland	cork-guide.ie
76	University of Salford, UK	tobermore.co.uk
76	Escofet Checkerblock paving, Spain	Escofet.com
77	Father Collins Park, Donaghmede, Ireland	guia-construccion.com
77	Mardyke Gardens, Cork, Ireland	upload.wikimedia.org
78	Grey to Green Project, Arup, Sheffield, UK	sheffield-consult.objective.co.uk
78	Greener Grangetown, Arup, Cardiff, Wales	greenblue.com
79	Eco-Sustainable House of Antony, Antony, France	architizer.com

Pg. No	Image Title	Source
80	Beam Parklands, UK	Copyright Arup
81	Thornton Creek, Seattle, USA	migcom.com
81	River Aire, Geneva, Switzerland	urbannext.net
82	Aarhus River Project, Denmark	urban-waters.org
82	City River, Seoul, Korea	pxhere.com
83	Kilmore Quay, Waterford, Ireland	irishtimes.com
83	Studland Bay, Dorset, UK	irishtimes.com
84	Krivany, Slovakia	nwrm.eu
84	Example of road side Sedimentation Pond, Norway	Management of contaminated runoff water: current practice and future research needs. Sondre Meland / Reasearch Gate
85	Davis Park, Florida, USA	i.pinimg.com
85	Salford Flood Improvement Scheme Bassin, Salford, Manshester, UK	questmedianetwork.co.uk
86	Phoenix Park, Dublin, Ireland	MickBarry.com
86	Triangle Park, Cambridge, UK	Stoss Landscape Urbanism
87	Northwood Hills, UK	greenblue.com
88	Norritonville, Pennsylvania, USA	Montgomery County Planning Commission
88	Grey to Green Project, Arup, Sheffield, UK	ceequal.com
89	Top image to be replaced with: Phoenix Park, Dublin, Ireland	wildirishwalks.ie
89	Water Sensitive Forest Management, Florence, Alabama, USA	fmsforestry.com
90	Dunmore East, Waterford, Ireland	irishtimes.com
90	Cabragh Wetlands, Co.Tipperary, Ireland	irishtimes.com
91	Natuurbrug Zanderij Crailoo, Netherlands	planetcustodian.com
91	Crossover Wildlife Corridor, Banff, Alberta, Canada	gaiaresources.com.au

Note - Images are © Unsplash unless otherwise stated.

Images

Pg. No	Image Title	Source
93	Animal Aided Designed City Park, Inglostadt, Germany	animal-aided-design.de
93	Biotape Area Factor, Berlin, Germany	berlin.de
94	Shanghai Drainage Model, Arup, China	Copyright Arup
94	Ballincollig Regional Park, Cork, Ireland	Rigodcork.ie
94	Ballincollig Regional Park, Cork, Ireland	Reddit.com
95	Cork passage railway Greenway Improvement Scheme, Cork, Ireland	passagegreenway.com
95	Hare's Corner Mini Woodland planting, Clare, Ireland	burrenbeo.com
96	Connswater Community Greenway, Belfast, UK	Copyright Arup
96	Gap of Dunloe, Kerry, Ireland	Copyright SRA
96	Guggan Barra, Cork, Ireland	Copyright SRA
97	Greener Grangetown, Arup, Cardiff, Wales	Copyright Arup
97	Vibrant verges in Fingal, Ireland	Copyright Arup
98	Grey to Green project, Arup, Sheffeild, UK	Copyright Arup
99	Coirib go Cósta - Galway City Flood Relief Scheme, Arup, Ireland	Copyright Arup
99	Inishowen Rivers Trust, Donegal, Ireland	inishowenriverstrust.com
100	Honey from Pasieka Kraków, Poland	radiokrakow.pl
100	The Apiary of Krakow, Krakow, Poland	radiokrakow.pl
100	Växjö invests in biomass, Växjö, Sweden	photo by John McConnico, found on theguardian.com
100	Vaxjo's bikeway network, Växjö, Sweden	ecocitiesemerging.org
101	New dwellings on the green belt, London, UK	independent.co.uk
101	London's green Belt, London, UK	highlivingbarnet.com
101	VERDIR project, Liege, Belgium	Liege University

Pg. No	Image Title	Source
102	All London Green Grid, UK	Supplementary Guidance to the 2011 London Plan, London, UK
102	Fitz Park London, London, UK	Copyright Arup
103	Biodiversity Net Gain, Keyn Glas, Cornwall, UK	Keyn Glas EDF CIEEM Awards 2020
103	Granby Park, A Temporary Park, Dublin, Ireland	olivialeaves.com
103	Granby Park, A Temporary Park, Dublin, Ireland	Builtdublin.com
104	Grey to Green Project, Arup, Sheffield, UK	Copyright Arup
105	Suspension Bridge Kenmare, Kerry, Ireland	Copyright SRA
107	Connswater Community Greenway, Arup, Belfast, UK	Paula Lindsay / Christopher Hill Photographic. Arup asset bank
108	Gap of Dunloe, Kerry, Ireland	Copyright SRA
110	Beach Nourishment, Nags Head, USA	Firstcoastal.com
111	Wexford, Ireland	Copyright Wexford County Council
112	Phoenix Park, Dublin, Ireland	SundayWorld.com
113	Ballybunion, Kerry, Ireland	Copyright SRA
114	Cavan's Jane Shackleton agroforestery farm, Cavan, Ireland	Arc2020.eu
119	Barrow Graigcullen, Carlow, Ireland	Copyright SRA
121	Shannon Estuary, Ireland	Copyright SRA
122	Fermoy Island, Cork, Ireland	Copyright SRA

Note - Images are © Unsplash unless otherwise stated.


Tionól Réigiúnach an Deiscirt
Southern Regional Assembly


Blue Green
City
Interreg Europe


ARUP