URBAN GreenUP

D1.4: Baseline Calculation Procedure

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0 Abstract

The foundation of any successful NBS project is to understand the baseline conditions that the project seeks to change, and evaluate the capacity of the city and partners to undertake the project. The baseline calculation procedure outlines a framework that assists and supplements the process of NBS implementation that helps municipal governments to:

1. Diagnose socio-ecological issues their city experiences,
2. Select the most suitable NBS intervention(s) to address them, and
3. Set key performance indicators (KPIs) that serve to monitor the performance and effectiveness of the intervention(s).

In short, the following report informs the on-going design, implementation and maintenance *of* NBS interventions, as well as help structure and guide future investment *in* NBS.

This report uses a 'Process Chain' to provide signposts for stakeholders (e.g. city planners, consultants) and to structure decision-making. This mechanism outlines the conceptual chain-links that guide NBS the integration of policy, legal requirements, thematic design principles and local needs assessment leading to more effective implementation. The process also provides guidance on when and how KPI metrics and targets should be set, although these will be reflective of local contextual analysis, i.e. of local socio-economic, ecological and political factors.

The process outlined focuses on the first four components of the chain-links: *policy structures*, *governance structures*, *local environmental context* and *thematic development objectives*. The aim here is to provide a scalar analysis of what municipal governments and other urban actors must take into consideration when deciding on how to approach their NBS vision(s). Understanding and appreciating context, place-based priorities, and the overlapping levels of governance and policies influencing development and implementation of NBS is essential if plans are to meet the requirements or aspirations of local government or communities. The process outlined in this document has been designed in such a way that it can be adapted to a wide variety of urban contexts. Rather than prescribing a set of objectives and procedures to meet them, it provides a flexible procedure that allows cities to understand how local conditions can be leveraged and adapted to effectively re-nature urban areas and address key societal challenges. The 'Process Chain' outlined in this document provide the foundation on which NBS plans can be constructed and success monitored.

1 Introduction

Europe and its citizenry are facing an increasingly complex set of challenges arising from drivers of environmental change, including unsustainable urbanisation, natural capital degradation and the growing threat of climate change and its hazards (e.g. extreme weather events). To tackle these interconnected challenges, the EU has developed a series of programmes focussed on Nature-Based Solutions (NBS), which they have conceptualised and mobilised via the Horizon 2020 funding programmes. The European Commission (EC) defines NBS as a means to foster biodiversity conservation and render Europe a more climate-resilient continent. Enshrined within policies such as the EU's Biodiversity Strategy (2020) and Adaptation Strategy (2018), the EU aims to:

- Provide the evidence for nature-based solutions.
- Improve framework conditions for nature-based solutions at EU policy level.
- Develop a European research and innovation community advance the development, uptake and upscale of innovative nature-based solutions.
- Mainstream nature-based solutions in international research and innovation.

Since 2017, the EU has funded several urban NBS demonstrator projects to test, deploy and promote NBS. These projects are: *URBAN GreenUP, Connecting Nature, Grow Green, NATURVATION* and *Clever Cities*. Treating cities as urban living labs, these projects are expected to provide a "repository of best-practice examples" (Faivre et al., 2017:513) that can be transferred and ultimately replicated globally.

The following document assists and supplements the process of NBS replication by providing a framework for baseline calculations that helps municipal governments to:

4. Diagnose socio-ecological issues their city experiences,
5. Select the most suitable NBS intervention(s) to address them, and
6. Set key performance indicators (KPIs) that serve to monitor the performance and effectiveness of the intervention(s).

In short, the following report looks to inform the on-going design, implementation and maintenance *of* NBS interventions, as well as help structure and guide future investment *in* NBS.

The baseline calculation procedure is a key part of the planning process in the Urban GreenUP Re-Naturing methodology (Figure 1, 1E).

How to start?	1st. Understand your present	2nd. Choose your future aspirations	3rd. Integrate RUP and keep	"Renaturing Urban Plan"
A. Engage and Co-create	Action 1A. Identify and involve stakeholders	Action 2A. Prepare for co-delivery		Chapter I. Introduction to Re-naturing
B. Explore	Action 1B. Understand your "city" needs	Action 2B. Choose your "city" targets	Action 3B. Prepare RUP Plan integration into the Urban Plans of Local Municipality	Chapter II. City Targets
C. Diagnose	Action1C. Understand your "city" capacity	Action 2C. Evaluate NBS Scenarios and select one	Action 3C. Define list of NBS Projects and Actions	Chapter III. City NBS Adopted Scenarios
D. Visualize	Action 1D. Map challenges	Action 2D. Set spatial priorities for NBS	Action 3D. Prepare assessment of the Impact and Risk	Chapter IV. City Impact
E. Plan	Action 1E. Establish Baselines	Action 2E. Choose how success will be monitored	Action 3E. Prepare the Up-scale Plan	Chapter V. Monitoring Program and Action Plan
F. Inform	Action 1F. Promote the initiative	Action 2F. Publish the RUP	Action 3F. Define budget, roles and responsibilities	Chapter VI. Roles and Responsibilities
A. Engage and Co-create	Action 3A. Assess lessons learnt and validate the strategy			Chapter VII. Processes and reforms

Figure 1: Summary of the main components of the URBAN GreenUP Methodology (Source: URBAN GreenUP, D1.3)

This report uses a 'Process Chain', outlined in Figure 2, to provide signposts for stakeholders (e.g. city planners[1]) to structure their decision-making. The idea of this chain is to outline key considerations and links between them (aka chain-links) that guide NBS planning. It allows cities to connect understanding about NBS and how they can solve societal challenges to practical requirements and constraints, particularly policy at multiple scales, legal requirements, thematic design principles and consideration of local needs. Such an assessment in this planning stage provides the foundation for more effective implementation than trying to apply a generic blueprint for NBS. The process also provides guidance on when and how KPI metrics and targets should be set, although these will be reflective of local context, i.e. of local socio-economic, ecological and political factors. Given that none of these factors are static, it is also important to

[1] The term "stakeholders" is used here to refer to the end users of this document, which includes anyone who is involved in the NBS planning process. Most often this will be employees in the cities and other organisations leading the planning process (e.g. city councils, non-profit organisations, engineering firms, consultancies).

bear in mind that flexibility is required in following all parts of the methodology, including this baseline step.

The process outlined focuses on the first four components of the chain-links: *policy structures*, *governance structures*, *local environmental context* and *thematic development objectives*. The aim here is to provide a structure of what municipal governments and other urban actors must take into consideration when deciding on how to approach their NBS vision(s) across multiple scales (e.g. street level, neighbourhood level, city level, regional level). Without awareness and appreciation of these intersecting contextual layers, NBS plans will potentially fail to meet the requirements or aspirations of local government or communities. What the 'Process Chain' provides, therefore, is the foundation on which NBS plans can be constructed.

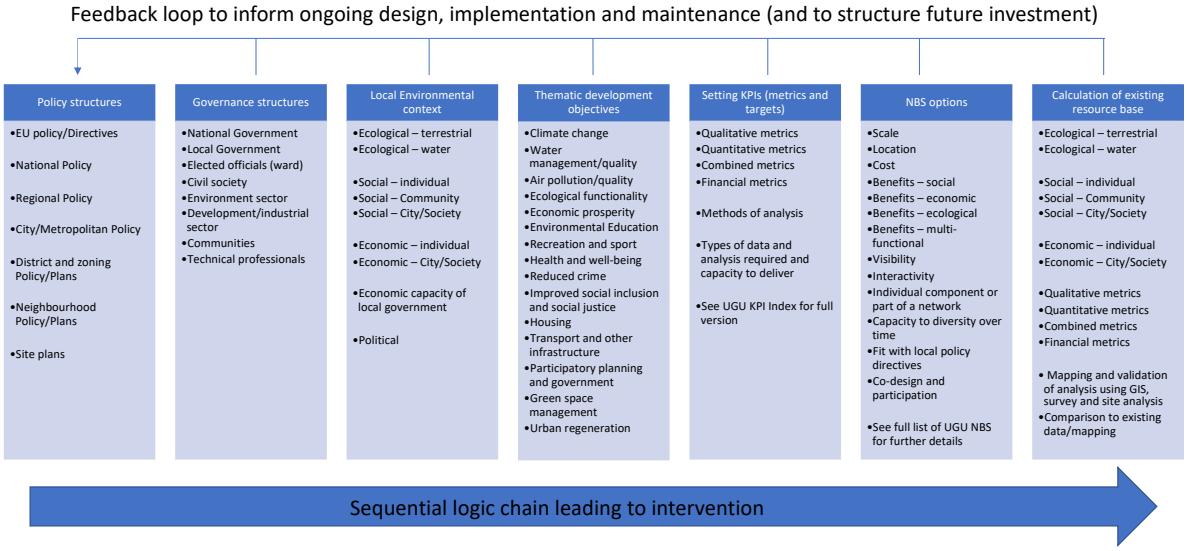

Figure 2. 'Process Chain' for calculation of NBS baseline position

To fully engage with the process outlined in this report, stakeholders must be aware that all baseline calculations are complex in terms of the integration of multi-scale policy agendas, assessment of local socio-economic and ecological context, and the governance structures support decision-making at the national, city and local, i.e. ward/sub-district scale. Each of these factors must be taken into consideration when developing a baseline calculation for it to be meaningful and deliverable in a specific city or location.

Moreover, the process requires decision-makers and stakeholders to take stock of their existing environmental and socio-economic context, to reflect on the wider political frameworks they work within (and their influence on practice), and assess what types of investment will meet the needs of their local and strategic objectives. This will mean that an extensive engagement with policy, practice and evidence is needed to develop a robust calculation, and at all stages within the process-chain stakeholders must consider why they are proposing to develop NBS and how this can be supported and integrated with existing policy and practice frameworks. Where gaps

in this evidence base exist then decision-makers can use the process-chain to identify where information can be found, and how it can be used to support policy and practice. Whilst specialist expertise in evaluation and/or research is helpful in developing a robust baseline and detailed consideration, such external expertise is not essential, and cities without funding for external experts can undertake a baseline calculation in-house.

Although the process chain is proposed as step-by-step approach, as with all planning processes, it is often iterative and can involve moving back and forth between stages. It also requires decision-makers within a location to think critically about the data they have available, their existing policy frameworks and strategic development targets, their identified socio-economic needs and ecological conditions (including climatic conditions), and the structures they have in place to deliver effective investment in NBS. Therefore, although the process chain lacks a spatial specificity, except in terms of being located within an EU policy/funding/legislation landscape, the decision-making needed to population the baseline calculation needs to be locally contextual and planned spatially. The inputs from the "Visualise" step of the methodology are thus critical for an effective baseline calculation (step D, Figure 1).

The following discusses Stages 1-4 of this process, as these are the core stages of evaluation needed to create a baseline calculation. Stages 5-7 involve setting KPIs, identifying NBS investment options and mapping the projects/spatial development objectives onto existing resources. This report focusses on the background analysis that is needed to support these decisions and addresses the questions that need to be asked by stakeholders regarding policy, governance, local context and finally thematic/strategic development objectives.

This document, and the process chain proposed, should be read as a complementary document to the city diagnoses documents produced for URBAN GreenUP, as it maps effectively onto a number of the forms of evaluation undertaken for these documents. These relate specifically to Stages 3 and 4 of this process chain. However, these analyses must be considered against the wider policy and governance practices used to structure planning and development within the URBAN GreenUP project. The level of data and subsequently analysis needed to create a baseline calculation will therefore vary due to the location, its political and planning/development structures, the thematic and strategic objectives of that city, i.e. the front runners of Izmir, Liverpool or Valladolid or the follower cities of Mantova (Italy), Ludwigsburg (Germany), Medellin (Colombia), Chengdu (China) or Binh Dinh-Quy Nhon (Vietnam). The contextual analysis proposed in Stages 3 and 4 is key to this process as it will provide the economic, social and ecological framing for investment.

The process chain discussed in the following section should be considered as a sequential form of analysis that builds a knowledge and evidence base that can then be used to identify KPIs and NBS interventions. It requires a number of decisions to be made based on baseline evidence and the political direction of a given city. However, by following the process chain and undertaking a systematic analysis based on the previous steps of the method, cities can effectively calculate the baseline position of their city to support the next monitoring and action plan produced at this stage of the methodology (Figure 1).

2 Stage 1 - Policy Structures

Internal stakeholders and their organisational knowledge are critical for developing a robust baseline. To aid the baseline calculation all stakeholders must have awareness, and potentially working knowledge within their institutional and/or partnership structures, of the complexities of urban and environment planning policy developed and applied at a number of socio-spatial scales to effectively situate NBS within broader policy arenas. An understanding of the linkages between these different policy scales, especially those *set* at an EU level and *applied* at the city scale via a cascading of legal requirements – are critical in this process as policy mandates, legislation and requirements need to be "nested" in actionable practice. This requires stakeholders to think strategically about how they use EU level policy in setting out local policy, and how the specific details or legislation, i.e. EU Biodiversity or Green Infrastructure (GI) targets, need to be applied. Furthermore, an awareness of what legal roles and responsibilities, policy imperatives, and existing capacity is needed, as the variability in requirements will significantly shape the scoping, design and delivery of NBS. It will also shape what guidance is needed, and if any legal or policy reforms are required in order to support the monitoring, implementation, and maintenance of NBS interventions. In many cases, stakeholders must situate themselves within the research discourses set by organisations like the EU in order to access both the technical expertise and funding streams they offer, whilst also adhering to four core guidelines:

1. Awareness of the full range of policy mandates and the connections between them, and how they could support or undermine successful implementation.
2. Design objectives that deliver on these mandates across a number of scales to ensure compliance and continuity in delivery of NBS.
3. Make connections between decision-making/policy-making bodies beyond those traditionally focused on the environment, to ensure all relevant knowledge and expertise is embedded within the process.
4. Integrate accountability mechanisms into the process to ensure policy directives, legal requirements, and other imperatives are adhered to.

The following section presents a sequential focus on the nested socio-spatial scales that compose this tiered system: *EU policy/Directives*, *National Policy*, *Regional Policy*, *City/Metropolitan Policy*, *District and zoning Policy/Plans* and *Site-specific Plans*, which all or a number of need to be engaged to effectively understand the policy landscape of a given city/city-region context, and how NBS can be located within these discussions.

3 EU Policy/Directives:

This section outlines some of the key EU-level policies that are relevant to NBS planning. Whilst it is by no means exhaustive, it does highlight a range of policies that stakeholders can use to support their efforts to mainstream the use of NBS in their city. Though institutions like the IUCN and World Bank have mobilised the NBS concept and have issued prominent pieces of work (c.f. Cohen-Shacham et al. 2016; IUCN 2020), it is the EU that is has been the frontrunner of making NBS the centrepiece of policy, particularly in urban areas. As noted in the introduction, this is representative of the EU's funding of practical NBS demonstrator projects, which have been used to (a) test the viability of concept in practice and (b) illustrates pathways to align environmental thinking/evidence with policy mandates. Therefore, when it comes to understanding key policy structures operating within the NBS discourse at the local level, EU legislation, guidance and evidence is the logical point of commencement.

The EU's policy agenda for NBS is outlined in 'Nature-Based Solutions & Re-Naturing Cities' (EC, 2015), a product of the Horizon 2020 Expert Group. The policy agenda outlines the vision the EU has for NBS (referenced in the introduction), provides a summary of key opportunity areas for research and innovation policy on NBS and recommends (research and innovation) actions cities can take in their approach to NBS provision. This policy agenda, and the single output it produced, can be seen as the foundation from which engagement with NBS should be initiated. However, this policy builds upon previous greening policies, and has itself helped to shape new ones. Moreover, NBS is a practical avenue in which the EU can contribute to multiple key environmental policies and directives which rest upon:

> "The principles of precaution, prevention and rectifying pollution at source, and on the 'polluter pays' principle. Multiannual environmental action programmes set the framework for future action in all areas of environmental policy. They are embedded in horizontal strategies and taken into account in international environmental negotiations. Last but not least, implementation is crucial" (EU Parliament, 2020).

Moreover, due to the interactivity of EU policy arenas, NBS and other nature-based approaches such as GI have been mobilised using a combination of:

1. **EU Green Infrastructure Policy.** The NBS concept it perceived to be an umbrella term that includes, or 'sweeps up', other urban greening terms (Pauleit et al., 2017). Green Infrastructure is the existing concept that shares the most similarity with NBS. The EU has been increasingly mobilising the GI term over the last decade, culminating in its 'Green Infrastructure (GI) – Enhancing Europe's Natural Capital' communication. Released in 2013, this document outlines the multi-functional (social, economic and ecological) benefits GI can provide. It also one of the first of the EU's official communications that utilises the NBS term which, at this time, was predominantly

associated with using ecosystem-based approaches to use ecosystem services for climate change adaptation and mitigation efforts.

2. **EU Adaptation Strategy.** The EU's GI paper introduced NBS as a tool for climate change adaptation and mitigation. Its 2018 Adaptation Strategy takes this point further, positioning NBS as adaptive tools that can supplement or even replace conventional grey infrastructural approaches to urban climate change management. With the present NBS demonstrator projects, this concept of climate change adaptation is central. With the every-growing threat of climate breakdown, this centrality is unlikely to change. Other EU policies aimed at contributing to climate change adaptation include the **EU Green Deal** that aims to guide the European community towards climate neutrality by mid-century (EC, no date) and the **Renewable Energy Directive** that has set the target of Renewable Energy Sources consumption to 32% by 2030 (EU Science Hub).

3. **EU Biodiversity Strategy.** Alongside climate change adaptation, natural capital protection and enhancement is a remit in which NBS has been increasingly mobilised by the EU. The institution has long been focused on biodiversity protection, as its work on the **Natura 2000, Habitats Directive/Birds Directive and LIFE programmes** illustrate. In its 2020 communication entitled 'EU Biodiversity Strategy for 2030 – Bringing Nature Back Into Our Lives' NBS is put forth as a concept that, if systematically integrated into urban planning and the wider built environment can build upon these existing schemes by symbiotically reverse trends of green urban ecosystem destruction, whilst also stimulating business and employment opportunities in different sectors.

Outside of official policies, the EU utilises nature-based approaches in other research arenas, namely **flood mitigation** and **air quality.**

1. **Flood mitigation.** The EU's 2000 **Water Framework Directive** institutionalised EU ecosystem-based objectives and planning processes at the hydrographic basin scale (Kallis & Butler, 2001) and in many ways set the foundation for the water governance and flood mitigation agendas and policies that followed. In 2017, the European Environment Agency (EEA) published its report entitled 'Green Infrastructure and Flood Management – Promoting cost-efficient flood risk reduction via green infrastructure solutions', which positioned NBS and GI interventions such as sustainable urban drainage systems (SUDs) and floodplain reclamation as being capable of providing essential benefits to flood management, as well as co-benefits to society and the economy.

2. **Air quality.** NBS such as street trees, green walls and green fences are increasingly being perceived as interventions that can mitigate greenhouse emissions and other airborne pollutants such as arsenic, cadmium, mercury and nickel (CORDIS, no date). For example, **Oppla**, the **European Environment Agency air pollution data centre** and

Climate-ADAPT are EU-funded networks and information sharing mechanisms that are mobilising nature-based approaches within the air quality arena.

4 National Policy

For any investment to be successful a full understanding of the parameters and focus of national policy in a given location is key. The direction of policy-making and its influence of local decision-making is critical to appreciate how NBS can be delivered. Identifying how policy at the national scale influences the direction of travel for NBS should be a priority for local delivery and policy partners.

As the latest entry to the urban greening discourse, NBS is still in its conceptual phase. As such, NBS funding is almost entirely coming from supranational entities – namely the EU. Moreover, in terms of implementation, it is at the city, rather than the national level of governance, that NBS interventions are tested. However, 66% of Paris Agreement signatories now include NBS within their Intended Nationally Determined Contributions (INDCs) to climate change action (IEDD, 2018). What this points to is that, in the near future, the NBS concept looks likely to be integrated into national policies aimed at tackling the same issues outlined in the EU discourse described above: namely climate change adaptation and natural capital depletion. The ability for national governments to engage with NBS depends on socio-economic positioning and ecological resources/issues. NBS design at the national level will be in response to the specific issues its ecological resources, or lack of, are creating.

However, it is important to note that many national policies and funding bodies are supporting NBS research, planning, and implementation without naming it as such. For example, the UK has incorporated the use of “natural flood management” as a matter of national policy priorities, and the interventions used (e.g. tree planting, leaky dams, sustainable urban drainage systems) are aligned with the concept of NBS. Large-scale tree planting and other forms of “green carbon” (e.g. restoration of peatlands) have become centrepieces of climate policy in many places across the world, and these interventions are often very large-scale versions of the NBS that are discussed in Europe. Natural capital approaches and natural capital accounting is also becoming more prominent, and these approaches are complementary to NBS. In Liverpool, for example, the city region is developing a natural capital baseline and investment strategy, and URBAN GreenUP’s NBS interventions are beginning to be incorporated into the baseline. Further investment in NBS in the region could be supported by investment in natural capital, should this trial prove successful.

For these reasons 1.3., it is important that stakeholders not restrict their evaluation of NBS policy to those documents specifically use the term, and instead look to the underlying messages of those documents to understand how priorities align with the goal of their NBS planning. For example, in the case of the UK, widespread destruction of native woodland has created significant issues for biodiversity, human recreation and carbon sequestration. This has led to the planning of **The Northern Forest**; a forest of 50 million new trees that stretches from Liverpool to Hull, through Manchester, Leeds and Sheffield, which aims to reduce the risk of flooding, sequester carbon, create new jobs and make improve the lives of people in the North

of England via improved access to nature and the promotion of healthier lifestyles. Whilst not commonly badged as NBS, the project most certainly meets the EU and international (e.g. IUCN) definitions of the term, and has even been referenced in the government's 25-year plan as a policy priority. An effective baseline identifies such linkages and seeks to effectively leverage them to support the monitoring and action plan that is produced in this stage of the plan (see Figure 1).

Similarly, many other European countries have long understood the value of NBS and can provide concrete examples of successful implementation and effective policy, even when they are not badged as such. A prominent example is the Netherlands, which has long used NBS as a means to address flooding; an issue precipitated mainly by its low-lying topography. Thus, in response to the severe flood damage the nation experienced in the 1990s, the national **Room for Rivers** policy was introduced in 2007. Its main goal was to use natural solutions to restore the natural river plains and manage higher water levels by creating water buffers, and integrate NBS alongside grey interventions such as the relocation of levees, deepening side channels and the construction of flood bypasses (Dutch Water Sector, 2019; BISE, no date). Around the same time, in response to Hurricane Katrina in America, the country committed to restoring vast areas of lost coastal marshes that once protected the Louisiana coast and re-naturalising waterways to address the immense social, economic, and ecological cost of natural hazards and boost the region's capacity to adapt to climate change (Day et al. 2007).

An effective way to approach this is to examine policies addressing each of the challenge areas that are being prioritised in the city's NBS plan. Whether it is climate change, biodiversity loss, community health and well-being, or any of the other challenge areas, there are inevitably national policy documents set by governmental agencies and departments that can lend legitimacy (and sometimes resources) to plans to re-nature urban areas. Often these are not led by environmental organisations and departments, which is an important consideration when seeking to break down silos in the NBS planning process (see guideline #4, section 2). For example, the UK **National Planning Policy Framework** (2019), for example, was developed by the Ministry of Housing, Communities and Local Government (MHCLG), and outlines ecological remits which national planning should take more seriously, namely green belt protection, biodiversity conservation, flood resilience, coastal change, climate change action and sustainable mineral use. Documents such as these are both bolstered and couched within wider discourses set by other, more far-reaching, policy agendas, that themselves are guided by the ideology that sustainable development must not come at the cost of economic growth. This position of 'clean growth' was set out in DEFRA's **25 Year Environment Plan** which aims to:

> "Help the natural world regain and retain good health. It aims to deliver cleaner air and water in our cities and rural landscapes, protect threatened species and provide richer wildlife habitats. It calls for an approach to agriculture, forestry, land use and fishing that puts the environment first" (DEFRA, 2018:9).

Alongside these ecological considerations, the ability for national governments to engage with nature-based approaches is guided by national political thinking towards nature itself. German federal law, for example, demands that each state produces a landscape plan, and federal conservation laws require compensation for environmental damage in greenfield developments, and green infrastructure is among the mechanisms of compensation encouraged under the law (Liebenath 2011). Moreover, a combination of federal and local laws, coupled with subsidies and punitive higher tax-rates on water run-off from conventional roofing has driven a green roof revolution across Germany, with cities such as Essen ruling that all new buildings and restoration work in it city centre must be fitted with green roofs. Contrast this positive political ideology on nature and its capacity to have positive human outcomes with the stance of Jair Bolsonaro's government in Brazil, where nature protection is seen as a barrier to economic growth and has thus been extensively rolled back, and in some cases removed entirely (NY Times, 2019). An appreciation of the political discussions that NBS is located within at a national level provides an indication of which planning and policy frameworks are likely to influence deliver and where barriers to this may exist.

5 Regional Policy

Proponents of nature-based approaches are increasingly realising that environmental issues are non-spatially discrete problems that cross jurisdictional boundaries. This is a long-standing challenge in environmental policy and lends strength to the argument that NBS should be implemented at larger (e.g. landscape) scales. This has been enshrined in the IUCN's NBS Standard (IUCN, 2020). Natural hazards, exacerbated by a changing climate, are a classic example of this problem of cross-jurisdictional challenges that cross jurisdictional boundaries. For example, flood events do not solely take place within a geographically bounded area i.e. a city or neighbourhood. Moreover, some ecological issues disproportionately impact specific areas over others e.g. coastal erosion along the East coast of the UK. The impacts of these events are therefore inherently dynamic and unbounded. For this reason, regional policies that involve urban greening concepts such as GI and NBS are increasing in number. The benefits of a regional approach to sustainability is that it can avoid the issues associated with both top-down approaches, led by federal and state governments, and bottom-up approaches, driven by individual localities and community groups (Talukdar, 2018). As outlined above, government-led approaches can be influenced by political ideologies and powerful interest groups and may fail to understand diverse and dynamic regional issues. In comparison, localised approaches to sustainability can risk being myopic and can have catalyse negative outcomes such as socio-spatial segregation, itself driven by green gentrification. Regionalist approaches to sustainability may in some cases therefore be more efficient and suitable, namely because they build upon a strong connection between "physical functions, social identity and economic units and political territories" (McEvoy & Ravetz, 2001:90). Moreover, regional approaches to sustainability can draw upon different forms and degrees of expertise in more than one city/city-region (a focus on governance structures will be provided in the next chapter).

The **Natural Course** project illustrates how 'the regional' has been targeted as the most effective scale to address flooding and water pollution in North West England. An EU-funded **LIFE** project, the Natural Course focuses on the watershed level to build capacity and improve the water environment in Merseyside, Lancashire, Greater Manchester, Cumbria and Cheshire (Natural Course, no date). The project brings together organisations from across the region, such as United Utilities and the Greater Manchester Combined Authority (GMCA), to design cost-effective 'blue' solutions across both the North West's urban and rural landscapes. Furthermore, two other examples of regional approaches to sustainability where GI and NBS are specifically used are the **Moreton Bay Green Infrastructure Strategy (Australia)** and **Milwaukee Metropolitan Sewerage District Regional Green Infrastructure Plan (USA).**The Moreton Bay Region is a local government area in South East Queensland that's current population of 469,000 is expected to grow by around 150,000 by 2031 (Moreton Bay Regional Council, 2015). The vision for this GI strategy is to use natural interventions such as street trees and ecological corridors to bring both aesthetic benefits for citizens and provide habitats for native flora and fauna. The MMSD's Regional Green Infrastructure Plan forms a central part of the organisation's '2035

Vision' for zero basement backups, zero overflows, and improved water quality in the Milwaukee City Region (home to 1.5 million people), this plan looks to use GI to capture stormwater and thus mitigate damage caused by flood events. Akin to Room for Rivers project described above, this plan looks to use natural interventions such as SUDs alongside regional grey infrastructure such as sewer pipes, storage tunnels and reclamation facilities.

Aligning NBS projects and policy with regional approaches is therefore a critical process in ensuring that the capacity and composition of a resource is maintained. It also allows stakeholders to consider the added-value of investing in NBS at the local and wider scale, which is important is setting integrated and achievable targets for investment.

6 City/Metropolitan Policy

As with the regional scale, city-level approaches to urban greening, and wider sustainability agendas, are reflective of national and supranational policies/directives. However, it is the city-scale where it is often most feasible to implement practical solutions to sustainability challenges. This is because, in many places, city government has power over a number of key activities that degrade the environment, but also have the potential to be reformed and targeted by NBS. Cities are also home to many degrading activities, e.g. cities currently produce 70% of global waste (Nature, 2018), consume 76% of global energy, and are responsible for between 41.5% – 66.3% of world-wide greenhouse gas emissions, and 71% of total energy related CO_2 emissions (Marcotullio et al., 2013). Cities are therefore increasingly conceptualised as the urban living labs where supranational level entities, such as the EU, can test their sustainability concepts such as NBS. Moreover, cities are the level whereby checks and balances can be made for national policy via their review and compliance cycles (usually 3, 5 or 10 years) to see whether they are effectively delivering wider sustainability discourses.

Whilst regional approaches may be able to draw upon different forms of expertise in multiple cities, they may lose the sight of local social, economic and environmental conditions and contexts that can be more easily observed and targeted at the city-level. Alongside this reflexivity, city approaches to sustainability can more easily and effectively harness knowledge(s) from development, community, environment and utilities sectors. The three examples below illustrate the different aspects of the sustainability agenda are being targeted through nature-based approaches.

1. **Yorkshire Water's 'Living with Water' partnership (UK).** This partnership looks to increase the flood resilience of the East Yorkshire city of Hull by prioritising sustainable natural solutions that protect nature whilst providing benefits to local communities. These solutions include 'aqua-green' spaces which reduce the pressure on storm drains and sewers by soaking up excess rainwater.

2. **Vitoria-Gasteiz Green Urban Infrastructure Strategy (Spain).** Launched in 2012, Vitoria-Gasteiz's strategy perceives itself as a manifestation of the EU's Green Infrastructure policy and aims to regenerate degraded urban areas through eco-design techniques, enhancing urban biodiversity and improving connectivity of existing green space (Climate Adapt, 2018).

3. **Million TreesNYC (USA).** Evolving out of Mayor Bloomberg's long-term sustainability plan – PlanNYC 2030 and the New York Restoration Project's (NYRP) aim to replenish the city's tree stock, the Million TreesNYC campaign was birthed in 2007 (Campbell, 2014). Mobilising more than 100 environmental organisations at different levels of

governance, this public-private partnership is an example of how networked governance structures can be harnessed to facilitate large-scale urban greening.

Though all of these projects utilising NBS/GI to bring about sustainability outcomes, the governance structure of each are worth noting. The **Living with Water** partnership is led by Yorkshire Water – a water company – but is closely supported by Hull City Council (city-level), East Riding of Yorkshire Council (regional-level), the Environmental Agency (national-level), the Rockerfeller Foundation (supranational-level) and Arup – a sustainable engineering business. In comparison, the MilllIon TreesNYC project involves many more actors from many socio-spatial levels (see next chapter), and the GI plan of Vitoria-Gasteiz is driven almost entirely by the city's council.

The policy environment at the city/local scale is potentially important, as it provides a line of travel between the wider discourses of central and regional government and the needs of local communities. An analysis therefore needs to be made at the city/local scale assessing how the environmental mandates of government can be used to deliver NBS at the local scale. It also provides opportunities for local government to integrate their local contextual knowledge into practice to ensure a more reflective process of investment in NBS occurs.

7 Districts and Zoning Policy/Plans:

Within city limits, specific districts can be targets for urban greening. In other cases, specific zones can be drawn up that will be the focus for green investment. Organisations at the national, regional and local level are increasingly utilising the concept of zoning within green space and green infrastructure plans. Whilst these do not always contain zoning regulations pertaining to what is allowed in each zone in terms of land 'use', they commonly utilise zone mapping to designate areas for specific types of 'action'[2]. Horizon2020-funded projects utilise non-statutory zone mapping for NBS provision. As a following chapter will illustrate, partners involved in these projects use different sets of indicators to guide their zones. In the socio-economic arena, indicators such as levels of deprivation and access to good transport links may dictate how stakeholders divide the city into areas of greater and lesser green space need. Within the ecological remit, a district's greater risk from flooding, for example, may lead city planners to focus green investment in that locality.

The **URBAN GreenUP** project itself utilises non-statutory zone mapping for NBS provision. In Liverpool, for example, the project has re-territorialised three zones within which interventions are to be implemented: The Baltic Triangle, The Otterspool Corridor and the City Centre. Whilst the demarcation of these sites already existed in some form or another (see Liverpool's Green Infrastructure Strategy, 2010), URBAN GreenUP has bounded them further through the use of strategic zoning. Another example of district level policies aiming at urban greening comes from the Swedish city of Malmö. Within the council's aim to be climate neutral, the city district of **Hyllie** been selected as the central urban living lab to test innovative energy, transport and green infrastructure projects. Supported by energy company E-ON and regional water and waste organisation VA SYD, the project's nature-based interventions include green rooftops (with areas for wild bees), urban farming and shade trees (Malmö Stad, no date).

[2] See report on Zoning developed for the URBAN GreenUP project for further details of the practices, positives and drawbacks of zoning in planning generally, and zoning for NBS.

8 Neighbourhood Policy/Plans

As illustrated above, urban greening can also be targeted within formally recognised districts. The same is true of neighbourhoods. Targeting the district and neighbourhood level means that if a robust baseline analysis is provided prior to nature-based intervention implementation, stakeholders can closely observe the extent of impacts they have on local socio-economic and environmental indicators near to real-time. These findings can create portfolios of findings that can serve to lever in future support for urban greening from institutions at different scales, as well as local/regional businesses and small-medium enterprises. However, localising the approach to urban greening can unwittingly extend the very socio-economic issues they were designed to address and ultimately alleviate. Anguelovski (2015) suggests that the advance of local greening initiatives, mobilised under the banner of 'sustainability', can threaten local people's 'right' to their locality, as they signal to the nexus of developers, real estate agents and wealthier outside residents that their neighbourhood is ripe for re-development, and ultimately gentrification. This illustrates that urban greening initiatives at lower scales must 1) be sure to ask themselves *who* greening is for, or risk creating green locally-unwanted-land-uses (LULUs) (Anguelovski, 2015) and 2) take measures to minimise potential gentrification outcomes.

A neighbourhood approach to NBS has been championed by the **Grow Green** project. Whilst URBAN GreenUP has locate NBS interventions across multiple focus sites, the three frontrunner cities in Grow Green – Manchester (UK), Wroclaw (Poland) and València (Spain) – have focused solely on delivering interventions in specific, historically socio-economically deprived neighbourhoods. The aim here is to stimulate economic regeneration whilst rendering communities more resilient to the impacts of climate change e.g. increased severity and regularity of flooding events and the urban heat island (UHI) effect.

9 Site Plans

At the 'lowest' social-spatial scale, urban greening is integrated into site plans predicated upon engagement with a diverse range of stakeholders (planning officers, developers, land owners, SMEs, NGOs and community groups/residents). The green wall on the St. John's shopping centre – funded by URBAN GreenUP - for example, involved engagement with the land-owner in London, the renters, the Mersey Forest (SME), officers from Liverpool City Council and many other parties. With the greening of small-scale plans, stakeholders may look to re-brand their site as a more sustainable and green enterprise with the aim of potentially inspiring other sites in the area to follow suit. However, akin to neighbourhood level greening, site greening can also trigger green gentrification (albeit with a lower threat level). The **High Line** in New York is a further example of this process. Opened in 2009, it is a retrofitted greenway built upon "the remains of an elevated train line spur, abandoned since the 1980s" (Wolch et al., 2014:239). Despite the project's designers aiming to green the neighbourhood "for the neighbourhood" (Bloomberg, 2017), the intervention has ultimately been "a catalyst for some of the most rapid gentrification in the city's history" (NY Times, 2012). Between 2003 and 2011, property values in the zone increased by 103%, leading to poorer members of the local community being forced to leave the area due to a sharp increase in rent prices (Wolch et al., 2014). Moreover, despite being projected to generate around $1 billion in tax revenues to the city over the next two decades, the locals that remain will not predominantly be among those who benefit from this (Bliss, 2017).

10 Summary

To ensure that the baseline calculations for investment in NBS are valid, city governments and other partners in NBS planning need to be aware of the ways in which policy hierarchies influence action from international all the way down to the local level. NBS offers an umbrella concept for a wide range of actions, and thus policies of relevance cut across political portfolios and scales. The full range of policies must be considered to ensure that the focus, legal requirements, evidence and practices that support investment in NBS can be delivered effectively. This will also require cities to consider the stakeholders engaged in this process, as well as the impacts of delivery within their legal boundaries and beyond. Furthermore, the integration of this knowledge requires stakeholders to consider a range of key questions when setting the baseline position (Table 1).

Table 1. Understanding the policy landscape and barriers to effective engagement with multi-scalar policy/legislative mandates.

Issue	Y	N	Comments / rationale for delivery or addressing lack of compliance
Does policy exist at the EU, National, Regional and local level which supports investment in NBS?			
Does legislation exist the requires a city to deliver specific environmental or NBS-focussed investment?			
Are there specific targets associated with this policy that are legally required, and are they being met?			
Are mechanisms in place to locate these policy mandates in local strategic planning/policy?			These could be at an officer or strategic level or via partnerships
Do barriers exist to the delivery of these policy/legal requirements?			What are they? How are they addressed? Who by?
Does a city have a legacy/history of effective investment and policy supporting NBS/environmental improvement?			

Does a city have a NBS/environmental champion overseeing policy development and investment?			This could be within a city council, a mayor or an external body.

11 Stage 2: Governance Structures

The previous section outlined the socio-spatial levels at which urban greening, as well as wider sustainability policies are formed and emanate from. To compliment this assessment the following illustrates how these policies are governed and by whom. The aim here is to help stakeholders understand and navigate the dynamic and often messy structures and linkages through which planning for sustainability must traverse. As illustrated on the 'Process Chain', the main governance structures at play within policy and plan mobilisation are:

- *national government*, *local government*, and *elected officials (ward)*,
- *civil-society*,
- *environmental sector*,
- *development/industrial sector*,
- *communities* and,
- *technical professionals*.

Before illustrating how more horizontal forms of governance have gained traction in contemporary times, we will succinctly unpack the meaning of these governance structures, and what type of expertise they bring.

- **National governments** shape and guide environmental policy and planning through their component departments e.g. DEFRA in the UK and the Forest Service in the US. Departmental wings such as these can offer guidance, expertise and funding streams to projects, as well as other partners involved within them. If a project has the backing of the national government e.g. the Northern Forest in the UK, this can drastically increase its visibility and can catalyse interest from other actors such as the private sector.

- **Local government** not only carry out agendas set by national governments, but also increasingly set their own planning agendas. The GI plan of **Vitoria-Gasteiz** is a good example of this. Though national governments can call upon a wider suite of actors, local governments are closer to the ground and can therefore more easily and effectively mobilise local businesses, civil-society groups such as SMEs and community groups.

- **Elected officials** at the local scale have an explicit understanding of the local context and provide key information and context to development proposals. Locally elected officials act as the conduit of discussion between communities, developers and local government and can be effective managers of expectations or figureheads for environmental campaigning. Across all the Horizon 2020 project elected officials, i.e. ward councillors, have played a pivotal role in translating local needs into policy and development mandates, and have been able to engage with local communities to inform, direct and debate the added-value of investment in NBS.

- The **environmental sector** has the capacity to shape public perceptions on issues through campaigns and public outreach/spectacle. A prime example of this is the work of **Greenpeace** and **Friends of the Earth** whose campaigns have galvanised interest in, and action on issues such as over-fishing and climate breakdown. Like local governments, groups within the environmental sector can call upon affiliated community groups and may have pre-existing connections with SMEs and even socio-ecologically conscious businesses.

- The **development/industrial sector** can bring a great deal of technical knowledge to projects. With urban greening projects, for example, you can have the backing of all levels of governance, but without the understanding of how to physically install and upkeep a green wall, the project will inevitably stagnate. The integration of this sector into the governance assemblage of a plan or project is therefore often key for projects to achieve their goals and KPIs. This is clear in the case of the **Living with Water** project in Hull, where sustainable engineering organisation Arup have been closely involved in the design and implementation of green and blue interventions. Moreover, another role of this sector within actualising sustainability policies and plans is funding. The **Rockerfeller Foundation**, for example, has partially bankrolled the **Million TreesNYC** project and is also providing close support to the **Living with Water** project.

- Unlike the other governance structures, **communities** are rarely directly or indirectly funded by/within sustainability plans and policies. Nonetheless, within many they act as the consistent backbone that can help to garner further support and, with the rise in citizen science, carry out plans and monitor interventions.

- As into the development/industrial sector, **technical professionals** provide key expertise and knowledge that other governance structures lack. To design sustainability plans and policies, universities are often utilised, for example. With their knowledge of policy context, sustainability concepts e.g. NBS, and comparative knowledge of best practice, these partners can play a key role in the design, implementation and reflection phases of projects and plans.

The fact that these connected, yet distinct governance structures must be taken into consideration by stakeholders when understanding how sustainability plans and policies are designed and carried out speaks to a wider shift in environmental governance. In the last two decades there has been a trend away from top-down, command and control approaches, in favour of more decentralized and hybrid strategies of governance (Lemos & Agrawal, 2006; Bulkeley, 2005). This shift has been catalysed by what Lemos & Agrawal (2005, p. 302) call the widespread “loss of faith in the state as a reliable custodian of nature”. In place of bureaucratic and top-down regimes, non-hierarchical and inherently multi-level forms of governance arrangements have been put forward as a more adaptive and egalitarian mechanism to tackle contemporary environmental issues such as climate change, and contribute to urban

sustainability aims. These decentralized forms of environmental governance are potentially superior to state-centric ones in seven ways:

- They integrate different scientific, technological and lay forms of knowledge.
- Provide flexibility in functional performance.
- Gain the involvement of multiple actors.
- Recognise that "the relationship between international regimes and non-state actors is fundamental to address economic and environmental changes" (Lemos & Agrawal, 2005:301-302).
- Identify "modalities of cooperation that go beyond legal arrangements" (ibid).
- Work across scales, developing synergy and cooperation to solve problems.
- Promote social learning and "compromise seeking".

To establish how best to deliver NBS it is important for stakeholders to use these questions to aid their assessments of the governance of investment. They should also reflect on role of various stakeholders, and the positive and negative impacts that they may have on the delivery of NBS.

Operating beyond national government jurisdiction and composed of stakeholders from city council, academic and SME backgrounds, NBS projects are prime examples of decentralized environmental governance. Connecting Nature, URBAN GreenUP and Grow Green are governed 'polycentrically' i.e. they contain multiple nodes of "semiautonomous decision making" (Carlisle & Gruby, 2017, p. 2). Polycentricity stands in opposition to monocentric forms of governance, where one entity or actor possesses a monopoly on power or authority over the governing of a common pool resource or public good; in this case urban vulnerability to climate change (Termeer et al., 2010).

Within each cities baseline calculation each city much therefore consider whether their funding and delivery frameworks make use of polycentric networks of stakeholders, and if not do they have the capacity to deliver a project independently. To illustrate how policies and plans are enacted through these more polycentric governance structures, we will use the examples of **Million TreesNYC** and **The Northern Forest**.

As illustrated in the prior section, the **Million TreesNYC** project was catalysed by NYC Mayor Bloomberg and the civil-society group New York Restoration Project. In comparison to The Northern Forest, the governance structure of Million Trees is more dynamic and involves a greater number of actors (see **Figures 3** and **4**). This is largely because the project was initiated far earlier: in 2007 compared to the Northern Forest which is still in the conceptual planning phase, with the preliminary plans only being granted by the UK government in 2018.

The Million TreesNYC project itself is composed of five strategic plans that aim to deliver multiple central aims, each tied to a specific KPI. These plans are:

1. The **tree planting** subcommittee strategic plan.
2. The **education** subcommittee strategic plan.
3. The **public policy** subcommittee strategic plan.

4. The **research** subcommittee strategic plan.
5. The **green jobs** subcommittee strategic plan.

The nature of the aim dictates which partners are involved. For example, the 3 central aims of the research and evaluation stream are (Million TreesNYC, 2013):

1. Support and/or promote urban forestry research and data to advance initiative goals.
2. Monitor and evaluate effectiveness of initiative programs and activities.
3. Establish measurements to ensure initiative is reaching PlaNYC tree planting and sustainability goals.

Unsurprisingly, technical professionals – in the form of universities – are more centrally involved in this strategic plan. Alongside leadership from the NYC Department of Parks & Recreation (local government), the New York Restoration Project (civil-society), the US Forest Service (national), four local academic institutions: New York University, Cornell University, Columbia University and the New School's Tishman Environment and Design Center are centrally involved in the following nine KPIs:

1. Building on Forest Service Science Plan, identify additional needs from Advisory Committee members.
2. Solicit research institutions and funders to advance research agenda.
3. Support continuous Million TreesNYC-related research among outside institutions.
4. Explore the creation of an annual symposium to share research.

Thus, for this research stream of the project, a governance model would resemble the flow diagram outlined above. To differentiate between governance structures, national government structures are in orange, local government structures are in red, civil-society structures are in blue and technical professionals are in green.

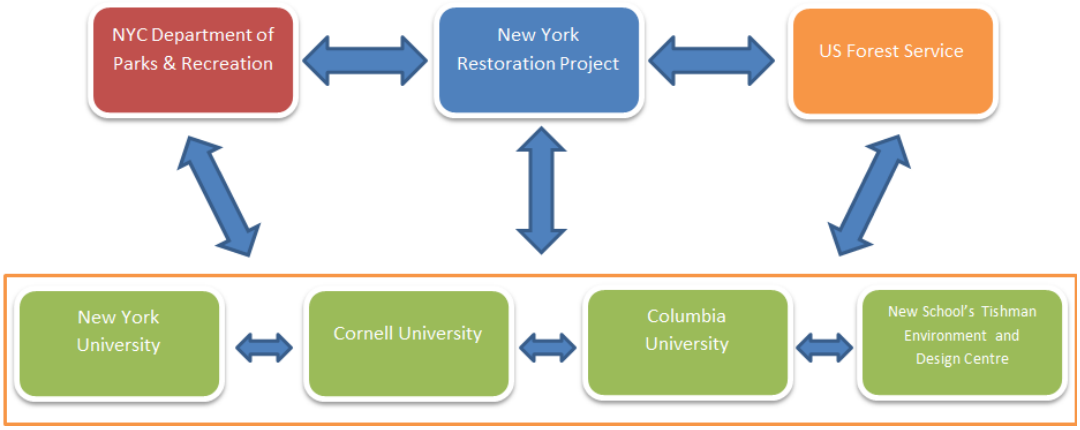

Figure 3: Million TreesNYC governance structure

In comparison to Million TreesNYC, the **Northern Forest** plan involves fewer organisations. It is predicted to cost £500 million to complete and, as of present, the only economic backing it has received from the UK government is £5.7 million (despite being an important feature of DEFRA's 25 Year Plan). At the head of its governance structures sit the Woodland Trust (environmental sector) and the four main UK community forests (civil-society): HEYwoods, the Mersey Forest, City of Trees and White Rose Forest. The Woodland Trust is responsible for raising funds for the plans, whilst each of the community forests has jurisdiction over the component parts of the forest: Hull and the East Riding of Yorkshire (HEYwoods), Merseyside and Cheshire (the Mersey Forest), Greater Manchester (City of Trees), and Leeds City Region (White Rose Forest). These four organisations work alongside city and regional councils to manage community groups who help to carry out project development e.g. tree planting and the governance of saplings. In a macro sense, therefore, the governance structure of the project is represented in the following flow chart. National government structures are in orange, local government structures are in red, civil-society structures are in blue and environmental sector structures are in purple.

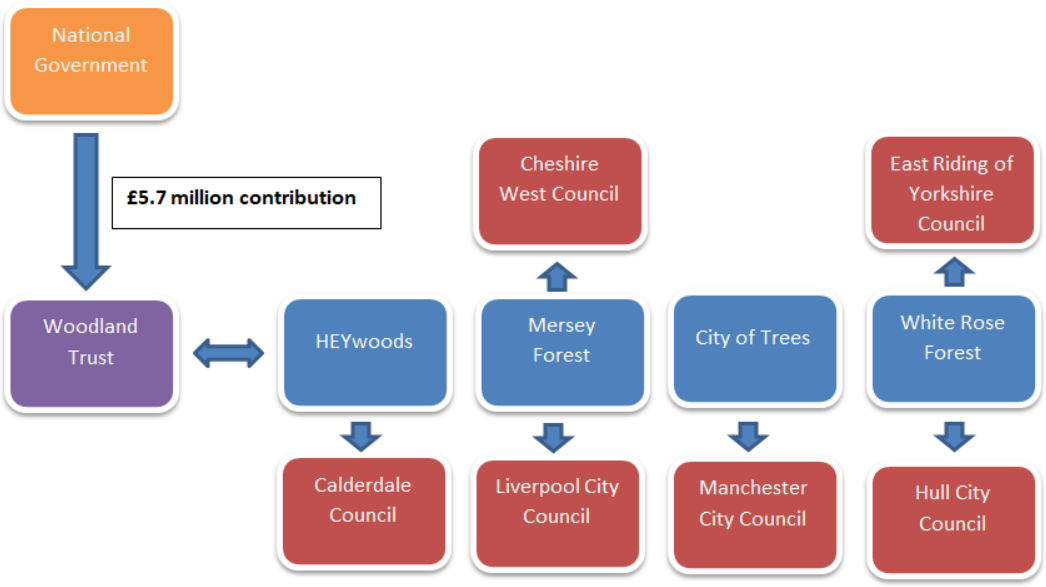

Figure 4. Northern Forest Governance Structure

To give an example of how this governance assemblage plays out, we will look at a central project within the Northern Forest project: the Mab Lane Community Woodland. Located in Stockbridge Village in Merseyside – an area that has historically suffered from a lack of quality green space – the project has turned a misused and mistreated space into a thriving community woodland. Led by the Mersey Forest (civil-society), and with support from Liverpool City Council (local government) and the Forestry Commission (technical professionals), the project engaged with the community to ultimately plant over 20, 000 trees in the locality (The Northern Forest, no date).

The governance of NBS investment is a complex process and requires a concerted effort to map how each potential stakeholder within the public, private, third and community sector influence development. However, as noted above, there is a significant level of local knowledge, technical expertise and political and financial acumen located within the broad range of stakeholders engaged with NBS. It is therefore vital when setting the baseline calculation that the following issues are taken into account:

1. Who is best placed to lead the development of an NBS project and what experience do they have?
2. Are there existing partnerships that can be used to facilitate NBS investment, and if so how can the governance structures be mapped onto local government and/or other stakeholder structures to ensure ease of use?
3. At what scale should the governance structures work (being dependent on project scale and scope of partnership)?
4. What are the long-term barriers to successful partnership and governance, i.e. funding, institutional capacity, project scope, or perceived benefits, and how can these be mitigated?

If all of these questions can be answered affirmatively then the governance structure for the baseline calculation should be effective. However, it is possible that gaps in knowledge, expertise or political/institutional support may be identifiable. Where this is the case efforts need to be made at the local scale to manage these deficiencies to minimise the negative impacts on the local context.

12 Stage 3: Local Environmental Context

The third stage of the Process Chain requires stakeholders to assess the current socio-cultural, ecological and economic context of their cities, and examine this within the political structures of local planning and development narratives. This is a complex process based on an extensive evaluation of available data to make a judgement regarding the current state of city and identify where opportunities for improvement exist. The City Diagnoses undertaken for Izmir, Liverpool and Valladolid illustrate how this process should be completed, as well as how useful these evaluations are in illustrating the current state of a city's natural and socio-economic environment. As with the Drivers, Pressures, State, Impact and Response (DPSIR) model developed by the EU, the analyses undertaken in Stage 3 provides clarity in understanding the context of a location.

To fully understand the state of a city's resource base a series of analyses are needed that reflect wider planning and development actions. These include analysis of environmental issues, i.e. flooding and flood risk, socio-cultural issues, i.e. crime and education, as well as economic issues, such as affluence and employment. The value of this process is the ability to identify areas is need of ecological and socio-economic enhancement via the presentation of areas of deprivation or over exposure to risk. By engaging with an analysis of a city's social, economic and ecological systems it becomes easier for stakeholders to make informed decision regarding where to locate NBS investment, what types of investment may be most appropriate and provide the rationale/justification for delivery.

Examples of the data needed to undertake this analysis can be found in the city diagnosis documents developed for URBAN GreenUP, but in terms of the process chain proposed in this report, the following areas are examples of those of critical importance to setting the baseline calculation (Table 2). These issues are not exhaustive, however, and should be modified and/or expanded for a given location. Refer to D1.8 for more details and for guidance on how to develop KPIs, which are used to establish the baseline conditions of the cities that will be monitored.

Table 2: Context - Biophysical Issues

Biophysical Issue	Type of data (spatial/spot)	Comment
Air quality	Spot	Particulates (PM2.5 and PM10), NOx, SOx, VOCs, and other parameters as dictated by EU directives and local policies. Can also be spatially modelled.

Biophysical Issue	Type of data (spatial/spot)	Comment
Biodiversity loss	Both	Loss of green space as well as poor management of green space can lead to a loss of biodiversity. Indicator species can be used in lieu of a comprehensive survey. This also links to quality.
Climate	Both	Assessment of climate stresses in an urban area with respect to air temperature, rainfall variability, heat waves, carbon emissions, etc.
Condition of green space/green space quality	Spatial	Helpful to have a target of % of NBS/GI in good condition. Often used as a proxy for environmental quality or biodiversity loss, although biodiversity merits specific attention.
Connectivity of green space	Spatial	Physical connectivity as well as species movement can be considered.
Green space quantity	Spatial	Many places have a target to have a certain number of m2 of NBS/GI per person and within a certain distance of each resident (see accessibility)
Natural hazards (e.g. flooding, disease risk, hurricanes)	Both	Locating current risk, but also projecting future risk under different climate scenarios.
Water quality	Spot	Metals, nutrients, CH4, and other parameters as dictated by EU directives and local policies. Can also be spatially modelled.

Table 3: Context – Socio-cultural issues

Socio-cultural Issues	Type of data (spatial/spot)	Comment
Demographic	Both	Can be complemented by census data.
Health inequality / well-being indices	Both	Understanding of existing health inequality and long-term trends in health linked to built environment, its quality, and broader socio-economic conditions.
Prevalence of crime	Both	Crime is often perceived to either increase or be reduced in urban green space. It is valuable to investigate both the perception of crime and actual reported crime.
Access to education / attainment	Spot	Can be complemented by census data.
Environmental awareness and community perceptions	Spot	Awareness of environmental issues, solutions, and how communities can change their behaviour can be enhanced through delivery of NBS if a strategy is in place to do so. Changes in perceptions and awareness prior to and after NBS implementation can be used to investigate impact.
Participation and engagement	Spot	Co-production and co-design are central tenants of NBS delivery. These require moving beyond general information giving activities with communities and engaging them in meaningful ways. How this impacts communities and the design and delivery of NBS can be measured.
Social learning or knowledge	Spot	At a basic level, it is helpful to get an understanding of level of

Socio-cultural Issues	Type of data (spatial/spot)	Comment
		environmental knowledge and within local communities and city governments. Ideally, this should be examined in more detail to see how this changes behaviour and practice among different stakeholder groups. Knowledge different to general awareness.
Use of GI/NBS	Both	How people actively use GI and the NBS interventions should change if the plan is effective.
Housing type, tenure, and price	Spatial	NBS can increase property value, but there is also some danger that this will price out people in certain areas (i.e. green gentrification). Both positive and negative effects should be included.
Social justice	Spot	This is a key challenge area for NBS, but generally requires both quantitative data and in depth qualitative data to understand the effects. Ideally, NBS should target those areas of the city that experience disproportionate levels of deprivation in order to address these social challenges.
Social cohesion	Spot	Communities with higher levels of cohesion have higher levels of well-being. Social capital and network-based approaches can provide a reasonable measure of social cohesion, and design and delivery of NBS can be designed to increase connections in social networks.

Table 4: Context – Economic issues

Economic Issue	Type of data (spatial/spot)	Comment
Access to employment and increase in "green jobs"	Spot	NBS are meant to be economically efficient as well as beneficial for providing additional green jobs. Green space is also known to increase footfall and spend.
Strategic development objectives of a city	Spatial	An understanding of the long-term role of NBS within city development proposals can help mainstream NBS.
Land holdings and local development priorities	Both	An understanding of how priorities and land use change over the course of the plan's implementation can help with evaluation of how NBS are being mainstreamed and incorporated into local priorities.
Funding and investment	Spot	Increase in investment in NBS or related investments (e.g. natural capital, GI). Analysis of capital and revenue funding that is available and how that changes.
Cost savings as a result of NBS	Spot	NBS can help save on energy costs and is often more cost effective than other "grey" or traditional solutions. Can also be modelled using a number of freely available models, if direct measurement is not possible.

Each of these factors needs to be taken into account to fully understand the context that any investment in NBS is being made within. Although this process proposes an integration of strategic and local knowledge this is crucial to the baseline calculation. Through a review of the local environmental, socio-cultural and economic profile of a city, stakeholders are able to make informed judgements regarding the quality, quantity and gaps in existing provision that can be

addressed via the later sections of the process chain (setting KPIs, establishing NBS options, and mapping new NBS onto existing provision).

It is also important to appreciate that these discussions are located with a changing political context. As a consequence, all decisions regarding the analysis of the local environmental context are subject to political considerations of bets-practice. What objectives are proposed are therefore situated within complex political discussions, as noted in Stage 2, and must be discussed to ensure that a robust approach to delivery is made.

To promote greater validity on the analysis a significant process of data collection and analysis is needed to identify where NBS could be most effectively used. This may cause tensions within discussions, but the evidence presented will complement the outcomes of Stage 1, 2 and 4 and support a more rational process of decision-making.

13 Stage 4: Thematic / Development Objectives

The final stage prior to consideration of NBS options, targets/metrics and/or KPIs is an assessment of the thematic or development objectives of a city. Stage 4 follows directly on Stages 1, 2 and 3 by examining the current approach to development in a specific location. The analysis needed for Stage 4 should reflect the thematic approaches of multi-scale policy, local development objectives (both strategic and site/discreet), and the needs of a location based on the local contextual analysis undertaken in Stage 3. As a consequence of this process a set of thematic objectives can be identified that map onto the needs identified.

In practice, this requires a consideration of the needs of a location to be centred in NBS discussions, as investments need to address local deficiencies/issues. This includes identifying health, well-being, economic, climatic, access, and biodiversity issues (amongst others) and using these to structure Stages 5, 6 and 7.

As this stage is a culmination of Stages 1-3, it requires less detail. However, it remains vital that stakeholders engage effectively and extensively with this process to provide a clear and understandable rationale for the type of NBS chosen, as well as their location, and proposed values. The diagnose documents used to URBAN GreenUP, as well as the KPIs developed for the project provide a clear of guidance for which socio-economic and ecological variables should be assessed when developing an investment plan for NBS. These will constantly evolve as an urban area is assessed from a local, city and regional/national policy and practice perspective. It is therefore essential to develop a robust evidence base of information that is reflective of the most pertinent issues influencing a city. If this can be achieved, then the process of setting KPIs and identifying deliverables becomes more effective.

14 Final Summary

The process chain outlined in this report should be used to establish a baseline calculation and should be used in conjunction with city diagnoses and/or existing strategic evidence bases to identify what and where NBS should be located. It outlines Stages 1-4 of the process with Stages 5-7 being used to set specific targets and outcomes. Stages 5-7 have not been discussed as they require local decision-makers to make choices regarding investment. What this document proposes is the process of discussion that supports decision-making by requiring stakeholders to reflect on the policy, legal requirements, thematic design principles and local needs assessment leading to more effective implementation. Furthermore, the process outlined in Figure 1 requires an extensive engagement with data and stakeholders to identify appropriate investment options. The time needed to effectively deliver this information should not be taken lightly and needs to be undertaken with the view that long-term and sustainable investment in NBS needs to be located in the right place, for the right reasons, and to deliver the right benefits. By engaging in the detailed analysis proposed in this document the decisions made by cities can be grounded in robust evidence and substantive analysis of local socio-economic and environmental contexts. Such a position is crucial if NBS are to address the variety of issues currently facing cities across Europe and globally. It also provides the rationale through which government at all scales, as well as communities, developers and other key stakeholders involved in NBS planning, can be confident that investments will be made that are appropriate.

National Government	Local government	Elected officials (ward)	Civil-society	Environmental Sector	Development/ industrial sector	Communities	Technical Professionals
US Forest Service	NYC City Hall	Queens Civic Congress	New York Restoration Project	Partnerships for Parks	Toyota	New Yorkers for Parks	American Society of Landscape Architects (ASLA)
National Park Services	NYC Department of Parks & Recreation	Mayor's Volunteer Center	Trees New York	Sustainable South Bronx	TD Bank	Grow NYC	American Planning Association
	NYC Association for Neighbourhood & Housing Development	Mayor's Volunteer Center	Youth Ministries for Peace and Justice (YMPJ)	Staten Island Botanical Garden	Con Edison	Friends of the Highline	American Institute of Architects
	NYC Department of Design & Construction	Mayor's Office of Long-term Planning & Sustainability	Regional Plan Association	New York Botanical Gardens	Rockerfeller Foundation	Citizens Committee for New York City	Cornell University
	NYC Department of Education	Mayor's Fund to Advance New York City	Solar One	Horticultural Society of New York	Bloomberg Philanthropies	Alianza Dominicana Cultural Cemter	The New School's Tishman Environment and Design Center
	NYC Department of Environmental Protection	Mayor's Community Assistance Unit	New York Cares	Metro Hort Group	Real Estate Board of New York		New York University
			Municipal Arts Society of New York		Community Energy		

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National Government	Local government	Elected officials (ward)	Civil-society	Environmental Sector	Development/ industrial sector	Communities	Technical Professionals
	NYC Department of Housing Preservation & Development NYC Department of Sanitation Bureau of Waste Prevention, Reuse and Recycling NYC Department of Transportation NYC Housing Authority New York Restoration Project		Industrial Areas Foundation Mosholu Preservation Corporation Generation On Council of New York Cooperative & Condominiums City Year New York City Parks Foundation	Greenbelt Conservancy Environmental Education Advisory Council Central Park Conservancy Brooklyn Botanic Garden	BNP Paribas		Columbia University

Figure 5. Million Trees NYC Governance Table

National Government	Local government	Elected officials (ward)	Civil-society	Environmental Sector	Development/ industrial sector	Communities	Technical Professionals
Central Government (£5.7 million pledged) Environment Agency DEFRA	Liverpool City Council Manchester City Council Hull City Council Calderdale Council Cheshire West Council Cheshire Council East Riding of Yorkshire Council	Sir Richard Leese (Leader of Manchester City Council) Dan Jarvis (Mayor of Sheffield)	HEYwoods Mersey Forest City of Trees White Rose Forest Treesponsibility Slow the Flow Whitworth Art Gallery The Oglesby Charitable Trust Trafford Countryside Management Partnership	Woodland Trust National Trust	Yorkshire Water Nationwide Building Society	Friends of Anderton and Marbury (Cheshire)	Forestry Commission Pennine Prospects

Figure 6. Northern Forest Governance Table

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