

Social innovations for delivering Blue and Green Infrastructure: *connecting multiple benefits, multiple stakeholders, and multiple domains*

Policy Brief from the Interreg North Sea Region BEGIN project

Background to BEGIN

The Interreg North Sea Region project BEGIN (2017-2021) aims to deliver Blue and Green Infrastructure through Social Innovation. The project is a unique partnership in which 10 cities and 6 research institutes combine forces to develop Blue and Green Infrastructure solutions and exchange experiences. The urgency to construct BGI is growing, because climate change and growing cities mean that drainage systems are struggling to cope with more frequent and intense rainfall. We are faced with the increasing risk of local floods impacting our homes, workplaces and urban environment. Moreover, cities increasingly experience a loss in biodiversity, feel the urgency of addressing heat stress and periods of drought, and want to promote citizens' health and wellbeing, to which BGI can contribute.

Box 1: What is Blue and Green Infrastructure?

Blue and Green Infrastructure (BGI) utilises natural and nature-based systems, providing multi-functional blue and green spaces in cities that are strategically planned and managed to provide not only water management benefits, but also a variety of ecological, social, and economic benefits¹. There are a wide range of BGI measures, such as green roofs, urban parks and raingardens². BGI is appealing because it provides attractive spaces and measures that can function in combination with existing urban systems. Moreover, the multi-functionality of BGI facilitates the integration of multiple societal goals, in which not only urban drainage is improved, but also public health, biodiversity and urban regeneration are supported. Overwhelming evidence shows that, unlike traditional buried piped drainage, the use of BGI can

¹ Demuzere, M., Orru, K., Heidrich, O., Olazabal, E., Geneletti, D., Orru, H., ... & Faehnle, M. (2014). Mitigating and adapting to climate change: Multi-functional and multi-scale assessment of green urban infrastructure. *Journal of Environmental Management*, 146, 107-115.

² Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., & James, P. (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. *Landscape and Urban Planning*, 81(3), 167-178.

increase property values and provide energy savings and carbon use reduction³⁴. In application, BGI requires and depends on citizen engagement and cooperation among local governments and private and commercial landowners much more so than piped drainage systems, because BGI depends upon land use and thus also entails urban planning⁵.

Utilisation of BGI can provide numerous opportunities when compared with traditional grey infrastructure to **capitalize on co-benefits and engage stakeholders**, since BGI integrates (urban) drainage into and with urban design and city planning. Through BEGIN, 10 cities in the North Sea area are **developing social innovations** in order to pursue the opportunities BGI offers in 10 different BGI-oriented cases of varying size and function, since up until now exploitation of these opportunities has been often overlooked. The BEGIN-project helps cities to identify, plan, value and deliver the benefits to those that could get the most from them. Likewise, BEGIN has supported cities in engaging stakeholders, including the residents, in a design process that could significantly enhance the liveability of their neighbourhoods.

Box 2: What is Social Innovation?

The European Commission (2013) defines social innovation as the development and implementation of new ideas (products, services and models) to meet social needs and create new social relationships or collaborations⁶. Social innovation often demands regulative, normative and cultural changes and is often detangled into three components⁷. Applied to the field of urban water management, the BEGIN-project has explored social innovations as part of a response to providing better public infrastructures that reduce flood risks, heat stress and biodiversity loss while simultaneously improve public wellbeing and economic development :

- 1. New combinations: these combinations relate to the multi-functional nature of BGI, which brings goals from different policy domains together. BGI does not just offer water management measures, but improves the quality of life in cities (related to wellbeing, biodiversity, economic development etc.);*
- 2. Cutting across boundaries: because of the involvement of different domains, knowledge, expertise and mandates are fragmented and dispersed among stakeholders. Therefore, organisational and disciplinary boundaries have to be crossed. Moreover, BGI depends on land use and has to be integrated into urban design and planning;*

³ EC (2012) *The Multifunctionality of Green Infrastructure*. Brussels: European Commission (Directorate-General Environment).

⁴ Ashley, R., Gersonius, B., Digman, C., Horton, B., Smith, B., & Shaffer, P. (2018). Including uncertainty in valuing blue and green infrastructure for stormwater management. *Ecosystem Services*, 33, 237-246.

⁵ Benedict, M. A., & McMahon, E. T. (2002). Green infrastructure: Smart conservation for the 21st Century. *Renewable Resources Journal*, 20(3), 12-17.

⁶ EC (2013) *Guide to Social Innovation*. Brussels: European Commission (Directorate-General for Regional Policy).

⁷ Mulgan, G., Tucker, S., Ali, R., & Sanders, B. (2007). *Social innovation: what it is, why it matters and how it can be accelerated*. Oxford: Skoll Centre for Social Entrepreneurship, University of Oxford.

- 3. Compelling new relationships: the co-benefits of BGI will often result in co-production between governments, local residents, developers, private landowners and others, that requires a shift away from a more traditional, hierarchical role by governments and sectoral 'experts', where for example 'the engineer knows best'.*

The main lessons from the social innovations developed in the BEGIN-project are used to support this policy brief. We set out four recommendations for ensuring that BGI and its delivery is included in policies.

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Recommendation 1: Identify the beneficiaries when making the case for BGI

The challenge: There are multiple business cases for BGI

Traditional grey infrastructure typically requires a single business case, because it provides a single function, although there may be multiple funders each of which may require a tailored business case. Since traditional grey infrastructure usually has a single purpose (e.g. flood risk reduction), the costs and benefits are usually well defined and making the case is relatively straightforward. In contrast, BGI has multiple benefits, including to ecology, recreation, economic development, and residents' wellbeing. **Because of the integrative character of BGI projects**, these are inherently more complex in planning, delivery and operation and require the collaboration of multiple actors. Hence **BGI usually requires bespoke business cases tailored for each of the many actors involved.**⁸ This means that for a BGI project there will be a wide range of potential benefits that need to be identified, requiring the valuation of these benefits and identification of the stakeholders who are accruing and providing these benefits. Partnerships will need to be established for funding to ensure that the wealth of benefits from using BGI will be delivered and sustained over time.

The social innovation: define the benefits of your BGI and associate these with beneficiaries

Water managers need to become more familiar with the overlapping ambitions and requirements of using BGI to create synergies between the different services that may be provided. This means working with others in interdisciplinary teams, especially land use managers. Managing stormwater runoff or reducing heat stress is just one purpose of using BGI. **Branding the broader benefits will create broad support for the use of BGI.** The co-benefits of BGI have been defined in numerous guidance and supporting documents, for which instruments, such as *BEST* (Benefits Estimation Tool) and *TEEB-stad*, can be used to identify and monetise the financial, social and environmental benefits provided by BGI⁹. Cities should develop strategic vision documents for BGI that illustrate the range of benefits and integrate these into a common vision with a strong message for convincing stakeholders to participate in or contribute resources for the use of BGI. Strategic vision documents should identify clearly who benefits from the use of BGI, including from enhanced liveability, new recreation areas, better ecology or improved health. These elements have to be sequenced in a way that a compelling brand can be created, presenting the BGI as an opportunity that will boost the whole neighbourhood. A strong, integrative brand can be sold more easily to politicians, policymakers and citizens alike.

Stakeholder mapping can be used to identify who needs to be involved. Strategic vision documents, should relate the BGI to developments in an area and reach out to the stakeholders involved. Moreover, teaming up becomes more likely if water managers and urban planners **understand what drives these stakeholders.** Examples of stakeholders are fellow departments within the City Council, water and environmental authorities, regional governments, businesses, or local NGOs. The BGI, then, becomes a joint effort in which each party contributes resources (financial, human, technology, land) and receives rewards. To this end, different types of business cases can be made, such as conjoined budgets of

⁸ O'Donnell, E. C., Lamond, J. E., & Thorne, C. R. (2017). Recognising barriers to implementation of Blue-Green Infrastructure: a Newcastle case study. *Urban Water Journal*, 14(9), 964-971.

⁹ See footnote 4.

different municipal departments or partnerships with communities and private enterprises, providing the means to build the BGI and maintain it over time. For example, communities can maintain with the support of the municipality, who provide the materials.

Illustrative examples

Strategic visioning for BGI

1. *Blue-green vision, City of Dordrecht*

The City of Dordrecht has developed a blue-green vision that demonstrates the multiple benefits of BGI for the city including climate adaptation, biodiversity, health and recreation. By not limiting the scope to only climate adaptation measures, Dordrecht City Council has succeeded in creating broad support and interest in the blue-green vision and two proposed blue-green zones in the city. The Dordtwijkzone is aimed at integrating a patchwork of sport parks, fields and parks into a healthy and robust blue-green zone accessible for every local resident. The Wantijzone will be a green corridor from the city centre right to the entrance of the Biesbosch National Park.

2. *Water Plan, City of Antwerp*

Antwerp's Water Plan aims to create a water-sensitive city that can only be effectuated by its government(s), businesses and community organisations together. The document combines a hydrological and spatial blueprint with pragmatic solutions. Several design workshops with a mix of stakeholders took place, in which design proposals for different locations in Antwerp were hydrologically calculated, spatially visualised and openly discussed. Consequently, the Water Plan is widely embraced by various stakeholders and sectors and acted upon.

3. *Green Climate Axes, City of Ghent*

Ghent City Council is working towards the creation of eight blue-green corridors – so-called “green climate axes” – that connect the city centre with the outskirts of the city. The axes are meant to link smaller blue-green areas with each other in order to promote ecological values and climate adaptation measures (such as infiltration and retention). As these blue-green corridors will run through each neighbourhood, they will be easily accessible for all residents. Moreover, the corridors will be complemented with comfortable de-paved hiking and cycling paths for promoting active modes of transportation.

Stakeholder and opportunity mapping

1. *Lightrail development with opportunities for BGI, City of Bergen*

Large-scale urban developments such as transportation investments offer opportunities to include BGI. One of the major transformations in Bergen is in the industrial Mindemyren district that will be turned into a residential area. The construction of a lightrail from the city centre to Mindemyren is the first stage of development. Comprehensive planning of Bergen City Council

ensured that infrastructure development is combined with other improvements such as BGI, resulting in the opening up of the canal that runs through the neighbourhood. The lightrail construction becomes more attractive with the provision of a linear blue-green space running through the area, which can be used for individual transport, including cycling, as well as for floodwater storage.

2. *Private investment for BGI, Enfield Town*

Private funding is available for BGI-related projects, yet often unknown to local authorities. Enfield City Council and The Rivers Trust secured private investments from the Coca-Cola Foundation and WWF for the construction of wetlands in Broomfield Park that will reduce pollution in the nearby Pymmes Brook. Coca-Cola and WWF have established a water stewardship partnership, which grants financial support for small-scale projects that replenishes water quality or quantity in local communities.

3. *Engagement with adjacent landowners, City of Aberdeen*

Through engaging with a housing developer on an adjacent site, Aberdeen City Council secured funding for the construction of a “safe route to school” foot- and cycle-path through the site of the Maidencraig Flood Management Wetland Scheme. The private developer was willing to invest in this route, because the scheme would benefit its property. This route is providing an enhanced route to school for children living in the new housing development and a new and improved link between communities separated by the site.

4. *Opportunity mapping through BEST, Kent County*

The BEST-tool assisted Kent County Council to maximise the benefits of the investment in sustainable urban drainage systems (SuDS) aimed at flood risk reduction of twelve properties at George V Park. Although flooding was the main motivator for the project, the tool considered life-cycle costs of the SuDS with consideration of other benefits including biodiversity, air quality, and health and wellbeing. As a result, local beneficiaries beyond the properties were identified, such as the local school, hospital and local council. This sparked relationships, which will enhance an ongoing stewardship and involvement of local stakeholders with the open space at George V Park.

Recommendation 2: Relate the BGI to communities by demonstrating the value to them

The challenge: making BGI a joint responsibility of public and private actors

BGI is typically built on the land surface and is much more visible to citizens compared to traditional grey infrastructure that is usually invisible (below the surface) and therefore often unknown to the general public¹⁰. Water on the surface flows from place to place and may pass through various spaces and properties, and can collect in low lying areas. Communities will occasionally need to understand and accept the need to have water on the surface where they do not normally see it. Much of these spaces can be blue or green and managing them as BGI can best be done by integrating them in urban plans for both public and private space. Consequently managing BGI will need to become a shared responsibility for public and private actors¹¹. Therefore, enterprise and community engagement become much more important in delivering BGI than for traditional infrastructure^{12,13}.

Establishing effective engagement (so activating citizens, communities and enterprises) has been challenging for urban water and city managers. Urban water management has traditionally been a highly-specialised field. Ways need to be found, **to better relate the need for technical solutions, such as more water on the surface, to citizens' daily life**. Citizens and others need incentives to engage in this, because they consider 'water management' as a governmental (public) responsibility for which they already pay taxes.

The social innovation: activating communities through city-wide campaigns and neighbourhood champions

The BEGIN-project recommends two pathways in order to transform passive communities into more active BGI engaged communities. These need to be tailored to the cultural context and local conditions.

Firstly, citizen interests can be activated through innovative awareness raising campaigns. The BEGIN-project demonstrates the importance of relating BGI (and use for climate change challenges) to the daily life of residents and the wider community, thus emphasising the human benefits and value from using BGI. How could, for example, BGI contribute to residents' wellbeing? City partners developed both **city-wide branding strategies** (showing how BGI climate change measures could improve the city) **and targeted activation techniques**. Since BGIs are typically constructed on the surface rather than below, the newly constructed blue-green elements can have multiple uses (see recommendation 1). **The multiple benefits offer opportunities to link the use of BGI with residents' and others daily life in the neighbourhood**. Translating benefits clearly into how these help with residents' daily life will engender support at the neighbourhood-level for the BGI.

Secondly, a different strategy is needed for community engagement in specific projects. A major component is in **finding the right entrances – "local champions"** – who can help in actively involving the

¹⁰ NAO (2017). *Internal Drainage Boards*. London: National Audit Office.

¹¹ Mees, H., & Driessen, P. (2019). A framework for assessing the accountability of local governance arrangements for adaptation to climate change. *Journal of Environmental Planning and Management*, 62(4), 671-691.

¹² Wilker, J., Rusche, K., & Ryma-Fitschen, C. (2016). Improving participation in green infrastructure planning. *Planning Practice & Research*, 31(3), 229-249.

¹³ Willems, J. J., Molenveld, A., Voorberg, W., & Brinkman, G. (2020). Diverging ambitions and instruments for citizen participation across different stages in green infrastructure projects. *Urban Planning*, 5(1), 22-32.

community in the design, construction and maintenance of the BGI. Champions should ideally either live or work in the neighbourhood, such as voluntary groups, welfare workers, school representatives or social entrepreneurs. Or they could be private enterprises engaging through corporate social responsibility (CSR) initiatives. Relating champions' interests to the BGI can provide a driving force for others to become engaged in the BGI. In parallel, **interactions with local champions can be formalised through voluntary agreements or partnerships** between the City Council and the community for taking care of the BGI. This can ensure longer-lasting interest in the BGI and potentially save costs for maintenance. For urban water managers, this requires the relinquishing of control when handing over responsibilities to communities, albeit while still keeping an overview of the continuing performance of the BGI.

Illustrative examples

City-wide branding

1. *Rain Gothenburg, City of Gothenburg*

With the launch of the Rain Gothenburg campaign, the Sewage and Water Department of Gothenburg City Council has emphasised the human dimensions of rainwater. Gothenburg is one of the rainiest cities in Europe, which the City Council would like to use as an asset for urban development and city branding. The creation of new BGI is combined with art installations and outdoor classrooms. As a result, communities have become more familiar with both the challenges and pleasures related to urban rainwater and the potential of BGI. Moreover, communities can feel a sense of pride in how their city is dealing with rainwater in a positive, rather than negative way.

Targeted activation

1. *Engaging communities through new service designs, Royal College of Arts*

Students from the Royal College of Arts developed, together with local city councils in the UK, new service designs to encourage communities to contribute to and take some ownership of their environment, and specifically new BGI. To illustrate, a new service design included an online platform which demonstrates how BGI schemes are planned, helping the public understand the decision-making process. A Community Garden Club was developed that helps connect children and parents with nature through gardening, but also provides opportunities for local authorities to set tasks that help maintain public space.

Finding local champions

1. *Partnerships with Friends of the Park, Enfield Town*

Enfield City Council has created wetlands in the Firs Farm, which can be used to collect storm water. A local community group – Friends of Firs Farm – has taken over the daily maintenance of the BGI. Members of this community meet weekly and the park has become an important

community hub with plenty of activities. This can also be seen on the Friends' lively group page on Facebook.

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Recommendation 3: BGI requires interdisciplinary municipal (and other) partnering

The challenge: a risk-averse culture in urban water management

In an increasingly complex society, where climate change is only one of the many challenges faced in cities, there is a shift from problem-centred thinking to ‘opportunity-centred’ thinking¹⁴. Integrated multi-functional approaches are gradually becoming the new standard for service and infrastructure provision all over Europe, delivering many benefits simultaneously, e.g. safe and attractive city spaces at the same time as alleviating urban heat. The demonstrated multiple benefits provided by BGI in BEGIN support this trend. This means that solely **relying on technical engineering expertise does not suffice anymore**.

The field of urban water management has historically been highly-specialised under the aegis of a mono-culture of water engineers, focused on ‘solving problems’¹⁵. This culture is known for its risk-aversion, for example by relying on well-established techniques used largely unchanged for millennia. The need to maintain public health and safety continues to encourage this approach, especially because of the fear of litigation after making mistakes. Tradition means that being the ‘technical expert’ can be used as a reason to engage with communities only in a rather limited way and to avoid innovations that appear risky.

The strong engineering-driven problem solving mono-culture may need to be challenged to ensure the appropriate incorporation of the wider cultures and interdisciplinary approach essential for effective BGI delivery. For example, BGI use is dependent on land use planning and both land use planners and landscape/urban designers have the key role in what type of BGI is feasible and desirable in a particular context, albeit informed by the technical analysis provided by the engineer.

The social innovation: reform technical urban water management departments

The BEGIN-project has identified three directions required for ensuring the essential interdisciplinarity in the approach to urban water management. The first entails **the appointment of ambassadors in the organisation that cross departmental and administrative boundaries**. These individuals typically have a rich social network and can easily bridge boundaries between organisations, viewpoints, and interests. BEGIN demonstrates that BGI projects need to be led by urban planning and design departments, because of the spatial and land use requirements of BGI. As such, planners can link the different domains involved in the delivery of BGI, in which urban drainage is only one component of a BGI-project.

The second direction is **the creation of planned experimentation spaces**, also referred to as pilots, living labs or testbeds. This can foster cross-departmental working, to which the different departments can contribute. Creating a distinct organisational unit, in which unhelpful organisational structures and responsibilities are suspended, is a way to experiment with new ways of working and with bringing different disciplines together. Pilots can work towards tangible outcomes (a BGI-solution), which can be used as prototypes. This prototyping highlights the *learning-by-doing* element of pilots. Moreover, pilots

¹⁴ Ashley, R., Gersonius, B., & Horton, B. (2020). Managing flooding: from a problem to an opportunity. *Philosophical Transactions of the Royal Society A*, 378(2168)

¹⁵ Brown, R., Ashley, R., & Farrelly, M. (2011). Political and professional agency entrapment: an agenda for urban water research. *Water Resources Management*, 25(15), 4037-4050.

can help in shared meaning-making (aligning interests and viewpoints) and, thus, also in building coalitions that help deliver the BGI. BEGIN demonstrates that external facilitation in these pilots (provided by teams or organisations dedicated to innovation) is often required to break through the traditional practices that can stifle innovation

A third direction is **becoming part of capacity building networks** that help in exchanging experiences and lessons-learned. BEGIN has used **city2city-learning**, which have built on the inspiration of Learning & Action Alliances as defined in the previous Interreg North Sea project MARE, and as now being used routinely for BGI planning and delivery.

Illustrative examples

The appointment of ambassadors

1. *Blue-green department, City of Dordrecht*

After the local elections in 2017, the City of Dordrecht defined a few city-wide challenges. One of these was to become a climate-adaptive, blue-green city, utilising BGI. To this end, a new organisational unit was established with limited financial resources. Therefore, the unit had to interact with other departments and bring together different disciplines in order to be able to deliver the planned BGIs. Meetings were often organised at the SpuiLab210, a location separated from the City Council in order to appeal to more stakeholders. The team successfully created a large network both inside and outside the City Council to mainstream BGI solutions and strategies to the entire municipality.

2. *Department of Place, City of Bradford*

The establishment of the Department of Place in Bradford City Council facilitated interdisciplinary working, since all domains that were involved in the physical environment are currently located in the same department. For the restoration of the Bradford Beck, landscape architects, highway planners, engineers, biodiversity and health officials currently work together more easily, compared with how it used to be when the urban drainage department was in the lead.

Planned experimentation spaces

1. *CityLab Sint-Anneke Plage, City of Antwerp*

Antwerp City Council started an Urban Living Lab for the redevelopment of Sint-Anneke Plage. The CityLab aimed to heighten the dykes for flood protection against sea level, to create more tidal nature, and to re-design the public domain with a key role for blue-green spaces and solutions. The lab brought together several experts, local landowners, NGOs, and residents to jointly develop a vision for the area. The City of Antwerp facilitated this process through its CityLab2050 department and external facilitators. The lab developed innovative ideas and

inspiration for the design of public space and created a better understanding among local stakeholders and a willingness to act. The lab also improved interdepartmental cooperation within Antwerp City Council.

Capacity building networks

1. Stronger positioning of BGI because of more interdepartmental cooperation, City of Bergen

The fifteen years of experience in Interreg projects has led to increased interdepartmental cooperation in Bergen City Council. To illustrate, BGI plays a central role in recent strategic plans, so new urban development should incorporate BGI. Interdepartmental cooperation also returns on the project level. Several municipal departments contribute their expertise to the urban regeneration project in Mindemyren, in which for example lightrail development, real estate development and environmental management return. As part of the BEGIN project, a dedicated working group was formed in which the different municipal disciplines come together on a monthly basis. The discussions in this group led to a new design for the planned BGI in Mindemyren. The new structure consists of both an open channel on the surface and a buried channel designed to handle flooding.

Recommendation 4 – Develop asset management principles and processes for BGI

The challenge: Fitting BGI into established asset management processes

BGI, like other systems and services, provides an important societal function that needs to be maintained over the expected lifetime. Unlike traditional drainage infrastructure, BGI provides multiple functions, each of which needs to be sustained by appropriate maintenance, repair, renovation and replacement. Traditional infrastructural assets are maintained in accordance with well-established standards like ISO 55000 and owners and operators are clear about how to do this to maximise value.

BGI is different as it provides many functions and, being nature-based, is often self-generative¹⁶, i.e. may function even without maintenance. Hence managing BGI assets requires a new vision and approach from that used for traditional asset management. Most drainage schemes that include BGI will also include some components of traditional piped drainage, for example, to interconnect each BGI measure, and for some there may need to be substantial buried infrastructure, depending on local circumstances. Hence many schemes will in future be hybrids, i.e. using both BGI and pipe or tank systems¹⁷. Monitoring records and depreciation schemes that are used to manage the lifecycle of existing grey infrastructure need to be adapted or modified for hybrid and BGI assets. Furthermore, the multi-functional nature of BGI requires a wider set of performance indicators. In short: **most BGI does not fit with the asset management frameworks that have been developed for grey infrastructures**. To illustrate, only recently has BGI been considered as an asset, being labelled as ‘a sewer’ in the UK¹⁸. Nonetheless, this does not capture the need to maintain the multi-functional nature of BGI.

Widespread applications of BGI are still in their infancy, hampering insight into **the long-term requirements and effects of maintaining and operating BGI**. Hence, there is considerable uncertainty about the lifecycle performance of BGI and to what extent the BGI can continue to deliver the benefits that have been predicted at the design stage. So far, most attention has been paid to the short-term for BGI use, despite tools like BEST including a long-term scenario planning option⁴.

The social innovation: better routine and long-term monitoring of BGI

More experience of the lifecycle performance, as well as the short-term performance and benefits of BGI assets is required, as BGI is increasingly being used. Did the BGI deliver what was promised? Better monitoring and evaluation of the benefits estimated in the design and planning stages is required. This assessment will allow for refinement in assumptions, useful for planning, designing and operating existing and future BGI. For instance, the assessment can enhance the uptake of BGI, since the benefits of BGI become more evidence-based. This would produce a better demonstration of the benefits that can be expected, and which benefits may be more challenging to achieve and maintain over time. This will help policymakers across Europe in their decision-making and make investing in BGI less of a risky business. Traditional flood risk management infrastructure is invariably designed for the longer term and

¹⁶ Fletcher, T. D., Shuster, W., Hunt, W. F., Ashley, R., Butler, D., Arthur, S., ... & Mikkelsen, P. S. (2015). SUDS, LID, BMPs, WSUD and more—The evolution and application of terminology surrounding urban drainage. *Urban Water Journal*, 12(7), 525-542.

¹⁷ EU (2019) Natural Capital Accounting: Overview and Progress in the European Union. 6th Report. May. ISBN 978-92-79-89744-3.

¹⁸ Water UK (2018). *A Climate Change Adaptation Approach for Asset Management Planning*.

established processes are being used to assess the robustness, based on asset management processes. The same approaches need to be used for BGI.

The findings will also **improve current asset management principles and processes**. Consequently, these principles can become better focused on managing BGI assets for maximum value. The ISO-standards used in traditional asset management can be refined in order to fully capture the scope of BGI value provision, rather than trying to force asset management processes used for grey infrastructure to work for BGI schemes.

Illustrative examples

More experience of lifecycle performance

1. *Pilot semi-paved car parking, City of Antwerp*

Antwerp City Council has started a pilot for semi-paved parking in order to improve the infiltration capacity. Asset managers will monitor the performance of this paving, so evidence will be gathered about the contribution of the BGI.

2. *Monitoring use and identifying trends, City of Aberdeen*

Maidencraig Flood Management Wetland Scheme Phase 2 includes the construction of several footpaths through the wetlands. Permanent pedestrian and cycle counters will be installed in three locations to monitor use and identify trends.

3. *Environmental volunteering for BGI maintenance, Enfield Town*

The maintenance of BGI is easier to identify (compared to grey infrastructure), as it is constructed above ground. This offers opportunities for including engaged citizens in identifying issues and reporting, for example via online apps. In Enfield, Firs Farm Eco Club and its Children's Club help the local council with cleaning up the wetlands.

Improve asset management principles

1. *New decision-making frameworks, City of Hamburg*

LBSG in Hamburg has developed a decision matrix for BGI that integrate and weigh different functionalities such as infiltration, retention, ecosystem values, and recreation. Also, safety regulations are linked to nature-based filter and retention basins, resulting in better asset management principles for BGI.

2. *Guidelines for BGI in public space manuals, City of Ghent*

The fourth version of the Integrative Plan Public Space of Ghent City Council consists of guidelines for designing climate-robust public spaces (streets, squares) for new urban developments. The new guidelines should result in not only more green space in the public domain, but also give way to cyclists and pedestrians and simultaneously reduce car use.

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Contact: Dr Jannes Willems (Erasmus University Rotterdam; willems@essb.eur.nl), Prof Richard Ashley (IHE-Delft; r.ashley@sheffield.ac.uk), Dr William Veerbeek (IHE-Delft; w.veerbeek@un-ihe.org),

BEGIN project leader: Ellen Kelder (City of Dordrecht; etgkelder@dordrecht.nl)

Further reading: <https://northsearegion.eu/begin/>

BEGIN is a partnership of 6 North Sea Region countries:

- **Belgium:** City of Antwerp; City of Ghent
- **Germany:** Agency for Roads Bridges and Waters, Hamburg; Hamburg University of Technology
- **The Netherlands:** City of Dordrecht; IHE Delft; Erasmus University Rotterdam
- **Norway:** City of Bergen
- **Sweden:** City of Gothenburg
- **United Kingdom:** Construction Industry Research Information Association (CIRIA); City of Bradford Metropolitan District Council; Kent County Council; Aberdeen City Council; Enfield City Council; Royal College of Arts; University of Sheffield