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Chapter 16

Case studies of blue-green infrastructure in spatial planning

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CONTENTS

This chapter presents an in-depth exploration of three case studies involving the use and application of blue-green infrastructure (BGI) in the English and Scottish planning systems. Each case study reflects a different scale of project and different stages in the policy and planning cycles. The case studies feature a local plan development in the South Downs National Park, an integrated landscape-scale blue infrastructure masterplan project in Glasgow and a highway city-centre improvement plan in Sheffield. Each case study demystifies the role and benefits of BGI through a critical discussion identifying the common ingredients of good BGI. Some of these ingredients include inter- and transdisciplinary collaboration and engagement championing co-design and coproduction; strong and effective leadership within cross-sector partnerships with an appetite for innovation and risk-taking. The results demonstrate the need for improved processes of engagement with relevant delivery partners from the outset, accounting for varying needs and priorities. While barriers identified include the need to better embed BGI in the business case and to move away from seeing BGI maintenance as a liability, overall the case studies challenge conventional wisdom that environment planning is a development constraint; instead, it is seen as an appreciating multifunctional asset, supporting regeneration and development.

Key messages

- Three case studies explore the use and application of BGI in the English and Scottish planning systems: a local plan development in the South Downs National Park, an integrated landscape-scale blue infrastructure masterplan project in Glasgow and a highway city-centre improvement plan in Sheffield.
- Ingredients for success include inter- and transdisciplinary collaboration and engagement with co-design and coproduction; strong and effective leadership within cross-sector partnerships and an appetite for innovation and risk-taking.
- Barriers identified include a current lack of embedding of BGI in the business case and BGI maintenance being seen as a liability.
- Collectively, the case studies challenge conventional wisdom that environment planning is a development constraint rather than a mechanism supporting regeneration and development.

16.1. Introduction

This chapter presents an in-depth exploration of three case studies involving the use and application of BGI in the English and Scottish planning systems (Table 16.1). These case studies reflect different scales of project and different stages in the policy and planning cycles: from local planning policy in the South Downs National Park, to a landscape-scale blue infrastructure project in Glasgow (the North Glasgow Integrated Water Management System), to a city-centre highway improvement in Sheffield (Grey to Green). Within the UK, different spatial planning approaches have emerged, reflecting different governance frameworks and local contextual priorities. Consequently, important lessons can be learnt from detailed case study assessments rather than the usual approach of using short case studies to illustrate largely positive points. Thus, the structure of this chapter is reversed from the usual format as it starts with an exploration of the three case studies from which we then identify and explore the common and bespoke ingredients that, seemingly, influence success, as well as discussing how to tackle the barriers that remain. This approach is designed to help the reader understand each case study in detail, with the ensuing discussion section providing a connection with the wider peer-reviewed literature to contextualise the findings therein. The chapter concludes with recommendations for addressing the barriers and opportunities for BGI with transferability in both UK and wider global contexts.

	South Downs National Park Local Plan	North Glasgow Integrated Water Management System	'Grey to Green' in Sheffield city centre
Tier	**Description**	**Purpose**	**Purpose**
Vision	Mainstreaming ecosystem approach across key statutory plans in the South Downs National Park	Delivering strategic regeneration through a resilient, BGI-led 'sponge city' water management approach	Revitalising redundant parts of the city through multifunctional green infrastructure
Focus	Local plan	Unlocking urban regeneration at scale by combining BGI with a technological solution to address water management	Highways
Behaviour	Building on a landscape-led approach within a new National Park Authority governance layer, with innovation at its core	BGI-first approach, operating within a partnership framework	Approaching the built environment as a porous network, making room for water, nature and traffic
Contribution to BGI	Recognises role of BGI as a delivery mechanism to achieve ecosystem service and natural capital benefits	Demonstrates how BGI can unlock and lead strategic development to maximise positive outcomes and different benefits	Shows how green infrastructure can be retrofitted in main highways to achieve different benefits
Contribution to engineering sciences	Embedded in regulatory framework but supported by guidance for householders and developers Uses a full range of ecosystem services suited to the place-based context	Re-purposing a historic monument by marrying a cutting-edge technological solution with BGI for managing surface water and providing different co-benefits	Challenges constraints usually levelled at BGI on road schemes Demonstrates value for money

Table 16.1 Summary of case studies in Chapter 16

16.2. South Downs National Park Local Plan: illuminating what good policy for BGI looks like

What is this case study about?

This case study is about mainstreaming the ecosystem approach, a 12-principle strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way, within a suite of core plans and strategies (partnership management plan, green infrastructure framework and local plan), which collectively provide a strong and robust policy foundation for the design, delivery and monitoring of BGI. This is built on the synergistic relationships between the stocks of natural capital with the flows and benefits of ecosystem services from which a number of benefits are delivered by BGI. This policy is written mindful of the place-based context and needs of the South Downs National Park. It champions a landscape-led approach, demonstrating how good BGI policy and planning is facilitated by an overall approach and ethic that seeks to mainstream the ecosystem approach throughout all the work of the park authority, rather than for an ad hoc initiative or project. The specific focus in this case study is on an innovative local plan policy underpinned by a sound evidence base and supported by associated developer and householder guidance that enables the policy to be effectively understood and delivered on the ground. This then links to wider ecological networks and natural capital investment programmes, as well as the wider cross-boundary cooperation on environmental matters, showing effective policy integration (Scott, 2020: Scott *et al.*, 2018).

Who are the key players and drivers?

The South Downs National Park Authority is the key driver of change but has worked in partnership with its 15 constituent local authorities and other key stakeholders. Since its creation in 2010, it has developed an agenda around the mainstreaming of ecosystem science throughout its work and plans, programmes and projects. This involved active transdisciplinary collaboration with their partners and academics including Andrew Church (Brighton University) and Alister Scott (Birmingham City/Northumbria Universities). Scott, in particular, worked with Tim Slaney (Director of Planning) and Chris Fairbrother (Landscape and Biodiversity lead) with staff and National Park board members to identify hooks and barriers to mainstreaming efforts and, in particular, to support the development of the local plan evidence base and ecosystem service policies.

What happened?

The South Downs National Park Authority took an early strategic decision after its inception to embed nature and ecosystem

services at the heart of all their core plans, programmes and projects. Following a series of iterative workshops with planners and the Park Board, they created a suite of core documents and policies, including a park management plan,[1] a local plan[2] and a green infrastructure framework,[3] based on a comprehensive ecosystem services evidence base to guide policy. For the local plan, there was particular interest in an innovative approach to recognising natural capital and ecosystem services throughout all planning policy, as realised through a core policy on ecosystem services (Box 16.1). This was one of four core policies that all development had to meet in all planning applications. The policy was built on a robust mapping evidence base of ecosystem services via Ecoserv.[4] Each ecosystem service – prioritised for the South Downs context; accessible nature, air purification, carbon storage, education, green travel, local climate regulation, noise regulation, pollination and water purification – was mapped using supply and demand assessments leading to spatially explicit management intervention zones: protect, maintain, improve, change and create (South Downs National Park Authority, 2018). This evidence base led to the design of a positively worded policy with a presumption in favour of development to help its wider mainstreaming. The positive presumption in favour of development moves away from the idea of the environment as a constraint to development.

The policy requires developers and householders to detail both the positive and negative impacts of any developments on a specified list of ecosystem services (translated into the South Downs context in plain English), and to actively seek out ways of enhancing ecosystem services to help secure planning permission, thus framing the green infrastructure narrative as an integral part of the business case for development. This is further supported by mapping the Nature Recovery Network and natural capital investment areas to identify ecosystem service priorities and impacts for any potential development location. Of crucial importance is the fact that this policy is underpinned by bespoke operational guidance for householders (Figure 16.1)[5] and developers,[6] which explicitly addresses viability, trade-offs and net gain potential. It then becomes effective as a negotiation tool to enable planners to embed biodiversity and wider environmental net gains explicitly in developments at any scale, showing how statutory planning policies, when used with guidance, can provide an important catalyst for the delivery of green infrastructure. This has recently been used to build natural capital investment areas associated with ecological networks (Figure 16.2). The local plan policy was approved in 2019 and thus now carries statutory weight, which is of great importance in helping achieve the Park's wider nature conservation objectives.

Underpinning this policy is also the 'duty to cooperate' (DtC) statement, which for the first time required constituent authorities to work together on a range of strategic opportunities for improving and enhancing key ecosystem services within the policy. This challenged the existing priority for the duty to cooperate on housing matters. (The duty to cooperate is a legal test that requires cooperation between local planning authorities and other public bodies to maximise the effectiveness of policies for strategic matters in local and strategic plans. This is now termed 'statements of common ground'.)

Box 16.1 Local Plan Core Policy SD2: Ecosystem Services (South Downs National Park Authority, 2019: p. 38)

1. Development proposals will be permitted where they have an overall positive impact on the ability of the natural environment to contribute goods and services. This will be achieved through the use of high-quality design, and by delivering all opportunities to:
   - (a) Sustainably manage land and water environments;
   - (b) Protect and provide more, better and joined-up natural habitats;
   - (c) Conserve water resources and improve water quality;
   - (d) Manage and mitigate the risk of flooding;
   - (e) Improve the National Park's resilience to, and mitigation of, climate change;
   - (f) Increase the ability to store carbon through new planting or other means;
   - (g) Conserve and enhance soils, use soils sustainably and protect the best and most versatile agricultural land;
   - (h) Support the sustainable production and use of food, forestry and raw materials;
   - (i) Reduce levels of pollution;
   - (j) Improve opportunities for people's health and wellbeing; and
   - (k) Provide opportunities for access to the natural and cultural resources which contribute to the special qualities.
2. Development proposals must be supported by a statement that sets out how the development proposal impacts, both positively and negatively, on ecosystem services.

Barriers and opportunities

The biggest opportunity here was that the South Downs was a new National Park, which set out from the start to be innovative in the way that it dealt with environmental issues. This culture of environmental innovation was present throughout the agency and its staff and board members. This fostered strong support for working with academic institutions to help build their capacity.

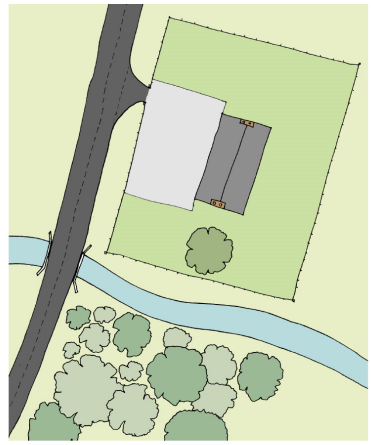
The creation of a new agency workforce also brought in some strong leaders both at officer and member level, who sought to push boundaries in pursuit of their agenda. Observing this at first hand within the UK National Ecosystem Assessment Follow-on Programme (Albon *et al.*, 2014) provided important insight into the micropolitics of BGI development where

This is Jill. She is thinking about getting an extension and needs to get planning permission. However she also wants to help the environment.

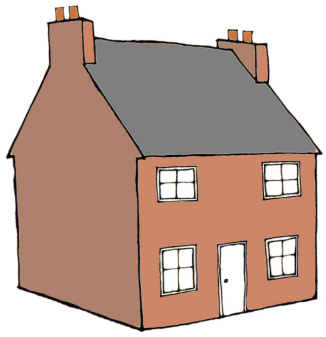
Jill lives in the South Downs National Park. She observes following about her home:

- There is a river and woodland alongside her house
- The busy road in front of her house sometimes floods
- Her house is surrounded by a close boarded fence
- She has noticed bats flying over her garden
- There is a large concrete parking area

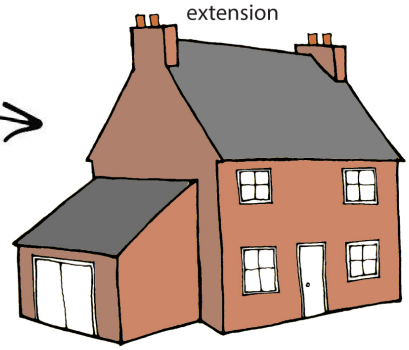
In order for her plans to have a possitive impact on the environment, Jill will need to address these issues.



Jill's house



Jill's proposed extension



Jill's actions

Replacing the close boarded fence with a native hedgerow helps to soak up excess water, improves air quality and is great for wildlife

Replacing the concrete parking area with permeable surfacing helps reduce flood risk and surface water

Installing bat boxes is an easy way for Jill to support the local bat population

Planting wild flower mix is great for insects, which provides a food source for bats

Solar panels are one which which can reduce Jill's carbon footprint

Figure 16.1 Householder Guidance for SD2 (Source: South Downs National Park Authority, 2022a)

there is not a sole champion of BGI or where it resides in the environmental section; rather, BGI development pervaded different departments from the outset. This was a highly significant difference from many other initiatives reported in the UK National Ecosystem Assessment Follow-on work (Scott *et al.*, 2014, 2018).

The ability to tap into free resources from Ecoserv for their evidence base using ecosystem mapping was important in developing a sound evidence base on which to build policies and future interventions.

The duty to cooperate was both an opportunity and challenge. It provided an opportunity for the Park to engage with local authorities on cross-boundary issues that affected the environment. This was challenging for all parties, given that their main concerns had hitherto been on housing need. However, the strong regulatory backing with the suite of park management plans and evolving policies meant that there was a compelling case. This took many authorities outside their comfort zones but DtC agreements were signed with all 15 local authorities.

The ongoing challenges will be monitoring the impact of this particular policy in decisions and also seeing the extent to which there are trade-offs between the different ecosystem services in the policy. Opportunities to use the new UK Nature tool[7] may help provide more evidence on its overall utility and help to bring higher-quality developments to the authority. Importantly, there is continual training of all staff involved and new staff with critical review of and celebration of success; for example, the Royal Town Planning Institute (RTPI) planning excellence award.

However, updating the ongoing evidence base requires a significant investment of time and resources, as Ecoserv access is no longer free. This creates a future resource challenge.

Lessons learnt

- Academia and practice working together in a transdisciplinary mode challenges traditional research models using the concepts of policy 'hooks' framed within the South Downs context to justify and legitimise the approach.
- Championing the ecosystem approach across the entire authority in its plans and operations created the conditions for successful culture change. For example, the planning staff were fully conversant with ecosystem services language and its application, as were other staff in the development pipeline feeding into the application process; this is rare in practice elsewhere.
- The positive framing of an environmental local plan policy moved it away from being seen simply as a constraint.
- Effective leadership at both senior officer and board level was key to success. Securing the support and active involvement of the political leadership (the National Park Committee) was seen as critical.
- The willingness of the organisation to learn and become an innovator in mainstreaming ecosystem services, notwithstanding it had the benefit of being a relatively new organisation, was an advantage.
- The development of a robust evidence base was underpinned by academic credibility. The work was embedded in the UK National Ecosystem Assessment Follow-on Project (Albon *et al.*, 2014; Scott *et al.*, 2014), giving the policy extra academic credibility in the planning system.
- Guidance was generated to show householders and developers how to embed SD2 policy into their practice. The use of householder guidance here is seen as particularly beneficial and innovative.
- The linking of plans and investment strategies makes a stronger business case for nature, addressing a current weakness in many BGI schemes (Figure 16.2).

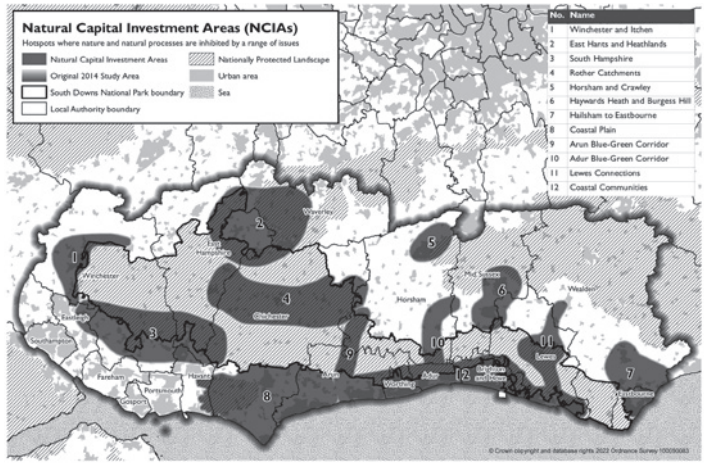


Figure 16.2 Natural Capital investment Areas (Source: South Downs National Park Authority, 2022b)

Future plans

The Nature Recovery programme is becoming an important hook to drive the policy forward and the South Downs National Park Authority are launching a 'call for sites', much like one does for housing and development land. However, in this case, it is a call for sites that could be renatured. The authority will concentrate on any sites that may be proposed that relate to existing BGI to try and get bigger, better, more joined-up habitats and renewal.

The Design Guide will be a critical supplement to the policy and is currently under development. The South Downs National Park Authority Design Awards Scheme, launched in 2019, seeks to promote and reward those schemes that really do embrace ecosystem services in the widest context.

As a result of monitoring the policy, there is evidence that planning applications are now being put forward at a scale that really meets policy requirements on all sides, including water usage, nature recovery, net zero carbon and passive house requirements, with BGI as a significant component.

16.3. North Glasgow Integrated Water Management System: a BGI-first approach

What is this case study about?

The North Glasgow Integrated Water Management System (NGIWMS), part of which is referred to as Glasgow's Smart Canal (Scottish Canals, 2018), is a phased programme of significant urban regeneration projects across a number of sites in north Glasgow (NatureScot, 2020). It was made possible through the use of an innovative 'sponge city' water management approach that repurposes the Forth & Clyde Canal as a surface-water conduit to deliver strategic flood risk management solutions and unlock regeneration of 110 ha of key vacant and derelict land (V&DL). (The 'sponge city' approach is an urban area intervention that has been designed to cope with excess rainfall or drought using a variety of techniques.) The primary innovation is the strategy to dynamically manage the level of water not only within the canal spine, but also potentially within each water management area across the various development sites. This is based on the concept of lowering the canal's water level in advance of meteorological predictions of severe storms and to allow for the drainage of surface water, thereby 'creating space for water'. This has the significant advantage of allowing water to be retained within sustainable drainage systems (SuDS) during normal weather conditions, as the volume occupied by the water can be used for flood storage when the water level is lowered. This greater presence of surface water adds to placemaking and urban cooling, compared with more traditional SuDS, where flood storage areas usually remain dry.

This exemplar BGI-first approach addressed the development barrier of a combined sewer system at capacity, and enabled further development and regeneration of other V&DL sites to make them viable, at significantly lower capital investment costs. It also unlocked a much wider range of positive outcomes in an area with some of the highest multiple-deprivation statistics in Scotland (Tieges *et al.*, 2020) by significantly adding to the BGI in the area, contributing to urban cooling and positive biodiversity outcomes, unlocking access to green space (including a designated Local Nature Reserve only 20 min walk from the city centre), controlling further development of greenfield sites, and connecting places and communities through active travel networks; all within the backdrop of predicted increases in more frequent extreme rainfall events as a result of climate change.

Who are the key players and drivers?

The project is led by the NGIWMS Drainage Partnership, a 60 year legally binding agreement (with a review period for extension after 50 years) between Glasgow City Council (GCC), Scottish Water and Scottish Canals, to work cooperatively to deliver the whole scheme. This partnership operates under the collaborative arrangements of the Metropolitan Glasgow Strategic Drainage Partnership (MGSDP)[8] – a collection of key stakeholders – to transform how the region thinks about water as an asset rather than a problem, reduce flood risk, improve water quality and deliver BGI to make the migration from an over-reliance on grey infrastructure. Other key players include AECOM, Collective Architecture,[9] Glasgow Clyde Valley Green Network Partnership (GCVGNP),[10] Land Use Consultants (LUC),[11] Mackenzie Construction Ltd and Fairfield Control Systems (2022), as well as a mixture of housing associations and private developers.

What happened?

A perfect storm of historic infrastructure, community desires, regeneration needs, constrained V&DL sites, increasing heavy rainfall events from climate change, existing flooding issues (e.g., of core Network Rail assets) and significant surface-water management constraints from sewer capacity issues all came together and led to the Forth & Clyde Canal becoming the solution. Glasgow City Council's 2018 Youth Olympics bid proposal for the Sighthill transformational regeneration area (TRA) brought the imperative to find a solution and – together with community aspirations for better green space – led to the project as we now know it (Glasgow City Council, 2022).

The Forth & Clyde Canal itself forms the spine of the NGIWMS system (Figures 16.3 and 16.4), with elements (limbs) going into each development site, and the 'fingertips' (sponges) and 'brain' (Smart Canal) embedded within those elements in the form of above-ground management, for example, basins, ponds, swales and street canal features to provide surface-water management. This should be able to manage 1-in-30 year storms without the canal being dynamically managed, with only larger rainfall events triggering the Smart Canal system itself to operate autonomously. The above-ground management used innovative designs, challenging convention as they did not conform to standard designs given by Sewers for Scotland (SfS).[12] This approach, however, was part of a wider rationale to deliver the best overall project in terms of other benefits, for example, for placemaking.

Alternative standard traditional drainage solutions to unlock regeneration would have required tunnelling and pipework, feeding water into combined drainage systems and onwards to the Kelvin or Clyde rivers, and subsequently requiring treatment. This BGI-first approach to the core smart canal elements cost the equivalent of 35% (£15 million) of the alternative grey solution (*c.* £45 million), and included many more benefits that ultimately helped leverage additional funding.

The carbon savings of re-purposing an existing asset (the canal) have been huge. By diverting surface water into the Smart Canal system, the project will realise an initial 5000 tCO_{2eq} capital saving, combined with a 500 tCO_{2eq}/year saving over

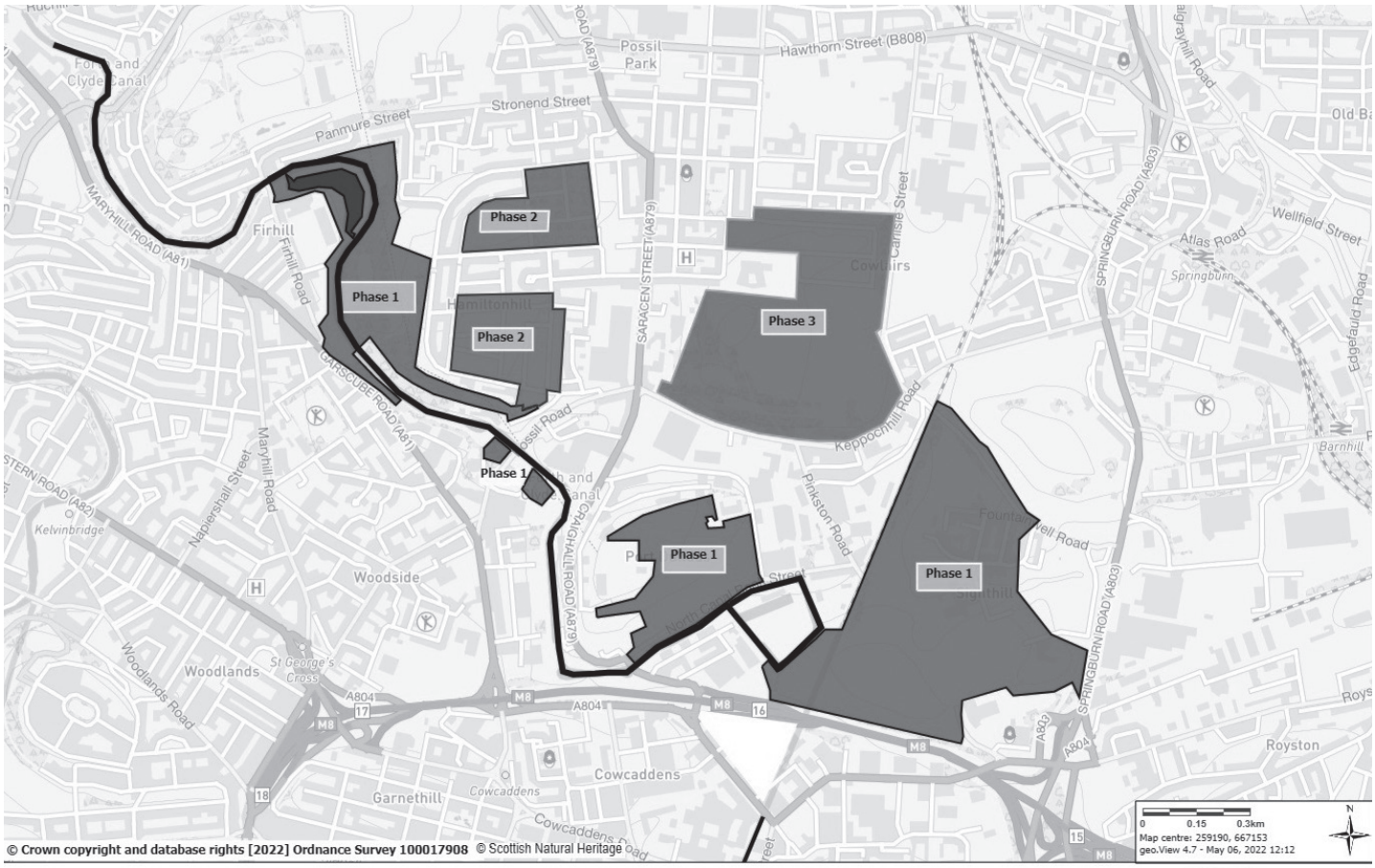


Figure 16.3 NGIWMS map (© NatureScot)

the 60 year operational agreement, compared with a standard traditional drainage solution. While carbon reduction was not a driver, it has been an added benefit to the project.

Barriers and opportunities

Agreeing how to deliver some of the more aspirational features that would be suitable for vesting by Scottish Water and adoption by the local authority (LA),[13] particularly for non-standard designs that were not laid out in SfS, was challenging. Additionally, there are currently two sets of legal responsibilities for Scottish Water and LAs – and separate budgets – that do not lead to the efficient management of flood risk and BGI.

A lack of funding for revenue (i.e., management and maintenance) costs of new assets, particularly for LAs, where budgets keep reducing, is also one of the single biggest challenges and frustrations. Compared with grey infrastructure, BGI entails vegetation that grows and needs regular maintenance to ensure ongoing provision of a number of benefits (further guidance is provided in Chapter 14). For those BGI elements that do not have a surface-water or flood risk management purpose, and therefore are not vested by Scottish Water or adopted by the LA, there is the challenge of assigning who is going to maintain them over the long term and providing certainty of funding.

Currently, BGI projects are regarded as liabilities on LA balance sheets; LAs cannot raise money on them as they can on, for example, buildings or bridges. Thus, the more BGI there is, the greater the so-called liability; there is a huge challenge for LAs in securing and keeping maintenance budgets, which must actively be taken into account. Once the wider benefits of BGI can be better defined and quantified in an agreed way, more funding streams can be realised.

Other barriers included the following:

- The partnership organisations exist as separate entities; this required legal agreement that took significant time and highlighted wider governance issues.
- Modelling the canal and integrating the concept of inputting live weather data feeds that instructed the opening or closing of valves was challenging to bring from theory to fruition.
- The initial intervention costs outlined by the civil engineers at the outline design stage significantly underestimated the actual costs

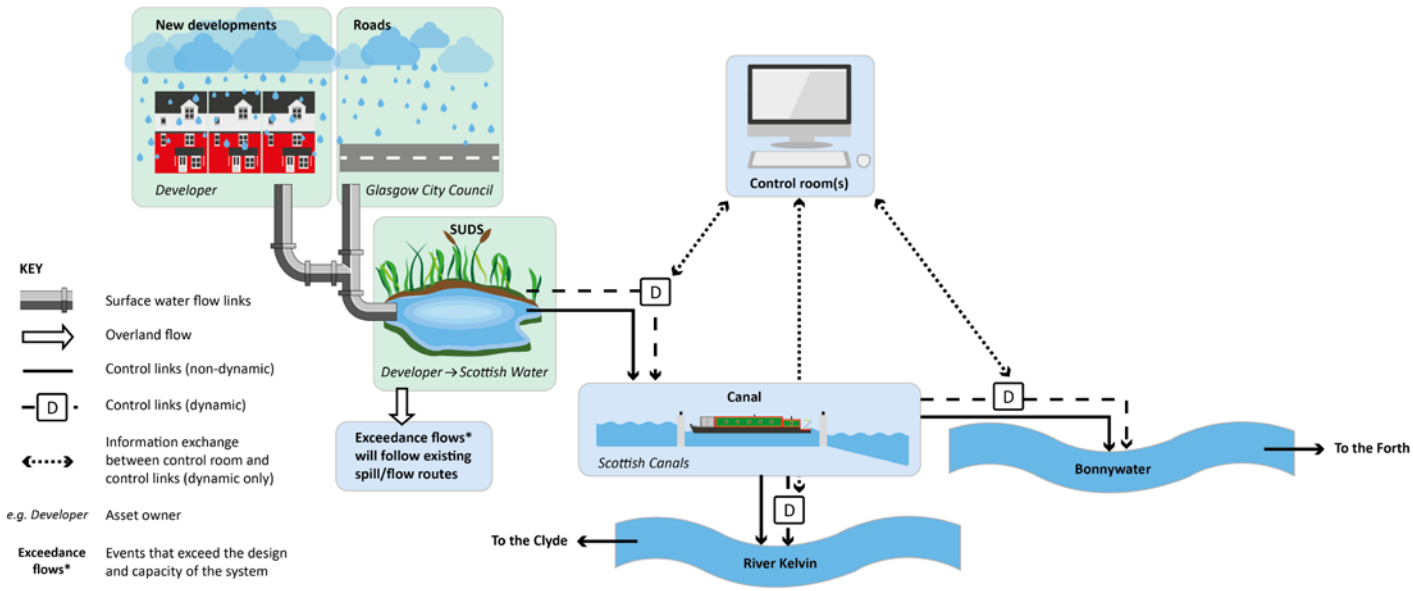


Figure 16.4 Canal diagram (© Centre of Expertise for Waters)

determined at the end of the detailed design stage, a common challenge across drainage infrastructure projects.

- The legacy of post-industrial sites often means dealing with contamination or mine shafts, for example, although these were known elements in this case.
- The interdisciplinary nature of the project was a key strength but its cross-cutting character made it difficult to put it into standard award categories that bodies work to; despite this, the intervention continues to win numerous awards.

A mixture of public and private funders provided the necessary blended capital finance. The wide range of funding streams reflects a wide range of policy outcomes, linked to the regeneration agenda in response to a changing climate. Furthermore, the inclusion of public funding reduced the risk to private investment in the innovative water management system. However, bringing various funding streams together was complex and time-consuming, with varying timelines and agreements needed on spend and measuring success.

The project came to fruition through the public-sector partnership organisations being willing to compromise and expose themselves to risks that they had no statutory obligations to take on. Scottish Water operates in a highly regulated environment; Scottish Canals does not. The Scottish Government encouraged Scottish Water to take risks to deliver aspirational water management measures. This is important, as public bodies are usually risk-averse.

Lessons learnt

- Have a core group (like the MGSDP) to provide strategic oversight to deal with complexity and improve integration.
- Build the green, blue and grey networks first – this leads to a spatial plan that then leads to partner agreement on maintenance, management and access, and enables a better assessment of what buildings can be accommodated in a sustainable way. This changes the process from a developer-driven one, focused on maximising return, to an infrastructure-driven one that maximises a number of benefits.
- Empower project champions to underpin the process, advocate within relevant organisations, ensure continuity and take on the role of brokers between the partner organisations.
- Control rainfall where it lands (rather than once it goes into a pipe) to provide many more options to avoid uncontrolled flooding, and get spaces to react quickly so that floods occur where wanted.
- Have holistic risk assessments proportionately identify risks across the entirety of a site and enable, for example, SuDS to be built without fencing because they are proportionately less of a risk (e.g., compared with a road, or the adjacent, unfenced, canal).
- A successful project has the right team culture, governance, corporate commitments and partner flexibility that understands that communities express the desire for projects, engineers put them in place and politicians provide the commitment.
- A loss of momentum is far more detrimental than a small gain by going back through a feedback loop, particularly for innovative projects.
- Technical engineering timescales do not necessarily reflect the time required for community engagement, legal agreements, different stakeholders, several phases or sites or complex funding packages.

- Technical or operational workshops, facilitated by an external person, knowledgeable in the subject area, who can ask probing questions, leads to more advanced thinking before lawyers are engaged to draft legal text.
- Close your green spaces in phases during construction so that there is some community access at all times, accompanied by clear communication and engagement.
- Be more aspirational and free of standard design regulations by creating new terms for water management elements.

Future plans

This large-scale investment project is part of a multiphased programme. The Smart Canal system went live and began managing rainwater at Sighthill in November 2021 (Figures 16.5 to 16.8). The successful first phase allows for a second phase of further development at Hamiltonhill, with infrastructure works and housing development planned from 2022 onwards. The third phase, at Cowlairs, is in the development and planning stage, and will be the final phase to be delivered.

16.4. Grey to Green in Sheffield city centre: putting long-term knowledge into action

What is this case study about?

The Grey to Green project in Sheffield city centre involves the transformation of 1.3 km of a redundant road carriageway into linear urban green space, Phase 1 of which was completed in 2016 (Grey to Green Sheffield, 2022). This case study is about how knowledge that germinates in a city over a long time can lead to action. While this might sound obvious, it is more often the case that action does not result from knowledge: there are well-rehearsed logics of *inaction* that prevail (Dempsey and Dobson, 2020). These are often expressed by practitioners, including engineers, in particular, through such well-coined phrases as: 'We can't do it that way because we've always done it this way,' or 'Your way costs too much,' or 'That might work over there, but it'd never work here.'

In the city of Sheffield, there is a long history of environmental action and improvements, including cleaning up of the city's industrially polluted rivers (1970s) to European Regional Development Fund investment in public realm improvements (1990s and 2000s). This case study emulates the long-standing idea held by many city stakeholders that healthy green infrastructure should be provided, enhanced and protected for 'Sheffielders'.

Who are the key players and drivers?

The key players include Sheffield City Council's City Centre Regeneration team[14] and the Department of Landscape Architecture at the University of Sheffield.[15] Another important player is Green Estate (2016) – a social enterprise that started life as an 18 month project funded through single regeneration budget funding in the late 1980s, administered locally by the Manor and Castle Development Trust.[16] Rooted in community development and based in the Manor estate (described in 1996 as the worst estate in Britain), Green Estate's approach was about long-term stewardship. They led on innovative low-maintenance design in the Manor's derelict green spaces throughout the late 1990s and early 2000s (Figure 16.9).

What happened?

The ideas were low-key but high-impact. Green Estate worked with Professors Nigel Dunnett (Dunnett, 2022) and James Hitchmough at the Department of Landscape Architecture

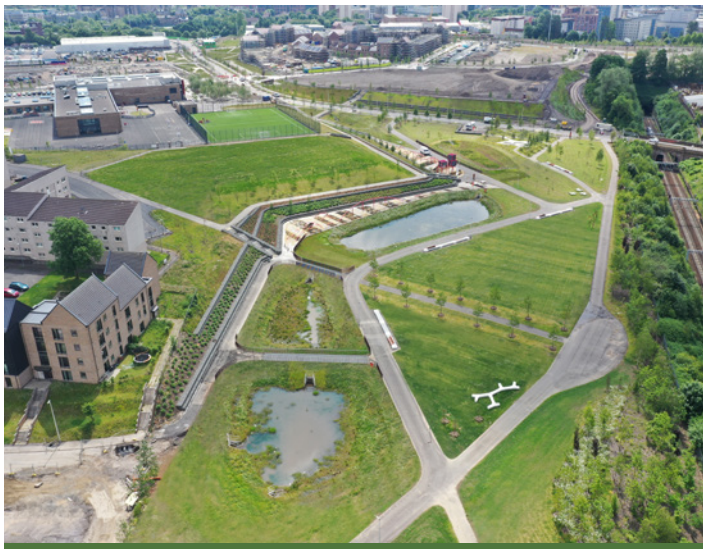


Figure 16.5 Sighthill detail (© LDA Design)

Figure 16.6 Sighthill (© Eye in the Sky Glasgow)

to implement experimental planting designs around the Manor estate. By improving the perceptions of the estate's urban landscapes through perennial wildflower meadows and low-maintenance planting, Green Estate developed pictorial meadows as a highly sought after planting approach that could be applied in a range of settings.[17] This planting was incorporated in the city's newest park, Manor Fields Park (Figure 16.9), managed by Green Estate. The park was developed with landowners Sheffield City Council, and included SuDS as a fundamental part of the design. Together, this helped turn 'one of the most rundown bits of wasteland in the city to one of the city's most attractive parks' (Stringer, 2019).[18] See also Chapter 5.

Some of the Council officers specialising in flood management, sustainable drainage and landscape design working in Manor Fields Park were also on the City Centre Regeneration (CCR) team. This was an interdisciplinary team, which included a water management engineer, property expert, planner and landscape architect, who wanted to translate this innovative design thinking to the city centre. They were keen to explore how these ideas could be applied to a hard landscape, moving beyond 'easier' residential areas, which have much more green space available (Figure 16.10).

These ideas did not develop in a vacuum. There were other pressing matters, which gave this innovative thinking traction. The severe floods of 2007 were still fresh in people's minds, as were the associated millions of pounds worth of costs to businesses in the city centre. There were also serendipitous events. These included a critical conversation between the University's Department of Landscape Architecture and the City Centre Regeneration (CCR) team. A doctoral researcher examining the high-quality but very high-cost water features in the city created in the early 2000s (including the Peace Gardens) asked why the water features couldn't be more natural.

Meanwhile, Professors Nigel Dunnett and James Hitchmough were developing the planting designs for the 2012 London Olympic Park with their horticulture PhD students and, in 2014, Simon Ogden – the council's CCR team manager – attended a talk by Professor Dunnett in Sheffield's Crucible Theatre on a small-scale rain garden he had designed in London for the retailer John Lewis. Simon Ogden brought Professor Dunnett together with the rest of the team to discuss applying his ideas at a larger scale. This was a case of new thinking for everyone involved.

This site was in a part of the city with no high-quality accessible public space, an area disconnected from the centre despite the large number of workers in the area. The usual treatment could have been applied and the CCR team could have narrowed the roads, planting trees every 10 m as part of a standard road carriageway improvement scheme. But the combination of flood management thinking with the added challenge of limited funds to deliver the project, led back to the question: Why can't the water features be more natural?

Figure 16.7 Claypits local nature reserve and Forth & Clyde Canal (© Eye in the Sky Glasgow)

Figure 16.8 Sighthill detail (© LDA Design)

Figure 16.9 The naturalistic and low-maintenance Manor Fields Park, Sheffield, designed and managed by Green Estate

The collective knowledge and interdisciplinary team working sparked innovative thinking leading to improved highway design, as far removed from 'business as usual' as we have seen to date in the UK.

Figure 16.10 Meadows and low-maintenance planting on the Manor Estate, Sheffield

Figure 16.11 Grey to Green Phase 1 (Bridge Street): before and after (images from Google Streetview)

According to Zac Tudor, principal landscape architect for the CCR team at the time, the Grey to Green project can be framed in different ways, reflecting the needs and priorities of the target audience. To water engineers, it is an answer to drainage problems. For traffic engineers, it is an innovative way of slowing traffic down and reducing accidents. For council members, it is about a sense of recreation in the city. For businesses, it brings life back to the area, while for the public it reconnects pedestrians to the city – all by reworking a redundant highway (Figure 16.11).

Figure 16.12 shows the location of Phase 1, which was the proof of concept demonstration project. It proved so successful that the scheme has since been extended in the city to connect

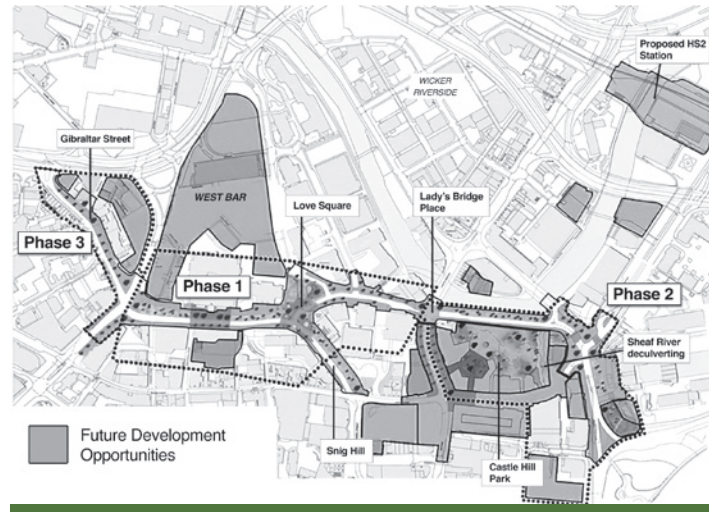


Figure 16.12 Plan showing the phased Grey to Green approach across the city (© Sheffield City Council)

Victoria Quays with the city centre. This translation of long-standing knowledge into action on the ground means that the Grey to Green approach provides the baseline standard for all of Sheffield's future urban highway schemes: it is how Sheffield does urban highways now.

Barriers and opportunities

Many aspects of the project could be considered both barriers and opportunities. Like all large-scale expensive urban projects, Grey to Green is dependent on capital funding, when it is available, thereby requiring a long-term view and an incremental approach. This can be seen in the different phases, where piecemeal applications for capital investment are 'joined-up' within one overarching project. This project is not just about road carriageways, but is also about regeneration, drainage, high street investment and climate change. These are just a few of the ways in which this project can be 'packaged' for funders, as well as decision-makers and the general public. Team members – particularly those providing expertise from outside the council – helped to improve understanding of the benefits of Grey to Green around the city. It was about translating these benefits into the language understood by the specific audience. Local businesses were very much interested in SuDS, flood risk mitigation and improving the public realm for their workforce, while council members and the general public were drawn in by the attractive and welcoming new streetscape. Knock-on effects of these public realm improvements include new businesses opening up in a part of the city that they would not have considered before.

The incremental approach has also allowed time for lesson learning. For example, pedestrian rather than cycle infrastructure was a priority in the first phase. The team responded to post-implementation criticisms with more cycle infrastructure in later phases. Another barrier (or opportunity)

was the 'native–non-native species' debate. Some ecologists baulked at the project using non-native plants, requesting native grassland species instead. But this would have resulted in untidy planting in the winter, conflicting with the need to create public urban landscapes that looked good all year round in a city-centre location. The very idea of having large-scale planting in such a location was radical for some stakeholders at the council and local businesses. The wider team's horticultural work, for example, in the Queen Elizabeth Olympic Park, helped to convince decision-makers that attractive and functional planting could actively encourage footfall, and this has been borne out (SYMCA, 2021). As one team member put it: 'Special interest groups are only focused on their special interests – they don't have the bigger picture.' This is what interdisciplinary team working can provide.

Opportunities arise around calls for further research. It is not unusual to hear community groups around the city requesting 'Grey to Green in our neighbourhood'. The specific approach taken to what was once a gateway into the city, with below-ground level archaeology, services and old tram tracks, will not be directly replicable in other parts of the city or other cities. More research is needed to explore how the Grey to Green approach performs over time, and how it might be applied elsewhere. This could include trials on contaminant capture and treatment, depending on the existing impervious surface materials, and research to chart the migration of microplastics through the drainage system.

Lessons learnt

- Positive framing of the project helps to integrate the different policy areas according to different needs.
- If you have not got an interdisciplinary team, create one. Interdisciplinary working can be invaluable to permit a broad range of solutions that might not occur to discipline-specific teams.
- Think outside the box: techniques and interventions can be taken from different projects and applied successfully to different contexts.
- Reframe the narratives and reduce professional jargon: there are always different stakeholders who 'speak different languages': highlight the benefits in terms that they understand to get support for projects.
- Taking an incremental approach can be less risky and allow for testing innovative ideas and learning from shared knowledge.
- Be patient: successful ideas can take a long time (decades) to grow and be successful.

Future plans

The second phase of Grey to Green was officially opened on 18 September 2021. Where Phase 1 was a proof of concept, Phase 2 has put into practice the lessons learnt. It is hoped that the political and public support for Grey to Green means that Phase 3 (and beyond) have traction and are now politically viable. However, they are also clearly going to be subject to funding. Grey to Green Phases 1 and 2 are templates for innovative city-centre planning, which can be adapted for the more retail-oriented streets in Sheffield. Around the world, we have seen city centres transform, struggling to adapt to challenges including online retail and COVID-19, and Sheffield is no exception. In response to this, Grey to Green is a fundamental part of Sheffield's future vision for revitalising its high streets.

16.5. Discussion: what does good planning for BGI involve?

Now that each case study has been presented in some detail, this section exposes and critically discusses the key ingredients that collectively demonstrate good spatial planning processes and outcomes across all three case studies. Looking at positive outcomes, a striking feature is that all the case studies demonstrate improved mainstreaming of nature or the environment using BGI. Here we see stakeholders outside the environmental sector engaging with BGI from the outset, enabling it to be seen, designed, used and valued as critical infrastructure (Hislop *et al.*, 2019). Scott *et al.* (2021) have advanced a useful definition of mainstreaming that captures both the processes and potential outcomes evident in the South Downs National Park, Glasgow and Sheffield studies. To paraphrase Scott *et al.* (2021), mainstreaming is an *interdisciplinary and transdisciplinary* process of transmorphing and *normalising* a concept, objective, policy or plan into the *decision-making and routine activities of different policy domains necessary for effective delivery and impact*; and in so doing *builds sufficient capacity and resilience* to improve operational processes and outcomes enabling *beneficial societal impacts for the long term*. The italicised phrases illuminate what we see as particularly influential across the case studies featured here.

The convergence of inter- and transdisciplinary working, from the outset, delivered change and policy integration built on a strong collaborative ethic, which was evident from the start across all studies (Cowling *et al.*, 2008; Scott *et al.*, 2021).[19] Here, collaboration is helped by the positive framing of the projects according to the audiences' specific priorities. For example, in Sheffield, BGI was farmed to water engineers as an answer to drainage problems; for traffic engineers, it slowed traffic, reducing accidents; for council members, it was about amenity in the city; for businesses, it brought back life and activity; while for the public it reconnects pedestrians to the city. This reframing is important as BGI provides the catalyst in changing the perception of the environment from a constraint to an asset; from a barrier to an opportunity. Furthermore, working across different languages and vocabularies and identifying key 'hooks' that can engage a particular target audience and

'bridges', which are terms that can unite different audiences, provide important mechanisms for initial traction, helping to maximise the potential for mainstreaming success (Scott *et al.*, 2018). The core ingredients of these are captured and discussed next, with reference to the case studies and wider literature.

Nature as an asset

All projects conceptualised and championed the idea of nature as a development asset across the different agencies and partnerships to build resilience. Here, the projects drew on the inter-relationships between natural capital, ecosystem services and the role of BGI as the key delivery mechanism for a range of economic, social and environmental benefits. The BGI benefits were dominant in the process, challenging traditional economic models, as found within the Treasury *Green Book*, for example (HM Treasury, 2022). This focus on doing things differently resonates with the geographical theory of diffusion of innovation through a wider policy ecosystem (Rogers, 2003; Scott *et al.*, 2018). According to Rogers (2003), as new ideas are invented, they progress through five key stages: knowledge or evidence generation, persuasion, decision (adoption or rejection), implementation and confirmation; although progress is not linear and can be reversed through policy failure or challenge (Scott *et al.*, 2021). In the case studies featured here, the ideas were carried through to adoption, involving a number of partners progressing beyond the usual environmental agencies; this is a key finding of note.

Success was catalysed by initial conversations, goals and a vision that explicitly sought to work across traditional policy silos through a process of policy integration. While each case study was different in approach, focus and scale (Table 16.1), all projects involved the positive framing of nature positioned as a development or regeneration asset or policy opportunity, rather than its often perceived traditional role as an obstacle or constraint to be overcome. This supports the findings of Runhaar *et al.* (2020), who observed the importance of positive framing of nature as a key hook in a literature meta-analysis for successful policy integration. This subtle change of framing from negative to positive is important in generating improved traction across a range of built and natural environment stakeholders who normally do not engage with, or see the value of, nature. This was evident in the case studies in different ways. The dedicated core ecosystem services policy and duty to cooperate hooks for the South Downs National Park helped to shape new dialogues with local authorities and stakeholders on ecosystem services, while the interdisciplinary Grey to Green approaches evident in Sheffield and Glasgow challenged established engineered solutions and reframed BGI across the diverse needs of stakeholders through its inherent multifunctionality. This mirrors findings from Mullally *et al.* (2018) in work on an innovative energy policy in Ireland, where the buy-in of stakeholders from the start reflected the desire to work in more collaborative ways; making things happen through finding constructive solutions to the usual barriers, as well as challenging those saying that it 'couldn't be done'.

The buy-in process in our case studies was characterised by effective partnerships, which also changed behaviours in the way nature was valued and prioritised in the development process. This highlights the importance of micropolitics in the people and agencies working on these projects and their collective and individual personal motivators and characters (McAreavy, 2006).

Mainstreaming through shallow and deep interventions

In all case studies, we can see the upfront investment in the process of mainstreaming and policy integration to address the challenge. This shows the interplay of both shallow and deep interventions (leverage points: Abson *et al.*, 2017; Chan *et al.*, 2020; Meadows, 2009; Scott *et al.*, 2021). Shallow interventions, such as taxes, are relatively easy and quick to employ, though they will only achieve minor or incremental system changes without necessarily generating long-term behaviour change. Indeed, they can often build resentment. By contrast, deeper interventions are based on changing people's value frameworks, which are more robust and resilient and which demand more upfront investment, with an emphasis on collaborative working, coproduction and knowledge exchange. Consequently, deeper interventions deliver greater resilience and potential for system and behaviour change, leading to stronger mainstreaming (Scott *et al.*, 2021). The case studies reveal the presence of a combination of both deep and shallow interventions, so it is not the case of one or other in driving forward the various BGI benefits.

Culture of innovation and managing risk: doing things differently

The appetite for innovation and doing things differently is a strong theme across all case studies, reflecting the importance of strong leadership. For the South Downs National Park, it was the mainstreaming of the ecosystem approach within a newly formed national park. For Sheffield, it was approaching the built environment challenges, building on a track record of past work and re-imagining the city streets as a porous network. While for Glasgow, it was about using aspirational solutions for responding to major flooding issues and wider needs for regeneration. While regulation (legal requirements) did help progress, in part, in each project, it actually was the wider upfront investment in collaboration and engagement with key actors and stakeholders, usually within strong multisector partnerships, that was crucial. This allowed the relevant teams to go beyond traditional reliance on top-down regulation and legislation in demonstrating wider buy-in and securing the necessary sufficient political commitment to create something excellent (Runhaar *et al.*, 2018). Furthermore, with this type

of mentality and culture, people are more willing to take risks, given the high levels of trust secured as they embarked on their journeys into innovation. Normally, public bodies are risk-averse but risk-taking was a key facet in all three public bodies featured here. The improved and stronger collaboration built from the start within inter- and transdisciplinary activity supports such approaches and provides the necessary social capital to solve problems (Reed, 2008).

Effective collaboration and stakeholder engagement

These opportunity spaces generated three big transformative ideas: from mainstreaming an ecosystem approach (South Downs) within a landscape-led approach to revitalising redundant parts of the city through multifunctional BGI (Sheffield) and generating an innovative sponge city (Glasgow). These ideas were positioned within powerful co-developed visions, which were underpinned by effective and inclusive collaboration processes throughout. Effective collaboration and stakeholder engagement is a necessary but often overlooked component in successful mainstreaming processes (Cowling *et al.*, 2008; Runhaar *et al.*, 2018). It builds trust and confidence that interventions will be fair and transparent (De Vente *et al.*, 2016); can assist knowledge transfer and social learning; and can enable new concepts to be tested and better adopted, ultimately enhancing the rate of diffusion (Scott *et al.*, 2018). Additionally, when practised as a two-way process, it explicitly addresses language barriers with the creation of common language, agreed terms of reference and shared understanding of issues and potential solutions (Benson *et al.*, 2014; Scott *et al.*, 2018). In all cases, the outcomes of the projects generated additionality in environmental, social and economic terms.

Shared language and understanding

The development of a shared language and the building of positive relationships is important in project development. The big ideas became important reference points for a shared story and journey, within which effective collaboration and knowledge exchange could be built across all stages, as the Sheffield case study shows. Moreover, this was helped in the South Downs and Glasgow by good facilitation from outside to help turboboost the collaborative outputs, helping optimise the win-win aspects of the groups involved and also manage the inevitable conflict in order to reach compromise. Both narratives talk about situations where safe spaces were involved to enable development of the project.

Leadership and teamwork

Behind each project, there was also recognition of a leadership and champion role, which was able to manage and catalyse change. However, this was manifest in ways that are different from the usual idea of one dominant personality driving the project through: these were shared ideas and knowledge bases, which were more informed across a whole team embracing concepts of inter- and transdisciplinarity – in effect, this led to a sum that was much greater than the parts, while ensuring greater organisational resilience.

Extant barriers to be tackled

From a purely environmental perspective, there are still pernicious barriers, which affect mainstreaming potential and still impact on our case studies and indeed could even reverse the successful mainstreaming direction of travel thus far. Perhaps the most significant barrier is that the environment does not easily generate direct financial revenue, although the Glasgow case study reveals how innovative funding models can be co-designed. Undoubtedly, the benefits of investments are not easy to capture or to transfer (Hanley and Barbier, 2009) and the ongoing cutting of resources for environmental planning, management and delivery is still widespread. Furthermore, conventional accounting methods treat the environment as a liability, ignoring the wider benefits to society because benefits (health, flood risk regulation, biodiversity, etc.) are not readily accounted for, while the associated costs of long-term environmental management can be accounted more easily (Horwood, 2011). Recently, the Dasgupta Review has advanced the case for such valuations and we are beginning to see the emergence of a whole new suite of green investment and finance for funding for nature (Dasgupta, 2021; HM Treasury, 2021). The Glasgow and Sheffield case studies here provide an insight into how improved collaboration and powerful visions can command support to make things happen. So, the maxim might be that a current lack of resources is no excuse for a lack of vision and the generation of a shared vision, which might lead to collective problem solving and opening of new funding opportunities. The final barrier is advancing BGI to be seen as critical infrastructure in built development from the outset rather than something that is purely environmental. As the setting in all our case studies, BGI demonstrates powerfully that it delivers a number of benefits. It can help tackle the global climate, biodiversity and economic emergencies. Key to future mainstreaming success will be the repositioning and reconstruction of BGI as critical infrastructure as integral parts of placemaking and placekeeping strategies.

16.6. Summary and key messages

- BGI is critical infrastructure and a development asset; not a constraint to be overcome.
- BGI is a delivery mechanism to capture the benefits of nature in development.
- The three case studies all capture the core ingredients of inter- and transdisciplinary collaboration, co-design, leadership, innovation, risk-taking and policy integration set within a positive framing of messages to deliver good and successful BGI schemes within the

planning system.

- Effective mainstreaming of nature is secured where translation of BGI value is made according to the needs and priorities of stakeholders *outside* the environment sector. This must happen from the outset to help break down silos. Hooks and bridges are powerful mechanisms to achieve this.
- Engage usual and unusual suspects by targeting messages according to their needs and priorities.
- Process matters; collaboration and engagement processes are needed from the outset to involve and motivate those players responsible for delivery.
- The planning system is not a constraint to development and needs to prioritise BGI and other aspects as well as housing to improve project outcomes.

Notes

1. https://www.southdowns.gov.uk/partnership-management-plan/ (accessed 01/08/2022)
2. https://www.southdowns.gov.uk/planning-policy/south-downs-local-plan/ (accessed 01/08/2022)
3. https://www.southdowns.gov.uk/planning-applications/do-i-need-planning-permission/south-downs-green-infrastructure-framework-informal-consultation/green-infrastructure-framework-main-evidence-report-first-draft/ (accessed 01/08/2022)
4. https://www.southdowns.gov.uk/wp-content/uploads/2016/12/EcoServ-GIS-Mapping-Tool-Evidence-Report-Draft.pdf (accessed 01/08/2022)
5. https://www.southdowns.gov.uk/planning-policy/south-downs-local-plan/local-plan-evidence-base/core-document-library/core-06-ecosystem-services-technical-advice-note-householder/ (accessed 01/08/2022)
6. https://www.southdowns.gov.uk/wp-content/uploads/2018/04/Core-07-Ecosystem-Services-Technical-Advice-Note-non-householder.pdf (accessed 01/08/2022)
7. https://nature-tool.com/ (accessed 01/08/2022)
8. https://www.mgsdp.org/ (accessed 01/08/2022)
9. https://www.collectivearchitecture.com/ (accessed 01/08/2022)
10. https://www.gcvgreennetwork.gov.uk/ (accessed 01/08/2022)
11. https://landuse.co.uk/ (accessed 01/08/2022)
12. https://www.scottishwater.co.uk/-/media/ScottishWater/Document-Hub/Business-and-Developers/Connecting-to-our-network/All-connections-information/SewersForScotlandv4.pdf (accessed 01/08/2022)
13. 'Vesting' is a Scottish-specific term. Once water mains are constructed, and if Scottish Water has made an offer to vest, the responsibility for ownership, operation and maintenance of the water mains is transferred to Scottish Water. This is relevant to Section 7 of the Sewerage (Scotland) Act 1968, which concerns shared maintenance agreements with local authorities and allows for the roads authority and Scottish Water to connect to each other's drainage systems where reasonable to do so. Scottish Water typically owns and maintains ('vests') below-ground assets where these are built to the standards of Sewers for Scotland.
14. https://www.sheffield.gov.uk/home/planning-development/city-regeneration (accessed 01/08/2022)
15. https://www.sheffield.ac.uk/landscape (accessed 01/08/2022)
16. https://manorandcastle.org.uk/ (accessed 01/08/2022)
17. Pictorial meadows (more widely known as urban meadows) were developed by Professor Nigel Dunnett of the University of Sheffield with Green Estate. They are based on the idea that colourful meadow flowers can thrive in urban areas. Seed mixes are designed so that the meadows flower from spring to late autumn, providing long term colour in the urban landscape. The management regime is less intensive than usual urban horticultural practices, such as short-mown grass. Research has also shown that local residents are very satisfied with urban meadows and that they are ecologically richer than short-mown grass; for example, leaving the flowers for as long as possible can provide food for birds in winter (Norton *et al.*, 2019).
18. https://www.manorfieldspark.org/ (accessed 01/08/2022)
19. Interdisciplinary working revolves around disciplines coming together at the outset to create new conceptual frameworks, models or approaches that cut across the disciplines, creating novel or new insights. Key is that the disciplinary integration happens at the outset, not at the end. Transdisciplinary working involves all the ingredients of interdisciplinary work but includes policy and practice stakeholders, with the focus on changing or adding value. See Scott *et al.* (2013) for a full description.

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