



GREEN INFRASTRUCTURE

DESIGN AND PLACEMAKING

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GREEN IS THE NEW BLACK

MINISTERIAL FOREWORD

Improving the quality of our urban and rural environments is vital if we are to deliver on our ambition to make Scotland a greener, wealthier and fairer, smarter, healthier and stronger, country. Green infrastructure is a way to support all of these strands.

The term 'green infrastructure' is relatively new and originated in the US, but the basic principles it embodies are familiar to us in Scotland. Green infrastructure differs from conventional approaches to open space planning because it offers greater functionality. It can offer an environmentally friendly approach to land development, growth management and built infrastructure planning. Well designed green infrastructure and creatively designed greenspaces offer lots of benefits and can support multiple agendas by helping to develop communities and places that are sustainable, attracting residents and business, support healthy lifestyles and encourage the kinds of behaviour that contribute towards the success of places in social, economic and environmental terms.

Moreover, green infrastructure can help tackle climate change – one of the main challenges of our time. It can advance developments which help to reduce Scotland's carbon footprint and provide solutions for climate change adaptation.

Green infrastructure planning works at national, regional and local levels and is an integral component of building well designed and sustainable communities. Indeed green infrastructure plays a key role when masterplanning both greenfield and regeneration sites, in a sustainable way.

Throughout the Scottish Sustainable Communities Initiative we have seen innovative approaches to the inclusion of green infrastructure as a placemaking tool. But we want to see green infrastructure providing solid foundations to deliver sustainable communities right across Scotland.

This document provides an overview green infrastructure as well as setting out some key design issues and techniques which can help to incorporate GI into place-making at all scales.



Stewart Stevenson MSP

Minister for Environment and Climate Change



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Minister for Local Government and Planning

CONTENTS

This document is aimed at planners, landscape architects, developers, housebuilders and others involved in shaping our built and green environments.

The content of the document builds on *Designing Places* and *Designing Streets* to give practical tips on incorporating green infrastructure in masterplans. It is split into two parts:

- Part 1 explains what green infrastructure is, who should be involved, when to think about it, and highlights the many advantages of taking an integrated approach to green infrastructure in designs.
- Part 2 focuses on masterplanning, in particular by showing how green infrastructure can contribute to each of the six qualities of successful places that have been identified throughout the Scottish Government's design policy.

The issues flagged in this guide apply from large scale frameworks, to masterplans and site briefs down to designs for individual projects. Throughout the guide, examples* from a range of scales and contexts are featured, to show good practice in the design and creation of green infrastructure.

In order to keep this document short and to avoid repeating information from other sources, a symbol **»** has been inserted, where appropriate, to signpost you to a further link.

*Some of the projects featured in this document may not yet have planning consent. These projects have been included to illustrate different ways in which green infrastructure can be incorporated in site appraisals and designs. Their inclusion in this document does not influence Planning Authority decision making.

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PART 2

GREEN INFRASTRUCTURE AND MASTERPLANNING

CURRENT PLANNING POLICY AND ADVICE ON GREEN INFRASTRUCTURE



SPP states that decisions on the layout and design of new development should:

- Encourage the use of active travel networks and public transport;
- Encourage energy efficiency through the orientation and design of buildings, choice of materials and the use of low carbon generating technologies;
- Encourage the use of sustainable and recycled materials in construction, and support habitat connectivity; and
- Support sustainable water resource management and waste management.



National Planning Framework 2 identifies the Central Scotland Green Network as a national development, signalling it as a form of green infrastructure of strategic importance. The CSGN promotes environmental quality and good connectivity, a strategic network of woodlands and other habitats, more sustainable and healthy patterns of travel, transport and land use, and expanding opportunities for communities and businesses across the whole of central Scotland.



Designing Places promotes six qualities of successful places; Identity, safe and pleasant, ease of movement, a sense of welcome, adaptability and good use of resources. These principles can be applied specifically to the design of green infrastructure including open spaces and green networks. It also highlights that “Places that are distinctive and designed with a real understanding of the natural world are likely to be enjoyed, cared for and valued”.



Designing Streets advocates street design that encourages place before traffic movement and promotes ‘permeability’ of urban form through the design of street patterns and the connectivity of streets with surrounding networks. It highlights that “Connected and permeable networks encourage walking and cycling, and make navigation through places easier”.



PAN 65 Planning and Open Space advises: “Some of the best open spaces are part of networks. These can help define the landscape or townscape structure, provide links with the countryside and allow movement of people and wildlife”. It goes on to suggest that “Local authorities should aim to maintain or form networks of green and civic spaces which maintain and enhance environmental qualities; provide a range of opportunities for recreation and leisure; link and create wildlife habitats; and encourage walking and cycling and reduce car use”.



PAN 83 Masterplanning aims to promote the use of masterplanning to create better places. It explains how to achieve more effective masterplanning, how to achieve more consistency in the presentation of masterplans, and it encourages good practice through a range of exemplary case studies. The document covers the masterplanning process from beginning to end.

PRACTICAL PROJECTS

The Scottish Government’s Architecture and Place Division within the Built Environment Directorate is developing a series of Practical Projects. These documents provide practical guidance and recommendations on the creation of better quality places.



The first document in the series looked at a residential streets project in Polnoon.



The second provided a summary of the Scottish Sustainable Communities Initiative (SSCI).



This third document in the series provides ideas on how to place green infrastructure at the core of masterplanning.

This document does not seek to reinvent nor reiterate the established masterplanning process. It complements existing advice in PAN 65 and PAN 83.

PART 1 – ABOUT GREEN INFRASTRUCTURE (GI)

WHAT?

Description

The European Commission defines **green infrastructure** as “the use of ecosystems, green spaces and water in strategic land use planning to deliver environmental and quality of life benefits. It includes parks, open spaces, playing fields, woodlands, wetlands, road verges, allotments and private gardens. Green infrastructure can contribute to climate change mitigation and adaptation, natural disaster risk mitigation, protection against flooding and erosion as well as biodiversity conservation.”

So **green** infrastructure is not just about greenspaces like parks and open spaces, it also incorporates **blue** infrastructure including sustainable urban drainage, swales, wetlands, rivers and canals and their banks, and other water courses. The figure below seeks to demystify ‘green infrastructure’ by setting out in basic terms examples of individual components of green infrastructure, at different scales.

Considering green spaces or connections as **infrastructure** arises because simple things like trees, greenspaces and watercourses can provide valuable services in an ecological way. Green infrastructure can deliver on functions and services such as shelter, access and travel, sustainable urban drainage, pollution mitigation and food production – as part of a wider ecosystem. Moreover this approach has the added benefit of enhancing habitats and creating attractive places. This multifunctional nature of green infrastructure is one of its intrinsic benefits and can operate at differing levels.

Individual elements of green infrastructure can serve a useful green infrastructure purpose, without being connected. However, when green infrastructure components are linked together to form **green networks** further combined benefits can be achieved at a strategic level.

The building – home, garden or workspace	Connections	The street	Connections	Neighbourhood	Connections	Strategic places
 <ul style="list-style-type: none"> • Green roofs • Living walls • Gardens or grounds • Rainwater harvesting systems • Driveways (permeable) 	 <ul style="list-style-type: none"> • Pedestrian paths and rights of way • Cycling routes • Green Links and corridors 	 <ul style="list-style-type: none"> • Boundary features eg hedges • Street trees • Verges • Swales • Porous paving • Sustainable Urban Drainage Systems (SUDS) 	 <ul style="list-style-type: none"> • Pedestrian paths and rights of way • Cycling routes • Green Links and corridors 	 <ul style="list-style-type: none"> • Amenity greenspace • Informal recreation spaces • Playspaces • Allotments, community growing spaces • Playing fields • Sports areas • Urban parks • Burial grounds, cemeteries • Swales • Urban woodlands • Ponds • Water courses 	 <ul style="list-style-type: none"> • Pedestrian paths and rights of way • Cycling routes • Green Links and corridors • River and canal corridors including their banks 	 <ul style="list-style-type: none"> • Civic scale spaces • Public parks and gardens • Green Networks • Country & Regional Parks • Natural/semi-natural greenspaces • Forests and Woodlands • Grasslands • Designed landscapes • Formal gardens • City farms • Blue Networks • Rivers, lochs and Wetlands

Range of scales

Green infrastructure should be thought about at every scale of planning, from the strategic framework (allowing cross boundary issues to be considered) right down through neighbourhoods and within streets to the individual house or flat.

Below are examples of how green infrastructure can be incorporated at each scale to make **connections and movement** easier.

The building



Green roof systems are now widespread across Europe. Green roofs (also known as vegetated roofs, or living roofs) are systems that are essentially roofs with vegetation placed upon them in a way to provide benefits. Similar construction techniques can be applied to wall surfaces to create living walls with similar benefits.

Green roofs can **provide and connect habitats for birds and insects, creating ecological corridors**.

Increasing the amount of vegetation can help absorb rainfall and mitigate against flooding, and so be seen as a climate change adaptation technique.

Rooftop surfaces cover a significant proportion of surface area in the built environment, but have been underutilised as functional space. They can be utilised as outdoor living spaces, terraces, roof gardens and on larger scales even allotments and parks – providing areas for escape and relaxation.

» Scottish Green Roof Forum

Street level



Green infrastructure can play a role in making streets pedestrian, cycle and vehicle-friendly.

Designing Streets encourages intelligent and appropriate planting in street design.

For example street trees can be incorporated as a **traffic calming measure** which also help soften the street scene by creating visual interest, improving the microclimate and providing valuable wildlife habitats.

Vegetation can be used to limit traffic speeds by limiting excessive forward visibility, whilst appropriate driver sightlines should be maintained.

» Designing Streets

Neighbourhood level



At the neighbourhood level it is important to think about how the scheme will integrate with existing roads, paths and surrounding development.

This means creating opportunities for **easy access into the green network** including accessible entrances in the right places and suitable paths. It also means avoiding ill siting of buildings which could block the best place for accessing the green network, the obvious desire lines.

Making it easy to access will encourage residents and workers to use the green network for short journeys rather than using cars, helping reduce emissions and promoting active lifestyles.

» South Lanarkshire Green Network Quality Design Guide, 2009

Strategic level



© Sheppard and Robson

Development plans and masterplans should knit developments into the wider green network.

Thinking about how development can join up to the existing green network not only provides opportunities to plug gaps in the strategic green network and landscape setting, it also offers benefits to the new development by providing **good connections and a continuous network of routes**.

Looking beyond the immediate boundary or site ownership is vital – allowing the bigger picture to emerge, and to think about how best to connect to the wider network.

» Scottish Placemaking Case Study – Clyde Gateway

Simple shifts from grey to green

Making the change from grey to green can be easier than you think and can achieve transformational change through practical measures for example:



*Photo credits 1: EDAW, 2: Greenroof UK Ltd, 3 & 6 The Metropolitan Glasgow Strategic Drainage Partnership, 4: Cadell2, 5: PARC Craigmillar

WHY?

Benefits

Placemaking

- reinforcing the local landscape character
- making places more beautiful, interesting and distinctive
- giving places character and a strong identity

Economic

- improving the image of a place
- boosting property values including house prices due to proximity to greenspace
- helping developers get the most out of the site by combining uses, eg open space+ SUDS, helping development viability
- attracting businesses and inward investors by creating attractive settings
- making it cheaper and easier to deal with surface water by keeping it on the surface
- saving energy and money for residents and end users

Climate change

- reducing CO₂ emissions by providing non-vehicular travel routes encouraging walking and cycling
- providing carbon storage and sequestration in vegetation
- providing shelter and protection from extreme weather
- managing flood risk: living roofs, large trees and soft landscape areas absorb heavy rainfall
- providing for storage of surface water in times of peak flow in SUDS and other water features
- cleaning and cooling the air, water and soil, countering the 'heat island' effect of urban areas
- saving energy: through using natural rather than engineered solutions
- saving energy: living roofs insulate buildings, and large trees provide shade, reducing the need for air conditioning in the summer and raising ambient temperatures in the winter, reduction in heating costs in the winter due to slowing of wind speeds in urban areas
- supplying locally sourced timber, biomass or other bio-fuels to replace fossil fuels

Environmental

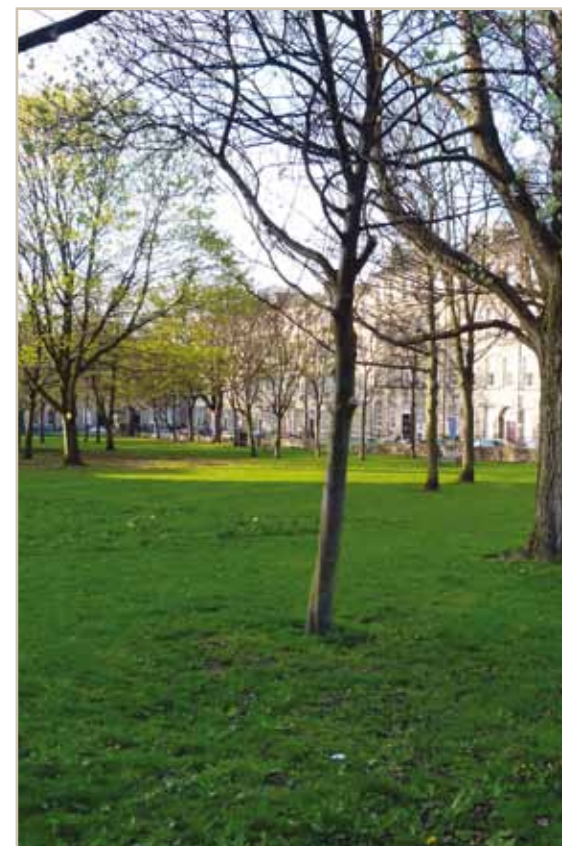
- reducing pollution through use of SUDS and buffer strips
- providing new and linking existing habitats or natural features, to allow species movement
- protecting aquatic species through appropriate management of waterside habitats
- preventing fragmentation of habitats
- allowing diverse habitats to be created which are rich in flora and fauna

Community and social

- creating green spaces for socialising, interaction and events
- more opportunities and places for children to play
- providing improved physical connections through green networks to get between places; and to communities, services, friends and family and wider green spaces
- providing spaces for practising and promoting horticultural skills
- creating opportunities for community participation and volunteering

Health and Well-being

- encouraging exercise and physical activity by providing quality green spaces for walking, cycling, sports and play
- providing better opportunities for active travel and physical activity
- improving mental well-being by providing access to nature and attractive green spaces and breathing spaces
- providing opportunities for growing food locally and healthy eating



» **Green Infrastructure Valuation Toolkit**
Green Infrastructure North West

» **Benefits of Green Infrastructure**
(Forest Research)

WHO?

Should think about green infrastructure?

Everyone can play their part in delivering green infrastructure. From householders looking to retro-fit their home, with elements of green infrastructure such as a roof garden, to community groups getting together to set up community gardens or allotments, through to housebuilders designing new sites, or infrastructure and service providers looking at ways to deal with flooding, green infrastructure can strike a chord with each.

Green infrastructure thinking spans the public sector (local authorities, government agencies), the private sector (landowners, developers), the third sector and communities.

Local authorities and developers should consider green infrastructure when considering masterplans and ensure necessary consultants are in place to marry design proposals with surface water management strategies and habitat networks (eg strategic drainage engineers, ecologists, landscape architects).

Should work together?

A collaborative multi-disciplinary approach offers great benefits in developing an integrated solution that will work on the ground, drawing upon different specialisms and areas of expertise, on a partnership basis.

Equally important is seeking input from local communities to tap into their local knowledge and give them a chance to shape the design. Communities can offer useful input of what existing green infrastructure should be kept, the best places for new connections, routes and linkages, and what new additions they would like in their area, be it allotments, cycle routes, parks or wildlife havens. This can help foster community pride in the place.

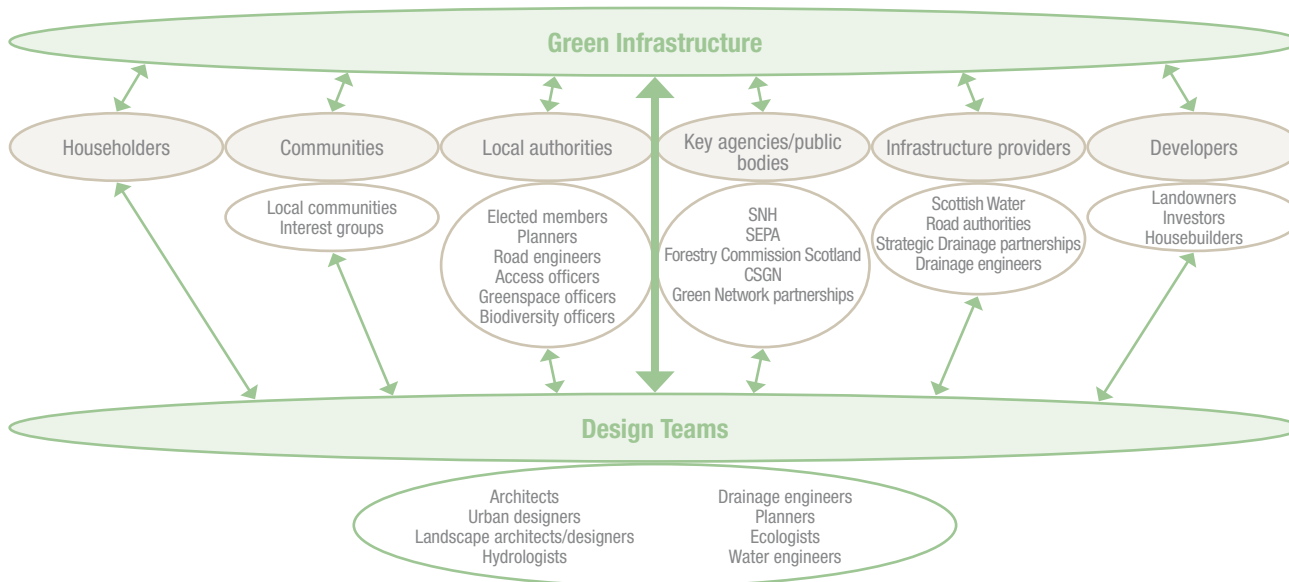
There are various green network partnerships operating across Scotland which can offer valuable support.

Can offer help and advice?

A great deal of support on green infrastructure is available. As well as local authorities and strategic planning authorities, other national and regional organisations and bodies can offer help and advice.

Financial support is available from the CSGN Development Fund which is intended to support the development and implementation of early projects delivering the Green Network on the ground. The Scotland Rural Development Programme is another potential source of support (particularly for urban woodland).

Sharing ideas and best practice amongst practitioners provides opportunity to learn from one another's experience. Case studies are available online from the Scottish Government, Greenspace Scotland, Central Scotland Green Network and local bodies like Glasgow and Clyde Valley Green Network Partnership.

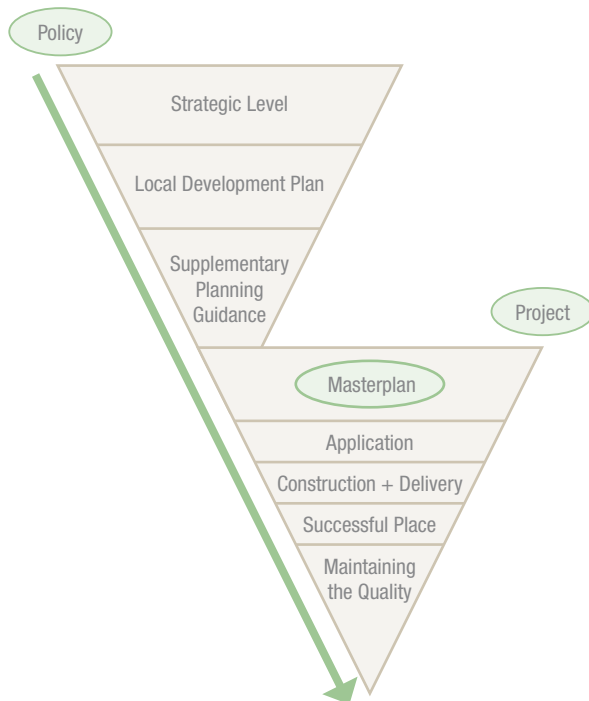


WHEN?

Policy Framework

Development plans and supplementary guidance should set the context upfront to support green infrastructure thinking at the design and masterplan level.

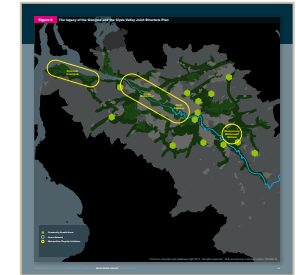
Green infrastructure can deliver on a range of good policy outcomes, for placemaking, health, sustainable transport, landscape, tackling flooding, climate change, sustainable flood management, biodiversity and economic growth. GI can be thought of as a green thread weaving through the tiers of policy and advice, bringing these ideas together in a holistic way.



Development Planning

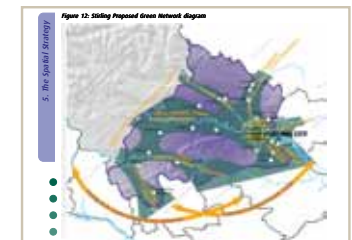
Strategic Development Plan

- Sets out strategic context
- Identifies key strategic projects/key areas to form part of larger networks
- Supports effective cross boundary and partnership working
- Embeds wider concept of green infrastructure and networks
- Provides for strategic routes for active travel



Local Development Plan

- Sets out the spatial strategy – detailed locations of the green network
- May set out a hierarchy of spaces in the green network
- May identify areas where actions could strengthen the green network or links enhanced
- Policies support incorporation of green infrastructure in the design of new places
- May set development aspirations
- Promotes a masterplanning approach



Supplementary Planning Guidance

- Sets out design principles for place-making
- May set out ways in which green infrastructure can be included in the design of new places
- May provide a guide to the delivery of high quality, well managed green network with accessible open space
- May provide guidance or a framework for assessing planning applications



Masterplan

- Designing individual spaces for multifunctional benefits
- Designing sustainable and attractive places and communities served with green infrastructure
- Identifying likely management costs at the outset and designing solutions to suit the budget



GREEN INFRASTRUCTURE CAN HAPPEN AT ALL STAGES OF POLICY MAKING AND PLANNING

WHEN?

Masterplan / Project

Green infrastructure principles should be embedded from the start; site appraisal through to the design stages in developing masterplans.

Planning the structure of planting and prioritising green infrastructure is a good and ecologically sound way to inform and underpin the overall design of a site or proposal. It should be thought about from the beginning rather than being something extra that has to be provided separately through developer contributions/obligations.

Developers of major developments are required to carry out pre-application consultation with the community before they submit their planning application. Green infrastructure is a relevant issue to be discussed in these pre-application consultations with the community who can offer local knowledge. It should also feature in pre-application discussions with the local authority and key agencies to help shape the masterplan at an early stage.



Temporary Greening

Stalled sites have become more common around the country, as the economic slowdown has resulted in development proposals often taking longer to get off the ground. If they become derelict, these stalled sites have potential to have a negative impact on local neighbourhoods, affecting the place's appearance and image. Temporary greening may be an appropriate way to create safe and attractive places until development can come back on stream. Issues around site ownership and managing community expectations should be discussed to determine whether temporary greening is appropriate in individual cases.

» Stalled Spaces, Report, Greenspace Scotland

Advance Greening

Green features on site can be kept and new structural planting put in in advance of construction. This can ensure essential green infrastructure, trees and other planting can become established, mature and resilient before the full development is completed, creating an attractive landscape framework.

Advanced greening need not be expensive within the overall budget of a development. But it can address neighbour issues, benefit the perception of the project and aid marketing of the site.



Advance planting at Business Park, Heartlands

© Ecosse Regeneration Ltd

Retrofitting

As well as delivering new green networks, the adaptation of existing communities with green infrastructure to cater for the present and future needs of society may be necessary. Climate change, in particular, brings significant issues that could necessitate the remodelling of open space and buildings. Reviews of existing open spaces creates the potential to improve the overall sustainability and performance of places; to make them more resilient to the effects of climate change; to renew tired and single function open space; and to provide for a wider range of uses with multiple benefits for people and wildlife, enhancing the quality of life and overall sustainability performance of communities in the future.

There are also important opportunities to re-establish missing links and to create new linkages to enhance strategic green networks.

There may be significant possibilities for green network promotion within areas of former industrial or brownfield land, or areas proposed for re-development or neighbourhood renewal. At a domestic level retro-fitting greenspaces around housing which have been lost to driveways (eg through permeable paving) can help alleviate local flood risks.

» An example retrofitting green infrastructure in New York is on page 25.

PART 2 – GREEN INFRASTRUCTURE AND MASTERPLANNING

How?

Looking at a site

When starting to look at a site it's helpful to think about the 3 elements of site appraisal: **Context**, **Identity** and **Connection** which are set out in PAN 83 *Masterplanning*. Green infrastructure can be used as a way of looking at and reinforcing each of the appraisal elements. Below are ideas of the green infrastructure elements to look for within each site appraisal element:

Context

- Location and surroundings
- Natural features
- Views
- Topography, natural undulations
- Hydrology and drainage (existing watercourses, pressures on watercourses, groundwater, sewer network and soil type)
- Microclimate (wind, sun, orientation, exposure, shelter)
- Wider green networks



Images from Scotland's Housing Expo 2010 © Cadell2

Identity

- Landscape character
- Green and blue corridors
- Greenspaces
- Flora and fauna
- Wildlife habitats (woodlands, grasslands & wetlands)



Connection

- Pedestrian movement, desire lines, green corridors, core paths, cycle routes, rights of way
- Habitat networks, linkages
- Vehicular movement; existing roads/transport connections, crossings
- The water journey, where does water go? (streams/areas prone to flooding etc)

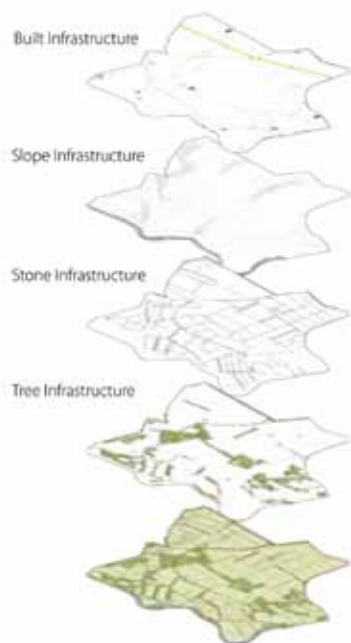


Examples of how to consider Green Infrastructure during a site appraisal

GRANDHOME

In the Grandhome SSCI Charette the design team mapped the existing 'traces on the land'.

Traces include paths, roads, ponds, woods, slopes, streams, wetlands or agricultural traces such as irrigation ditches or stone walls.



The analysis of the traces on the Grandhome site.

“Design the parks and squares around ponds, wooded areas or specimen trees as much as possible, so that mature trees grace the public spaces of the community from the outset.”

TORNAGRAIN

The Tornagrain SSCI project shows how an understanding of topography and key views has been utilised and combined with a skilful approach to urban design. The existing landscape provided a starting point to inform the creation of distinctive neighbourhoods within the masterplan.

The green network takes the form of a series of natural and formalised spaces, each with its own character and identity and serving an important context for built development. Retention and enhancement of the surrounding woodland resource provides a wider landscape and recreational context for the settlement whilst offering important physical connections for people and wildlife to the wider proposed A96 green network project.



- Understand the topography
- Make the most of views from the site
- Think about how the development will be seen
- Use the existing landscaping and trees to reinforce the unique context and create attractive settings for development

INTEGRATED URBAN INFRASTRUCTURE

A series of four Design Studies have been carried out for:

- Johnstone South West
- The Burgh of Pollockshaws
- Jackton and Gill Burn
- Cowlairs Urban Village



© Glasgow City Council
(Collective Architecture in association with AECOM Ltd)

These design studies look at how understanding water's behaviour can create new opportunities for quality developments and how pressures on the water environment can be addressed, so that water can be integrated into the design of urban areas, as part of the answer rather than the problem.

GREEN INFRASTRUCTURE AND MASTERPLANNING

Creating a masterplan

Designing Places (2001) sets out the Government's aspirations for design and identifies six qualities of successful places.

The next section of this document, looks at each of the **six qualities** in turn and gives **examples** of ways that green infrastructure can deliver on each of these qualities to create high quality sustainable places and contribute to placemaking. It is intended to provide examples of issues policy planners should be including in plans and development briefs, ideas for designers in developing proposals and setting out things that planners should be looking for when assessing masterplans and planning applications.



Welcoming



Distinctive

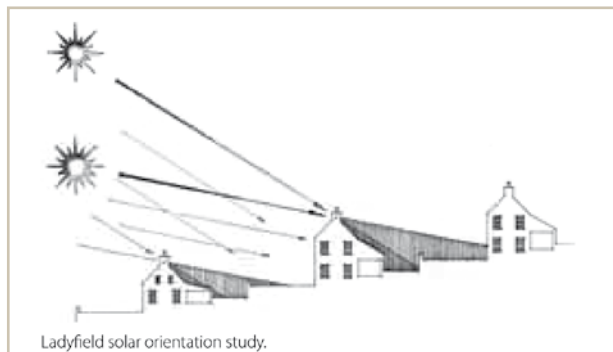


Safe and Pleasant

*1



Easy to move around



Resource Efficient

Ladyfield solar orientation study.



Adaptable

*2

* Photo credits 1: Cadell2 2: Assist Architects

» PAN 83 Masterplanning

» Polnoon – Masterplan: Idea to design

» Design Snapshot

Welcoming

Welcoming places are open, pleasant and well connected, this can help people find their way around a place, new district or development. Masterplans should consider how landmarks and layouts can make it easy for people to find their way around. Green infrastructure features are a useful way to form clear and attractive entrances and maintain and inject distinctive features, landmarks and routes into a place to make it more welcoming.

Including entrance and gateway features

Green infrastructure features, such as feature trees, tree avenues or other forms of planting, can be celebrated and used to form clear entrances and gateways.

POLNOON, EAST RENFREWSHIRE

The main entrance has an emphasis on safety and landscaping. The design retains an existing hedge which the houses sit behind and a new pathway connects into the development.



» Polnoon – Masterplan: Idea to design

Making it easy to find your way around

Many people find it easy to navigate themselves in relation to a key feature or route such as the location of a river or watercourse, where possible these should be made key parts of the design rather than sidelined.

Keeping large trees, water features and other natural physical features such as hills can form landmarks that residents and visitors can easily recognise and use to help find their way about.



Creating places with a positive image

Welcoming places make people feel relaxed and at ease. Trees and other landscaping not only help to make places feel leafy and attractive, they can also give us fresh air, promoting a sense of well-being.

Making good use of views (into, within and out of a development) can also take in glimpses of greenspaces, and provide a high quality landscape setting for development.



Distinctive

Special and memorable places are often distinctive and easily recognisable, particularly when compared with standard ‘anywhere developments’. High quality design can give developers that unique selling point. Creating a unique and distinctive place often means embracing the local context and taking it as design inspiration. Green infrastructure can both provide that local context and be enhanced and added to, to create attractive, distinctive places.

Reinforcing local landscape character and identity

Making the most of the existing landscape, natural features and topography.

AN CAMAS MOR, NEAR AVIEMORE

This project seeks to avoid sensitive habitats and utilises existing site topography and natural vegetation to inform the layout of the open space and built form. The vision of a compact and distinctive new community in a woodland setting is taken forward by an approach that starts with the existing natural assets of the site and builds a design approach that concentrates on: “life, space and buildings” (in that particular order), with the aim to: “create a good habitat for humans”.



© An Camas Mòr

Using unique design features

For example, not only can SUDS, buffer strips and innovative landscapes help address flooding, they can form water features, adding a lot to the design and feel of a place, creating attractive, tranquil settings for development. Opening up watercourses and addressing pressures arising from culverting, embankments and realignment can facilitate attractive waterfront development often boosting property prices.

RENNPLATZ, REGENSBURG, BAVARIA

The Rennplatz was a former racecourse site. In redeveloping the site, the aim was clear: to create a new neighbourhood of both high density and good quality. Despite the high density, there was a concerted effort to create a ‘green concept’; 30% of the site is green. This includes integrated play space areas and public art – which not only looks good, but is also interactive. The site contains many water features. The sustainable drainage system (SUDS) is open planned, positioned as an attractive feature and designed to be used as a skating rink in the winter.



Creating a sense of place

Green Infrastructure can intrinsically promote a sense of identity and character, working what’s there locally to inform the design.

HOUSING EXPO

The masterplan for the Balvonie site, near Inverness, incorporates the wider green infrastructure/ecosystem services to provide the landscape setting. The design responds to the topography and landscape using the street layout to take advantage of views to give a true sense of the Highland identity.



© Cadell2

Safe and pleasant

Green infrastructure can create pleasant places for fun, play and relaxation. Green networks, such as paths and cycle ways can provide safe off-road routes for walkers, joggers and cyclists away from vehicles and emissions. The masterplan stage is a key point to look ahead and consider safety issues and perceptions, this is the stage when the design and layout can be most easily adapted to create safer places.

Creating a series of safe and attractive places to meet, talk and play

Open spaces should be well-located, linking into the wider green network, and connecting into well used routes. Overlooking of open space and routes by buildings and streets provides natural observation from residents, pedestrians and passing motorists. This can encourage people to use these places where they feel safe.

Green infrastructure features can provide stimulating opportunities for play and places to enjoy sport and recreation. Designs should create places that are attractive and easily accessible to all regardless of age and ability.

Layouts should be designed so that the houses face onto the open space, providing surveillance, and placing the play spaces at the heart of the development.



Barony Community Garden, Edinburgh

» PAN 77 Designing Safer Places

Addressing risks through design

Lighting within green networks can help to reduce crime, provide reassurance, as well as making areas more enchanting and appealing.

Boundary features including hedges and walls can help define public and private spaces and increase the feeling of community ownership and responsibility, they can also contribute to the green network providing habitats for birds, insects and small animals.

SUDS, particularly open ponds and wetlands are often perceived as posing risks of drowning. So the principles of safety by design should be embraced. Careful design can help to minimise or design out risks so that SUDS features pose little or no risk. This can be done through easy design solutions like including gentle side slopes and shallow shelves within ponds and wetlands.



Dunfermline © Collective Architecture

» SUDS for Roads

Delivering quality through design and maintenance

High quality facilities and public spaces should be designed to be durable and appropriate to the location to ensure continuing high standards.

It is important at the design stage to think about the different maintenance regimes different types of green infrastructure will need. For example green corridors, and semi-natural greenspaces may require less ongoing maintenance and costs than more formal types of open space.

The maintenance programme should be tuned to the type of space, durability, wildlife habitats present, level of usage and local interests. The management and maintenance regime including ownership and responsibilities and paying for the management and maintenance should be agreed early on, and suitable, transparent, arrangements put in place.



Raploch, river walk playpark. © Raploch URC Ltd

Easy to move around

Green networks provide attractive opportunities for walking and cycling, encouraging more people to take part in active travel more often, as a sustainable and viable alternative to the car. Green networks offer a range of other benefits: economic, social and environmental, including creating sustainable drainage systems, providing areas of green space and paths for recreation and social interaction, as well as improving habitat connectivity and tackling climate change through reducing carbon emissions.

Green Networks

Often the basis of an area's green infrastructure is already in place, eg the woodlands, shelter belts, green corridors, paths etc but there is added value in connecting these up so they function as a system – the whole really is greater than the sum of the parts.

Development inherently involves land use change, so it can offer a chance to think strategically, in particular with regard to green networks and how to incorporate and create them from the start, including putting in missing green links.

Masterplans should consider:

- the wider landscape or urban setting;
- the green networks in and around the site;
- the potential the development offers to join up existing networks; and
- where best to make green links and connections, to strengthen and enhance the green network.



Connections for... people...



Paths and routes which are accessible to all

» **Core Path Plans: A Guide to Good Practice**

and wildlife



- Significant natural features and other biodiversity should be protected and intrusion minimised, as appropriate in the design.

- As well as protection, masterplans should be thinking about how they can integrate and/or enhance surrounding habitats where appropriate.
- Opportunities should be taken to incorporate biodiversity features (such as green roofs) into the fabric of the buildings and the spaces between them.

Integrated Habitat Network Model

This project was developed by Glasgow Green Network Partnership in association with Scottish Natural Heritage and Forestry Commission Scotland.

It creates a detailed habitat map of the Glasgow and Clyde Valley region for which habitat networks for woodland, grassland and wetland can be modelled. It can be interpreted to identify the location and types of habitat that need to be protected, enhanced or created.

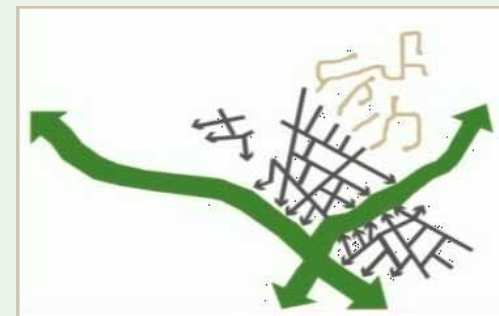
» **SNH Habitat networks and spatial ecology webpages**

CRAIGMILLAR

The proposed development framework creates an integrated network of streets that promote good connectivity of residential areas with open space and wider green networks. By comparison, existing areas of housing show cul-de-sac style development and generally poor connectivity with open space and green networks.



© PARC Craigmillar



Resource Efficient

SUDS and Water Resource Management

Having considered the area's natural hydrology, including any permanent or ephemeral watercourses, designers should make provision so that these can be kept and opportunities to deliver improvements to the water environment (eg opening up culverted watercourses) are harnessed wherever possible. Sustainable urban drainage systems and innovative landscapes to retain flood water should be considered early on as a means to deal with issues of water quantity, water quality and amenity in an integrated way.

SUDS work on the principles of: managing surface water run-off on-site as near to source as possible; slowing down run-off; treating it naturally; and releasing good quality surface water to watercourses or groundwater. Keeping surface water on the surface increases the capacity for flood storage, provides easy access for maintenance and is cheaper to construct. Moreover the end design solutions can become attractive amenity features within the development, and provide wildlife habitats.

SUDS can feature at both the strategic site-wide level and the street level, as shown below.

Strategic level

- Allowing the natural hydrology to influence the site's overall design and layout



LADYFIELD

The SSCI Charette in Ladyfield, Dumfries developed the 'Light Imprint' Plan which aimed to incorporate sustainable urban drainage strategies and solar orientation, whilst maintaining a high standard of urban design and walkability. This geometry funnels drainage corridors through integrated swales to the sports pitches and allotments to the south of the site.



JACKTON AND GILL BURN VALLEY

The Gill Burn Way is a safe, green route through the valley bounded by linear retention ponds, paths and cycleways. It connects two public park areas which are located in the flood plain. It also connects green routes leading down and through surrounding neighbourhoods.



© Glasgow City Council (Collective Architecture in association with AECOM Ltd)

Street level

- Using permeable surfaces to address surface water run-off
- Incorporating rainwater harvesting systems to provide water to irrigate gardens and open spaces

CRAIGMILLAR

As well as connecting to the wider green network, and creating a pleasant urban environment, streets in Greendykes North, Craigmillar provide an important part of the wider SUDS strategy. Following the approach outlined in the Craigmillar Urban Design Framework, local water attenuation is achieved by means of permeable paving which incorporates water storage in the sub base of the street.



© PARC Craigmillar

SOUTH DALMARNOCK

Masterplan: A view looking along a typical street showing the integration of surface water drainage systems into the public realm.



© Sheppard and Robson

The goal in creating sustainable communities should be to reduce the environmental impact and carbon footprint of the development. Resource efficiency and making best use of what the site offers should be sincerely thought about.

Sustainable use of materials

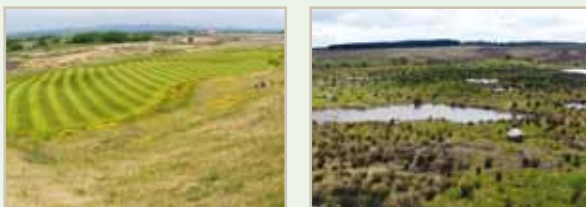
Local and sustainable sources of materials should be used. Not only can this provide solutions that sit happily in their context, transporting materials can be minimised reducing emissions and transport costs. In addition working with the landscape to reduce the need for cut and fill to help reduce soil disturbance and movements.

HEARTLANDS, WEST LOTHIAN

Heartlands is on the site of the former Polkemmet Colliery in West Lothian and is one of the largest brownfield regeneration projects in Europe. The masterplan includes, homes, business land, community facilities and golf courses. One of the ideologies of the project is the theme of recycling and reusing material that is available on the site.

Recycled colliery waste is reused in the building of the golf courses. Ecosse Regeneration Ltd are championing the use of recycled materials in just about every part of the golf course construction. In possibly the first project of its kind in the world the golf courses are being built with a new technique that combines screened inert colliery waste shale from the coal bings on the Polkemmet site with high-quality locally produced compost avoiding the traditional method of importing tonnes of new topsoil and slashing the cost of regenerating the land.

Trees planted on the site will provide a future fuel source for biomass. Native tree species have been harvested from the remediation area to a nursery and will be replanted within the green ways and SUDS areas.

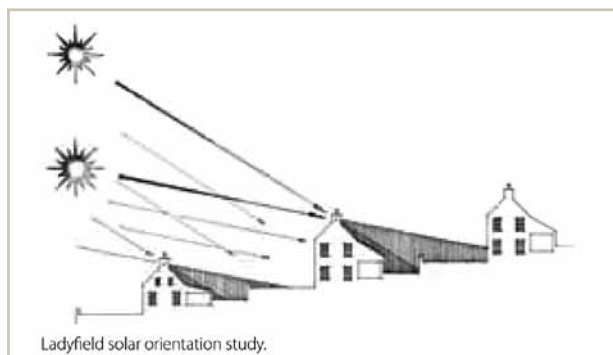


© Ecosse Regeneration Ltd

Microclimate and Saving Energy

Orientation

- Buildings and rooms within developments should be orientated to minimise energy use.
- Opportunities for roofs to incorporate solar hot water and solar PV should be considered.



Shelter

- Structure planting, shelter belts and trees can provide shading and shelter for buildings and spaces enhancing the site's microclimate, and reducing heating costs in winter.

Insulation

- Green roofs can be used as an alternative way to provide insulation.

Cooling

- Blue spaces (water bodies) can provide cooling during summer months, stabilising urban temperatures – scope for incorporating them within developments should be considered.
- Trees can also provide a cooling function.

Renewable Energy

Infrastructure for sustainable energy should be designed in from the start, harnessing the natural resources that are available.

HOUSING EXPO: THE APARTMENTS

All heating and hot water demands for the six apartments is provided through an independent biomass boiler located within the curtilage of the plot.

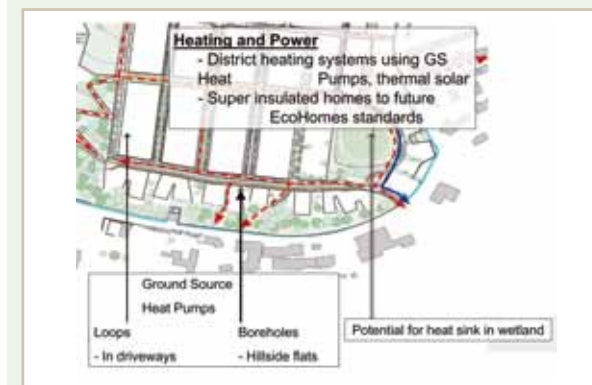


- Design in green infrastructure from the start, eg biomass boiler and storage area.
- Think about scale.

(Keppie Design, William Gray Construction, Albyn Housing Society ©Ewan Wetherspoon)

COWLAIRS, URBAN VILLAGE

Cowlairs is a 30ha site to the north of Glasgow city centre. It features an innovative approach with ground source heat pumps within the porous paving.



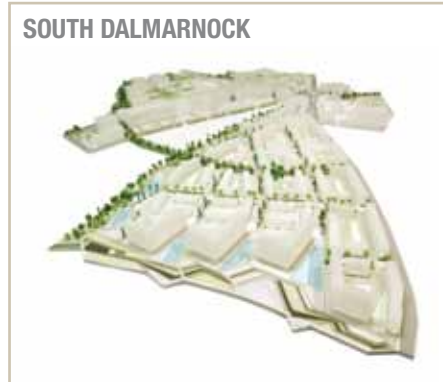
Adaptable

Masterplans should look to incorporate green infrastructure that can serve a number of different functions and adapt to future uses. Green infrastructure through green networks can offer a range of benefits to society. These benefits include; providing places for amenity, biodiversity, flood control, mitigation of pressures on the water environment, environmental education, growing food, outdoor activity and enjoyment.

Creating multi-functional open spaces

Green infrastructure including open spaces can offer a range of benefits to society, and creating multi-functional spaces increases the potential benefits.

- For example open spaces designed for amenity space, and biodiversity can also operate as outdoor classrooms giving children a chance to learn about nature and their environment.
- Football pitches can also be designed to hold large volumes of water during heavy rain, reducing the risk of flooding elsewhere.
- Sustainable drainage combines well with open space requirements as indicated below.



SINGLE USE



These are individual open spaces designed with a single purpose.

- For example:**
Single open spaces can include:
- Play parks for children.
 - Allotments for food production.
 - Kick-about areas for recreation.

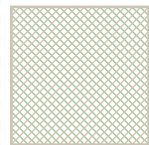
Maximising single uses, i.e. combining



Consider how you maximise the use of a single space by combining with, or adding, other uses.

- For example:**
Ensure that environmental sustainability can be built into the design such as:
- SUDS
 - Shelter
 - Bio-diversity
- As well as social and physical uses.

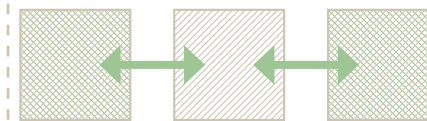
MULTIPLE USE



These are individual open spaces designed to achieve multiple benefits and uses.

- For example:**
A grass kick-about area with storm water storage capacity and bio-diverse planting providing shelter and a high-quality landscaped setting for built development.

Maximising multiple uses, i.e. connecting



With the use of open space maximised to its full potential, the aim is to look for opportunities to connect other spaces. to create a green network. If a single use open space cannot be maximised any further, it can still be linked with surrounding multi-functional open space.

- For example:**
To create a multifunctional green network, spaces can be linked together via paths, drainage corridors, woodland and other uses, providing for wider habitat connectivity, active travel routes and other strategic benefits.

INCREASING VALUE →

Providing opportunities for productive landscapes

Allotments, community gardens, and community orchards, as well as private gardens can provide access to fresh healthy fruit and veg, with fewer food miles, help encourage physical activity, and tackle health inequalities.

Where there is local demand for allotments or other forms of community growing, developers may wish to consider whether there is scope to include this type of open space within the development.

Community woodlands can also get local people involved in growing trees whether for fruit or to harvest as wood fuel for local heating systems.



© Assist Architects

» **Community Growing in Scotland – Towards a framework for action, Greenspace Scotland**

LEARNING FROM ABROAD

DISTINCTIVE SUSTAINABLE NEIGHBOURHOOD – Vauban, Freiburg, Germany.

Vauban is part of a former French barrack site, in Freiburg. It was developed as a new district for more than 5,000 inhabitants and 600 jobs. The area has been internationally recognised as a sustainable and distinctive neighbourhood and features green infrastructure at the heart of the design concept. Below some of its GI features are shown against the 6 qualities of successful places.

Welcoming

- residential pattern around common courtyards, featuring green facades
- mixed uses at entrance to neighbourhood including café, enhanced with planting



Distinctive

- green corridors with retained mature trees
- green facades and SUDS as key design features



Safe and Pleasant

- greenspaces and corridors providing space for social activities (playgrounds, sun bathing areas, barbeque areas, water basins and pumps, seating areas)



Easy to move around

- use of an ecological traffic and mobility concept, where the principles of 'car-free' and 'parking-free' living have been applied



Resource Efficient

- extensive use of ecological building material
- SUDS and infiltration of rainwater into the ground to reduce water run-off
- solar energy
- cogeneration plant operating on wood-chips connected to the district's heating grid



Adaptable

- public green spaces, designed with local residents
- balconies used by residents to grow plants and produce



» Issues and Lessons from Freiburg Study Visit

RETROFITTING GREEN NETWORKS

New York Highline



The High Line is located on Manhattan's West Side. It runs from Gansevoort Street in the Meatpacking District to West 34th Street between 10th & 11th Avenues.

The High Line was built in the 1930s, as part of a massive public-private infrastructure project called the West Side Improvement. It lifted freight traffic 30 feet in the air, removing dangerous trains from the streets of Manhattan's largest industrial district. No trains have run on the High Line since 1980. Friends of the High Line, a community-based non-profit group, formed in 1999 when the historic structure was under threat of demolition. Friends of the High Line works in partnership with the City of New York to preserve and maintain the structure as an elevated public park.

The public space blends plant life (reminiscent of the quiet contemplative nature of the self-seeded landscape and wild plantings that once grew on the unused High Line) with long, narrow 'planks', forming a smooth, linear, virtually seamless walking surface. The public environment on the High Line contain special features, including a water feature, viewing platforms, a sundeck, and gathering areas to be used for performances, art exhibitions and educational programs.

» <http://www.thehighline.org/>

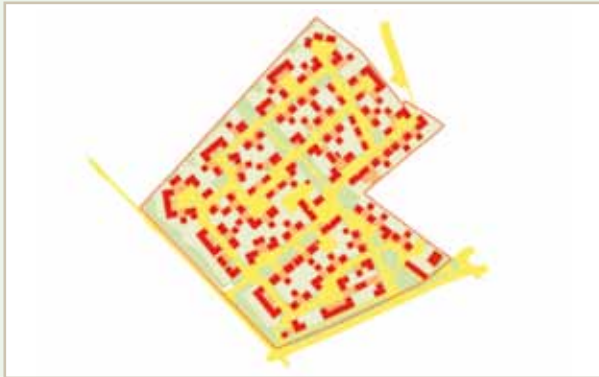
© Katie Casanta

SHOWING THE DESIGN

B-plan, Bavaria

In a Bavarian bebauungsplan (B-plan), design concepts are considered in terms of 3 key uses;

Buildings, Spaces and **Movement**. Green Infrastructure can fit into each of these, which shows how integral it is to placemaking for example:



Buildings

eg green roofs, orientation etc, biomass storage facilities

Spaces

eg open spaces, SUDS, landscaping, trees etc

Movement

eg paths for active travel, green networks, habitat networks, movement of wildlife

SUMMARY

Green Infrastructure considerations when developing a masterplan

Distinctive	Reinforcing the landscape character and identity	<input checked="" type="checkbox"/>
	Using unique design features	<input checked="" type="checkbox"/>
	Creating a sense of place	<input checked="" type="checkbox"/>
Welcoming	Including entrance and gateway features	<input checked="" type="checkbox"/>
	Making it easy to find your way around	<input checked="" type="checkbox"/>
	Creating places with a positive image	<input checked="" type="checkbox"/>
Safe and pleasant	Creating places with a positive image	<input checked="" type="checkbox"/>
	Addressing risks through design	<input checked="" type="checkbox"/>
	Delivering quality through design and maintenance	<input checked="" type="checkbox"/>
Easy to move around	Green Networks	<input checked="" type="checkbox"/>
	Connections for people	<input checked="" type="checkbox"/>
	Connections for wildlife	<input checked="" type="checkbox"/>
Resource Efficient	SUDS and water resource management	<input checked="" type="checkbox"/>
	Sustainable use of materials	<input checked="" type="checkbox"/>
	Microclimate and saving energy	<input checked="" type="checkbox"/>
	Renewable energy	<input checked="" type="checkbox"/>
Adaptable	Creating multi-functional open spaces	<input checked="" type="checkbox"/>
	Creating opportunities for productive landscapes	<input checked="" type="checkbox"/>

Green infrastructure should be considered integral to design, thinking about it from the outset can lead to the creation of high quality sustainable places.



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