Module 5: Climate Change Planning for Green Infrastructure

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Welcome

Introductions

House Keeping

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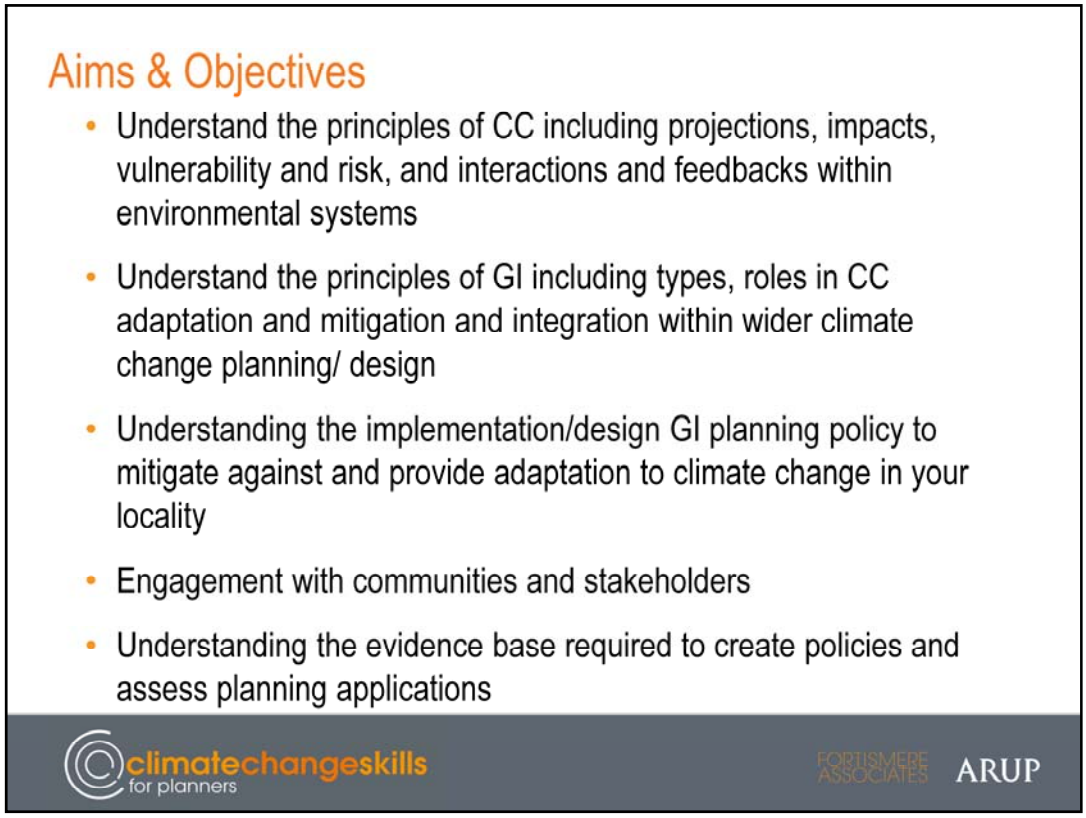

The module provides introductions to the definitions of GI and how it relates to climate change.

The objectives of the module are to:

To provide an active and stimulating learning experience through the use of evidence based guidance, regional and local case studies, use of multimedia presentations and group exercises and discussion.

To encourage innovative behaviour and efficiency savings through sharing of information between professions in local authorities working to manage green infrastructure and climate change by identifying common objectives, complementary knowledge and skills sets and effective signposting and dissemination of information.

Workshop Structure

- Session 1 What is GI and what does CC mean
- Exercise 1 Identifying GI and carbon offsetting
- Session 2 CC/GI Concepts
- Coffee Break
- Session 3 GI/CC Drivers & Policy Formulation
- Exercise 2 Discussion about Policy Development
- Session 4 Review & Case Studies
- Exercise 3 GI Scenario

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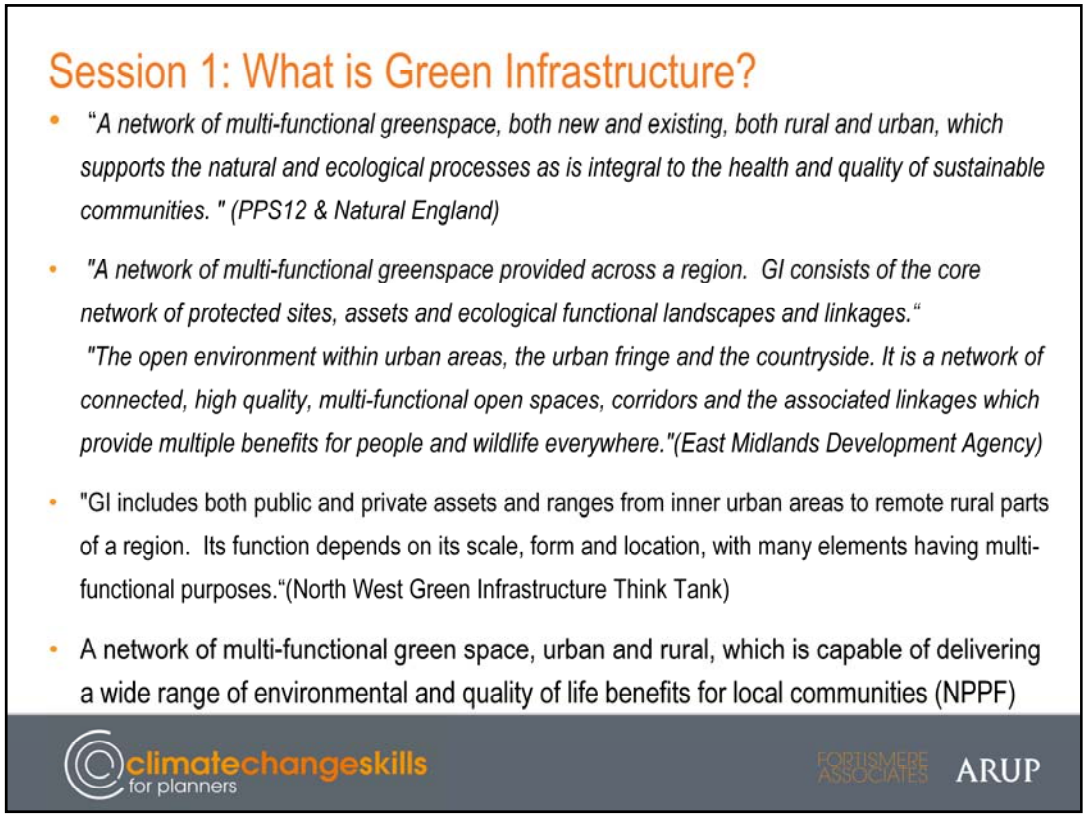
Programme



Green infrastructure is our "life support system – the network of natural environmental components and green and blue spaces that lie within and between our cities, towns and villages and provide multiple social, economic and environmental benefits".

How to recognise green infrastructure and how do you assess its quality & value?

It's not the same thing as "critical infrastructure" - but should it be planned and managed as a critical infrastructure.

Alternatively -The Fifth Critical Infrastructure

• Infrastructure – the basic physical and organisational structures needed for the operation of society or enterprise (Oxford English Dictionary).

The 4 Critical Infrastructures; Transport. Water. Power. Waste. Is the 5th Critical – Green?

Commonalities – 5 attributes common to these definitions:

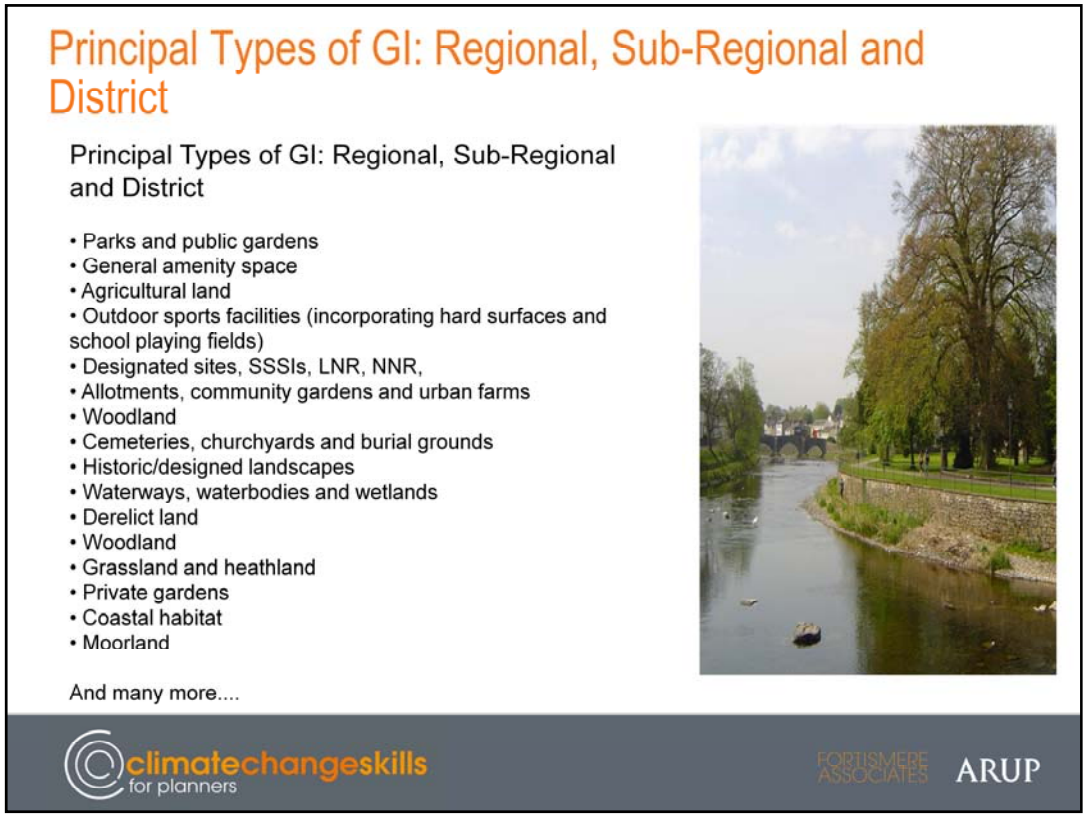
Attribute 1 Typology

Attribute 2 Function

Attribute 3 Context

Attribute 4 Scale

Attribute 5 Connectivity



GI typologies

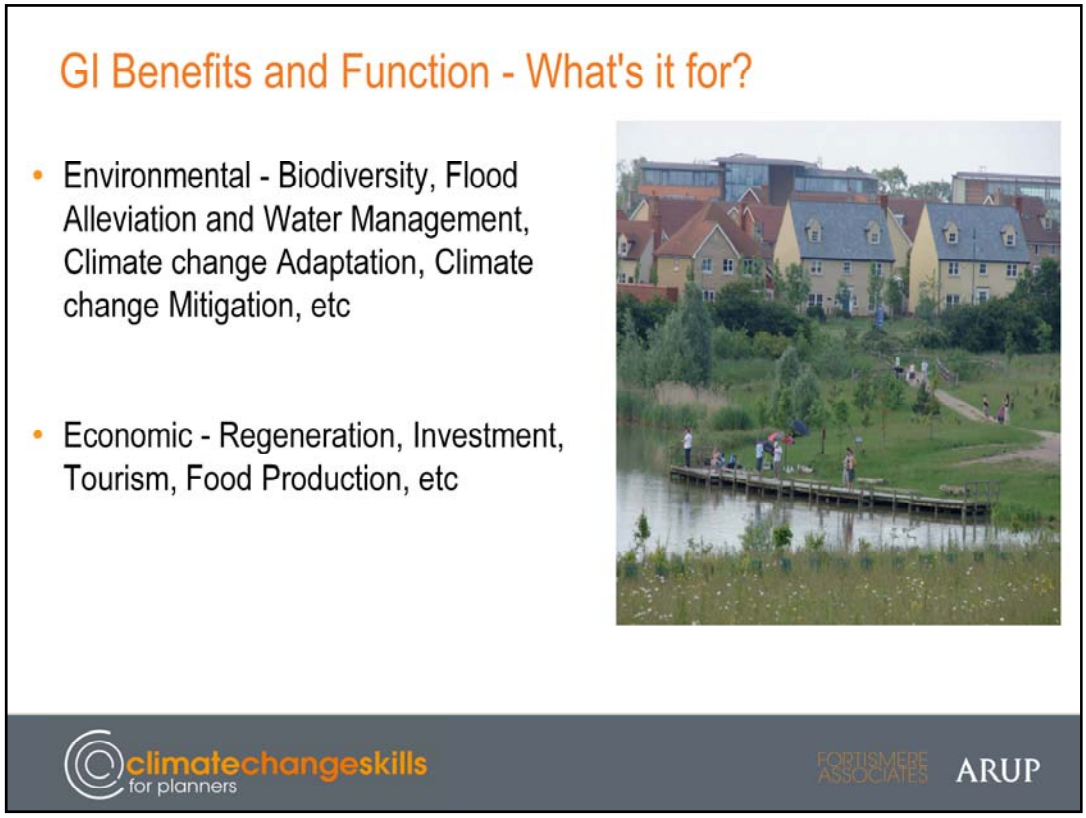
And these work differently at different spatial scales: Regional, Sub-Regional and District

Attribute 1 – Typology

The **physical components** that make up green infrastructure.

This includes open spaces, waterways, street trees and verges, woods, grasslands and heaths, coastal habitats, public parks, private gardens etc. Green infrastructure can be natural, semi-natural and designed spaces and features.

Can often be referred to as GI assets



And the spaces where these overlap are important!

Attribute 2 - Functionality

Functionality **is not about physical description** but about **what the green infrastructure is actually doing – the functions it performs**.

green infrastructure is **multi-functional.**

Multifunctionality involves the beneficial integration and interaction between local economies, the environment and social objectives through spatial integration of land uses and activities.

GI Benefits and Function

- Social - Recreation and Amenity, Access to Natural Green Space, Health, Education, Culture, etc
- Multifunctional - Labour productivity, Health and Well Being, Recreation and Tourism, etc
- AND Climate change Adaptation, Climate change Mitigation

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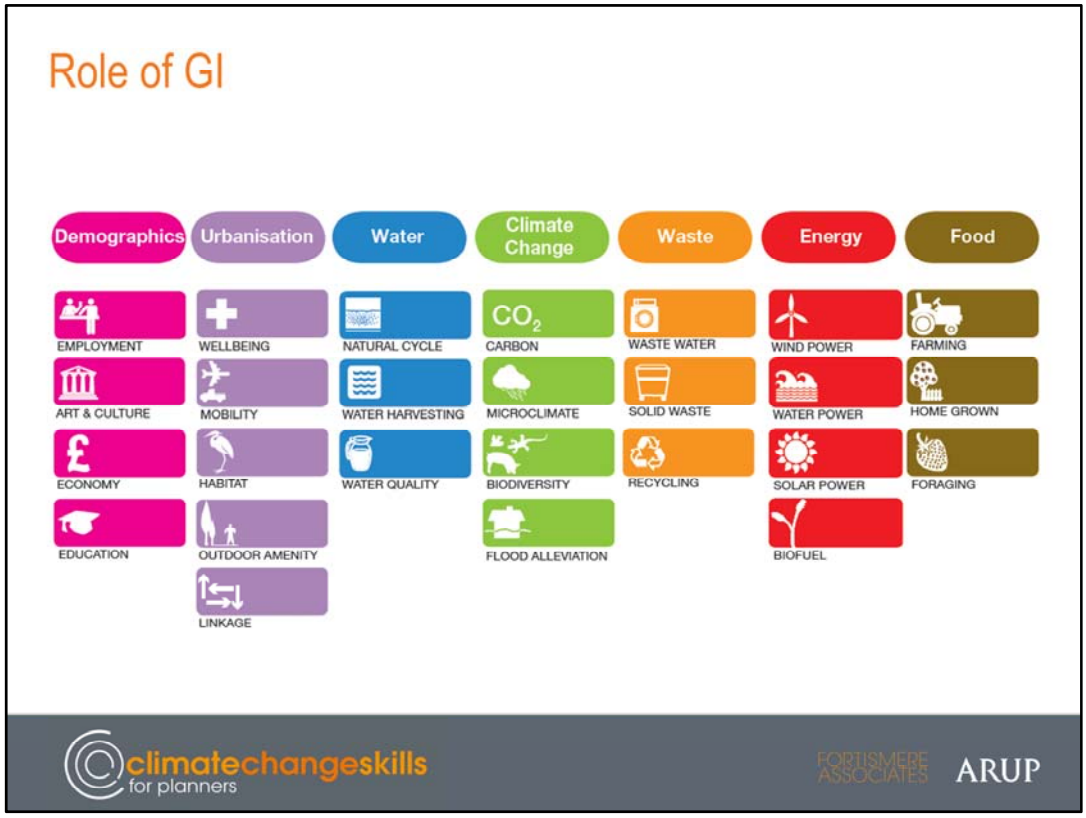


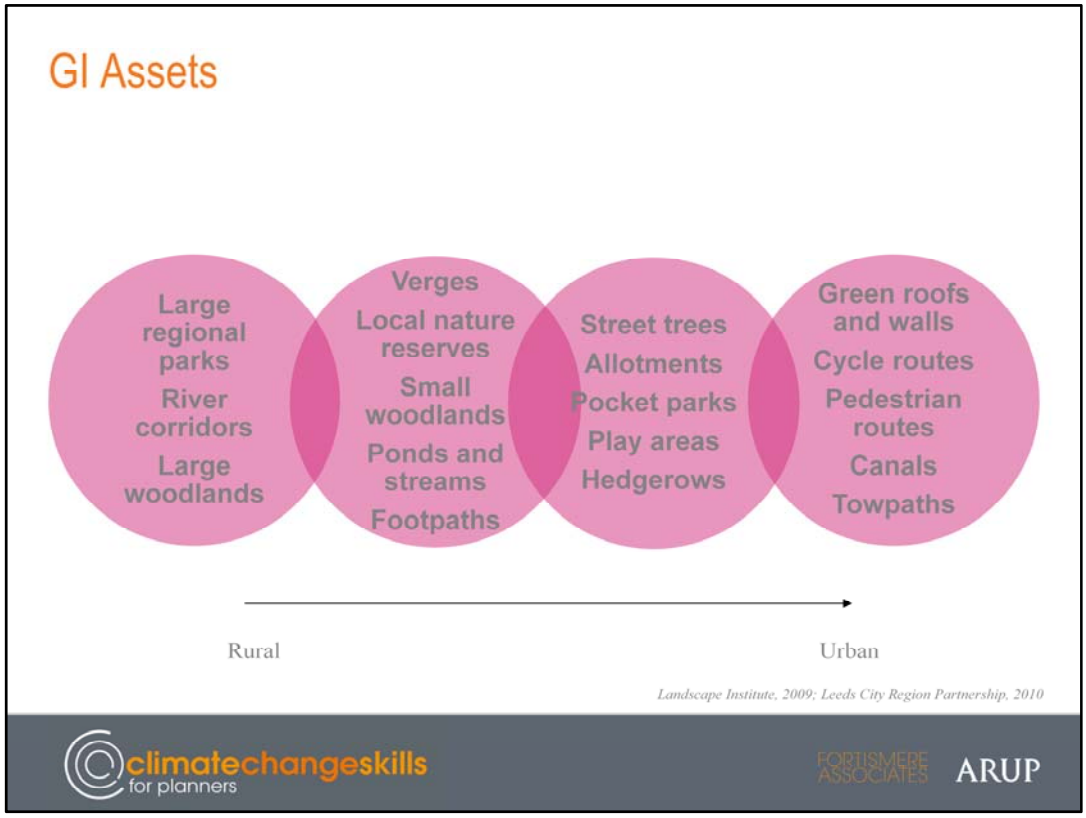
Many GI strategies categorise the function or role of GI.

Generally divided into:

social (Leisure and recreation, proximity of habitation, capacity to improve health, capacity as an educational resource, proximity to social deprivation, community safety),

environmental (flood control, air quality, tree cover, biodiversity, connectivity) and

economic (Capacity to generate income, availability for social enterprises, food production, local house prices) functions.

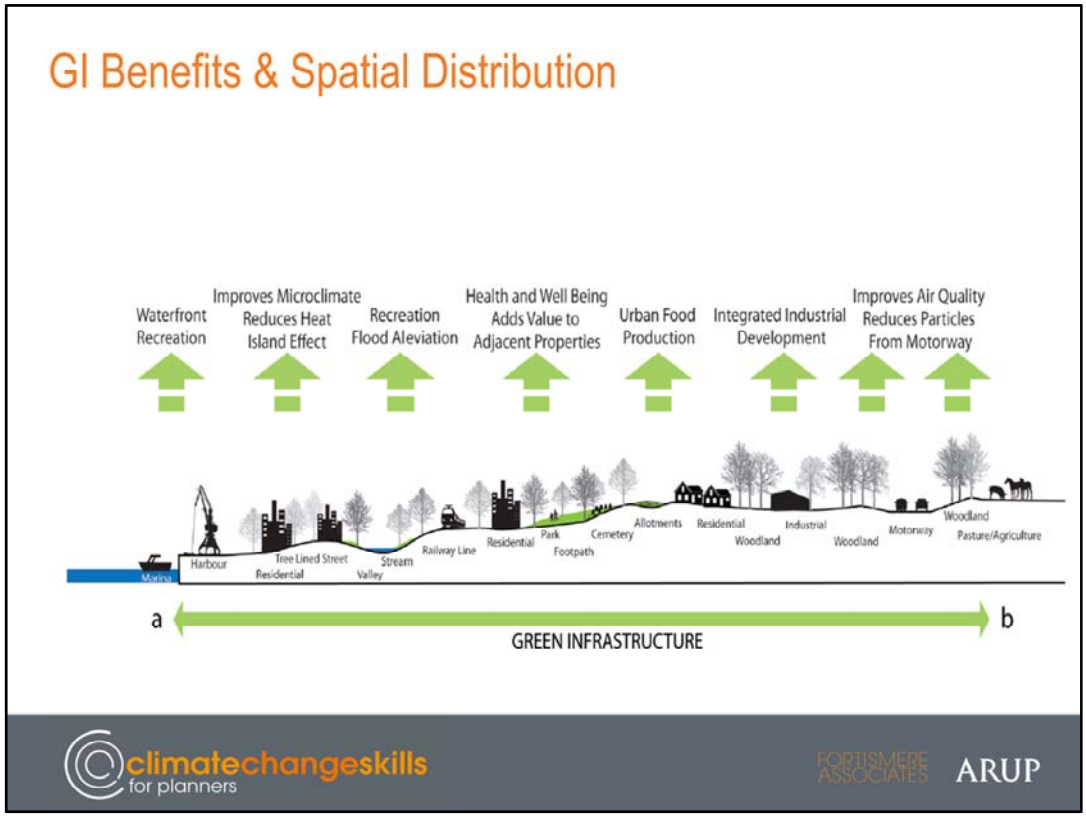


Attribute 3 – Context

Green infrastructure exists in a number of geographic contexts ranging from deep urban, urban fringe and peri-urban, rural and remote.

It may be lowland or upland, inland or coastal.

The **significance of context** is that it will **determine the green infrastructure typologies, functionalities** and therefore **issues that green infrastructure planning will address**.



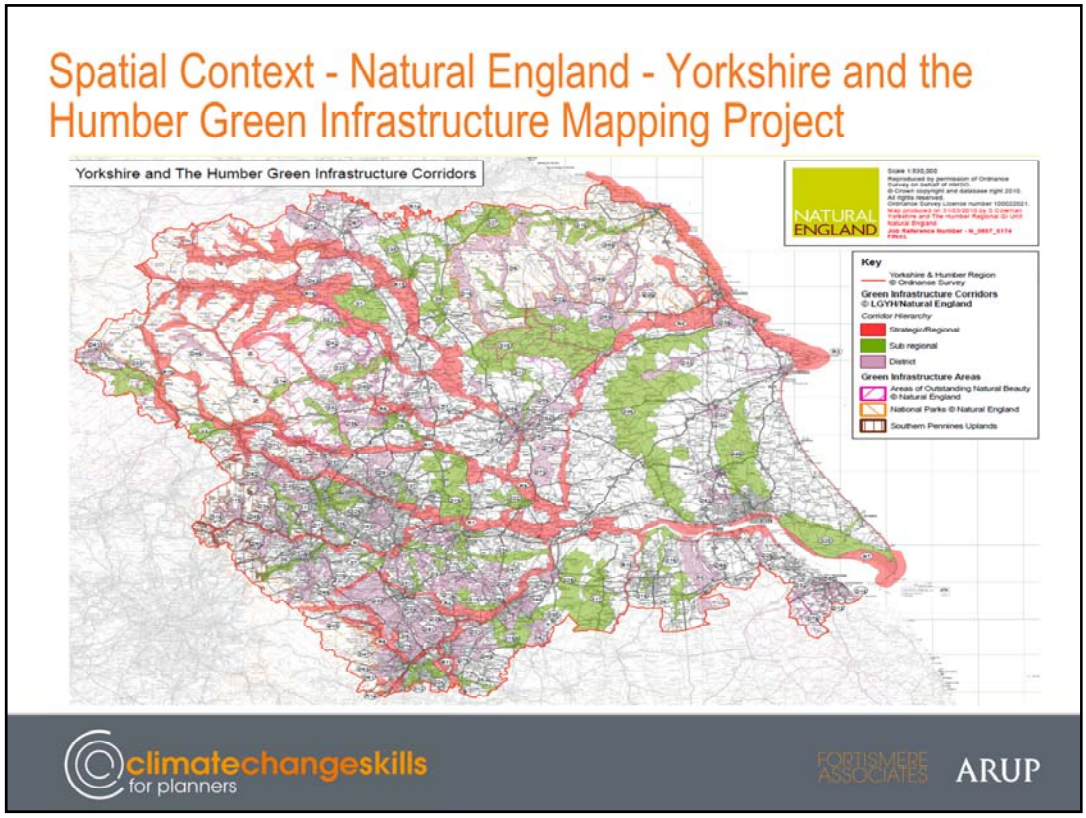
Attribute 4 – Scale

Landscape of GI

Green infrastructure exists and **operates** at both **small and large scales**. How the **management of green infrastructure** systems is conducted will be **scale dependent**. Some benefits will add up regionally, others will be local.

Scale allows for **the consideration of green infrastructure** to encompass **assets of different sizes** ranging from a street tree (neighbourhood scale) through to an entire moorland (county scale) or total environmental resource base (regional scale).

Many examples – this example captures the wider role once again reflecting urban rural gradient



Attribute 5 – Connectivity

Connectivity is the **degree to which green infrastructure exists as a network**. This can mean **a physically connected network** and/or **functionally connected** such as a dispersed ecological framework of habitats.

The **degree of connectivity** will **determine** the degree to **which functions will be connected to beneficiaries**.

NE mapping tool

Spatial understanding of the extent and cross-boundaries of GI

The Yorkshire & Humber Green Infrastructure Mapping Project was carried out to help local authorities protect and create green infrastructure through their Local Development Frameworks (LDFs). Natural England, working in partnership with all local authorities in the region as well as other partners, worked to ensure a consistent approach was taken to green infrastructure mapping.

Natural England is keen to see this evidence used to support projects and policy at both strategic and local levels. It has already been used by Leeds City Region and South Yorkshire to inform projects, as well as being an evidence base for LDFs

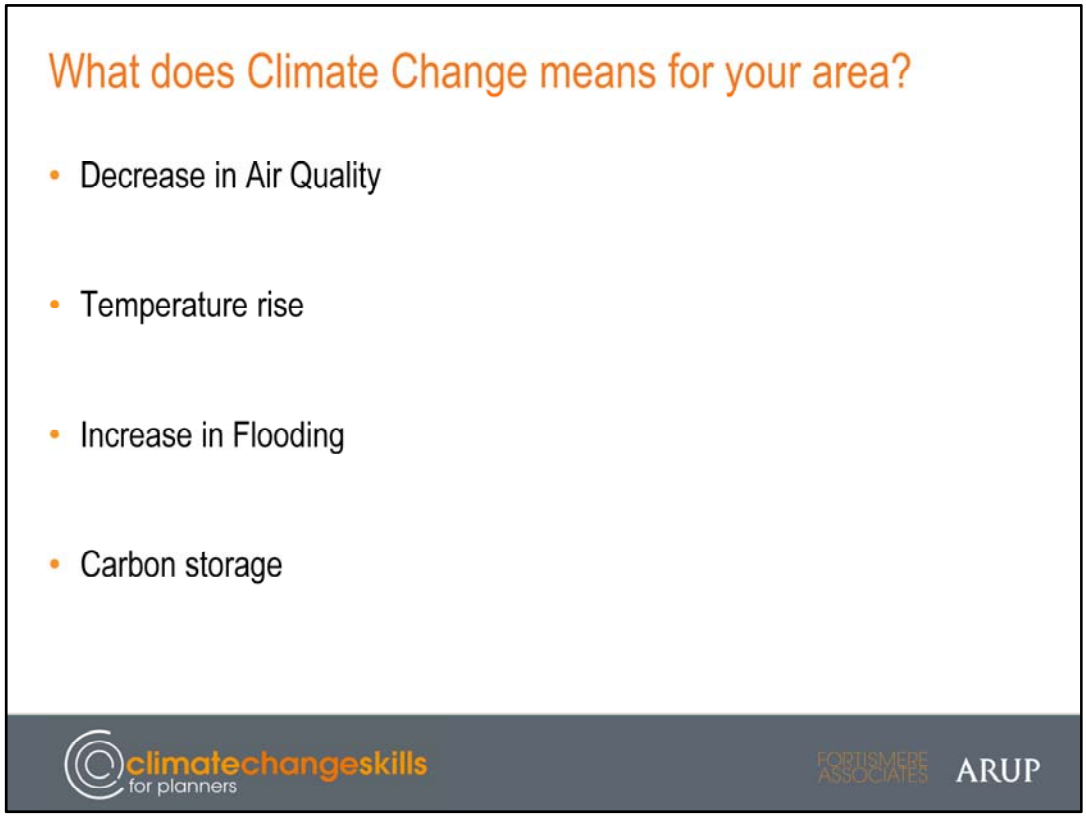
What is Climate Change?

Effects of Climate Change – the Headlines:

- The effects of climate change can be seen in the UK and around the world. UK temperatures, including those of British coastal waters, have already risen. Globally, extreme weather is predicted to become more common and to have a negative impact on humans, animals and plants. The period between spring and autumn when plants grow is now about a month longer in central England than it was in around 1900.
- **Rising temperatures**: The overwhelming view amongst climate science experts is that, if we continue to emit greenhouse gases: by the end of the 21st century global temperatures could rise between 1.1 and 6.4 degrees above 1980 to 1999 levels

Climate Change

- **Changing sea levels and temperatures**: Globally, the average sea level could rise by 18 to 59 centimetres, or more, by the end of the century.
- **Extreme weather**: Globally, continuing warming means that extreme weather events – like severe floods and droughts are likely to become more frequent and dangerous.
- **The cost of climate change**: The costs of climate change are expected to be huge, as the Stern Report on the economics of climate change made clear. The report estimated that not taking action could cost from five to 20 per cent of global Gross Domestic Product (GDP) every year. In comparison, reducing emissions to avoid the worst impacts of climate change could cost around one per cent of global GDP each year. (Directgov, 2011)



Invite participant feedback

Temperature - Urban heat island

There is a significant risk that urban centres may become unliveable due to the interaction

between increased heat and air-pollution (**Local climate regulation and Air-quality).**

Flooding

Climate change is likely to increase the severity and frequency of flooding. **Water**

Climate change will drive decreasing availability of freshwater, particularly in the summer and in

the South East. **Problems with polluted agricultural runoff are also expected to**

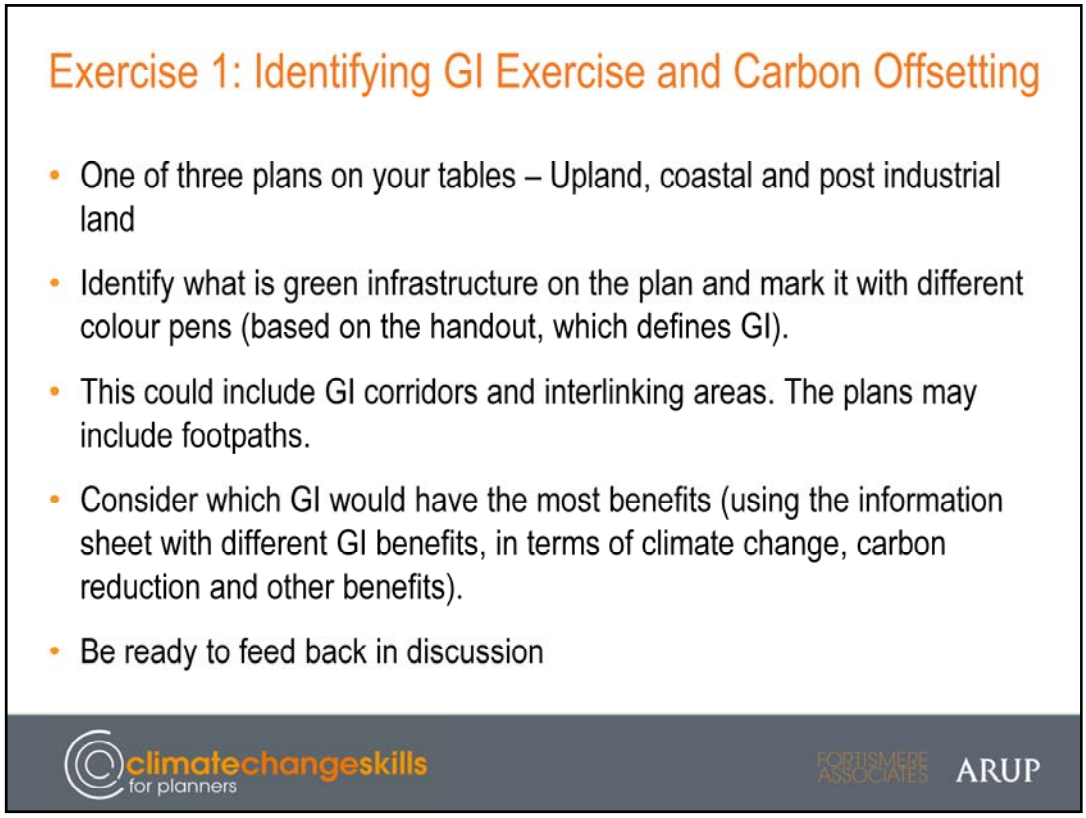
increase with climate change

Carbon sequestration

Land use change can reduce or increase the rate of carbon emission, as well as sequester

carbon. Deliberate investment in the carbon sink function of land is therefore a priority for climate

change mitigation (see **Carbon sequestration**



This exercise will identify that green infrastructure is far more than the 'green bits' on the urban map. It is also, in the main, a public resource, ready for use by the 80 per cent of the population who live in towns and cities.

The exercise crib sheet provides more information on this exercise.

Session 2: Climate Change/GI Concepts

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Climate Change Mitigation & Adaptation

- Climate change mitigation
- Mitigation refers to reducing greenhouse emissions and concentrations in order to limit the severity of future climate change.
- The mitigation role of green infrastructure is limited but important, and includes:
- Carbon storage and sequestration
- Fossil fuel and material substitution
- Food production
- Reducing the need to travel by car.

Climate change adaptation

- Adaptation recognises that there is now some inevitable climate change locked into the system. It seeks to build capacity and take action to respond to the likely impacts.

- In the UK, where climate change scenarios suggest warmer wetter winters and hotter drier summers, with more extreme events such as heatwaves, droughts and heavy rainfall, the adaptation role of green infrastructure is perhaps more significant.

Climate Change Adaptation – GI's Role

- Moderating urban temperature extremes to ensure that towns and cities continue to be attractive and comfortable places to live, work, visit and invest
- Reducing flood risk and managing surface water
- Allowing species to move northwards to new 'climate spaces' through a more permeable landscape
- Providing a recreation and visitor resource for a more outdoors lifestyle, and helping to divert pressure from landscapes which are sensitive to climate change.

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Example for each point – i.e. value/cost of benefit

Tree cover in the West Midlands

A study in the West Midlands (Hewitt, 2002) was undertaken to identify the effects trees had on air quality and how this might benefit human health. The study concluded that doubling the number of trees in the region would reduce the concentration of small particles (PM10) in the air by 25%, which in turn may lead to reducing human deaths in the area by up to 140 per year. The study also identified that trees with the largest leaf surface area have the best effect on air quality. In the West Midlands, this was found to include Scots Pine, common alder, larch, Norway maple, field maple, ash and silver birch. The study goes on to highlight that the increased surface area of leafs and trees exposure to wind means capture of airborne particles on an area of woodland is three times the rate of grassland.

Social Benefits

- **Increasing social cohesion**
- Promoting community interaction;
- Reducing crime;
- **Enhancing and providing green amenity**
- Promoting green spaces;
- Improving visual amenity;
- Enhancing and conserving historic and cultural amenity

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Mitigating psychological precursors to violence

A number of studies have also shown a connection between green space and lower levels of violence (Mooney and Nicell, 1992; Rice and Remy, 1998), which is closely related to the stress reducing properties of green environments. Recovery from mental fatigue, a trigger of angry outbursts and potentially violence, has been shown to be helped by greater contact with nature (Canin, 1991).

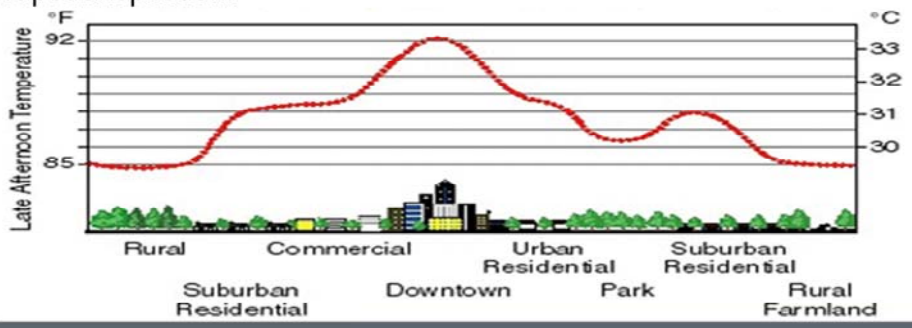
Case study – Reducing crime

Robert Taylor Housing Project, Chicago

Example 1: Urban Heat Island (UHI) Effect

UHI is caused by two main factors:

- Buildings and other hard surfaces are warmed by direct solar radiation. Heat is released into the atmosphere at night, causing a general warming of urban air.
- Loss of vegetation in urban areas reduces the amount of cooling by evapotranspiration.



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An urban heat island (UHI) is a metropolitan area which is significantly warmer than its surrounding rural areas. The temperature difference usually is larger at night than during the day, and is most apparent when winds are weak. Seasonally, UHI is seen during both summer and winter. The main cause of the urban heat island is modification of the land surface by urban development which uses materials which effectively retain heat. Waste heat generated by energy usage is a secondary contributor. As population centres grow they tend to modify a greater and greater area of land and have a corresponding increase in average temperature.

Health impacts – (as referenced earlier) e.g. reduction in air quality and increase in respiratory illness

Also Summer heat in urban areas can also bring about:

• Increased levels of indoor and outdoor thermal discomfort.

• A likely increase in adverse health effects such as sunburn, skin cancer and cataracts (Kovats, 2008).

• An increase in direct energy costs associated with air conditioning.

Note: the debate over UHI causing or contributing to CC

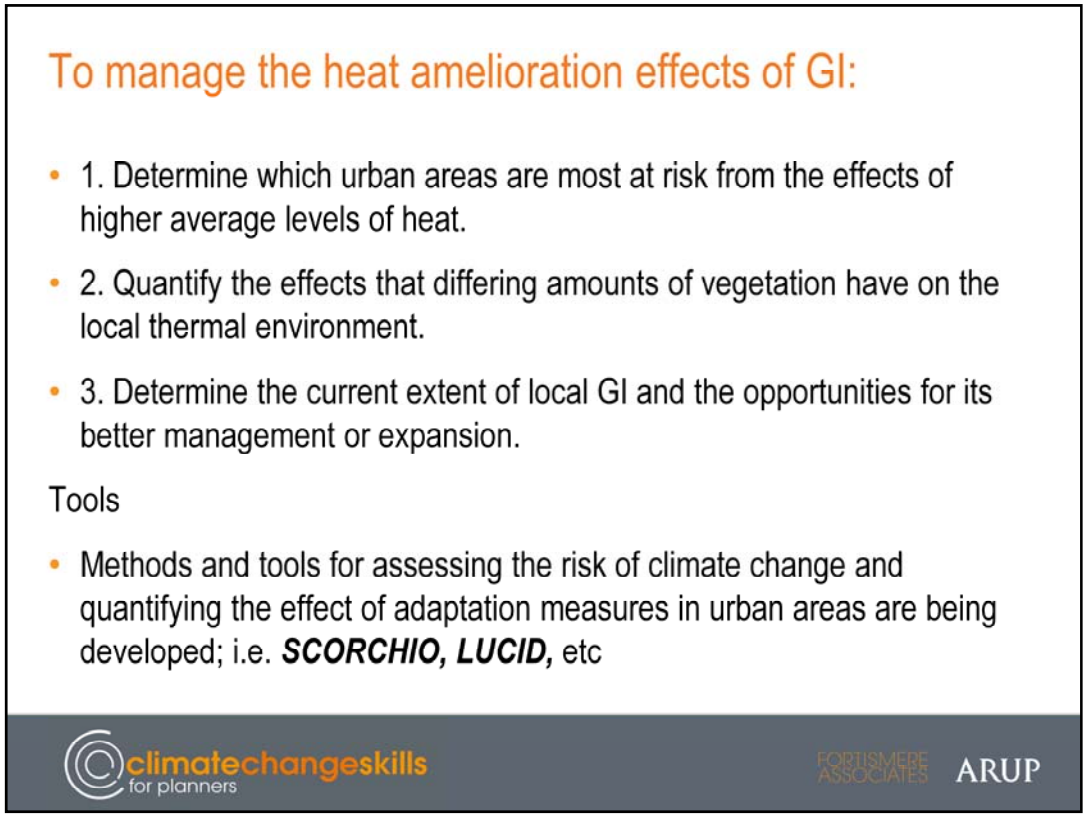
GI reduces the impacts of higher temperatures in different ways:

• Trees and shrubs provide protection from both heat and UV radiation by direct shading (both of buildings and outdoor spaces).

Evapotranspiration reduces the temperature in the area around vegetation by converting solar radiation to latent heat.

• Lower temperatures caused by both evapotranspiration and direct shading lead to a reduction in the amount of heat absorbed (and therefore emitted) by low albedo man-made urban surfaces (Dimoudi and Nikolopoulou, 2003).

This results in towns and cities remaining noticeably hotter than the surrounding countryside, particularly at night on calm, clear summer nights. The UHI can add 5-6°C to the nighttime temperatures experienced. During the summer heatwave of 2003, differences of up to 10°C between city and rural temperatures were measured in London.

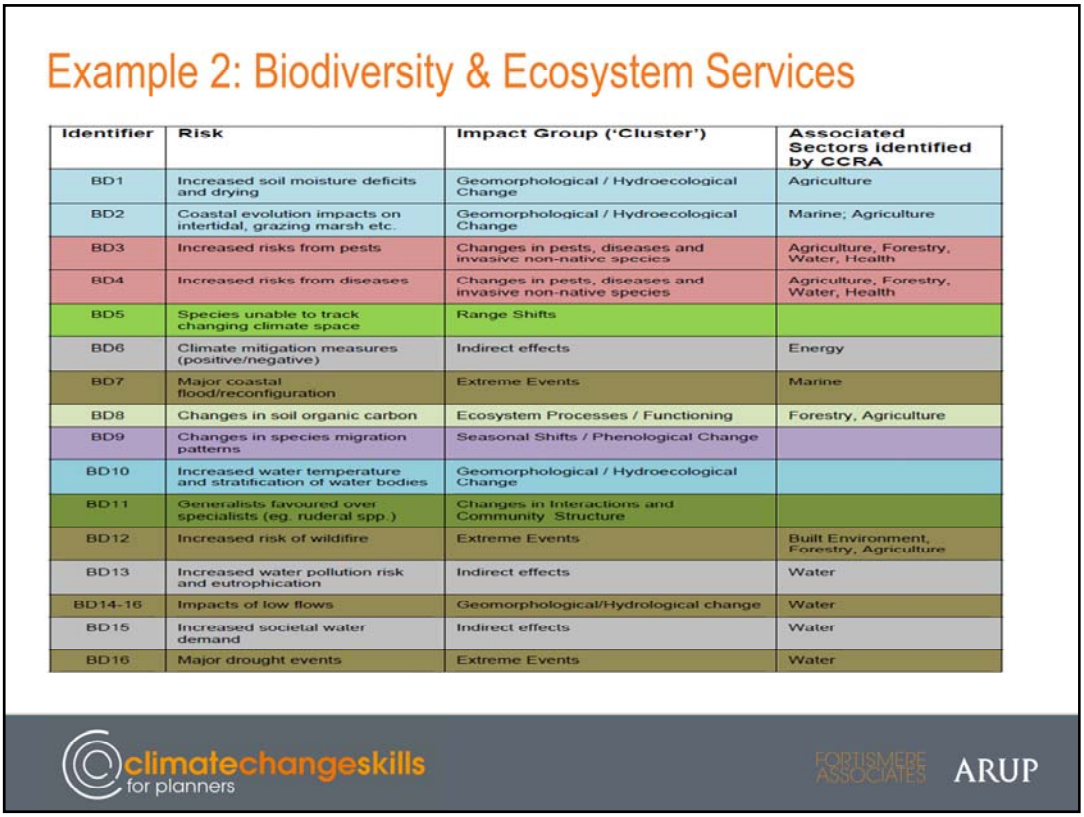


SCORCHIO **Sustainable Cities: Options for Responding to Climate cHange Impacts and Outcomes**

This project aims to develop tools that can quantify risk from the combined effects of the UHI and climate change, and show how best to target adaptation strategies over a large urban area (Smith and Lindley, 2008). Further details can be found on the project website at www.sed.manchester.ac.uk/research/cure/research/scorchio.

LUCID

LUCID is developing more localised tools for quantifying the effects of building structure and form, climate, energy use and effects on human health. Further details can be found on the project website at www.lucid-project.org.uk.



The Government published the UK **Climate Change Risk Assessment (CCRA)** on 25 January 2012, the first assessment of its kind for the UK and the first in a 5 year cycle.

The CCRA has reviewed the evidence for over 700 potential impacts of climate change in a UK context. Detailed analysis was undertaken for over 100 of these impacts across 11 key sectors, on the basis of their likelihood, the scale of their potential consequences and the urgency with which action may be needed to address them.

Agriculture

Biodiversity and Ecosystem Services

Business, Industry and Services

Energy

etc

Changes in soil moisture deficits and drying (BD1).

UK habitats sensitive to a change in climate towards a state where present-day 'extreme' dry conditions become the norm. Some habitats and species are particularly sensitive to even small changes in moisture. This can lead to **loss of ecosystem function** and **key services provided by wetlands** and other habitats which could impact upon provisioning, regulating and **Coastal evolution, extreme flooding events or coastline reconfiguration (BD2 and BD7).**

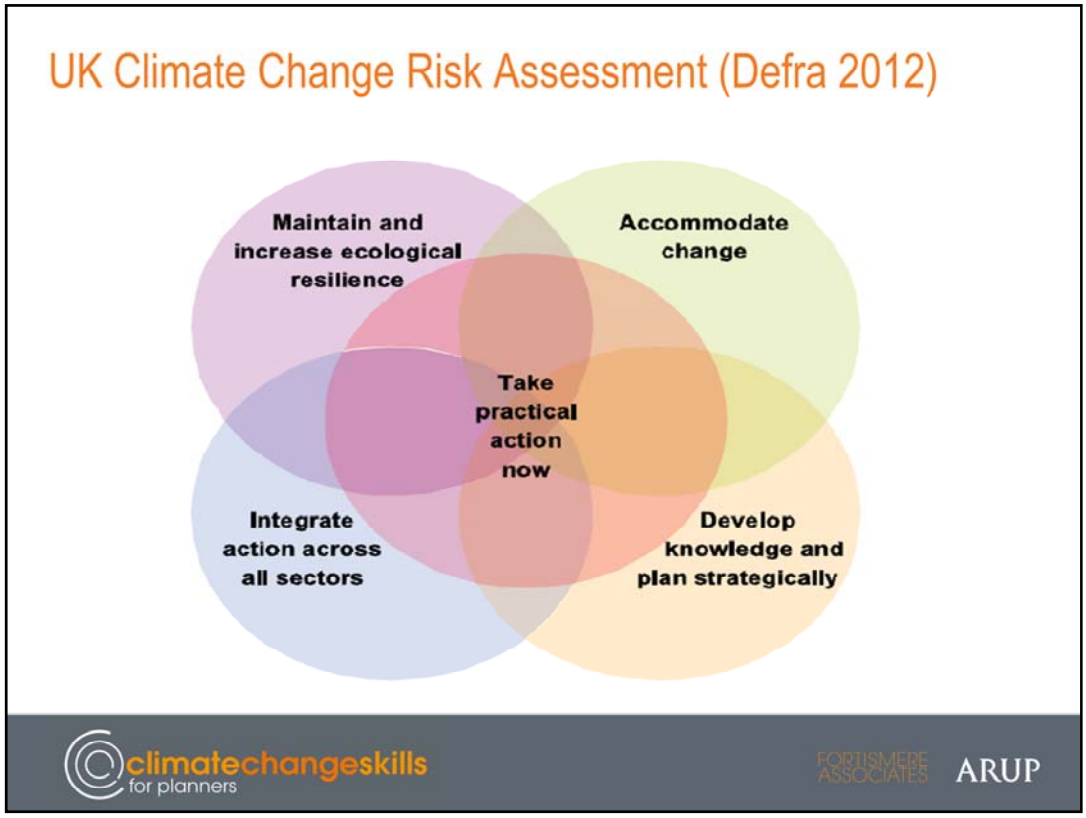
Impacts of Increased water temperature and changes in stratification (BD10).

Many aquatic species have life cycles that are based upon particular thermal requirements and are, therefore, sensitive to changes in water temperatures. Temperature changes may also change the thermal or salinity stratification of water bodies, such that the mixing between surface and subsurface water layers is altered, affecting the supply of oxygen and nutrients. Aquatic ecosystems feature intricate food webs therefore changes in individual species can modify the structure and functioning of the whole system. Aquatic and wetland ecosystems provide a key service to humans by regulating water quality and flow levels.

Generalist species benefiting at the expense of specialists (BD11).

A changing environment can modify ecological niches, meaning species will need to adapt to change. This typically means that those species that have less specific habitat preferences have advantages over those that have developed specialist requirements. As a consequence, change could lead to more 'generalist' species benefiting at the expense of 'specialist' species, with a reduction in biological diversity.

(BD3). Changes in ecosystem structure from species loss could disrupt the delivery of key **services such as pollination.**



The **England Biodiversity Strategy** identified a series of high-level principles to facilitate the adaptation process (Figure).

These **emphasise the need to strategically plan and implement cross-sectoral actions to enhance ecological resilience and accommodate change,** based upon best available knowledge.

The project has considered criteria to measure progress for these principles, together with an understanding of barriers to implementation and guidance on overcoming these obstacles (Berry *et al.,* 2011). **The Biodiversity sector generally has a very high awareness of climate change impacts, combined with a strong perception that these risks may be severe and escalating**.

However, a series of barriers acts against implementation of the principles. These include current organisational structures across government and the many agencies that have interests in or requirements to deliver objectives that are wholly or partially related to biodiversity. This structural issue is often particularly apparent from national to regional to local scale, and can hinder opportunities to share information. Related to this is limits on human resources to scope and implement adaptation actions, together with an often more pressing requirement to deal with short-term requirements.

In summary - adapting to change

- Our climate is changing
- Need to climate proof our cities and towns
- GI has a role in mitigation but a bigger one in adaptation
- Anticipate and plan to cope with probable increased storminess, rain storms and heat events
- Robust city centres and protected vulnerable communities

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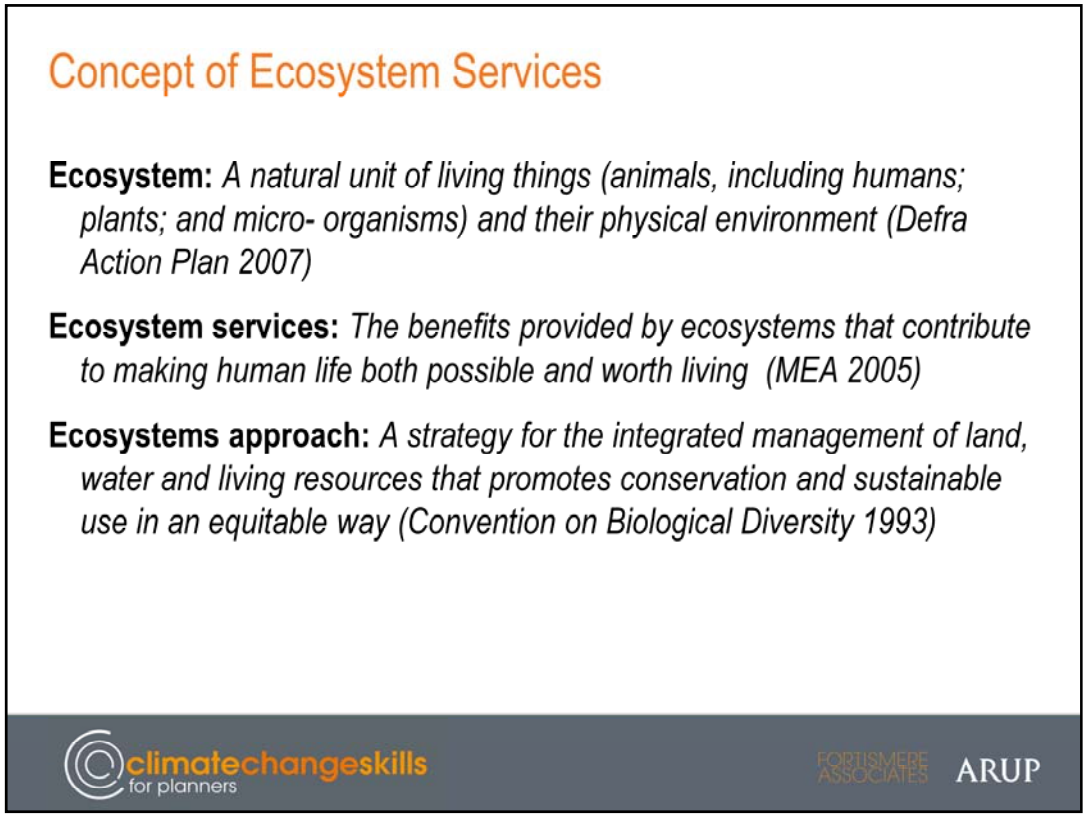
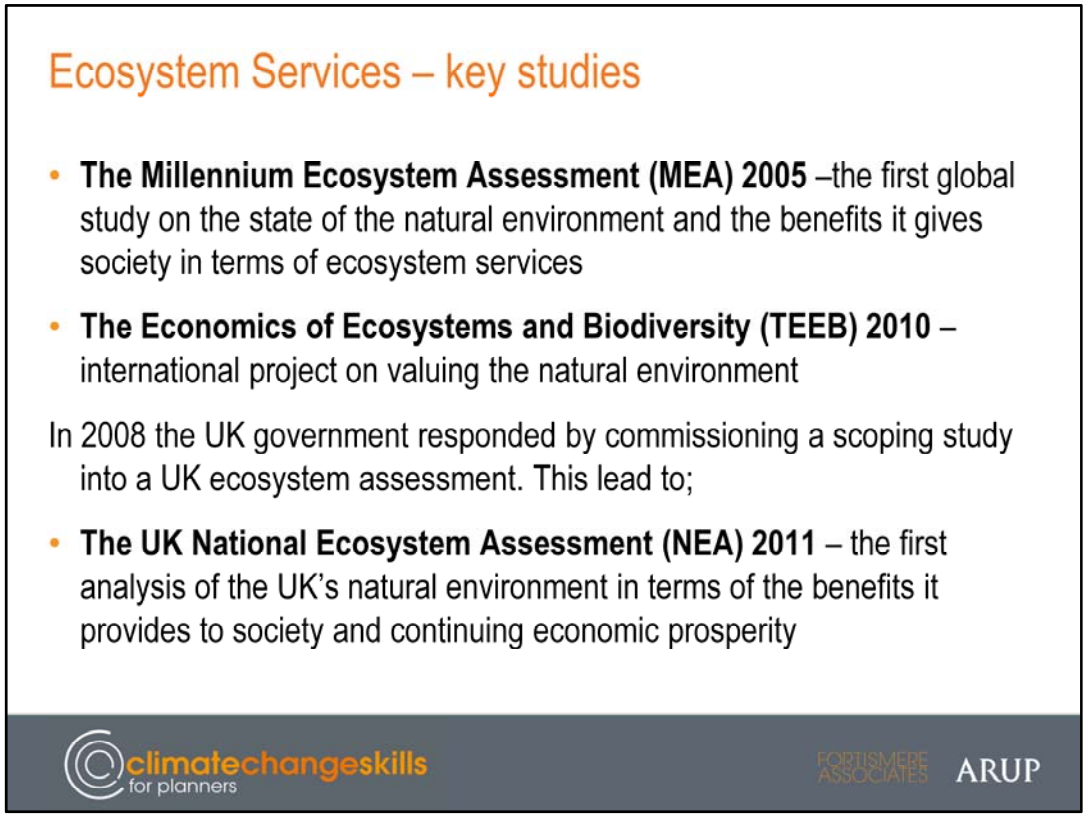


Can't talk about GI without talking about ES

An ecosystems approach necessitates a way of working and decision-making that cuts across traditional policy and institutional boundaries **bringing together consideration of natural, economic and social sciences into a single methodological framework.**



MEA categorised and captured the services

TEEB set out economic valuation methodologies for valuing ES

NEA builds upon MEA

The NEA assessed the **social and economic benefits we get from the natural environment** and showed that **30% are in decline**.

The **NEA specifically highlights reductions in both the quality and quantity of urban green space**.

One in six urban local authorities believe their green spaces are declining. In addition to setting out the risks we all face if such declines are not tackled, the NEA also highlights the huge opportunities for improved health, wealth and happiness if we take action now

National Ecosystem Assessment

Box 4. Ecosystem Services

The UK NEA classifies services into four types:

Provisioning services: the products we obtain from ecosystems such as food, fibre and fresh water.

Regulating services: the benefits we obtain from the regulation of ecosystem processes such as regulation of pollination, the climate, noise and water.

Cultural services: the non-material benefits we obtain from ecosystems, for example through spiritual or religious enrichment, cultural heritage, recreation and tourism or aesthetic experience.

Supporting services: ecosystem functions that are necessary for the production of all other ecosystem services such as soil formation and the cycling of nutrients and water.

Provisioning	Regulating	Cultural	Supporting
			
Provision of timber	Regulation of climate	Recreation and tourism	Cycling of nutrients

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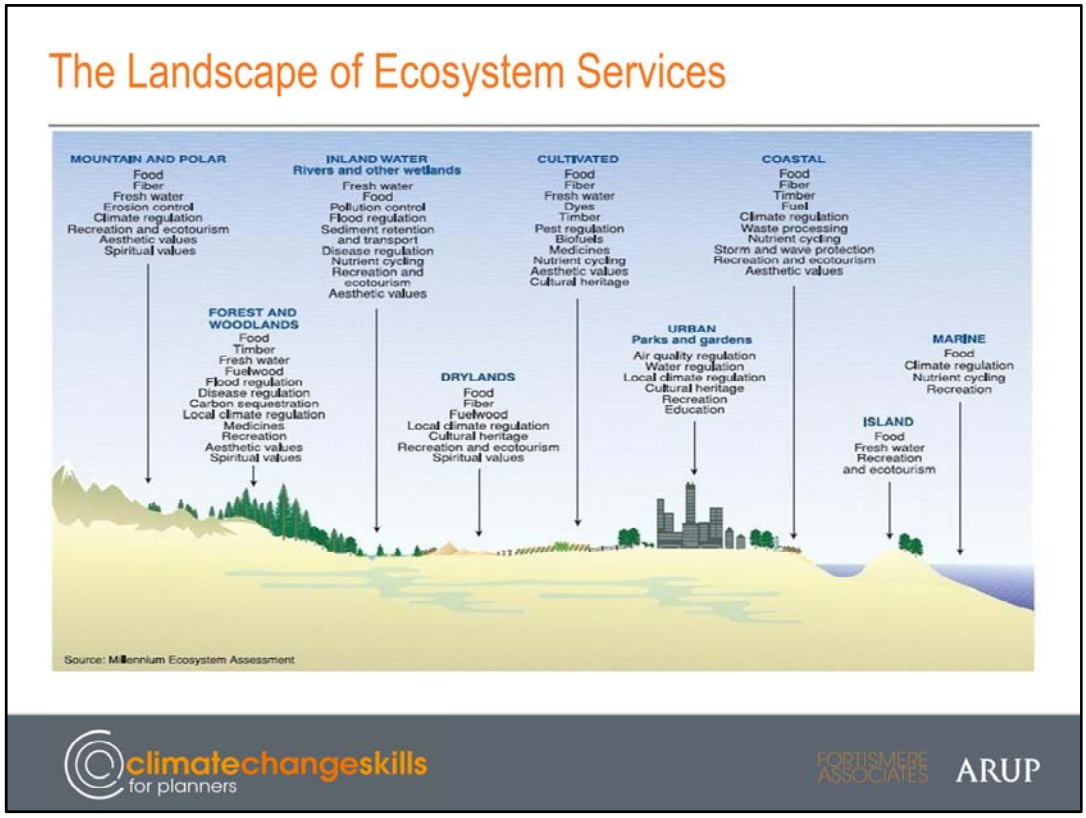
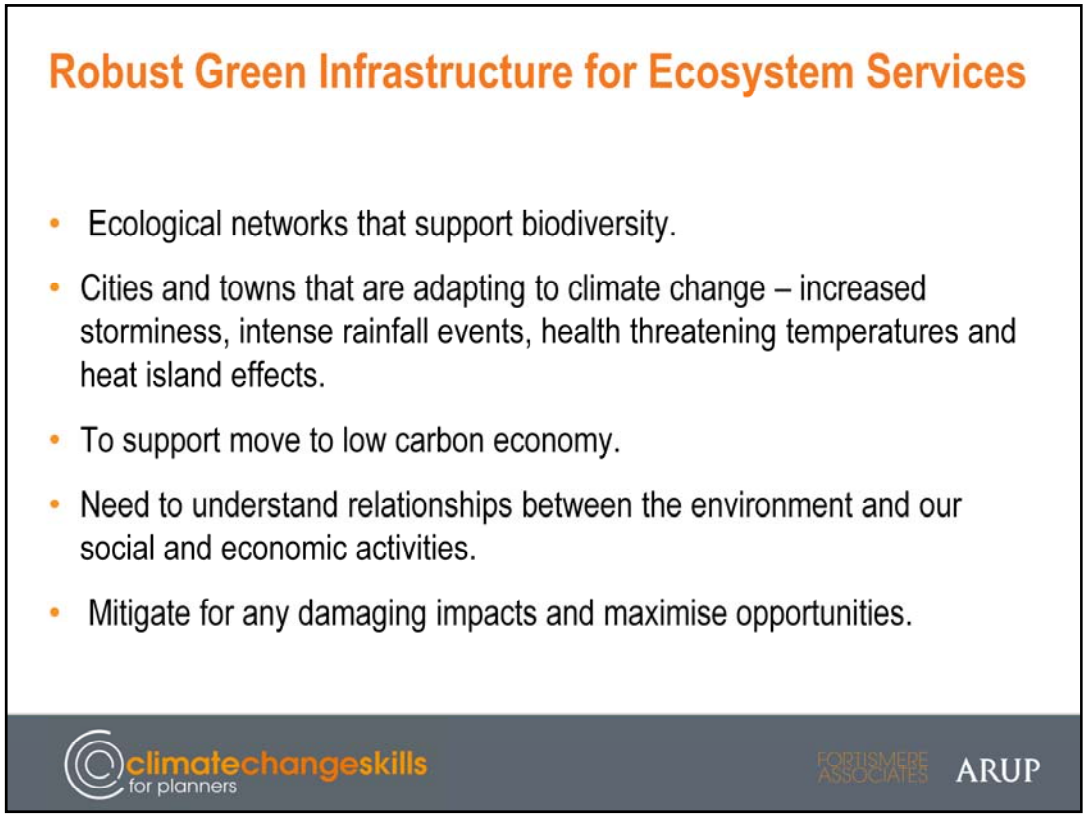
Emphasise the role of supporting services

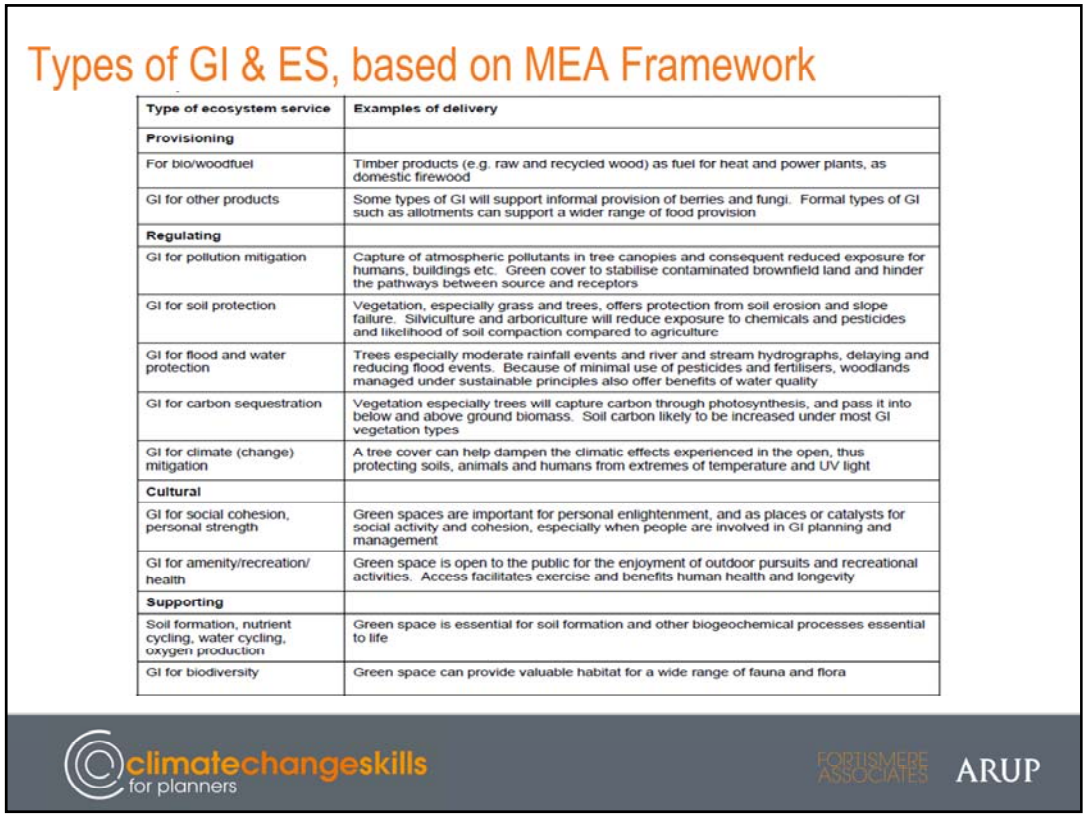


Comparison to GI slide on attribute 4 - Scale

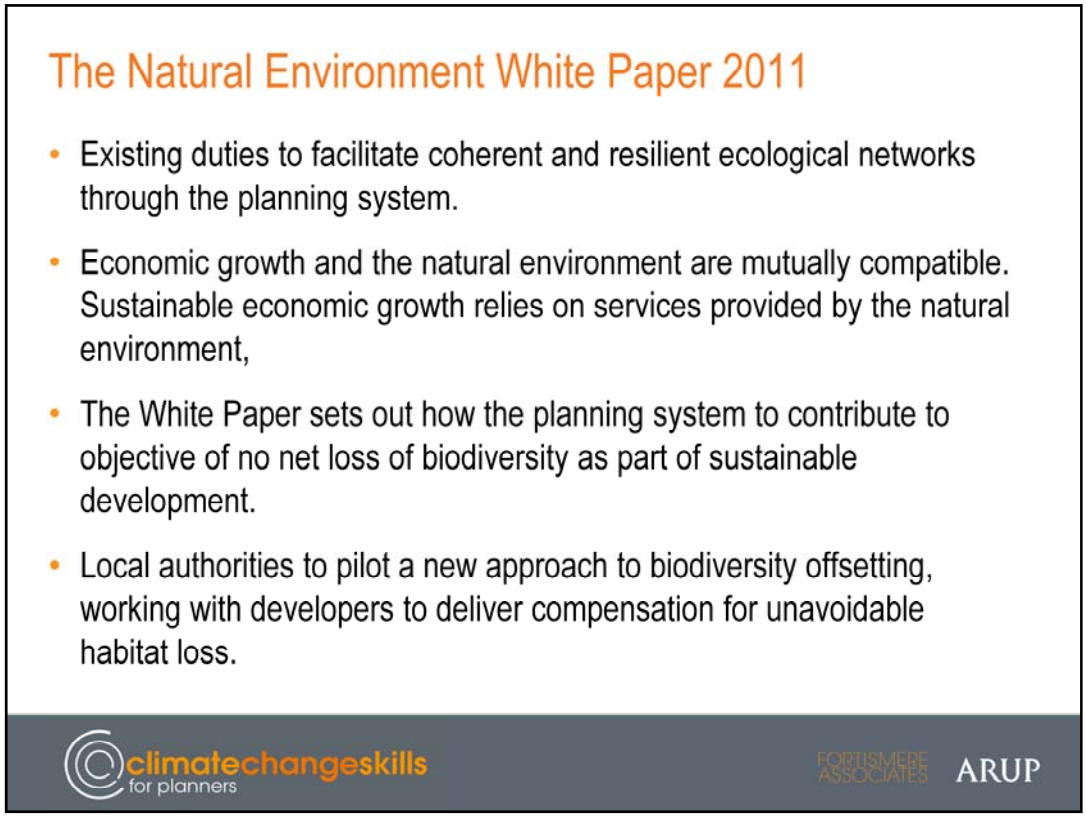
Detailing what these functions are and what the overlap with GI



Green Infrastructure is critical for robust Ecosystem Services.



Overlay types of GI/ES on the MEA framework



Local authorities have duties to facilitate coherent and resilient ecological networks through the planning system. The White Paper sets out how we expect the planning system to contribute to our objective of no net loss of biodiversity as part of sustainable development. For example, we are inviting local authorities to pilot a new approach to biodiversity offsetting, working with developers to deliver compensation for unavoidable habitat loss. Local authorities have

Economic growth and the natural environment are mutually compatible. Sustainable economic growth relies on services provided by the natural environment, often referred to as 'ecosystem services'. Some of these are provided directly, such as food, timber and energy. Others are indirect, such as climate regulation, water purification and the productivity of soil.

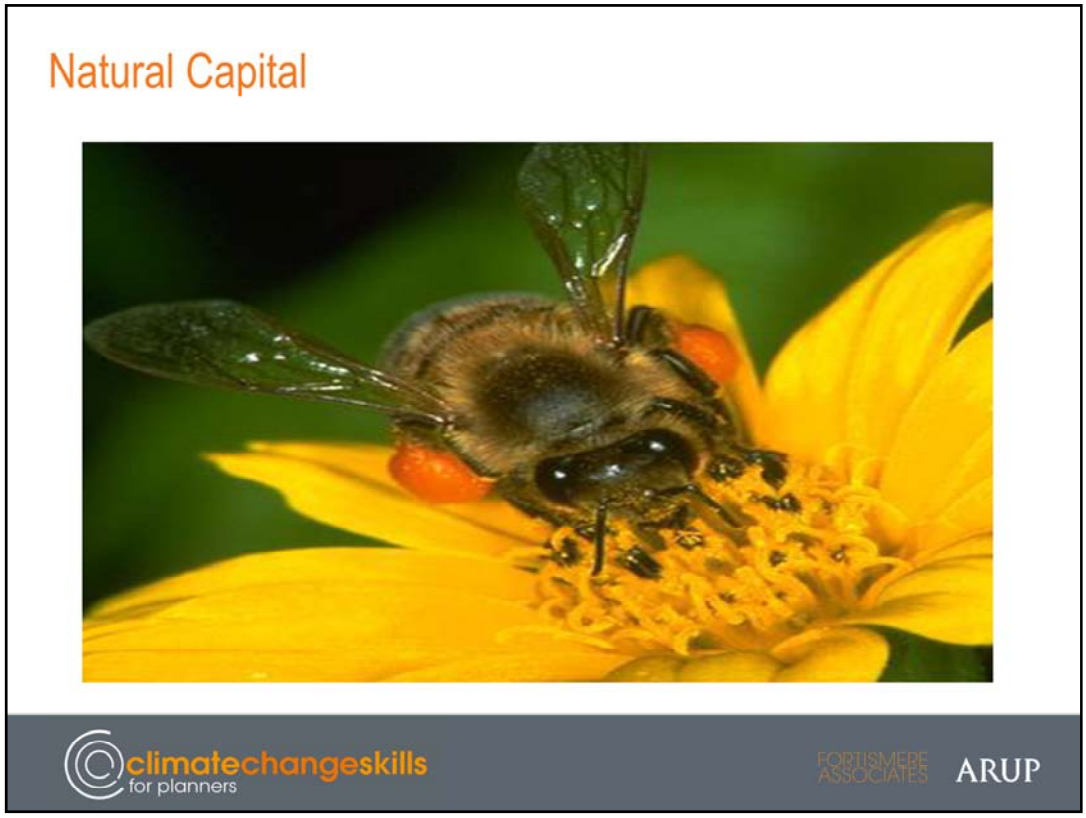
The Economics of Ecosystems and Biodiversity study shows that protected natural areas can yield returns many times higher than the cost of their protection. There are multi-million pound opportunities available from greener goods and services, and from markets that protect nature's services.

Also

NIA

LNP

And establish a Green Infrastructure Partnership to consider how green infrastructure can improve communities' health, quality of life and resilience to climate change.



ES services **underpin most of what we do** – e.g. **economic activity**

Need to be thinking about ES when you are thinking about GI

Coffee Break (30 mins)

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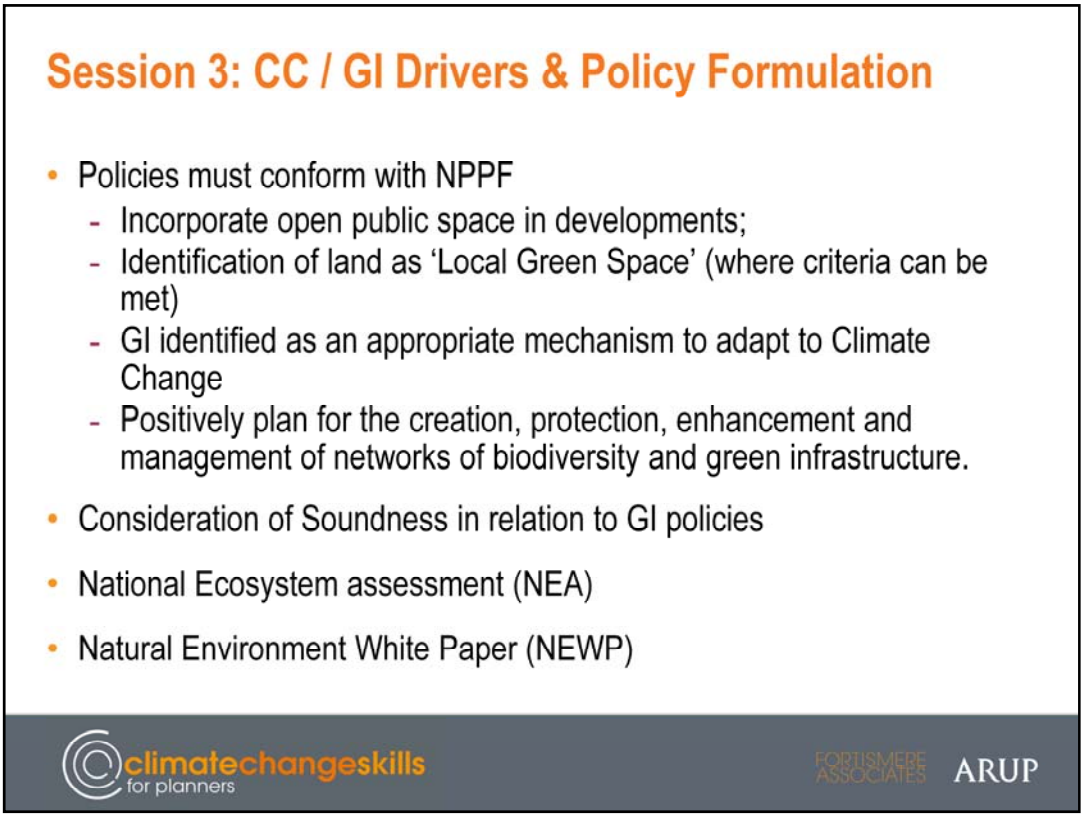

NPPF Polices on Green Infrastructure

7. Requiring good design

Para 58. Local and neighbourhood plans should develop robust and comprehensive policies that set out the quality of development that will be expected for the area. Such policies should be based on stated objectives for the future of the area and an understanding and evaluation of its defining characteristics.

Planning policies and decisions should aim to ensure that developments:

● optimise the potential of the site to accommodate development, create and sustain an appropriate mix of uses **(including incorporation of green and other public space as part of developments)** and support local facilities and transport networks;

8. Promoting healthy communities

76. Local communities through local and neighbourhood plans should be able to identify for special protection green areas of particular importance to them. By designating land as Local Green Space local communities will be able to rule out new development other than in very special circumstances.

Identifying land as Local Green Space should therefore be consistent with the local planning of sustainable development and complement investment in sufficient homes, jobs and other essential services. Local Green Spaces should only be designated when a plan is prepared or reviewed, and be capable of enduring beyond the end of the plan period.

77. The Local Green Space designation will not be appropriate for most green areas or open space. The designation should only be used:
• where the green space is in reasonably close proximity to the community it serves;
• where the green area is demonstrably special to a local community and holds a particular local significance, for example because of its beauty, historic significance, recreational value (including as a playing field), tranquillity or richness of its wildlife; and
• where the green area concerned is local in character and is not an extensive tract of land.

78. Local policy for managing development within a Local Green Space should be consistent with policy for Green Belts.

10. Meeting the challenge of climate change, flooding and coastal change

99. Local Plans should take account of climate change over the longer term, including factors such as flood risk, coastal change, water supply and changes to biodiversity and landscape. New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change. **When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure.**

11. Conserving and enhancing the natural environment

114. Local planning authorities should:
• set out a strategic approach in their **Local Plans, planning positively for the creation, protection, enhancement and management of networks of biodiversity and green infrastructure**; and
• maintain the character of the undeveloped coast, protecting and enhancing its distinctive landscapes, particularly in areas defined as Heritage Coast, and improve public access to and enjoyment of the coast.

Soundness

Recent Examination reports have generally not said very much about GI policies. They have been accepting of specific areas being identified and generally supporting GI corridors.

Additional Point: Cross boundary approach – consider how policies link with other topics – flood risk, biodiversity etc.

a lot of work is being done on GI and lots of non statutory strategies but its not always being taken into statutory plan making. To give it the bite to make it happen.

The way we make the plans is as important as the policy that is crafted, A robust approach should be holistic and not treat GI as an after thought.

The GI studies are important parts of the evidence base but its what you do with them that counts- GI should be part of your evidence base, your strategy, your allocations and your DM policy. (as well as CIL/ S106). It should be considered from the outset in the same way as other networks (e.g road and rail) to assist with locational policy and making places. The policy should also seek to link up the different assets in the network.

Its also important to make the links between areas of policy such as that for flood alleviation and SUDS, childrens play etc. And treat the spaces and links as the multifunctional entities they are instead of pidgeonholing them into a single function in policy.

Its about using this eco systems approach.

Relationship to Local Infrastructure Plan

Local Infrastructure Plan – GI should be considered, could be based on *PAS definition below*. However it is only really possible to quantify certain types of green infrastructure. For example green spaces and gardens, play areas, sports facilities and allotments. There is no way of quantifying how much moorland an area should have to support your planned housing and employment growth. So that is more about using policy to link urban areas to e.g. moorland.

Green Infrastructure – policy for on-site or a commuted sum through S106 – different LPA's have different approaches – maybe ask the group how many promote on site Vs off-site. Bradford – parks team prefer off-site even though the policy approach is for on-site. Whilst Leeds heavily promote on-site provision.

Planning Advisory Service Definition of GI - The planning advisory service has produced a range of guidance documents on how to do Infrastructure Studies. They carried out a LDF seminar in 2008 entitled Infrastructure Planning and Delivery 2008, producing a participant's resource book. \In this they define Green Infrastructure as:

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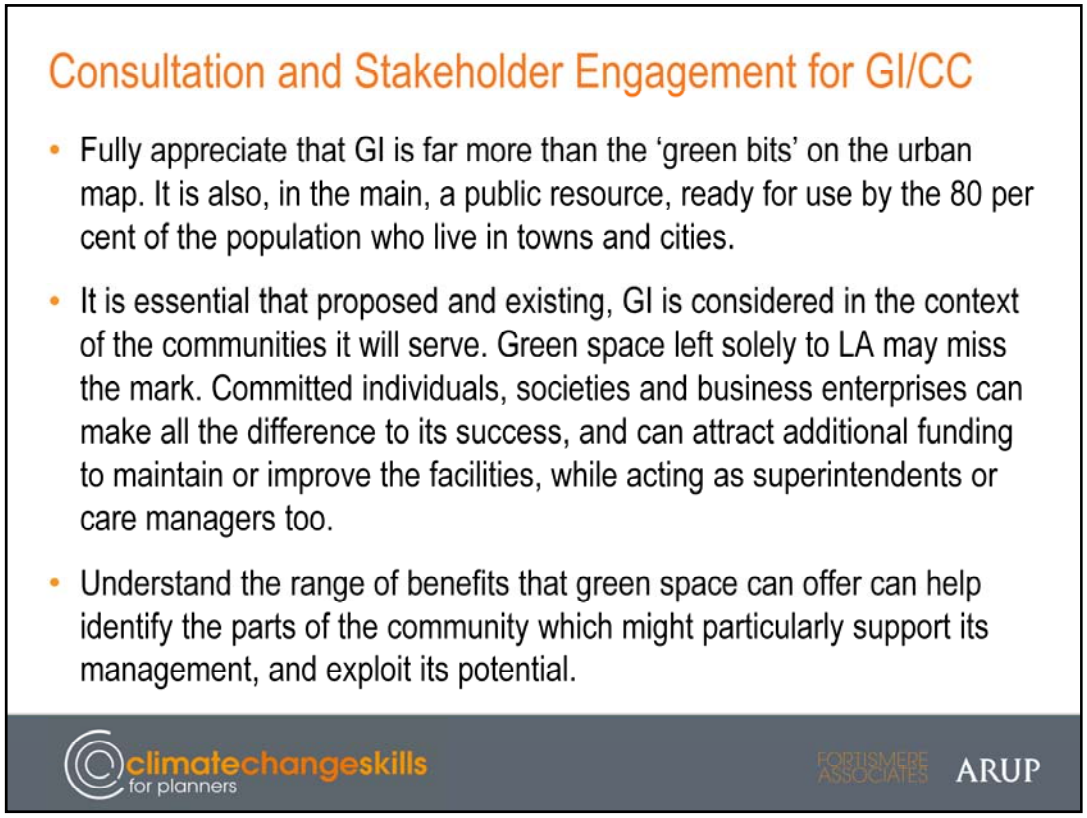
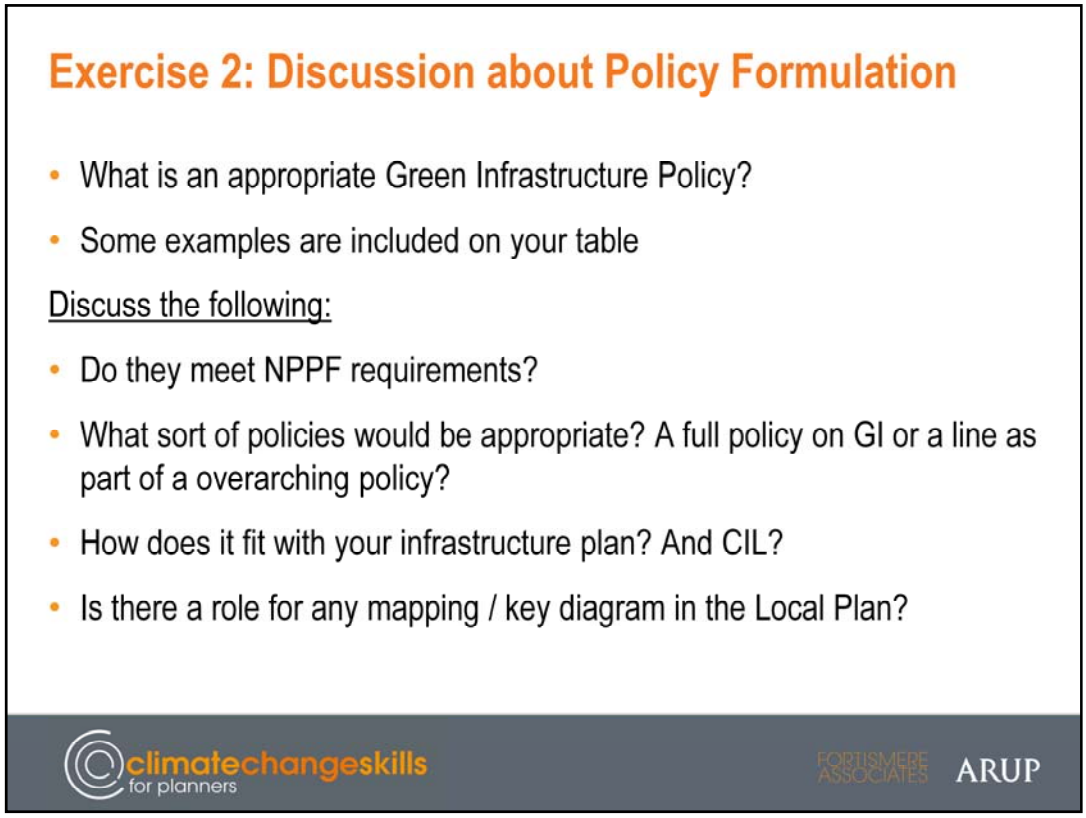
Parks, Children's play areas, sports pitches and courts, country parks, green public realm, national parks and other area management, open space forests and woodland, allotments, footpaths, river corridors, coasts, historic sites.

CIL – a number of LPAs are looking at includeding Green Infrastructure within their charging schedule

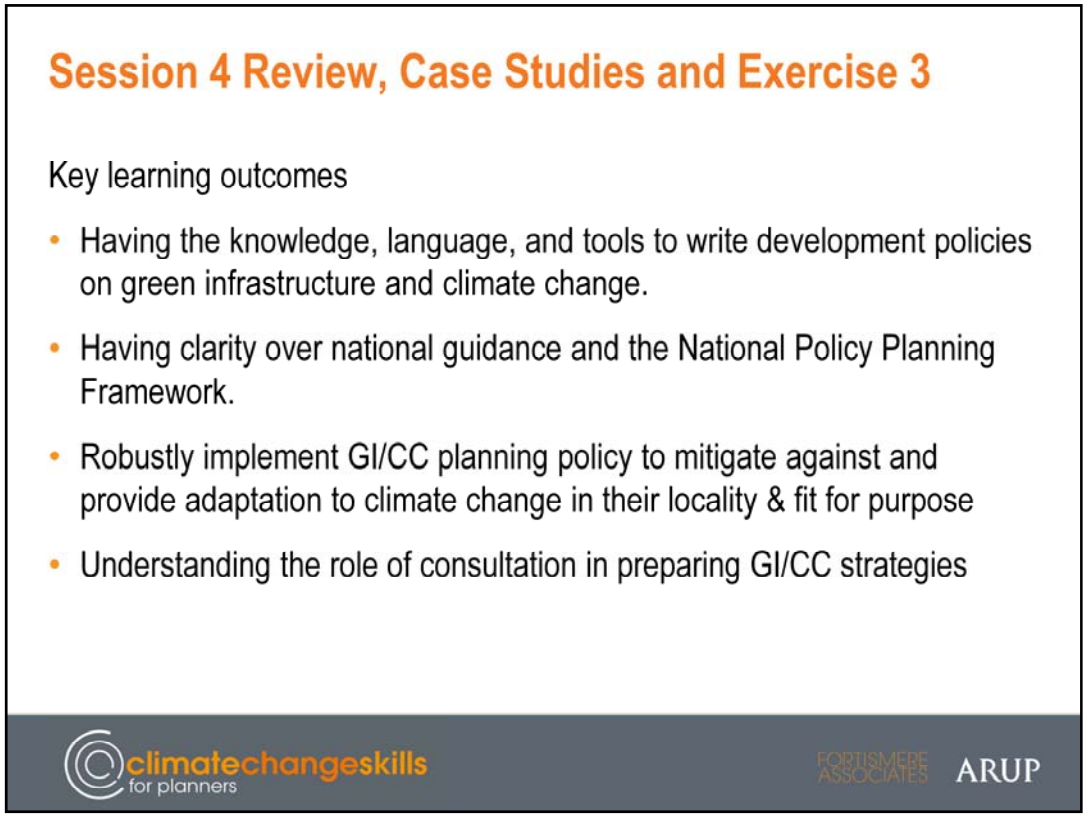


a latent demand, set against the comparatively small resource that green space still is, requires careful planning in order to maximise its cost effectiveness and its ability to deliver the most desirable goods and services in a sustainable way.

There is now considerable evidence that the most successful elements of this infrastructure are those where effort has been made to consult and, more importantly, to engage with these communities.



Please see the exercise note for details of this exercise.



1

Planning officers having the knowledge, language, and tools to write development policies on green infrastructure and climate change.

(The module provides introductions to the definitions of GI and how it relates to climate change. The training also sets out the types of GI and how this relates to blue and grey infrastructure.)

2

Having clarity over national guidance and the National Policy Planning Framework

(The training will set out the distinction between GI and its role in the emerging NPPF and the White Paper on the Natural Environment.)

3

Planning officers having the confidence to design robust green infrastructure/climate change policies which are defensible, integrate with economic and social drivers, and are sound in relation to development management.

(The training will provide specific policy guidance on GI that builds on Module 2 and sets out the key issues to consider at planning application stage.)

4

Planning officers are able to produce and verify policy that is applied and implementable on the ground.

(This will be largely covered in Module 2, however the training will focus of specific language and tools needed to write development policies on green infrastructure and climate change. This is based on best practice information produced by Arup and

Case Studies - How can GI help us adapt to climate change

Case studies and best practice

- Humberside – Paull Holm Strays Managed Re-alignment (Sea level rise and coastal protection)
- North Yorkshire – Pickering Flood Alleviation
- Bristol - Hanham Hall Integrated GI and Sustainable Housing
- South Yorkshire - Dearne Valley / Manor Fields Park Urban Regeneration
- West Yorkshire – Leeds City Region GI Strategy
- Green and Blue Space Adaptation for Urban Areas and Eco Towns (GRABS)

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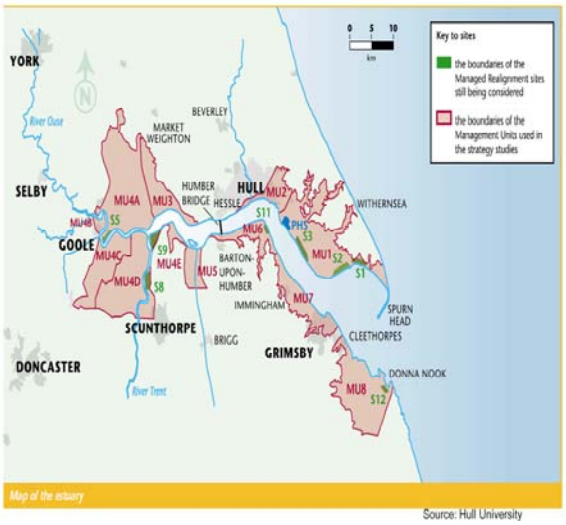
Humberside

- Sea Level Rise – Paull Holme Strays Managed Re-alignment (Sea level rise and coastal protection)



Source: Hull University

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MR on the Humber Estuary, why – current issues

1. Existing deterioration of the traditional sea defences within the Humber Catchment.

2. The loss of intertidal habitats through reclamation and coastal squeeze is of major concern in the Humber

3. Ecosystem resilience

These problems are likely to be exacerbated by climate change. Present sea level rise is calculated at 3.5mm per year and is mainly caused by the tectonic sinking of the land surface. Global warming may increase this rate to 6mm per year, so that sea levels in **50 years will be 300mm higher** (Environment Agency, 2000). Accelerated sea level rise will result in reduction of intertidal habitats by coastal squeeze. Furthermore, Foresight (2004) highlighted that estuaries and the East Coast as at high risk from coastal erosion and flooding.

- Paull Holme Strays was first site of the **first major managed realignment** scheme on the Humber – 80ha.

- MR is a **soft engineering coastal defence technique** which aims to achieve sustainable flood defence by recreating eroded saltmarsh and mudflat habitat. This is achieved by creating new defences further inland and allowing the existing defence line to breach with the land to be tidally inundated.

Created by the Environment Agency as part of a flood risk management scheme, Humber Estuary Special Protection Area (SPA), Ramsar Site and possible Special Area of Conservation (pSAC).

At 91 years old, Topsy Clinch is an active member of the Pickering Flood Defence Group and volunteered to sit for this picture illustrating the devastation flooding can cause to homes and towns.

This pioneering project makes the **best use of the natural environment** surrounding the town to store, **divert** and **slow the flow** of excess water rather than **relying on traditional defences**.

The approach includes **planting more trees, restoring wetlands, building natural dams in streams and reducing water runoff** from fields.

These techniques ultimately aim to help reduce the amount of flood water reaching the town during periods of heavy rainfall.

Presence of SSSI

The new money will help pay for the coordination, monitoring and evaluation of the next stage of the project which will include the creation of floodplain woodlands, the building of more natural dams and earth flood banks, as well as vital improvements, maintenance and monitoring work.

Hanham Hall, Bristol

- Integrated GI with Sustainable Housing

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Arup was appointed by Barratt to deliver the first carbon challenge initiative, undertaking a wide range of specialist consultancy roles in developing Hanham Hall. This new zero-carbon development will provide a mixture of houses, apartments and facilities for the community incorporating a restaurant, nursery, community hall, café and offices. This will enable the new community to lead a more sustainable lifestyle.

The Hanham Hall will contain some 180 residential units, including detached properties, townhouses and blocks of flats amongst others. All of the units will be constructed with a timber frame solution and offsite manufactured panellised systems from Kingspan. This system, together with the mechanical ventilation systems with heat recovery, preheating the incoming air, and high levels of air tightness form the basis of the strategy followed to achieve the demanding requirements of thermal efficiency required by the Code for Sustainable Homes.

Renewable energy

With 100% of the lighting being of an energy efficient nature inside the dwellings and the commercial space, the Hanham Hall development will be powered with a 100kWe biomass combined heat and power unit, delivering most of the electricity and heat required in the development.

Water

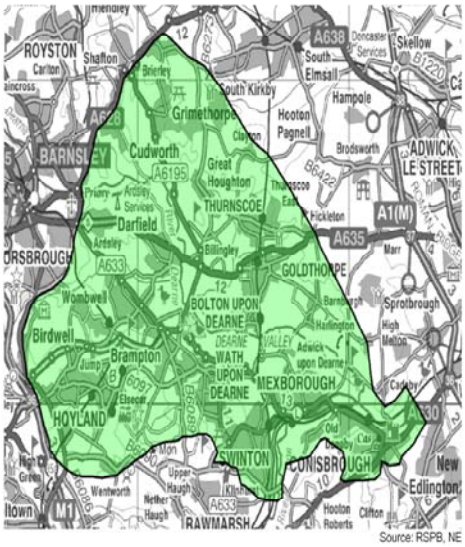
Water efficient appliances and fittings will be combined with a site rainwater collection system so that potable water consumption is limited to 80l/person/day, around 50% reduction on the typical UK consumer.

Key featuresGreen spaces, allotments, hedges, cycle and walking routes

- **First community to be completely Code for Sustainable Homes Level 6**
- **Net zero carbon**
- **Biomass combined heat and power plant**
- **Site wide rainwater harvesting**
- **Energy monitoring**
- **Landmark scheme**
- **Circa 190 dwellings and** commercial space

South Yorkshire

- Dearne Valley Green Heart Partnership - Brown field site and economic regeneration.
- Natural Improvement Area



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The Dearne Valley Green Heart partnership

The Dearne Valley Green Heart partnership (DVGH) is led by **the Environment Agency, Natural England, and RSPB together with Barnsley, Rotherham and Doncaster Councils**. Its objective is to bring about landscape-scale environmental improvements in the Dearne Valley. The three lead partners are working with a wide range of organisations including the three local authorities of the Valley and a range of environmental and community groups. DVGH is developing a programme of projects which will take several years to implement. This programme is needed **to help regeneration and face the new challenge of climate change**.

The projects the partnership is working on can be **divided in to three** main areas: **Habitats and Places; Access; People and Communities.**

The programme will build on the three principal existing 'green assets' of the Dearne Valley, RSPB nature spaces including Old Moor, the Trans Pennine Trail and the River Dearne itself.

The work of the DVGH is centred on the river corridor and in particular the washlands. Whilst fully retaining their flood management function, DVGH is working to change land-use within the washlands to biodiversity and appropriate recreation.

Nearly £600,000 is to be spent creating wildlife havens in South Yorkshire's Dearne Valley.

The area is one of 12 in England that have been chosen by the government to become Nature Improvement Areas (NIAs).

The Dearne Valley Green Heart Partnership will use the money to restore the River Don floodplain and create new woodlands and wetlands.

Vegetation Management Strategies – Network Rail

- Innovative low-cost solution to the 'shrink-swell' effect of embankments constructed on London Clay, which is being exacerbated by climate change; which causes poor track alignment, damage to lineside infrastructure and high remediation costs.
- Vegetation management as an engineering solution is a new concept to Network Rail and could result in a significant reduction in the number of remediation schemes required.

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The VMS entails a phased and specific management strategy through selective removal of high (water) demand species and subsequent rebalancing through the replanting of less demanding species.

The rotational approach is critical to alleviate sudden movement issues and potentially address predicted impacts of climate change.

Vegetation management as an engineering solution is a new concept to Network Rail and could result in a significant reduction in the number of remediation schemes required.

Energy and waste is also minimised.

The main driver is to enhance one of the most sustainable forms of transport, reducing carbon, delays and costs and improving the level of service for Network Rail

Manor Fields Park, in the Manor Housing Estate, Sheffield, has taken formerly derelict land in an area of high deprivation and transformed it into a place of enjoyment and delight. Development of the project took place gradually, showing sensitivity to the natural environment and ensuring that future maintenance costs would be carefully controlled. The local community was closely engaged in the design of the site and continues to play an active role in its management.

Manor Fields Park contains a range of wild spaces in addition to innovative landscaped areas. Within these there are opportunities for children to play, not only on the brand new playground but also in the trees, streams and grassed areas. The site has over 4km of footpaths, as well as smaller paths in order to encourage exploration of the wilder, hidden areas.

A sustainable drainage system (SuDS) has removed the need for underground engineering. The SuDS scheme used the site's existing landscape and character as a basis for design. This was put to the test during the floods of summer 2007 and performed well. Floodwaters were contained and within four days the site was being used once again as a community open space.

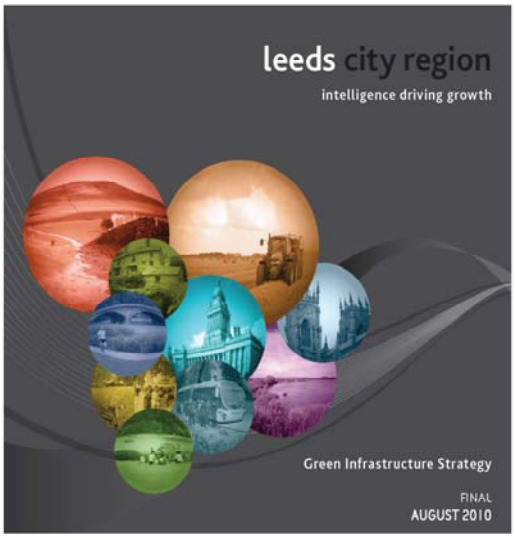
The recent completion of a formal 'Gateway' now connects the park via good public transport links to the whole of Sheffield making it truly a regional park and not just one for local people. Innovative design has continued with the implementation of another SuDS scheme incorporating a water garden.

The development of Manor Fields Park, through cooperation between Sheffield City Council and stakeholders, has added significantly to the regeneration of the area, creating an inspiring, safe and welcoming high-quality space for residents and visitors alike. The approach has resulted in an environment which is well adapted to future climate change.

(Landscape Institute - Local Green Infrastructure: Helping communities make the most of their landscape)

West Yorkshire

- City Region Approach - Leeds City Region Green Infrastructure Strategy
- Planning for growth and climate change adaptation



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The Leeds City Region partnership comprises the districts of Barnsley, Bradford, Calderdale, Craven, Harrogate, Kirklees, Leeds, Selby, Wakefield, York and North Yorkshire County Council. It has a £51bn economy, over 100,000 businesses and over 3 million inhabitants. It is the largest economic and population centre in the country outside London. Against this backdrop, local authority and business leaders came together and submitted a proposal to Government to be granted Local Enterprise Partnership (LEP) status in September 2010.

LEPs are partnerships between local authorities and businesses which play a central role in determining local economic priorities, driving growth and job creation within their boundaries. The Leeds City Region proposal was approved by Government in October 2010.

A key feature of the submission was the green infrastructure strategy, which contains a number of investment programmes highlighting the ways in which green infrastructure delivers a wealth of economic, and other, benefits. The strategy maps existing aspects of the natural environment and suggests how this can be enhanced and new features added in order to increase the number of benefits. A delivery plan for the strategy's flagship project, Fresh Aire, will be developed in 2011 in order to ensure the thinking in the strategy is translated into reality on the ground.

The strategy contains an investment programme designed to to minimise the effect of new development on future climate change. In recognition of increased flooding and higher temperatures, particularly in towns and cities, the strategy proposes a number of green infrastructure interventions such as increased tree planting and the greening of urban areas.

Another aspect of the strategy focuses on enhancing green infrastructure on derelict sites to improve local environmental quality, thereby increasing the attractiveness of the area to developers and investors. In order to continue to deliver strong, yet sustainable, economic growth it is crucial that the city region continues to improve and make best of use of its natural environment. The Leeds Region green infrastructure strategy will be central to achieving this.

(Landscape Institute - Local Green Infrastructure: Helping communities make the most of their landscape)

The GRaBS project is a network of leading pan-European organisations involved in integrating climate change adaptation into regional planning and development.

To help develop better understanding of climate risks and demonstrate effective climate adaptation strategies the GRaBS project will help organisations and individuals by sharing results and best practice.

Southampton, Low Carbon City Strategy, 2011 – 2020

This is a non-statutory document that sets out how Southampton plan to become a low carbon city.

Climate Change Adaptation Strategy, Malmo City

Northwest Regional Development Agency 'Framework for Action' (Adaptation Action Plan), 2011

The first GRaBS adaptation action plan, 'A Framework for Action', has been developed by Community Forests Northwest on behalf of the NWDA. It sets out green spaces such as parks, gardens, trees, green roofs, rivers, and floodplains can be used to mitigate and adapt to climate change in urban areas throughout the region, including Cheshire, Cumbria, Greater Manchester, Lancashire, and Merseyside. The new Framework for Action sets out comprehensive actions to ensure that green infrastructure is planned, designed, and managed by all relevant stakeholders, involving and engaging local communities, in order to combat climate change and deliver wider benefits.

Adaptation Action Plan Guidance

01-01-2010 - TCPA

Guidance to assist the partners of the GRaBS Project with the production of their AAPs

http://www.grabs-eu.org/casestudies.php

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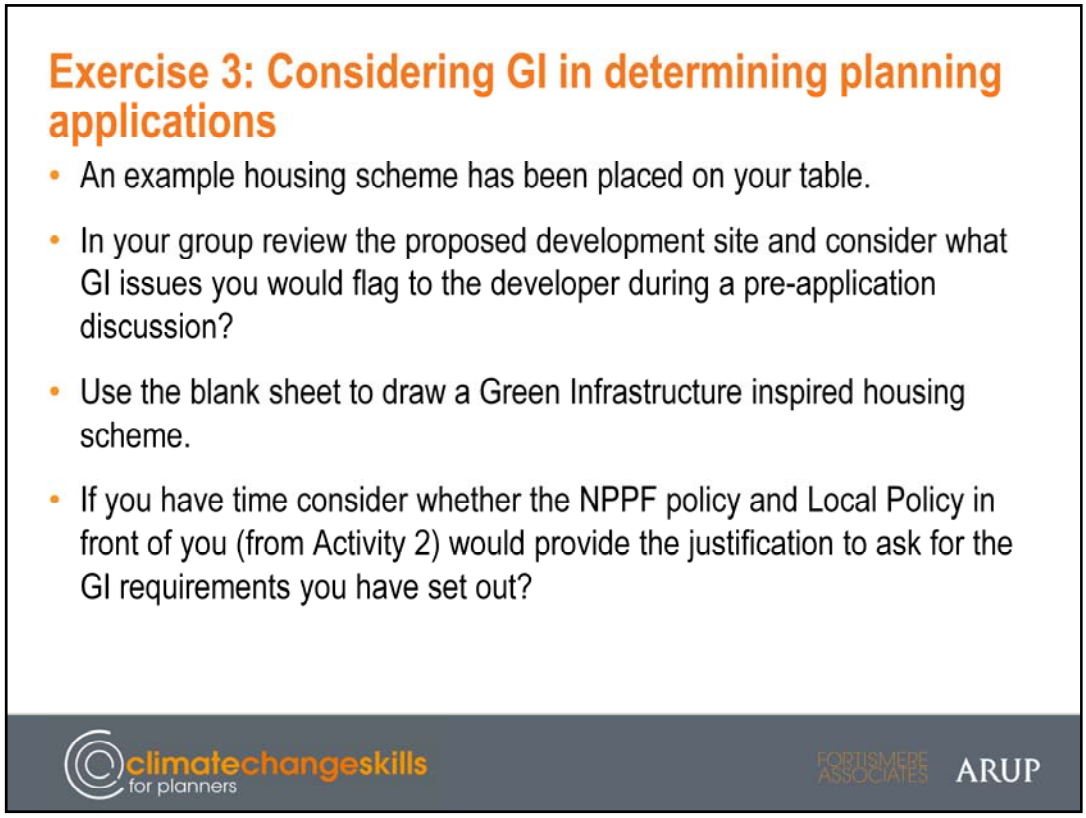

The exercise crib sheet includes more information on this exercise.

Signposting and Resources (1)

- **Yorkshire and the Humber Green Infrastructure Mapping Project, Natural England, 2010**
  http://www.naturalengland.org.uk/regions/yorkshire_and_the_humber/ourwork/yandhgreeninfrastructuremappingproject.aspx
- **Biodiversity Mapping by Natural England :**
  http://www.natureonthemap.naturalengland.org.uk/map.aspx?m=int_sites
- **Green Infrastructure and the Regional Spatial Strategy for Yorkshire and the Humber: Developing the evidence base, a report for the Regional and Humber Assembly, 2008**
  http://www.yhassembly.gov.uk/Our%20Work/Regional%20Planning/Regional%20Spatial%20Strategy%20Partial%20Review/Evidence/Infrastructure/Green%20Infrastructure/

Signposting and Resources (2)

- **Benefits of Green Infrastructure, Report by Forest Research, October 2010**
- http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=17&ved=0CF8QFjAGOAo&url=http%3A%2F%2Fwww.forestry.gov.uk%2Fpdf%2Furgp_benefits_of_green_infrastructure.pdf%2F%24FILE%2Furgp_benefits_of_green_infrastructure.pdf&ei=Vw3PTm3MMng8AOur9y3DA&usg=AFQjCNGYlsKZIYSQaZnmvJDF4Bs84UimTg&sig2=s8cO5GWHRt932MinMTwI-g
- **South Yorkshire, Green Infrastructure Strategy, 2011**
  http://www.syforest.co.uk/projects.php?p=273
- **Natural Environment and Rural Communities Act (2006)** – includes a duty for public authorities to conserve biodiversity (including LPAs)
  http://www.legislation.gov.uk/ukpga/2006/16/contents

Signposting and Resources (3)

- **Green and Blue Space Adaptation for Urban Areas and Eco Towns (GRaBS)** For more information: http://www.grabs-eu.org/casestudies.php
- **The Natural Environment White Paper 2011** - encourages the joining up of partnership work and integration of activity to achieve multiple benefits from green infrastructure It includes Local Nature Partnerships and links to Local Economic Partnerships (LEPS) http://www.defra.gov.uk/environment/natural/whitepaper/
- **National Ecosystem Assessment (NEA)** - assessed the economic and social benefits we gain from the natural environment http://www.defra.gov.uk/environment/natural/uknea/