Green Infrastructure: concepts, perceptions and its use in planning

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What is Green Infrastructure all about?

Parris Glendening 59th
Governor of Maryland

Key words and phrases to consider:

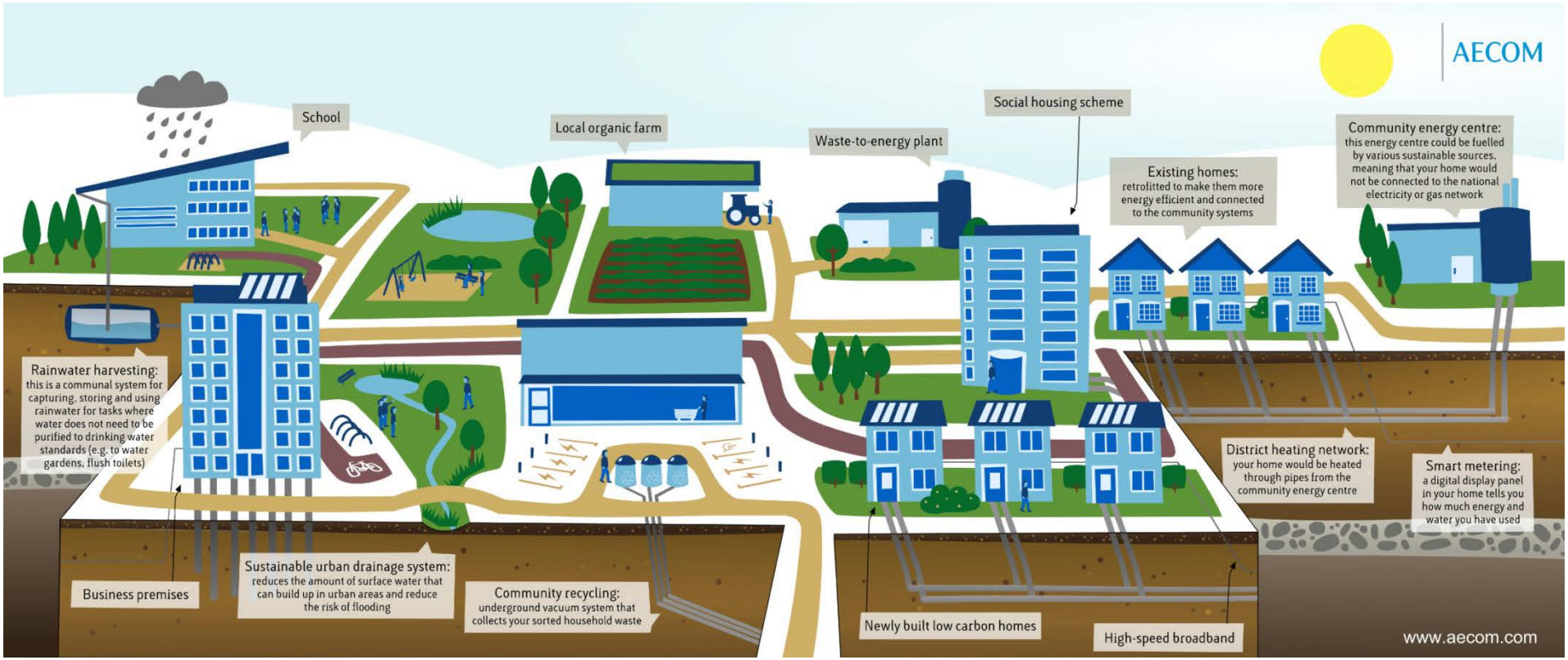
Green, Infrastructure, Planning, Urban, Landscape, Space, Environment/al, Management, Scale, Value

Green Infrastructure: principles

- Integrated approach to investment in urban (and urban-rural interface) environments
- Holistic understanding of systems and their supporting capacity
- Promotion of cross-boundary implementation
- Connectivity between/across urban locations
- Delivery of multiple benefits simultaneously
- Diverse range of investment options
- Long-term and strategic approach to the investment and management of urban environmental resources

(Benedict & McMahon, 2006; Beatley, 2000; Tzoulas et al., 2007; Gill et al, 2007; Ahern, 2007; Kambites & Owen, 2006; Weber, Sloan & Wolf, 2006; Mell, 2009; 2010; 2013)

What is Green infrastructure?



Assessments (and graphics) of this nature have been produced by the EU, US EPA, The Conservation Fund (USA), Natural England, The Heritage Conservancy (USA), England's Community Forests in order to explain the complexity and interactivity of Green Infrastructure functions. The success of this process has been varied.

We can, and should, also ask questions whether we're looking to *develop new resources*, *retrofit existing ones* or attempt to *integrate* a range of Green Infrastructure resources within our urban environments.

We also needs to evaluate whether Green Infrastructure is simply rhetoric/greenwash (i.e. India) or an actionable form of sustainable urban development (i.e. western Europe)

Green infrastructure (GI) provides planners, developers and citizens with opportunities to rethink their relationships with the environment.

This can lead to innovations in spatial form and application of GI and the creation of multi-functional landscapes (i.e. connectivity and spatial distribution of resources)

Conceptualised cycle-super highway, London

'Green Finger Plan' Copenhagen

Key principles:

Green Infrastructure brings together the key ideas of integration, diversity, innovation and a strategic investments/interpretation of urban environments

Stockholm - Lehmann (2011)

This is achieved through:

Better housing, better (and more focussed) greening, consideration of climate change (adaptation and mitigation), improved street scene, human-environmentally conscious, consideration scale

Grey-Green continuum – How do we value it?

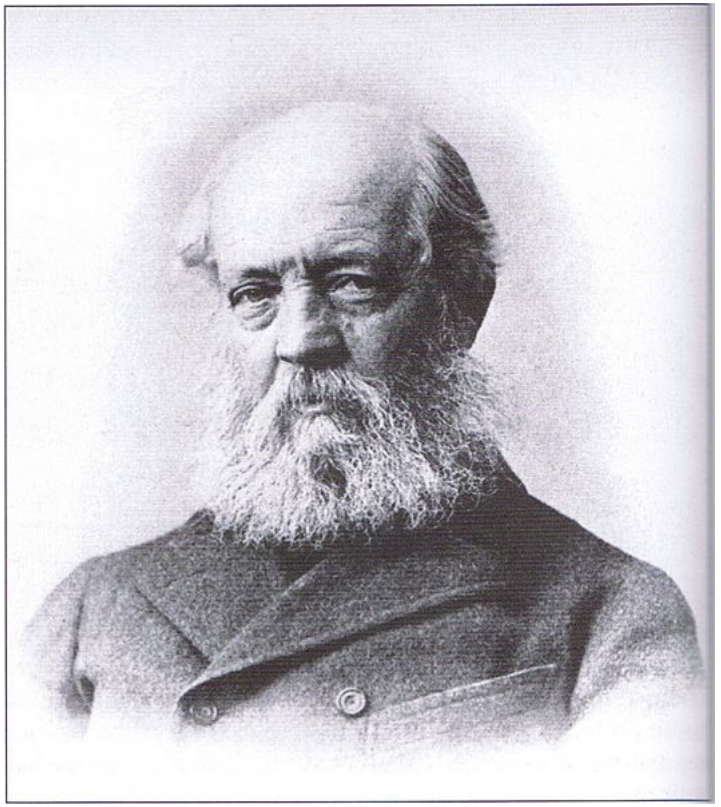
This also raises the question of what should we be valuing in green infrastructure research/practice?

Figure 2. The grey–green continuum.

Davies et al.(2006 - Green Infrastructure Planning Guide: Version 1) outlined a number of projects which could be classified as green infrastructure but raised the question of whether they should be valued as ‘grey’ or ‘green’ landscape elements

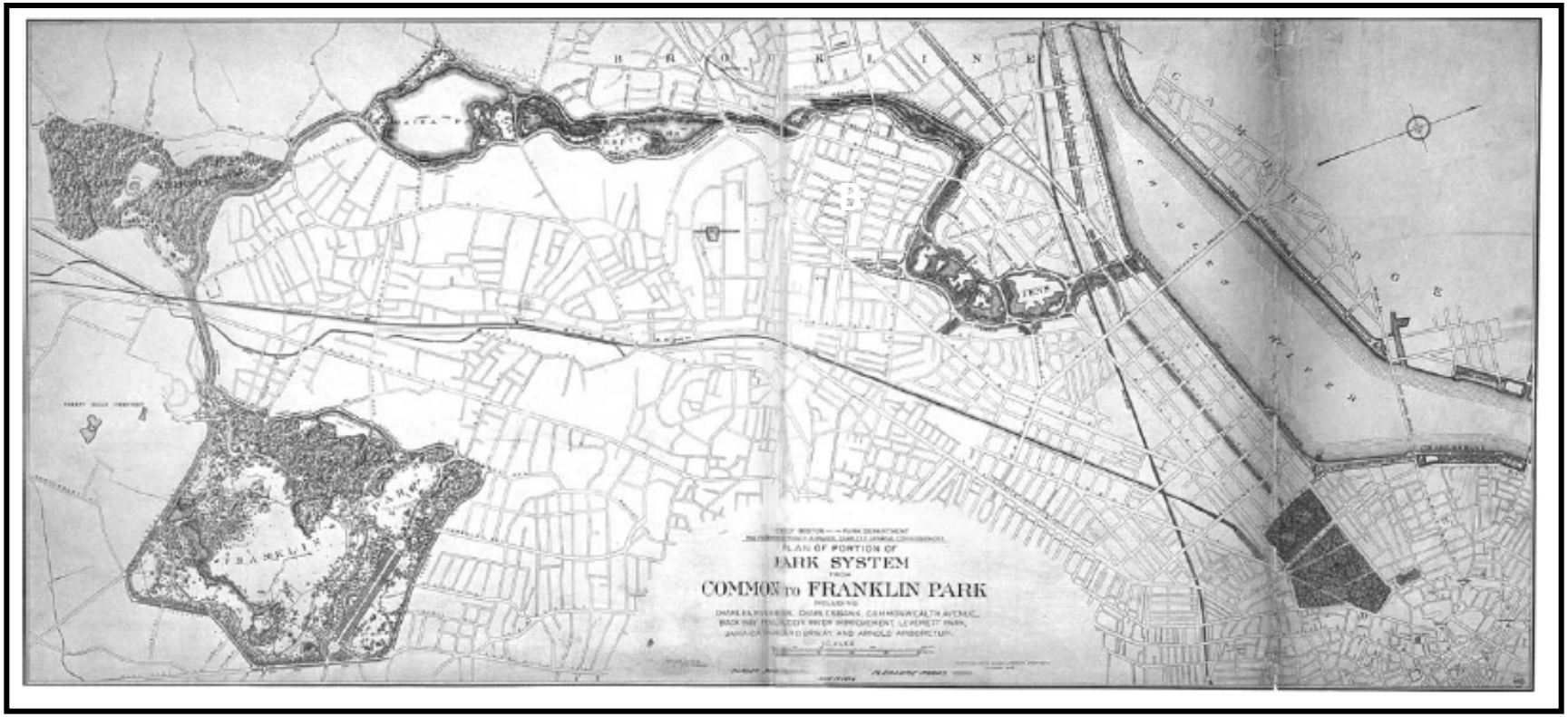
Concepts:
1. Howard's Garden Cities and Olmsted's Greenways

Sir Ebenezer Howard
(1850-1928)



Frederick Law Olmsted
(1822-1903)

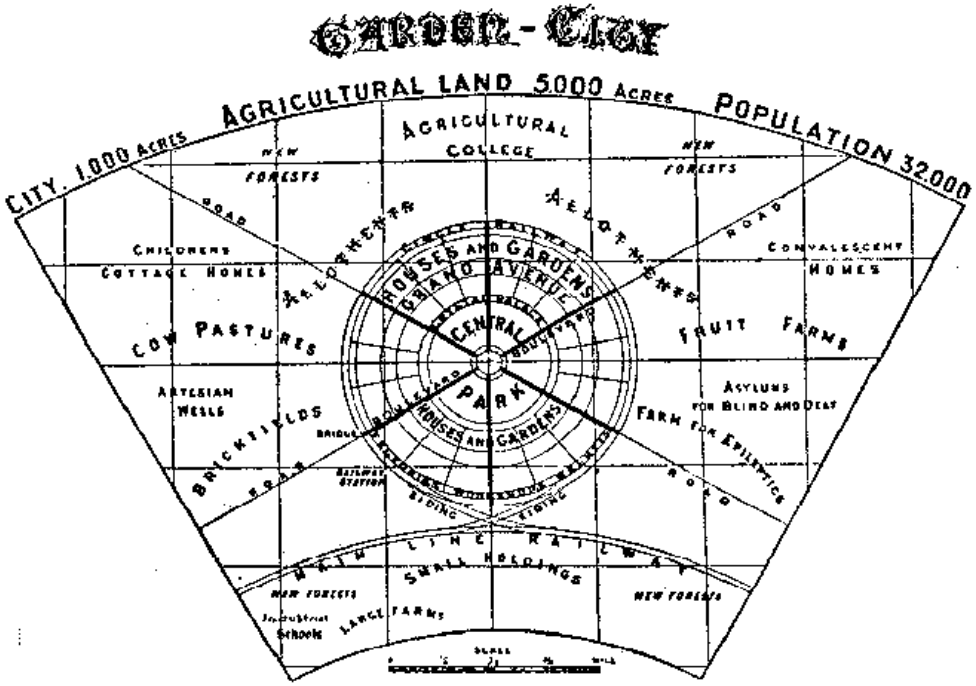
What is the Boston Emerald Necklace (1878) for?

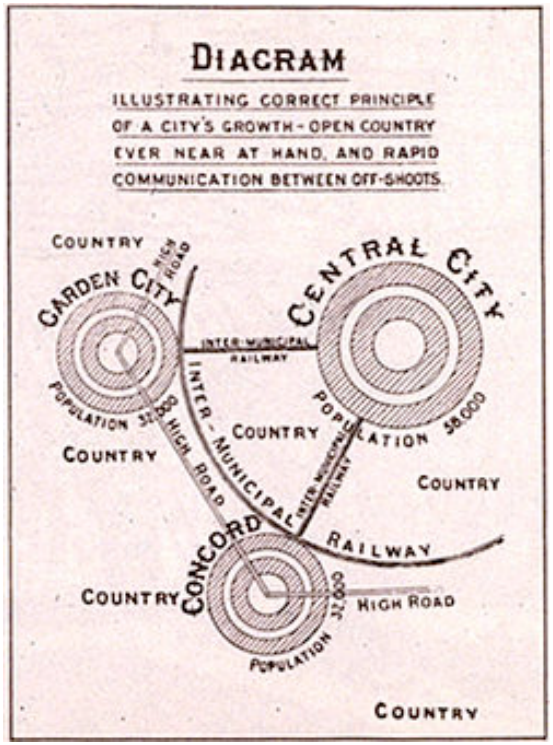


Originally – 7 mile long flood mitigation and pollution control

Now – it is promoted as a multi-functional greenway addressing sustainable drainage and flood control, tourism, recreation, promotes well-being, increases access to linear mobility features, and supports biodiversity/habitats for migratory birds.

Blending the agricultural with the urban – creating what we know as Town & Country planning. Howard identified the role of a diverse, yet functional and accessible, urban environment as the key to a more sustainable life.

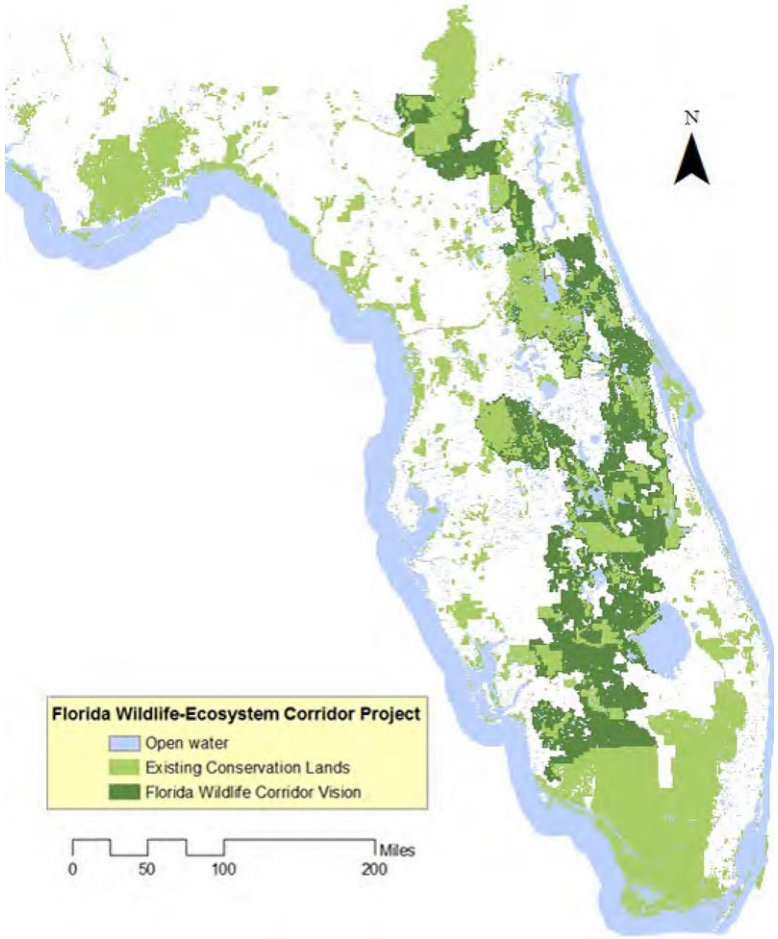




Howard also saw the value of linkages proposing that smaller cities be connected to larger urban areas through greenways and more efficient public transport (i.e. railway) systems.

2. Landscape Ecology and scale

- Again, supporting, competing and complimentary networks are important
- Fragmentation and physical isolation become more prominent as scale increases
- Investment, management and evaluation can occur at a number of scales – as ecological networks are not constrained by physical boundaries (admin/legal)
- At an international scale Landscape Ecology looks at ecosystem functionality, services and values; whilst at a sub-national scale it also looks at species.
- The larger the scale the greater the input from a number of systems and processes



(Benedict & McMahon, 2006; Hellmund & Somers Smith, 2006; Rouse & Bunster-Ossa, 2013)

3. Multi-functionality

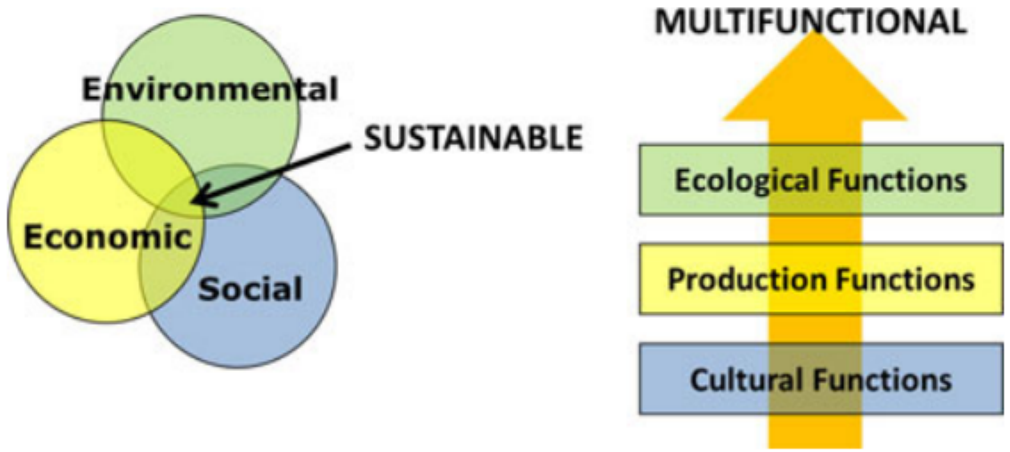
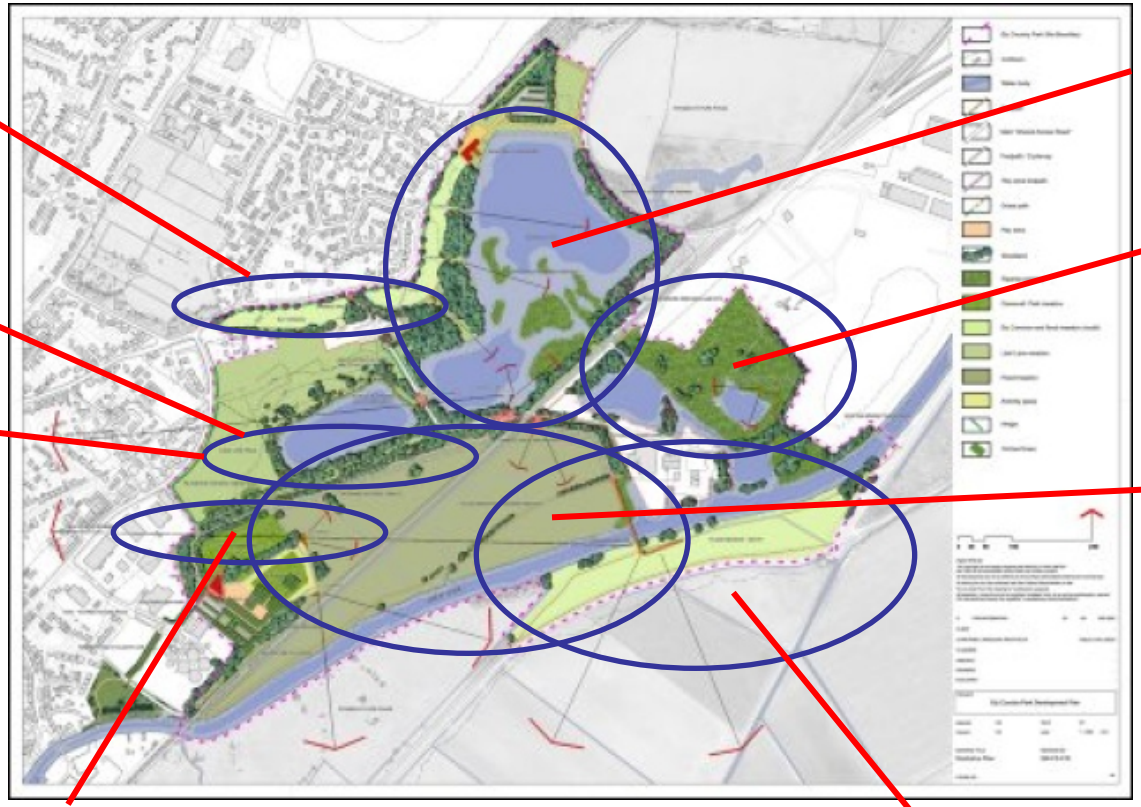


Fig. 1 Comparison of the concept of sustainable with that of multifunctional. Sustainable is often represented by the overlapping of environmental, economic, and social pillars, whereas multifunctionality can be envisioned as the stacking of ecological, production, and cultural functions to achieve greater overall performance

Lovell, ST and Taylor, JR (2013) Supplying urban ecosystem services through multifunctional green infrastructure in the United States. *Landscape Ecology*, 28, 1447-1463.

Ely Country Park (local scale multi-functionality)



Such developments have very complex/delicate visioning/management programmes that need to reflect a range of objectives and possible outcomes (ECDC, NE, WT, Ely Wildscape)

4. GI and Water Management

As land pressure builds - green and blue must be recognised as providing numerous and essential services, and to be embedded into planning and funding priorities to increase resilience

- green space can reduce run off and increase natural infiltration

- tree planting and green roofs to increase interception levels, along with permeable paving options to reduce surface run-off

- river and floodplain restoration to help alleviate flood risk and reduce the reliance on “hard” defences

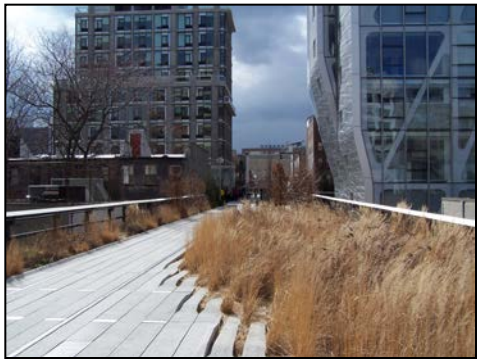
GI offers multiple benefits - by working with nature these can reduce our reliance on “hard” and costly management approaches

Qian’an City, Hebei Province, China
http://www.landezine.com/index.php/2012/01/ecological-coridor-landscape-architecture/

Water management practices that utilise natural systems approaches to regulate inputs and outputs offer one of the most effective and efficient form of urban GI investment.

Portland, OR

Perceptions: Understanding components of the landscape



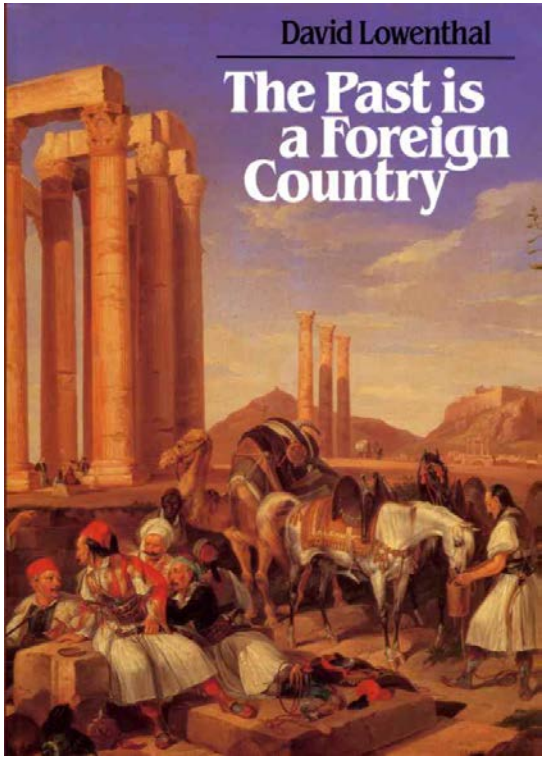
Key question:

What are we actually looking for/at in a GI landscape?

- What are we looking at?
- How do we value it?
- Should GI be viewed from an economic, social or environmental perspective?
- How do these things change depending on your geographical and cultural position?

- How do all these things influence how we value and manage the environment?

“The past is a foreign country; they do things differently there” Hartley (1953) The Go-Between



“The past is everywhere. All around us lie features which, like ourselves and our thoughts, have more or less recognizable antecedents. Relics, histories, memories suffuse human experience. Each particular piece of the past ultimately perishes, but collectively they are immortal. Whether is it celebrated or rejected, attended or ignored, the past is omnipresent.”

D. Lowenthal (1985) The Past is a Foreign Country

In Lowenthal’s research he explore the value of the contemporary landscape against a lens of what has gone before. He concludes that whilst **change is inevitable**, that current landscape perceptions are in fact **heavily influenced by aspects of the historical environment**.

Social values/interpretations of landscape



As Kevin Lynch (The Image of the City, 1960) states our perceptions of the environment are not static but are based on a constant adjustment to our surroundings. From this we extract structure, identify and meaning and place values on the visual, as well as, the physical and cultural materials we are faced with.

Therefore to understand the three images you need to have an orientation of Vancouver and Copenhagen, the physical environment of those cities, plus knowledge of the social value of each of these landscapes.

North America ecological linkages/spatial distribution– Kevin Lynch

Landscape Ecology principles are visible in a number of other urban planning texts.

The key to their use is the spatial distribution and networking capacity of urban areas, which draw on a number of social and ecological landscape elements:

- The Image of the City - hubs, links and nodes
- Socio-Ecology – perceptions and interactions with the landscape which link use, value and location
- Shaping cities through networks and connective pathways

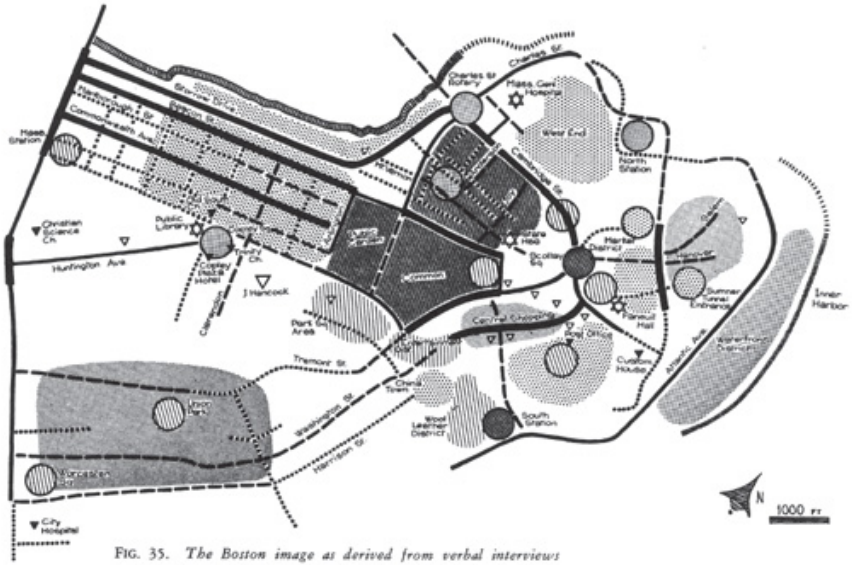


FIG. 35. *The Boston image as derived from verbal interviews*

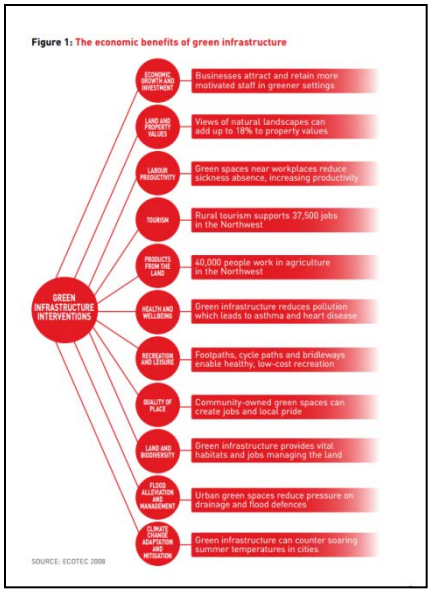
FIG. 14. *The visual form of Los Angeles as seen in the field*

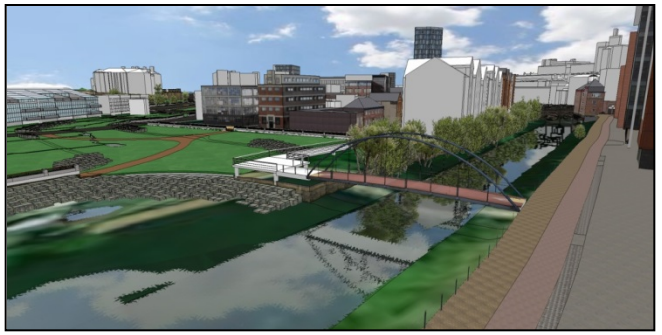
Ecological value/interpretations of landscape

Jorgenson and Keenan (Urban Wildscapes, 2012) argue that ecological values and perceptions are often placed within the context of dilemmas. They note that people think *that GI is valuable* but are often unable to define *what is valuable about them*.

Normative approaches to development may therefore minimise the priority of biodiversity and GI as it is deemed to be 'less' important. However, these locations: Wicken Fen (Cambs), Fredericksburg (Copenhagen) and Bryant Park (New York) all have a major impact on the climatic and ecological functionality of their respective locations.

Economic value/interpretations of landscape





Natural Economy Northwest (The Economic Value of Green Infrastructure, 2009) and Mell et al (2012a; 2012b; 2013) debated how the establishment of economic values for GI are constrained, like ecological valuations, by a lack of awareness of the functionality of green resources.

They argue that economic, i.e. financially driven, perceptions manifest themselves when people are asked their opinions. Unlike other authors (i.e. Herrington, 2009) they suggest that economic valuation does not have to conform to an innate interpretation perspective but can be considered to be a learnt experience (i.e. life experience = economic value).

Research assessing the value of urban forests in Finland illustrated similar results noting that valuation was most frequently ascribed to GI when people were exposed and questioned about it (Tyrväinen, 2001; Tyrväinen and Väänänen, 1998)

Financing the *tangible* and *intangible*

Can GI valuation be broken down into a simple equation?

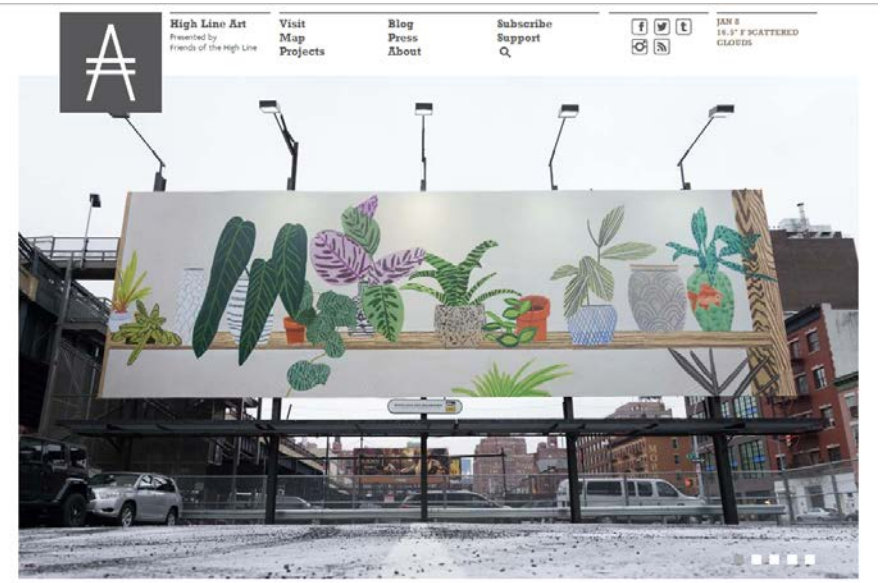
$$WTP = \frac{(L + T + PG + SE)}{(R/T + BI)}$$

WTP: Willingness to Pay
L: Location
T: (GI) Treatment
PG: Perceived greenness
SE: Socio-economic variables
R/T: Existing rent/mortgage/taxes
BI: Existing built infrastructure

Mell & Allin (2014) Evaluating the role of high quality 3D-visualisations in establishing economic valuations for urban green infrastructure investments. envecon 2014: Applied Environmental Economics

The High Line, New York:

The High Line in New York challenges people to reimagine what they know about the environment, the layout and the value of New York City.



The reinstatement of biodiversity and GI into the core of Manhattan has been part of a wider New York GI Plan (PlaNYC) to increase the proportion of GI in the city, as well as, making people more aware of its value. This challenges people to think beyond Central Park as New York's only important green space.

Green Infrastructure development priorities and needs assessments

Initial conceptualisations of GI (1998-2008)

- Small number of objectives
- Small number of outputs
- Use of land use data sets (i.e. NLUD)
- Spatially specific (local assessments)
- Initial conceptualisation focussed on developing tools
- Very limited funding to develop process and policy

Second generation GI research (2008 -)

- Wider breadth/complexity of objectives
- More diverse interaction with advocacy and government in development process
- Spatially diverse
- Strategies looked to identify funding sources
- Development of new classifications and samples
- Thematically focussed (very diverse)

The transition from the initial conceptualisation of Green Infrastructure to its current form placed on a number of pressures on those people trying to develop its concepts, principles and applicability as a form of planning (Mell, 2010; 2013, 2014)

Spatial differences in GI development (policy and practice)

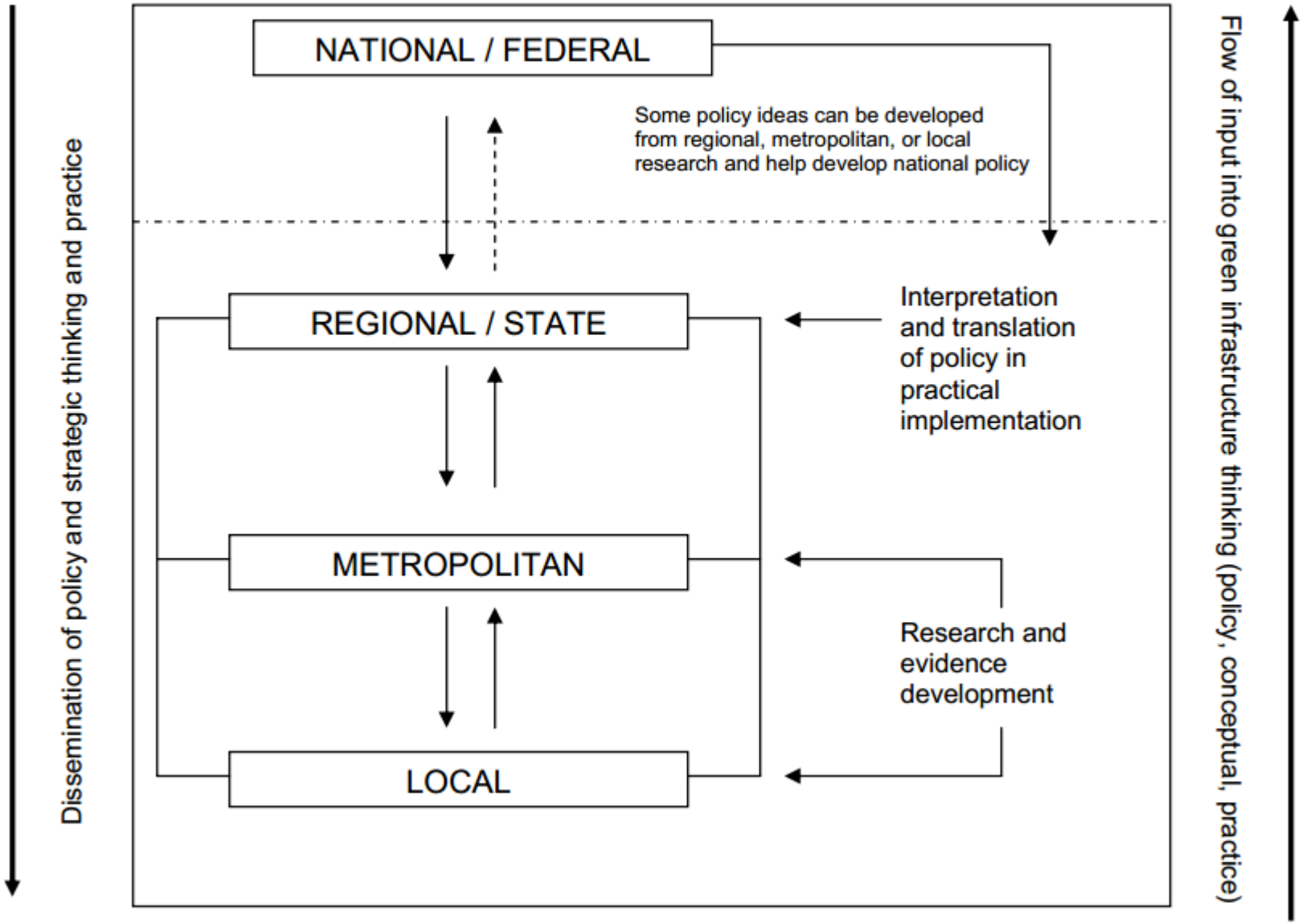
UK: Integrated, holistic, strategic, somewhat reactive, terrestrial resource focus

North America: Water-centric, environmental management-engineering focussed, moving towards an integrated human-environmental focus

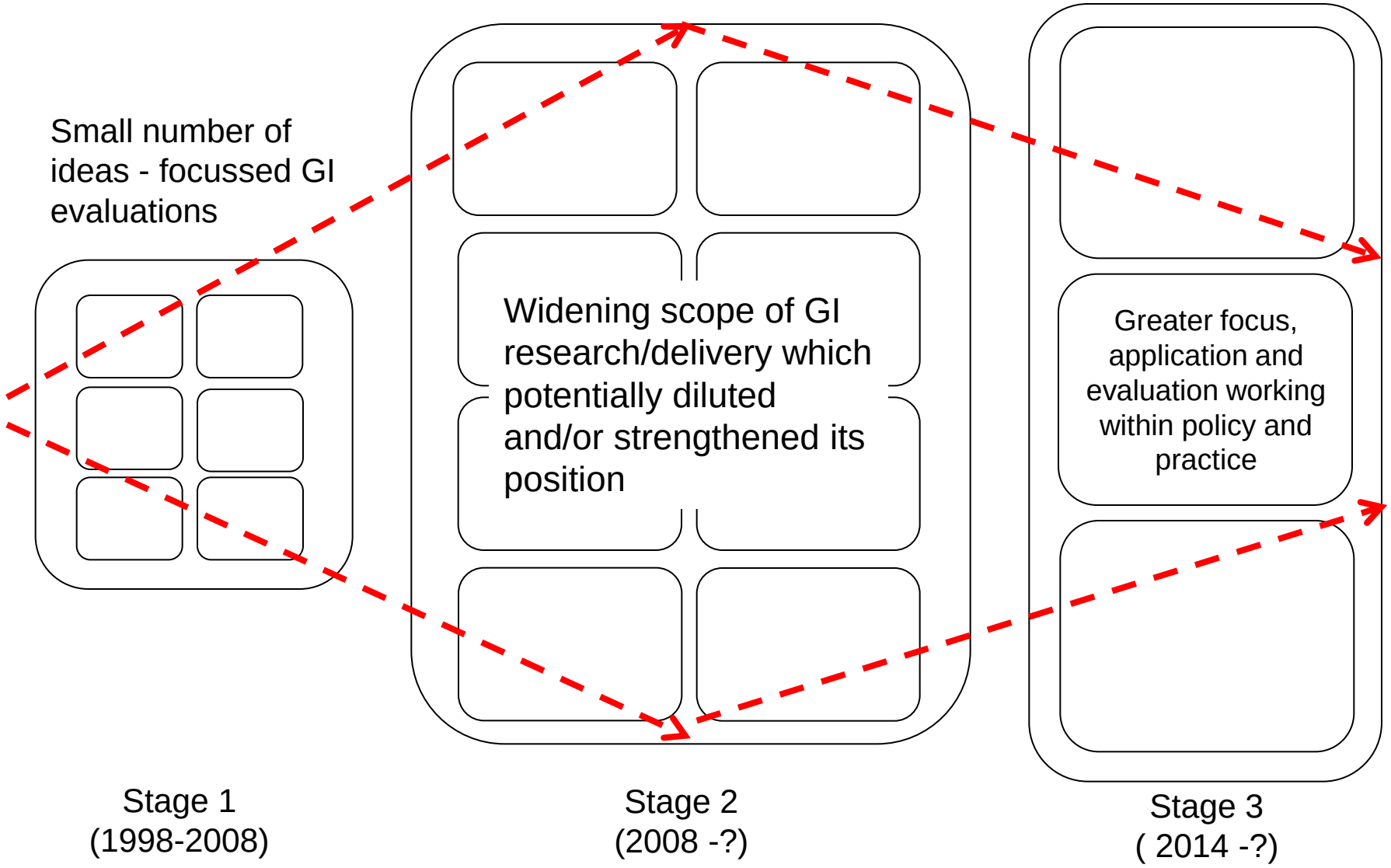
EU: Integrated, increased awareness of development pressures (land availability issues), integrated water management, human-environment focussed

There is also a growing literature focussing on GI development in Asia (China, South-East Asia, India and Pakistan). However, to date there is a less well defined narrative of how, why and what focus GI investment takes in these location.

Figure 9.4 Development of green infrastructure thinking



The progression of Green Infrastructure planning (scale, depth and focus)



Global discussion/use of Green Infrastructure principles:

Green – extensive, Amber – moderate, Red – weak discussion (Mell, forthcoming 2014)

GI Principle	UK	USA	Europe	Asia	Australasia
Sustainability					
Multi-functionality					
Accessibility					
Connectivity					
Social Benefits					
Ecological Benefits					
Economic Benefits					
Ecosystem services					
Scaled					
Integrated policy					
Holistic planning approach					
Water management					
Engineered					
Climate Change					
Co-ordinated					
Funding					
Long-term values					
Urban					
Rural					
Government policy					
Regional/local policy					
Government led					
Regionally/locally led					
Advocacy policy					
Advocacy led					

Based on:

Ahern, 2007; Allen III, 2012; Beatley, 2000; 2009; Benedict & McMahon, 2006; Boyle et al., 2013; Gill et al., 2007; Hellmund & Smith Somers, 2006; Horwood, 2011; Kambites & Owen, 2007; Lehmann, 2011; Lerner & Allen III, 2012; Little, 1990; Mell, 2009; 2010; 2013; Natural England & Landscape Consultants, 2009; Roe & Mell, 2013; Schäffer & Swilling, 2012; Schilling & Logan, 2008; Schwab, 2009; Siemens, 2011; South Yorkshire Forest Partnership-Sheffield City Council, 2012; Tzoulas et al., 2007; UNEP-WCMC, 2011; Weber, Sloan & Wolf, 2006; Wright, 2011)

London: green city or urban monster?

Does the proportion of Green Infrastructure (%) and the water resources which serve the city make it a green city or has continued growth/urbanisation and the development of *grey* infrastructure undermined its green credentials?

New York City Green Infrastructure

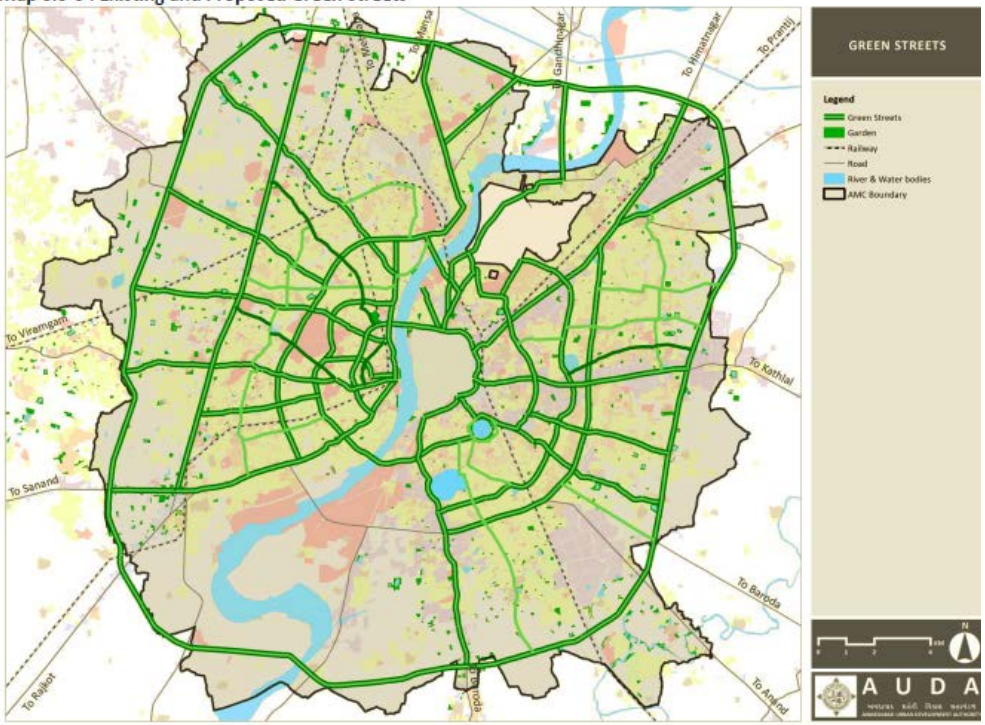
New York's Mayor has implemented a city wide programme of Green Infrastructure investments that include:

- Multi purpose cycleways
- Urban greenways
- Hudson River reclamation and de-pollution
- Improvements and development of new parks and public open spaces
- Designation of open shared spaces within the city's core areas
- Advancements in green technology
- Improved public transport infrastructure (subway, buses and cycling)

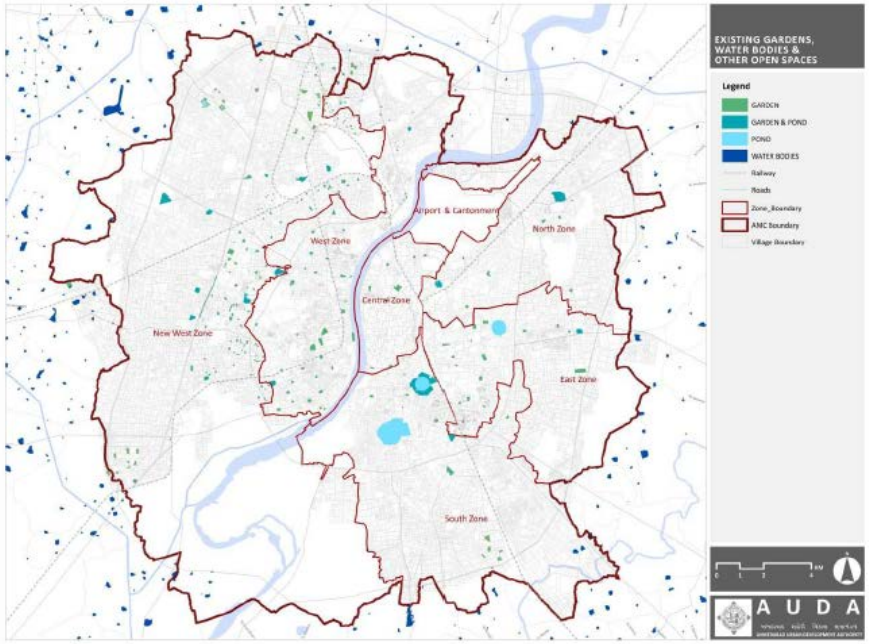
The aim of this programme was to integrate people and the landscape to ensure that activities caused as little harm as possible. The programme also aimed to increase awareness of environmental issues.

Proposed and existing green infrastructure in Ahmedabad, India

Map 3.5-3 : Existing and Proposed Green Streets



Map 10.3 Existing garden, water bodies and other open spaces



Key principles:

- connectivity,
- spatial distribution/coverage - scaled interventions ,
- development of multi-functional locations,
- urban climate control

Where has Green Infrastructure come from and where can it go next?

1. Green Infrastructure thinking/planning is constantly developing
2. It has grown exponentially since 1998 and continues to do so
3. It has gained political and delivery approval becoming the most accepted form of greenspace management
4. Green infrastructure integrates a wide range of green space, landscape, ecological and sustainability issues – it is therefore fluid in terms of its meanings and definitions

- Bigger, bolder and greener (India and China)
- More effective integration of GI in local, regional, national and international policy
- Greater zeal from government to support GI investment and management
- Greater local/grass roots activism
- More refined understanding of the economic values and costs of GI implementation

Green Infrastructure policy: the future

- A growing/continuing recognition of the value of Green Infrastructure within all scales of policy

- Increased awareness of the functionality and spatial variety of Green Infrastructure planning at different sectors
- Recognition, due to climatic variation, that Green Infrastructure can actually help manage the environment more effectively that hard engineering

- Continual update of management/funding mechanisms aimed at implementing more sustained and sustainable Green Infrastructure delivery
- Integration of central and LPA strategic objectives with developers, advocates and citizens to identify and deliver appropriate local/regional/national Green Infrastructure investments

- Establishment a more meaningful focus to the allocation and distribution of Green Infrastructure investment funds