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Just Cities

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Blue-Green Infrastructure

A base for urban development opportunities

29th September 2021

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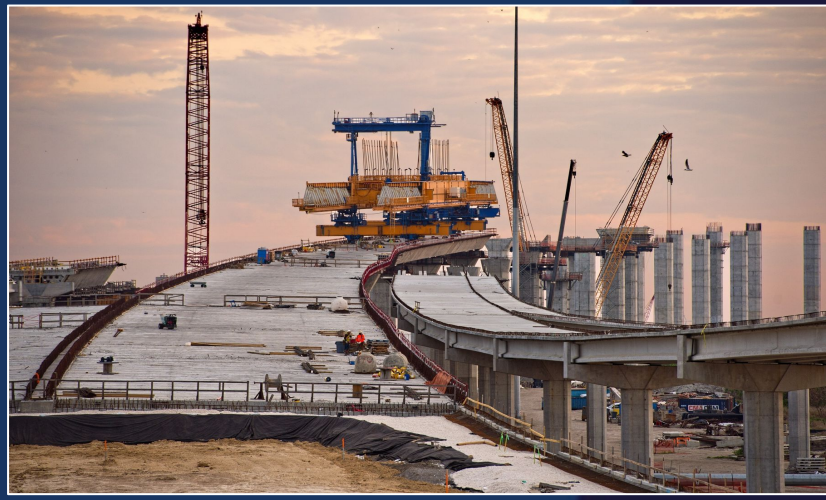
Outline

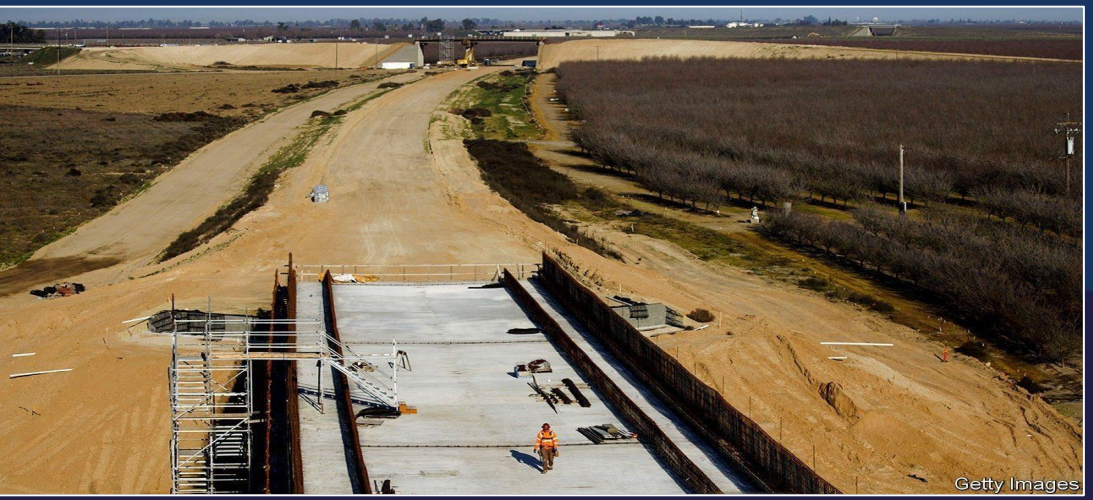
- BGI & Gray Infrastructure
- What is BGI
- BGI & Regular Infrasture
- Similar Concepts to BGI
- BGI Functions (How it works)
- BGI Classifications
- Lessons & Concerns
- A case study
- Food for thought

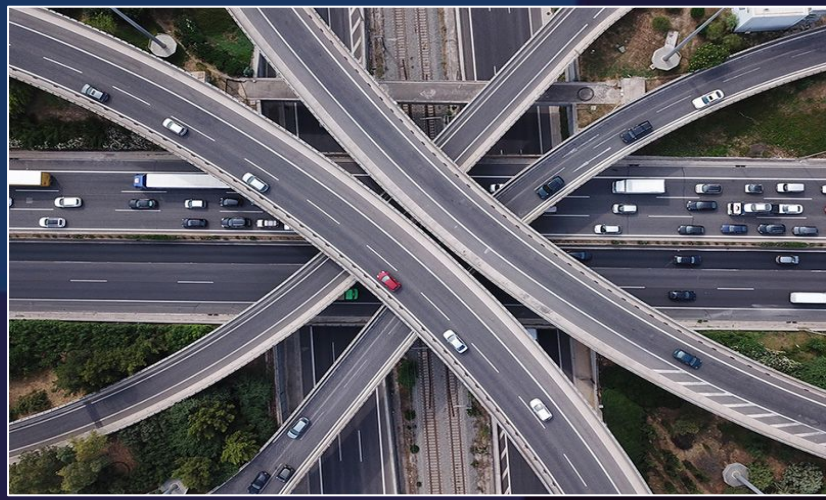
BGI & Grey Infrastructure

Regular (Grey) Infrastructure

Infrastructure is the general term for the basic physical systems of a cities, regions, or nation. Examples of infrastructure include transportation systems, communication networks, sewage and electric systems







What is BGI

Blue-Green Infrastructure

Blue-Green Infrastructure (BGI) is an approach to urban flood resilience, recognised globally and in international literature, that capitalises on the benefits of working with urban green-spaces and naturalised water-flows

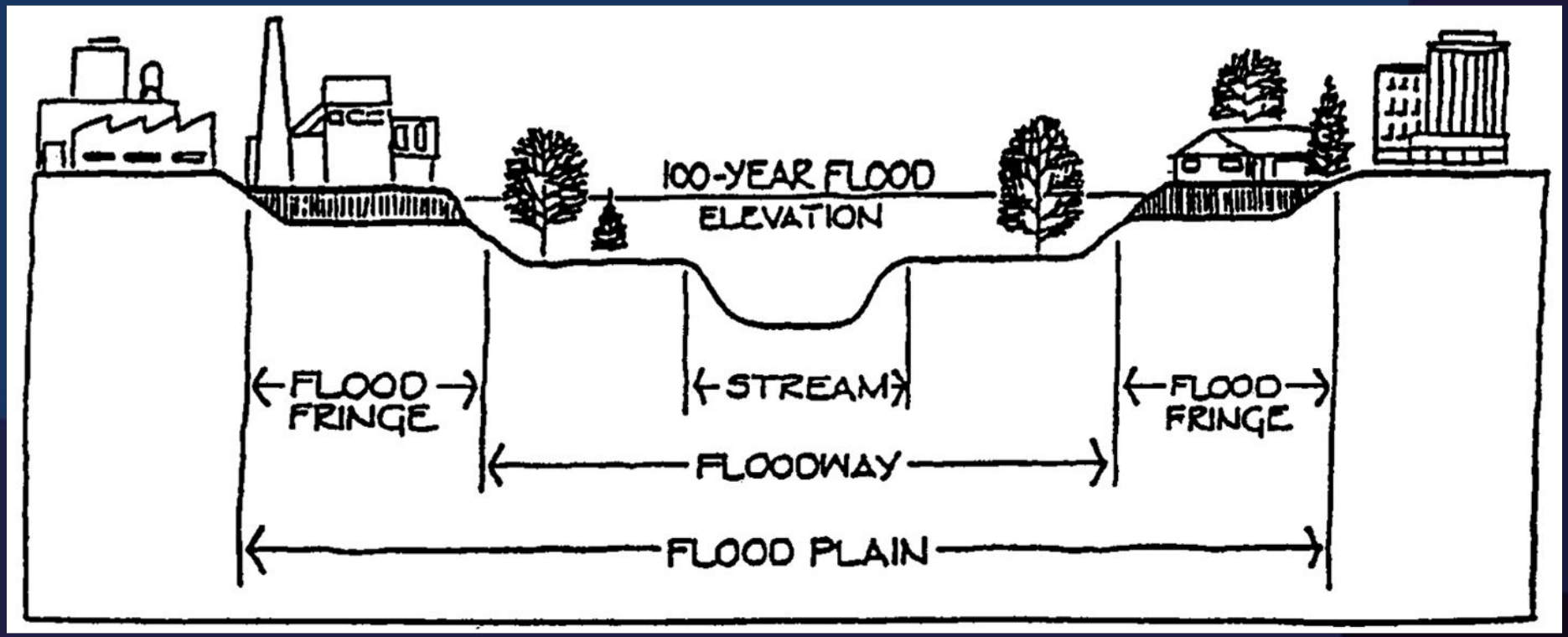
BGI & Regular Infrasture

Roads Swerve Water Pipes Electric Towers	Detention Ponds Water Channels Holding Tanks	Network of Wetlands Floodplain Restoration
• Centralized • Conflict with Ecosystem • Constructed with no or little ecological considerations • High Impacts	• Traditional engineering following ecological guides • Slow release to the sewer • Peak reduction • Medium Impacts	• Allows infiltration • Improves water quality • Reduces erosion/ sedimentation • Helps restoration • Low Impacts

Practices before BGI

New term but not very new practice

While BGI is a relatively new term, the utilization of water-related ecosystem services is not new. Landscape planners used floodplain restoration as a measure to flood mitigation; constructed wetlands to treat domestic graywater; and promoted nature-based solutions for stormwater management



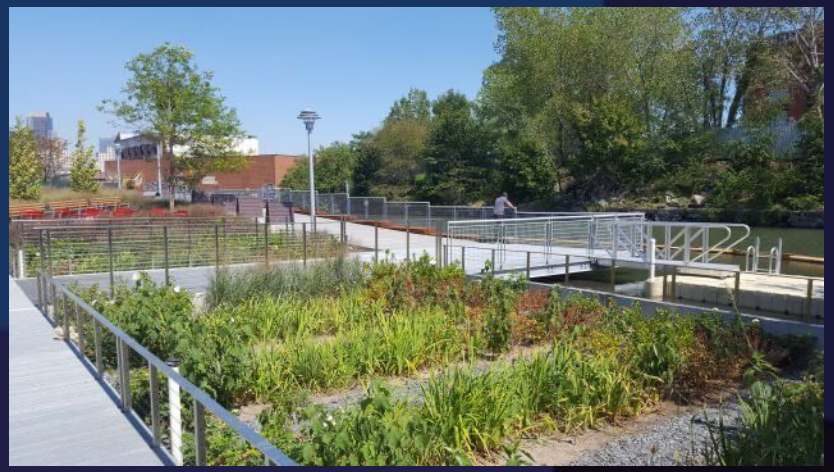
Similar Concepts to BGI

Greenway

A network of wildlife reserves and corridors should serve as the skeletal framework of a comprehensive greenway system

Green Infrastructure

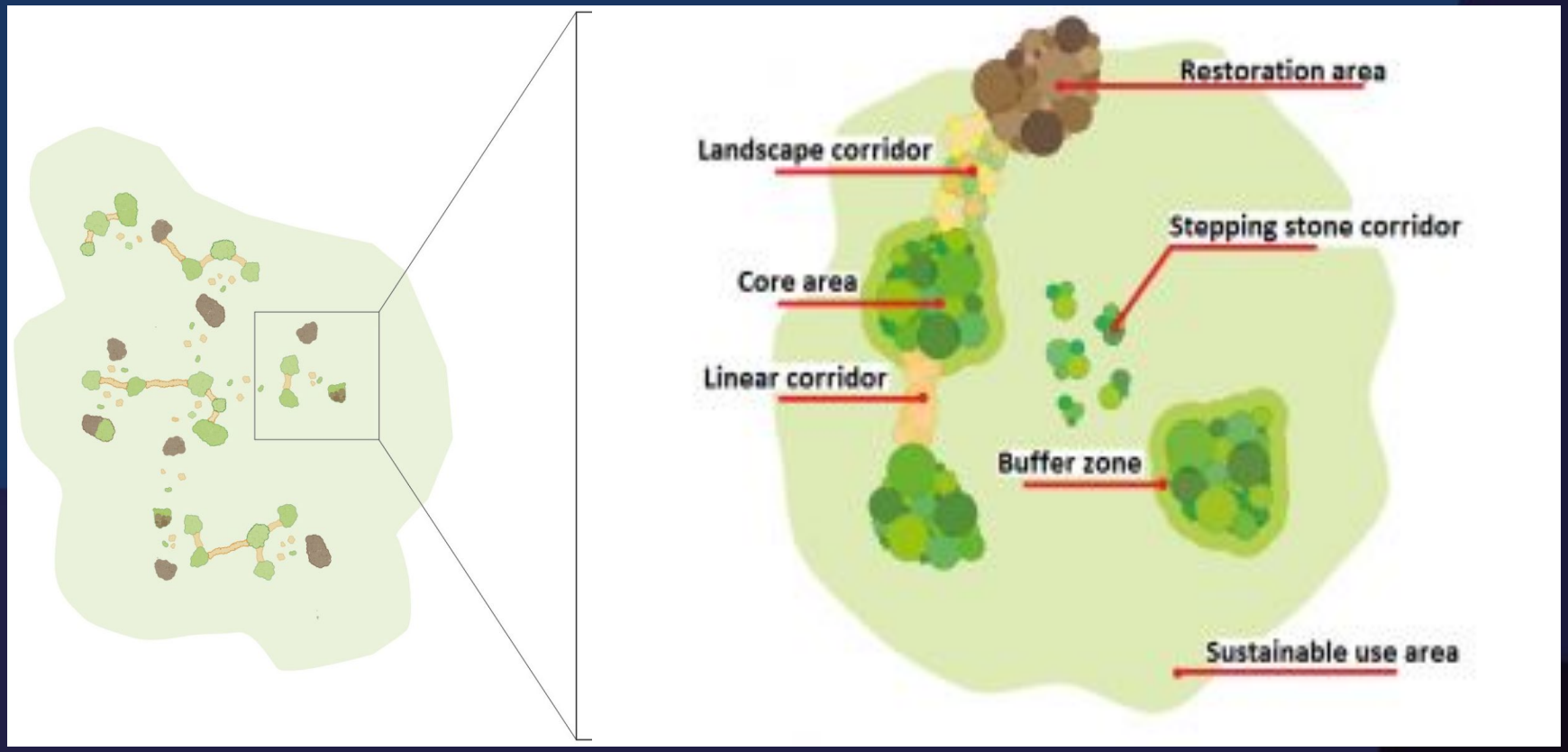
Green infrastructure is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation.



Similar Concepts to BGI

Ecological Networks

Ecological networks are representations of the interactions that occur between species within a community. The interactions include competition, mutualism and predation, and network properties of particular interest include stability and structure.



Similar Concepts to BGI

Ecosystem Services

Ecosystem services are the many and varied benefits to humans provided by the natural environment and from healthy ecosystems. Such ecosystems include, for example, agroecosystems, forest ecosystems, grassland ecosystems and aquatic ecosystems. These ecosystems, functioning in healthy relationship, offer such things like natural pollination of crops, clean air, extreme weather mitigation, and human mental and physical well-being.

Conventional vs BGI solutions

Conventional Solutions

Conventional urban water management has been preoccupied with large-scale, capital-intensive engineering solutions that are often single functional; for example:

- storm drains function only for stormwater conveyance and
- levees only for flood prevention.

BGI Solutions

BGI focuses on decentralized, nature-based solutions that are often multifunctional; for example:

- rain gardens can function for not only stormwater quality treatment, but also flood mitigation and environmental education.

How it works

BGI aim to reintroduce the natural water cycle into urban environments and provide effective measures to manage fluvial (river), coastal, and pluvial (urban runoff or surface water) flooding.

BGI works as a range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters.

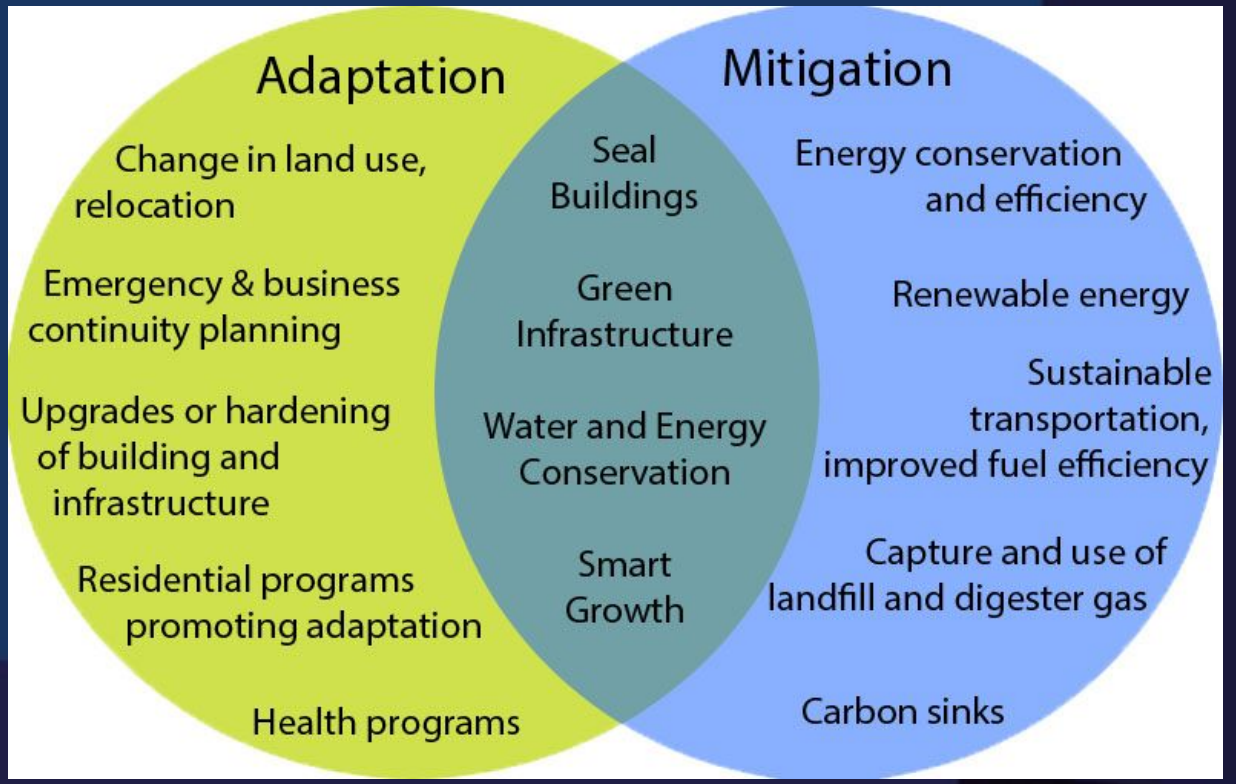
BGI & Climate Change

Climate Mitigation

Climate change mitigation means avoiding and reducing emissions of heat-trapping greenhouse gases into the atmosphere to prevent the planet from warming to more extreme temperatures.

Climate Adaptation

Climate adaptation means altering our behavior, systems, and, in some cases, ways of life to protect our families, our economies, and the environment in which we live from the impacts of climate change



BGI Main Functions

Ecological

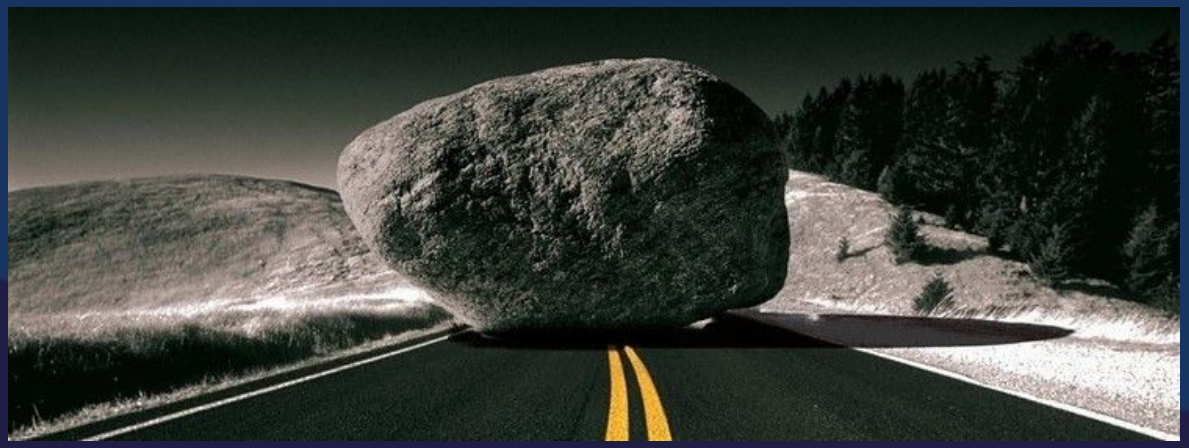
- Water storage
- Regulators of river systems
- Habitat for plants and animal wildlife
- Growth of wetlands

Social

- Zones for recreational activities (social)
- Social Integration
- Areas for community activities (i.e. festival,...)
- Aesthetic values

BGI Obstacles

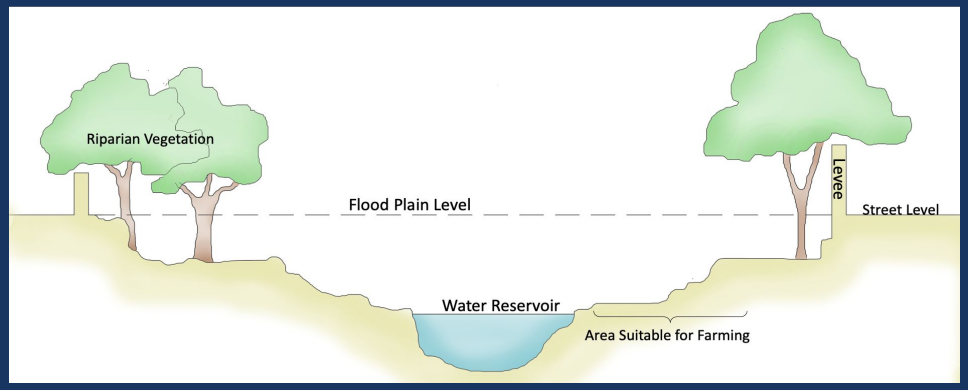
- Lack of Awareness
- Extensive Planning Needed
- Lack of political will
- Lack of resources (although this point is defensible because the avoided damage is always higher cost
- Massive land use change needed



BGI Classification

According to Position/Location

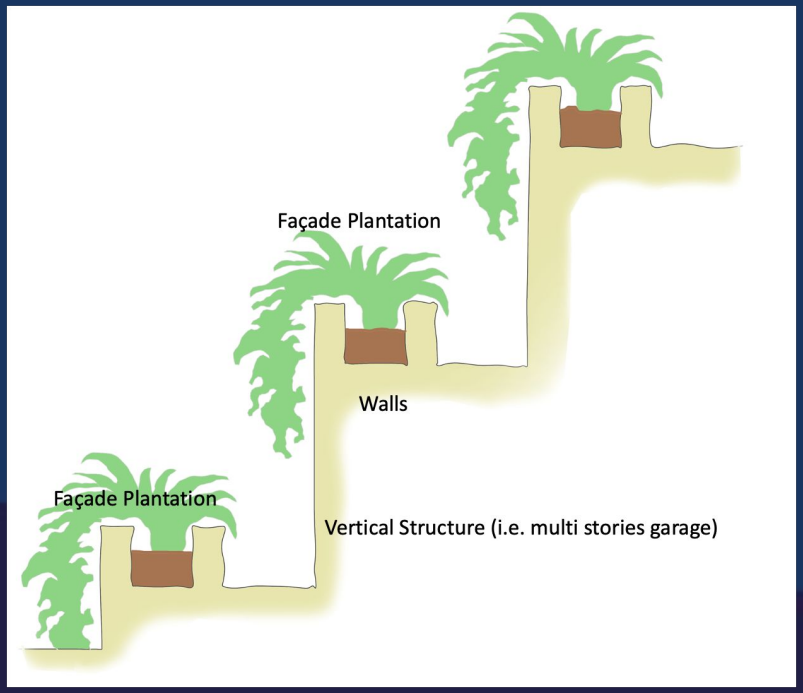
On ground

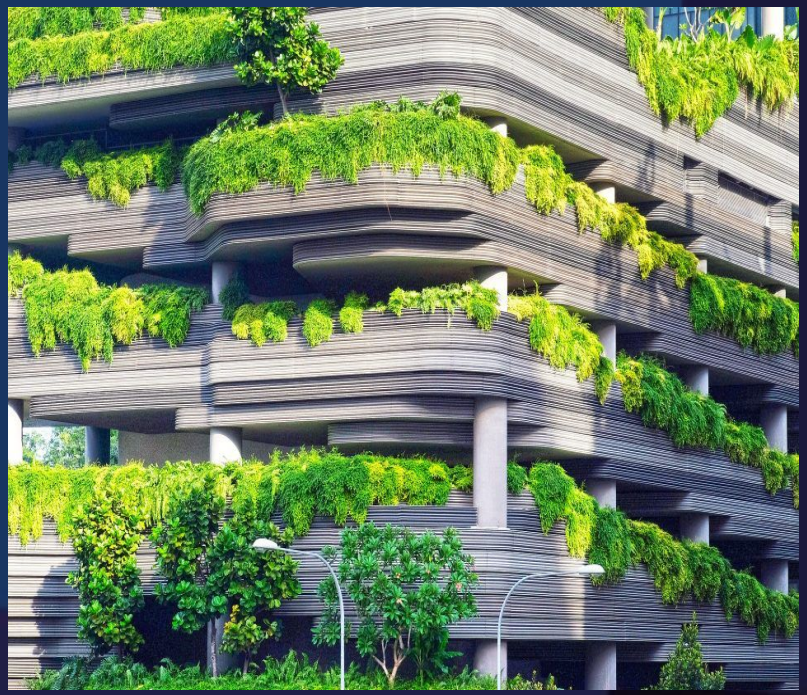


BGI Classification

According to Position/Location

Above ground





BGI Classification

According to Scale

REGIONAL SCALE

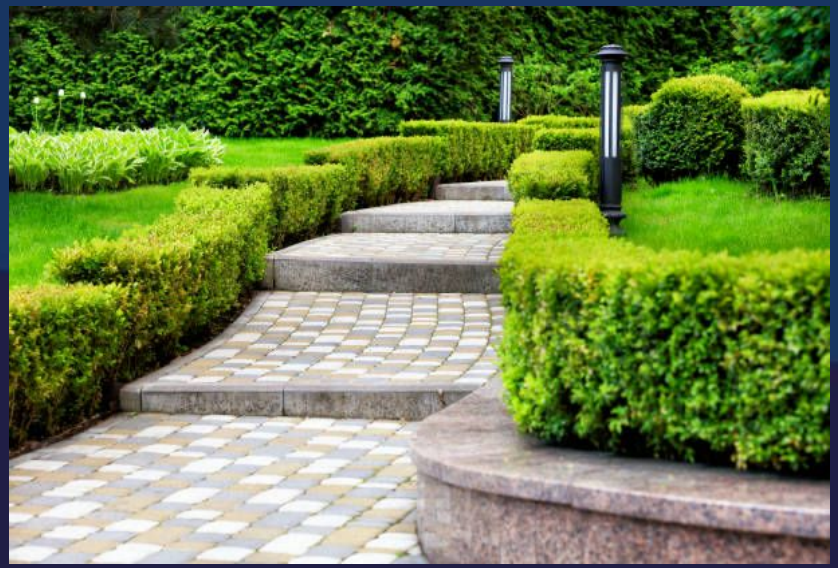
- Parks,
- Agriculture lands,
- Protected areas,
- Detention ponds, and
- Wetlands

BGI Classification

According to Scale

URBAN/CITY SCALE

- Public squares,
- City parks,
- Recreational place
- River banks within cities
- Green walkways



BGI Classification

According to Scale

BUILDING SCALE

- Green roofs,
- Green walls,
- House gardens,
- Rain water containers

Lessons & Concerns

Lessons

- BGI are crucial to adaptation and not an option any more
- Need for ongoing management and maintenance beyond the life of BGI
- It is important to educate people (as voters) and stakeholder organizations (as implementers/managers) about the role of the GBI and their importance of their quality of life and well-being.
- Across institutions coordination is fundamental to the long-life of BGIs and their relation with other land uses in the city.
- Public participation is key to the success of designing, implementing and managing BGI in the community

Lessons & Concerns

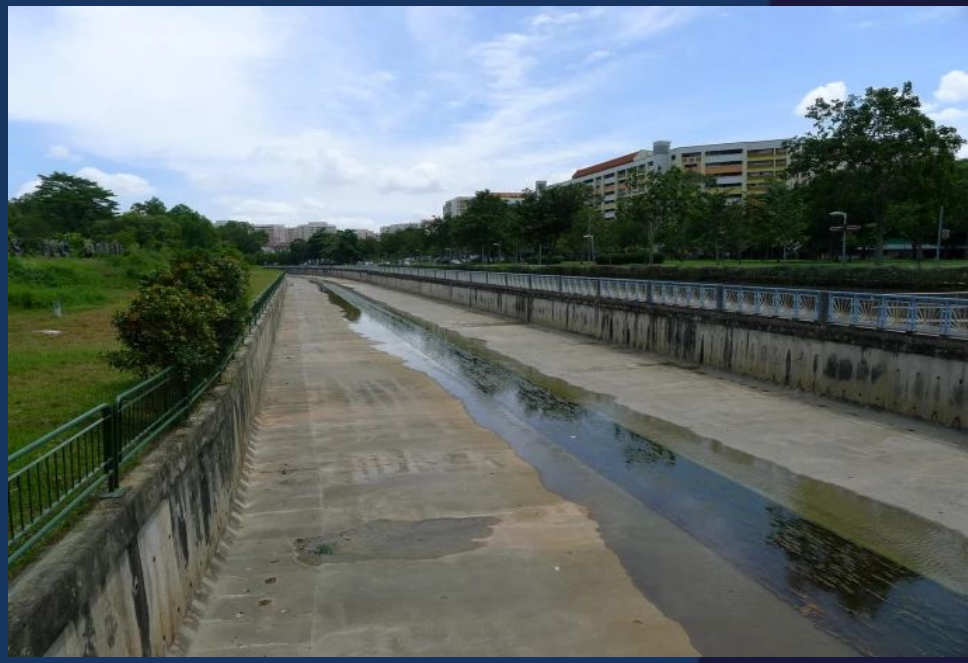
Concerns

- Not including climate change as a whole strategy can be an obstacle to incorporate BGI in general
- There are always doubts that future governments will sustain such projects and continue to fund it and maintain it
- Ensuring social equity while delivering BGI is not always guaranteed if not considered at easy stage
- Securing the community buy-in and acceptance to the BGI is not always guaranteed
- Lack of political will
- Lack of resources (although this point is defensible because the avoided damage is always higher cost)
- Massive land use change needed to start

Singapore case study

Objective

Launched in 2006, the ABC Waters Program aims to simultaneously improve the recreational value, physical appearance, and water quality of all waters in Singapore through 2030



In the past

Singapore's surface water management focused solely on efficient drainage for flood control and water collection for water supply. Most rivers and streams in Singapore have been heavily channelized

The problem

Drained directly into the receiving waterbodies, stormwater runoff is a major source of pollution in Singapore's water network

Singapore case study

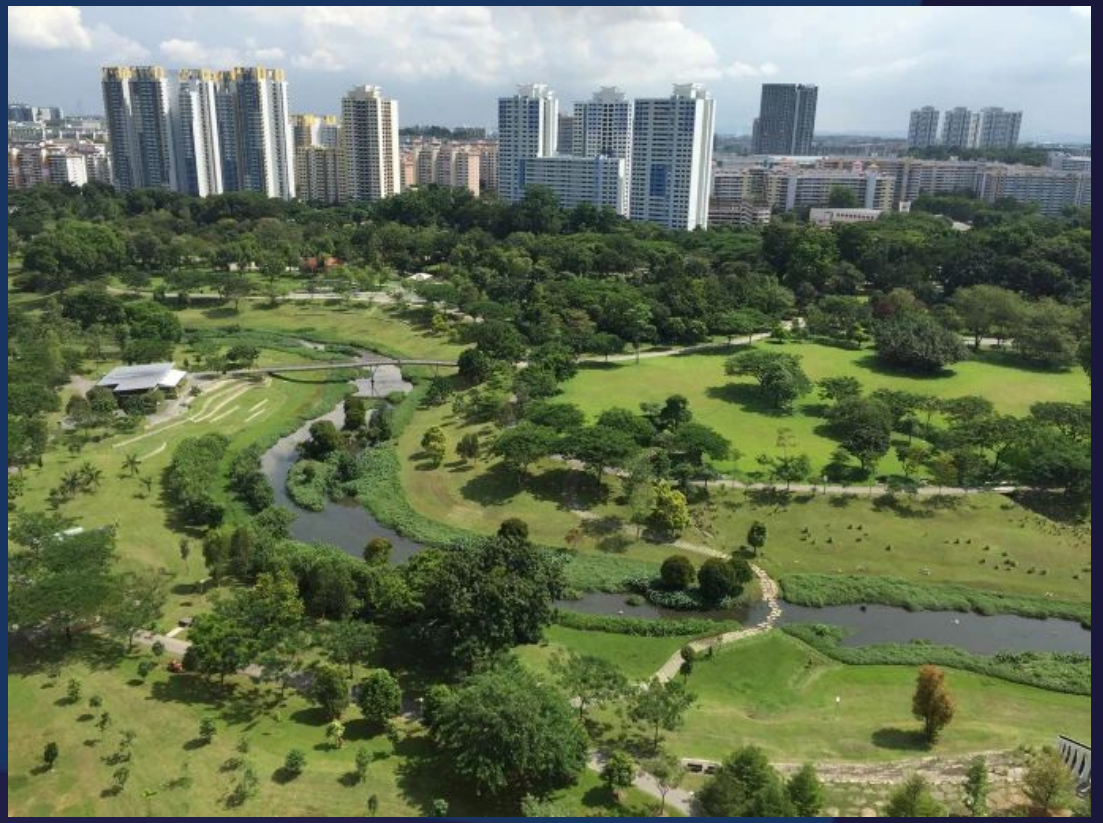
Common measures include:

- greening of the embankment and the waterfront area;
- adding amenities such as benches and look-put decks along the waterfront;
- building weirs to form a permanent pool of water; and
- using gabions or other soil bioengineering techniques to naturalize the embankment

Singapore case study

Stream Restoration

- The original 2.7-km concretized, straight channel has been transformed into a 3.2-km naturalized, meandering river, integrated with the surrounding terrestrial green space

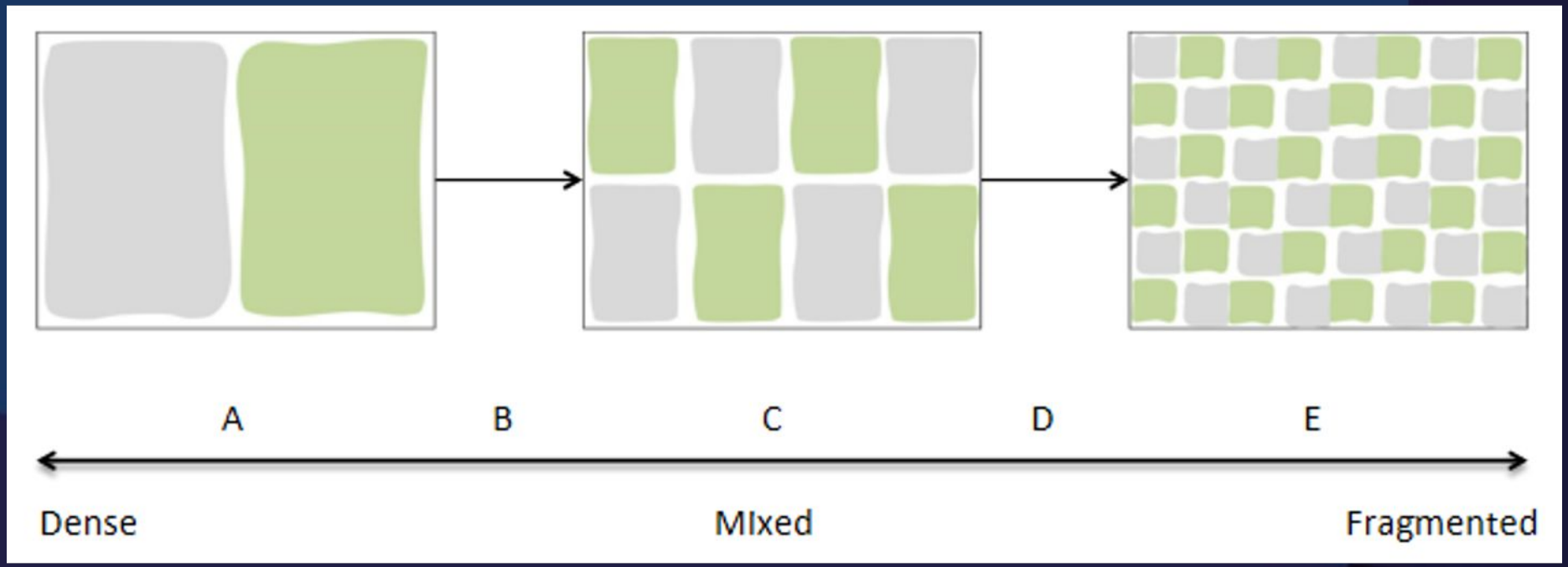


- The heterogeneous geomorphology of the naturalized Kallang River—meander bends, varying channel width, rock beds, and vegetated banks—is an attempt to generate diverse flow patterns and provide a variety of wildlife habitats
- Biodiversity has increased in the park by 30%
- The Bishan-Ang Mo Kio Park now resembles a natural river corridor, which entails not only the channel but also the closely interacting floodplain and riparian zone

Design features	Functions
Vegetated swales	• Similar to concrete drains, vegetated swales function to convey stormwater runoff. However, the flow velocity is lower in the vegetated swale, which can help prevent erosion of the downstream ABC Waters design features and the receiving waterbody • While water treatment is not its main function, a vegetated swale could still remove coarse sediment and act as a pretreatment mechanism for the downstream ABC Waters design features
Bioretention swales	• Different from vegetated swales, bioretention swales are designed mainly to encourage biological uptake of nutrients by plants for water quality treatment
Bioretention basins (rain gardens)	• Bioretention basins are to detain and treat stormwater runoff. They are similar to bioretention swales in that they filter stormwater runoff through the densely-planted surface. • Bioretention basins are not designed to convey stormwater runoff
Sedimentation basins	• Sedimentation basins function to temporarily retain stormwater runoff to facilitate sedimentation. • They are designed to capture 70–90% of coarse to medium-sized sediment, also functioning as a pretreatment mechanism
Constructed wetlands	• Constructed wetlands are used primarily to remove fine to colloidal particles and dissolved contaminants
Cleansing biotopes	• Cleansing biotopes are a form of constructed wetlands. They consist of nutrient-poor substrates and are often designed to allow the treated water to circulate back to the biotope for further treatment

Food for thought

If you are a mayor of a new city or a planer that is given the possibility to incorporate 50% of this area to be designated for BGI, Public spaces and ecosystem services; in the continue below where would you stand in terms of distribution of the green open space



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THANK YOU
Happy to answer all your questions

Get in touch if you have any further questions or discussions:

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