ECOSYSTEM SERVICES IN SHORELINE PLANNING AND DESIGN

CASE STUDIES FROM THE NORDICS

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2018 ACES A Community on Ecosystem Services™
Natural Resources Benefitting People
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TOPICS

1. Concepts in Soft-Engineering for Waterfront Planning & Design

2. Nordic Design Experience

3. Nordic “Green/Eco” Solutions Framework

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Concepts in Soft-Engineering for Waterfront Planning & Design

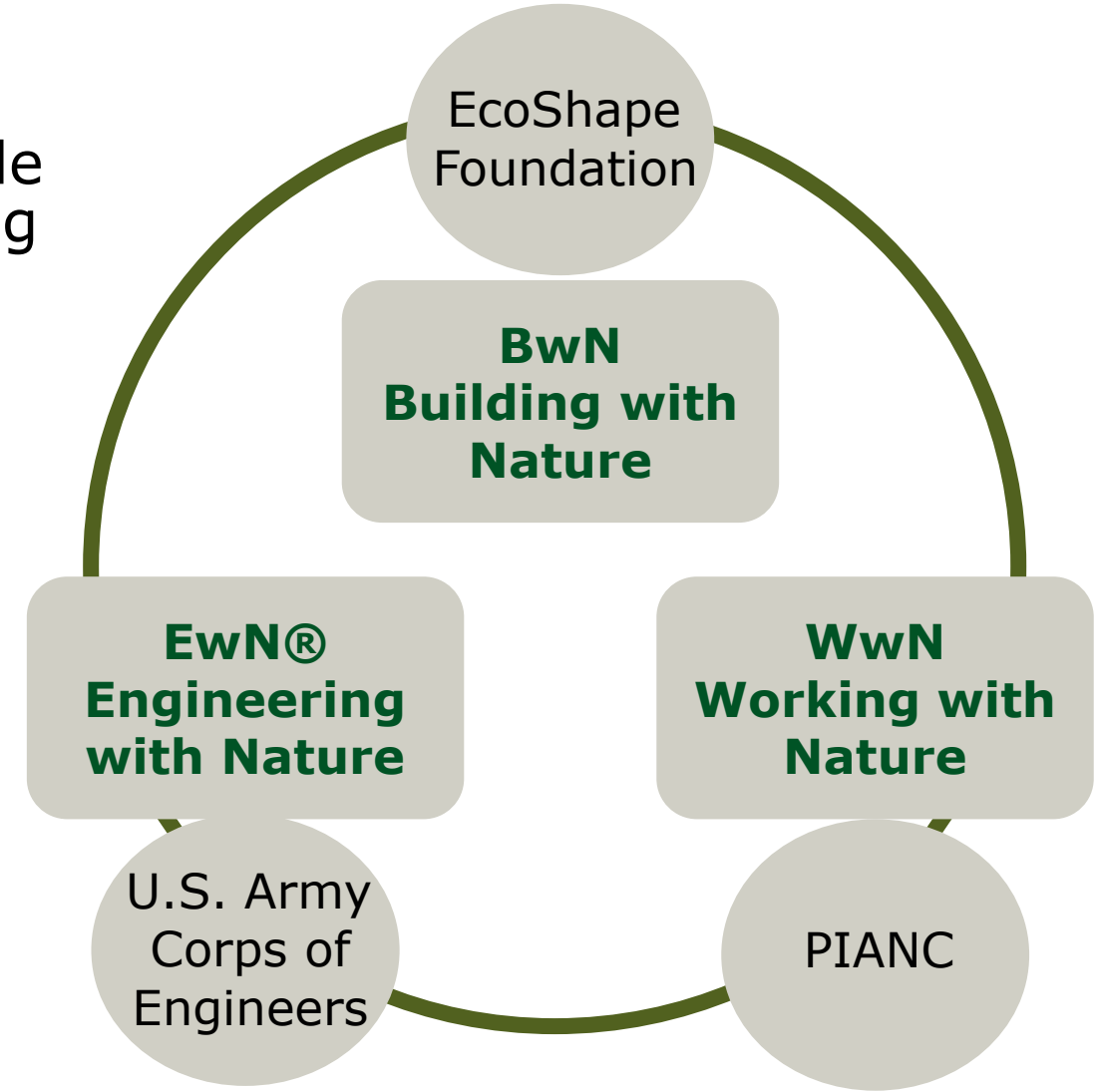
WHAT IS "SOFT ENGINEERING"?

Use of **ecological principles** and practices to reduce erosion and achieve the stabilization and safety of shorelines and surrounding area…., while enhancing habitat, improving aesthetics, and saving money.

Caulk et al. 2000

ECO-SHORELINES

- Design structures that do not degrade or create obstacles in the surrounding ecosystem
- Incorporate multiple purposes and functions
- Preserve, protect and/or enhance vital ecosystem services
- Encourage habitats and natural communities hospitable to native species



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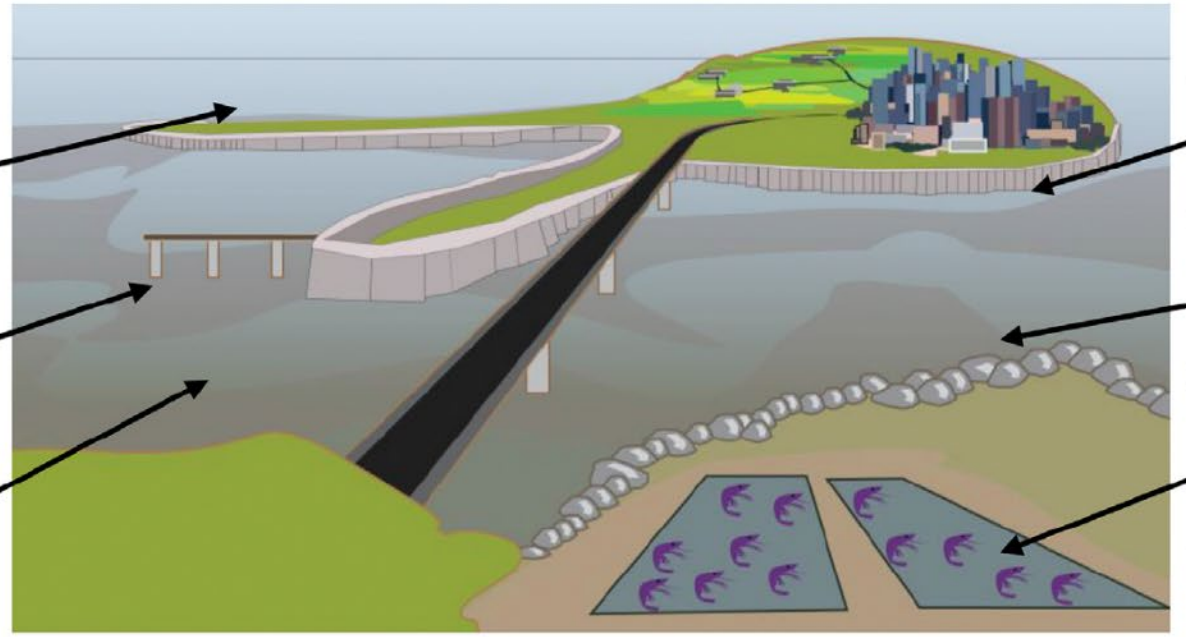
(a) Artificial island without eco-engineering



No mangroves means that the island is susceptible to storms and erosion

Low biodiversity due to limited habitat availability

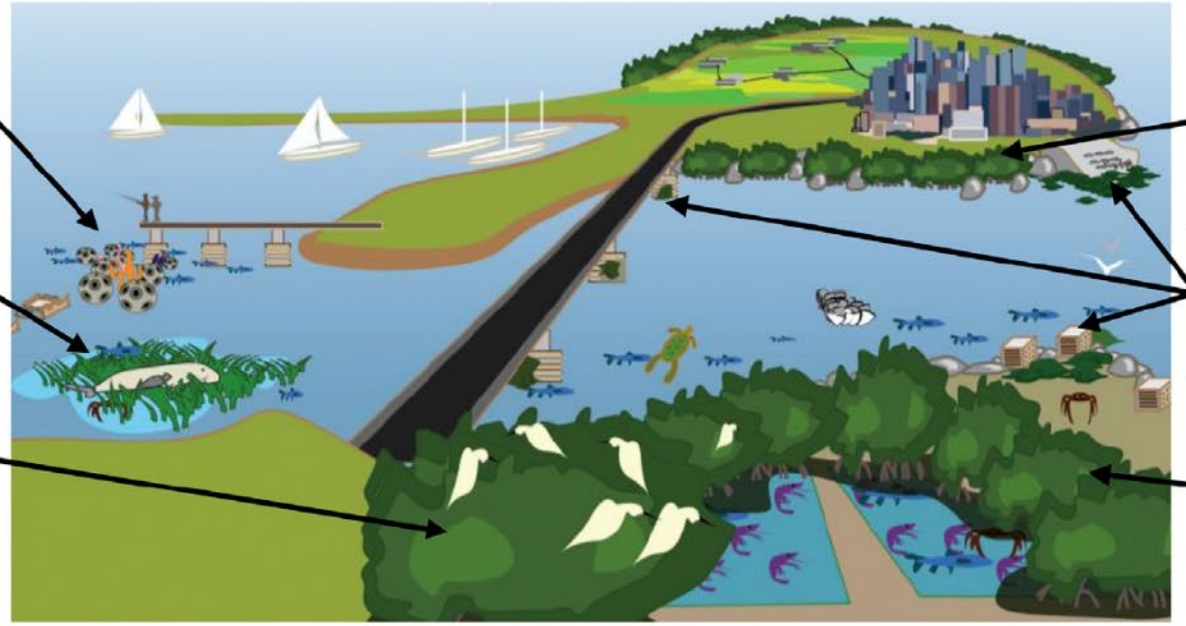
Poor water quality with no natural biofilters like bivalves and corals

No coastal wetlands which can treat anthropogenic discharge

No mangroves providing coastal protection or habitat for wildlife

Shrimp ponds hot with no shade or refuge from predation. Banks collapse easily

(b) Artificial island with eco-engineering



Reef balls and oyster castles can enhance fisheries

Rehabilitated seagrass beds provide habitat for fish and food for dugongs and turtles

Mangroves provide coastal protection and habitat for wildlife

Artificial wetlands can treat anthropogenic discharge such as wastewater and runoff

Eco-engineering enhances biodiversity and other ecosystem services

Mangroves around shrimp ponds provide shade and refuge from predation. Banks stabilised by mangrove roots

Chee et al. GEC, 2017

NORDIC FOCUS ON URBAN DEVELOPMENT

Liveability & cultural identity

Increasing demand for cities and suburbs to be developed as integrated com-munities with focus on city planning and urban open spaces to enhance "Liveability" and create cultural identity for citizens

Climate change & adaption

Climate change / extreme weather events are encouraging both human and natural disasters from flooding to rising sea levels… actions are required to fundamentally change current practices

Green agenda

Cities are taking concrete actions to reduce greenhouse gas emissions and climate risks through regulations, mandates and incentives such as building energy policies, climate action plans and fuel standards

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Tianjin, China
Completed 2012

The urban lake is a storm water feature, handling 10-year cloudburst events and buffering 100-year rain storm events.

Tree and marsh plantings act as a cleansing biotope by linking subsurface retention trenches that feed water to the lake.

The lake is a self-sustaining natural ecosystem and helps reduces local temperature extremes.

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Stuttgart, Germany
Completed 2011

A cloudburst water capture and retention system integrates generous planting around a pond and a restored creek with a recreational path and viewing areas.

Streetscapes are distinctively pedestrian, but fully accessible for vehicles, with parking options in an underground garage situated between gardens on the unique load-bearing planting substrate.

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Singapore
Completed 2014

Catchments and sub-catchments support an urban water management masterplan with short-term and long-term solutions for flood protection and drinking water collection while creating benefits for the landscape, city recreational spaces and biodiversity.

Blue-green infrastructure includes floating wetlands, rain gardens, swales, wetlands, cleansing biotopes, naturalised canal edges and retention ponds.

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Copenhagen, Denmark Completed 2013

Responding to severe city flooding caused by July 2011 cloudburst, a new city masterplan divided Copenhagen into catchments that integrate planning and implementation of blue-green infrastructure projects.

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Singapore, Jurong Town Council Completed 2013

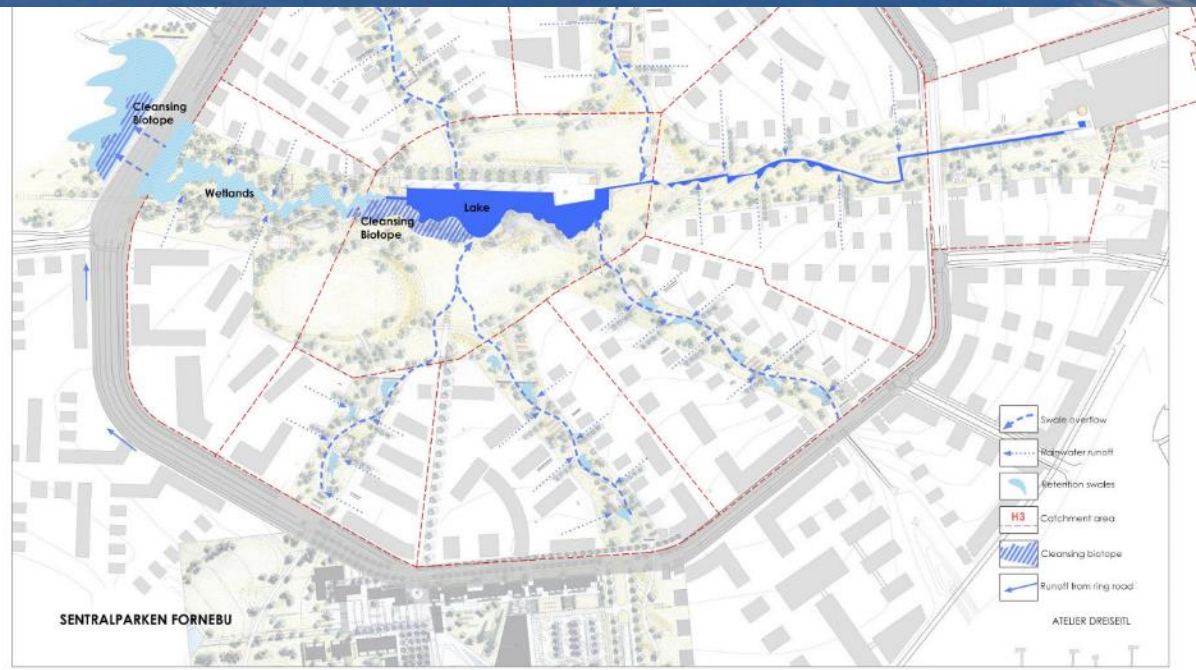
Native eco-habitats, including grassland, wetlands, and wooded areas, were retained to support native wildlife species and a natural corridor connecting the park and surrounding environment.

Natural topography and water elements were enhanced to support water flow. Bio-swales purify and channel rain runoff to a wetland, where it is circulated through a cleansing biotope for further purification, before being reused for non-potable uses.

Fornebu-Oslo, Norway Completed 2008

Created a lake system to shift land use of the small fjord island from an abandoned airport to a park and residential area.

The lake's ecological infrastructure receives and treats storm water run-off from the surrounding development. Therefore, it manages stormwater and helps protect water quality in Oslo Harbor.



Nordhavnen, Denmark On-going

Scandinavia's largest city project, covering 625 football fields. A sustainable mixed use urban landscape design capable of handling extreme cloudburst and tidal events.

The area is serviced by elevated metro and bicycle networks in green arteries. Elevated metro tracks provide cover for bicycle paths, so cyclists stay dry at all times.

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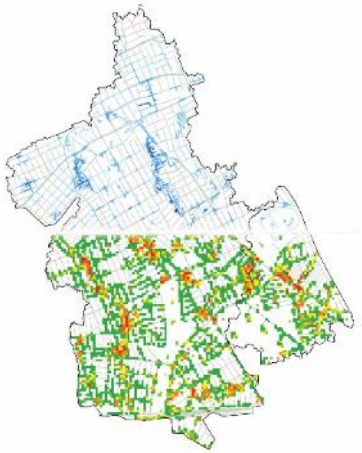
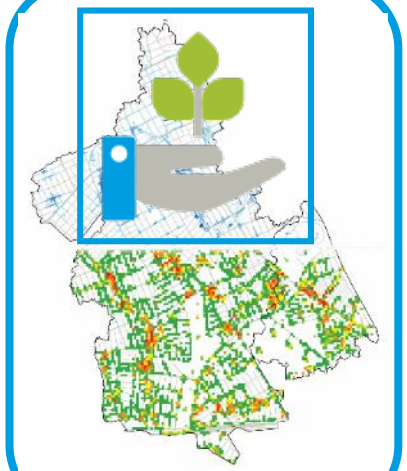
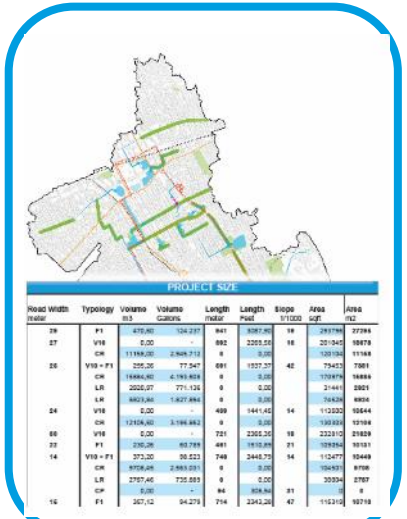
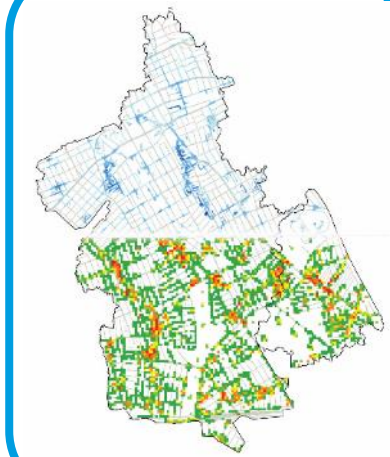
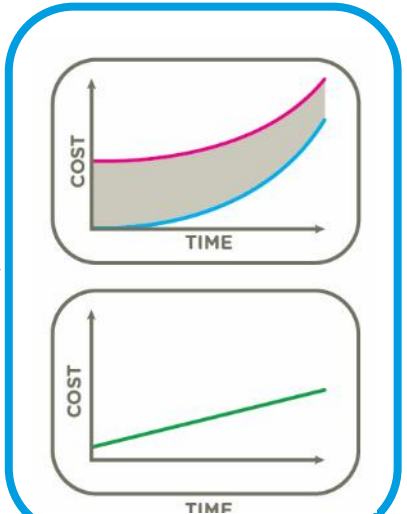
Nordic "Green/Eco" Solutions Framework

RISK-BASED RESILIENCY PLANNING

Iterative process

STEPS	1	2	3	4	5
	DETERMNE RISKS	UNDERSTAND NATURE	PLAN & DESIGN	MEASURE EFFECTS	EVALUATE COSTS
TOOLS	CLIMATE CHANGE RISK ASSESSMENT ECO-VULNERABILITY REVIEW CITY MASTER PLANS	HABITAT SURVEYS ENV. MONITORING BIODIVERSITY SEASONAL CHANGES	INTEGRATED PLANNING & DESIGN	FLOOD MAPPING RISK MAPPING	AVOIDED DAMAGES RETURN ON INVESTMENT OVER TIME
RESULTS					

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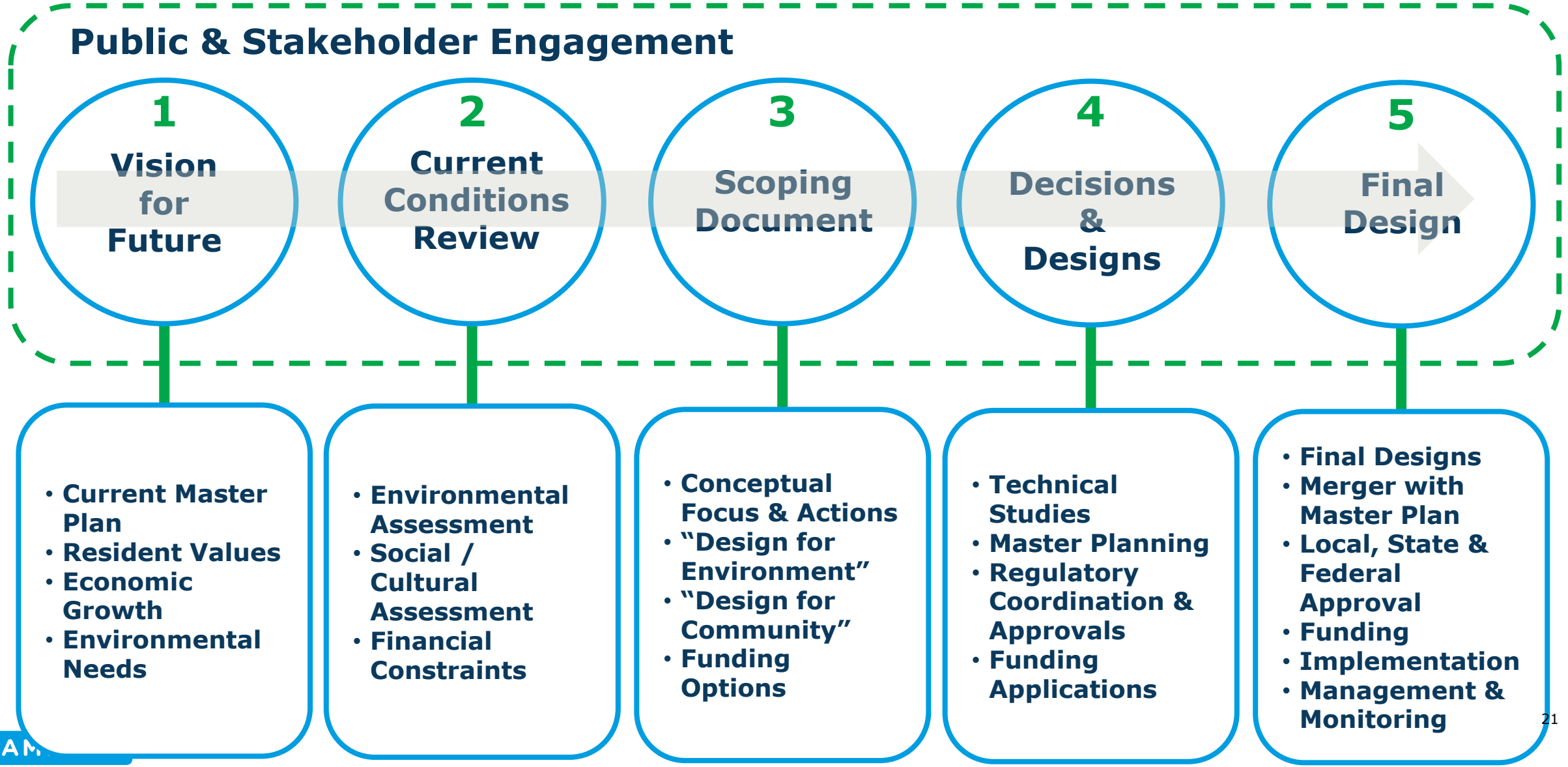
PLANNING AND BUILDING TOGETHER



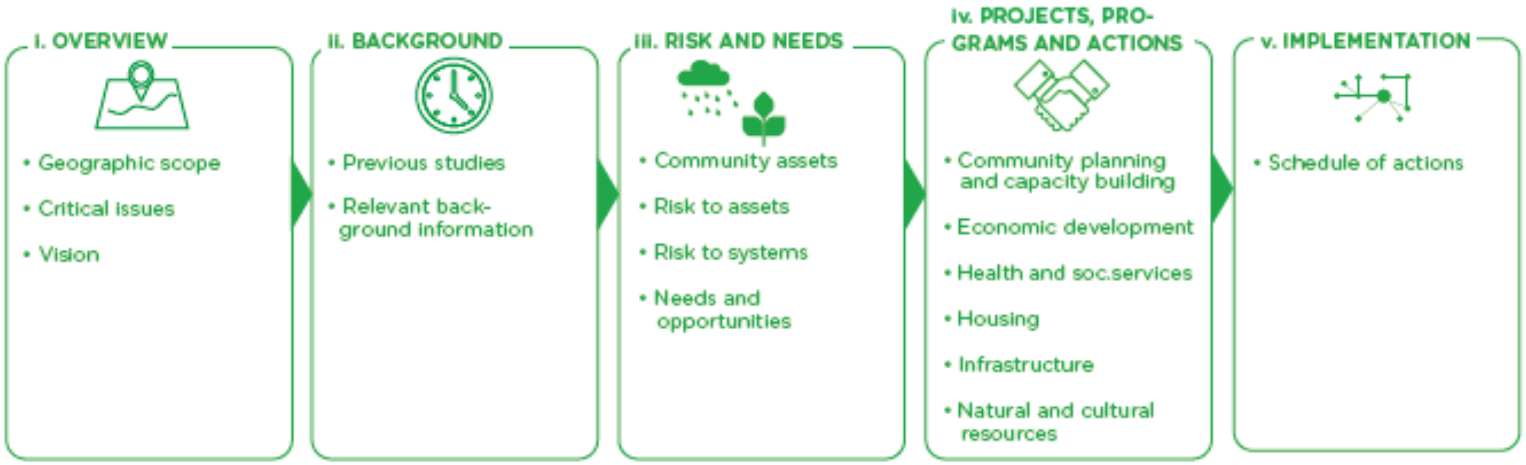
"TOOL BOX" APPROACH TO INTERVENTION MEASURES

Blue / Green Infrastructure

- Placement of Dunes
- Smart Street
- Bioswales
- Living Reefs
- Littoral Sand Replenishment / Management
- Marsh Islands
- Sculpted Land
- Blue-Green Parks / Public Facilities
- Wetlands

Built Infrastructure

- Floodgates
- Elevated Structures
- Outfall Invert Flaps
- Deployable Flood Barriers / Gates
- Integration with Inland Storm Water BMPs
- Pond / Lake / Stream Management
- Raised Streets / Barriers
- Legislation and Planning
- Retreat and Land-use Planning



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