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PRESENTS
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MIAMI DADE COLLEGE
PRESENTS
The Apparition
From the Director of Marguerite
8:40 PM 9:20 PM
TOWER


Biscayne bay:
Turn the tide

An integrated landscape approach for coastal restoration in Biscayne Bay through spatial and ecological interventions

P5 - Iris van Driel (4158245)

Mentors dr.ing. Steffen Nijhuis and Yuka Yoshida

Delft University of Technology - Faculty of the Built Environment - Landscape Architecture

Academic year 2018 / 2019 - Studio Flowscapes

"To completely change the direction of something"

Cambridge dictionary of American idioms (2003)

I

Introduction to the Mangrove Landscape

SPATIAL STRUCTURE

Source: Google Earth

COASTAL DEFENCE

WILD LIFE HABITAT

Mangrove distribution worldwide

Edited map obtained via Mapchart. Retrieved on December 29 2018 from www.map-chart.net

Mangrove distribution worldwide

STORM SURGE

Edited map obtained via Mapchart. Retrieved on December 29 2018 from www.map-chart.net

Mangrove distribution worldwide

STORM SURGE

GROUND WATER
SALINIZATION

FISH STOCK
DECREASE

LESS CARBON
STORAGE

Edited map obtained via Mapchart. Retrieved on December 29 2018 from www.map-chart.net

Mangrove distribution worldwide

STORM SURGE

GROUND WATER
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FISH STOCK
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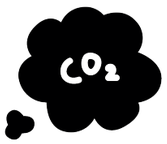
Mangrove distribution worldwide

STORM SURGE

GROUND WATER
SALINIZATION

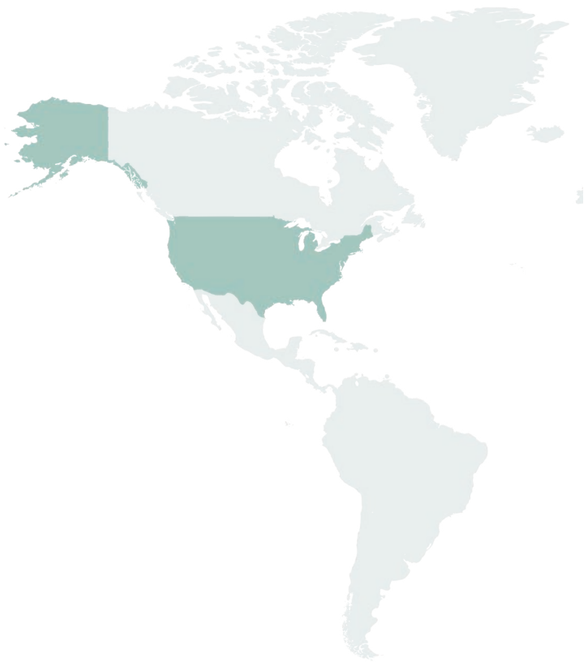
FISH STOCK
DECREASE



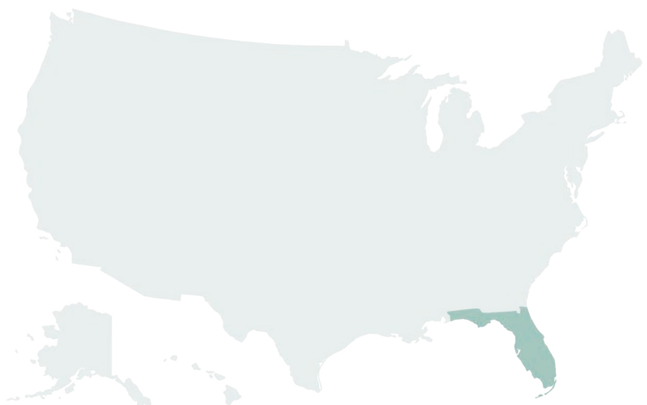
LESS CARBON
STORAGE

Edited map obtained via Mapchart. Retrieved on December 29 2018 from www.map-chart.net

Study area



United States of America

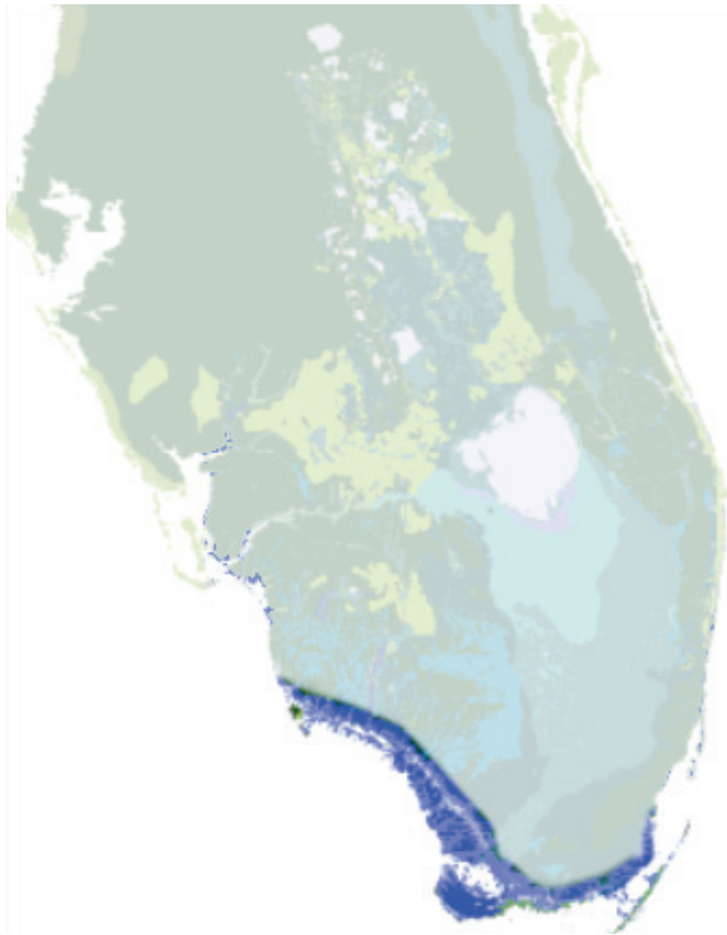


Florida

Biscayne Bay

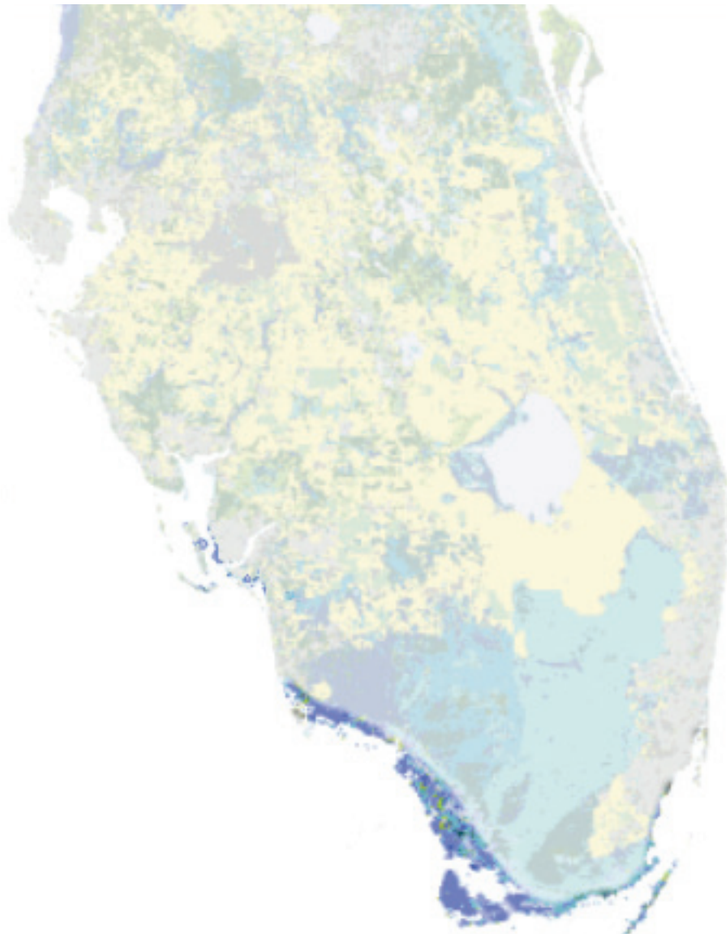
Impression of the natural landscape

Mangrove loss in south florida



>40 %

LOSS



Mangrove distribution 1900

Mangrove distribution 1992

Maps and data obtained via NASA. Retrieved on October 24 2018 from www.arthobservatory.nasa.gov

Impression of the cultural landscape

Problem statement

CAUSE

URBANIZATION

Replacing natural coastline for urban development.
Altering water system.

EFFECT

MANGROVE LOSS

Absence of the mangrove landscape and its vital functions
Consequences as flooding, salt intrusion and wildlife habitat loss

THREAT

CLIMATE CHANGE

Sea level rise.
Impact of increasing tropical storms.

Source: www.miamiherald.com


Future?

Identify and explore

DESIGN STRATEGIES

for the development of the

MANGROVE LANDSCAPE

of Biscayne Bay,

Research objective

Identify and explore

DESIGN STRATEGIES

for the development of the

MANGROVE LANDSCAPE

of Biscayne Bay,

in order to REDUCE FLOOD RISK caused by

TROPICAL STORMS AND SEA LEVEL RISE,

Research objective

Identify and explore

DESIGN STRATEGIES

for the development of the

MANGROVE LANDSCAPE

of Biscayne Bay,

in order to **REDUCE FLOOD RISK** caused by

tropical storms and sea level rise, as well as

PROVIDE AESTHETIC, ECOLOGICAL AND FUNCTIONAL QUALITIES

that contributes to the **identity and resilience** of this coastal region.

Research questions

How does the mangrove landscape function in South Florida and how did it change in Biscayne Bay?

What spatial and ecological design principles can provide conditions to restore and improve the mangrove landscape in order to let it function as coastal defence and let users reconnect with the natural landscape.

What are the spatial possibilities to create the needed conditions and reconnection in Biscayne Bay and how can they be made resistant to threats such as sea level rise and tropical storms?

What lessons are learned from using the mangrove landscape in a landscape architectural design for Biscayne Bay, in order to reduce flood risk in the Miami Metropolitan Area and reconnecting inhabitants and visitors to its origin and function.

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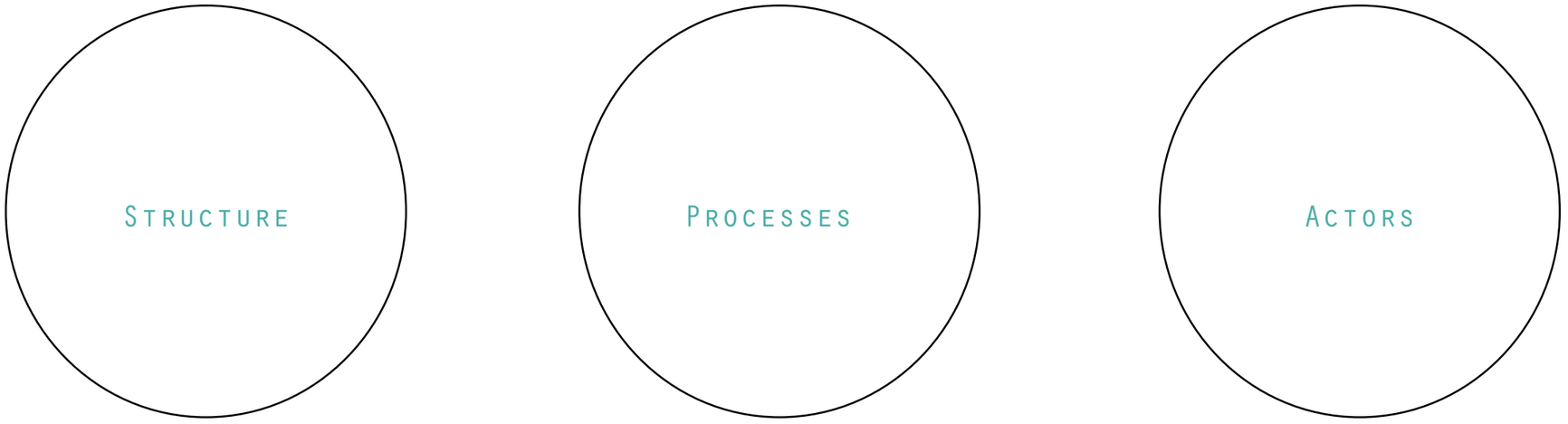
II

Approach

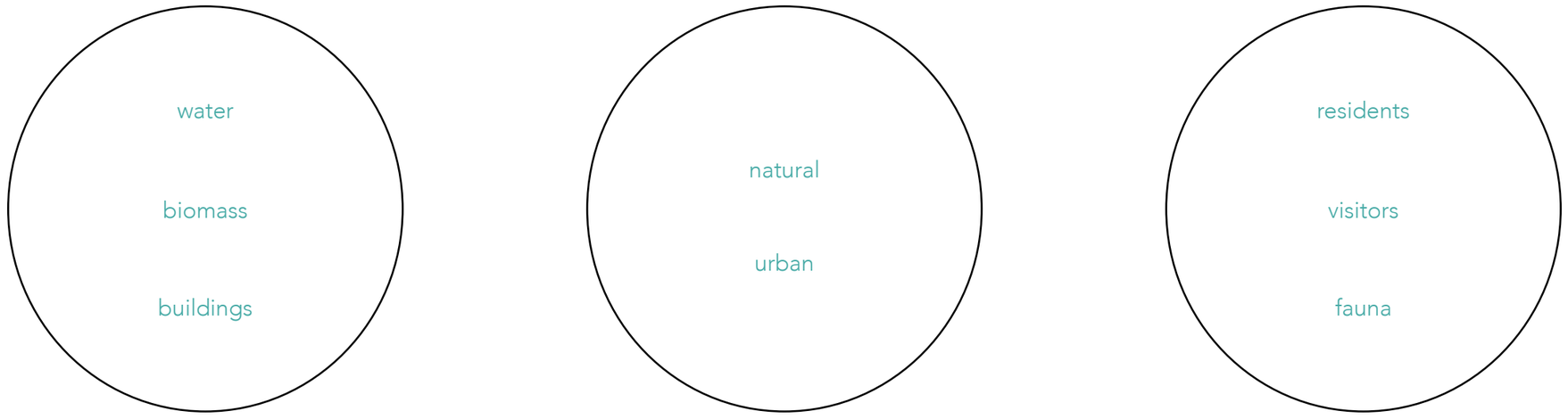
Landscape as a system

Dimensions



Landscape as a system

COMPONENTS



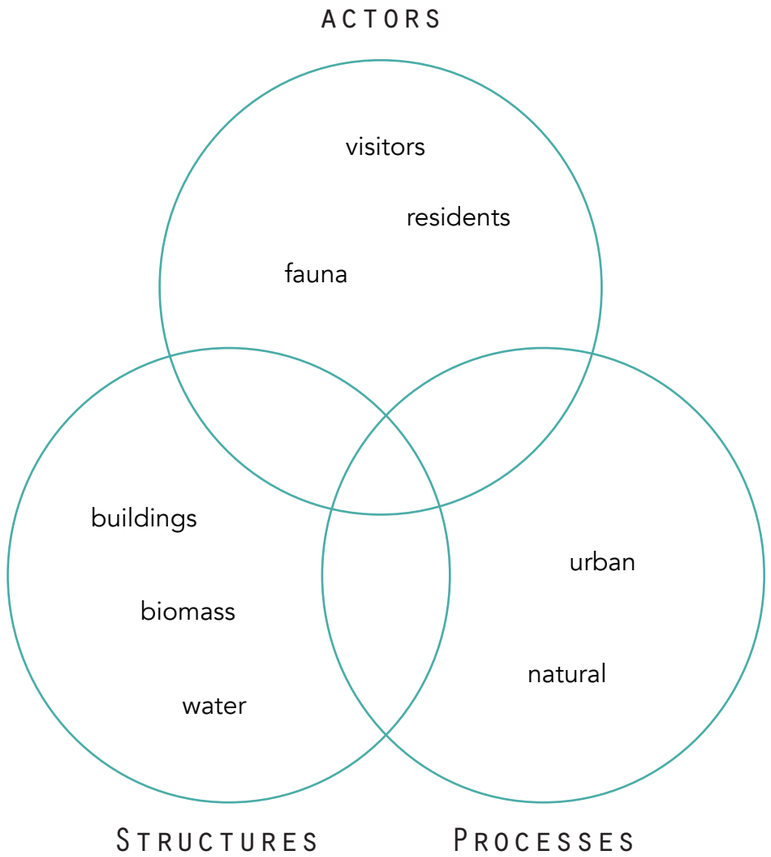
STRUCTURE

PROCESSES

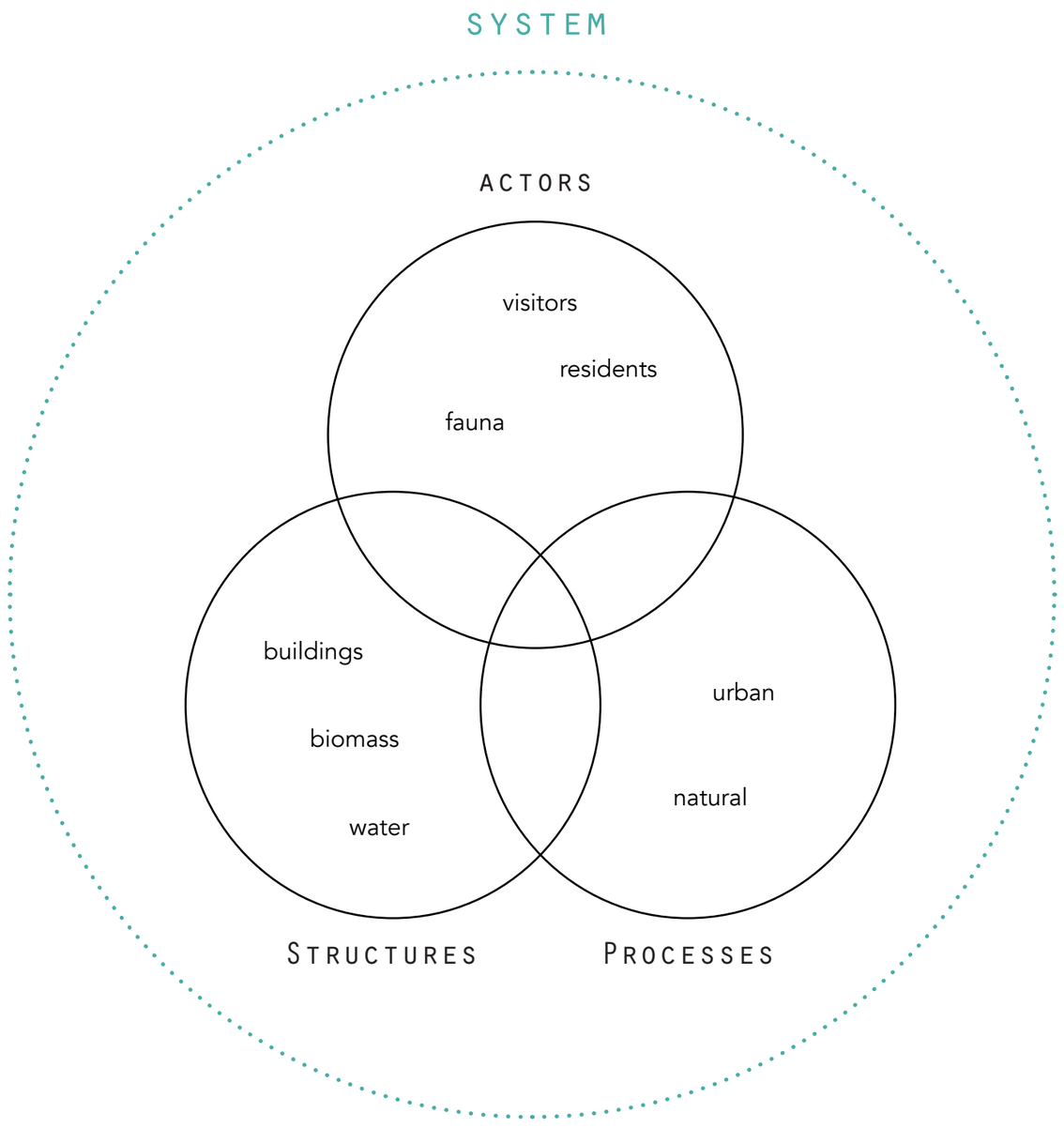
ACTORS

Landscape as a system

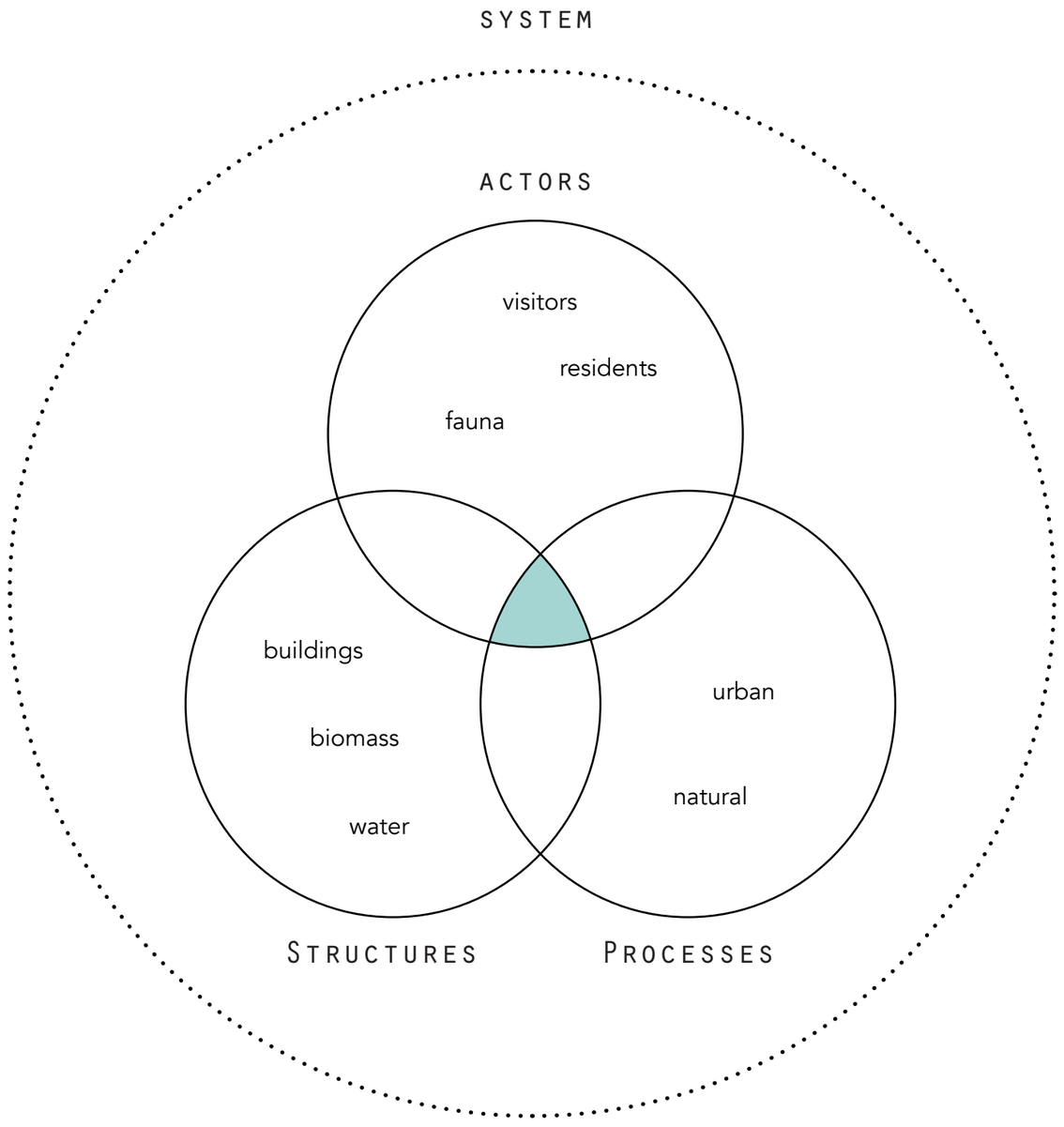
RELATION



Landscape as a system



Landscape as a system

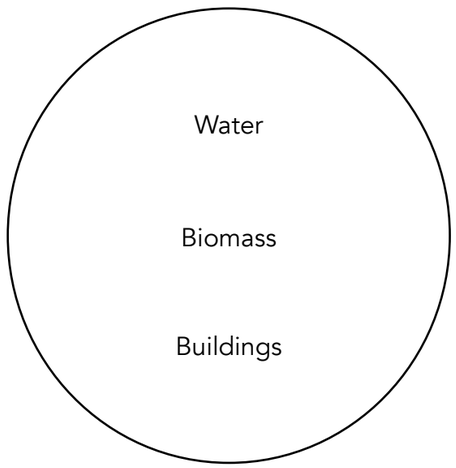


DESIGN RELATED RESEARCH

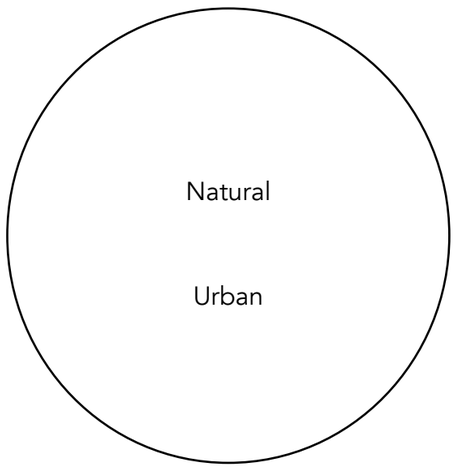
III

Understanding the Mangrove Landscape

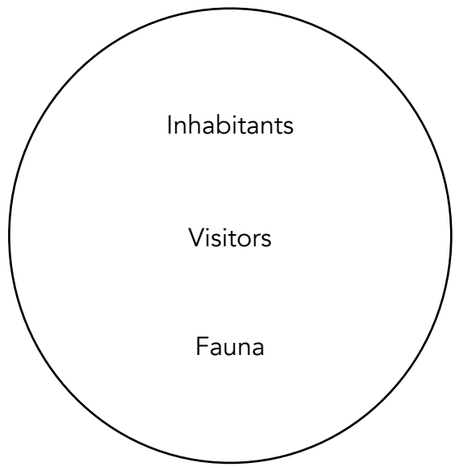
How does the mangrove landscape function in South Florida and how did it change in Biscayne Bay?



Structures

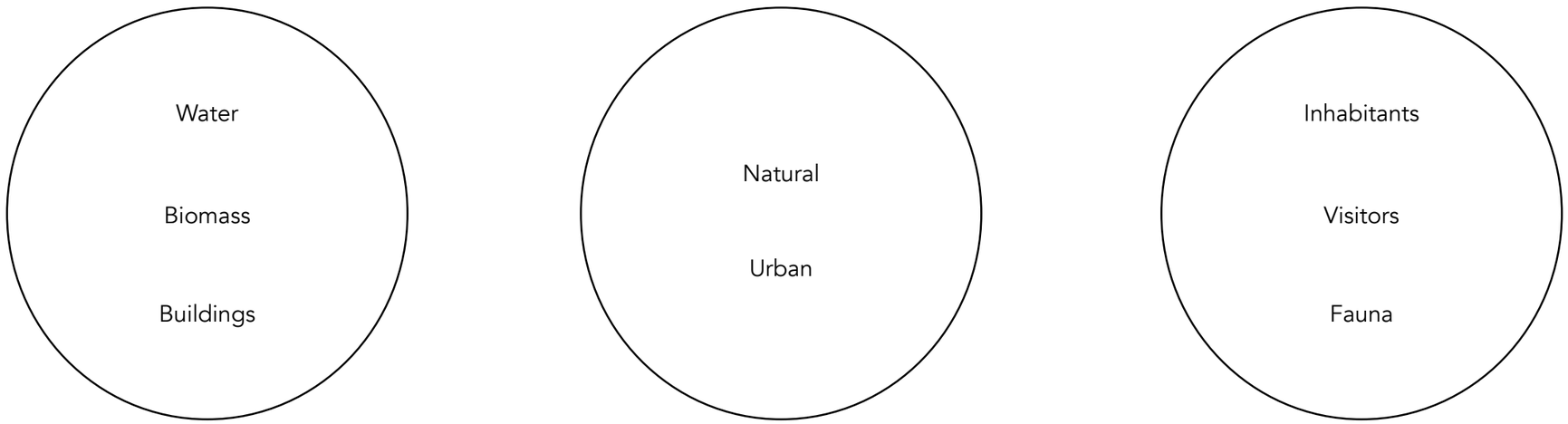


Processes



Actors

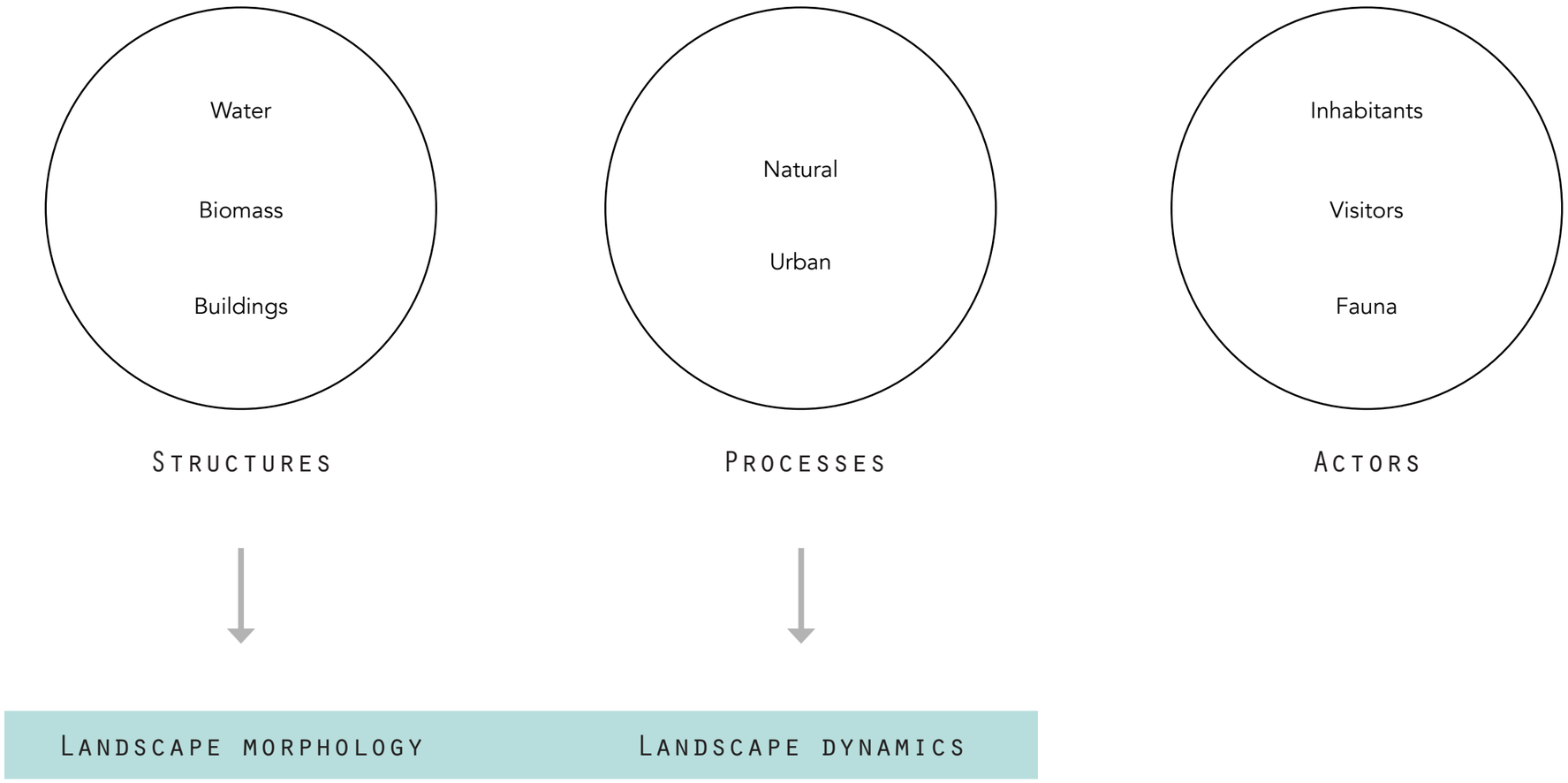
How does the mangrove landscape function in South Florida and how did it change in Biscayne Bay?



Structures | Processes | Actors

Landscape morphology

How does the mangrove landscape function in South Florida and how did it change in Biscayne Bay?



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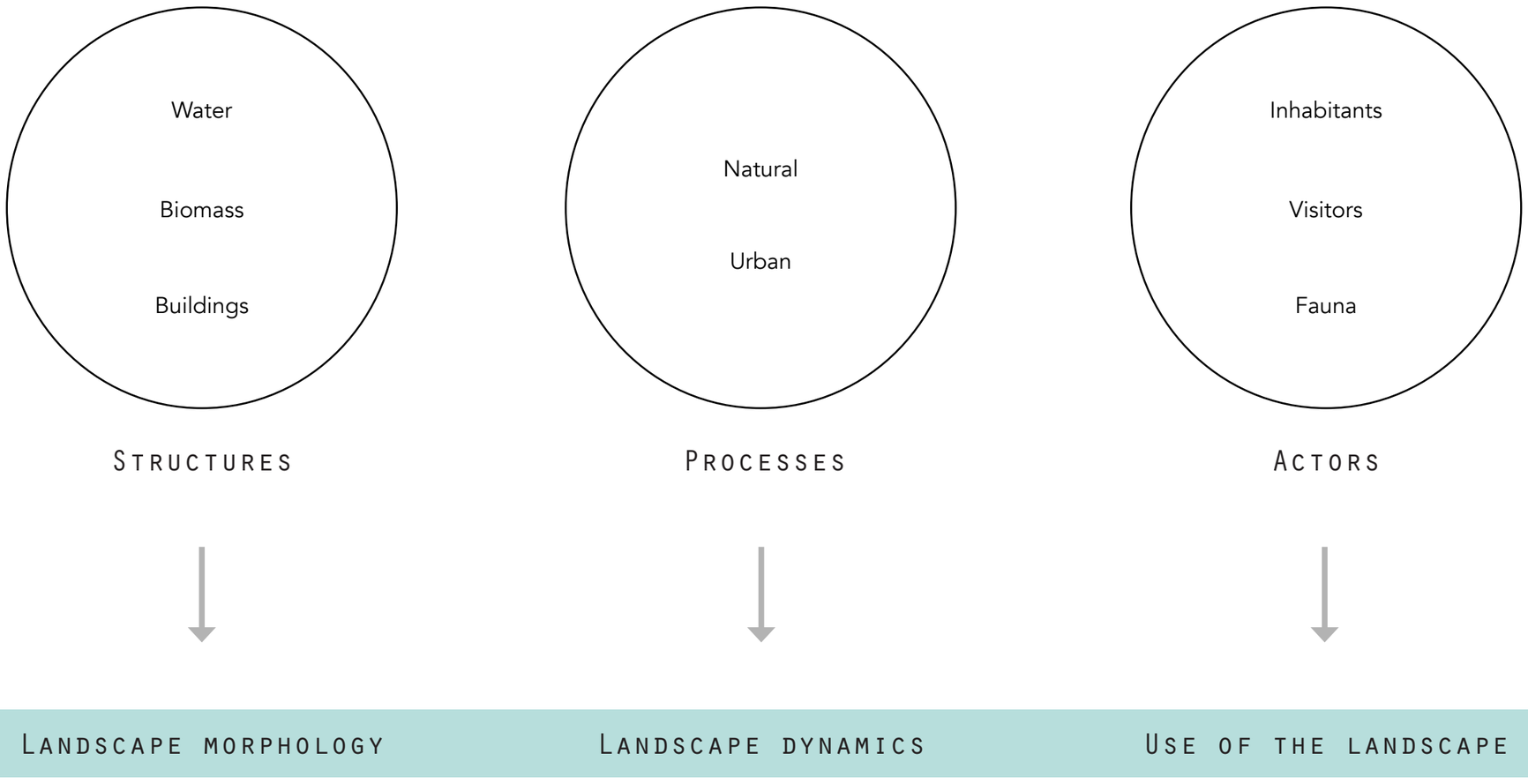

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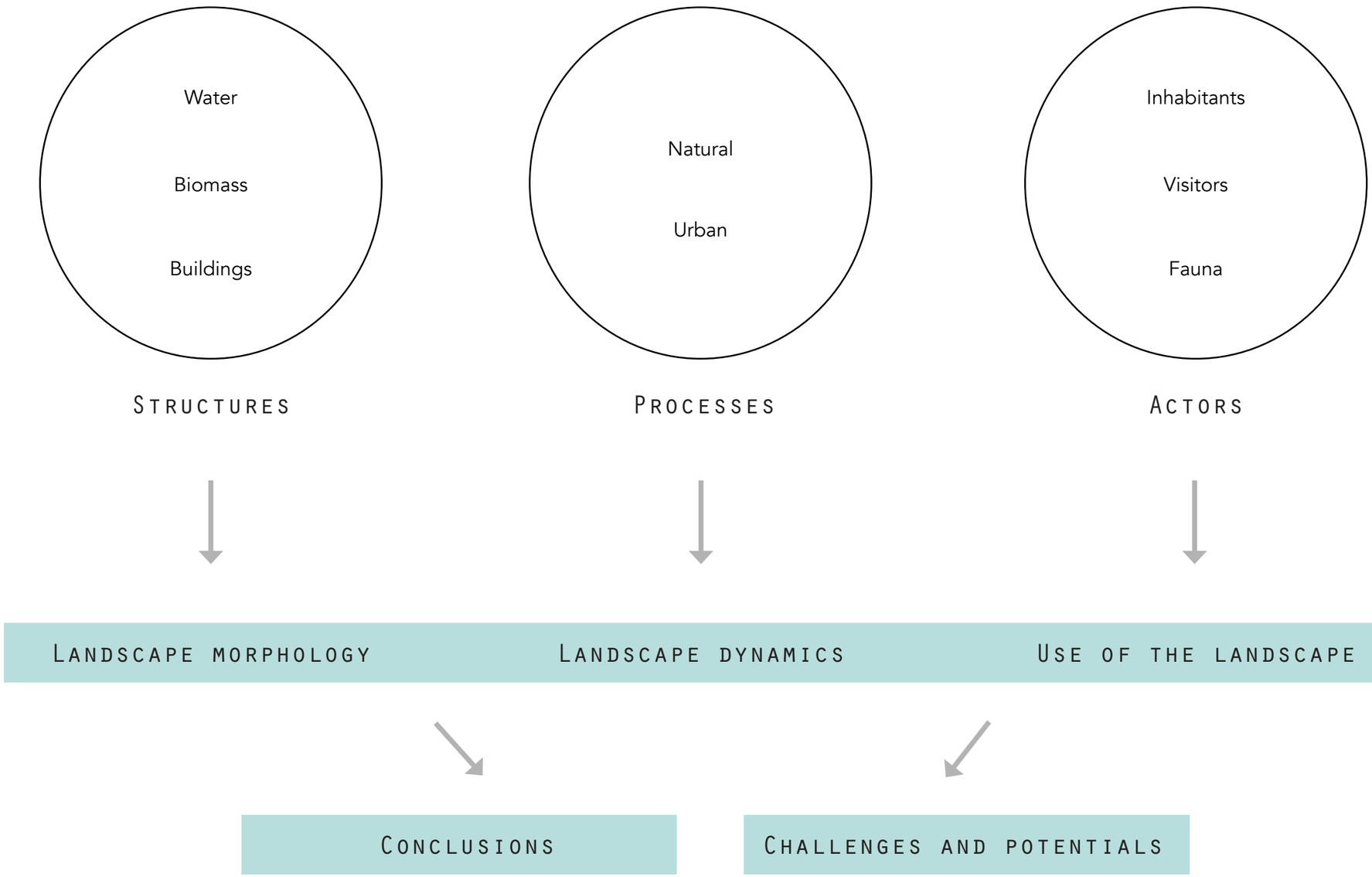
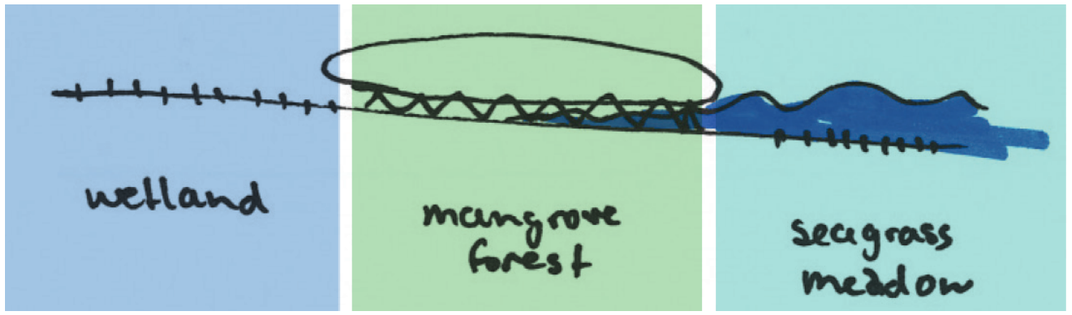


Layers of the mangrove landscape

Landscape typologies



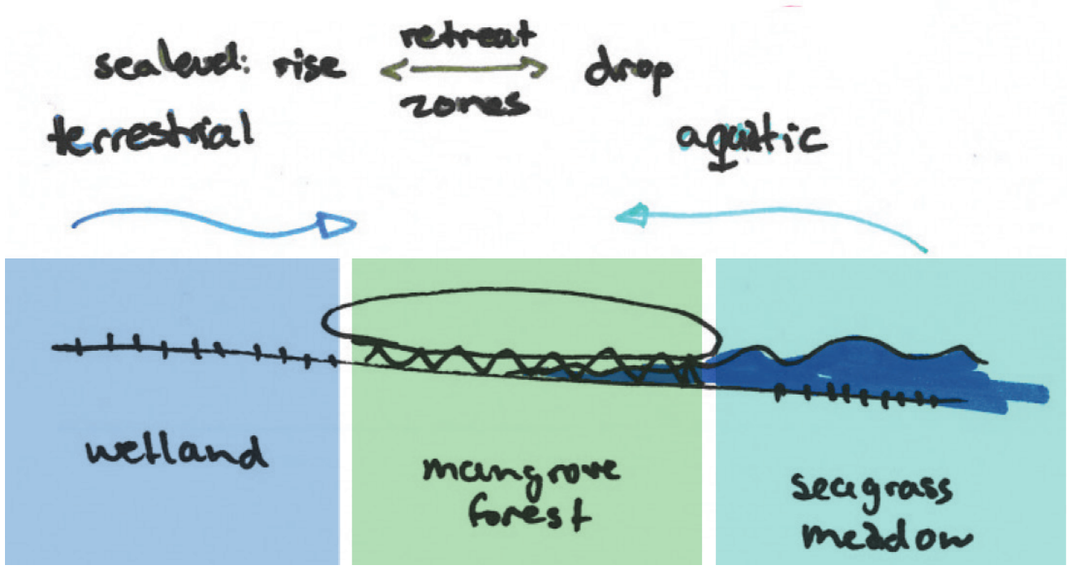
STRUCTURES

ELEMENTS OF THE BISCAYNE BAY COASTLINE

Wetland

Meadow

Layers of the mangrove landscape



Water flows

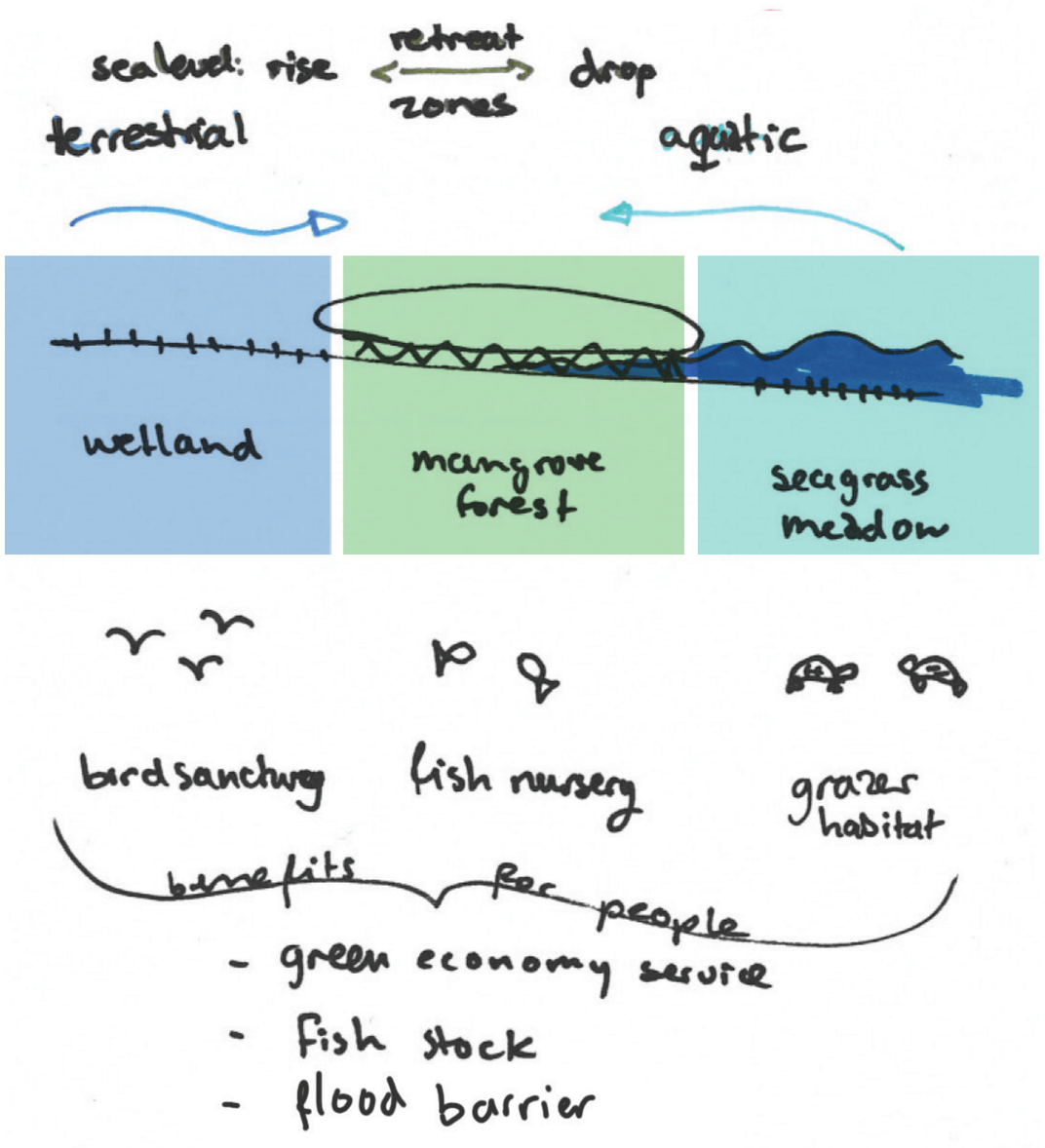
PROCESSES

Landscape typologies

STRUCTURES

ELEMENTS OF THE BISCAYNE BAY COASTLINE

Layers of the mangrove landscape



Water flows

Landscape typologies

Use

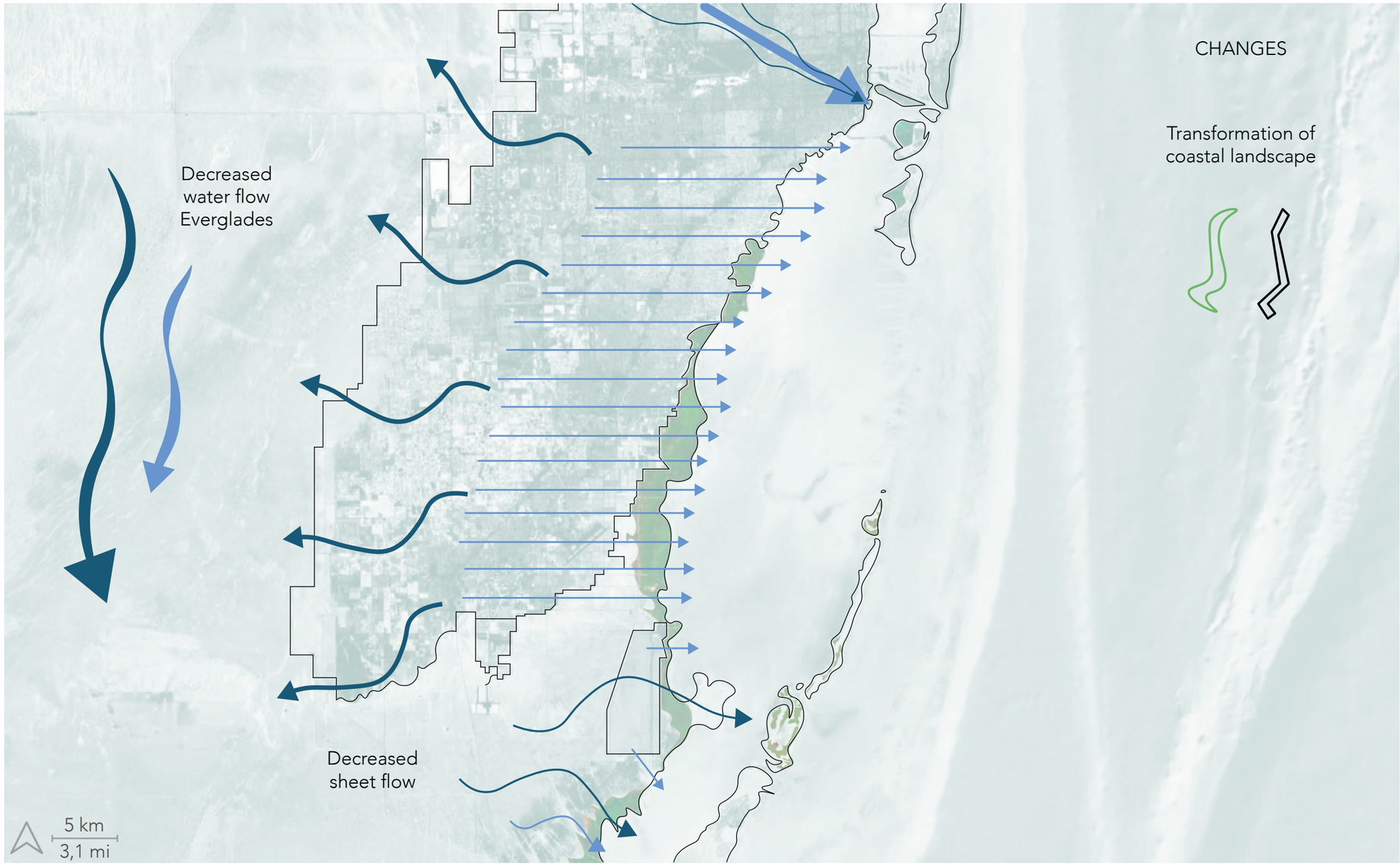
PROCESSES

STRUCTURES

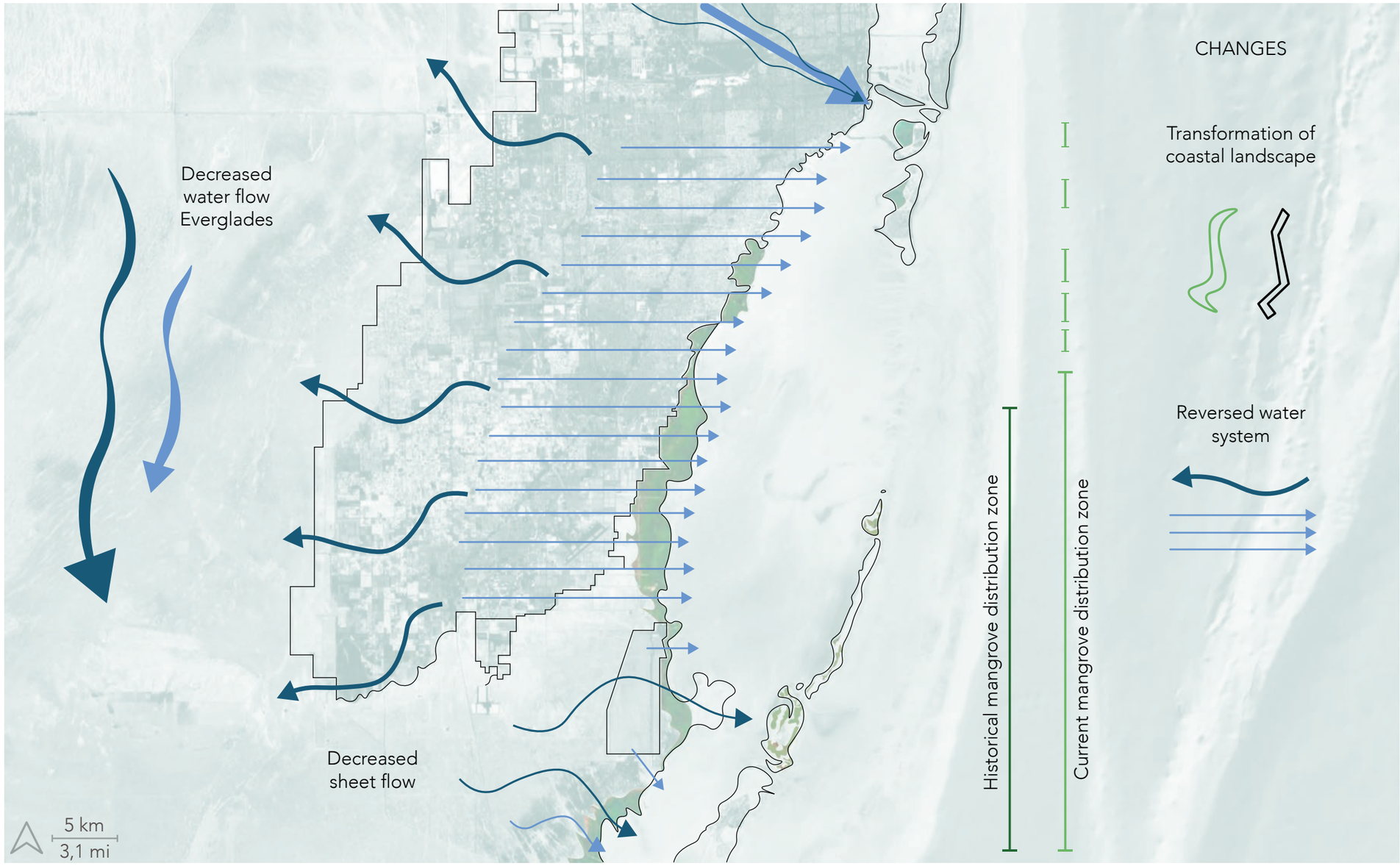
ACTORS

ELEMENTS OF THE BISCAYNE BAY COASTLINE

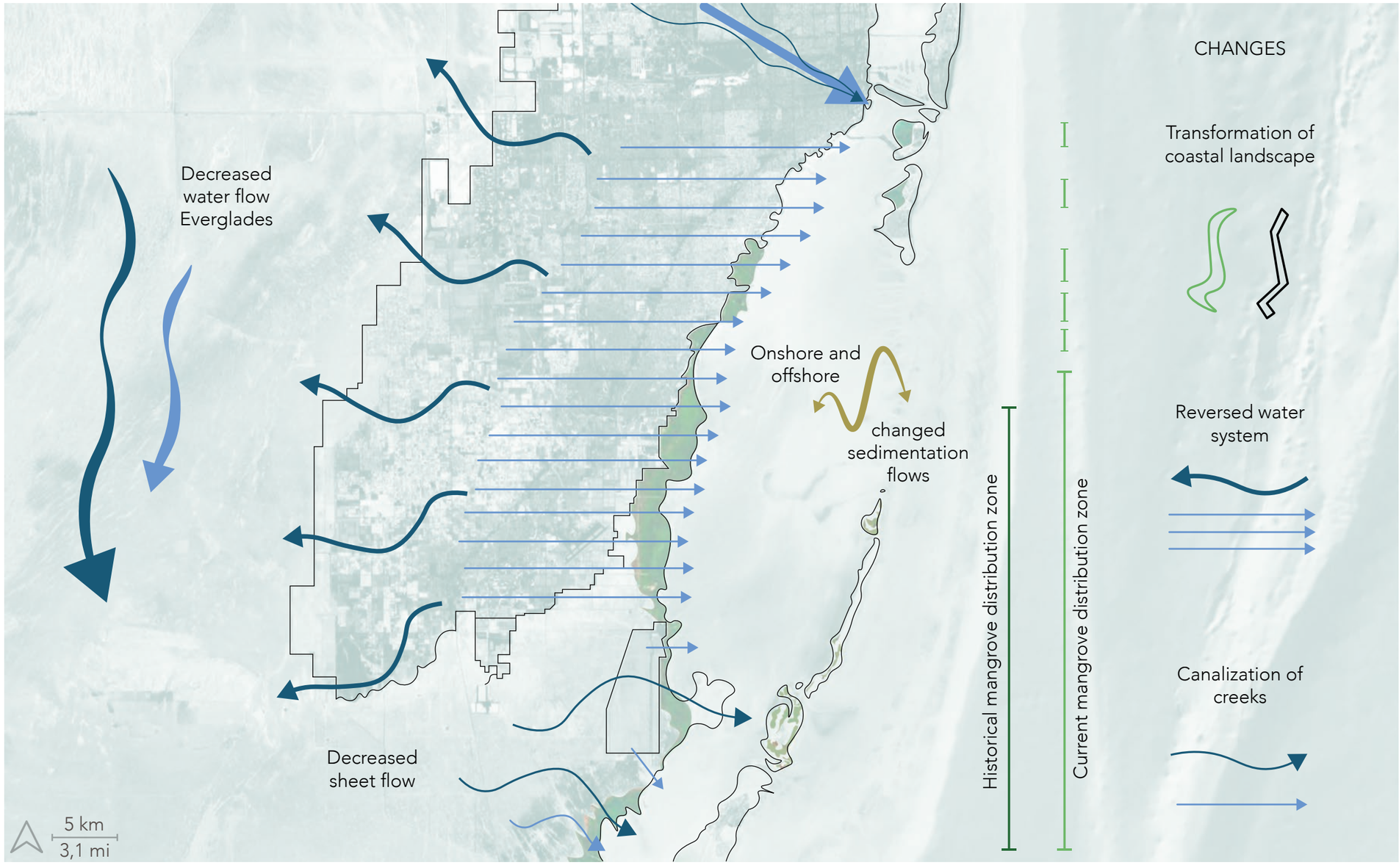
Structure map



STRUCTURE MAP

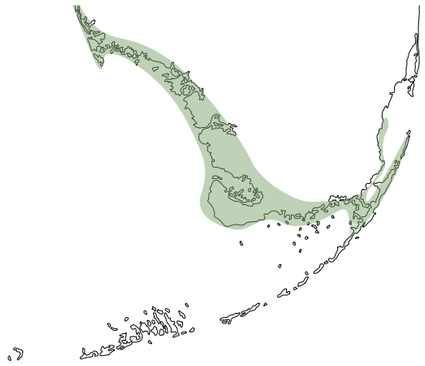


STRUCTURE MAP



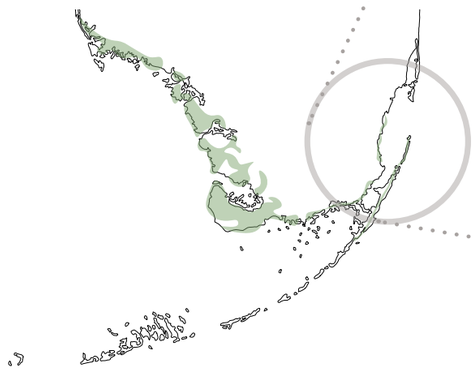
Potential of Biscayne Bay

Historical situation

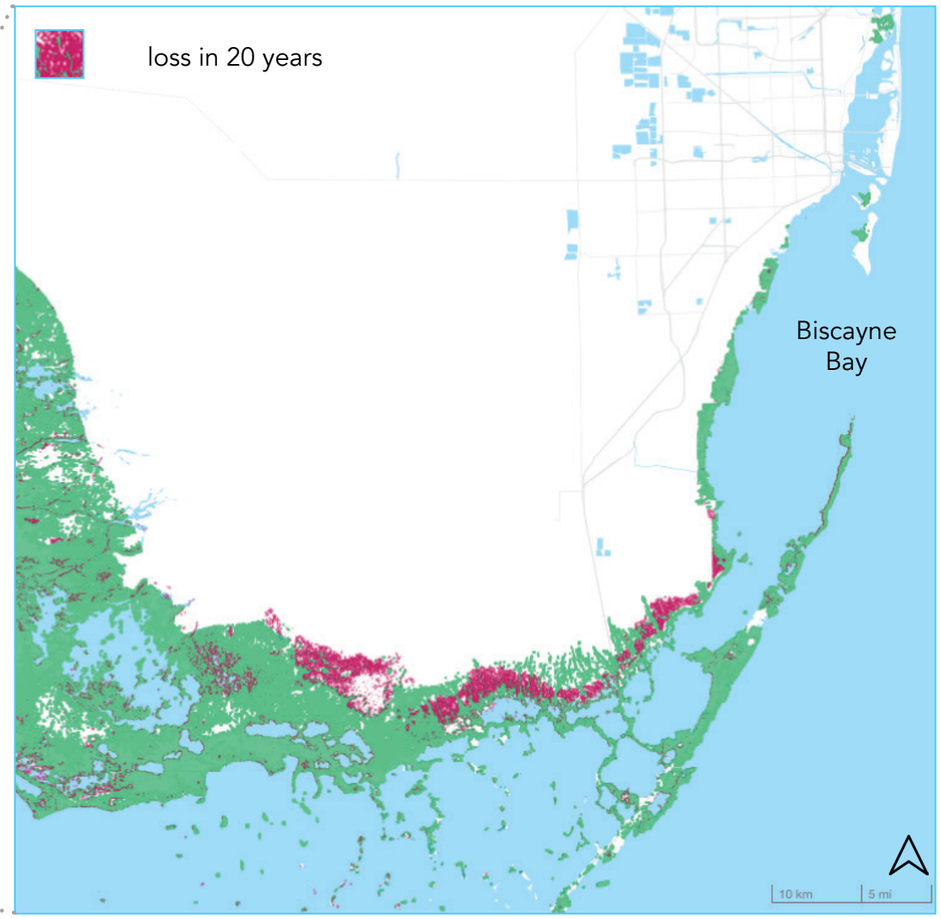


Vast mangrove area

Current situation



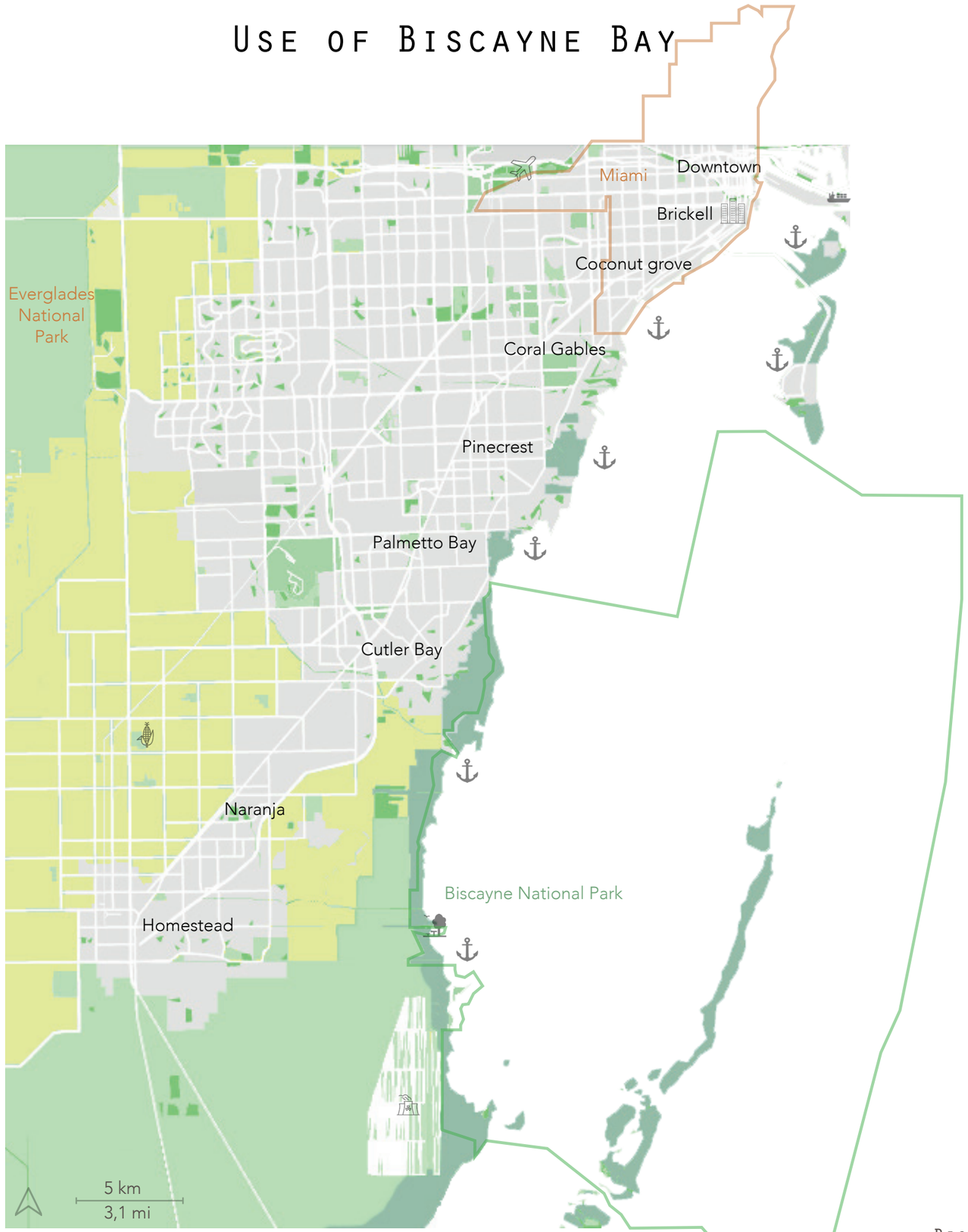
Decreased mangrove area



Mangrove loss South Florida 1996 - 2016

Map obtained via GFW. Retrieved on January 12 2019 from www.globalforest-watch.org

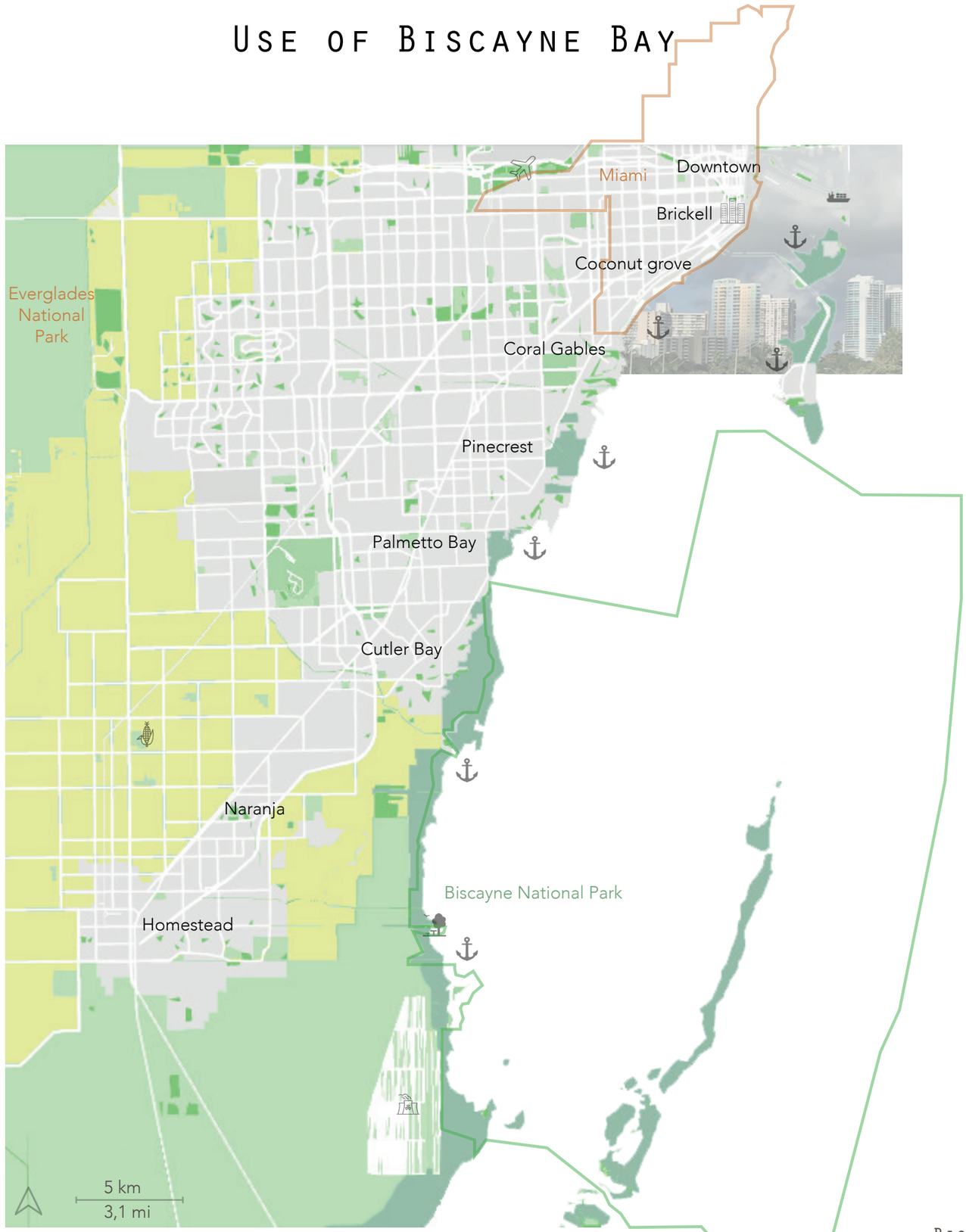
Use of Biscayne Bay



Residential area
Agriculture
Wetland
Mangrove

Map based on data provided by Delft University of Technology

Use of Biscayne Bay



Residential area
Agriculture
Wetland
Mangrove

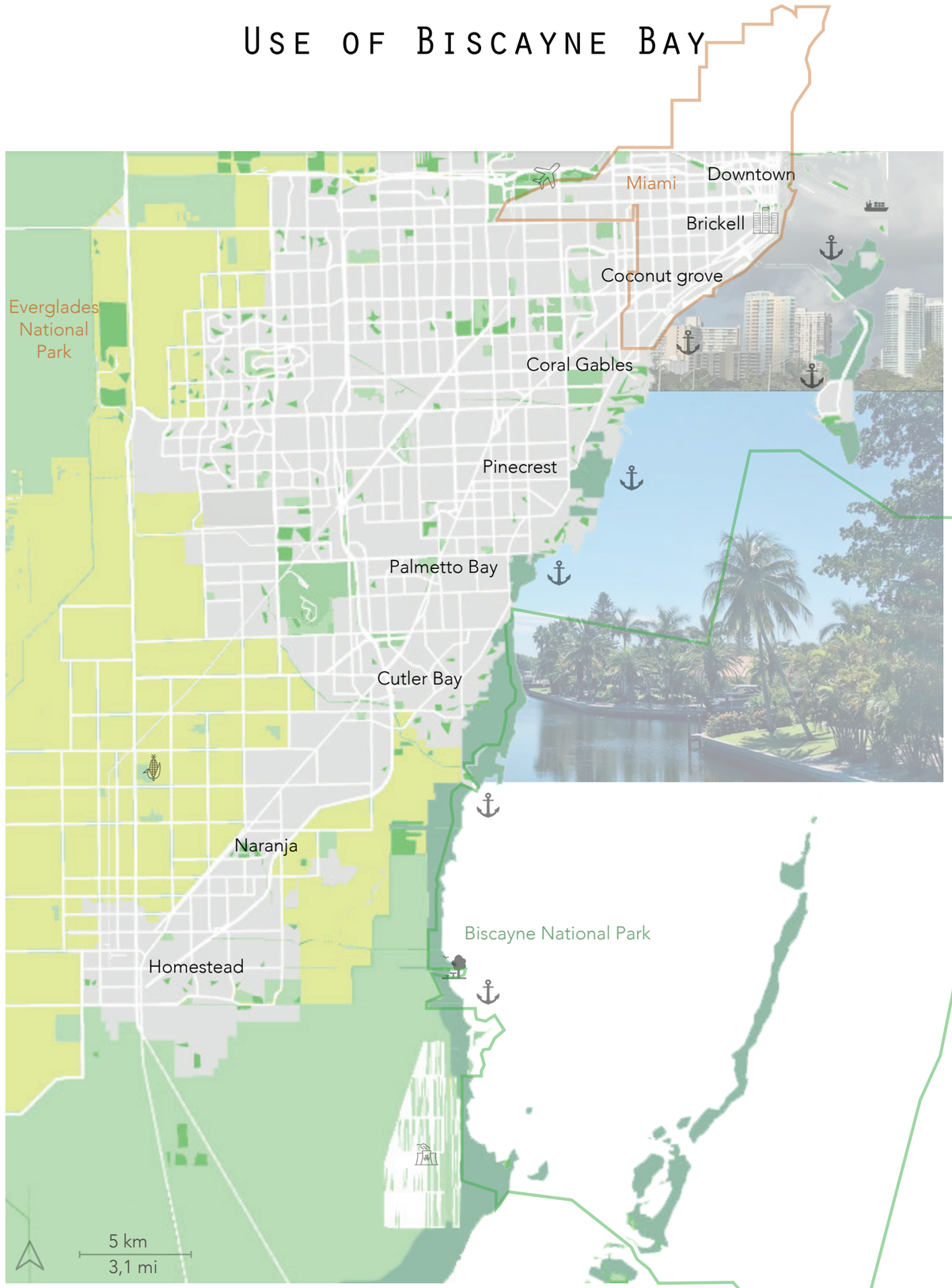
Map based on data provided by Delft University of Technology

Urban

Source: www.luxlifemiamiblog.com

Source: www.nytimes.com

Use of Biscayne Bay



Urban

Residential

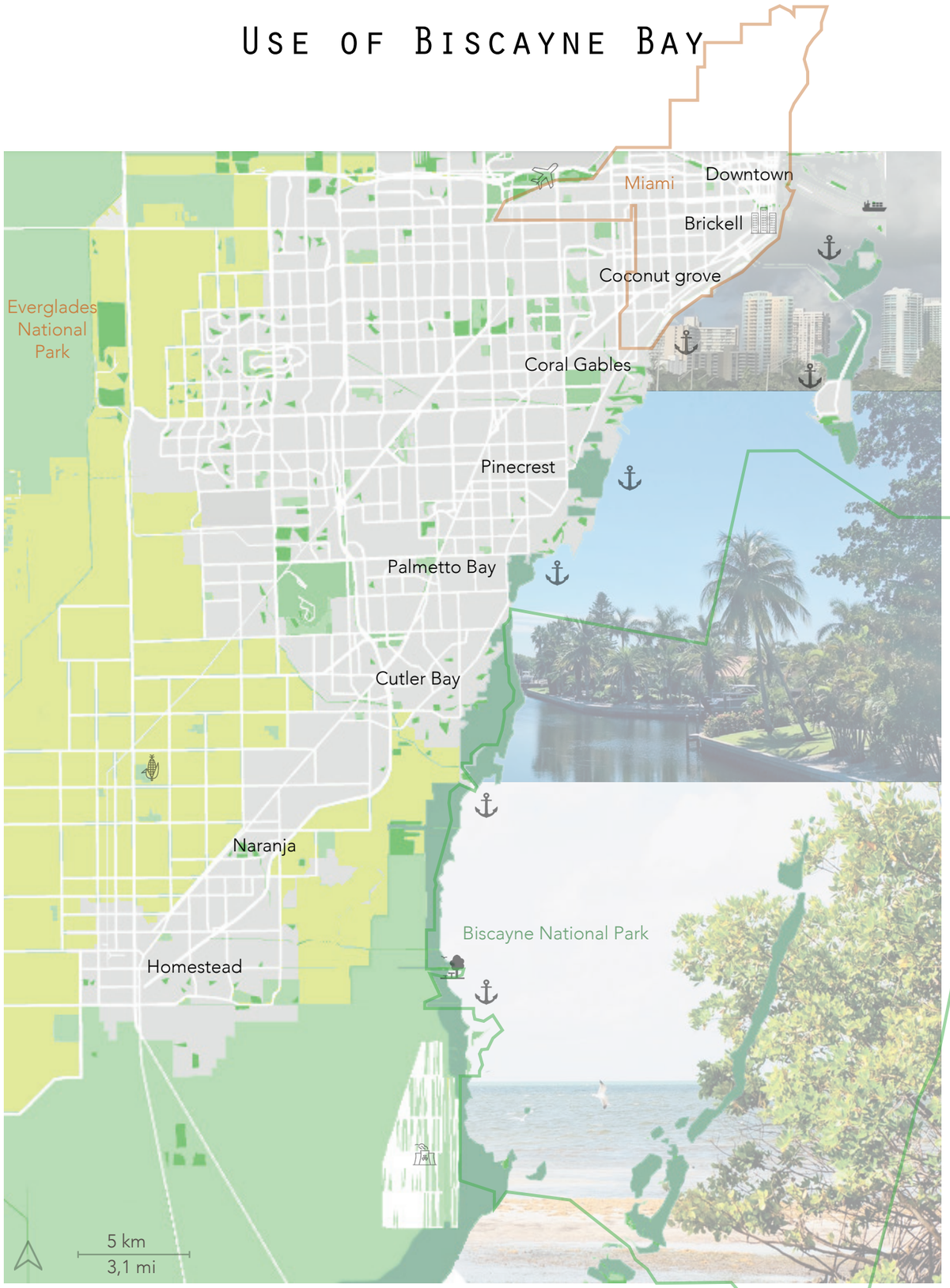
Residential area
Agriculture
Wetland
Mangrove

Map based on data provided by Delft University of Technology

Source: www.miamiluxuryliving.com

Source: www.activerain.com

Use of Biscayne Bay



Urban

Residential

Natural

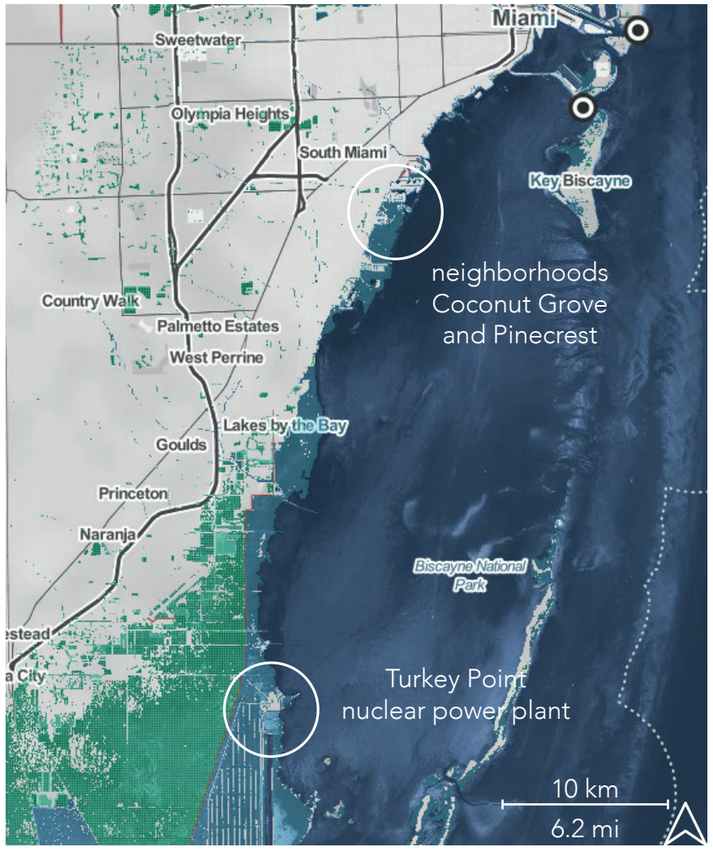
Residential area
Agriculture
Wetland
Mangrove

Map based on data provided by Delft University of Technology

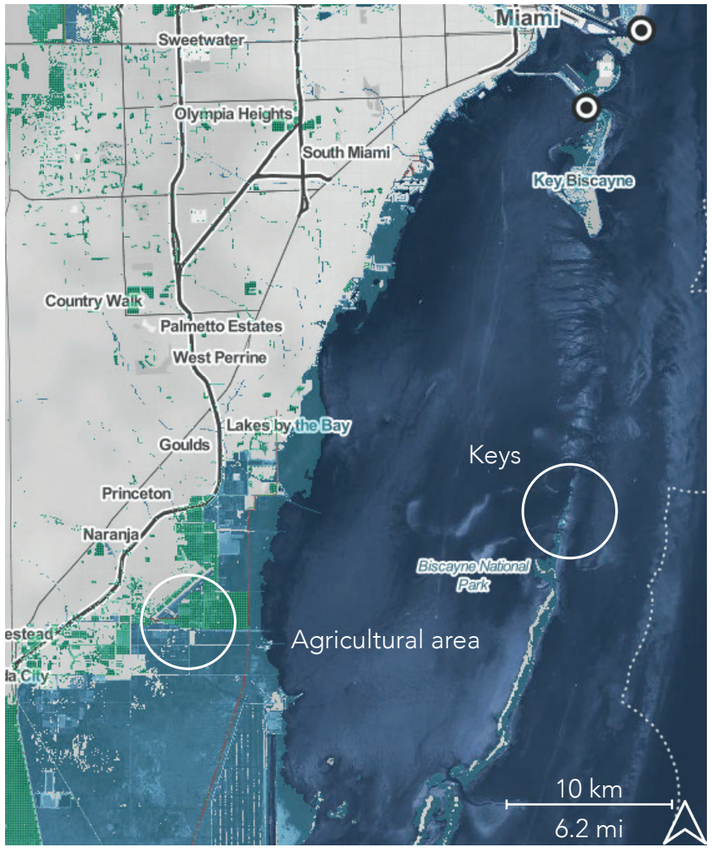
Source: Alex Sotomayor

Sea level rise scenarios

Current king tide and 2100 projection



1. Sea level rise of 0,5 meter / 1,6 ft

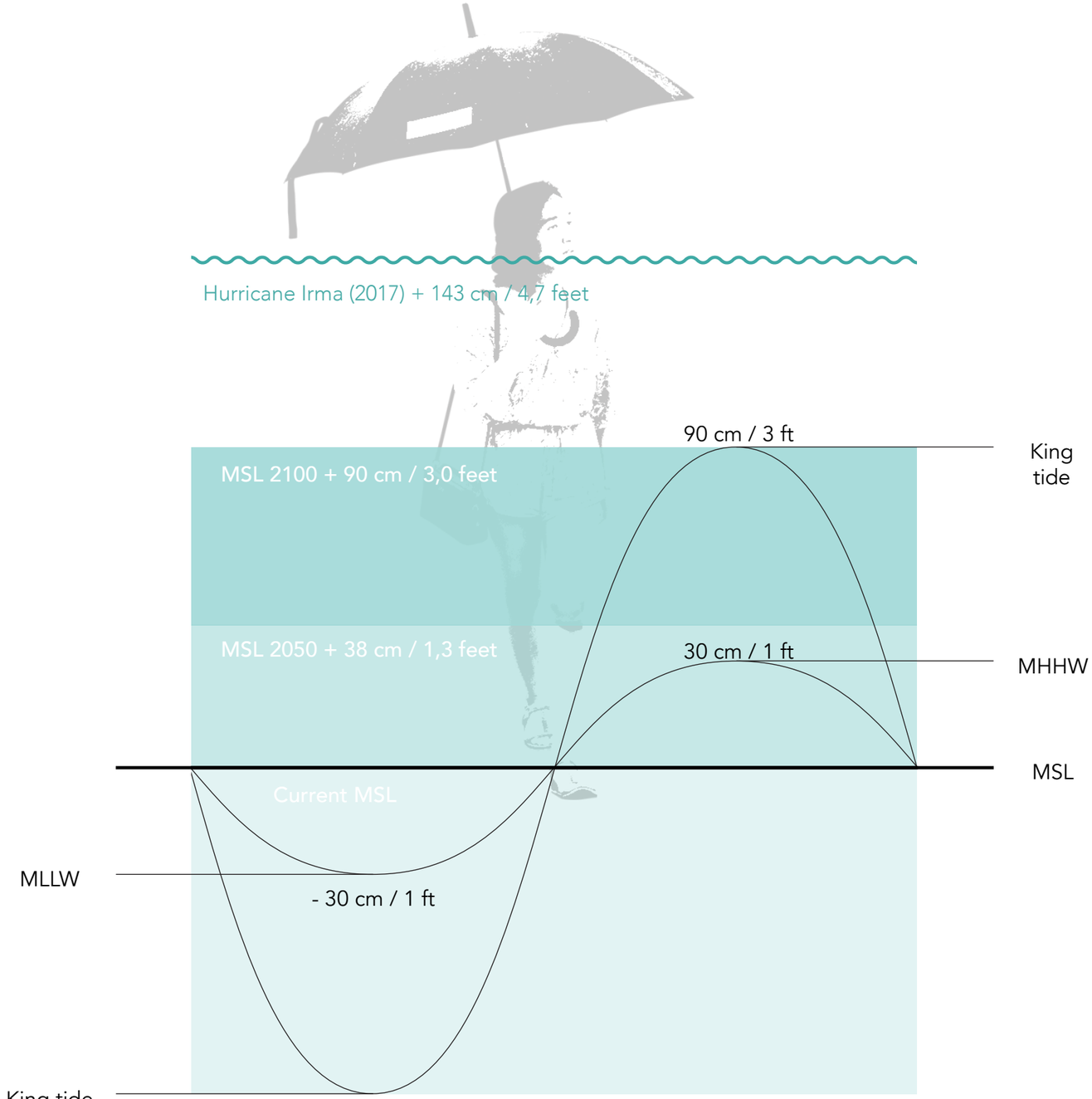


2. Sea level rise of 1 meter / 3,3 ft

3. Sea level rise of 3 meter / 9 ft

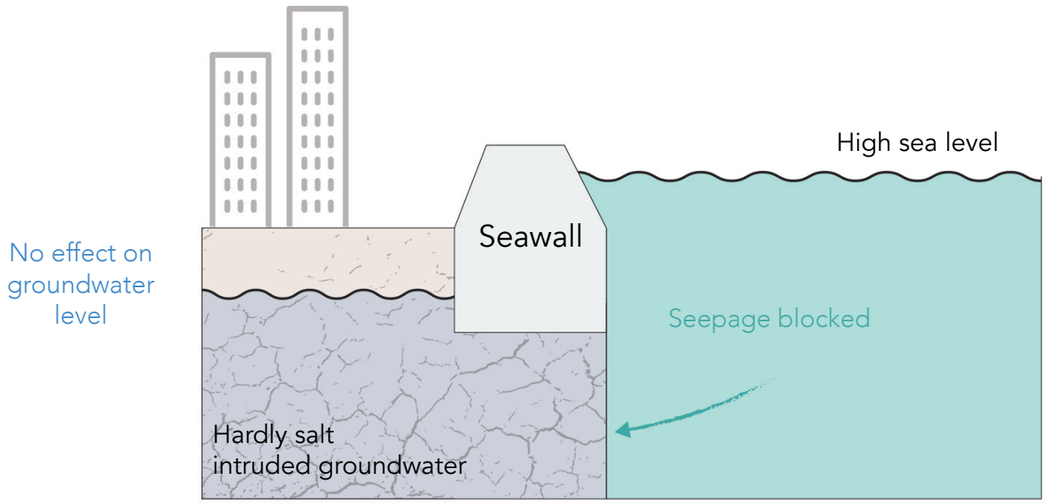
Source: Climate Central. Retrieved on December 12 2018 from http://sealevel.climatecentral.org

Water levels

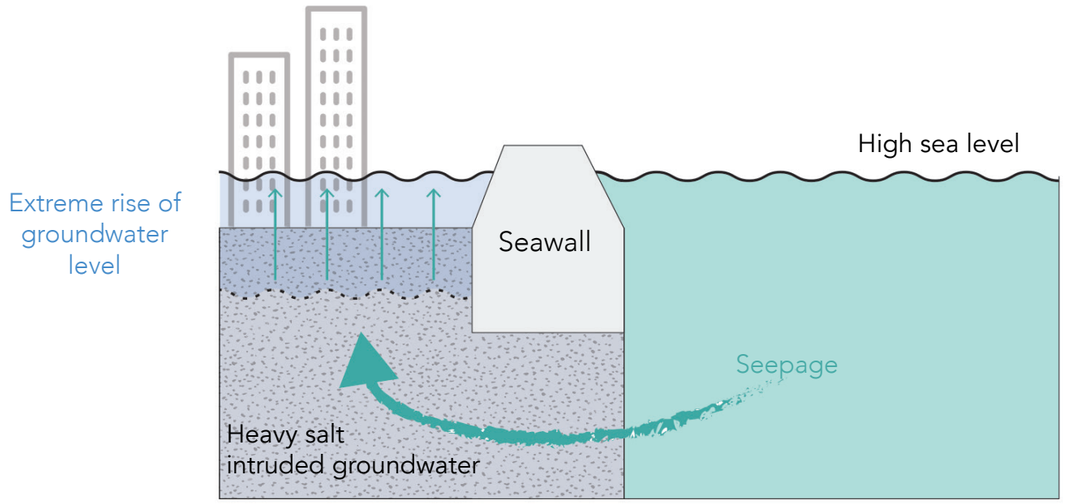


Data based on the National Hurricane Center

EFFECTIVENESS OF A SEAWALL



Clay soil coast line



Lime stone coast line

IV

Mangrove design principles

What spatial and ecological design principles can provide conditions to restore and improve the mangrove landscape in order to let it function as coastal defence and let users reconnect with the natural landscape.

Restoration methods
Conditions for reforestation

Spatial application
Design experience

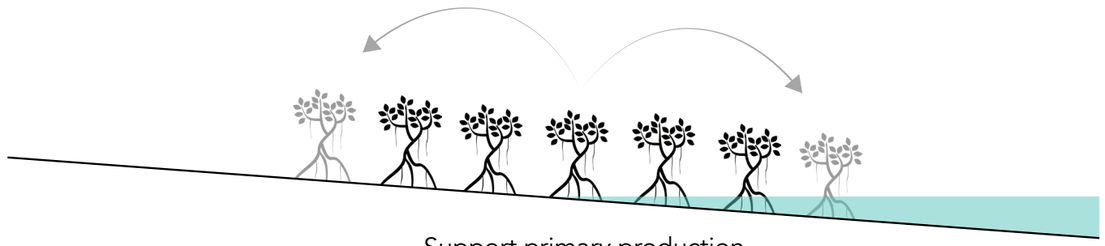
Research through design

Research on design

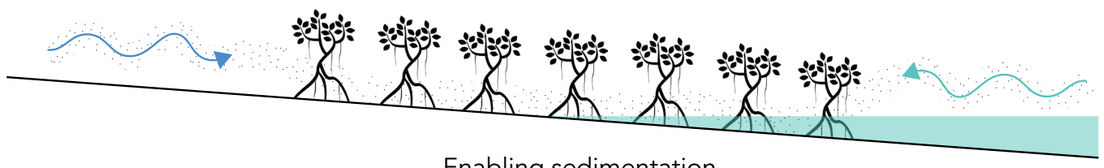
Principles and strategy

Design principles

RECOVERY CONDITIONS



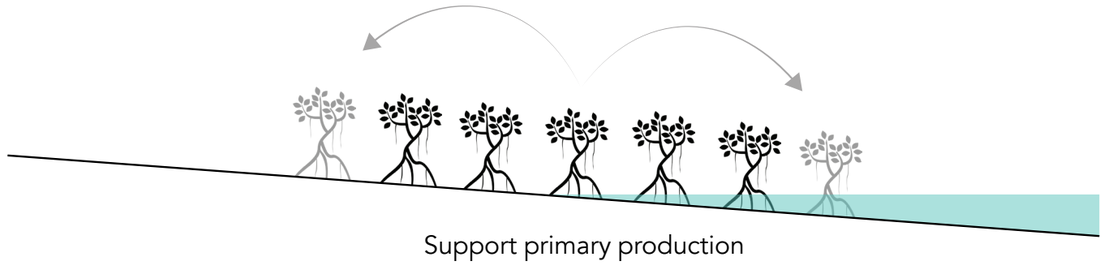
Support primary production



Enabling sedimentation.

Design principles

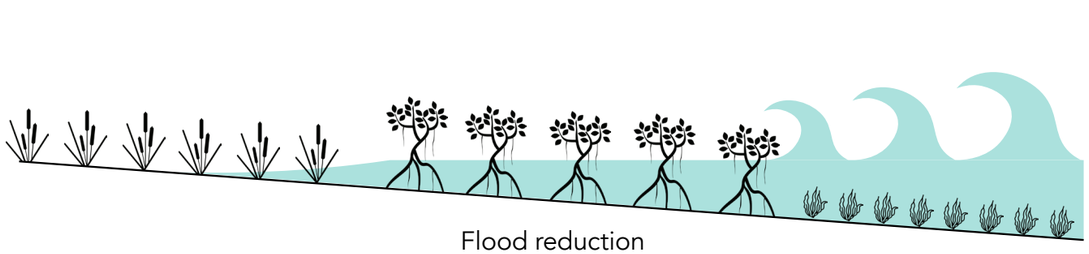
Recovery conditions



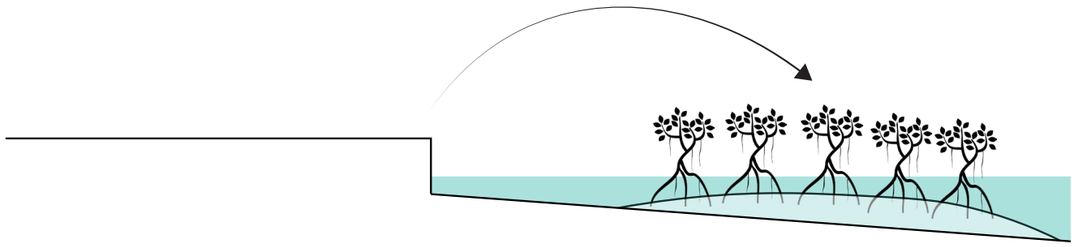
Support primary production

Enabling sedimentation.

Layers and barriers



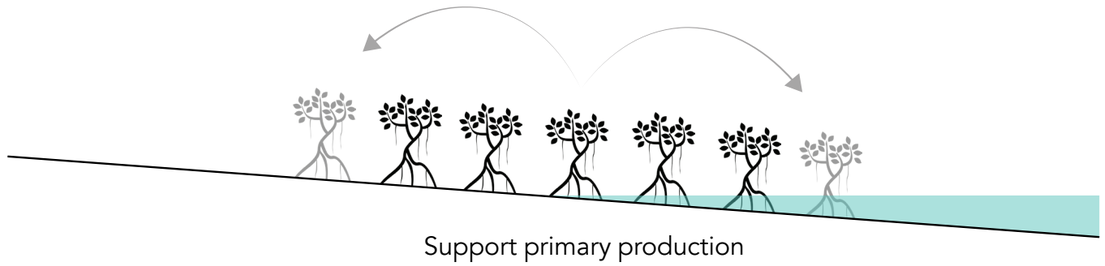
Flood reduction



Relocate barrier

Design principles

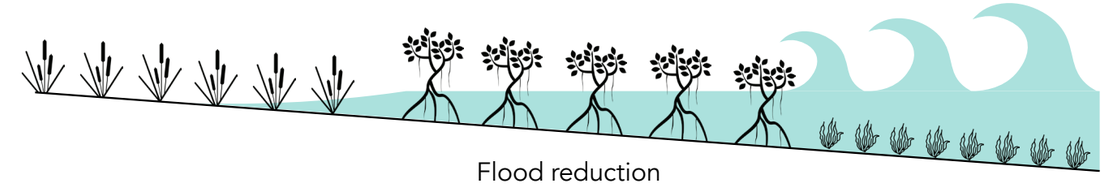
Recovery conditions



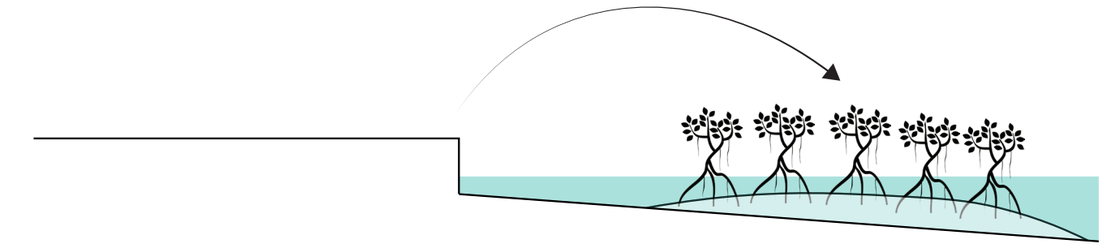
Support primary production

Enabling sedimentation.

Layers and barriers

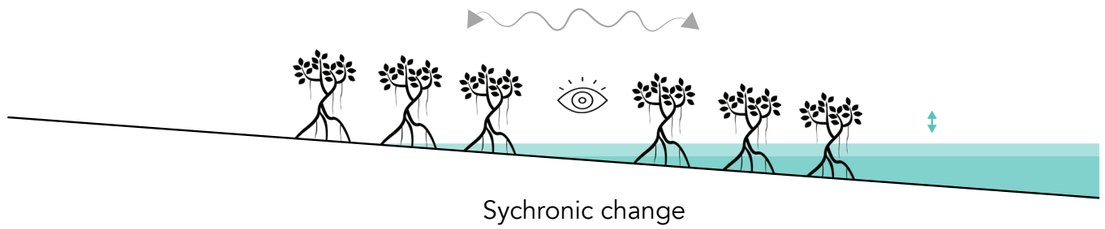


Flood reduction

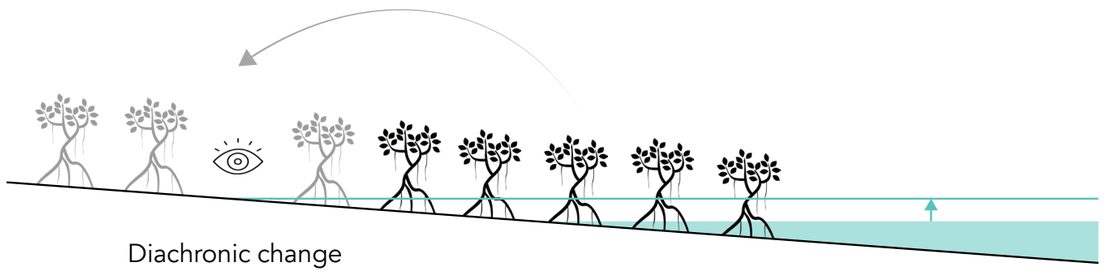


Relocate barrier

Visualization of change



Sychronic change



Diachronic change

LAYERED STRATEGY

Desired:
Three layers are continuous

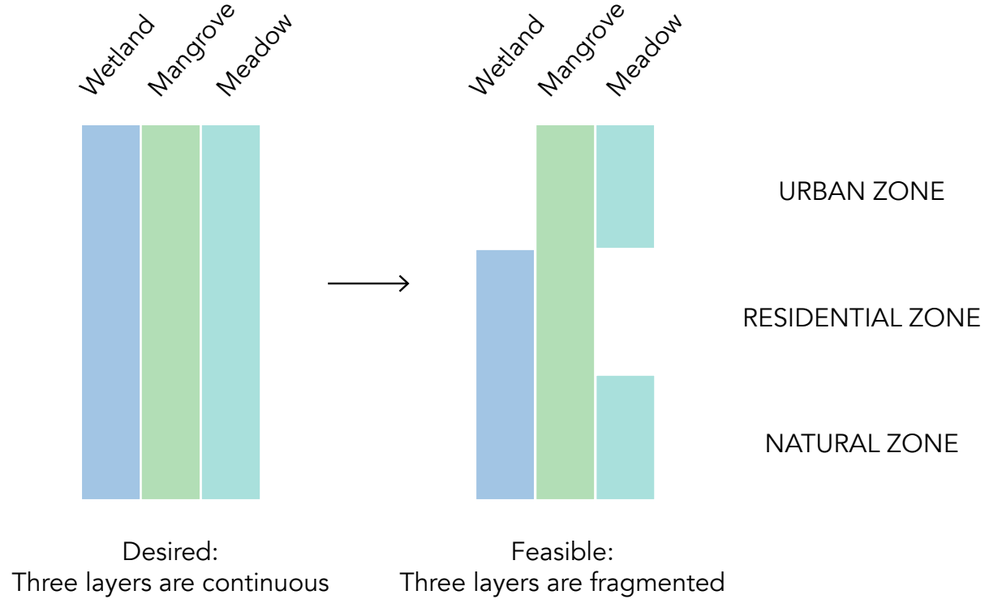
Wetland

Forest

Meadow

Strategy

LAYERED STRATEGY

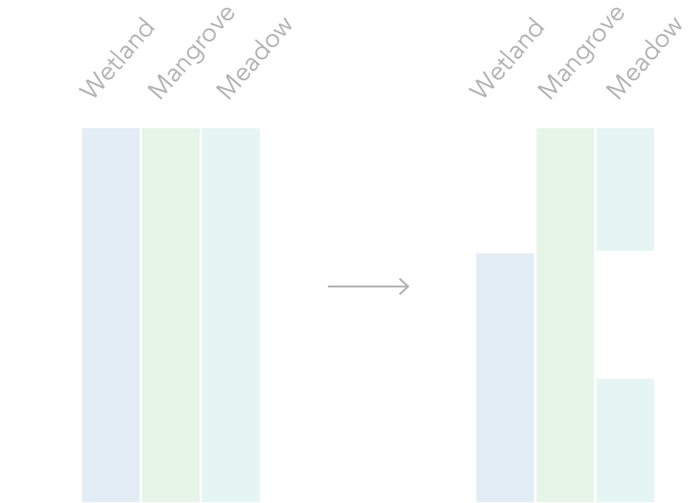


Desired:
Three layers are continuous

Feasible:
Three layers are fragmented

Strategy

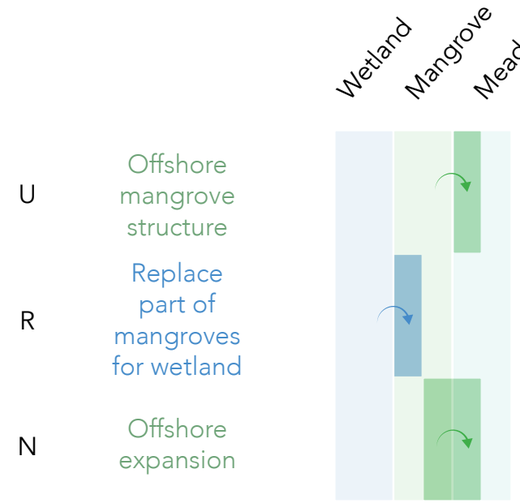
LAYERED STRATEGY



Desired:
Three layers are continuous

Feasible:
Three layers are fragmented

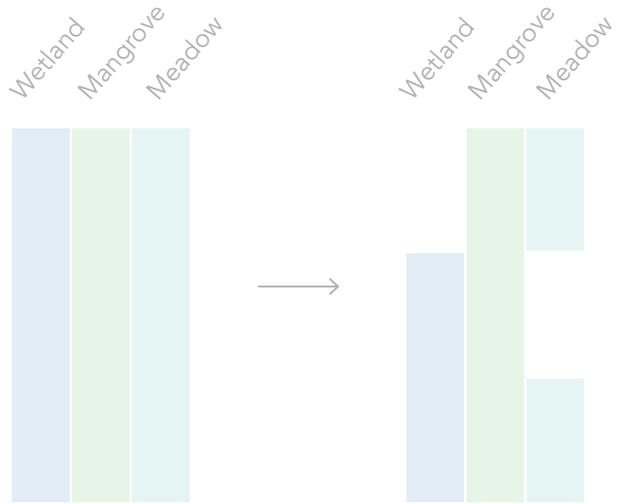
SHIFTING TYPOLOGIES



Actions

Strategy

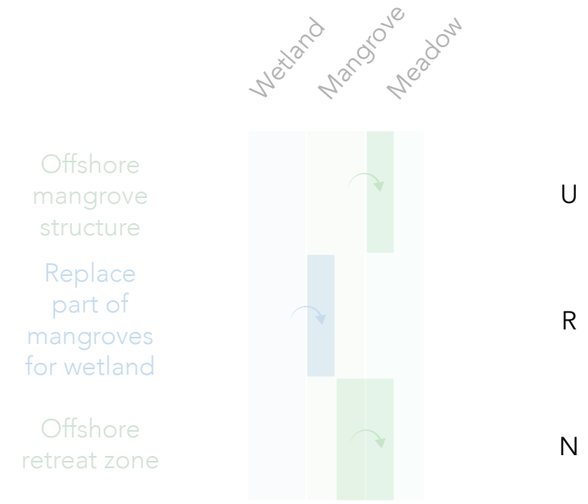
LAYERED STRATEGY



Desired:
Three layers are continuous

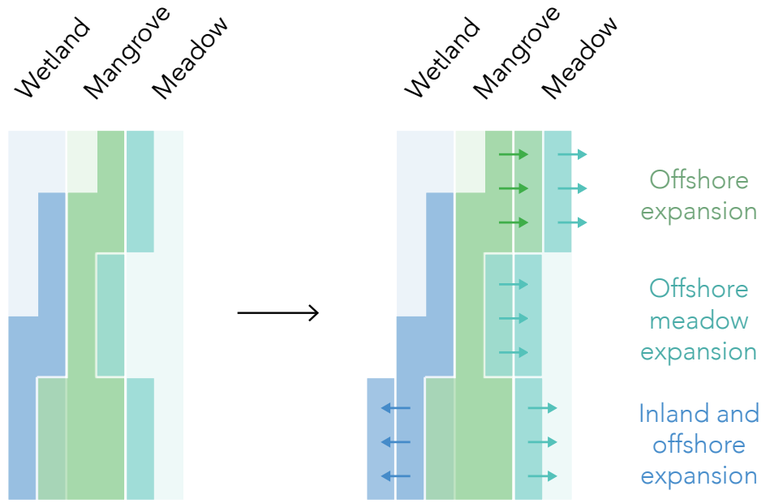
Feasible:
Three layers are fragmented

SHIFTING TYPOLOGIES



Actions

SPATIAL APPLICATION



Interwoven layers

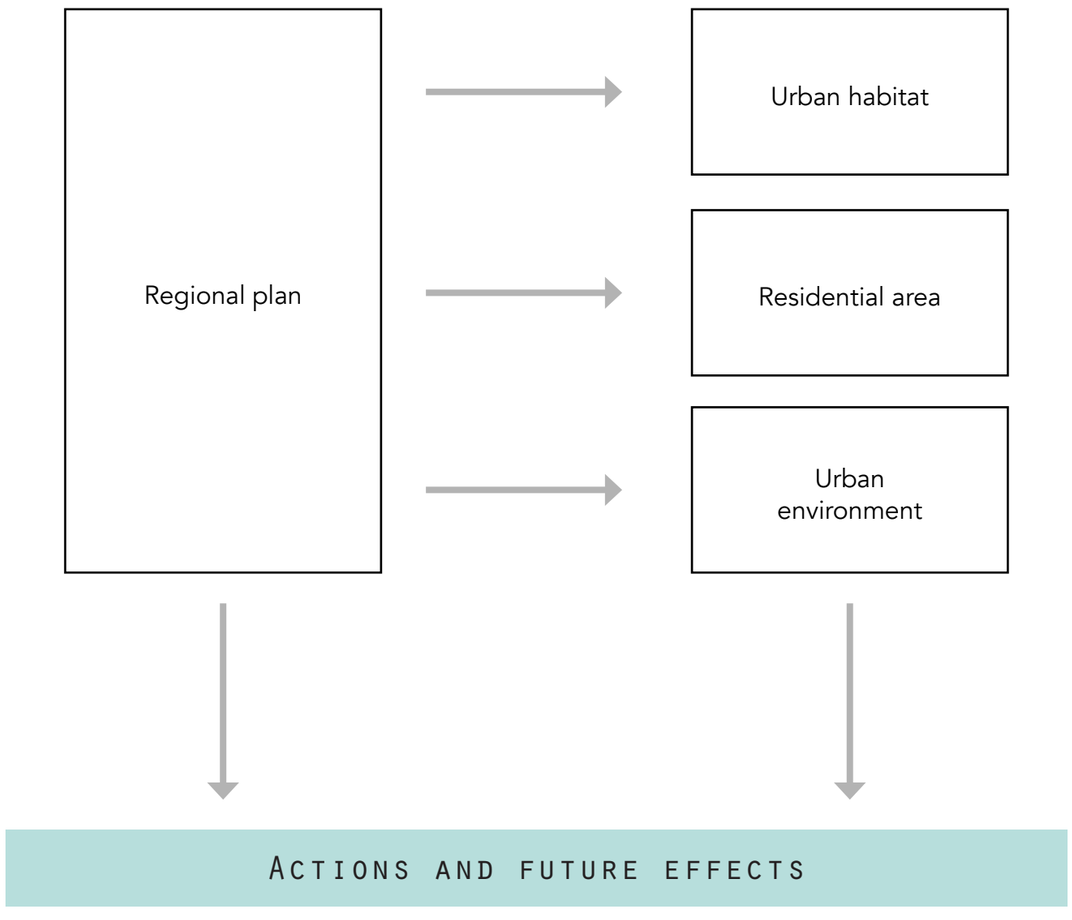
Dynamic borders

V

A new coastline for Biscayne Bay

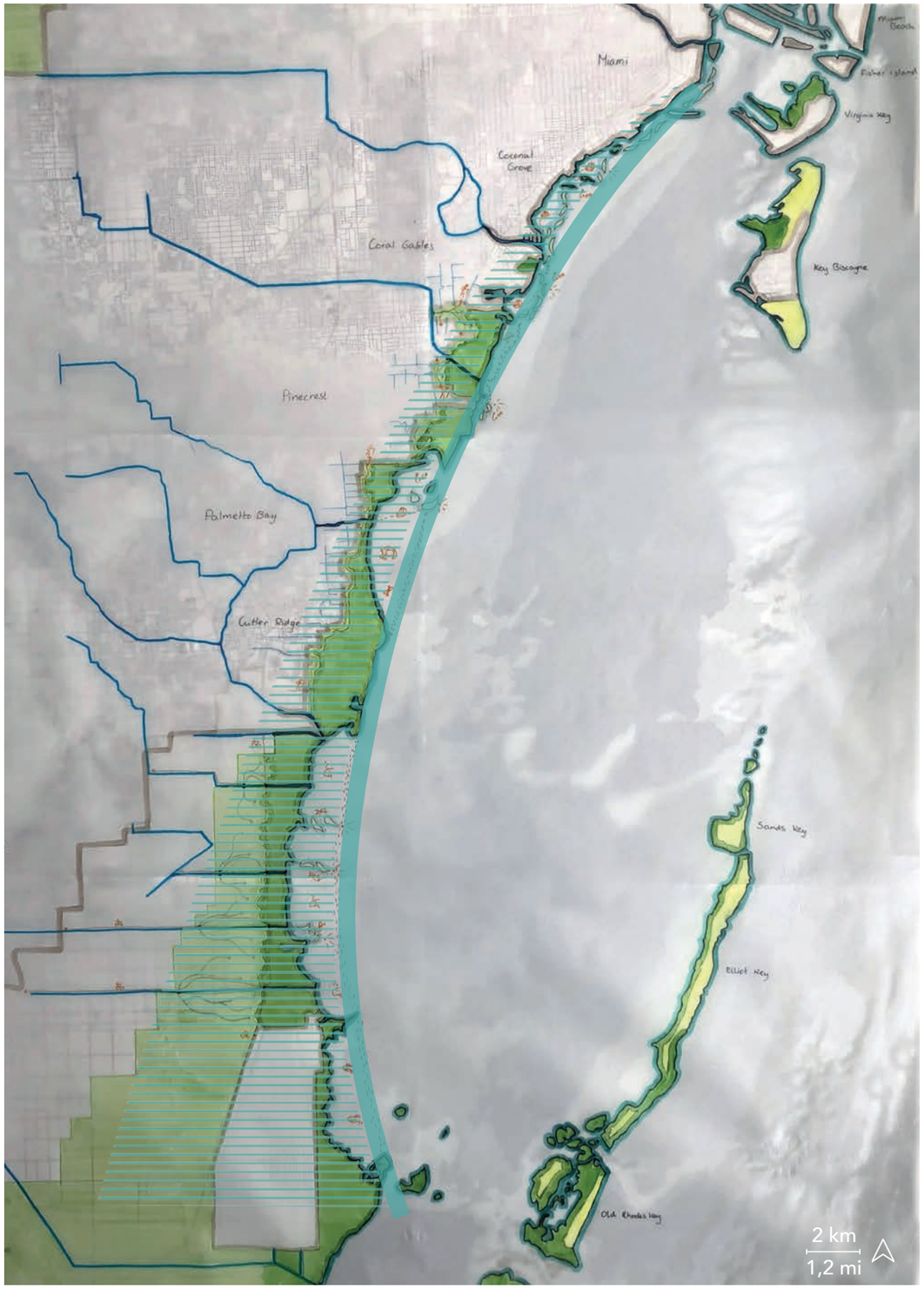
What are the spatial possibilities to create the needed conditions and reconnection in Biscayne Bay and how can they be made resistant to threats such as sea level rise and tropical storms?

What are the spatial possibilities to create the needed conditions and reconnection in Biscayne Bay and how can they be made resistant to threats such as sea level rise and tropical storms?



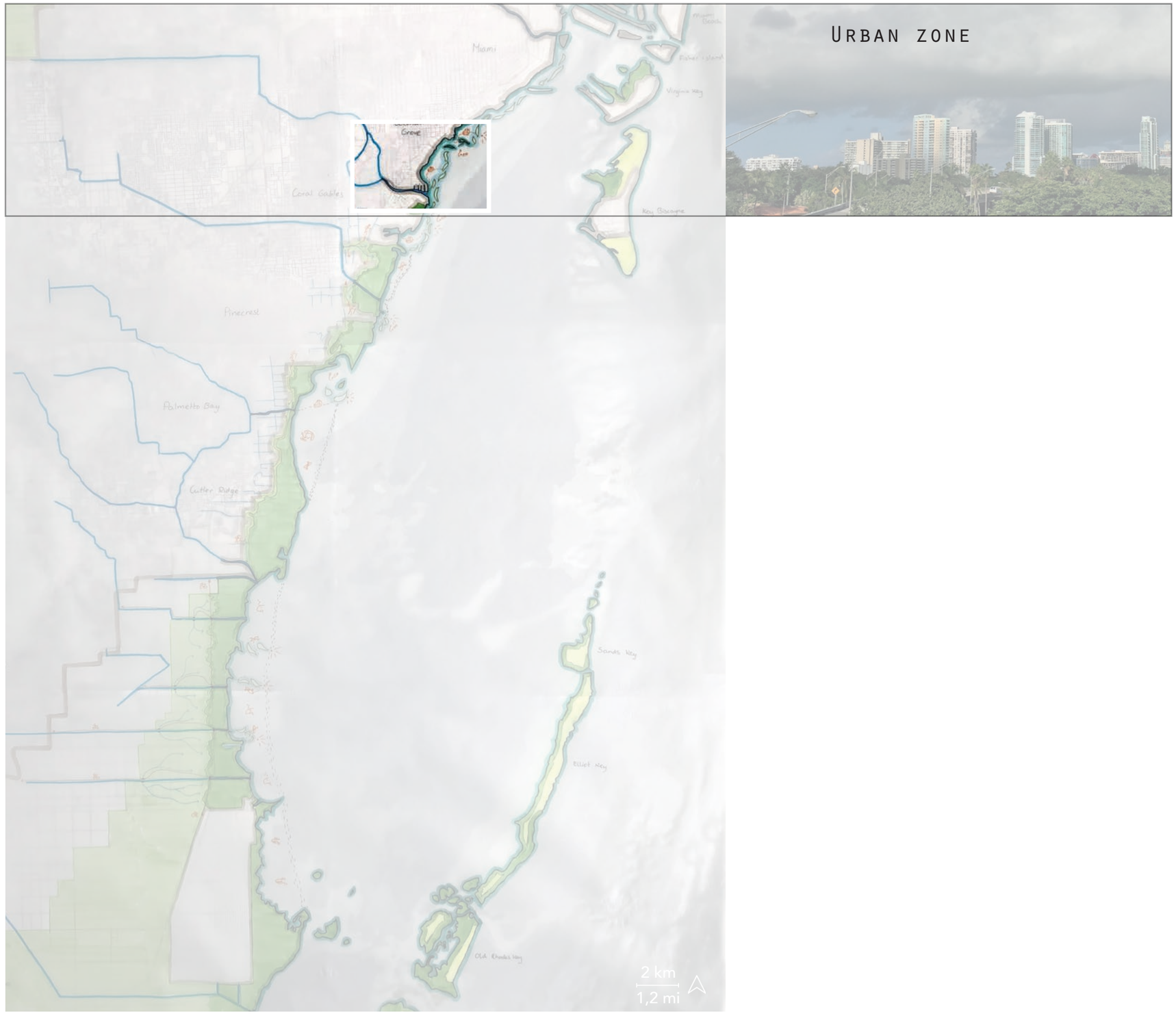
Regional plan

Regional plan



Restoration line

Focus areas

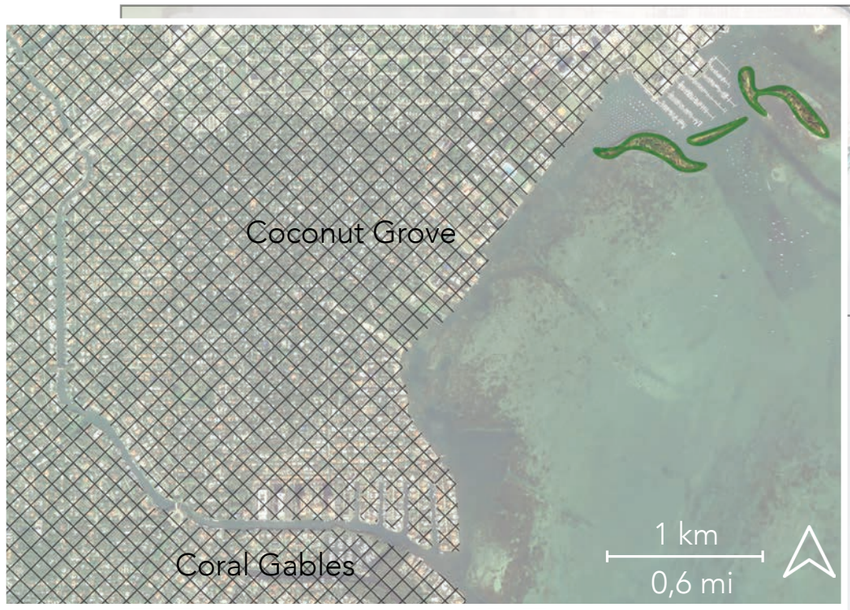

Miami
Coral Gables
Pinecrest
Palmetto Bay
Cutler Ridge
Key Biscayne
Virginia Key
Fisher Island
Sands Key
Elliot Key
Old Rhodes Key
2 km
1,2 mi

Urban zone

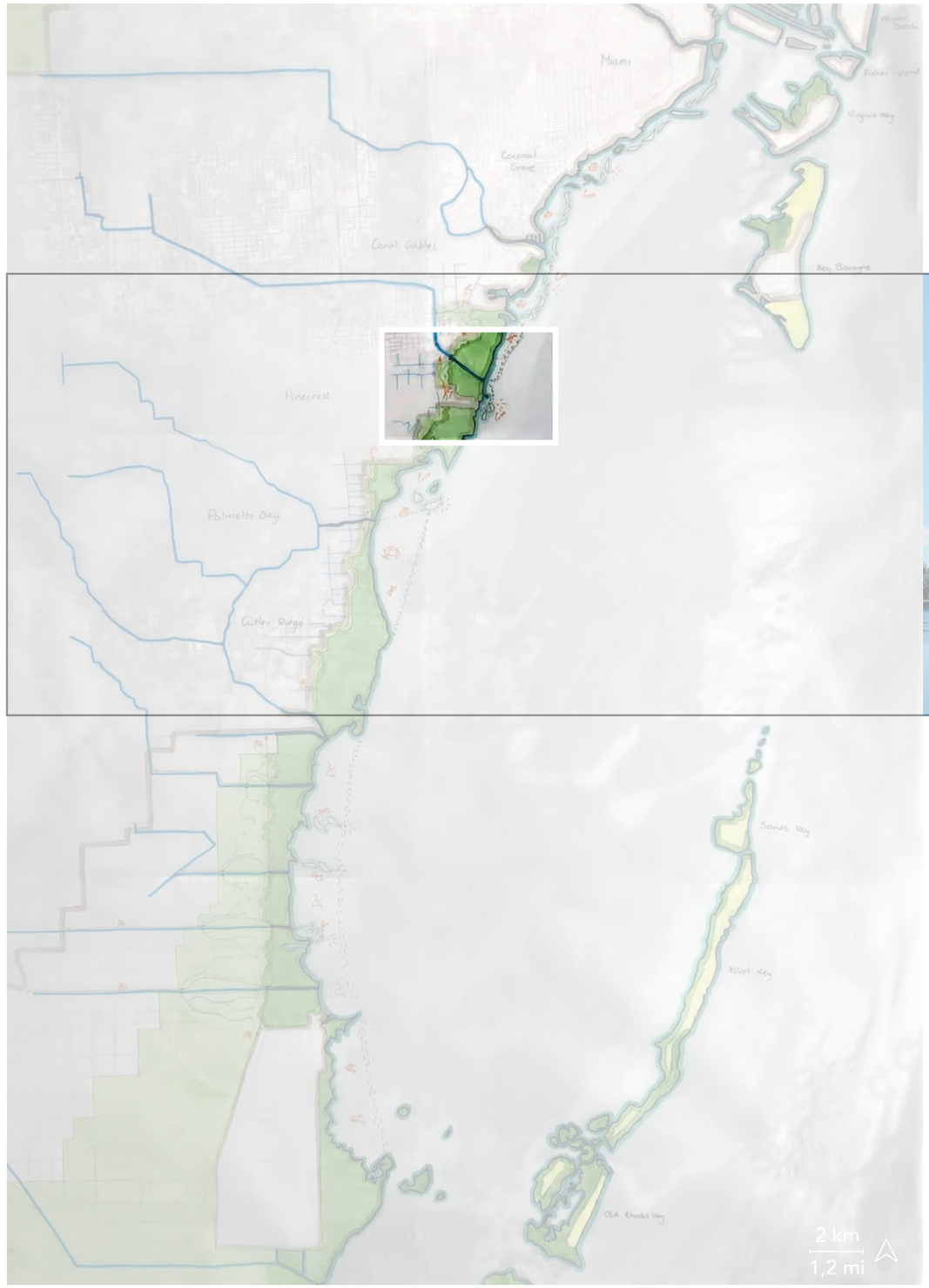
Focus areas

Urban

Offshore mangrove structure



Focus areas


Miami
Coconut Grove
Coral Gables
Key Biscayne
Pinecrest
Palmetto Bay
Cutler Ridge
Sands Key
Elliot Key
2 km
1,2 mi


Residential zone

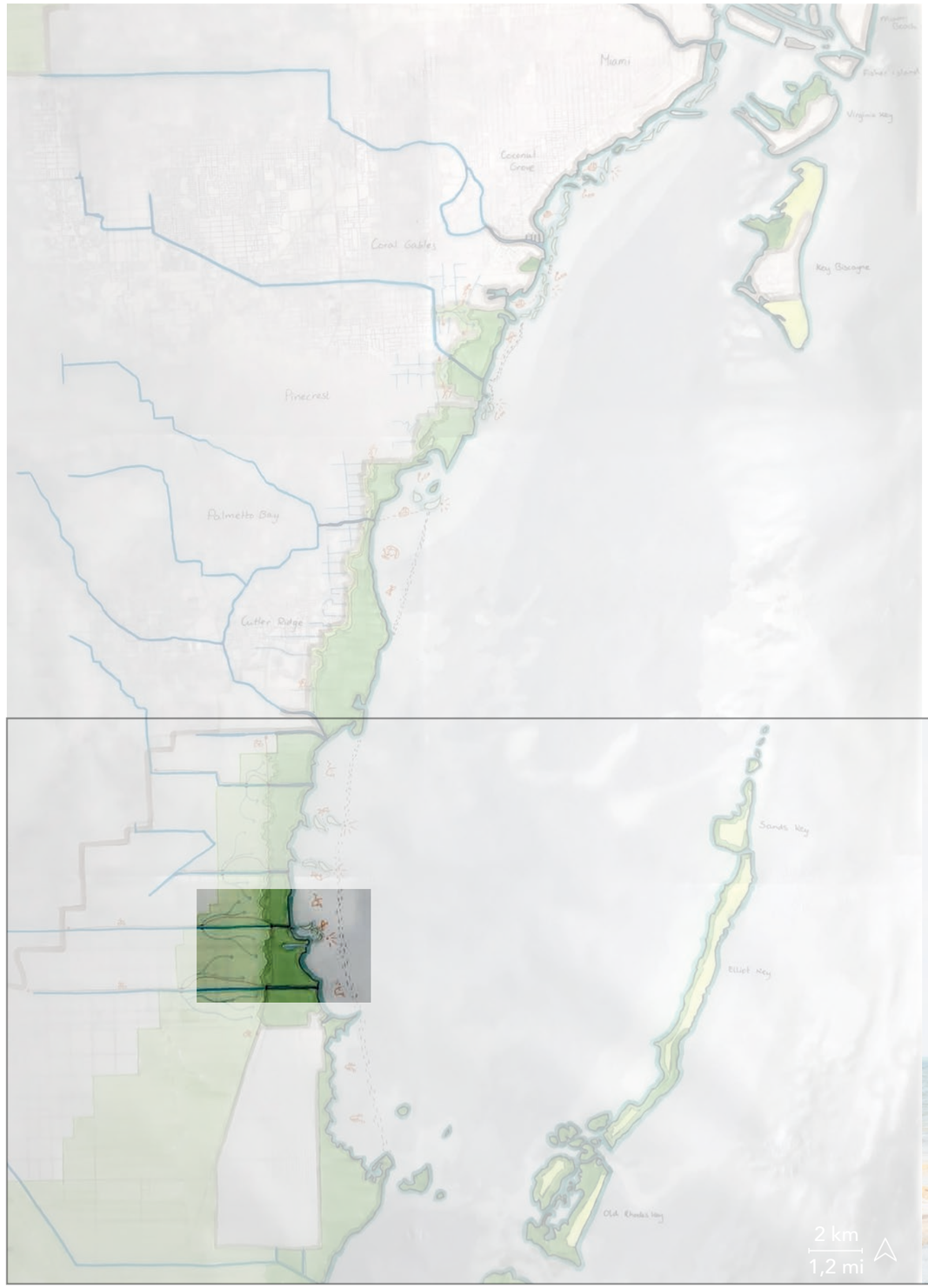
Focus areas

Residential

Replace part of mangroves for wetland

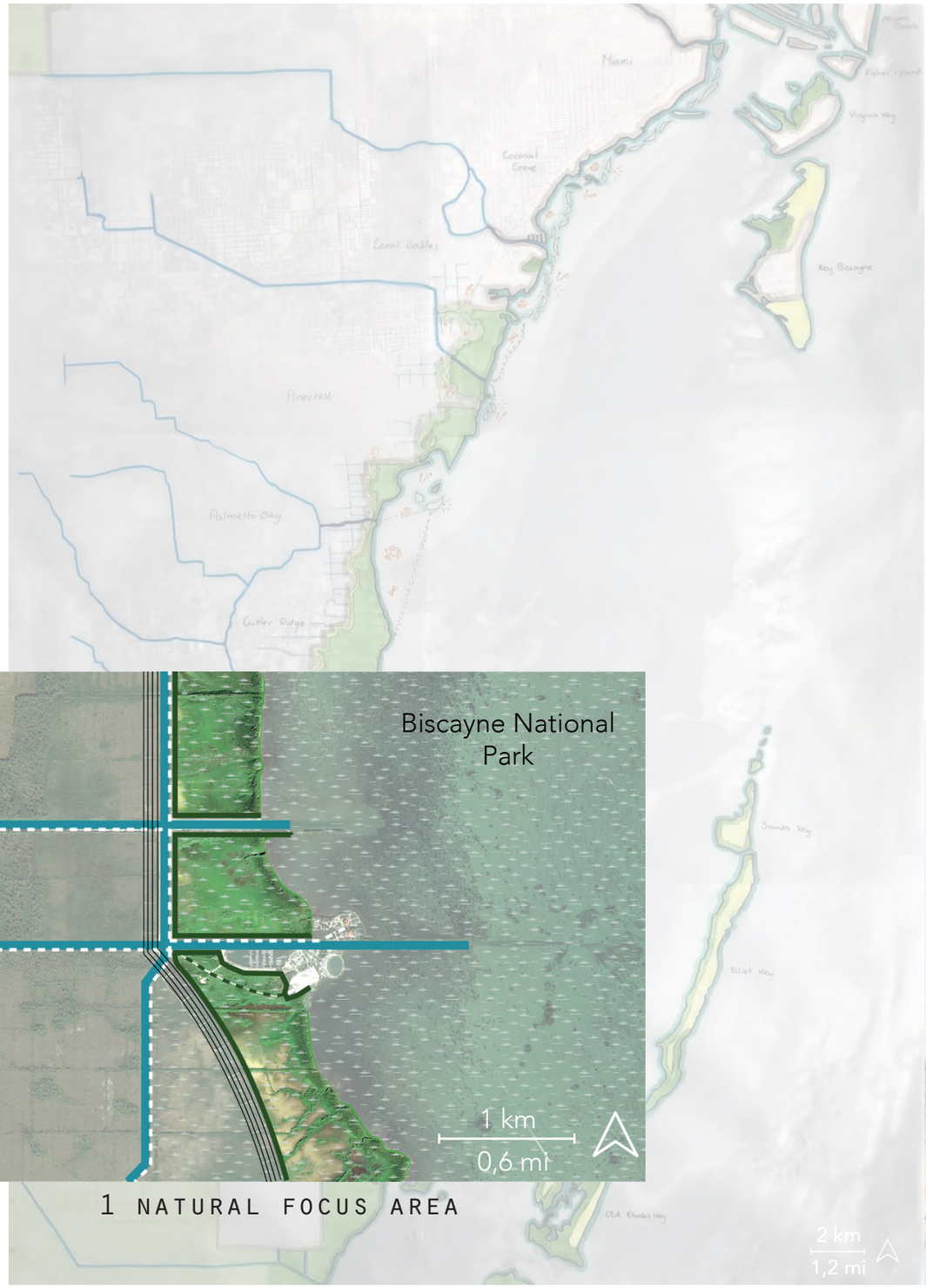
2 RESIDENTIAL FOCUS AREA

Focus areas



Natural zone

Focus areas



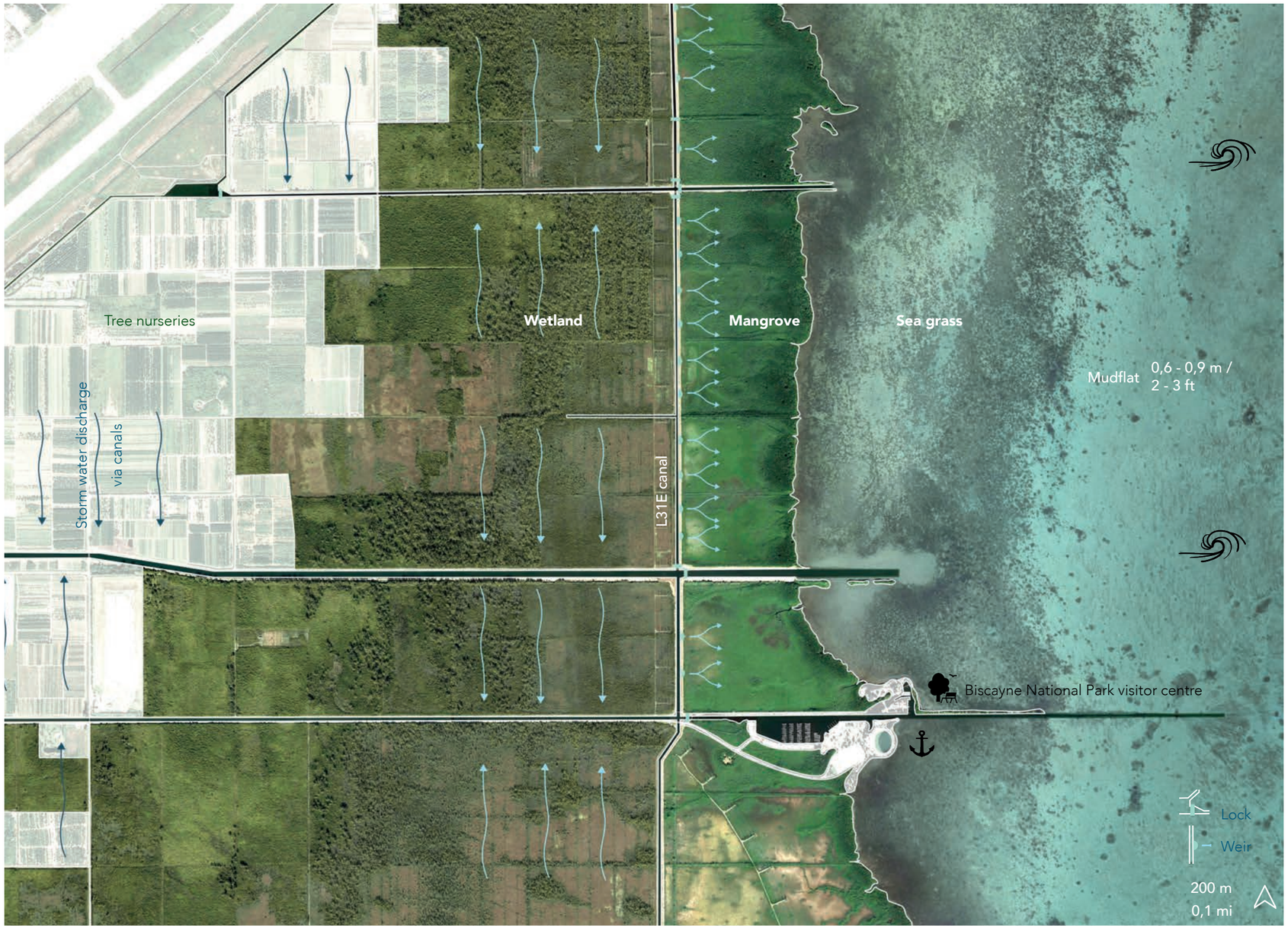
Natural

Inland and offshore expansion

1 NATURAL FOCUS AREA

Natural zone

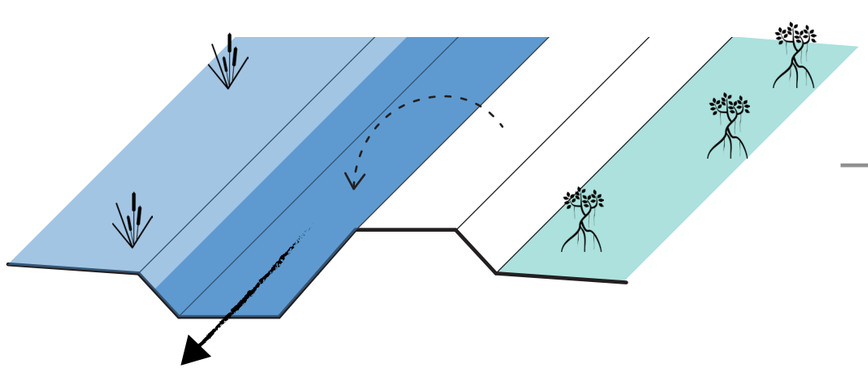
Current situation



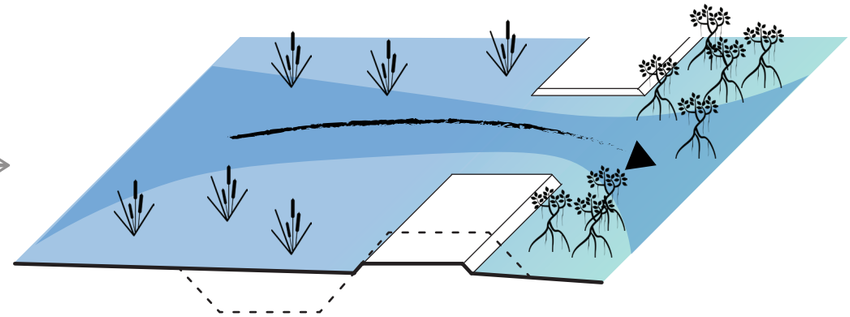
CURRENT SITUATION OF FOCUS AREA ON LOCAL SCALE

Map based on USGS The National Map (2019) and Google Earth

Breaking barriers

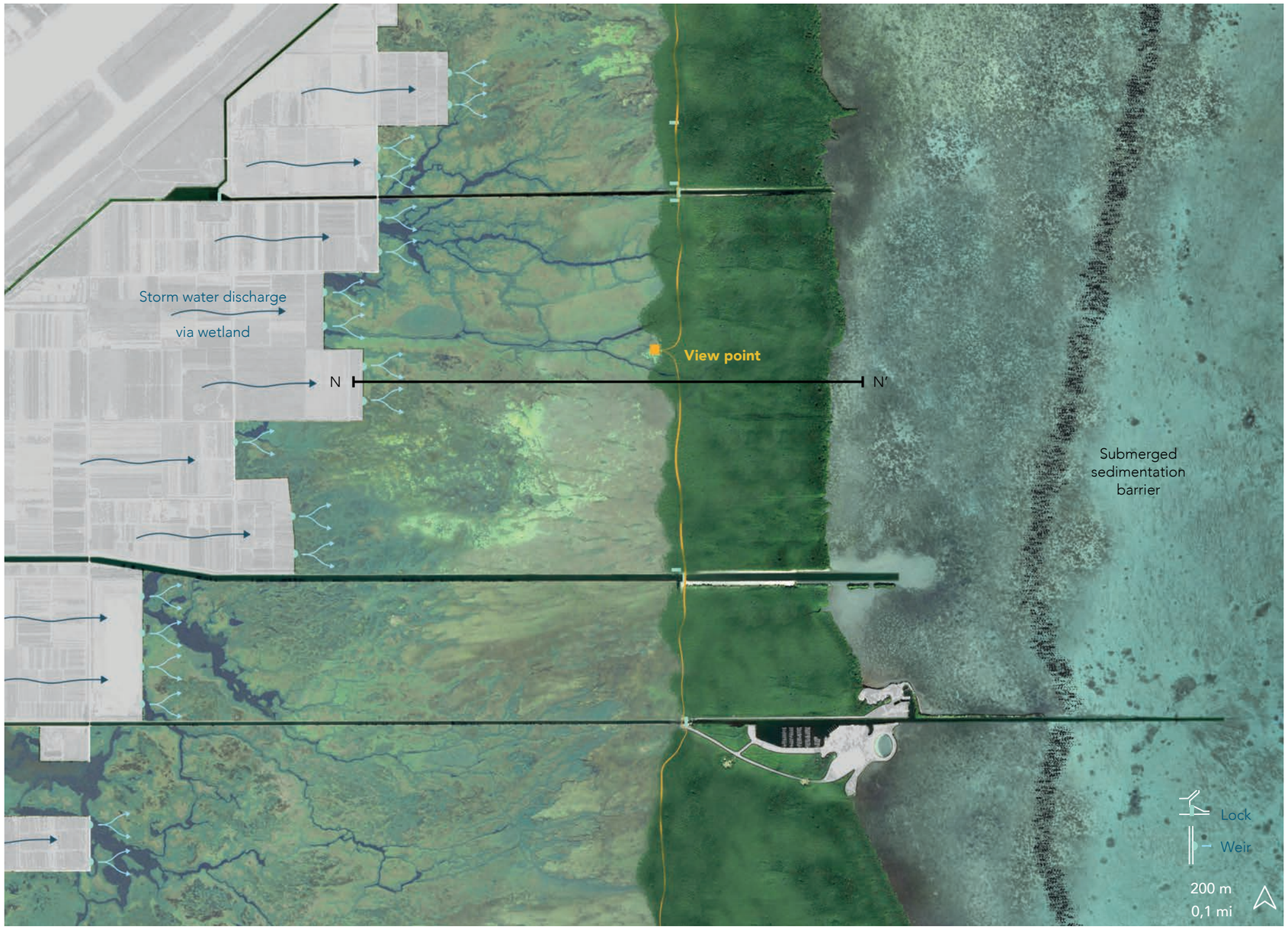


FILLING UP CANAL

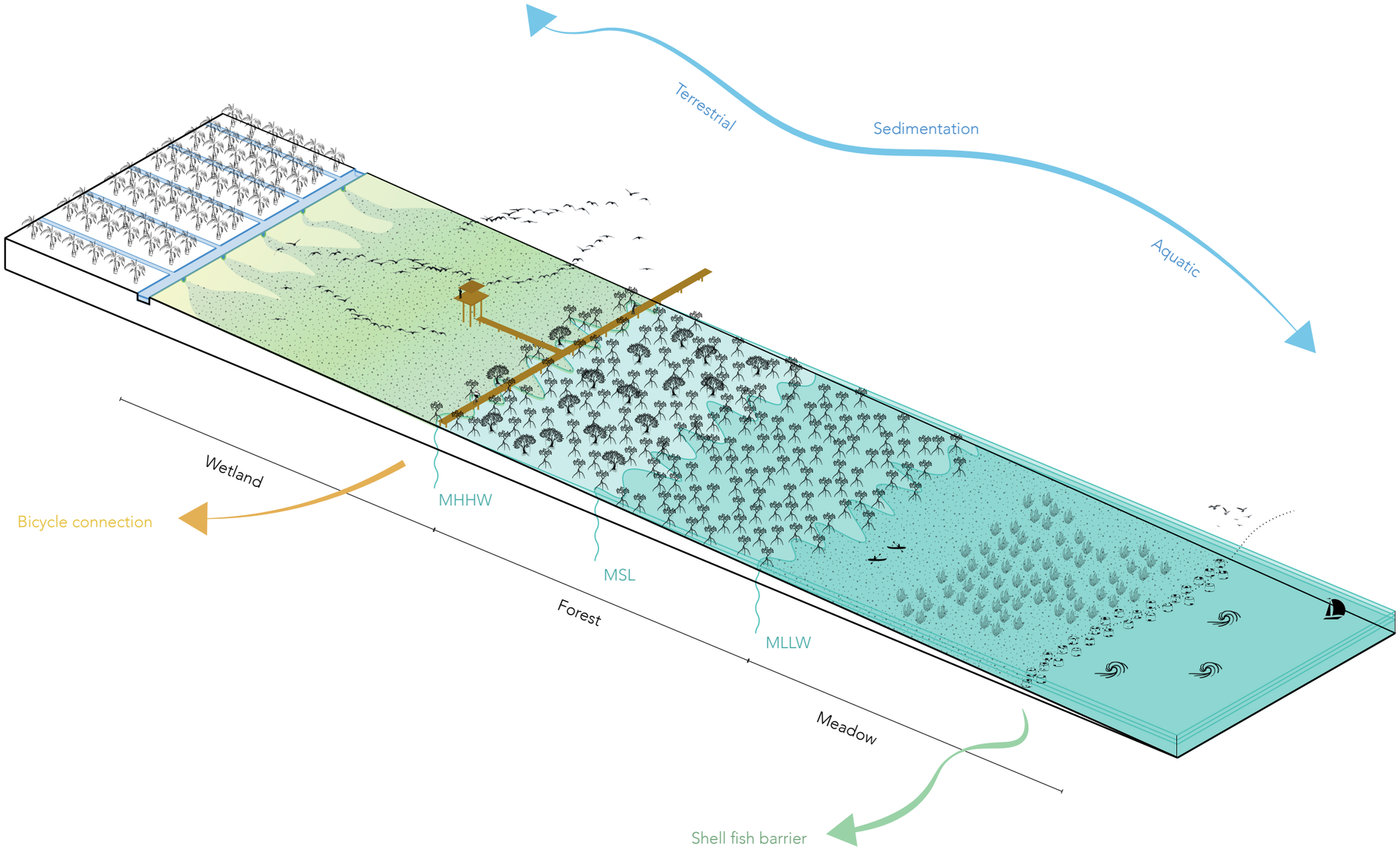


RESTORED SHEET FLOW

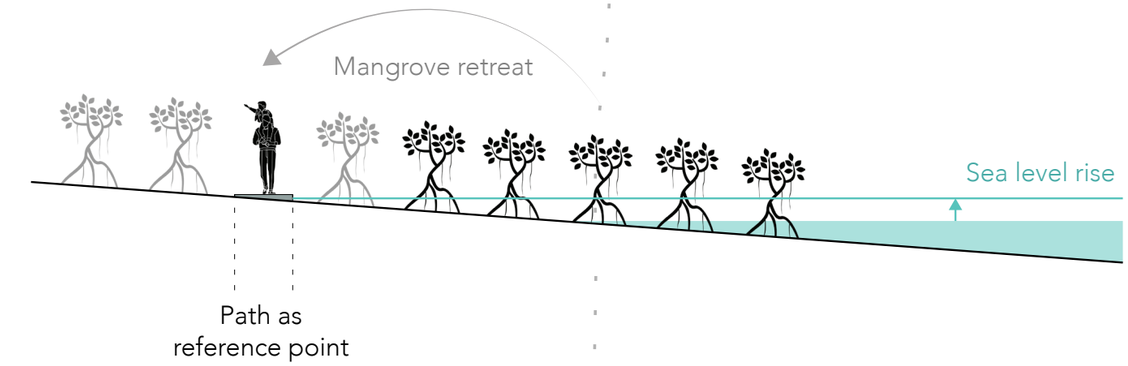
Design


Storm water discharge
via wetland
N
N'
View point
Submerged
sedimentation
barrier
Lock
Weir
200 m
0,1 mi

Landscape system



Mangrove movement experience

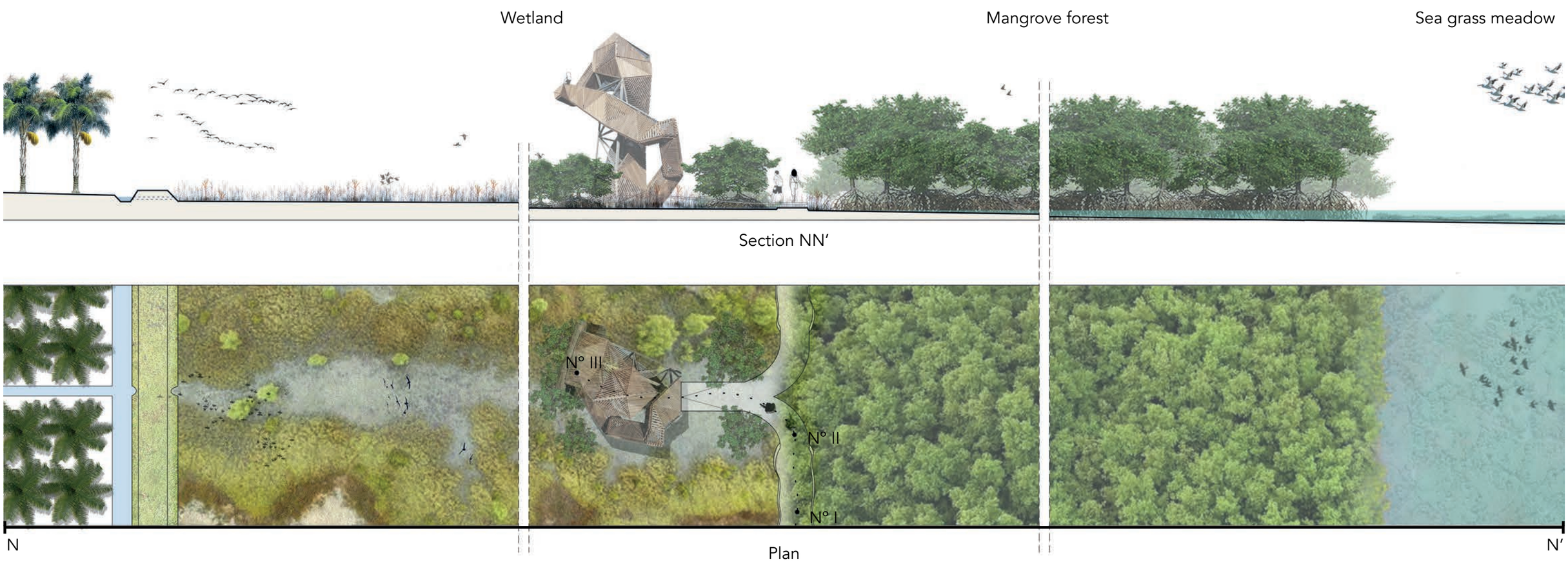


N° III

N° II

N° I

The layers


Wetland
Mangrove forest
Sea grass meadow
Section NN'
N° III
N° II
N° I
N
Plan
N'

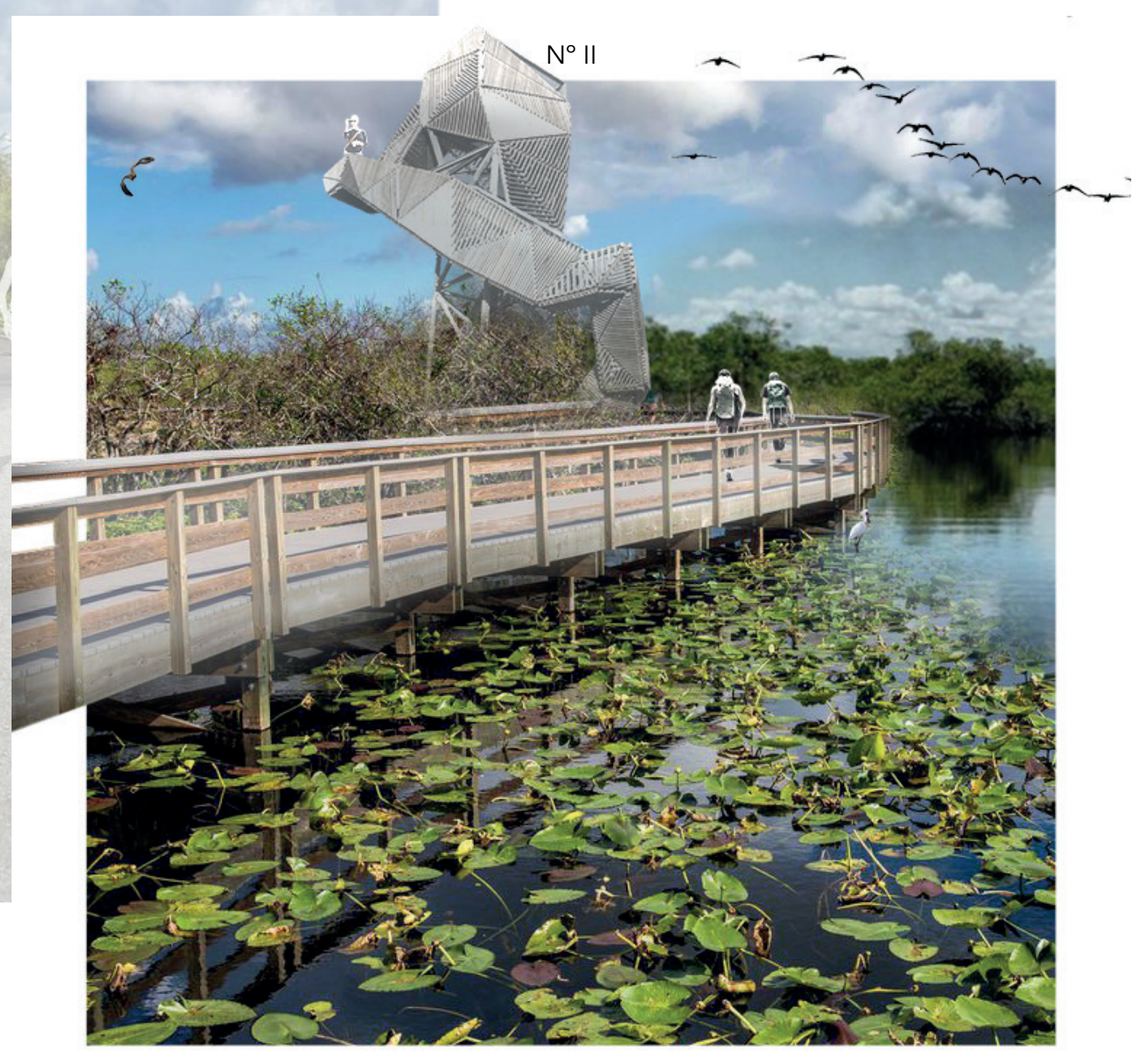
Route through the transition zone

N° I

Route through the transition zone

N° I

N° II



Route through the transition zone

N° I

N° II

N° III

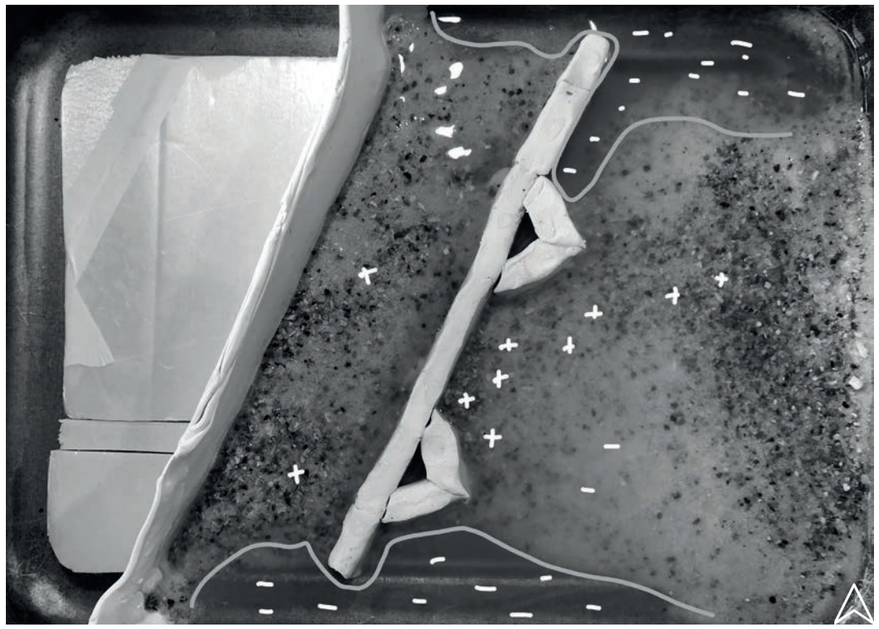
Urban zone

Current situation

CURRENT SITUATION OF FOCUS AREA ON LOCAL SCALE

Map based on USGS The National Map (2019) and Google Earth

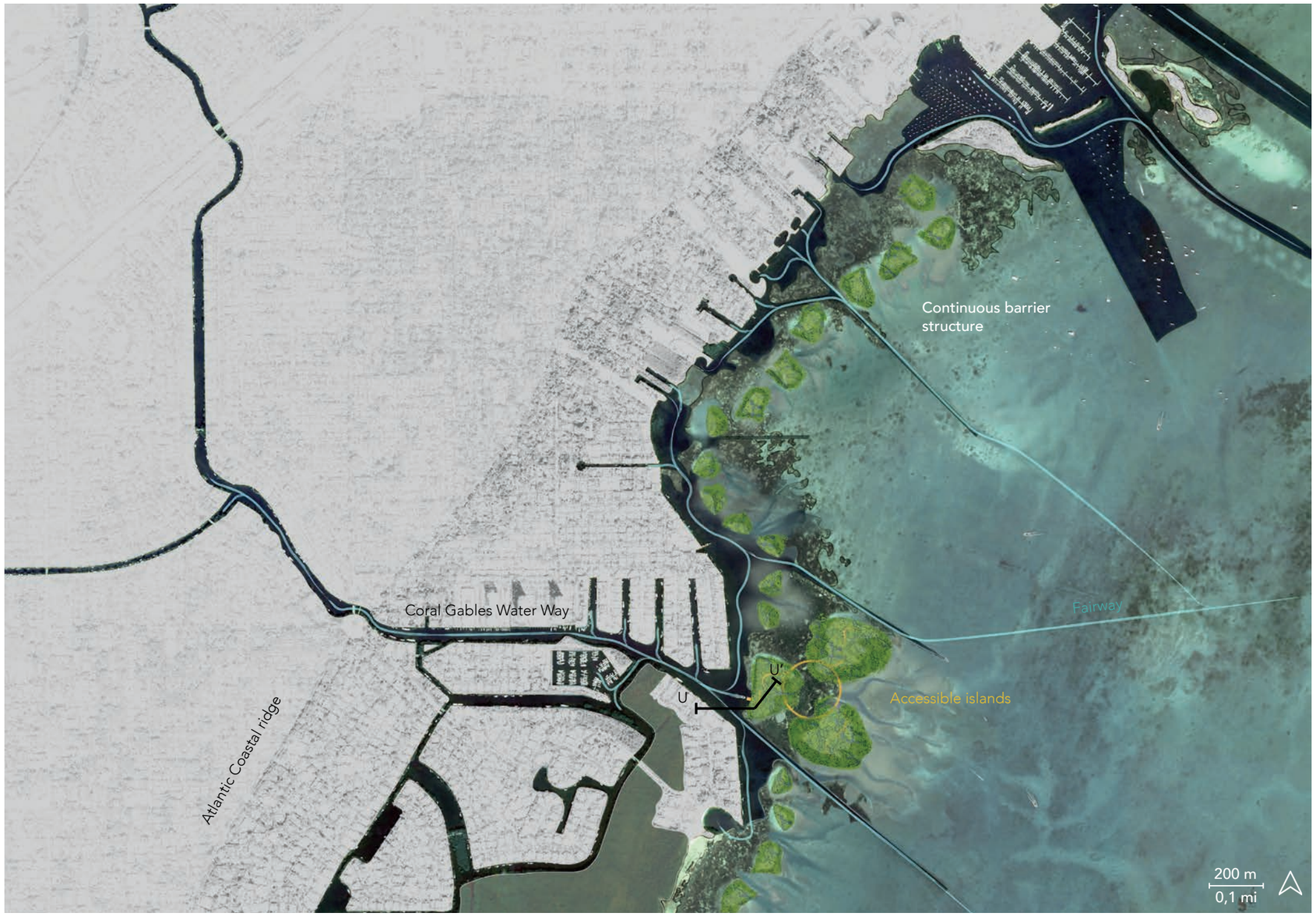
Mangrove islands



SEDIMENTATION DEVELOPMENT

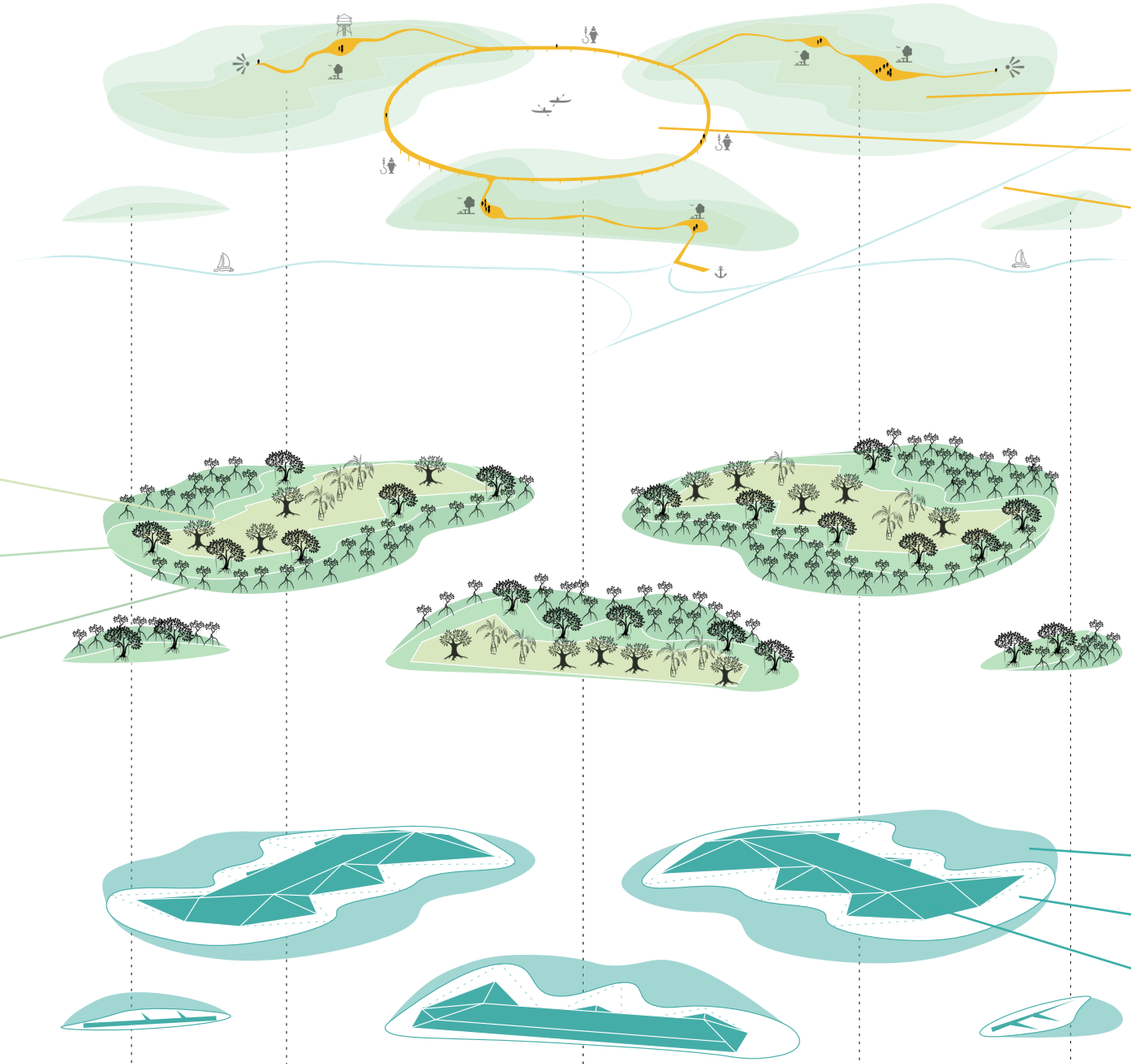
MANGROVE DEVELOPMENT

Design



DESIGN OF FOCUS AREA ON LOCAL SCALE

Exploded view accessible barrier islands



Actors

- Routing
- Kayak zone
- Fairways

- Picnic place
- View point
- Observation tower
- Kayak zone
- Fishing spot
- Boat dock

Process

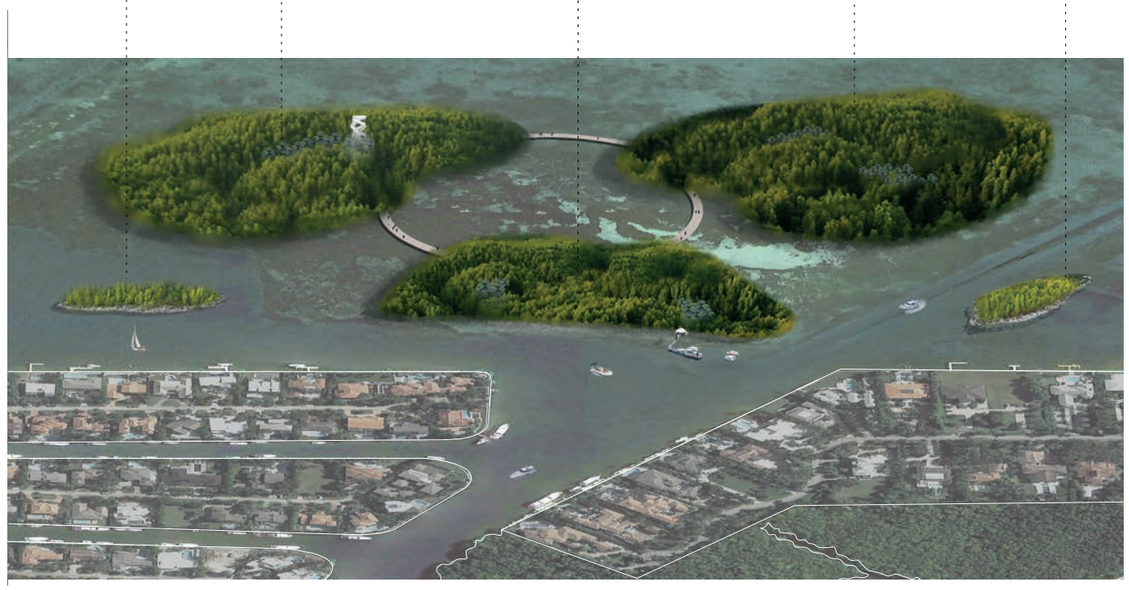
- Dry zone, mix of White Mangrove and tropical hardwood
- Shallow intertidal area, dominated by Black Mangrove
- Deep intertidal area, dominated by Red Mangrove

- Laguncularia racemosa and Conocarpus erectus
- Avicennia germinans
- Rhizophora mangle

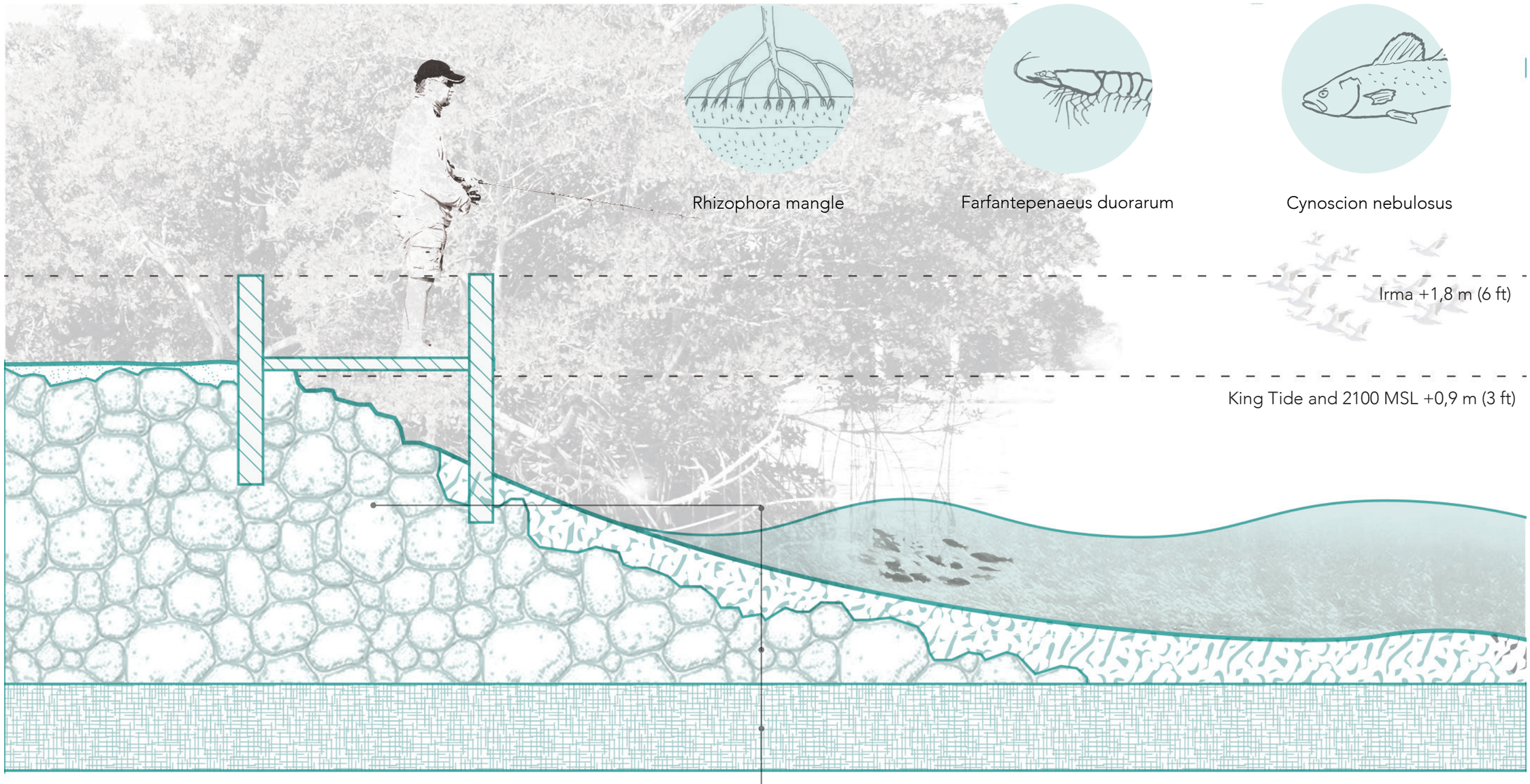
Structure

- Expansion zone
- Sedimentation zone
- Base structure

- Basalt rock base
- Silica sand and mud
- Peat as top layer



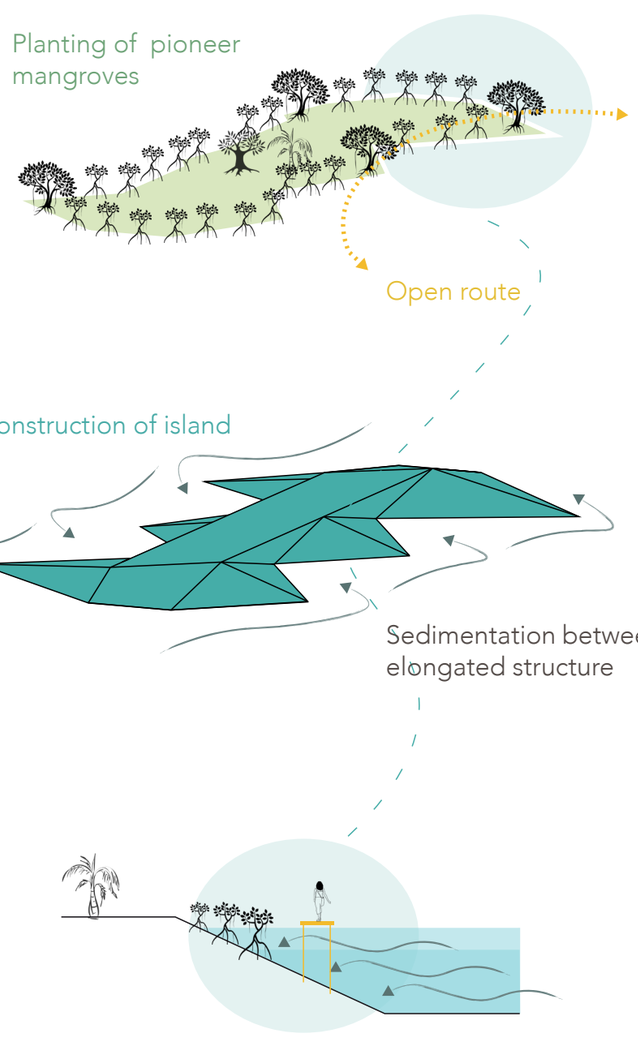
Building of the island



Windward side barrier island
Detail 1:50

Development of the barrier islands

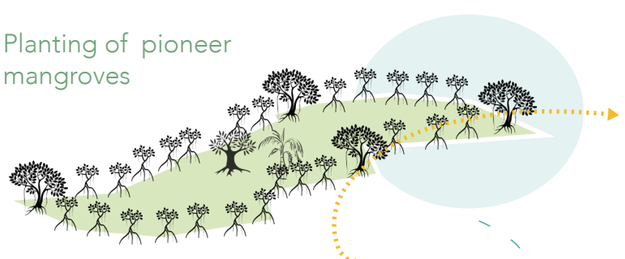
START



Development of the barrier islands

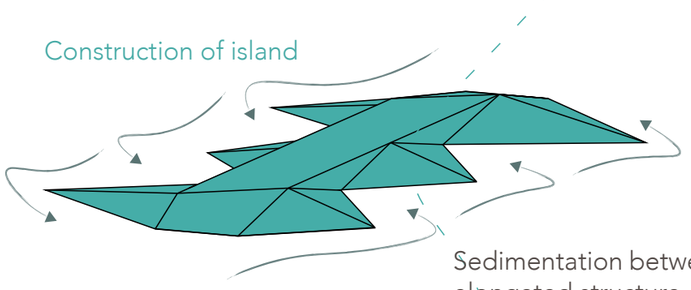
START

Planting of pioneer mangroves

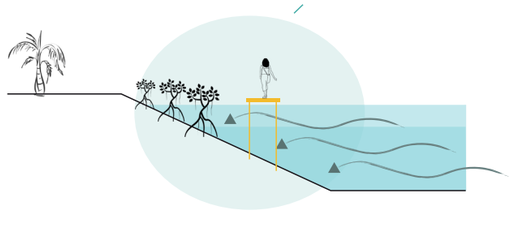


Open route

Construction of island



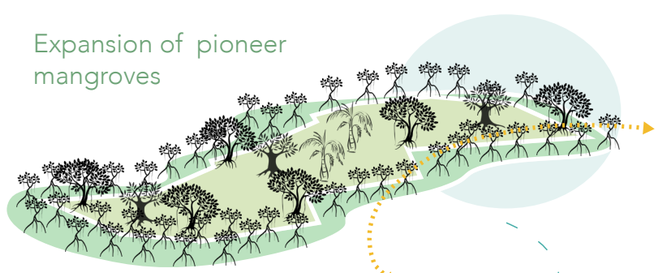
Sedimentation between elongated structure



Red mangrove dominated shore line

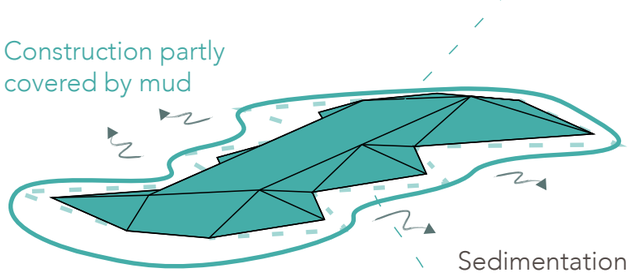
+ 5 YEARS

Expansion of pioneer mangroves

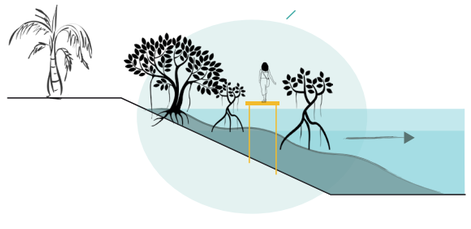


Route starts to overgrow

Construction partly covered by mud



Sedimentation enabled by vegetation



Offshore relocation of Red mangrove and introduction of Black mangrove on shores

Development of the barrier islands

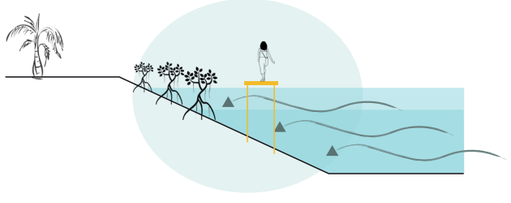
START

Planting of pioneer mangroves

Open route

Construction of island

Sedimentation between elongated structure



Red mangrove dominated shore line

+ 5 YEARS

Expansion of pioneer mangroves

Route starts to overgrow

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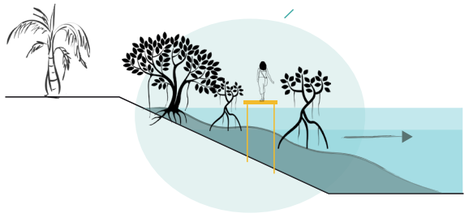


Offshore relocation of Red mangrove and introduction of Black mangrove on shores

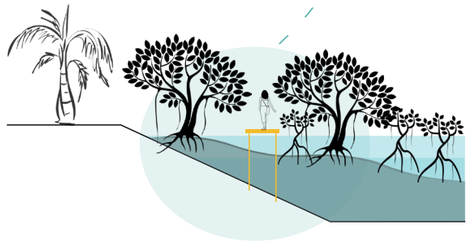
> 10 YEARS

Succession of mangroves

Overgrown route

Island expansion

Further expansion



Higher shores dominated by Black mangrove and lower shores by Red mangrove

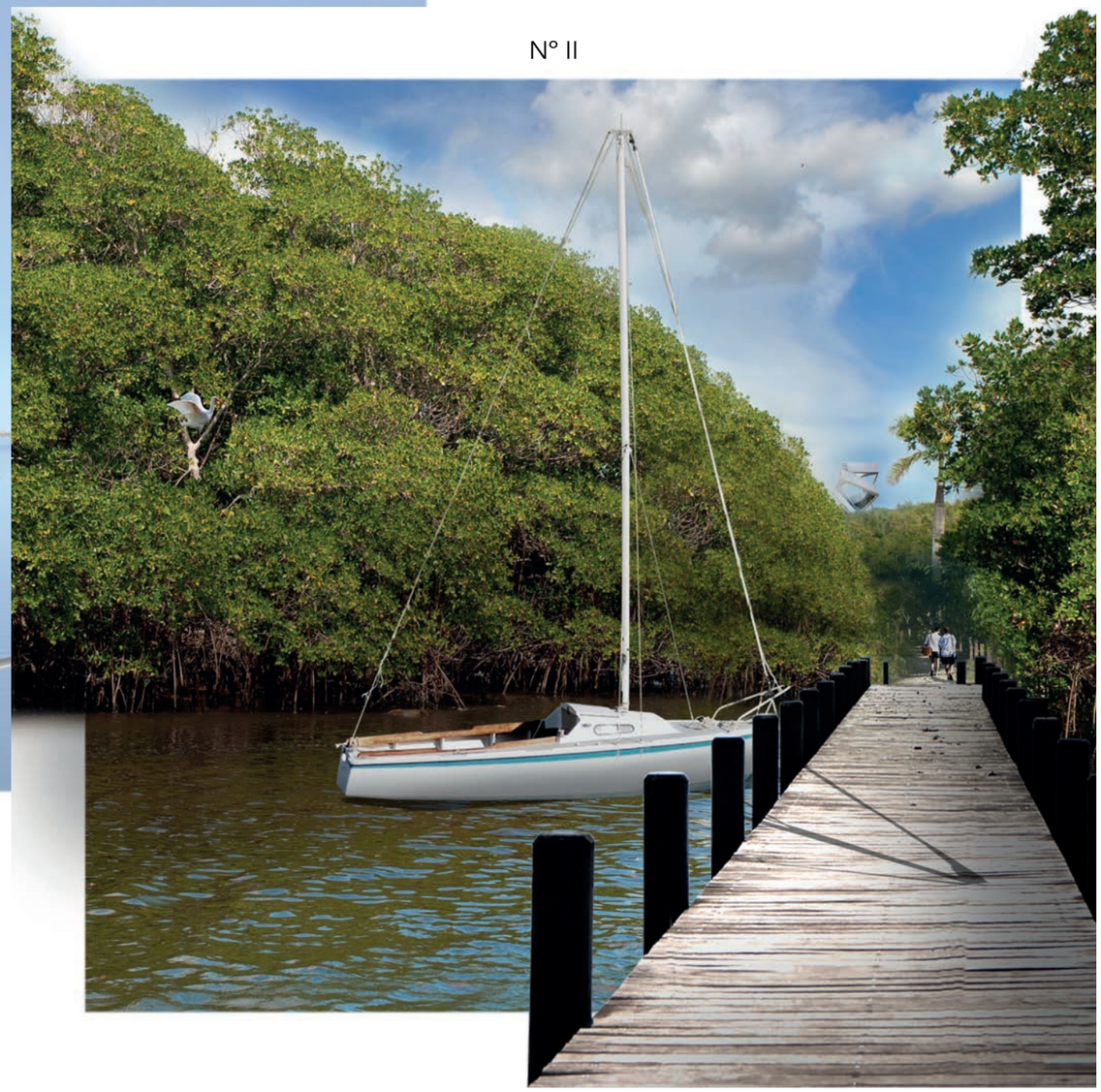
Mangrove island route

N° I

Mangrove island route

N° I

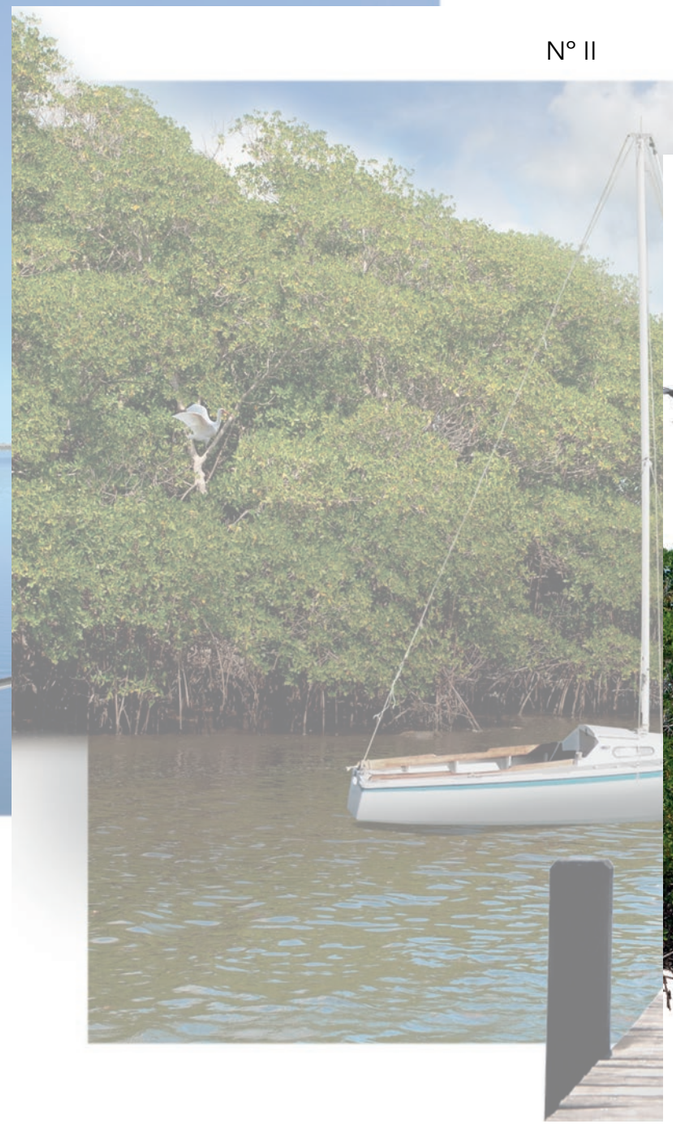
N° II



Mangrove island route

N° I

N° II



N° III

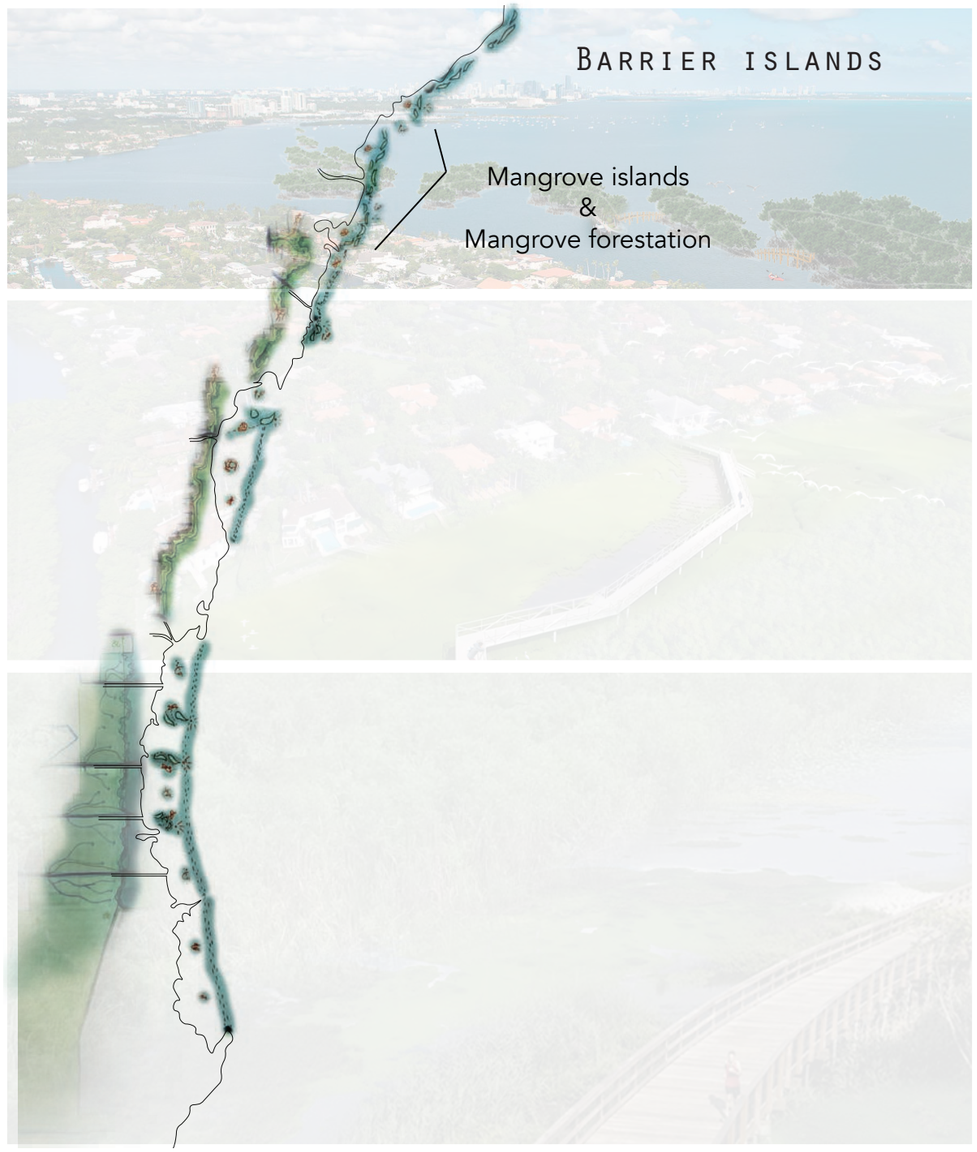
Conclusions

Planning

REGIONAL PLAN

DESIGN ACTIONS

Conclusions

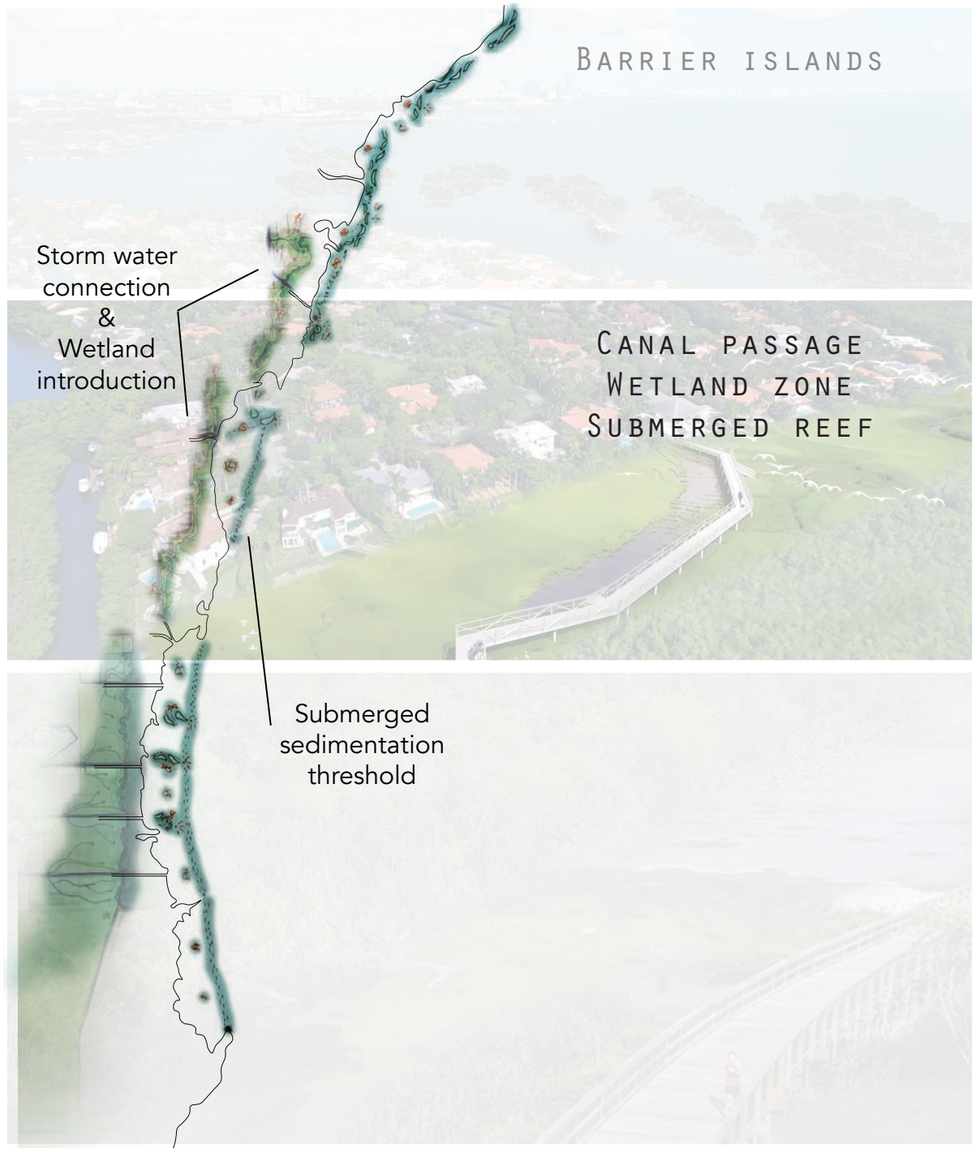


Planning

REGIONAL PLAN

DESIGN ACTIONS

Conclusions

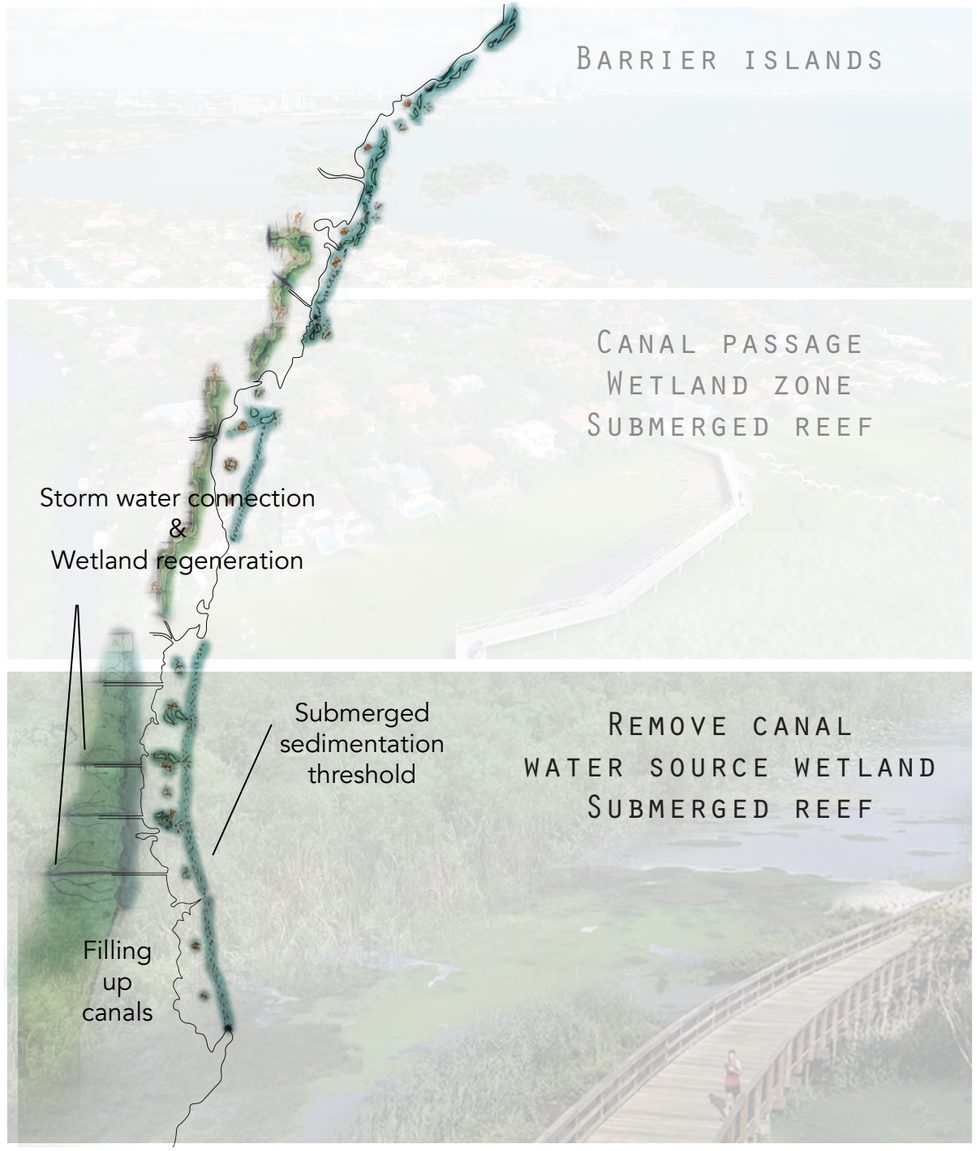


Planning

REGIONAL PLAN

Design actions

Conclusions

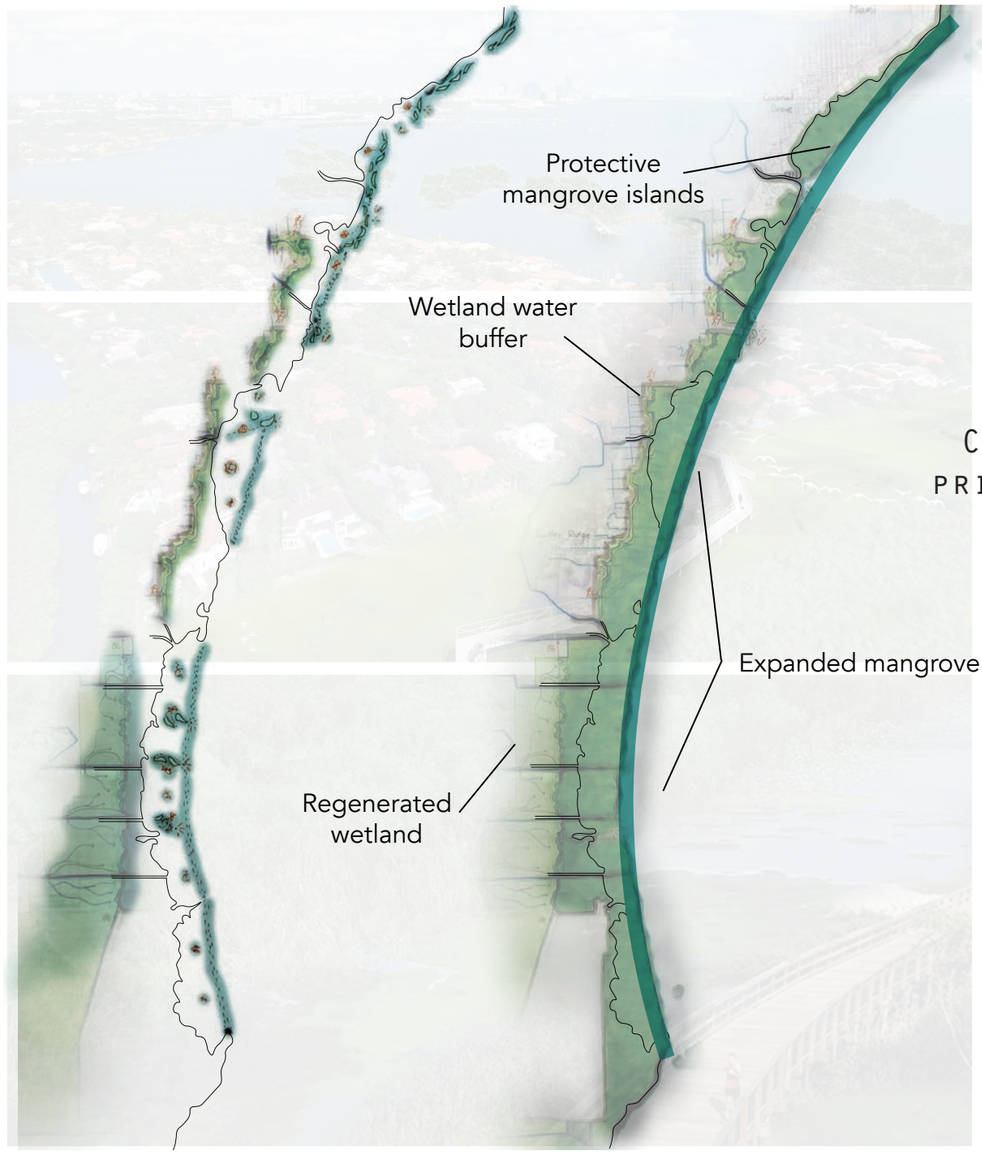


Planning

REGIONAL PLAN

Design actions

Conclusions



Continuous landscape
primary coastal defense
Closed barrier

Planning

REGIONAL PLAN

DESIGN ACTIONS

FUTURE EFFECTS

VI

Conclusions and discussion

Can we completely change the direction of something?


Biscayne Bay: Turn


Biscayne Bay: Turn


BISCAYNE BAY: TURN

Turn the tide!

Biscayne bay:
Turn the tide

An integrated landscape approach for coastal restoration in Biscayne Bay through spatial and ecological interventions

Thank you for your attention

Distances