THE OPERATING VENETIAN LAGOON: THE AGENCY OF *BARENE*

A RESILIENT LANDSCAPE INFRASTRUCTURE TOWARDS ECOLOGICAL, CULTURAL, AND PRODUCTIVE HERITAGE PRESERVATION.

P5 / 02.07.2020

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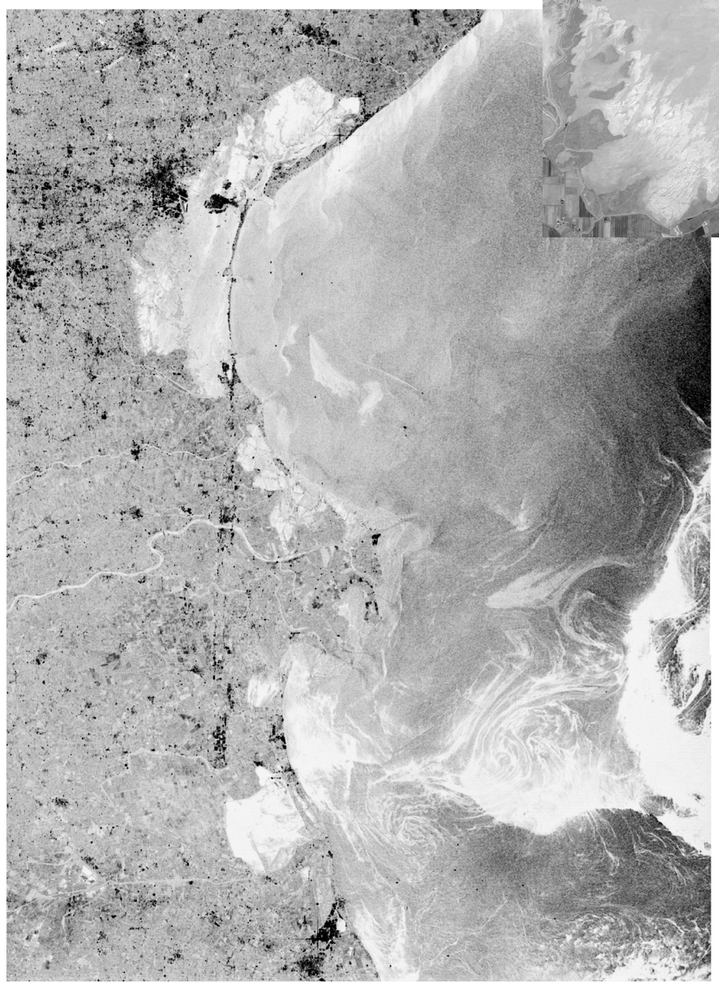
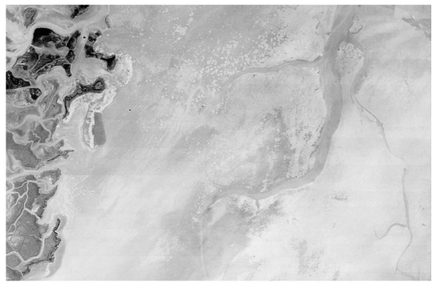






horizontality



horizontality



horizontality
reflection





horizontality



horizontality
reflection





horizontality
reflection
visibility



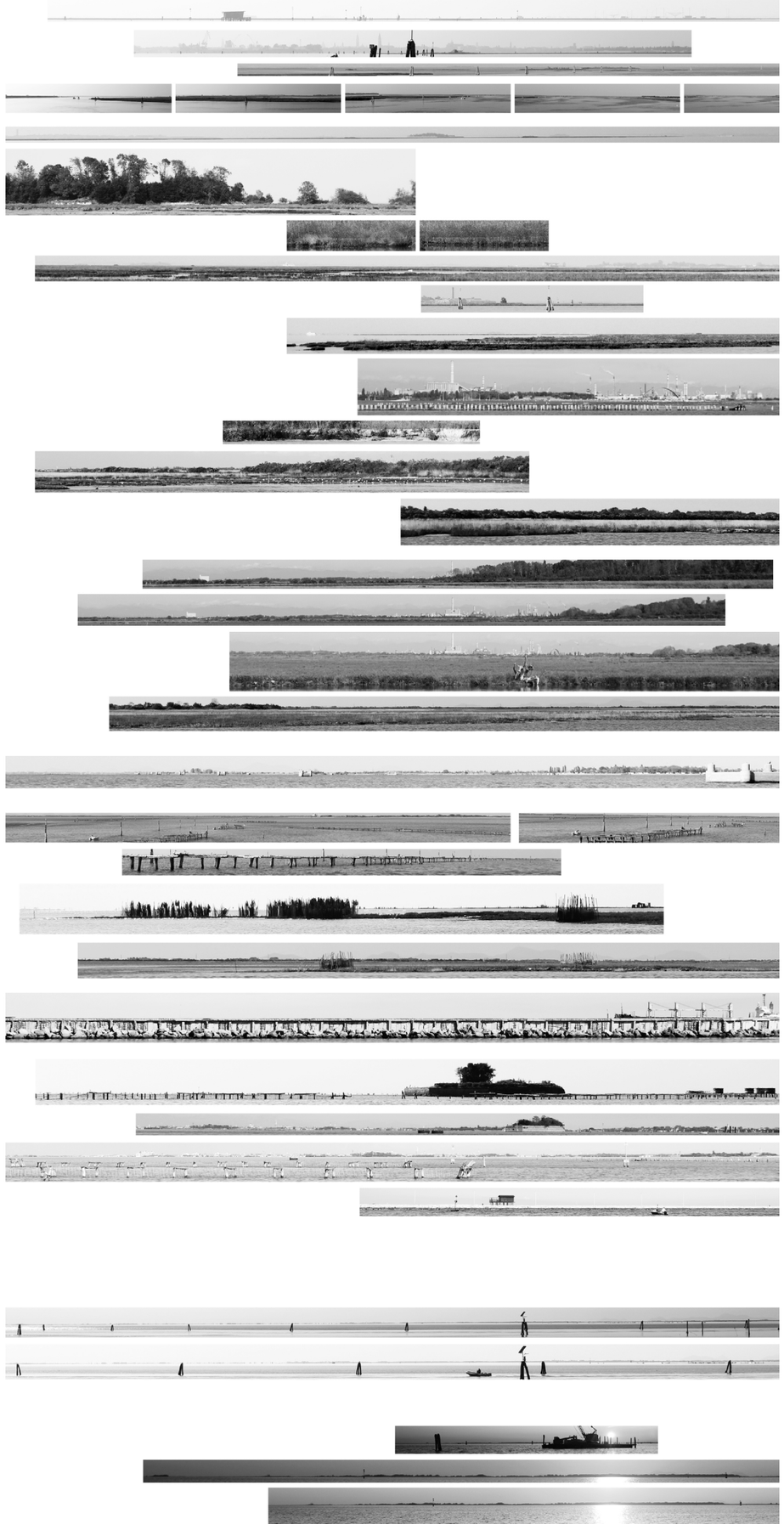
+0.00 m
view from the boat

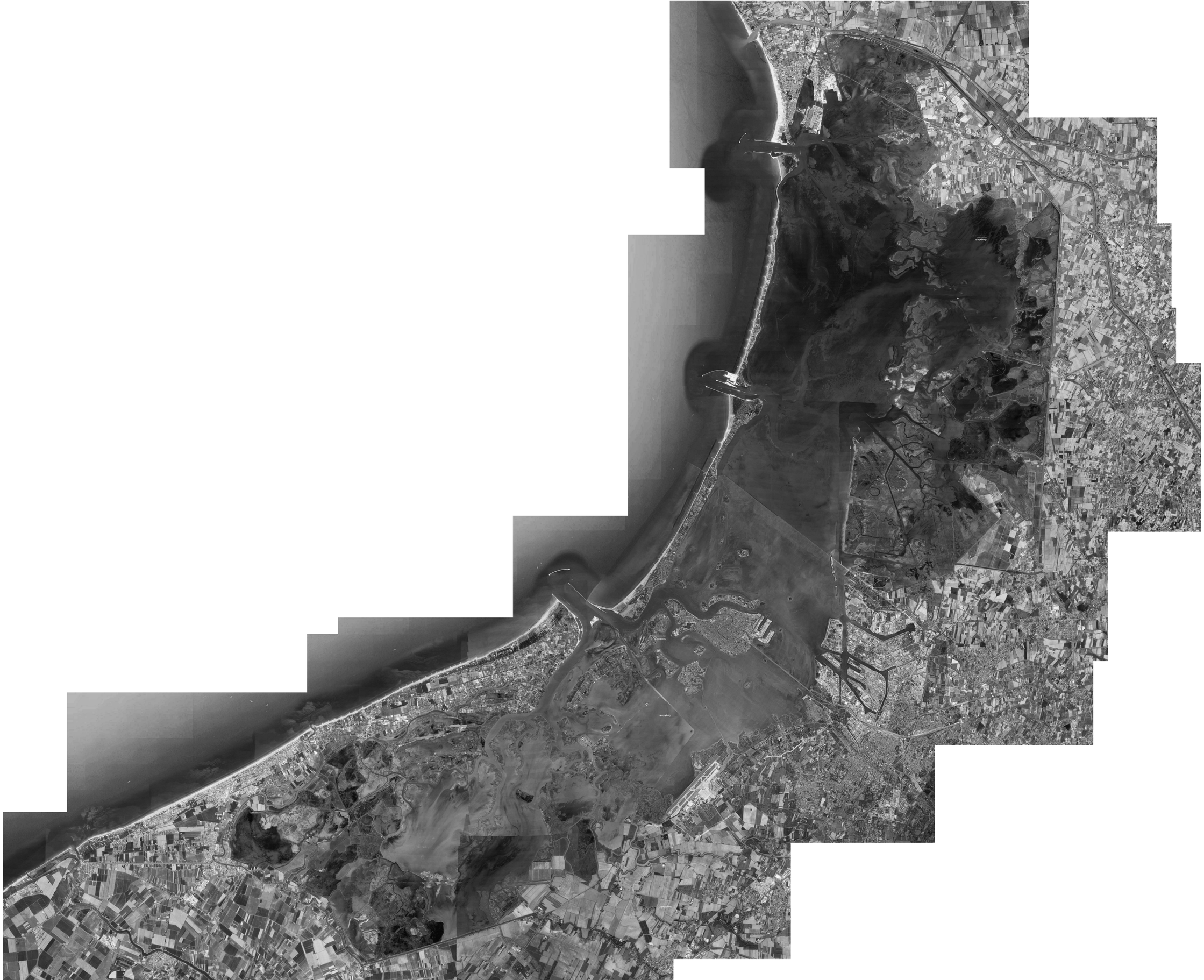


+1.50 m
view from Valle Liona embankment



+5.00 m
view from Spignon lighthouse







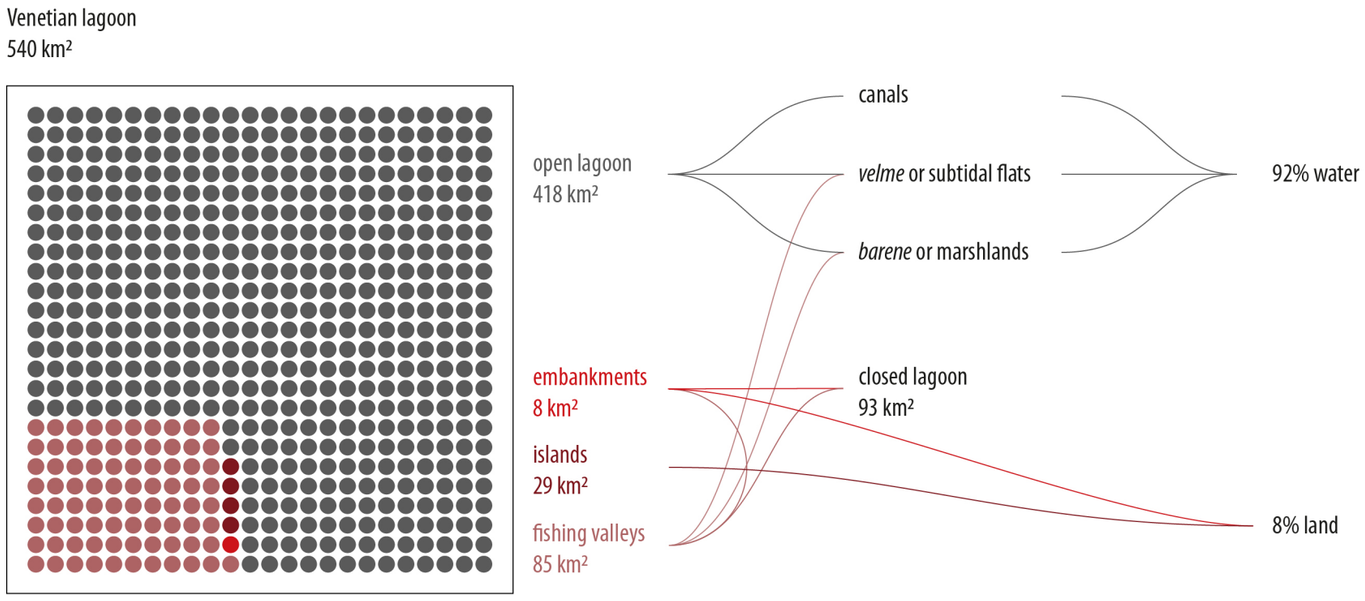
Non in terra neque in aqua sumus viventes

We do live neither on water nor on land

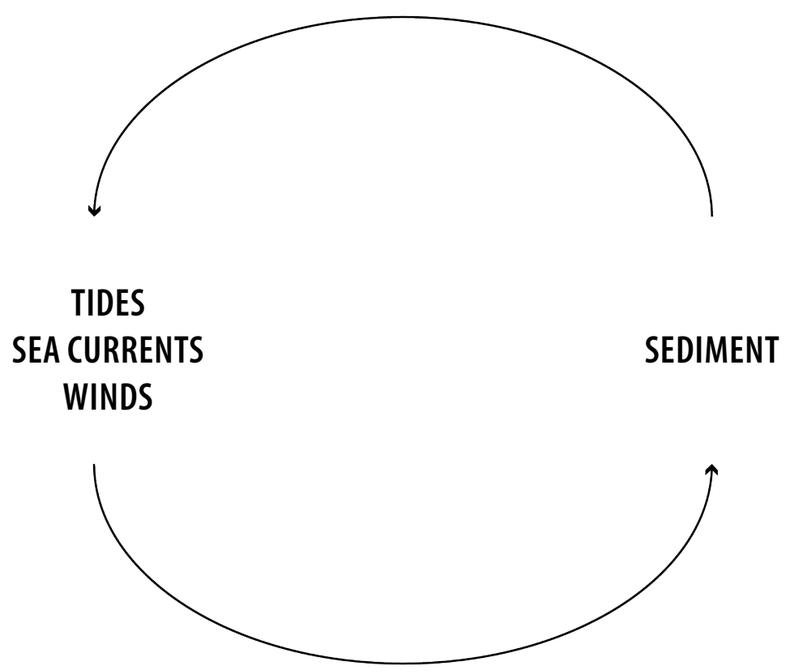
Paolo Diacono, Historia Langobardorum, 589



"Opponesi elemento ad elemento", translated literally with "opposing element to element". Engraving realized by Alessandro Zucchi, 1750.


Venetian lagoon
540 km²
open lagoon
418 km²
canals
velme or subtidal flats
barene or marshlands
92% water
embankments
8 km²
islands
29 km²
fishing valleys
85 km²
closed lagoon
93 km²
8% land

HYDROMORPHOLOGICAL FUNCTIONING


TIDES
SEA CURRENTS
WINDS
SEDIMENT

main winds: *bora* and *scirocco*



seasonal average sea current



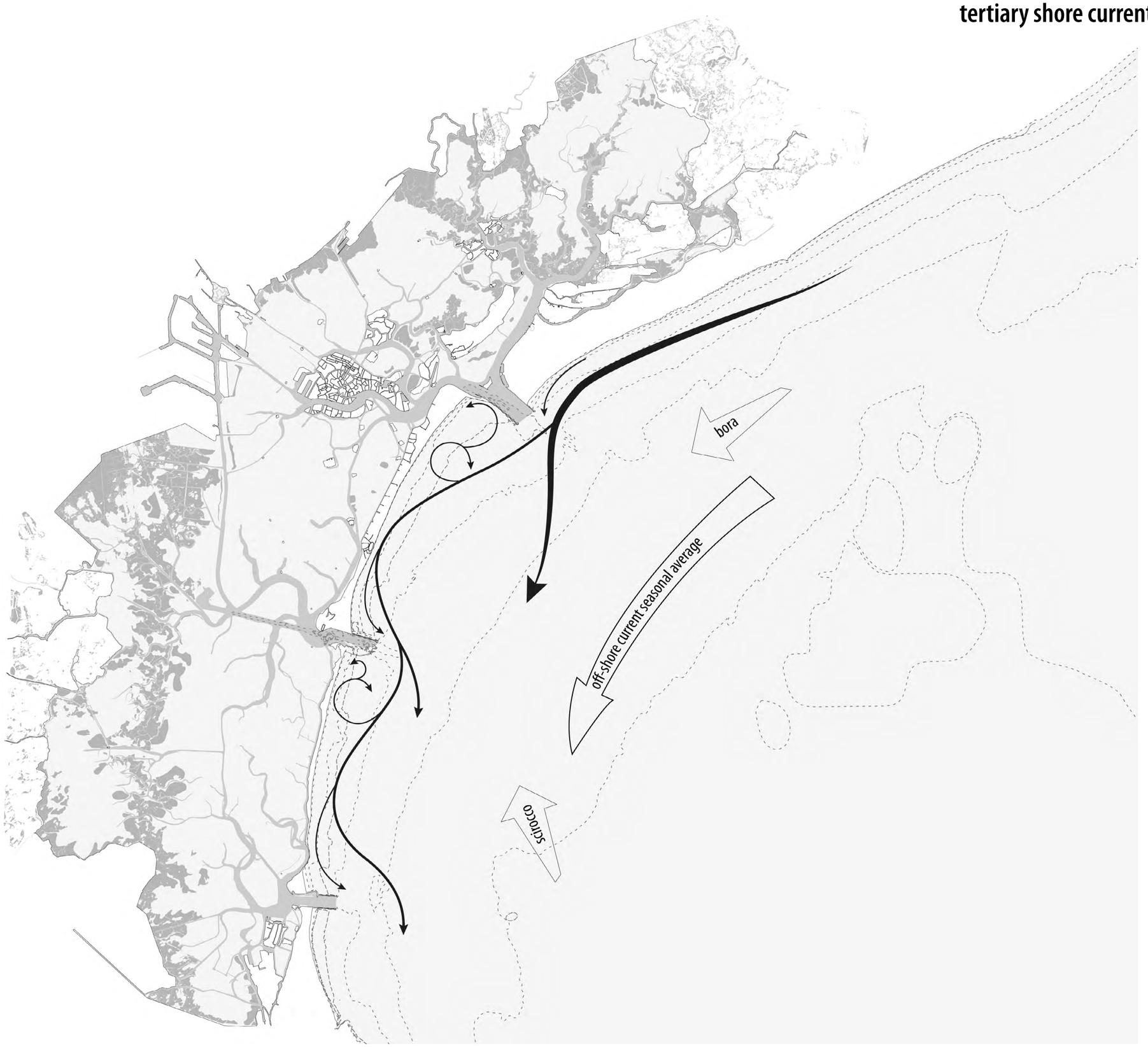
main shore current



secondary shore currents



tertiary shore currents



seabed and beach erosion

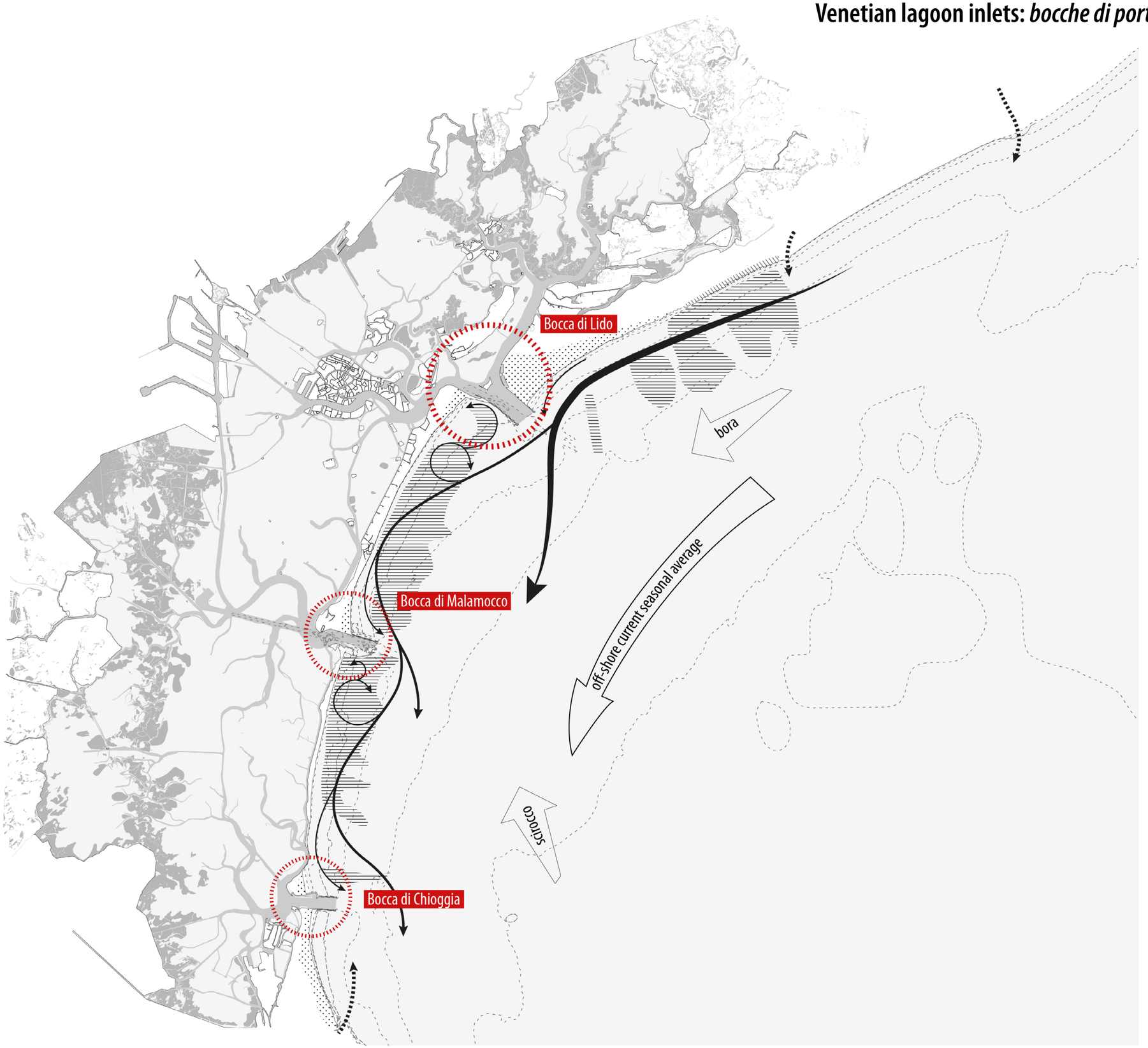


fluvial water and sediment discharge




bora
off-shore current seasonal average
sciroco

Venetian lagoon inlets: *bocche di porto*



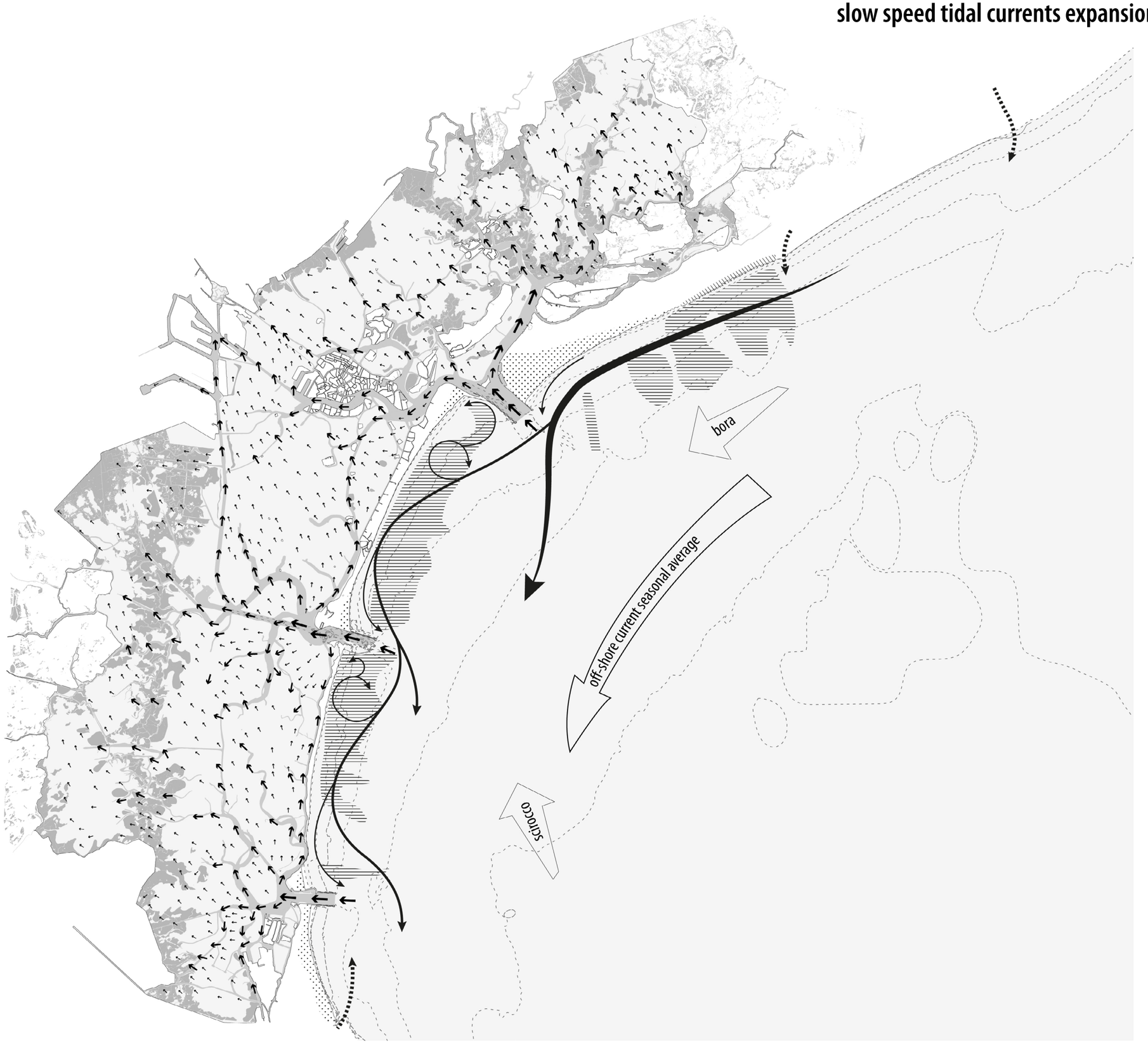
fast speed tidal currents



medium speed tidal currents



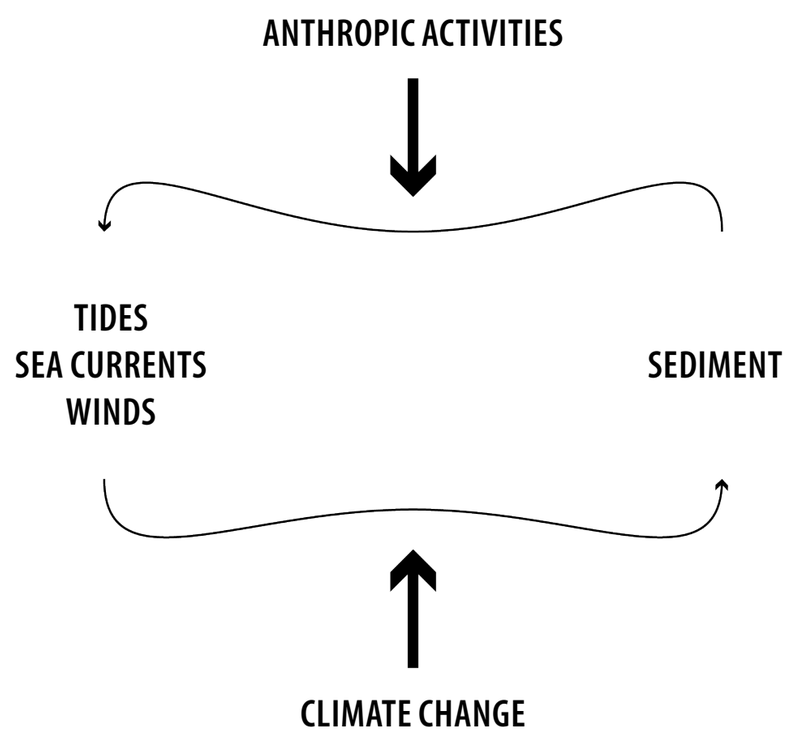
slow speed tidal currents expansion




bora
off-shore current seasonal average
scirocco


Treporti sub-basin
Lido sub-basin
Malamocco sub-basin
Chioggia sub-basin
bora
off-shore current seasonal average
sciroco

THREATS


ANTHROPIC ACTIVITIES
TIDES
SEA CURRENTS
WINDS
SEDIMENT
CLIMATE CHANGE



Editto di Egnazio, Museo Correr
once Palazzo dei Dieci Savi in Rialto, headquarter of *Ministry of Waters* (Magistrato alle Acque)

"[...] therefore anyone who dares to harm public waters in any way is condemned as an enemy of the homeland [...]"

DEEPENING
of shallow water seabed



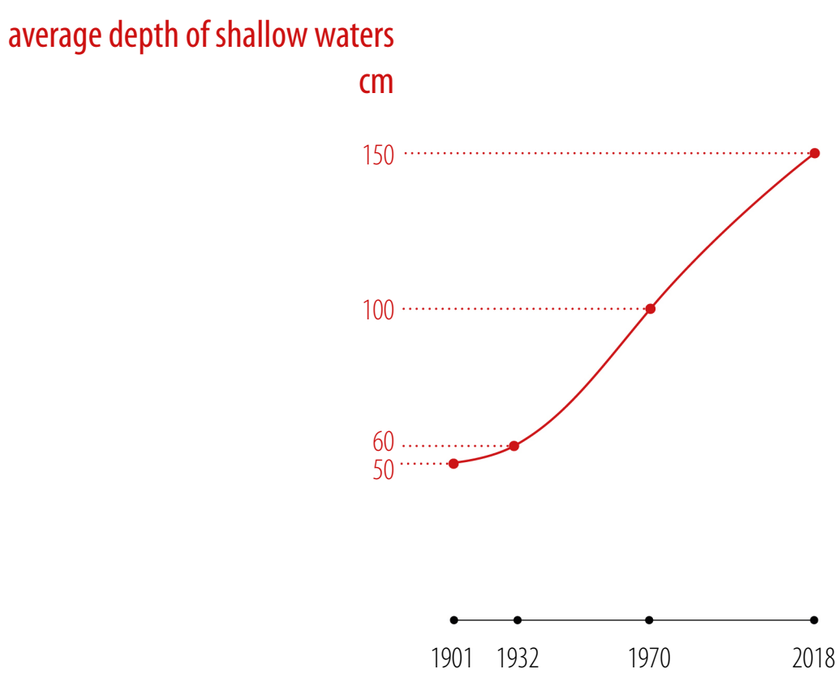
1970



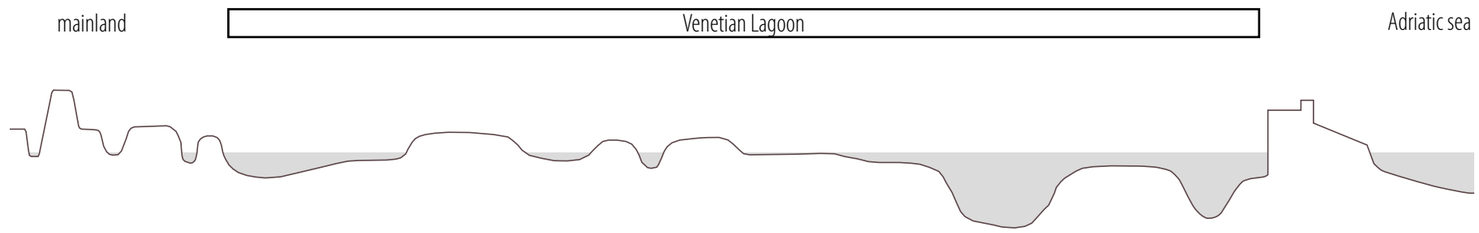
1990



2000


average depth of shallow waters
cm
150
100
60
50
1901
1932
1970
2018

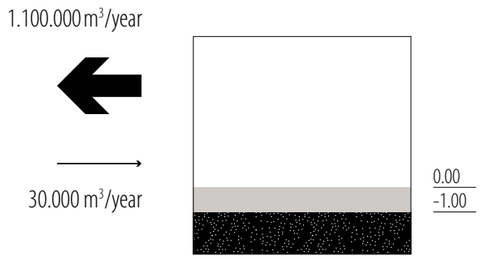
FLATTENING
and horizontal erosion



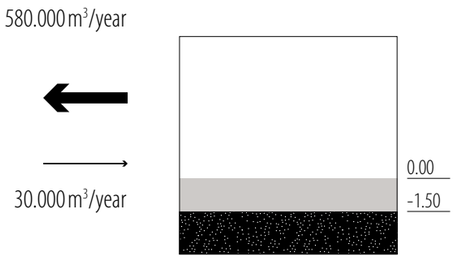
until half of XX century



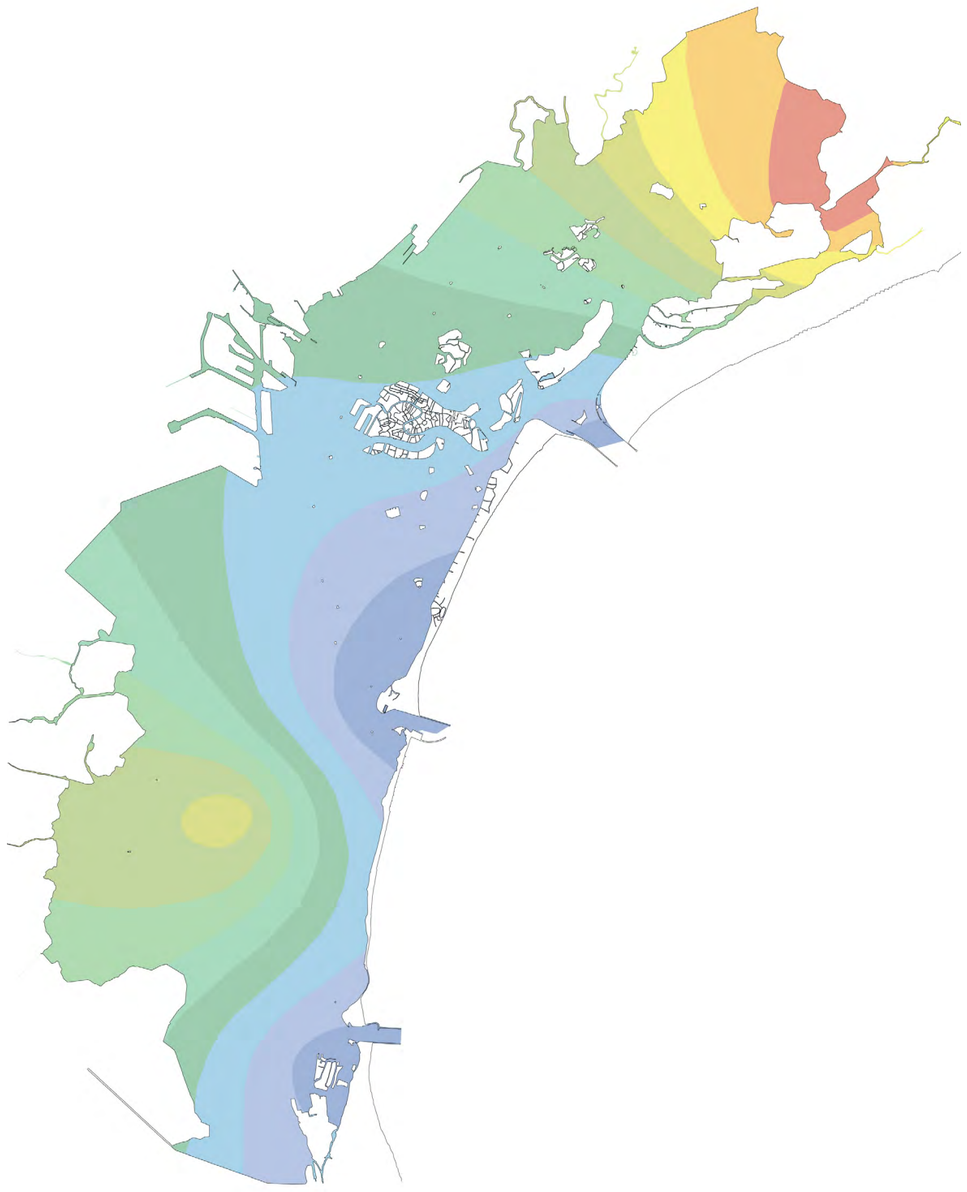
contemporary tendence



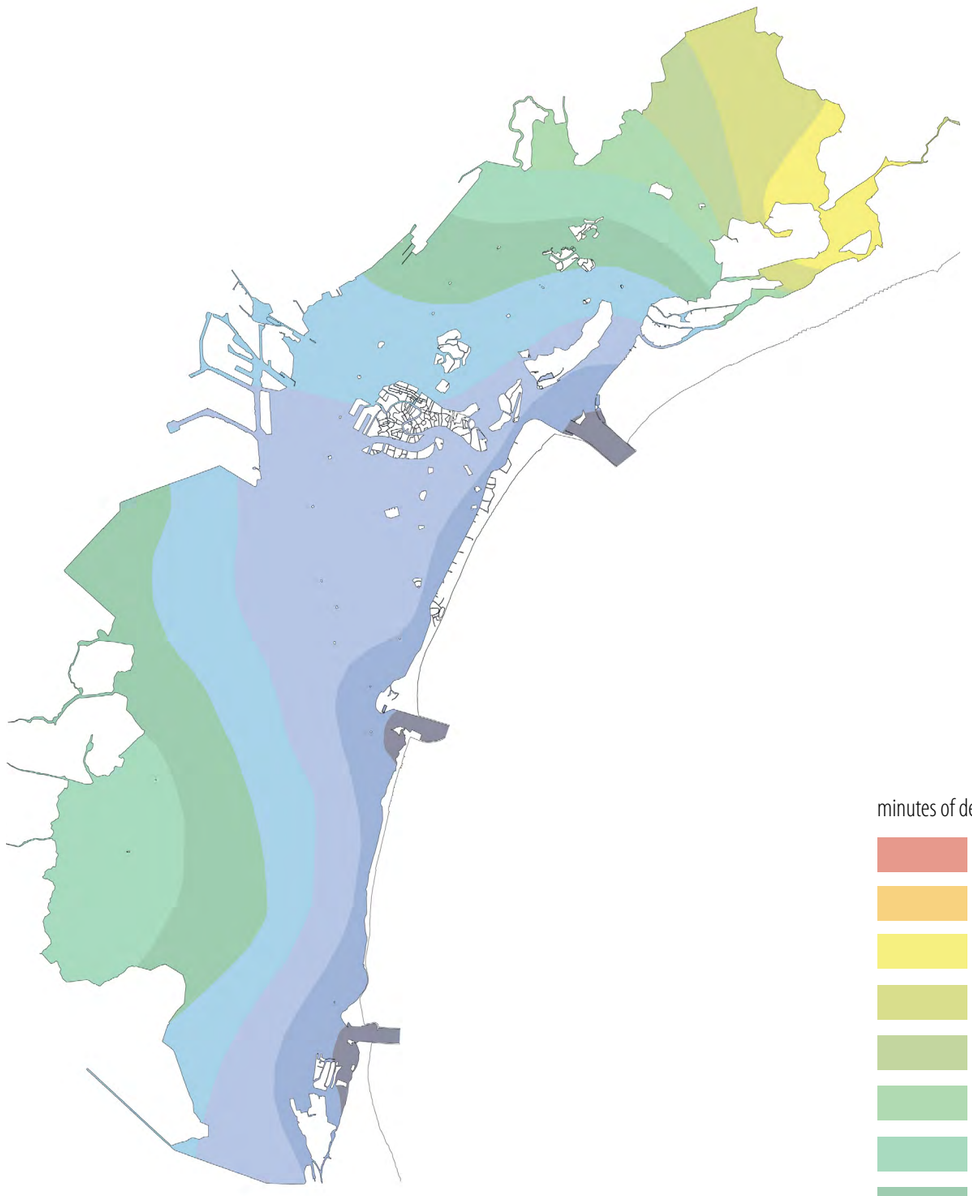
1970-90



1990-2015



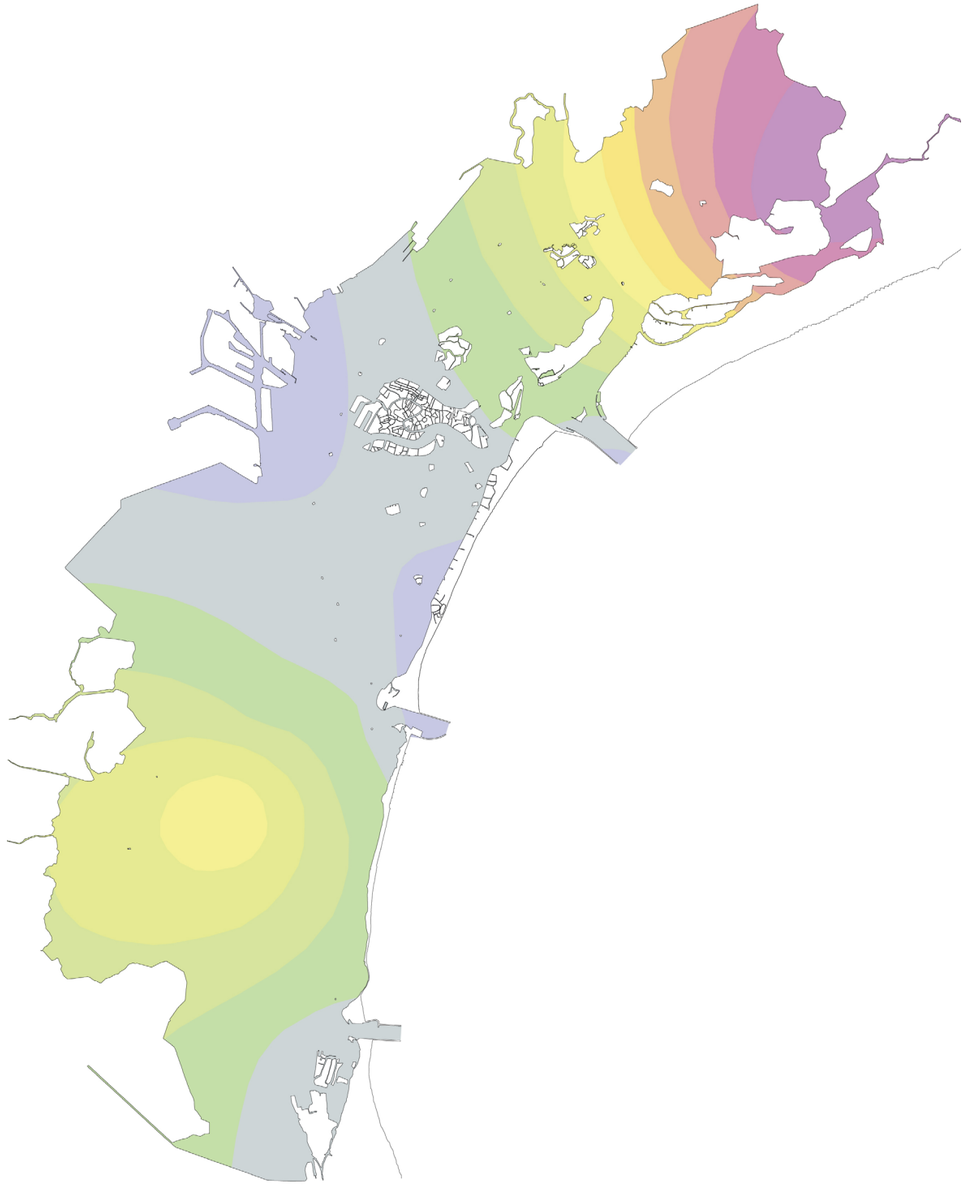
beginning of XX century



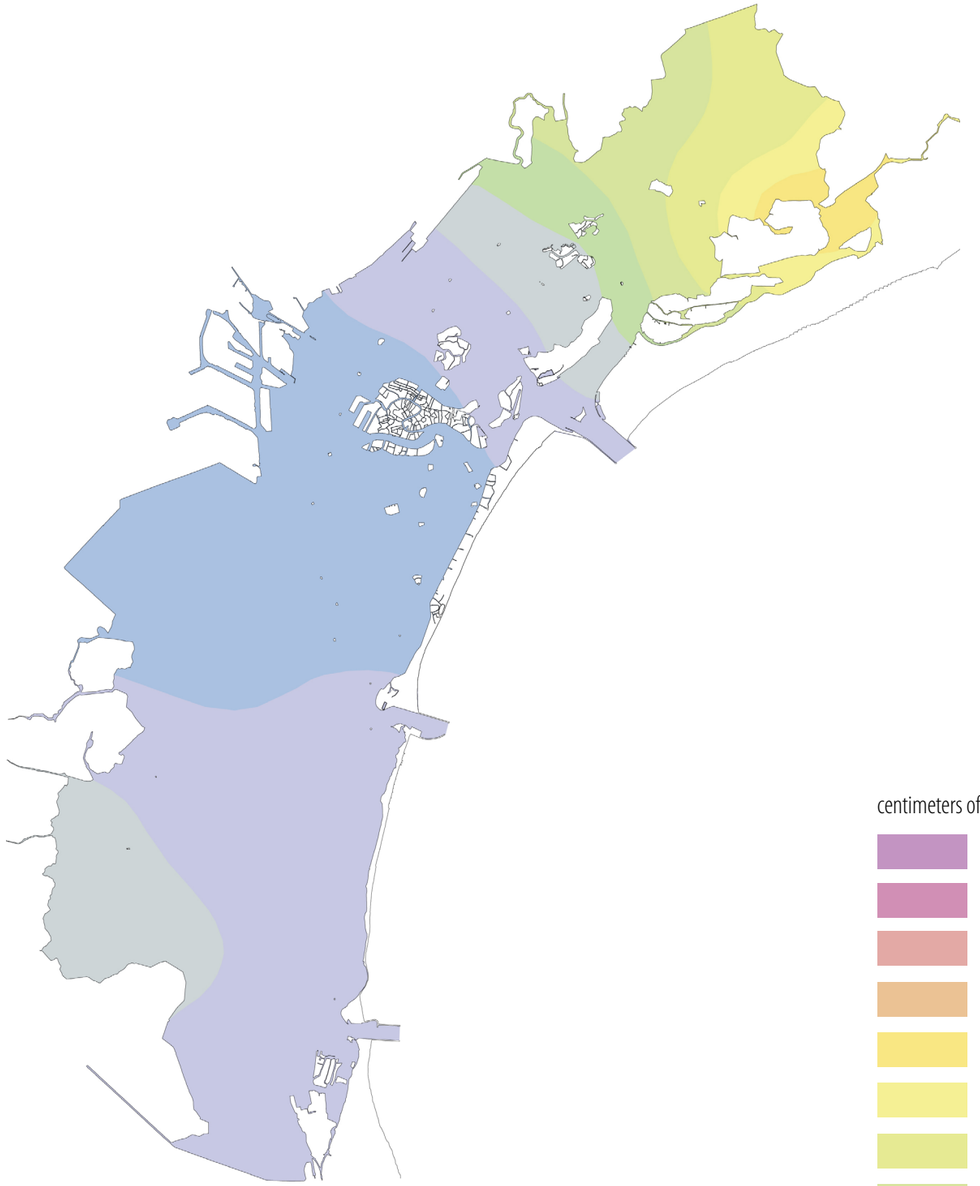
beginning of XXI century

minutes of delay

- 220
- 200
- 180
- 160
- 140
- 120
- 100
- 80
- 60
- 40
- 20
- 0



beginning of XX century

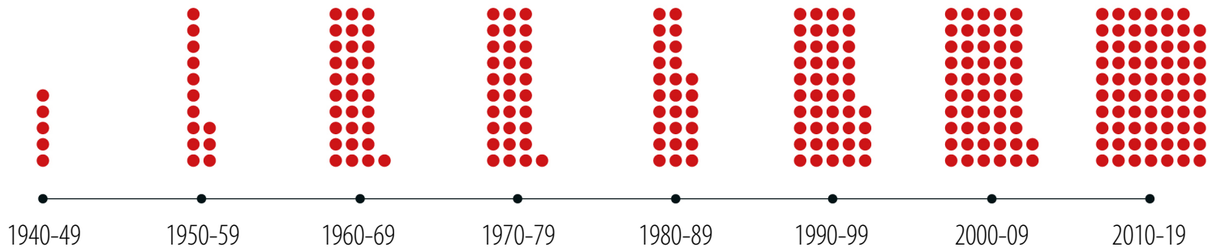


beginning of XXI century

centimeters of height

- 16
- 18
- 20
- 22
- 24
- 26
- 28
- 30
- 32
- 34
- 36
- 38

INCREASE
of high water events during the last century



THREATS
and their causes

DEEPENING OF SHALLOW WATER SEABED

FASTER TIDAL PROPAGATION

GENERAL FLATTENING AND HORIZONTAL EROSION

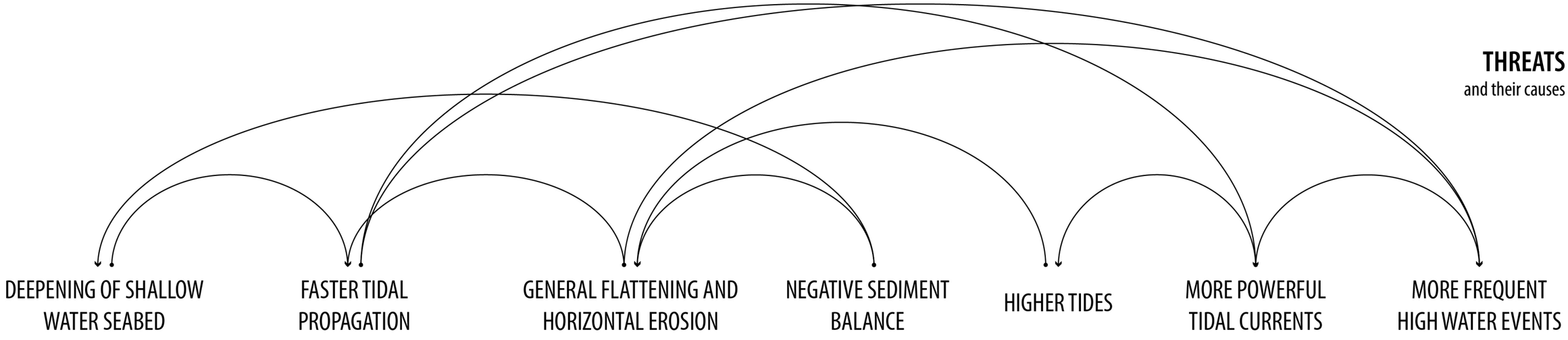
NEGATIVE SEDIMENT BALANCE

HIGHER TIDES

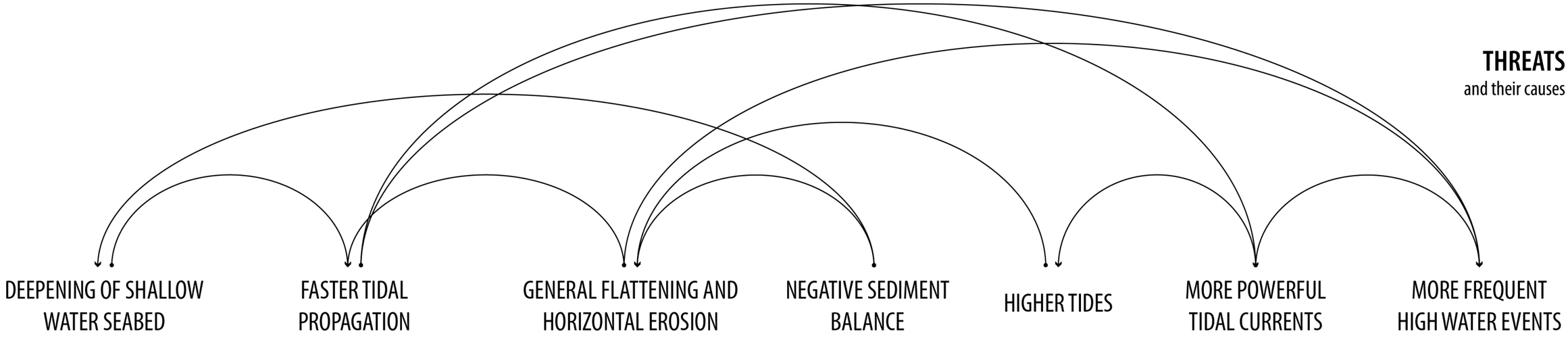
MORE POWERFUL TIDAL CURRENTS

MORE FREQUENT HIGH WATER EVENTS

THREATS
and their causes

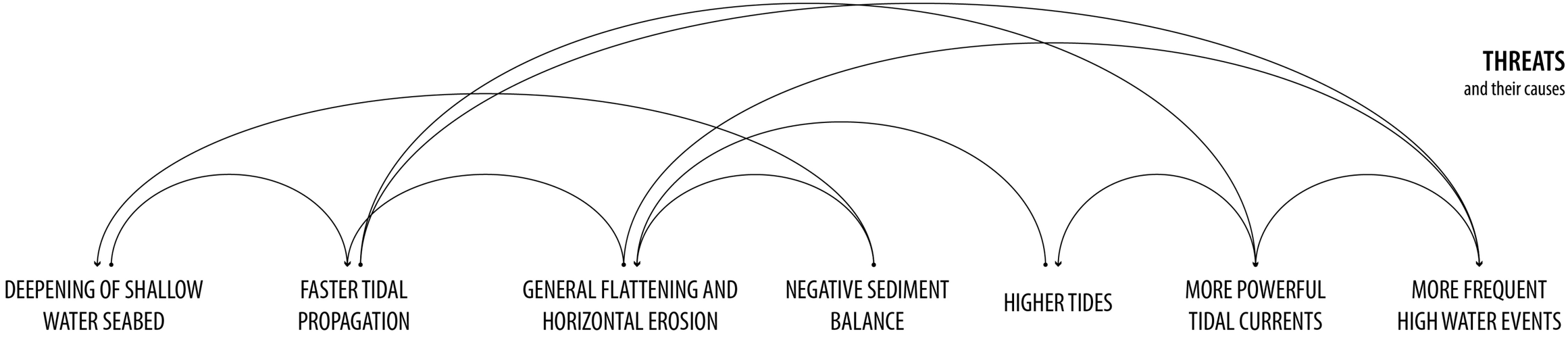


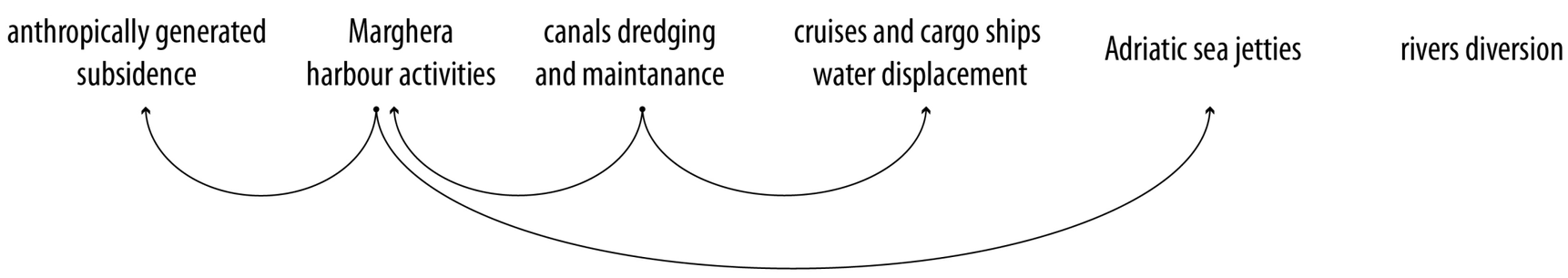
THREATS
and their causes



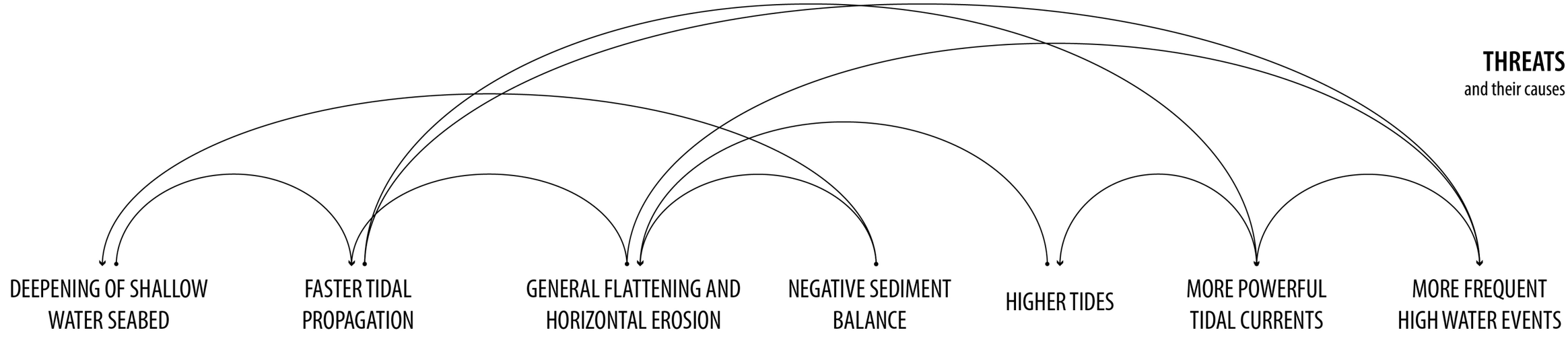
anthropically generated subsidence	Marghera harbour activities	canals dredging and maintanance	cruises and cargo ships water displacement	Adriatic sea jetties	rivers diversion

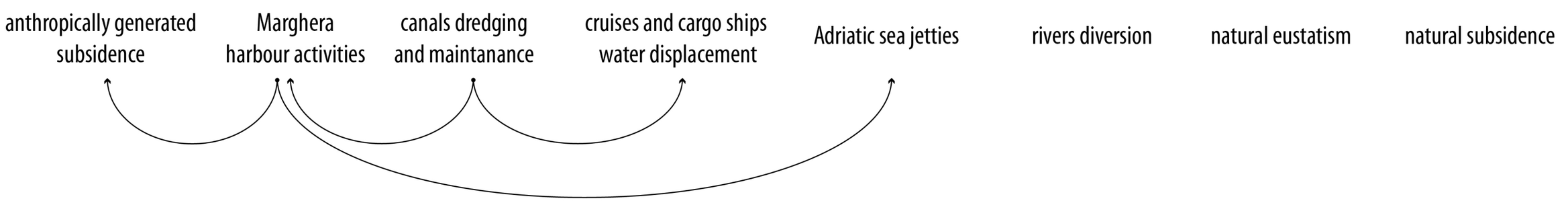
THREATS
and their causes





THREATS
and their causes





THREATS
and their causes

DEEPENING OF SHALLOW WATER SEABED

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anthropically generated subsidence

Marghera harbour activities

canals dredging and maintanance

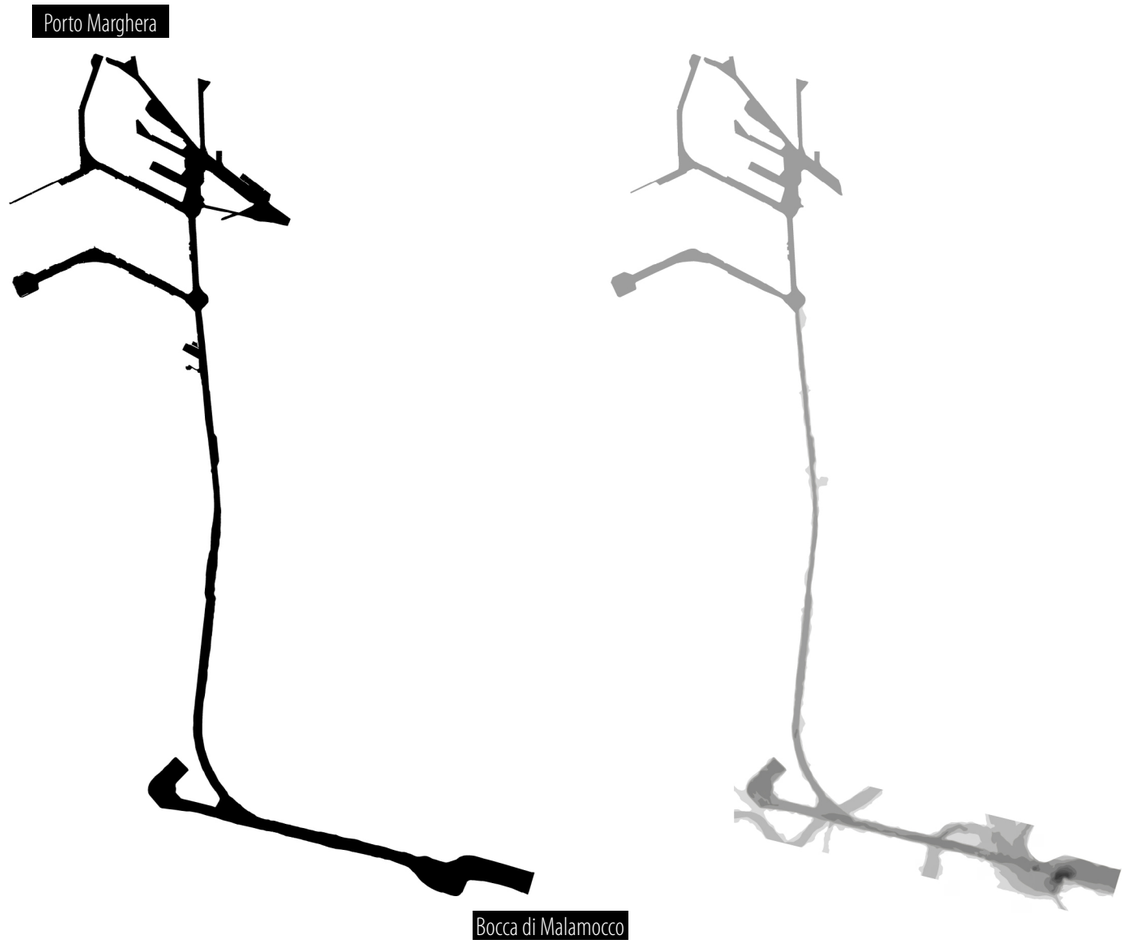
cruises and cargo ships water displacement

Adriatic sea jetties

rivers diversion

natural eustatism

natural subsidence


Porto Marghera
Bocca di Malamocco

CONSEQUENCES
of Canale Malamocco-Marghera excavation



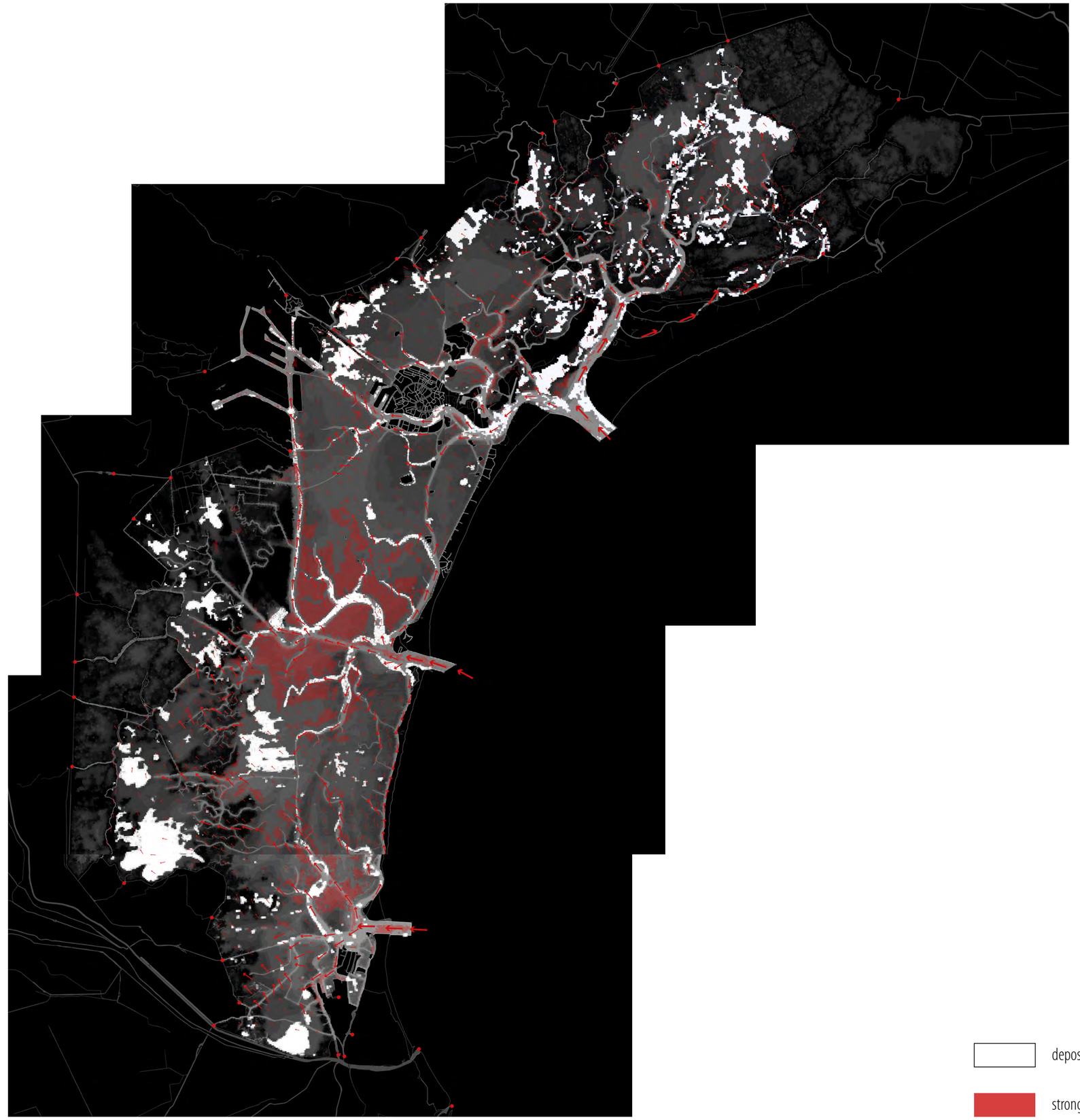
1969



2009

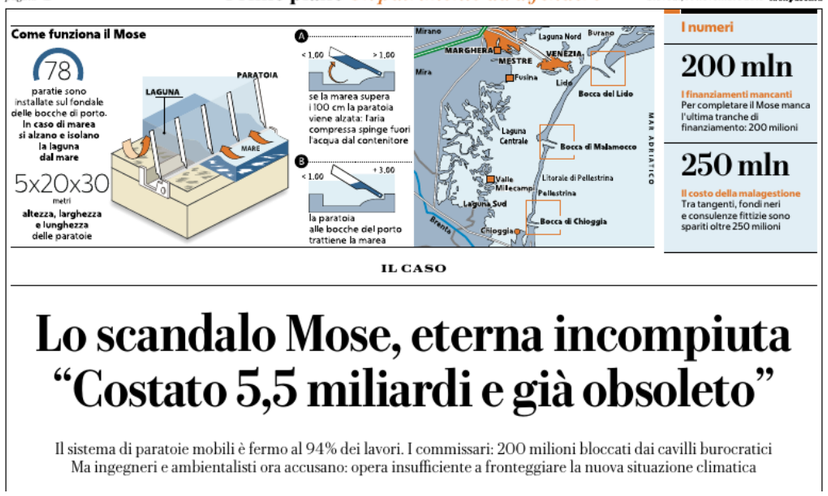
CONSEQUENCES

of Canale Malamocco-Marghera excavation



deposition (+ 0.1 mt)

strong erosion (- 0.50 mt)



IL CASO

Lo scandalo Mose, eterna incompiuta "Costato 5,5 miliardi e già obsoleto"

Il sistema di paratoie mobili è fermo al 94% dei lavori. I commissari: 200 milioni bloccati dai cavilli burocratici
Ma ingegneri e ambientalisti ora accusano: opera insufficiente a fronteggiare la nuova situazione climatica

"The scandal of MOSE. Eternally unfinished, its costs reached 5,5 billion and it is already obsolete"



Mo.S.E. movable sluices during a test in Lido inlet.

agi

L'acqua alta record a Venezia era imprevedibile, dice il Cnr

15:09, 13 novembre 2019
di Carmelo Rapisarda

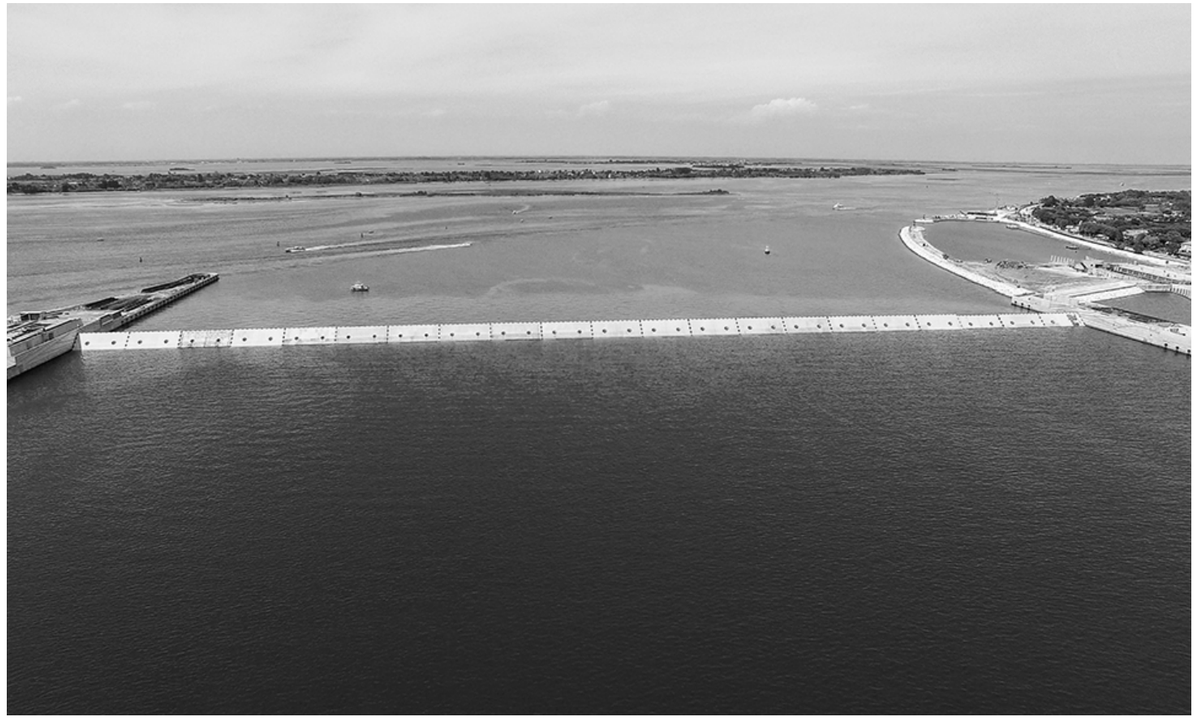
La marea ha raggiunto 1,87 metri. Mai così dal '66. Inondata per la seconda volta in meno di 12 ore la Basilica di San Marco. Un altro record atteso per il 17 novembre

Un'imbarcazione spostata dall'acqua alta

ACQUA ALTA VENEZIA SAN MARCO

Una **marea eccezionale** ha fatto irruzione nella laguna e ha sommerso fino al collo Venezia sotto un'**acqua alta** che non raggiungeva questi livelli dal 1966: un **picco di 1,87 metri**. Una marea **imprevedibile**, dice il Cnr.

"Record high water level was unpredictable, says Cnr"



Mo.S.E. bird-eye view, Lido inlet. Source: metropolitano.it/speciale-mose

VALUES

ecological system of
BARENE
(brackish marshlands)

cultural system of
SECONDARY ISLANDS

productive system of
FISHING ACTIVITIES

ECOLOGICAL SYSTEM OF *BARENE*

brackish marshland





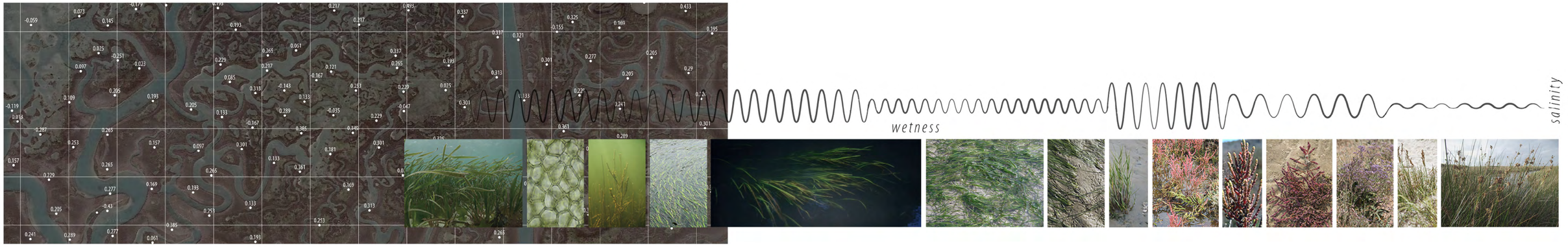
Aerial photograph pictured by Fulvio Roiter. The island in the centre is Torcello, located in the northern Venetian Lagoon.



source: https://www.youtube.com/watch?v=bFOI5mYTnWA&t=182s
edited by the author

BARENE

brackish marshland



BARENE
brackish marshland



Salicornia veneta
25-40 cm



Spartina stricta
40 cm



Sarcocornia fruticosa
50-100 cm

Limonium narbonensis
10-70 cm
Spartina maritima
40 cm
Salicornia europaea
40 cm

Agropyron pungens
30 cm
Artemisia coerulescens
35 cm
Aster tripolium
30-120 cm
Atriplex latifolia
10-100 cm
Beta vulgaris maritima
30-100 cm
Halimione portulacoides
20 cm
Inula crithmoides
30-80 cm
Juncus maritimus
15-30 cm
Juncus acutus
50-150 cm



Puccinellia palustris
40-60 cm



Puccinellia maritima
20-80 cm

Limonium narbonensis
10-70 cm
Sarcocornia fruticosa
50-100 cm



Limonium serotinum
10-70 cm

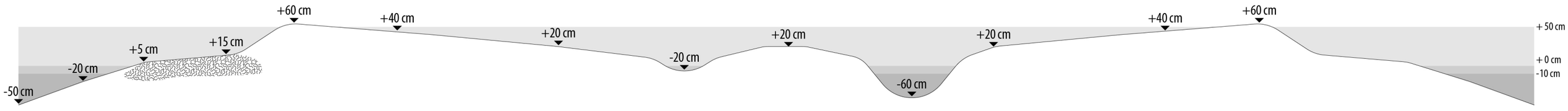


Artheocnemum fructicosum
30-100 cm

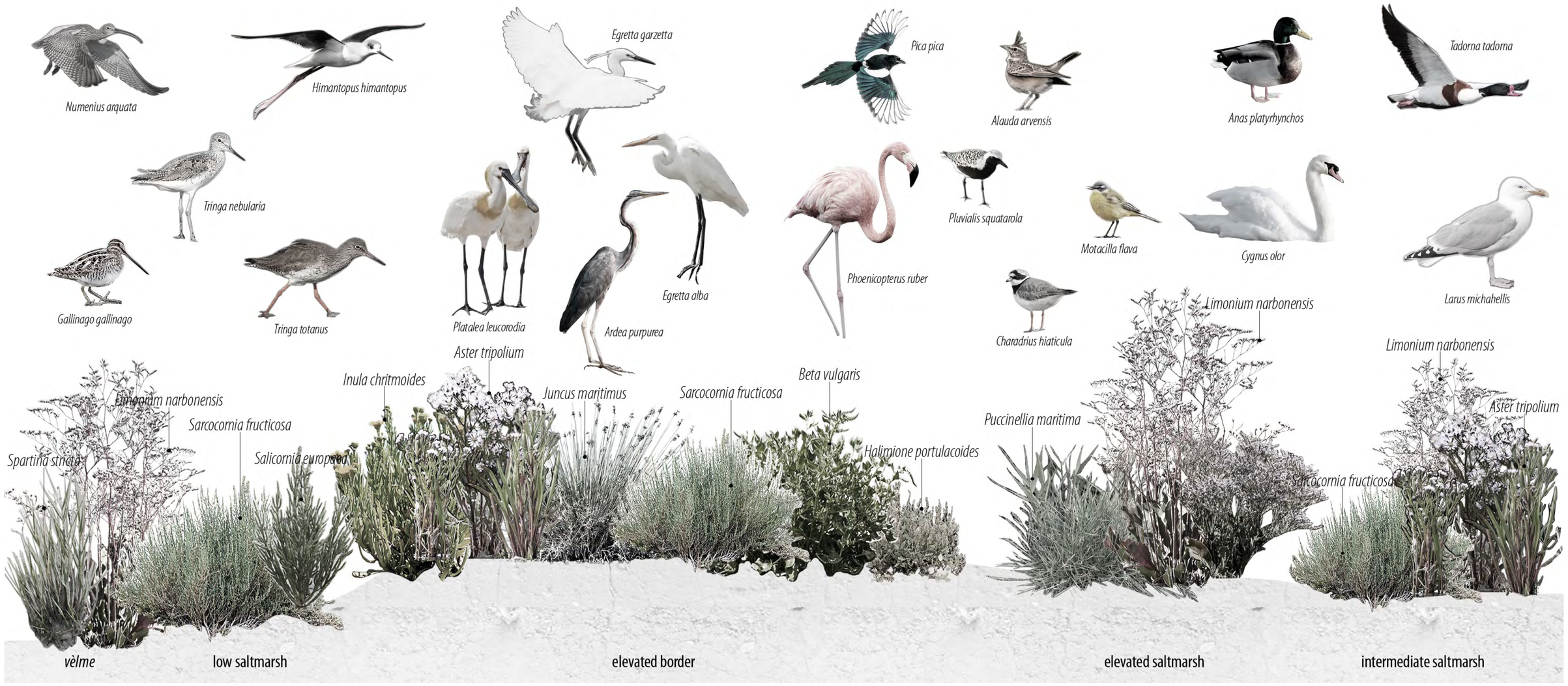


Suaeda maritima
30 cm

Aster tripolium
30-120 cm
Juncus maritimus
15-30 cm
Limonium narbonensis
10-70 cm

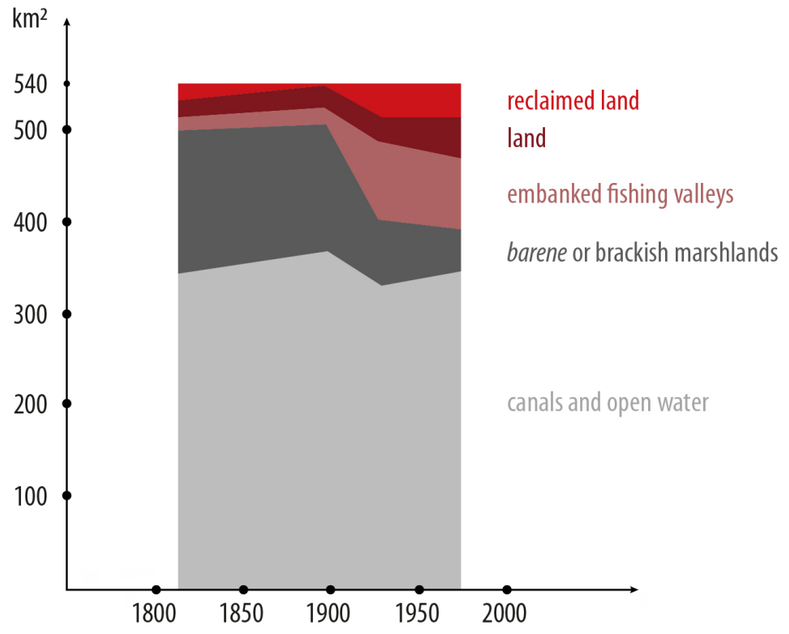


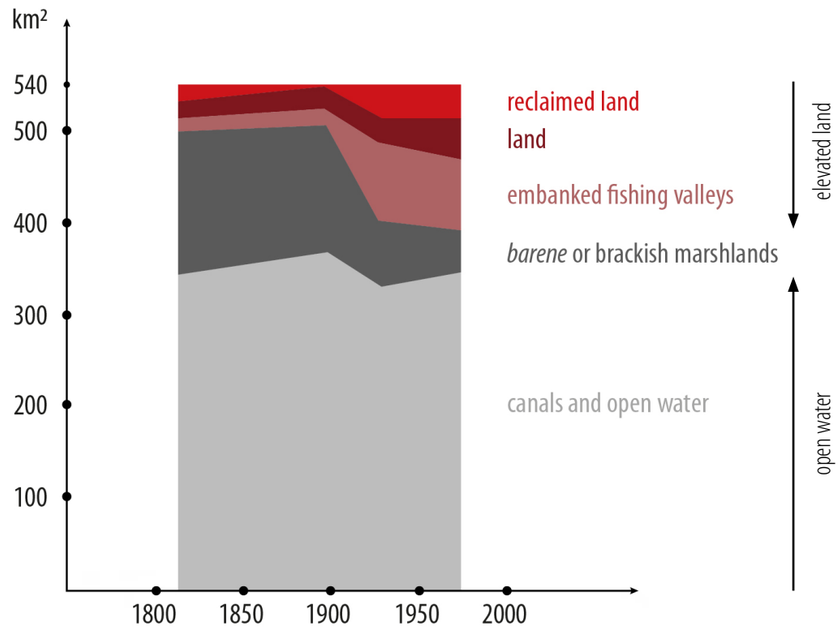
BARENE
brackish marshland





1811 1843 1901 1932 1971 2013


km²
540
500
400
300
200
100
1800
1850
1900
1950
2000
reclaimed land
land
embanked fishing valleys
barene or brackish marshlands
canals and open water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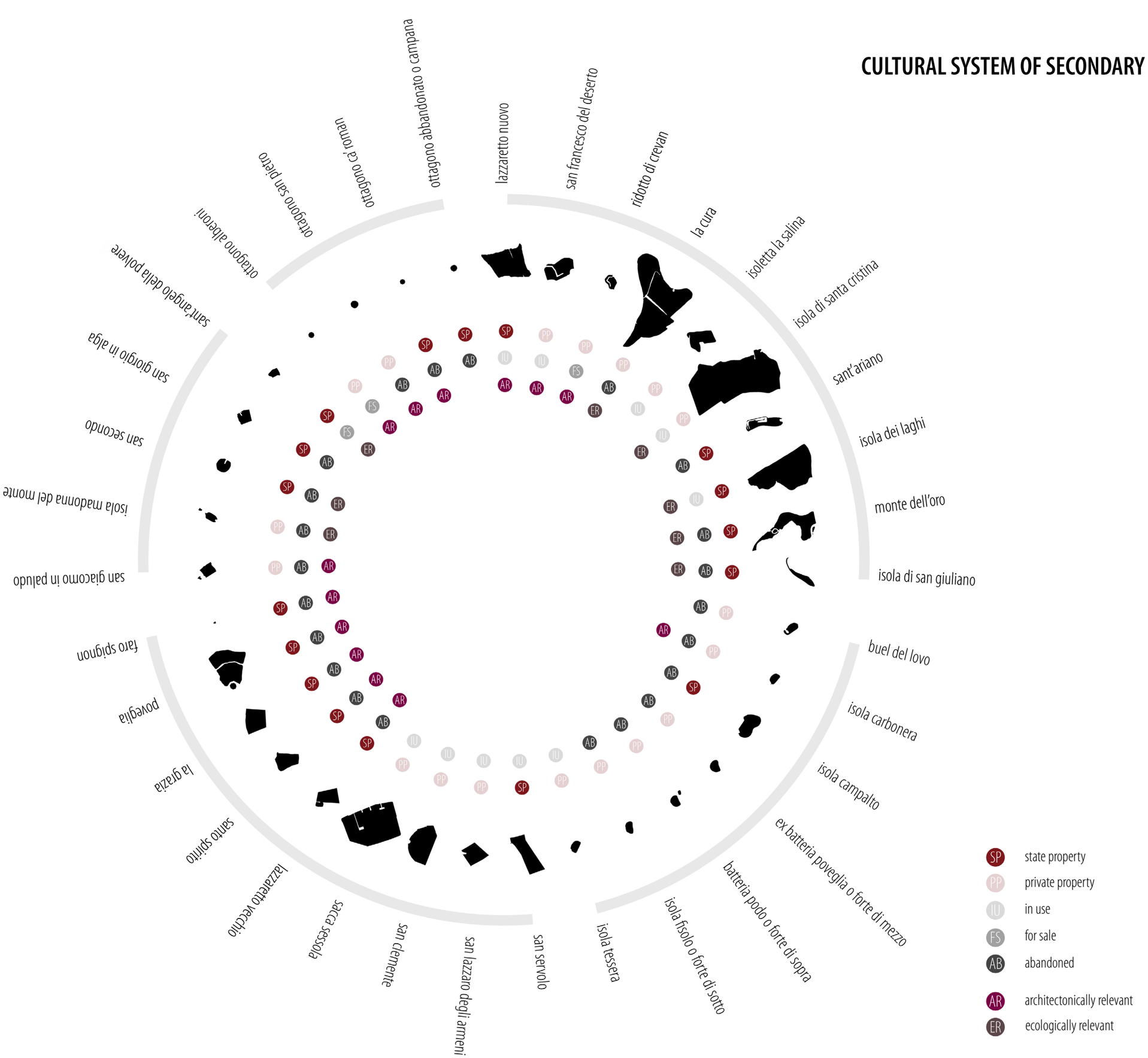
barene or brackish marshlands
canals and open water
elevated land
open water

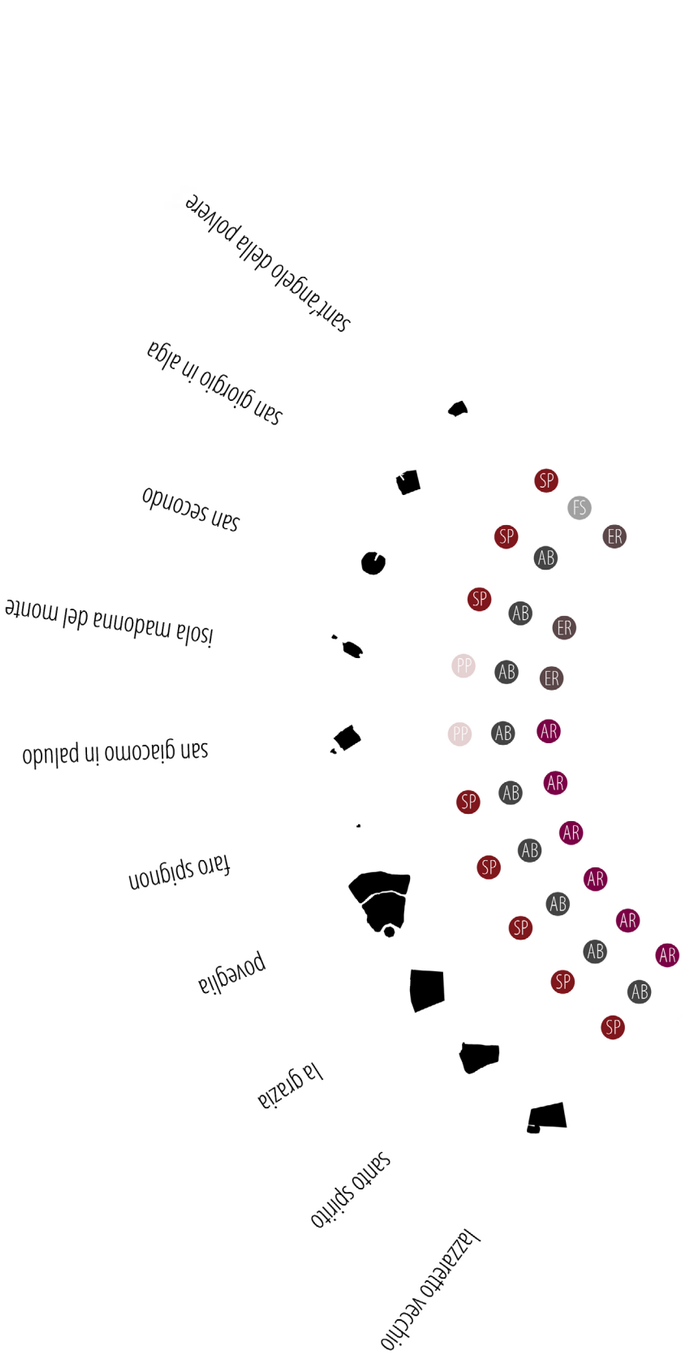


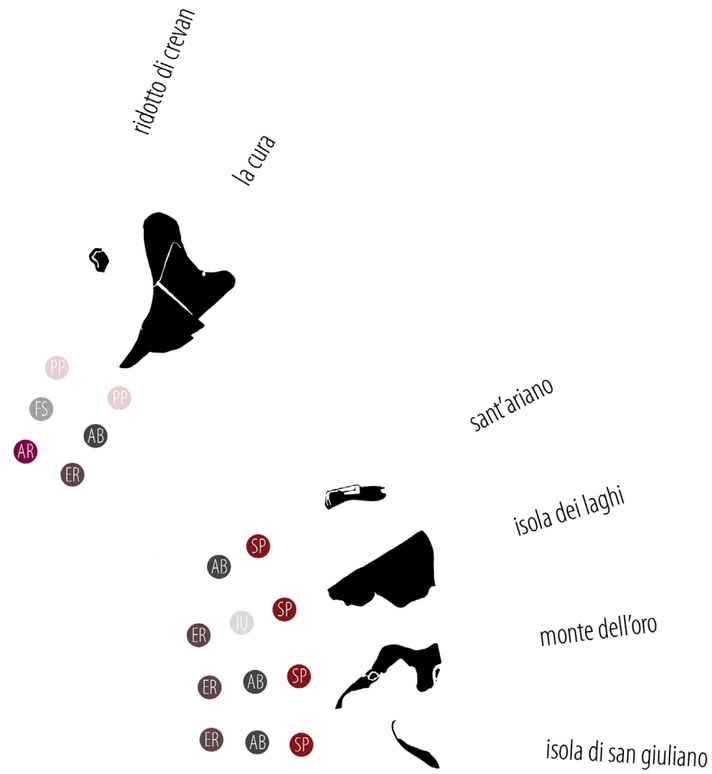
CULTURAL SYSTEM OF SECONDARY ISLANDS



CULTURAL SYSTEM OF SECONDARY ISLANDS

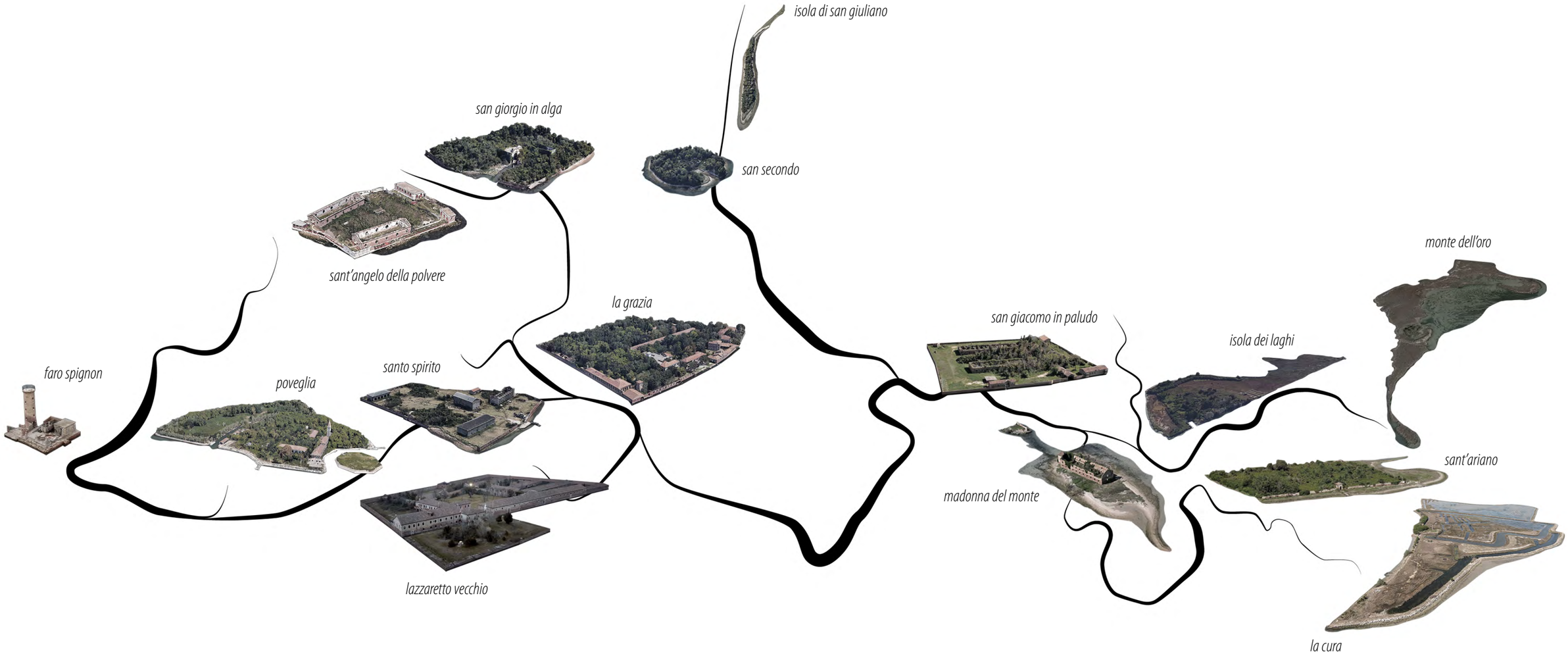
state property, abandoned and
architectonically and ecologically relevant





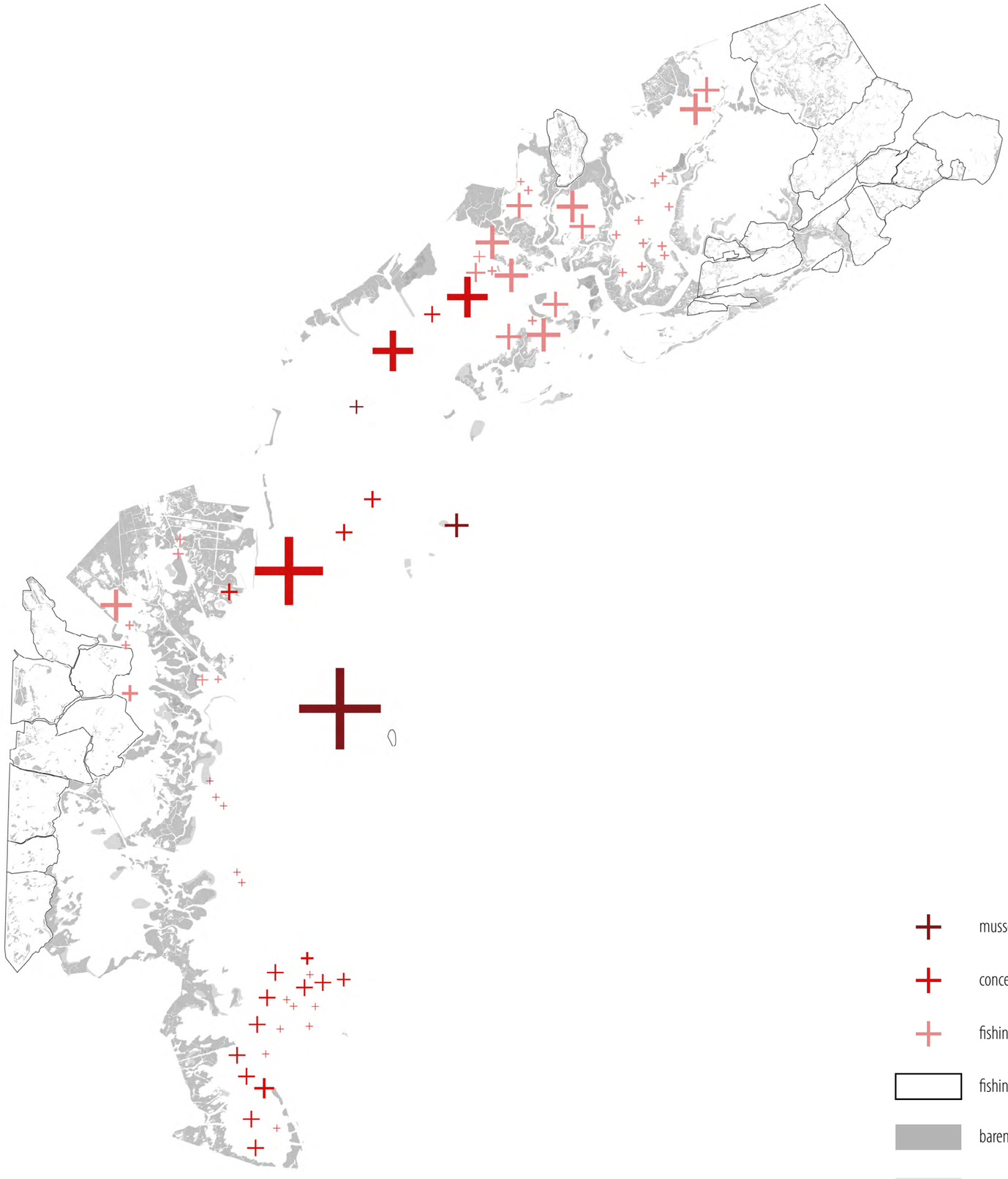
CULTURAL SYSTEM OF SECONDARY ISLANDS

state property, abandoned and
architectonically and ecologically relevant





FISHING ACTIVITIES



mussels cultivation

concessed areas for clam cultivation

fishing activities with movable nets

fishing valley

barene

velme



informal fishing base



mussels cultivation



bilancere



informal fishing base



temporary nets and traps



casone



casone

In this way, the mansions arranged along either bank of the canal made one think of objects of nature, but of a nature which seemed to have created its works with a human imagination.

Marcel Proust, À la recherche du temps perdu, vol. six "Albertine disparue", chapt. III "Venise"



source: https://www.youtube.com/watch?v=bFOI5mYTnWA&t=182s
https://www.youtube.com/watch?v=VTp0-6-yyB4
edited by the author

PROBLEM FIELD AND RESEARCH QUESTIONS

A
SYSTEMIC, INCLUSIVE AND COMPREHENSIVE LANDSCAPE APPROACH

A
CLEAR VISION REGARDING THE SPATIAL AND FUNCTIONAL FUTURES OF THE VENETIAN LAGOON

are missing

FLOWS, FUNCTIONS AND FORMS

venetian lagoon
hydromorphological sufferance

flows

over-engineered approach
to design flood defences

functions

neglected heritage of Venetian lagoon
barene, **islands, and fishing activities**

forms

ARE NOT IMPLEMENTED
THROUGH A UNITARY VISION AND
AS PART OF A UNIQUE CO-OPERATING SYSTEM

CAN THE ECOLOGICAL SYSTEM OF BARENE BE IMPLEMENTED AND USED AS THE MEANS TO ACHIEVE A
SYSTEMIC, INCLUSIVE AND COMPREHENSIVE VISION FOR THE VENETIAN LAGOON?

HOW CAN *THE AGENCY OF BARENE* BE EMPLOYED TO
MITIGATE THE IMPACT OF ANTHROPIC AND NATURAL THREATS ACTING AS A NATURE-BASED FLOOD DEFENCE (FUNCTION),
RECOVER THE HYDROMORPHOLOGICAL SUFFERANCE (FLOW) AND
SUPPORT THE CULTURAL AND PRODUCTIVE HERITAGE (FORM),
MAKING THE VENETIAN LAGOON FUNCTION AS A *RESILIENT LANDSCAPE INFRASTRUCTURE*?

“THE AGENCY OF BARENE”

building-with-nature flood defence

hydromorphological processes **recovery**

ecology and biodiversity **restoration and enrichment**

abandoned cultural heritage **requalification**

fishing industry **production support**

LANDSCAPE RESILIENCE

LANDSCAPE AS INFRASTRUCTURE

BUILDING WITH NATURE

LANDSCAPE RESILIENCE

the ability of a landscape to sustain desired ecological functions, robust native biodiversity and critical landscape processes over time, under changing conditions, and despite multiple stressors and uncertainties

Beller at al., 2015

LANDSCAPE AS INFRASTRUCTURE

BUILDING WITH NATURE

LANDSCAPE RESILIENCE

the ability of a landscape to sustain desired ecological functions, robust native biodiversity and critical landscape processes over time, under changing conditions, and despite multiple stressors and uncertainties

Beller at al., 2015

ABOUT...

setting for constraints and opportunities

processes for dynamism

connectivity for movement

diversity and **complexity** of options

redundancy against loss

multi-scalarity for space and time provision

people for resilient opportunities

LANDSCAPE AS INFRASTRUCTURE

BUILDING WITH NATURE

LANDSCAPE RESILIENCE

LANDSCAPE AS INFRASTRUCTURE

BUILDING WITH NATURE

landscape is treated as an operative field that defines and sustains urban development, and ecological and economic processes are employed as formative design tools.

Nijhuis and Jauslin, 2015

LANDSCAPE RESILIENCE

LANDSCAPE AS INFRASTRUCTURE

BUILDING WITH NATURE

landscape is treated as an operative field that defines and sustains urban development, and ecological and economic processes are employed as formative design tools.

Nijhuis and Jauslin, 2015

ABOUT...

constructing the landscape and **creating** favourable conditions for future development

cross-scaling

balancing out services and qualities Busquets & Correa, 2006

guiding and **facilitating** flows Allen, 1999

creating adaptive systems open to change Gharajedaghi, 2011

persisting and **adapting** Corner, 2004

including multiple actors

diversifying contribution Allen, 1999

LANDSCAPE RESILIENCE

LANDSCAPE AS INFRASTRUCTURE

BUILDING WITH NATURE

a design principle that flexibly integrates land-in-sea and water-in-land in complex ecosystem, taking into account existing and potential landscape values, in harmony with natural materials and forces, in order to reduce the usage of invasive techniques.
Waterman, 2007

LANDSCAPE RESILIENCE

LANDSCAPE AS INFRASTRUCTURE

BUILDING WITH NATURE

a design principle that flexibly integrates land-in-sea and water-in-land in complex ecosystem, taking into account existing and potential landscape values, in harmony with natural materials and forces, in order to reduce the usage of invasive techniques.

Waterman, 2007

ABOUT...

understand system functioning

identify the system's functions and plan a project accordingly

determine how natural processes can be used and stimulated to achieve the project goals and others

determine how governance processes can be used and stimulated to achieve the project goals

monitor the environment during execution

monitor the environment after completion, to assess the project's performance, adapt its management, and to learn for the future

Deltares



Salvador Dalì picturing San Marco from inside the lagoon waters.

(L) scenarios for the venetian lagoon

“THE OPERATING LAGOON“

12 design strategies

(M) design for the central lagoon:
between lido and malamocco sub-basin

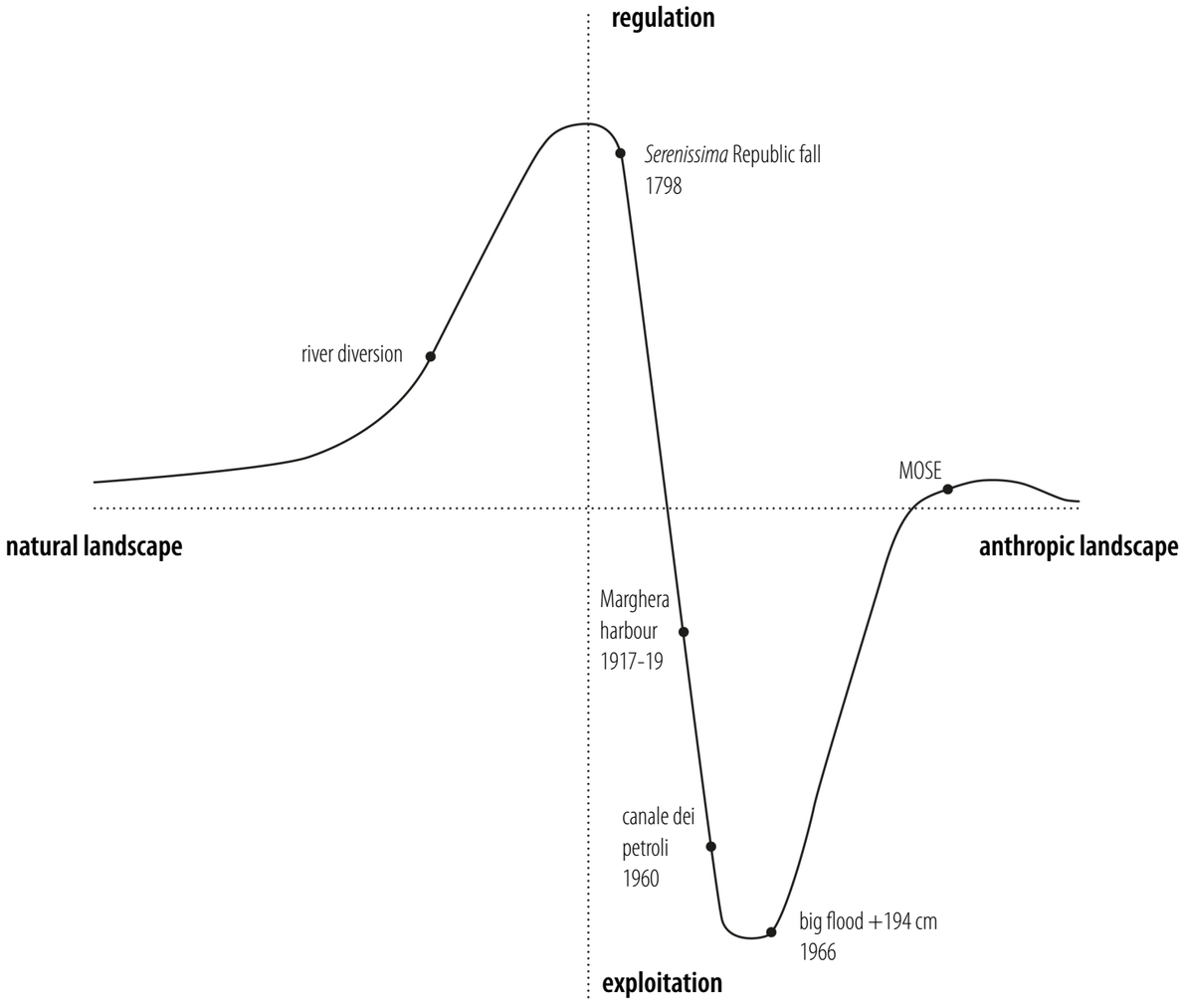
“THE AGENCY OF BARENE”

3 technical typologies

(S) detailing of santo spirito, forte di mezzo, and ottagono alberoni island

3 islands and 3 barene

“THE OPERATING LAGOON”


regulation
Serenissima Republic fall
1798
river diversion
MOSE
natural landscape
anthropic landscape
Marghera
harbour
1917-19
canale dei
petroli
1960
big flood +194 cm
1966
exploitation

preservation

resilience

resistance

transformation

preservation

THE OPERATING LAGOON

THE ENGINEERED LAGOON

resilience

resistance

THE ARCHIPELAGO

THE FRESHWATER RESERVOIR

transformation

preservation

THE OPERATING LAGOON

THE ENGINEERED LAGOON

resilience

resistance

THE ARCHIPELAGO

THE FRESHWATER RESERVOIR

transformation

land and sea
depth and horizon
open
cumulative
negotiation

preservation

THE ENGINEERED LAGOON

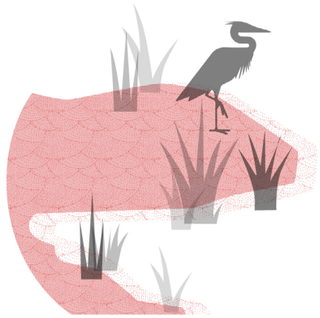
resilience

THE ARCHIPELAGO

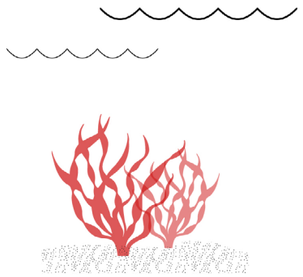
resistance

THE FRESHWATER RESERVOIR

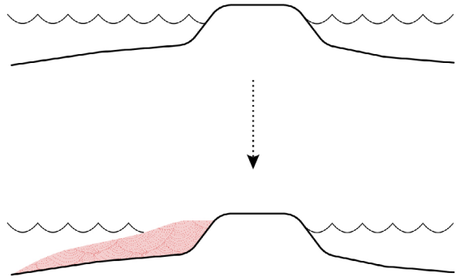
transformation



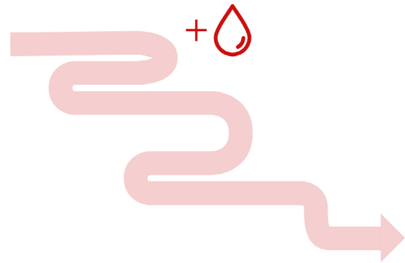
1. increase *barene* surface



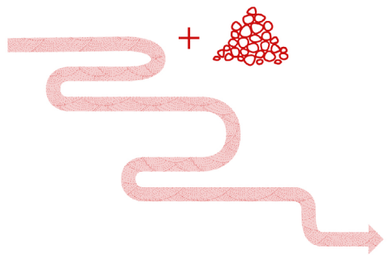
2. implement underwater vegetation



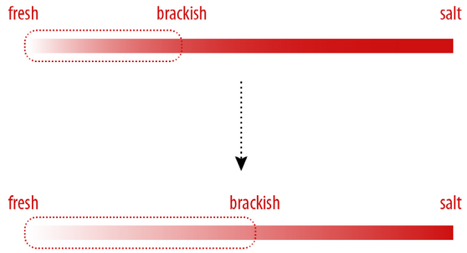
3. creation of water dykes to promote deposition



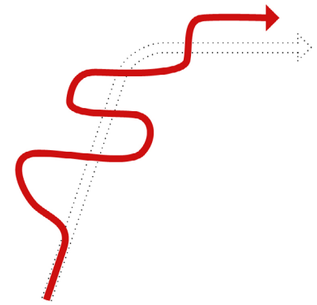
4. increase freshwater discharge



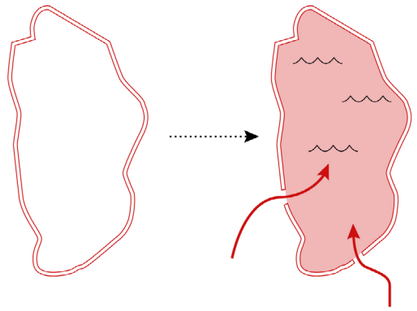
5. increase fluvial sediments discharge



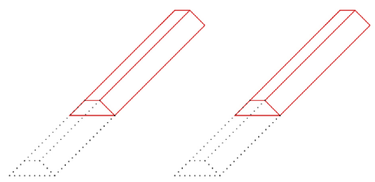
6. expand fresh-brackish-salt water gradient



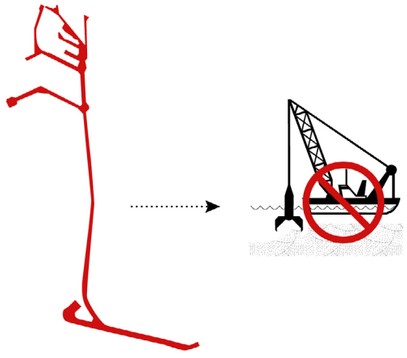
7. reshape and design with lagoon canals



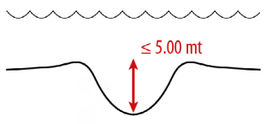
8. open fishing valleys in case of exceptional high water events



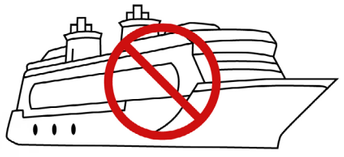
9. reduce in lenght concrete jetties of the inlets



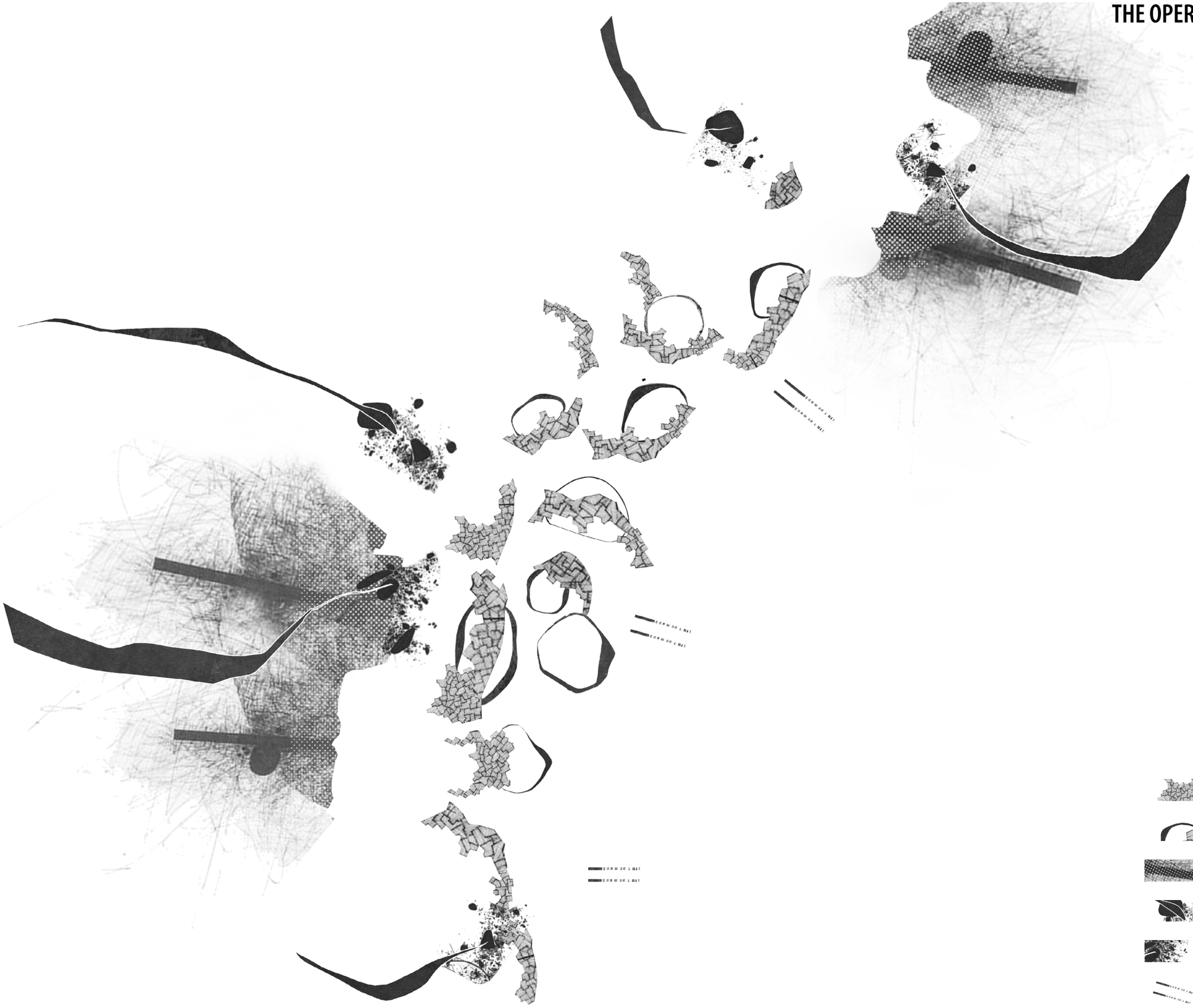
10. stop dredging and maintaining Porto Marghera *Canale dei Petroli* (Oil Canal)



11. maximum canal's depth set at 5.00 mt



12. stop cruise traffic



increase *barene* surface

underwater prairies of marine phanerogams

water intrusion in fishing valleys

increase in freshwater discharge

fresh-brackish water vegetation gradient

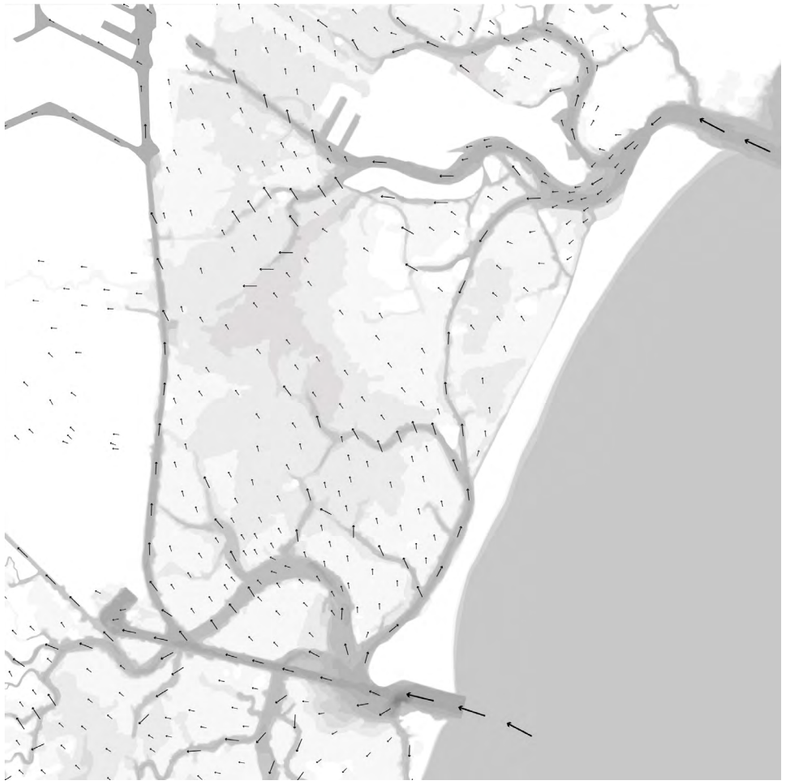
length reduction of jetties

“THE AGENCY OF BARENE”



THE FLUXES
influencing the design

TIDAL EXPANSION



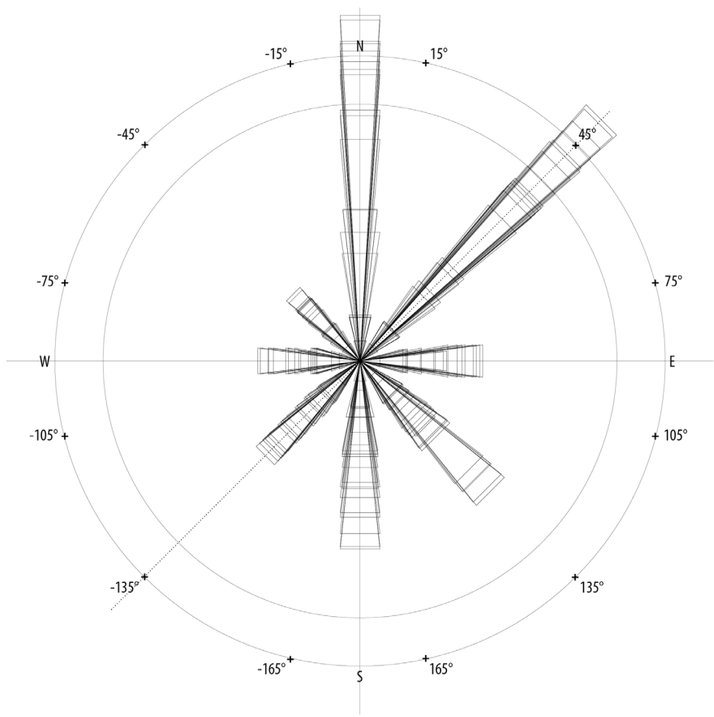
water

SEDIMENT PLUME



sand

WINDS' DIRECTION

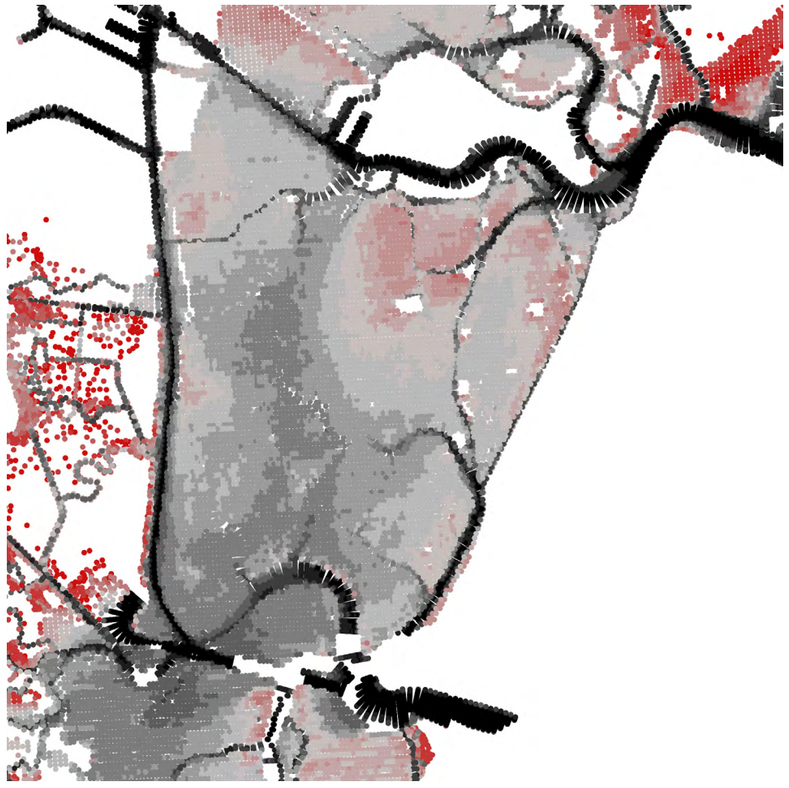


air

CANAL STRUCTURE



BATHYMETRY

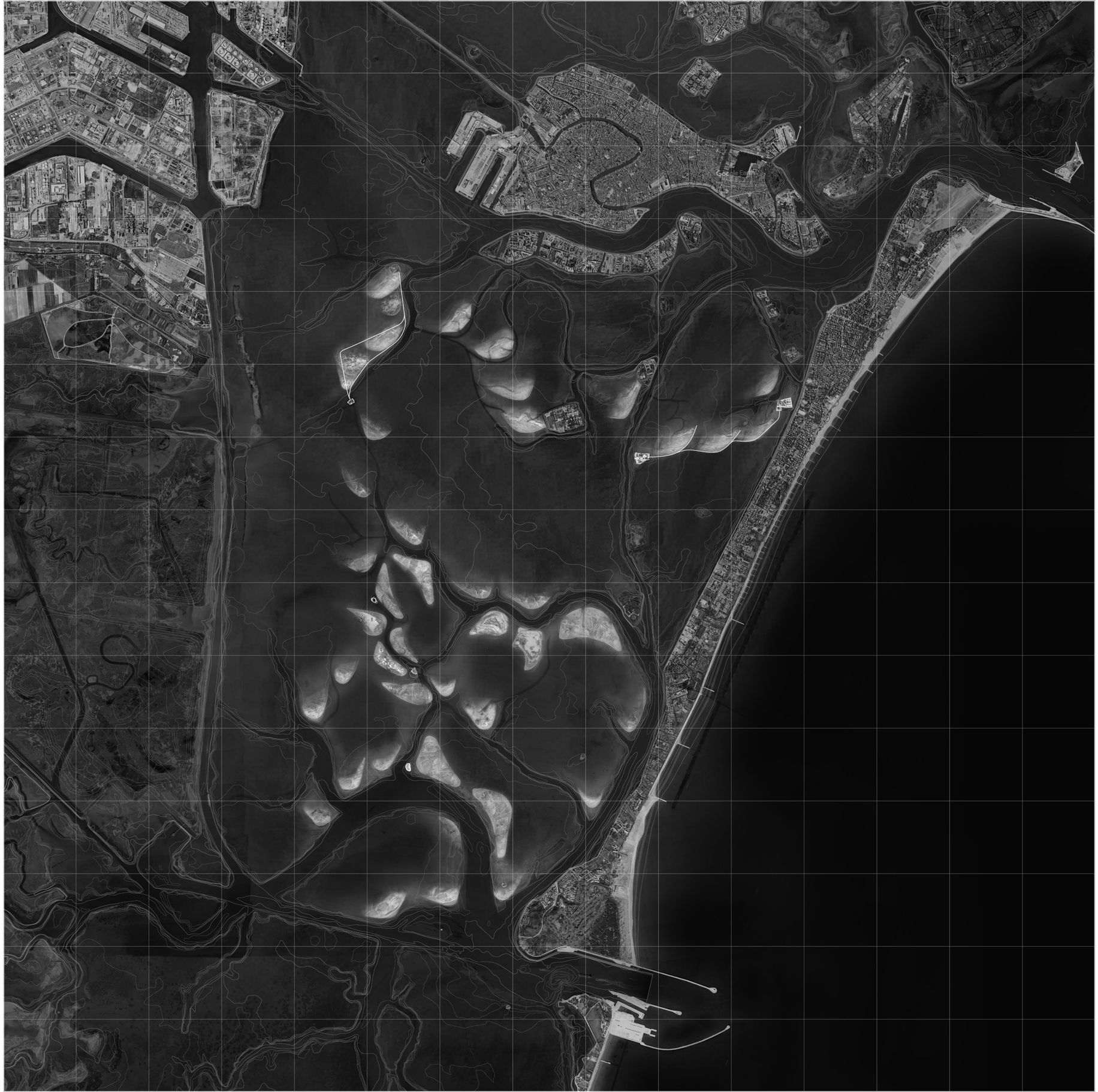


ISLANDS



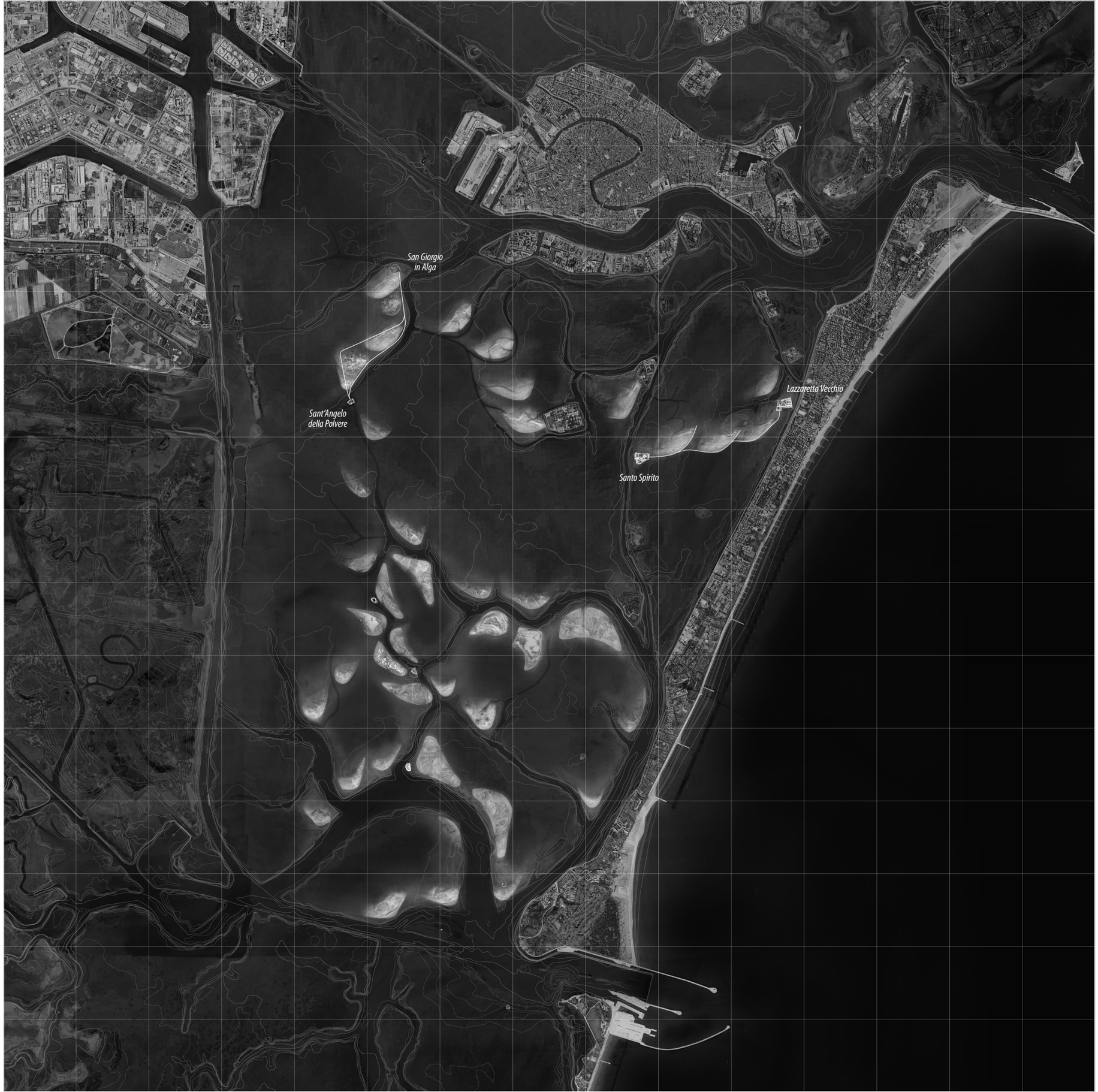
MASTERPLAN

2050



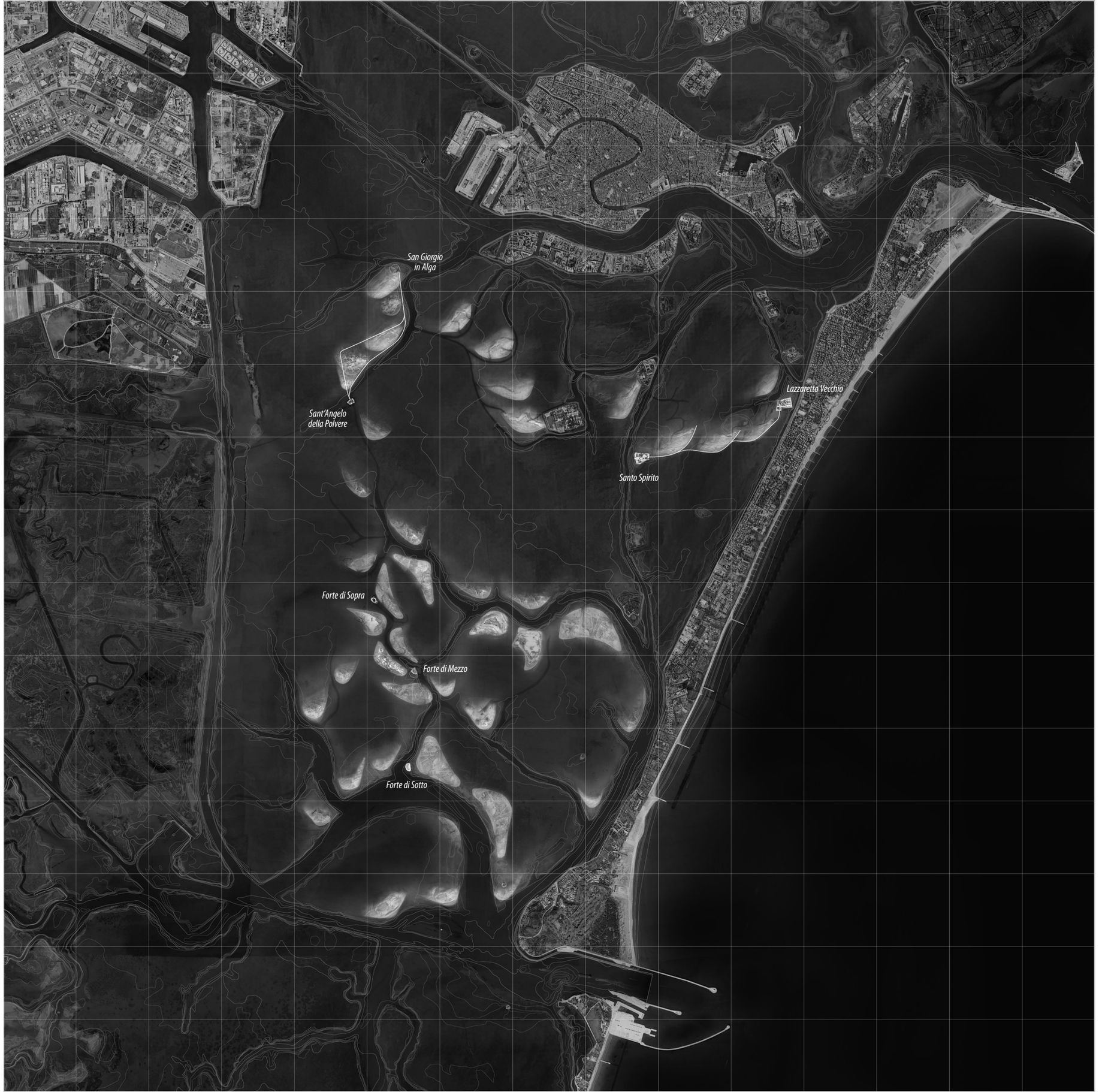
0 1 km

MASTERPLAN
2050



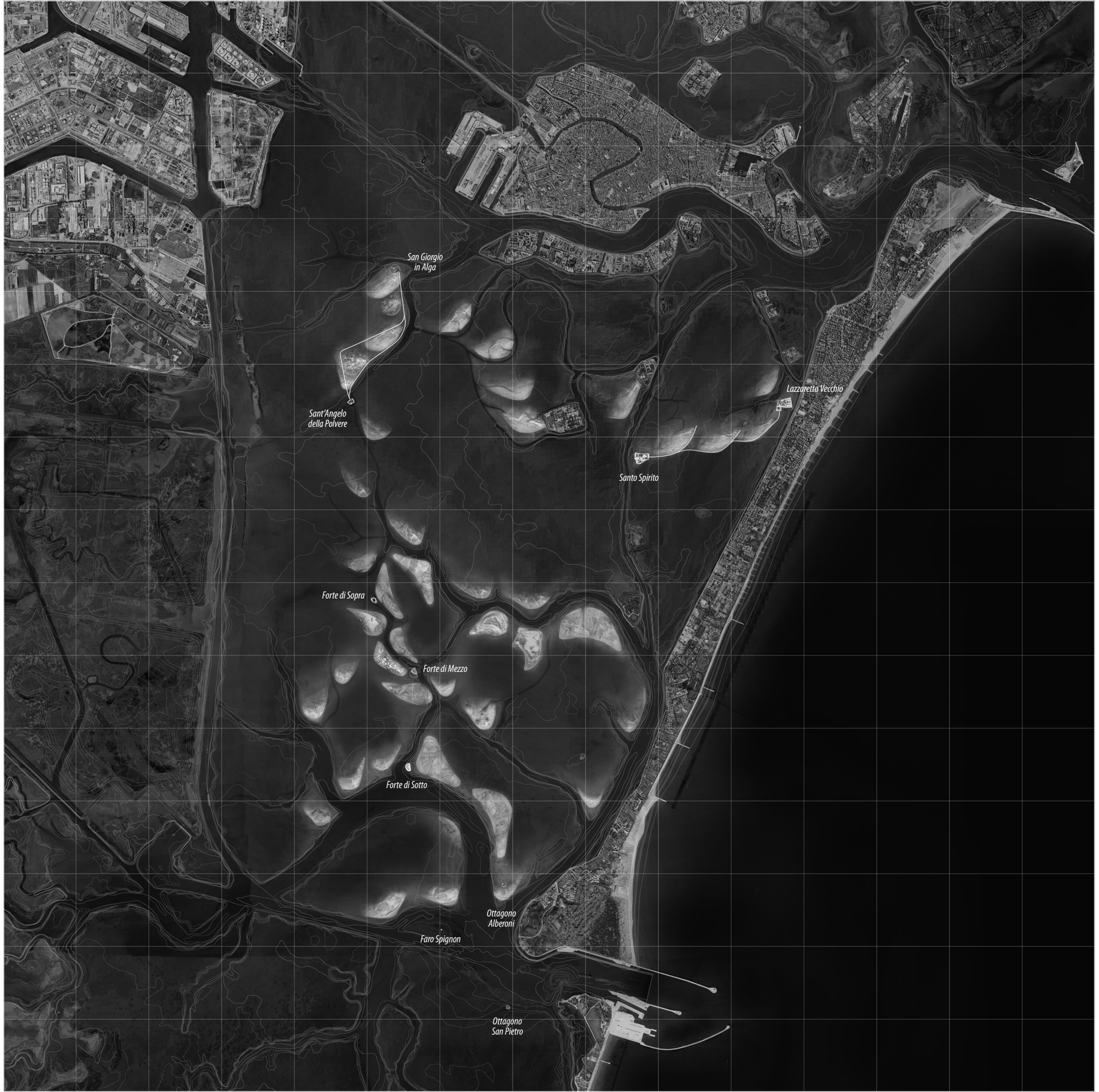
0 1 km

MASTERPLAN
2050

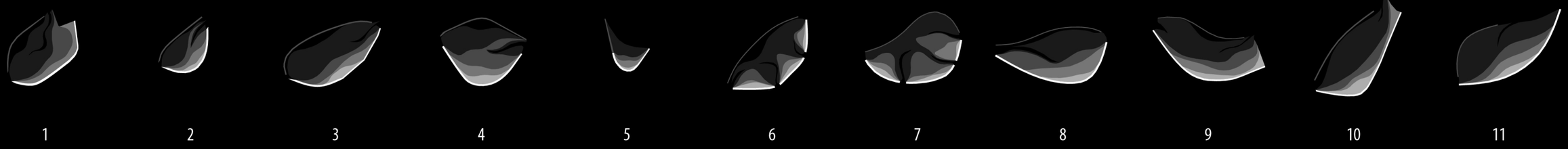


0 1 km

MASTERPLAN
2050



0 1 km



1 2 3 4 5 6 7 8 9 10 11

12 13 14 15 16 17 18 19 20 21 22



23 24 25 26 27 28 29 30 31 32 33

34 35 36 37 38 39 40 41 42 43 44

TYPE 1

CONDITIONS

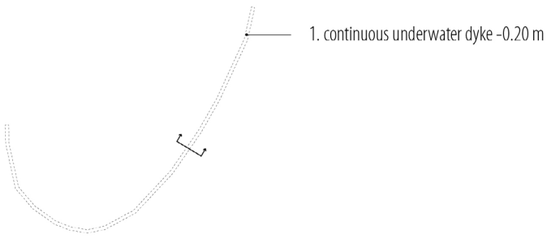
_relatively deep seabed
_powerful waves

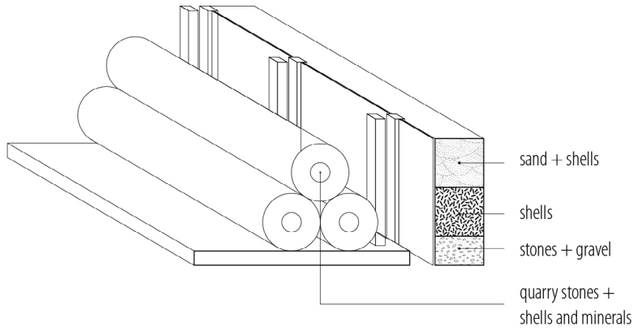
GOALS

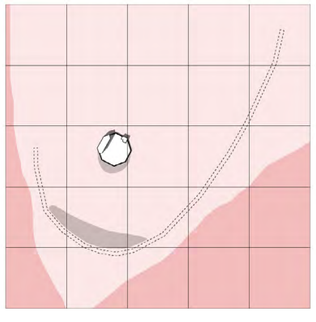
_interrupt wave formation (1)
_underwater morphology differentiation (1)
_tidal expansion speed reduction (1)



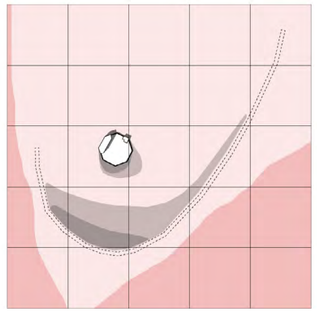
0 1 km



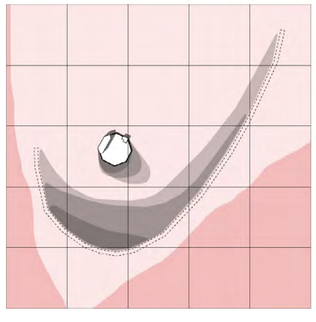




2022



2030



2040

0 100 m

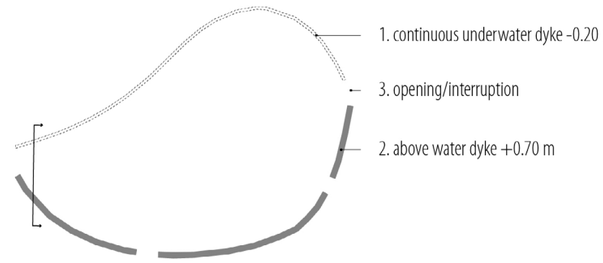
TYPE 2A

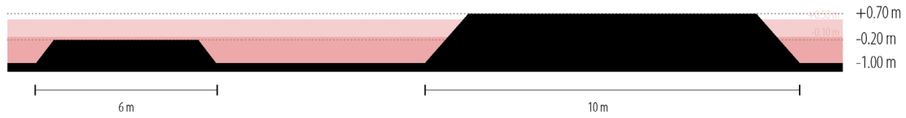
CONDITIONS

_relatively deep seabed
_powerful waves

GOALS

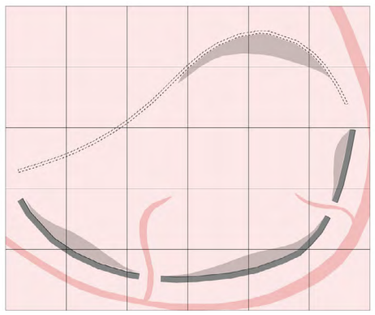
_interrupt wave formation (1)
_above and underwater morphology differentiation (1, 2)
_tidal expansion speed reduction (1)
_wind break (2)
_avoid sediment dispersal (1)
_natural formation of creeks and shallow lakes (3)



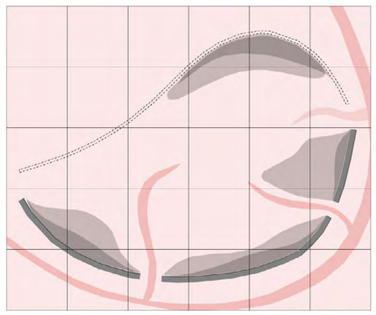




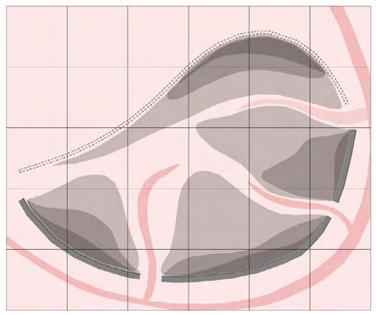
0 1 km



2029



2040



2050

0 100 m

TYPE 2B



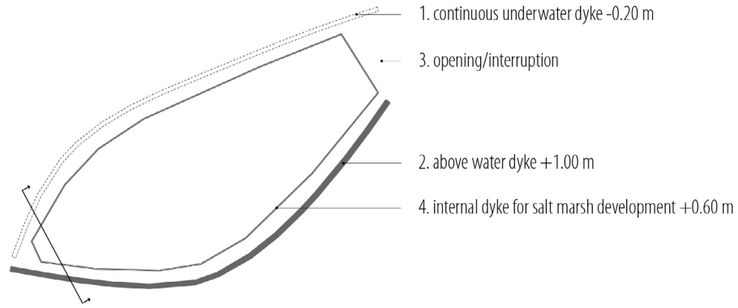
0 1 km

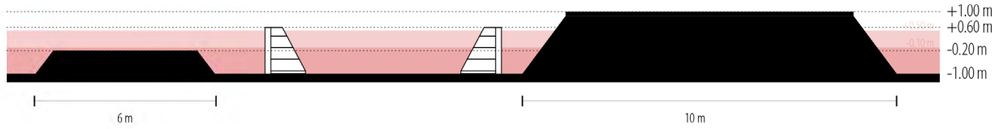
CONDITIONS

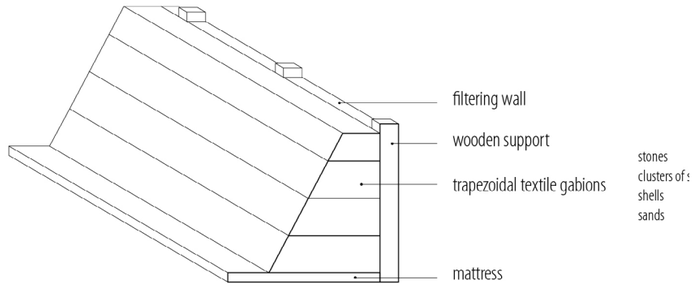
_relatively deep seabed
_powerful waves

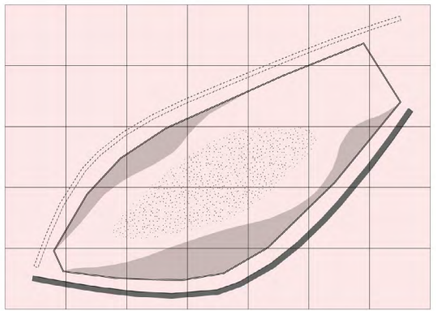
GOALS

_interrupt wave formation (1)
_above and underwater morphology differentiation (1, 2)
_tidal expansion speed reduction (1)
_wind break (2)
_avoid sediment dispersal (1)
_natural formation of creeks and shallow lakes (3)
_thin sediment (silt+clay) accretion (4)

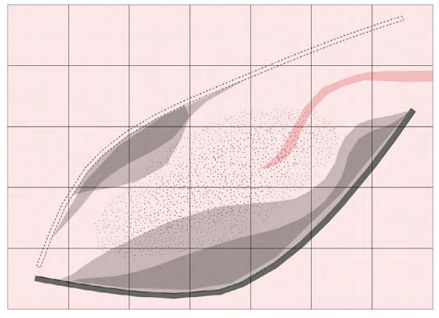








2025



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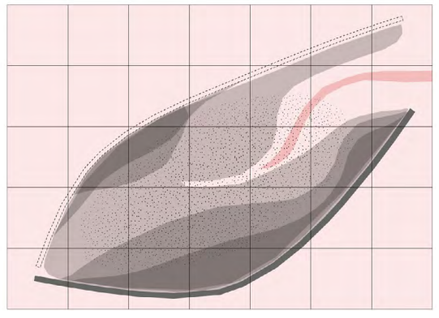
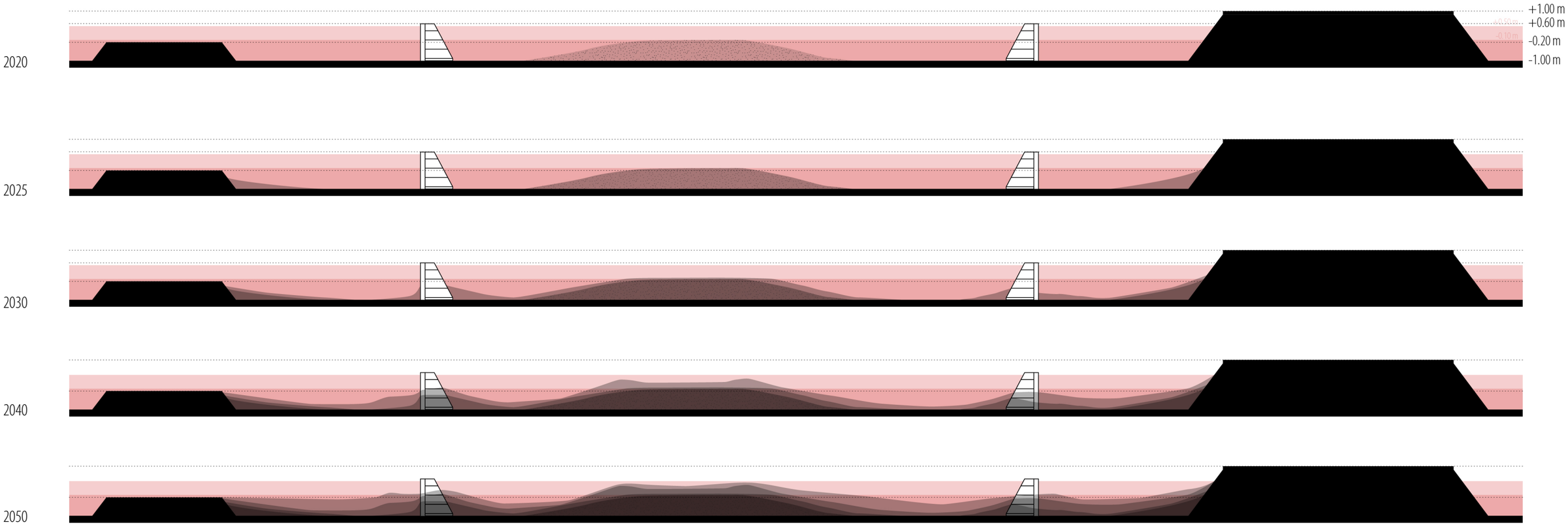


2040

0 100 m


2020
2025
2030
2040
2050
+1.00 m
+0.60 m
-0.20 m
-1.00 m



12 months



24 months



36 months

TYPE 3A

CONDITIONS

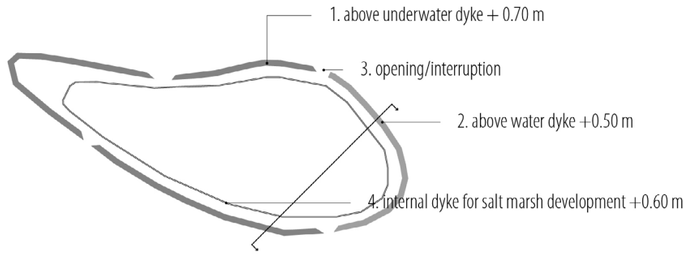
_deep seabed
_powerful waves

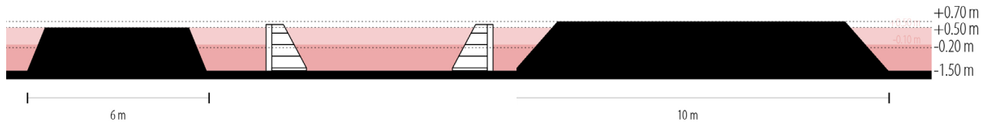
GOALS

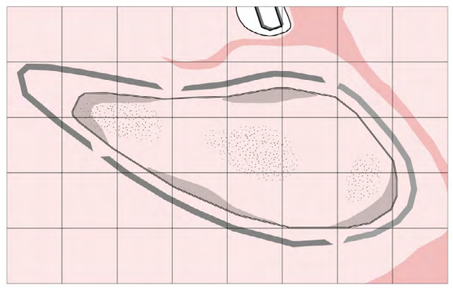
_interrupt wave formation (1)
_above and underwater morphology differentiation (1, 2, 4)
_tidal expansion speed reduction (1)
_wind break (2)
_avoid sediment dispersal (1, 2, 4)
_natural formation of creeks and shallow lakes (3)
_thin sediment (silt+clay) accretion (4)



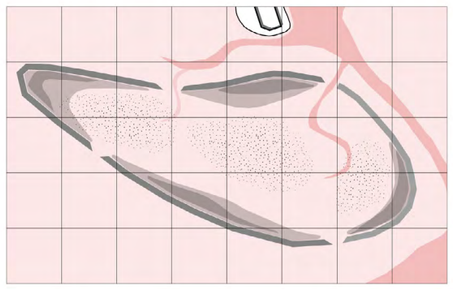
0 1 km



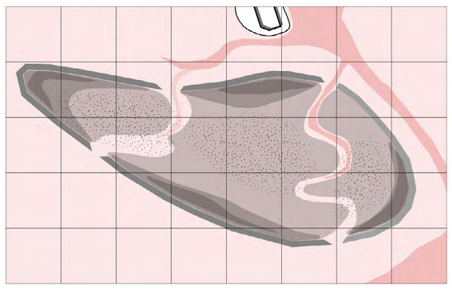




2025



2030



2040

0 100 m

TYPE 3B

CONDITIONS

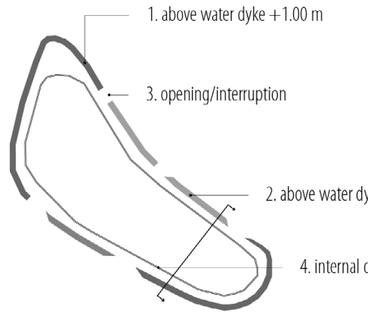
_deep seabed
_powerful waves

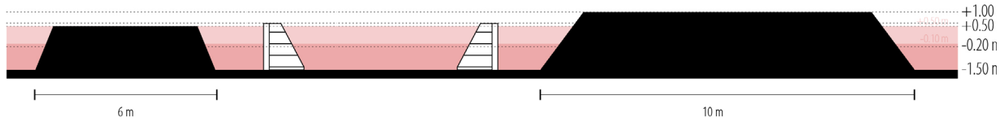
GOALS

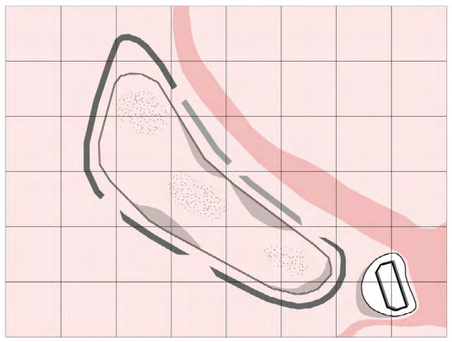
_interrupt wave formation (1)
_above and underwater morphology differentiation (1, 2, 4)
_tidal expansion speed reduction (1)
_wind break (2)
_avoid sediment dispersal (1, 2, 4)
_natural formation of creeks and shallow lakes (3)
_thin sediment (silt+clay) accretion (4)



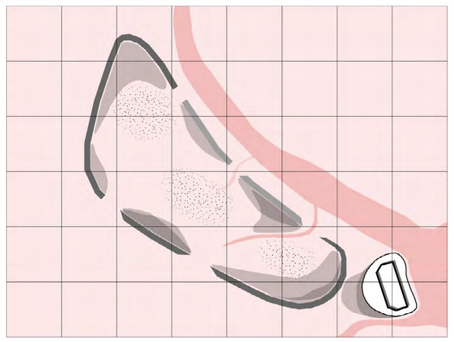
0 1 km



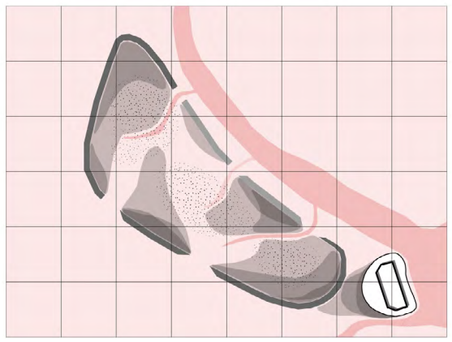




2025



2030



2040

0 100 m

1ST CLUSTER

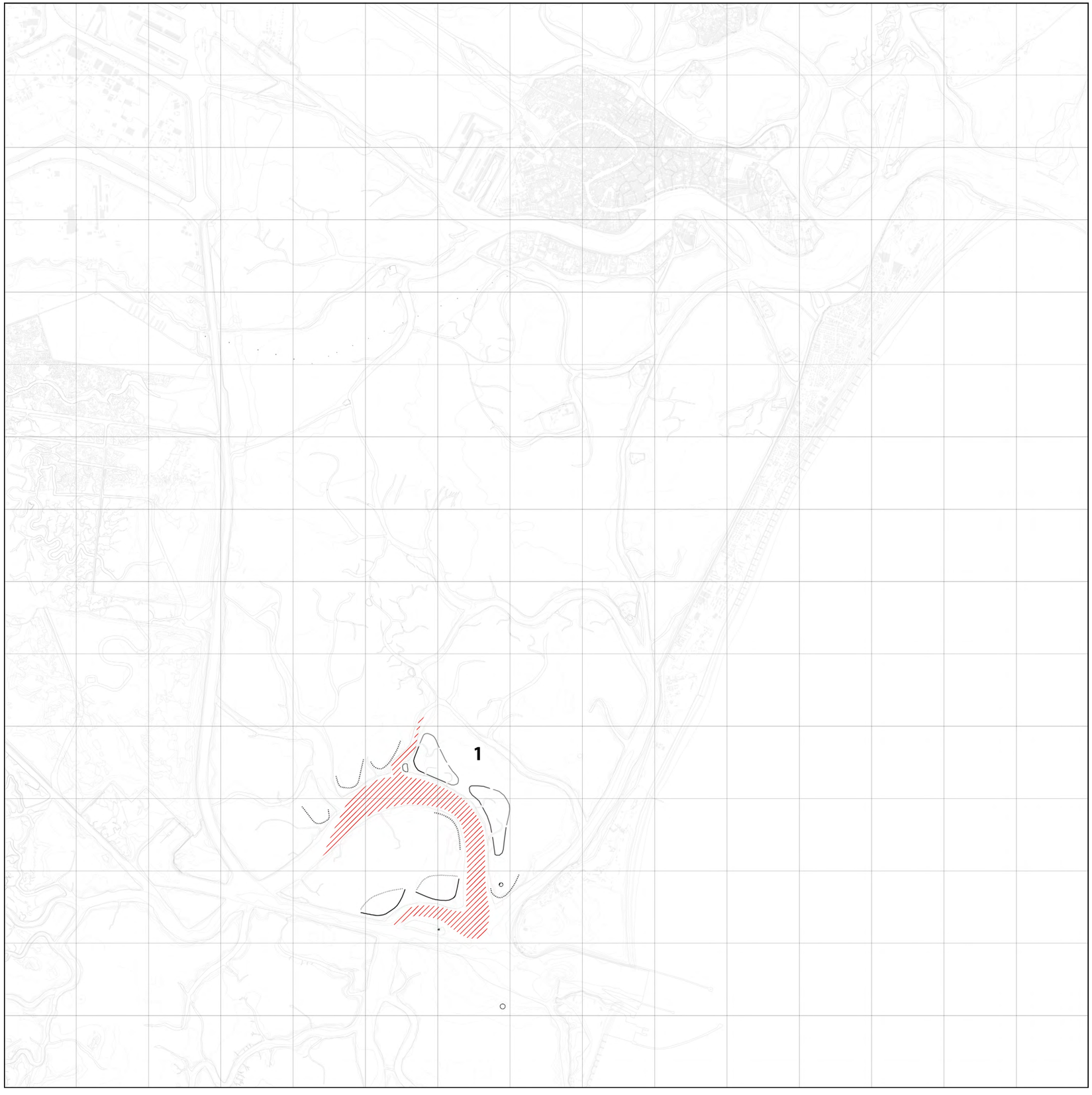
structures construction

2020



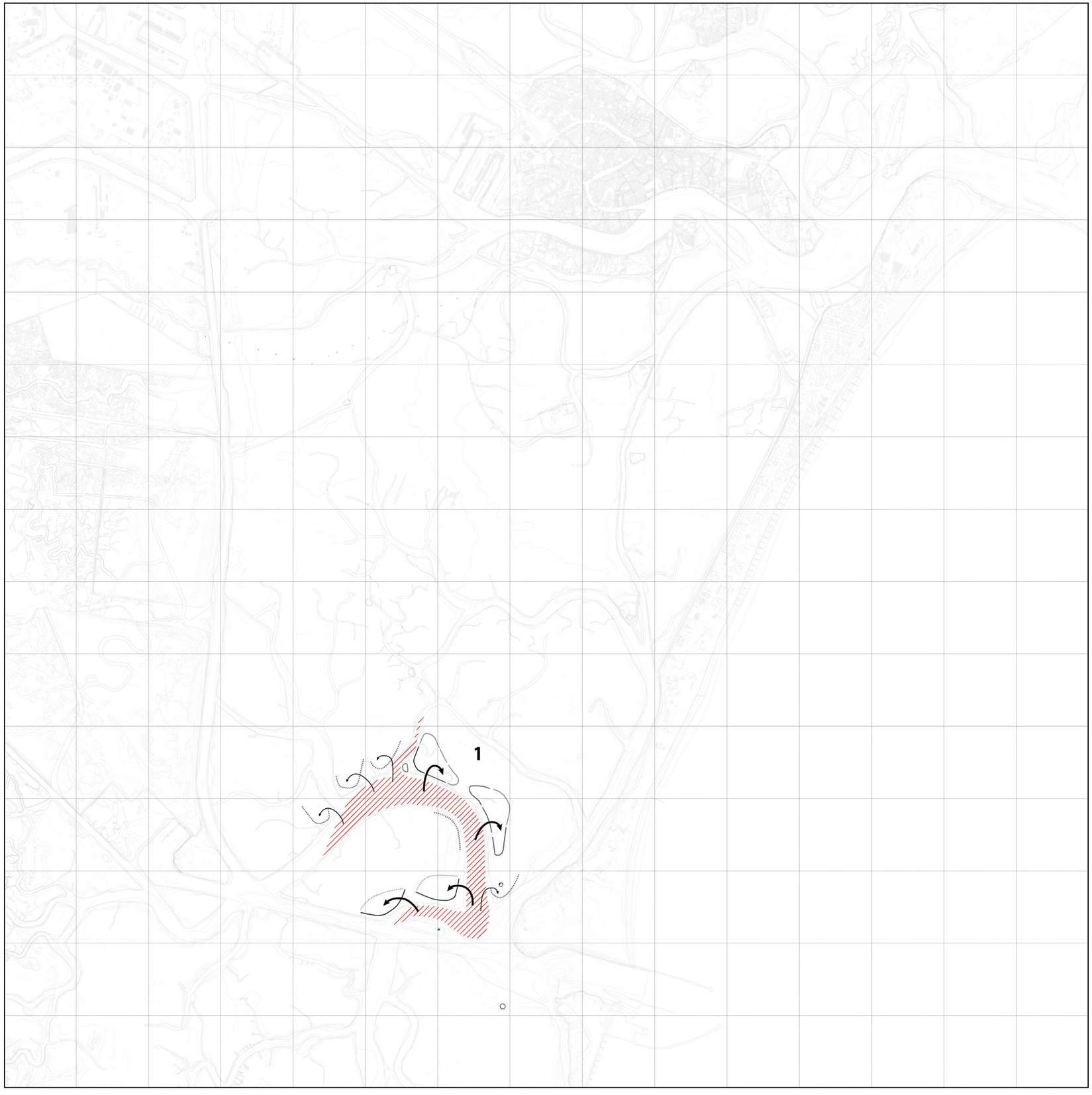
1ST CLUSTER

Canale Fisolo dredging
2021-2022



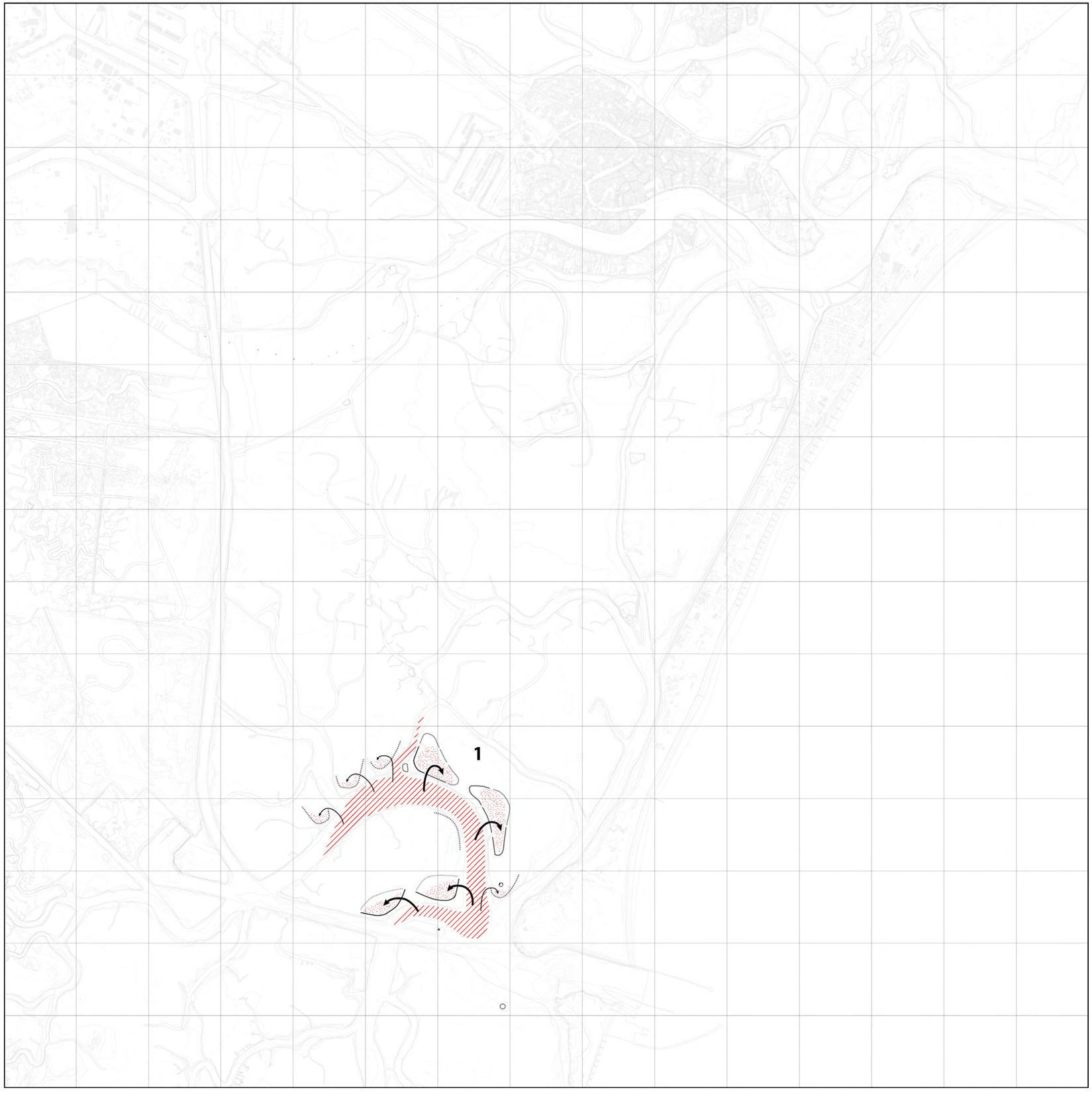
1ST CLUSTER

use sediment excavated from Canale Fisolo to nourish the first cluster 2021-2022



1ST CLUSTER

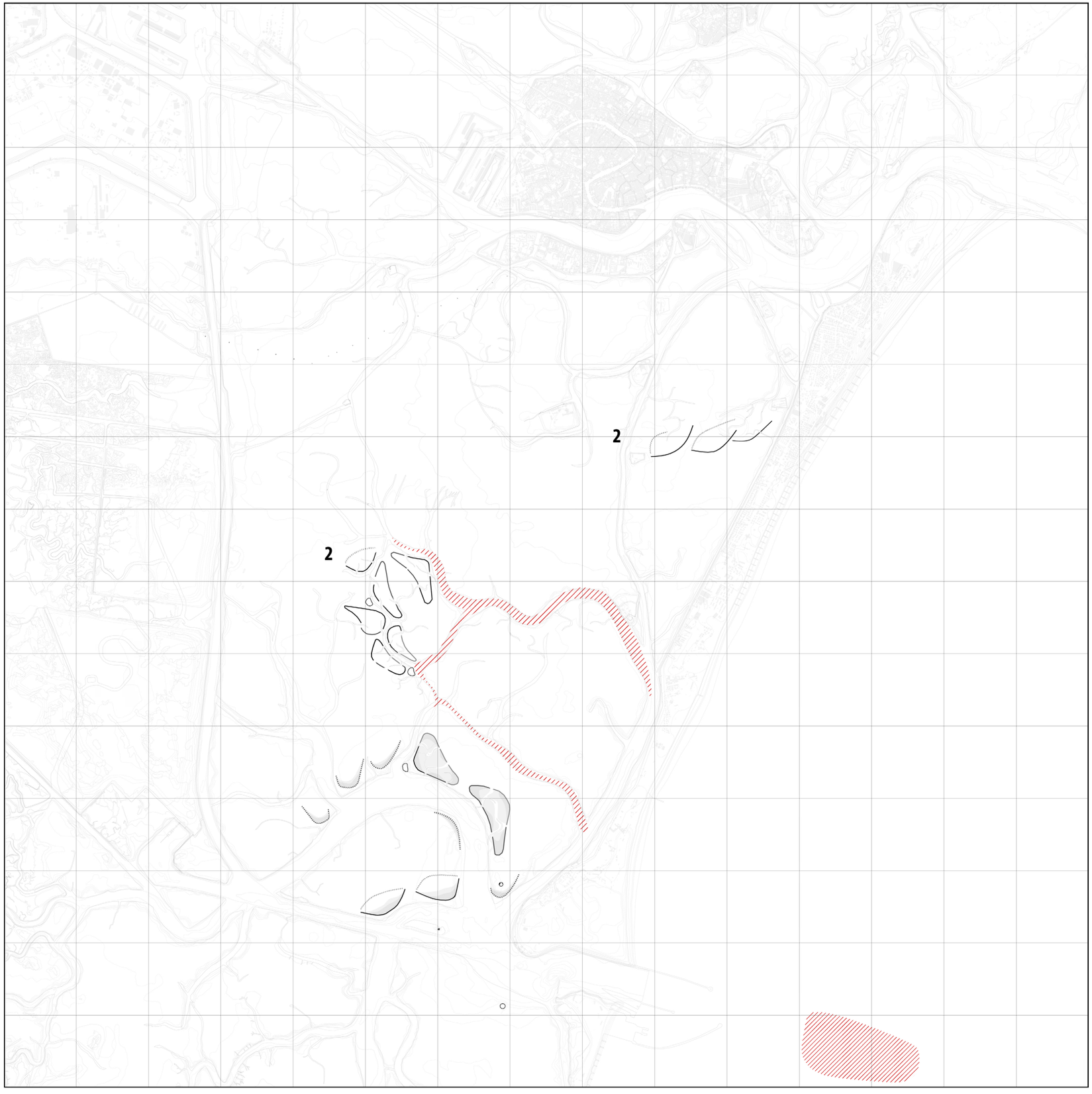
use sediment excavated from Canale Fisolo to nourish the first cluster 2022




2
2

2nd CLUSTER

Canale Campana, Canale Perarcolo,
Canale di Poveglia dredging
2023-2024



2nd CLUSTER

use sediment excavated from Canale Campana, Canale Perarcolo, Canale di Poveglia to nourish the second cluster 2023-2024



2nd CLUSTER

use sediment excavated from Canale Campana, Canale Perarcolo, Canale di Poveglia to nourish the second cluster 2023-2024



3nd CLUSTER

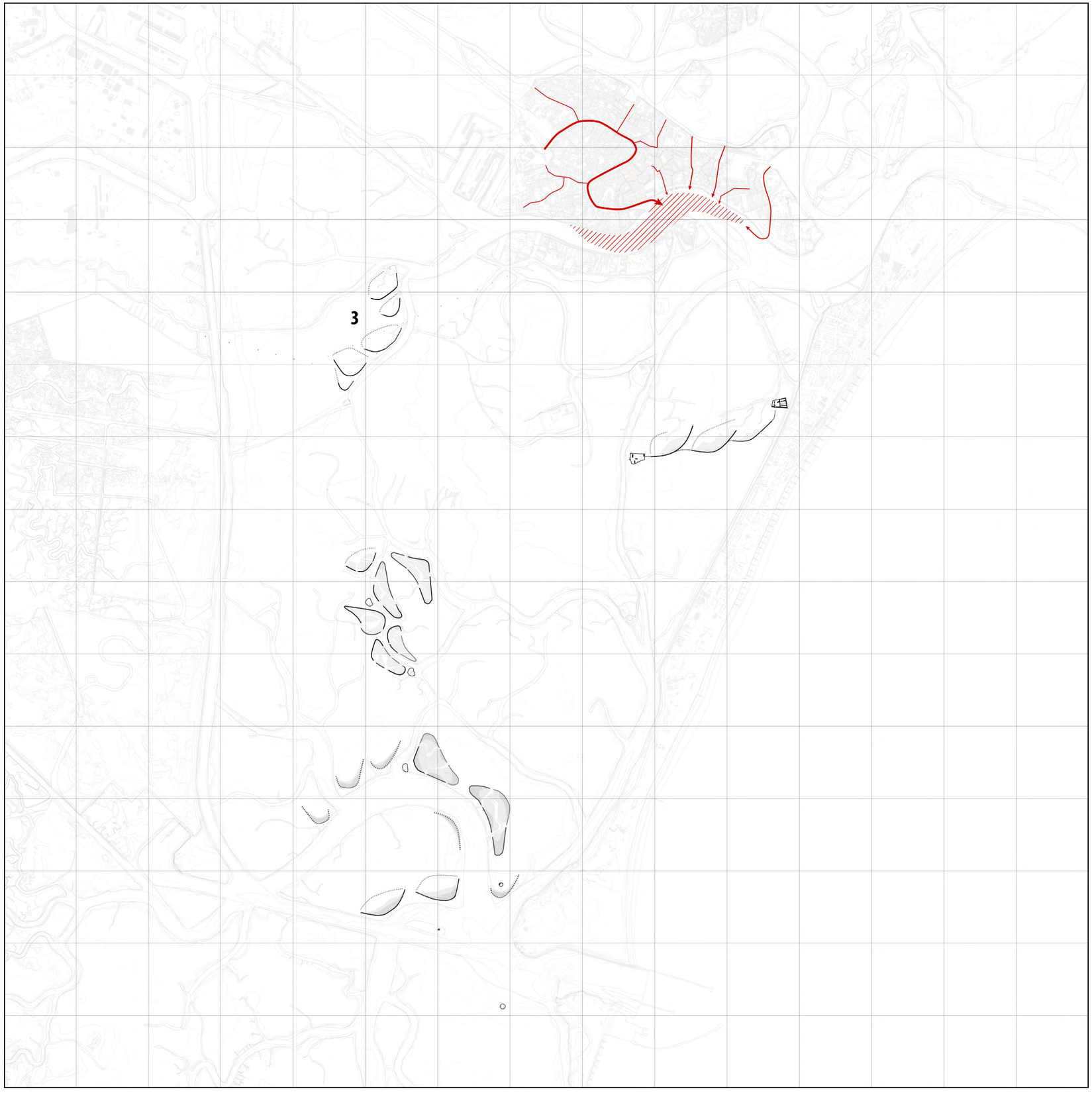
structures construction

2025



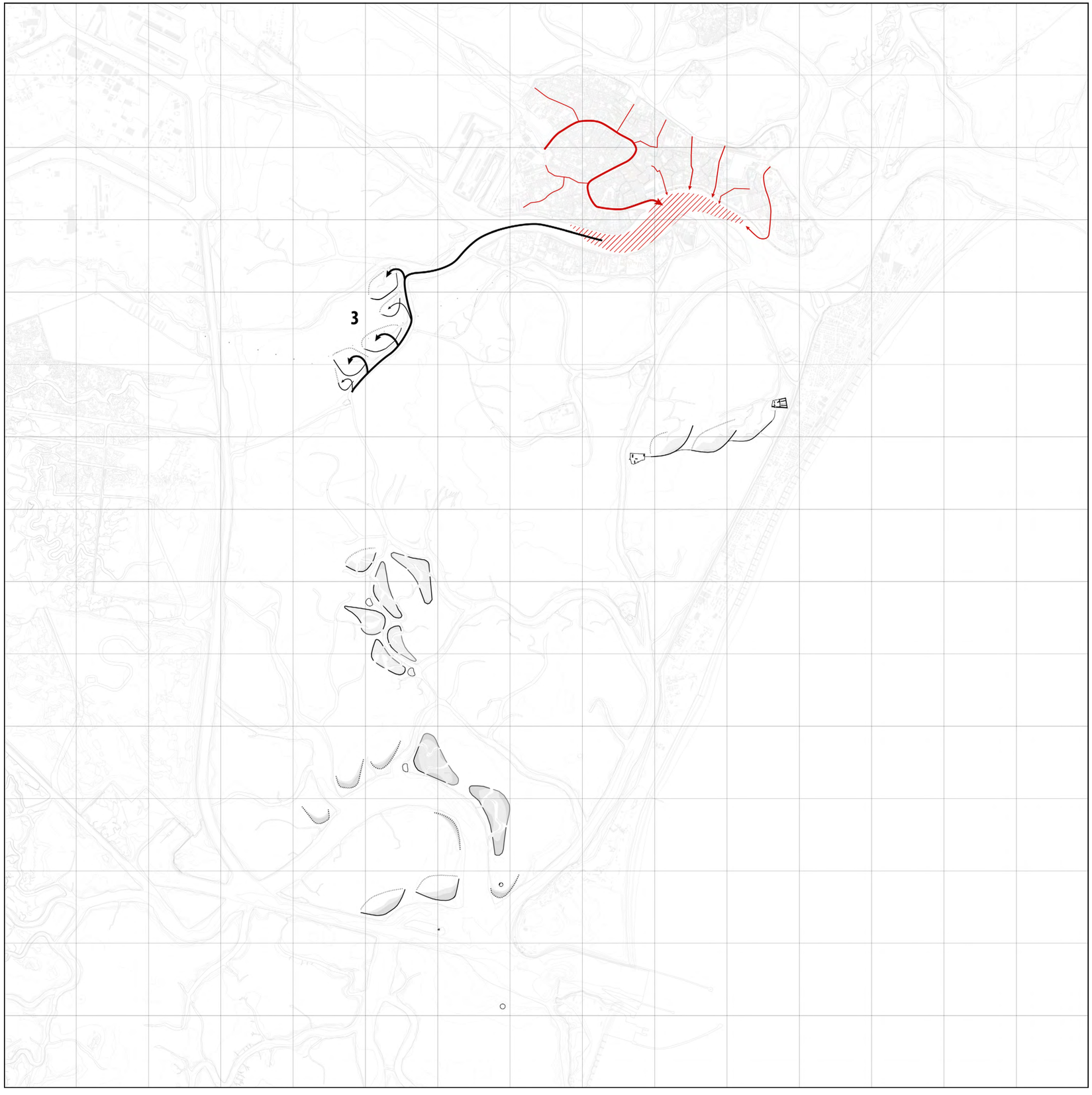
3nd CLUSTER

use of dredging coming from Venice canal maintenance to nourish the third cluster of barene
2025-2026



3nd CLUSTER

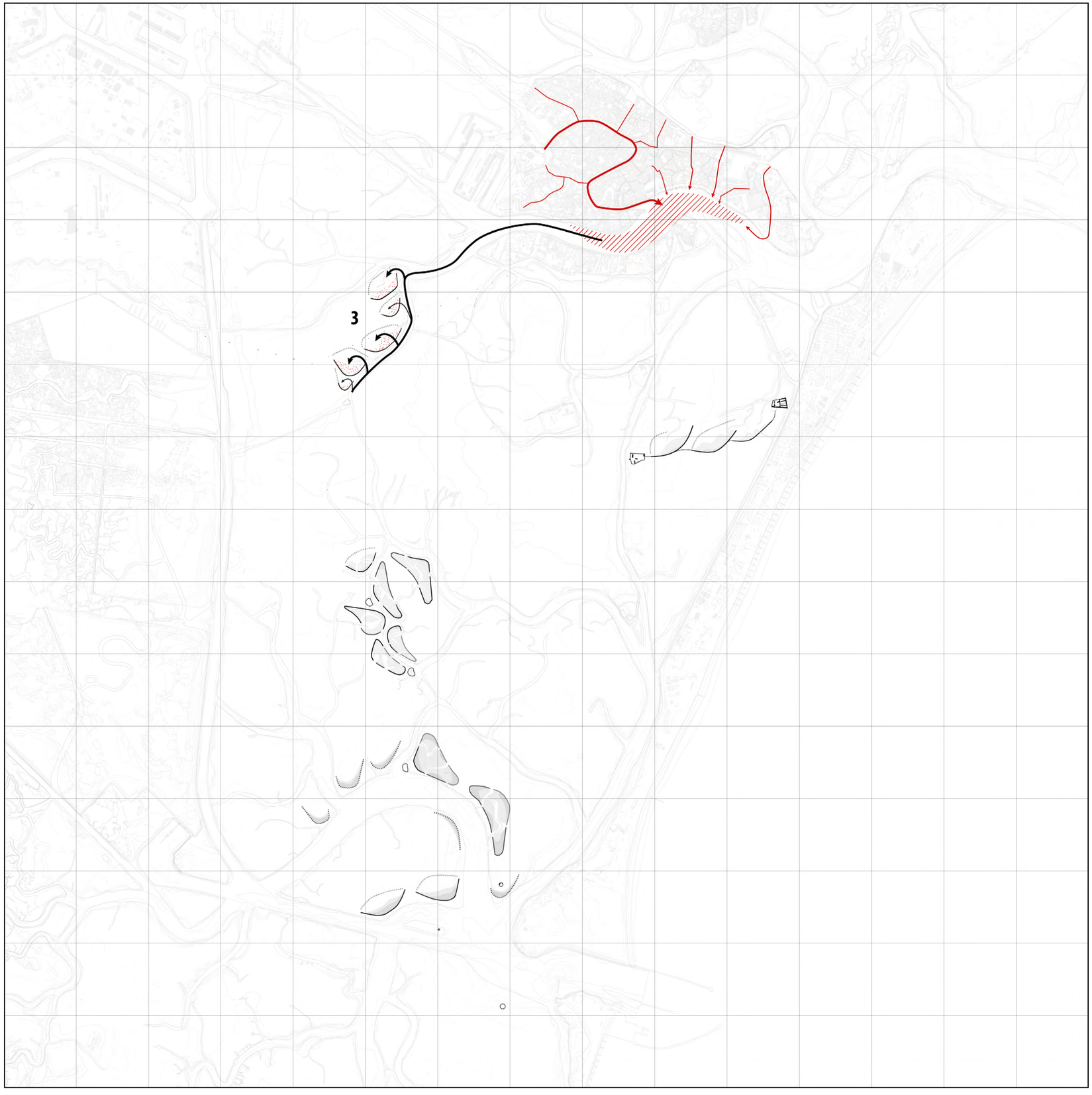
use of dredging coming from Venice canal maintenance to nourish the third cluster of barene
2025-2026



3nd CLUSTER

use of dredging coming from Venice canal maintenance to nourish the third cluster of barene

2025-2026



4th CLUSTER

structures construction

2027



5th CLUSTER

structures construction

2029



6th CLUSTER

structures construction

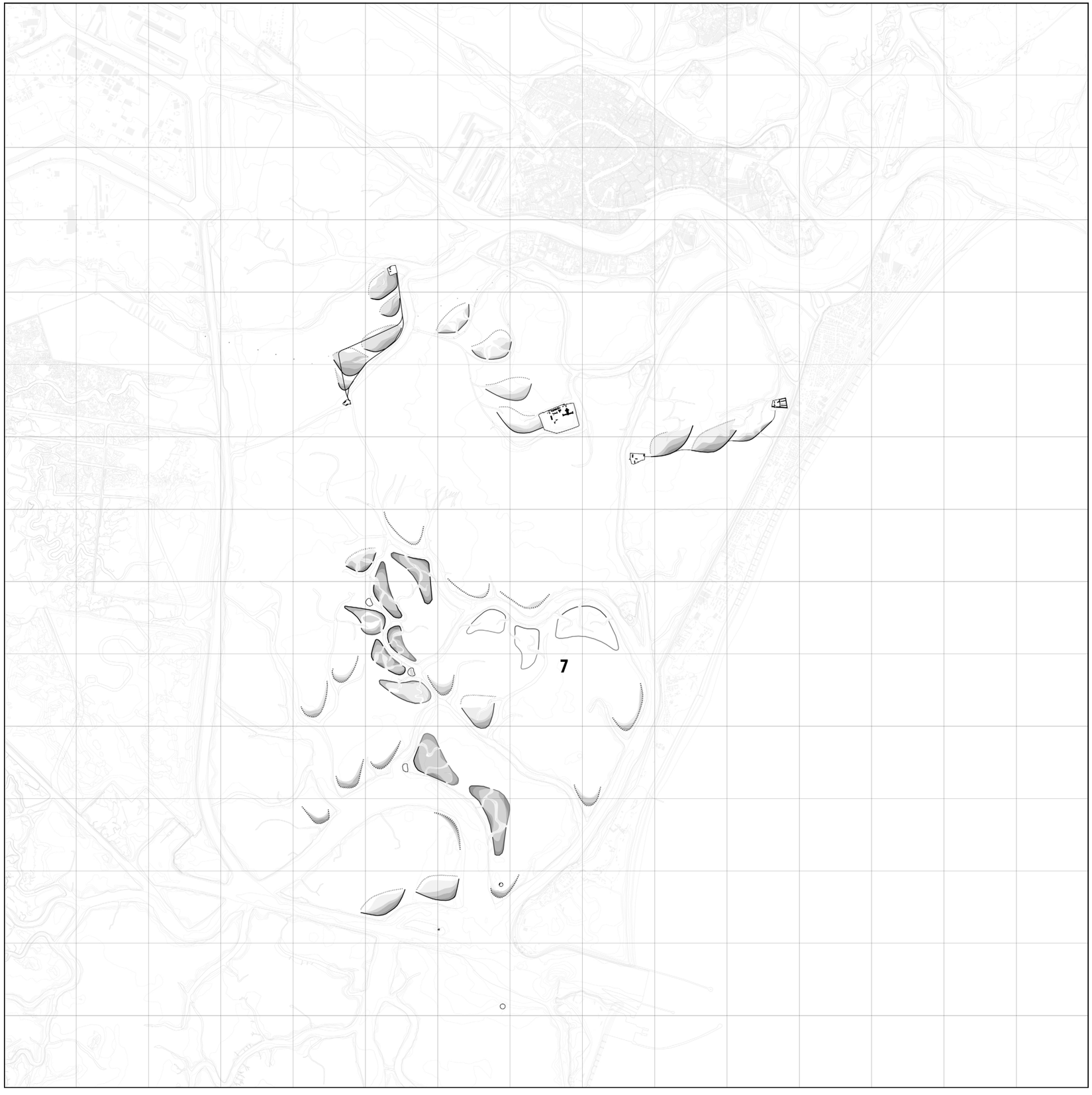
2030



7th CLUSTER

structures construction

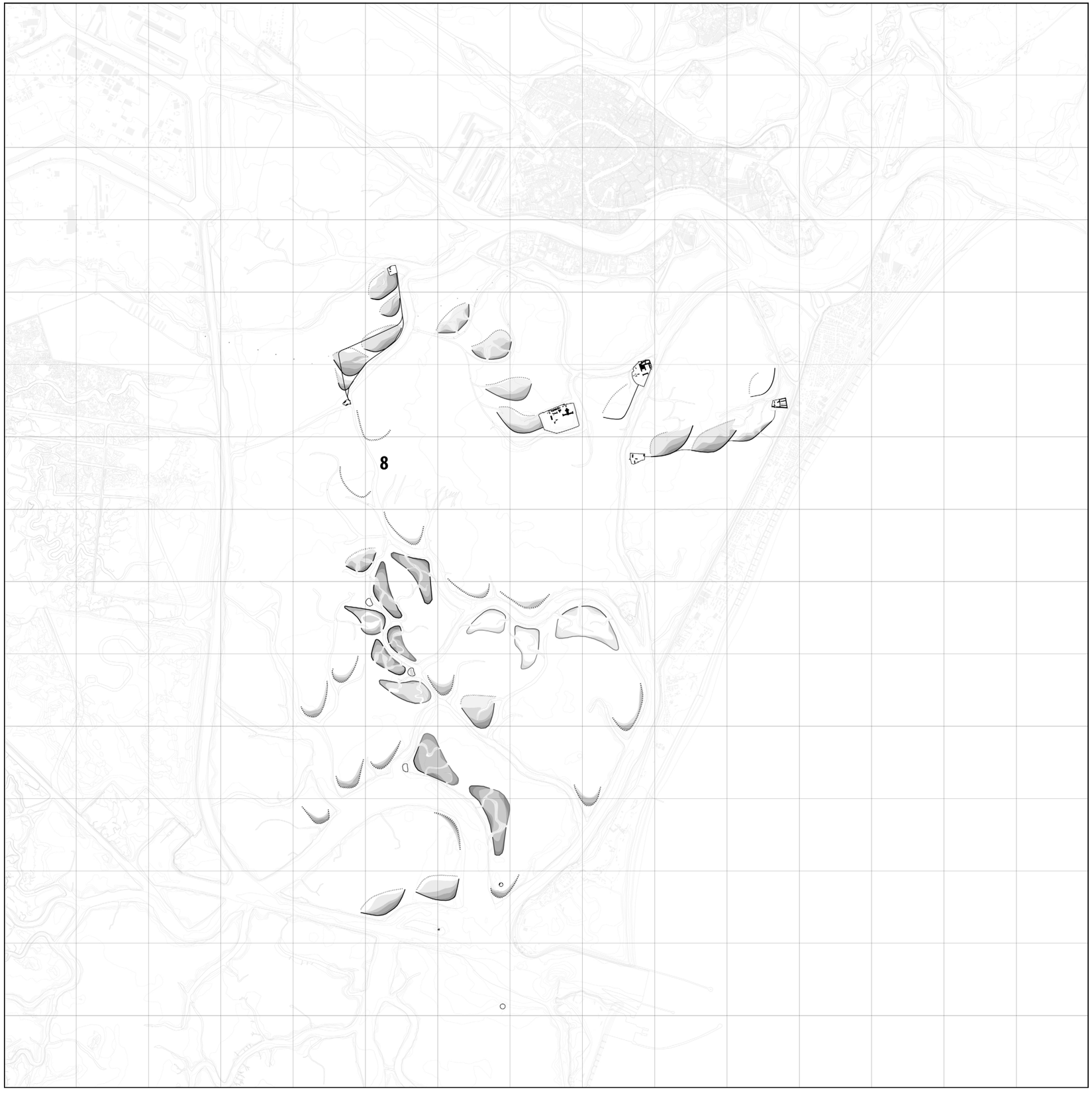
2031



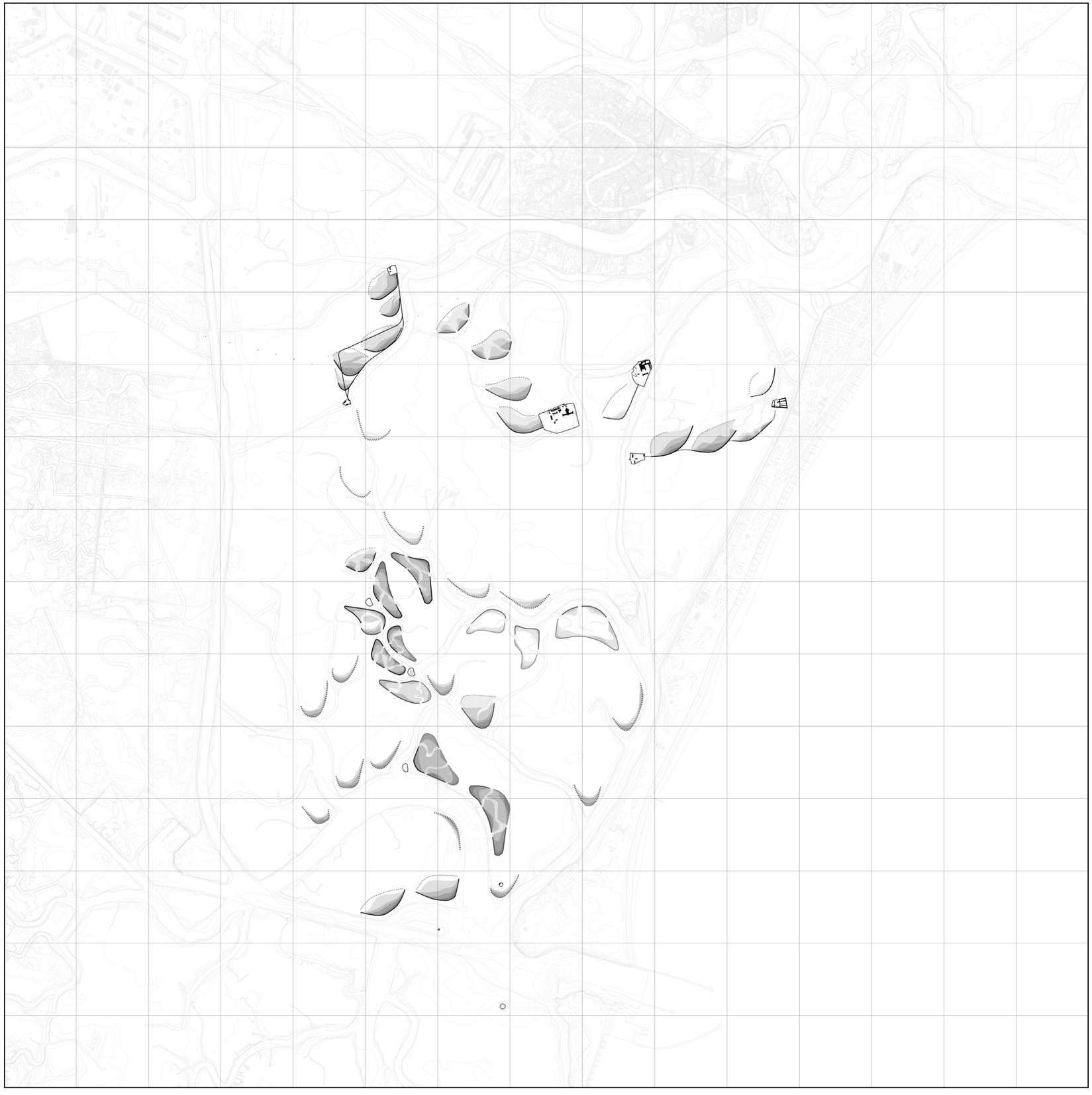
8th CLUSTER

structures construction

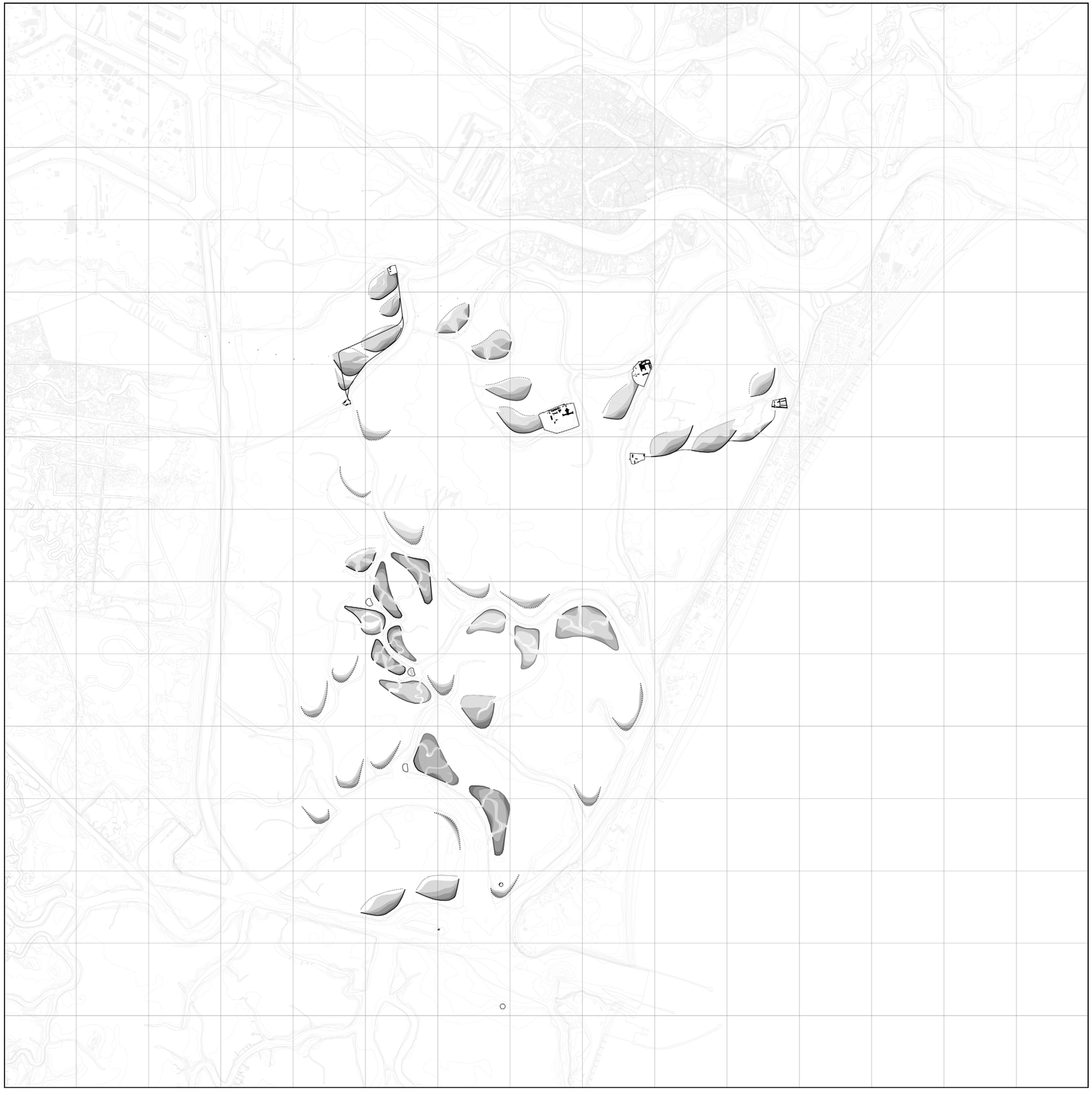
2032



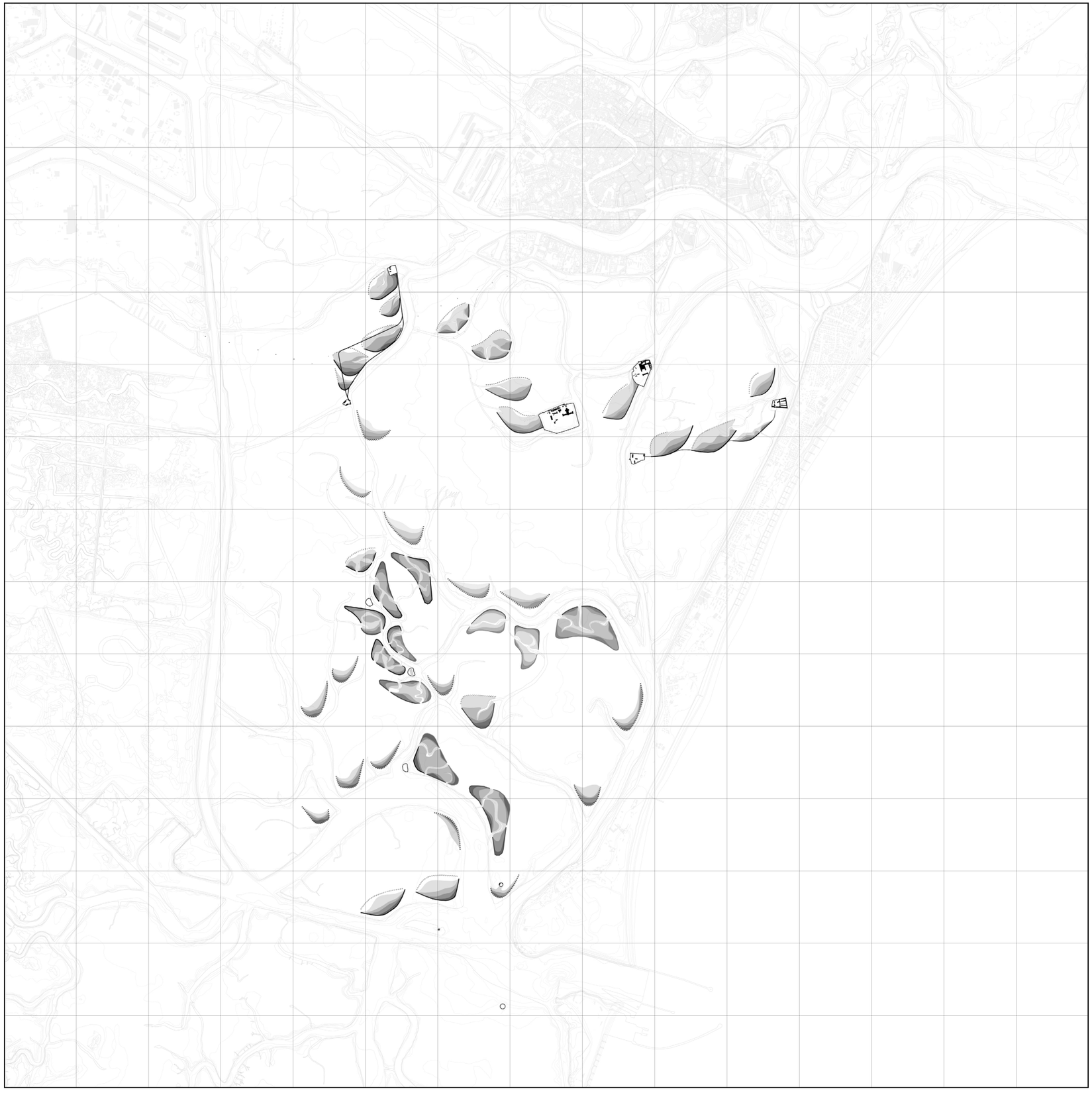
BARENE
natural growth
2033



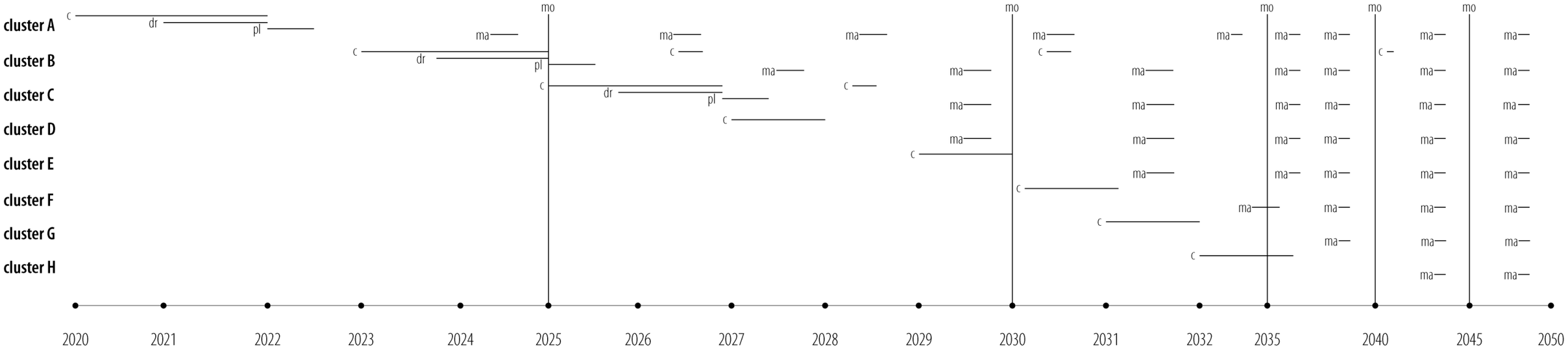
BARENE
natural growth
2040



BARENE
natural growth
2050



CONSTRUCTION, MAINTENANCE AND MONITOR



c: construction
dr: dredges
pl: planting
ma: ordinary maintenance
mo: monitor

fishermen, anglers, local workers

means and tools (boats)

territorial and geographical knowledge

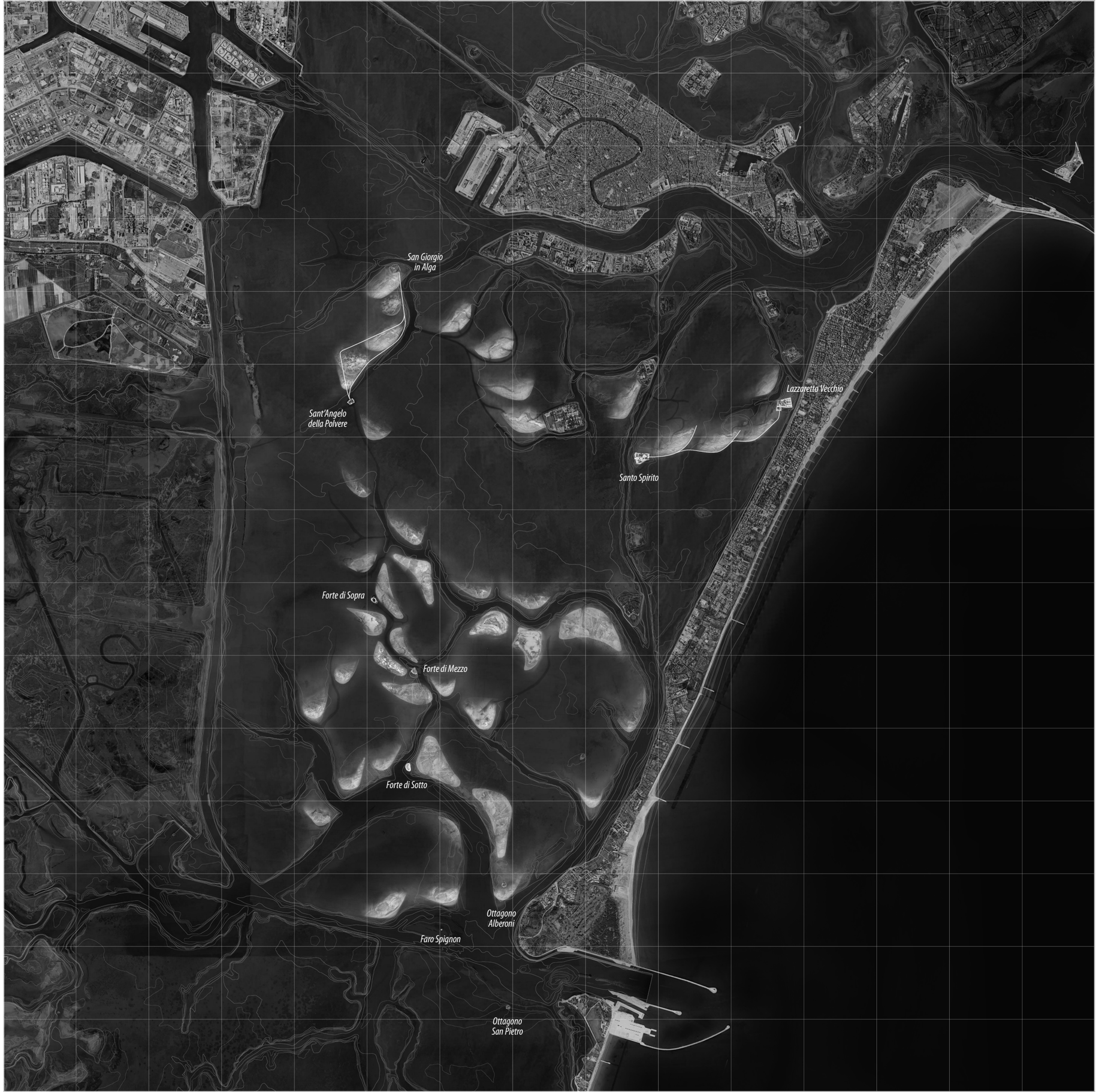
ordinary maintenance
every 12-18 months

- image
  - conservation
    - *barene* and *velme* correct evolution (elevation, vegetation species)
    - walking paths and docks
    - material decay
- functioning
  - functional efficiency
    - growth
    - sediment transportation
    - water flow
  - structural efficiency
    - dykes
    - walking paths and docks

monitor
every 5 years

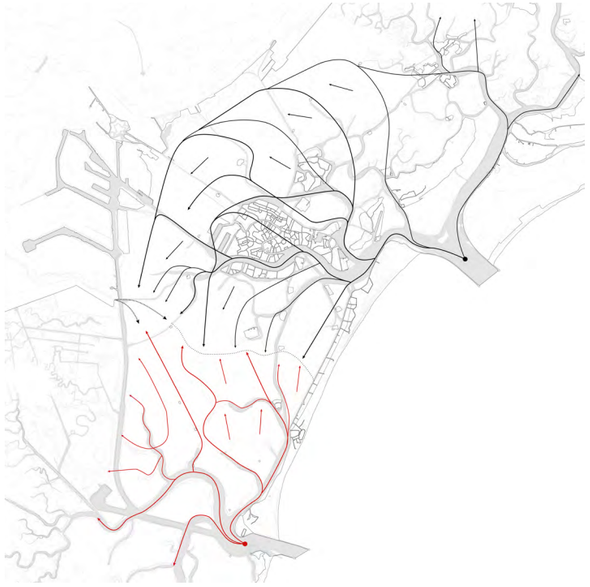
- tidal expansion and currents
- tidal speed
- wind bursts
- wave formation
- sediment accretion

MASTERPLAN
2050

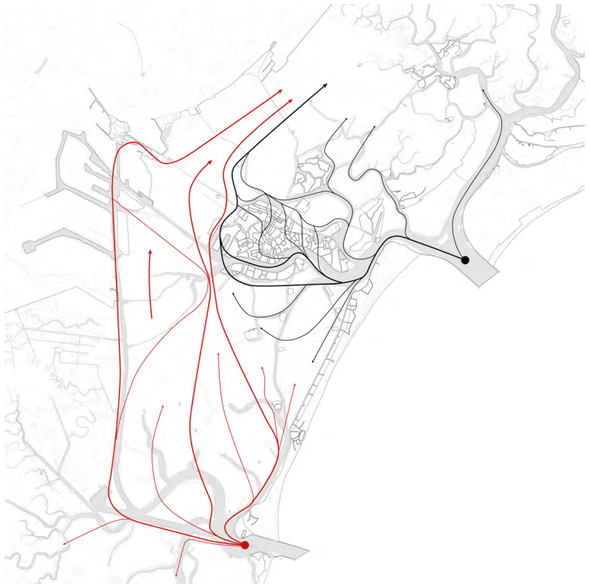


0 1 km

TIDAL CURRENTS EXPANSION



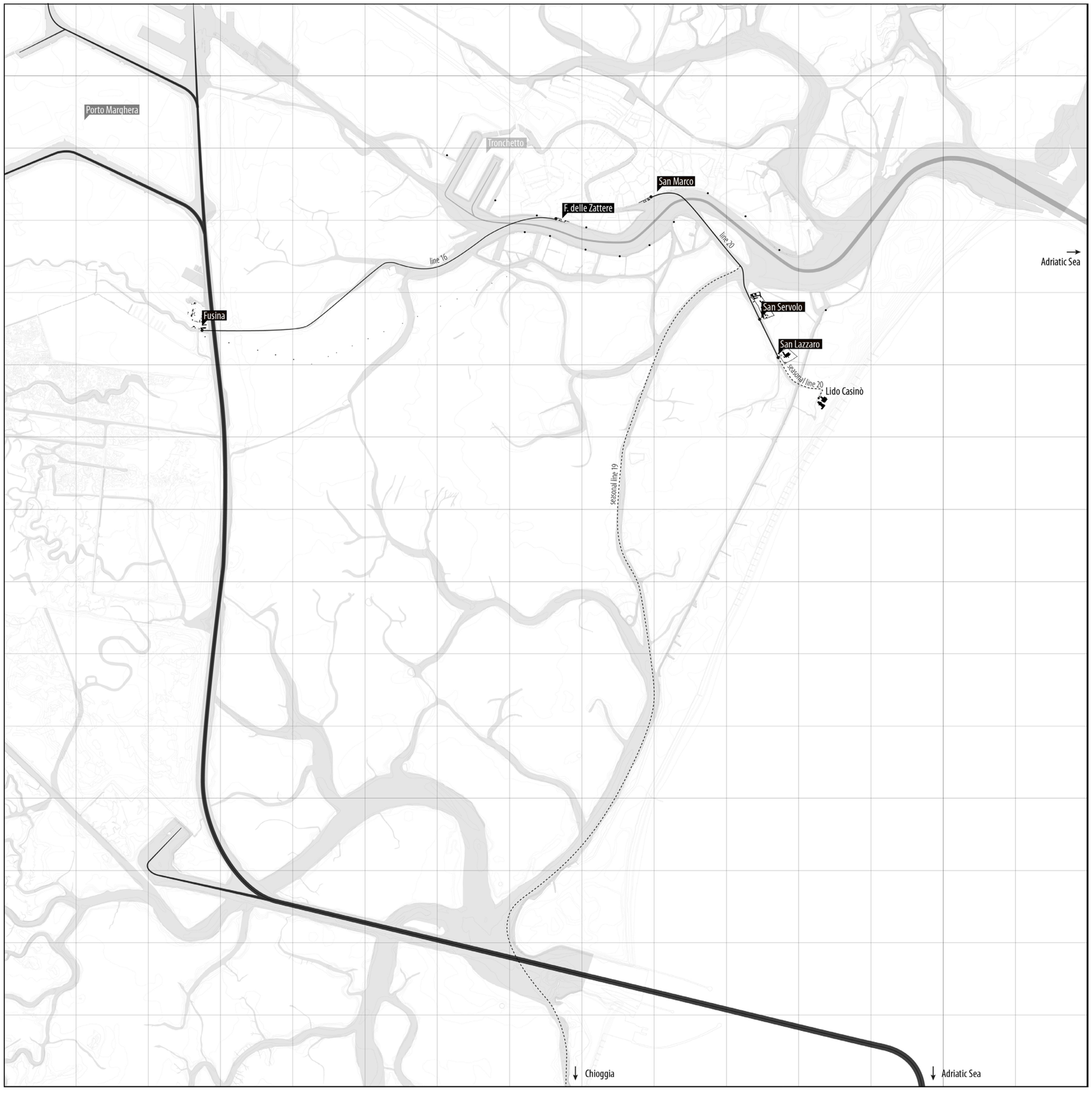
1969



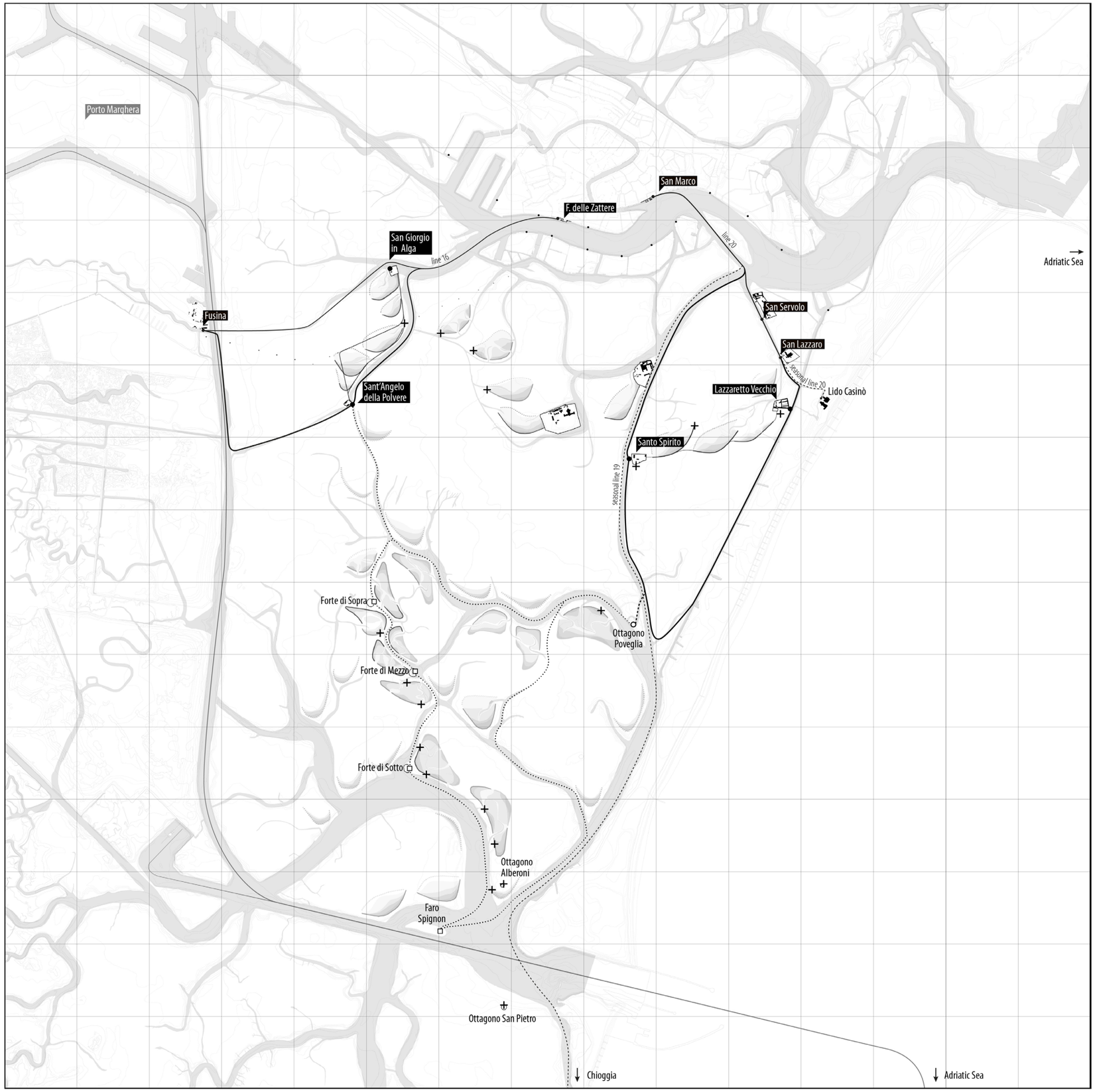
2009

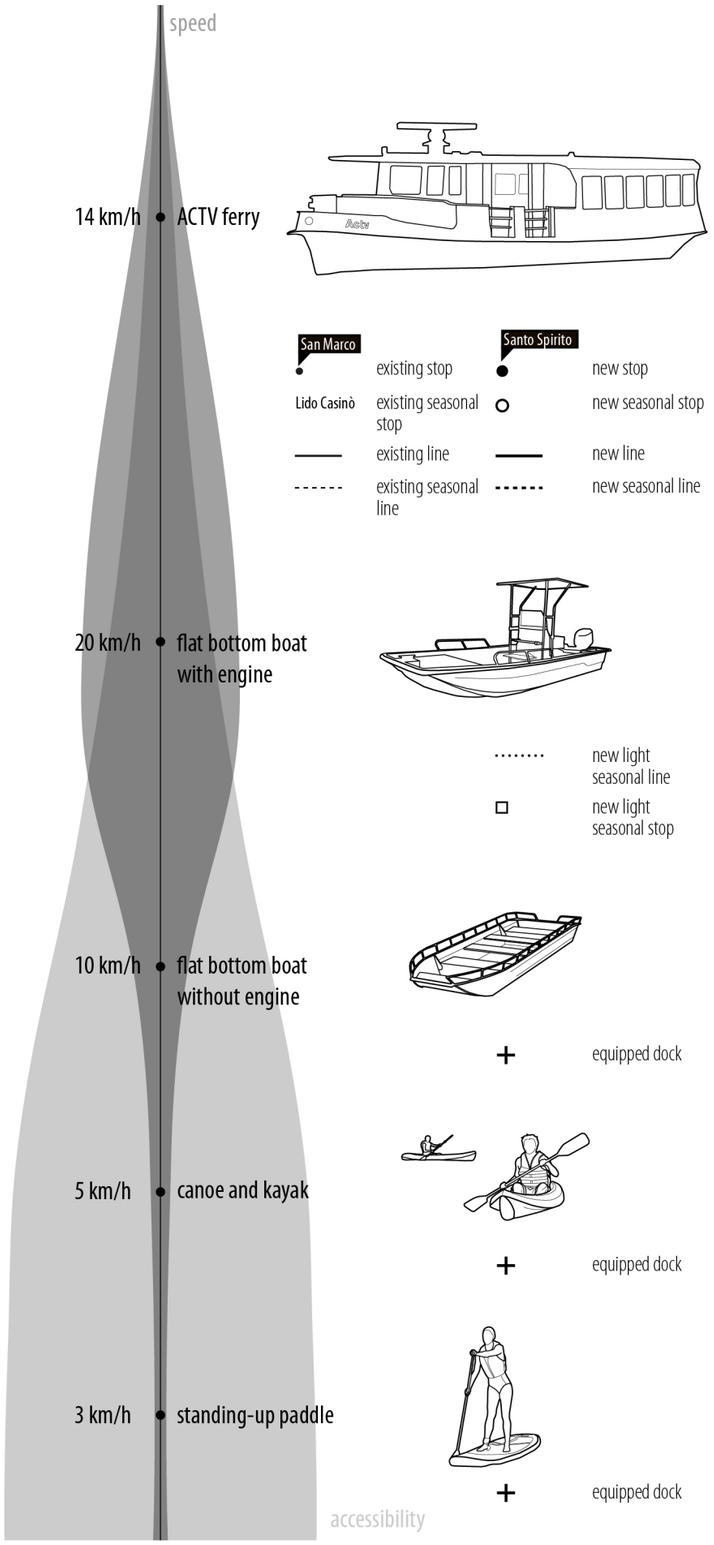


TRANSPORTATION
network 2020

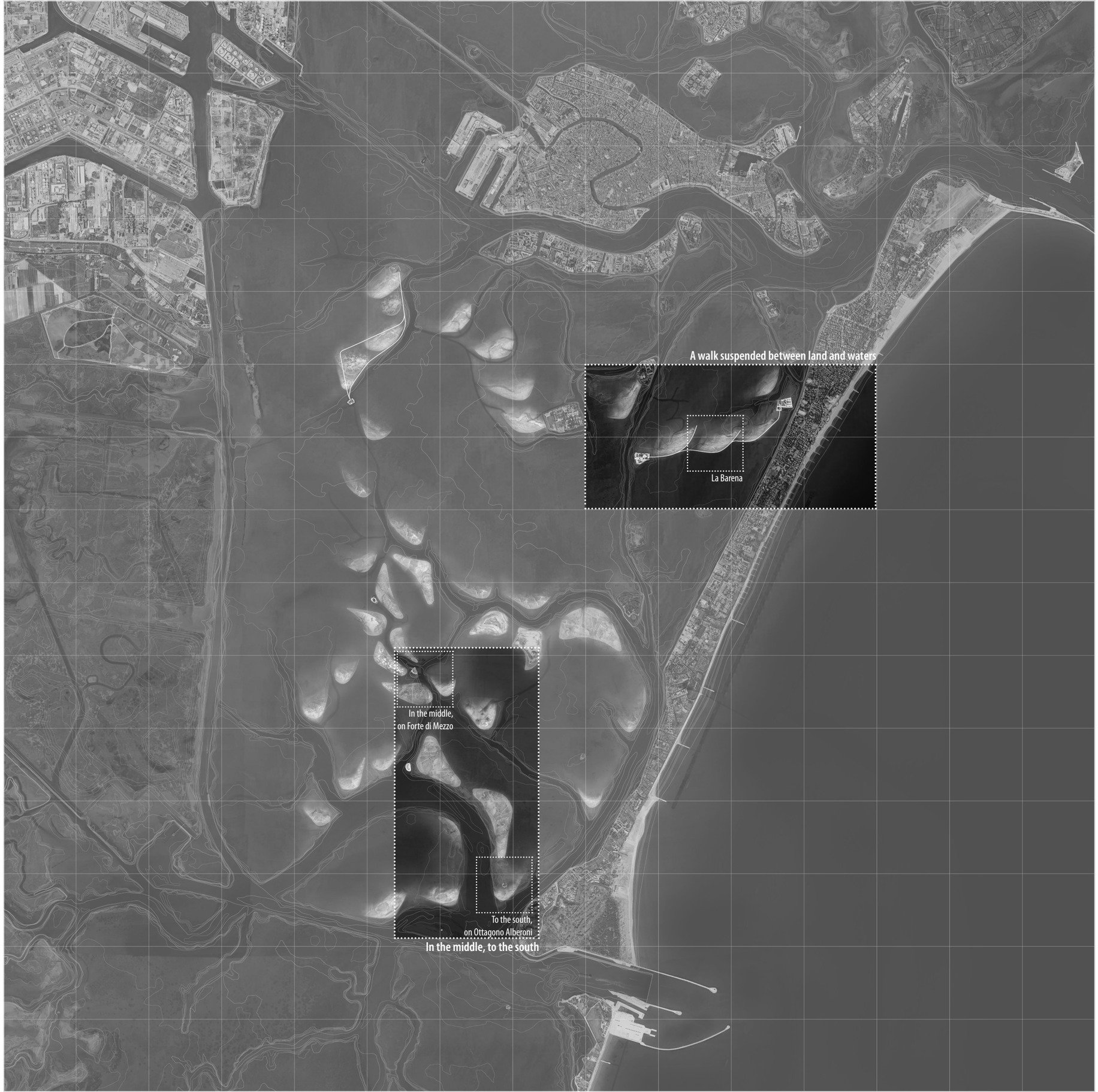


TRANSPORTATION
network 2050





MASTERPLAN
2050



0 1 km

A WALK SUSPENDED BETWEEN LAND AND WATERS

2050



0 250 m

EXISTING SITUATION
2020



1ST PHASE

meandering canals excavation and structures construction

2023



2ND PHASE

sand nourishment from Malamocco dredges

2024



2ND PHASE

sand nourishment from Malamocco dredges

2024



3RD PHASE

clay nourishment from Malamocco dredges

2025



3RD PHASE

clay nourishment from Malamocco dredges

2025



4TH PHASE

underwater vegetation planting to trap sediment
end of 2025



5TH PHASE

planting of perennials populating the elevated borders of barene; alophyte pioneer species will spread naturally and more quickly

early 2026



Juncus maritimus

Halimione portulacoides

Sarcocornia fruticosa

WIND OF BORA

natural bursts of Bora from north-north east will help to consolidate the sediment nourished and naturally accumulated



FLOOD TIDE

flood tide will help to redistribute and consolidate sediment
nourished and naturally accumulated



EBB TIDE

ebb tide will help to redistribute sediment nourished and
naturally accumulated
the underwater dykes and vegetation prairies will contribute
not to disperse excessively the sediment accumulated



6TH PHASE

barene start to consolidate thanks to wind, tides and vegetation spread; the first part of the walking path is built in this phase

2026



7TH PHASE

barene continue to consolidate thanks to wind, tides and vegetation spread; natural creeks and canals form; the second part of the walking path is built in this phase

2030



8TH PHASE

barene continue to consolidate thanks to wind, tides and vegetation spread; natural creeks and canals continue to form; sediment start to accumulate also on the outer part of the dykes

2035

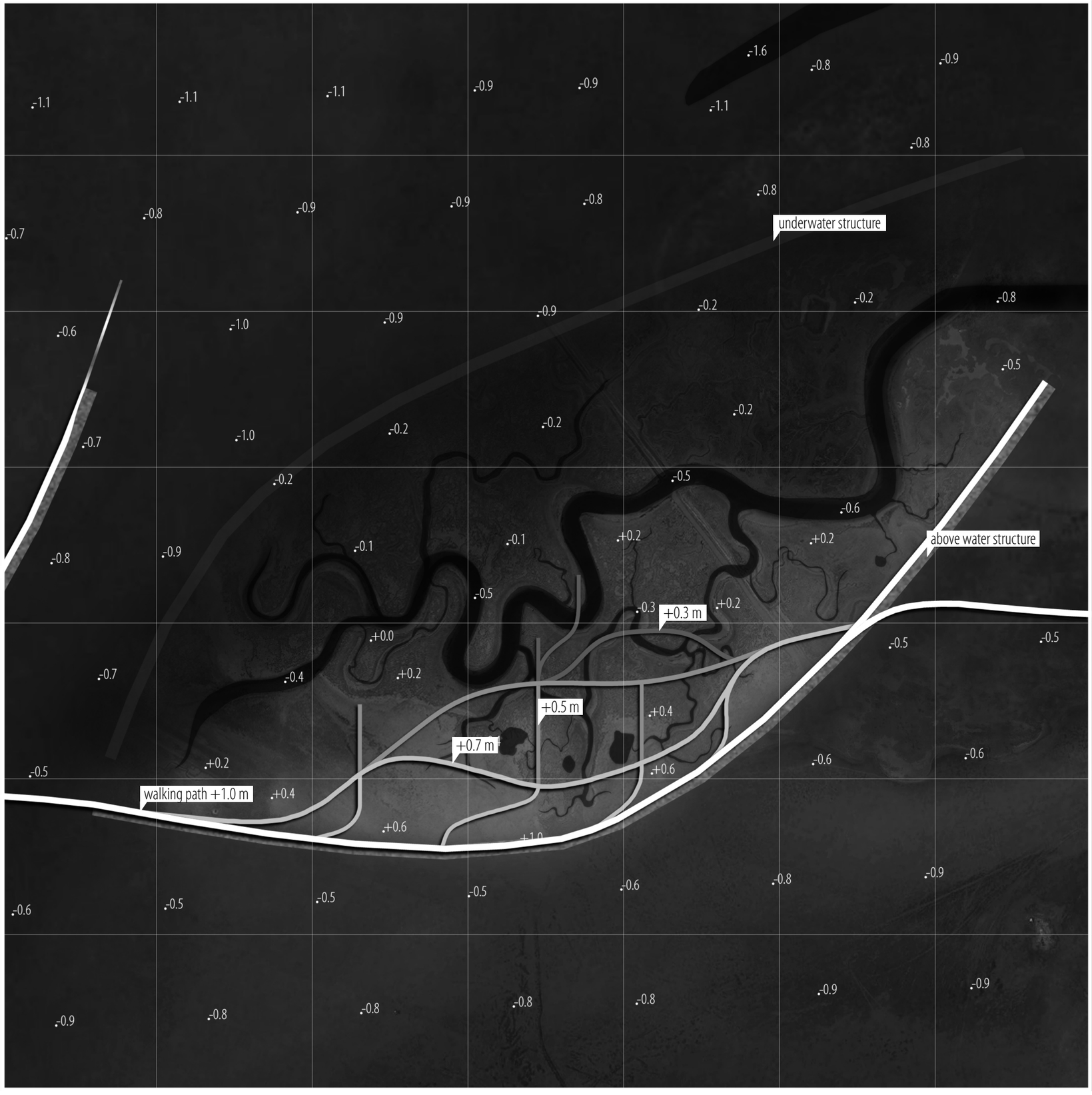


9TH PHASE

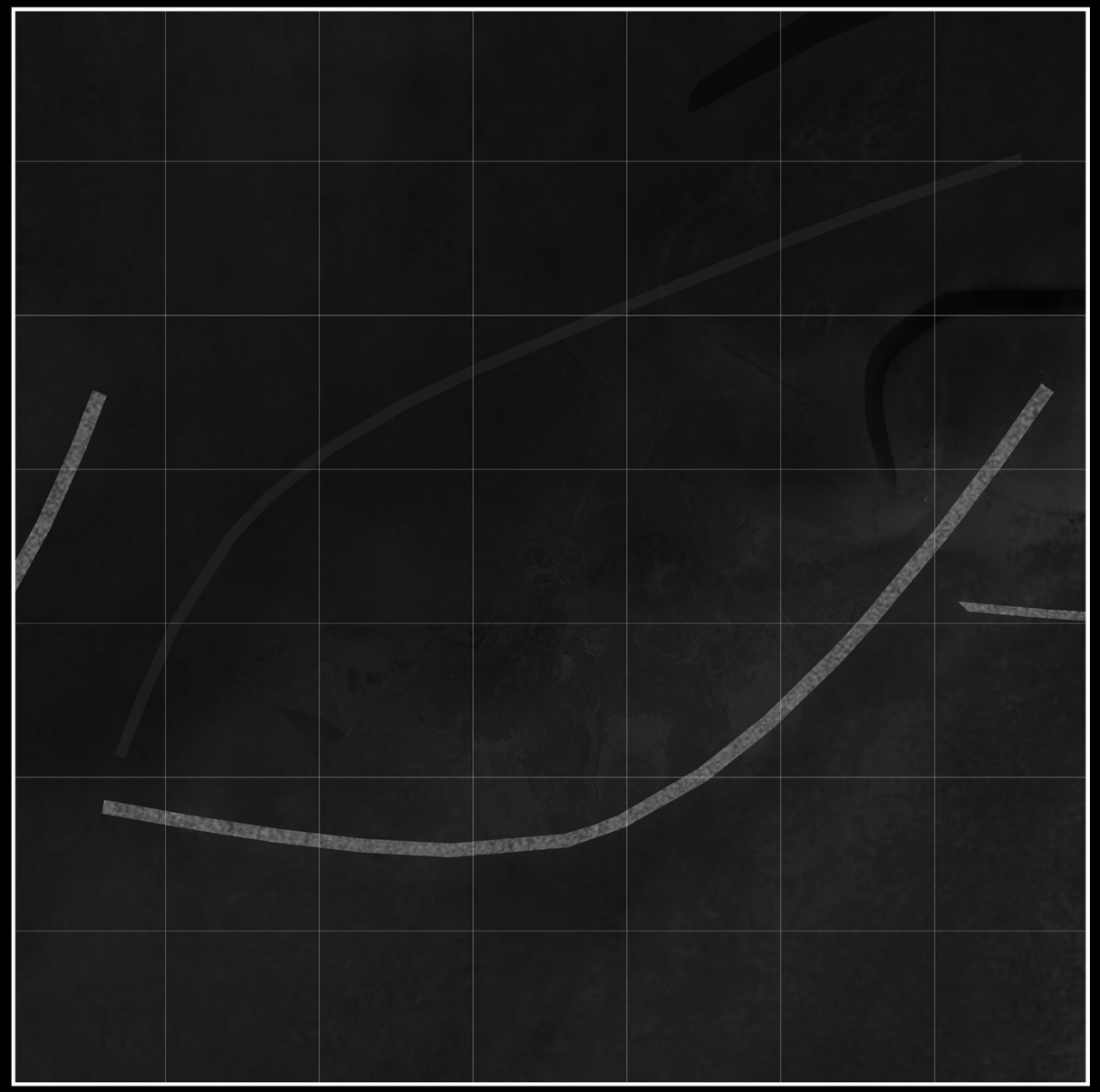
barene continue to consolidate thanks to wind, tides and vegetation spread; natural creeks and canals continue to form; sediment continue to accumulate on the outer part of the dykes; the third part of the walking path is built in this phase

2040



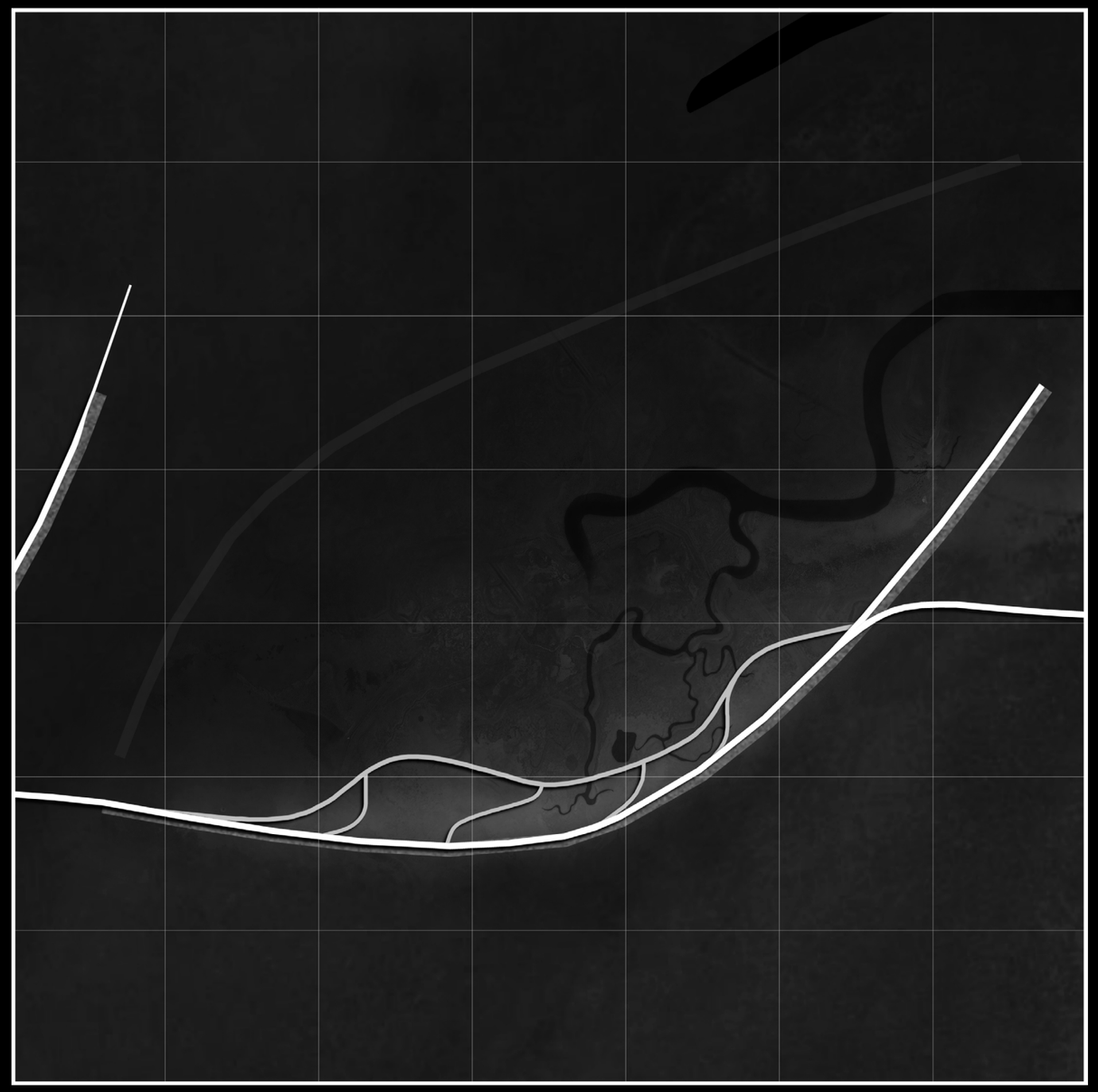

underwater structure
above water structure
+0.3 m
+0.5 m
+0.7 m
walking path +1.0 m
0
100 m

LA BARENA
evolution through time



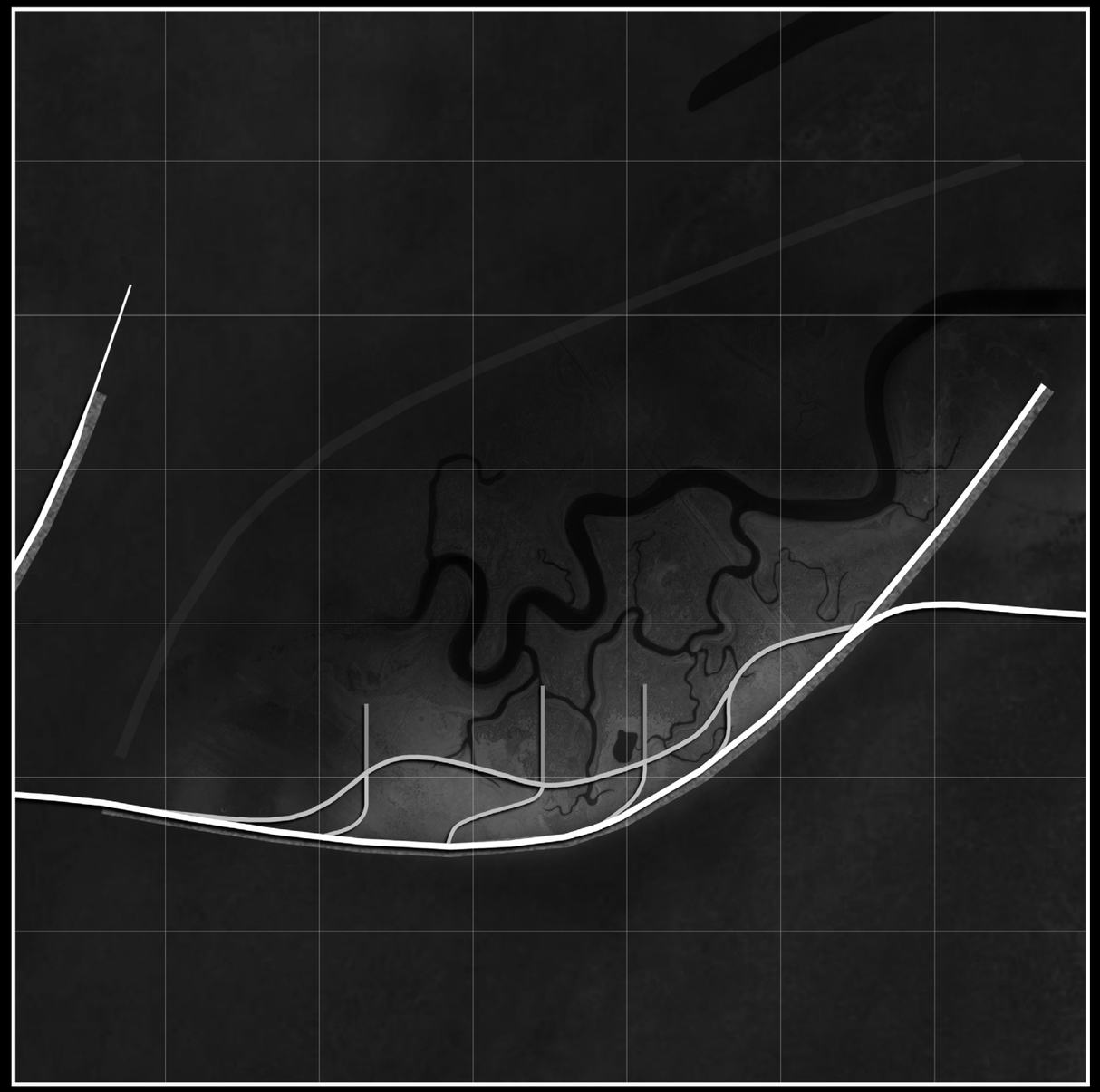
2023

LA BARENA
evolution through time



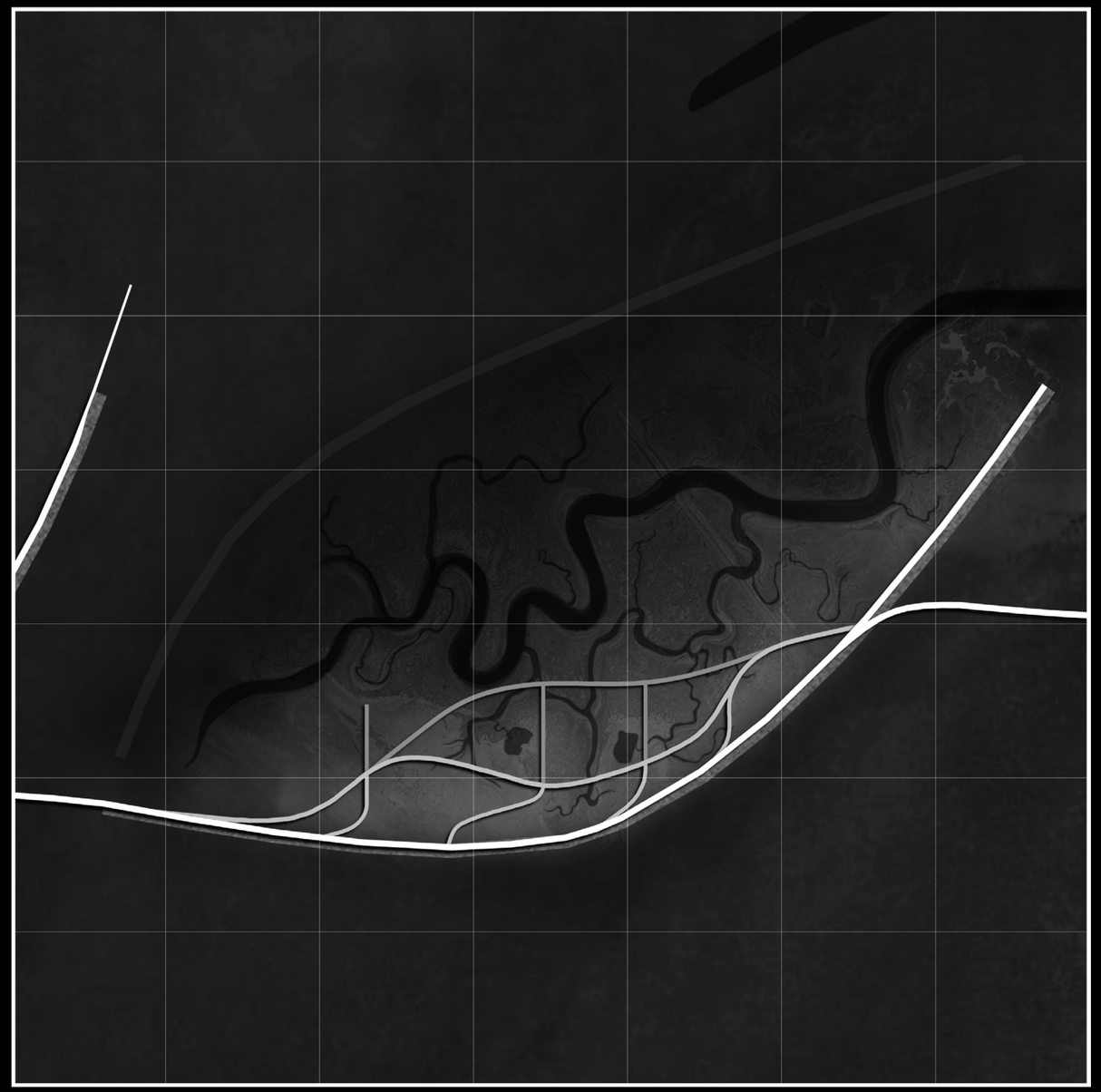
2026

LA BARENA
evolution through time



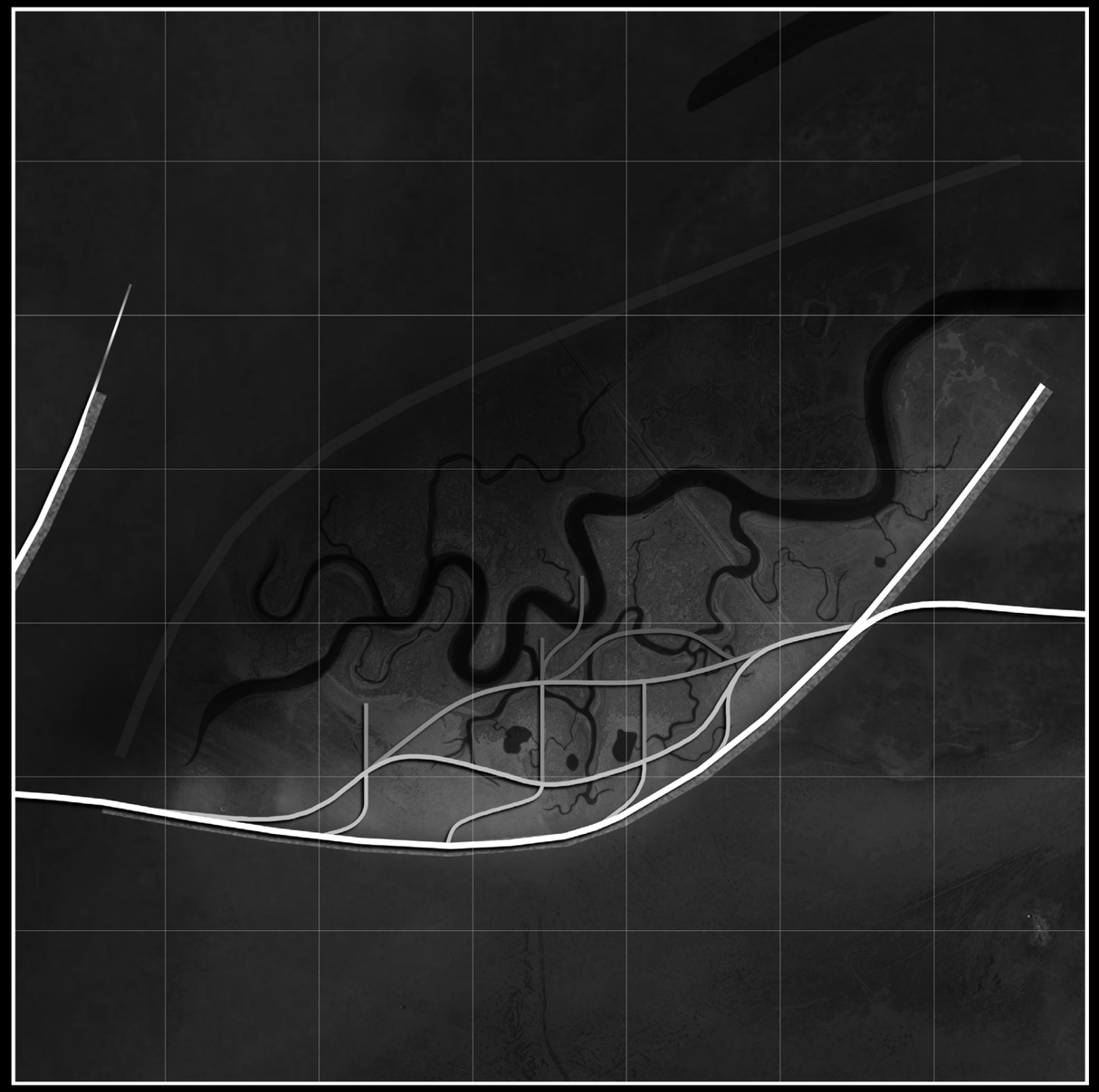
2028

LA BARENA
evolution through time



2030

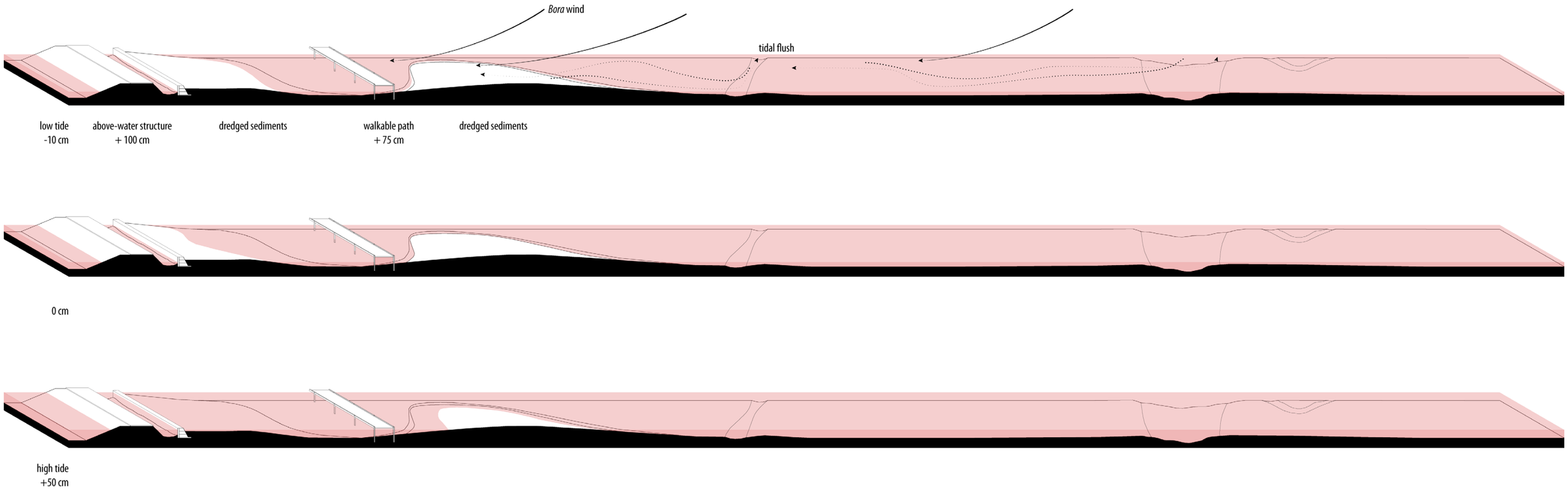
LA BARENA
evolution through time



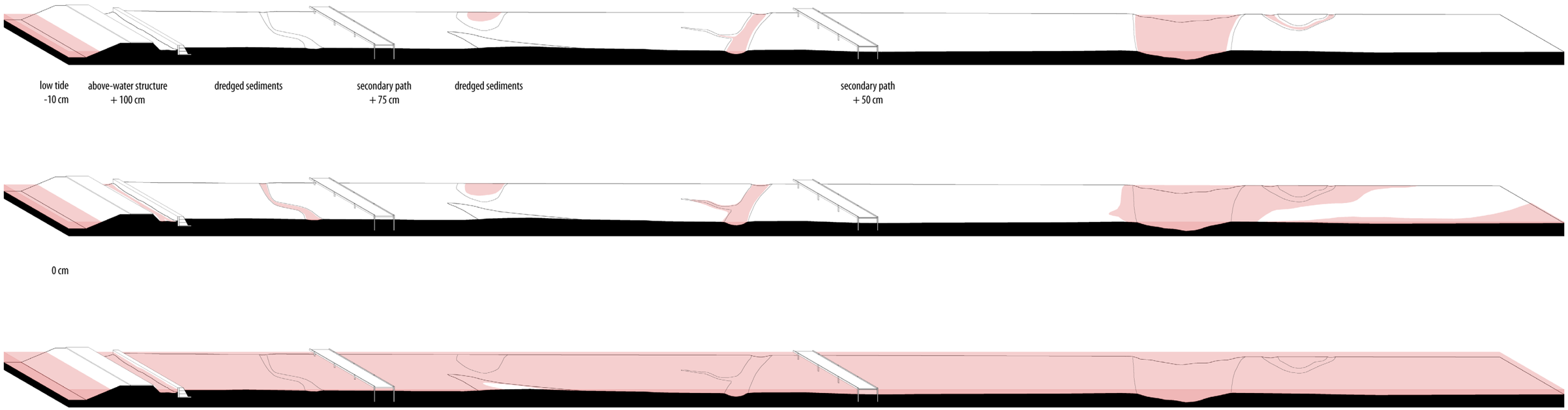
2040


low tide
-10 cm
above-water structure
+ 100 cm
0 cm
high tide
+50 cm

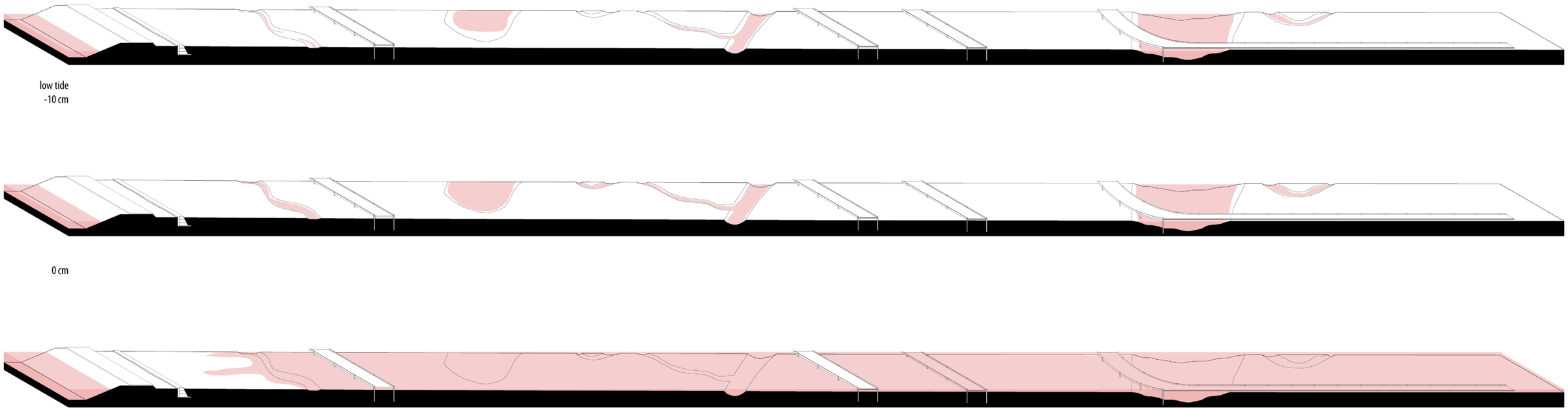
2023


Bora wind
tidal flush
low tide
-10 cm
above-water structure
+ 100 cm
dredged sediments
walkable path
+ 75 cm
dredged sediments
0 cm
high tide
+50 cm

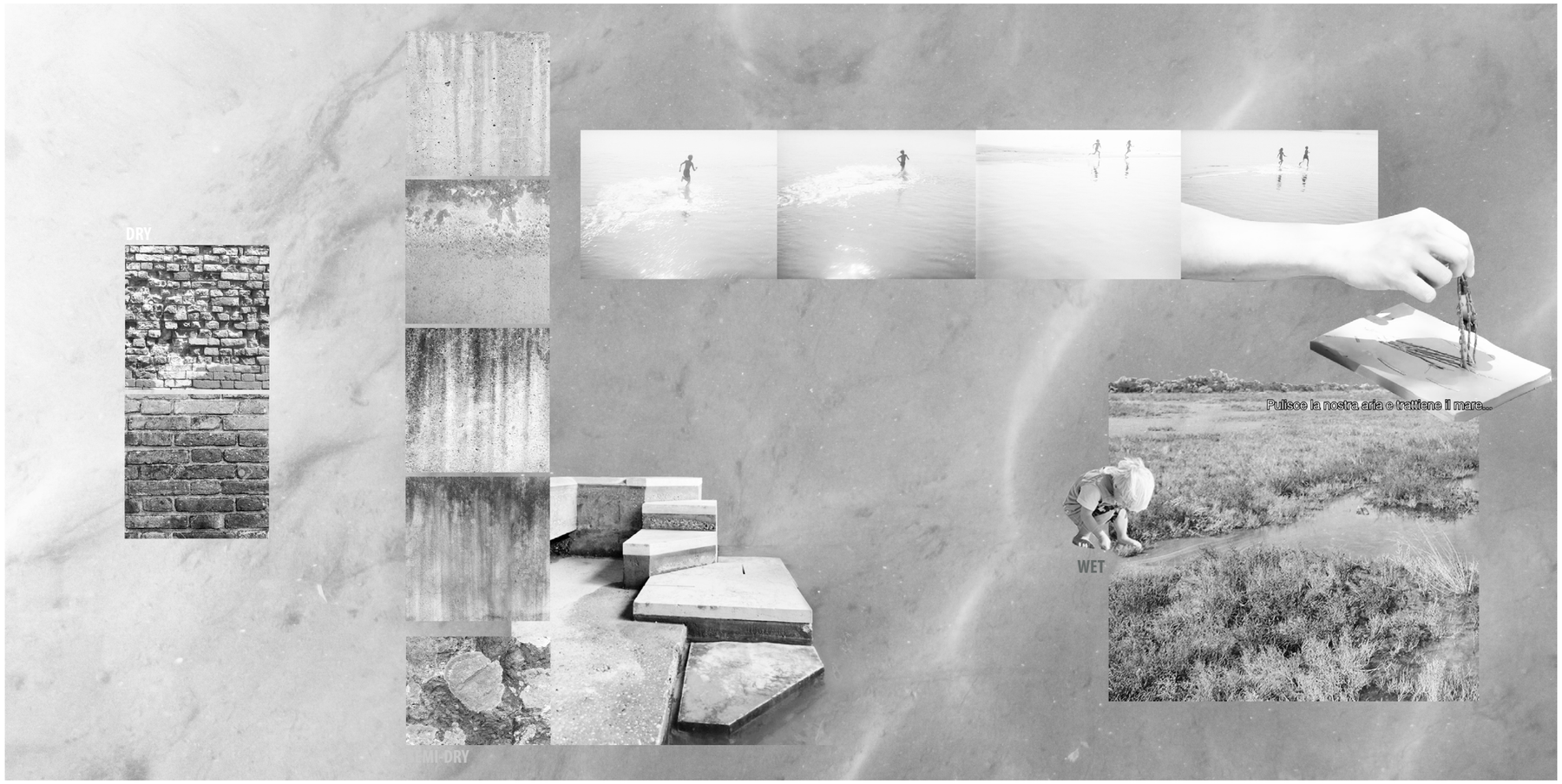
2026


low tide
-10 cm
above-water structure
+ 100 cm
dredged sediments
secondary path
+ 75 cm
dredged sediments
secondary path
+ 50 cm
0 cm
high tide
+50 cm

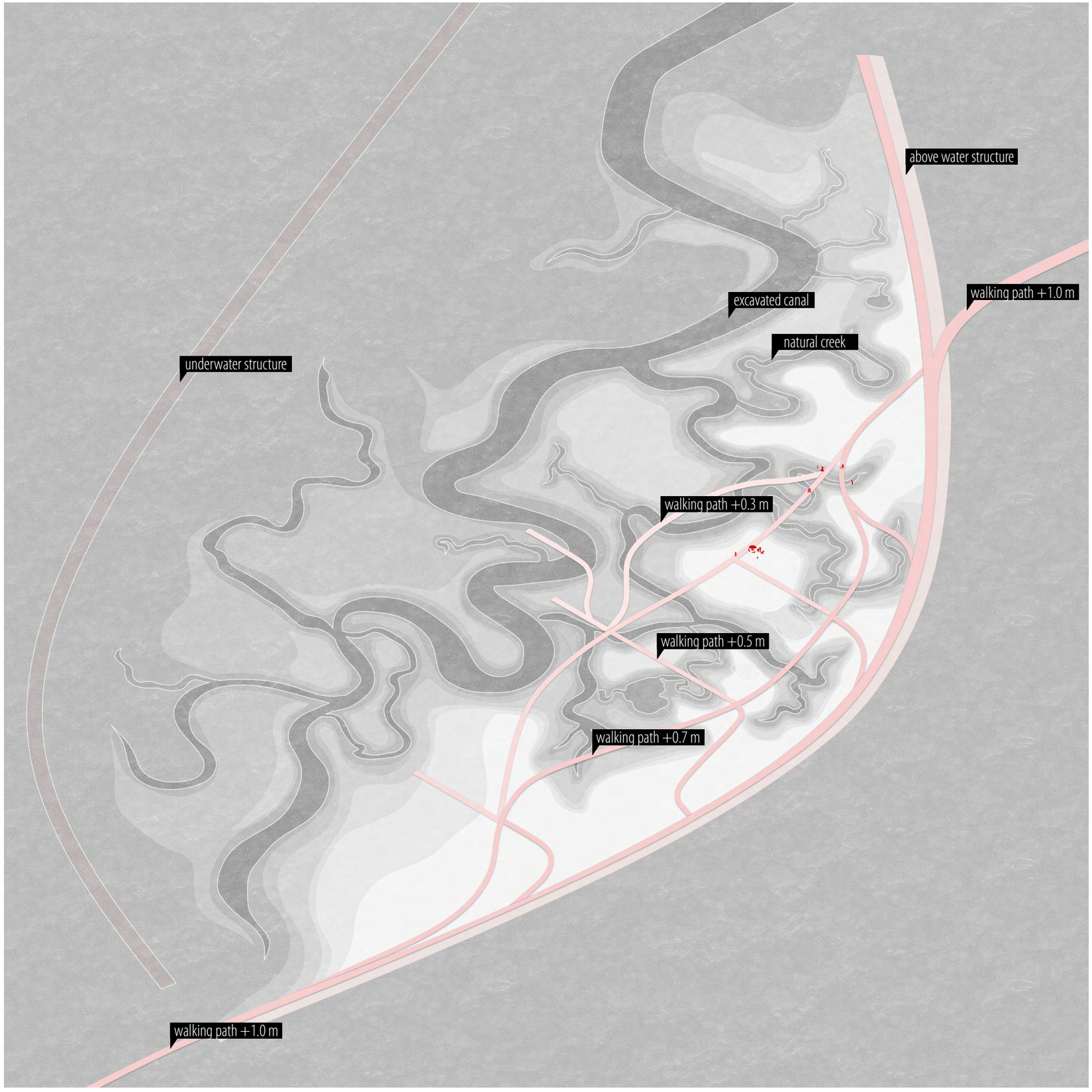
2030

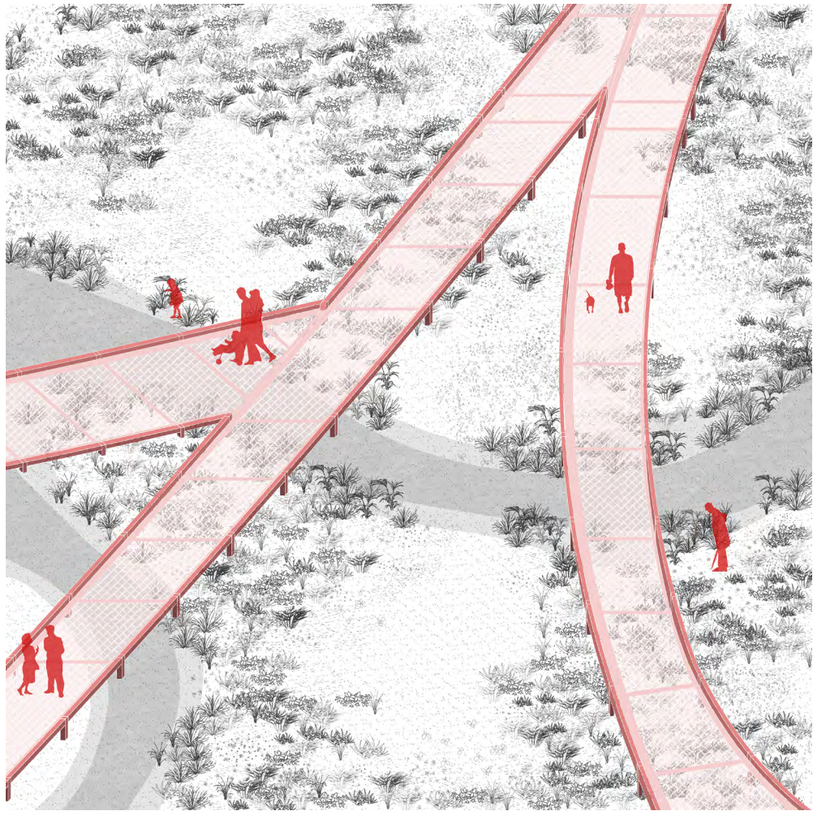


2040

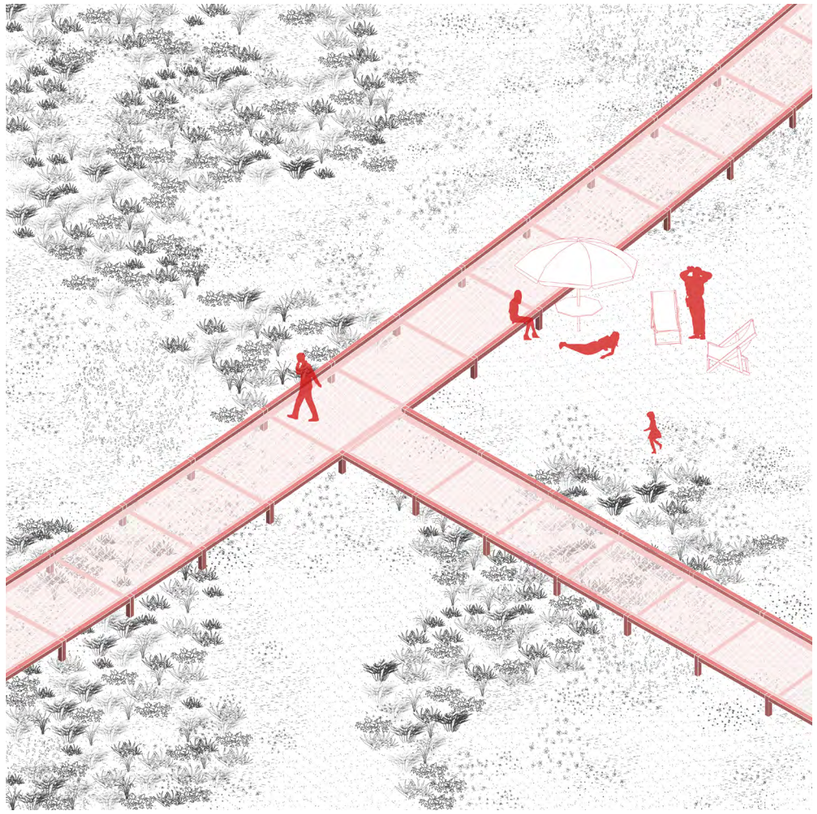


to unveil mechanisms and dynamics
to learn about the Venetian lagoon system
to be in contact

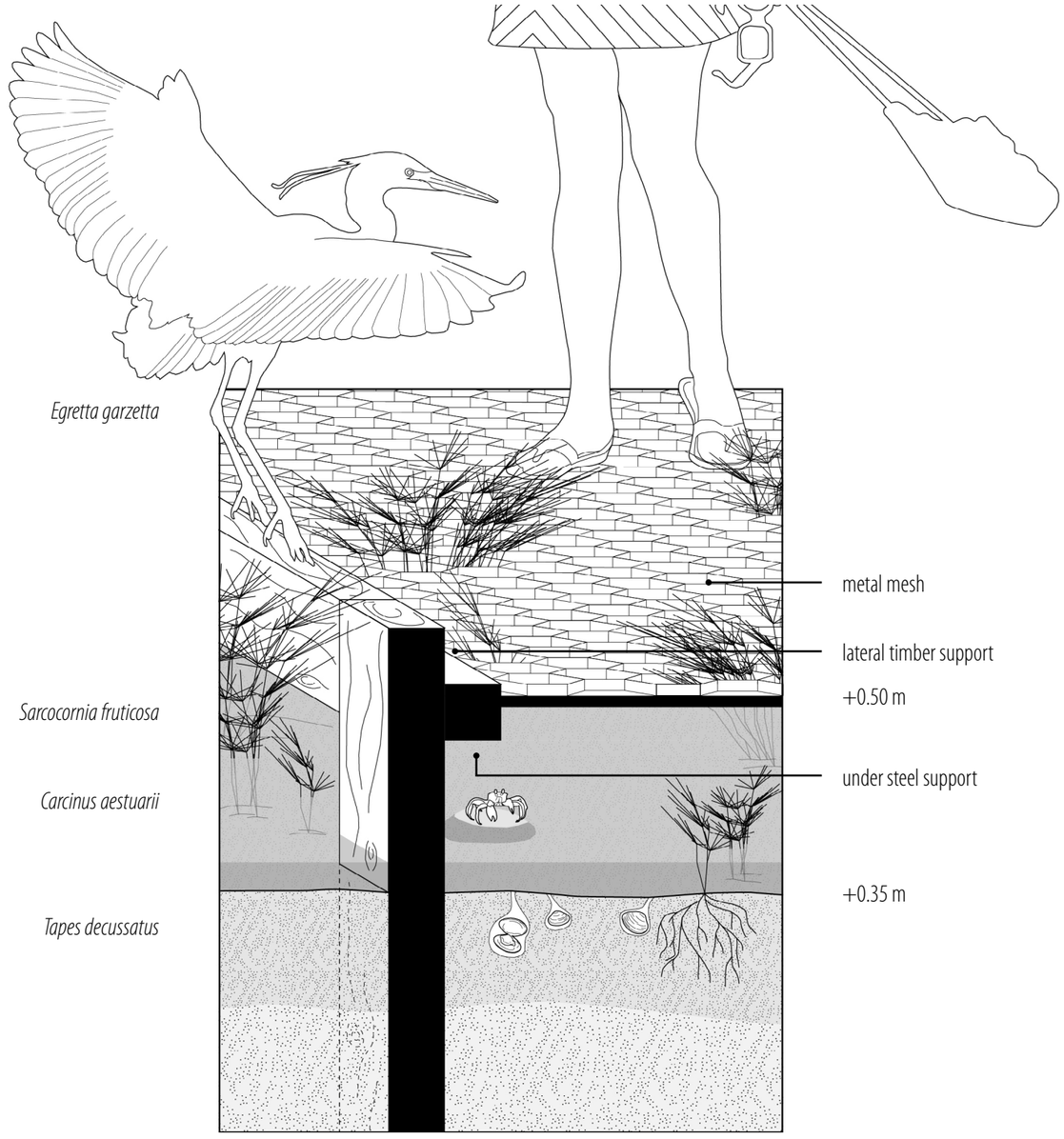

above water structure
excavated canal
walking path +1.0 m
natural creek
underwater structure
walking path +0.3 m
walking path +0.5 m
walking path +0.7 m
walking path +1.0 m

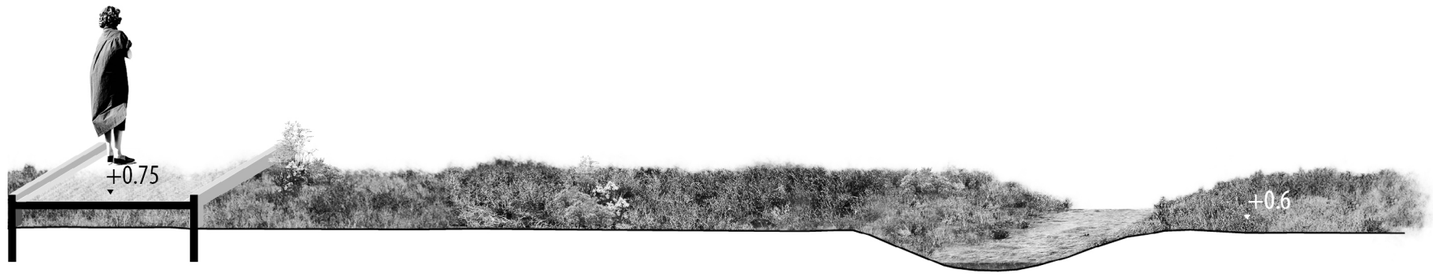


Walking paths +0.70 m, +0.50, +0.30 m high, low tide, 2036



Walking path +0.50 m, low tide, 2036


Egretta garzetta
Sarcocornia fruticosa
Carcinus aestuarii
Tapes decussatus
metal mesh
lateral timber support
+0.50 m
under steel support
+0.35 m


+0.75
+0.6

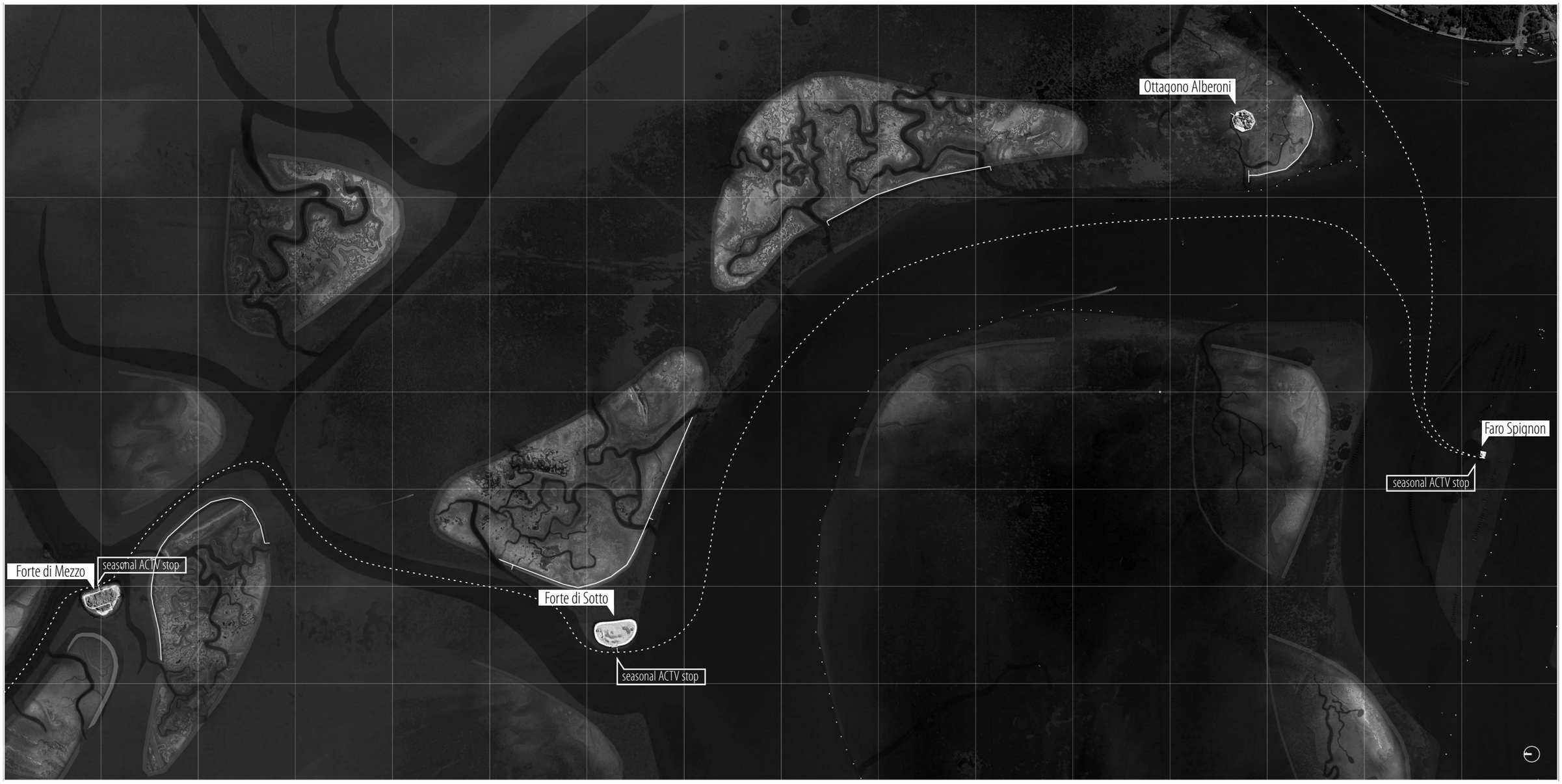




La Barena, June 2036, low tide

IN THE MIDDLE, TO THE SOUTH

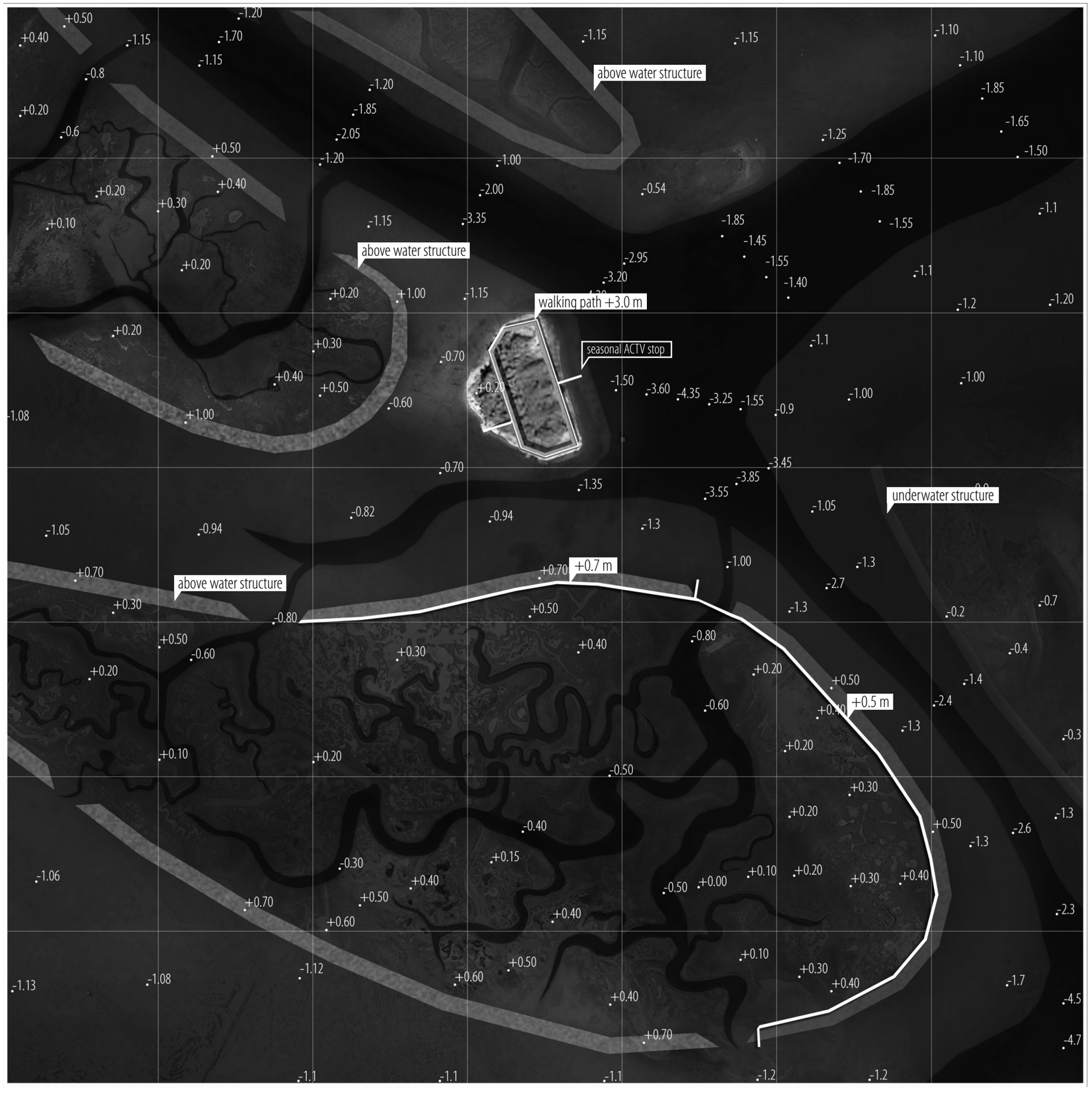
2050



0 250 m

IN THE MIDDLE, ON FORTE DI MEZZO

2050

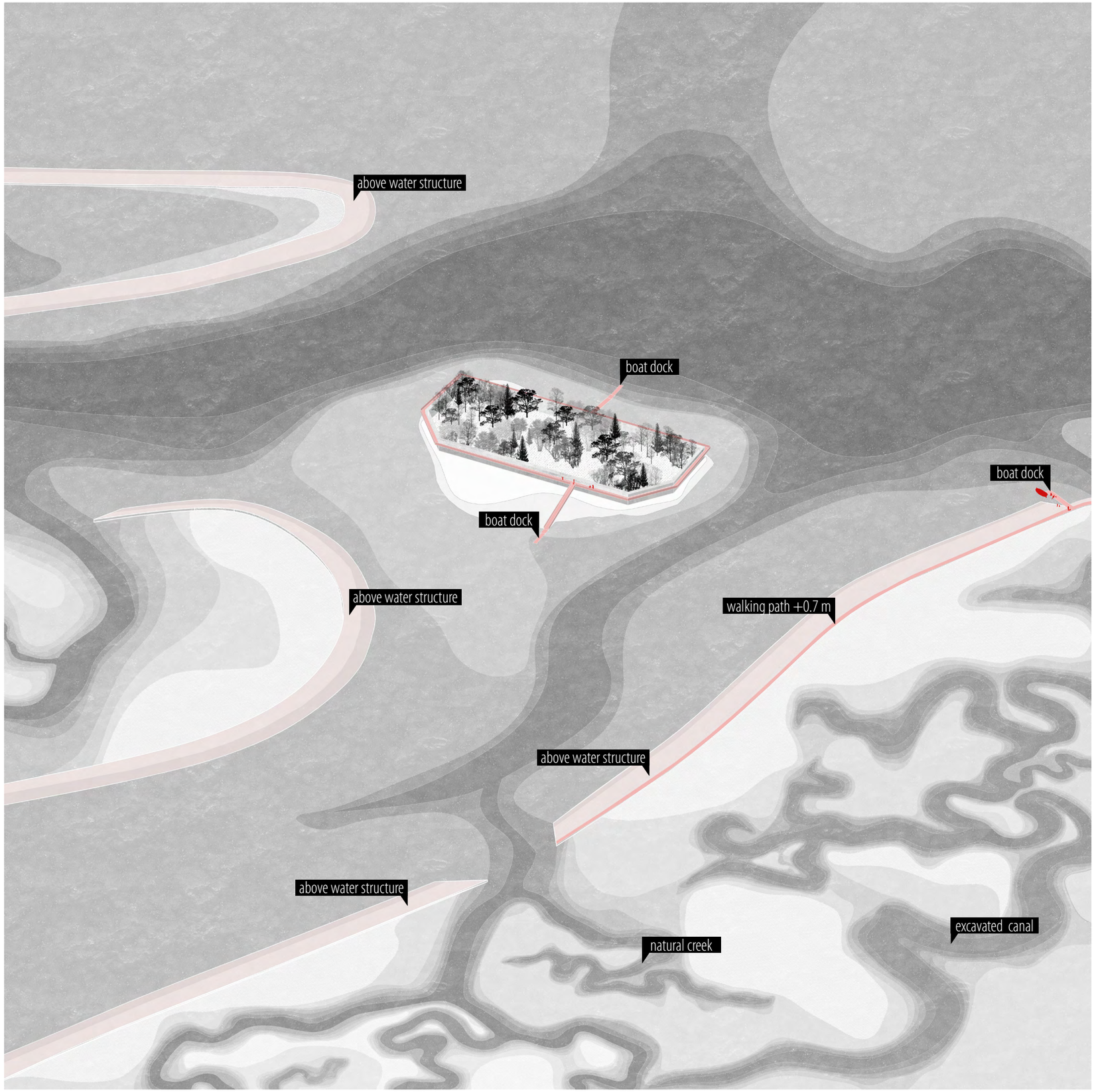


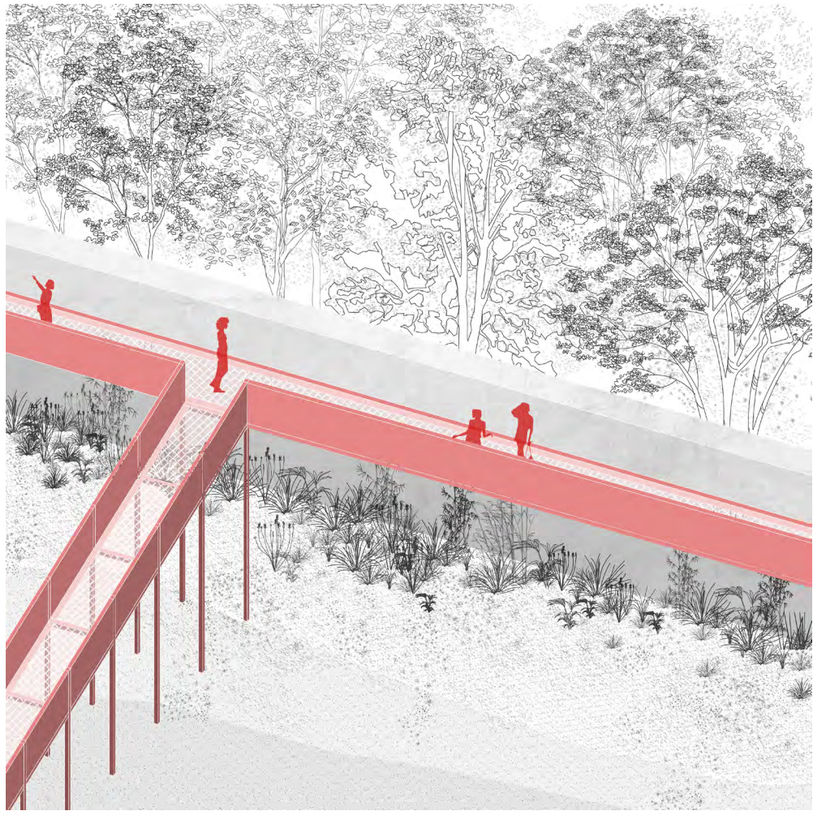
0 100 m



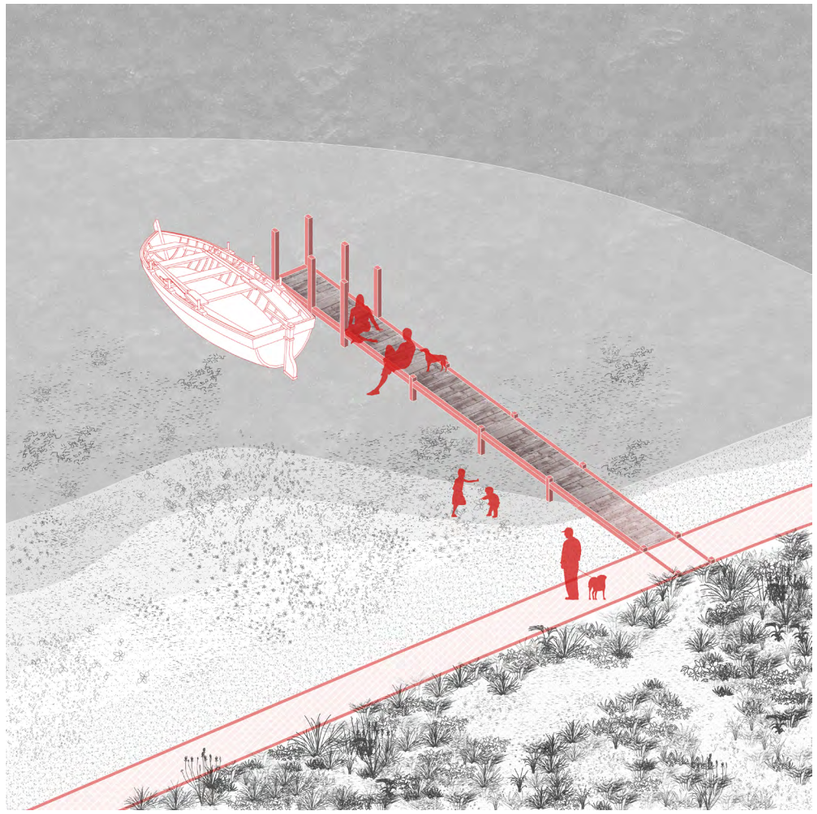
to observe from distance
to experience seasonally: from time to time
to give time and space to nature to reconstitute

IN THE MIDDLE,
ON FORTE DI MEZZO

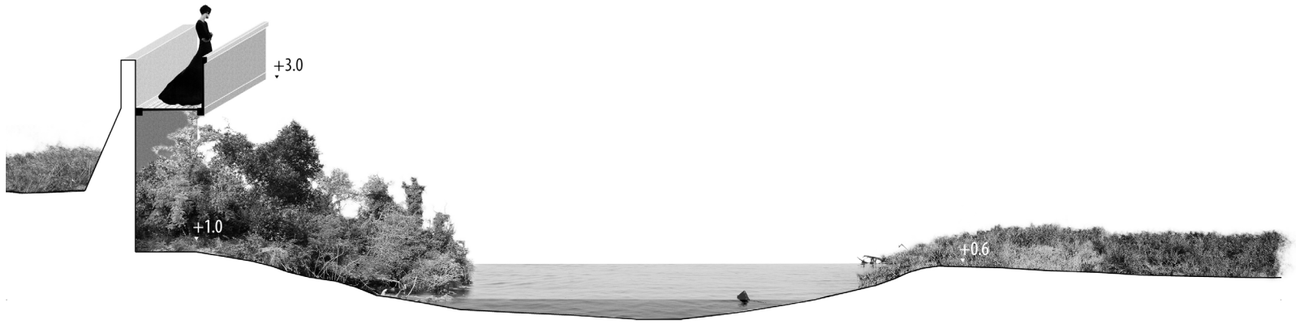




Ramp and elevated walking path at +3.0 m on Forte di Mezzo, 2030



Wooden dock on the barena close to Forte di Mezzo, 2030



Forte di Mezzo

Forte di Mezzo

Himantopus himantopus, a flock



Inula chritmoides

Phoenicopterus ruber, a flock

Sarcocornia fruticosa

Himantopus himantopus, a couple

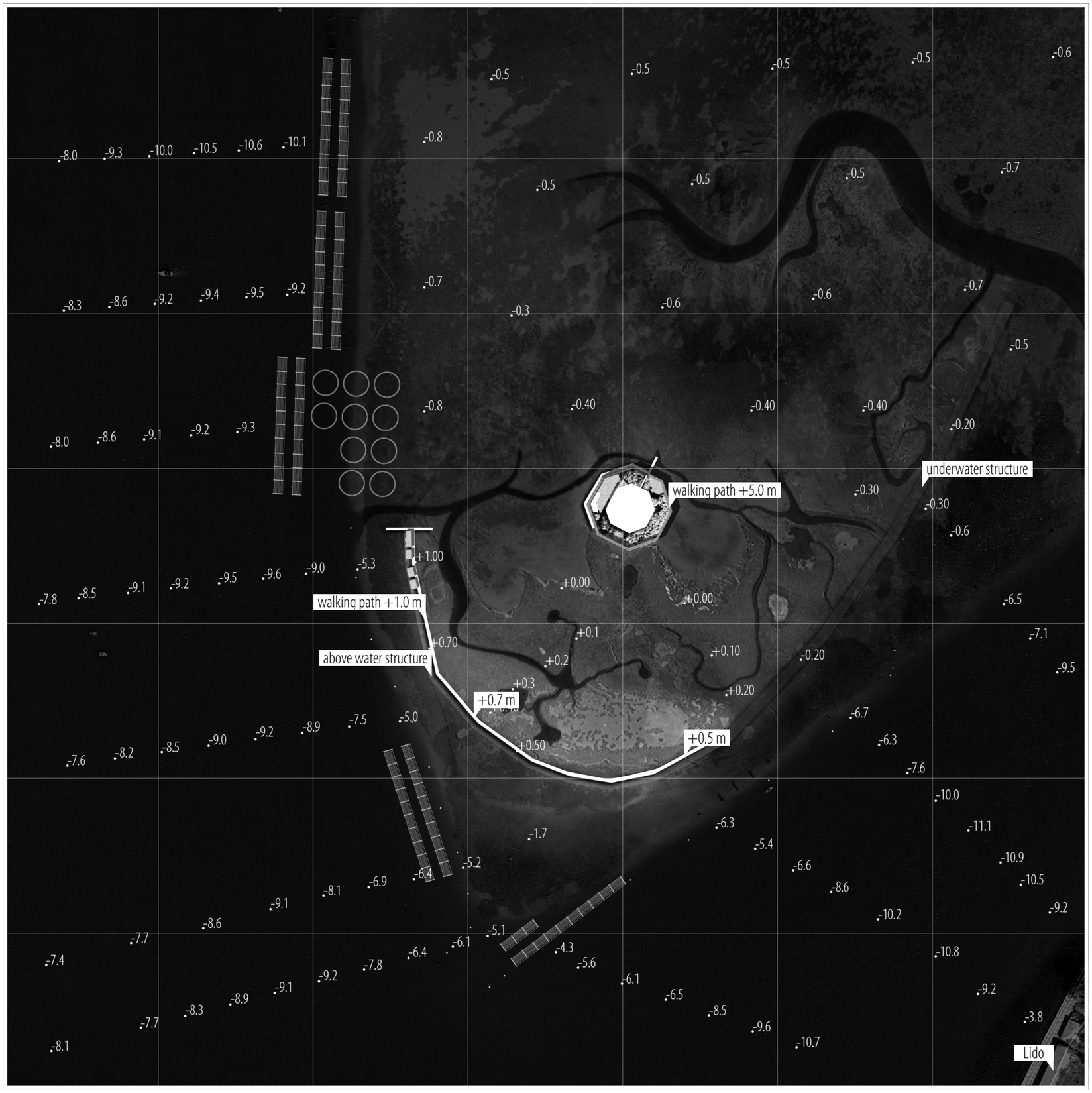
ghèba, shallow canal

Juncus maritimus

Ardea purpurea

In the middle, May 2035, low tide

TO THE SOUTH,
ON OTTAGONO ALBERONI
2050

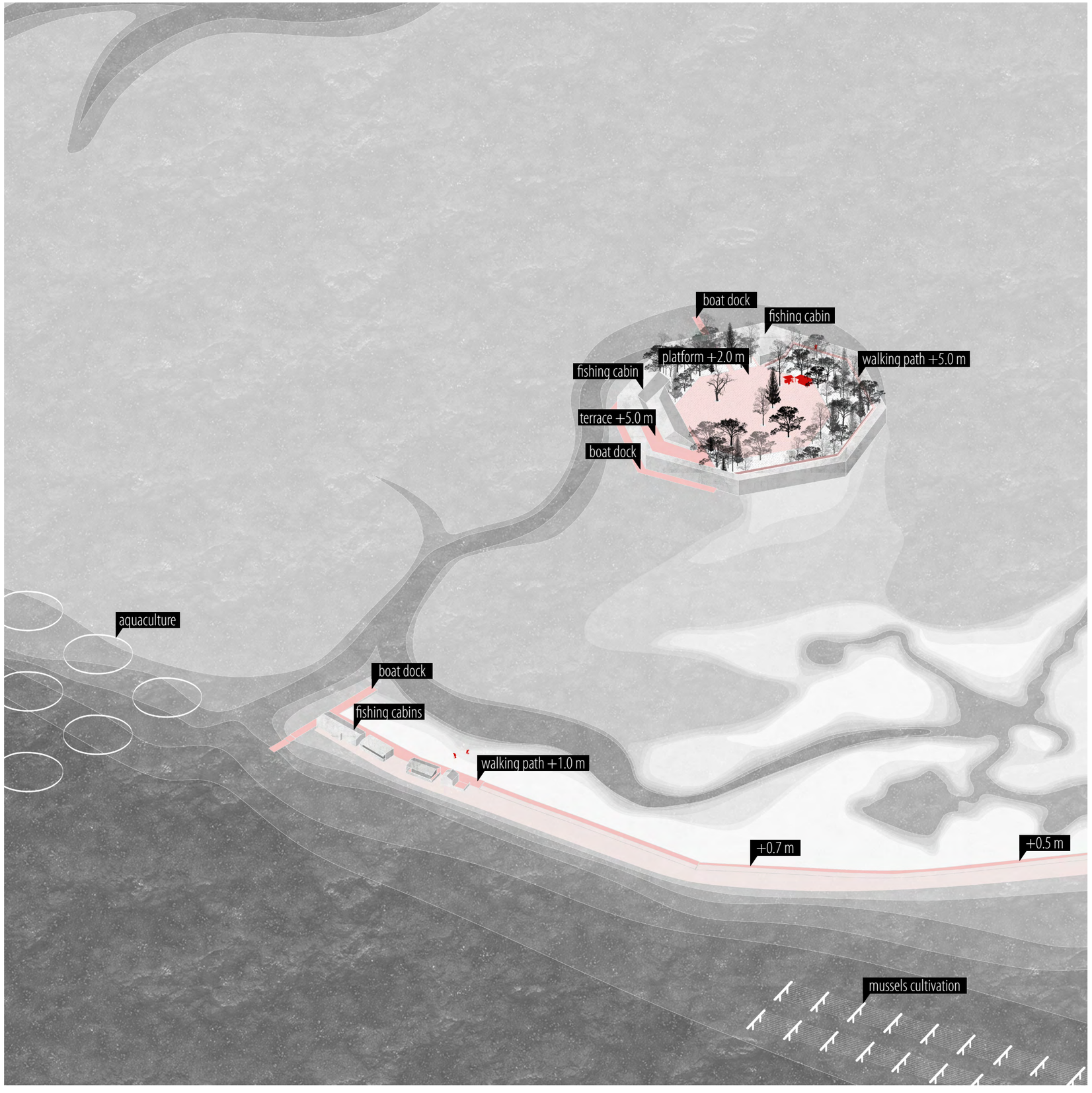


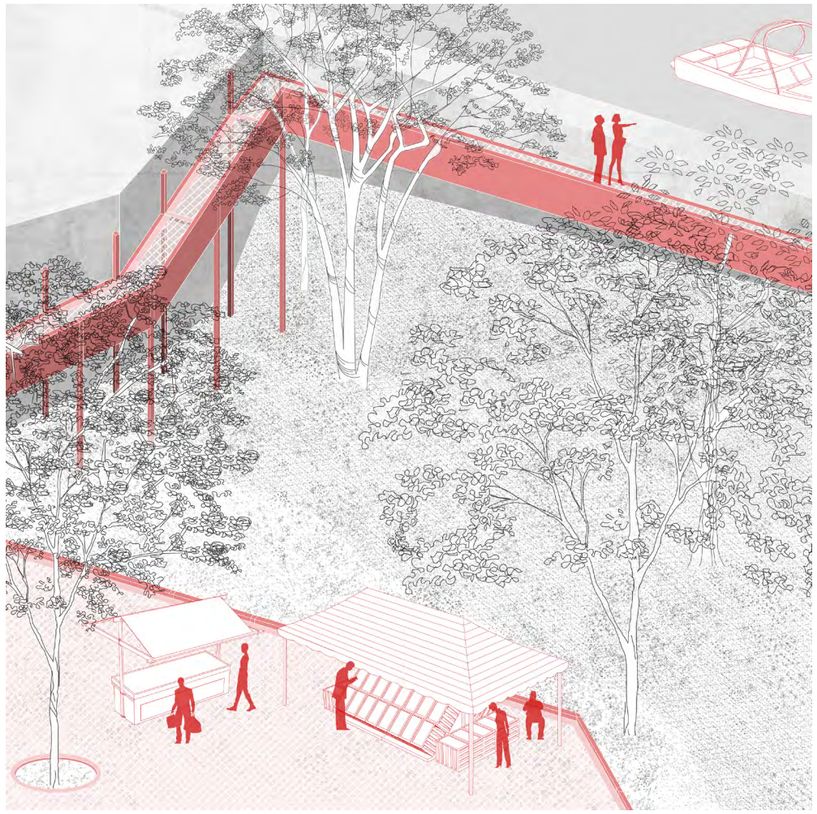
0 100 m



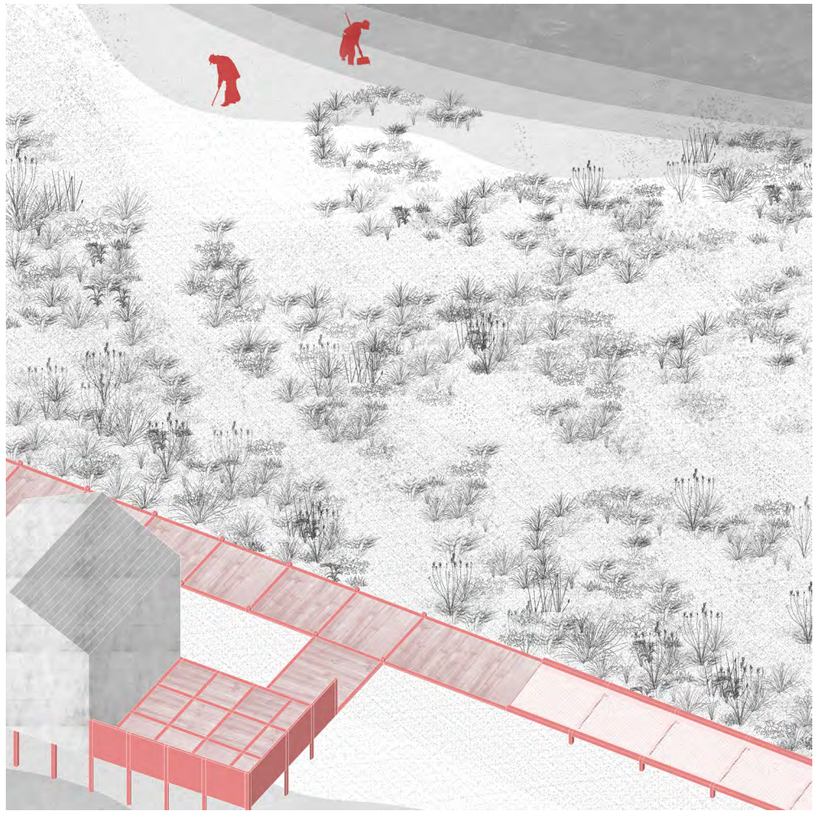
to profit sustainably from the barene and their biodiverse environment

TO THE SOUTH,
ON OTTAGONO ALBERONI





Ramp leading to the elevated path at +5.0 m and view over the central platform, 2035



Walking paths in wood and metallic mesh, fishermen's cabin, barena and clamsmen, 2035

TO THE SOUTH,
ON OTTAGONO ALBERONI
path detailing



Ottagono Alberoni





To the south, March 2040, low tide

ON FARO SPIGNON

or

A FINAL GLIMPSE AT THE VENETIAN LAGOON



to elevate



to see



to understand the organic system of the Venetian Lagoon, Venice and the barene and fishing activities and the islands



ON FARO SPIGNON

now



ON FARO SPIGNON

then




thank you