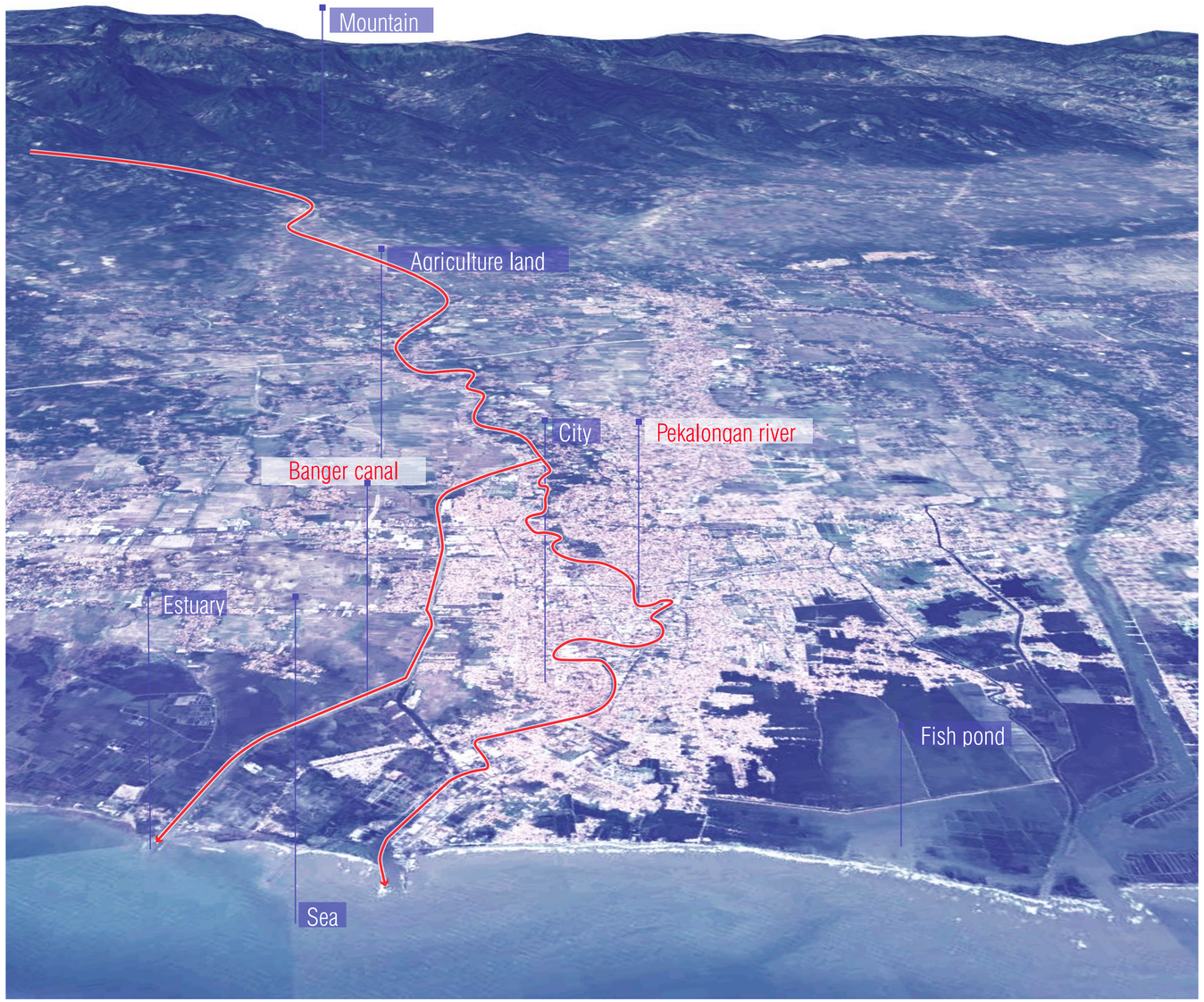
– Colored Water –

Designing A Resilient Landscape Framework that Facilitates Water Safety and Batik Development in Pekalongan City

P5
Resilient Coastal Landscapes
Yayun Gao
5078024
first mentor Steffen Nijhuis
second mentor Taneha Kuzniecow Bacchin
25.06.2021

-INTRODUCTION-



Source: Google Earth, https://www.google.com/maps/place/Pekalongan,+Pekalongan+City,+Central+Java,+Indonesia/@-6.8959407,109.6394839,13z/data=!3m1!4b1!4m5!3m4!1s0x2e70242ca490fe13:0xc0c68a126b258cb6!8m2!3d-6.8898362!4d109.6745916, edited by the author.

| Location


Java sea
Java sea
Pekalongan city
Pekalongan river
Banger canal
Kupang watershed
Dieng Plateau +2,000m
0
10km

| A city fed on batik production



-FASCINATION-

“The local people have taken many measures,
but the situation is even getting worse”

Seawater

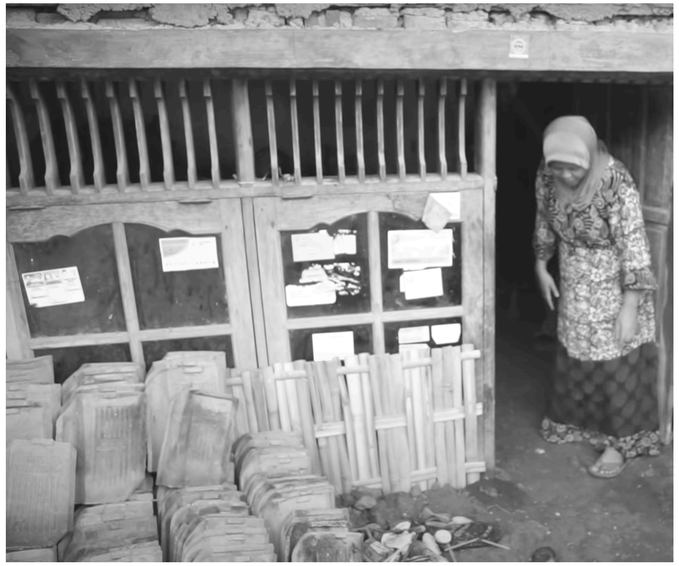


Subsidence MAX 34cm/year
Rising sea level 6-10cm/ year

Rising sea level

Storm surge in Pekalongan city, Source: https://otomotifnet.gridoto.com/read/232179885/jeep-wrangler-tak-goyah-disembur-ombak-2-meter-pekalongan-dikepung-banjir-rob

Seawater



Half a meter per five years since 2010

Brick & Tile | Raised floor

Bricks and tiles used to raise the floor,
Source: *Rising Threats From the Sea*, https://www.youtube.com/watch?v=foXMXCAgKq4.

Seawater



170cm VS. 160cm

The local cannot stand up straight within the house in 2020,
Rising Threats From the Sea, Source: https://www.youtube.com/watch?v=foXMXCAgKq4.

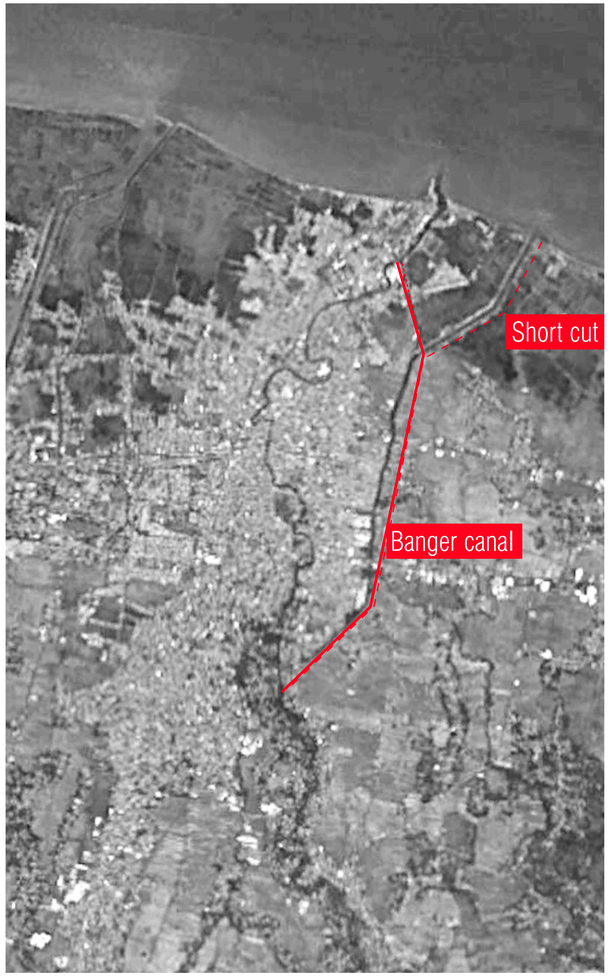
Freshwater



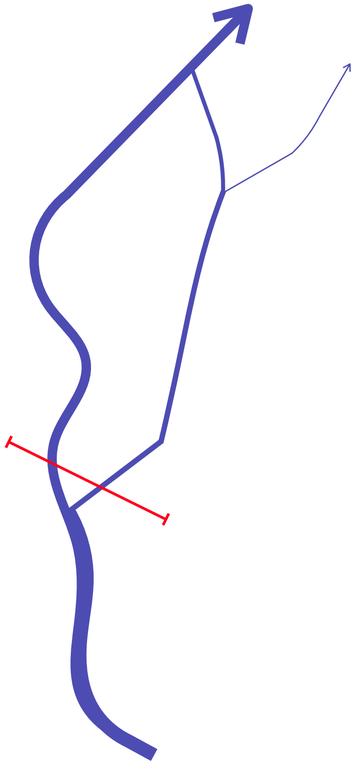
Pekalongan river | Overflow

Historical map of Pekalongan, *Google Earth*
Source: https://earth.google.com/web/@-6.88981563,109.67459166,-56282.28832987a,73258.46256089d,35y,0h,0t,0r?utm_source=earth7&utm_campaign=vine&hl=zh-CN

Freshwater



To divert part of floods from Pekalongan River, A bypass channel built in 1988



1988 Banger canal | 2003 Short cut

Historical map of Pekalongan, *Google Earth*

Source: https://earth.google.com/web/@-6.88981563,109.67459166,-56282.28832987a,73258.46256089d,35y,0h,0t,0r?utm_source=earth7&utm_campaign=vine&hl=zh-CN

Freshwater



The flow capacity of the Pekalongan river decreased by 19.33% since 1989 (DPU Kota Pekalongan)



Since 2003 | More floods

The city faces more floods, Source: http://www.kebumenekspres.com/2017/06/banjir-rob-rendam-9100-rumah-di.html

Batik

75% Pekalongan adults engage in batik industry



Batik Industry | 2009 Heritage culture

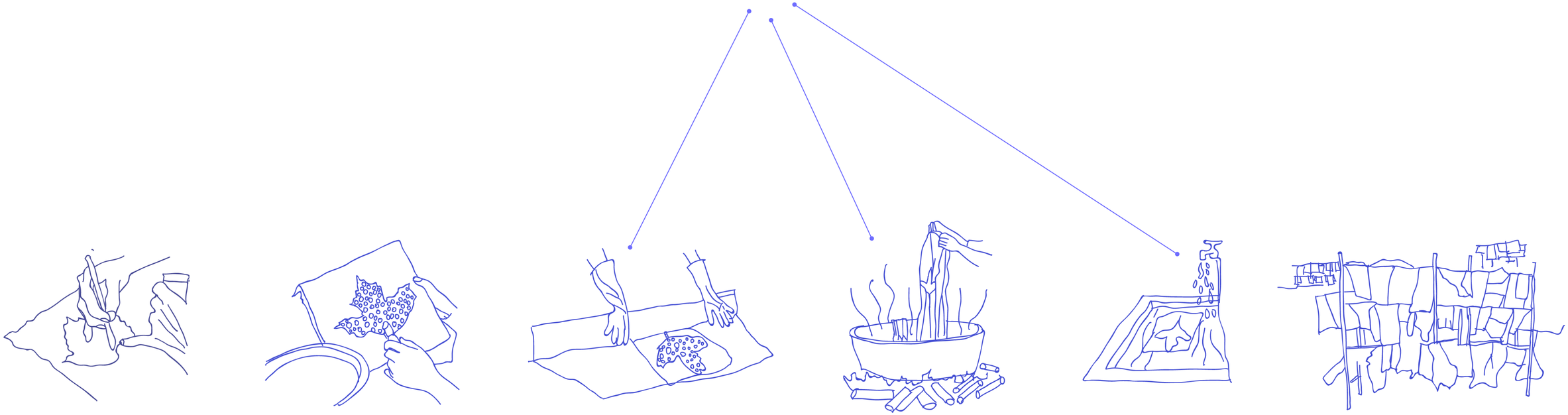
Batik is a representative of Pekalongan city.
Source: https://id.m.wikipedia.org/wiki/Berkas:Solo_Batik_Carnival.jpg

UNESCO has confirmed batik as a human heritage. In the category of Oral and Non-Material Culture (*Masterpieces of the Oral and Intangible Heritage of Humanity*) since October 2, 2009. As a result of this inauguration, the demand for batik in the national or international market has grown rapidly.

Meanwhile, Pekalongan city became the first Creative City in South-east Asia for batik

Batik

Batik production is highly rely on natural resources, especially **water**



Drawing on a motif fabric

Fill the background with dot pattern

Coloring

Boiling the fabric

Washing

Drying

917 Batik industry

85,277m³/month

1,023,324m³/year

(Budiyanto, S., Anies, Purnaweni, H., & Rya Sunoko, H. , 2018)

Batik



Water extraction

Water extracted from the ground was the dominant water source for the batik industry.
Source: https://www.posjateng.id/warta/pemkab-pekalongan-alokasikan-rp200-juta-untuk-sumur-pompa-b1Xoo9crH

Batik

Water quantity & Water quality



Freshwater scarcity



Water pollution

BPBD is distributing clean water in a village affected by droughts and pollution.
Source: https://radarpekalongan.co.id/84452/pemkab-pekalongan-akan-manfaatkan-embung-untuk-persediaan-air-bagi-warga/

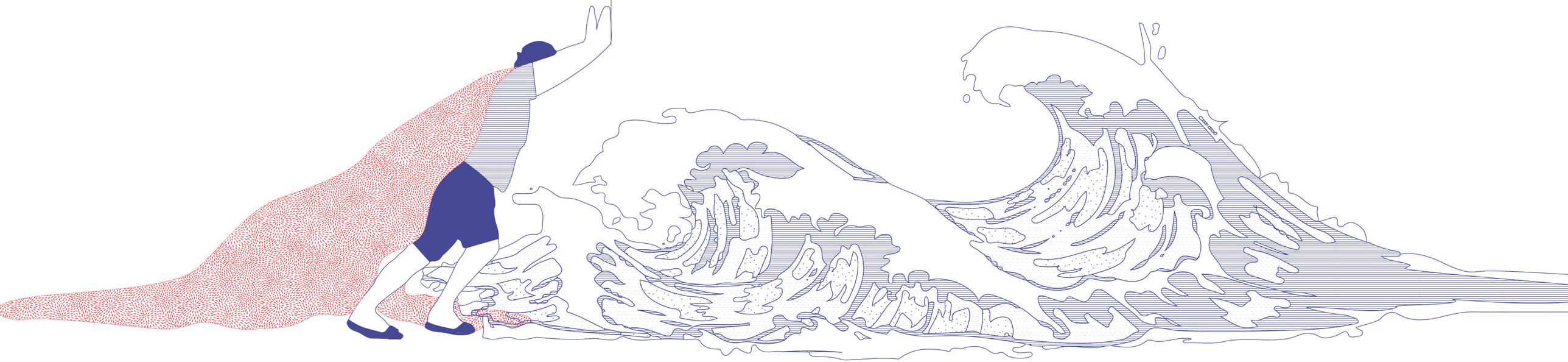
Raise floor
Shortcut
Bypass channel
More defence
Raise road base
Extract deeper
Dike
Water extraction
Mass production
...

?

Batik

Pekalongan city

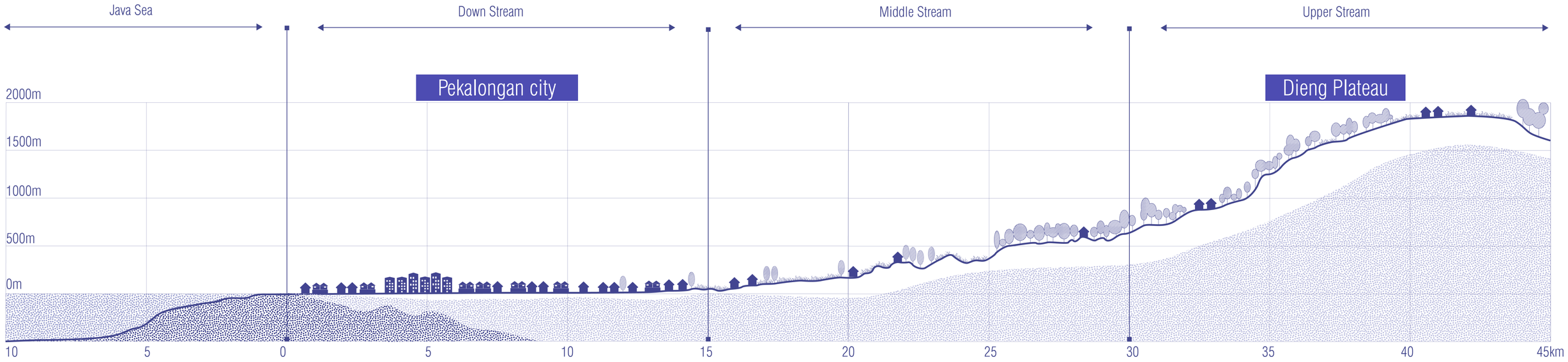
Water



-PROBLEM FIELD-

-Human changed the way how nature works-

The section of Kupang watershed



Human interventions

Downstream

Middlestream

Upper-stream



Mangrove

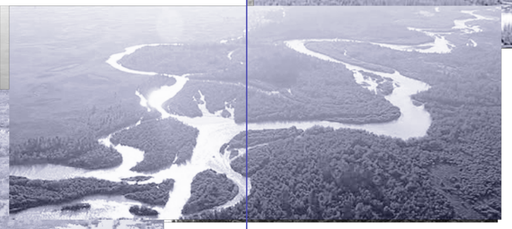


Beach

Beach ridge



Swamp land



River



Grassland

Wetland



Forest



Economic forest



Village



Agricultural land



Settlements

Canal



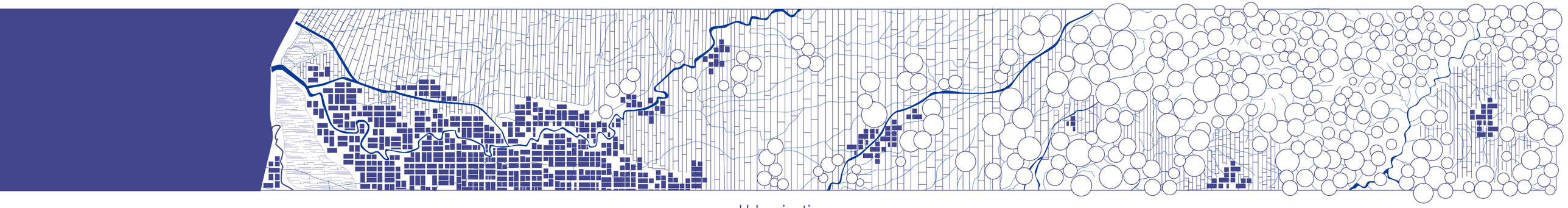


Fishpond

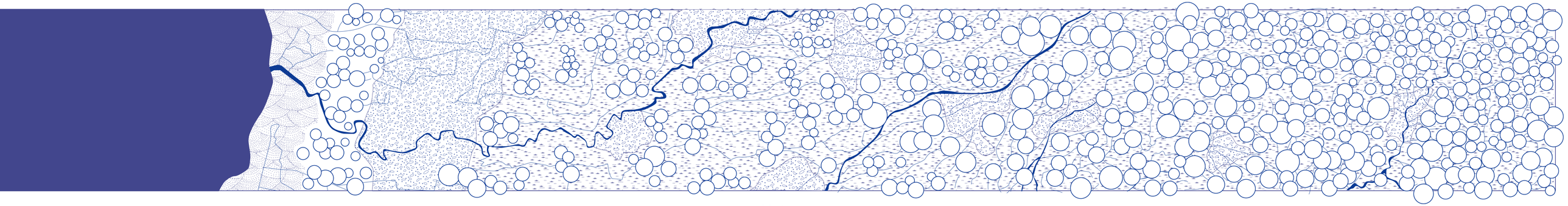


Rice field

The landscape has been changed



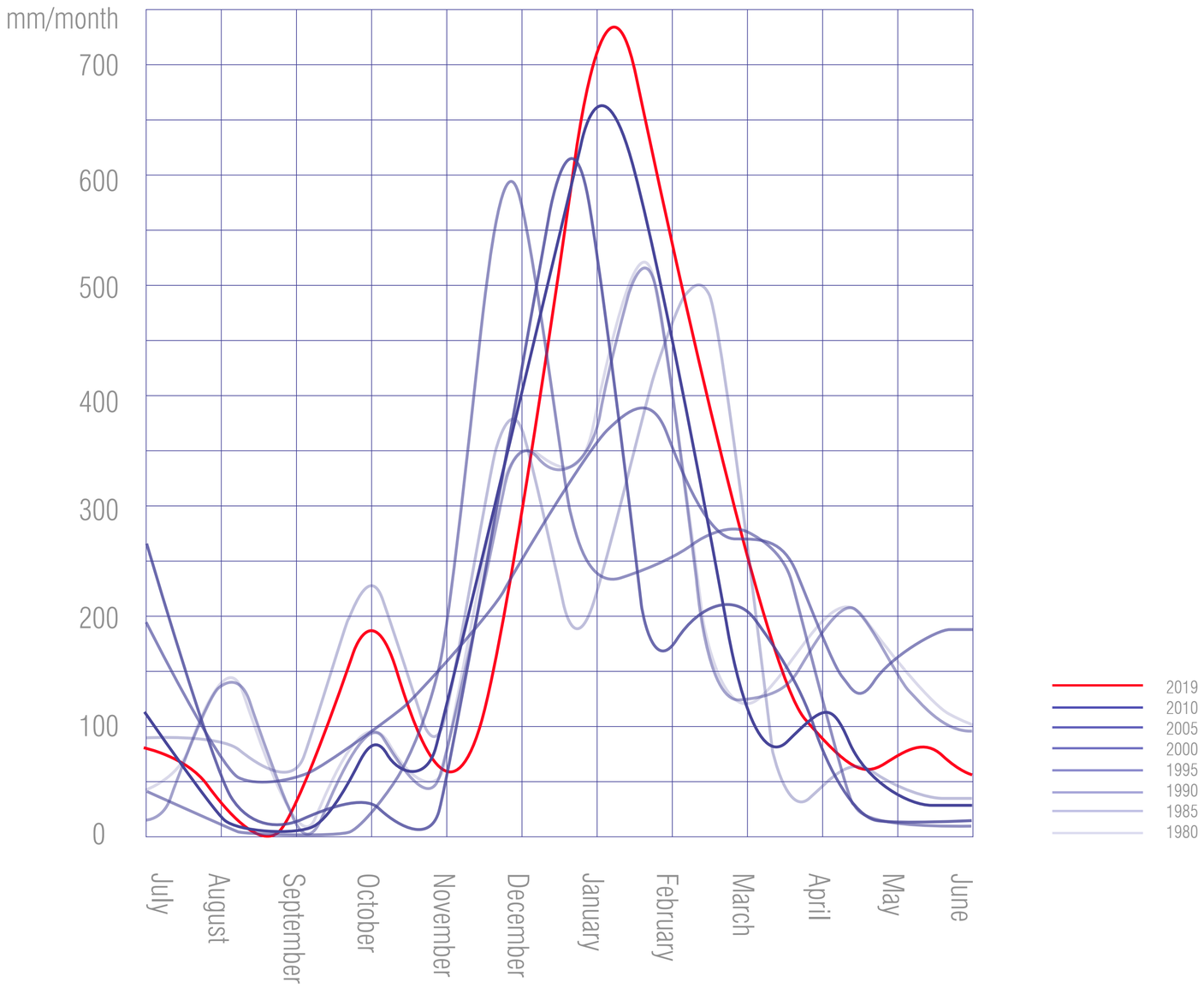
Urbanisation



Nature

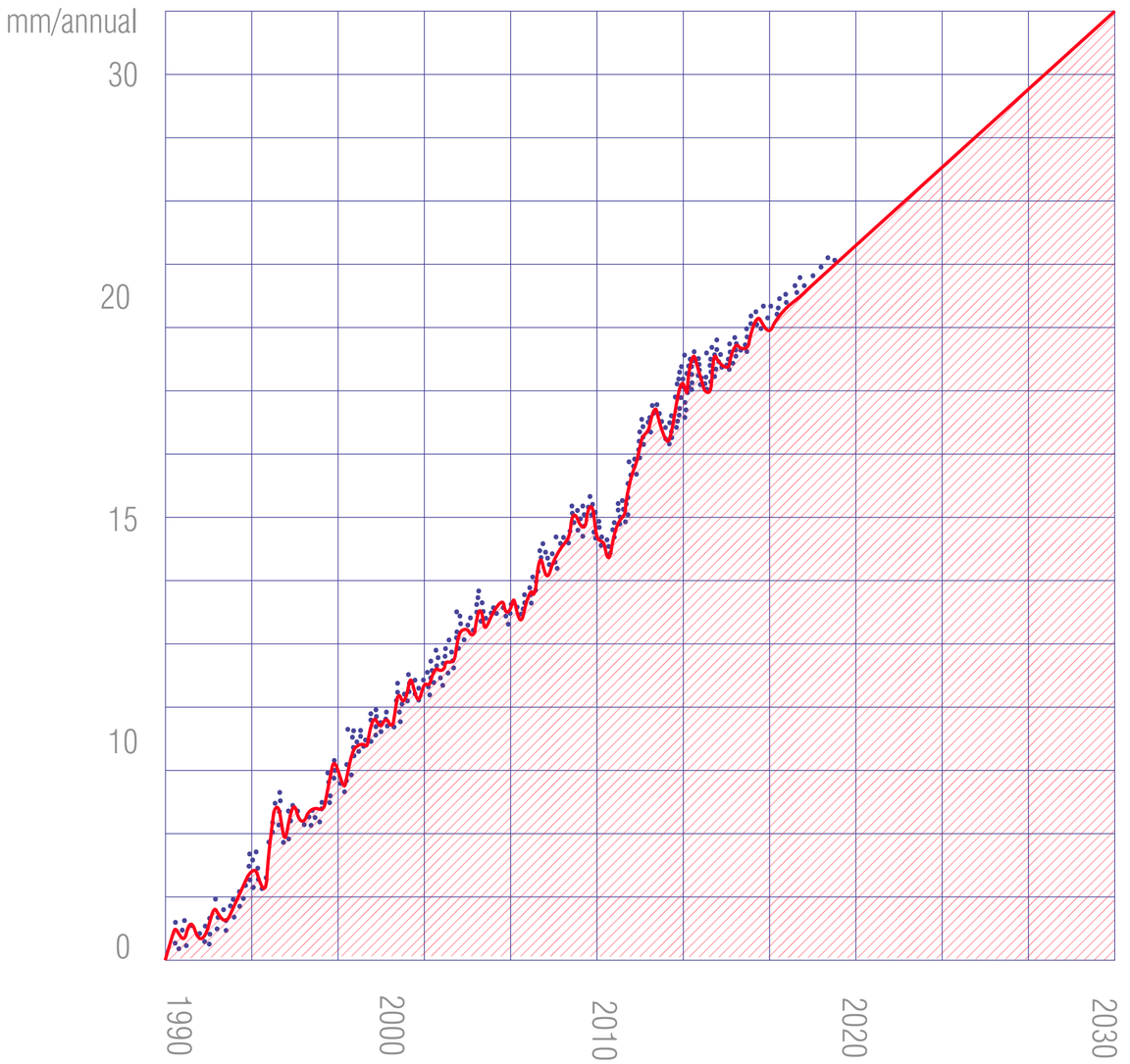
Natural forces

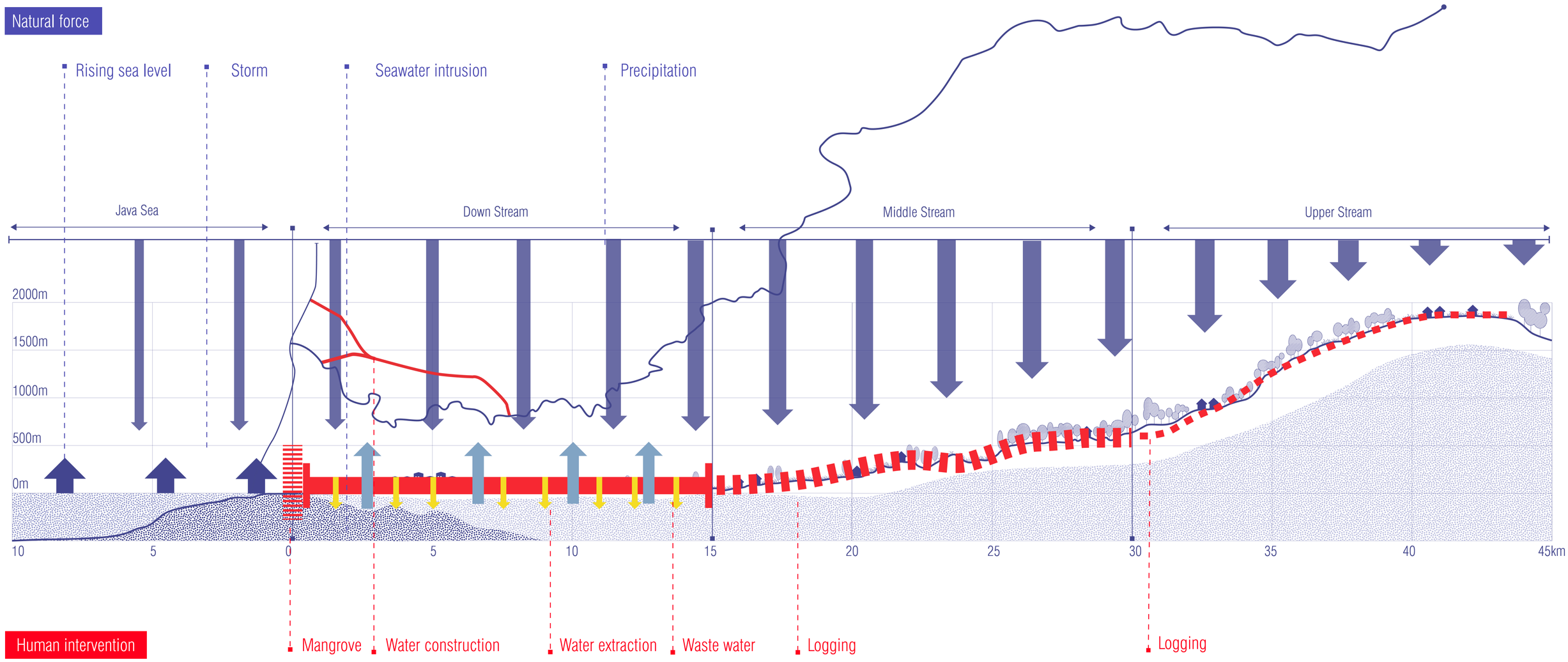
Intenser and shorter period precipitation



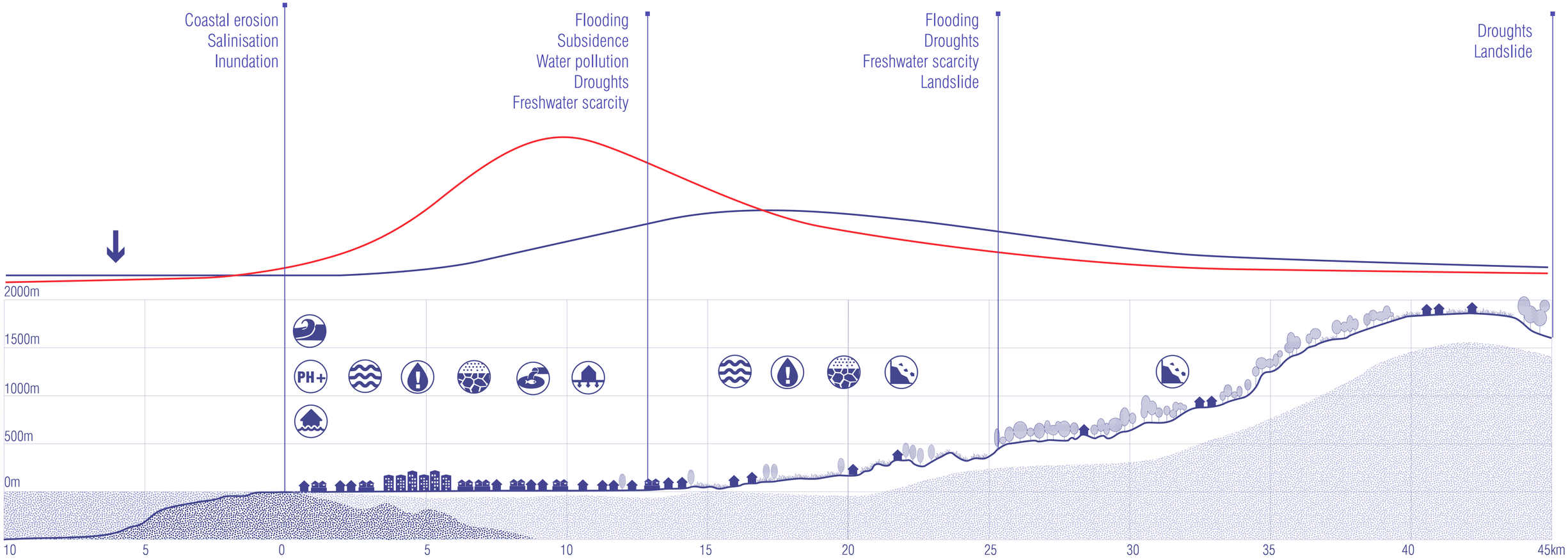
Natural forces

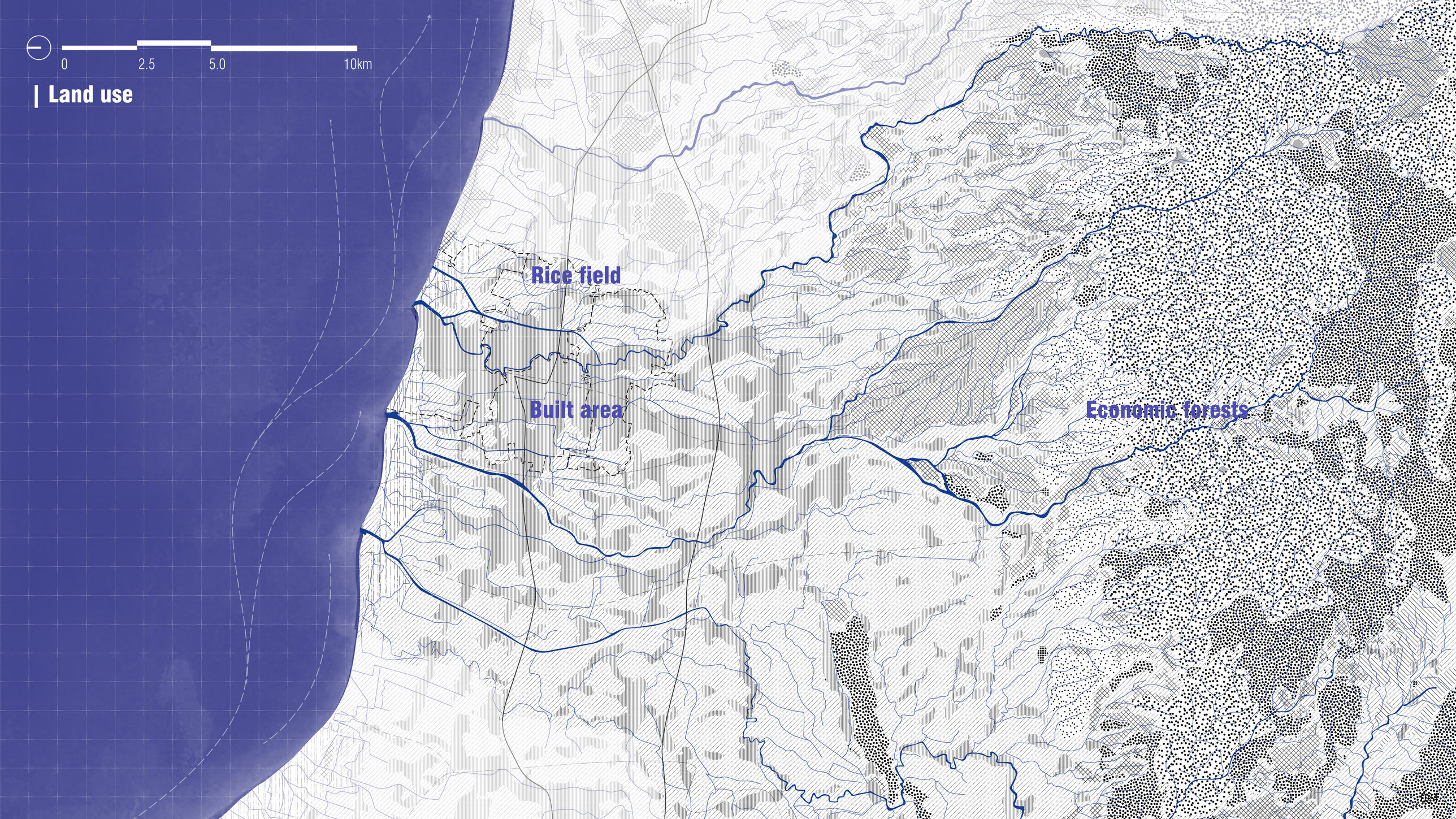
Rising sea level

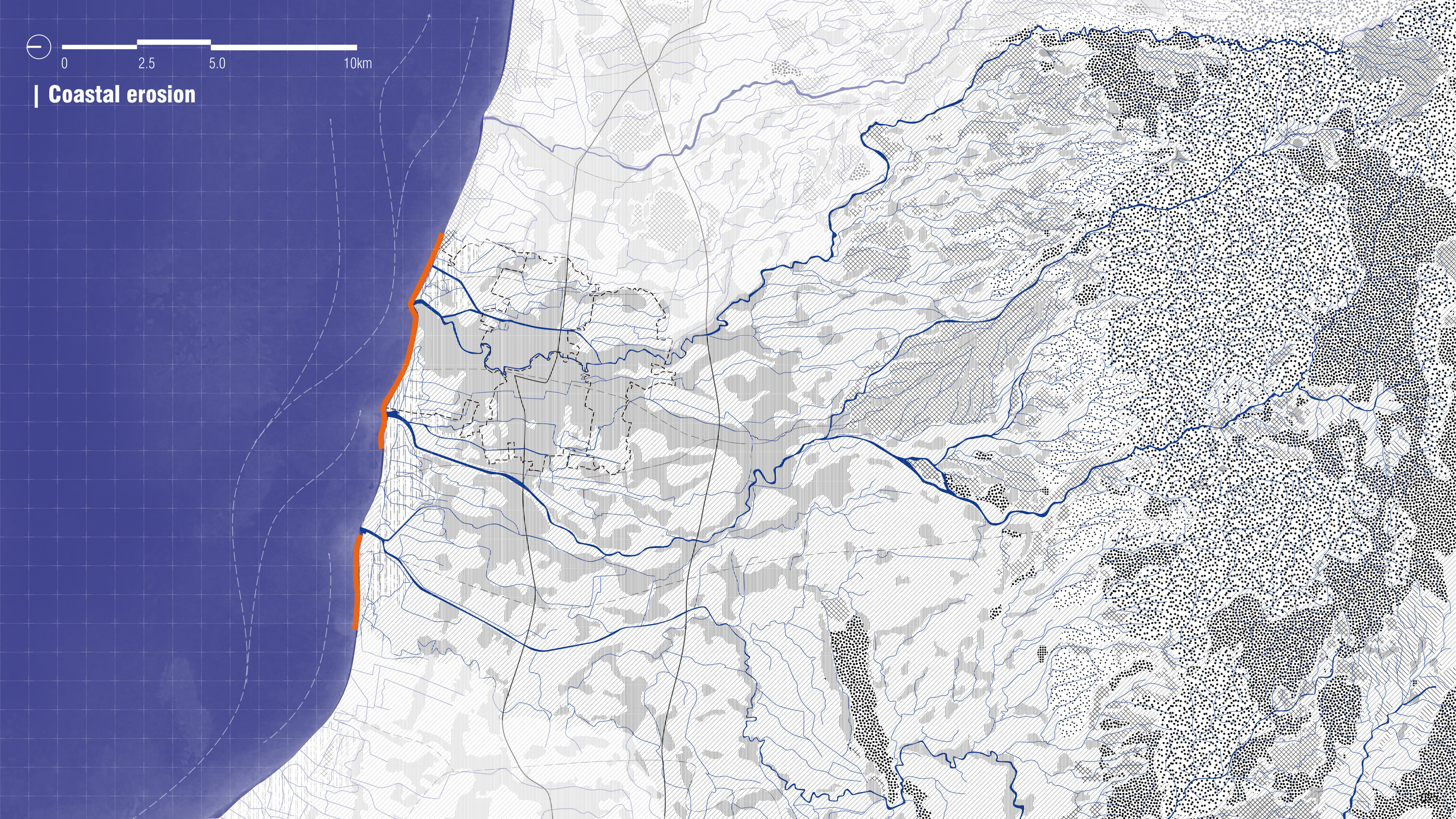


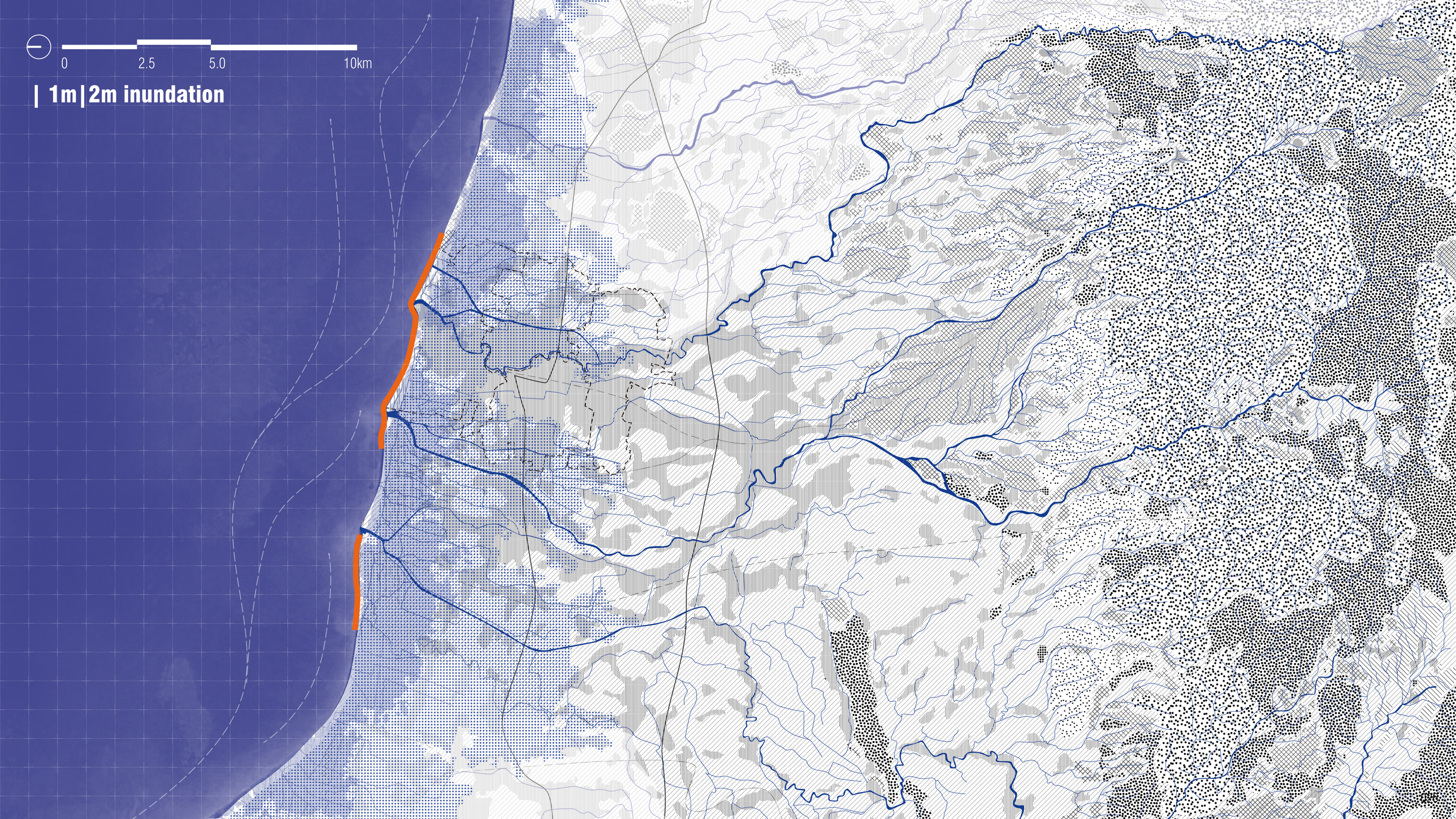

Natural force
Rising sea level
Storm
Seawater intrusion
Precipitation
Java Sea
Down Stream
Middle Stream
Upper Stream
2000m
1500m
1000m
500m
0m
10
5
0
5
10
15
20
25
30
35
40
45km
Human intervention
Mangrove
Water construction
Water extraction
Waste water
Logging
Logging

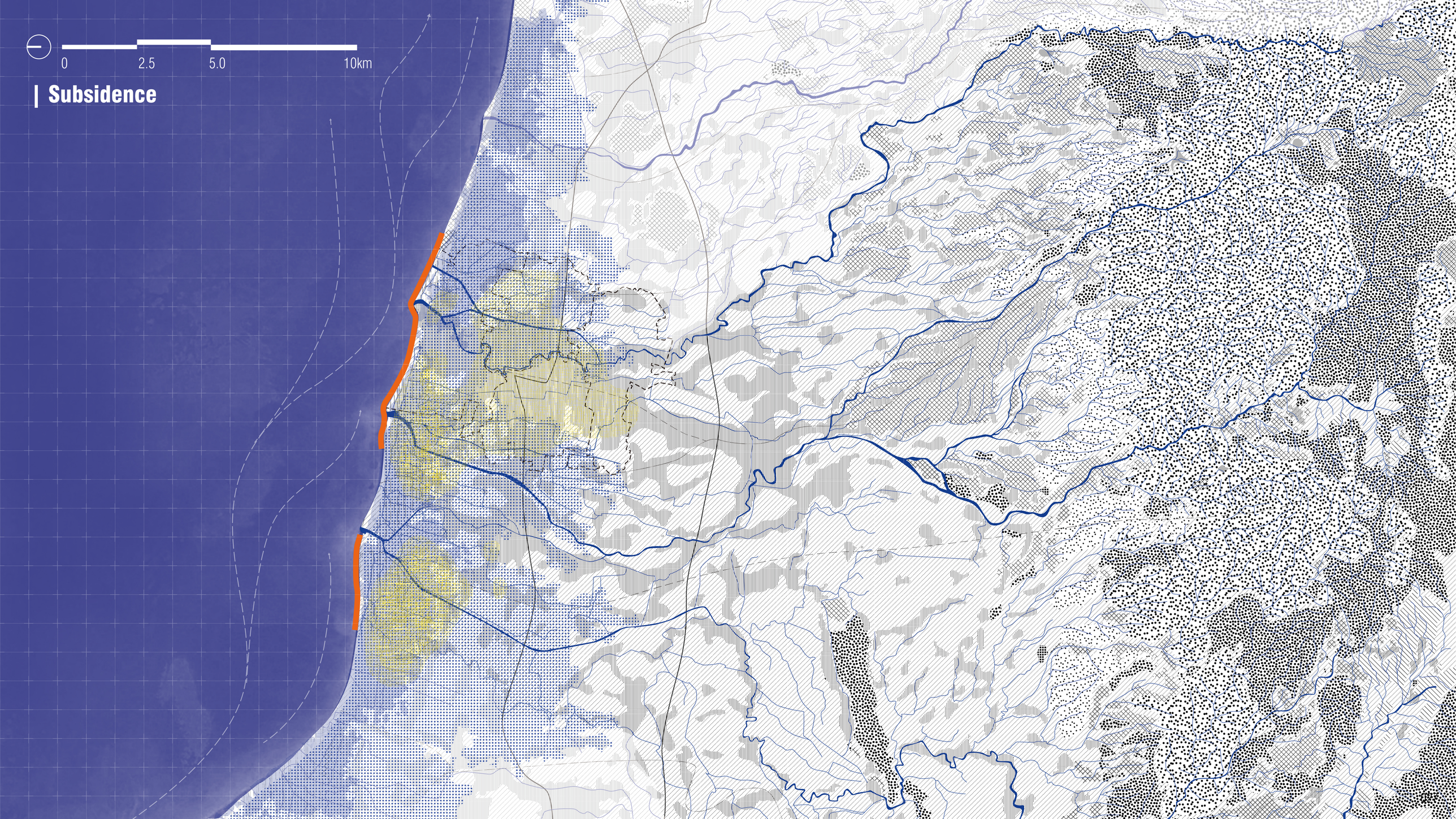
Problem field

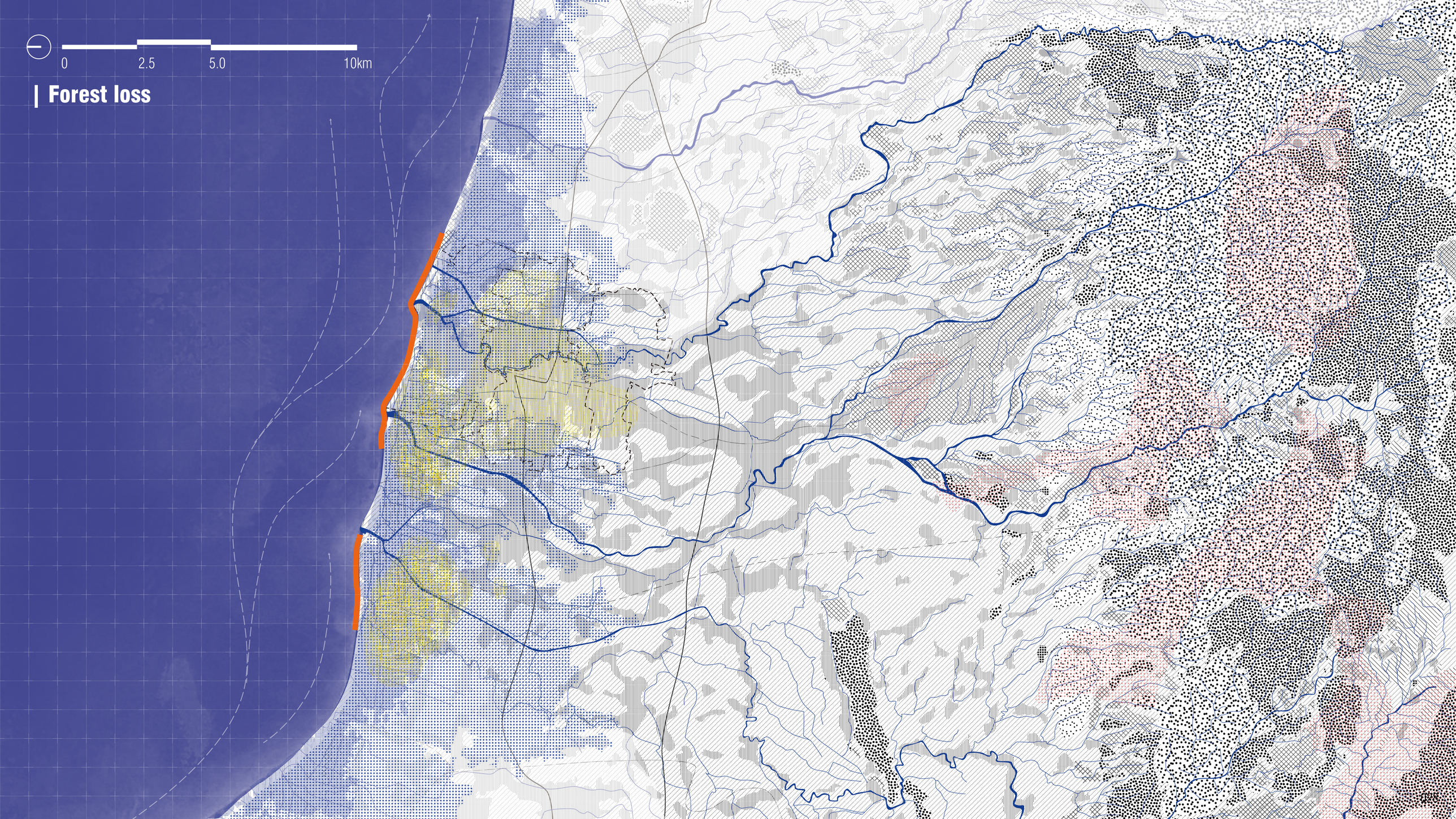


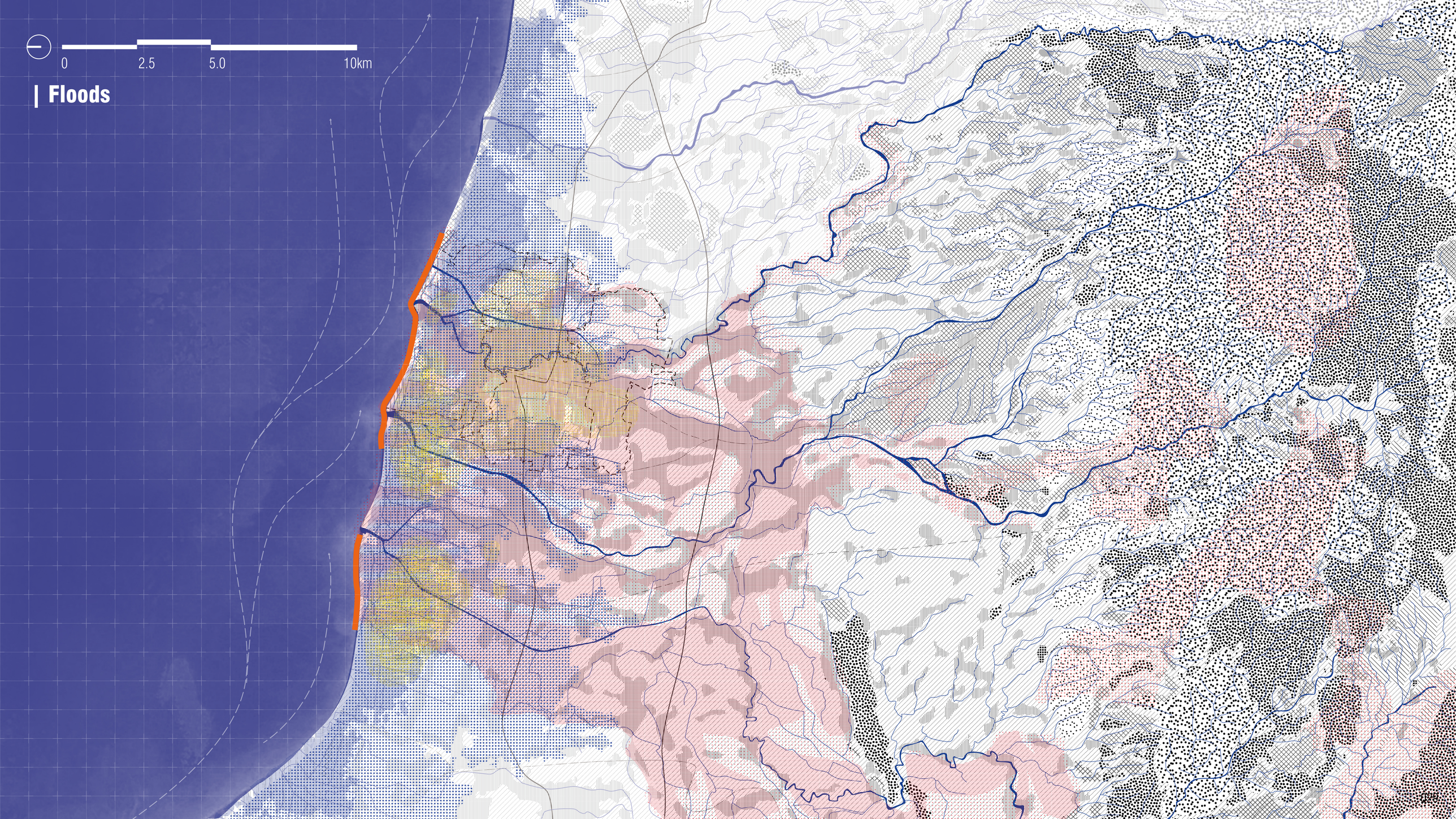

0
2.5
5.0
10km
Land use
Rice field
Built area
Economic forests

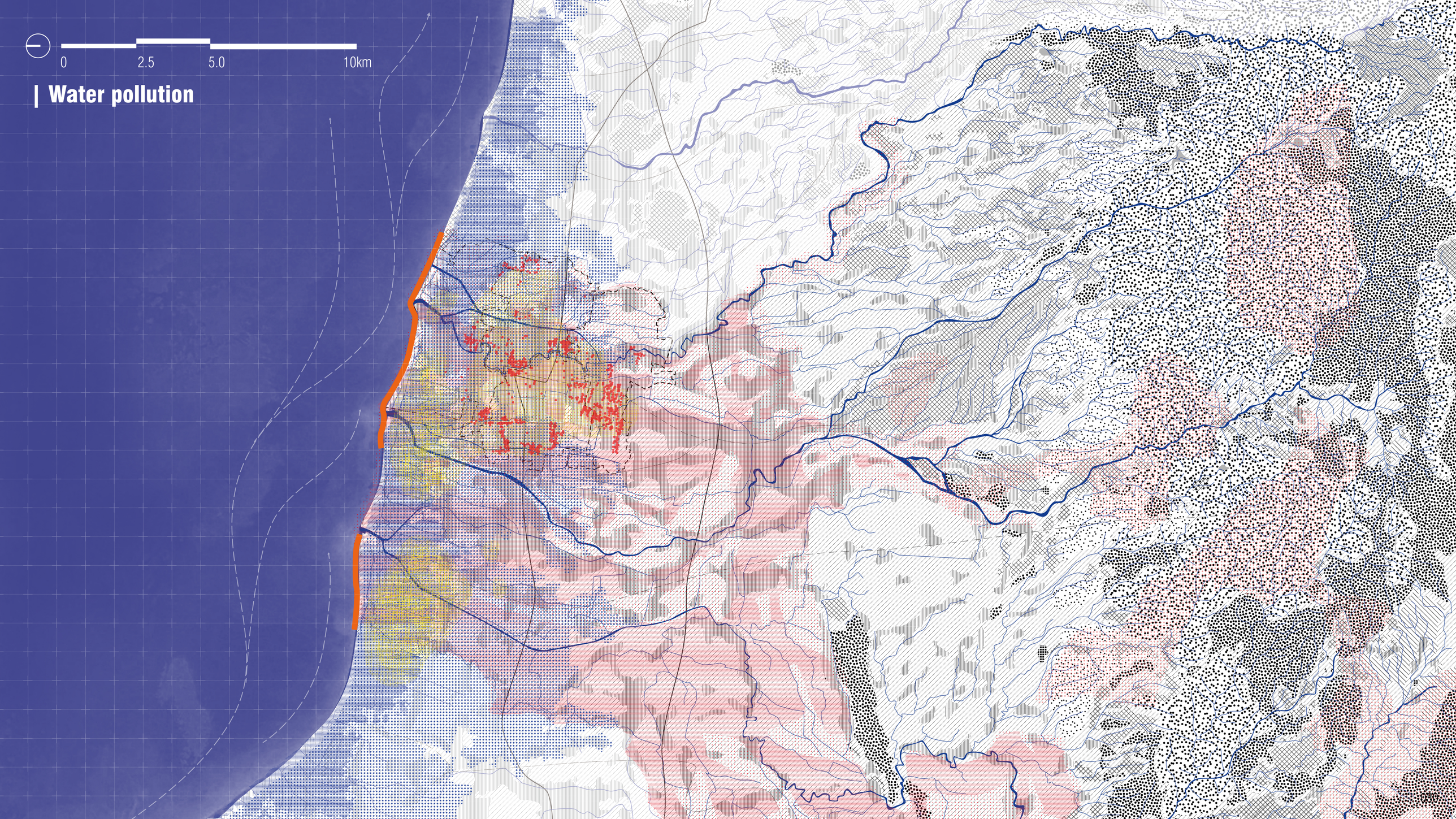

0
2.5
5.0
10km
| Coastal erosion


0
2.5
5.0
10km
| 1m | 2m inundation


0
2.5
5.0
10km
| Subsidence


0
2.5
5.0
10km
| Forest loss


0
2.5
5.0
10km
| Floods


0
2.5
5.0
10km
| Water pollution



Dry season, agriculture field, Pekalongan, 08/16/2017

Drought, agriculture field, Pekalongan, 08/16/2017
Source: https://www.shutterstock.com/zh/search/dry+season+in+indonesia



Rainy season, Flood in Pekalongan, 01/17/2019

FIG.6.20 Flood in Pekalongan, 01/17/2019
Source: https://www.antaranews.com/video/1984701/banjir-pekalongan-belum-surut-bantuan-terus-mengalir



Red flood in Pekalongan, 06/02/2021

FIG.6.21 Flood in Pekalongan, 06/02/2021
Source: https://www.bbc.com/news/world-asia-55966175

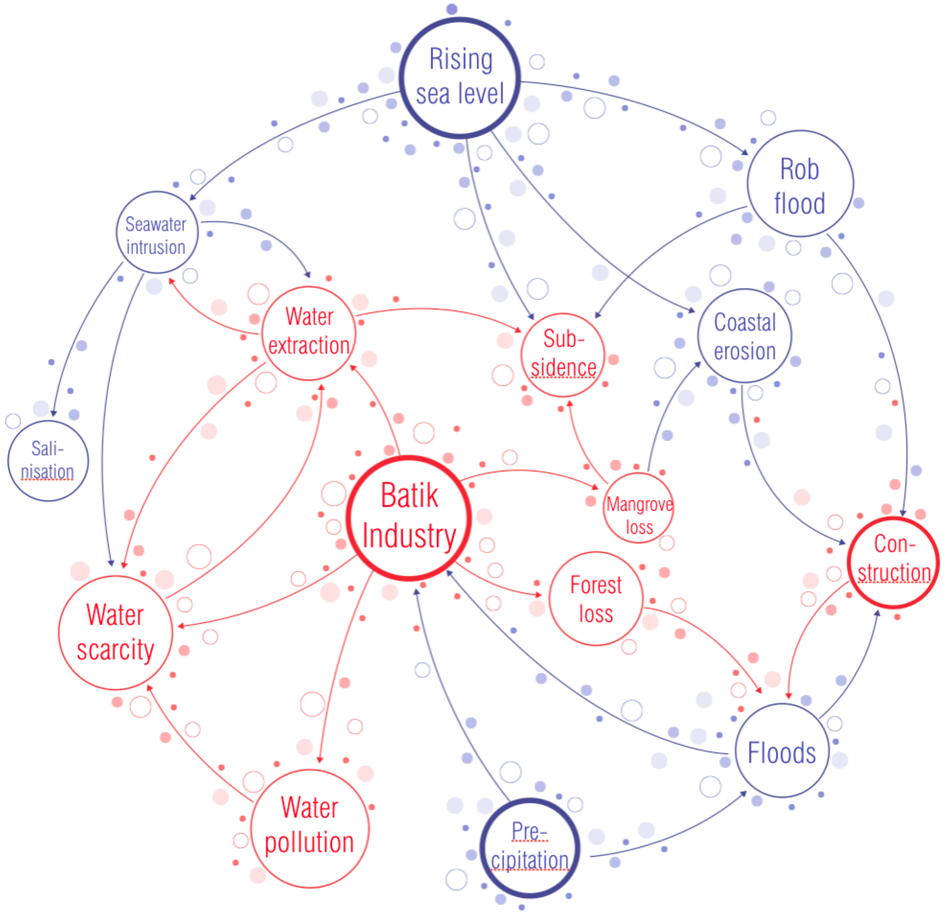
The potentials / role of landscape ?

-PROBLEM STATEMENT-

-Water safety-

-Dilemma between cultural development and natural resources-

-Potentials of landscape are ignored-

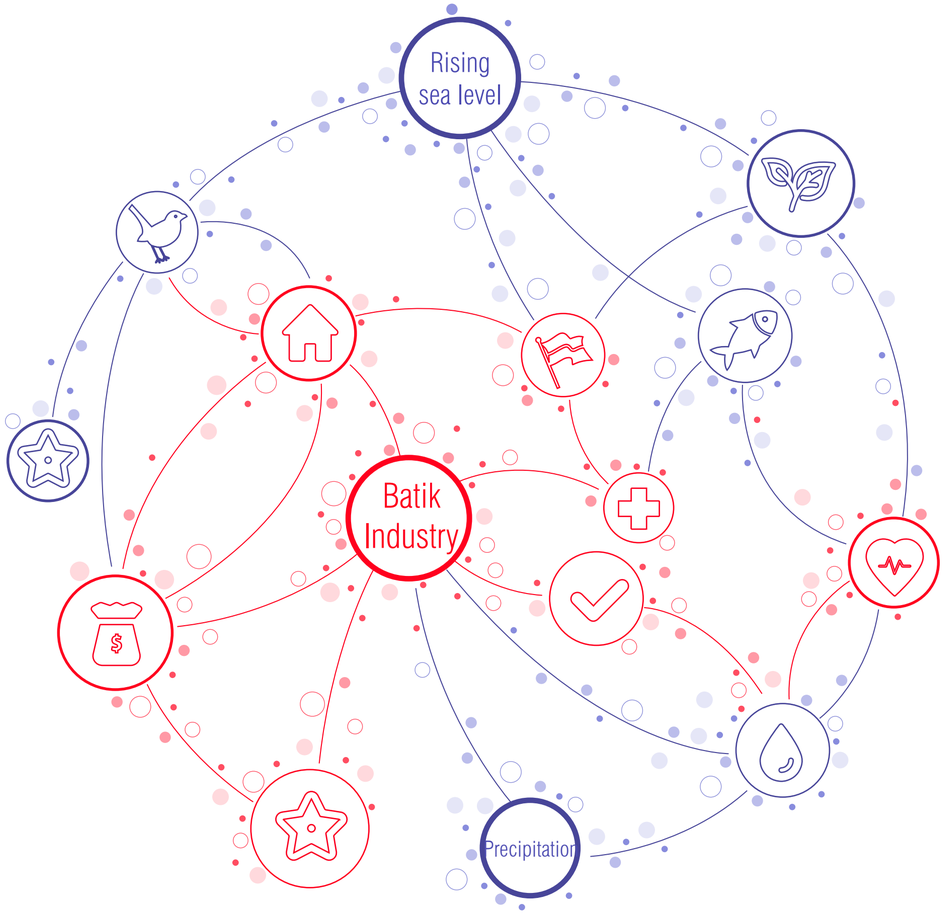


-OBJECTIVE & RESEARCH QUESTIONS-

How to create a resilient landscape framework

that facilitates

water safety and batik development in Pekalongan city ?



SUB RESEARCH QUESTIONS ?

What is the water safety issue, and the interconnection with the Batik industry ?

What does resilience mean for water safety and batik development ?

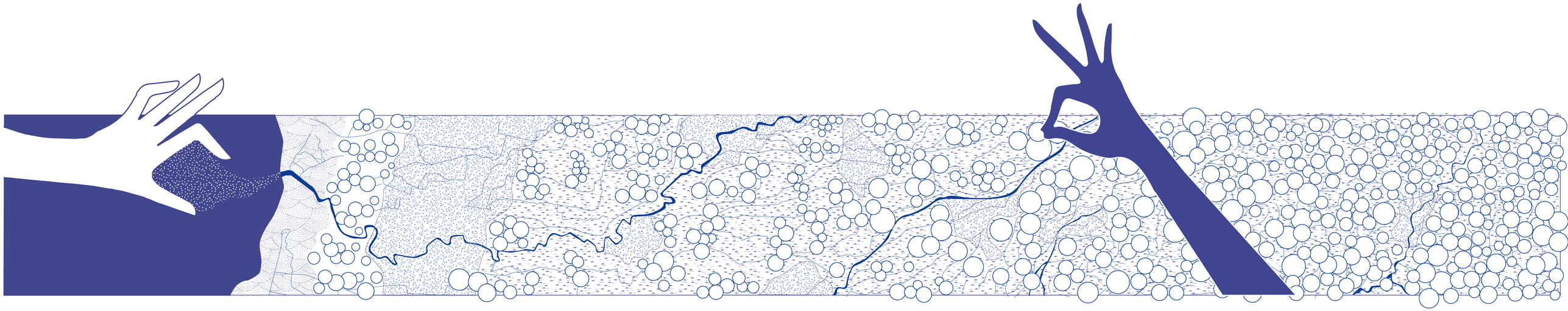
What are the principles to increase water safety and social practice ?

How to apply the strategy and principles within the cultural and natural conditions of the city Pekalongan ?

How to generate the spatial potentials / integration in different scales in the terms of landscape view ?

-METHODOLOGY-

The thesis applied one theory and three methods&approaches as a foundation. **(1) Landscape resilience** provides the theoretical framework and guidelines, On the other hand, the combination of **(2)Design research** and **(3)Research by design** provides a systematic approach to understand the context, investigate study area, summarise toolbox and conduct the actual design. **(4)Landscape-based solutions/Landscape approach** indicates the design methods.

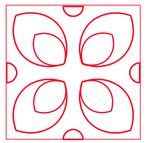


-UNDERSTANDING-

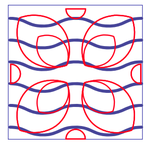
Three systems-



Water



Batik



Water-batik

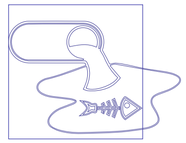
Three challenges-



Dangerous environment



Water scarcity



Environment pollution

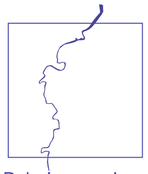
Five potentials-



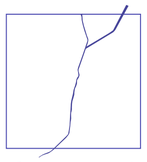
Precipitation



Sediments



Pekalonga river

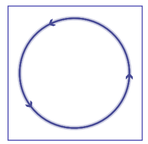


Banger canal

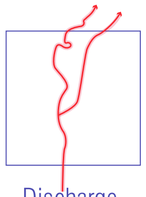


Mangrove

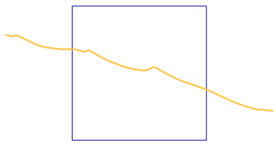
Three assignments-



Water circulation

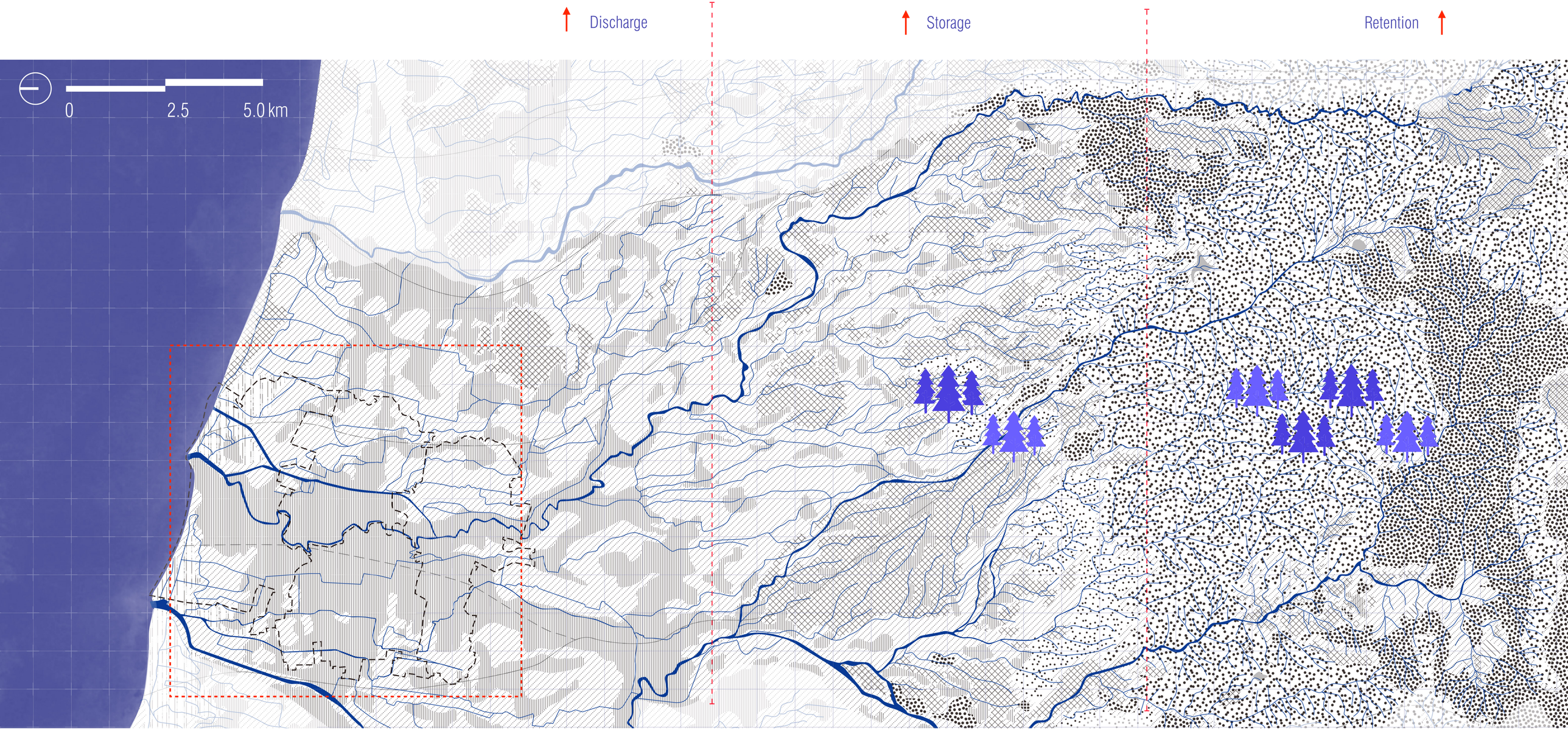


Discharge

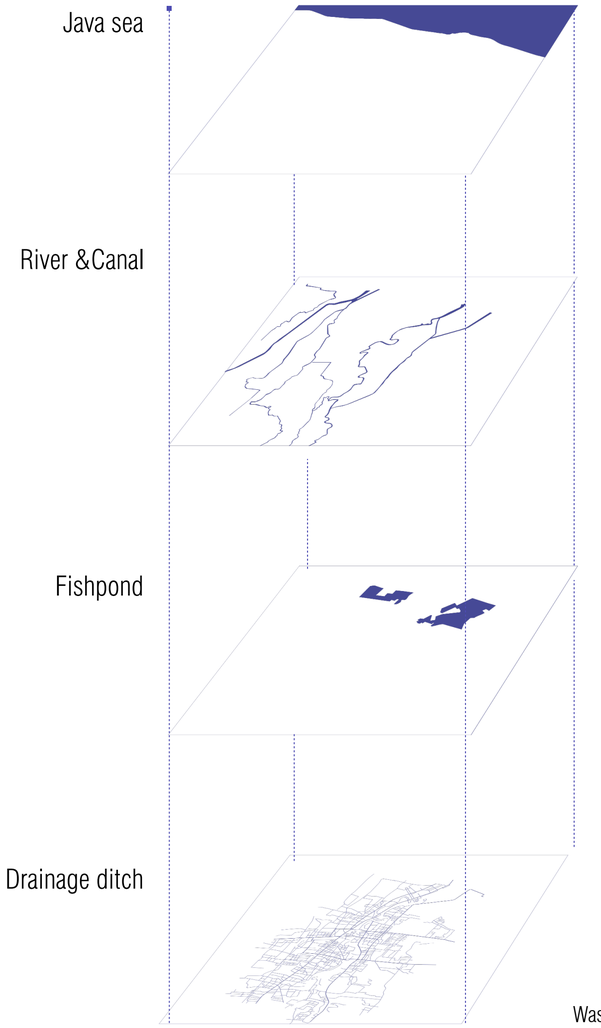


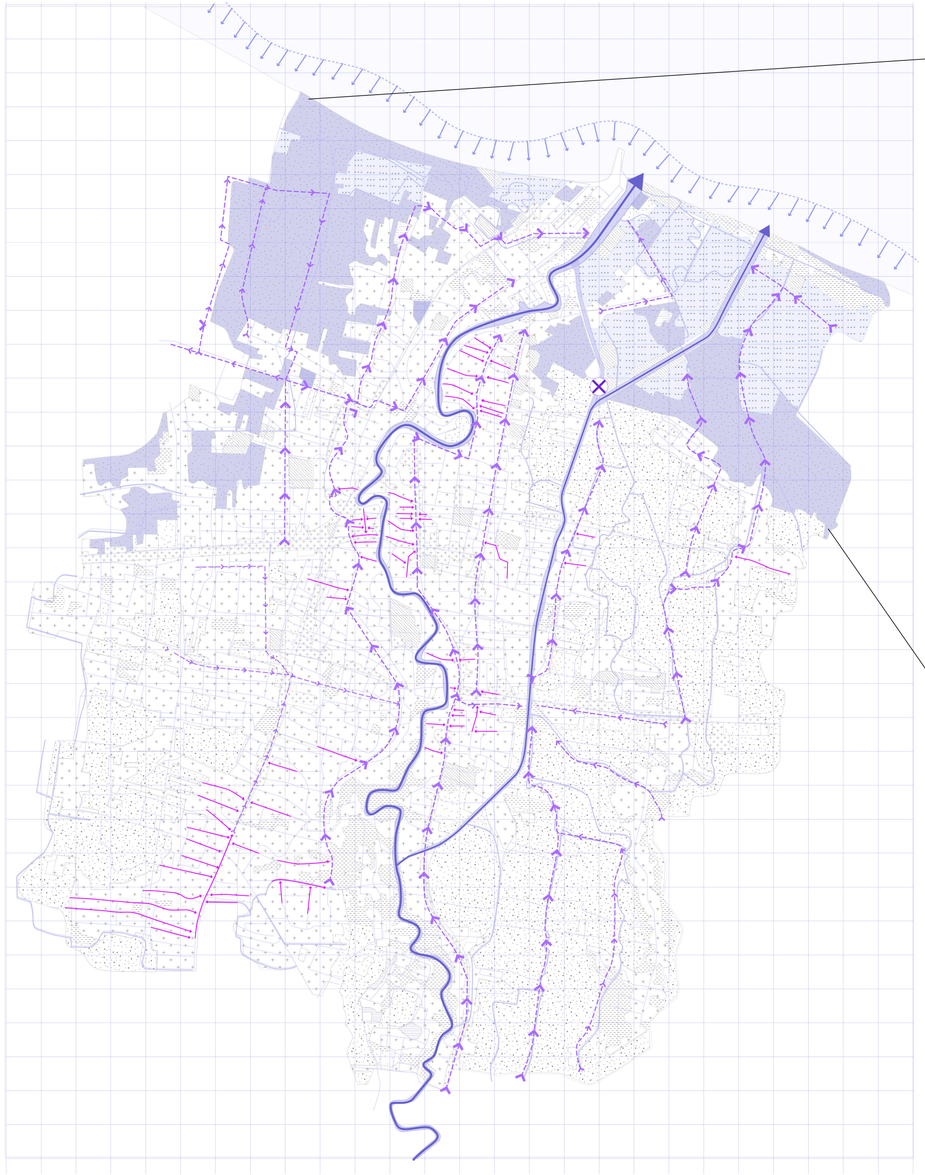
Coastal protection

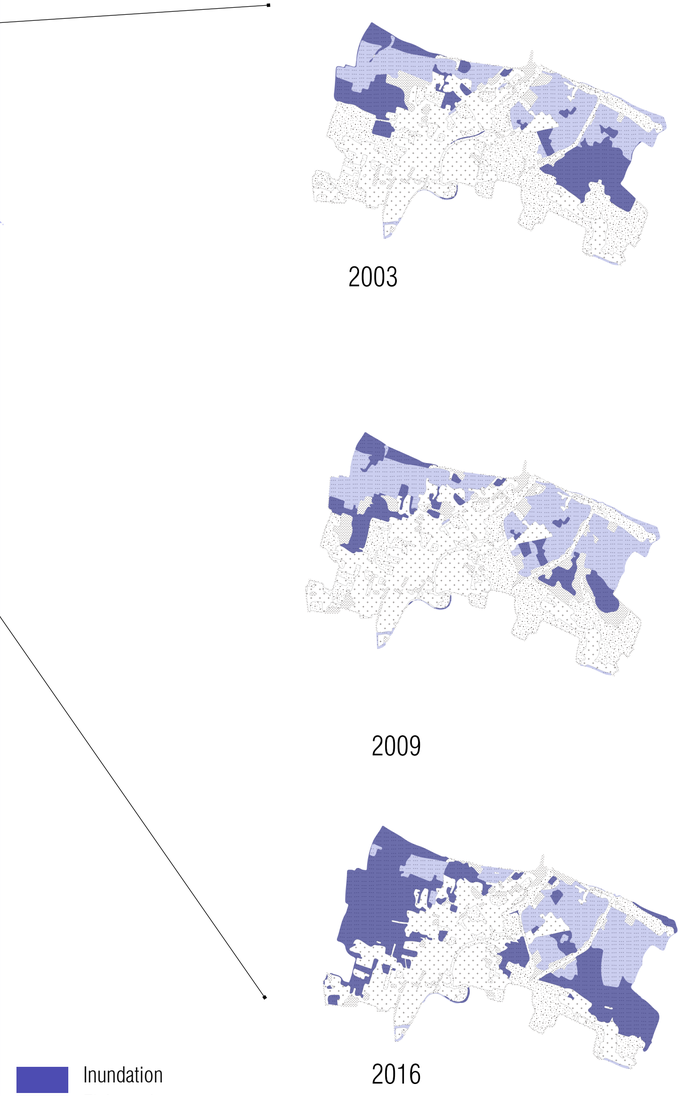
| Water - Kupang watershed



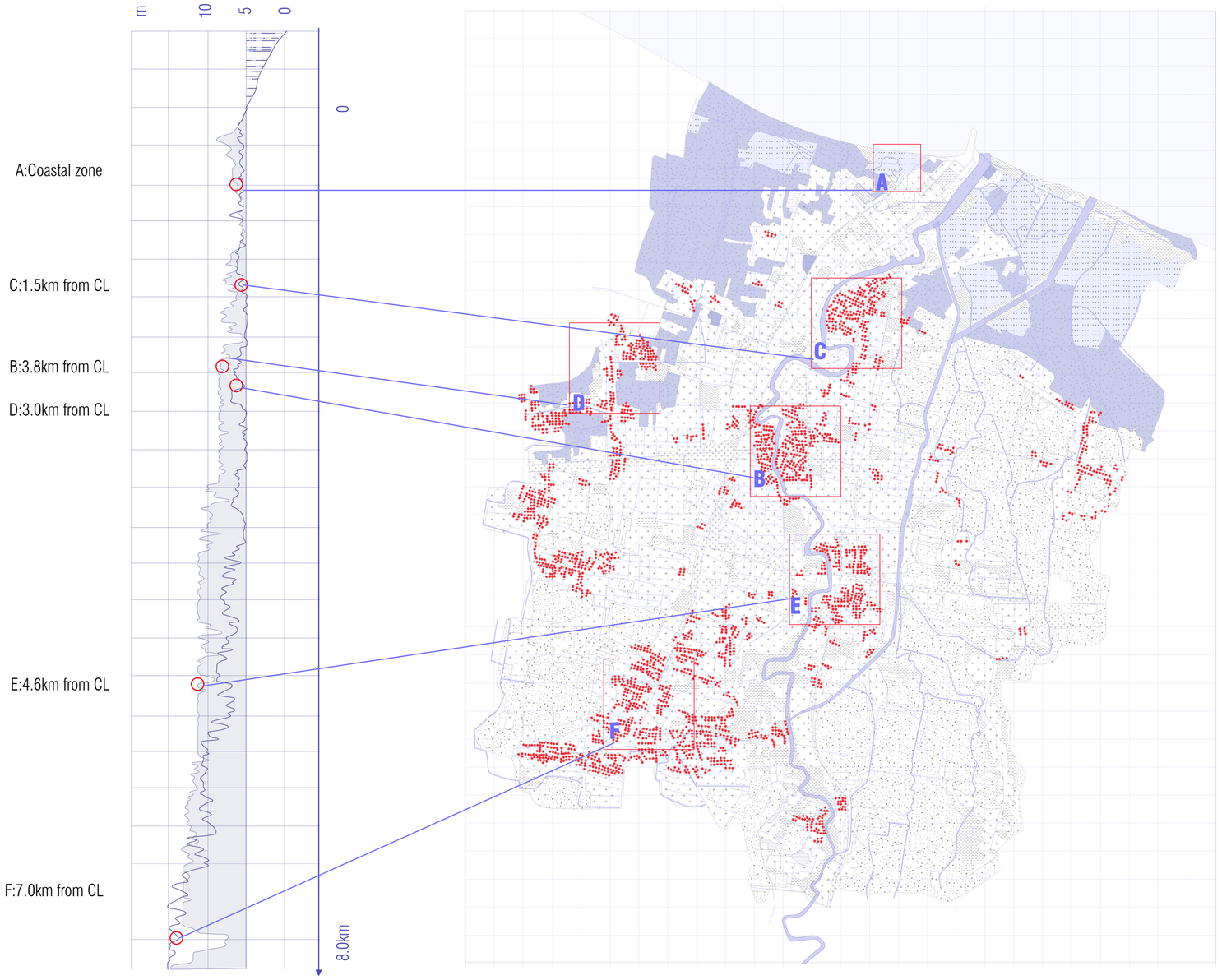
| Water-four layers







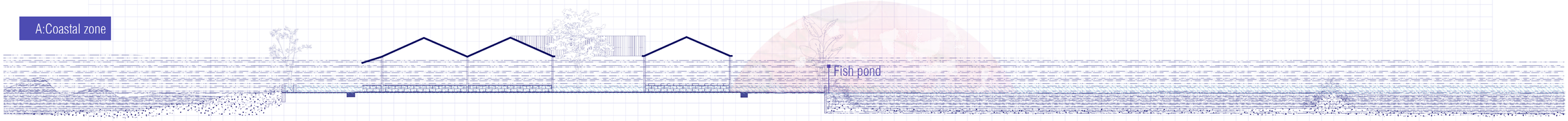
| Batik



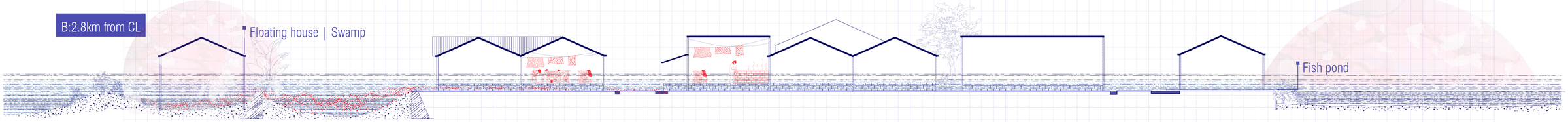
The batik factories distributed mainly along water courses.

Instead of gathering toghter, the city has six different batik renters.

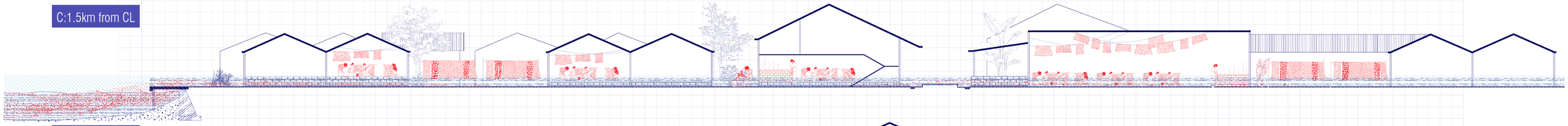
A:Coastal zone



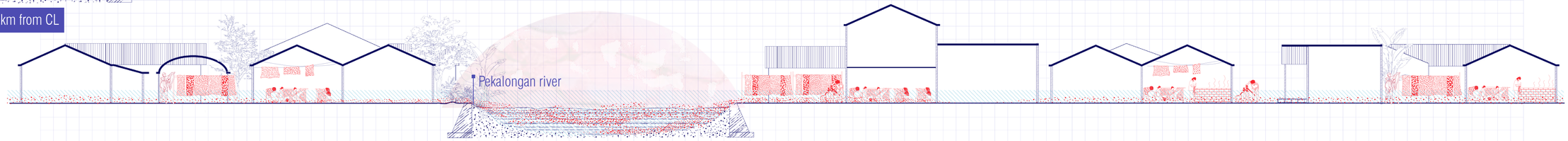
B:2.8km from CL



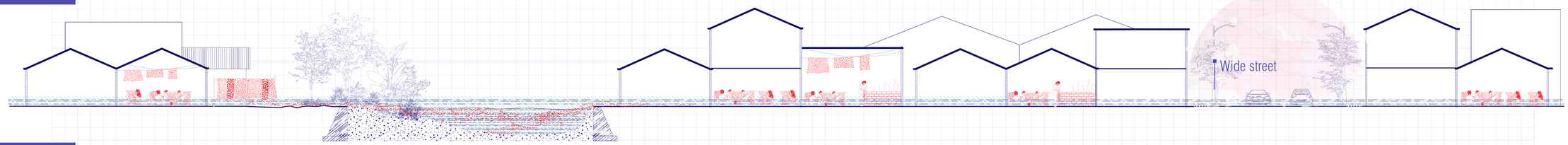
C:1.5km from CL



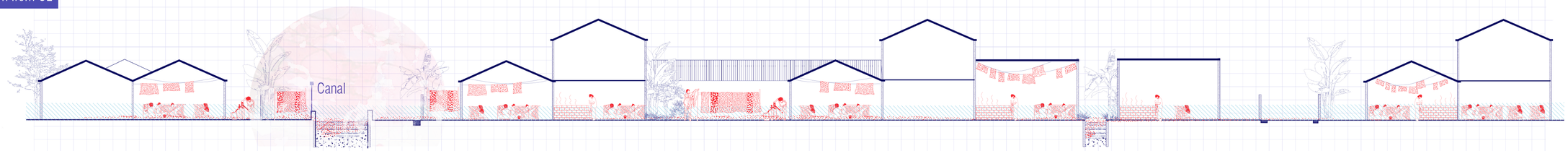
D:3.0km from CL



E:4.6km from CL



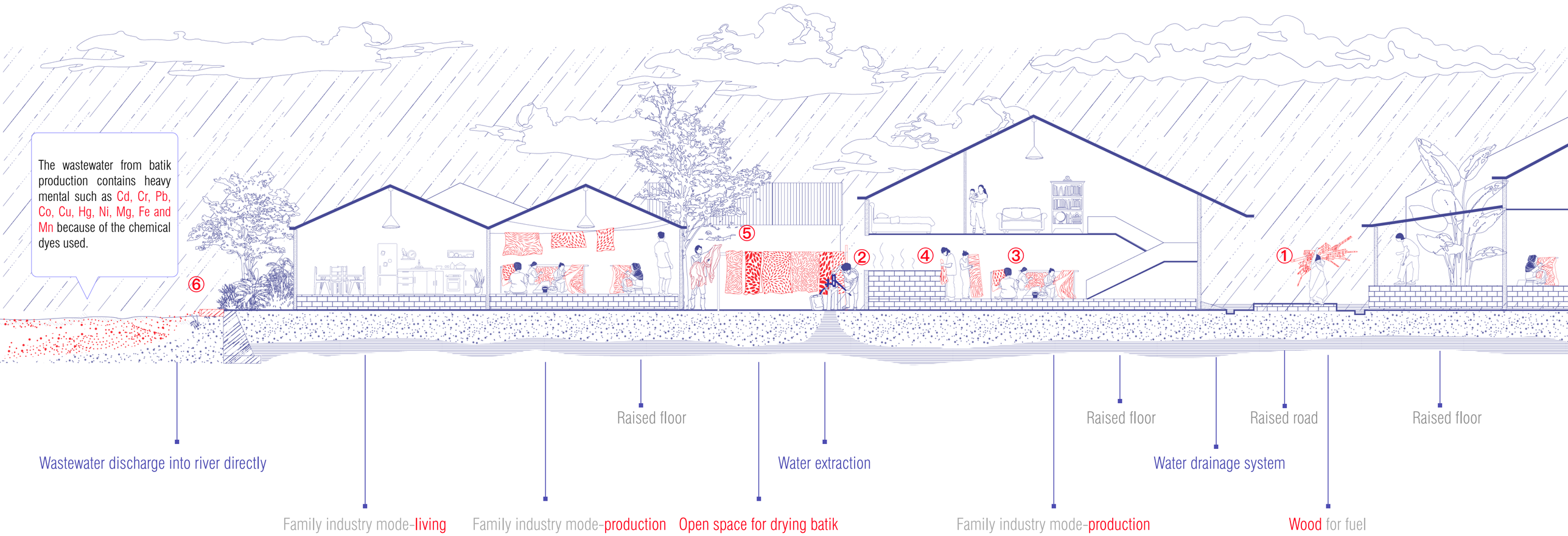
F:7.0km from CL



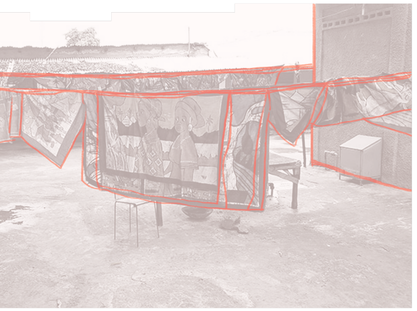
| Water-Batik system

97% batik industries are in family mode

e.g. Section C

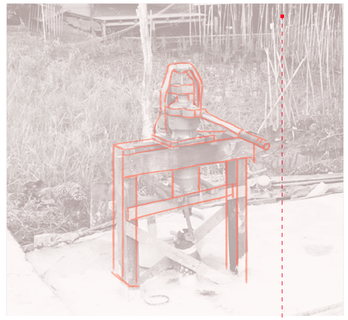


| Water-Batik system



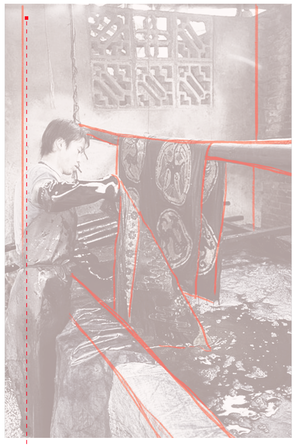


Open sape



Courtyard

Water-pump



Interior space

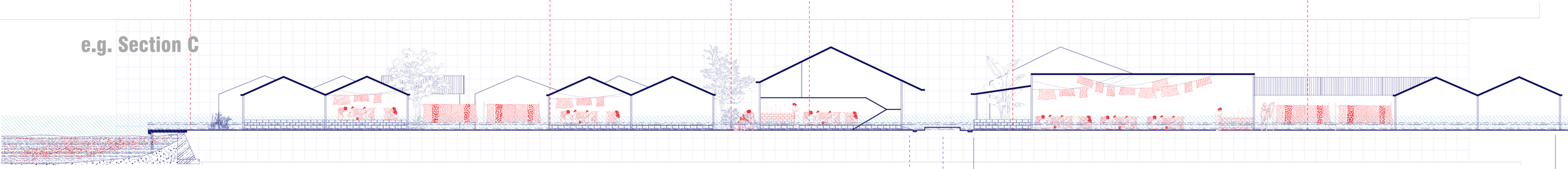


Interior space



Courtyard

e.g. Section C



Water-related elements



Pekalongan River



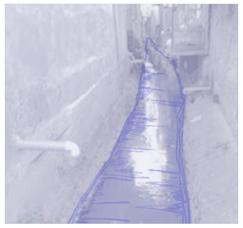
Drainage ditch - roadside



Drainage ditch



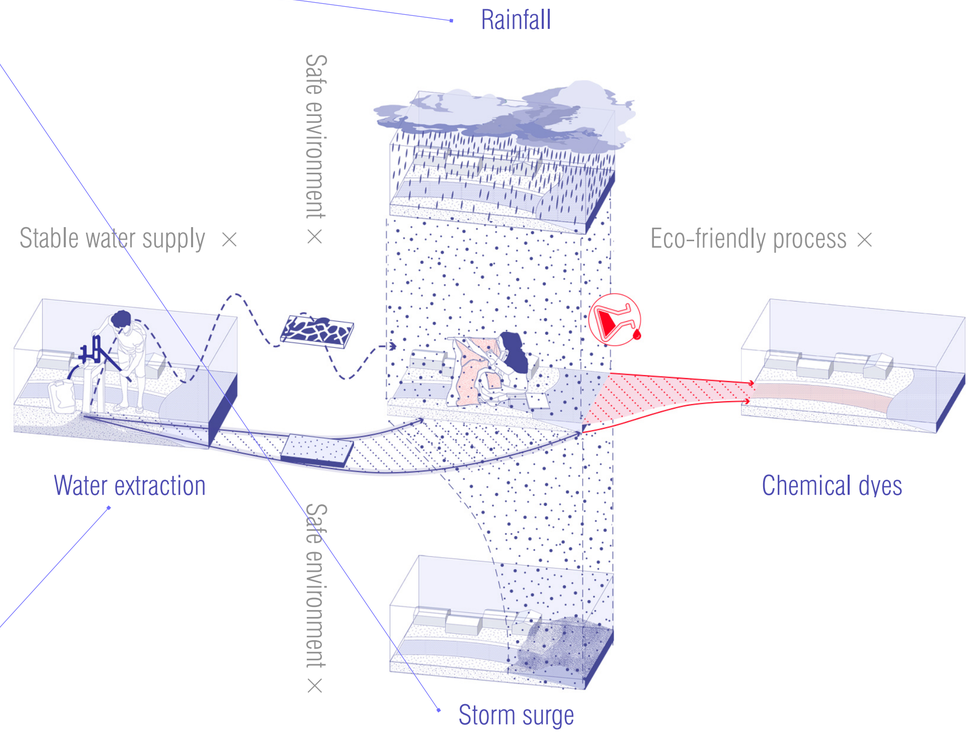
Inundated main street and raised sideroad



Small canal

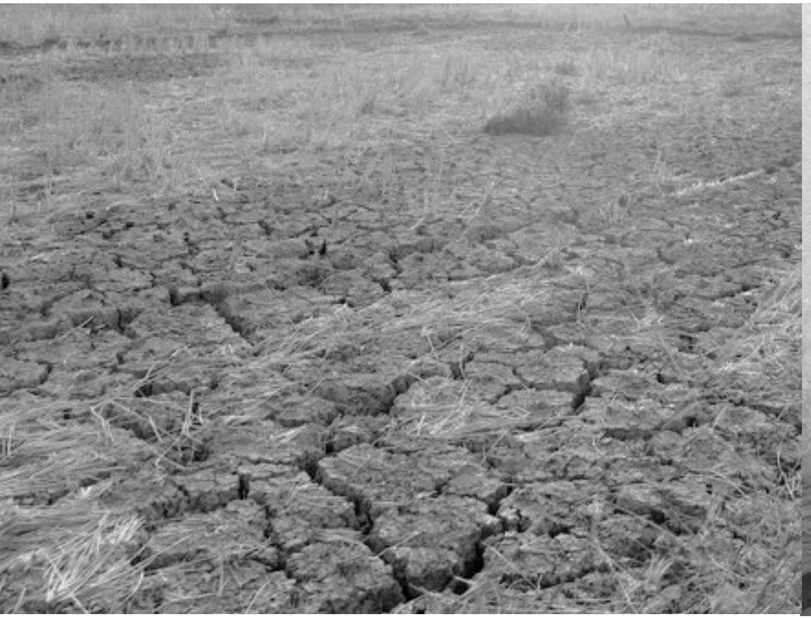
| Challenges

1.Vulnerable water environment



3. Uneco-friendly production process

2. Unstable water resource



Dry season, agriculture field, Pekalongan, 16/08/2017

Drought, agriculture field, Pekalongan, 16/08/2017
Source: https://www.shutterstock.com/zh/search/dry+season+in+indonesia



Storm surge, Pekalongan

Storm surge in Pekalongan city, Source: https://otomotifnet.gridoto.com/read/232179885/jeep-wrangler-tak-goyah-disembur-ombak-2-meter-pekalongan-dikepung-banjir-rob



Flood, Pekalongan

Storm surge in Pekalongan city, Source: https://otomotifnet.gridoto.com/read/232179885/jeep-wrangler-tak-goyah-disembur-ombak-2-meter-pekalongan-dikepung-banjir-rob



A boy is washing batik in the river.

Source: https://docplayer.info/65128833-Pemodelan-spasial-untuk-penentuan-lokasi-instalasi-pengolahan-air-limbah-ipal-batik-di-kota-pekalongan-jawa-tengah-putri-yasmin-nurul-fajri.html



The ditch is coloured by waste water from the batik industry.

Source: https://www.jawapos.com/jpg-today/21/10/2018/ulah-pabrik-tekstil-bikin-air-pdam-jadi-merah/



The wastewater

Source: https://www.greennews.ro/article/impactul-industriei-fashion-asupra-planetei-doar-15-din-deseurile-textile-se-reciclează-desi-95-s-ar-putea-valorifica

| The potential of landscape

① Rainwater → water source

Precipitation

2300mm/year ✖ 3,000,000m²

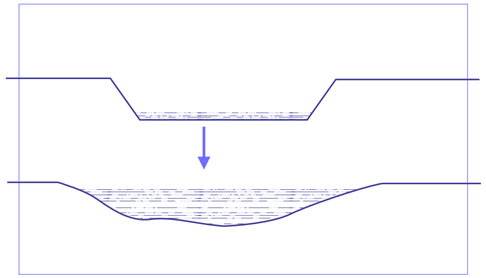
V

Batik industry

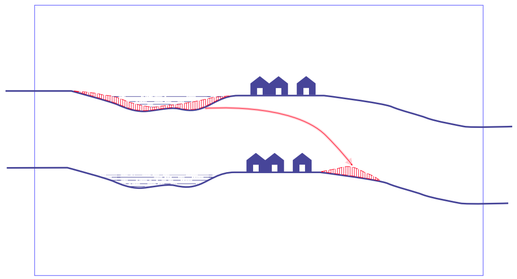
Consumption 1,023,324mm³/year

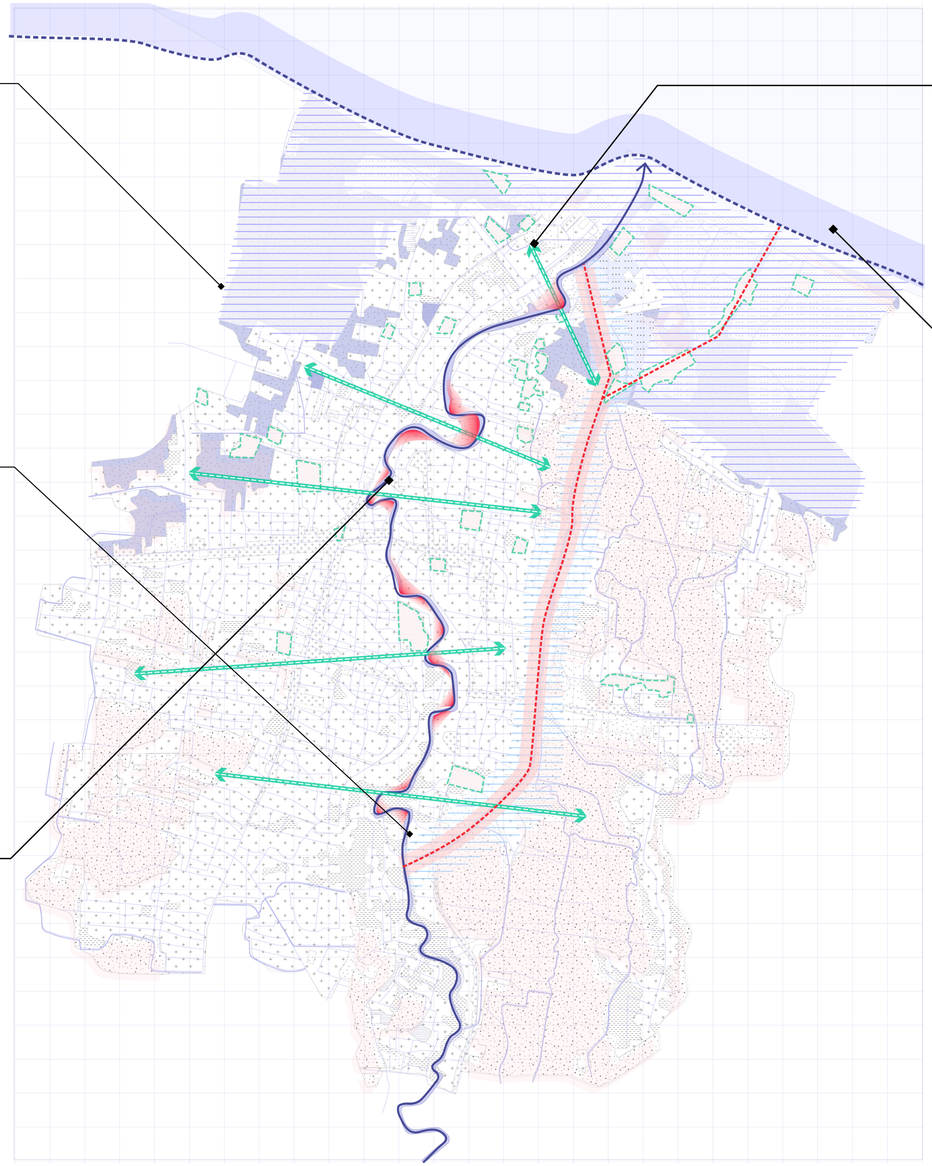
Emissions 972,157m³/year

② Banger canal → Water storage

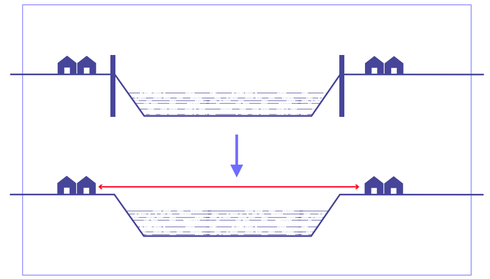


③Sediments → coastal protection

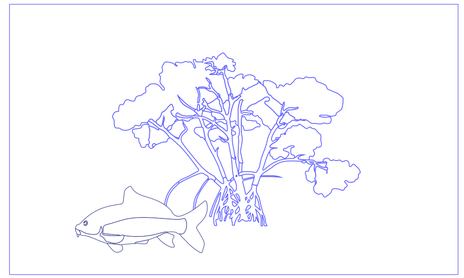




④ Pekalongan river → ecology & recreation

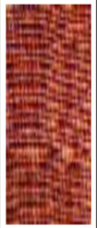
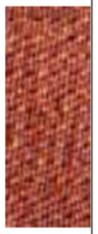
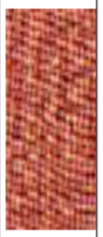
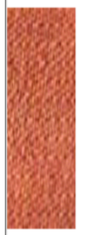


⑤ Mangrove → natural dyes/ aquaculture/ defence



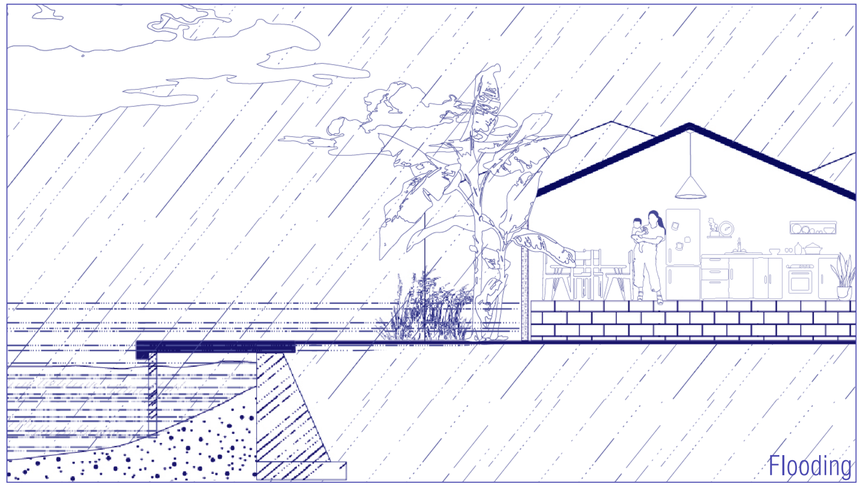
| The potential of landscape

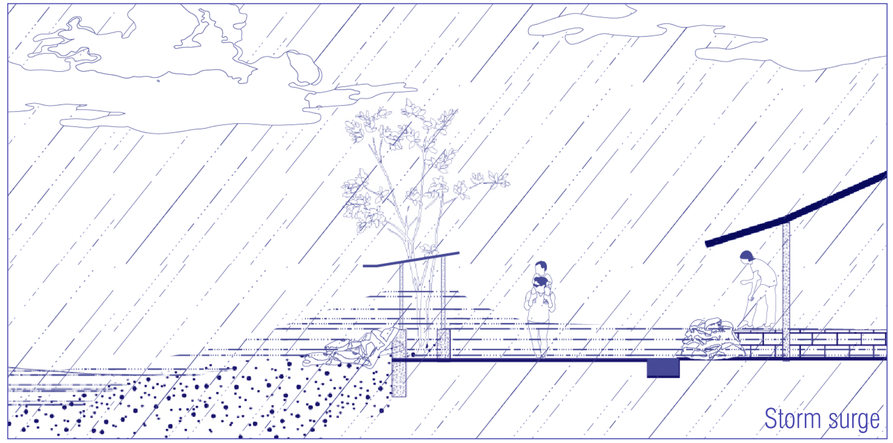
Natural dyes by waste mangrove fruit

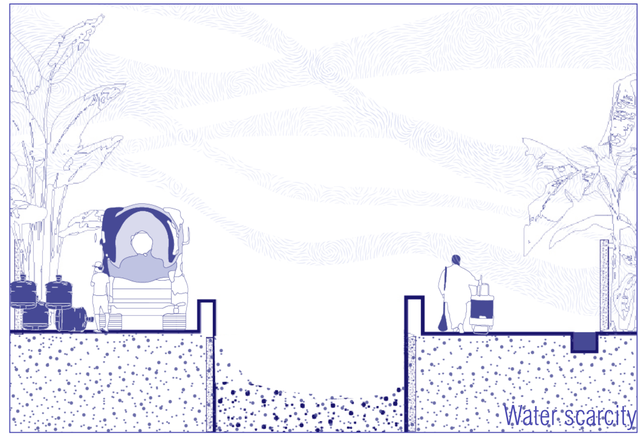
Bagian tanaman	*Sorenasia alba*			*Rizophora* sp			*Avecenia* sp			*Ceripos decandra*			*Agriceros* sp			*Lumicera* sp		
	TA WAS	KA PUR	TUN JUNG	TA WAS	KA PUR	TUN JUNG	TA WAS	KA PUR	TUN JUNG	TA WAS	KA PUR	TUN JUNG	TA WAS	KA PUR	TUN JUNG	TA WAS	KA PUR	TUN JUNG
Daun																		
Batang																		

Beautiful batik dyed by waste fruit from mangrove.

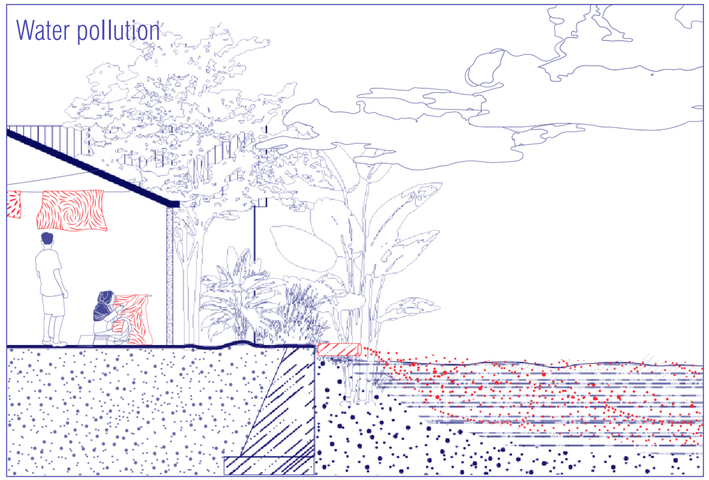
Source: http://www.asiantextilestudies.com/brown.html

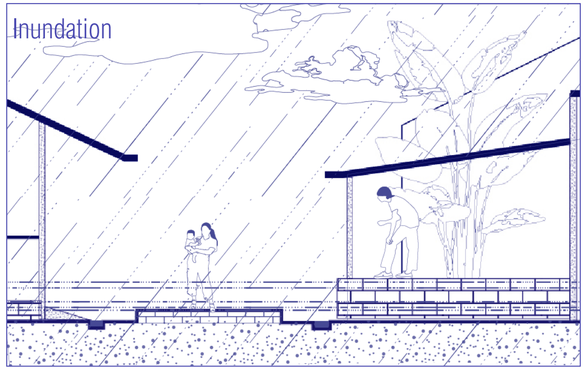


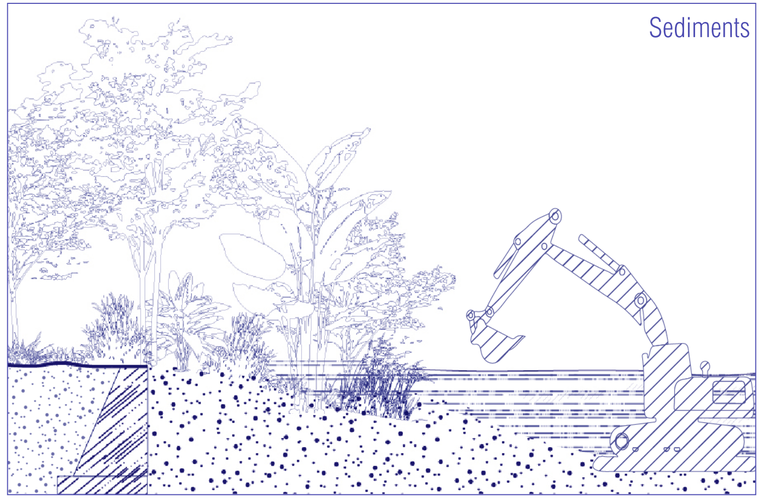








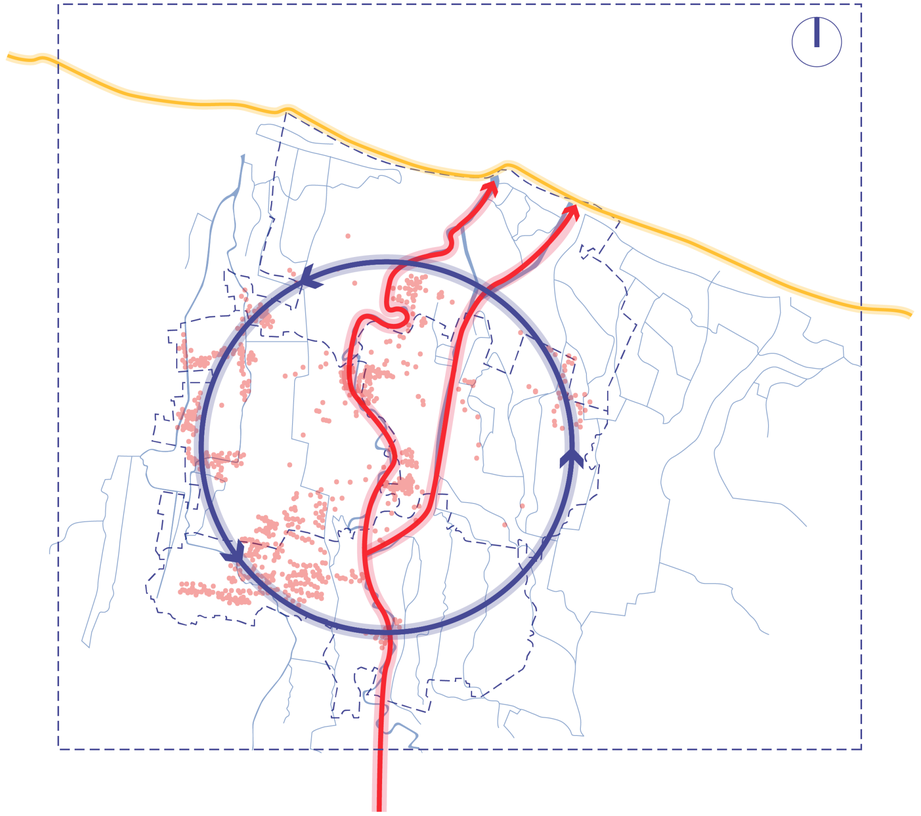




coastal erosion -COASTAL PROTECTION- coastal inundation | storm surge
water pollution | water scarcity -WATER CIRCULATION- flooding | intense precipitation
flooding -DISCHARGE CAPACITY- sediments

| Design assignment

Discharge capacity | Water circulation | Coastal protection



-CASE STUDY & PRINCIPLES-

| Bishan-Ang Mo Kio Park | RambolI Studio DreiseitI

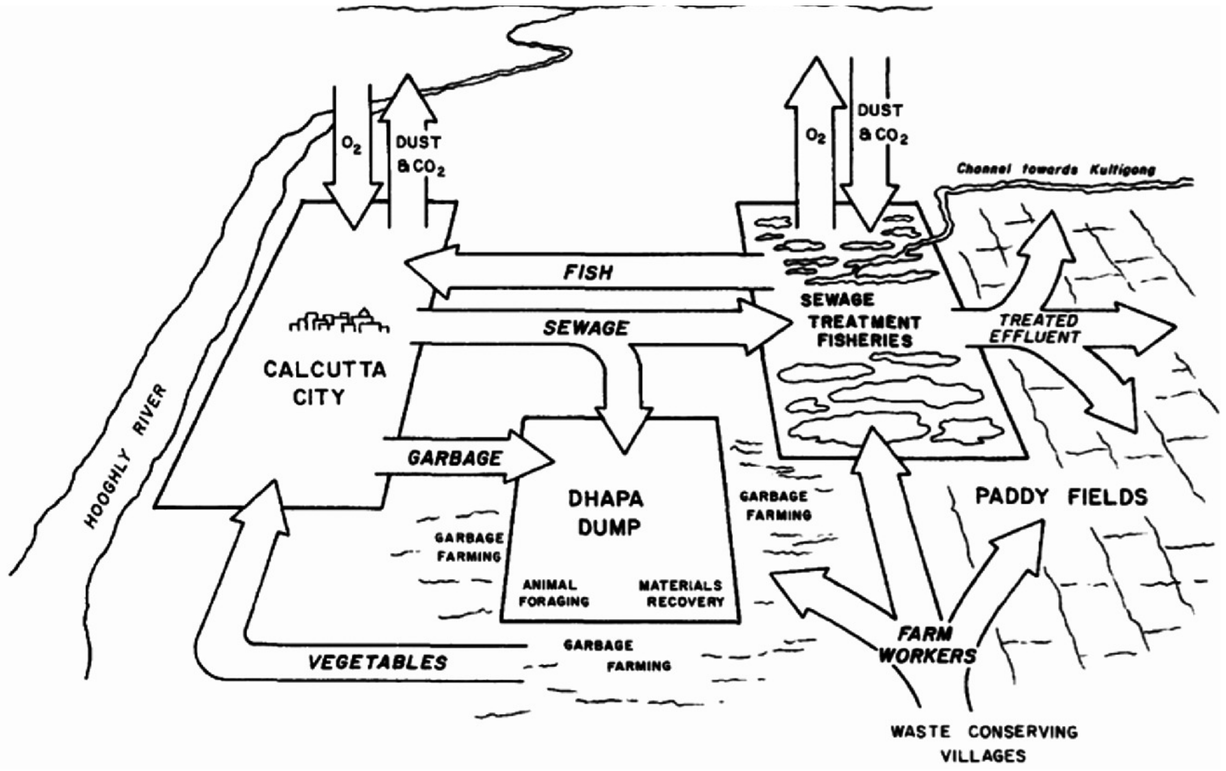
http://www.dreiseitl.com/en/portfolio#bishan-ang-mo-kio-park



Canal Renaturalization

Bheri Wastewater Aquaculture | A traditional aquaculture system 1920CE

Source: https://www.theguardian.com/sustainable-business/2017/jan/25/kolkata-west-bengal-india-cites-fish-farming-sewage-food-demand-real-estate



Traditional aquaculture syetem

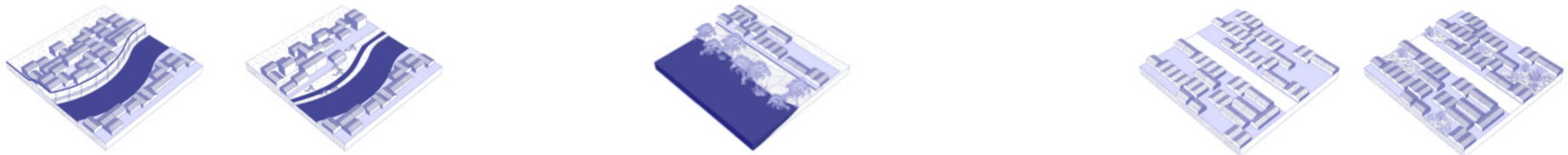
Discharge capacity

Coastal protection

Water circulation

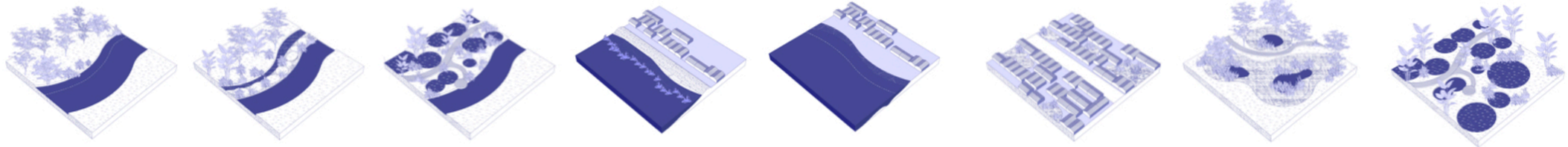
S

Double deck	Sub-canal	Mangrove	Green roof	Green courtyard



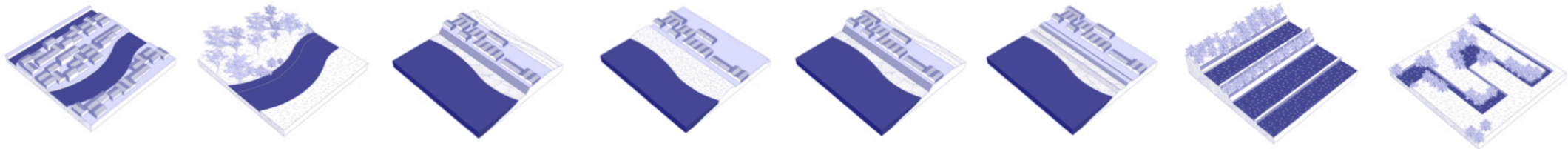
M

More zoom	Sub-canal	Wetland	Oyster feef	New shoreline	Wetland	Green street	Wetland



L

Alternative by-pass	More zoom	Multi functional dike	Sand engine	Multi functional dike	Double dune	Water purification	Liner purification



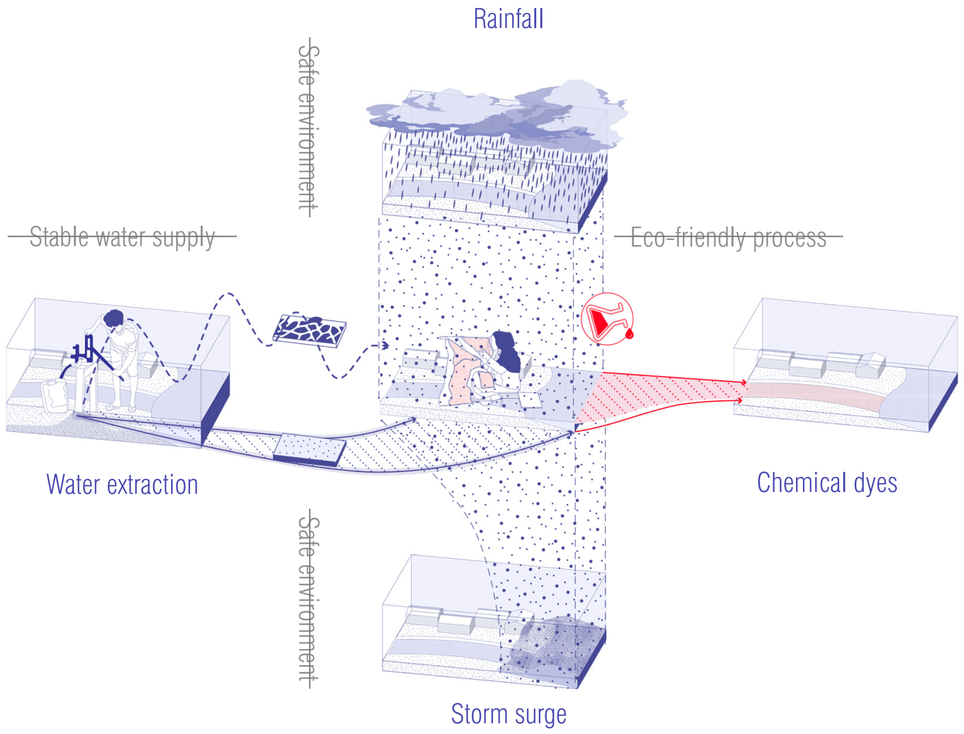
-DESIGN EXPIORATION-

-The new batik-water system-

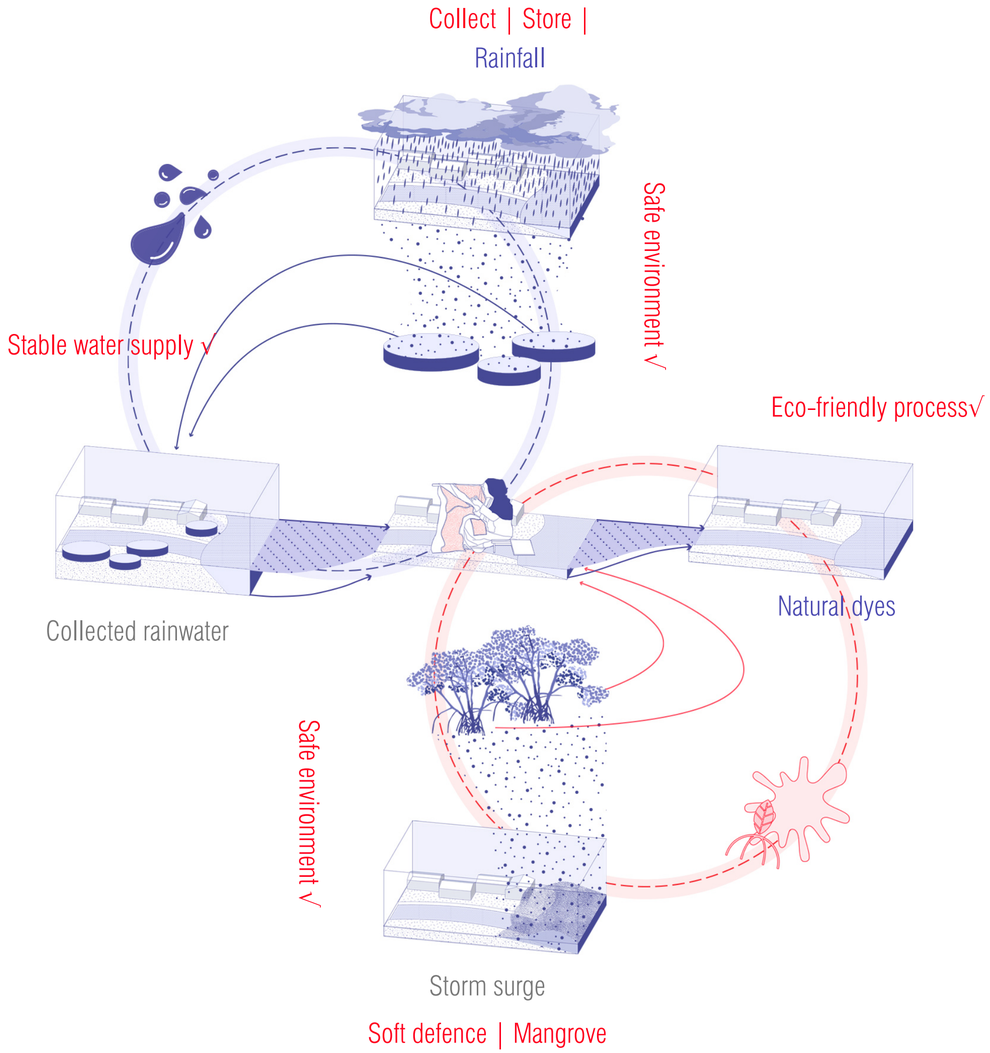
-Water system as the base-
-The three water related assignments-
-Landscape as a whole-

| The new Batik-water system

-Current water-batik system-



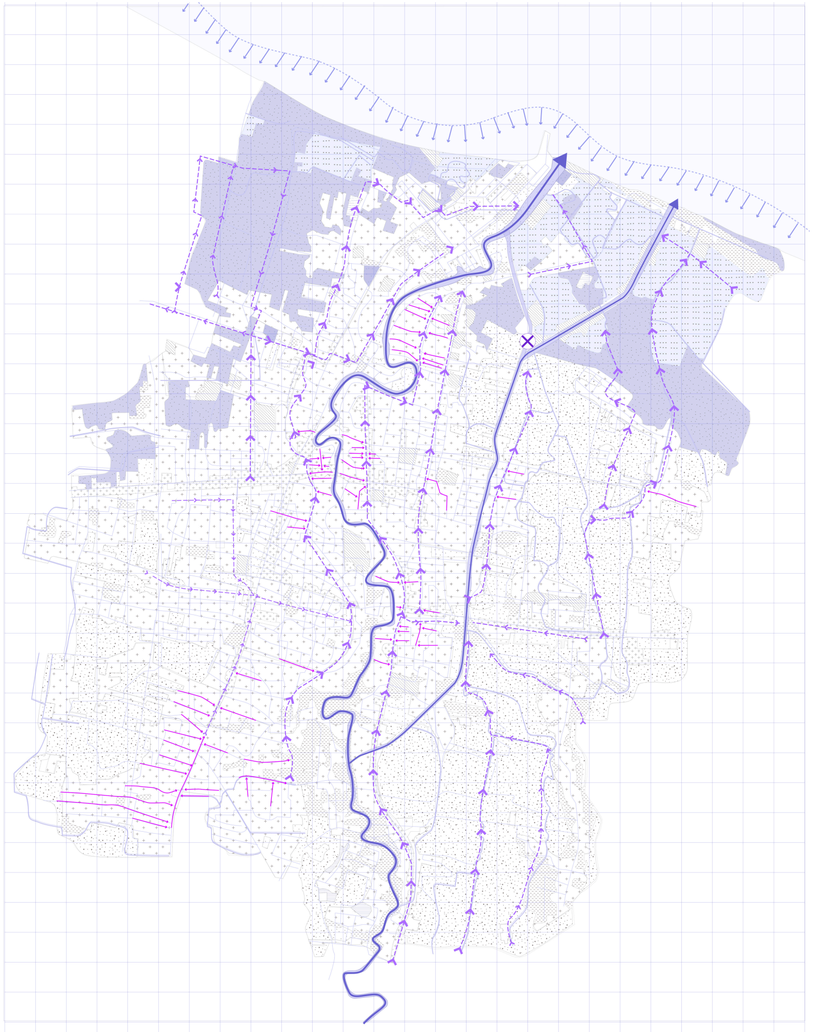
-Proposed water-batik system-



How to achieve the new water-batik system spatially ?

| Water flow

-Current water flow-

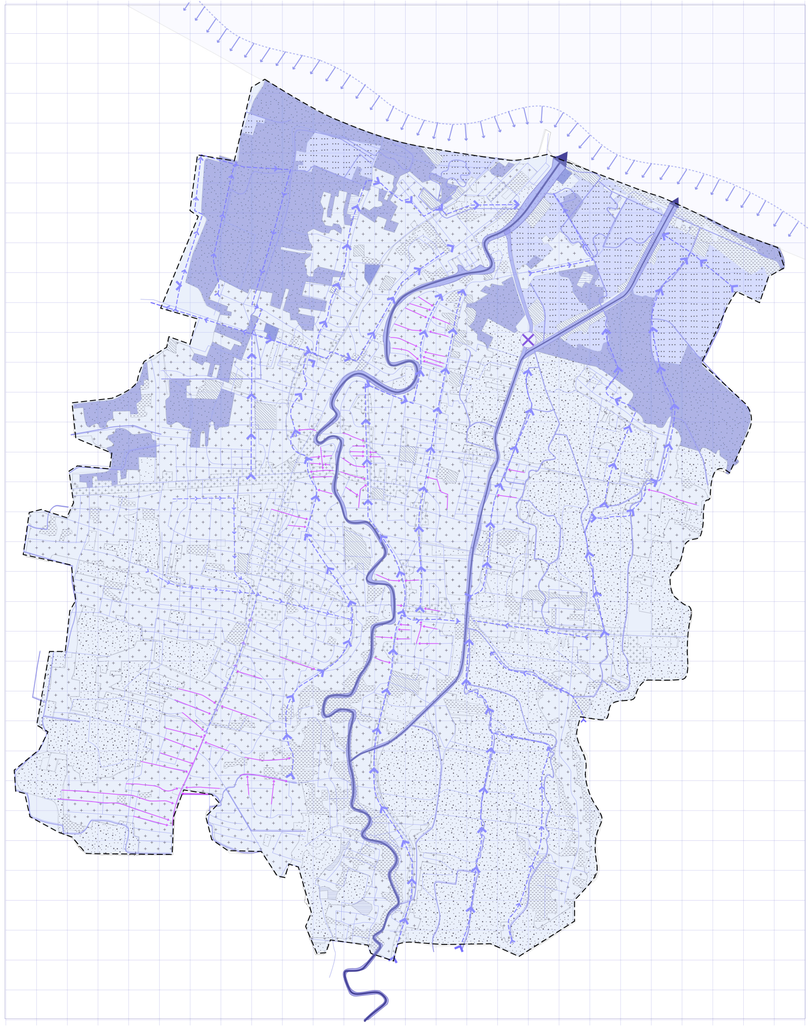


-Proposed new system-

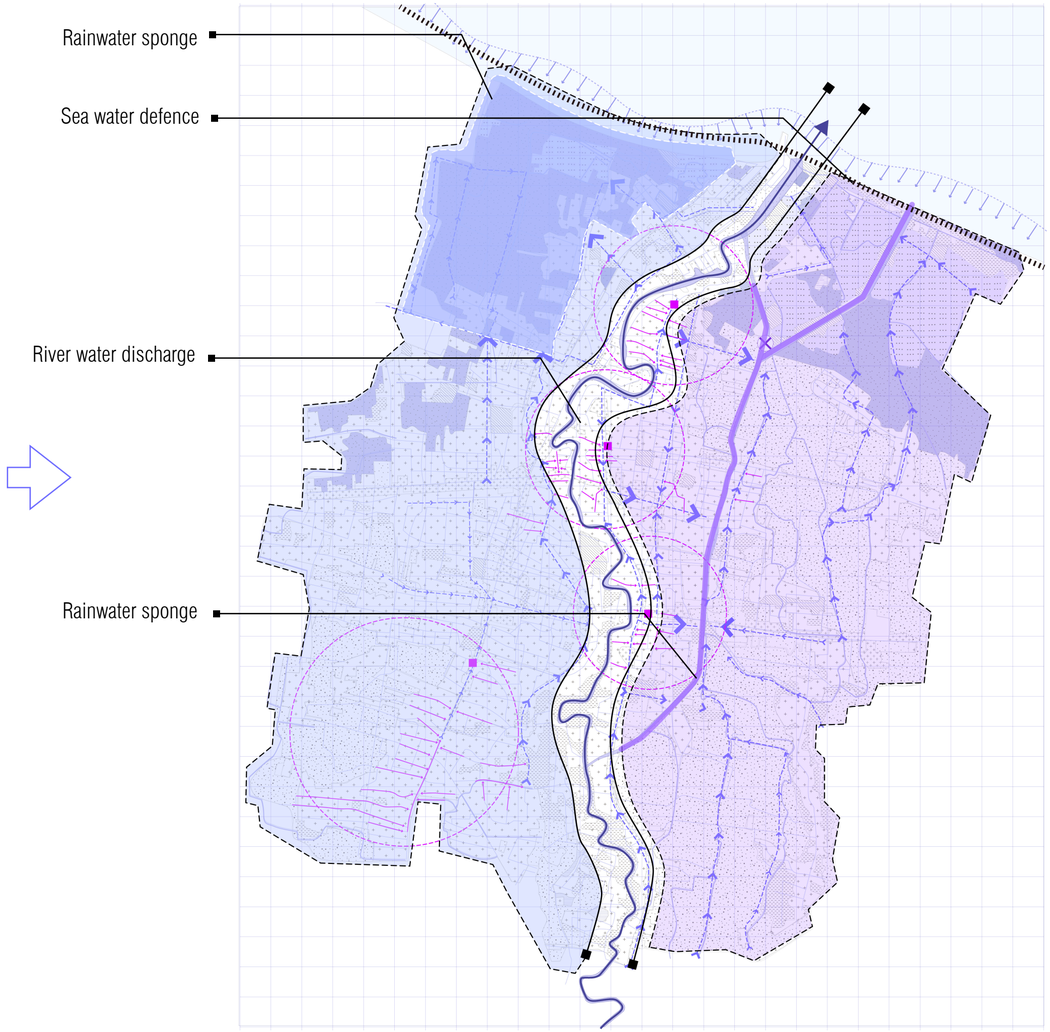


| Water system as the base

-Current water system-

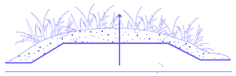


-Proposed new system-

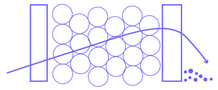


| Water infrastructure

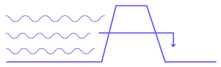
Hidden dike



Bamboo structure



Inlet



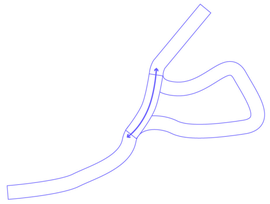
Sluice

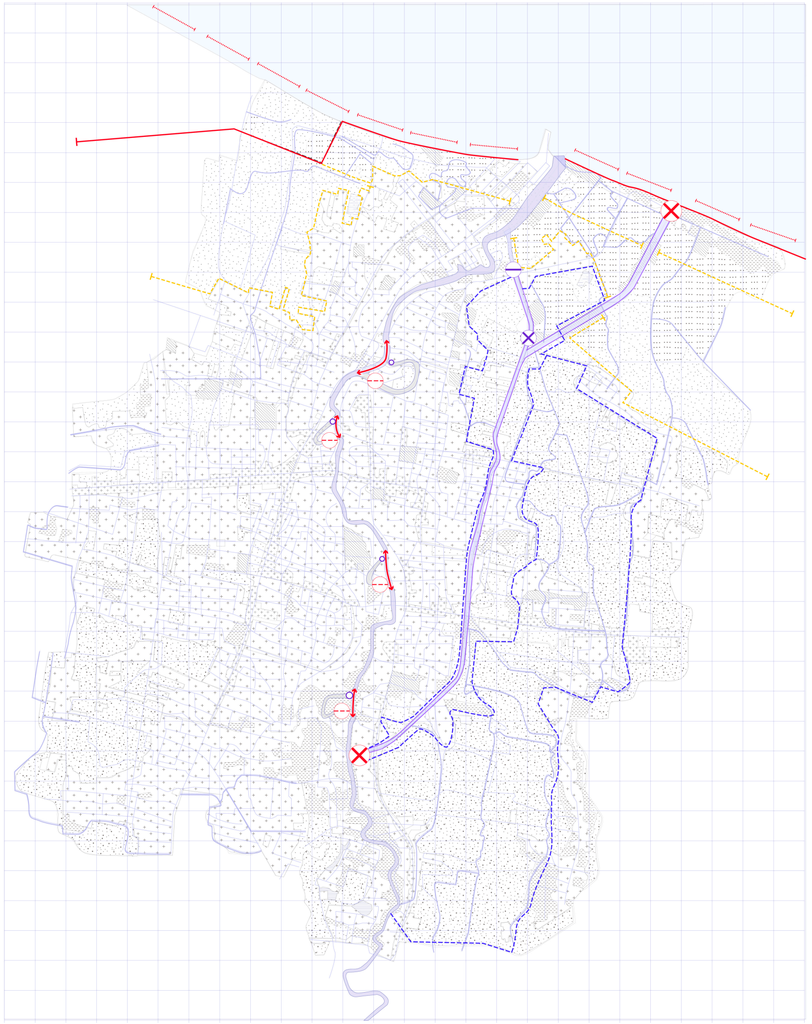


Pump



New river-course





| Decompose to three water-related assignments

COASTAL PROTECTION



Productive & protective coast

DISCHARGE CAPACITY



Resilient Pekalongan river

WATER CIRCULATION



Sponge city

-1/3 COASTAL PROTECTION-



2003

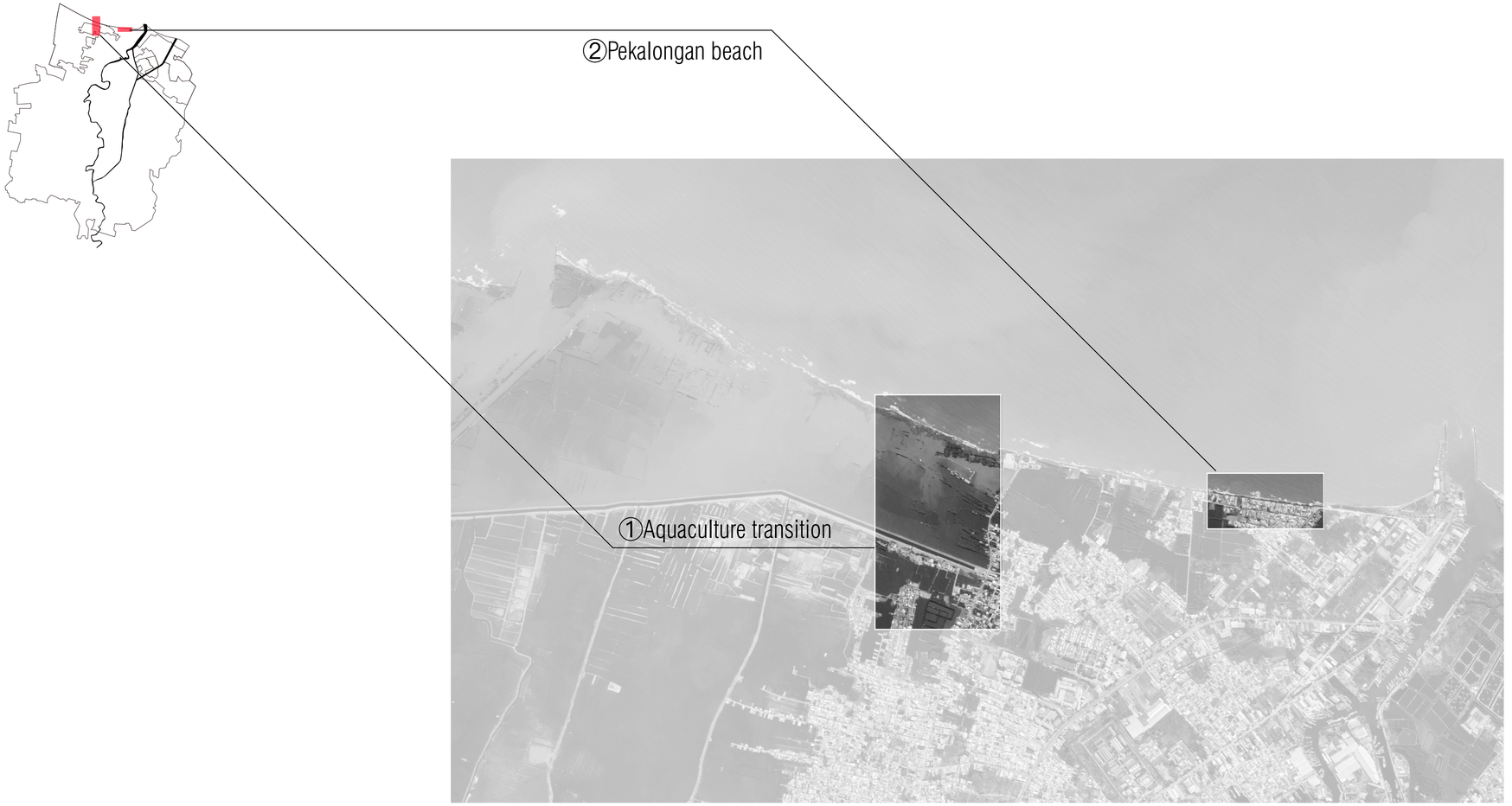
Source: Google map, https://www.google.com/maps/place/Pekalongan,+Pekalongan+City,+Central+Java,+Indonesia/@-6.8959407,109.6394839,13z/data=!3m1!4b1!4m5!3m4!1s0x2e70242ca490fe13:0xc0c68a126b258cb6!8m2!3d-6.8898362!4d109.6745916, edited by the author.



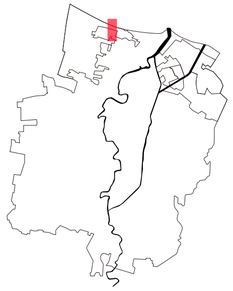
2020

Source: Google map, https://www.google.com/maps/place/Pekalongan,+Pekalongan+City,+Central+Java,+Indonesia/@-6.8959407,109.6394839,13z/data=!3m1!4b1!4m5!3m4!1s0x2e70242ca490fe13:0xc0c68a126b258cb6!8m2!3d-6.8898362!4d109.6745916, edited by the author.

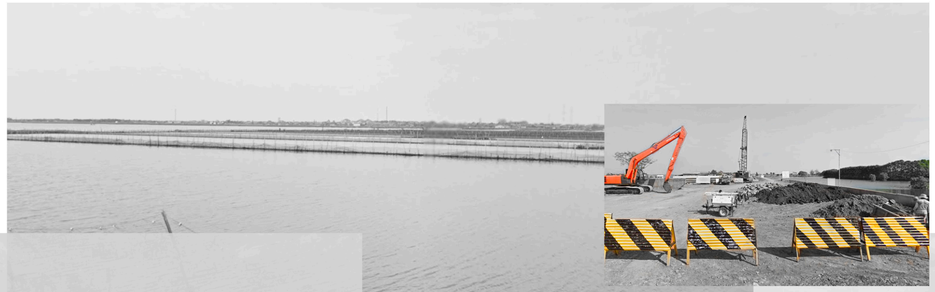
| Study location



| Current situation- The zone focus on aquaculture



① Flat vulnerable landscape with hard infrastructure under construction.



Dike under construction



Poor defence between sea and land

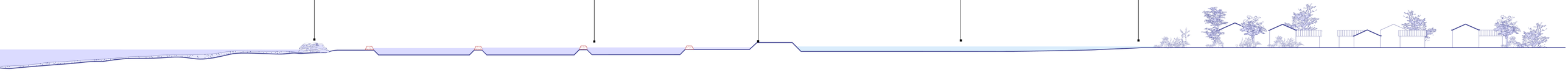
Fishpond



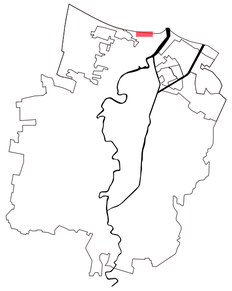
Fishpond prone to be inundated



Fish hut

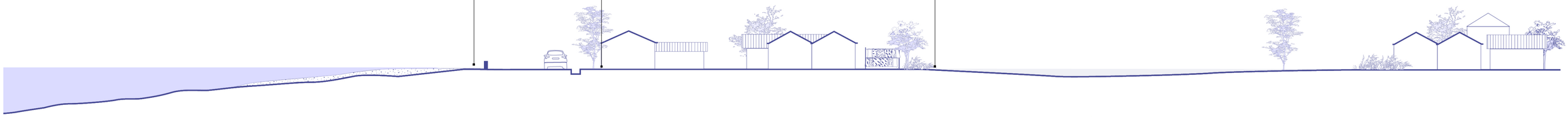


| Current situation-The beach and coastal community



② Poor facilities and vulnerable coastal community





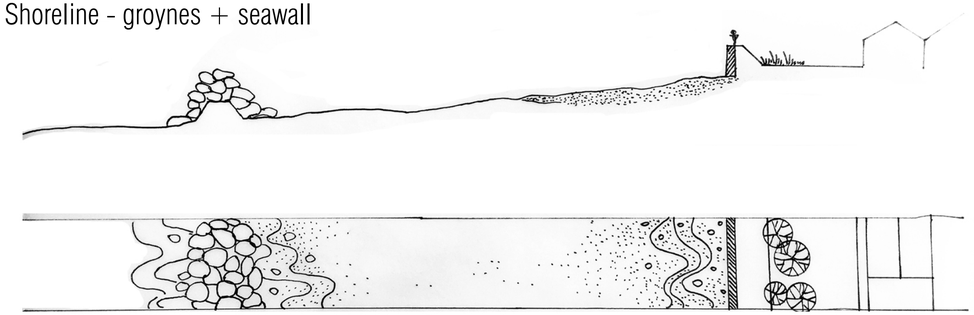
| General concept

Protective + Productive transitional zone

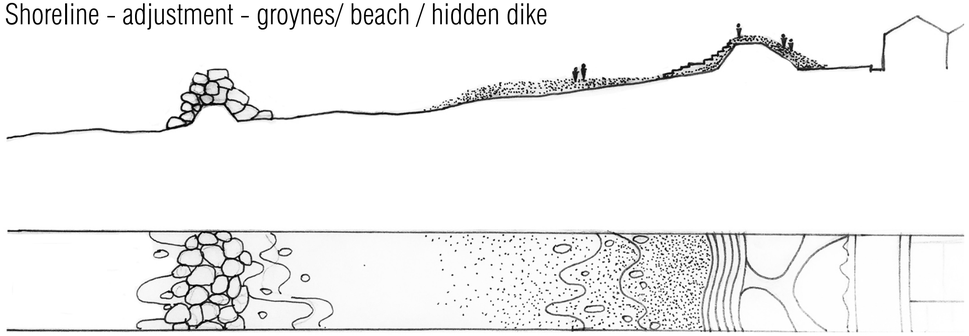


| Design exploration - alternatives and improvements

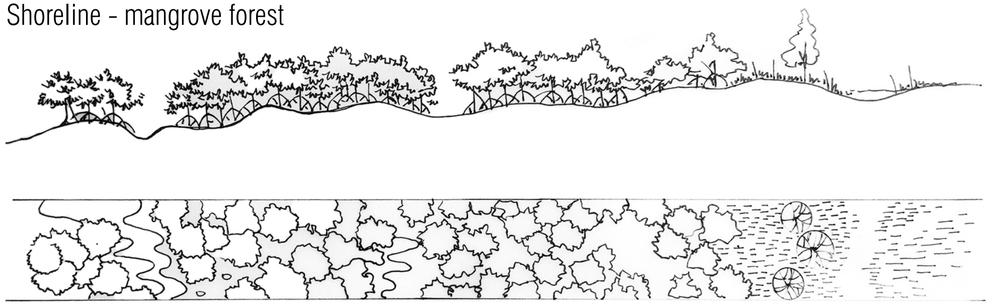
Shoreline - groynes + seawall



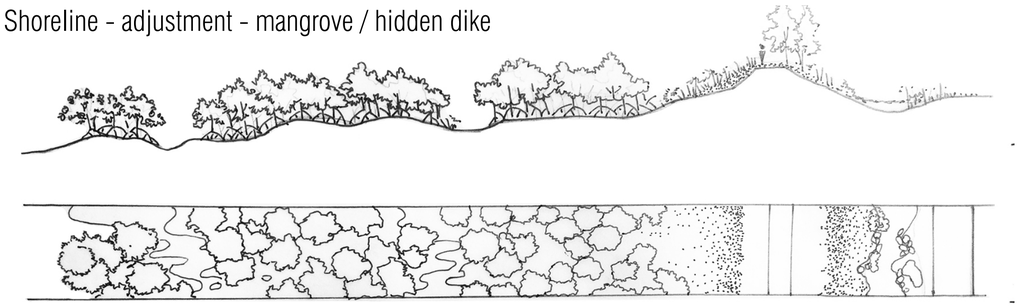
Shoreline - adjustment - groynes/ beach / hidden dike



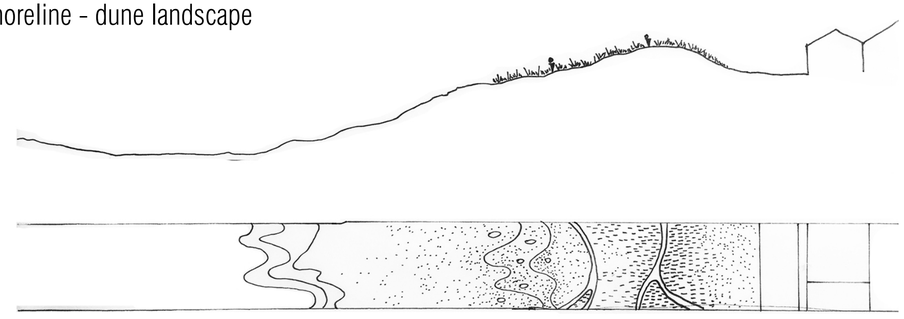
Shoreline - mangrove forest



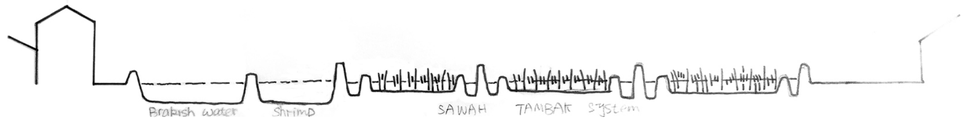
Shoreline - adjustment - mangrove / hidden dike



Shoreline - dune landscape



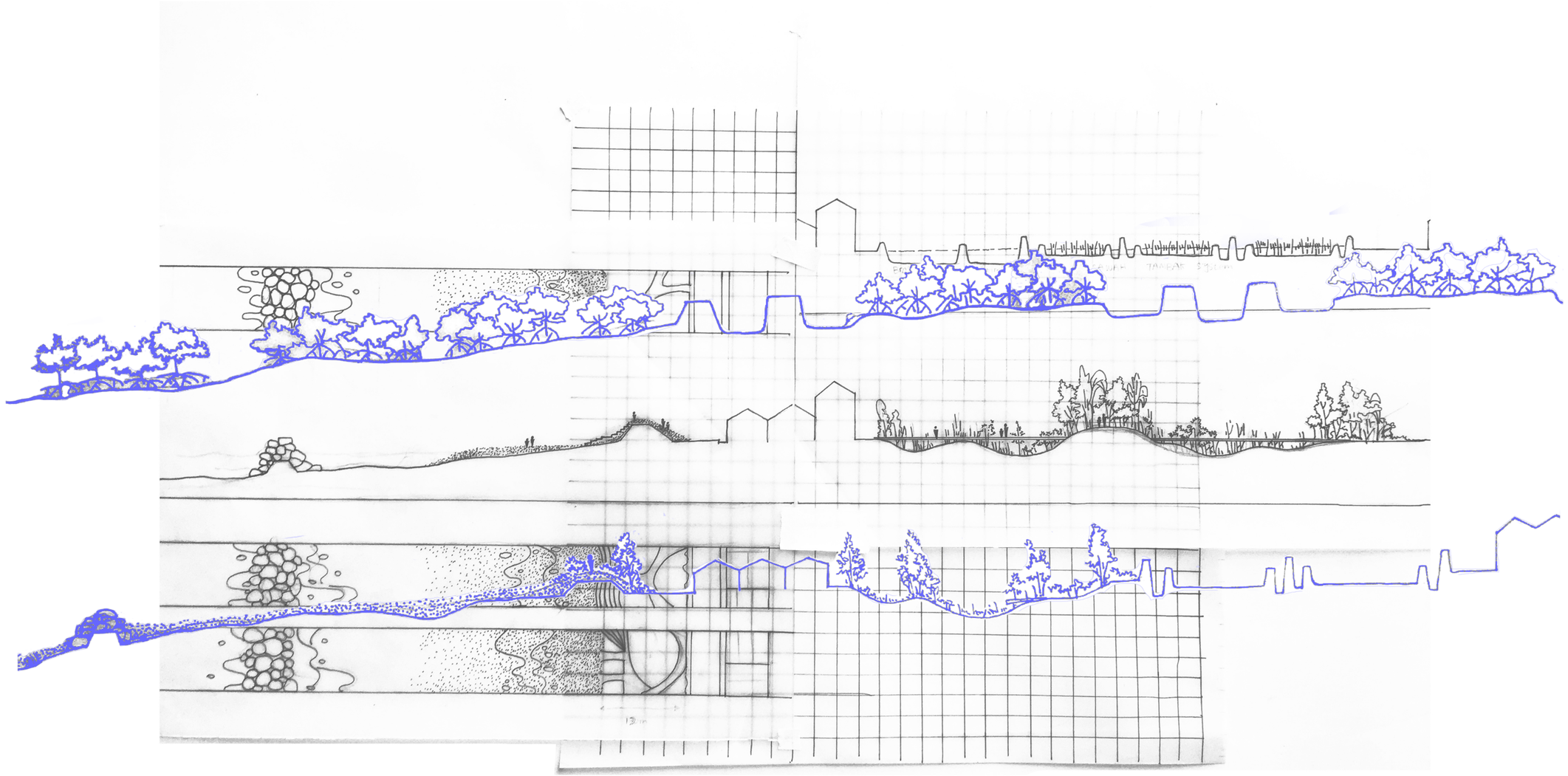
Coastal landscape - fishery



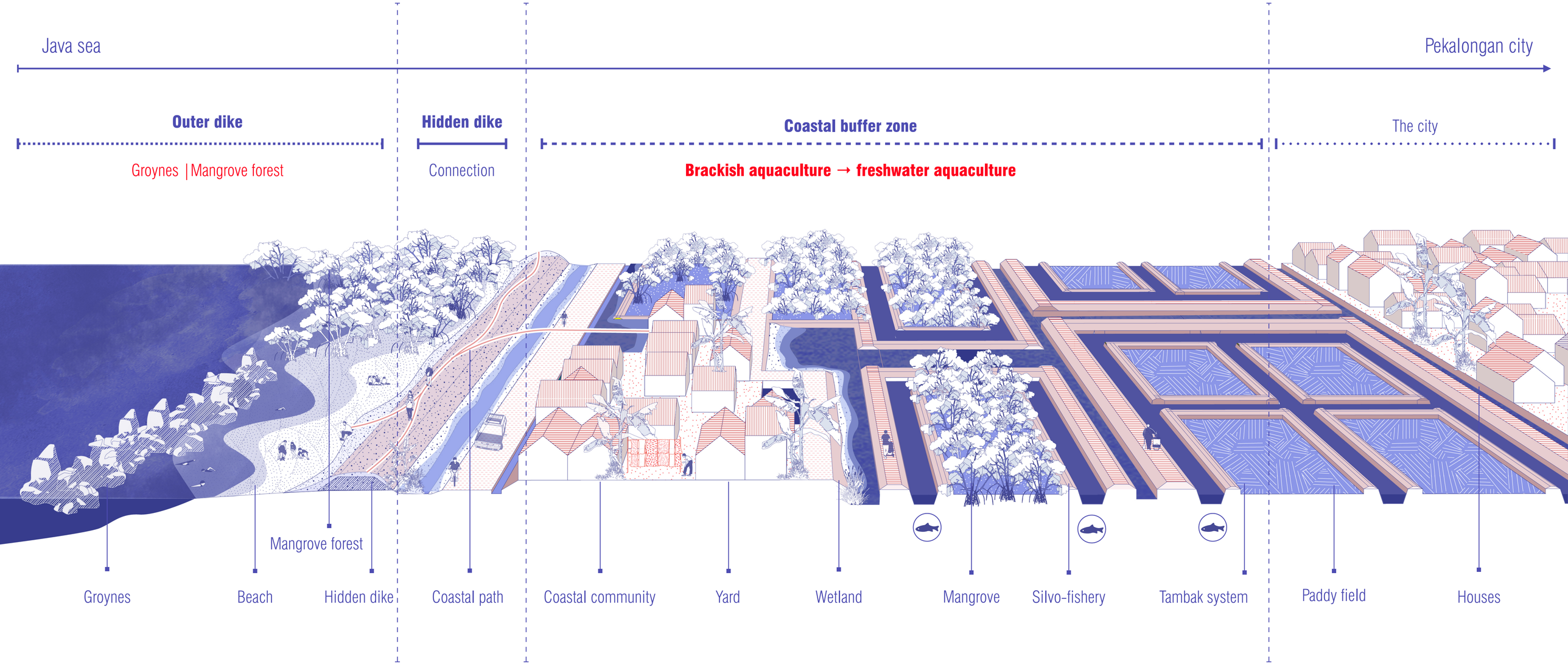
Coastal landscape - wetland



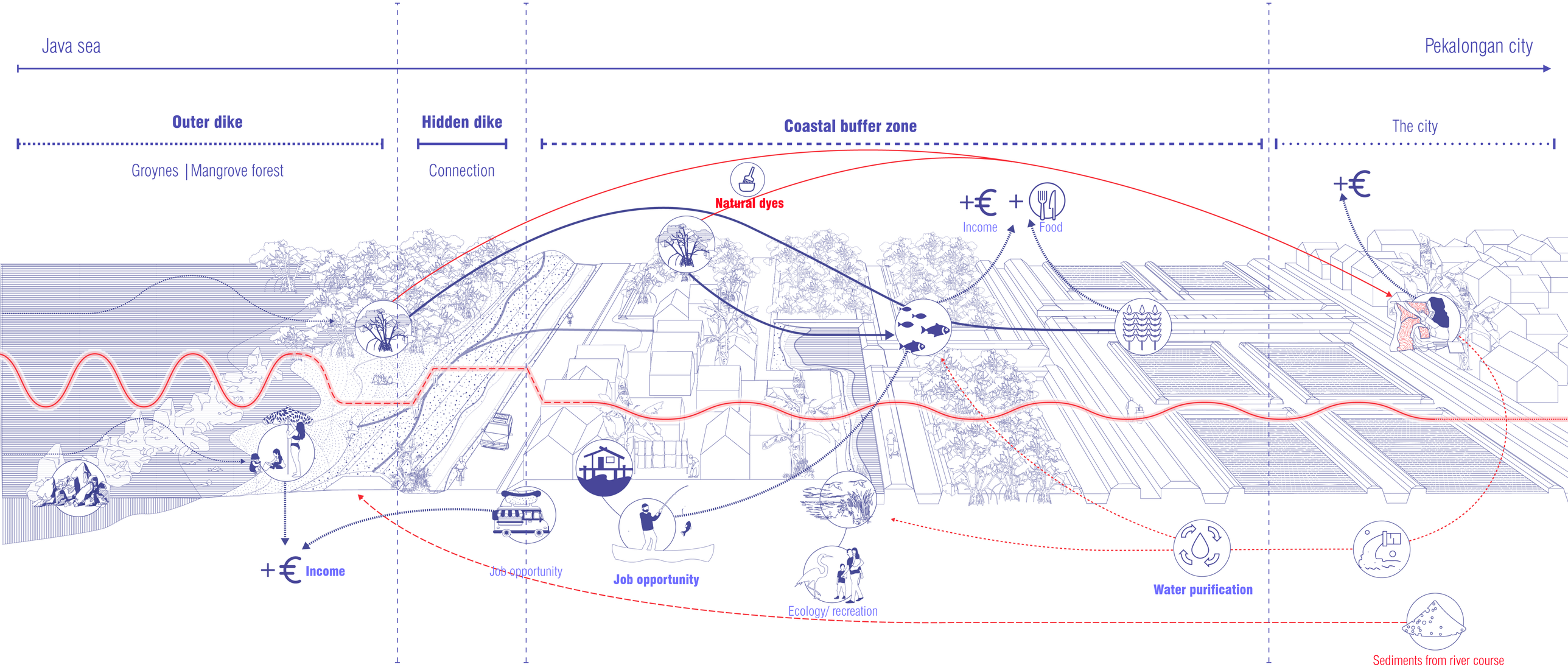
| Design exploration - different combinations



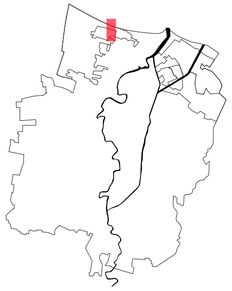
| General concept : Infrastructure + landscape to protect the city from being flooded

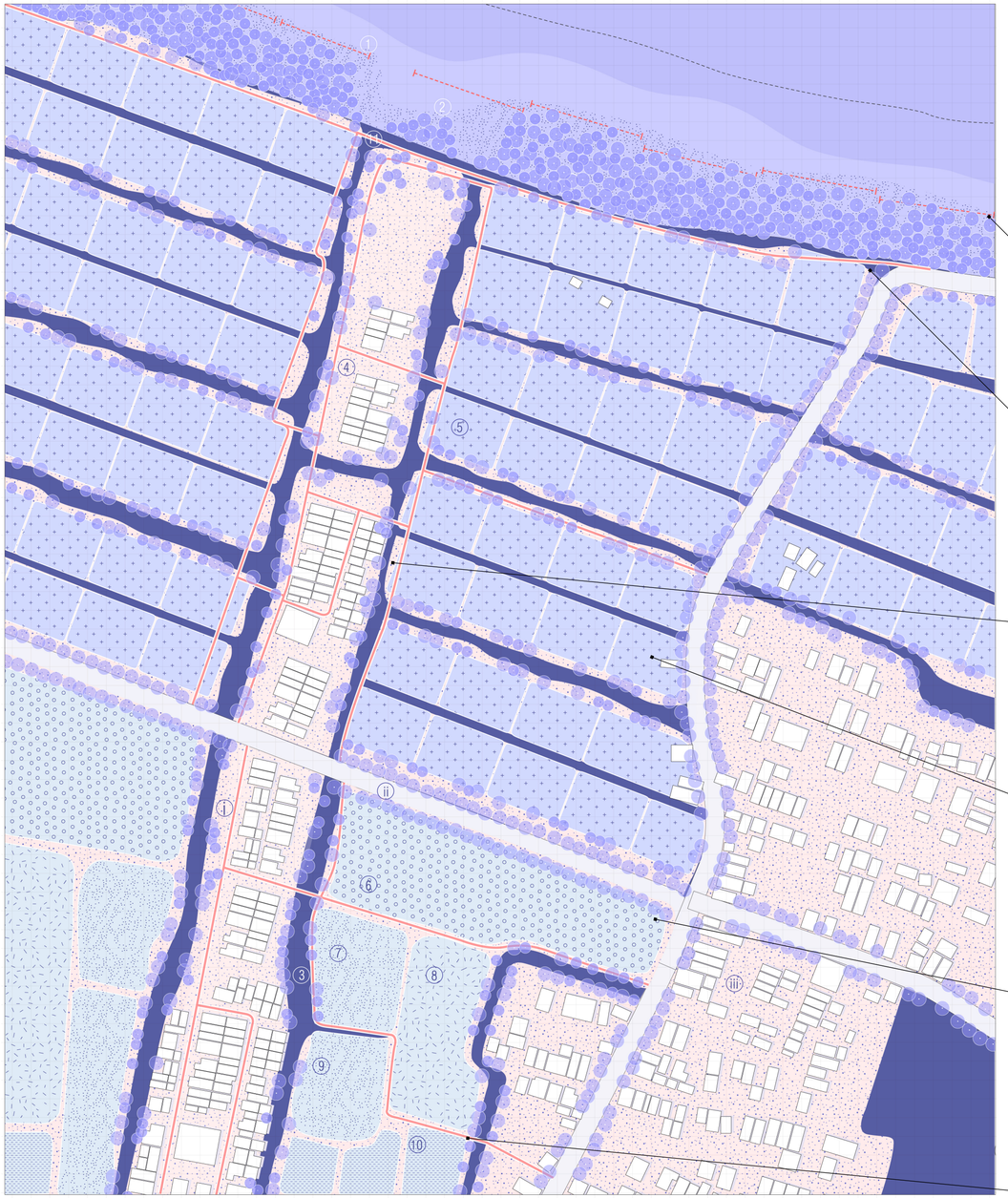


| Income | job opportunity | productions



| Local implantation: Aquaculture transition

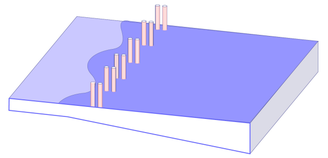




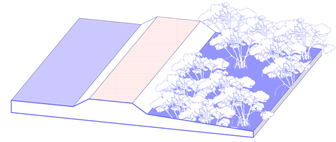
i Current dike
ii existing fishing huts
iii Urban settlements

1 Permarble infrastructure
2 Mangrove defence
3 Freshwater course
4 Newly built fish huts
5 Newly built fish huts
6 Fishery with mangrove
7 Harvest pond
8 Pretreatment pond
9 Filterlization pond
10 Stocking pond
11 Stocking pond
12 Hatch pond
13 Hidden dike

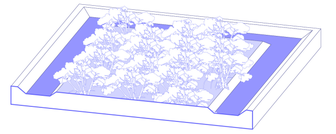
25*25m



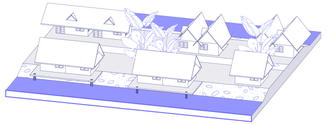
▫Bamboo structure



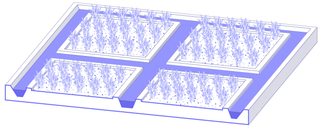
▫Hidden dike-green path



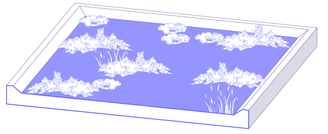
▫Silvo fishery- brackish water



▫Fish hut

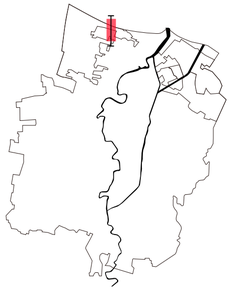


▫Tambak fishpond



▫Fluctuated pond

| Design intervention



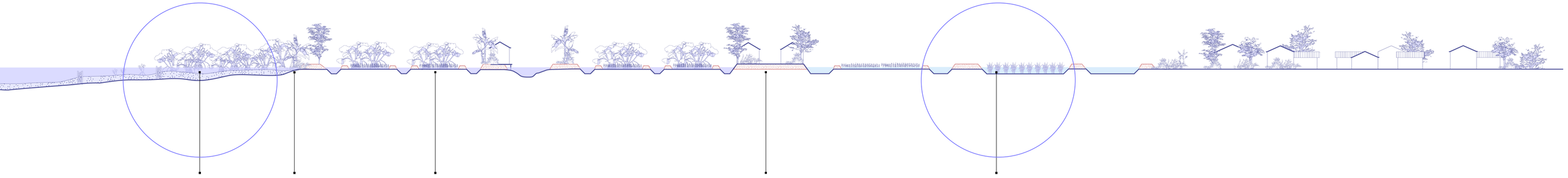
Current situation

Flat vulnerable landscape with hard infrastructure under construction.



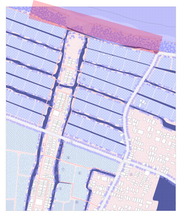
Design proposal

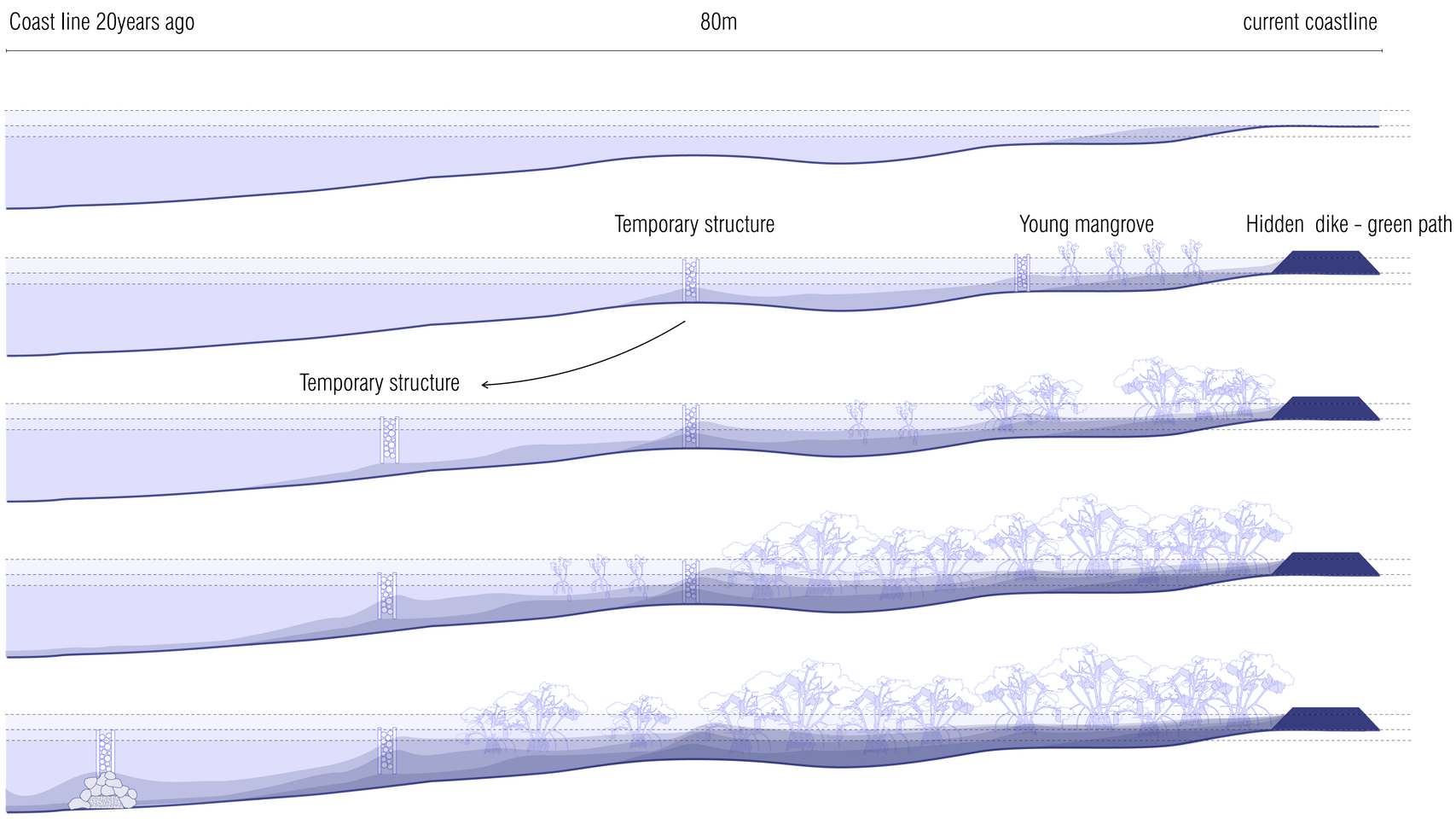
Productive and productive landscape which also provides ecological functions.



Mangrove defence Hidden dike | Green path Fishery with mangrove-Brackish Adaptive fish huts **Sewage aquaculture system-fresh water**

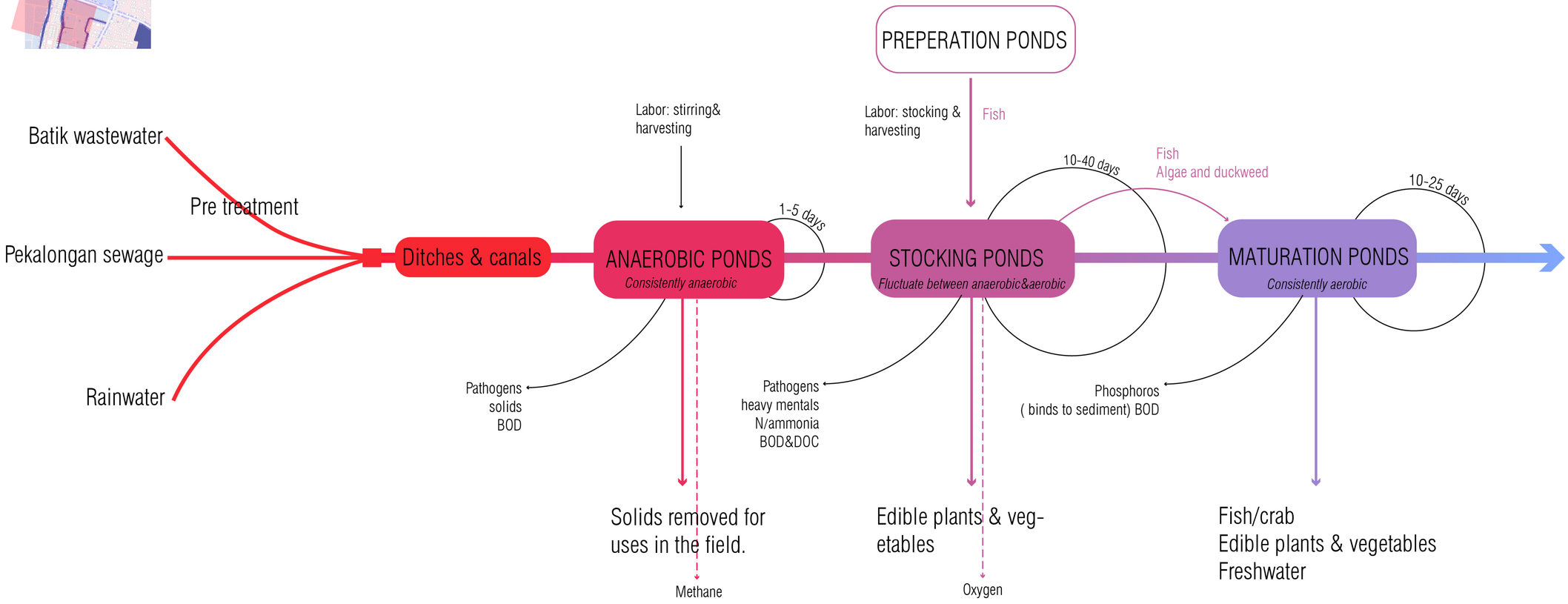
| Soft mangrove defence





| Sewage aquaculture system-water purification and fish harvest

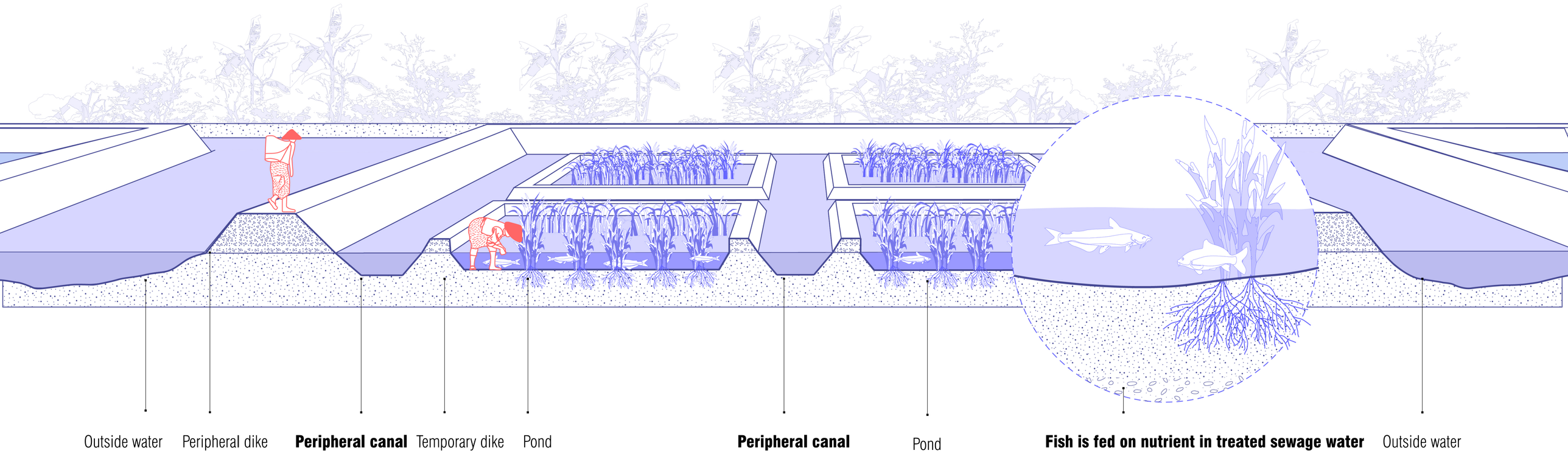




| Sewage aquaculture system- pond structure



Eg. Maturation pond

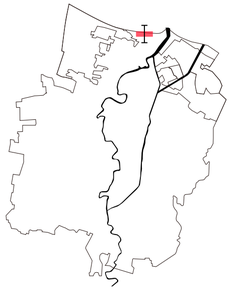


| ② Pekalongan beach



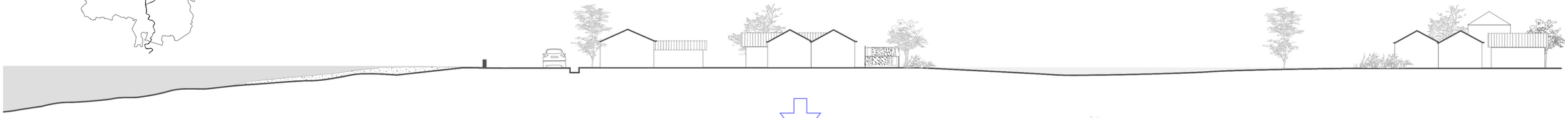
Source: Google map, https://www.google.com/maps/place/Pekalongan,+Pekalongan+City,+Central+Java,+Indonesia/@-6.8959407,109.6394839,13z/data=!3m1!4b1!4m5!3m4!1s0x2e70242ca490fe13:0xc0c68a126b258cb6!8m2!3d-6.8898362!4d109.6745916, edited by the author.

| Design intervention



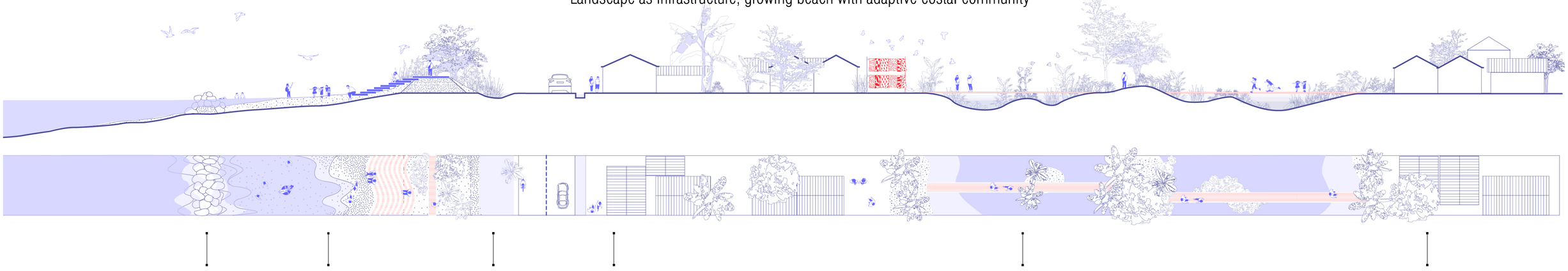
Current situation

Poor facilities and vulnerable coastal community

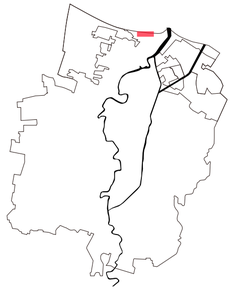


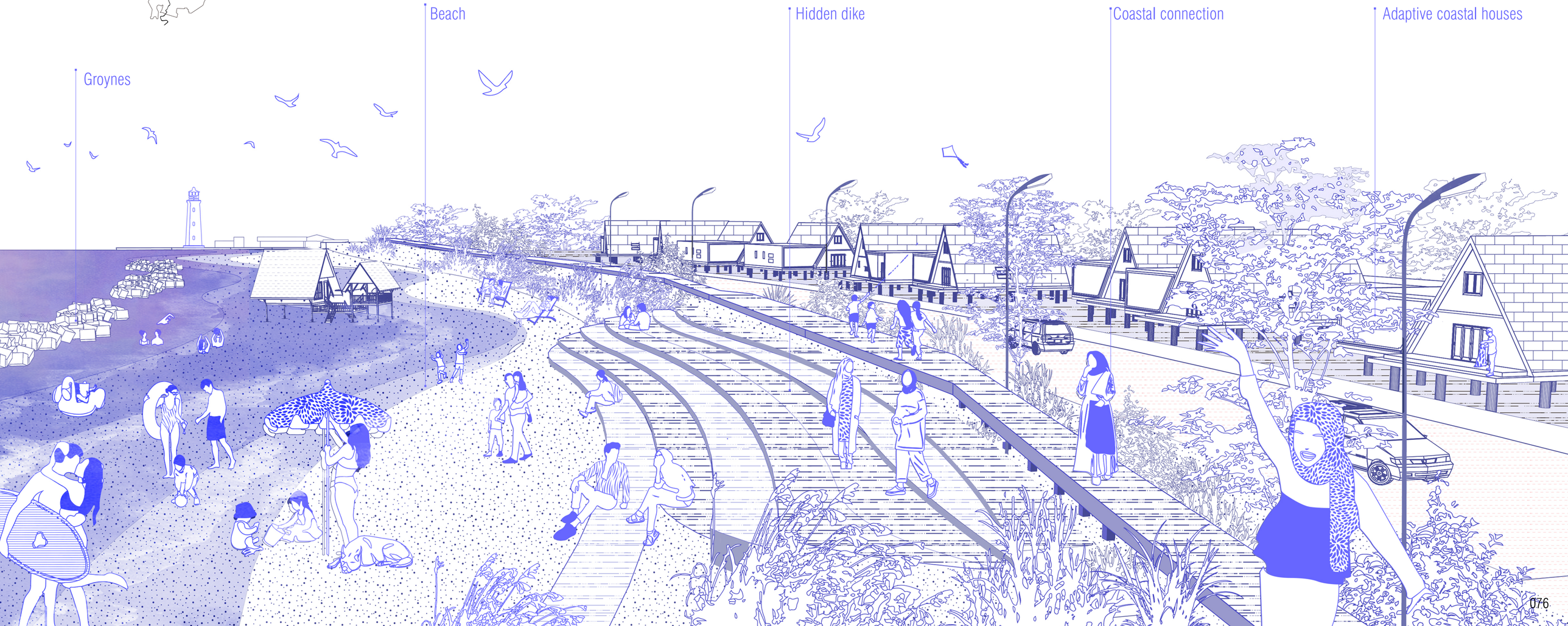
Design proposal

Landscape as infrastructure, growing beach with adaptive costal community



| Perspective - Pekalongan beach





-CONCLUSION | COASTAL PROTECTION -

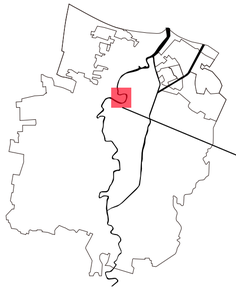
By Innovative aquaculture(Brackish aquaculture integrated with mangrove＋sewage freshwater aquaculture)
and soft defence (mangrove)
The coast zone which prone to be inundated is transformed into a defence
while providing diverse productions and materials for batik production.

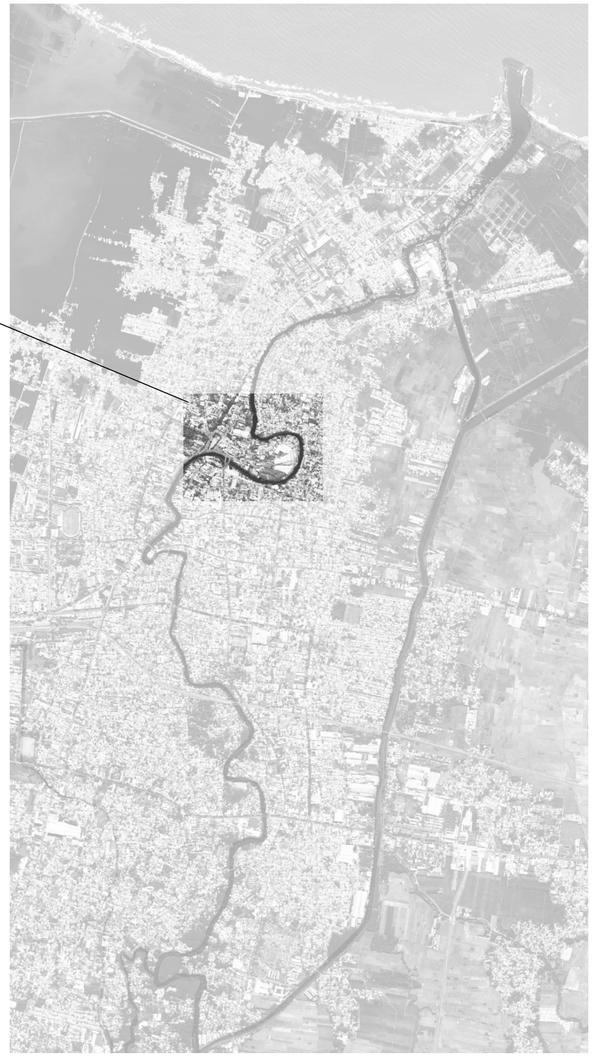
-2/3 Discharge Capacity-



Meandering river under natural conditions

| Study location





Pekalongan prison

Dense populated

Heavy pollution

Floods

Batik center

Central point of Java island

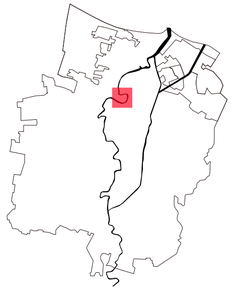
Textile industry

Batik museum

Government office

Sports complex

| Current situation





The garbage appears in the river during the dry season when the water level is low.

Source: https://www.youtube.com/watch?v=VRpiViJcTRk&list=PLIjHHQqrIWu_tolzkp6N-iKrrheNNpup8&index=20

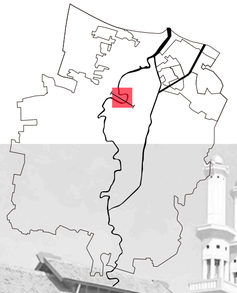


Wastewater is discharge into the river and the river is densely clocked by houses

Source: https://www.youtube.com/watch?v=VRpiViJcTRk&list=PLIjHHQqrIWu_tolzkp6N-iKrrheNNpup8&index=20

| Current situation

The Pekalongan river is turning its back to the city



Batik museum



Prison

Street



Grassland

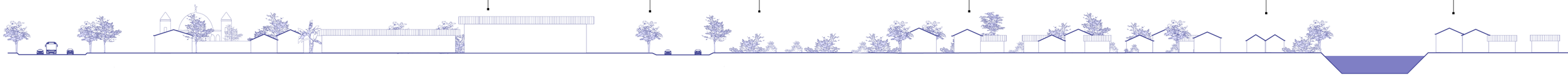


Batik village



Dense houses and trees

Blocked and polluted river

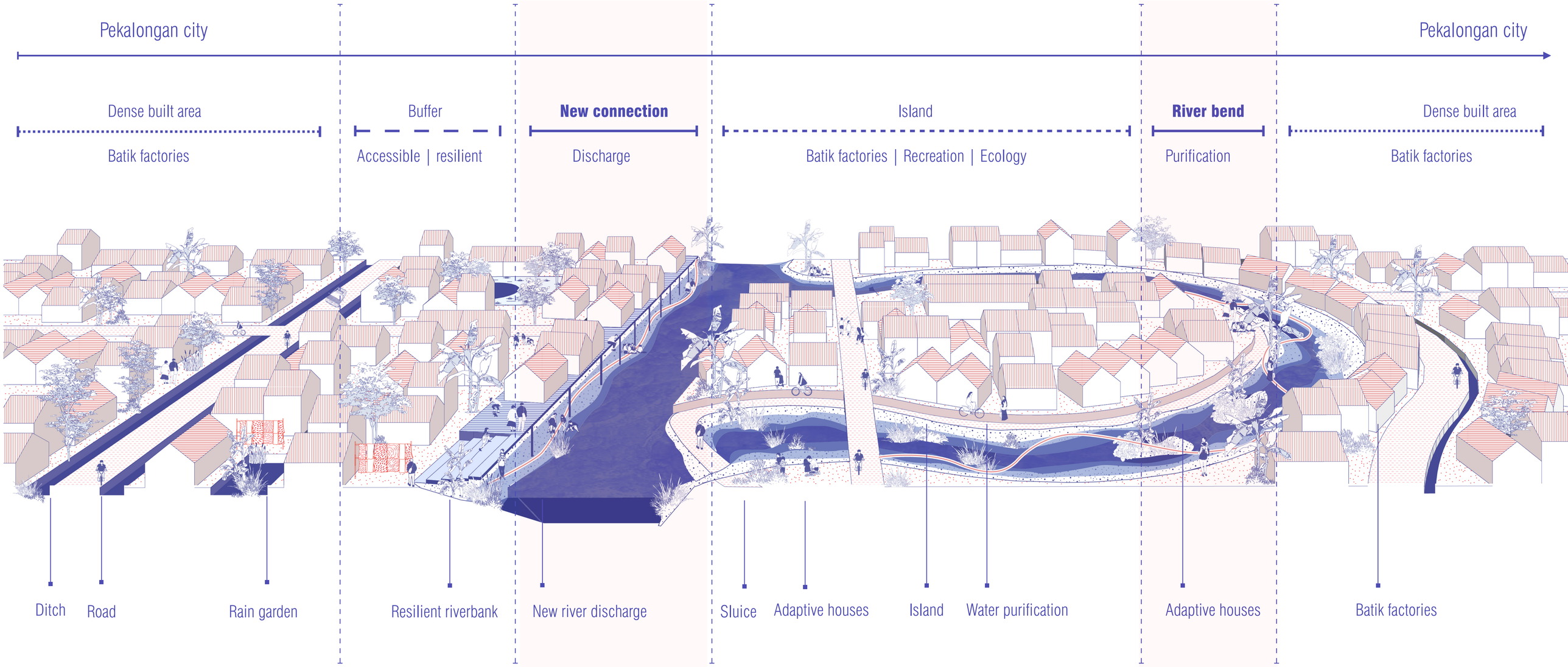


| General concept

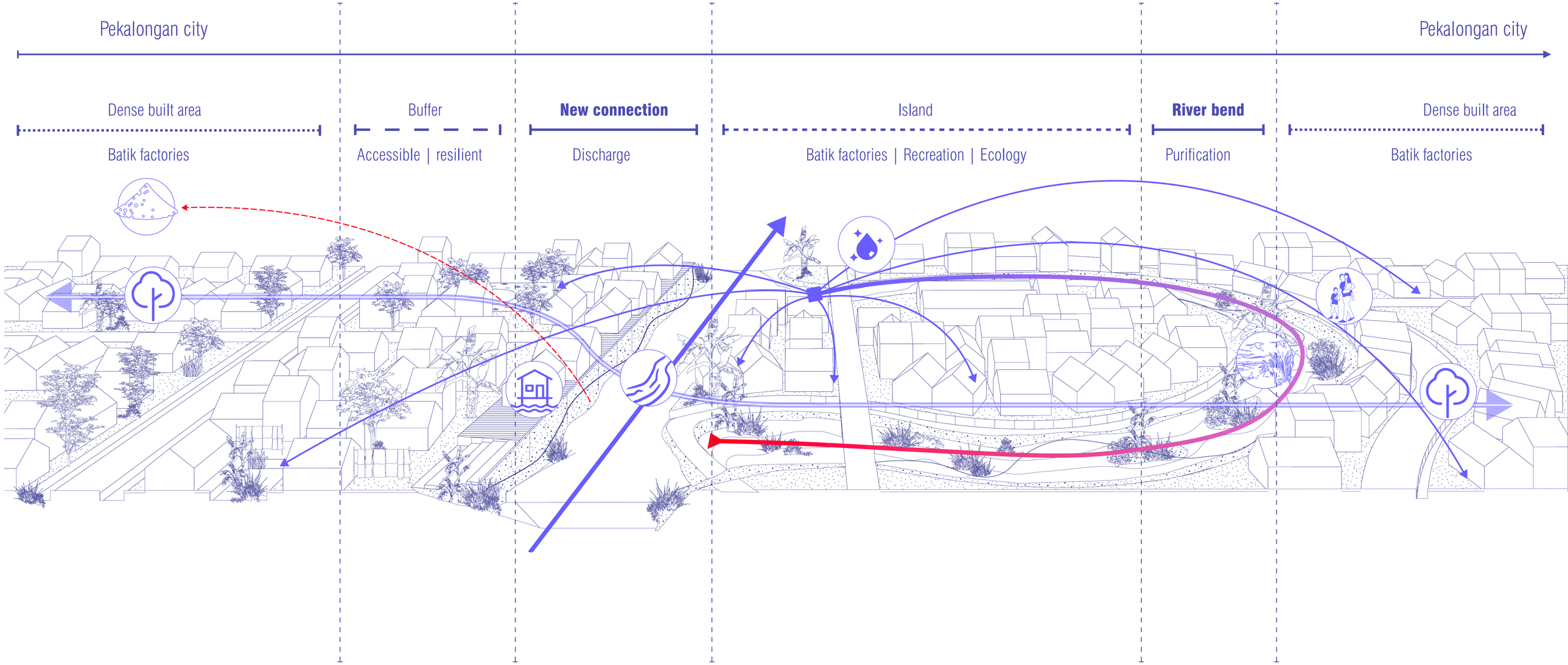
Short cut + Urban green space



| General concept :New connection + Urban green structure

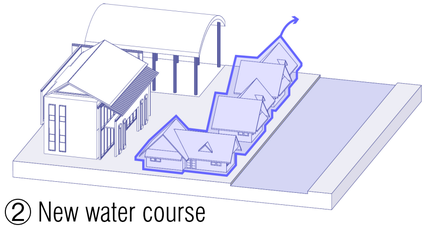


| General concept: Water flow

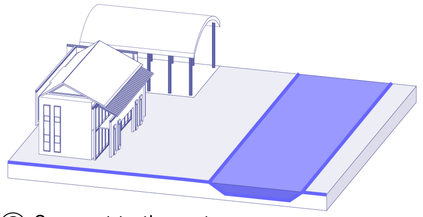


| Local implantation: Process

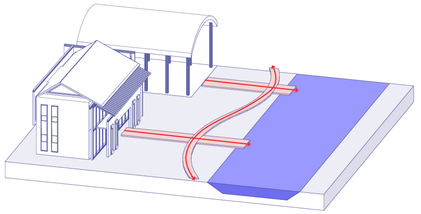
① Remove houses



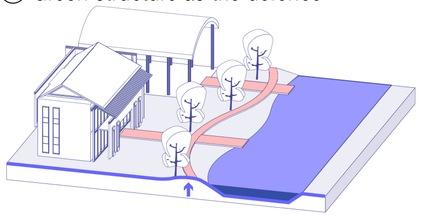
② New water course

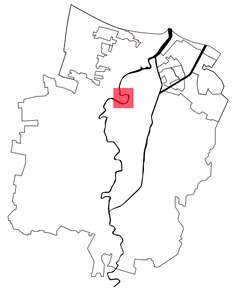


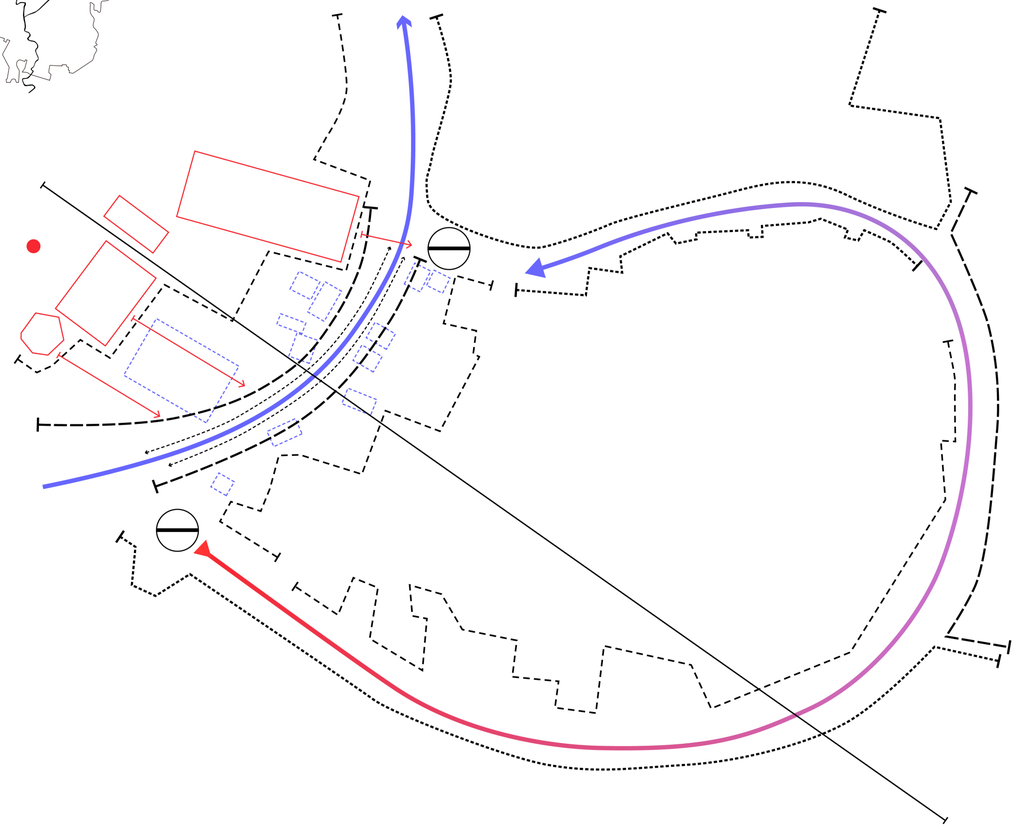
③ Connect to the water



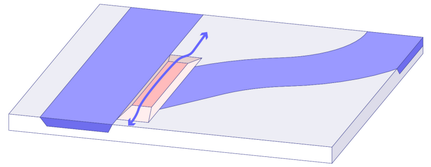
④ Green structure as the defence



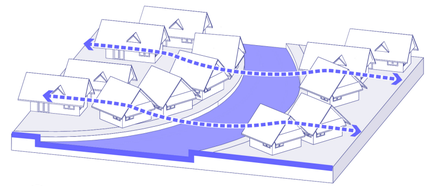




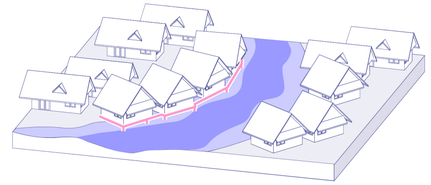
① Sluice



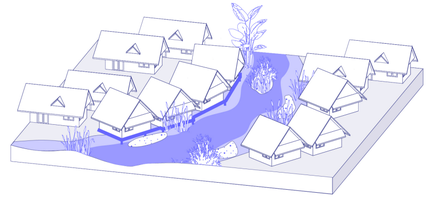
② Gradient riverbank



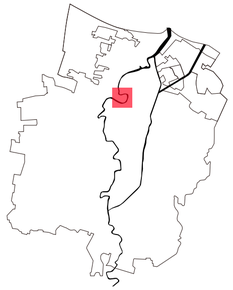
③ Adaptive house



④ Purification system-Park structure



| Local implantation





i Batik museum
ii Mosque
iii Sports complex
iv Batik industry
v The central point of Java island

1 New river course
2 Water front steps
3 Landmark
4 Bridge
5 Sports
6 Water front path
7 Water front square
8 Bridge
9 Water front square
10 Water front platform
11 Pump
12 Purification-Natural aeration
13 Purification-Heavy mental removal
14 Purification-Nutrient removal
15 Purification-Biological purification
16 Purification-Sand filter
17 Purification-Clean water
18 Floating deck

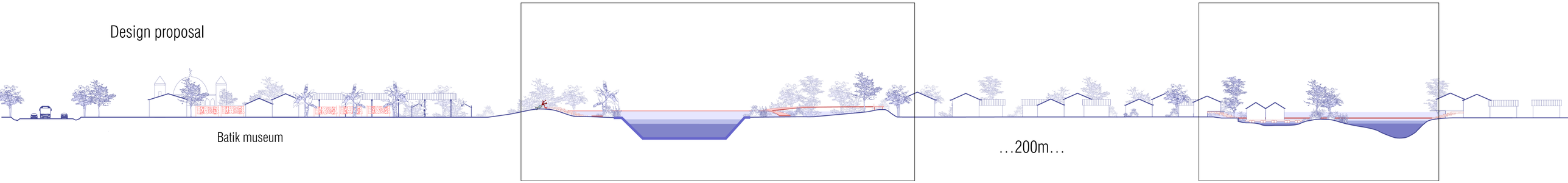
0 100m

| Design exploration

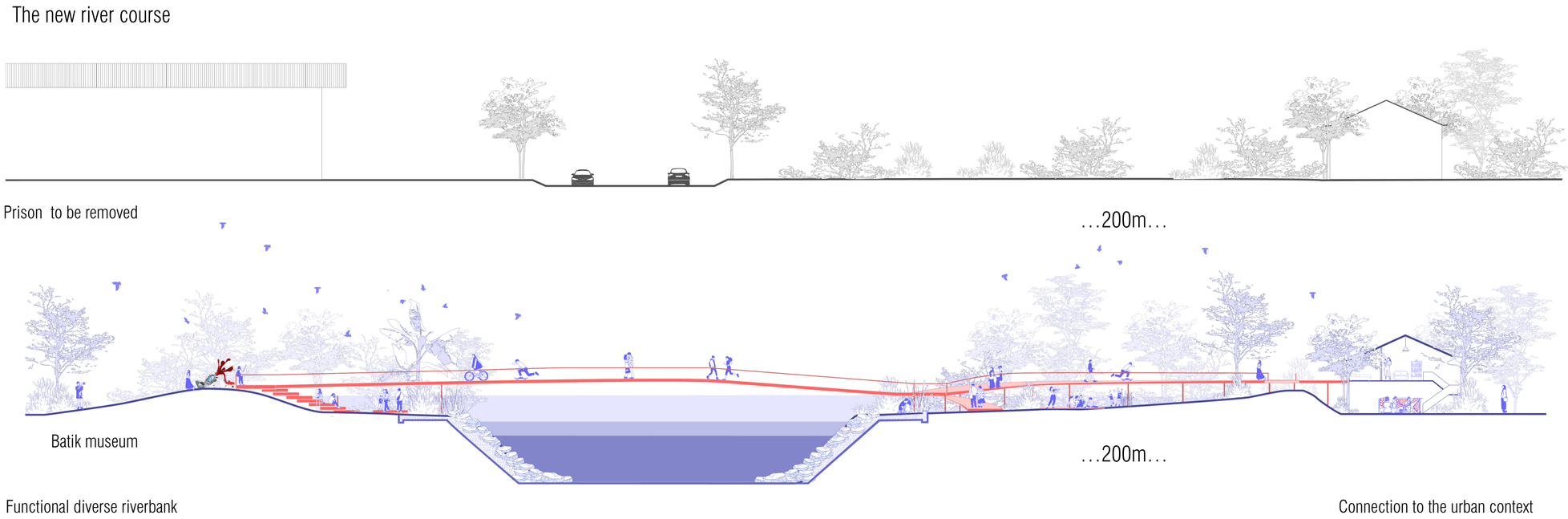
Current situation



Design proposal



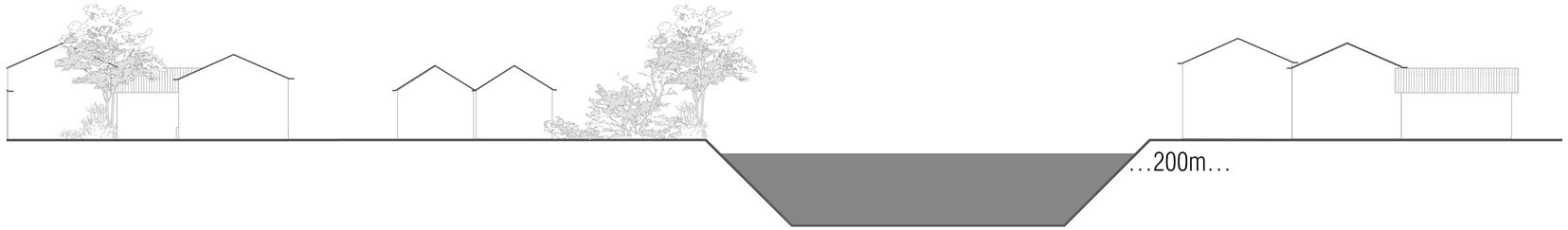
| Design exploration



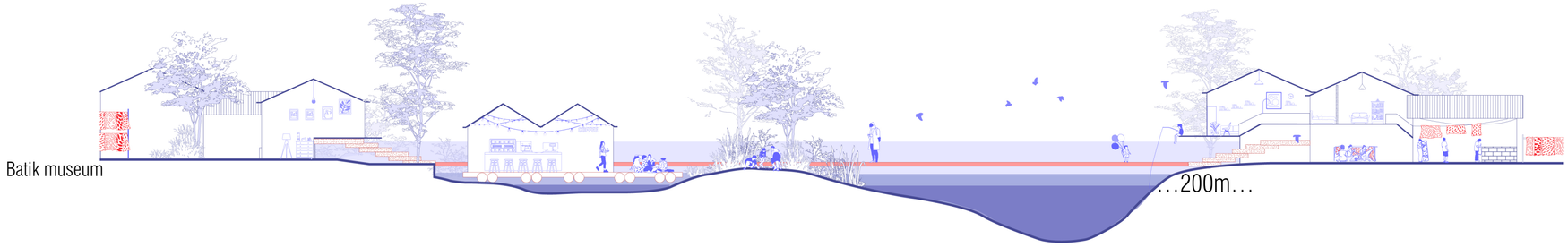
| Design exploration

Previous river bend

Current situation



Design proposal

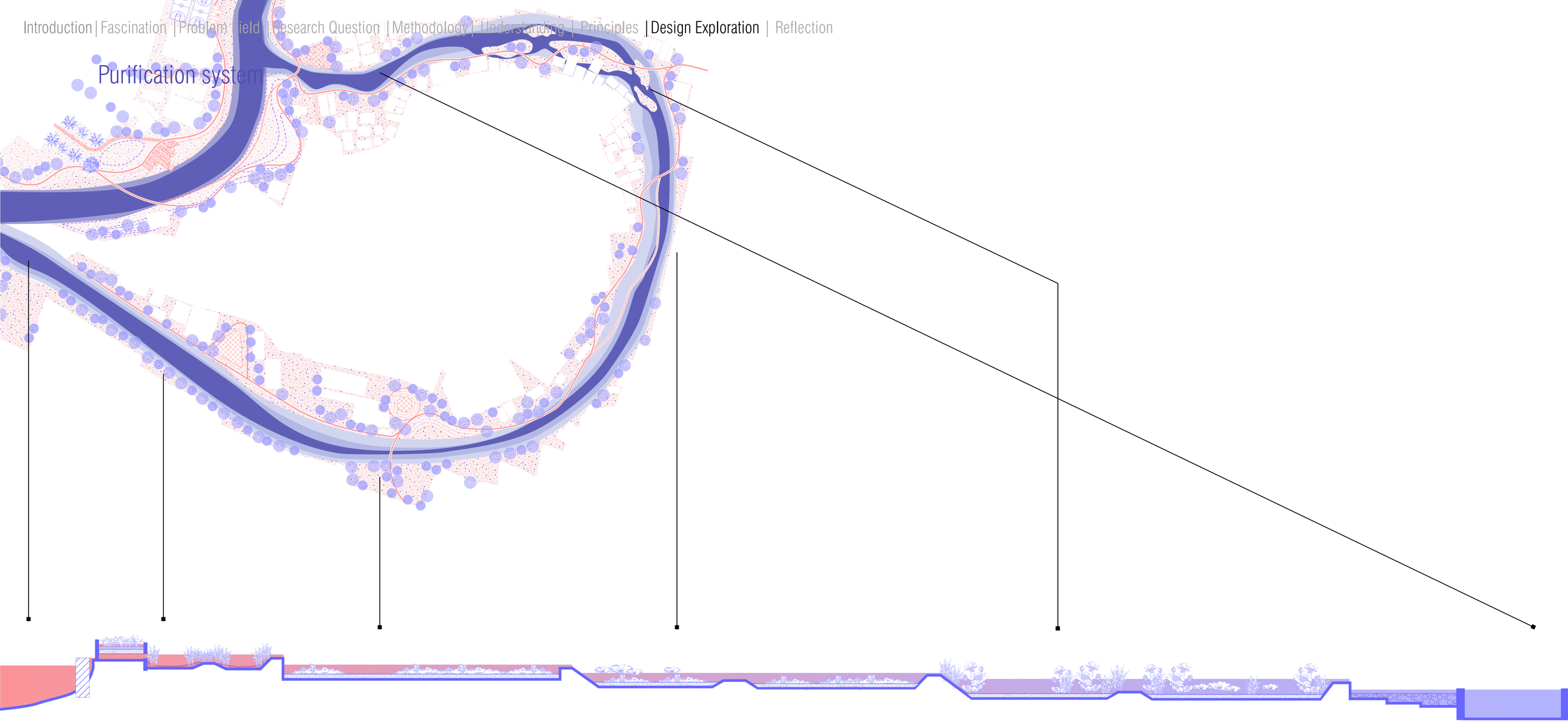


Adaptive houses

Urban green space

Accessibility to water

Purification system



| New connection- Dry season



| New connection- Extreme flood



-CONCLUSION | DISCHARGE CAPACITY -

Based on the understanding of natural movement of water,

new shortcut are created to help the water flows smoothly,

resilient riverbank protect the dense populated zone from being flooded

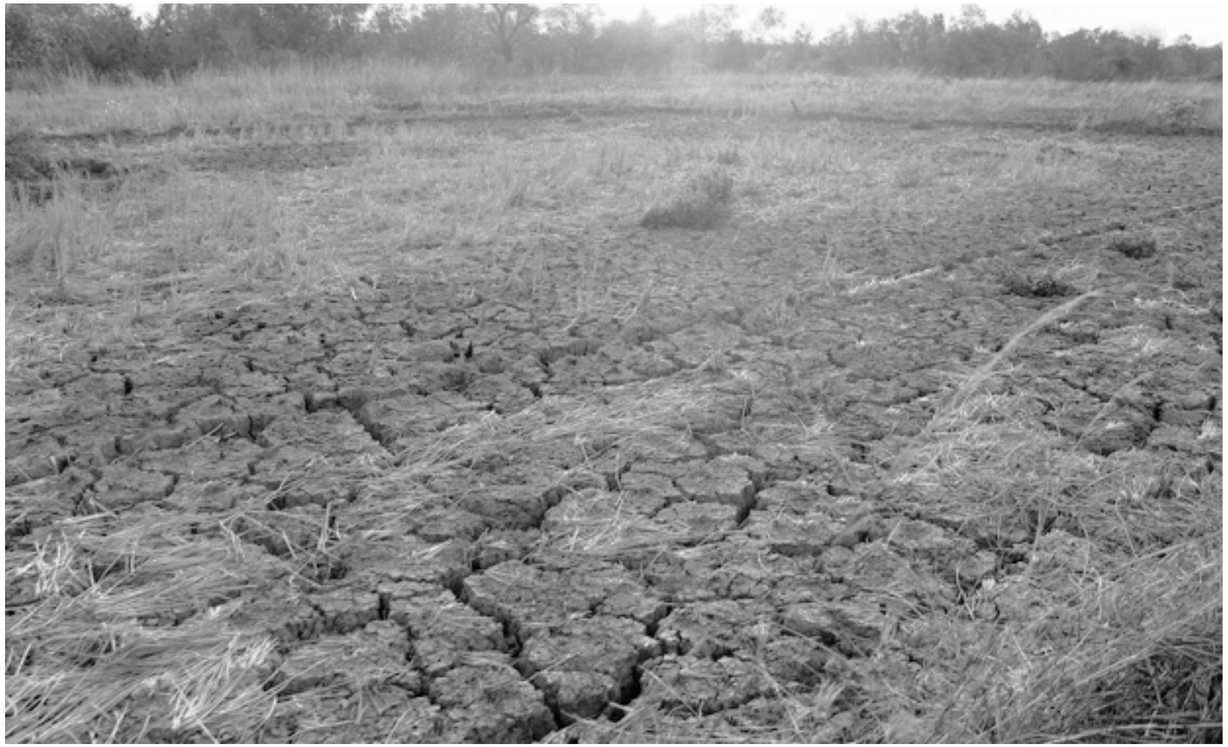
functions as part of urban green structure, build up the connection between urban context, batik and water.

-3/3 Water Circulation-



Source: https://www.youtube.com/watch?v=E2RymMwem6Q

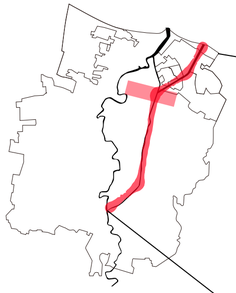
Floods



Droughts

Source: https://www.shutterstock.com/zh/search/dry+season+in+indonesia

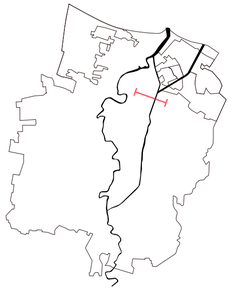
| Study location





The Banger canal
The transition from urban context to Banger canal

| Current situation





Courtyard with stagnant water



Urban park with impervious paving



Ditch



The garbage shows up when the water level goes down



Hard riverbank

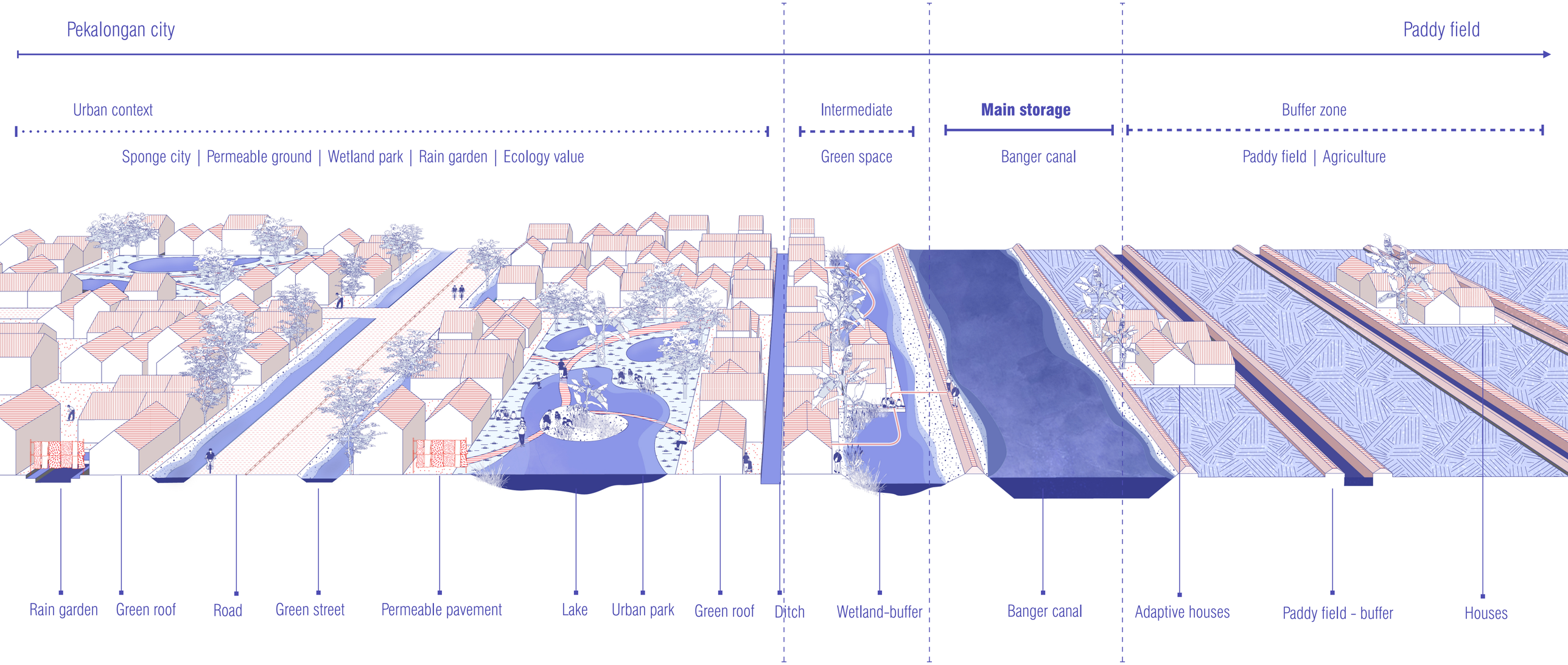


| General concept

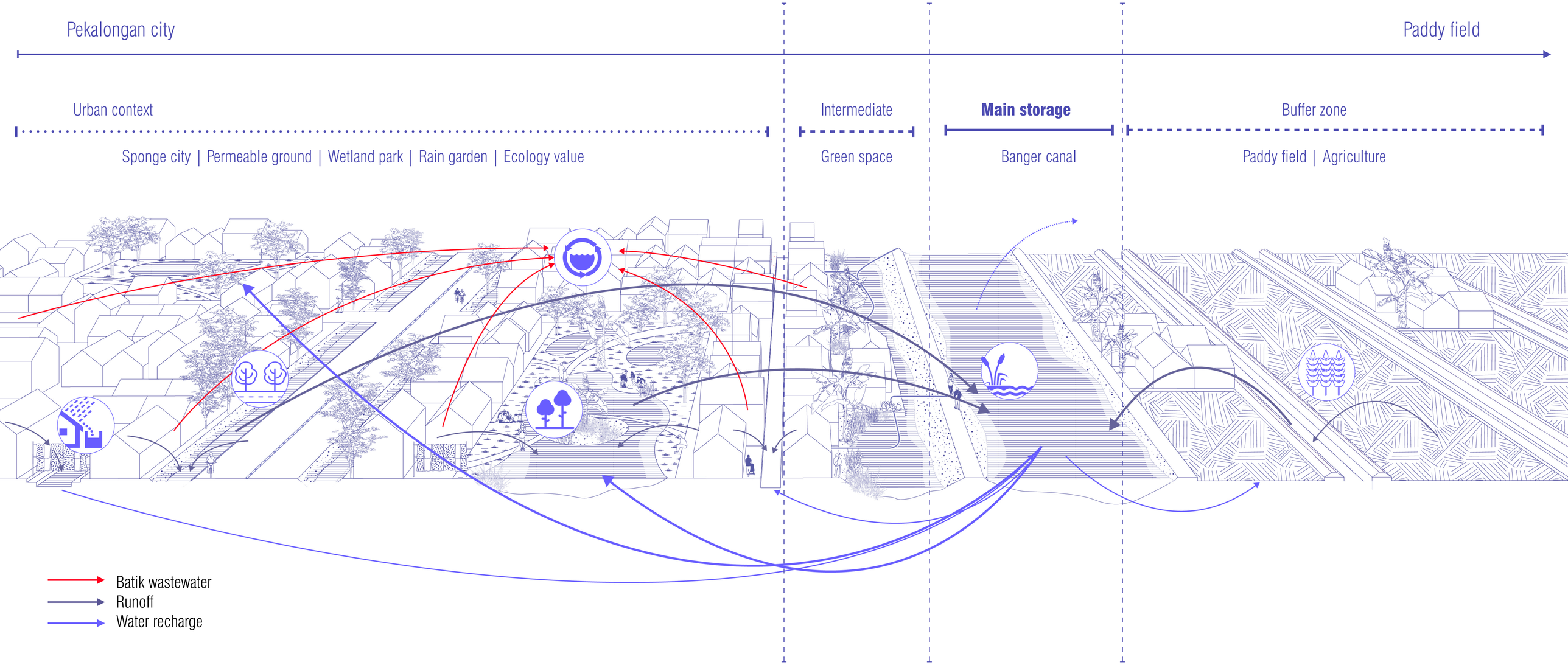
Urban sponge



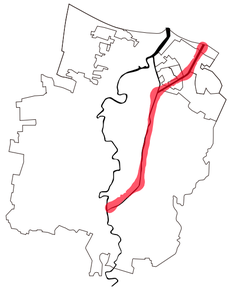
| Water circulation

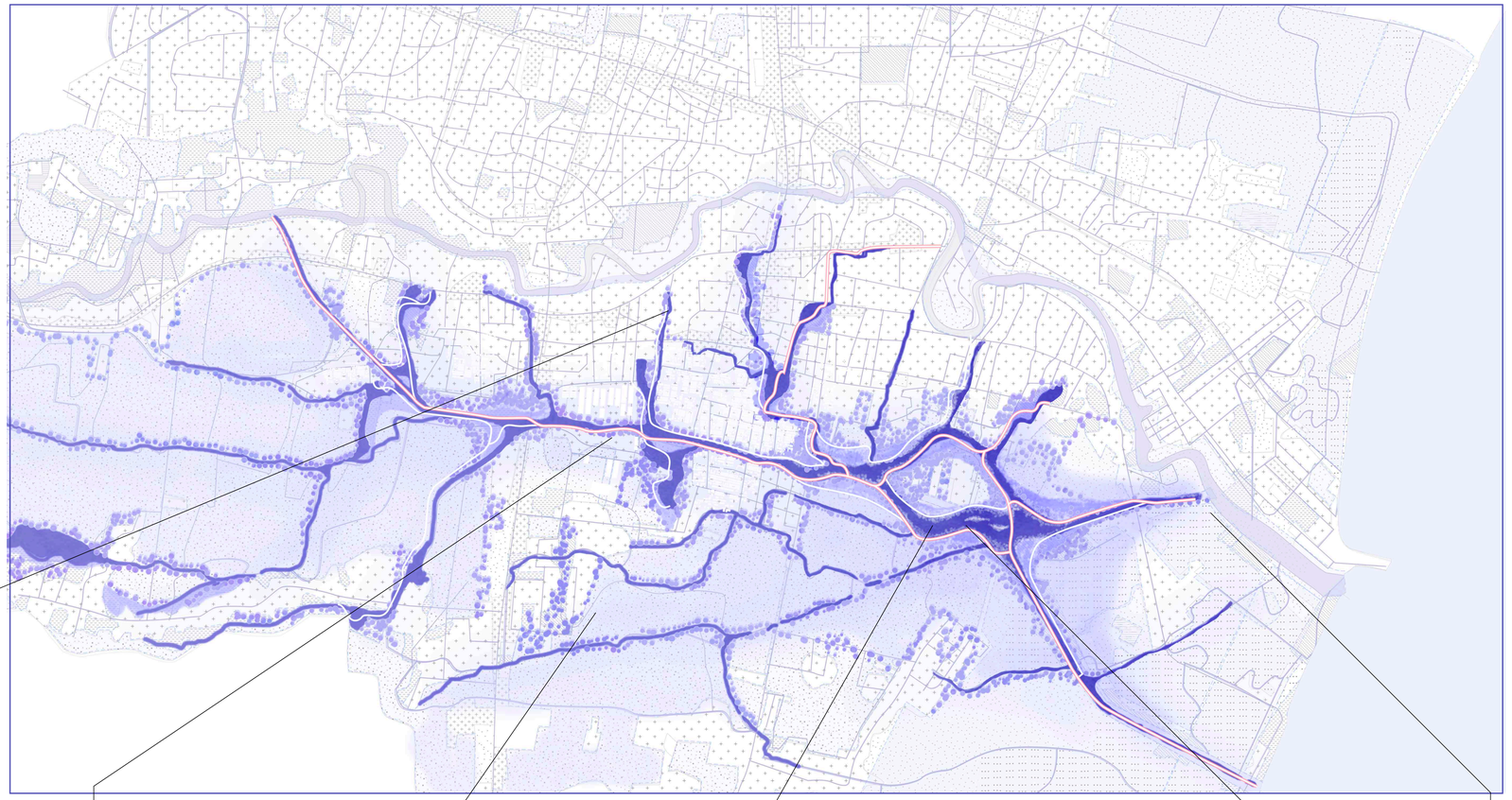


| Water circulation



| Banger canal as the sponge space





Courtyard

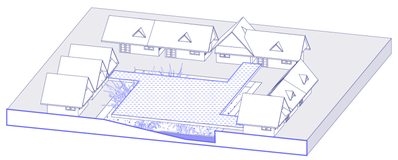
Dense populated zone

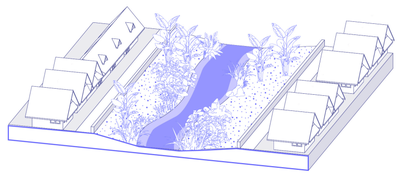
Paddy field

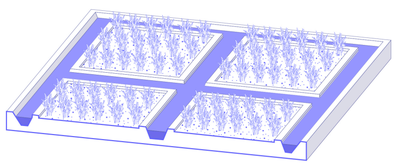
Renaturalization canal

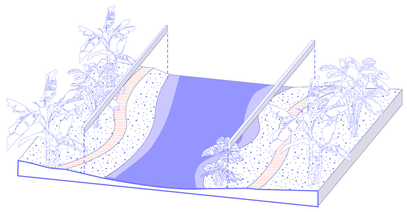
Green structure

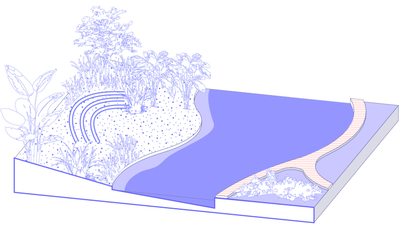
Connect to the river

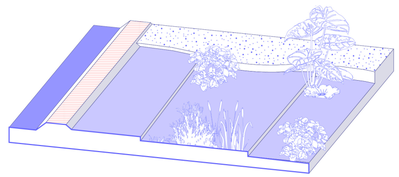




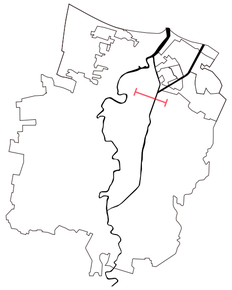




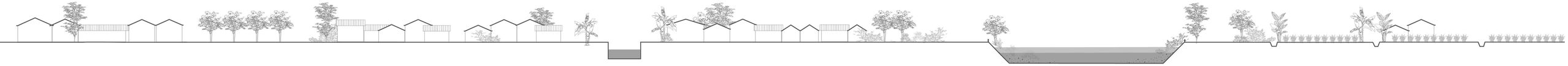




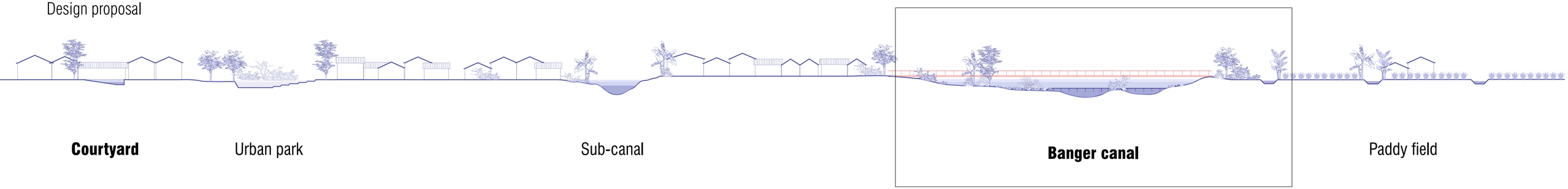
| Banger canal as the sponge space



Current situation

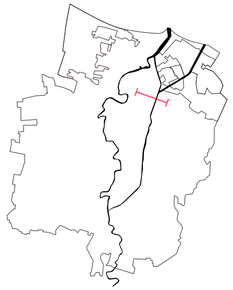


Design proposal

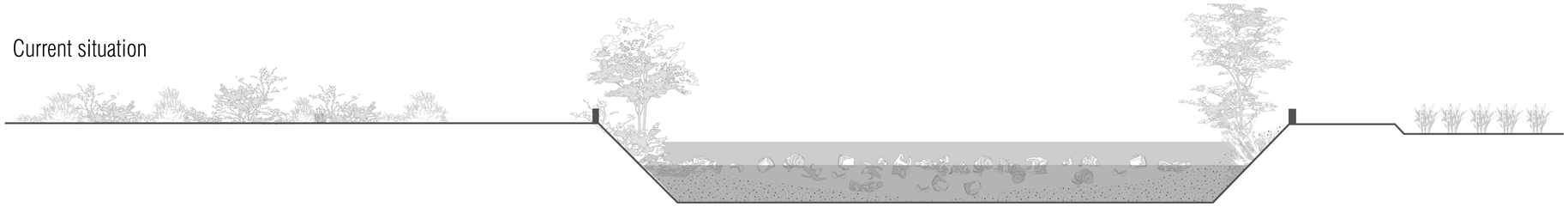


Courtyard Urban park Sub-canal **Banger canal** Paddy field

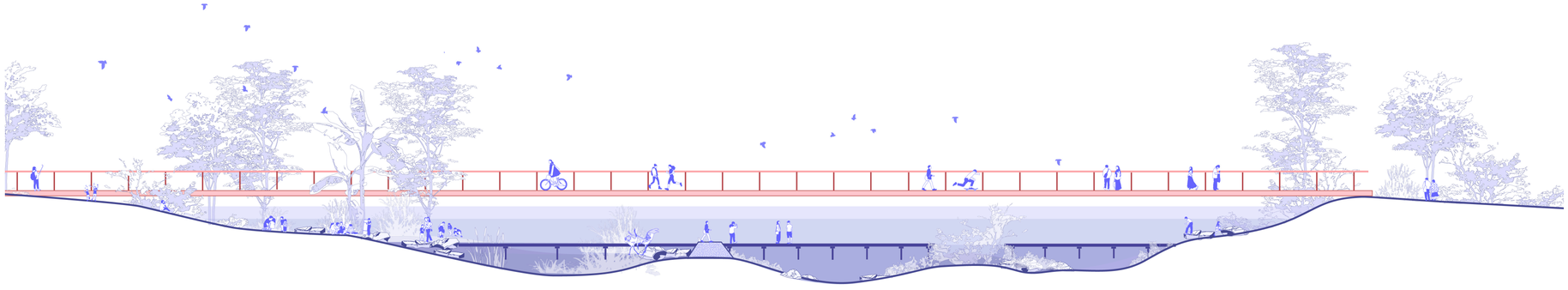
| Banger canal as the sponge space



Current situation



Design proposal Extra room for water | Gradient riverbank with fluctuating water level



| Courtyard


Water supply
Connect to outside ditch
Space for rainwater storage

| Banger canal- Dry season



| Banger canal- Rain season



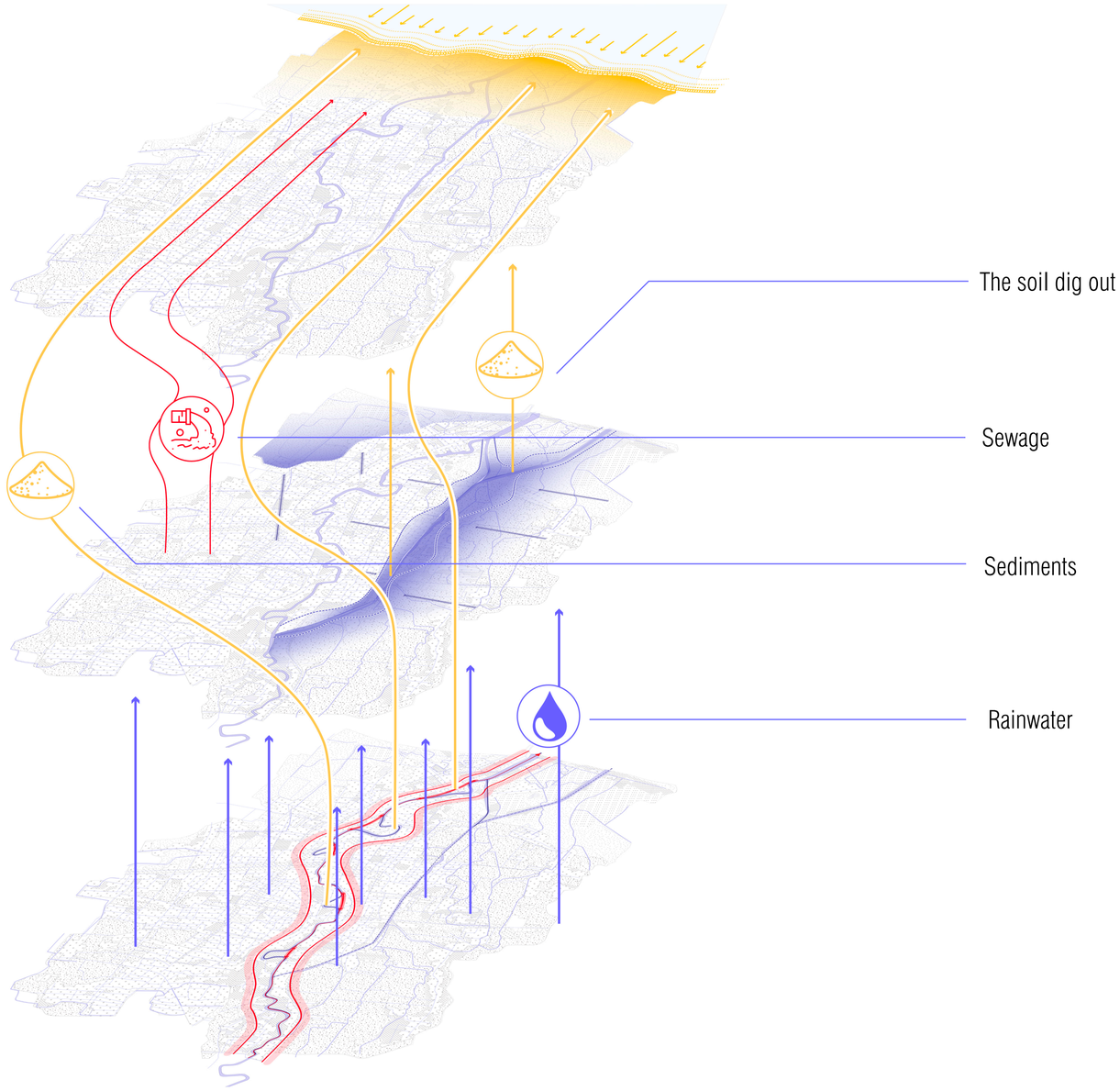
- CONCLUSION | WATER CIRCULATION -

The sponge space in the city can be ranges from small scale courtyard to Banger canal.
Instead of getting rid of the rain water,
preparing more space for water can protect the city from being flooded
while supply water during dry season.

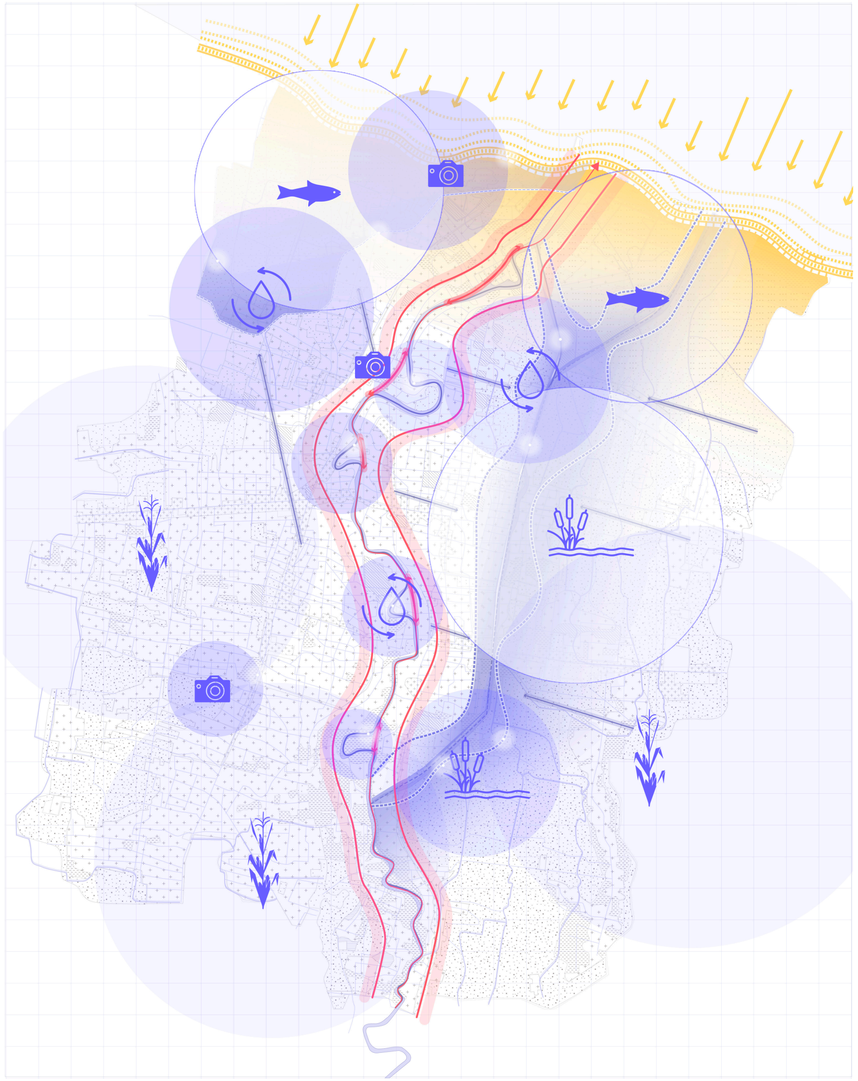
Landscape as the whole

| Integration of three design assignment

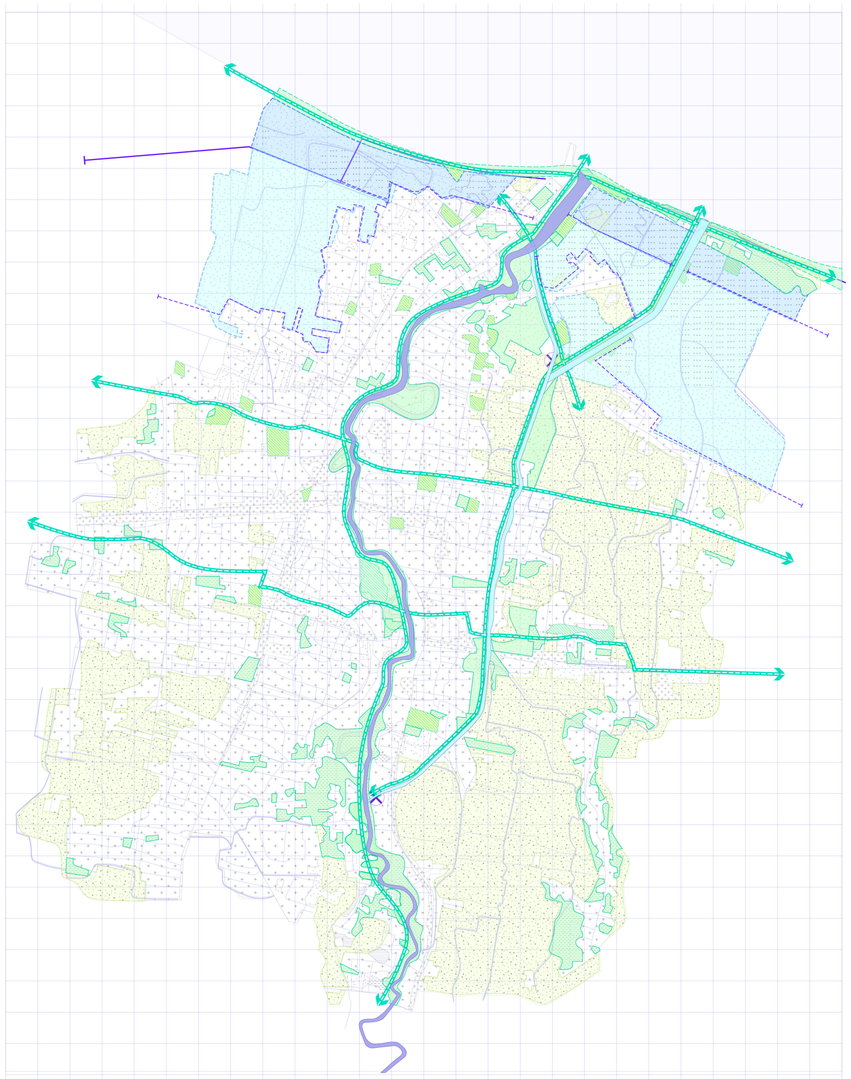
The exchange of materials



| Integration of three design assignment-added values

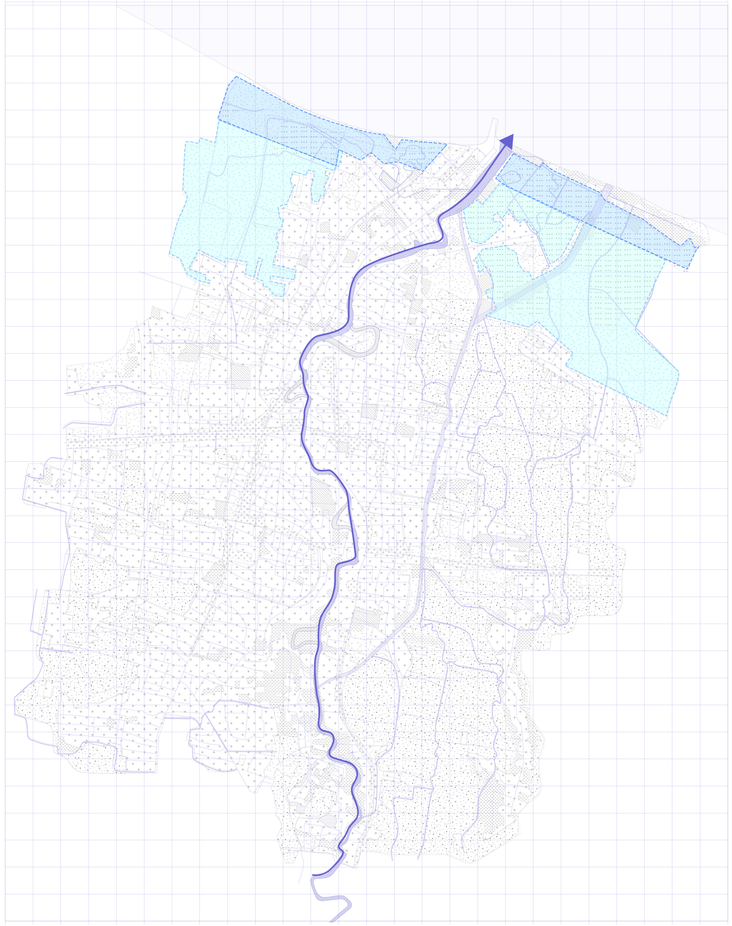


| The green structure



| A Resilient landscape framework

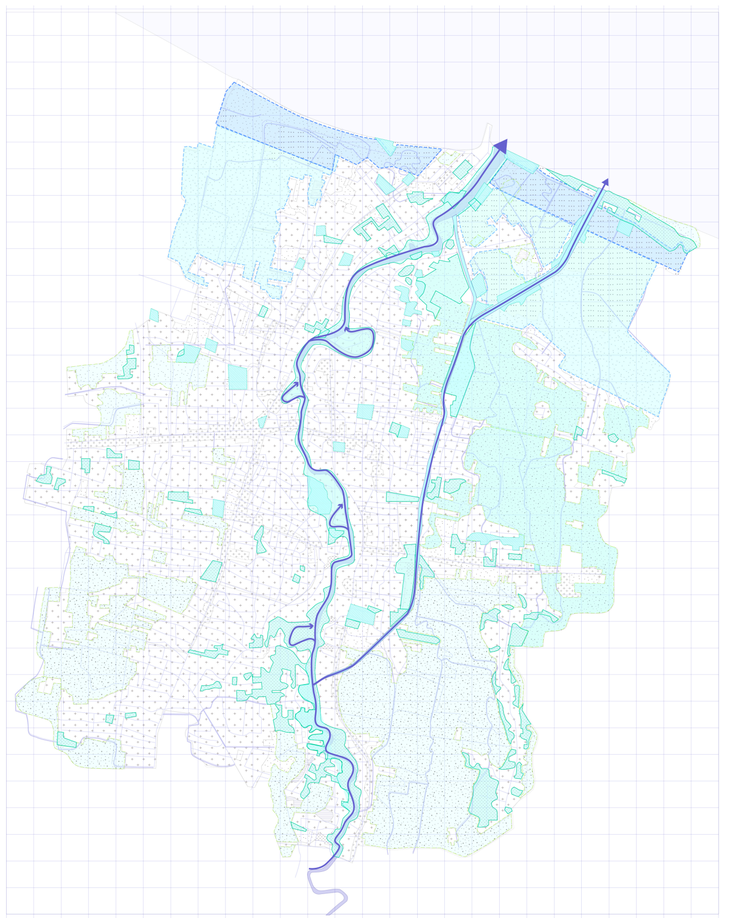
Dry season



Rainy season



Extreme situation



Where to start ?

| Strategic plan

Invite more natural process into the city



Temporary structure- To catch sediments, prepare the conditions for mangrove rehabilitation

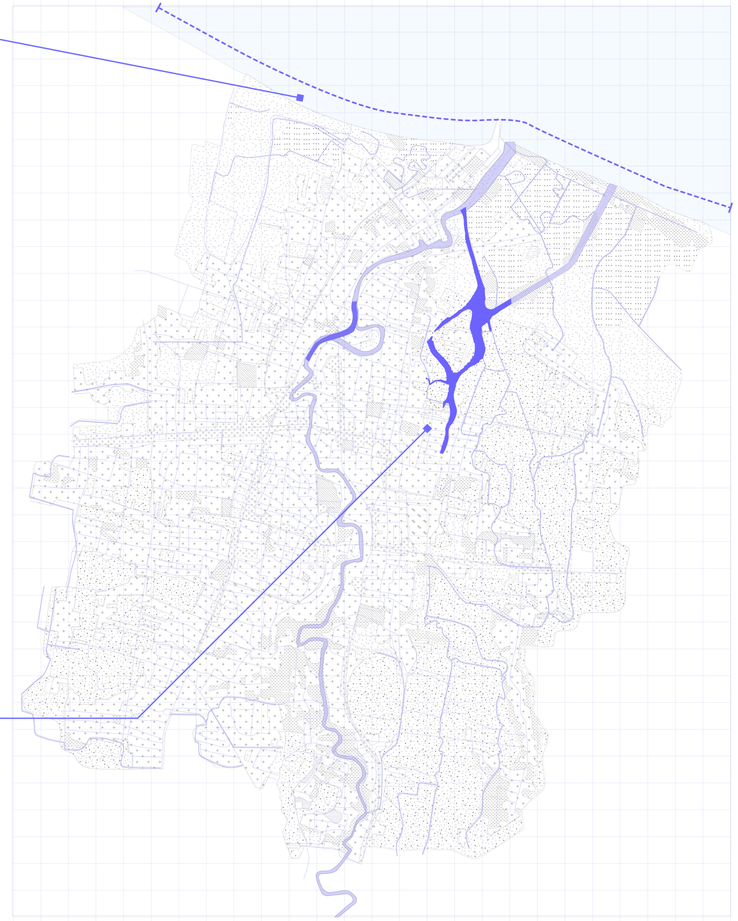
https://www.deltares.nl/en/news/indonesia-netherlands-launch-large-coastal-safety-initiative-java/



Re-naturalisation Banger canal, make room for water.

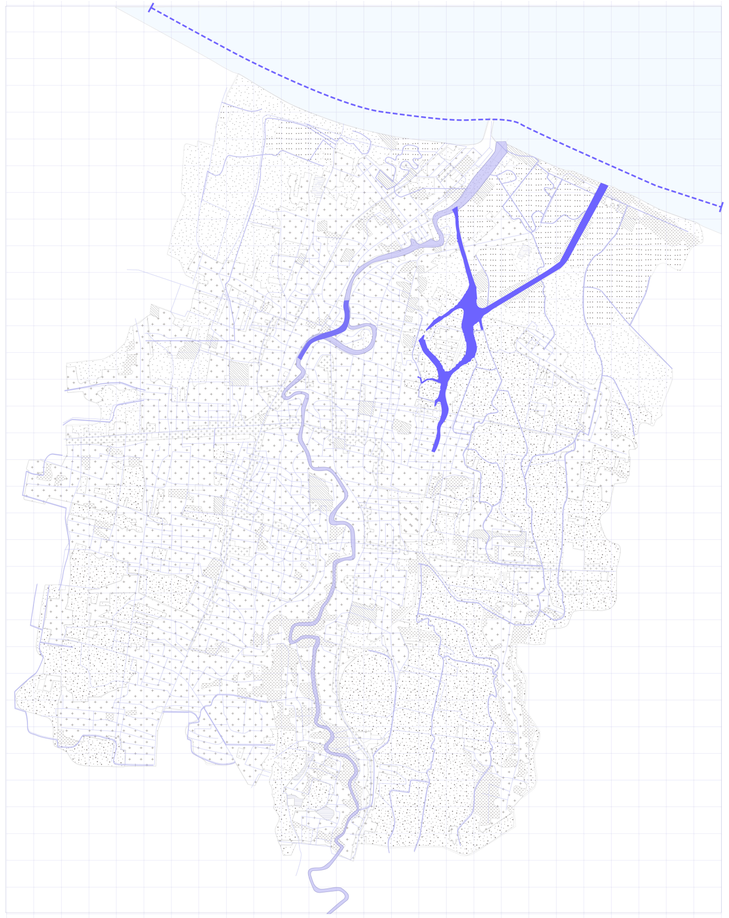
Source: http://www.dreiseitl.com/en/portfolio#bishan-ang-mo-kio-park

Pilot projects- Create conditions for nature

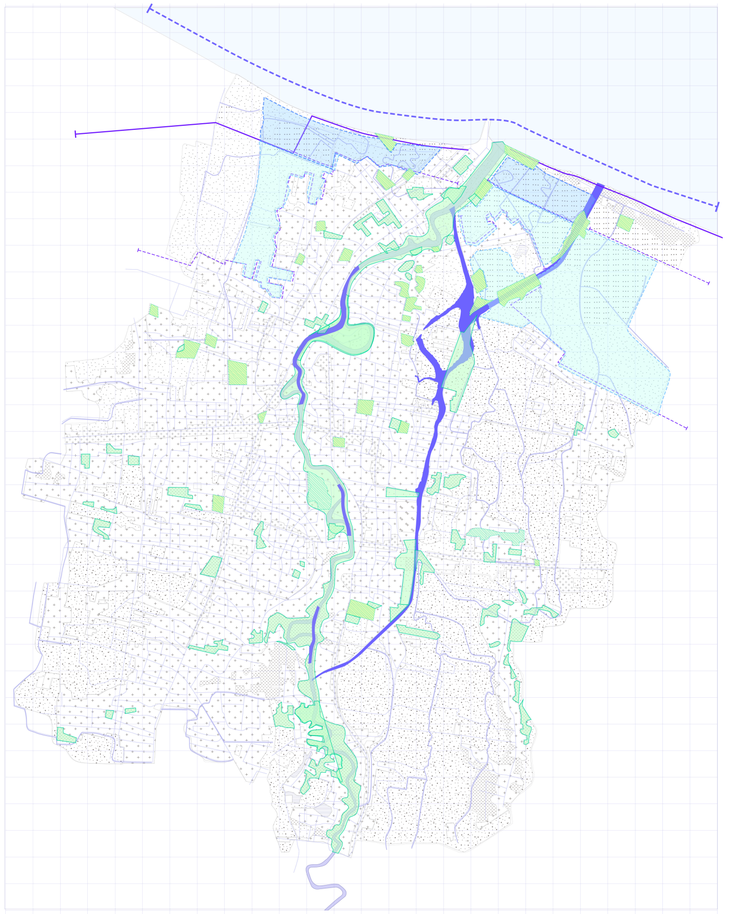


| Strategic plan

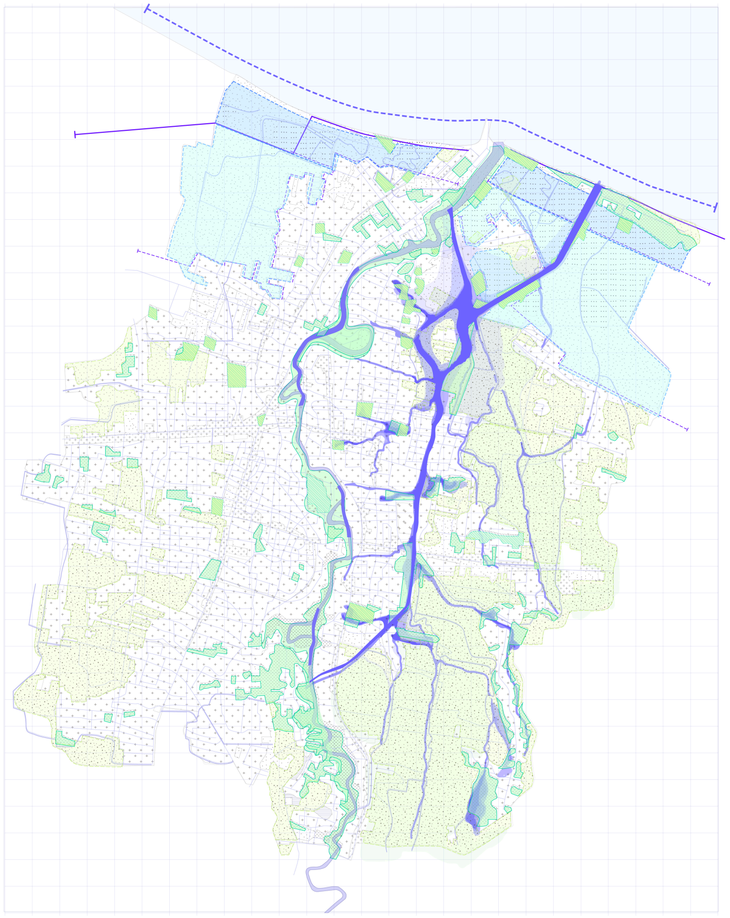
Pilot projects



5-20Years



20-50Years



-CONCLUSION & REFLECTION-

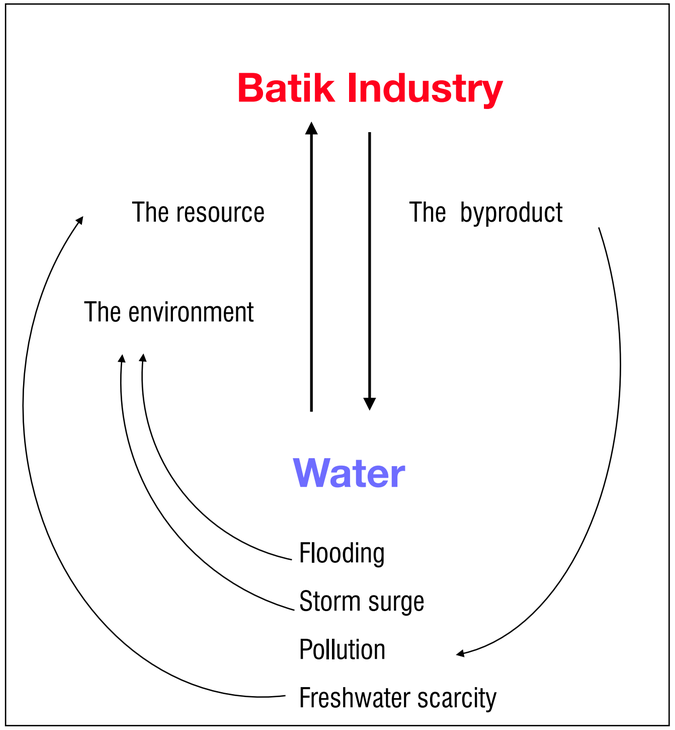
How to create a resilient landscape framework

that facilitates

water safety and batik development in Pekalongan city ?

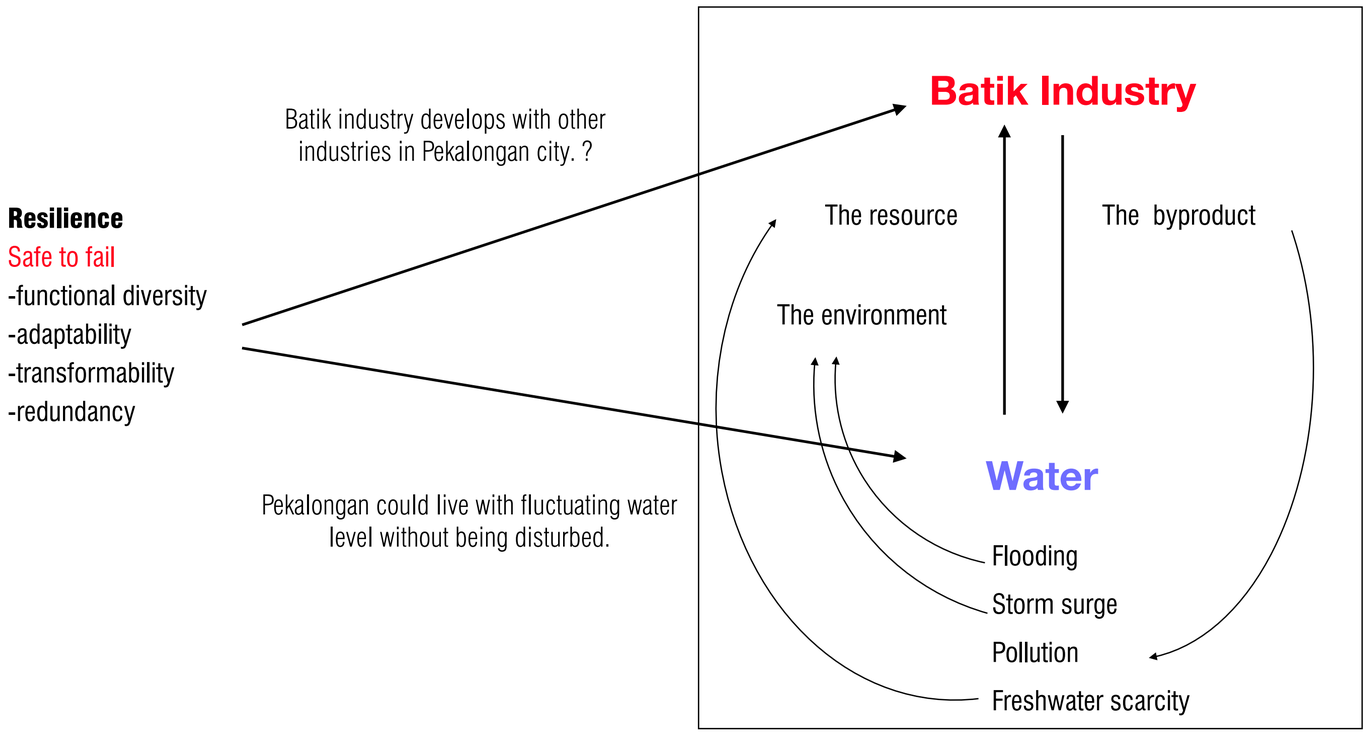
| Conclusion

What is the water safety issue, and the interconnection with the Batik industry ?



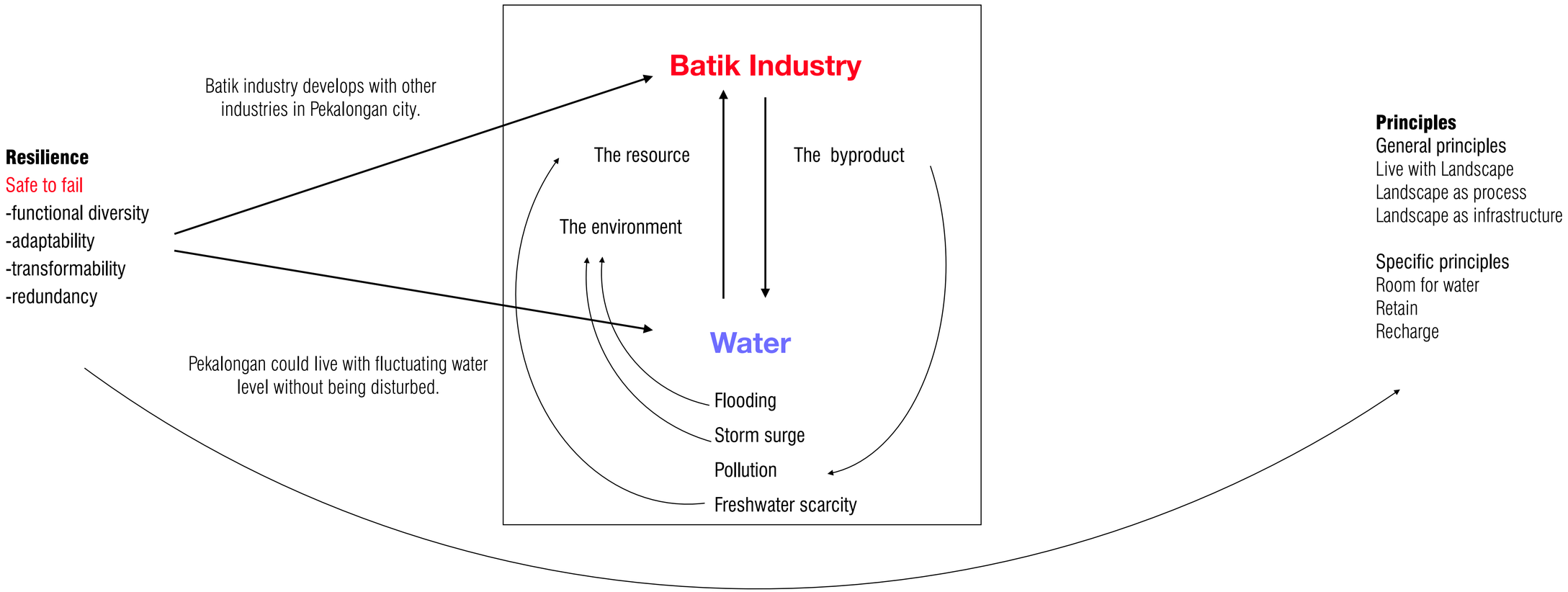
| Conclusion

What does resilience mean for water safety and batik development ?



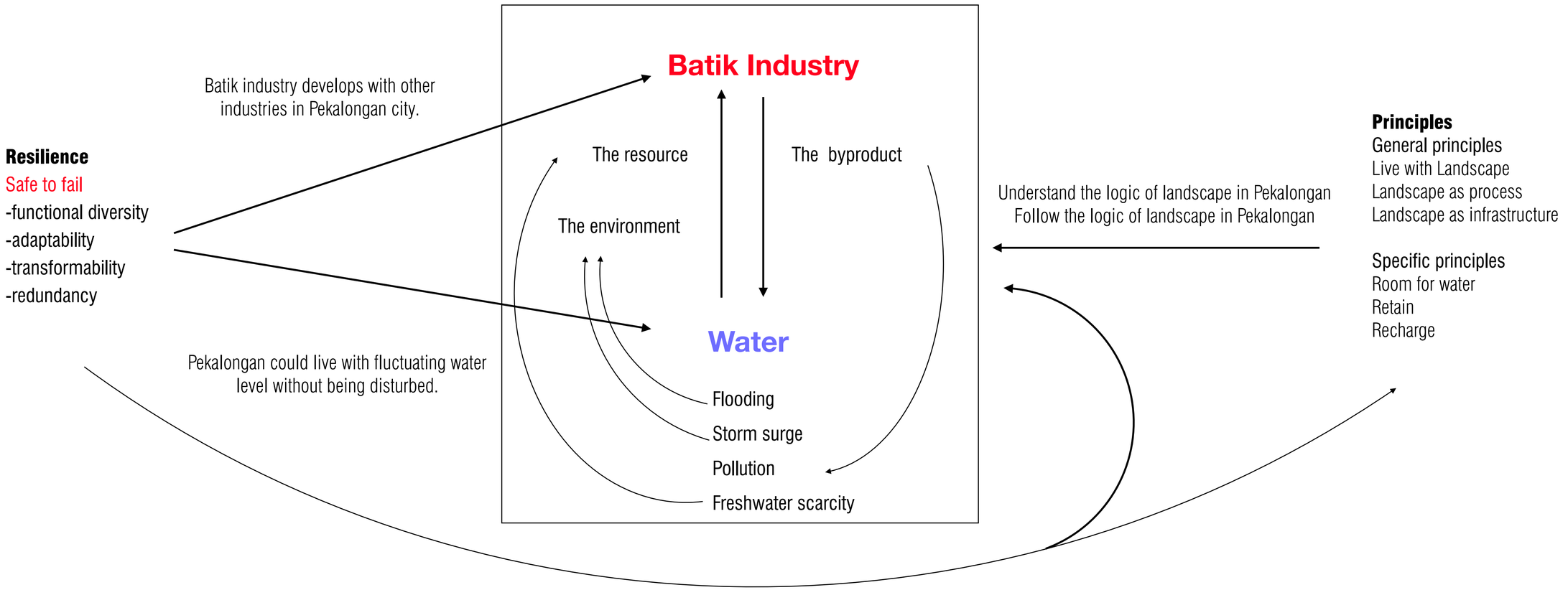
| Conclusion

What are the principles to increase water safety and social practice ?



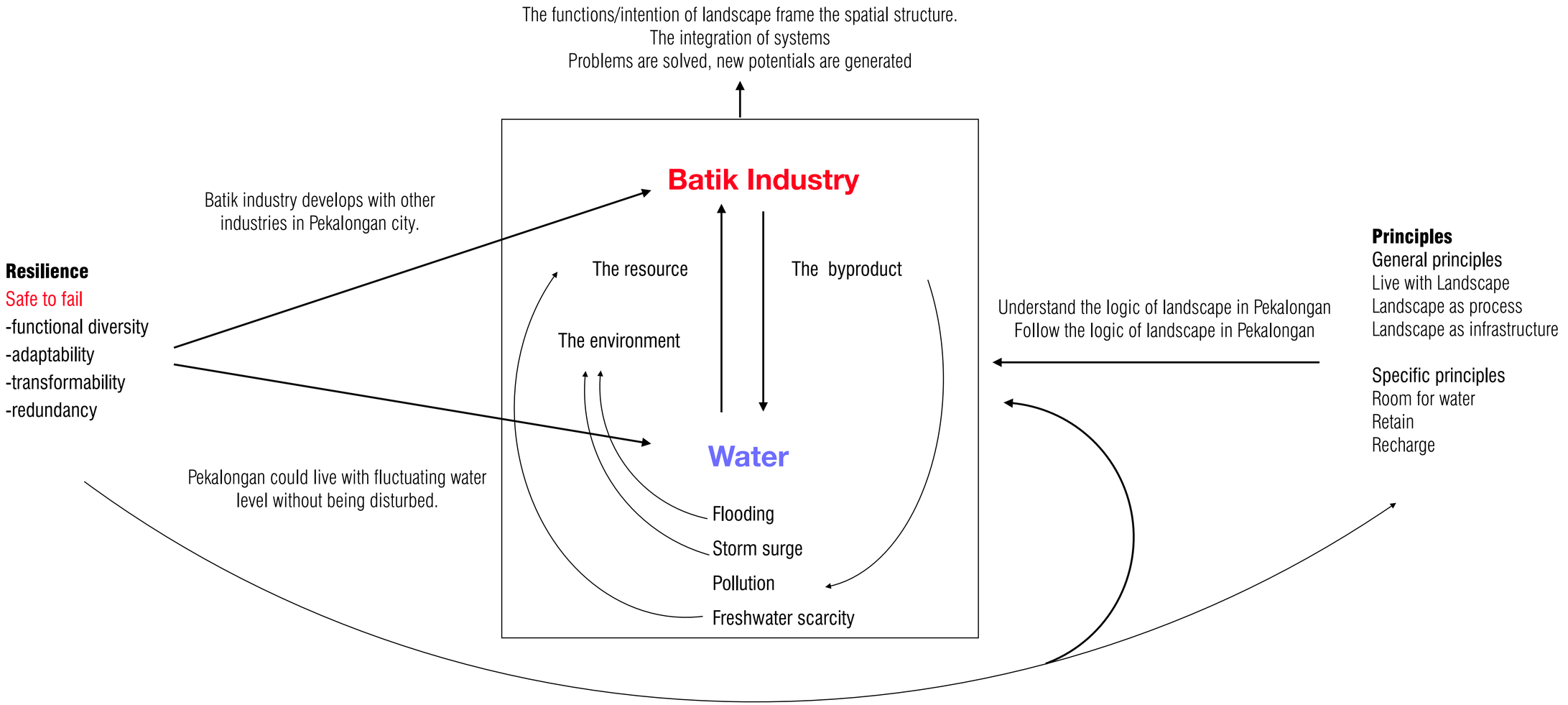
| Conclusion

How to apply the strategy and principles within the cultural and natural conditions of the city Pekalongan ?



| Conclusion

How to generate the spatial potentials / integration in different scales in the terms of landscape view ?



| Reflection

Limitation of the project :
Stakeholder (people engage in Batik industry/ the government) provide clue for detail design
Modelling to test and modify (short cuts/ space for water/ sediments catcher)
Missing landscape element (vegetation species / soil type)

Research & Design: Work in collaboration
-research: grab knowledge, get to know the study location, provide guidance for the design.
-design: frame the scope of research | figure out the knowledge gap | test and renew the knowledge of research.
analysis, synthesis, evaluation, the final solutions and also the reflections back to the proposed problems.

Lessons learnt: Knowledge in different topics | The way to work and think

| Reflection during the process

Design should be based on the logic of landscape: Understand the logic behind landscape and follow it.

Landscape as whole: All the things are brought together at the end.

Design through scales: Design explorations in different scales parallely helps open the mind and make the design more reasonable

The role of Landscape: diagnose the problems | figure the logic and connections | find out the solutions

-COLOURED WATER-

Designing A Resilient Landscape Framework that Facilitates Water Safety and Batik Development in Pekalongan City

