Beyond H20

Water-based landscape architecture in Nusantara

Robin Zwartsenberg

YAMAHA

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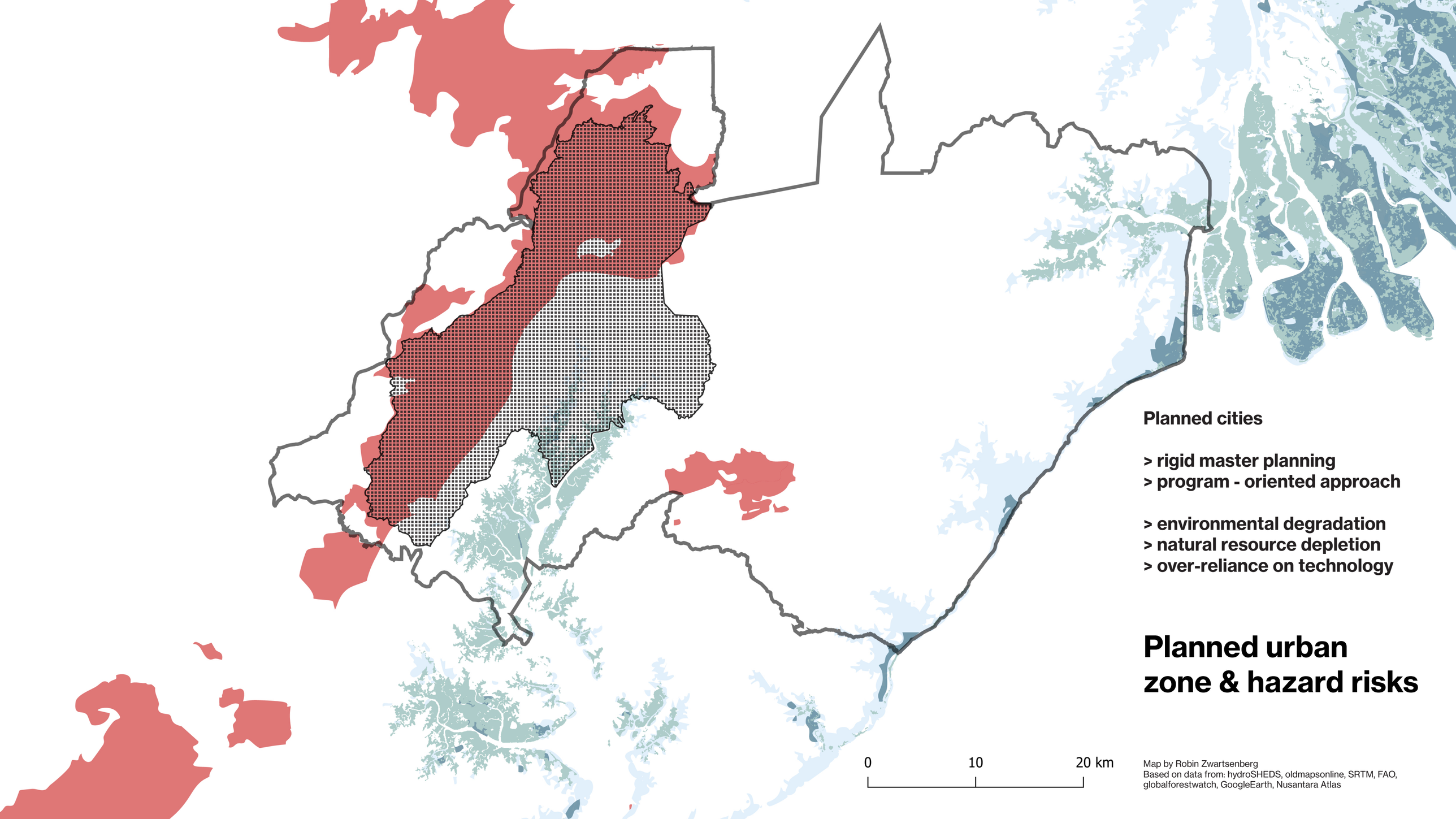
2. Methodology
3. Understanding the landscape system
4. Design approach
5. Design
6. Discussion

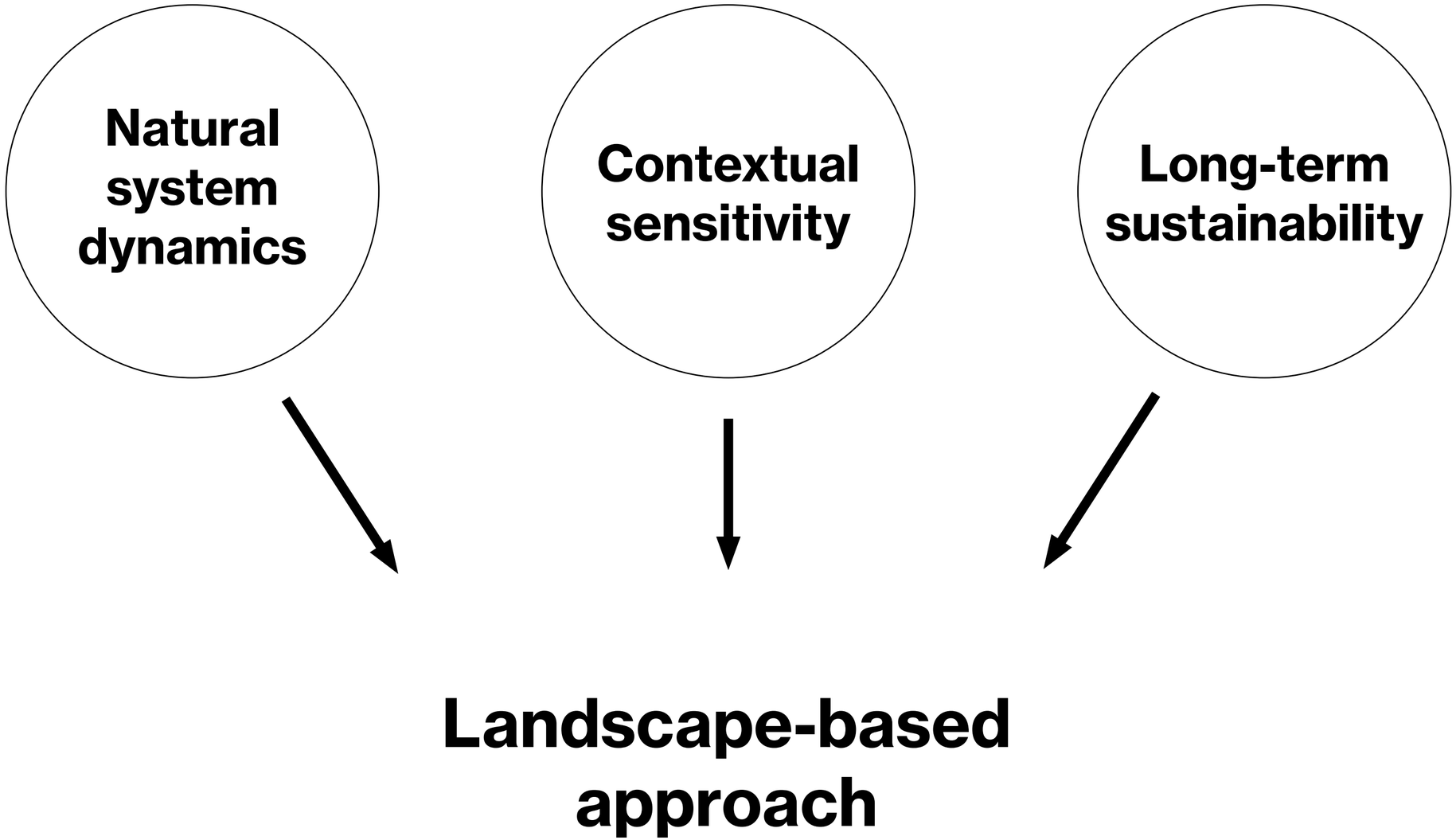
All images by author

1. Introduction

Nusantara, East-Kalimantan, Borneo
Jakarta, Java


Planned cities
> rigid master planning
> program - oriented approach
> environmental degradation
> natural resource depletion
> over-reliance on technology
Planned urban zone & hazard risks
0
10
20 km
Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

A new city is an opportunity to improve biodiversity and local livelihoods!


Natural system dynamics
Contextual sensitivity
Long-term sustainability
Landscape-based approach

Water beyond H20

>

a formative power for design

Objective

To design a water-based landscape framework that leverages water to guide sustainable, socio-ecological urban development in Nusantara.

2. Methodology

Methods

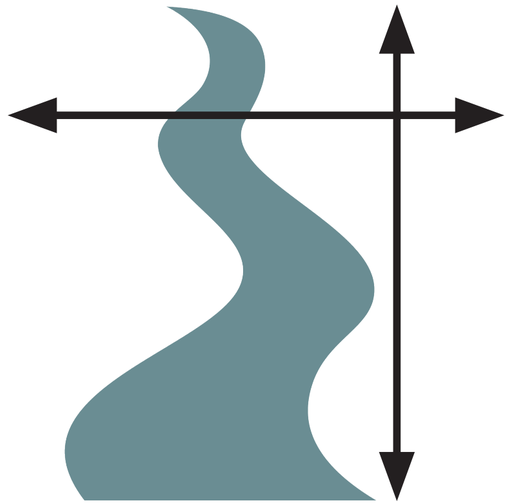
Phase	Understanding	Analysing	Designing	Reflecting
Methods	**Literature review** **Site visit**	Literature review Site visit **Critical GIS mapping**	**Research through design** Precedent studies	Discuss
Outcome	Problem statement Research questions	Maps Sections Written analysis	Maps Sections Visualizations Design principles	Design tools Improved design

Theoretical framework

Design with nature -
Watershed approach

(Ian Mcharg, 1969)

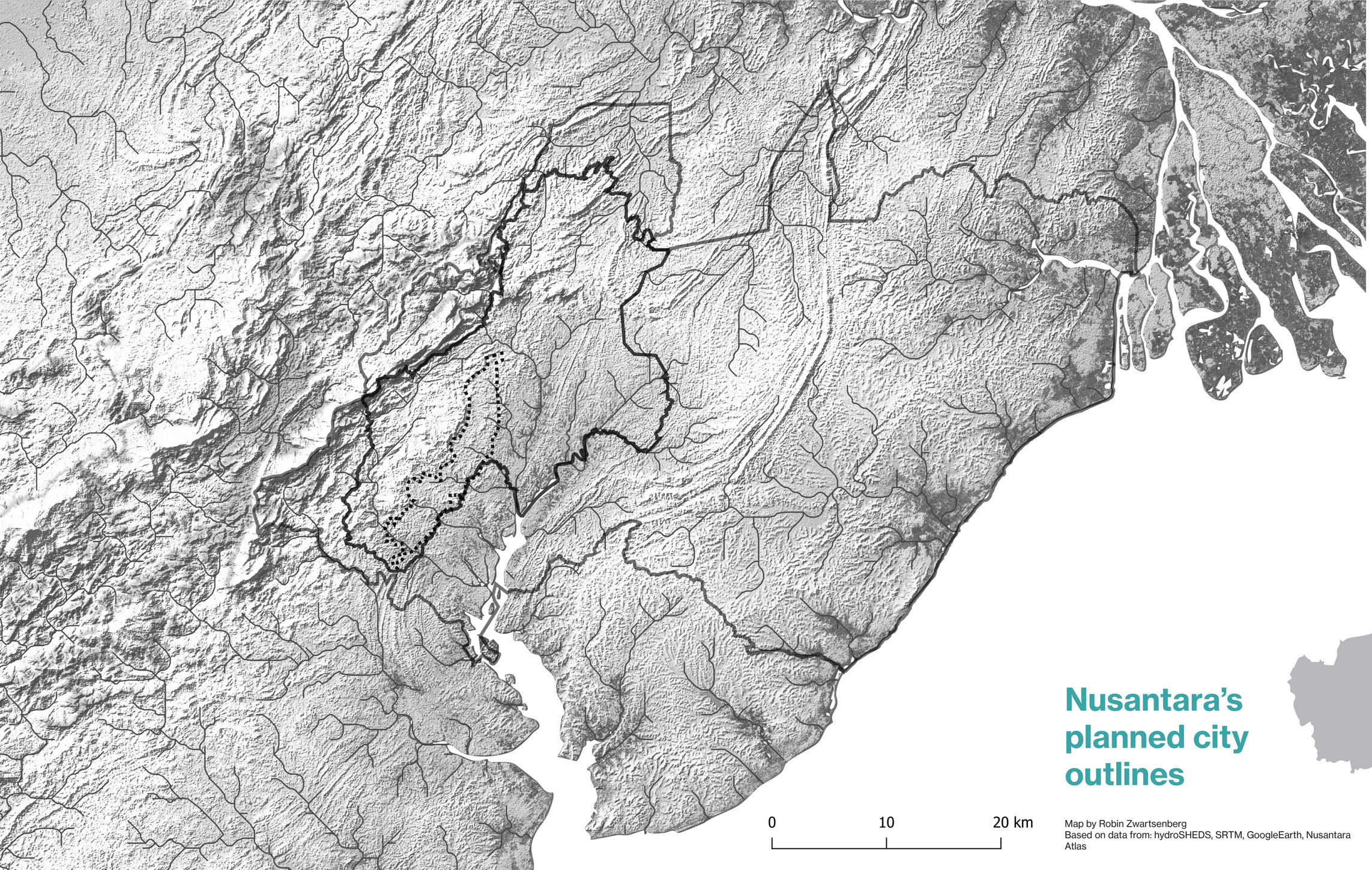
Theoretical framework



Two networks strategy -
fast and slow zones

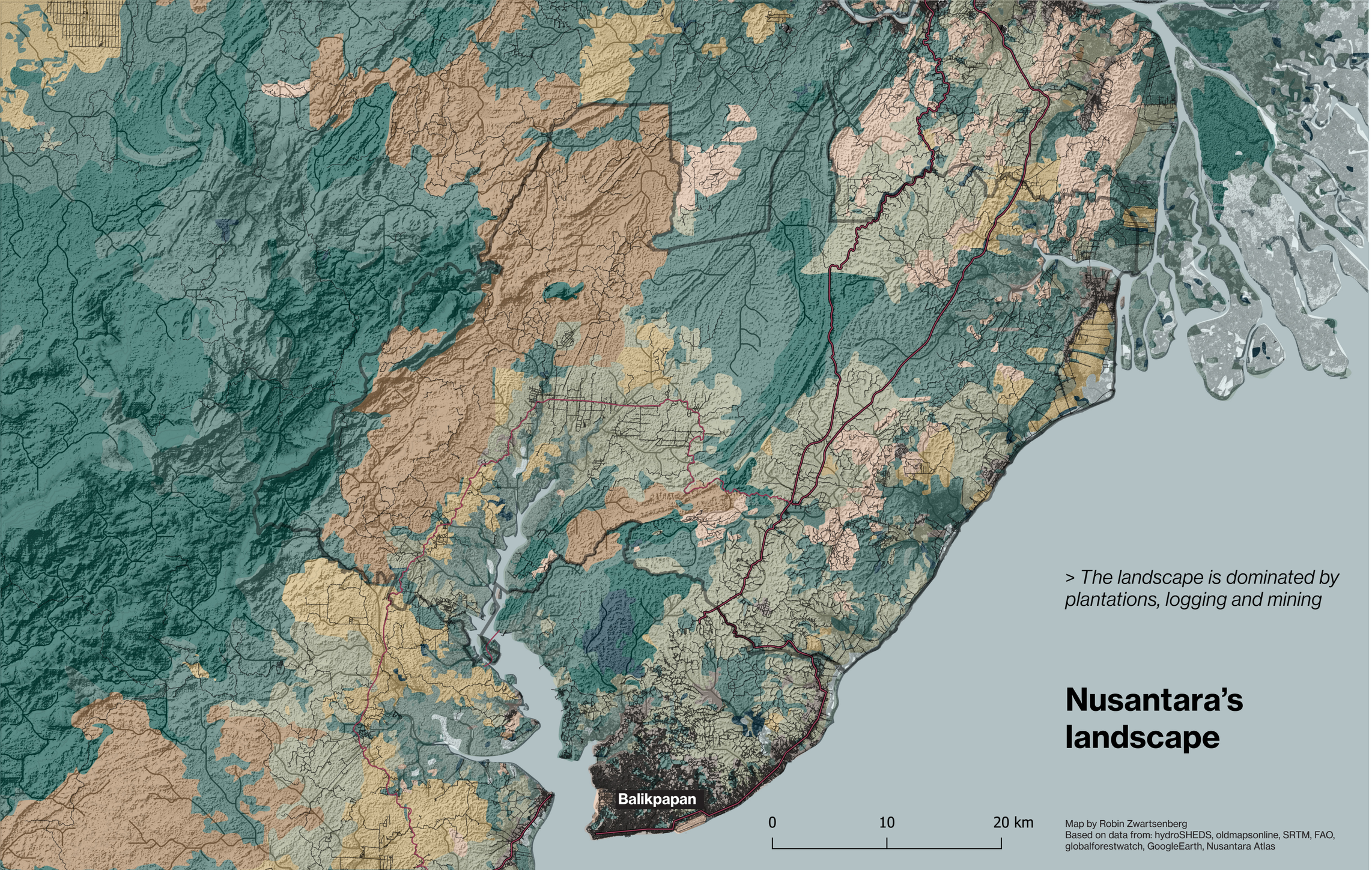
(Tjallingii, 2015)

3. Understanding the landscape system



Nusantara's planned city outlines

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, SRTM, GoogleEarth, Nusantara Atlas



Natural landscapes

- Primary forest
- Secondary forest
- Secondary mangrove
- Forest with large scale illegal deforestation
- Bay and ocean

Livelihoods

- Dryland farming and grassland
- Aquaculture
- Urban

Extraction landscapes

- Large scale plantation (pulp wood, oil palm)
- Small scale plantation (pulp wood, oil palm)
- Mining

Roads

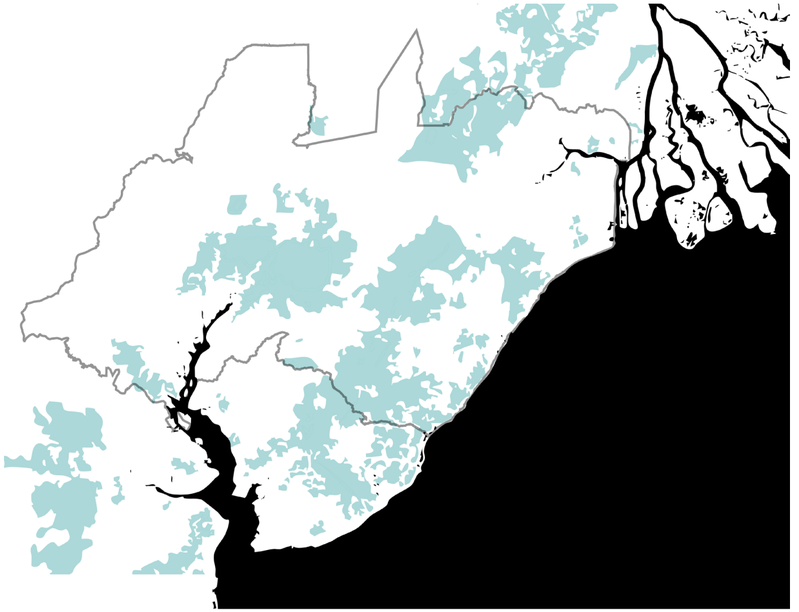
- Local road
- Federal road
- Pronvincial road

> The landscape is dominated by plantations, logging and mining

Nusantara's landscape

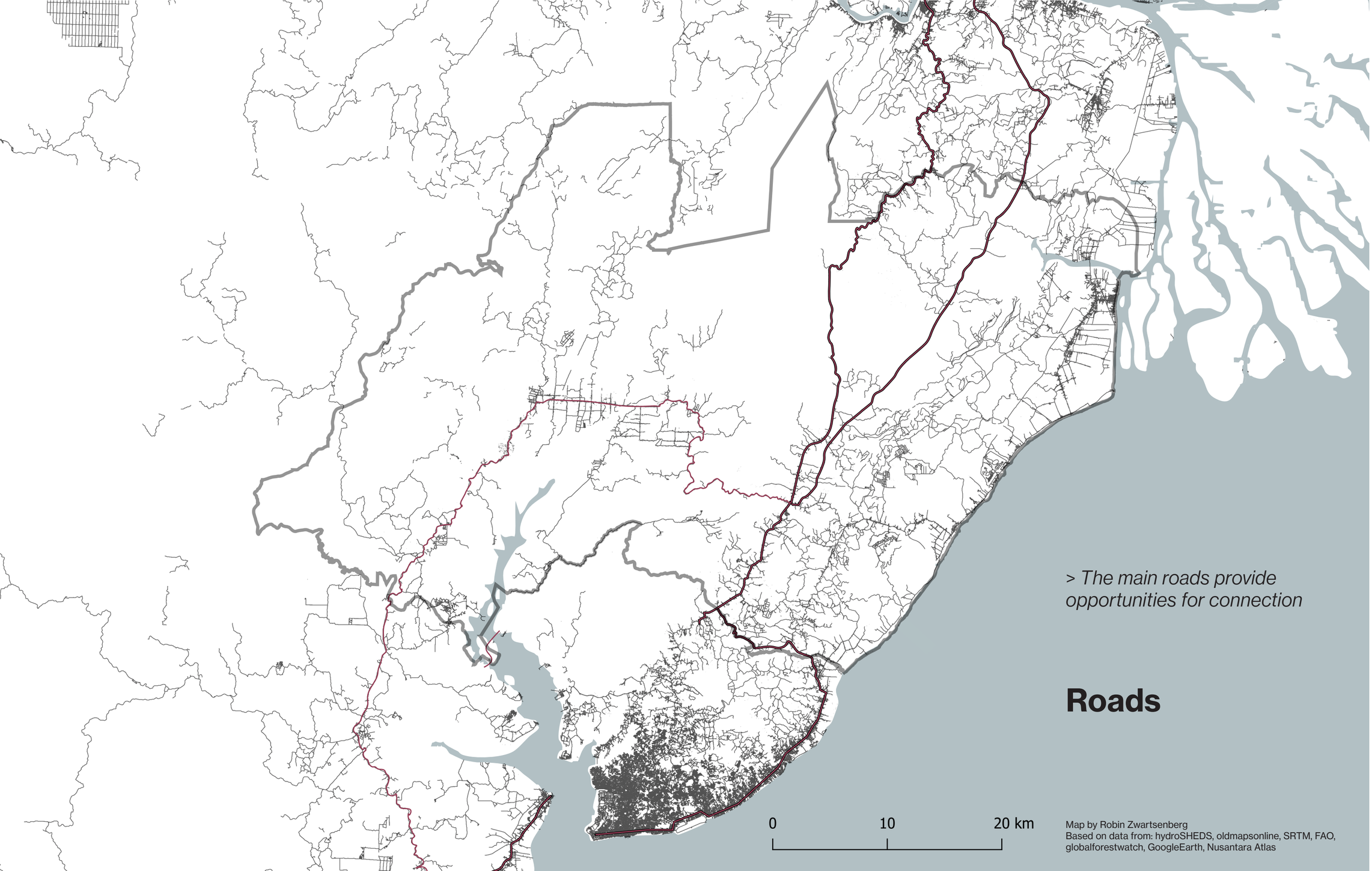
Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

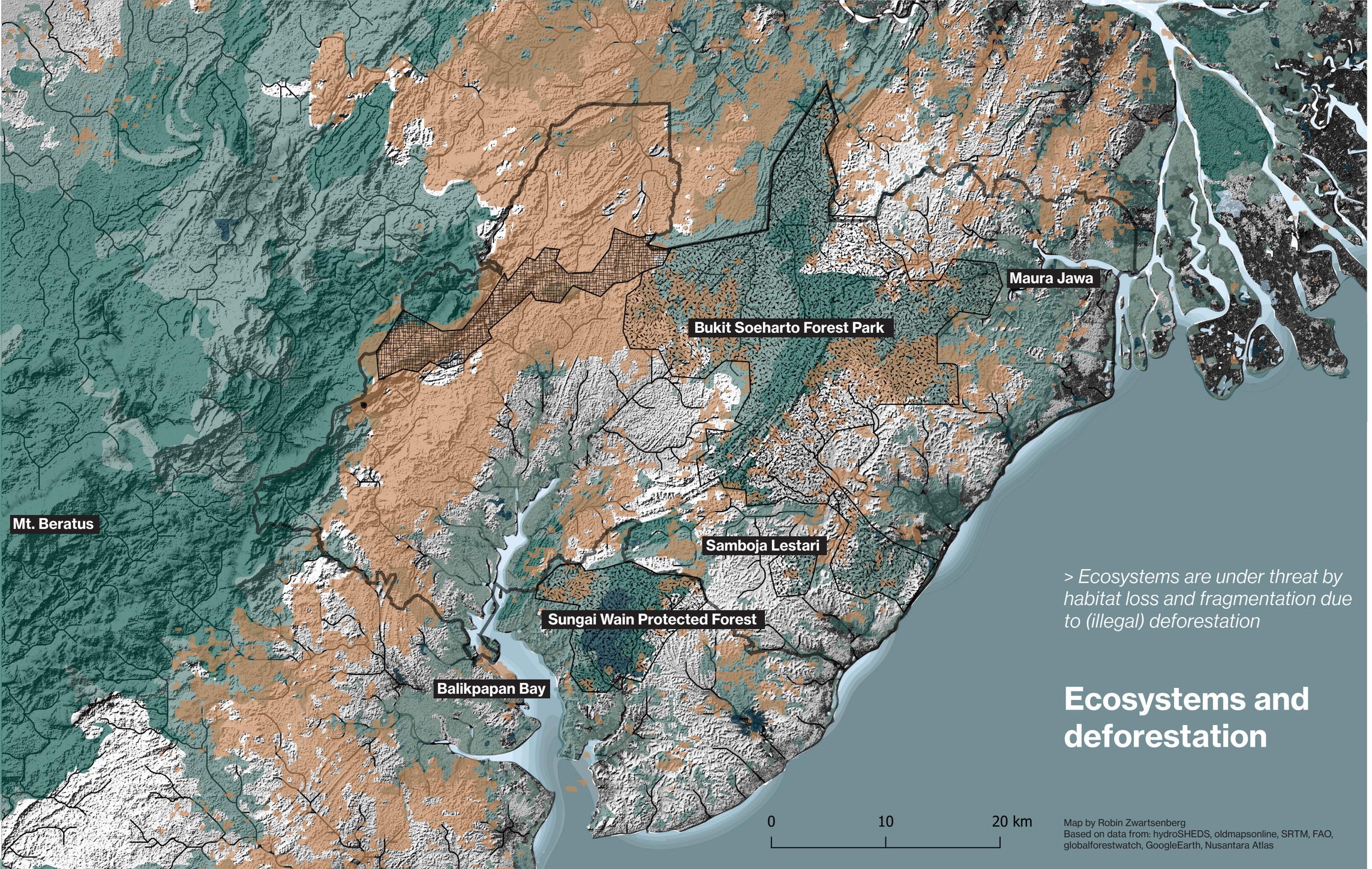
Dryland agriculture and grasslands



Fisheries and aquaculture in Balikpapan Bay

Urban living


> The main roads provide opportunities for connection
Roads
0
10
20 km
Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas



Primary forest

Secondary forest

Forest with large scale illegal landuse

Mangrove

Deforestation since 2015

Brackish marine ecosystems

Saline marine ecosystems

Assigened forest conservation area

Assigned animal corridor

> Ecosystems are under threat by habitat loss and fragmentation due to (illegal) deforestation

Ecosystems and deforestation

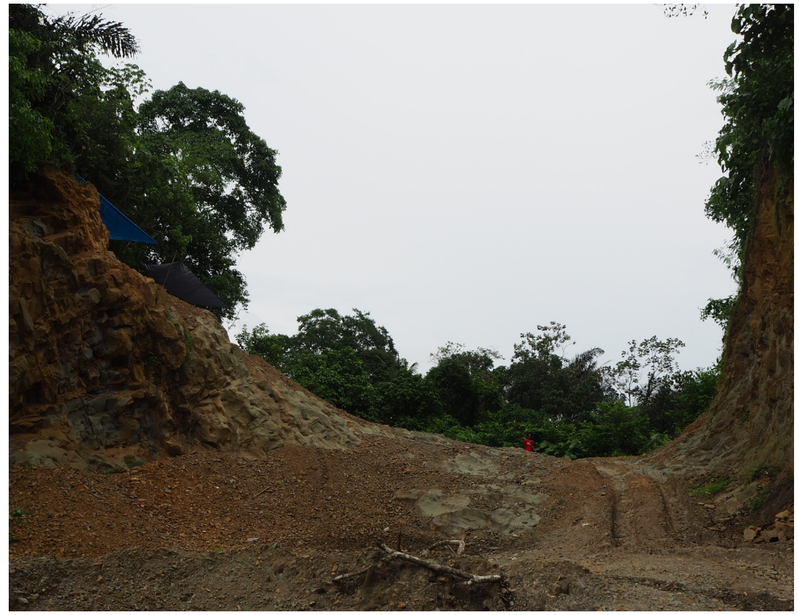
Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

High- and lowland rainforest

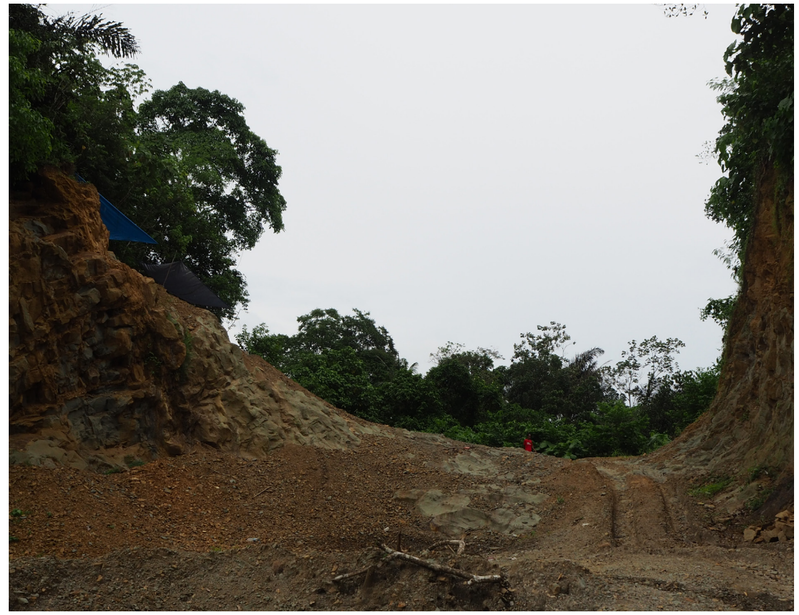
Mangrove wetlands

Coastal and marine ecosystems

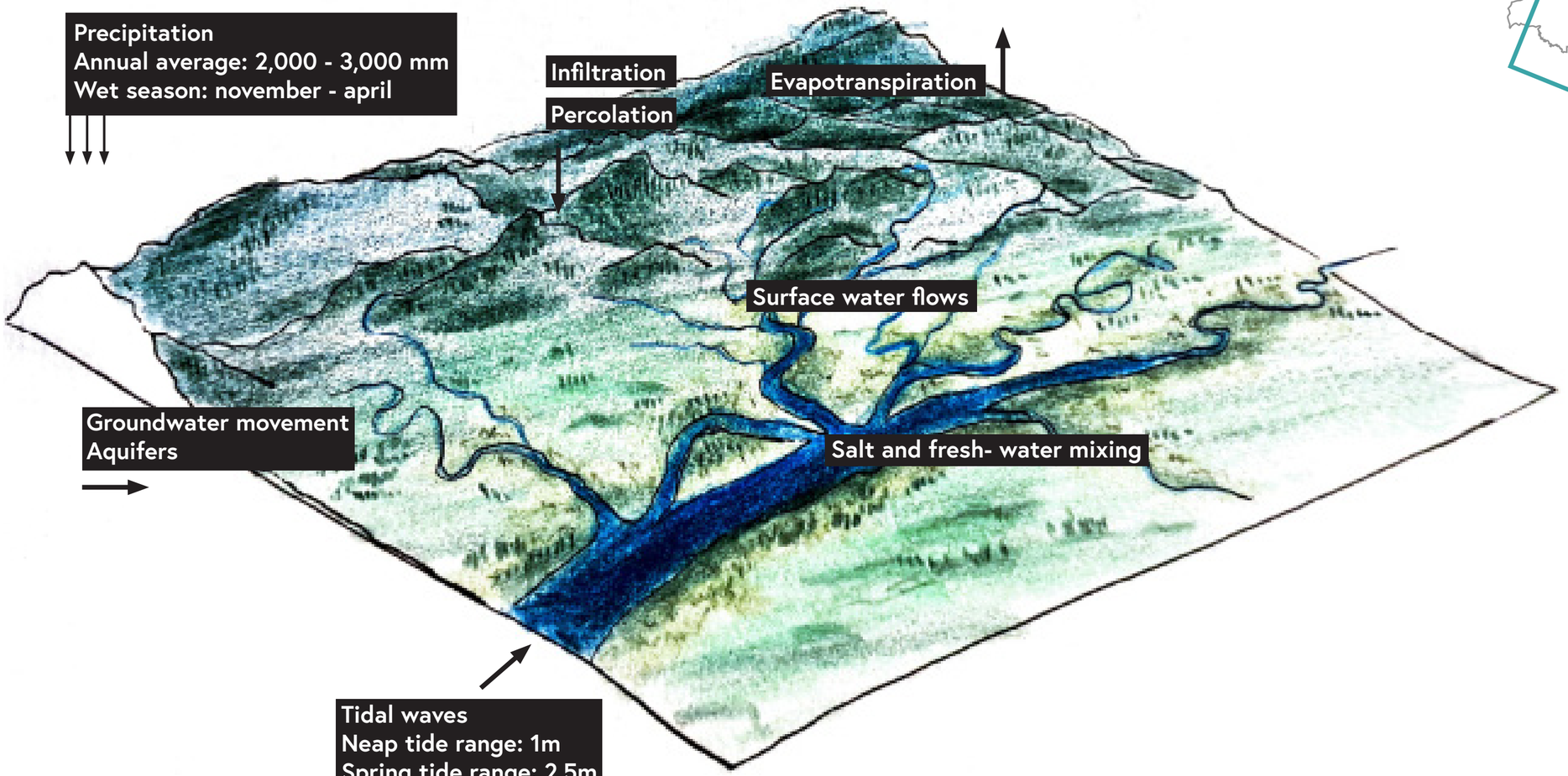
Forest suffering large scale legal and illegal logging

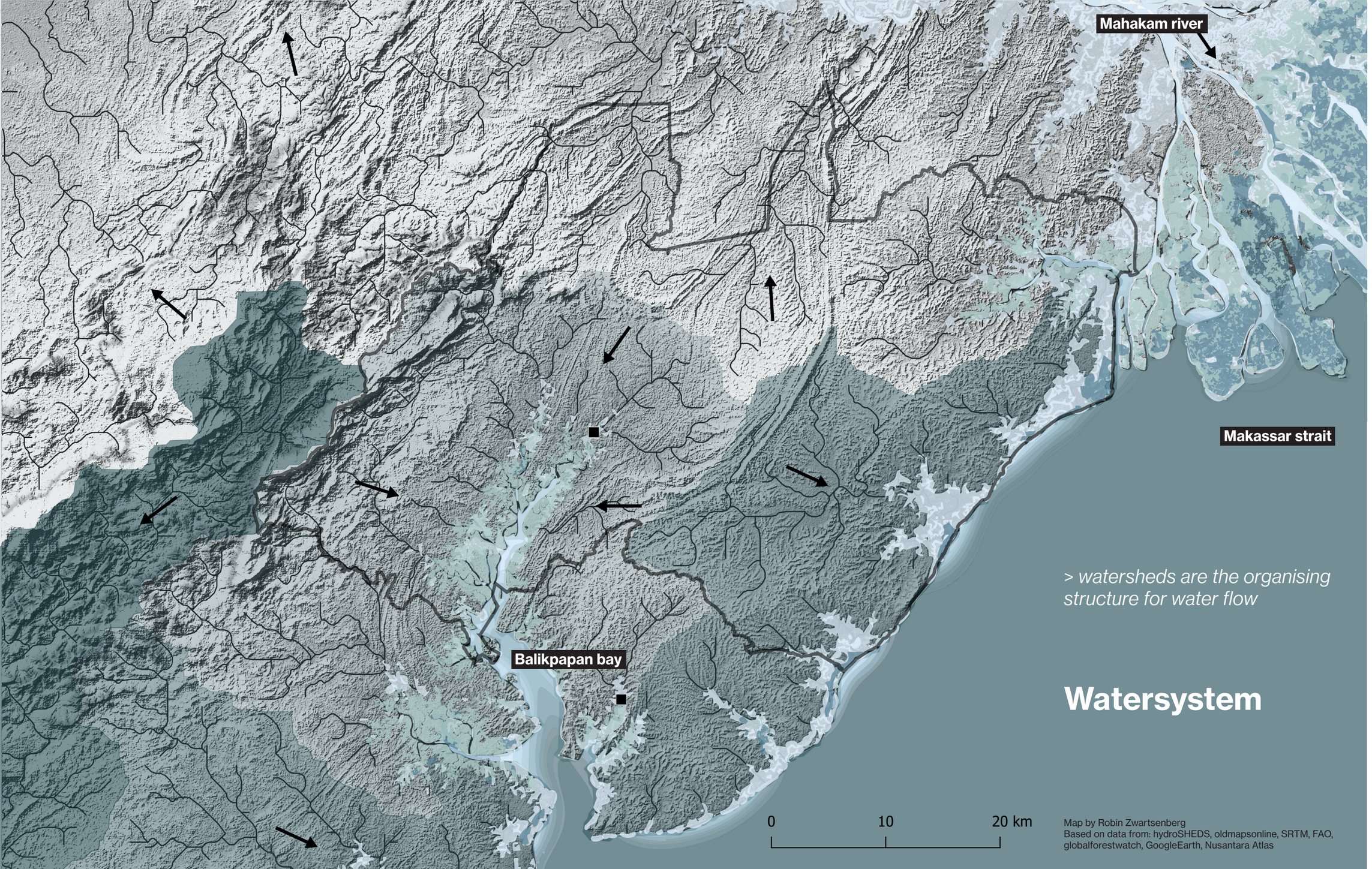


Industrial pulp wood and oil palm plantations



Hydrological cyle in East - Kalimantan



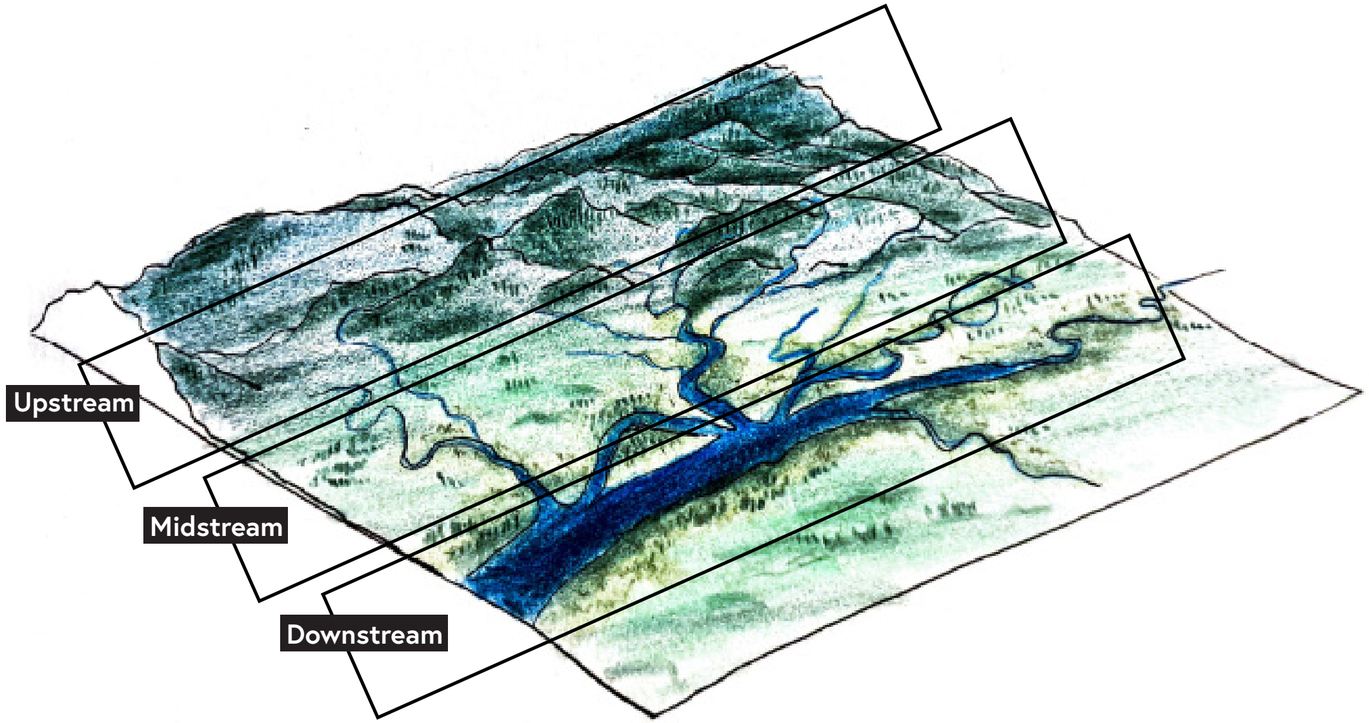


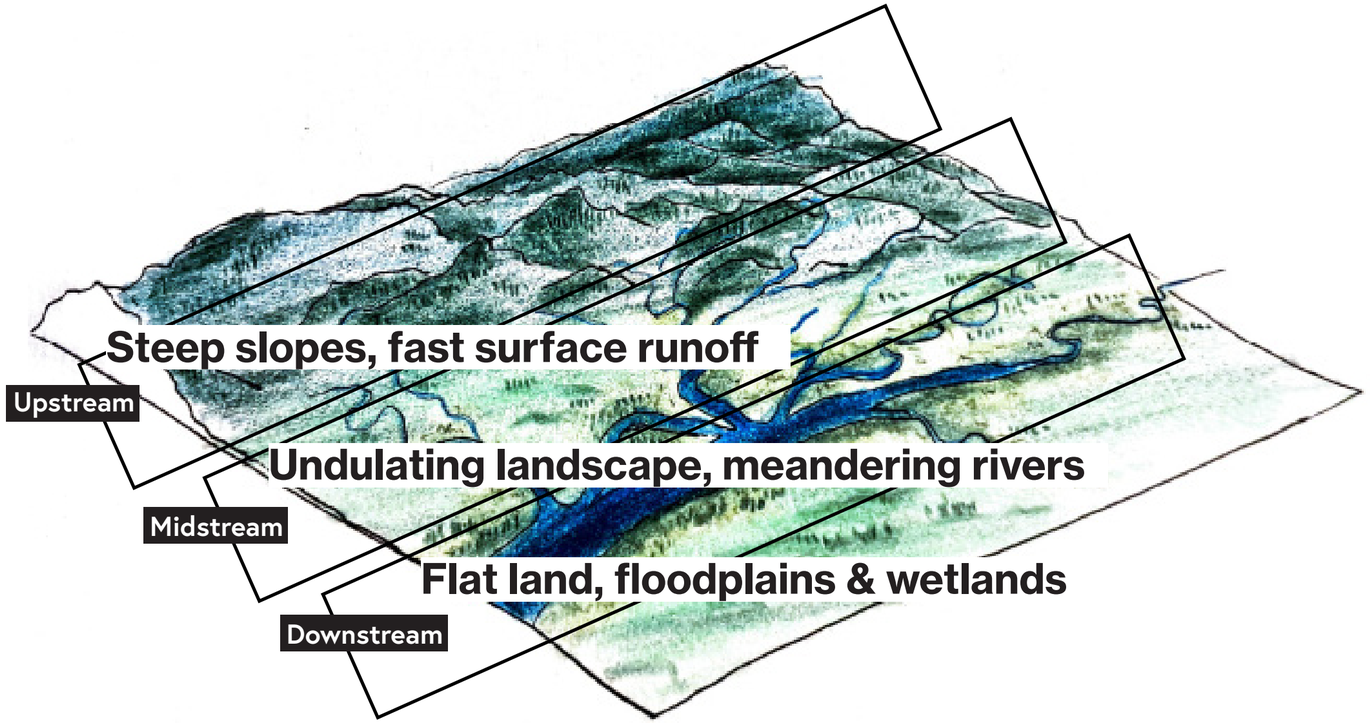
Watershed Balikpapan bay
Watershed Mahakam river
Watershed ocean
Watershed Telake river
Mangrove
Aquaculture ponds
Wetland
Saline surface water
Fresh surface water
Dam

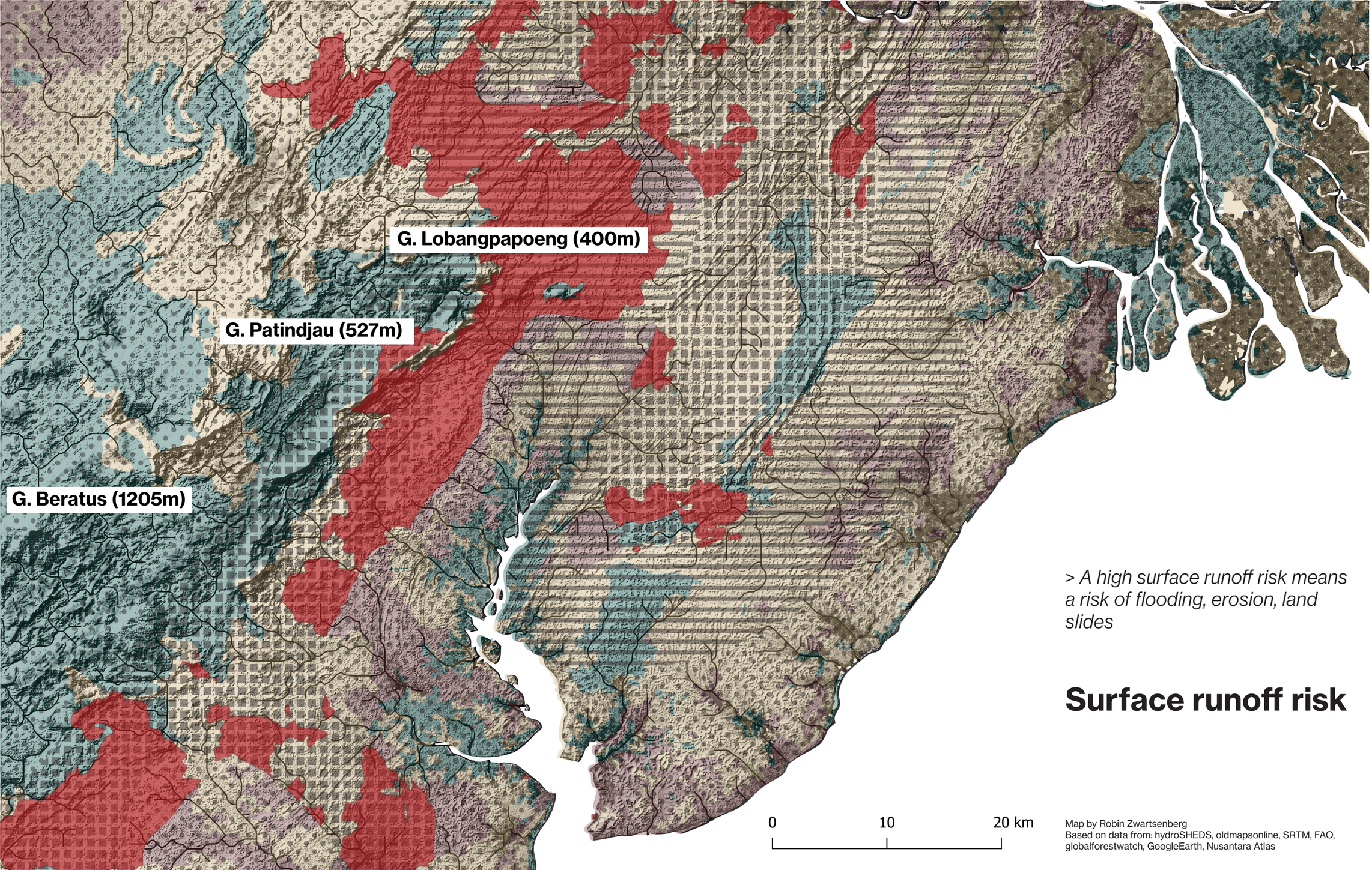
> watersheds are the organising structure for water flow

Watersystem

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas


Upstream
Midstream
Downstream


Steep slopes, fast surface runoff
Upstream
Undulating landscape, meandering rivers
Midstream
Flat land, floodplains & wetlands
Downstream

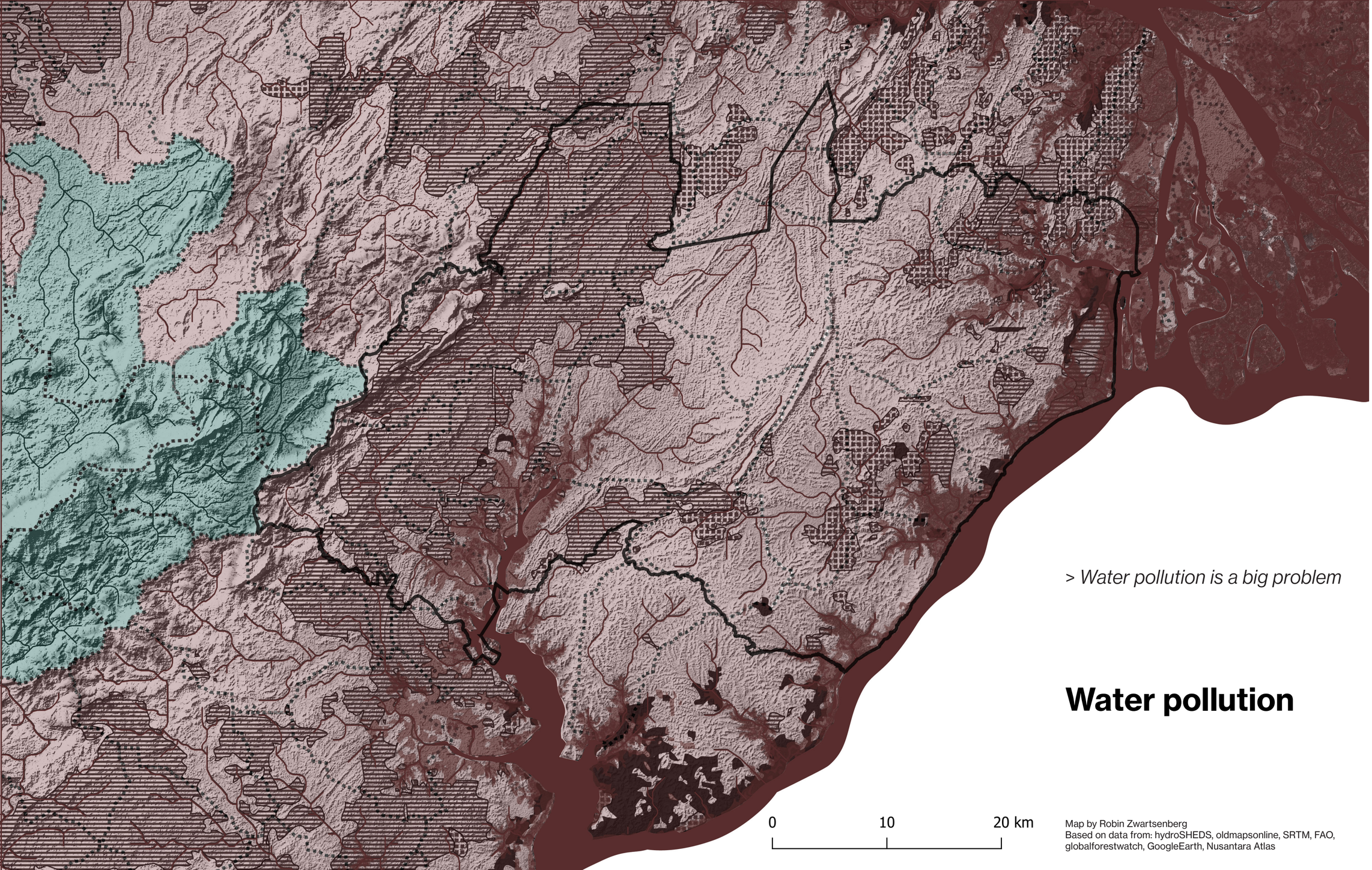


> A high surface runoff risk means a risk of flooding, erosion, land slides

Surface runoff risk

0 10 20 km

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas



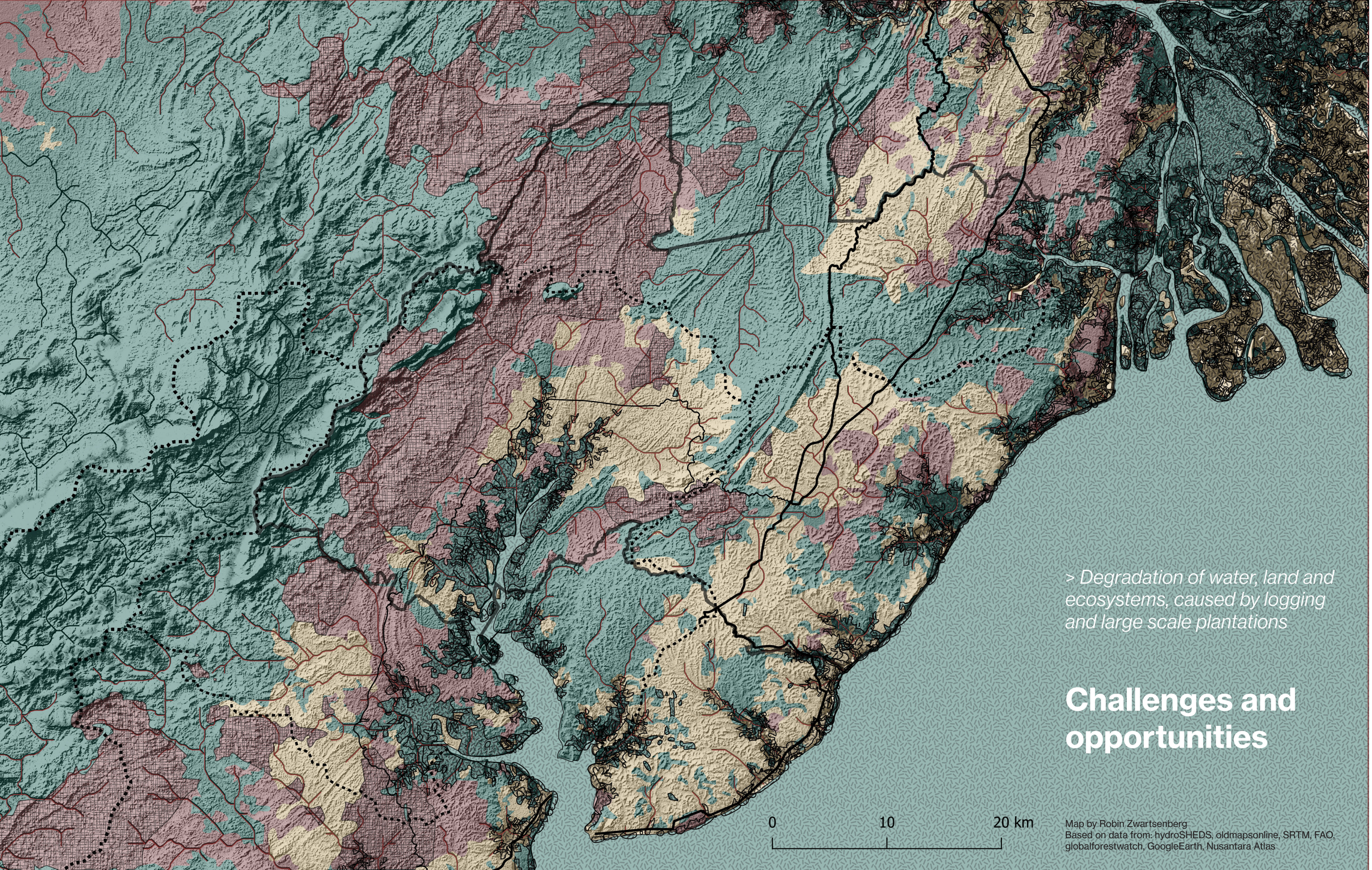
Waterbody with high pollution risk
Watershed with high pollution risk
Watershed with low pollution risk
Plantation
Mining
Urban area
Watershed boundary

> Water pollution is a big problem

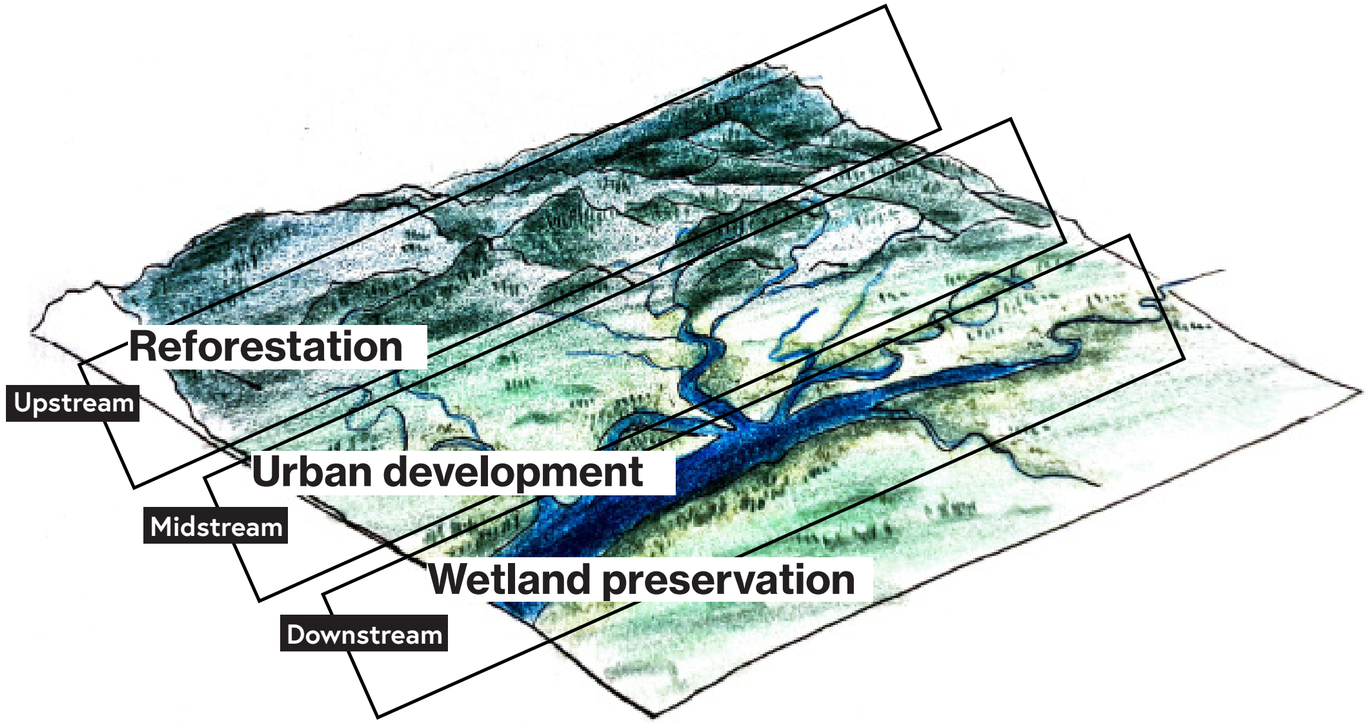
Water pollution

0 10 20 km

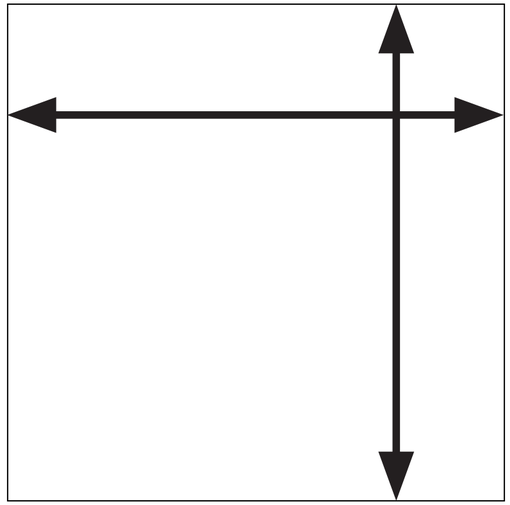
Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

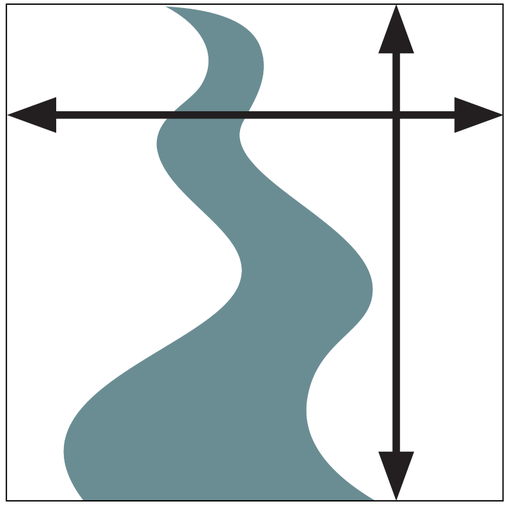

Not to mildly degraded
Partly degraded
Severely degraded
Erosion and surface runoff hotspots
Water bodies prone to pollution
> Degradation of water, land and ecosystems, caused by logging and large scale plantations
Challenges and opportunities
0
10
20 km
Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

4. Design approach

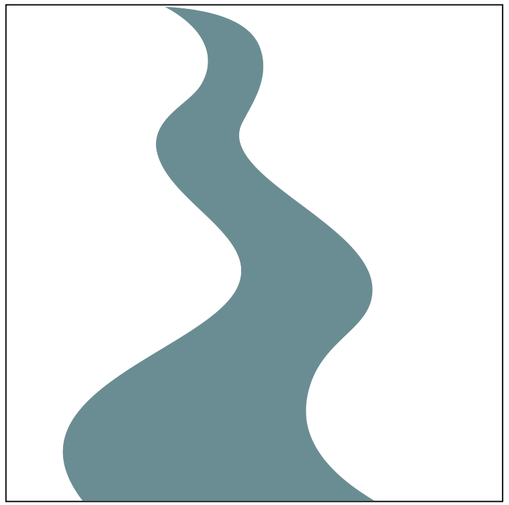

Reforestation
Upstream
Urban development
Midstream
Wetland preservation
Downstream

The two networks strategy





Slow zone



Water as carrying network

- natural drainage pattern
- rivers
- floodplains
- infiltration zones
- steep slopes
- valleys

Water quality

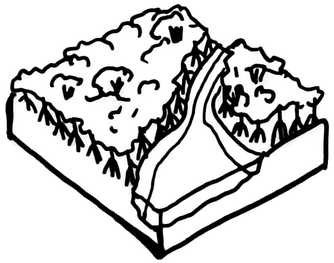
Water quantity

Biodiversity

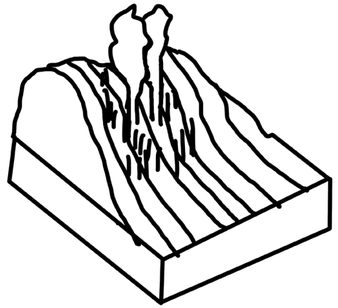
Local food production

Low impact human activity

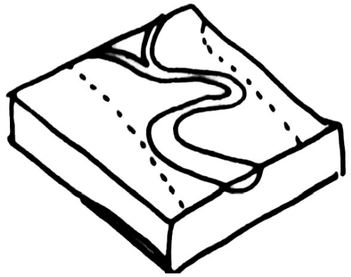
Slow zone toolbox



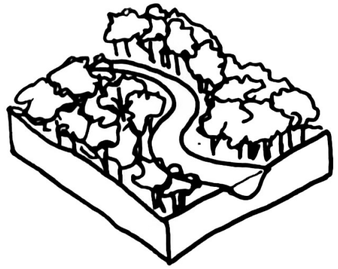
Using rivers, drainage patterns and infiltration zones for slow zone



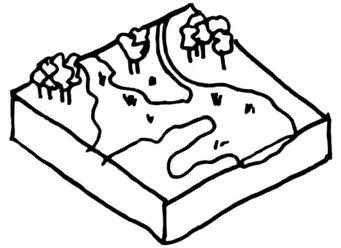
Vegetating steep slopes



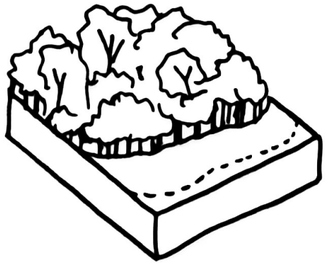
Leaving room for the river and floodplains



Implementing riparian buffers

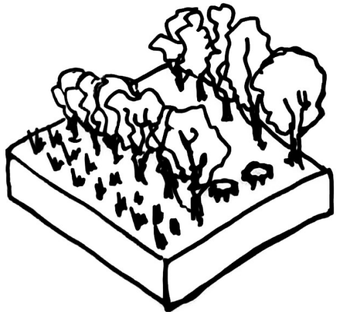


Preservation of wetlands

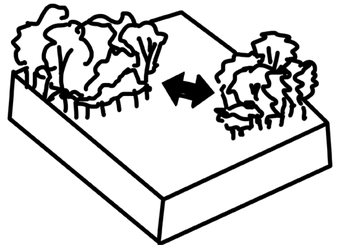


Protection of remaining forest

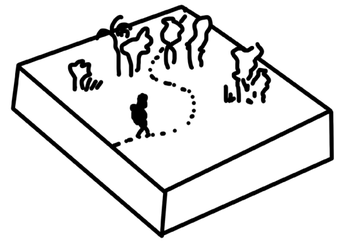
Forest regeneration through accelerated succession



Agroforestry

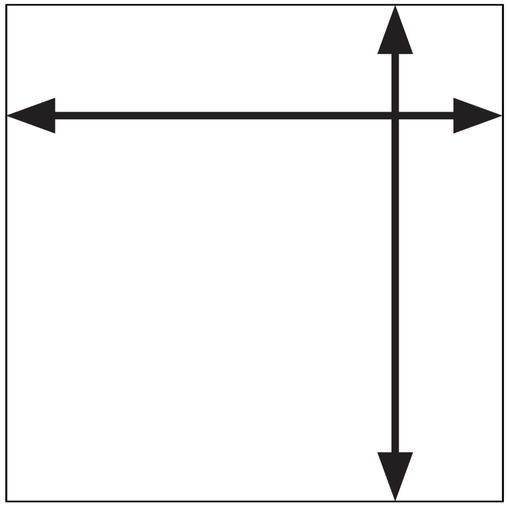


Connection of ecosystems through creating corridors



Facilities for low impact recreation

Fast zone



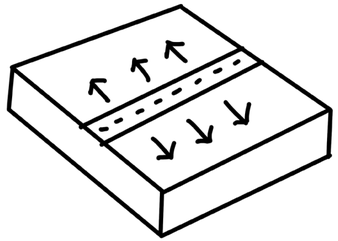
Traffic as carrying network (roads, railways)

Accessibility

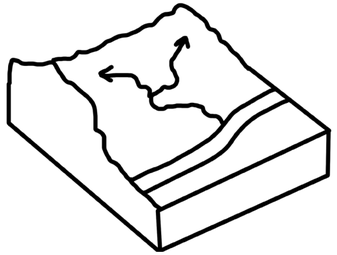
High density built environment

Commercial activity

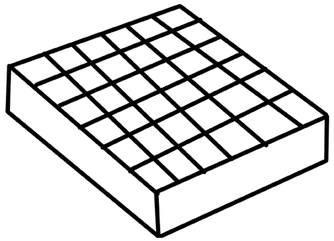
Fast zone toolbox



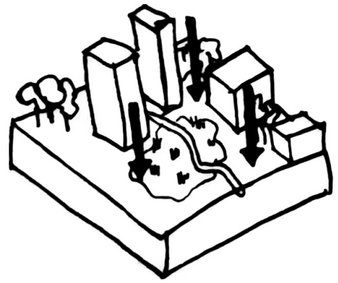
Traffic network
as base for urban
expansion



use existing roads
where possible

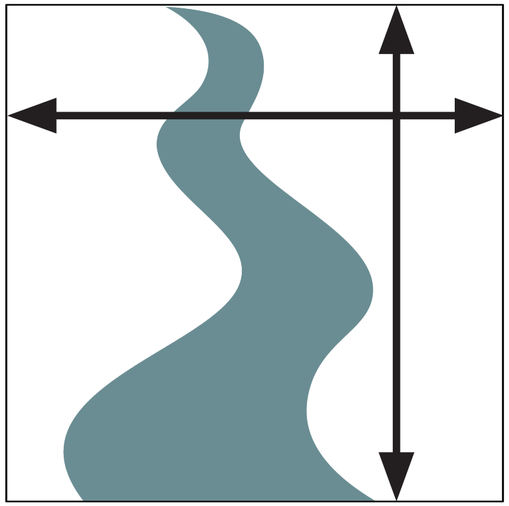


100x100m grid for
walkability and human
scale



Permeable urban
zones

Integration

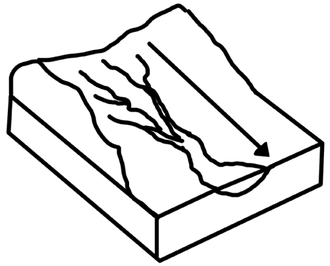


“..how vital it is for a town to give people both intense activity and deep

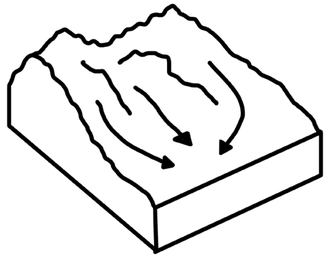
and satisfying quiet”

(Alexander et al., 1977).

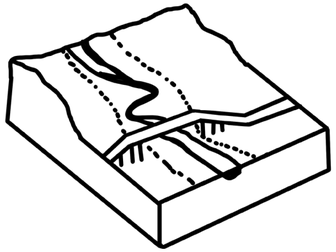
Integration toolbox



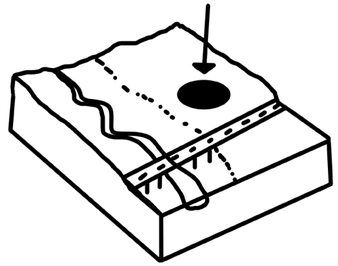
Orienting the city based on upstream downstream axis



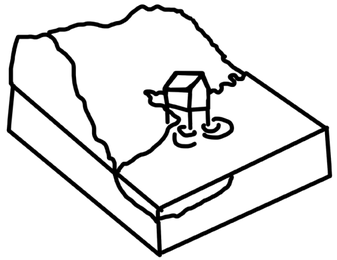
Natural drainage pattern as bioswales in urban zone



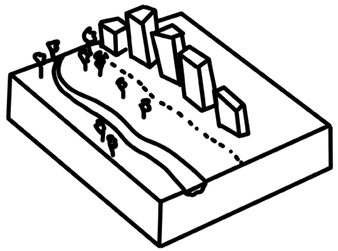
Bridges to cross the greenblue corridors



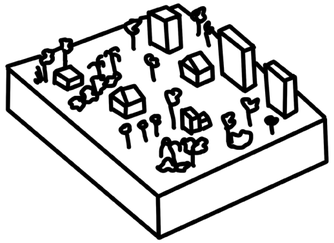
Urban nodes close to crossing fast and slow zone



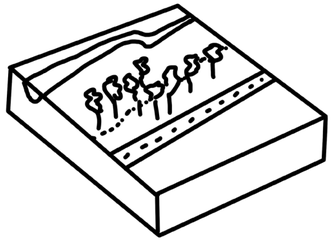
Low - density housing adapted to the local landscape



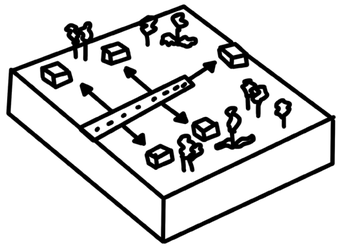
High contrast edge between fast zone and slow zone



Gradient edge between slow zone and fast zone

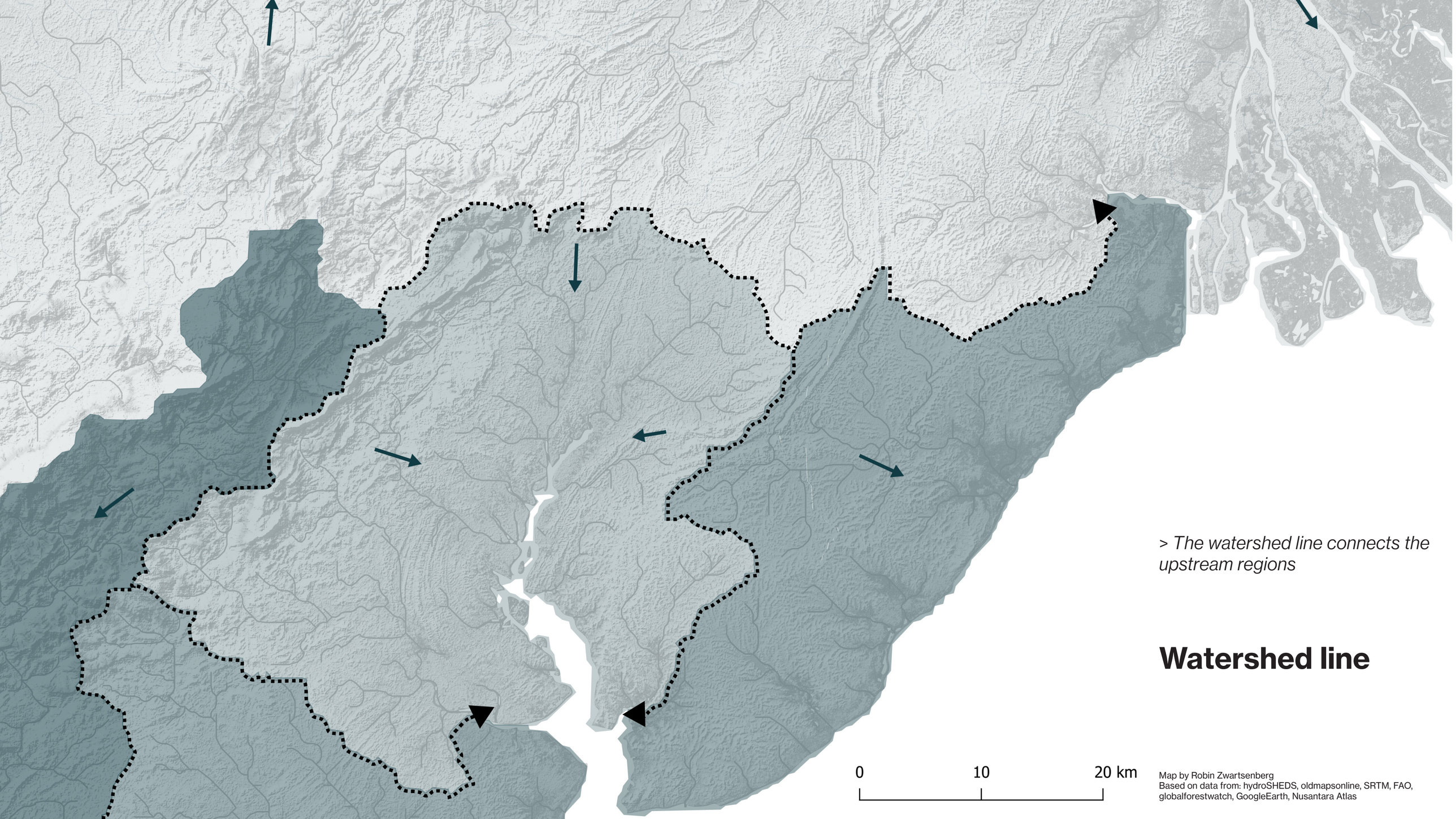


Transition zone between road and slow zone



Access from the inside, landscape outside

5. Design

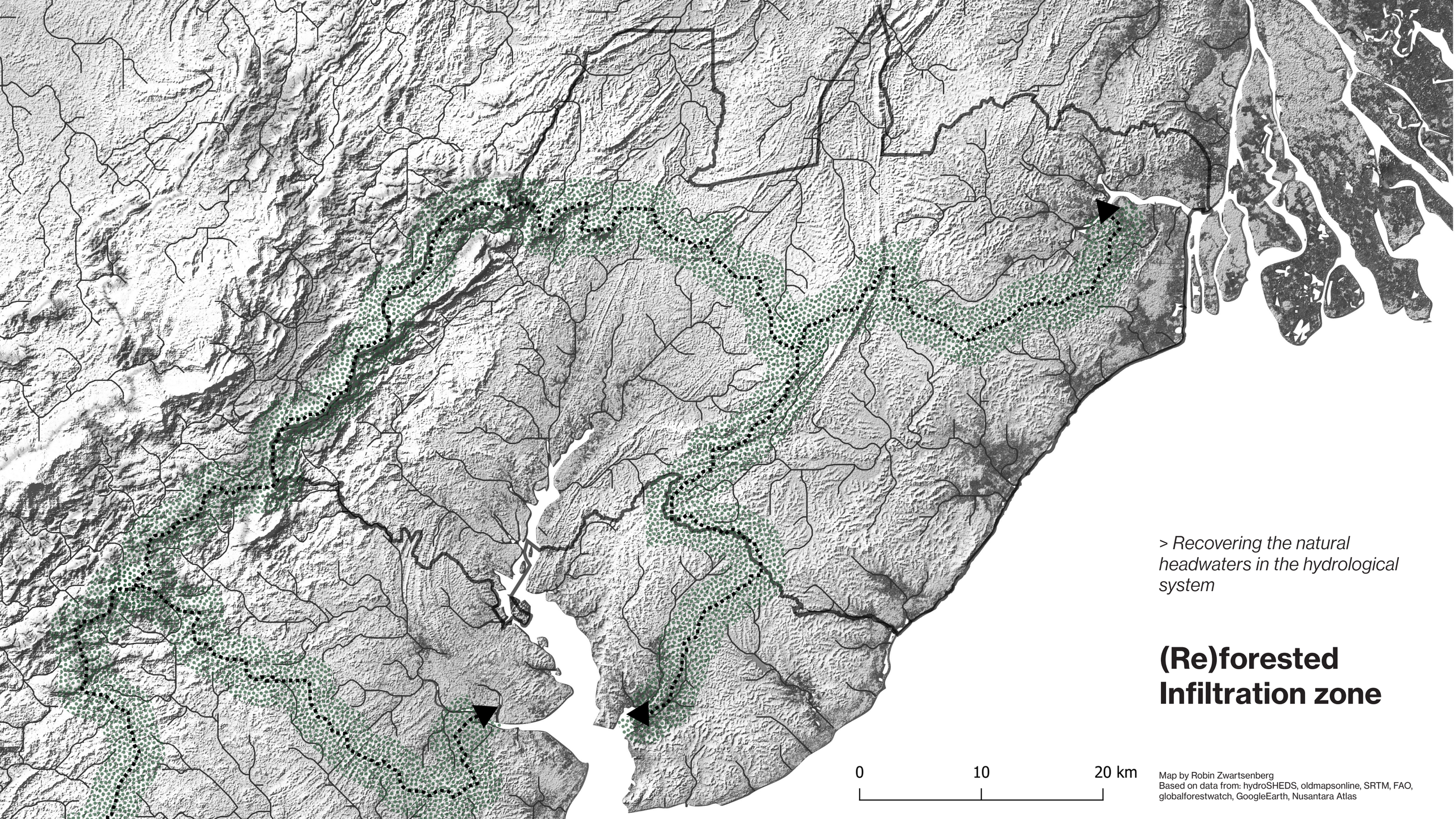


> The watershed line connects the upstream regions

Watershed line

0 10 20 km

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

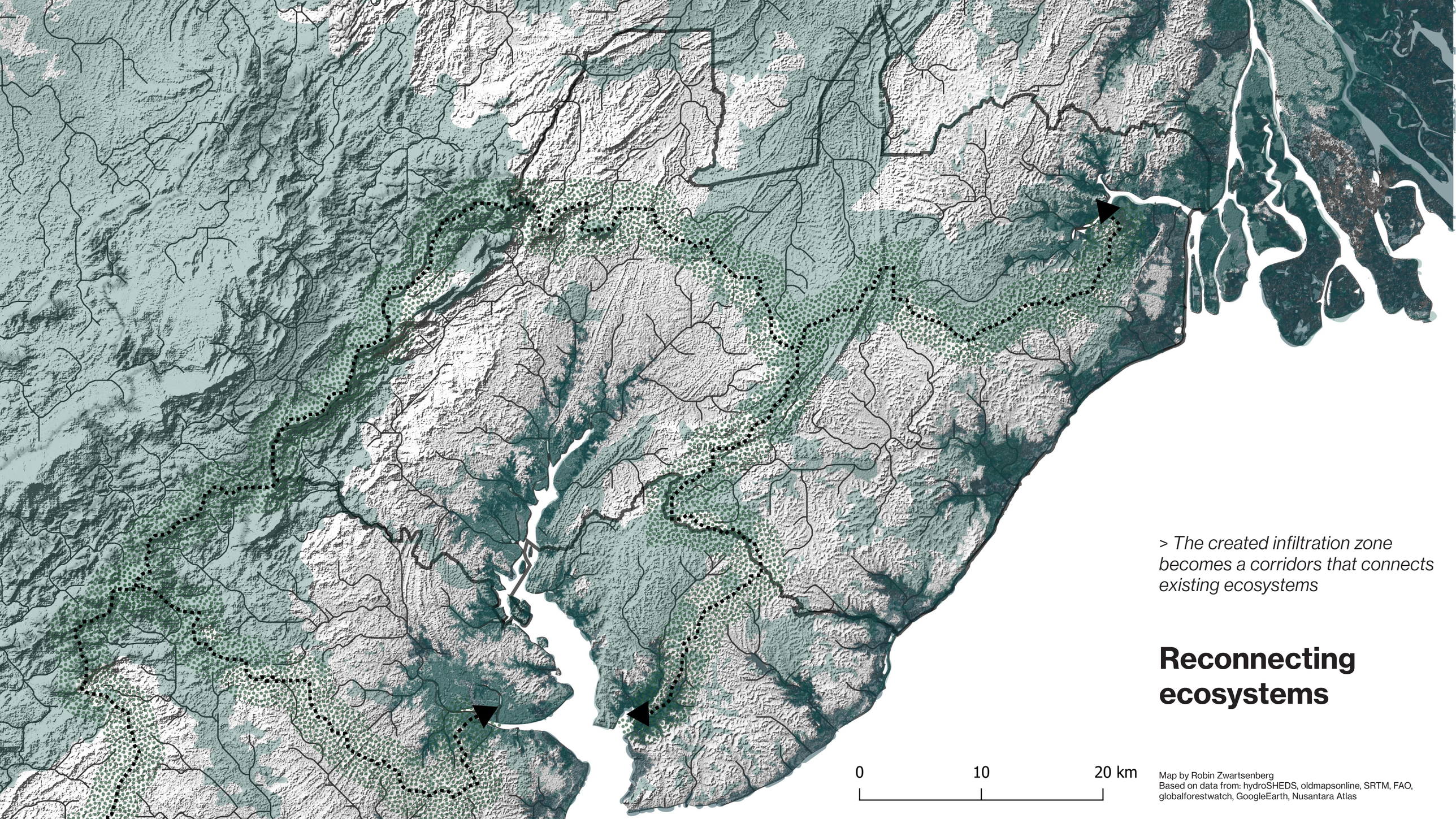


> Recovering the natural headwaters in the hydrological system

(Re)forested Infiltration zone

0 10 20 km

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

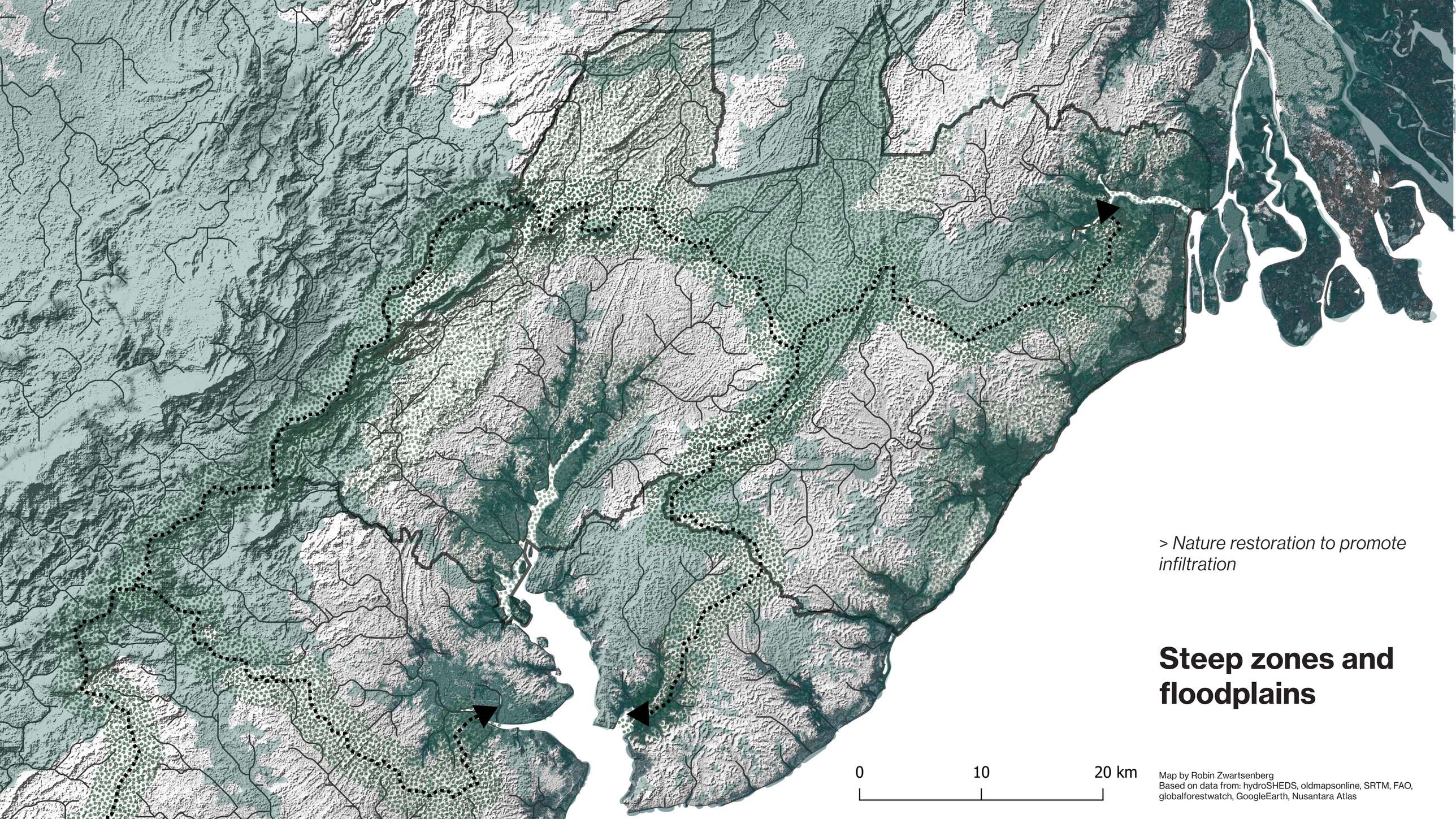


> The created infiltration zone becomes a corridors that connects existing ecosystems

Reconnecting ecosystems

0 10 20 km

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

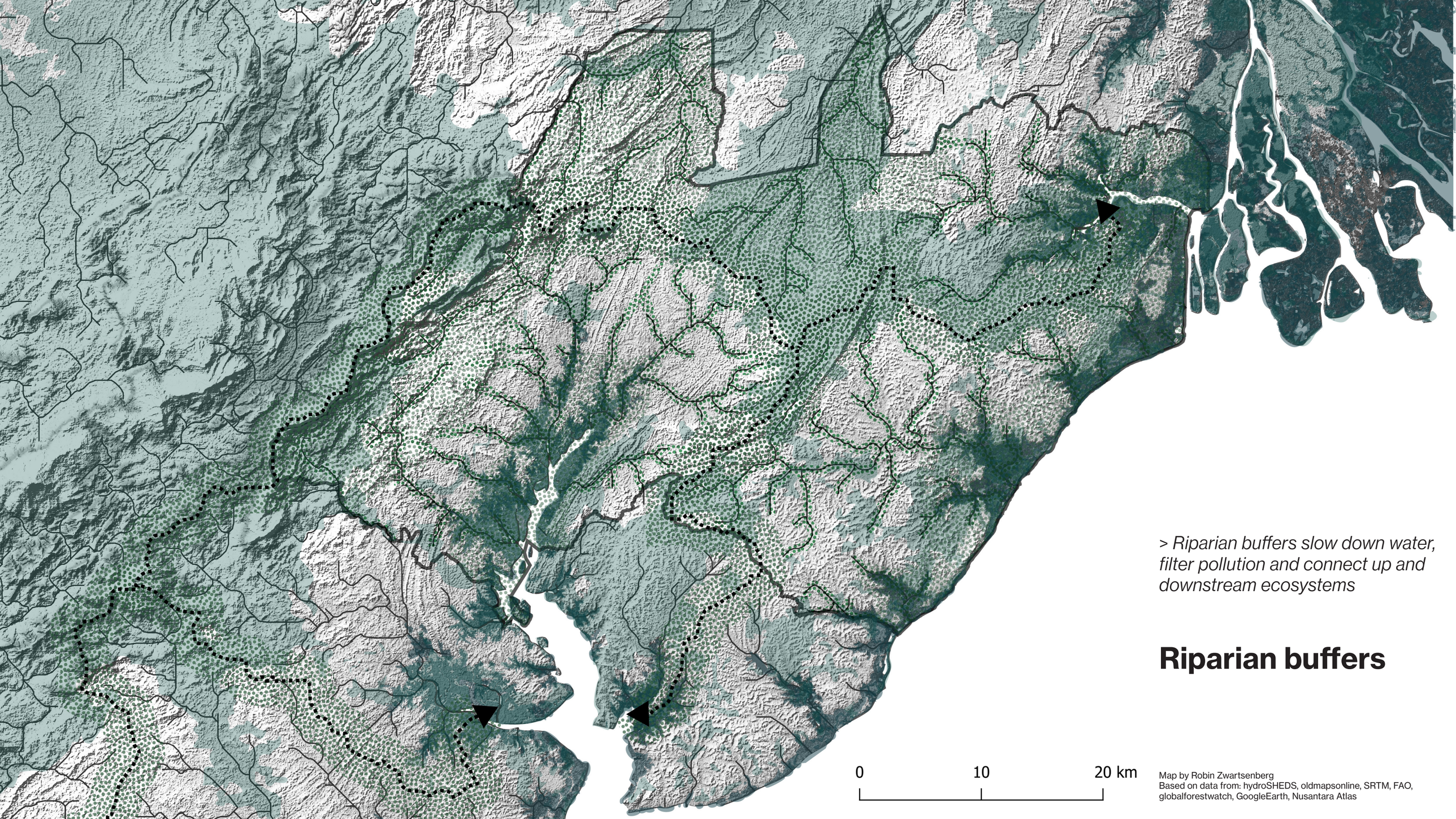


> Nature restoration to promote infiltration

Steep zones and floodplains

0 10 20 km

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

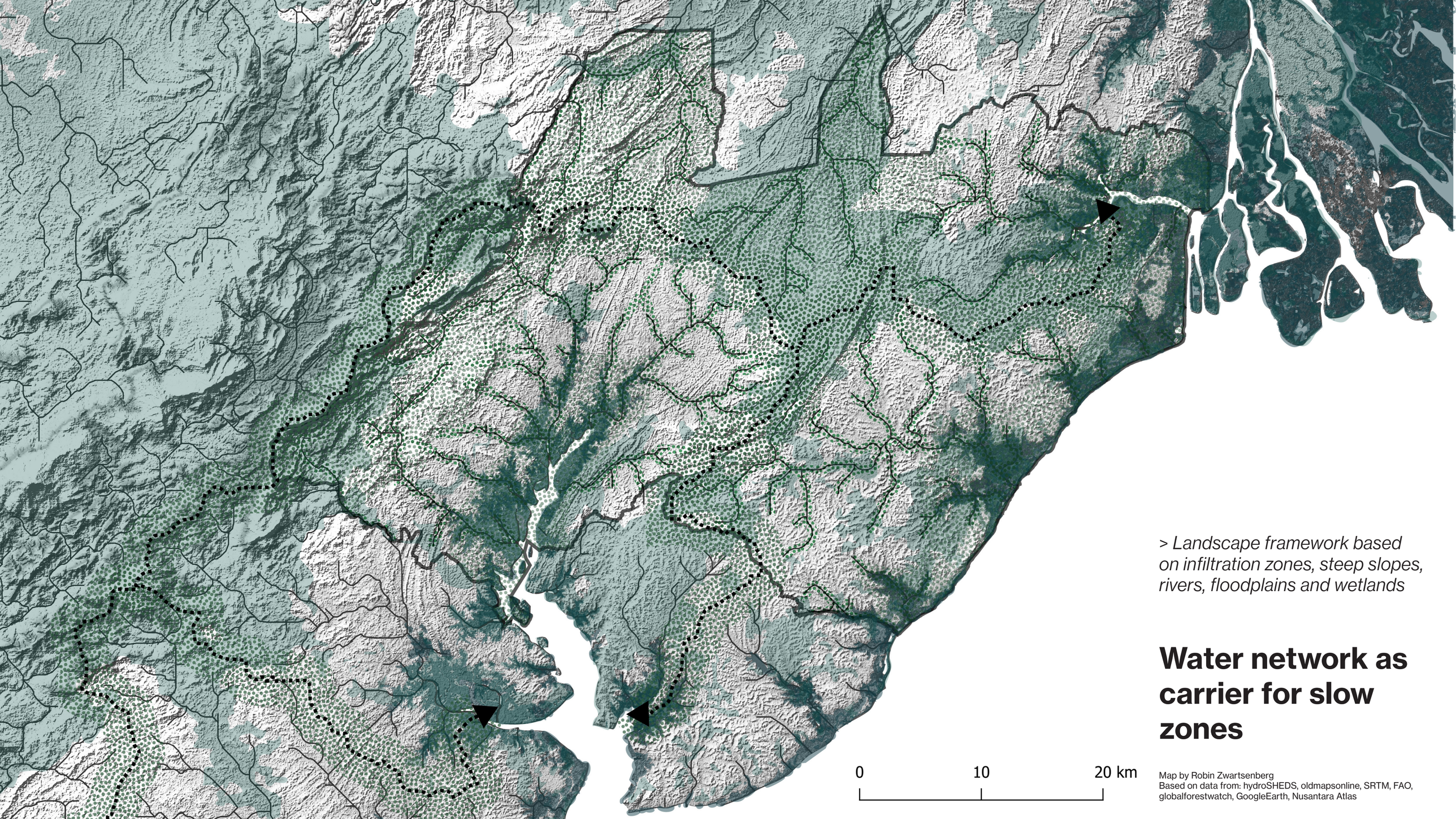


> Riparian buffers slow down water, filter pollution and connect up and downstream ecosystems

Riparian buffers

0 10 20 km

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

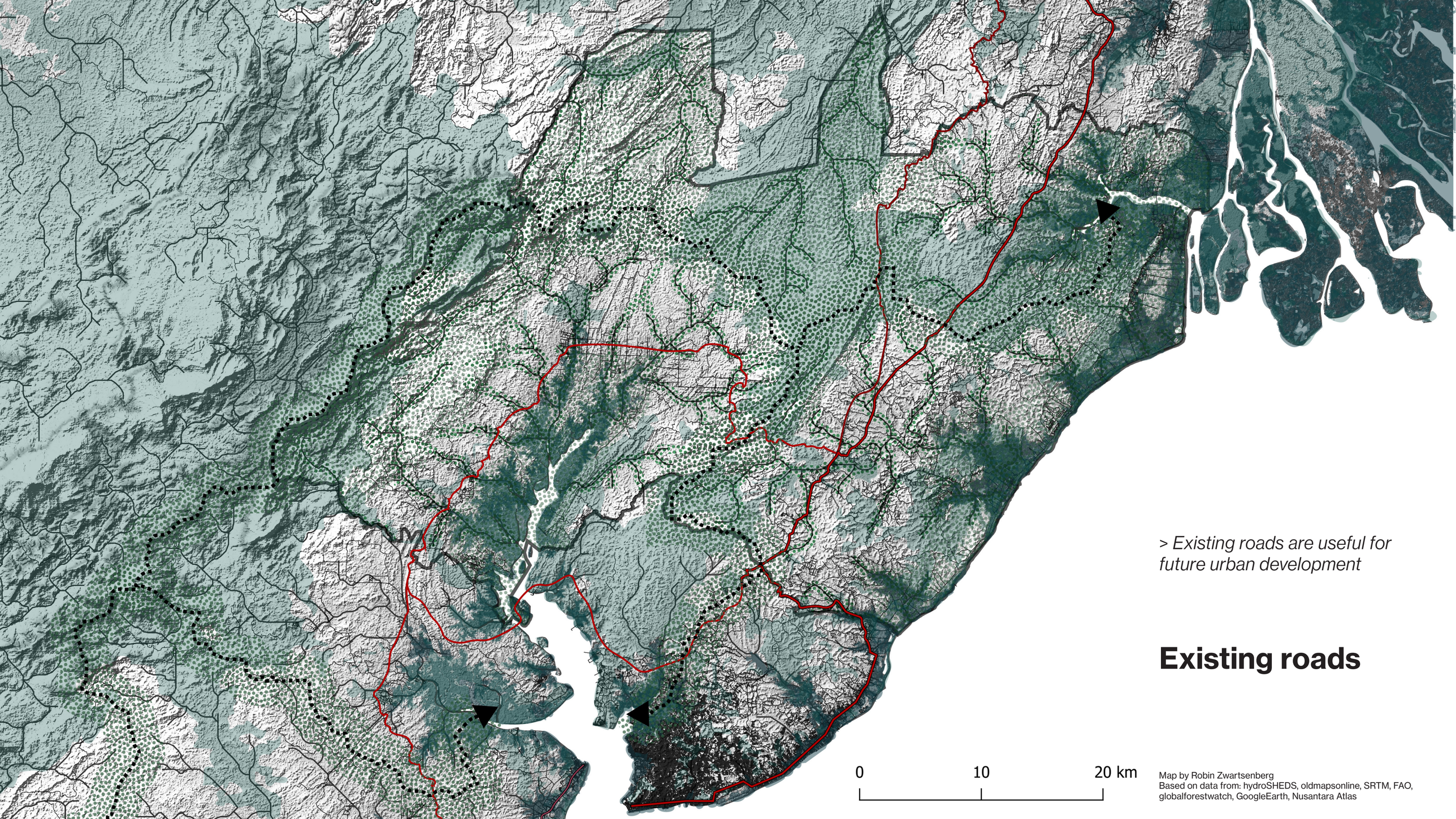


> Landscape framework based on infiltration zones, steep slopes, rivers, floodplains and wetlands

Water network as carrier for slow zones

0 10 20 km

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

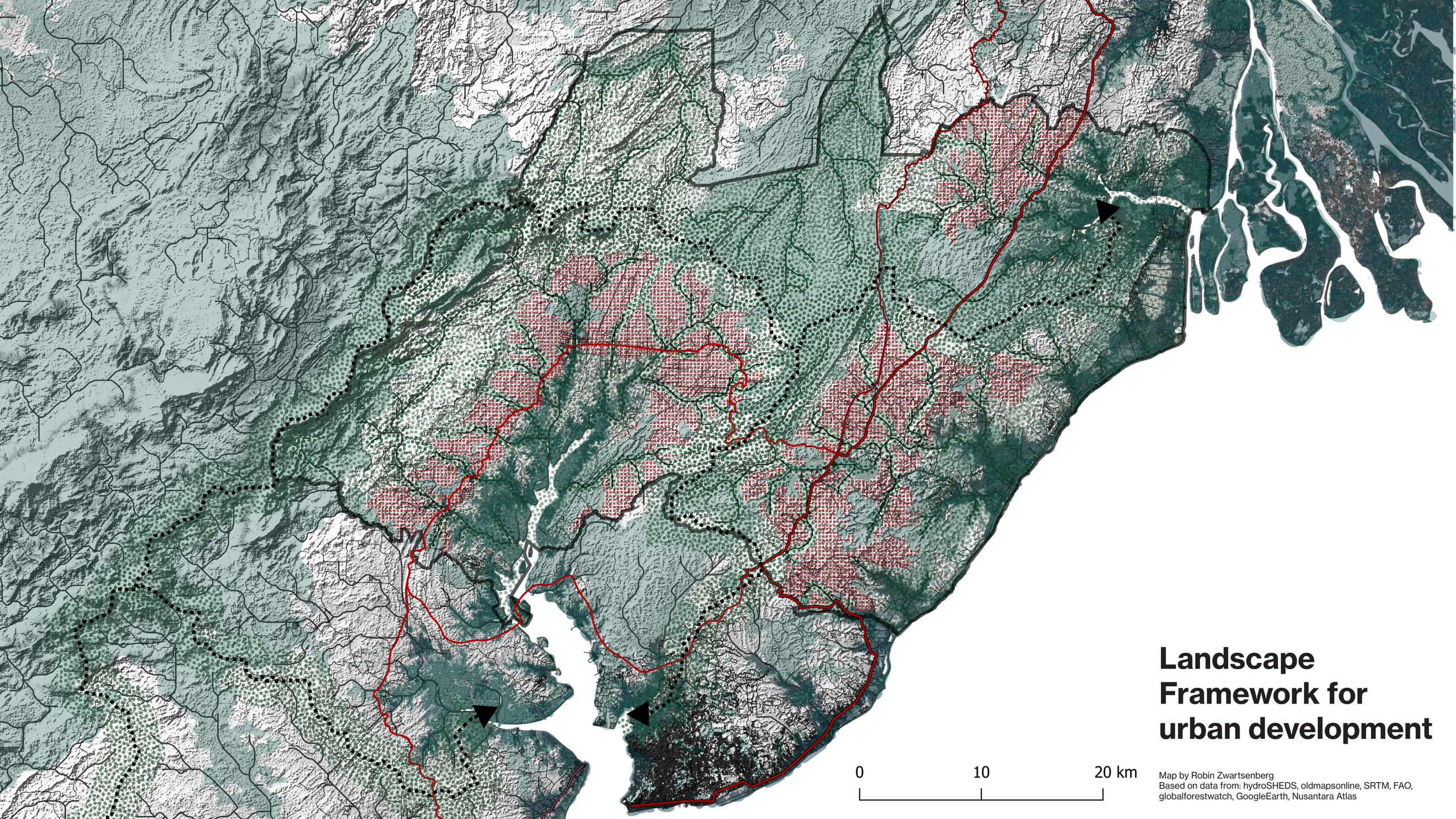


> Existing roads are useful for future urban development

Existing roads

0 10 20 km

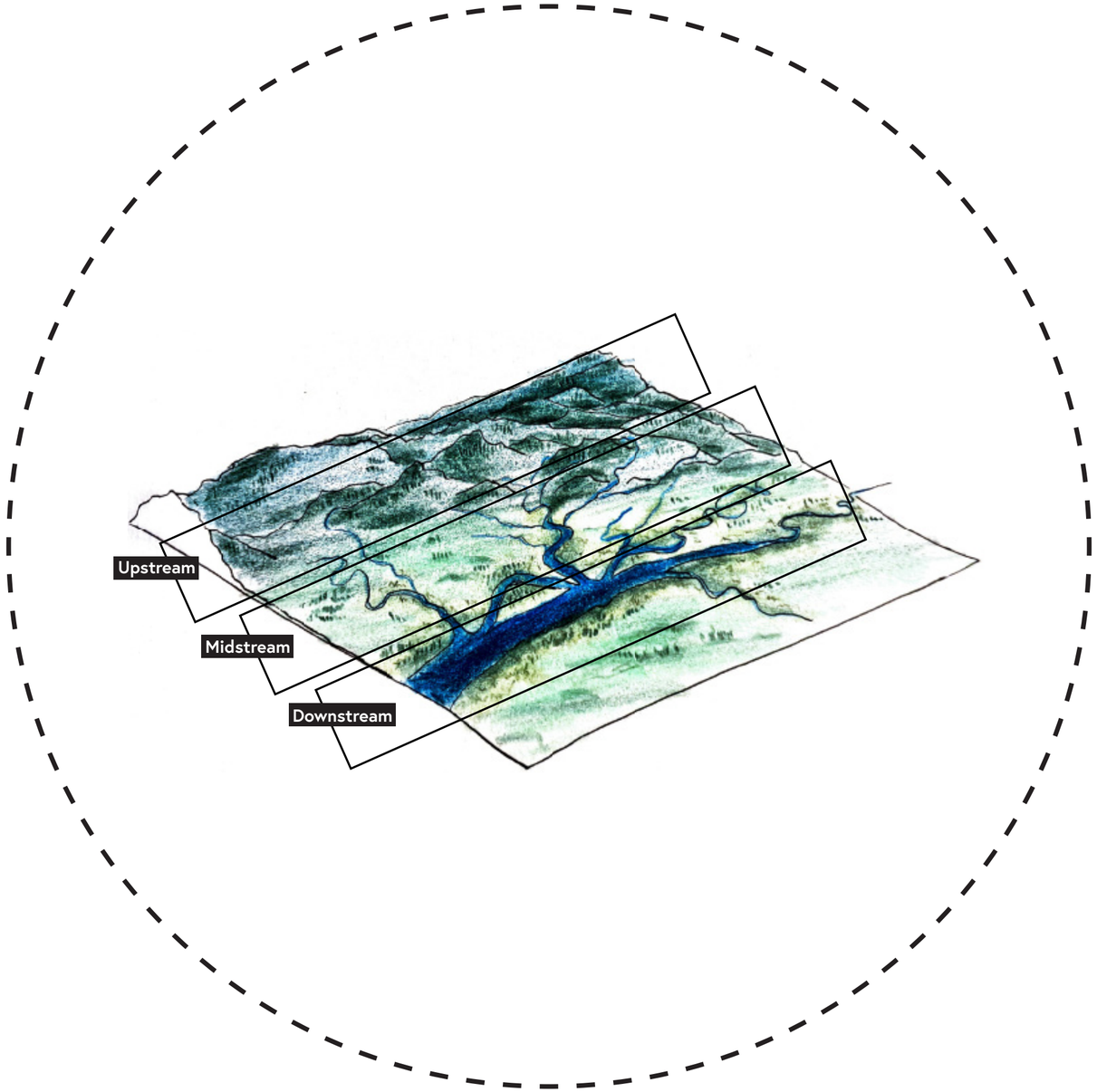
Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas



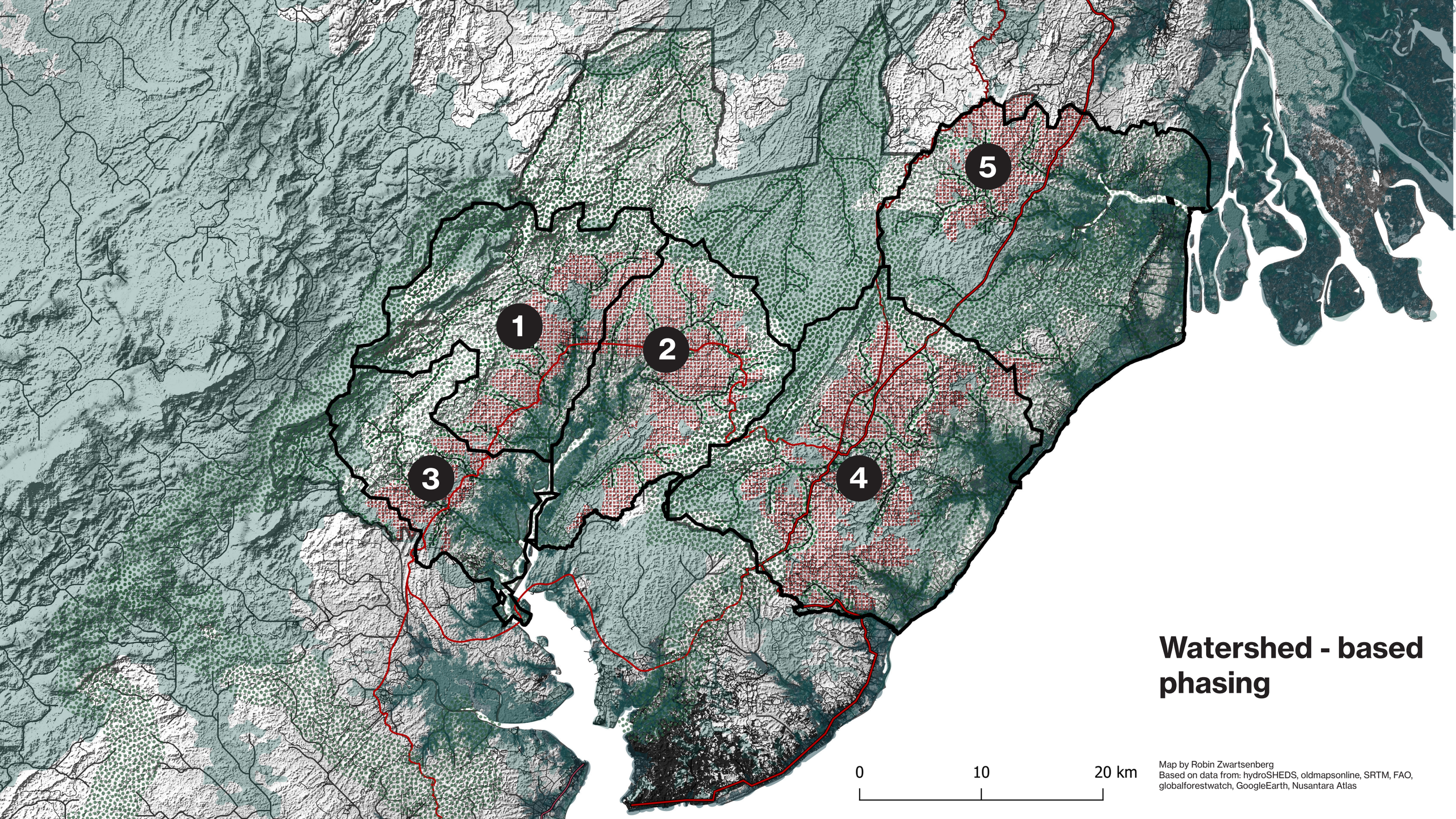
Landscape Framework for urban development

0 10 20 km

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas


Upstream
Midstream
Downstream

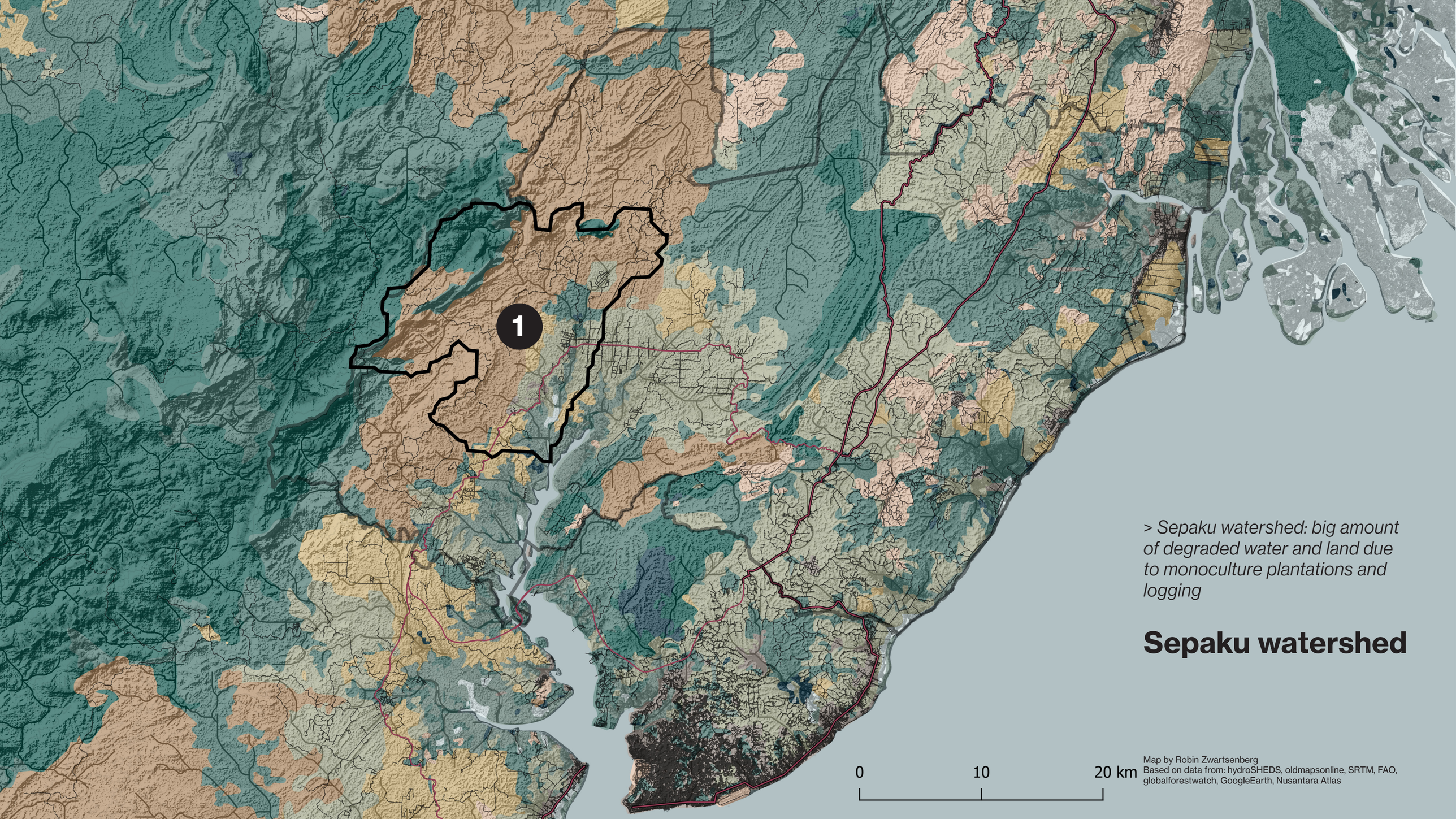
Watershed - based phasing



Watershed - based phasing

0 10 20 km

Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas



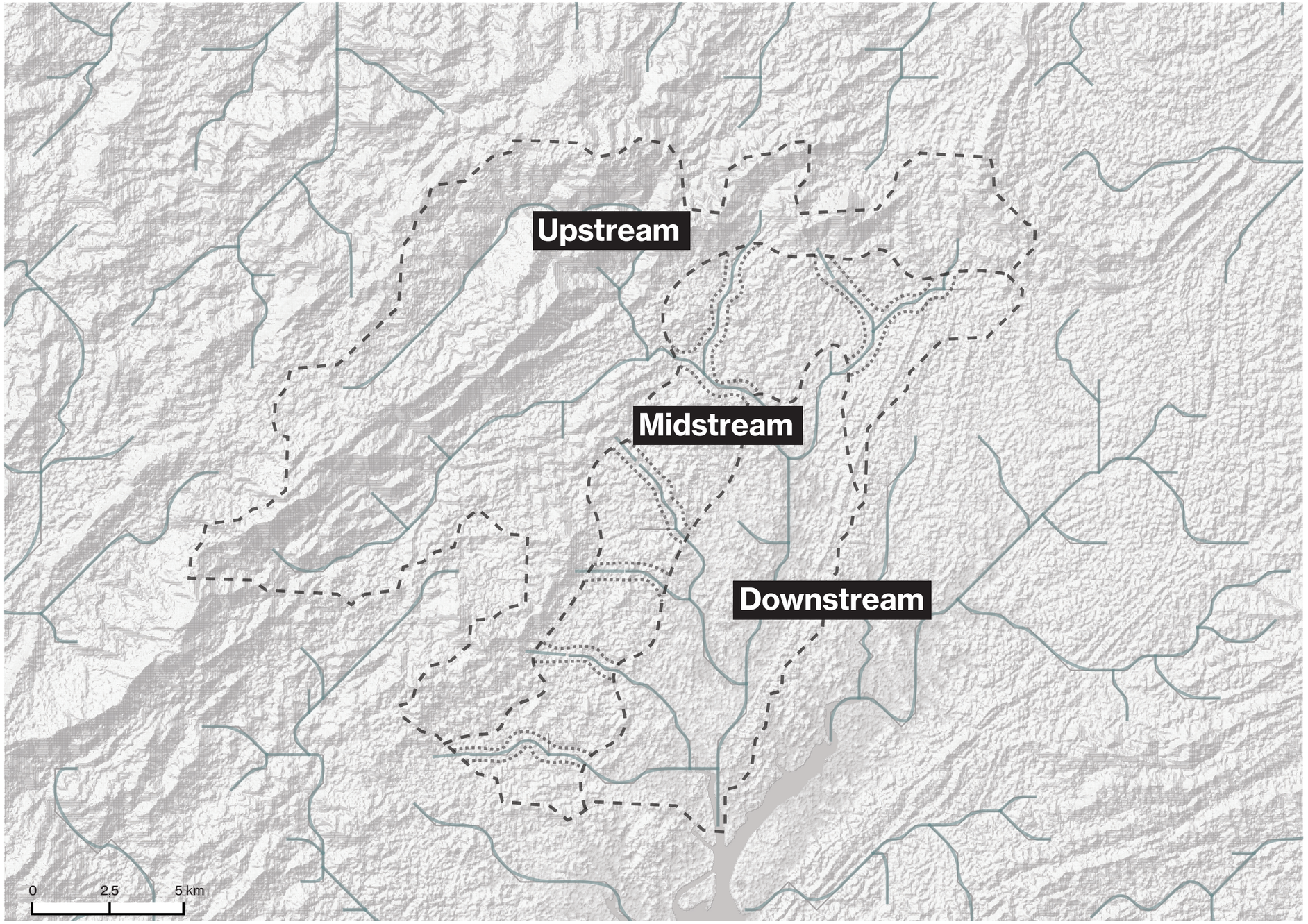
> Sepaku watershed: big amount of degraded water and land due to monoculture plantations and logging

Sepaku watershed

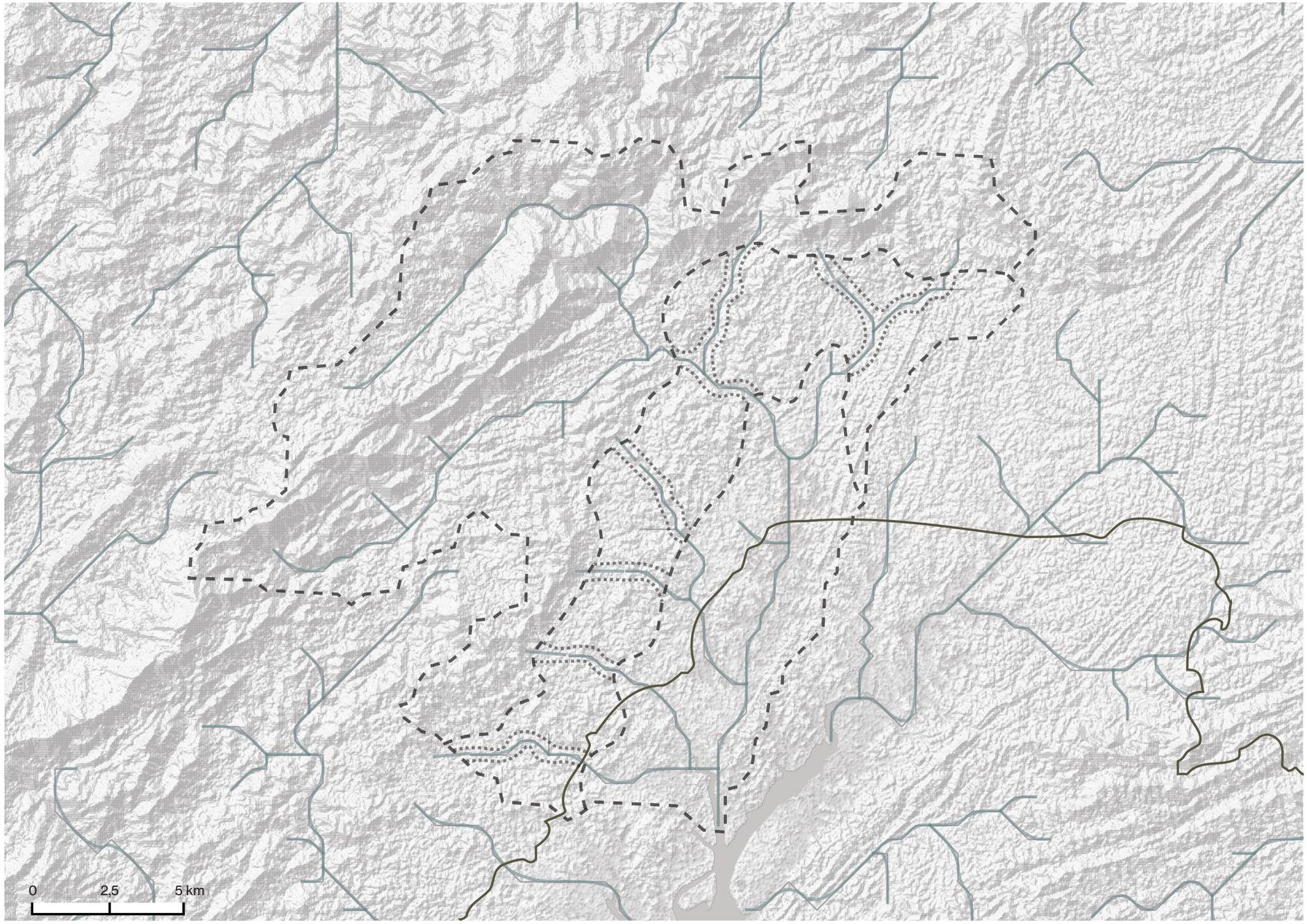
Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

A new city is an opportunity to improve biodiversity and local livelihoods!
> Sepaku watershed: big amount of degraded water and land due to monoculture plantations and logging
Sepaku watershed
0
10
20 km
Map by Robin Zwartsenberg
Based on data from: hydroSHEDS, oldmapsonline, SRTM, FAO, globalforestwatch, GoogleEarth, Nusantara Atlas

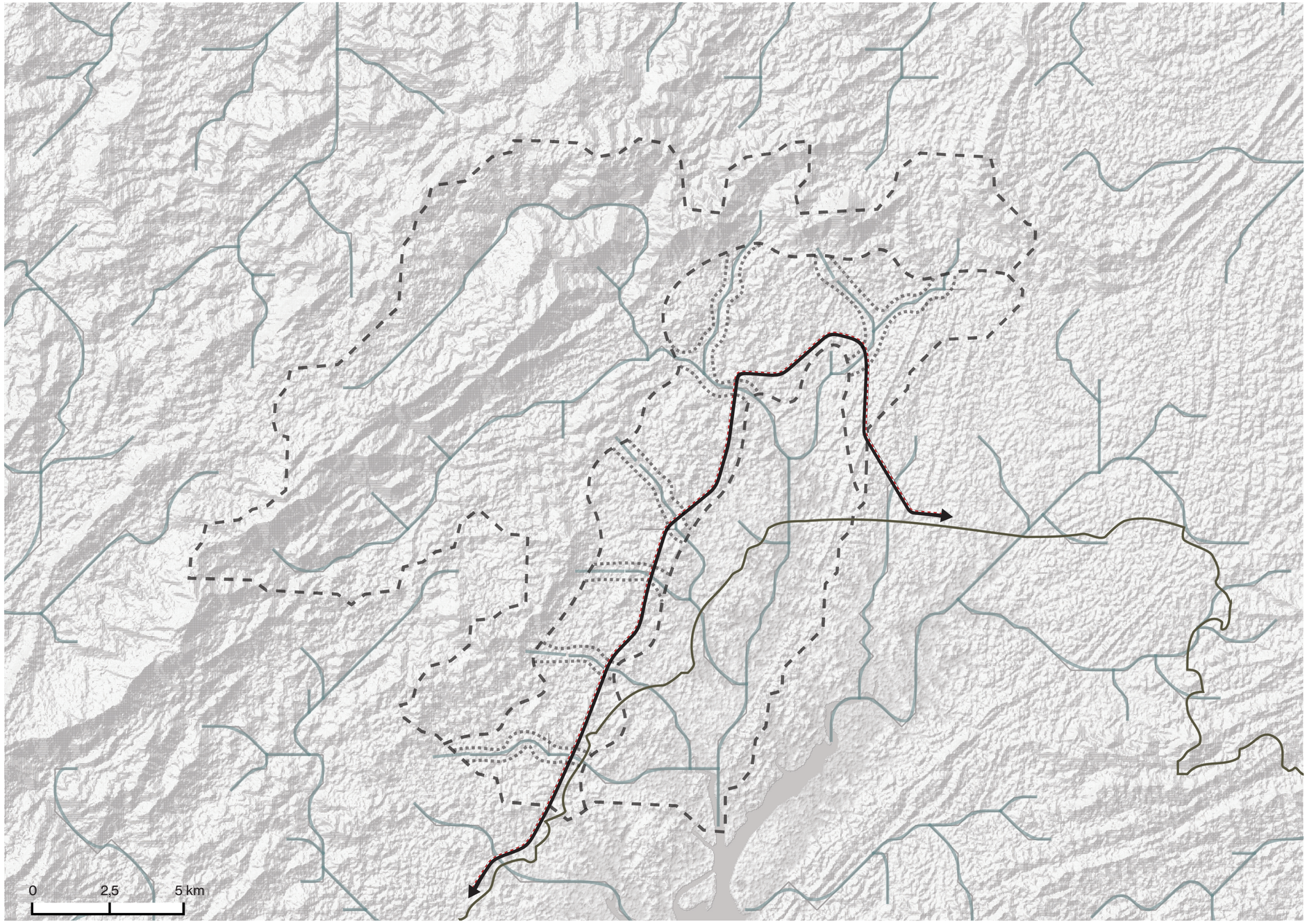
Slow zone framework



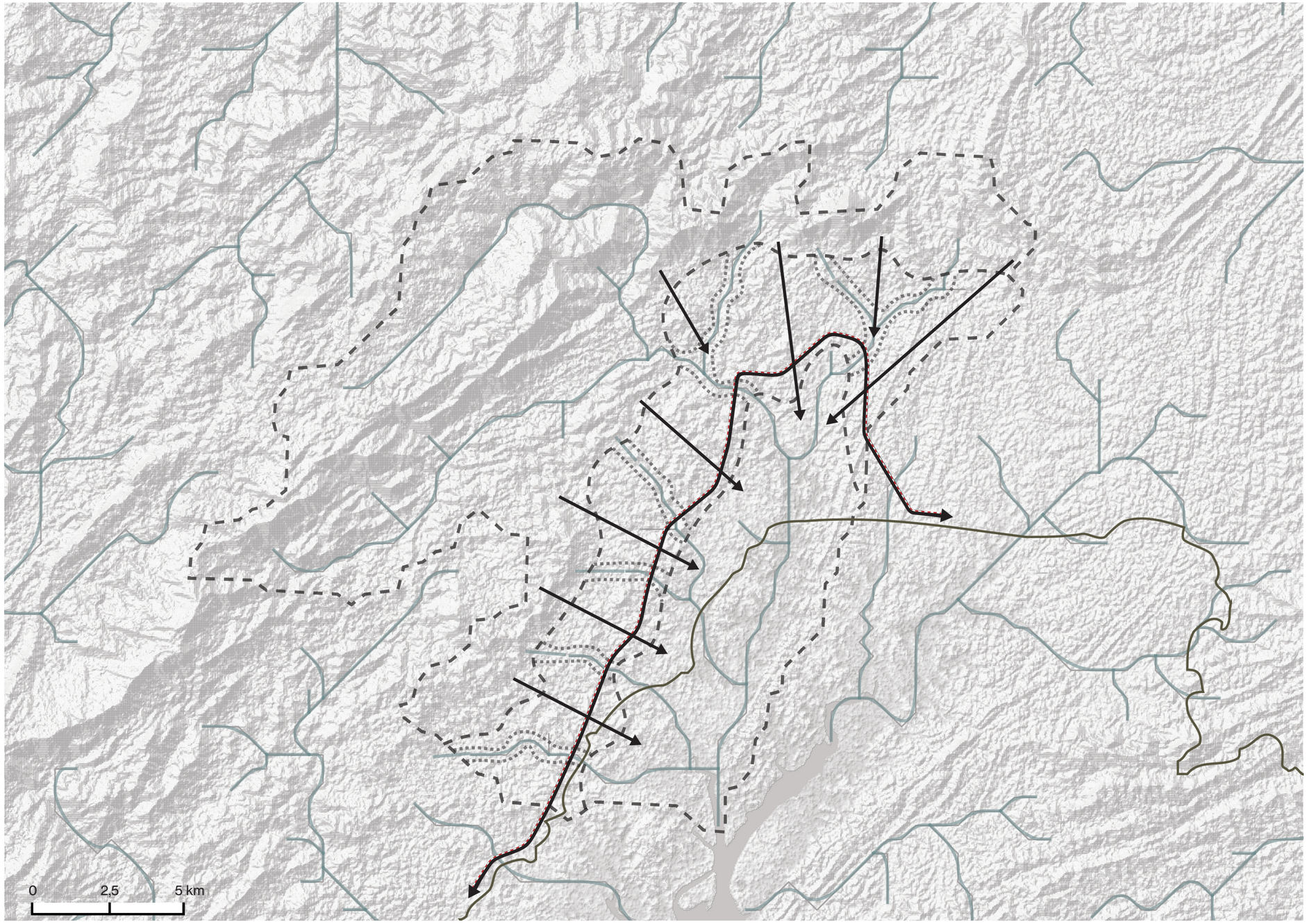
Existing road



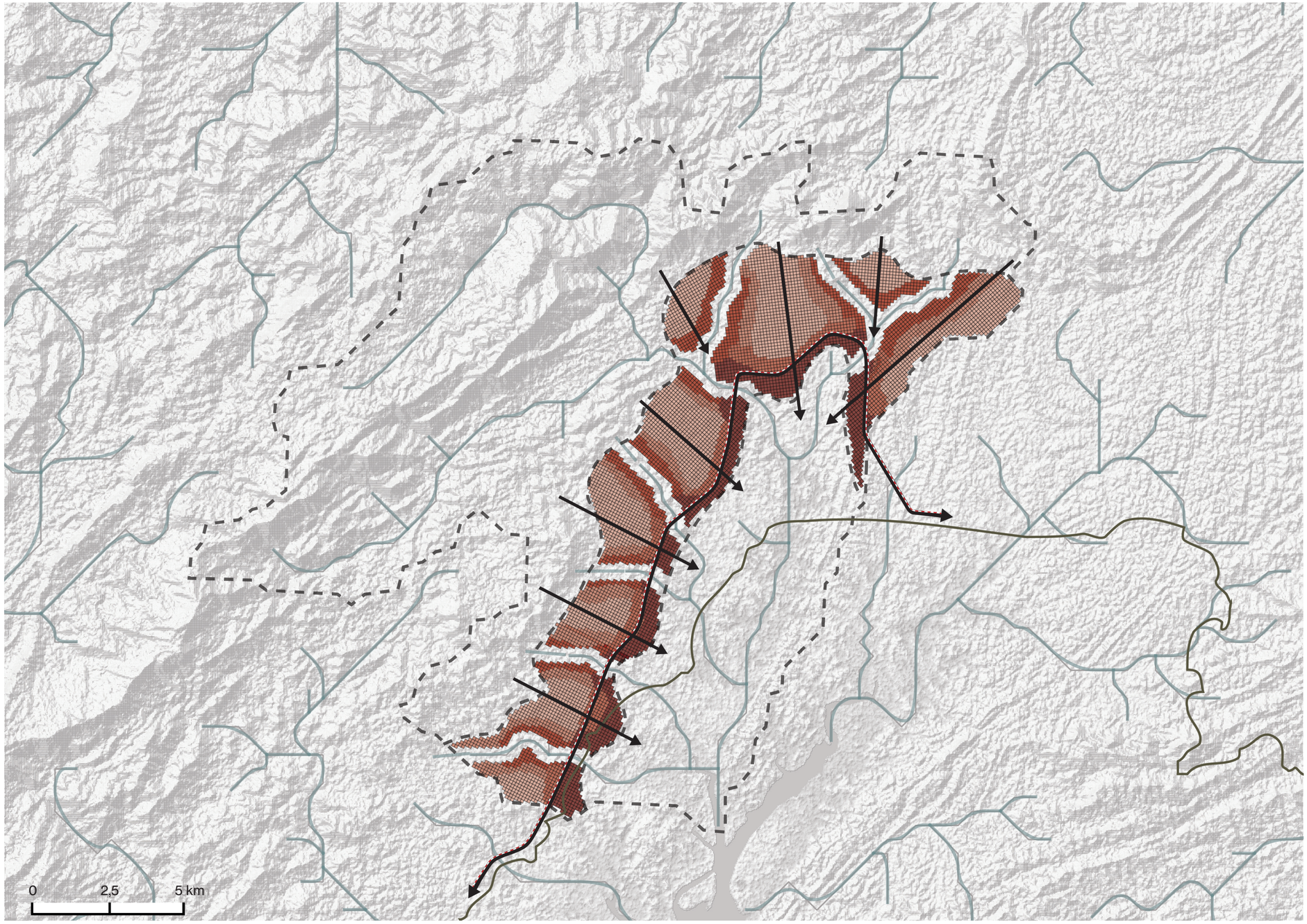
Proposed new road and railway



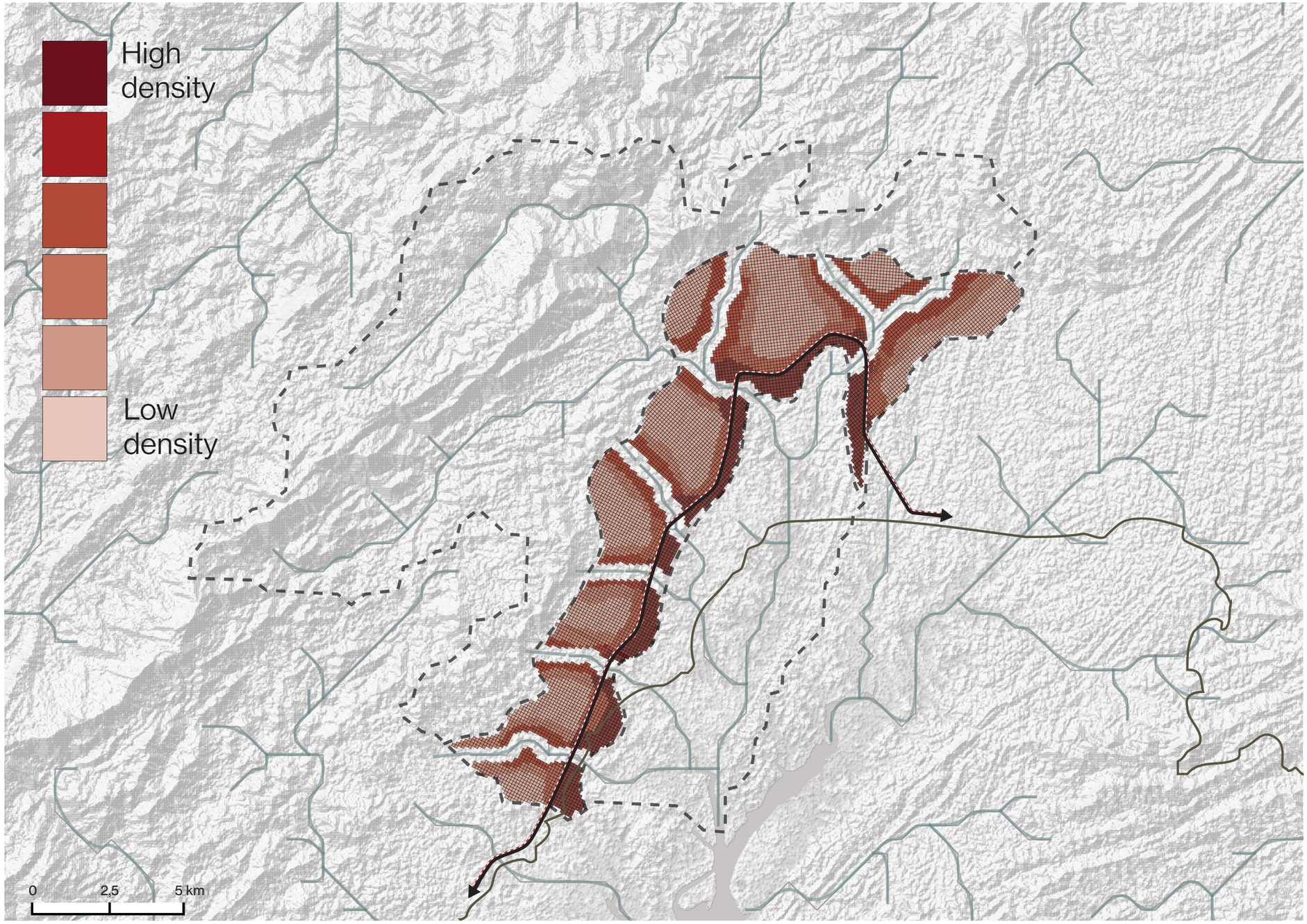
up - downstream axis

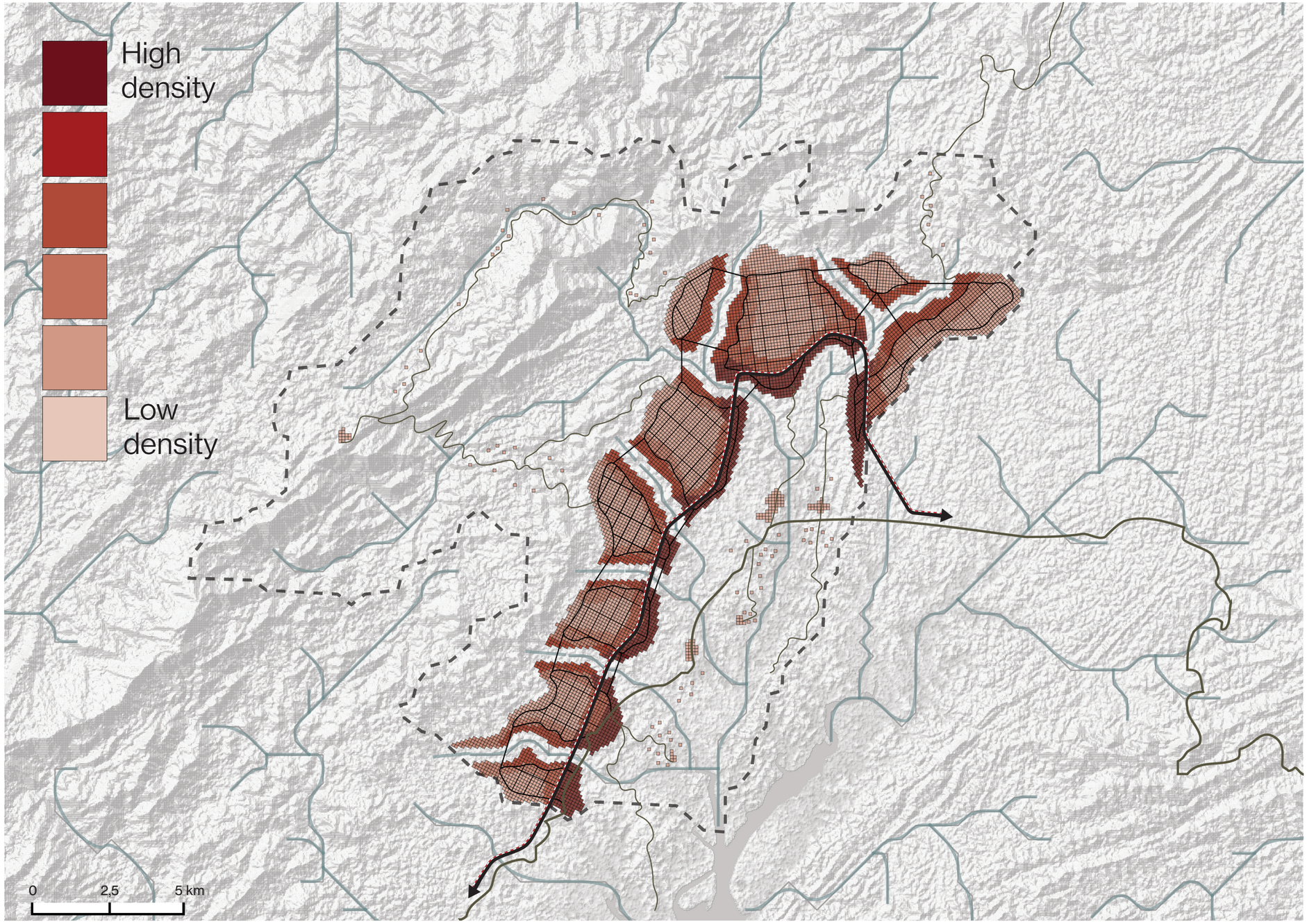


Districts



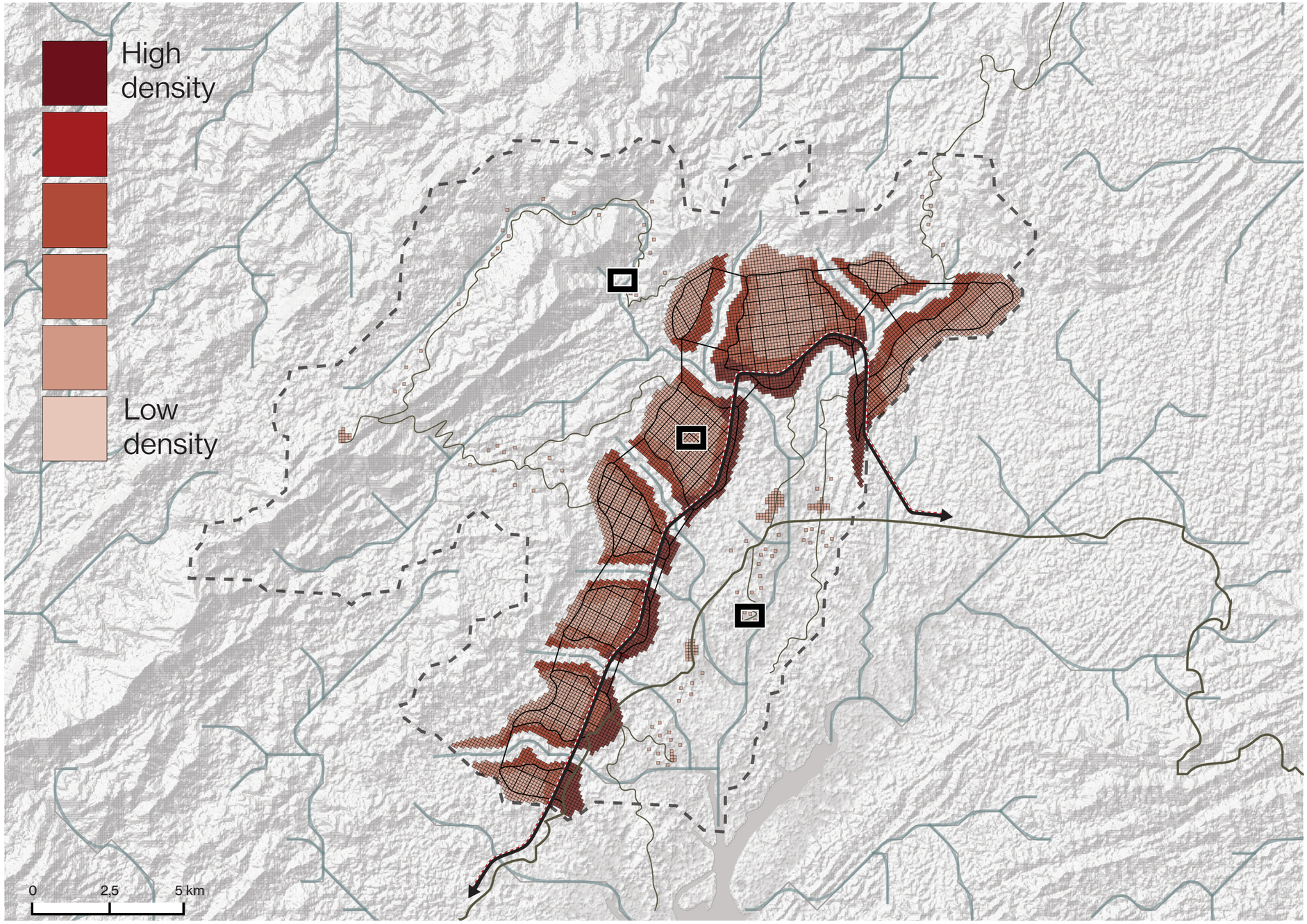
Building densities

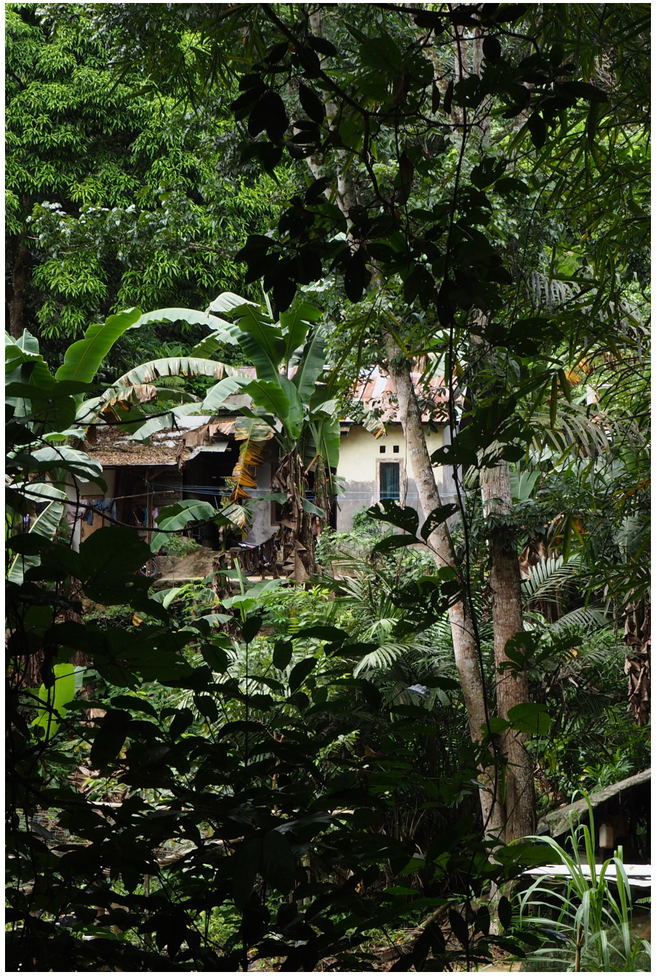




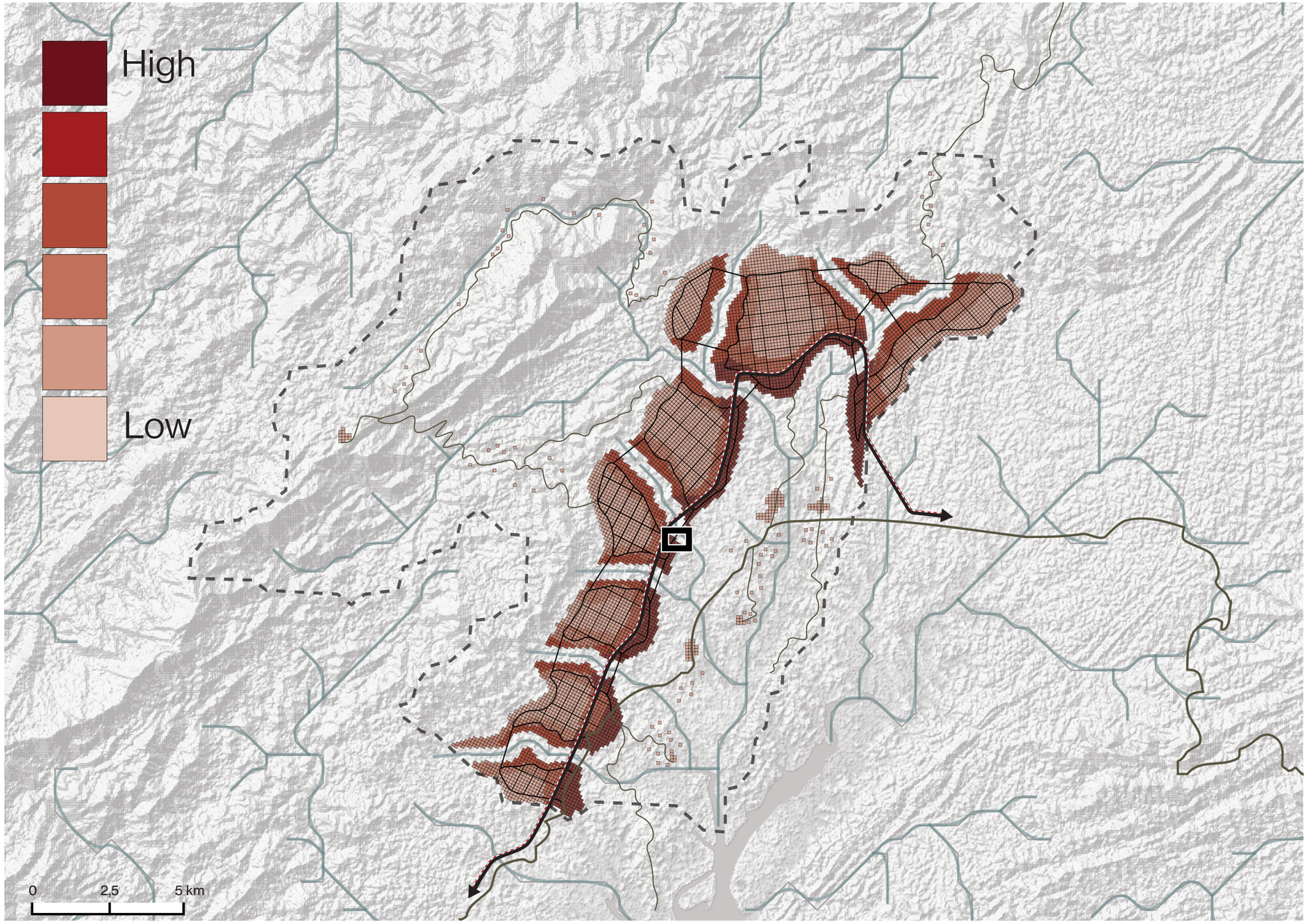
**Ring roads,
secondary roads,
logging roads**

Low density developments

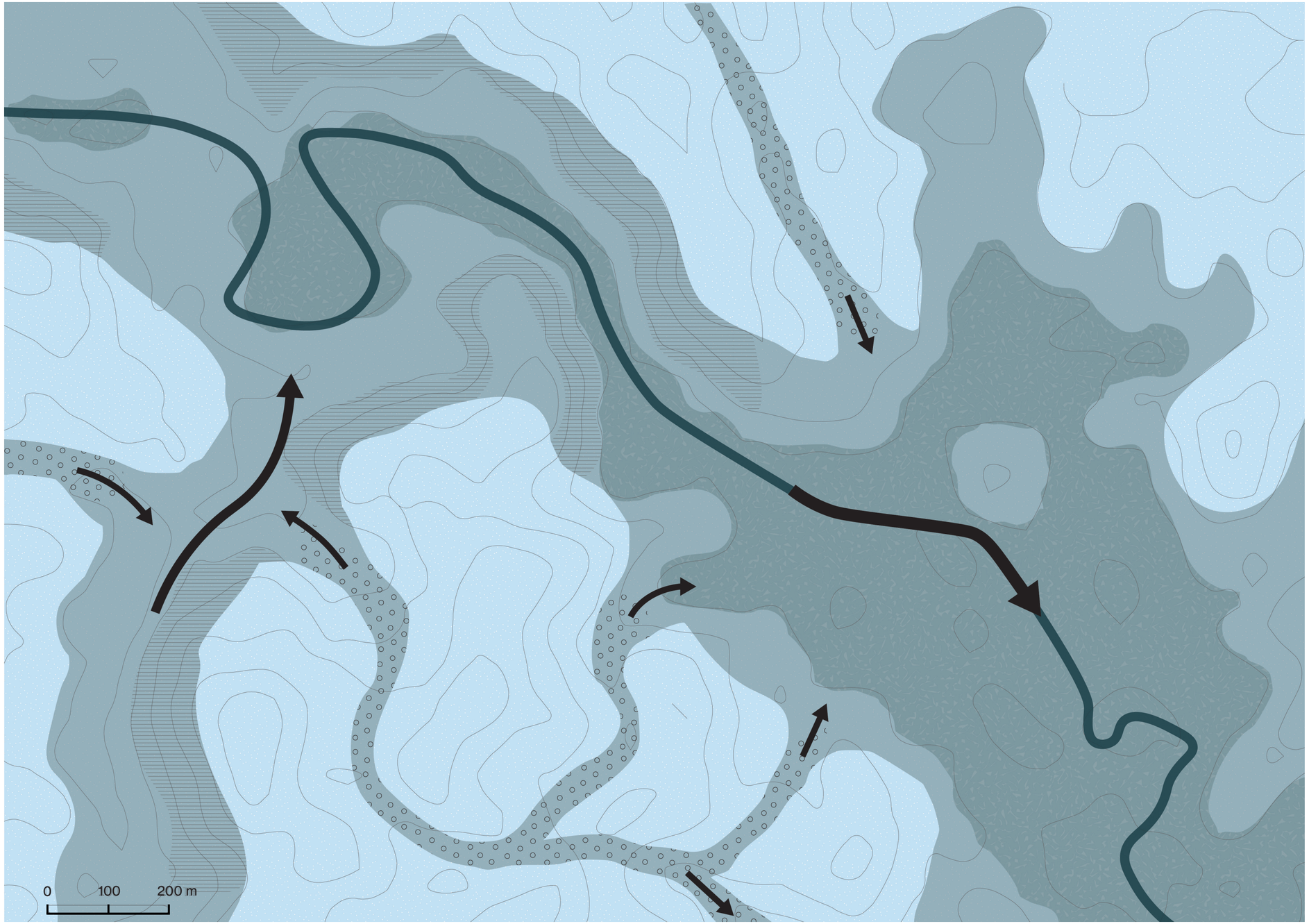




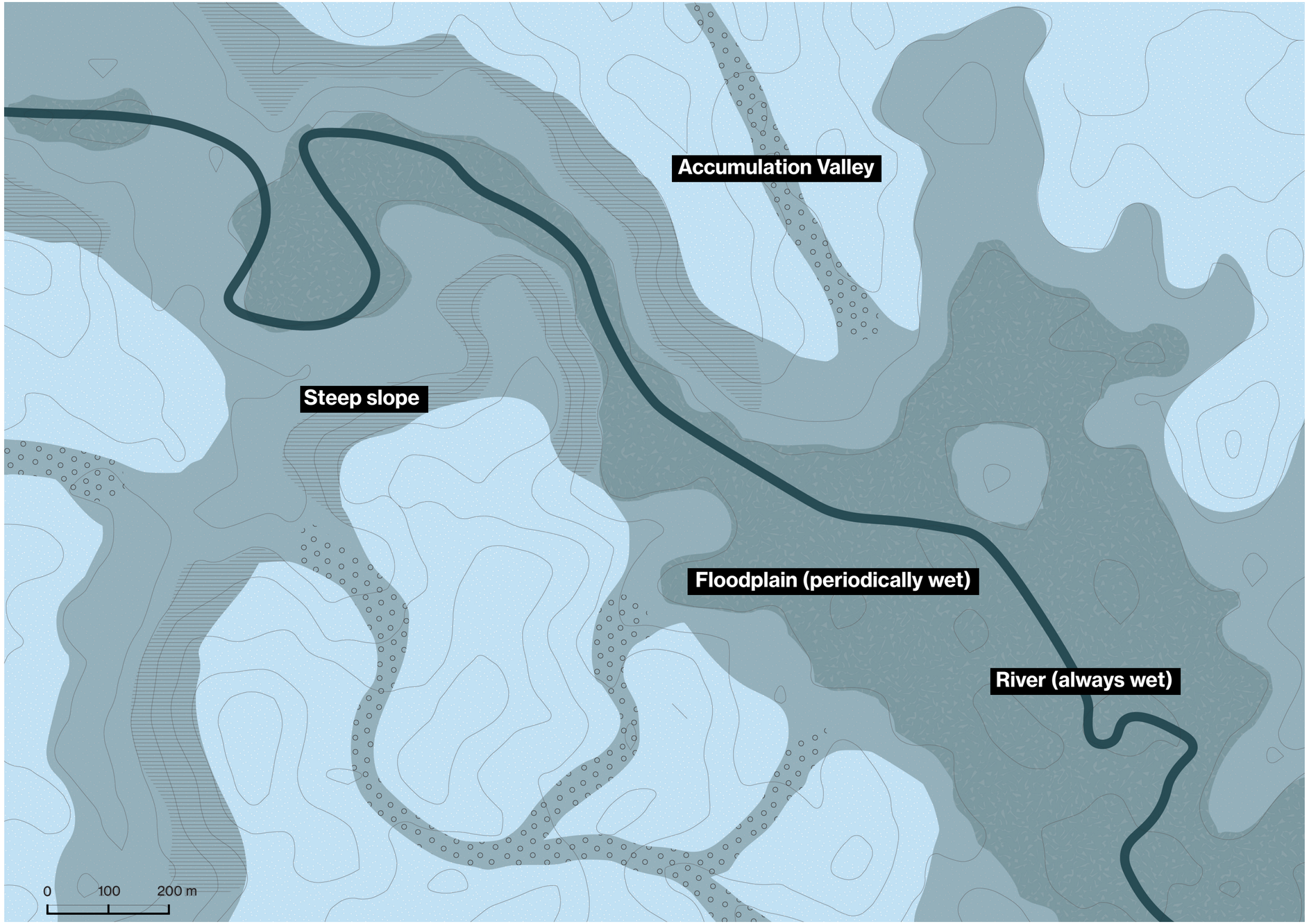
Zoom in location high contrast edge



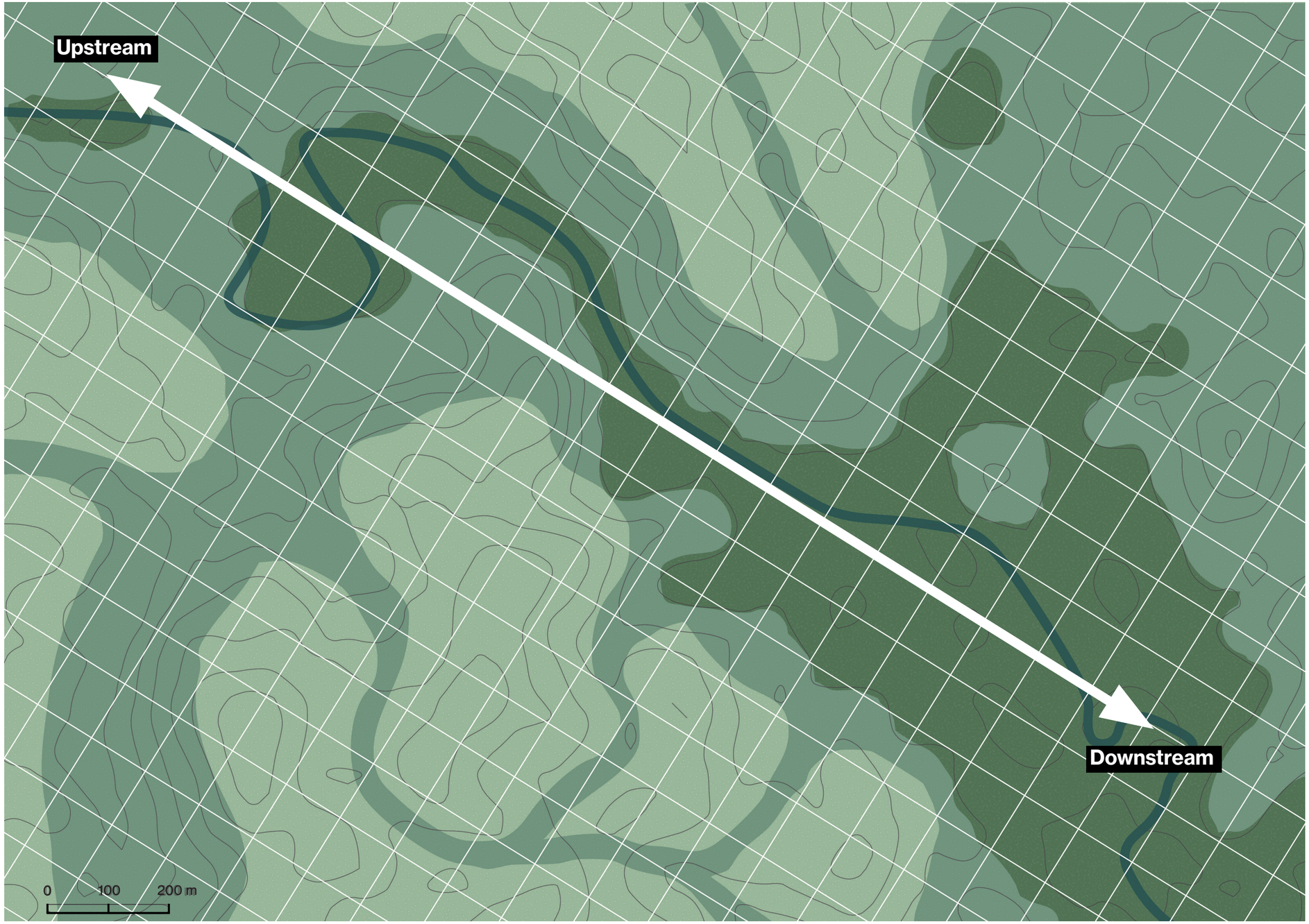
water network as carrier slow zone



water network as carrier slow zone



Grid along Up - downstream axis



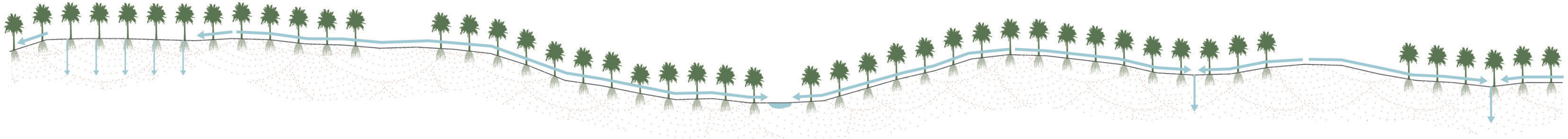
Roads and paths

Masterplan

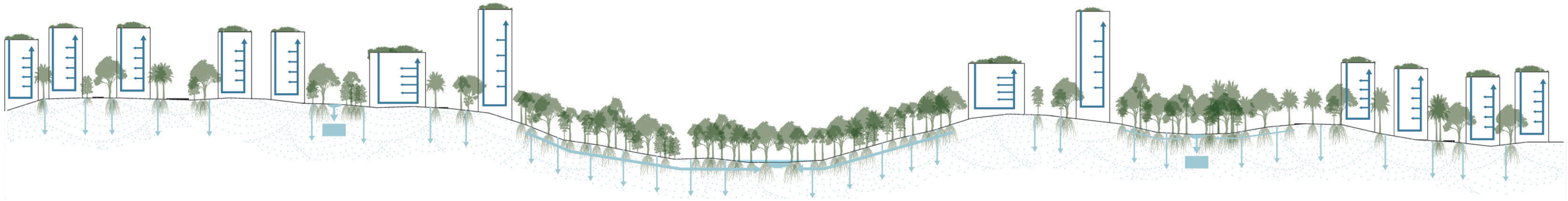
Access and facilities

Section location

Now

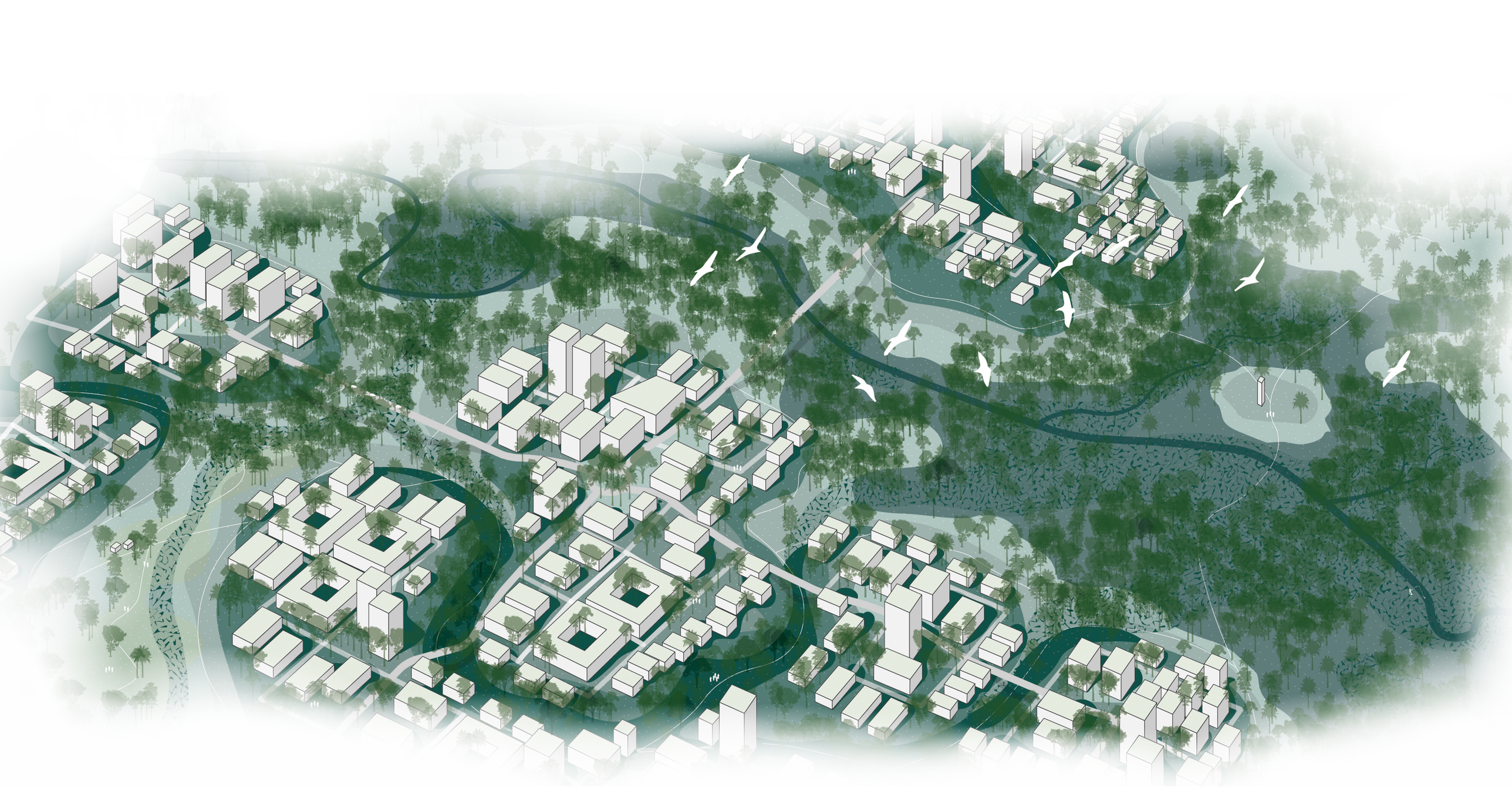


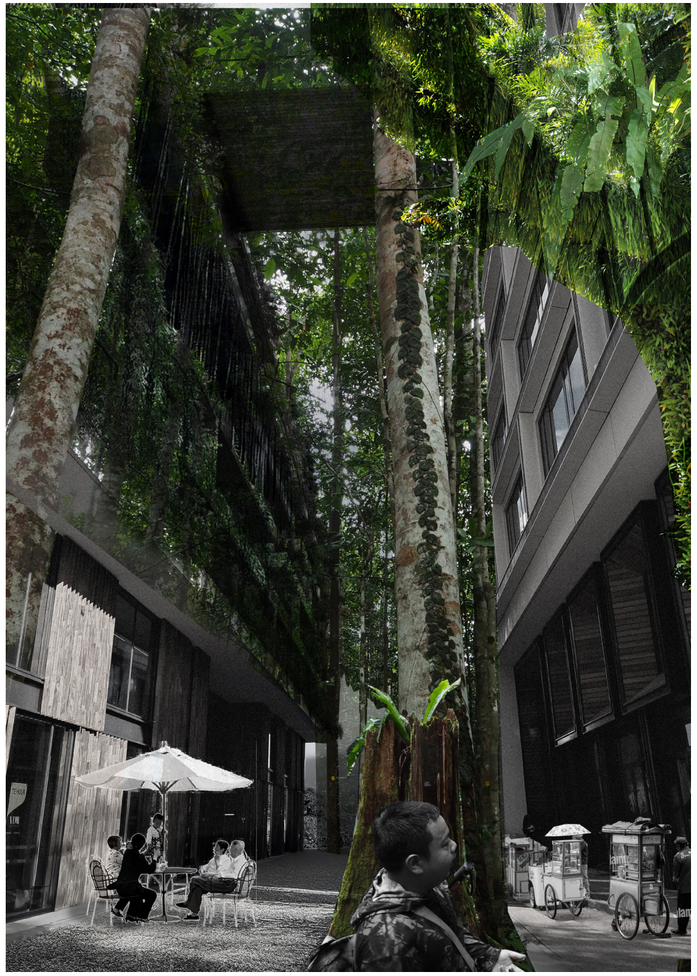
Design



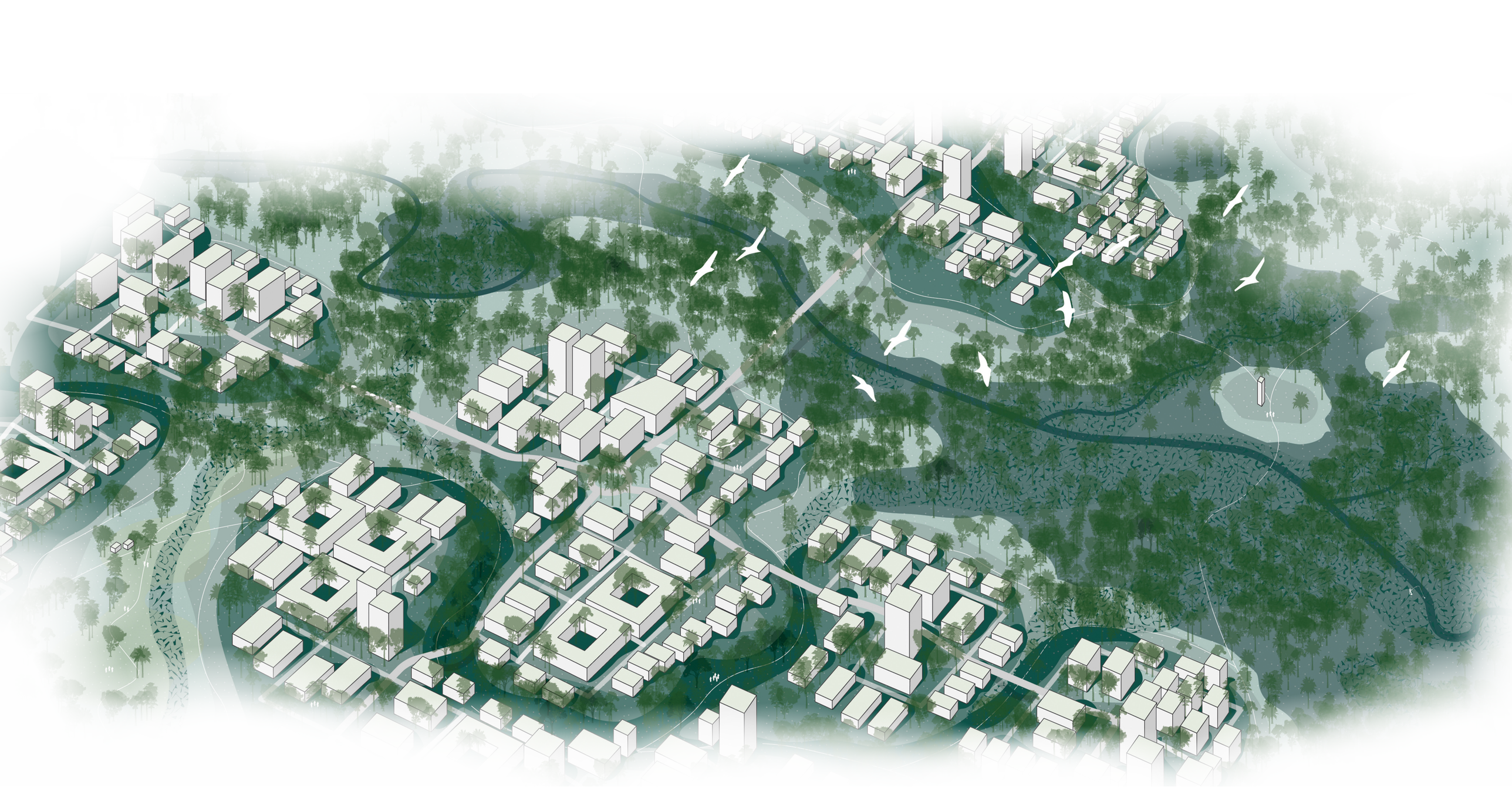
Masterplan

Urban green space
Wetland forest
Park
Green corridor
0
100
200 m





6. Discussion

- Watershed approach
- Two networks strategy
- Research through design

- Water supply
- Replicability
- Difference with current design