



Human Well-being and Ecological Potential for Public Space in dense Urban Environments

A Biophilic Design for Delfshaven
Rotterdam

Student
Studio
1st mentor
2nd mentor

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Design of the Urban Fabric
Rients Dijkstra
Alexander Wandl

- **Introduction**

Problemization
Research question
Methodology
Location

- **Mobility**

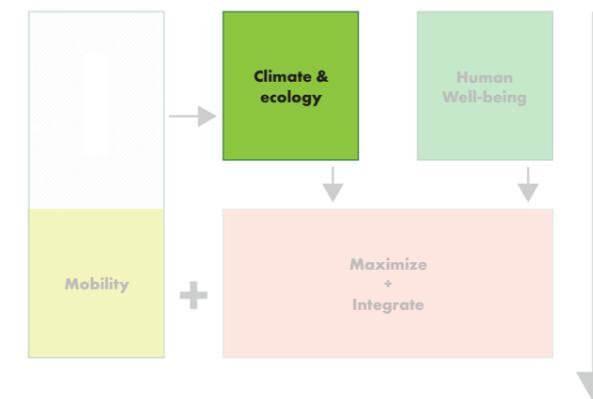
- **Ecology & Climate**

- **Human Well-being**

- **Integrated design**

- **Conclusions & Discussion**

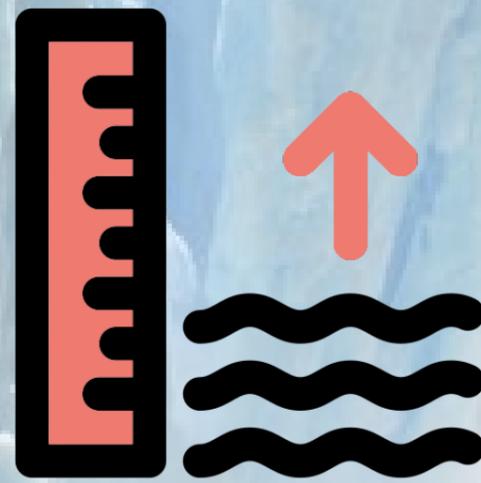
Ecology & climate



Climate change



Heavy rainfall



Sealevel rise

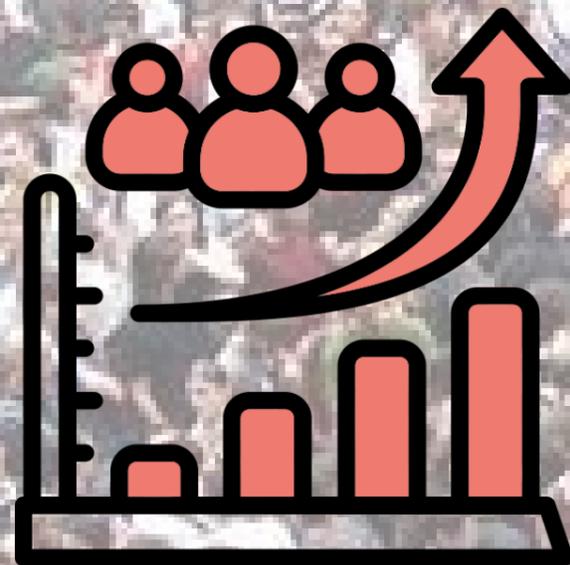


Urban heat island

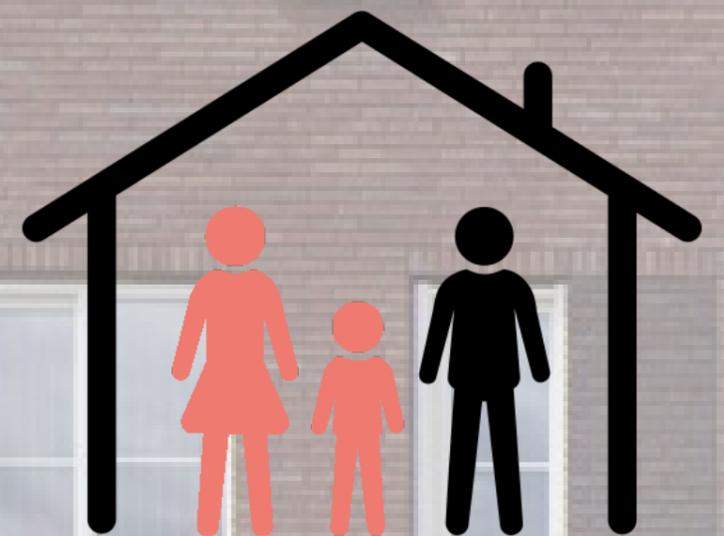
Urbanization



Urban expansion

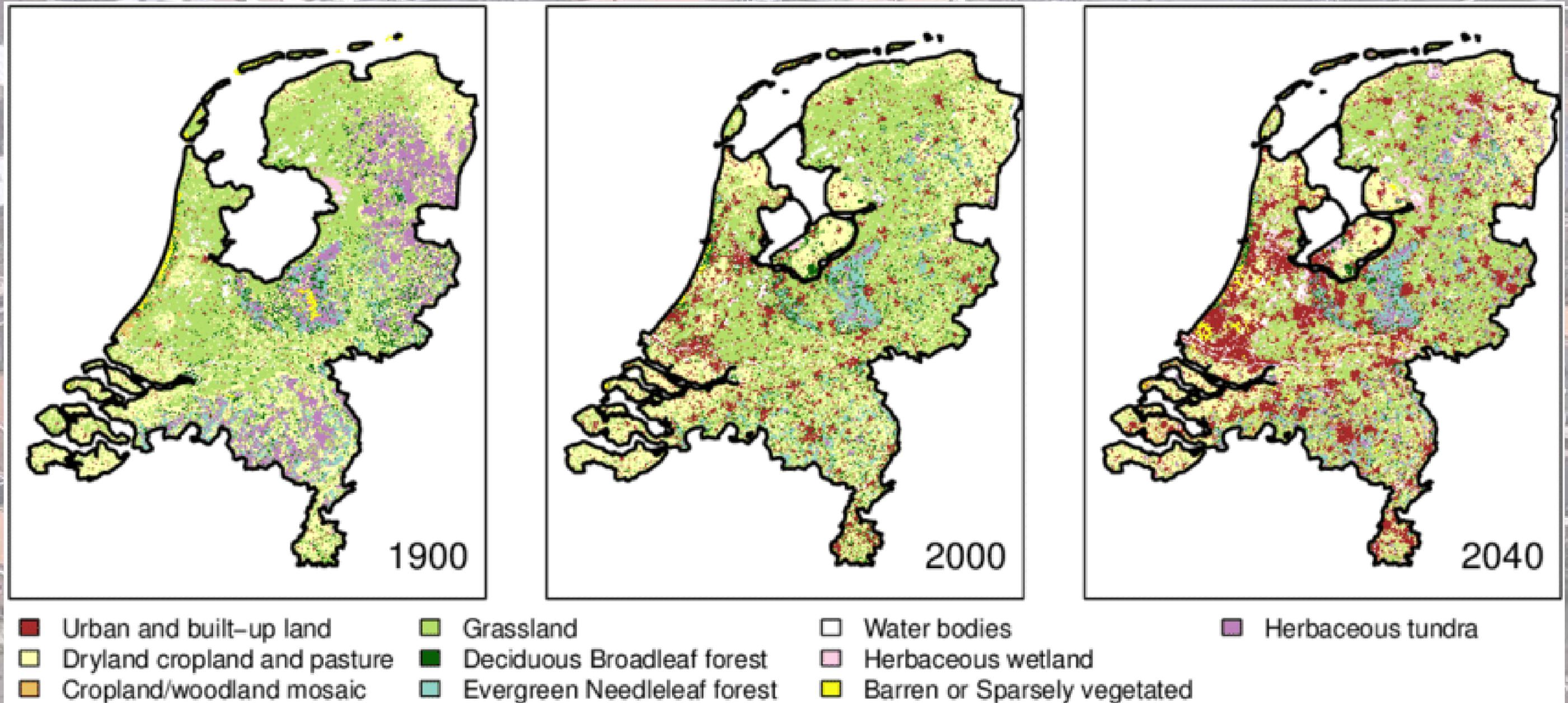


Population growth



Changing households

Urbanization

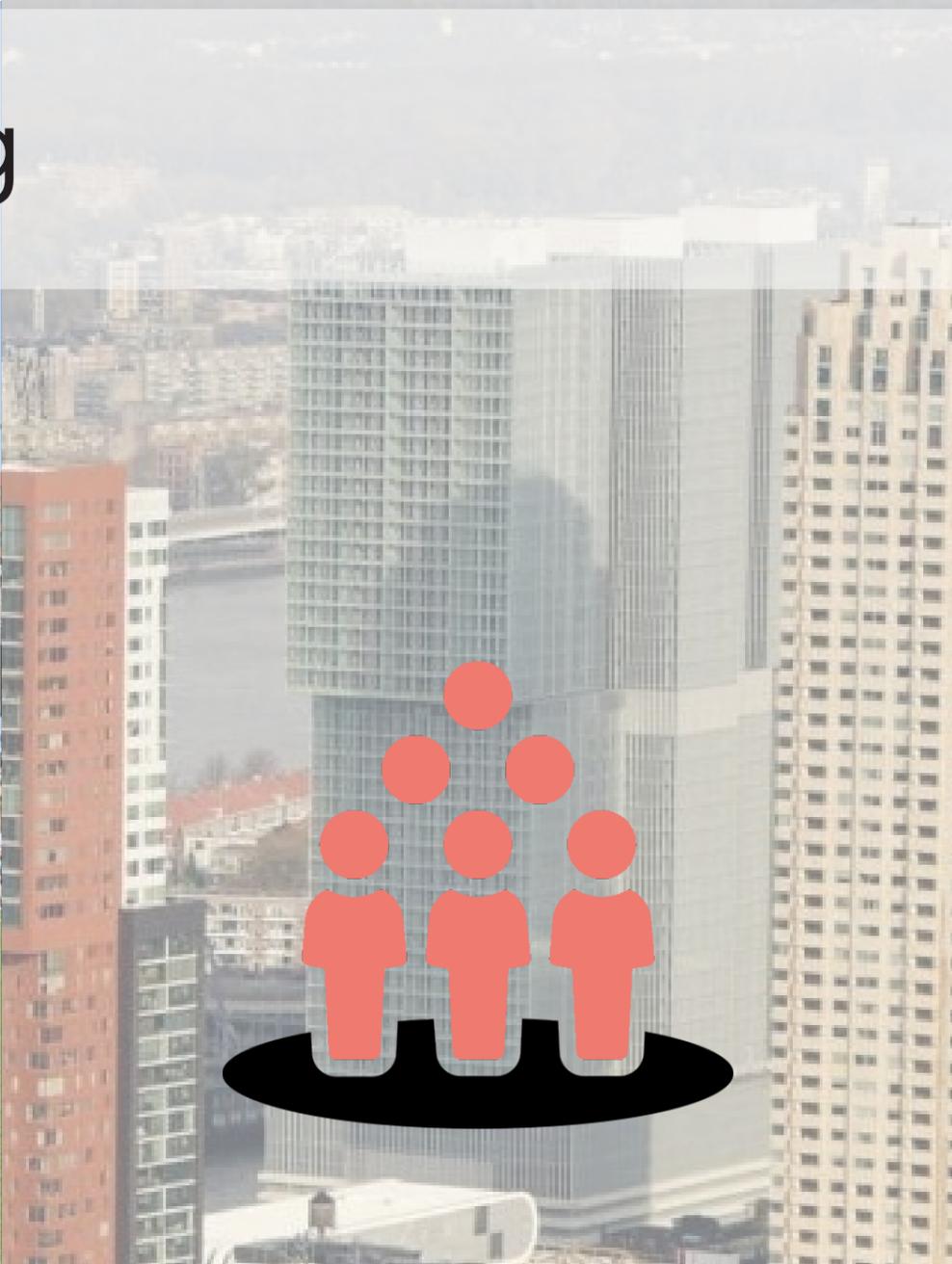


Urbanization of the Netherlands (PBL, 2014)

Human Well-being



Changing needs



Increasing densities



Gentrification

Mobility



Car oriented design

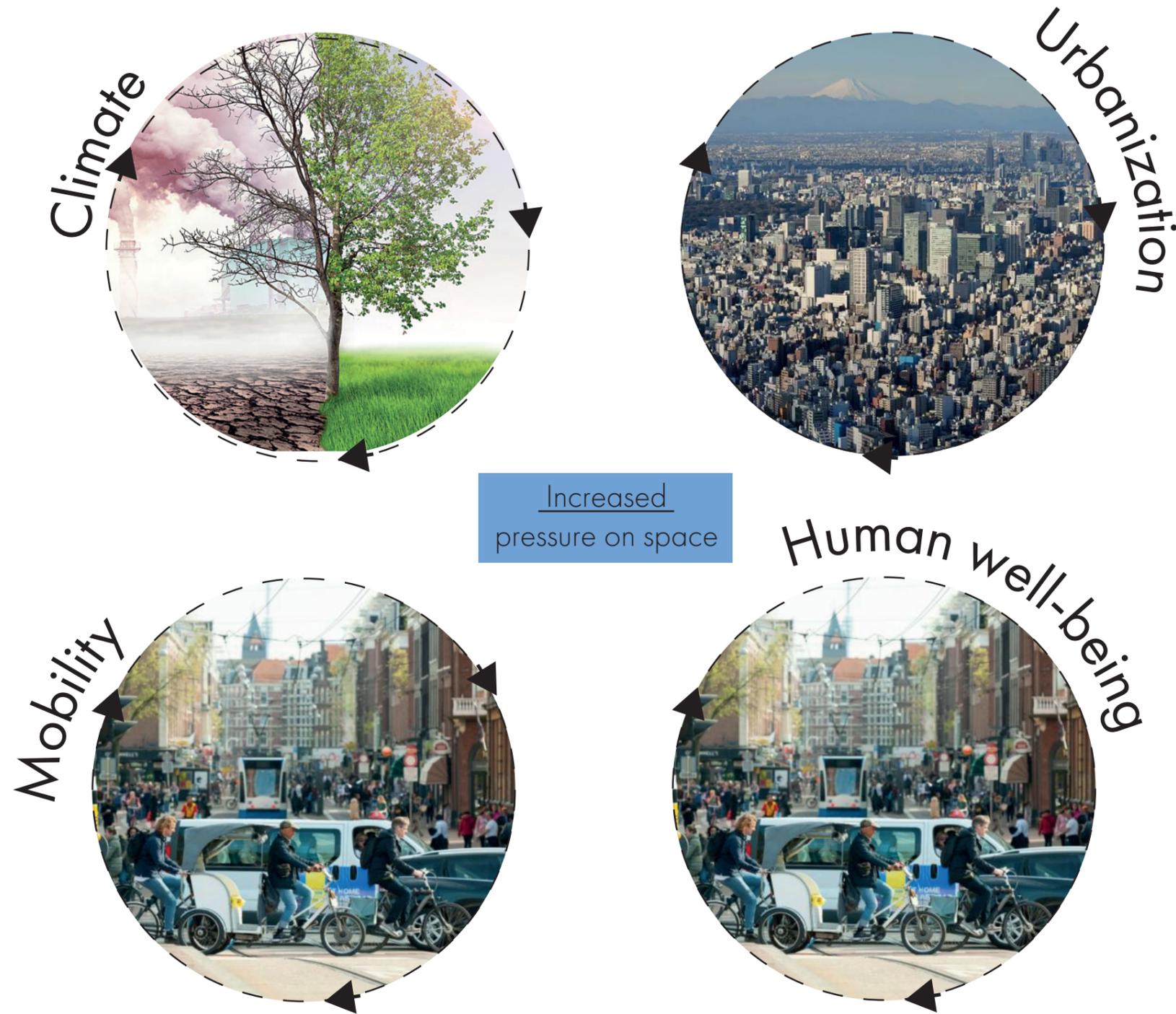


Increased ownership



Limited capacity

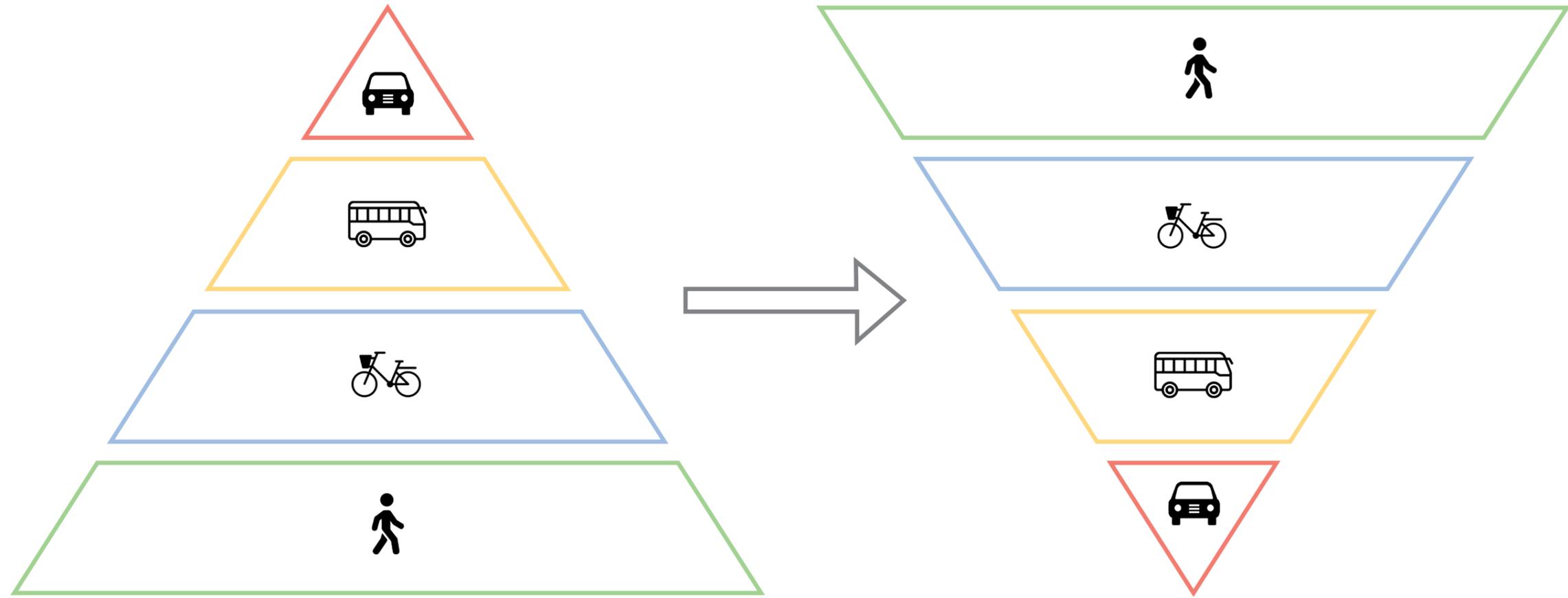
Problemization



Research question

1. How can we use public space more sustainable in terms of climate adaptation, ecology, human well-being and mobility?

Mobility shift



Redefine streets

From an infrastructural place for cars ...

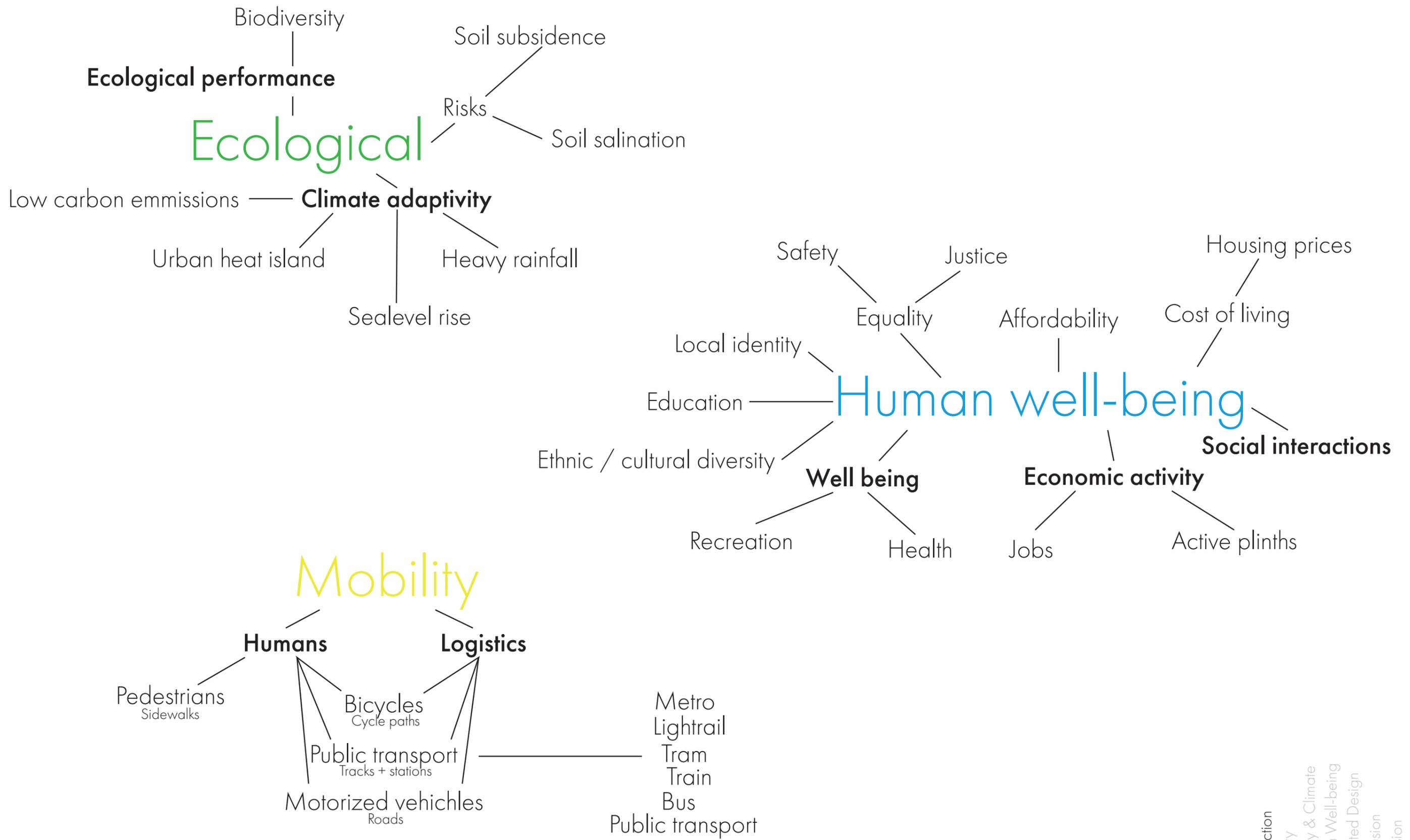


Willem Buytewechstraat (Google Maps, 2022)



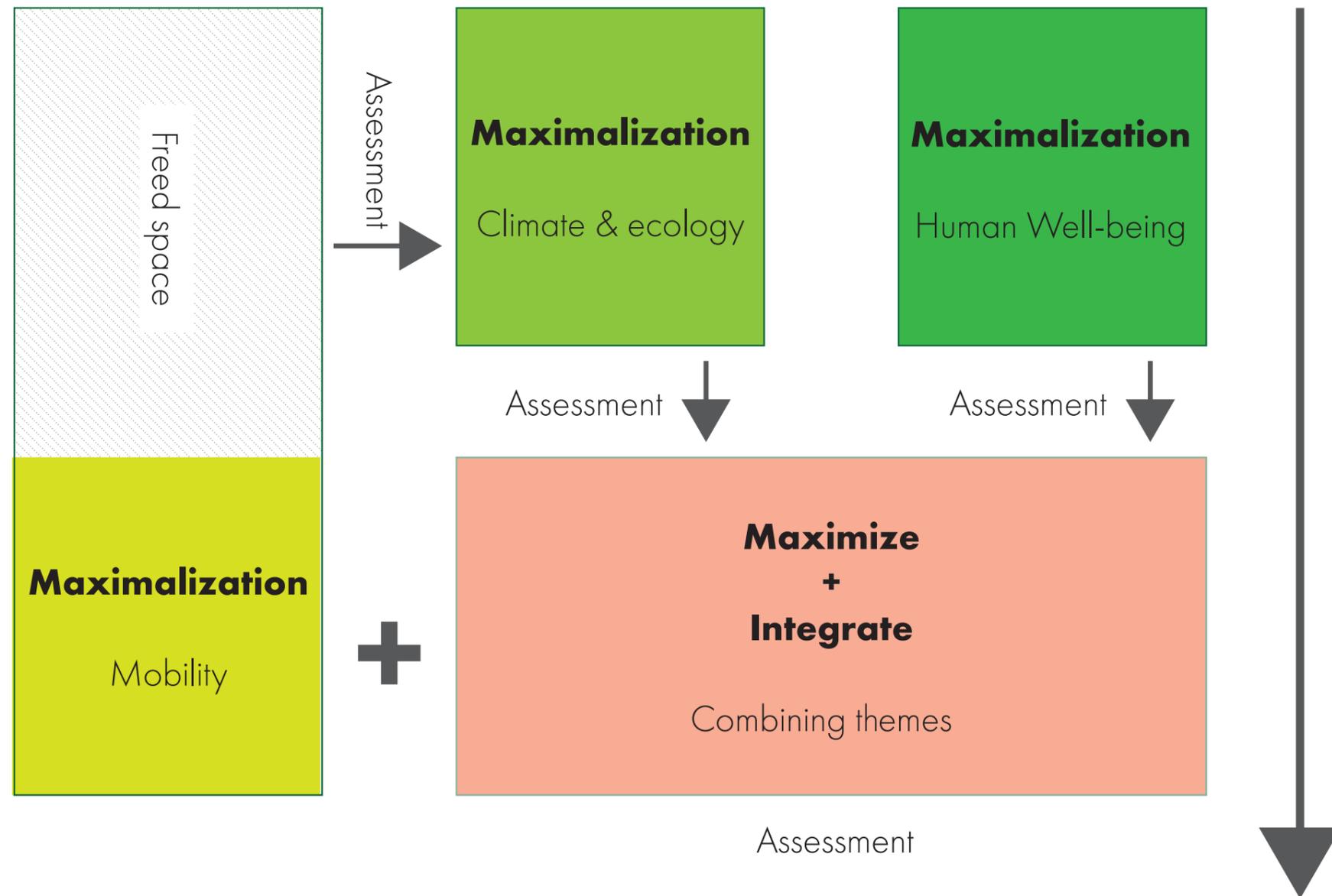
Transformation Willem Buytewechstraat (Made by Author)

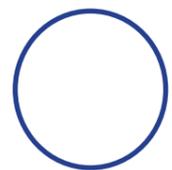
... to a public space for everyone!



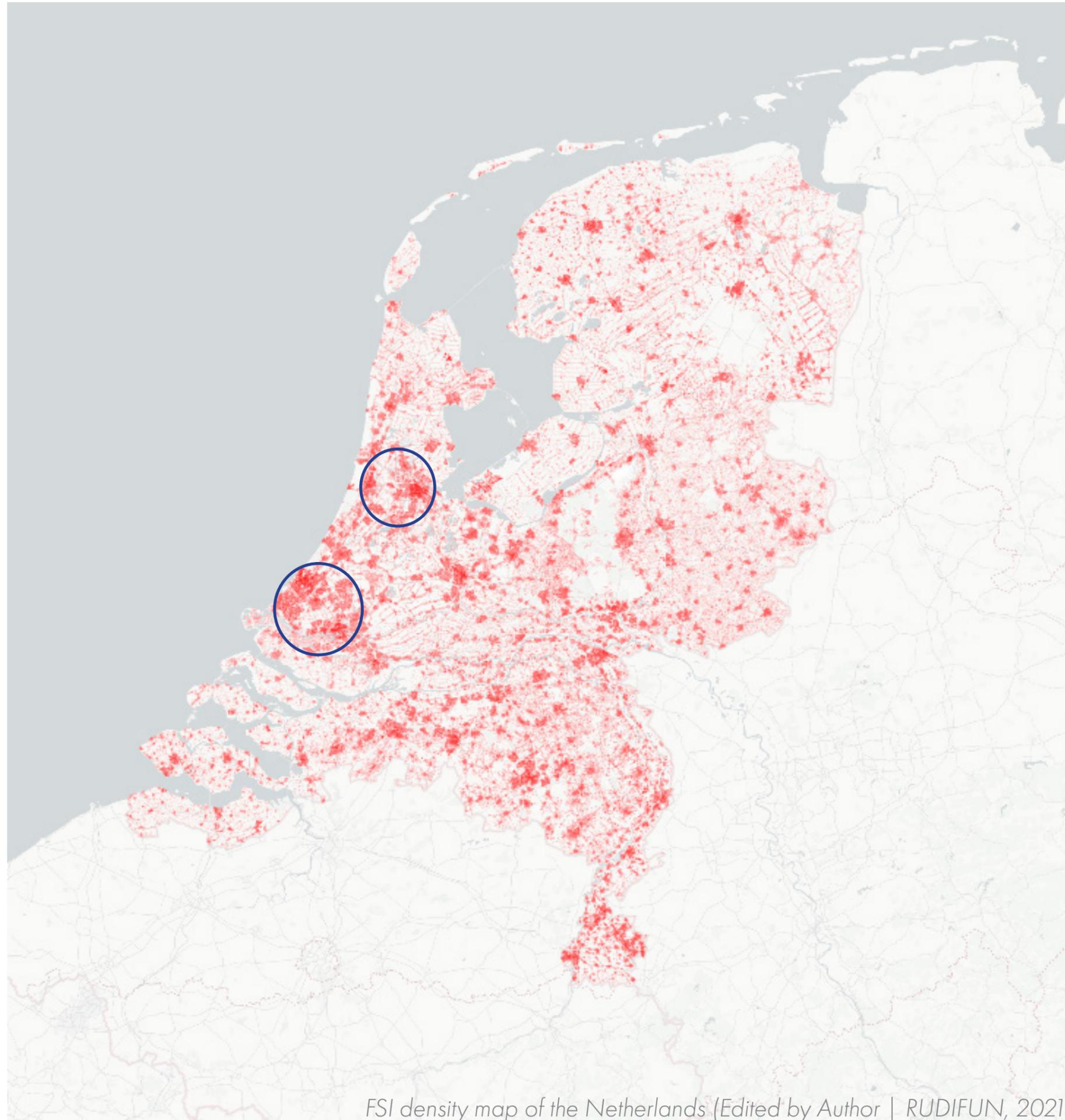
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- Human Well-being
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Design methodology





Critical space



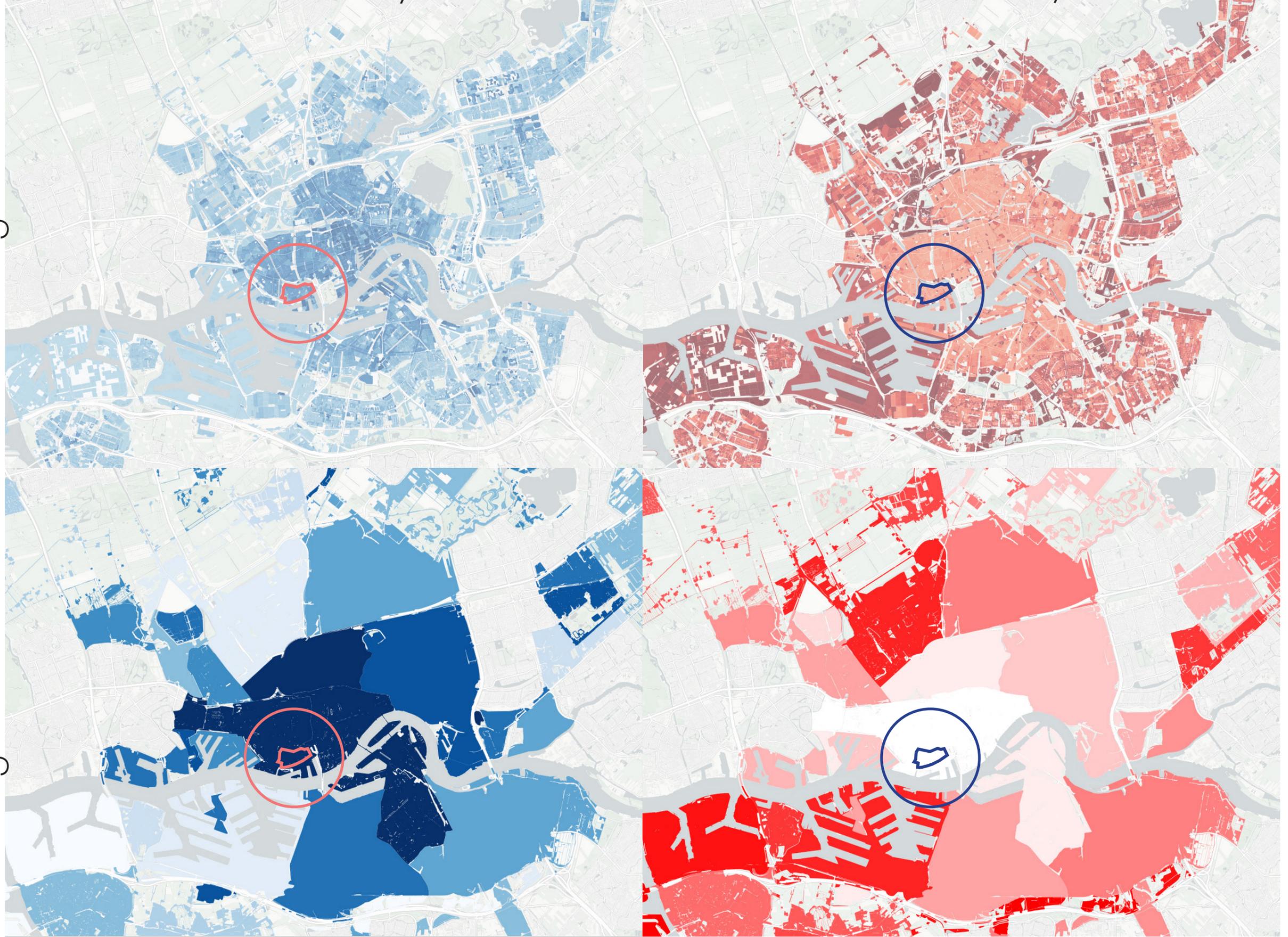
FSI density map of the Netherlands (Edited by Author | RUDIFUN, 2021)

Building block

Neighbourhood

FSI density

OSR density





Delfshaven connectivity (Made by Author)



Delfshaven satalite view (Google Earth, 2022)

50%

of public space for cars

(PDOK, 2022)

0,7

cars per household

(Kadaster, 2022)



Mobility

Cover image (Made by Author)

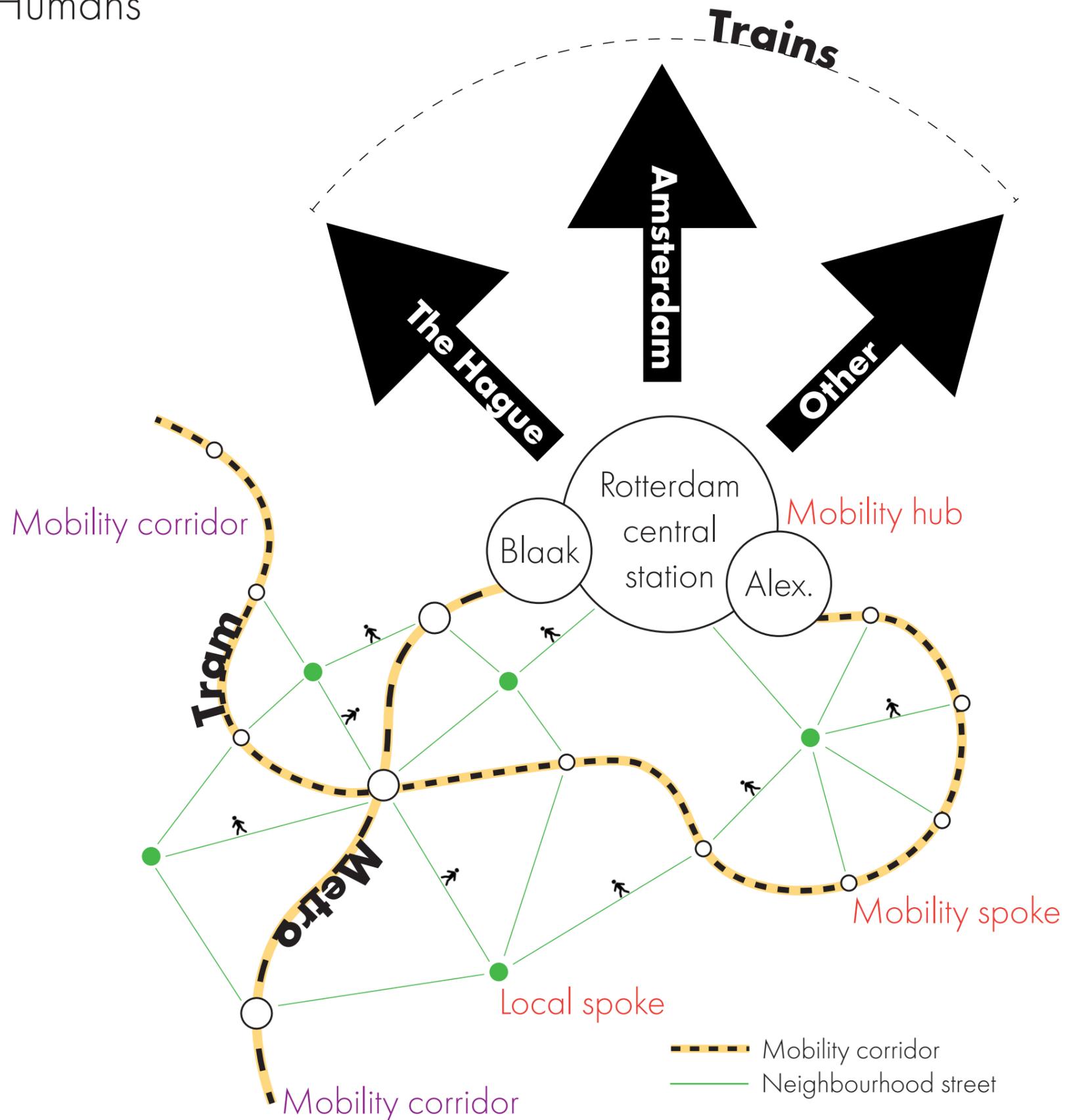
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Mobility

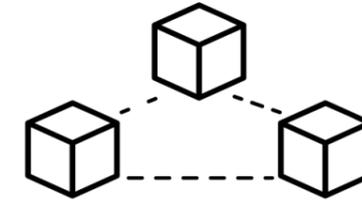
1. Cities are accountable for **70% of CO² emissions globally**, of which 78% is created by vehicular transportation. (Allam et al., 2022)
2. **Half of the public space** in Delfshaven **is used to accommodate cars**. (PDOK dataset, 2022)
While only 35% of residents say they primarily use the car for trips longer than 30 minutes. (Research by Author)
3. **Shared cars** require as low as 1 car per 14 users (Greenwheels, 2019)

Humans

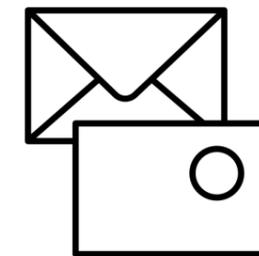


Mobility system (Made by Author)

Logistics

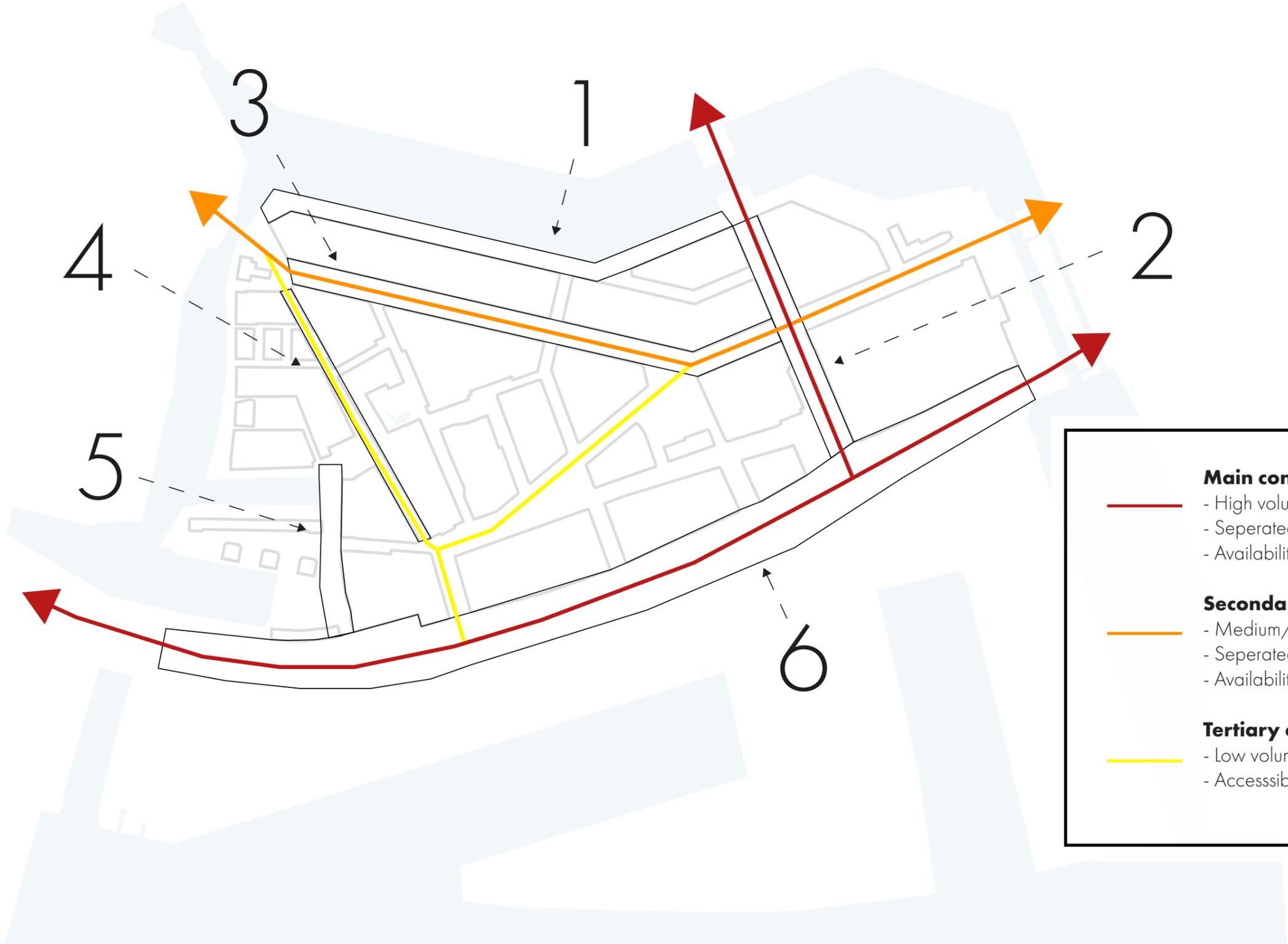


Post distribution



Waste collection





Main connector

- High volume of users
- Separated mobility flows
- Availability of public transport

Secondary connector

- Medium/high volume of users
- Separated cycling & pedestrian paths
- Availability of public transport

Tertiary connector

- Low volume of users
- Accessible for destination cyclists

Selection of representative streets (Made by Author)

1

Coolhaven



2

Pieter de Hoochweg



3

Willem Buytewechstraat



4

Havenstraat



5

Kapiteinsbuurt

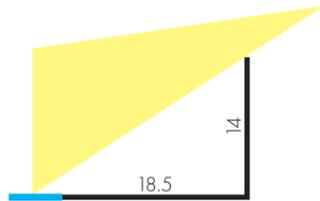


6

Westzeedijk



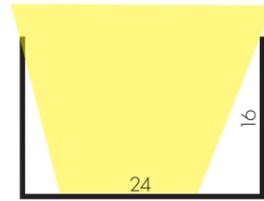
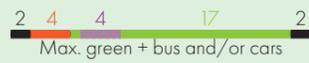
Selection of representative streets (Google Streetview, 2022)



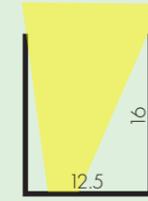
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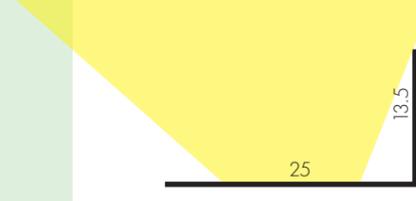
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3



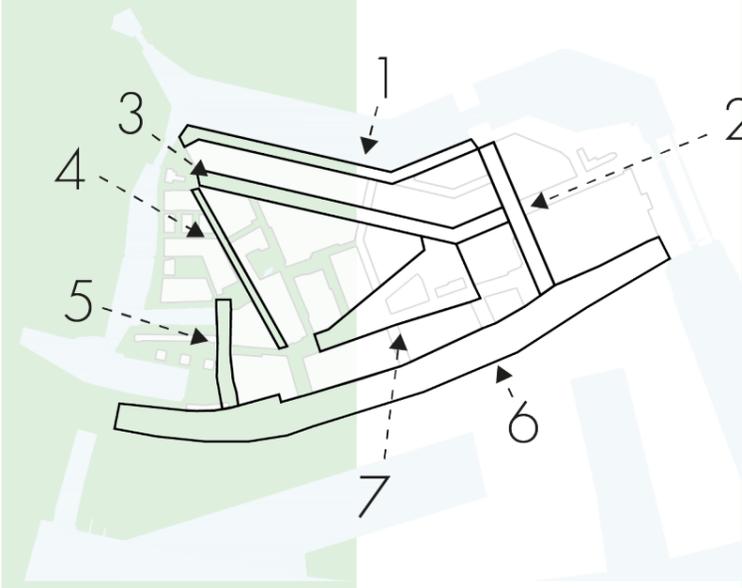
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5



6

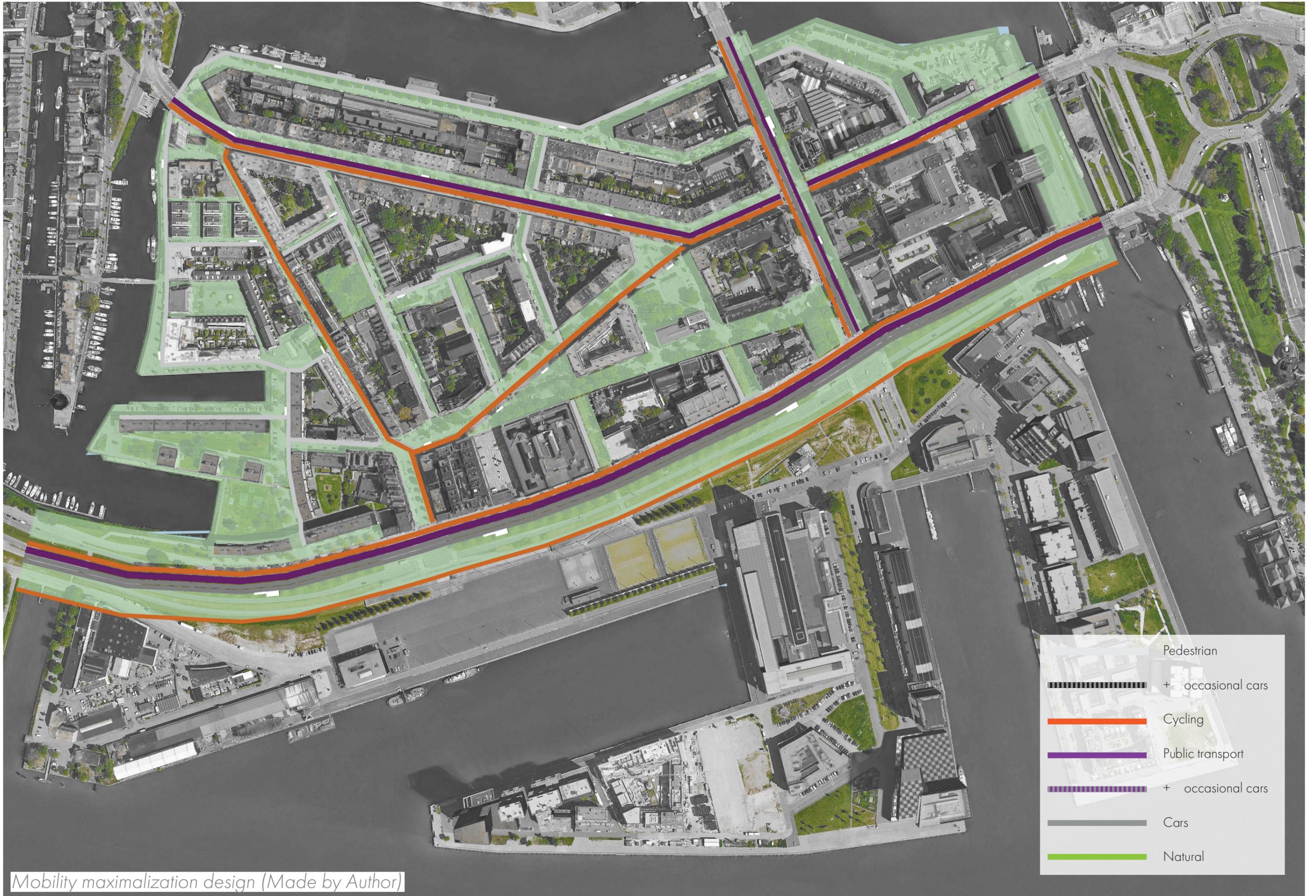


- Pedestrian
- + occasional cars
- Cycling
- Public transport
- + occasional cars
- Cars
- Natural

Maximize green

Maximize accessibility

Balanced / preferred



Mobility maximalization design (Made by Author)



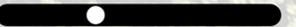
Space for potential interventions (Made by Author)

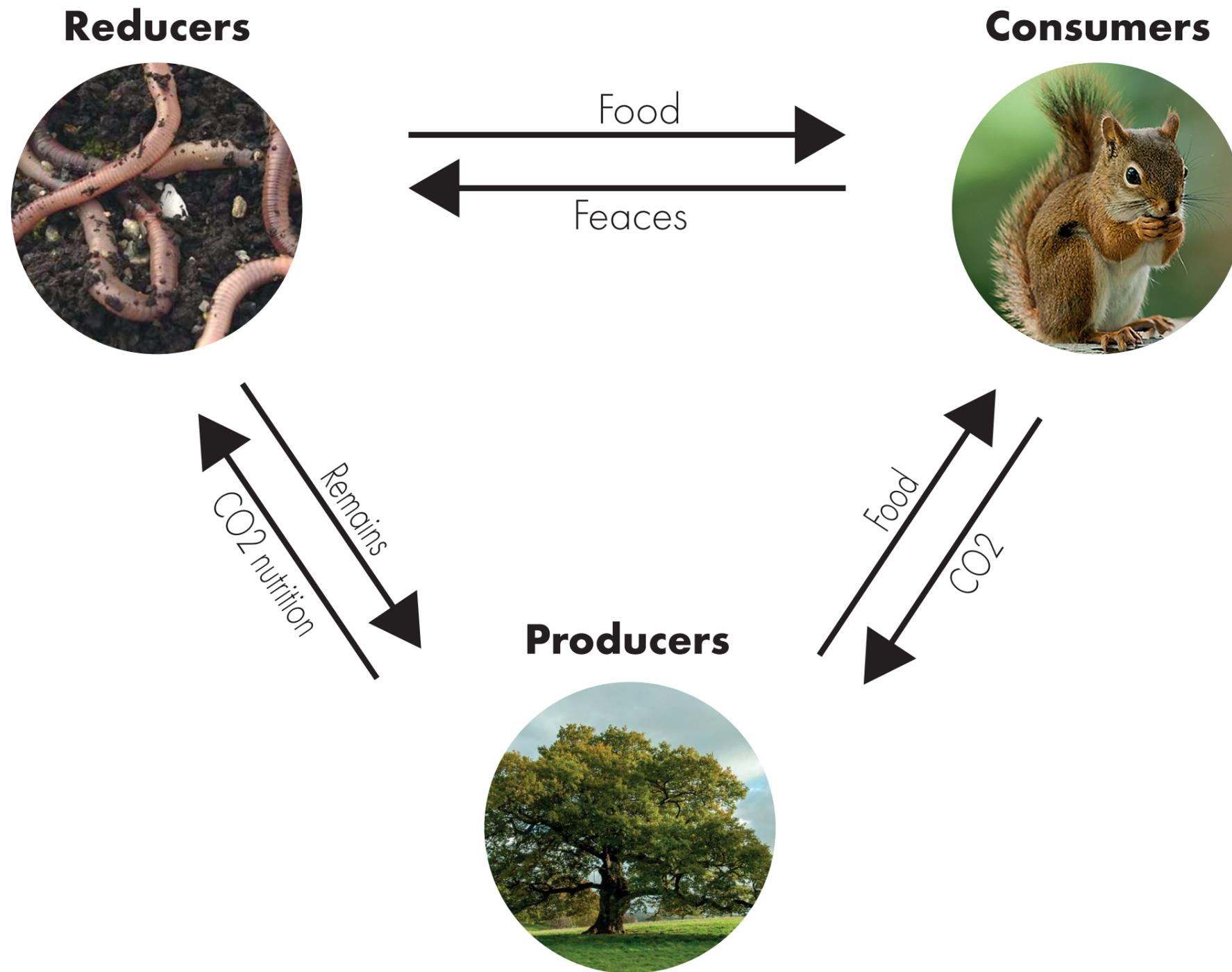


Ecology & Climate

Cover image (Made by Author)

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Ecosystem food chain (Made by Author)

Urban Ecosystems

1. Habitat **variety and size** positively influence biodiversity, but small individual plots still considerably support biodiversity (Norton et al., 2016)
2. Large urban areas limit species dispersal, but can be mitigated by creating and improving **ecological connections.** (Norton et al., 2016)
3. **Large trees** cool down surroundings similar to 10 room sized air conditioning units operating 20 hours a day. (Beatley, 2011)

Trees	Specification	Requirements
	<p>General</p> <p>Large > 18m height ~15m crown diameter</p>	<p>1 m³ roots space / year 1/2 m³ groundwater / year 1/3 m³ high quality soil/ year</p> <p>~60 years 60m³ root space 30m³ groundwater 20m³ high quality soil</p>
	<p>Medium 9-18m height ~9m crown diameter</p>	<p>~30 years 30m³ root space 15m³ groundwater 10m³ high quality soil</p>
	<p>Small < 9m height ~4m crown diameter</p>	<p>~10 years 10m³ root space 5m³ groundwater 3m³ high quality soil</p>

Growth of trees (Made by Author | data from Gemeente Utrecht, 2022)



Trees

Plants

Trees					Plants					
Weeping Willow Salix Babylonica BD	White Maple Acer Saccharinum BE	Northern Maple Acer Platanoides ABE	Winter Lime Tilia Cordata BE	Bald Cypress Taxodium Distichum BDE	Oriental Sycamore Platanus Orientalis ABE	Trumpet Tree Catalpa speciosa BD	American Persimmon Diospyros Virginiana AD	Ivy Hedera Helix BE	Yellow Iris Iris Pseudacorus BD	Hairy Willowherb Epilobium Hirsutum BD

- Roots in water
- Squirrels and other small mammals
- Bees, wasps, etc.
- Leaves good for flowers
- Birds
- Butterflies
- Strong roots / long lifespan
- Moths
- Caterpillar

Various images (Made by Author)

Trees

- White Maple
- Northern Maple
- American Lime
- Western Sycamore



Plants

- Hairy Willowherb

Guidelines

Ecology



Habitat variety

- The neighbourhood includes a variety of habitat types

Large ecological areas

Qualitative

Connective

Reduce barriers

- Ecological corridors are connected to large nature inclusive areas
- Limit barriers on corridors
- Pedestrians have priority and other modes of mobility are limited

Climate



Collective

Maintenance, garden management

Cooling down

Surface nature, tree cover

Reduce flood risk

Draining & retaining water

- Participation in design and maintenance by residents

- 40+% surface vegetation
- 30+% tree crown cover

100mm rain (38.000m³)

- Capacity to drain 40% to canals
- Capacity to retain 60% in area (23.000m³)

Ecology types



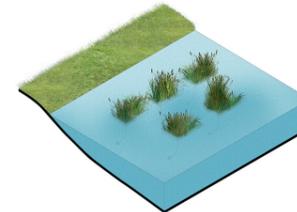
Parks



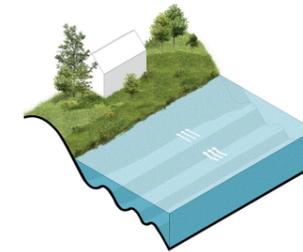
Primary corridor



Secondary corridor



Wetland



Sloped quays



Mobility corridor

Condition

Large trees, wide dense tree crowns, spontaneous vegetation

Medium to large trees, dense high tree crowns, deciduous

Medium trees, dense high tree crowns, deciduous, sitable grass

Temporarily wetland, water resistant vegetation, water purifying vegetation

Water resistant vegetation, water purifying vegetation

Small to medium trees, dense high tree crowns, road salt-resistant, pollution resistant

Species

White Maple, Northern Maple, American Lime, Western Sycamore, Tullip Tree, Prunus, Horse Chestnut, Oak, Walnut tree, shrubs, flowerbeds

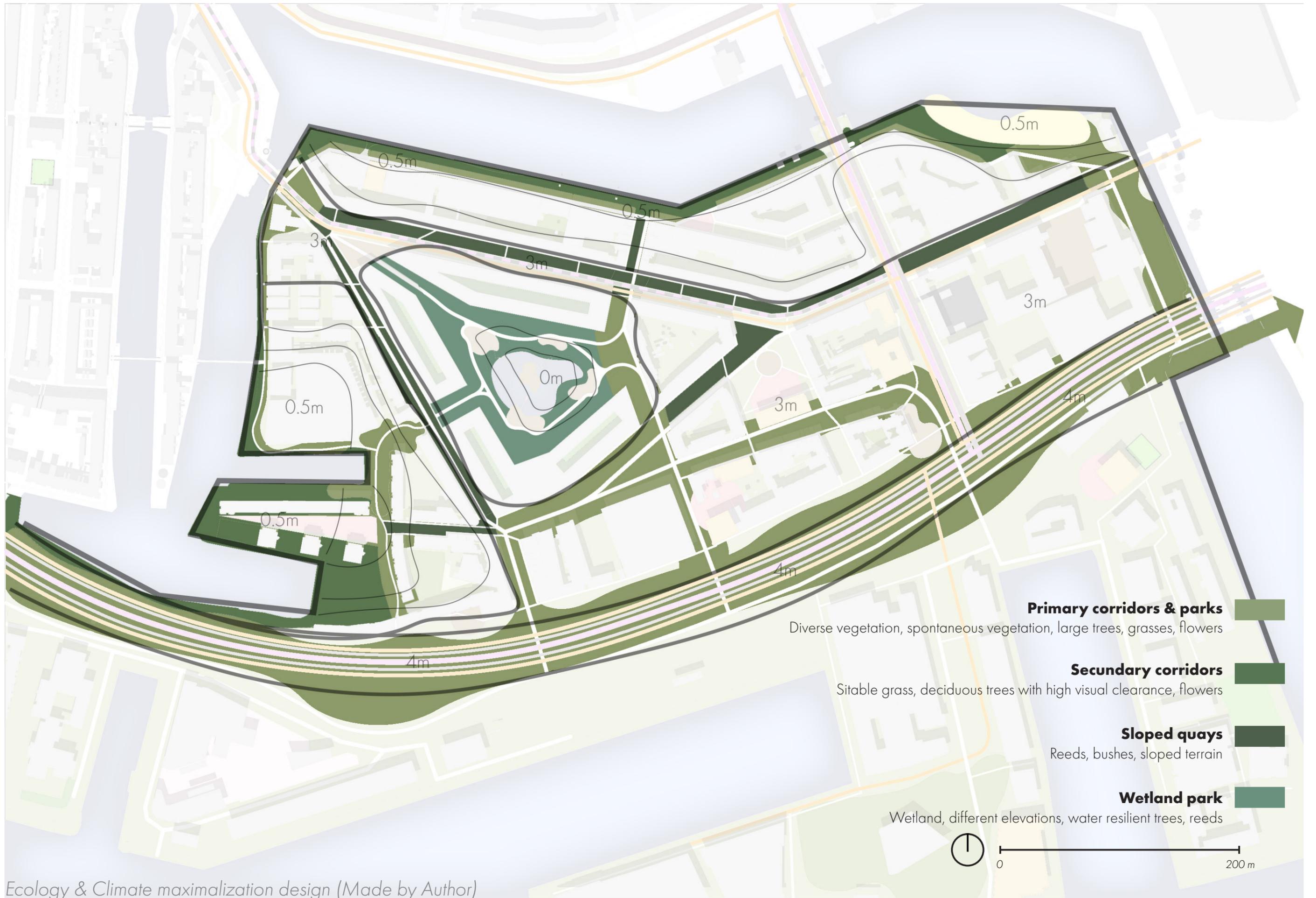
White Maple, Northern Maple, Western Sycamore, Horse Chestnut, prunus, Tullip tree, Oak, Shrubs, flowerbeds

Northern Maple, Western Sycamore, Oak, Lime, Hornbeam, shrubs, sitable grass, hawthorn

Reeds, Willowherb, Lilies, Woolgrass, Blue Vervain

Weeping willow, reeds, Willowherb, Woolgrass

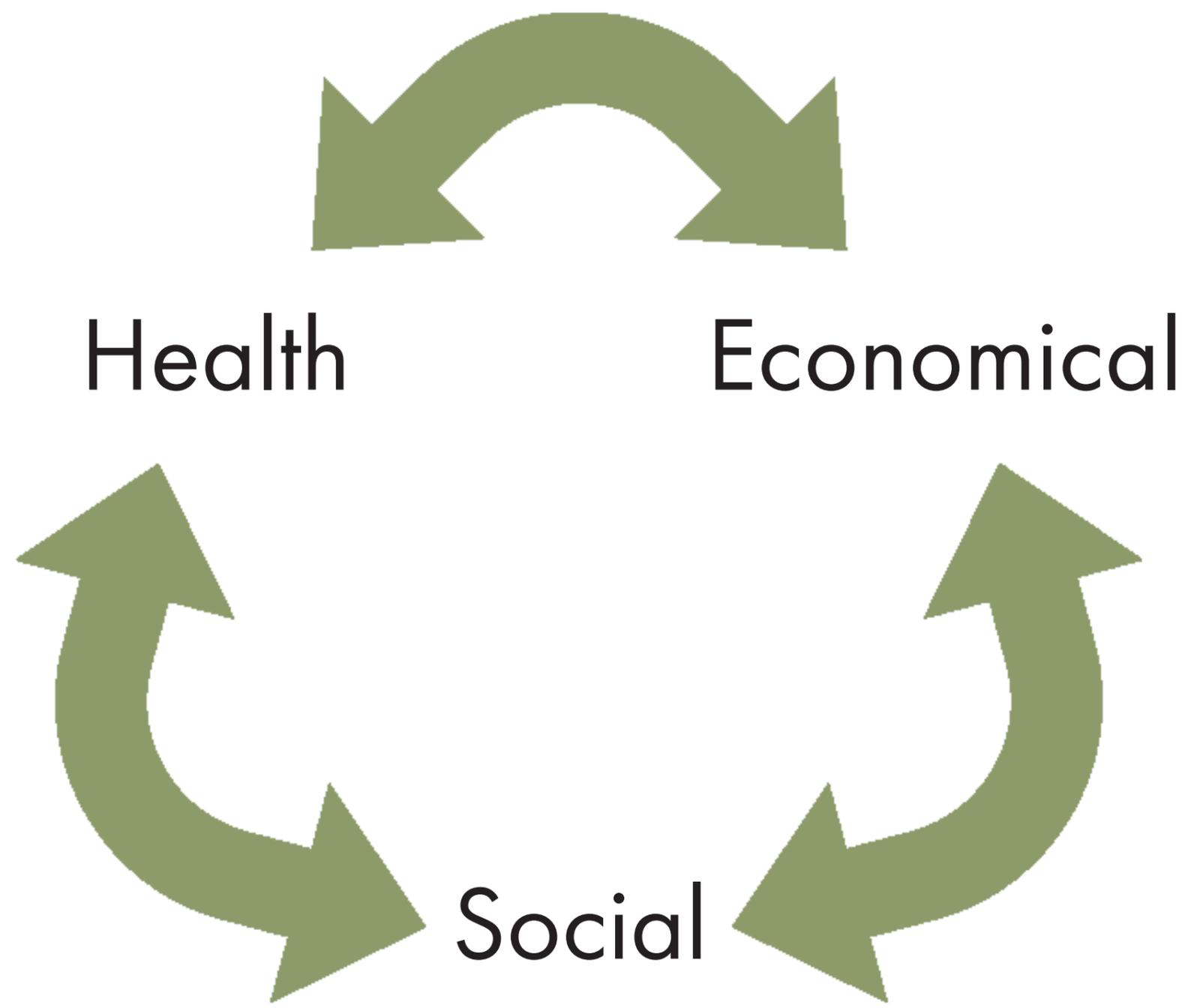
Northern maple, Oak, American Lime, Hornbeam



Human Well-being

Cover image (Made by Author)

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Health

1. **Natural urban areas** contribute to well-being of humans and **are considered enjoyable** to be in or around.

(Kothencz et al., 2017)

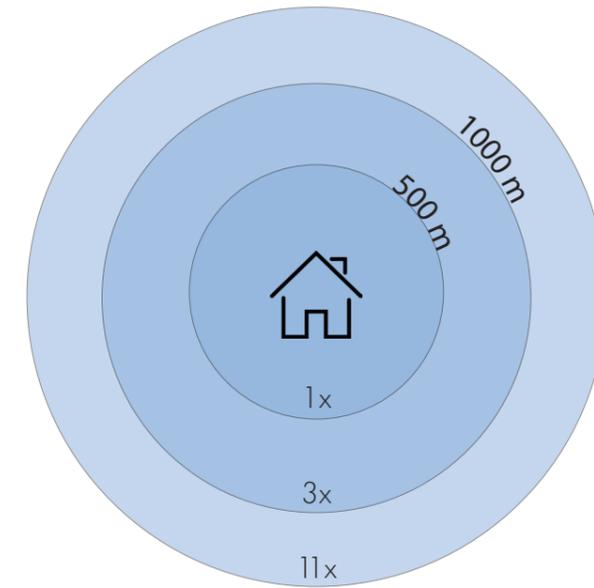
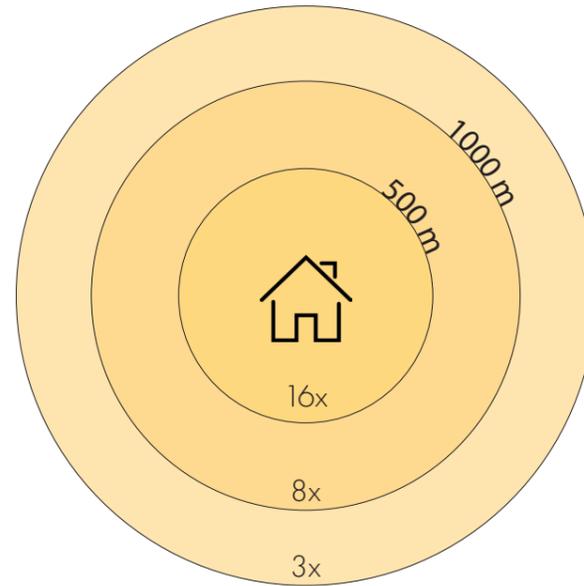
2. **Urban nature improves physical and mental health** of residents living within close proximity.

(Lee & Maheswaran, 2010)

Social

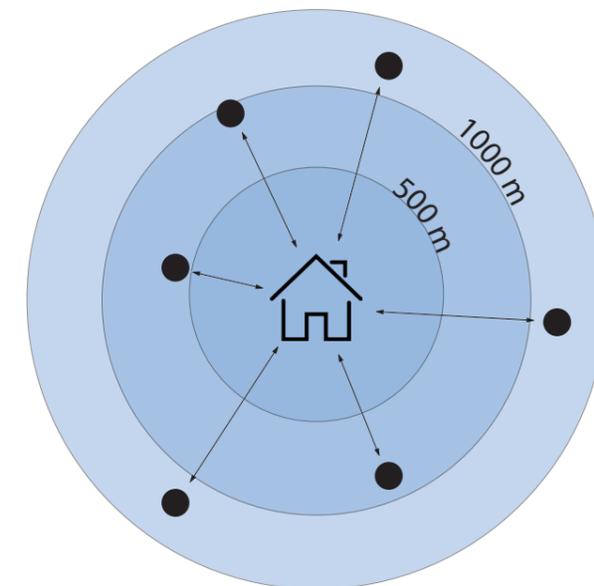
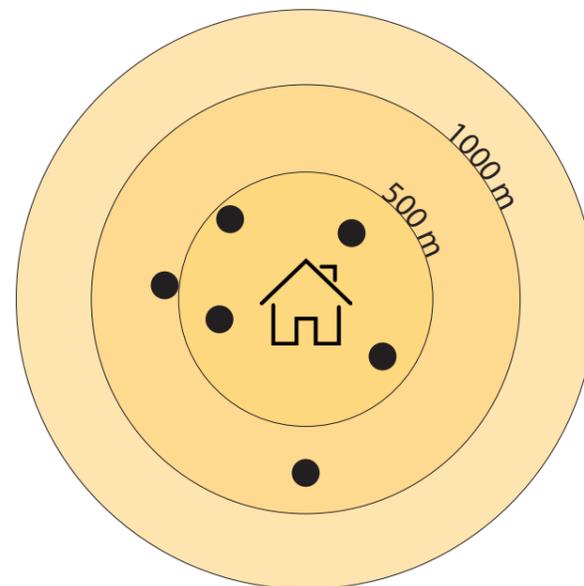
1. **Safer environments** mean that people experience less stress and feel more invited to spend time outside and letting their kids play freely without parent supervision. (Karsten & Felder, 2016)
2. **Attractiveness of a path** can influence peoples perception of distance and time and thus extend accaptable walking distances. (Beatley, 2011)
3. Parents and kids that live in **proximity to school** often have stronger and longer lasting social relations. (Karsten & Felder, 2016)

Distance to school



Distance to school (Karsten, 1998)(edited by author)

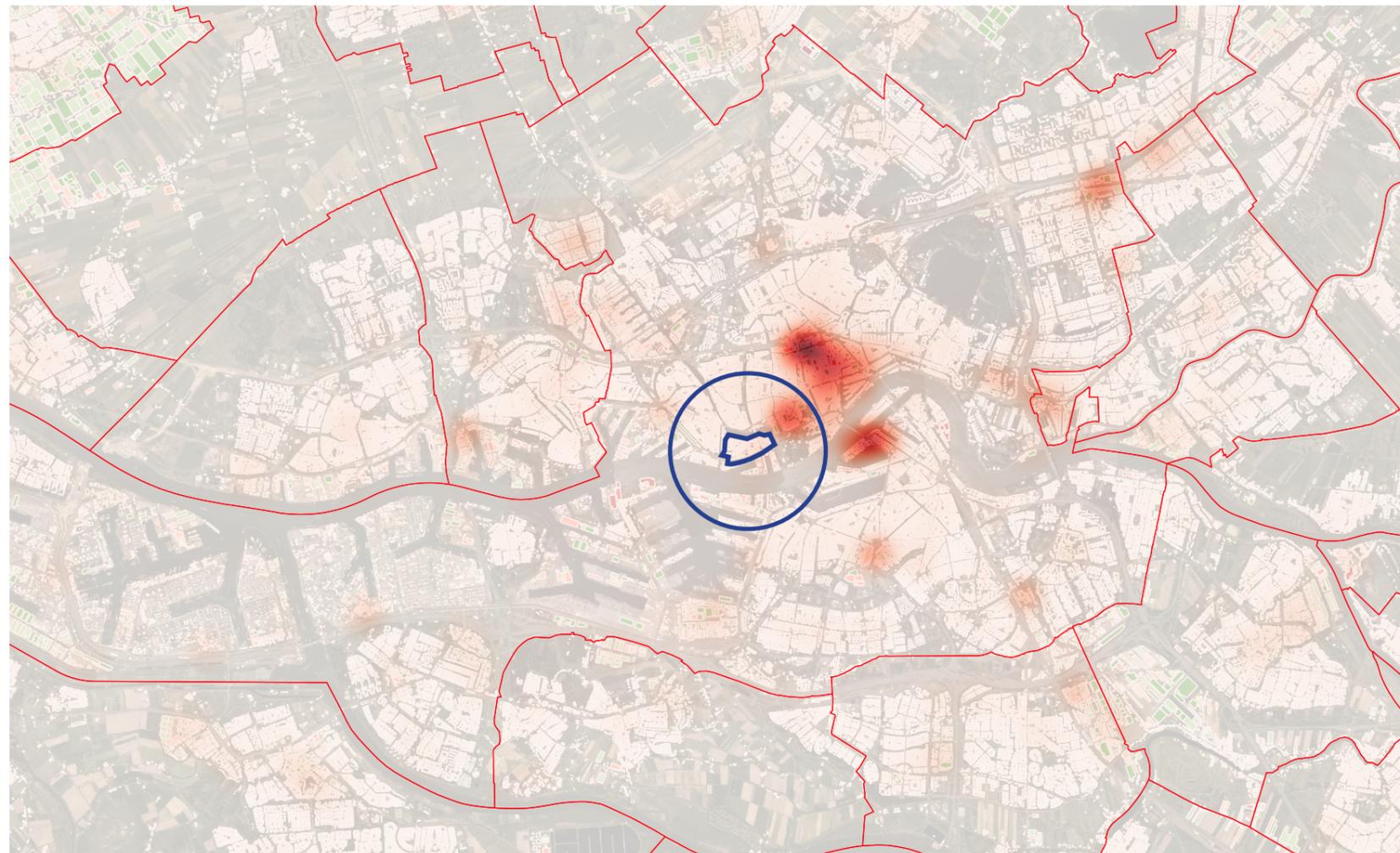
Distance to friends



Distance to childhood friends (Karsten, 1998)(made by author)

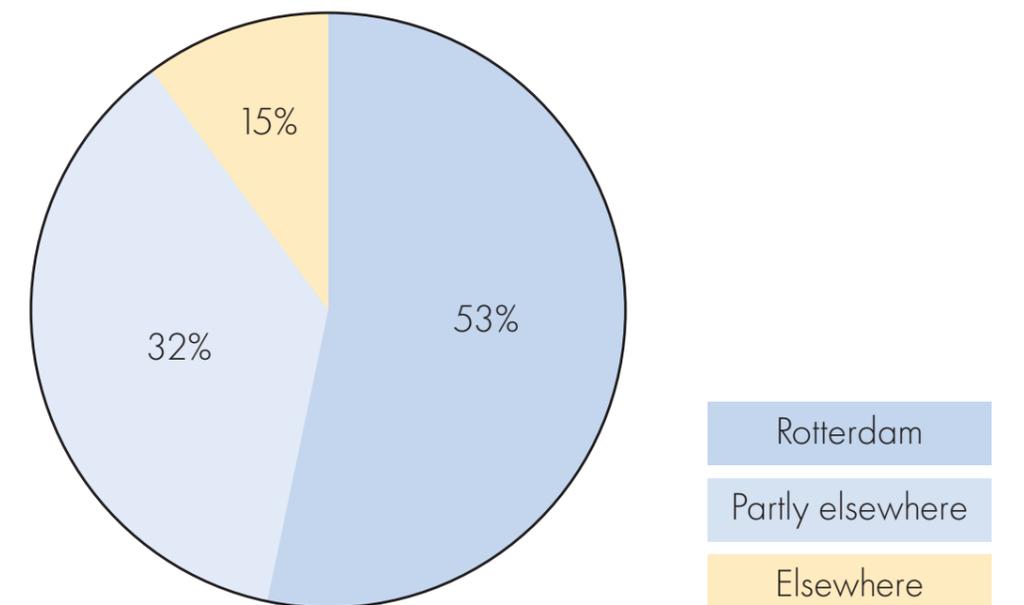
Economic

Jobs concentration



Heatmap of full time jobs with municipal borders (LISA, 2018 | Edited by Author)

Workplace parents



Job location of parents (Karsten, 1998)(edited by author)

Human Well-being



Social space

Interactive, inviting, friendly, diverse

- Public space includes a variety of spaces to meet and interact

Active space

Active, fun, adventurous, useful

- Parks and squares have unique designs
- Public space includes elements where residents can interact with nature

Comfort space

Safe, 'green', walkable, attractive

- Dwellings facing public space
- Wide and attractive walking routes

Accessible space

Connected, continuous, proximity

- Park or square within 300 meters
- At least two parks or squares accessible without crossing any barrier

Integrated Design Phase

Cover image (Made by Author)

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Mobility



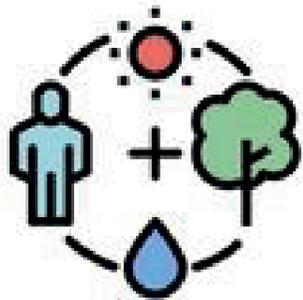
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Ecology



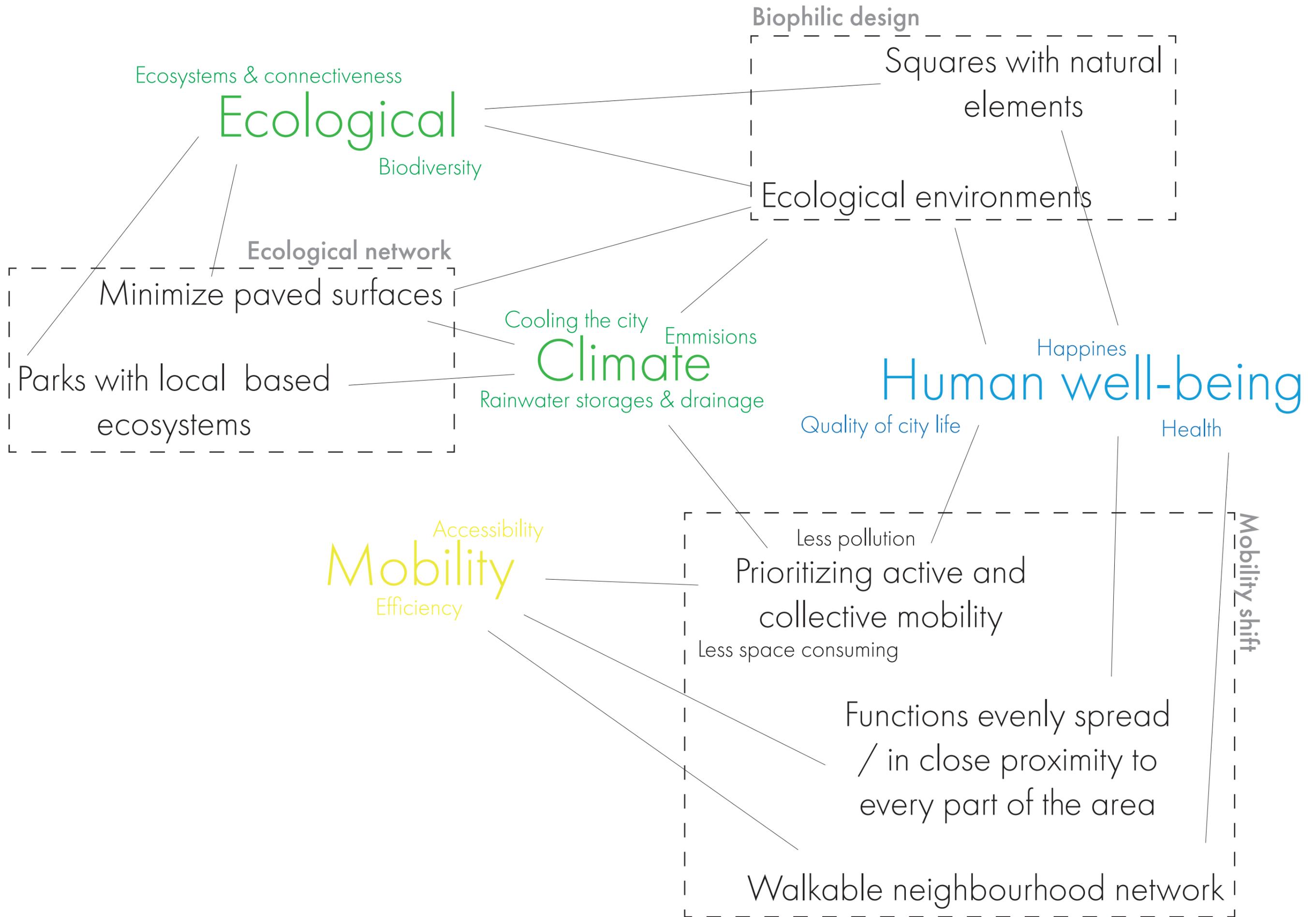
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Human Well-being



=

?



- The neighbourhood includes a variety of habitat types

Habitat variety

Collective

Maintenance, garden management

- Participation in design and maintenance by residents

- Ecological corridors are connected to large nature inclusive areas

Large ecological areas

Qualitative

Cooling down

Surface nature, tree cover

- 40+% surface vegetation
- 30+% tree crown cover

- Limit barriers on corridors

Connective

Reduce barriers

Reduce flood risk

Draining & retaining water

100mm rain (38.000m³)

- Capacity to drain 40% to canals
- Capacity to retain 60% in area (23.000m³)

- Pedestrians have priority and other modes of mobility are limited

Ecology



Climate



Mobility



Human Well-being

- Electric

Sustainable

Social space

Interactive, inviting, friendly, diverse

- Public space includes a variety of spaces to meet and interact

- No private car ownership

Collective

Active space

Active, fun, adventurous, useful

- Parks and squares have unique designs
- Public space includes elements where residents can interact with nature

- Cheaper & faster than cars

Appealing

Comfort, efficiency, costs

Comfort space

Safe, 'green', walkable, attractive

- Dwellings facing public space
- Wide and attractive walking routes

- 15 minute schedule

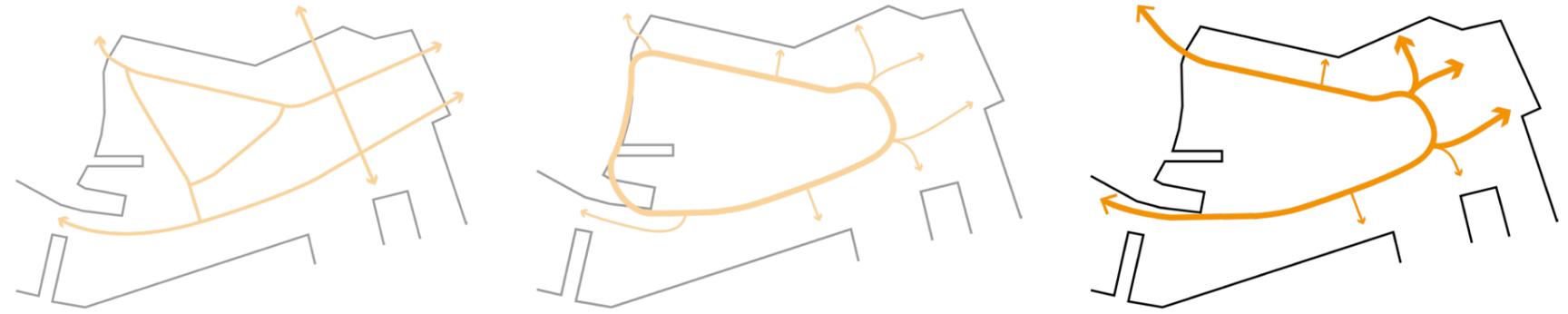
- Ample peak capacity

Accessible space

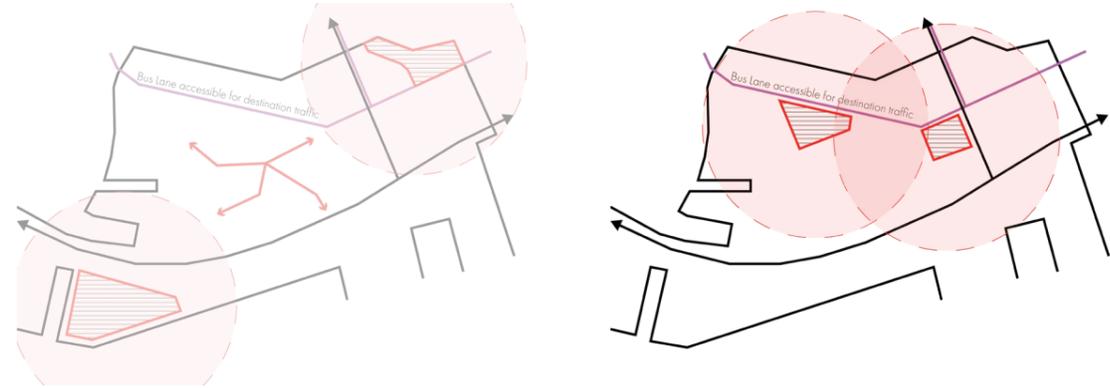
Connected, continuous, proximity

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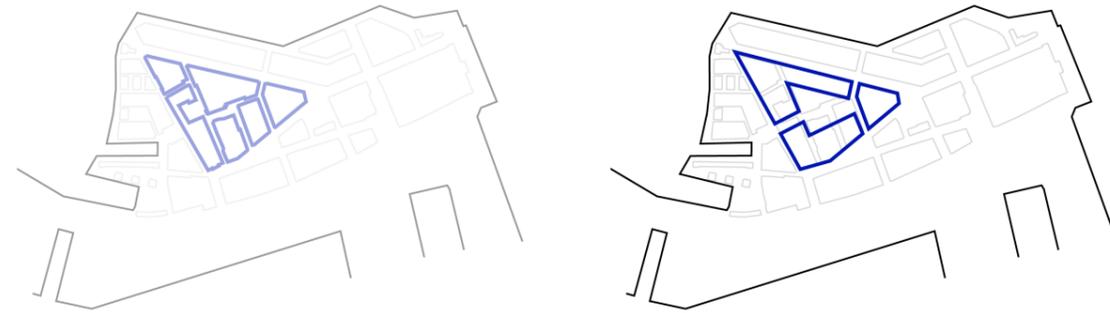
Cycle network



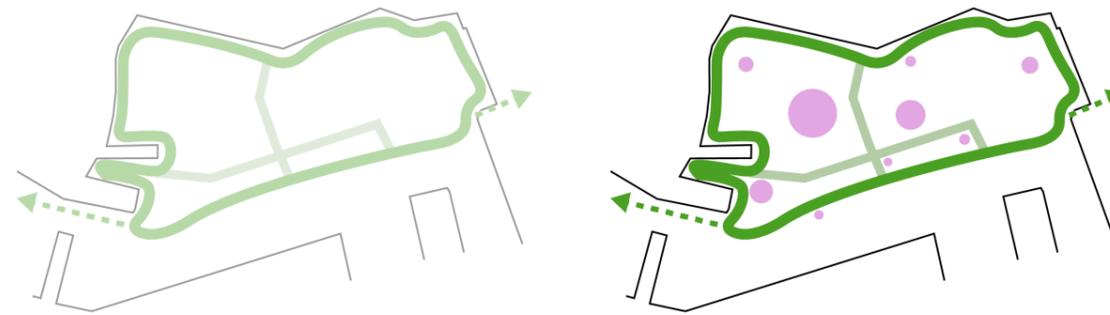
Shared mobility

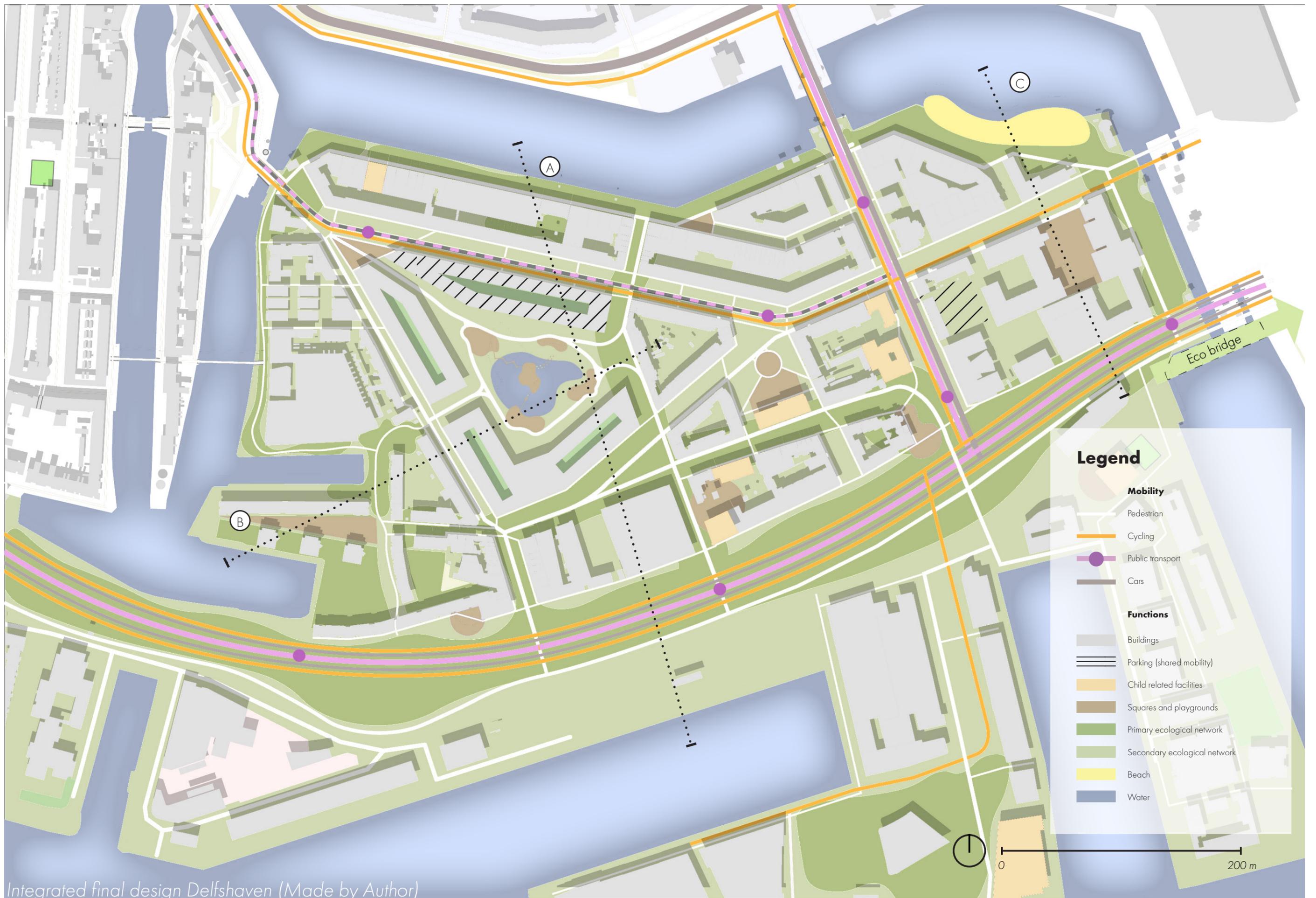


Transformation



Squares & parks





Integrated final design Delfshaven (Made by Author)

Subsoil infrastructure below pavements

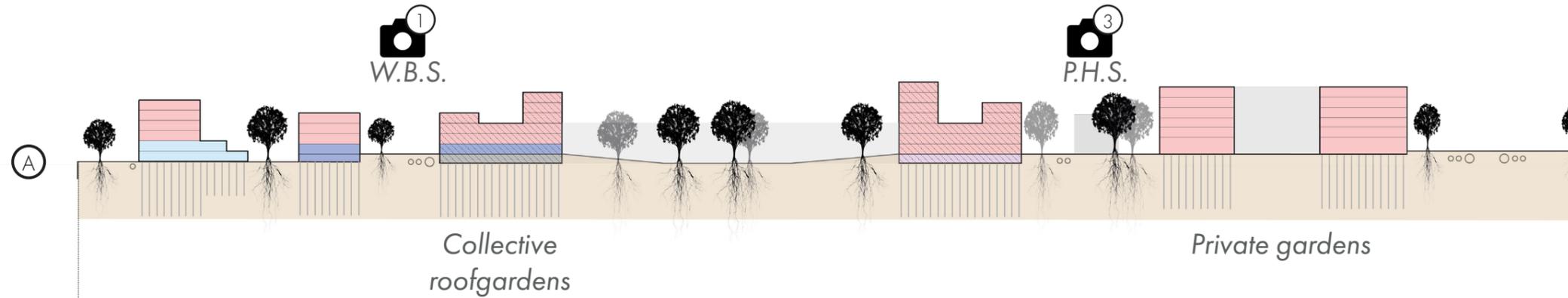
Sewage pipes downsized

Functions

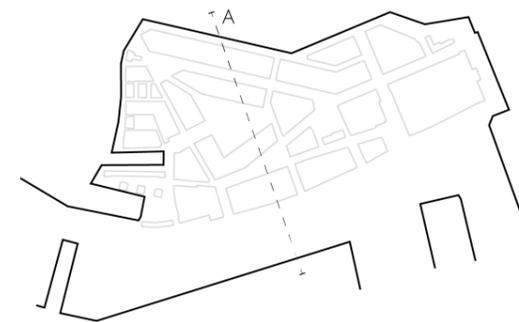
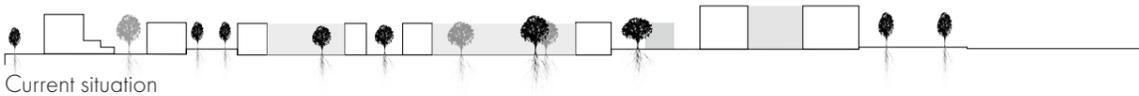
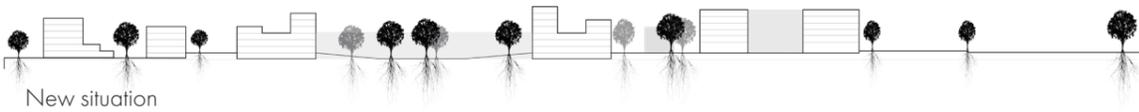
- Residential
- Commercial (shops, cafés, restaurants...)
- Workspaces (offices, flex workplaces...)
- Car parking (shared mobility)
- Bicycle parking
- New building

Subsoil

- Utility tunnel
- Sewage pipe
- Cables (electricity, internet...)
- Bioswale
- Contaminated soil
- Decontamination by vegetation
- Decontamination by soil replacement



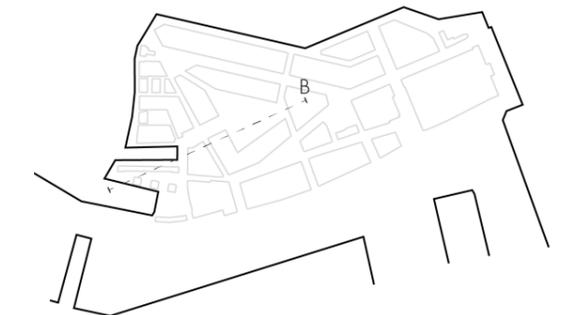
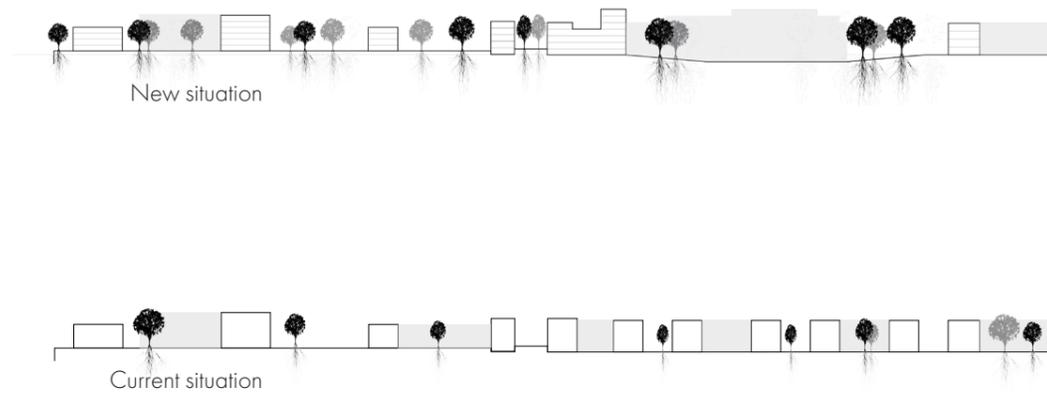
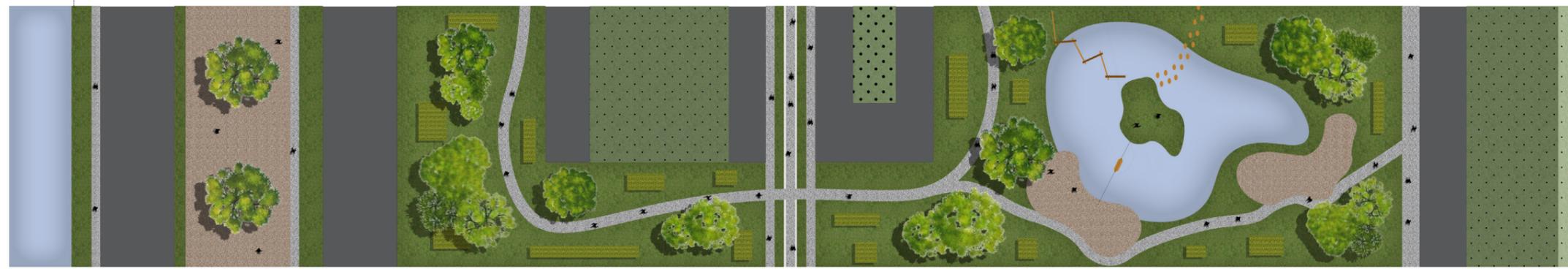
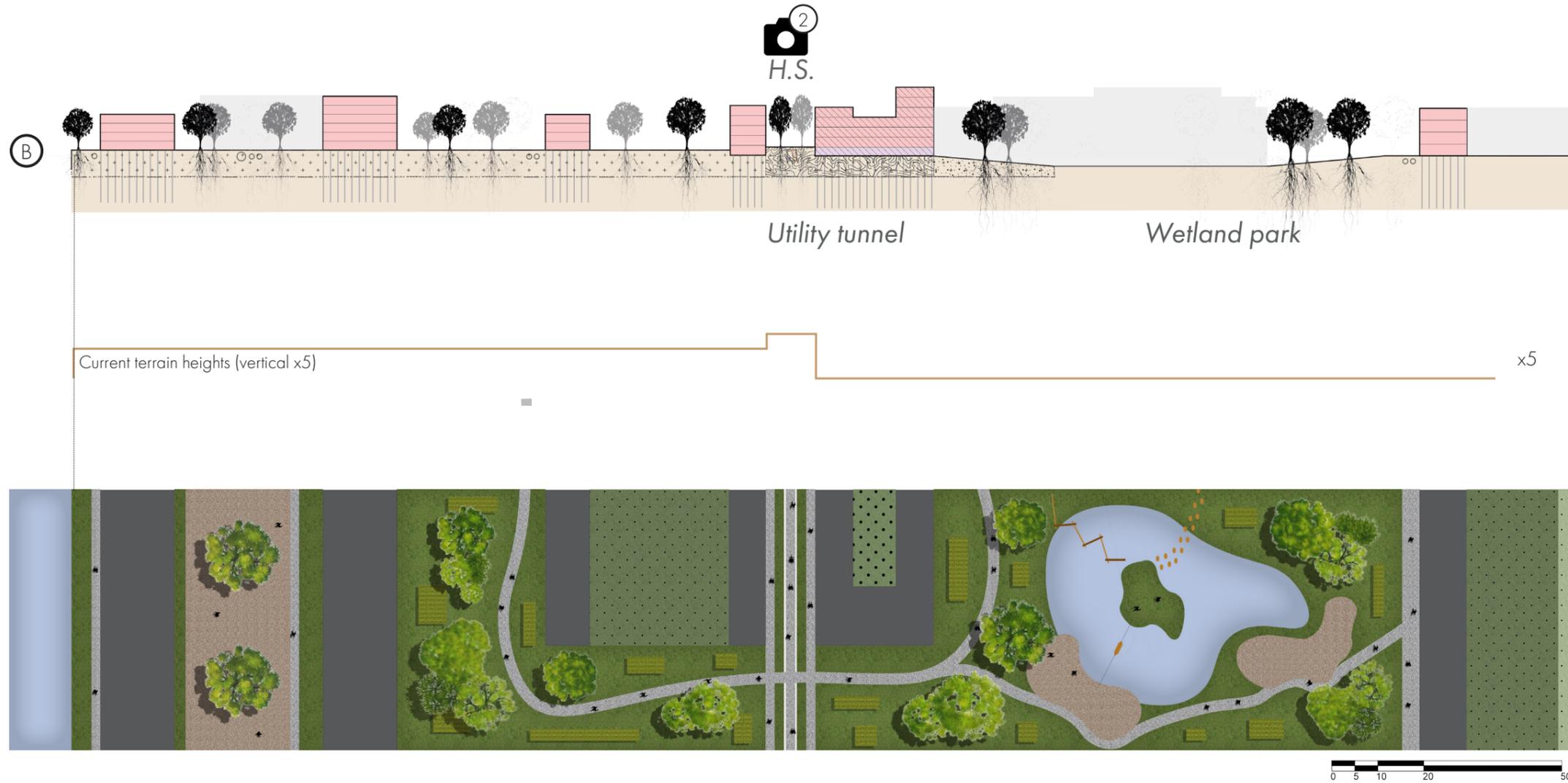
x5



- Car lanes / Buslanes
- Bicycle path
- Pedestrian path (Bike & car limited space)
- Playground pavement (soft springy material)
- Square pavement (permeable)
- Pedestrian area pavement (flat cobblestone)
- Grass
- Flowerbeds or spontaneous vegetation
- Roof gardens (collectively managed)
- Backyards (individually managed)
- Trees
- Playground

Section A (Made by Author)

Soil decontamination

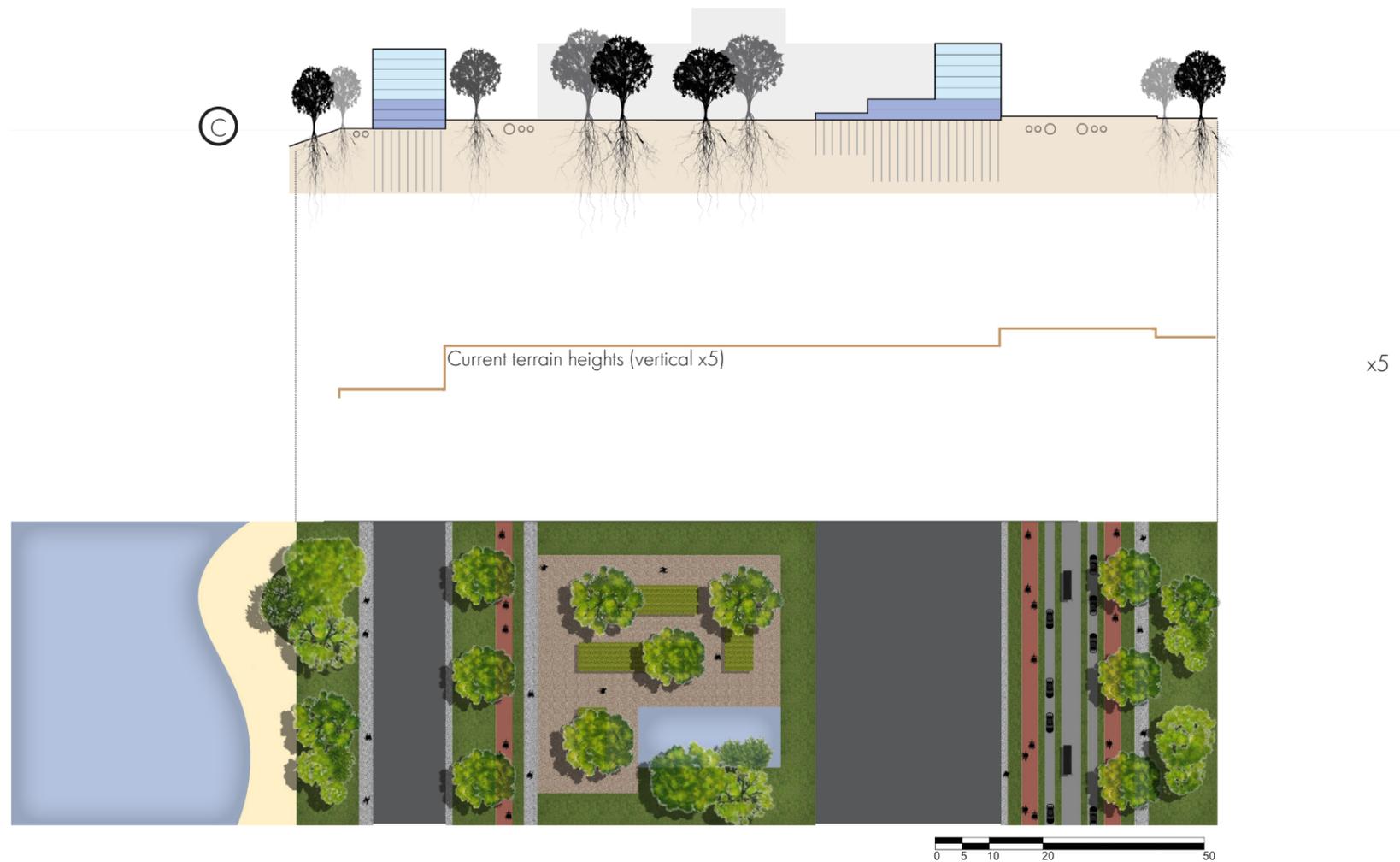


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- Trees
- Playground

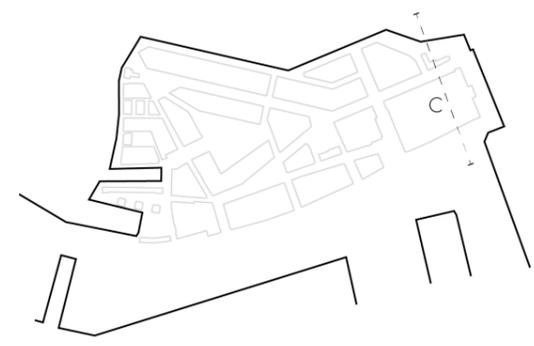
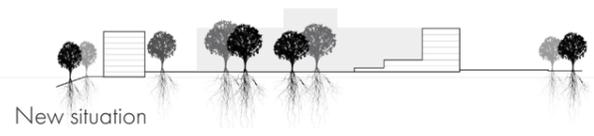
Section B (Made by Author)

Pocket parks on former parking lots

Westzeedijk mobility corridor



- Functions**
- Residential
 - Commercial (shops, cafés, restaurants...)
 - Workspaces (offices, flex workplaces...)
 - Car parking (shared mobility)
 - Bicycle parking
 - New building
- Subsoil**
- Utility tunnel
 - Sewage pipe
 - Cables (electricity, internet...)
 - Bioswale
 - Contaminated soil
 - Decontamination by vegetation
 - Decontamination by soil replacement

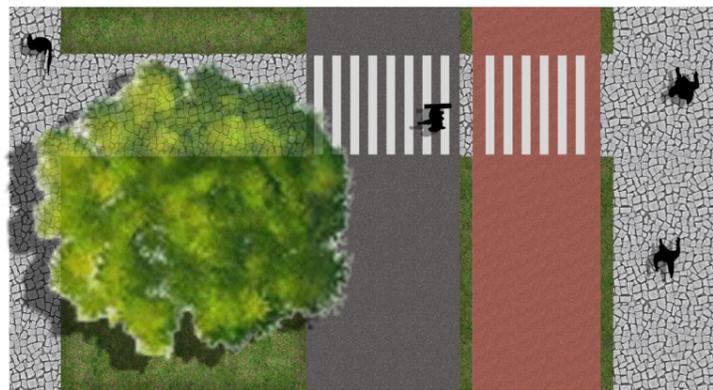
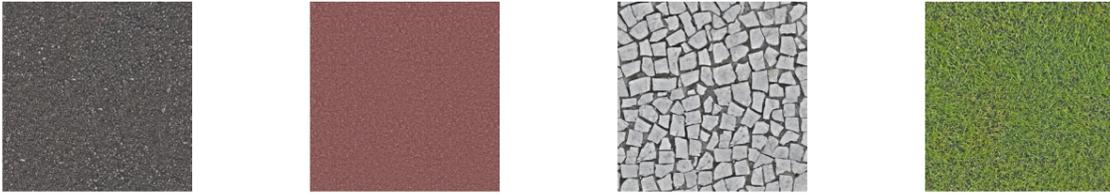


- Car lanes / Buslanes
- Bicycle path
- Pedestrian path (Bike & car limited space)
- Playground pavement (soft springy material)
- Square pavement (permeable)
- Pedestrian area pavement (flat cobblestone)
- Grass
- Flowerbeds or spontaneous vegetation
- Roof gardens (collectively managed)
- Backyards (individually managed)
- Trees
- Playground

Section C (Made by Author)



Willem Buytewechstraat

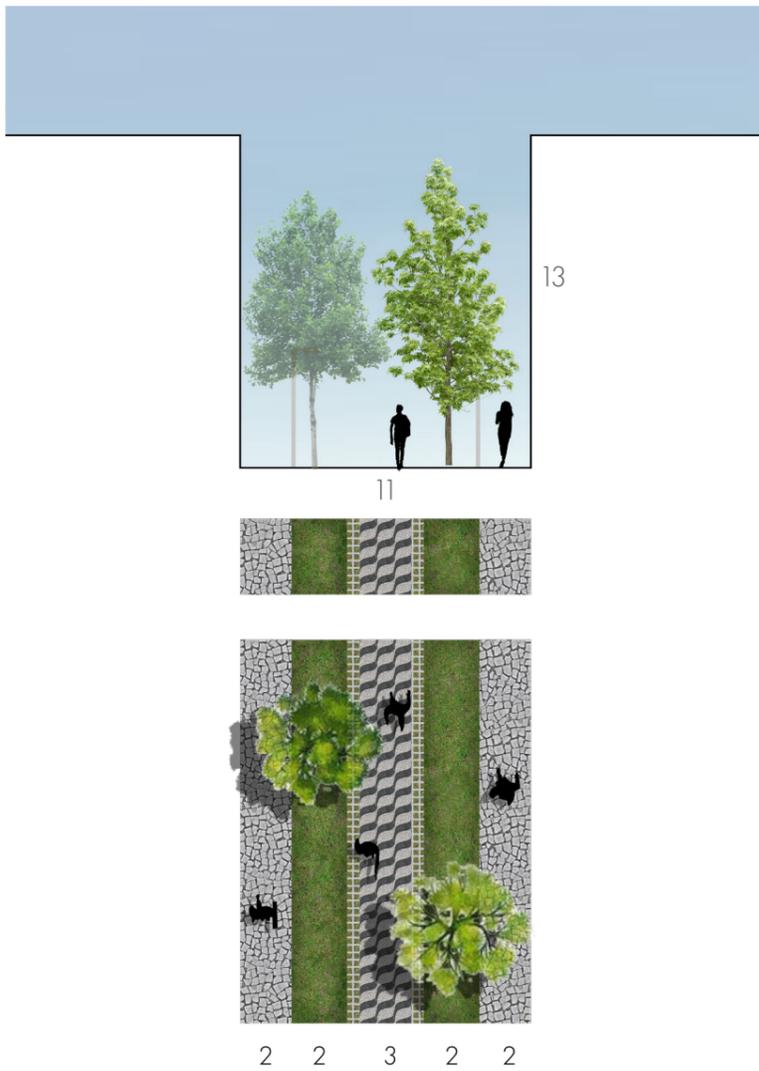
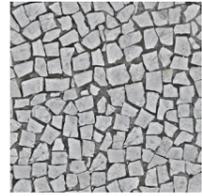


2 10 6 5 4

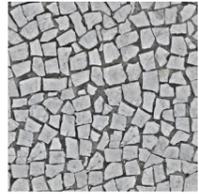


Streetscape 1 (Made by Author)

Havenstraat



Pieter de Hoochstraat



27



2

19

6

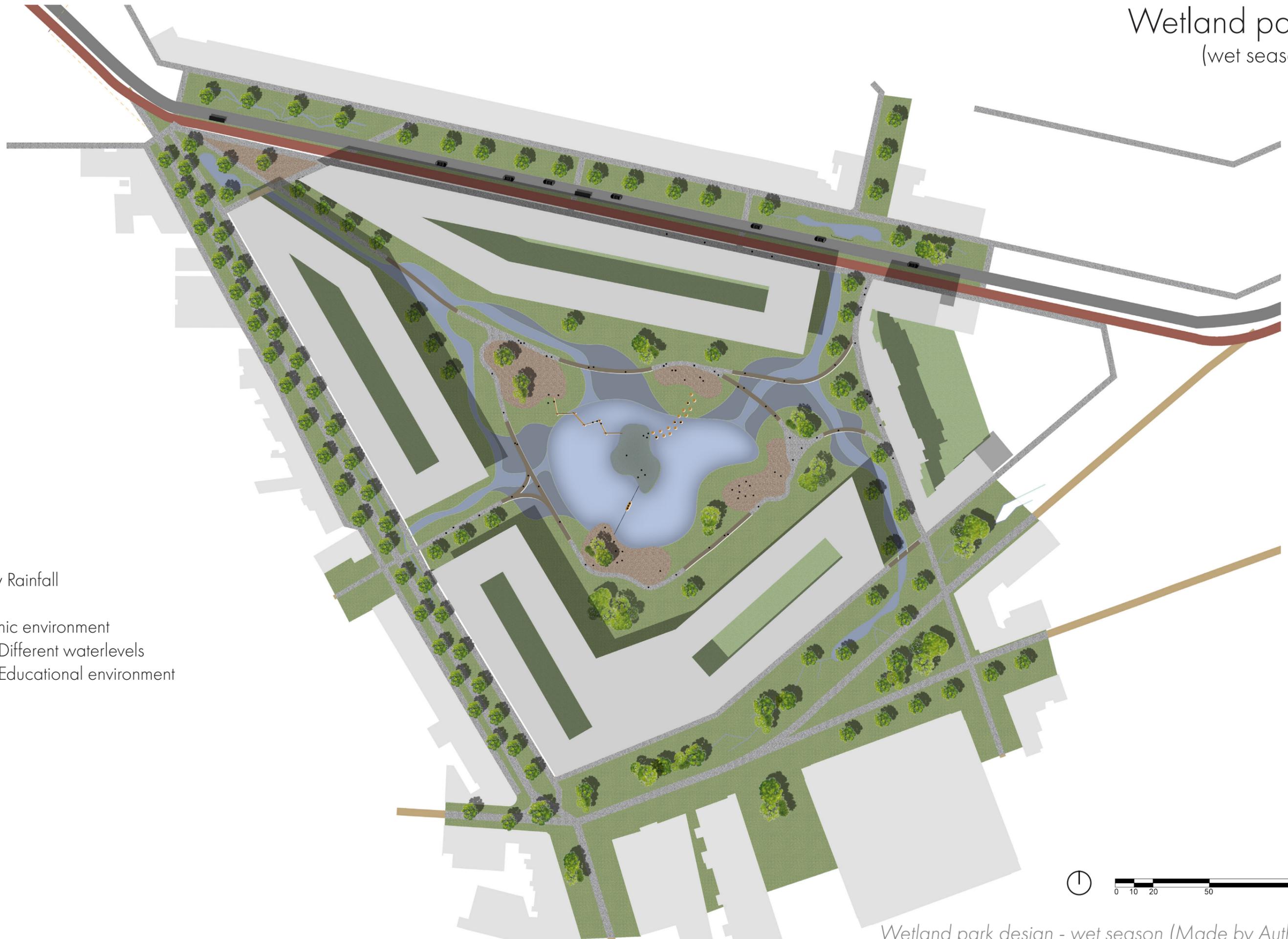
Streetscape 3 (Made by Author)



Wetland park (dry season)



Wetland park (wet season)

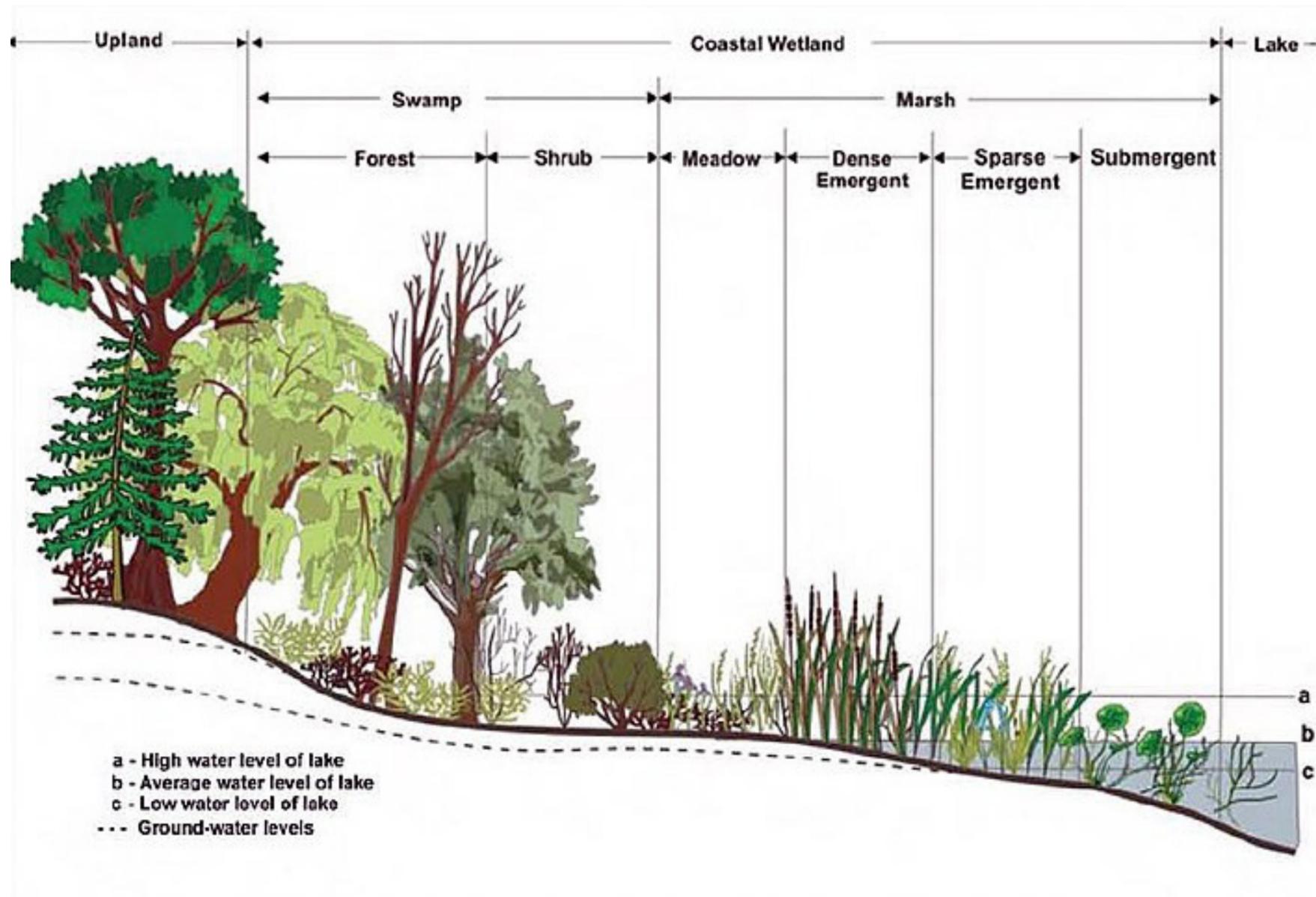


Heavy Rainfall

Dynamic environment
Different waterlevels
Educational environment



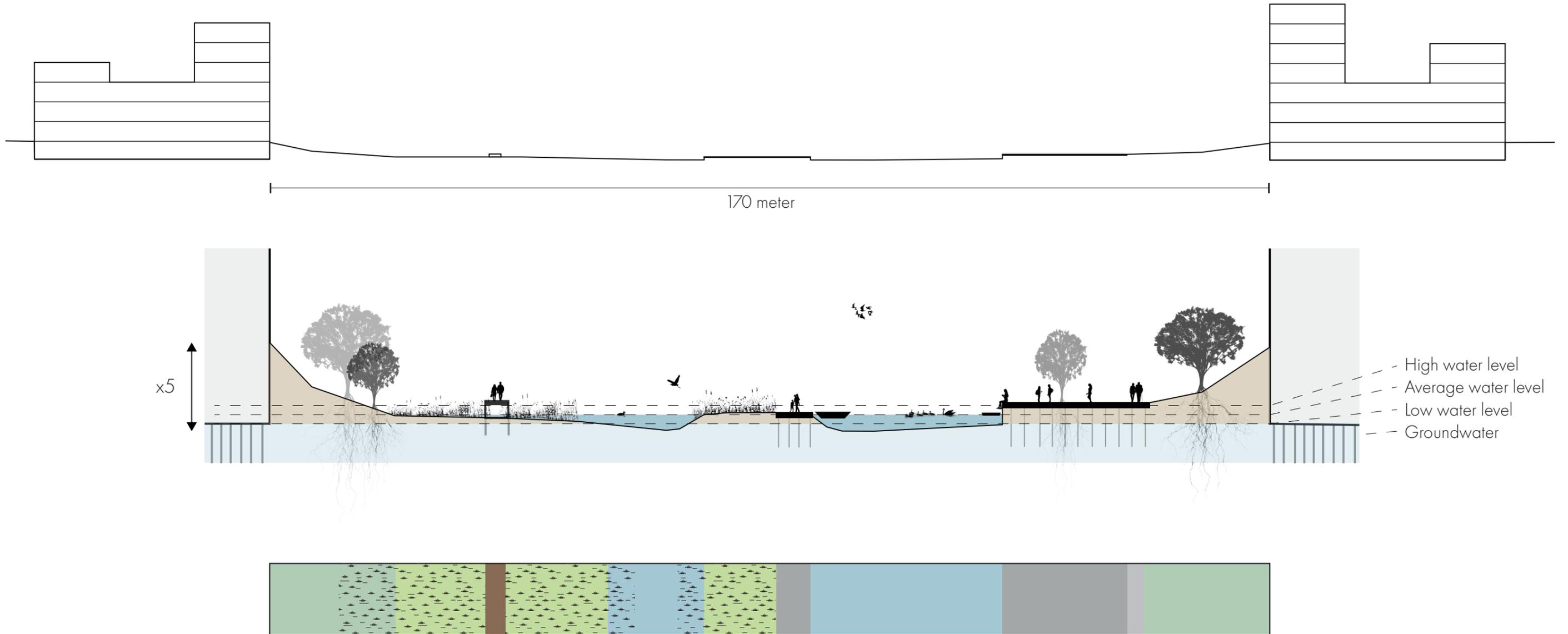
0 10 20 50 100



Wetland vegetation (Douglas et al., 2012)

Wetland park

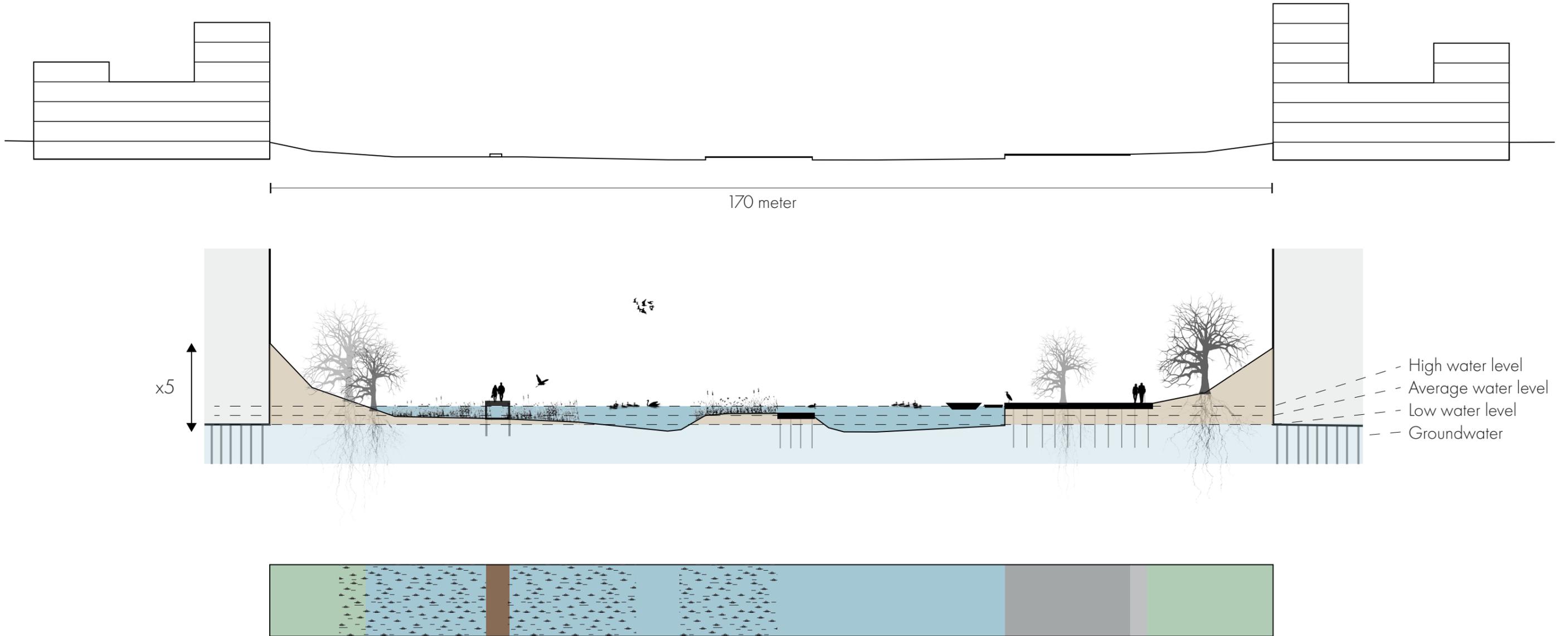
(dry season)



Wetland park setion - dry season (Made by Author)

Wetland park

(wet season)



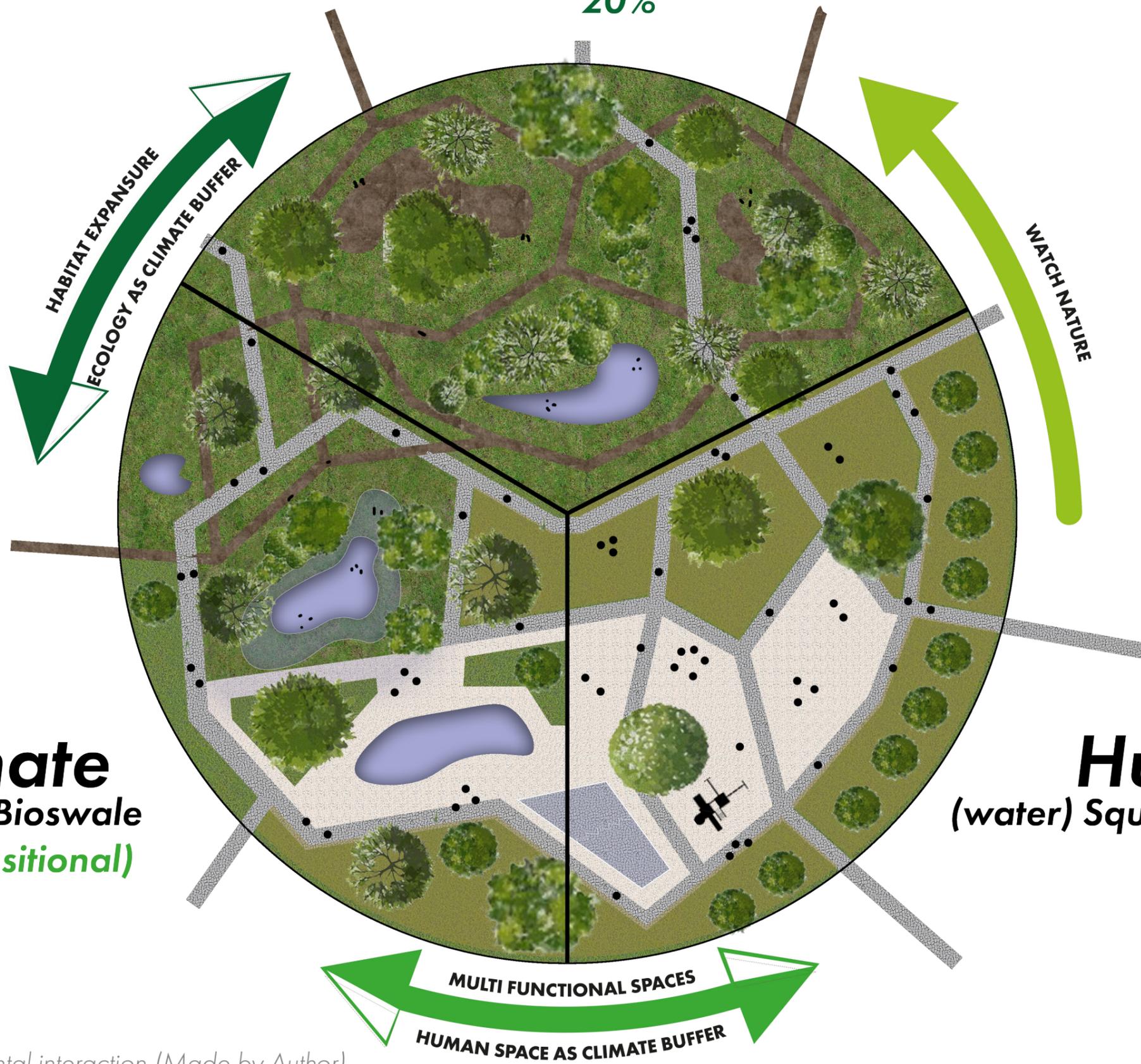
Wetland park setion - wet season (Made by Author)

Ecology

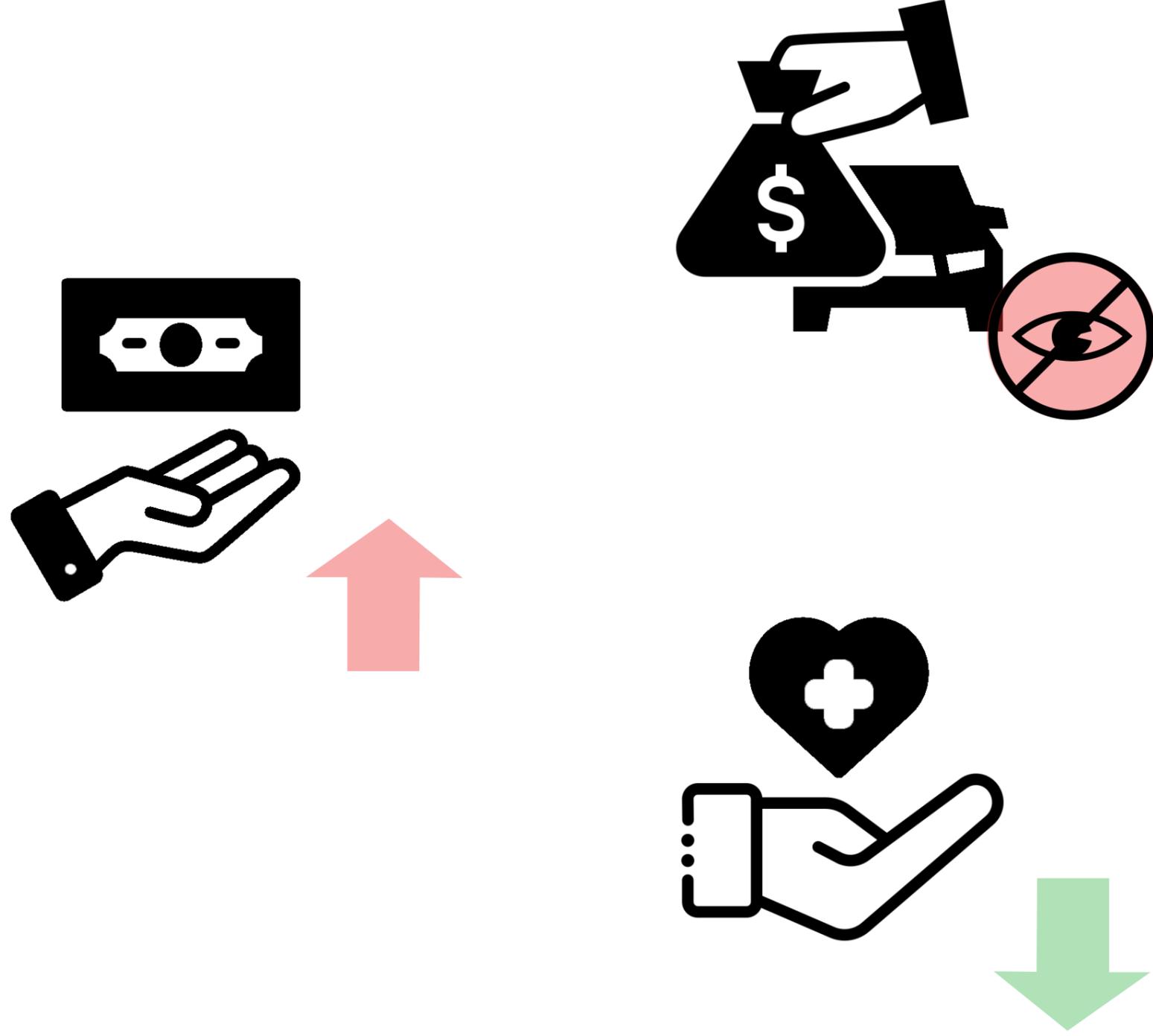
Various habitats
20%

Climate
Wetland, Bioswale
20% (transitional)

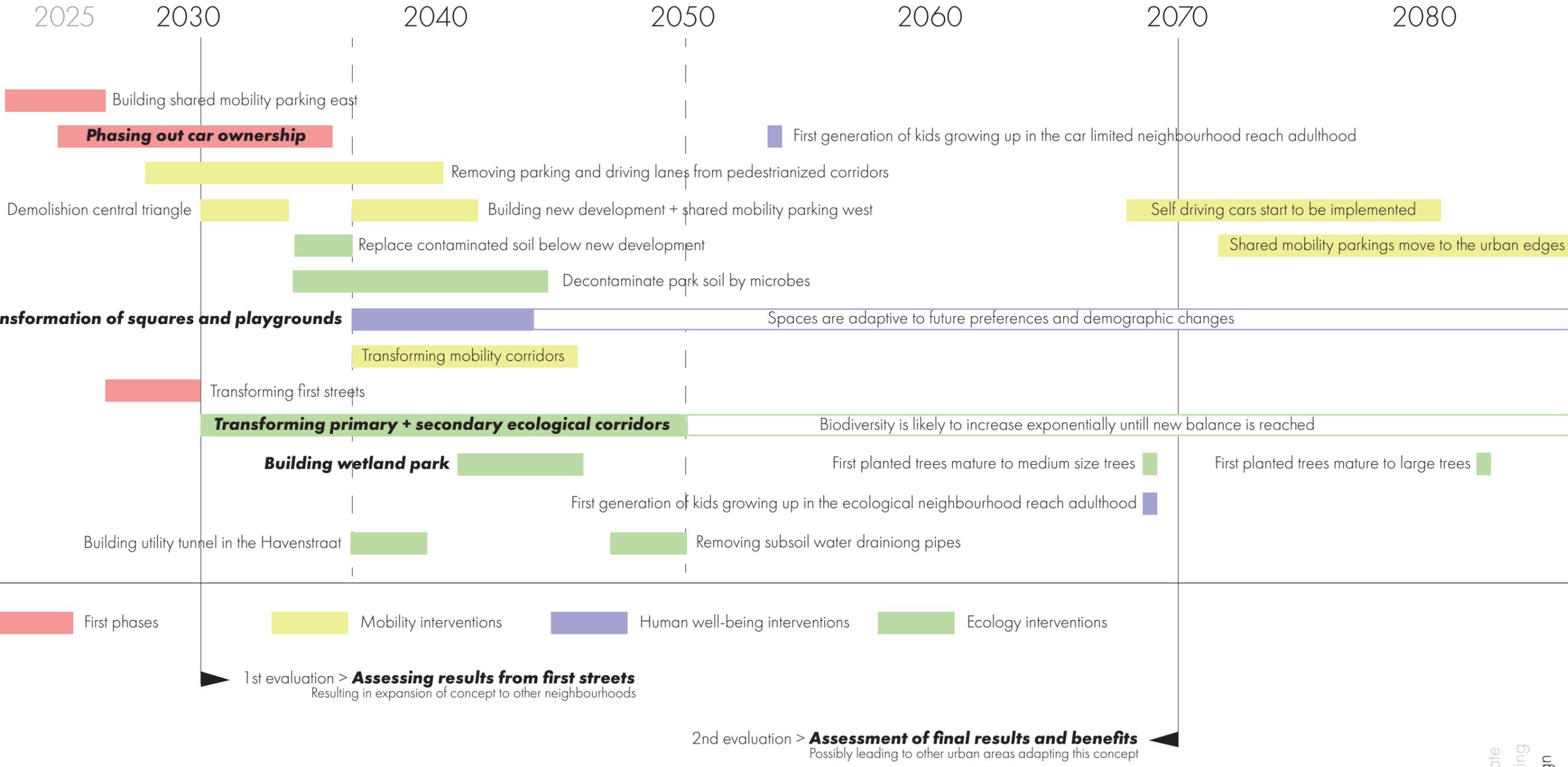
Human
(water) Square, Sitable grass
60%



Financing

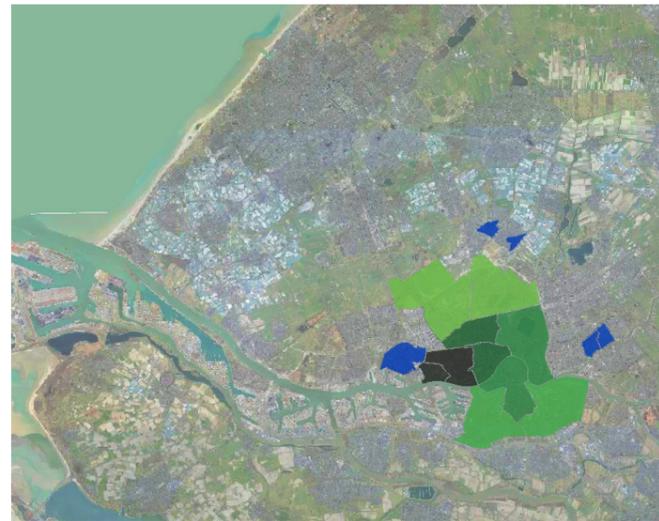


Preperation Transformation Final stages

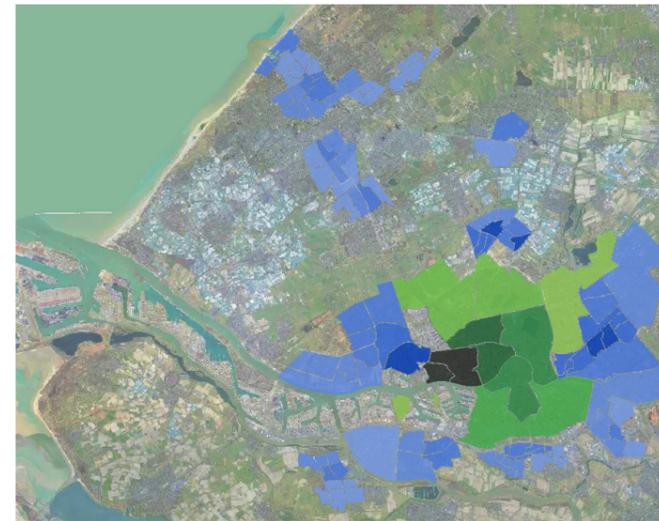




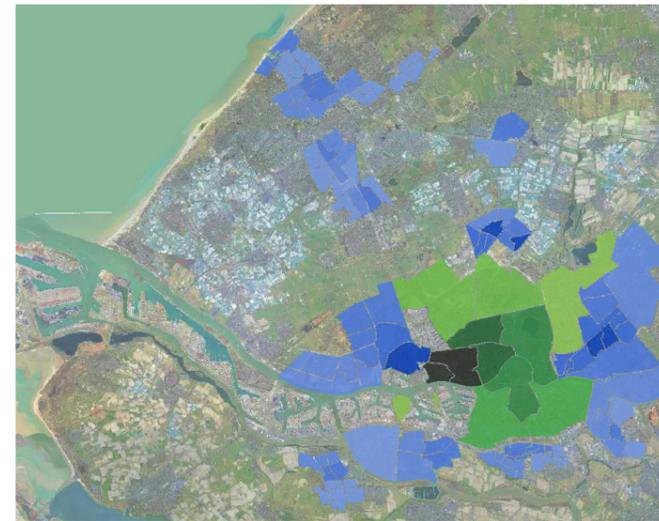
2030



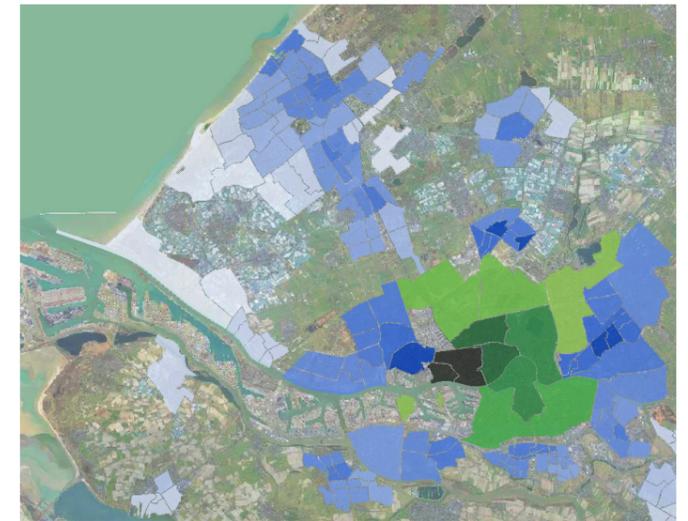
2035



2040



2045



2050



Rotterdam

Urban Area



2040

2045

2050

2055

2060

Conclusion

Interventions have positive interrelated effects

Delfshaven as pilot project

Introduction
Mobility
Ecology & Climate
Human Well-being
Integrated Design
Conclusion
Discussion

48% $\xrightarrow{-92\%}$

4%

Public space used by cars

8% $\xrightarrow{+460\%}$

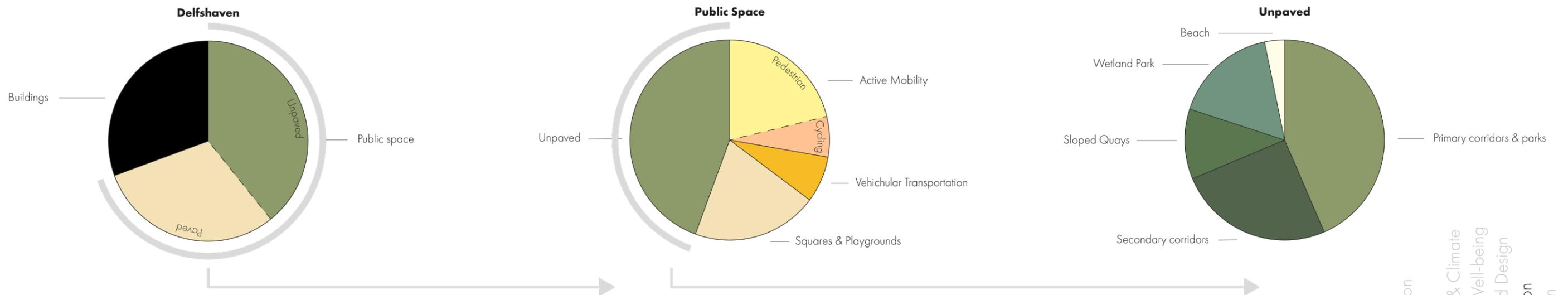
45%

... of area is unpaved and used to improve
... ecology
... climate adaptability
... physical and mental health

3% $\xrightarrow{+200\%}$

9%

... of area consists of squares or playgrounds that improve
... likeliness of kids playing outside
... social interaction between residents
... diversity in public space





Discussion

Cover image (Made by Author)

- Introduction
- Mobility
- Ecology & Climate
- Human Well-being
- Integrated Design
- Conclusion
- Discussion



Student
Studio
1st mentor
2nd mentor

Jochem Vellinga (4686098)
Design of the Urban Fabric
Rients Dijkstra
Alexander Wandl



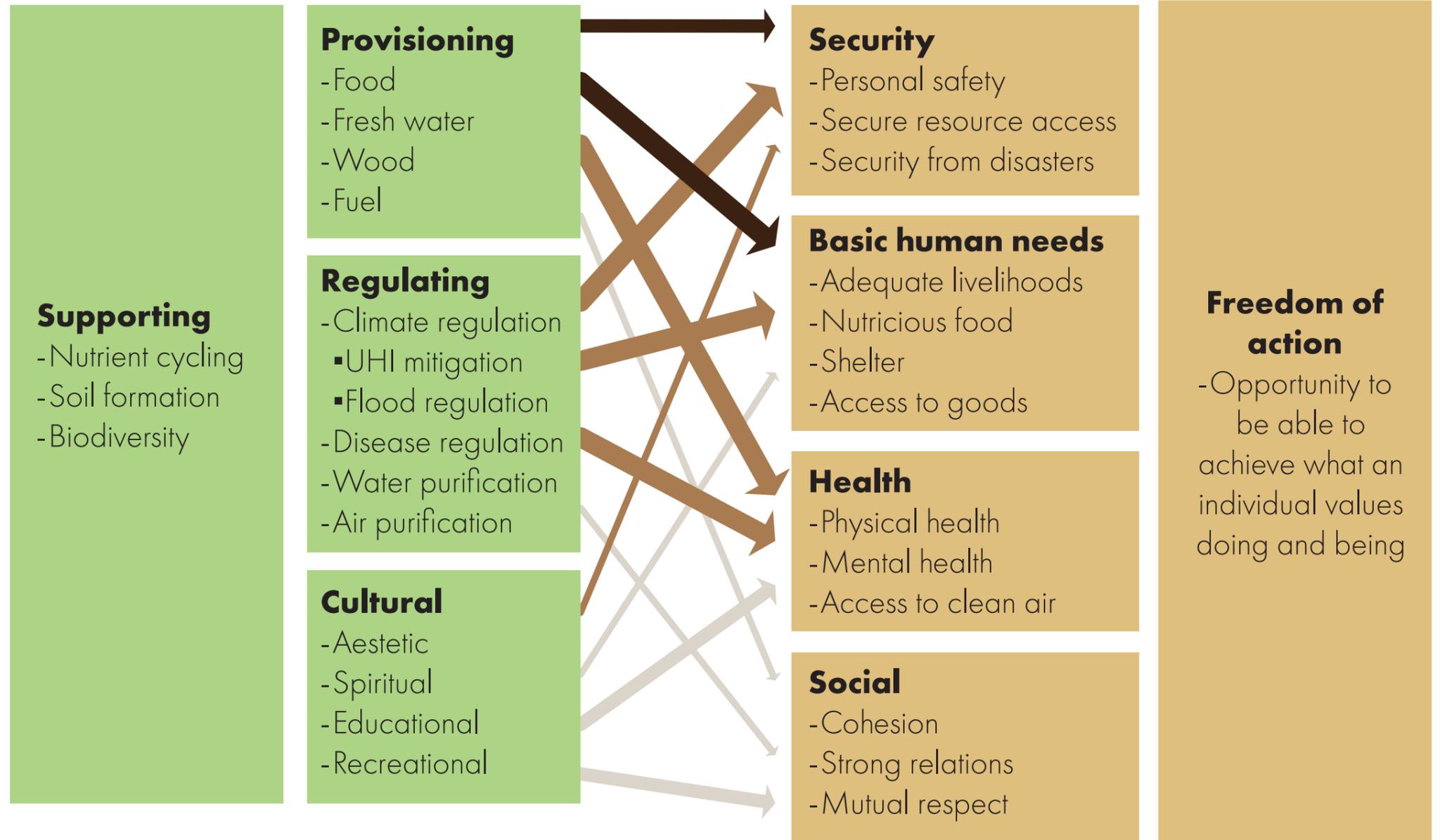
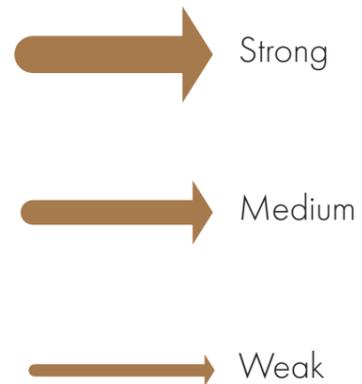
Eco system services

Constituents of well-being

Potential for mediation by socioeconomic factors

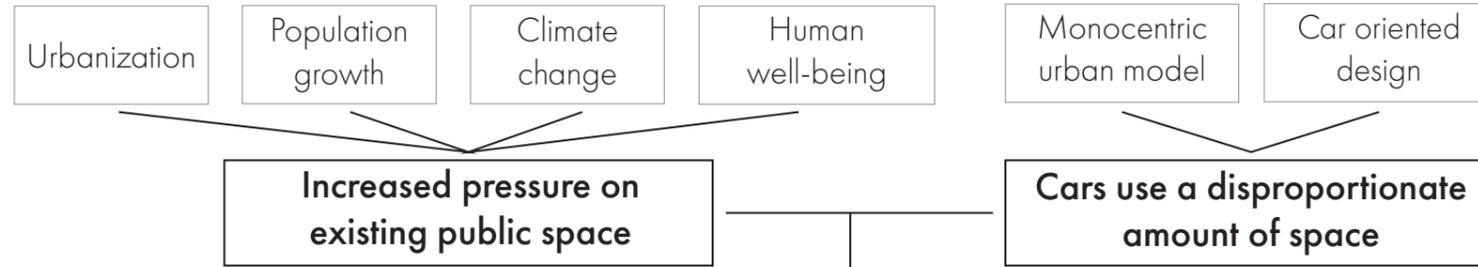


Intensity of linkage between ecosystem services and human well-being

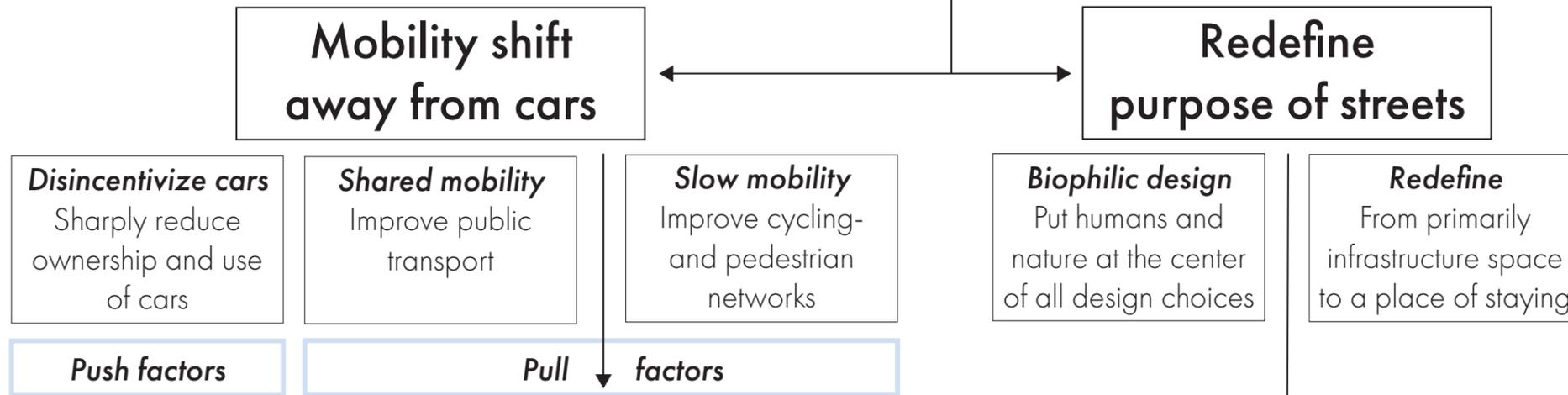


Ecosystem services and relation to human well-being (Edited by Author) (Millenium Ecosystem Assessment, 2005)

Challenges



Strategies



Free up space

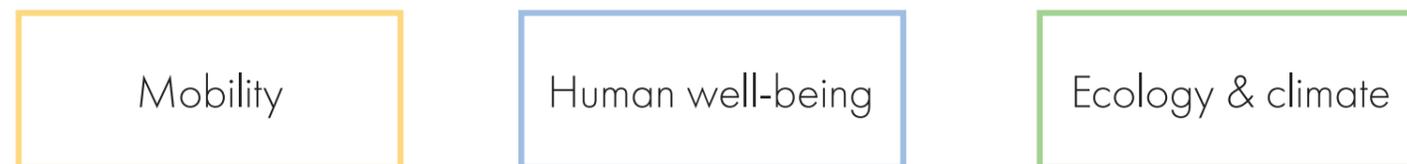
Design



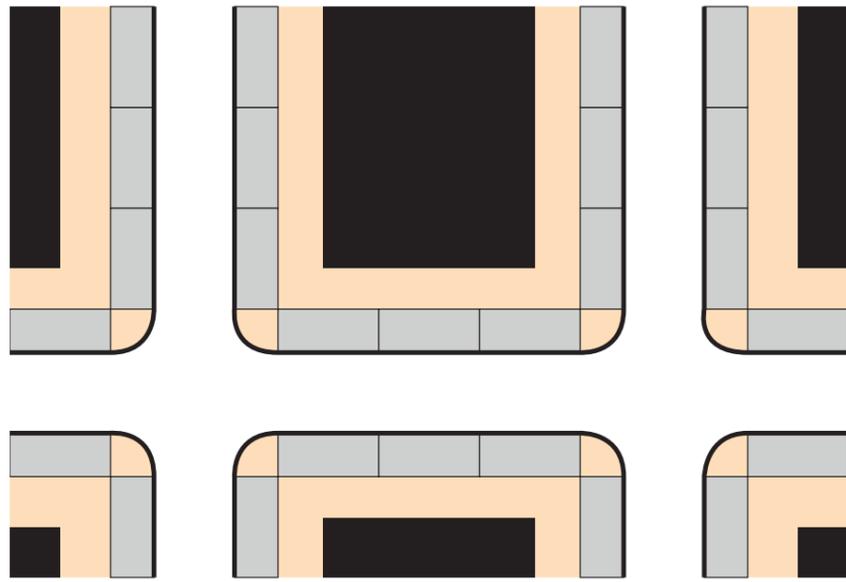
Re-design streets for

- Humans
- Nature
- Climate

(design phase) Themes

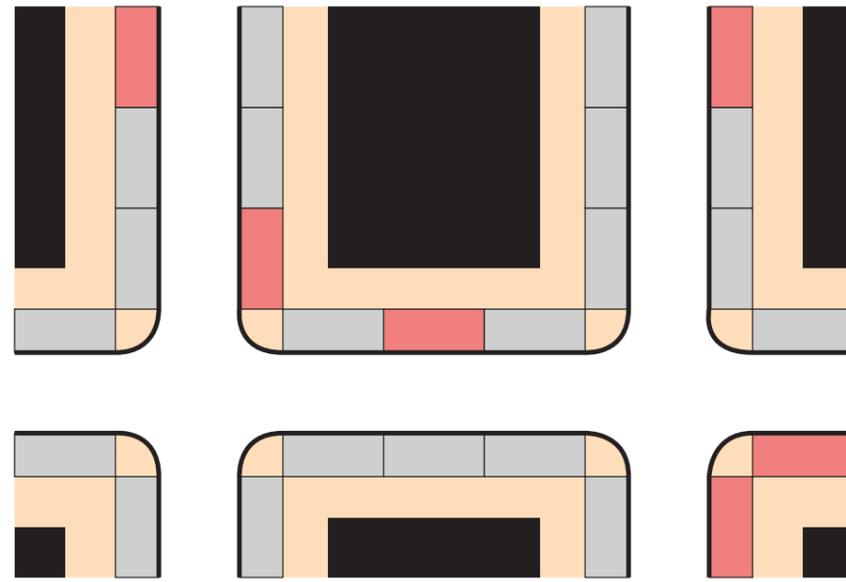


Next slide



Current situation

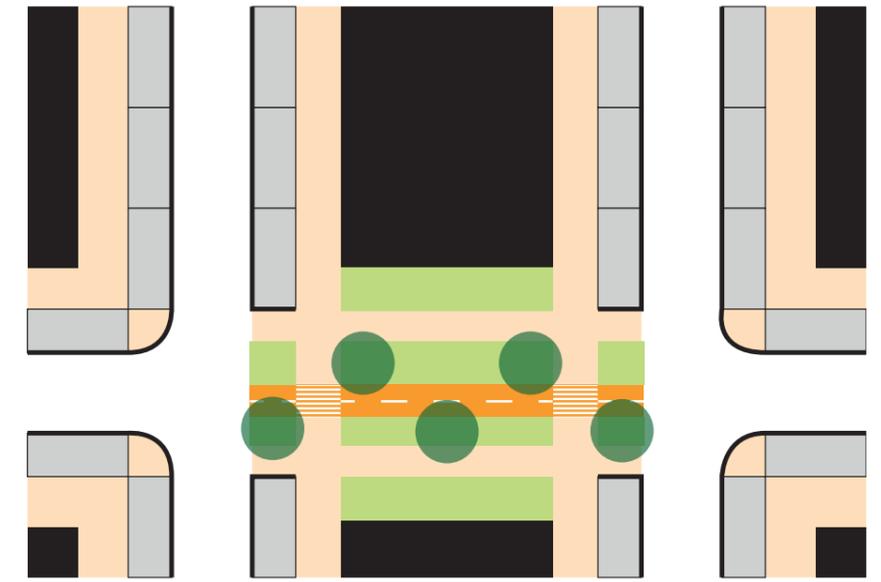
- Most streets have side parking
- All streets are accessible by car



Parking reduction

- Parking **voluntarily** reduces by providing:
 - Low cost alternative distant parking
 - Low cost shared mobility
 - Improved public transport
 - High trade-in value for cars
- Parking **forcibly** reduces by:
 - Not giving out new parking permits
 - Increasing parking tariffs

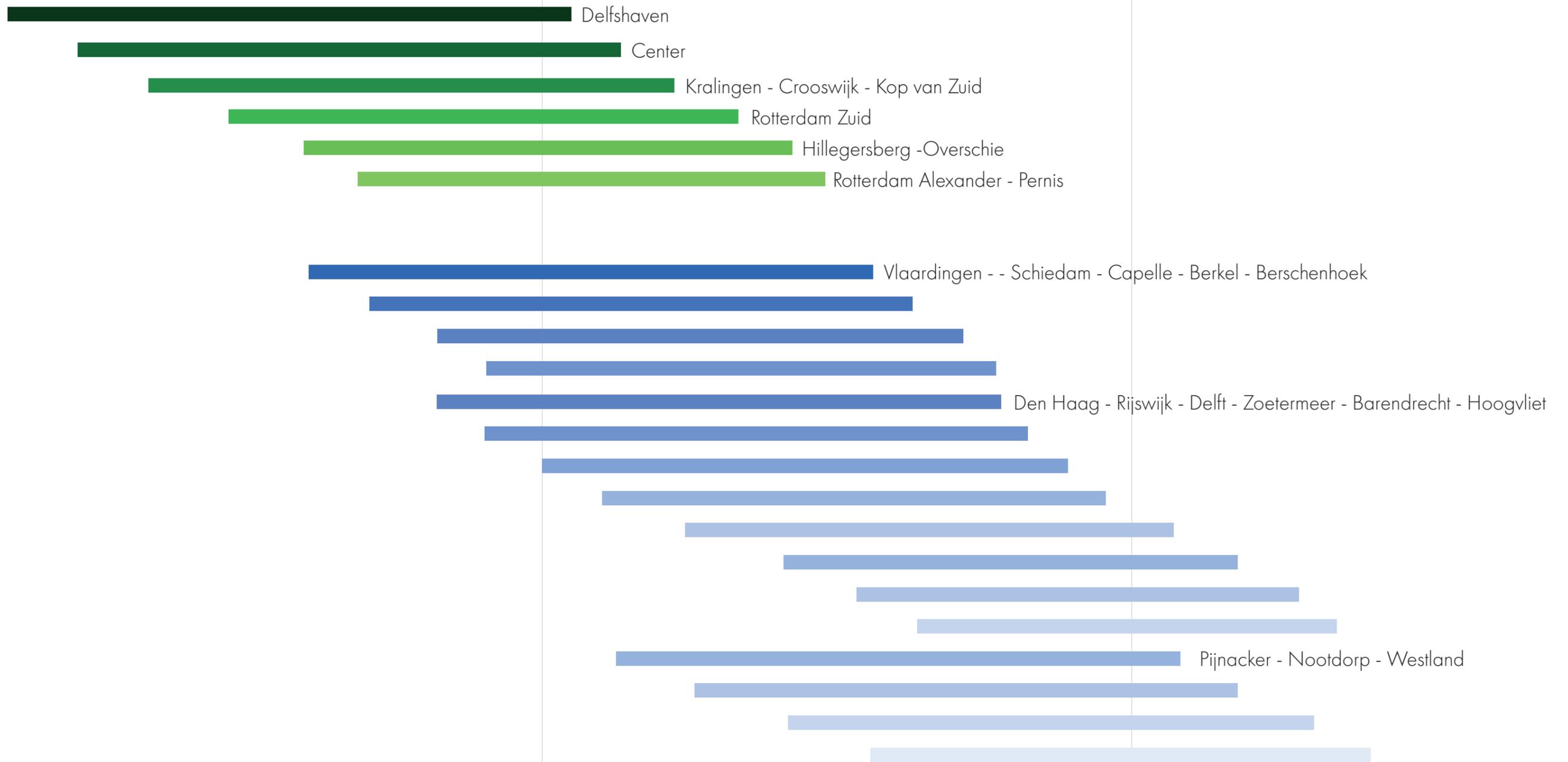
Existing parking permits will not be taken away



Street transformation

- Streets transform when:
 - Parking demand is reduced sufficiently
- Neighbourhood is **fully transformed** when:
 - All parking is voluntarily reduced 'or'
 - All parking permits expire

2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080 2085

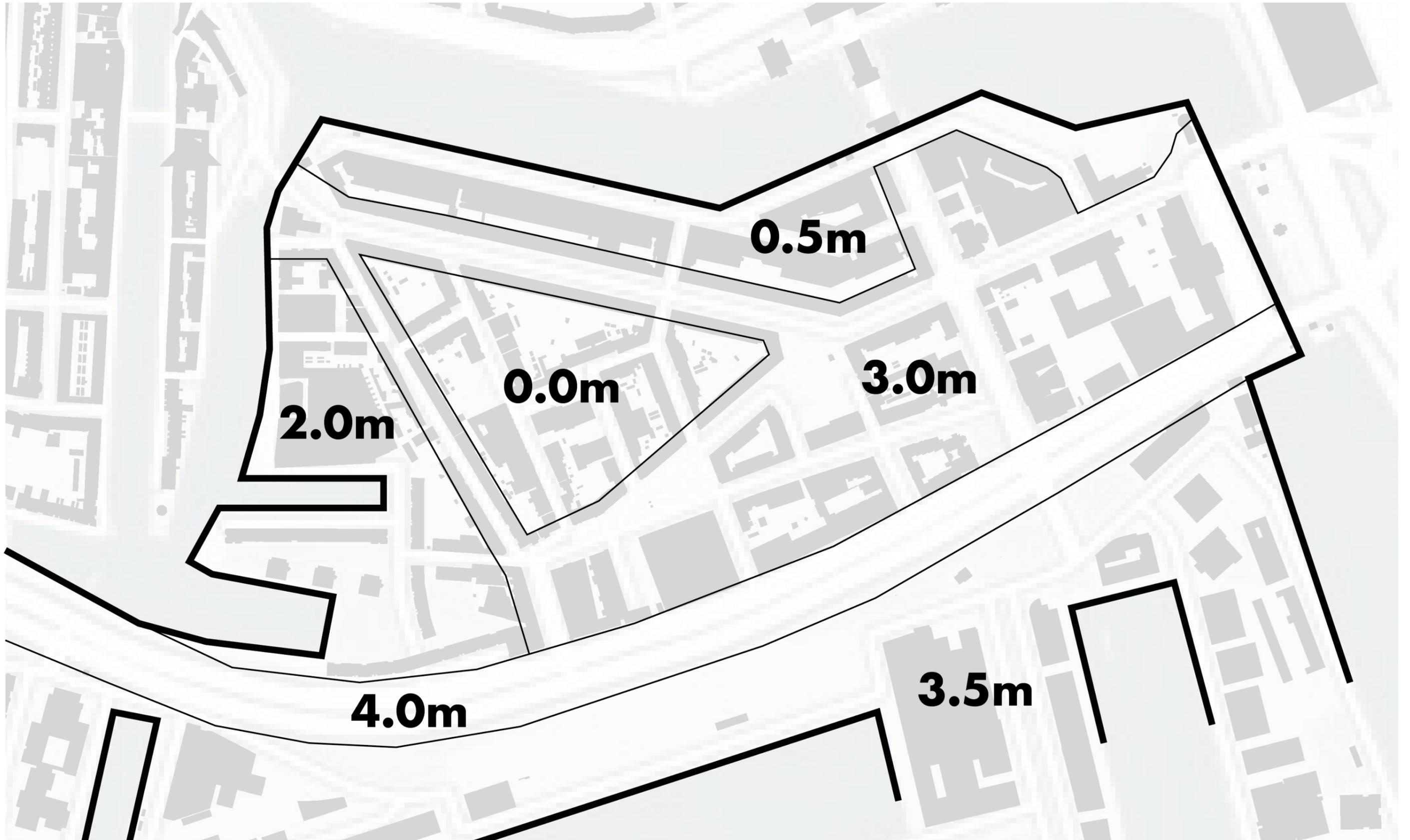




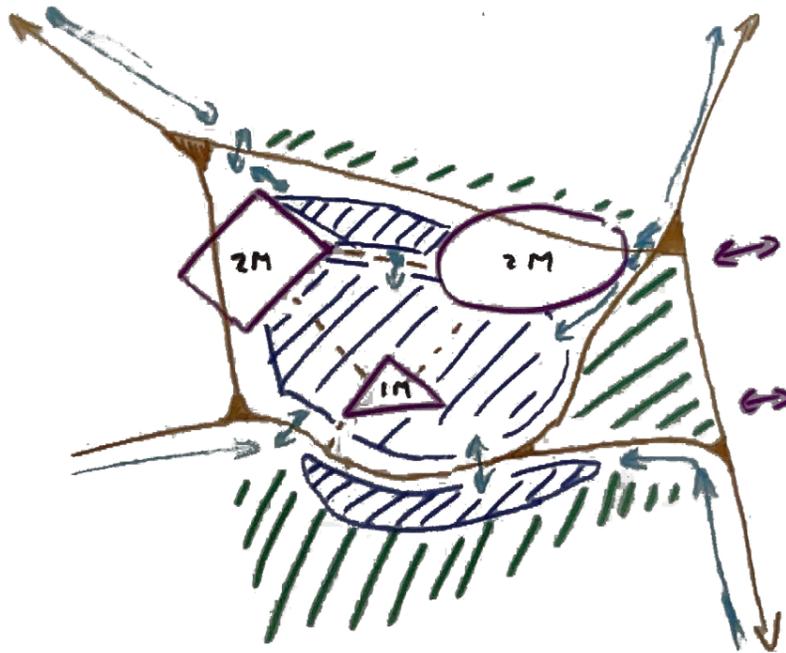
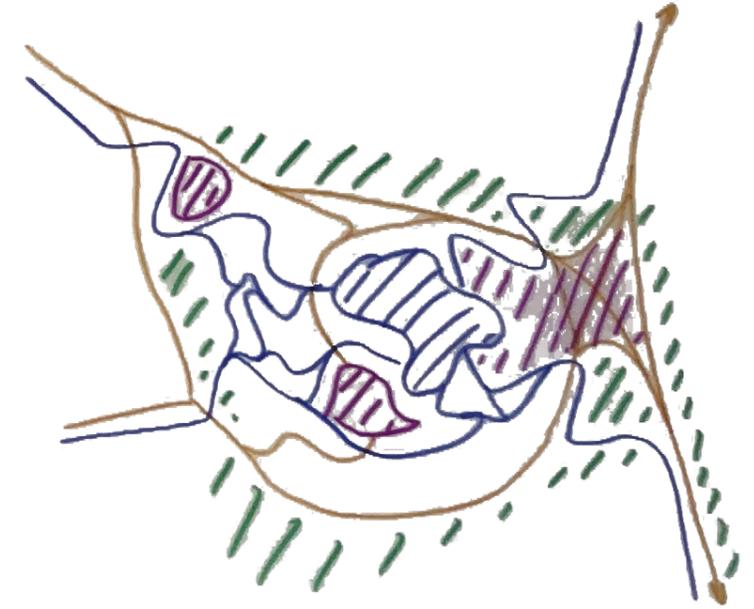
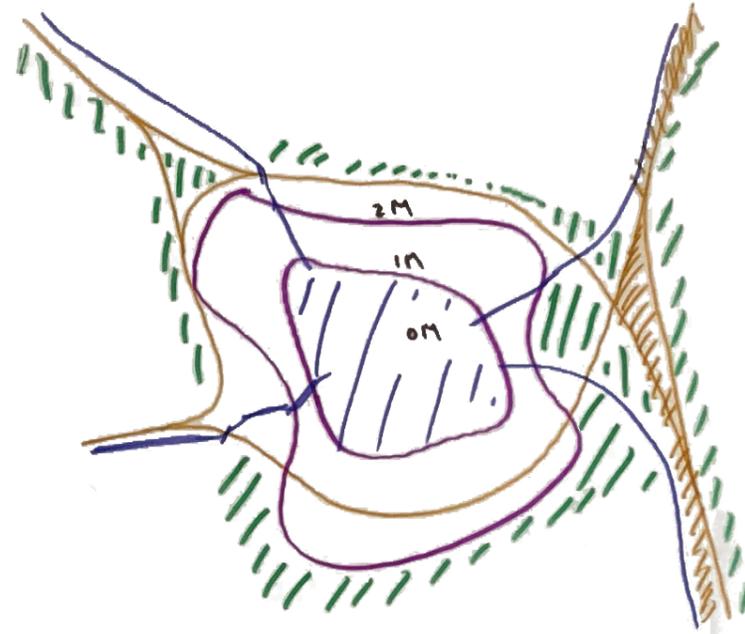
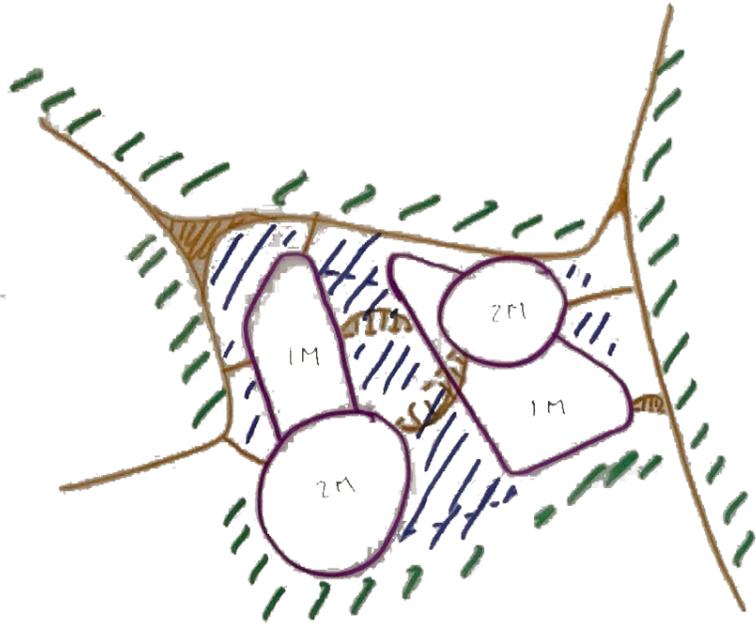
Energylabels of buildings in Delfshaven (Nationale Energie Atlas, z.d.)



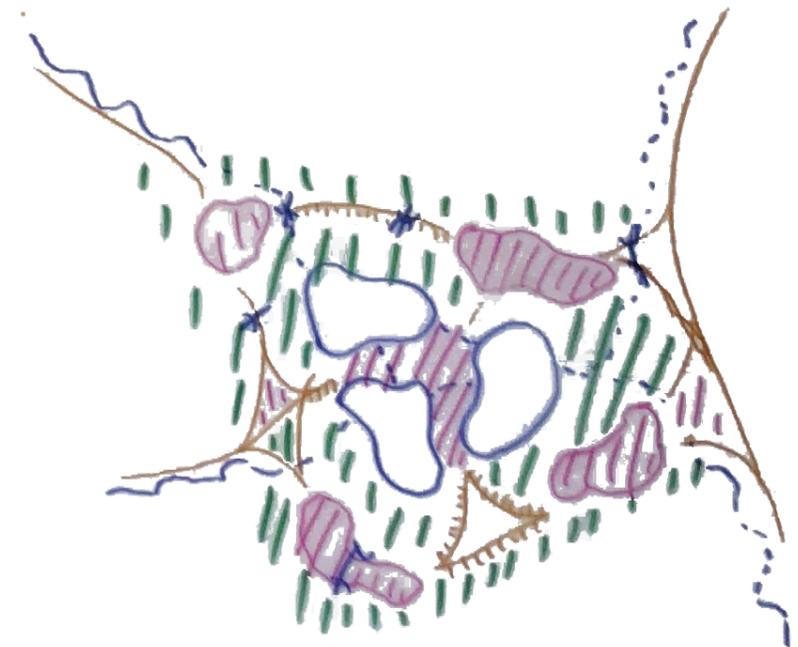
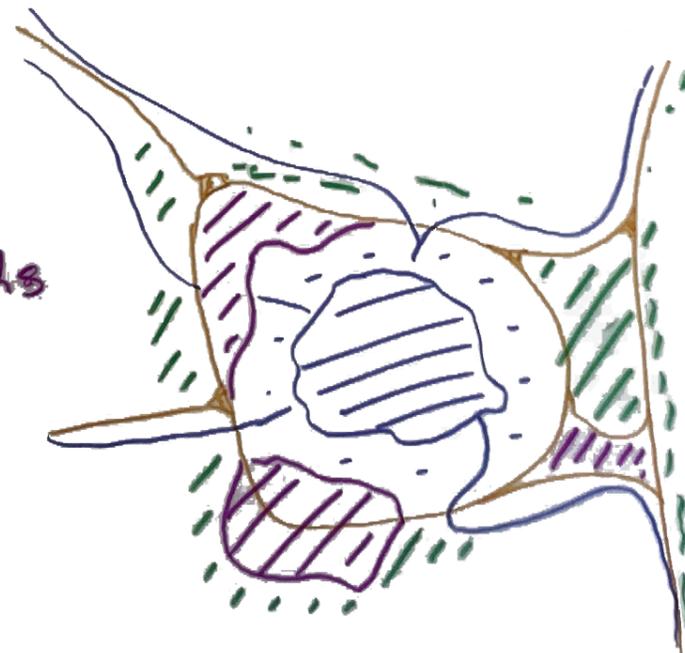
Construction years of buildings in Delfshaven (PDOK 2022)



Delfshaven terrain heights (Made by Author | data from ahn)



Active
Plants



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Problemization
Strategies
Project scope
Location
The system
Methodology
Mobility
Ecology
Human wellness
Obstacles
Concluding